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TECHNICAL SPECIFICATIONS

REPORT NO.:202210-TS-S2

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GENERAL TECHNICAL SPECIFICATIONS FOR BUILDING WORKS GENERAL:

1. *In the specifications "as directed" / "approved" shall be taken to mean "as directed" / "approved by the Engineer-in-Charge".*
2. *Wherever a reference to any Indian Standard appears in the specifications, it shall be taken to mean as a reference to the latest edition of the same in force on the date of agreement.*
3. *In "Mode of Measurement" in the specifications wherever a dispute arises in the absence of specific mention of a particular point of aspect the provisions on these particular points, or aspects in the relevant Indian Standards shall be referred to*
4. *All measurements and computations, unless otherwise specified, shall be carried out nearest to the following limits:*

(i)	Length, width and depth (height)	0.01	meter
(ii)	Areas	0.01	Sq. Mt.
(iii)	Cubic Contents	0.01	Cu. Mt.

In recording dimensions of work the sequence of length, width and height (depth) or thickness shall be followed.

5. *The distance which constitutes lead shall be determined along the shortest practical route and note necessarily the route actually taken The decision of the Engineer-in-charge in this regard shall be taken as final.*
6. *Where no lead is specific, it shall mean "all leads"*
7. *Lift shall be measured from plinth level.*
8. *Up to "floor two level" means actual height of floor (Maxi 4 M) up to 3 Mt. above plinth level.*
9. *Definite particulars covered in the items of work, though not mentioned or elucidated in its specifications shall be deemed to be included therein.*
10. *Reference to specifications of materials as made in the detailed specification of the items of works is in the form of a designation containing the number of the specification of the material and prefix 'M' e.g. 'M-5',*
11. *Approval to the samples of various materials given by the Engineer-in-charge shall not absolve the contractor from the responsibility of replacing defective material brought on site or materials used in the work found defective at a later date. The contractor shall have no claim to any payment or compensation whatsoever on account of any such materials being rejected by the Engineer-in-charge.*
12. *The contract rate of the item of work shall be for the work completed in all aspects.*
13. *No collection of materials shall be made before it is got approved from the Engineer-in-charge.*
14. *Collection of approved materials shall be done at site of work in a systematic manner. Materials shall be stored in such a manner as to prevent damage, deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work*

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15. *Materials, if and when rejected by the Engineer-in-charge, shall be immediately removed from the site of work.*
16. *No materials shall be stored prior to, during and after execution of a structure in such a way as to cause or lead to damage or overloading of the various components of the structure.*
17. *All works shall be carried out in a workmanlike manner as per the best techniques for the particular item.*
18. *All tools, templates, machinery and equipment for correct execution of the work as well as for checking lines, levels, alignment of the works during execution shall kept in sufficient numbers and in good working condition on the site of the work.*
19. *The mode, procedure and manner of execution shall be such that it does not cause damage or over-loading of the various components of the structure during execution or after completion of the structure.*
20. *Special modes of construction not adopted in general Engineering practice if proposed to be adopted by the Contractor, shall be considered only if the contractor provides satisfactory evidence that such special mode Of construction is safe, sound and helps in speedy construction and Completion of work to the required strength and quality. Acceptance of the same by the Engineer-in-Charge shall not, however absolve the contractor of the responsibility of any adverse effects and consequences of adopting the same in the course of execution of completion of thework.*
21. *All installations pertaining to water supply and fixtures there of as well as drainage lines and sanitary fittings shall be deemed to be completed only after giving satisfactory tests by thecontractor.*
22. *The contractor shall be responsible for observing the rules and regulations imposed under the "Minor Minerals Act", and such of the laws and rules prescribed by Government form totime.*
23. *All necessary safety measures and precautions {including those laid down in the various relevant Indian Standards) shall be taken to ensure to ensure the safety of men. Materials and machinery onthe works as also of the workitself.*
24. *The testing charges of all materials shall be borne by theContractor.*
25. *Approval to any of the executed items for the work does not in any relieve the contractor of his responsibility for the correctness, soundness and strength of the structure as per the drawings and specifications*

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GENERAL

STANDARD TECHNICAL SPECIFICATIONS

Sr. No. of the item in the Schedule 'B' of tender	Sr. No, of applicable Specification	Sr. No. of the item in the Schedule 'B' of tender	Sr. No. of applicable Specification	Sr. No. of the item in the Schedule 'B' of tender	Sr. No. of applicable specification
1		26		51	
2		27		52	
3		28		53	
4		29		54	
5		30		55	
6		31		56	
7		32		57	
8		33		58	
9		34		59	
10		35		60	
11		36		61	
12		37		62	
13		38		63	
14		39		64	
15		40		65	
16		41		66	
17		42		67	
18		43		68	
19		44		69	
20		45		70	
21		46		71	
22		47		72	
23		48		73	
24		49		74	
25		50		75	

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Sr. No. of the item in the Schedule 'B' of tender	Sr. No, of applicable Specification	Sr. No. of the item in the Schedule 'B' of tender	Sr. No. of applicable Specification	Sr. No. of the item in the Schedule 'B' of tender	Sr. No. of applicable specification
76		101		126	
77		102		127	
78		103		128	
79		104		129	
80		105		130	
81		106		131	
82		107		132	
83		108		133	
84		109		134	
85		110		135	
86		111		136	
87		112		137	
88		113		138	
89		114		139	
90		115		140	
91		116		141	
92		117		142	
93		118		143	
94		119		144	
95		120		145	
96		121		146	
97		122		147	
98		123		148	
99		124		149	
100		125		150	

SPECIFICATIONS OF MATERIALS**M-1. Water**

1.1. Water shall not be salty brackish and shall be clean, reasonably clear and free objectionable quantities of silt and traces of oil and injurious alkalis, salts, organic matter and other deleterious material which will either weaken the mortar of concrete or cause efflorescence or attack the steel in R.C.C. Container for transport, storage and handling of water shall be clean. Water shall conform to the standard specified in I.S.456-1978.

1.2. If required by the Engineer-in-Charge it shall be tested by comparison with distilled water Comparison shall be made by means of standard cement tests for soundness time of setting and mortar strength as specified in I.S. 269-1976. Any indication of unsoundness charge in time of setting by 30 minutes or more or decrease of more than 10 per cent in strength, of mortar prepared with water sample when compared with the results obtained with mortar prepared with distilled water shall be sufficient cause for rejection of water undertest.

1.3. Water for curing mortar, concrete or masonry should not be too acidic or too alkaline.

It shall be free of elements which significantly affect the hydration reaction or otherwise interfere with the hardening of mortar or concrete during curing or those which produce objectionable stains or other unsightly deposits on concrete or mortar surfaces

1.4. Hard and bitter water shall not be used for curing

1.5. Potable water will generally found suitable for curing mortar or concrete.

M-2. Lime

2.1. Lime shall be hydraulic lime as per I.S. 712-1973 Necessary tests shall be carried out as per I.S. 6932 (Parts I to X) 1973

2.2. The following field tests for limes are to be earned out:

(1) A very rough idea can be formed about the type of lime by its visual examination i.e. fat lime bears pure white colour, lime in form of porous lumps of dirty white colour indicates quick lime, and solid lumps are the un burnt limestone.

(2) Acid tests for determining the carbonate content in lime Excessive amount of impurities and rough determination of class of lime.

2.3. Storage shall comply with J.S. 712-1973 The slaked lime, if stored, shall be kept in a weather proof and damp-proof shed with impervious floor and sides to protect it against rain, moisture, weather and extraneous materials mixing with it. All lime that has been damaged" in any way shall be rejected and all rejected materials shall be removed from site of work.

2.4. Field testing shall be done according to I.S 1624-1974 to show the acceptability of materials.

M-3. Cement

3.1. Cement shall be ordinary Portland slag cement as per I.S.269-1976 or Portland slag cement as per I.S.455-1976

M-4. White Cement

4.1. The white cement shall conform to I.S. 8042-E-1978.,

M-5. Coloured Cement

5.1. Coloured cement shall be with white of grey Portland cement as specified in the item of the work.

5.2. The pigments used for coloured cement shall be of approved quality and shall not exceed 10% of cement used in the mix. The mixture of pigment add cement shall be properly ground to have a uniform colour and shade. The pigments shall have such properties to provide for durability under exposure to sunlight and weather.

5.3. The pigment shall have the property such that it is neither affected by the cement nor detrimental to it

M-6 Sand

6.1. Sand shall be natural sand, clean, well graded hard strong, durable and gritty particles free from injurious amounts of dust, clay kankar nodules, soft or flaky particles shale, alkali salts organic matter, loam, mica or other deleterious substances and shall be got approved from the Engineer-in-Charge. The sand shall not contain more than 8 percent of silt as determined by field test, if necessary the sand shall be washed to make it clean.

6.2. Coarse Sand : The fineness modulus of coarse sand shall not be less than 2.5 and shall not exceed 3.0. The sieve analysis of coarse sand shall be as under.

<i>I.S. Sieve</i>	<i>Percentage by weight</i>	<i>I.S. Sieve</i>	<i>Percentage by weight</i>
<i>Designation</i>	<i>Designation</i>	<i>Designation</i>	<i>passing sieve</i>
4.75 mm	100	600 micron	30 – 100
2.36 mm	90 to 100	300 micron	50 – 70
1.18 mm	70 to 100	150 micron	0 – 50

6.3. Fine Sand:

The fineness modulus shall not exceed 1.0 The sieve analysis of fine sand shall be as under.

<i>I.S. Sieve</i>	<i>Percentage by weight</i>	<i>I.S. Sieve</i>	<i>Percentage by weight</i>
<i>Designation</i>	<i>Designation</i>	<i>Designation</i>	<i>passing sieve</i>
4.75 mm	100	600 micron	40 – 85
2.36 mm	100	300 micron	5 – 50
1.18 mm	75 to 100	150 micron	0 – 10

M-7. Stone Dust

7.1. This shall be obtained from crushing hard black trap or equivalent. It shall not contain more than 8% of silt as determined by field test will measuring cylinder. The method of determining silt contents by fields test is given as under:

7.2. A sample of stone dust to be tested shall be placed without drying in 200 mm. measuring cylinder. The quantity of the sample shall be such that it fills the cylinder up to 100 mm. mark. The clean water shall be added up to 150 mm. mark. The mixture shall be stirred vigorously and the content allowed to settle for 3 hours.

7.3. The height of silt, visible as settled layer above the stone dust shall be expressed as percentage of the height of the stone dust below The stone dust containing more than 8% silt shall be washed so as to bring the content within the allowable limit.

7.4. The fineness modules of stone dust shall not be less than 1.80

M-8. Stone Grit

8.1. Grit shall consist of crushed or broken stone and be hard, strong, dense, durable, clean of proper gradation and free from skin or coating likely to prevent proper adhesion of mortar Grit shall generally be cubical in shape and as far as possible flakey elongated pieces shall be avoided. It shall generally comply with the provisions of I.S. 383-1970. Unless special stone of particular quarries is mentioned grit shall be obtained from the best black trap or equivalent hard stone as approved by the Engineer-in-charge. The grit shall have no deleterious with cement.

8.2. The grit shall conform to the following gradation as per sieve analysis:

<i>I.S. sieve</i>	<i>Percentage passing</i>	<i>I.S. Sieve</i>	<i>Percentage passing</i>
<i>designation</i>	<i>through siev</i>	<i>Designation</i>	<i>through Siev</i>
12,50 mm	100 %	4.75 mm	0-20%
1000 mm	85 - 100%	2.36 mm	0-25%

8.3. The crushing strength of grit will be such as to allow the concrete in which it used to build-up the specified strength of concrete

8.4. The necessary tests for grit shall be carried out as per the requirements of I.S.2386- (parts-I to VIII} 1963r as per instructions of the Engineer-in-charge. The necessity of test will be decided by the Engineer-in- charge.

M-9. Cinder

9.1. Cinder is will burnt furnace residue which has been fused or sintered into lumps of varyingsizes

9.2. Cinder aggregates shall be well burnt furnace residue obtained from furnace using coal fuel only It shall be sound clean and free from clay dirt, ash or other deleteriousmatter

9.3. The average grading for cinder aggregates shall be as mentioned below.

<i>I.S.SieveDesignation</i>	<i>Percentagebypassing</i>	<i>I.S.sieveDesignation</i>	<i>Percentage bypassing</i>
20 mm	100	4.75mm	70
10 mm	86	2.36mm	52

M-10. LimeMortar

10.1. Lime : Lime shall conform to specification M-2, Water : Water shall conform to specification M-1 and Sand: Sand shall conform to specificationM-6

10.2. Proportion ofMix:

10.2.1. mortar shall consist of such proportions of slaked lime and sand as may be specified in item The slaked lime and sand shall be measured by volume

10.3. Preparation ofmortar;

10.3.1. Lime mortar shall be prepared by wet process as per I S 1625-1971 .Power driven mill shall be used for preparation of lime mortar. The slaked lime shall be placed in the mill in an even layer and ground for 180 revolutions with a sufficient water. Water shall be added as required during grinding (care being taken not to add more water) that will bring the mixed material to a consistency of stiff paste. Thoroughly wetted sand shall then be added evenly and the mixture ground for another 180revolutions.

10.4. Storage:

10.4.1. Mortar shall always be kept damp, protected from sun and rain till used up, covering it by tarpaulin or open sheds.

10.5. Use:

10.5.1. All mortar shall be used as soon as possible after grinding. It should be used on the day on which it prepared, But in no case mortar made earlier than 36 hours shall be permitted for use.

M-11. Cement Mortar

11.1. Water shall conform to specification M-1, Cement : Cement shall conform to specifications M-3 and Sand : Sand shall conform toM-6

11.2. Proportion of Mix

11.2.1. Cement and sand shall be mixed to specified proportion, sand being measured by measuring boxes, the proportion of cement will be by volume on the basis of 50 Kg/Bag of cement being equal to 0.0342 Cu.m. The mortar may be hand mixed or machine mixed as directed.

11.3. Proportion of Mortar:

11.3.1. In hand mixed mortar, cement and sand in the specified proportions shall be thoroughly mixed dry on a clean impervious platform by turning over at least 3 times or more till a homogeneous mixture of uniform colour is obtained. Mixing platform shall be so arranged that no deleterious extraneous material shall get mixed with mortar or mortar shall flow out. While mixing, the water shall be gradually added and thoroughly mixed to form a stiff plastic mass of uniform colour so that each particle of sand shall be completely covered with a film of wet cement. The water cement ratio shall be adopted as directed

11.3.2. The mortar so prepared shall be used within 30 minutes of adding water. Only such quantity of mortar shall be prepared as can be used within 30minutes

M-12. Stone Coarse Aggregate For Nominal Mix Concrete

12.1. coarse aggregate shall be of machine crushed stone of black trap or equivalent and be hard strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar

12.2. The aggregate shall generally be cubical in shape Unless special stones of particular quarries are mentioned aggregates shall be machine crushed from the best black trap or equivalent hard stone as approved Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement and ordinary reinforced cement concrete shall generally be as per the table given below.

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However, in case of reinforced cement concrete the maximum limit may be restricted to 6 mm. less than the minimum lateral clear distance between bars or 6- mm. less than the cover whichever is smaller.

TABLE

I S. Sieve Designation	Percentage passing for single Sized aggregates of Nominal size			I S. Sieve Designation	Percentage passing for single Sized aggregates of Nominal size		
	40mm	20mm	16mm		40mm	20mm	16mm
80 mm	-	-	-	12.5 mm	-	-	-
63 mm	100	-	-	10 mm	0.5	0.20	0.30
40 mm	85-100	100	-	4.75 mm	-	0.5	0.5
20 mm	0.20	85-100	100	2.35 mm	-	-	-
16mm	-	-	85-100				

Note : This percentage may be varied some what by the Engineer-in-charge when considered necessary for obtaining better density and strength of concrete.

12.3. The grading test shall be taken in the beginning and at the change of source of materials. The necessary tests, indicated in I.S. 383-1970 and 456~197f shall have to be carried out to ensure the acceptability. The aggregates shall be stored separately and handled in such a manner as to prevent the intermixing of different aggregates. If she aggregates are covered with dust, they shall be washed with water to make them clean..

M-13. Black Trap or Equivalent Hard Stone Coarse

13.1. Aggregate For Design Mix Concrete . Coarse aggregate shall be of machine crushed stone of black trap or equivalent hard stone and be hard, strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar.

13.2. The aggregates shall generally be cubical in shape. Unless special stones of particular quarries are mentioned, aggregates shall be machine crushed, from the best, black trap or equivalent hard stones as approved, Aggregate shall have no deleterious with cement

13.3. The necessary tests indicated in I S. 383-1970 and I.S.456-1978 shall have to be carried out to ensure the acceptability of the material.

13.4. If aggregate is covered with dust it shall be washed with water to make it clean.

M-14. Brick Bats Aggregate

14.1. Brick bat aggregate shall be broken from well burnt or slightly over burnt and dense bricks. It shall be homogeneous in texture, roughly cubical in shape, clean and free from dirt of any other foreign material. The brick bats shall be of 40 mm - 50 mm. size unless otherwise specified in the item The under burnt or over burnt brick bats shall not be allowed.

14.2. The brick bats shall be measured by suitable boxes or as directed.

M-15. Bricks

15.1. The bricks shall be hand or machine molded and made from suitable soils and kiln burnt. They shall be free from cracks and flaws and nodules of free lime they shall have smooth rectangular faces with sharp corners and shall be of uniform colour.

The bricks shall be- moulded with a frog of 100 mm. x 40 mm. and 10 mm. to 20 mm. deep on one of its flat sides. The bricks shall not break when thrown on the ground from a height of 600mm.

15.2. The size of modular bricks shall be 190 mm.x 90 mm.x 90mm.

15.3. The size of the conventional bricks shall be as under :

(9" x 4.3/8" x 2,3/4") 225 x 110 x 75mm.

15.4. Only bricks of one standard size shall be used on one work. The following tolerances shall be permitted in the conventional size adopted in a particular work.

Length $\pm 1/8"$ (3.0 mm.) Width $\pm 1/16"$ (1.50 mm.) Height $\pm 1/16"$ (1.50 mm.)

15.5. The crushing strength of the bricks shall not be less than 35 Kg/Sq. Cm. The average water absorption shall not be more the 20 percent by weight Necessary tests for crushing strength and water absorption etc. shall be carried out as per I.S. 3495 (Part-I to IV) -1976

(13)

M-16. Stone

16.1. The stone shall be of the specified variety such as Granite/Trap Stone/ Quartzite or any other type of good hard stones. The stones shall be only from the approved quarry and shall be hard sound, durable and free from defects like cavities, cracks, sand holes, flaws injurious veins, patches of loose or soft materials etc., and weathered portions and other structural defects Or imperfections tending to affect their soundness and strength. The stone with round surface shall not be used. The percentage of water absorption shall not be more than 5% of dry weight. When tested in accordance with I.S. 1124-1974. The minimum crushing strength of stone shall be 200 Kg/.Sq. Cm. unless otherwise,specified

16.2. The samples of the stone to be used shall be got approved before the work is started

16.3. The Khanki facing stone shall be dressed by chisel as specified in the item for khanki facing in required shape and size. The face of the stone shall be-so dressed that the bushing on the exposed face shall not project by more than 40 mm. from the general wall surface and on face to be plastered it shall not project by more than 19 mm. nor shall it have depressions more than 10 mm. from the average wall surface

M-17. Laterite Stone

17.1. Laterite stone shall be obtained from the approved quarry it shall be compacted in texture sound, durable and free from soft patch. It shall have minimum crushing strength of 100 Kg/Sq. Cm. in its dry condition. It shall not absorb water more than 20% of its own weight, when immersed for 24 hours in water. After quarrying, the stone shall be allowed to weather for some time before using in work.

17.2. The stone shall be dressed into regular rectangular blocks so that all faces are free from waviness and unevenness, and the edges true and square

17.3. Those types of stone in which white clay occurs should not be used

17.4. Special corner stones shall be provided where so directed.

M-18. Mild Steel Bars

18.1. Mild steel bars reinforcement for R.C C. work shall conform to I.S. 432 (Part -II) 1966 and shall be of tested quality. It shall also comply with relevant part of I.S.456-1978.

18.2. All the reinforcement shall be clean and free from dirt, paint, grease, mill scale or loose or thick rust at the time of placing

18.3. For the purpose of payment, the bar shall be measured correct up to 10 mm. length and weight payable worked out at the rate specified below:

1.	6mm	0.22 Kg/Rmt.	8.	20 mm.	2 47 Kg/Rmt
2.	8mm.	0.39 Kg/Rmt.	9	22 mm.	2.98 Kg/Rmt.
3.	10mm.	0.62 Kg/Rmt.	10.	25 mm.	3.85 Kg/Rmt.
4.	12mm.	0.89 Kg/Rmt.	11.	28 mm.	4.83 Kg/Rmt.
5.	14mm	1.21 Kg/Rmt.	12.	32 mm.	6.31 Kg/Rmt.
6.	16mm	1 58 Kg/Rmt	13.	36 mm.	7 99 Kg/Rmt. *
7.	18mm.	2.00 Kg/Rmt.	14.	40 mm.	9,86 Kg/Rmt.

M-19. High Yield Strength Steel Deformed Bars

19.1. High yield strength steel deformed bars shall be either cold twisted other rolled and shall conform to I.S. 1786-1966 and I.S. 1139-1966 respectively.

19.2. Other provisions and requirements shall conform to specification No. M-18 for Mild Steel Bars.

M-20. High Tensile Steel Wires

20.1. The high tensile wires for use in pre stressed concrete work shall conform to I.S,2090-1962.

20.2. The tensile strength of the high tensile steel bars shall be as specified in the item. In absence of the given strength the minimum strength shall be taken as per Para 6-1 of the I.S. 1785-1962. Testing shall be done as per I.S.requirements.

20.3. The high tensile steel shall be free from loose mill scale, rust, oil, grease, or any other harmful matter.

Cleaning of steel bars may be carried out by immersion in solvent solution, wire brushing or passing through a pressure box containing Carborundum.

20.4. The high tensile wire shall be obtained from manufacturers. in coils having diameter not less than 350 times the diameter of wire itself so that wire springs back straight on being uncoiled.

M-21. Mild Steel Binding Wire

21.1. The mild steel wire shall be of 1.63 mm. or 1.22 mm. (16 to 18 gauge) diameter and shall conform to I.S. 280-1972.

21.2. The use of black wire will be permitted for binding reinforcement bars. It shall be free from rust oil paint, grease loose mill scale or any other undesirable coating which may prevent adhesion of cement mortar

M-22. Structural Steel

22.1. All structural Steel shall conform to I S. 226-1985: The steel shall be free from the defects mentioned in I.S 226-1975 and shall have a smooth finish. The material shall be free from loose mill scale, rust pits or other defects affecting the strength and durability. River bars shall conform to I.S.1148-1973.

22.2. When the steel is supplied by the Contractor test certificate of the manufacturers shall be obtained according to I.S. 226-1975 and other relevant Indian Standards.

M-23. Galvanised Iron Sheets

23.1. The galvanised iron sheets shall be plain or corrugated sheets of gauges as specified in item The G.I. Sheets shall conform to I.S.277-1977. The sheets shall be undamaged in carriage and handling either by rubbing off of zinc coating or otherwise. They shall have clean and bright surface and shall be free from dents, bends, holes, rust or white powdery deposit.

23.2. The length and width of G.I. sheets shall be as directed as per site condition.

M-23.A :G.I. Valleys gutter, ridges

23.A.1. The G.I. ridges and hips shall be of plain galvanised sheets Class - 3 of the thickness as specified in item. These shall be 600 mm. in width and properly bent up to shape without damage to the sheets in process of bending.

23.A.2. Valleys gutters and flashings shall also be of galvanised sheet of thickness as specified in item Valleys Shall be 900 mm. wide overall and flashing shall be 380 mm. wide overall They shall be bent to the required shape without damage to the sheet in the process of bending.

M-24. Asbestos Cement Sheets

24.1. Asbestos cement sheets plain, corrugated or semi-corrugated shall conform to I.S.459-1970 The thickness of the sheets shall be as specified in the item. The sheets shall be free from all defects such as cracks, holes, deformities chipped edges or otherwise damaged.

24.2. Ridges & Hips:

24.2.1. Ridges and hips shall be of same thickness as that of A.C. sheets. The types, of ridges shall be suitable for the type of sheets and location.

24.2.2. Other accessories to be used in roof such as flashing pieces eaves filler pieces, valley gutters, north light, and ventilator curves, barge boards etc, shall be of standard manufacture and shall be suitable for the type of sheets and location.

M-25. Mangalore Pattern Roof Tiles

25.1. The mangalore pattern tiles shall conform to I S 654-1972 for Class AA or Class A type as specified in item. Samples of the tiles to be provided shall be got approved from the Engineer-in-charge. Necessary tests shall be carried out as directed.

M-26. Shuttering

26.1. The shuttering shall be either of wooden planking of 30 mm. minimum thickness with or without steel lining or of steel plates stiffened by steel angles The shuttering shall be supported on battens and beams and props of vertical bullies properly cross braced together so as to make the centering rigid. In places of bullies props, brick pillar of adequate section built in mud mortar may be used

26.2. The form work shall be sufficiently strong and shall have camber so that it assumes correct shape after deposition of the concrete and shall be able to resist forces caused by vibration of live load of men working over it and other incidental loads associated with it. The shuttering shall have smooth and even surface and its joints shall permit leakage of cement grout

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26.3. If at any stage of work during or after placing concrete in the structure, the form work sags or bulges out beyond the required shape of the structure, the concrete shall be removed and work redone with fresh concrete and adequately rigid form work. The complete form work shall be got inspected by and got approved from the Engineer-in-charge, before the reinforcement bars are placed in position.

26.4. The props shall consist of bullies having 100 mm minimum diameter measured at mid length and 80 mm at thin end shall be placed as per design requirement. These shall rest squarely on wooden sole plates 40 mm thick and minimum bearing area of 0-10 sq m laid on sufficiently hard base.

26.5. Double wedges shall further be provided between the sole plate and the wooden props so as to facilitate tightening and easing of shuttering without jerking the concrete.

26.6. The timber used in shuttering shall not be so dry as to absorb water from concrete and swell or bulge nor so green or wet as to shrink after erection. The timber shall be properly sawn and planed on the sides and the surface coming in contact with concrete. Wooden form work with metal sheet lining or steel plates stiffened by steel angles shall be permitted.

26.7. As far as practicable, clamps shall be used to hold the forms together and use of nails and spikes avoided.

26.8. The surface of timber shuttering that would come in contact with concrete shall be well wetted and coated with soap solution before the concreting is done. Alternatively coat of raw linseed oil or oil of approved manufacture may be applied in place of soap solution. In case of steel shuttering either soap solution or raw linseed oil shall be applied after thoroughly cleaning the surface. Under no circumstances black or burnt oil shall be permitted.

26.9. The shuttering for beams and slabs shall have camber of 4 mm per meter (1 in 250) or as directed by the Engineer-in-charge so as to offset the subsequent deflection. For cantilevers, the camber at free end shall be 1/50 of the projected length or as directed by the Engineer-in-charge.

M- 27. Expansion Joints - Premoulded filler

27.1. The item provides for expansion joints in R.C.C. frame structures for internal joints, as well as exposed joints, with the use of premoulded bituminous joint filler.

27.2. Premoulded bituminous joints filler i.e. performed strip of expansion joints filler shall not get deformed, or broken by twisting bending or other handling when exposed to atmospheric condition. Pieces of joints filler that have been damaged shall be rejected.

27.3. Thickness of the per-moulded joints filler shall be 25 mm. unless otherwise specified.

27.4. Premoulded bituminous joints filler shall conform to IS 1838-1961

M-28. Expansion joints-Copper strips & hold fasts

28.1. The item provides for expansion joints in R.C.C. frame structure for internal joints, as well as exposed joints, with the use of premoulded bituminous joint filler.

28.2. Copper sheet shall be of 1.25 mm. width and or 125 mm. width and the " U " shape in the middle. Copper strip shall have holdfast of 3 mm diameter copper rod fixed to the plate soldered on strip at intervals of about 30 cm or as shown in the drawing or as directed. The width of each flange (horizontal side) of the copper plate to be embedded in the concrete work shall be 25 mm depth of "U" to be provided in the expansion joint, in the copper plate shall be of 25mm.

M-29. Teak wood

29.1. The teak wood shall be of good quality as required for the item to be executed. When the kind of wood is not specifically mentioned, good Indian teak wood as approved shall be used.

29.2. Teak wood shall generally be free from large, loose dead or cluster knots, flaws, shakes, warps, twists, bends or any other defects. It shall generally be uniform in substance and of straight fibers as far as possible. It shall be free from rot decay, harmful fungi and other defects of harmful nature which will affect the strength, durability or its usefulness for the purpose for which it is required. The colour shall be uniform as far as possible. Any effort like painting using any adhesive materials made to hide the defects shall render the pieces liable to rejection by the Engineer-in-charge.

29.3. All scantlings, planks etc., shall be sawn in straight lines and planes in the direction of grains and of uniform thickness.

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29.4. The tolerances-in the dimensions shall be allowed at the rate of 1.5 mm. per face to be planed.

29.5. First class teakwood

29.5.1. First class teak wood shall have no individual hard and sound knots, more than 6 sq. cm. in size and the aggregate area of such knots shall not be more than 1% of area of piece, The timber shall be closed grained.

29.6. Second Class Teak Wood:

29.6.1. No individual hard and sound knots shall be more than 15 sq. cms. in size and aggregates area of such knots shall be not exceed 2% of the area of piece.

M-29. A Non-teak wood:

The non-teak wood shall be chemically treated, seasoned as per I.S. Specifications and of good quality. The type of wood shall be got approved before collecting the same on site Fabrication of wooden members shall be started only after approval.

For this purpose wood of Bio, Kalai, Sires. Saded, Behda, Jamun, Sisoo will be used for door where as only Kalai. Sires, Halda. Kalam etc. will be permitted for shutters after proper seasoning and chemical treatment. The non-teak wood shall be free from large loose dead of cluster knots, flows, shakes, warps, bends or any other defects, It shall be uniform in substance and of straight fibers as far as possible It shall be free fro rots, decay, harmful fungi and other defects of nature which will effect the strength, durability or its usefulness for the purpose for which it is required. The colour of wood shall be uniform as far as possible. The scantlings planks etc. shall be saw in straight lines and planes in the direction of grain and of uniform thickness. The department will use the Agency to produce certificate from Forest Department in event of dispute and the decision of the Department shall be final and binding to the contractor. The tolerance in the dimension shall be allowed at 1.5 mm. per face to be planed.

M-30. Wooden flush door shutters (solid core)

30.1. The solid core type flush door shutters shall be of decorative or non-decorative type as specified in the drawing. The size and thickness of the shutter shall be as specified in drawings or as directed. The timber species for core shall be used as per I.S.2202 (part -I) 1980. The timber shall be free from decay and insect attack Knots and knot holes less than half the width of cross-section of the members in which they occur may be permitted. Pitch pockets, pitch streaks and harmless pin holes shall be permissible except in the exposed edges of the core members. The commercial plywood, cross-bands shall conform to I.S.303-1275

30.2. The face-pane! of the shutters shall be formed by gluing by the hot press process on both faces of the core with either plywood or cross-bands and face veneers. The¹ hopping, rebating. opening of glazing, venation etc., shall be provided if specified in the drawing.

30.3. All edges of the door shutters shall be square. The shutters shall be free from twist or warp in its plane. Both faces of the shutters shall be sand papered to smooth eventexture.

30.4. The shutters shall be testedfor-

(1) **End immersion test:** The test shall be carried out as per I.S.2202 (part-1) 1980 There shall be no delamination at the end of the test.

(2) **Knife Test :** The face panel when tested in accordance with I.S 1659-1979 shall pass the test.

(3) **Glue adhesion test :** The flush door shall be tested for glue adhesive test in accordance with I S 2202 (part -I) 1980. The shutters shall be considered to have passed the test, if no delamination occurs in the glue lines in the plywood and if no single determination more than 80 mm in length and more than 3 mm in depth has occurred in the assembly glue lines between the plywood face and the style and rail. Delamination at the corner shall be measured continuously around the corner Delamination at the knots, knot hole and other permissible wood defectects shall not be considered in assessing the sample.

30.5. The tolerance in size of scud core type flush door shall-be as under :In

Nominal thickness \pm 1.2 mm. In Nominal height \pm 3m

30.6. The thickness of the shutter shall be uniform throughout with a permissible variation of not more than 0.8 mm when measured at anypoints.

M-31. Aluminum doors, windows, ventilators

31.1. Aluminum alloy used in the manufacture of extruded window sections shall conform to I.S. designation HEA-WP of I.S. 733-1975 and also to I.S. Designation WVG-WP of I.S. 1285-1975 The section shall be as specified in the drawing and design. The fabrication shall be done as directed

31.2. The hinges shall be cast or extruded aluminum hinges of same type as in window but of larger size.

31.3. The hinges shall normally be of 50 mm. projecting type. Non-projecting type of hinges may also be used if directed. The handles of door shall be of specified design A suitable lock for the door Operable either from outside or inside shall be provided. In double shutter door, the first closing shutter shall have concealed aluminum alloy bolt at top and bottom.

M-32. Rolling Shutters

32.1. The rolling shutters shall conform to I.S.6248-1979 Rolling shutters shall be supplied of specified type with accessories. The size of the rolling shutters shall be specified in the drawings. The shutters shall be specified in the drawings. The shutters shall be constructed with interlocking lath sections formed from cold rolled steel strips not less than 0.9 mm. thick and 80 mm. wide for shutters up to 3.5 m. width not less than 1.25 mm. thick and 80 mm wide for shutters 3.5 m. in width and above unless otherwise specified.

32.2. Guide channels shall be of mild steel deep channel section and of rolled pressed or built up (fabricated) joint less construction The thickness of sheet used shall not be less than 3 15mm.

32.3. Hood covers shall be made of M.S. Sheets not less than 0.90 mm. thick. For shutters having width 3.5 Meter and above, the thickness of M.S. sheet for the hood cover shall be not less than 1 25 mm.

32.4. The spring shall be of best quality and shall be manufactured from tested high tensile spring steel wire of strip of adequate strength to balance the shutters in all position. The spring pipe shaft etc . shall be supported on strong M S of malleable C I. brackets. The brackets shall be fixed on or under the lintel as specified with-raw! plugs and screws boltsetc.

32.5. The rolling shutters shall be of self rolling up to 8 Sq. m. clear area without ball bearing and up to 12 Sq.m. clear area with ball bearing. If the rolling shutters are of larger, then gear operated type shutters shall be used.

32.6. The locking arrangement shall be provided at the bottom of shutter at both ends The shutters shall be opened from outside.

32.7. The Shutters shall be completed with door suspension shafts, locking arrangements, pulling hooks, handles and other accessories.

M-33. Collapsible Steel Gate

33.1. The collapsible steel gate shall be in one or two leaves and size as per approved drawings or as specified. The gate shall be fabricated from best quality mild steel channels, flats etc. Either steel pulleys or ball-bearings shall be provided in every double channel Unless otherwise specified the particulars of collapsible gate shall be as under.

(a) Pickets : These shall be of 20 mm. M.S. channels of heavy sections unless otherwise shown on drawings. The distance centre to centre of pickets shall be 12 cms .with an opening or 10Cms

(b) Pivoted M.S. flats shall be 20 mm x6mm

(c) Top and bottom guides shall be from tee of flat iron of approved size.

(d) The fittings like stoppers fixing, locking cleats, brass handles and cast iron rollers shall be of approved design and size

M-34. Welded Steel Wire Fabric

34.1 Welded steel wire fabric for general purpose shall be manufactured from cold drawn steel wire "as drawn" or galvanized steel conforming to I.S. 226-1975 with longitudinal and transverse wire securely connected at every intersection by a process of electrical resistance welding and conforming to I.S.4948- 1974. it shall be fabricated and finished in workmanlike manner and shall be free from injurious defects and shall be rust proof The type of mesh shall be oblong or square as directed The mesh sizes and sizes if wire for square 3b well as oblong welded steel wire fabric shall be as directed The steel wire fabric in panels shall be in one whole piece in each panel as far as stock sizes permit.

M-35 Expanded Metal Sheets

35.1. The expanded metal sheets shall be free from flaws joints broken strands laminations and other harmful surface defects. Expanded metal steel sheet shall conform to IS-412-1975. except that blank sheets need not be with guaranteed mechanical properties The size of the diamond mesh of expanded metal and dimensions of strands (width and thickness) shall be as specified. The tolerance on nominal weight of expanded metal sheets shall be of \pm 10percent.

35.2. Expanded metal in panels shall be in one whole piece in each panel as far as stock sizes permit. The expanded metal sheets shall be coated with suitable protective coating to prevent corrosion.

M-36. Mild Steel Wire (Wire Gauze Jali)

36.1. Mild steel wire may be galvanized as indicated. All finished steel wire shall be well cleanly drawn to the dimensions and size of wire as specified in item. The wire shall be sound free from splits surface flaws, rough jagged and imperfect edges and other harmful surface defects and shall conform to I.S.280-1978.

M-37. Plywood

37.1. The plywood for general purpose shall conform I.S.303-17-1975.

Plywood is made by cementing together than boards or starts of wood into panels. There are always an odd number of layers, 3,5,7,9, ply etc. The piles are placed so that grain of each layer is at right angles to the grain in the adjacent level.

37.2. The chief advantages of plywood a single board of the same thickness is the more uniform strength of the plywood, along the length and width of the plywood and greater resistance to cracking and splitting with change in moisture content.

37.3. Usually synthetic resins are used to gluing, phenolic resins are usually cured in a hot press which compresses and simultaneously heats the plies between hot plates which maintain a temperature of 90 degree C to 140 degree C and a pressure of 11 to 14 Kg/ Sq. Cm on the wood. The time of heating may be anything from 2 to 60 minutes depending upon thickness

37.4. When water glue are used the wood absorbs so much water that the finished plywood must be dried carefully. When synthetic resins are used as adhesive the finished plywood must be exposed to an atmosphere of controlled humidity until the proper amount of moisture has been absorbed.

37.5. According to I.S. 303-1975 the plywood for general purpose shall be of the grades namely BWR, WWR and CWR depending up to the adhesives used for bonding the veneers and it will be further classified into six types namely AA, AB, AC, BB, BC and CC based on the quality of the two faces each face being of three kinds namely A, Band C After pressing, the finished plywood should be reconditioned to a moisture content not less than 8 percent and not more than 16percent.

37.6. Thickness of plywood Boards.

TABLE

Board	Thickness	Board	Thickness	Board	Thickness	Board	Thickness
3 ply.	3 mm.	5 ply.	5 mm.	7 ply.	9 mm.	9 ply.	16 mm
	4 mm.		6 mm.		13 mm.		19 mm.
	5 mm.	8 mm.	7 mm.	9 ply.	16 mm.	11 ply.	19 mm.
	6 mm.		8 mm.		13 mm.		25 mm.

M-38. Glass

38.1. All glass shall be of the brief quality, free from specks, bubbles, smokes veins, air holes blisters and other defects. The kind of glass to be used shall be as mentioned in the item or specification or in the special provision or as shown in detailed drawings. Thickness of glass panes shall be uniform. The specifications for different kinds of glass shall be as under.

38.2. Sheet Glass

38.2.1. In absence of any specified thickness or weight in the item or detailed specifications of the item of work, sheet glass shall be weighing 7.5 Kg/Sq. m for panes up to 600 mm x 600mm.

38.2.2. For panes larger than 600 mm x 600 mm and up to 800 mm x 800 mm the glass weighing not less than 8.75 Kg/Sq m shall be used For bigger panes up to 900 mm x 900 mm. glass weighing not less than 8.75 Kg/Sq. m shall be used. For bigger panes up to 900 mm x 900 mm. glass weighting not less than

11.25 Kg/Sq. m. shall be used

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38.2.3. Sheet glass shall be patent flattened glass of best quality and for glazing and framing purposes shall conform to I.S. 1761-1960. Sheet glass of the specified colours shall be used, if so shown, on detailed drawings or so specified For important buildings and for panes with any dimension over 900 mm plate glass of specified thickness shall be used

38.3. PlateGlass:

38.3.1. When plate glass is specified it shall be "polished patent plate glass" of best quality It shall have both the surface ground flat and parallel and polished to obtain clear undisturbed vision and reflection The plate glass shall be of the thickness mentioned in the item or as shown in the detailed drawing or as specified. In absence of any specified thickness, the thickness of plate glass to be supplied shall be 6 mm. and a tolerance of 0.20 mm shall be admissible

38.4. ObscuredGlass:

38.4.1. This type of glass transmits light so that vision is partially or almost completely obscured. Glass shall be plain rolled, figured, ribbed or fluted, or frosted glass as may be specified as required. The thickness and type of glass shall be as per details on drawings or as specified or as directed

38.5. WiredGlass:

38.5.1. Glass shall be with wire netting embedded in a sheet of plate glass. Electrically welded 13 mm Georgian square mesh shall be used Thickness of glass shall not be less than 6 mm Wired glass shall be of type and thickness as specified

M-39. Acrylic Sheets

39.1. Acrylic sheets shall be of thickness as specified in the item and of an specified shape and size as the case may be panels may be flat or curved It should be light in weight it shall be colourless or coloured or opaque as specified in the item. Colourless sheet shall be as transparent as the finest optical glass. Its light transmission rate shall be about 95% Transparency shall not be affected for the sheets of larger thickness, it shall be extremely resistant to sunlight weather and low temperatures.

It shall not show any significant yellowing or change in physical properties or loss of light transmission over a longer period of use. The sheet shall be impact resistant also Sheets should be of such quality that they can be cut, bent jointed as desired Solution for the joints shall be used as per the requirement of manufacturer.

M-40. Particle board

40.1. The particle boards used for face panels shall be of best quality free from any defects. "The particle boards shall be made with phenolaldehyde adhesive The particle boards shall conform I S 3087-1905" Specification for wood particle board for general purpose" The size and the thickness shall be as indicated. **M-41. Expanded polystyrene or framed styrofoam slabs**

41.1. The expanded polystyrene ceiling boards and tiles shall be of approved make and shall be of sizes, thickness, finish and colour as indicated. It shall be of high density and suitable for use as insulating material. The insulating material shall be like slabs of Thermocole etc.

M-42. Resin bonded fiber glass.

42.1. The resin bonded fiber glass tiles or rolls shall be of approved make and shall be of sizes, thickness, and finish as indicated.

42.2. For test of Mineral wool thermal insulation [Blanket I S 3144-1965 shall be followed

42.3. Insulation wool blankets shall be with the following coverings on one or both sides as indicated

- (1) Bituminous Hessian Kraft paper suitable for use in position where moisture has to be excluded.
- (2) Hessian cloth or Kraft paper for keeping out dust
- (3) G.I wire netting, suitable for surfaces to be plastered over

M-43. Fixtures and fastenings

43.1. General:

43.1.1. The fixtures and fastenings, that is butt hinges tee and strap hinges sliding door bolts, tower bolts, door latch, bath-room latch, handles door stoppers, casement window fasteners, casement stays and ventilators catch shall be made of the metal as specified in the item or its specification.

43.1.2. They shall be of iron, brass, aluminum chromium plated iron, chromium plated brass, copper oxidised iron, copper oxidised brass or anodised aluminum as specified

43.1.3. The fixtures shall be heavy medium or light type. The fixtures and fastenings shall be smooth finished and shall be such as will ensure ease of operations.

43.1.4. The samples of fixtures and fastenings shall be got approved as regards, quality and shape before providing them in position

43.1.5. Brass and anodised aluminium fixtures and fastenings shall be bright finished

43.2. Holdfasts:

43.2.1. Holdfasts shall be made from mild steel flat 30 cm length and one of the holdfasts shall be bent at right angle and two nos of 6 mm. diameter holes, shall be made in it for fixing it to the frame with screws. At the other end, the holdfast shall be forked and bent at right angles in opposite directions

43.3. Butt hinges:

43.3.1. Railway standard heavy type butt hinges shall be used when so specified

43.3.2. Tee and strap hinges shall be manufactured from M S Sheet

43.4. Sliding door bolts (Aldrops):

43.4.1. The aldrops as specified in the item shall be used and shall be got approved.

43.5. Tower bolts (Barrel Type):

43.5.1. Tower bolts as specified in the item shall be used and shall be got approved

43.6. Door Latch:

43.6.1. The size of door latch shall be taken as the length of latch.

43.7. Bathroom Latch:

43.7.1. Bathroom latch shall be similar to tower bolt.

43.8. Handle:

The size of the handles shall be determined by the inside grip length of the handles. Handles shall have a base plate of length 50 mm. more than the size" of the handle.

43.9. Door Catch:

43.9.1. Door stoppers shall be either floor door stopper type or door catch type Floor stopper shall be of overall size as specified and shall have a rubber cushion.

43.10. Door Stoppers:

43.10.1. Door catch shall be fixed at a height to about 900 mm from the floor level such that one part of the catch is fitted on the inside of the shutter and the other part is fixed in the wall with necessary wooden plug arrangements for appropriate fixity The catch shall be fixed 20 mm inside the face of the door for easy operation of catch.

43.11. Wooden Door Stop with hinges:

43.11.1. Wooden door stop of size 100 mm x 40 mm shall be fixed on the door frame with a hinge of 75 mm. size and at a height of 900 mm. from the floor level The wooden door stop shall be provided with 3 coats of approved oil paint

43.12. Casement Window Fastener:

43.12.1. Casement window fastener for single leaf window shutter shall be left or right handed as directed

43.13. Casement stays (Straight Red Stay):

43.13.1. The stays shall be made from a channel section having three holes at appropriate position so that the window can be opened either fully or partially as directed. Size of the stay shall be 250 mm to 300 mm. as directed.

43.14. Ventilator Catch:

43.14.1. The pattern and shape of the catch shall be as approved

43.15. Pivot:

43.15.1. The base and socket plate shall be made from minimum 3 mm. thick plate: and projected pivot shall not be less than 12 mm diameter and 12 mm. length and shall be firmly welded to the base plate in case of iron pivot and in single piece plate in the case of brass pivot.

M-44. Paints:

44.1. (A) Oil paints:

44.1.1. Oil paints shall be of the specified colour and as approved. The ready mixed paints shall only be used. However, if ready mixed paint of specified shade or tint is not available white ready mixed paint with approved stainer will be allowed. In such a case the contractor shall ensure that the shade of the paint so allowed shall be uniform.

44.1.2. All the paints shall meet with the following general requirements

(i) Paint shall not show excessive setting in a freshly opened full can and shall easily be ready spread with a paddle to a smooth homogeneous state. The paint shall show no curdling, leivering, caking or colour separation and shall be free from lumps and skins

(ii) The paint as received shall brush easily, possess good leveling properties and show no running or sagging tendencies

(iii) The paint shall not skin within 48 hours in a three quarters filled closed container

(iv) The paint shall dry to a smooth uniform finish free from roughness, grit, unevenness and other imperfections

44.1.3. Ready mixed paint shall be used exactly as received from the manufacturers and generally according to their instructions and without any admixtures whatsoever

44.2. (B) Enamel paints:

44.2.1. The enamel paint shall satisfy in general requirements in specification of oil paints, Enamel paint shall conform to I.S.2933-1975.

M-45. French Polish

45.1. The French polish of required tint and shade shall be prepared with the below mentioned ingredients and other necessary materials:

(i) Denatured spirit of approved quality (ii) Chandras (iii) Pigment.

45.2. The French polish so prepared shall conform to I S : 348-19C8.

M-46. Marble chips for marble mosaic terrazzo

46.1. The marble chips shall be of approved quality and shades. It shall be hard, sound, dense and homogeneous in texture with crystalline and coarse grains. It shall be uniform in colour and free from stains, cracks, decay and weathering.

46.2. The size of various colours of marble chips ranging from the smallest up to 20 mm shall be used where the thickness of top wearing layer is 6 mm size. The marble chips of approved quality and colours only as per grading as decided by the Engineer-in-charge shall be used for marble mosaic tiles or works

46.3. The marble chips shall be machine crushed. They shall be free from foreign matter, dust etc. Except as above, the chips shall conform to I S 2114-1962

M-47. Flooring Tiles

47.1. (A) Plain Cement tiles;

47.1.1. The plain cement tiles shall be of general purpose type. These are the tiles in the manufacture of which no pigments are used. Cement used in the manufacture of tiles shall be as per Indian Standards.

47.1.2. The tiles shall be manufactured from a mixture of cement and natural aggregates by pressure process. During manufacture the tiles shall be subjected to pressure of not less than 140 Kg/Sq. Cm. The proportion of cement to aggregate in the backing of the tiles shall be not less than 1.3 by weight. The wearing face, through the tiles are of plain cement, shall be provided with stone chips of 1 to 2 mm. size. The proportions of cement to aggregate in the wearing layer of the tiles shall be three parts of cement to one parts chips by weight. The minimum thickness of wearing layer shall be 3 mm. The colour and texture of wearing layer shall be uniform throughout its face and thickness. On removal from mould, the tiles shall be kept in moist condition continuously at least for seven days and subsequently, if necessary, for such long period as would ensure their conformity to requirements of I.S.1237-1980 regarding strength, resistance to wear and water absorption.

47.1.3 The wearing face of the tiles shall be plane, free from projections, depressions and cracks and shall be reasonably parallel to the back face of the tile. All angles shall be right angle and all edges shall be sharp and true.

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47.1.4. The size of tiles generally be square shapes 24.85 Cm x24.85 Cm. or 25 Cm x 25 Cm The thickness of tiles shall be 20mm.

47.1.5. Tolerance of length and breadth shall be plus of minus one millimeter Tolerance on thickness shall be plus 5mm.

47.1.6. The tiles shall satisfy the tests as regards transverse strength, resistance to wear and water absorption as per I.S.1237-1980.

47.2. (B) Plain Coloured Tiles:

47.2.1. The tiles shall have the same specification as for plain cement tiles as per (A) above expect that they shall have a plain wearing surface wherein pigments are used. They shall conform it I.S.1237-1980.

47.2.2. The pigments used for colouring cement shall not exceed 10 percent by weight of cement used in the mix. The pigments, synthetic or otherwise, used for colouring tiles shall have permanent colour and shall not contain materials detrimental to concrete

47.2.3 The colour of the tiles shall be specified in the item or as directed

47.3. (C) Marble mosaic tiles:

47.3.1. These tiles have same specification as per plain cement tiles except the requirements as stated below

47.3.2. The marble mosaic tiles shall conform to I.S 1237-1980. The wearing face of the tiles shall be mechanically ground and filled. The wearing face of tiles shall be free from projections depressions and cracks and shall be reasonably parallel to the back face of the tiles. All angles shall be right angles and all edges shall be sharp and true.

47.3.3. Chips used in the tiles be from smallest up to 20 mm. size. The minimum thickness of wearing layer of tiles shall be 6 mm. For pattern of chips to be had on the wearing face; a few samples with or without their full size photographs as directed shall be approved by the Engineer-in-charge, for approval.

47.3.4. Any particular samples if found suitable shall be approved by the Engineer-in-charge, or he may ask for a few more samples to be presented The samples shall have to be made by the contractor till a suitable sample is finally approved for use in the work. The Contractor shall ensure that the tiles supplied for, the work shall be in conformity with the approved sample only, in terms of its dimensions, thickness of backing layer and wearing surface, materials, ingredients, colour, shade, chips, distribution etc. required.

47.3.5. The tiles shall be prepared from cement conforming to Indian Standards or coloured port land cement generally depending upon the colour of tiles to be used or as directed.

47.4. (D) Chequered Tiles:

47.4.1. Chequered tiles shall be plain cement tiles or marble mosaic tiles. The former shall have the same specification as per (A) above and the latter as per marble mosaic tiles as per (C) except as mentioned below

47.4.2. The tiles shall be of nominal size of 250 mm. x 250 mm. or as specified. The centre to centre distance of chequer shall not be less than 25 mm. and not more than 50 mm. The overall thickness of the tile shall be 22mm

47.4.3. The grooves in the chequers shall be uniform and straight. The depth of the grooves shall not be less than 3 mm. The chequered tiles shall be plain coloured or mosaic as specified The thickness of the upper layer measured from the top of the chequers shall not be less than 6 mm. The tiles shall be given the first grinding with machine before delivery to site

47.4.4. Tiles shall conform or relevant I.S 1237-1980.

47.5. (E) Chequered Tiles For Stair Cases:

47.5.1. The requirements of these tiles shall be the same as chequered tiles as per (D) above except in following respects:

(1) The length of a tile including nosing shall be 300 mm (2) The minimum thickness shall be 28 mm (3) The nosing shall have also the same wearing layer as at the top. (4) The nosing edge shall be rounded (5) The front portion of the tile for a minimum length of 75 mm. from and including the nosing shall have grooves running parallel to nosing and at centers not exceeding 25 mm Beyond that the tiles shall have normal chequer pattern.

M-48. Rough Kotah Storm

48.1. The Kotah stones shall be hard even, sound, and regular in shape and generally uniform in colour. The colour of the stone shall generally be green Brown coloured shall not be allowed for use They shall be without any soft veins, cracks offlaws.

48.2. The size of the stones to be used for flooring shall be of size 600 mm x 600 mm and/or size 600mm. x 450 mm as directed However smaller sizes will be allowed to be used to the extent of maintaining required pattern. Thickness shall be as specified

48.3. The edges of minus 30 mm on accounts of chisel dressing of edges shall be permitted for length as well as breadth. Tolerance in thickness shall be ± 3 mm

48.4. The edges of stones shall be truly chiseled and table rubbed with coarse sand before paving. All angles and edges of the stones shall be true, square and free from chipping and surface shall be true and plain

48.5. When machine cut edges are specified, the exposed and the edges at joints shall be machine cut The thickness of the exposed machine cut edges shall be uniform

M-49. Polished Kotah Stoics

49.1. Polished kotah stone shall have the same specification as per rough kotah stone except as mentioned below

49.2. The stones shall have machine polished surface. When brought on site, the stones shall be single polished or double polished depending upon its use. The stones for paving shall generally be single polished The stones to be used for dado, skirting, sink, veneering, sills steps etc. where machine polishing after the stones are fixed in situ is not possible shall be double polished

M-50. Dholpur Stone Slab

50.1. Dholpur stone slab shall be of best quality as approved by the Engineer-in-charge The stone slab shall be without any veins, cracks, and flaws The stone slab shall be even sound and durable regular in shape and of uniform colour

50.2. The size of the stone shall be as specified in the item or detailed drawing or as approved by the Engineer-in-charge The thickness of the stone shall be as specified in the item of work with the permissible tolerance of plus or minus 2 mm. The provision in respect of polishing as for polished kotah stone shall apply to polished Dholpur stone also. All angles and edges of the face of the stone slab shall be fine chiseled or polished as specified in the item of work and all the four edges shall be machine cut All angles and edges of the stone slab shall be true and plane

50.3. The sample of stone shall be got approved by the Engineer-in-charge for a particular work It shall be ensured that the stones to be used in a particular work shall not differ much in shade or tint from the approved sample

M-51. Marble Slab

51.1. Marble slab shall be white or of other and of best quality as approved by the Engineer-in-charge

51.2. Slabs shall be hard, close, uniform and homogeneous in texture. They shall have even crystalline grain and free from defects and cracks. The surface shall be machine polished to an even and perfect plane surface and edges machine cut true and square. The rear face shall be rough to provide key for the mortar

51.3. Marble slabs with natural veins, if selected shall have to be laid as per the pattern given by the Engineer-in-charge. Size of the slab shall be minimum 460 mm x 450 mm and preferably 600 mm x 600 mm. However, smaller sizes will be allowed to be used to the extent of maintaining required pattern.

51.4. The slab shall not be thinner than the specified thickness at its thinnest part. A few specimens of finished slab to be used shall be deposited by the Contractor in the office for reference

51.5. Except as above the marble slabs shall conform to I.S.1130-1969

M-52. Granite Stone slab

52.1. Granite shall be of approved colour and quality. The stone shall be hard, even sound and regular in shape and generally uniform in colour. It shall be without any soft veins, cracks offlaws

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52.2. The thickness of the stone shall be specified in items

52.3. AH exposed faces shall be double polished to tender truly smooth and even reflecting surface. The exposed edges and corners shall be rounded off as directed. The exposed edges shall be machine cut and shall have uniform thickness.

M-53. P.V.C. Flooring

53.1. P.V.C. sheets for P.V.C., floor covering shall be of homogenous flexible type conforming to I S 3462-1966. The P.V.C. covering shall neither develop any toxic effect while put to use nor shall give off any disagreeable odour.

53.2. Thickness of flexible type covering tiles shall be as specified in the description of the item

53.3. The flexible type shall be backed with Hessian or other woven fabric. The following tolerances shall be applicable on the nominal dimensions of the rolls or tiles:

(a) Thickness ± 0.15 mm.

(b) Length or Width

(1) 300 mm. Square tiles ± 0.20 mm.

(3) 900 mm Square tiles ± 0.60 mm.

(2) 600 mm. Square tiles ± 0.40 mm.

(4) Sheets and roll ± 0.10 percent.

53.4. Adhesive:

53.4.1. The adhesive for PVC flooring shall be of the type and make recommended by the manufacturer of PVC sheets/tiles.

M-54. Facing Tiles

54.1. The facing tiles (burnt clay facing bricks) shall be free from cracks, and nodules of free lime. They shall be thoroughly burnt and shall have plane rectangular faces with parallel sides and sharp straight right angled faces. The texture of the finished surface that will be exposed when in place shall conform to an approved sample consisting not less than for stretcher bricks each representing the texture desired. The facing tiles shall have a pleasing appearance, sufficient resistance to penetration by ram and greater durability than common bricks. The tiles shall conform to I.S.2691-1972.

54.2. The standard size of facing brick tiles shall be 19 x 9 x 4 cms. The facing brick tiles shall be provided with frog which shall conform to I.S.11077-1976.

54.3. The permissible tolerance in dimensions specified above shall be as follows:

Size	Tolerance for	
	1st Class Brick	2nd Class Brick
19cm.	± 6 mm.	± 10 mm.
9cm.	± 3 mm.	± 7 mm.
4cm.	± 1.5 mm.	± 3 mm.

The tolerance for distortion or warpage of face or edges of individual brick from a plane surface and from a straight line respectively shall be as follows:

Facing dimensions	Permissible tolerance
Max. below 19cms.	Max. 2.5mm.
-do- above 19cms.	Max. 3.0mm.

54.5. The average compressive strength obtained as a sample of five tiles when tested in accordance with the procedure laid as per I S 1077-1976 shall be not less than 175 Kg/Sq Cm. The average compressive strength of any individual bricks shall be not less than 160 Kg /Sq.Cm.

54.6. The average water absorption for five bricks tiles shall not exceed 12 percent of average weight of brick before testing. The absorption for each individual bricks shall not exceed 25 percent.

54.7. The brick tiles when tested in accordance with I.S. 1077-1976, the rate of efflorescence shall not be more than "Slightly effloresced"

M-55. white Glazed tile

55.1. The tiles shall be of best quality as approved by the Engineer-in-charge. They shall be flat and true to shape. They shall be free from cracks, crazing spots, chipped edges and corners. The glazing shall be of uniform shade.

(26)

55.2. The tiles shall be nominal size of 150 mm x 150 mm unless otherwise, specified. The maximum variation the stated sizes other than the thickness of tile shall be plus or minus 1.5 mm. The thickness of tile shall be mm. Except as above the tiles shall conform to I.S.1977-19/0

M-56. Galvanised from pipes and fittings

56.1. Galvanised iron pipes shall be of the medium type and of required diameter and shall comply with I.S. 1239-1979. The specified diameter of the pipes shall refer to the inside diameter of the bore. Clamps, screw and all galvanised iron fittings shall be of the standard ' R ' or equivalent make

M-57. Bib cock and stop cock

57.1. A bib cock is a draw off tap with a horizontal inlet and free outlet A stop cock is a valve with suitable means of connection for insertion in a pipe line for controlling or stopping the flow

57.2. They shall be of screw down type and of brass chromium plated and of diameter as specified in the description of the item. They shall conform to I.S. 781-1977 and they shall be of best Indian make. They shall be polished bright.

57.3. The minimum finished weight of bib cock and stop cock shall be as given below

Diameter	Bib cock	Stop cock	Diameter	Bib cock	Stop cock
8 mm	0.25 kg.	0.25 kg.	15 mm	0.40 kg.	0.40 kg.
10 mm	0.30 kg.	0.35 kg.	20 mm	0.75 kg.	0.75 kg.

M-58. Gun metal wheel valve

58.1. The gun metal wheel valve shall be of approved quality. These shall be of gun metal fitted with wheel and shall be of gate valve opening full way and of the size specified. These shall conform to I.S. 778-1971.

M-59. White glazed porcelain wash basin

59.1. Wash basin shall be of white porcelain first quality best Indian make and it shall conform to I.S. 2556 (Part -IV)

-1972 and I.S. 771-1979. The size of the wash basin shall be as specified in item. Wash basin shall be of one piece construction with continued over flow arrangements All internal angles shall be designed so as to facilitate cleaning. Wash basin shall have single tap hole as specified. Each basin shall have a circular waste hole which is either welded or beveled internally with 65 mm. diameter at top and 10 mm. depth to suit the waste fitting. The necessary stud slot to receive the bracket on the under side of the basin shall be provided Basin shall have an internal soap holder which shall fully drain into the bowl.

59.2. White glazed pedestal of the quality and colour as that the basin shall be provided where specified in the item. It shall be completely recessed at the back for reception of supply and wash pipe. It shall be capable of supporting the basin rigidly and adequately and shall be so designed as to make the height from the floor the floor to top of the rim of basin 750 mm. to 800 mm. as directed.

M-60. European type water closet/with low flushing

60.1. The European type water closet shall be white glazed porcelain first quality and shall be of wash down type conforming to I.S. 2556-1973 and I.S.771-1979

60.2. 'S' trap shall be provided as required with water seal not than 50 mm. The solid plastic seat and cover shall be of best Indian make conforming to I.S 2548-1980. They shall be made of moulded synthetic materials which shall be tough and hard with high resistance to solvents and shall be free from blisters and surface defects and shall have chromium plated brass hinges and rubber buffer of suitable size.

M-61. Orrissa type water closet

61.1. The Specification of Orrissa type white glazed water closet of first quality shall conform to I.S. 2256 (Part-III) -1981 and relevant specification of Indian type water closet except that pan will be with the integral squatting pan of size 580 mm x 400 mm with raised footrest.

M-62. Indian type water closet

62.1. The Indian type white glazed water closet of first quality shall be of size as specified in the item and conforming to I.S. 771-1979 and I.S. 2556 – (Part-II) 1981. Each pan shall have integral flushing. It shall also have an inlet at back or front for connecting flush pipes as directed. The inside of the bottom of the pan shall have sufficient slope from the front towards the outlet and surface shall be uniform and smooth. Pan shall be provided with 100 mm. diameter 'P' or 's' trap with approximately 50 mm. Water seal and 50 mm. diameter vent horn.

M-62. A. Foot Rests

62.A.1. A pair of whit glazed earthen ware rectangular foot to minimum size 250 mm.x 130 mm. x 20 mm shall be provided with the water closet.

M-63. Glazed Earthen Ware Sink

63.1. The glazed earthen-ware sink shall be of specified size, colour and quality. They sink shall conform, to I.S. 771 part – II – 1979. The brackets for sinks shall conform to I.S.775-1970

63.2. The pipes shall conform to I.S. 1239-part-I 1973 and I.S. 404-1962. for steel and lead pipes respectively. 32 mm. brass waste coupling of standard pattern with brass chain and rubble plug shall be provided with sink.

M-64. Glazed earthen-ware Lipped type flat back urinal/corner type urinal

64.1. The lipped type urinal shall be fiat back or corner type as specified in the item and shall conform to I.S 771-1979. It shall be of best Indian make and size as specified and approved by the Engineer-in-charge. The flat back of corner type urinal must be of 1st quality free from any defects, cracks etc.

M-65. Low level Enamel flushing tank

65.1. The low level enamel flushing tank shall be of 15 liters capacity. It shall conform of I S 774-1971. The flushing cistern shall be of best quality and free from any defects. The flushing tank shall have outlet 32 mm. diameter. The outlet shall be connected with W.C. pan by lead pipe or P.V.C. pipe as specified. The flushing tank shall be provided with inlet and outlet for fixing G.I. inlet pipes and over-flow pipes. The flushing cistern shall be provided with chromium plated handle for flushing The flushing tank shall be provided with bracket of cast iron so that it can be fixed on wall at specified height. The brackets shall conform to I.S.775-1970.

M-66. Cast iron flushing cistern.

66.1. The cast iron flushing cistern shall be of 15 liters capacity. It shall conform to I.S. 774-1971. The flushing cistern shall be of best quality free from any defects. The flushing cistern shall have outlet of 32 mm diameter. The lead pipe shall conform to I.S 404 (Part-I) - 1962; For fixing G.I. inlet pipes and overflow pipe 20 mm. dia. inlet and outlet shall be provided The flushing cistern shall be provided with galvanised iron chain and pull of sufficient length and shall be got approved from the Engineer-in-charge. The cast iron flushing cistern shall be painted with one coat of anticorrosive paint and two coats of paints The flushing cistern shall be fixed on two C I brackets The C I brackets shall conform to I S775-1970.

M-67. Flush cock.

67.1. Half turn flush cock (Heavy weight) shall be of gun metal chromium plated of diameter as specified in the description of the item. The flush cock shall conform to relevant Indian Standard.

M-68. Cast iron pipes and fittings.

68.1. All soil water, vent and anti syphonage pipes and fitting shall conform to I S.1729-1964. The pipes' shall have spigot and socket ends with head on spigot end. The pipes and fitting shall be true to shape smooth, cylindrical, their inner and outer surfaces being as nearly as practicable concentric. They shall be sound and nicely cast and shall be free from cracks, laps, pinholes or there imperfection and shall be neatly dressed and carefully fettled.

68.2. The end of pipes and fittings shall be reasonable square to their axis.

68.3. The sand of cast iron pipes shall be of the diameter as specified in the description and shall be in lengths of 1.5 M., 1.8 M. including socket ends of the pipe unless shorter lengths are either specified or required at junctions etc. The pipes and fittings shall be supplied without ears unless specified or directed otherwise.

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68.4. Tolerances:

68.4.1. The Standard weights and thickness of pipes shall be as shown in the following table A tolerance up to minus 10 per cent may however be -allowed against these standardweights

Sr. No.	Nominal dia. of bore	Thickness	Overall 1.5 m. long	Weight of pipe 1.8 m long	excluding ears 2.m long
1.	75 mm.	5.0 mm.	12.38 Kg.	16.52 Kg.	18.37 Kg.
2	100. mm.	5.0 mm.	18.14 Kg.	21.67 Kg.	24.15 Kg.

68.4.2. A tolerance up to minus 15 percent in thickness and 20 mm. length will be allowed For fittings tolerance in lengths shall be plus 25 mm. and minus 10mm.

68.4.3. The thickness of fittings and their socket and spigot dimensions shall conform to the thickness and dimensions specified for the corresponding sizes of straight pipes. The tolerance in weights and thickness shall be the same as for straightpipes.

M-69. Nahni Trap

69.1. Nahni trap shall be of cast iron and shall be sound and free from porosity or other defects which affect serviceability The thickness of the base metal shall not be less than 6.5 mm The surface shall be smooth and free .form craze, chips and other flaws or any other kind of defects which affect serviceability The size of nahni trap shall be specified and shall be of self cleaningdesign.

69.2. The Nahni trap shall be of-quality approved by the Engineer-in-charge and shall generally conform to the relevant IndianStandards.

69.3. The Nahni trap provide shall be with deep seal, minimum 50 mm. except at places where trap with deep seal cannot be accommodated. The cover shall be cast iron perforated cover shall be provided on the trap of appropriatesize.

M-70. Gully Trap

70.1. Gully trap shall conform to I.S. 651-1980. If shall be some, free .from defects such as fire-cracks or hair cracks. The glaze of the traps shall be free from crazing. They shall give a sharp clear note when struckwith light hammer. There shall be no brokenblisters.

70.2. The size of the gully trap shall be as specified in theitem.

70.3. Each gully trap shall have one C.I. grating of square size corresponding to the dimensions, of inlet of gully trap. It will also have a water tight C.I. cover with frame inside dimensions 300 mm. x 300 mm. the cover with frame inside dimensions 300 mm. x 300 mm. the cover and weighing not less than 4.53 Kg. and the frame not less than 2.72 Kg. The grating cover and frame shall be of sound and good casting and shall have truly square machined seatingfaces.

M 71. Glazed Stone Ware pipe And Fittings

71.1. The pipes and fittings shall be of best quality as approved, by the Engineer-m-charge. The pipe shallbe of best quality manufactured from stone- ware of fire clay, salt glazed thoroughly burnt through the whole thickness, of a close, even texture, free from air blows, fire blisters, cracks and other imperfections, which affect the serviceability. The inner and outer surfaces shall be smooth and perfectly glazed. The pipe shall be capable to withstand pressures or 1.5 M lead without showing sign of leakage. The thickness of thewall shall not be less than 1/12th of the internal dia. The depth of socket shall not be less than 38 mm. The socket shall be sufficiently large to allow a joint of 6 mm. around thepipe.

71.2. The pipes shall generally conform to relevant I S651-1980.

M-72. Wall Peg Rail

72.1. The aluminum wall peg rail shall have three aluminum pegs approved quality and size. It shall be fixed on teakwood plank of size 450 mm x 75 mm x 20 mm. The teakwood shall be French polished or oil painted as specified.

M-73. G.I. Water Spot

73.1. The G.I. pipes of 40 mm dia shall be of medium quality and specials shall be of 'R' brand or equivalent brand of best approvedquality

(29)

73.2. The pipe shall have length as required for the thickness of wall in which it is fixed and at outside end tee bend cut at half the length shall be provided and at other end coupling shall be provided to have better fixing. The water spout shall be provided as per detailed drawing or as directed

M-74. Asbestos Cement pipe (A.C. pipe)

74.1. The asbestos cement pipe of diameter as specified in the description of the item shall conform to I.S. 1626-1980. Special like bends, shoes, cowl, etc. shall conform to relevant Indian Standards. The interior of pipe shall have smooth finish, regular surface and regular internal diameter. The tolerance in all dimensions shall be as I.S. 1626-part-I-1980.

M-75. Crydon Ball valve

75.1. Ball valve of screwed type including polythene float and necessary level etc shall be of the size as mentioned in the description of item and shall conform to I.S. 1703-1977

M-76. Bitumen Felt For Water proofing And Damp Proofing

76.1. Bitumen felt shall be on the fiber bases and shall be of type 2, self finished felt grade-2 and shall conform to I.S. 1322-1970

M-77. Selected Earth

77.1. The selected earth shall be that obtained from excavated material or shall have to be brought from outside as indicated in the items. If item does not indicate anything the selected earth shall have to be brought from outside.

77.2. The selected earth shall be good yellow soil and shall be got approved from the Engineer-in-charge. In no case black cotton soil or similar expansive and shrinkable soil shall be used. It shall be clean and free from all rubbish and perishable materials, stones or brick bats. The clods shall be broken to a size of 50 mm or less. Contractor shall make his own arrangement at his own cost for land for borrowing selected earth. The stacking of material shall be done as directed by the Engineer-in-charge in such a way not to interfere with any construction activities and in proper stacks.

77.3. When excavated material is to be used only selected stuff got approved from the Engineer-in-charge shall be used. It shall be stacked separately and shall comply with all the requirements of selected earth mentioned above

M-78. Barbed Wire

78.1. The barbed wire shall be of galvanised steel and it shall generally conform to I.S. 278-1978. The barbed wire shall be of type-I whose nominal diameter for line wire shall be 2.5 mm. and point wire 2.24 mm. The nominal distance between two barbs shall be 75 mm unless otherwise specified in the item. The barbed wire shall be formed by twisting together two fine wires. One containing the barbs. The size of the line and point wires and barb spacing shall be as specified above. The permissible deviation from the nominal diameter of the line wire and point wire shall not exceed ± 0.08 mm

78.2. The barbs shall carry four points and shall be formed by twisting two point wires, each two turns tightly round one line wire making altogether four complete turns. The barbs shall have a length of not less than 13 mm and not more than 18 mm. The point shall be sharp and cut at an angle not greater than 35 degree of the axis of the wire forming the barbs.

78.3. The line and point wires shall be circular in section, free from scale and other defects and shall be uniformly galvanized. The line wire shall be in continuous length and shall not contain any welds other than those in the rod before it is drawn. The distance between two successive splices shall not be less than 15 meters.

78.4. The lengths per 100 Kg. of barbed wire I.S. type I shall be as under:

Nominal 1000 meter Minimum 934 meter Maximum 1066 Meter.

Sub- Head - I , Earth Work

Item no. 1.

Clearing and grubbing road including uprooting rank vegetation grass bushes, shrubs , sapling and trees girth upto 300mm removal stumps of trees cut earlier and disposal of unserviceable (D) By mechanical means in area of thorny jungle.

Clearing and Grubbing: This involves removing all vegetation and obstacles from the proposed area where the building will be constructed. It includes:

Uprooting rank vegetation: Removing thick, wild growth of plants and grasses.

Removing bushes, shrubs, and saplings: Clearing smaller woody plants and young trees.

Disposal of Unserviceable Material (D): This typically refers to disposing of the vegetation, stumps, and any other unusable materials that are cleared from the site. This disposal is done using mechanical means, which could involve machines like bulldozers, excavators, or chippers to grind down vegetation.

Overall, the process ensures that the proposed area is completely cleared of vegetation and obstacles to prepare it for road & Building construction, using mechanical equipment for efficiency and effectiveness in clearing large areas.

Workmanship

The relevant specification of item shall be followed as above.

Mode of measurements & payment

The rate shall include the cost of materials and labour involved in all the operations described above. The rate shall be a unit of Hactare.

Item no. 2.

Excavation for foundation upto 1.5m depth including sorting out and stacking of useful materials , back filling in sides of sides of foundations etc. In layers not exceeding 20cm .in depth consolidating each deposited layer by ramming and watering etc and disposing off the excavated stuff upto any lead and lift. Dense or hard soft soil

Dense or Hard Soil

1.0. General

1.1. Any soil which generally yields to the application of pickaxes and shovels, phawaras rakes or any such ordinary excavating implement or organic soil, gravel silt, sand turf loam, clay, peat etc., fall under this category.

2.0. Clearing the site

2.1. The site on which the structure is to be built shall be cleared, and all obstructions loose stone, materials and rubbish of all kind bush wood and trees shall be remove! As directed The materials so obtained shall be property of the Government and shall be conveyed und stacked as directed within any lead. The roots of the trees coming in the sides shall be cut and coated with a hotasphalt

2.2. The rate of side clearance is deemed to be included in the rate of earth work for which no extra will bepaid.

3.0. Setting out

After clearing the site the centre lines will be given, by the Engineer-in-charge. The contractor shall assume full responsibility for alignment, elevation and dimension of each and all 'parts of the work. Contractor shall supply labours materials, etc. Required for setting out the reference marks and bench 'marks and shall maintain them as long as required anddirected.

4.0. Excavation

The excavation in foundation shall be carried out in true line and level and shall have the width and depth as shown in the drawings or as directed. The contractor shall do the necessary shoring and shutting or providing necessary slopes to a safe angle, at his own cost. The payment for such precautionary measures shall be paid separately it not specified. The bottom of the excavated area shall be leveled both longitudinally and transversely as directed by removing and watering as required No. Earth filling will be allowed for bringing it to level If by mistake or any excavation is made deeper or wider than, that shown on the plan or directed. The extra depth or width shall be made up with concrete of same proportion as specified for the foundation concrete at the cost of the contractor. The excavation up to 1.5 m depth shall be measured under this item.

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Backfilling: Once the foundation work is complete, the sides of the foundation trench or pit/under Floor need to be filled back in. This is done in layers to ensure stability and proper compaction.

6.0. Mode of measurements & payment

6.1. The measurement of excavation in trenches for foundation shall be made according to the sections of trenches shown on the drawing or as per sections given by the Engineer-in-charge. No payment shall be made for surplus excavation made in excess of above requirements or due to stopping and sloping back as found necessary on account of conditions of soil and requirements of safety.

The rate shall be for a unit of one cubic meter

Item no. 3.

Excavation for foundation for a depth from 1.5m to 3.0m depth including sorting out and stacking of useful materials back filling in sides of foundations etc. In layers not exceeding 20cm .in depth consolidating each deposited layer by ramming and watering etc and disposing off the excavated stuff upto any lead . (D)Dense or hard soft soil . Quantity for excavation shall be paid based on actual dimensions in the drawings

Dense or Hard Soil

1.0. Workmanship

The relevant specifications of item No. 2 shall be followed except that the excavation work shall be carried out with 1.5 M. To 3.0 M. Lift in dense or hard soil.

2.0 Mode of Measurement & Payment

2.1 The relevant specifications of item No.2 shall be followed.

2.2. The excavation work from 1.5 to 3.0M shall be measured under this item

2.3. The rate shall be for a unit of one cubic meter.

Item no. 4.

Excavation for foundation for a depth from 3.0m to 5.0m depth including sorting out and stacking of useful materials back filling in sides of sides of foundations etc. In layers not exceeding 20cm .in depth consolidating each deposited layer by ramming and watering etc and disposing off the excavated stuff upto any lead . (D)Dense or hard soft soil . Quantity for excavation shall be paid based on actual dimensions in the drawings

1.0. Workmanship

1.1. The relevant specifications of item No.2 shall be followed except that the excavation work shall be carried out from 3.0.m. To 5.0.m. Lift in Dense or Hard soil.

2.0. Mode of Measurement &Payment

2.1. The relevant specifications of item No. 2 shall be followed:

2.2. The excavation work from 3.0. M. To 5,0 M. Lift shall be measured under this item.

The rate shall be for a unit of one cubic metre.

Item no. 5.

Filling in plinth with (good quality) sand under floors including watering, ramming, consolidating and dressing etc. Complete.

1.0. Materials

1.1. Sand shall conform to M6

2.0. Workmanship

1.0. The earth to be used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken.

1.1. As soon as the work in foundation has been completed and measured the site of foundation shall be cleared of all debris, brick bats: mortar dropping etc., and filled with earth in layers not exceeding 20 cms. Each layer shall be adequately watered, rammed and consolidated before the succeeding layer is laid The earth shall be rammed with iron rammers where feasible and with the but ends of crow-bars, where rammer cannot be used.

1.2. The plinth shall be similarly filled with earth in layers not exceeding 20 cms. Adequately watered and consolidated by ramming with iron or wooden rammers. When filling reaches finished level the surface shall be flooded with water for at least 24 hours and allowed to dry and then rammed and consolidated.

1.3. The finished level of filling shall be kept to shape intended to be given to floor.

1.4. In case off large heavy duty flooring like factory flooring, the consolidation may be done by power rollers, where so specified. The extent of consolidation required, shall also be as specified.

1.5. The excavated stuff of the selected type shall be allowed to be used in filling the trenches and plinth. Under no circumstances black cotton soil be used for filling the plinth.

Including watering, ramming, consolidating and dressing etc , complete.

3.0. Mode of Measurements &Payment

3.1. The relevant specifications of item No. 4.12 shall be followed.

3.2. The rate includes cost of collecting, carting sand with all lead and labour for filling the same in plinth underfloors.

3.3. The rate shall be for a unit of one cubicmeter.

Item no. 6.

Carring out plinth treatment to post construction / during construction by spraying chemical solution for termite control treatment including labour and material consistment with I.S.I specification. Using Chlordene and Chiorpurfiles 20 EC. As Per 6131_paret-II Concentration Weight one percent is recommended i.e one litre 20EC chemical emulsion with 19 liter give 1% concentration inclusive of one litre chemical emulsion appication at the rate of 5Litre chemical / Sqm of surface is recommended as per I.S. Plinth area only shall be measured for payment purpose.

Workmanship

Chemicals:

Any one of the following chemicals in water emulsion to achieve the percentage concentration specified against each chemical shall be used:

- (i) Chlorphriphos emulsifiable concentrate of 20%
- (ii) Lindane emulsifiable concentrate of 20%

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Anti-termite treatment chemical is available in concentrated form in the market and concentration is indicated on the sealed containers. To achieve the specified percentage of concentration, Chemical should be diluted with water in required quantity before it is used. Graduated containers shall be used for dilution of chemical with water in the required proportion to achieve the desired percentage of concentration. For example, to dilute chemical of 20% concentration. 19 parts of water shall be added to one part of chemical for achieving 1% concentration. Engineer -in-Charge shall procure the chemical of required concentration in sealed original containers directly from the reputed and authorized dealers, chemical shall be kept in the custody of the Engineer-in-Charge or his authorized representatives and issued for use to meet the day's requirements. Empty containers after washing and concentrated chemical left unused at the end of the day's work shall be returned to the Engineer-in-Charge or his authorized representative

Treatment

Treatment along outside of foundations and under floor - The soil in contact with the external wall of the building shall be treated with chemical emulsion at the rate of 7.5 litres per square metre of vertical surface of the sub-structure to a depth of 300 mm. To facilitate this treatment, a shallow channel shall be excavated along and close to the wall face. The chemical emulsion shall be directed towards the wall at 1.75 litres per running metre of the channel. Rodding with 12 mm diameter mild steel rods at 150 mm apart shall be done in the channel. If necessary, for uniform dispersal of the chemical to 300 mm depth from the ground level. The balance chemical of 0.5 litre per running metre shall then be used to treat the backfill earth as it is returned to the channel directing the spray towards the wall surface.

If there is a concrete or masonry apron around the building, approximately 12 mm diameter holes shall be drilled as close as possible to the plinth wall about 300 mm apart, deep enough to reach the soil below and the chemical emulsion pumped into these holes to soak the soil below at the rate of 2.25 litres per linear metre. In soils which do not allow percolation of chemicals to desired depth, the uniform disposal of the chemical to a depth of 300 mm shall be obtained by suitably modifying the mode of treatment depending on site condition.

Measurements:

The length and breadth shall be measured correct to the nearest cm at plinth level and area worked out in square metre correct to two places of decimal.

The rate shall be for a unit of one sqm.

Item no. 7.

Providing & laying cement concrete 1:3:6 (1: cement: 3 coarse sand: 6 machine crust stone aggregates 40 mm nominal size) for all depths below and up to plinth level in foundations and curing etc. Complete including cost of formwork in Footings & Ground, Plinth Beams & below Floors

1.0. Materials

1.1. Water shall conform to M-1. Cement shall conform to M-3 Sand shall conform to M-6. Stones aggregate 40 mm. Nominal size shall conform to M-12.

2.0. Workmanship

2.1. General

2.1.1. Before stating concrete the bed of foundation trenches shall be cleared of all loose materials, leveled, watered and rammed as directed

2.2. Proportion of Mix:

2.2.1. The proportion of cement, sand and coarse aggregate shall be one part of cement. 3 parts of sand and 6 parts of stone aggregates and shall be measured by volume.

2.3. Mixing:

2.3.1. The concrete shall be mixed in a mechanical mixer at the site of work. Hand mixing may however be allowed for smaller quantity of work if approved by the Engineer-in-charge. When hand mixing is permitted by the Engineer-in-charge in case "of break-down of machineries and in the interest of the work, it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency, However in such case 10% more cement than otherwise period 1 1/2 to 2 minutes. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the purpose.

2.4. Transporting & Placing the Concrete:

2.4.1. The concrete shall be handed from the place, of mixing to the final position in not more than 15 minutes by the method as directed and shall be placed into its final-position, compacted and finished within 30 minutes of mixing with water i.e. Before the setting commences.

2.4.2. The concrete shall be laid in layers of 15 cms. To 20cms.

2.5.1. The concrete shall be rammed with heavy iron rammers and rapidly to get the required compaction and to allow all the interstices to be filled with mortar.

2.6. Curing:

2.6.1. After the final set, the concrete shall be kept continuously wet if required by ponding for a period of not less than 7 days from the date of placement.

2.7. Mode of Measurement & Payment:

2.7.1. The concrete shall be measured for its length, breadth and depth, limiting dimensions to those specified on plan or as directed.

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The rate shall be for a unit of one cubic meter.

Item no. 8.

Providing and laying cement concrete 1:4:8 (1- Cement : 4- coarsesand : 8- hand broken stone aggregates 40 mm nominal size) and curing complete excluding cost of formwork in (A) Foundation and Plinth

1.0. Materials

1.1. Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6 stone aggregate 40 mm. Nominal size shall conform tom-12.

2.0. Workmanship

2.1. Relevant Specifications of item No7 shall be followed except that cement concrete shall be mixed in the preparation of 1:4:8 instead of 1:3.6 by volume.

3.0. Mode of measurement and payment

3.1. The concrete shall be measured for its length, breadth and depth, limiting dimensions to those specified on plans or as directed

The rate shall be for a unit of one cubic meter

Item no. 9.

Providing and laying cement concrete 1:2:4 (1 Cement :2-coarse sand :4-crushed stone aggregates 20 mm nominal size) In Foundation & plinth and curing complete including cost of form work, dewatering etc. Rates are incl. Shoring & strutiing and dewatering. No extra payment will be made for Shoring, Strutting and dewatering

Materials

Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Grit shall conform to M-8. Graded stone aggregate 20 mm nominal size shall conform to M-12.

2.0. General

2.1. The concrete mix is not required to be designed by preliminary testes. The proportion of the concrete mix shall be 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. Nominal size) by volume concrete work shall have exposed concrete surface or as specified in theitem

2.2. The designation ordinary M-100, M-150m M-200, M-250 specified as per I.S. correspond approximately to 1:3:6, 1:2:4, 1:1.1/2:3 and 1:1:2 nominal mix of ordinary concrete by volume respectively

2.3. The ingredients required for ordinary concrete containing one beg of cement of 50 kg. By weight (0.0342 Cu M.) For different proportions of mix shall be asunder:

Grade Of concrete	Total quantity of dry aggregate by volume per 50 kgs. Of cement to be taken as the sum of individual volume of fine and coarse aggregates, Maximum	Proportion of fine aggregate to coarse aggregate	Quantity of water per 50 Kecs. Of cement maximum
1	2	3	4
M-100 (1:3:6)	300 Liters	Generally 1:2	For Line 34 Liters
M-150 (1:2:4)	220 Liters	Aggregate to coarse aggregate	32 Liters
M-200 (1:1.1/2:3)		By volume 160 but subject to	30 Liters
M-250 (1:1:2)	100 Liters	An upper limit of 1:1.1/2 and Lower limit	1:3 27 Liters

2.4. The water cement ratios shall not be more than specified in the above table. The cement content of the mix specified in the table shall be increased if the quantity of water in mix has to be met eased to overcome the difficulties of placements and compaction so that the water-cement ratio specified in thetable is notexceeded.

2.5. Workability of the concrete shall be controlled by maintaining a water -cement-ratio that is found to give a concrete mix which is just sufficient wet to be placed and compacted without difficulty with the meansavailable.

2.6. The maximum size of course aggregate shall be as large as possible within the limits specified but in no case greater than one forth of the minimum thickness of the member provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and to fill the corners of the form.

3.0. Workmanship

3.1. Proportioning : Proportioning shall be done by volume, except which shall be measured in terms of bags of 50 kg. Weight, the volume of one such bag being taken as 0.0342 cu. Meter Boxes of suitable size shall be used for measuring sand aggregate. The size of boxes (internal) shall be 35 x 25 cms. And 40 cms deep while measuring the aggregate and sand the boxes shall be filled without shaking ramming or hammering. The proportioning of sand shall be on the basis of its dry volume and in case of damp saner, allowances for bulk age shall be made.

3.2. Mixing:

3.2.1. For all work, concrete shall be mixed in a mechanical mixed which along with other accessories shall be kept in first class working condition and so maintained throughout the construction Measured quantity of aggregate, sand and cement required for each batch shall be poured into the claim of the mechanical mixer while it is continuously running. After half a minute of dry mixing measured quantity of water required for each batch of concrete mix shall be added gradually and mixing continued for another one and a half minute Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shows complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after-oil ingredients have been put into the mixer.

3.2.2. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons, it shall be done on the smooth watertight platform large enough to allow efficient tuning over the ingredients of concrete before and after adding water Mixing platform shall be so arranged that no foreign material gets mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be spread in a layer of uniform thickness on the mixing platform. Dry coarse and fine aggregate and cement shall then be mixed thoroughly by turning over to get a mixture to uniform colour. Specified quantity water shall then be added gradually through a rose can and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 percent above that specified

3.2.3. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to by the Engineer in-charge the first batch of concrete from the mixture shall contain only two thirds of normal quantity of coarse aggregate Mixing plant shall be thoroughly cleaned before changing from one type of cement to another

3.3. Consistency:

3.3.1. The degree of consistency which shall depend upon the nature of the work and methods of vibration of

Concrete, shall be determined by regular slump tests in accordance with I.S. 1199-193. The slump of 10 mm. To 25 mm shall be adopted when vibrators are used and 80 mm. When vibrators are not used.

3.4. Inspection:

3.4.1. Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength, alignment and general fitness but such inspection shall not relieve the contractor of his responsibility for the safety of men machinery materials and for results obtained immediately before concreting all forms shall be thoroughly cleaned.

3.4.2. Centering design and its erection shall be got approved from the engineer-in-charge. One carpenter with helper shall invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited for reinforcement laid in position. For access to different parts suitable mobile platforms shall be provided so that steel reinforcement in position is not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber kapachi or metal pieces shall not be used for this purpose.

3.5. Transporting and laying:

3.5.1. The method of transporting and placing concrete shall be as approved. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All form work shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the engineer-in-charge has been obtained.

3.5.2. Concreting shall proceed continuously over the area between construction joints. Fresh concrete proper contraction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer. Except where otherwise agreed to by the engineer-in-charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 meter when internal vibrators are used and not exceeding 0.30 meter in all other cases.

3.5.3. Unless otherwise agreed to by the Engineer-in-charge concrete shall be dropped in to place from a height exceeding 2 meters. When trucking or chutes are used they shall be kept close and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept clean, thoroughly wetted and covered with a 13 mm. Thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. Layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150 mm. In thickness and shall be well rammed against old work, particular attention being given to corners and close spots.

3.5.4. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting under water, where vibrators cannot be used. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event of breakdowns. Concrete shall be judged to be compacted when the mortar fills the spaces between the coarse aggregate and begins to cream up to form an even surface. Compaction shall be completed before the initial setting starts i.e. Within 30 minutes of addition of water to dry mixture. During compaction, it shall be observed that needle vibrators are not applied on reinforcement which is likely to destroy the bond between concrete and reinforcement.

3.6. Curing:

Immediately after compaction, concrete weather including rain, running water, shocks, vibration, traffic, rapid temperature changes, frost and drying out process. It shall be covered with wet sacking or similar absorbent material approved, soon after the initial set, and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over foundation concrete may be started after 48 hours of its laying but curing of concrete shall be continued for a minimum period of 14 days

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Specified strength provided the lowest value is not less than 85% of the specified strength. If the concrete made in accordance with the proportions given for a particular grade does not yield the specified strength, such concrete shall be classified as belonging to the appropriate lower grade. Concrete made in accordance with the Proportions given for a particular grade shall not, however be placed in a higher grade on the ground that the test strength are higher than the minimum specified.

3.7. Stripping:

3.7.1. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike the form work. While fixing the time of removal of form work, due consideration shall be given to local conditions, character of the structure, the weather and other conditions that influence the setting of concrete and of the materials used in the mix. In normal circumstances (generally where temperatures are above 20°C) and where ordinary concrete is used, forms may be struck after periods specified in item No.9.1 (A) for respective item of formwork.

3.7.2. All form work shall be removed without causing any shock or vibration as would damage the concrete. Before the soft and struts are removed, the concrete surface shall be gradually exposed, where necessary in order to ascertain that concrete has sufficiently hardened. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal tiles are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm. Cover to the finished concrete surface. Where it is intended to re-use the form work, it shall be cleaned and made good to the satisfaction of the Engineer-in-charge. After removal of form work and shutting, the Executive Engineer shall inspect the work and satisfy by random checks that concrete produced is of good quality.

3.7.3. Immediately after the removal of forms, all exposed bolts etc. Passing through the cement concrete member and used for shuttering or any other purpose shall be cut inside the cement concrete member to a depth of at least 25 mm. Below the surface of the concrete and the resulting holes be filled by cement mortar, all fins, caused by form joints, all cavities produced by the removal of form tiles and all other holes and depressions, honeycomb spots, broken edges or corners and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in proportions used in the grade of concrete that is being furnished and of as dry consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surface which are pointed shall be kept moist for a period of 24 hours. If rock pockets/honeycombs in the opinion of the Engineer-in-charge are of such an extent or character as to effect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of structure affected.

4.0. Mode of Measurement & Payment

4.1. The consolidated cubical contents of concrete work as specified in item shall be measured. No deduction shall be made for

(a) Ends of dissimilar materials such as joints, beams, posts, girders, girders, girders, purling trusses, corbels and steps etc., up to 500 Sq. Cm. In section.

4.2. The rate includes cost of all materials labour, tools and plant required for mixing, placing in position, vibrating and compacting, finishing, as directed, curing and all other incidental expenses for producing concrete of specified strength. The rate includes the cost of formwork.

The rate shall be for a unit of one cubic meter.

Item no. 10.

Providing and laying damp proof course 100 mm thick cement concrete 1:2:4 (1- Cement: 2 coarse sand: 4 stone aggregate 10 mm nominal size) and curing complete including providing and mixing water proofing material in cement concrete in mix proportion recommended by the manufacturers.

The specifications of item No. 9 of ordinary concrete shall be followed except that the size of the stone aggregate shall be 10 mm nominal size and the concrete work shall be carried out in 100 mm. Thick damp proof course

2.0. Mode of measurements & payment

2.1. The rate includes cost of all materials and labour required to complete the item

The rate shall be for a unit one sq. meter

Item no. 11.

(38)

Providing and filling in Aerated block bats (broken pieces) in single or multiple layers in super structure, filling the joints with sand mortar (not more than 20%) 20mm thick cement sand mortar screed in proportion of 1:6 shall be laid as per drawing. Crushing strength of aerated concrete block /bats shall not be less than 40 kg/sqcm, minimum density in dry oven condition between 651 to 750 kg /cum, thermal conductivity shall not exceed 0.3W / mk, fire resistance 4 hours, in line and plumb, cleaning the surface with tools and tackles, at all level, all height, all floors including curing, scaffolding, complete as per specifications, drawings and directed by engineer in charge.

1. Workmanship

To fulfill the requirements for providing and filling in aerated concrete block bats (broken pieces) in superstructure, along with filling joints with sand mortar and laying cement sand mortar screed, follow these detailed steps:

1. Aerated Concrete Block Bats Broken pieces of aerated concrete blocks meeting the following criteria:

- A) Crushing strength not less than 40 kg/sqcm.
- B) Minimum density in dry oven condition between 651 to 750 kg/cum.
- C) Thermal conductivity not exceeding 0.3 W/mk.
- D) Fire resistance of 4 hours.
- E) Sand as per M-6)
- F) Cement as per M-3)
- G) Water as per M -1)

The substrate should be clean, free of debris, and adequately prepared to receive the aerated concrete block bats and after that Aerated Concrete Block Bats shall be filled. Place the broken pieces of aerated concrete blocks (bats) in single or multiple layers as required. Cement sand mortar shall be 1:6 (1 part cement to 6 parts sand). Ratio of Cement sand mortar and Aerated Block Bats shall be ratio 1:4 (1 sand cement mortar :4Aerated block bats).

2.0. Mode of measurements & payment

2.1. The rate includes cost of all materials and labour required to complete the item
The rate shall be for a unit one cum.

Item no. 12.

Making plinth protection 50mm thick of cement concrete 1:3:6 (1 cement:3 coarse sand:6 graded stone aggregate 20mm nominal size over 75mm thick bed of dry brick ballast 40mm nominal size, well rammed and consolidated and grouted with fine sand, including necessary excavation, levelling and dressing & finishing the top smooth, including toe wall 230mm wide and 450mm deep on the edge to plinth protection with common burnt clay bricks including grouted with cement mortar 1:4 (1 cement:4 fine sand)

1. Workmanship

Excavation of the area where plinth protection is to be provided to the required depth, with proper levelling and compacting of the sub-base. 75mm thick Dry Brick Ballast of 40mm nominal size. This bed shall be laid with rammed and consolidated. The Plinth level shall be finished with 50mm thick Cement concrete layer of mix proportion 1:3:6 (1 part cement, 3 parts coarse sand, 6 parts graded stone aggregate 20mm nominal size).

2.0. Mode of measurements & payment

2.1. The rate includes cost of all materials and labour required to complete the item
The rate shall be for a unit one sqm.

Item no. 13.

Providing TMT Bar FE 500D reinforcement for RCC work including bending, binding with G.I Binding wire and placing in position complete at all heights, all lifts and all levels as shown in the drawing

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1.0. Materials

1.1. TMT Bar FE 500D bars shall conform to M-19. Mild steel binding wires shall conform to M-21.

2.0. Workmanship

2.1. The work shall consist of furnishing and-placing reinforcement to the shape and dimensions shown as on the drawings or as directed.

2.2. Steel shall be clean and free from rust and loose mill scale at the lime of fixing in position and subsequent concreting.

2.3. Reinforcing steel shall conform accurate to the dimensions given in the bar bending schedules shown on relevant drawings. Bars shall be bent cold to specified shape and dimensions or as directed, using a proper bar bender, operated by hand or power to attain proper radius of bends. Bars shall not be bent or straightened in a manner that will injure the material. Bars bent during transport-or handling shall be straightened before being used on the work. They shall not be heated to facilitate bending Unless otherwise specified a "U" type hook at the end of each bar shall invariably be provided to main reinforcement. The radius of the bend shall not be less than twice the diameter of the round bar and the length of the straight part of the bar beyond the end of the curve shall be at least four times the diameter of the round bar. In case of bars which are not round and in case of deformed bars, the diameter shall be taken as the diameter of circle having an equivalent effective area. The hooks shall be suitably encased to prevent any splitting of the concrete.

2.4. All the reinforcement bars shall lie accurately placed in exact position shown on the drawings, and shall be securely held in position during placing of concrete by annealed binding wire not less than 1 mm in size, and by using stay blocks or metal chair spacers, metal hangers supporting wires or other approved devices at sufficiently close intervals, Bars shall not be allowed to sag between supports nor displaced during concreting or any other operations of the work. All devices used for positioning shall be of non-corrodible material. Wooden and metal supports shall not extend to the surface of concrete, except where shown on drawings. Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacing shall not be allowed. Pieces of broken stone or brick and wooden blocks shall not be used. Layers of bars shall be at all heights, all lifts and all levels.

Separated by spacer bars, precast mortar blocks or other approved devices Reinforcement after being placed in position shall be maintained in a clean condition until completely embedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed. To prevent reinforcement form corrosion, concrete cover shall be provided as indicated on drawings. All the bars protruding from concrete and to which other bars are to be sliced and which are likely to be exposed for a period exceeding 10 days shall be protected by a thick coat of neat cementgrout.

2.5. Bars crossing each other where required shall be secured by binding wire (annealed) of size not less than 1 mm. In such a manner that they do not slip over each other at the time of fixing and concreting.

2.6. As far possible, bars of full length shall be used. In case this is not possible. Over lapping of bars shall be done as directed When practicable, overlapping bars shall not touch each other, but be kept apart by 25 times the diameter. Where not feasible, overlapping bars shall be bound with annealed wires not less than 1 mm. Thick twisted tight. The overlaps shall be staggered for different bars and located at points, along the span where neither shear nor bending moment is maximum.

2.7. Whenever indicated on the drawings or desired by the Engineer-in-charge, bars shall be jointed by couplings which shall have a cross-section sufficient to transmit the full stresses of bars. The ends of the bars that are joined by coupling shall be upset for sufficient length so that the effective cross section at the base of threads is not less than the normal cross-section of the bar. Threads shall be standard threads Steel for coupling shall conform to I.S.226.

2.8. When permitted or specified on the drawings, joints of reinforcement bars shall be bull-welded so as to transmit their full stresses. Welded joints shall preferably be located at points when steel will not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that at any one section not more than 20 percent of the rods are welded. Only electric arc welding using a process which excludes air from the molten metal and conforms to any or all other special provisions for the work shall be accepted. Suitable means shall be provided for holding bars securely in position during welding. It shall be ensured that no voids are left in welding and when welding is done in two or three stages, previous surface shall be cleaned properly. Ends of the bars shall be cleaned of all loose scale, rust, oil, paint and other foreign matter before welding. Only competent welders shall be employed on the work. The M.S. electrodes used for welding shall conform to I.S. 814. Welded pieces of reinforcement shall be tested. Specimen shall be taken from the actual site and their number and frequency of test shall be as directed.

3.0. Mode of Measurements & Payment

Reinforcement shall be measured in length including overlaps, separately for different diameters as actually used in the work. Where welding or coupling is resorted to in place lap joints, such joints shall be measured for payment as equivalent length of overlap as per design requirement. From the length so measured, the weight of reinforcement shall be calculated in tones on the same basis of as per M-18 even though steel is supplied to the contractor by the department on actual weight. Length shall include hooks at the ends Wastage and annealed steel wire for binding shall not be measured and the cost of these items shall be deemed to be included in the rate for reinforcement.

3.1. The rate for reinforcement includes cost of steel binding wires. Its carting from Department store to work site, cutting, bending, placing, binding and fixing in position as shown on the drawings and as directed It shall also include all devices for keeping reinforcement in approved position, cost of joining as per approved method and all wastage and spacer bars.

3.2. The rate shall be for a unit of One Kg.

Item no. 14.

Providing and laying in position machine batched and machine mixed design mix M-300 grade concrete for reinforced cement concrete work , using cement content as per approved Design Mix manufactured in fully automatic batching plant and transported to site of work in transit mixer for any lead having continuous agitated mixer , manufactured as per mix design of specified grade for RCC work including pumping of RMC from transit mixer to site of laying including the cost of centering shuttering finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 410 kg) for Footing/Raft /grade slab upto plinth level.

1.0. Materials

1.1. Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Grit shall conform to M-8 Course aggregate shall conform to M-12.

2.0. General

2.1. The relevant specification of item No. 9. Of ordinary concrete shall be followed except that the concrete

mix shall be designed from preliminary tests. The proportioning of cement and aggregates shall be done by weight and necessary precautions shall be taken in the production to ensure that the required work cube strength is attained and maintained. The mix design concrete shall be in grades of M-100, M-150, M-200, M-250, M-300, M-350 & M-400 with prefix admixer added to it. The letter M refers to mix and the numbers specify 28 days work cube compressive strength of 150 mm. Cubes of the mix expressed in Kg./Crnt.

2.2. The proportion of cement, sand and coarse aggregate shall be determined of weight. The weight batch machine shall be used for maintaining proper control over the proportion of aggregates as per mix design. The strength requirements of different grades of concrete shall be asunder:

Grade Concrete	Compressive strength of 15 cms. Cubes in kg./Cmt. at 28 days, conducted in withi.S.5161959.Preliminary test Min.	Work test Min.
M-150	200	150
M-200	260	200
M-250	320	250
M-300	380	300
M-350	400	350
M-400	500	400

(42)

In all cases, the 28 days compressive strength specified in above be the criteria for acceptance or rejection of the concrete. Where the strength of a concrete mix as indicated by tests, lies in between the strength of any two grades specified in the above table, such concrete shall be classified in for purpose as concrete belonging to the lower of the grades between which its strength lies.

3.0. Workmanship

3.1. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work question and can be property compacted with means available except where ft can be shown to the satisfaction of the Engineer-in-charge, that supply of properly graded aggregate of uniform quality can be maintained till the completion of work, grading of aggregate shall be controlled by obtaining the coarse aggregates in different sizes and bending them in the right proportions as required. Aggregates of different sizes shall be stocked in separate stock piles. The required quantity of material shall be stock piled several hours, preferably a day before use. The grading of coarse and fine aggregate shall be checked as frequently as possible, the frequency for a given job being determined by Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests..

3.2. In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement is determined by accepting the maker's weight per bag, a reasonable number of bags shall be weighted separately to check the net weight. Where cement is weighted form bulk stocks at site and not by bags, it shall be weighed separately from the aggregate. Water, shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in clean, and serviceable condition. Their accuracy shall be periodically checked.

4.0. It is most important to keep the specified water cement ratio constant and at its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined by the Engineer-in-charge according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture content. For the determination of moisture content in the aggregates. I.S. 2386 (Part-III) shall be referred to. Suitable adjustments shah also be made in the weights of aggregates due to variation in their moisture content. Minimum quantity of cement to be used in mix concrete shall be mentioned as per boq item .

Mode of measurement &payment

4.1. The relevant specifications of itemno.9 shall be followed ,except that the design mix concrete R.C.C. work as specified in item shall be measured under this item. The rate includes the cost of form work refer item no. 34 but excluding Reinforcement. The cement Consumption in the Mix shall be followed as per BOQ item. The Location ,type of component of Concrete and levels shall be followed as per boq item.

Item no. 15.

Providing and laying in position machine batched and machine mixed design mix M-300 grade concrete for reinforced cement conctere work , using cement content as per approved Design Mix manufactured in fully automatic batching plant and transported to site of work in transit mixer for any lead having continuous agitated mixer , manufactured as per mix design of specified grade for RCC work including pumping of RMC from transit mixer to site of laying including the cost of centering shuttering finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 410 kg) for plinth beam / beam upto Plinth level

Workmanship

The relevant specifications of item No.14 shall be followed

Mode of Measurement &Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 16.

Providing and laying in position machine batched and machine mixed design mix M-400grade concrete for reinforced cement conctere work , using cement content as per approved Design Mix manufactured in fully automatic batching plant and transported to site of work in transit mixer for any lead having continuous agitated mixer , manufactured as per mix design of specified grade for RCC work including pumping of RMC from transit mixer to site of laying including the cost of centering shuttering finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing

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strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 440 kg) for Columns, pillars Post Struts upto Plinth level

Workmanship

The relevant specifications of item No.14 shall be followed

Mode of Measurement &Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 17.

Providing and laying in position machine batched and machine mixed design mix M-400 grade concrete for reinforced cement concrete work , using cement content as per approved Design Mix manufactured in fully automatic batching plant including the cost of centering shuttering finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 440 kg) for Wall / shear wall upto Plinth level

Workmanship

The relevant specifications of item No.14 shall be followed

Mode of Measurement &Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 18.

Providing and laying in position machine batched and machine mixed design mix M-300 grade concrete for reinforced cement concrete work , using cement content as per approved Design Mix manufactured in fully automatic batching plant including the cost of centering shuttering (height upto 4.2M) finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 410 kg) for Lintels/beams/Cantilevers Girders Bressumers at Ground Floor

Workmanship

The relevant specifications of item No.14 shall be followed

Mode of Measurement &Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 19.

Providing and laying in position machine batched and machine mixed design mix M-300 grade concrete for reinforced cement concrete work , using cement content as per approved Design Mix manufactured in fully automatic batching plant and transported to site of work in transit mixer for any lead having continuous agitated mixer , manufactured as per mix design of specified grade for RCC work including pumping of RMC from transit mixer to site of laying including the cost of centering shuttering (height upto 4.2M) finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 410 kg) for Lintels/beams/Cantilevers Girders Bressumers at First Floor

Workmanship

The relevant specifications of item No.14 shall be followed

Mode of Measurement &Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 20.

Providing and laying in position machine batched and machine mixed design mix M-300 grade concrete for reinforced cement concrete work , using cement content as per approved Design Mix manufactured in fully automatic batching plant and transported to site of work in transit

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mixer for any lead having continuous agitated mixer , manufactured as per mix design of specified grade for RCC work including pumping of RMC from transit mixer to site of laying including the cost of centering shuttering (height upto 4.2M) finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 410 kg) for Lintels/beams/Cantilevers Girders Bressumers at Second Floor

Workmanship

The relevant specifications of item No.14 shall be followed

Mode of Measurement &Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 21.

Providing and laying in position machine batched and machine mixed design mix M-300 grade concrete for reinforced cement concrete work , using cement content as per approved Design Mix manufactured in fully automatic batching plant and transported to site of work in transit mixer for any lead having continuous agitated mixer , manufactured as per mix design of specified grade for RCC work including pumping of RMC from transit mixer to site of laying including the cost of centering shuttering (height upto 4.2M) finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 410 kg) for Lintels/beams/Cantilevers Girders Bressumers at terrace Floor

Workmanship

The relevant specifications of item No.14 shall be followed

Mode of Measurement &Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 22.

Providing and laying in position machine batched and machine mixed design mix M-400 grade concrete for reinforced cement concrete work , using cement content as per approved Design Mix manufactured in fully automatic batching plant and transported to site of work in transit mixer for any lead having continuous agitated mixer , manufactured as per mix design of specified grade for RCC work including pumping of RMC from transit mixer to site of laying including the cost of centering shuttering finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 440kg) for Columns, pillars Post Struts at **Ground Floor Level.**

Workmanship

The relevant specifications of item No.14 shall be followed

Mode of Measurement &Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 23.

Providing and laying in position machine batched and machine mixed design mix M-400 grade concrete for reinforced cement concrete work , using cement content as per approved Design Mix manufactured in fully automatic batching plant and transported to site of work in transit mixer for any lead having continuous agitated mixer , manufactured as per mix design of specified grade for RCC work including pumping of RMC from transit mixer to site of laying including the cost of centering shuttering finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 440kg) for Columns, pillars Post Struts at **First Floor Level**

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Workmanship

The relevant specifications of item No.14 shall be followed

Mode of Measurement &Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 24.

Providing and laying in position machine batched and machine mixed design mix M-400 grade concrete for reinforced cement concrete work , using cement content as per approved Design Mix manufactured in fully automatic batching plant and transported to site of work in transit mixer for any lead having continuous agitated mixer , manufactured as per mix design of specified grade for RCC work including pumping of RMC from transit mixer to site of laying including the cost of centering shuttering finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 440kg) for Columns, pillars Post Struts at **Second Floor Level**

Workmanship

The relevant specifications of item No.14 shall be followed

Mode of Measurement &Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 25.

Providing and laying in position machine batched and machine mixed design mix M-400 grade concrete for reinforced cement concrete work , using cement content as per approved Design Mix manufactured in fully automatic batching plant and transported to site of work in transit mixer for any lead having continuous agitated mixer , manufactured as per mix design of specified grade for RCC work including pumping of RMC from transit mixer to site of laying including the cost of centering shuttering finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 440kg) for Columns, pillars Post Struts at **Terrace Floor Level**

Workmanship

The relevant specifications of item No.14 shall be followed

Mode of Measurement &Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 26.

Providing and laying in position machine batched and machine mixed design mix M-400 grade concrete for reinforced cement concrete work , using cement content as per approved Design Mix manufactured in fully automatic batching plant and transported to site of work in transit mixer for any lead having continuous agitated mixer , manufactured as per mix design of specified grade for RCC work including pumping of RMC from transit mixer to site of laying including the cost of centering shuttering finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 440kg) for Wall / shear wall **Ground Floor level**

Workmanship

The relevant specifications of item No.14 shall be followed

Mode of Measurement &Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 27.

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Providing and laying in position machine batched and machine mixed design mix M-400 grade concrete for reinforced cement concrete work , using cement content as per approved Design Mix manufactured in fully automatic batching plant and transported to site of work in transit mixer for any lead having continuous agitated mixer , manufactured as per mix design of specified grade for RCC work including pumping of RMC from transit mixer to site of laying including the cost of centering shuttering finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 440kg) for Wall / shear wall **First Floor level**

Workmanship

The relevant specifications of item No.14 shall be followed

Mode of Measurement & Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 28.

Providing and laying in position machine batched and machine mixed design mix M-400 grade concrete for reinforced cement concrete work , using cement content as per approved Design Mix manufactured in fully automatic batching plant and transported to site of work in transit mixer for any lead having continuous agitated mixer , manufactured as per mix design of specified grade for RCC work including pumping of RMC from transit mixer to site of laying including the cost of centering shuttering finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 440kg) for Wall / shear wall **Second**

Floor level

Workmanship

The relevant specifications of item No.14 shall be followed

Mode of Measurement & Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 29.

Providing and laying in position machine batched and machine mixed design mix M-400 grade concrete for reinforced cement concrete work , using cement content as per approved Design Mix manufactured in fully automatic batching plant and transported to site of work in transit mixer for any lead having continuous agitated mixer , manufactured as per mix design of specified grade for RCC work including pumping of RMC from transit mixer to site of laying including the cost of centering shuttering finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 440kg) for Wall / shear wall **Third Floor level**

Workmanship

The relevant specifications of item No.14 shall be followed

Mode of Measurement & Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 30.

Providing and laying in position machine batched and machine mixed design mix M-300 grade concrete for reinforced cement concrete work , using cement content as per approved Design Mix manufactured in fully automatic batching plant and transported to site of work in transit mixer for any lead having continuous agitated mixer , manufactured as per mix design of specified grade for RCC work including pumping of RMC from transit mixer to site of laying including the cost of centering shuttering (height upto 4.2M) finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing

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strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 410 kg) for Slab /Shelves/ landing balconies, access platform , staircase at **Ground Floor Level**

Workmanship

The relevant specifications of item No.14 shall be followed

Mode of Measurement &Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 31.

Providing and laying in position machine batched and machine mixed design mix M-300 grade concrete for reinforced cement concrete work , using cement content as per approved Design Mix manufactured in fully automatic batching plant and transported to site of work in transit mixer for any lead having continuous agitated mixer , manufactured as per mix design of specified grade for RCC work including pumping of RMC from transit mixer to site of laying including the cost of centering shuttering (height upto 4.2M) finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 410 kg) for Slab /Shelves/ landing balconies, access platform , staircase at **First Floor Level**

Workmanship

The relevant specifications of item No.14 shall be followed

Mode of Measurement &Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 32.

Providing and laying in position machine batched and machine mixed design mix M-300 grade concrete for reinforced cement concrete work , using cement content as per approved Design Mix manufactured in fully automatic batching plant and transported to site of work in transit mixer for any lead having continuous agitated mixer , manufactured as per mix design of specified grade for RCC work including pumping of RMC from transit mixer to site of laying including the cost of centering shuttering (height upto 4.2M) finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 410 kg) for Slab /Shelves/ landing balconies, access platform , staircase at **Second Floor Level**

Workmanship

The relevant specifications of item No.14 shall be followed

Mode of Measurement &Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 33.

Providing and laying in position machine batched and machine mixed design mix M-300 grade concrete for reinforced cement concrete work , using cement content as per approved Design Mix manufactured in fully automatic batching plant and transported to site of work in transit mixer for any lead having continuous agitated mixer , manufactured as per mix design of specified grade for RCC work including pumping of RMC from transit mixer to site of laying including the cost of centering shuttering (height upto 4.2M) finishing and excluding reinforcement including cost of admixtures in recommended proportions as per IS: 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer - in - charge. Without Fly Ash (Min cement level as per latest IS 456 shall be maintained) (Cement level 410 kg) for Slab /Shelves/ landing balconies, access platform , staircase at **Third Floor Level**

Workmanship

The relevant specifications of item No.14 shall be followed

Mode of Measurement &Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 34.

Extra for Additional height of propping and centering where the height of propping and centering exceeds 4.2 m between supporting floor to ceiling upto 8.4 M.

Workmanship

FORM WORK (CENTRING & SHUTTERING)

Form Work Form work shall include all temporary or permanent forms or moulds required for forming the concrete which is cast-in-situ, together with all temporary construction required for their support.

Design & Tolerance in Construction Form work shall be designed and constructed to the shapes, lines and dimensions shown on the drawings with the tolerance given below.

(a) Deviation from specified dimension of cross section of columns and beams +10 mm -5 mm (b) Deviation from dimensions of footings (i) Dimension in Plan (+ 50 mm (-10 mm (ii) Eccentricity in plan 0.02 times the width of the footing in the direction of deviation but not more than 50 mm. (iii) Thickness +50mm Or ± 0.05 times the specified thickness Whichever is less (Note- These tolerance apply to concrete dimensions only, and not to positioning of vertical steel or dowels).

General Requirement It shall be strong enough to withstand the dead and live loads and forces caused by ramming and vibrations of concrete and other incidental loads, imposed upon it during and after casting of concrete. It shall be made sufficiently rigid by using adequate number of ties and braces, screw jacks or hard board wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete. Form shall be so constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections, care shall be taken to see that no piece is keyed into the concrete.

Material for Form Work (a) Propping and Centering : All propping and centering should be either of steel tubes with extension pieces or built up sections of rolled steel.

(a) Centering/Staging : Staging should be as designed with required extension pieces as approved by Engineer-in-Charge to ensure proper slopes, as per design for slabs/ beams etc. And as per levels as shown in drawing. All the staging to be either of Tubular steel structure with adequate bracings as approved or made of built up structural sections made form rolled structural steel sections. (b) In case of structures with two or more floors, the weight of concrete, centering and shuttering of any upper floor being cast shall be suitably supported on one floor below the top most floor already cast. (c) Form work and concreting of upper floor shall not be done until concrete of lower floor has set at least for 14 days.

Shuttering: Shuttering used shall be of sufficient stiffness to avoid excessive deflection and joints shall be tightly butted to avoid leakage of slurry. If required, rubberized lining of material as approved by the Engineer-in-Charge shall be provided in the joints. Steel shuttering used or concreting should be sufficiently stiffened. The steel shuttering should also be properly repaired before use and properly cleaned to avoid stains, honey combing, seepage of slurry through joints etc. (a) Runner Joists: RSJ, MS Channel or any other suitable section of the required size shall be used as runners. (b) Assembly of beam head over props. Beam head is an adopter that fits snugly on the head plates of props to provide wider support under beam bottoms. (c) Only steel shuttering shall be used, except for unavoidable portions and very small works for which 12 mm thick water proofing ply of approved quality may be used.

Form work shall be properly designed for self weight, weight of reinforcement, weight of fresh concrete, and in addition, the various live loads likely to be imposed during the construction process (such as workmen, materials and equipment). In case the height of centering exceeds 3.50 metres, the prop may be provided in multi-stages.

Camber: Suitable camber shall be provided in horizontal members of structure, especially in cantilever spans to counteract the effect of deflection. The form work shall be so assembled as to provide for camber. The camber for beams and slabs shall be 4 mm per metre (1 to 250) or as directed by the Engineer-in- Charge, so as to offset the subsequent deflection, For cantilevers the camber at free end shall be 1/50th of the projected length or as directed by the Engineer-in-Charge.

Walls : The form faces have to be kept at fixed distance apart and an arrangement of wall ties with spacer tubes or bolts is considered best. The two shutters of the wall are to be kept in place by appropriate ties, braces and studs,

Removal of Form work (Stripping Time) : In normal circumstance and where various types of cements are used, forms, may generally be removed after the expiry of the following periods: Type of Form work Minimum period Before Striking Form work for OPC 33 grade Minimum period Before Striking Form work for OPC 43 grade Minimum period Before Striking Form work for PPC (a) Vertical form work to columns, walls, Type of Form work Minimum period Before Striking Form work for OPC 33 grade Minimum period Before Striking Form work for OPC 43 grade Minimum period Before Striking Form work for PPC (b) Soffit form work to slabs (Props to be refixed immediately after removal of formwork) 3 days 3 days 4 days (c) Soffit form work to beams (Props to be refixed immediately after removal of formwork) 7 days 7 days 10 days (d) Props to slabs: (1) Spanning upto 4.5m (2) Spanning over 4.5m 7 days 14 days 7 days 14 days 10 days 20 days (e) Props to beams and arches: (1) Spanning upto 6m (2) Spanning over 6m 14 days 21 days 14 days 21 days 20 days 30 days

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Note 1: For other types of cement, the stripping time recommended for ordinary Portland cement may be suitably modified. Generally If Portland Pozzolana or low heat cement or OPC with direct addition of fly ash has been used for concrete, the stripping time will be 10/7 of the period stated for OPC with 43 grade cement above.

Note 2: The number of props left under, their sizes and disposition shall be such as to be able to safely carry the full dead load of the slabs, beam or arch as the case may be together with any live load likely to occur during curing or further construction.

Note 3: For rapid hardening cement, 3/7 of above periods for OPC 33 grade will be sufficient in all cases except for vertical side of slabs, beams and columns which should be retained for at least 24 hours.

Note 4: In case of cantilever slabs and beams, the centering shall remain till structures for counter acting or bearing down have been erected and have attained sufficient strength.

Note 5: Proper precautions should be taken to allow for the decrease in the rate of hardening that occurs with all types of cement in cold weather and accordingly stripping time shall be increased. Note 6: Work damaged through premature or careless removal of forms shall be reconstructed within 24 hrs.

Surface Treatment

Oiling the Surface : Shuttering gives much longer service life if the surfaces are coated with suitable mould oil which acts both as a parting agent and also gives surface protections. A typical mould oil is heavy mineral oil or purified cylinder oil containing not less than 5% pentachlorophenol conforming to IS 716 well mixed to a viscosity of 70-80 centipoises. After 3-4 uses and also in cases when shuttering has been stored for a long time, it should be recoated with mould oil before the next use. The second categories of shuttering oils / leavening agents are Polymer based water soluble Compounds. They are available as concentrates and when used diluted with water in the ratio of 1:20 or as per manufacturer specifications. The diluted solution is applied by brush applications on the shuttering both of steel as well as ply wood. The solution is applied after every use.

The design of form work shall conform to sound Engineering practices and relevant IS codes. 5.2.5 Inspection of Form Work The completed form work shall be inspected and approved by the Engineer-in-Charge before the reinforcement bars are placed in position. Proper form work should be adopted for concreting so as to avoid honey combing, blow holes, grout loss, stains or discoloration of concrete etc. Proper and accurate alignment and profile of finished concrete surface will be ensured by proper designing and erection of form work which will be approved by Engineer-in-Charge. Shuttering surface before concreting should be free from any defect/ deposits and full cleaned so as to give perfectly straight smooth concrete surface. Shuttering surface should be therefore checked for any damage to its surface and excessive roughness before use.

Erection of Form Work (Centering and shuttering): Following points shall be borne in mind while checking during erection. (a) Any member which is to remain in position after the general dismantling is done, should be clearly marked. (b) Material used should be checked to ensure that, wrong items/ rejects are not used. (c) If there are any excavations nearby which may influence the safety of form works, corrective and strengthening action must be taken. (d) (i) The bearing soil must be sound and well prepared and the sole plates shall bear well on the ground. (ii) Sole plates shall be properly seated on their bearing pads or sleepers. (iii) The bearing plates of steel props shall not be distorted. (iv) The steel parts on the bearing members shall have adequate bearing areas. (e) Safety measures to prevent impact of traffic, scour due to water etc. Should be taken. Adequate precautionary measures shall be taken to prevent accidental impacts etc. (f) Bracing, struts and ties shall be installed along with the progress of form work to ensure strength and stability of form work at intermediate stage. Steel sections (especially deep sections) shall be adequately restrained against tilting, over turning and form work should be restrained against horizontal loads. All the securing devices and bracing shall be tightened. (g) The stacked materials shall be placed as catered for, in the design. (h) When adjustable steel props are used. They should: 1. Be undamaged and not visibly bent. 2. Have the steel pins provided by the manufacturers for use. 3. Be restrained laterally near each end. 4. Have means for centralizing beams placed in the forkheads. (i) Screw adjustment of adjustable props shall not be over extended. (j) Double wedges shall be provided for adjustment of the form to the required position wherever any settlement/ elastic shorting of props occurs. Wedges should be used only at the bottom end of single prop. Wedges should not be too steep and one of the pair should be tightened/ clamped down after adjustment to prevent shifting. (k) No member shall be eccentric upon vertical member. (l) The number of nuts and bolts shall be adequate. (m) All provisions of the design and/or drawings shall be complied with. (n) Cantilever supports shall be adequate. (o) Props shall be directly under one another in multistage constructions as far as possible. (p) Guy ropes or stays shall be tensioned properly. (q) There shall be adequate provision for the movements and operation of vibrators and other construction plant and equipment. (r) Required camber shall be provided over long spans. (s) Supports shall be adequate, and in plumb within the specified tolerances.

Guidelines for Multistage Centering: The proper handling the situation of multistage centering in buildings or where height of casting of concrete is higher than normal height of 3.5 M or where higher loadings are coming during casting of concrete or large span structures and in situations of casting of some special structures like Domes, Vaults etc. In all situations, centering/scaffolding/staging for casting of these structures should be properly designed by a qualified and experienced person/agency having past experience in design of false work (centering) for concrete structures and should be proof checked by similar experienced person/ agency and it should be properly approved and issued to contractor by Engineer-In-Charge. The provisions of clause 7 of IS:14687 may be referred for design of false work (centering). A method statement for erection and dismantling of the centering/scaffolding/staging and process of concreting shall be prepared by contractor and submitted to Engineer-in-Charge for approval and the work shall be commenced only after approval of method statement by Engineer-in-Charge. The provisions of clause 9 of IS:14687 may be referred for erection of false work (centering), safety precautions and other site operations, pertaining to false work (centering). Experienced form watcher shall be engaged during erection, concreting and dismantling for early detection of any movement or instability in the system. The field engineers shall ensure that CPWD specifications and provisions of BIS codes are strictly followed. A detailed programme of field safety inspection of centering/scaffolding/form work of such structures during different stages should be chalked out and strictly followed. Provision of safety net, fall arresting system including other safety gears, for workers, working over these structures shall be made in contract and should be followed strictly. 5.2.6 MEASUREMENTS

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5.2.6.1 General : The form work shall include the following: (a) Splayed edges, notching, allowance for overlaps and passing at angles, sheathing battens, strutting, bolting, nailing, wedging, easing, striking and removal. (b) All supports, struts, braces, wedges as well as mud sills, piles or other suitable arrangements to support the form work. (c) Bolts, wire, ties, clamps, spreaders, nails or any other items to hold the sheathing together. (d) Working scaffolds, ladders, gangways, and similar items. (e) Filleting to form stop chamfered edges of splayed external angles not exceeding 20mm wide to beams, columns and the like. (f) Where required, the temporary openings provided in the forms for pouring concrete, inserting vibrators, and cleaning holes for removing rubbish from the interior of the sheathing before pouring concrete. (g) Dressing with oil to prevent adhesion and (h) Raking or circular cutting

Classification of Measurements: Where it is stipulated that the form work shall be paid for separately, measurements shall be taken of the area of shuttering in contact with the concrete surface. Dimensions of the form work shall be measured correct to a cm. The measurements shall be taken separately for the following. (a) Foundations, footings, bases of columns etc. And for mass concrete (b) Walls (any thickness) including attached pilasters, buttresses, plinth and string courses etc. (c) Suspended floors, roofs, landings, shelves and their supports and balconies. (d) Lintels, beams, plinth beams, girders, bressummers and cantilevers. (e) Columns, pillars, piers, abutments posts and struts. (f) Stairs (excluding landings) except spiral staircase. (g) Spiral staircases (including landings). (h) Arches, Domes, vaults, shells roofs, arch ribs, curvilinear shaped folded plates (i) Extra for arches, domes, vaults exceeding 6 m span other than curvilinear shaped (j) Chimneys and shafts. (k) Well steining. (l) Vertical and horizontal fins individually or forming box, louvers and bands. (m) Waffle or ribbed slabs. (n) Edges of slabs and breaks in floors and walls (to be measured in running metres where below 200 mm in width or thickness). (o) Cornices and mouldings. (p) Small surfaces, such as cantilevers ends, brackets and ends of steps, caps and boxes to pilasters and columns and the like. (q) Chullah hoods, weather shades, chajjas, corbels etc. Including edges and (r) Elevated water reservoirs.

Centering, and shuttering where exceeding 3.5 metre height in one floor shall be measured and paid for separately.

Where it is not specifically stated in the description of the item that form work shall be paid for separately, the rate of the RCC item shall be deemed to include the cost of form work.

No deductions from the shuttering due to the openings/ obstructions shall be made if the area of each openings/ obstructions does not exceed 0.4 square metre. Nothing extra shall be paid for forming such openings.

Form work of elements measured under categories of arches, arch ribs, domes, spiral staircases, well steining, shell roofs, curvilinear folded plates & curvilinear eaves board, circular shafts & chimneys shall not qualify for extra rate for circular work.

Extra for circular work shall be admissible for surfaces circular or curvilinear in plan or in elevation beyond the straight edge of supporting beam in respective mode of measurement. However, there may be many different types of such structures. In such cases, extra payment shall be made judiciously after deducting areas where shuttering for circular form work is not involved.

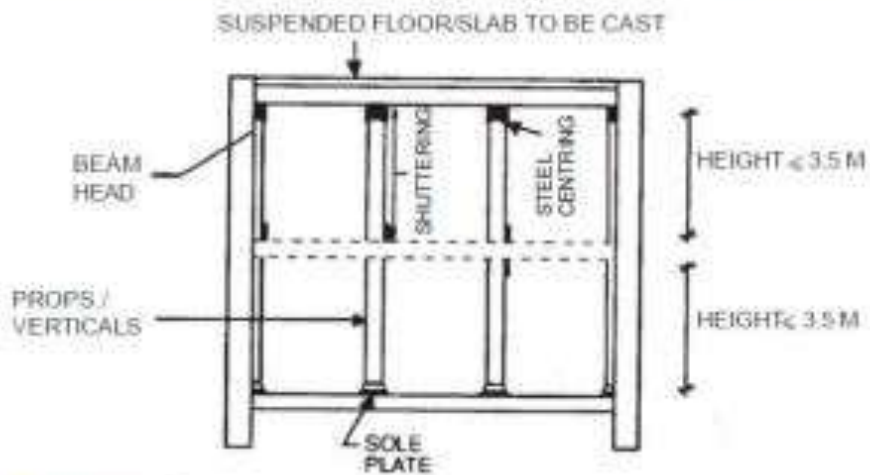
Rate The rate of the form work includes the cost of labour and materials required for all the operations described above

Mode of Measurement & Payment

The rate shall be for a unit of one sq. Meter

TYPICAL DETAILS OF MULTI STAGE SHUTTERING

Sub Head : R.C.C. (Form Work)
Clause : 5.2.3.4



All Members are of Steel

**Fig. 5.9A : Suspended Floor – Multi Stage Shuttering
(Vertical Section)**

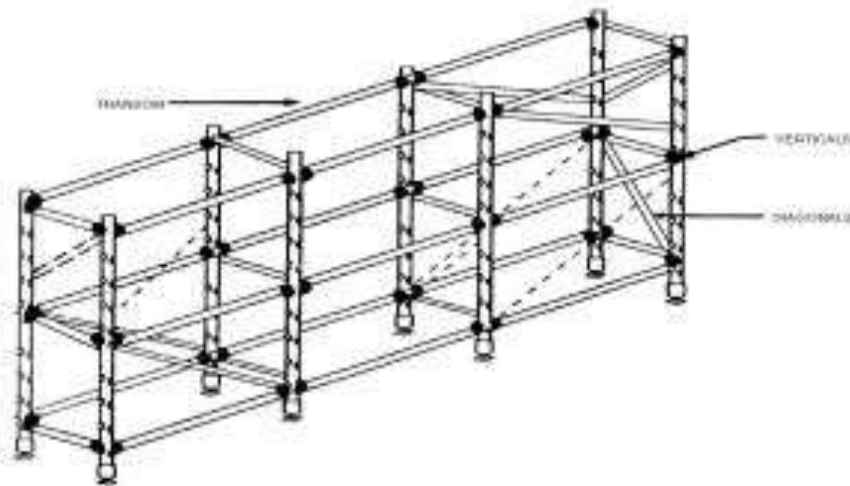


Fig. 5.9B

Fig. 5.9 : Typical Details of Multi-State Shuttering

Item no. 35.

Brick work using common burnt clay building bricks having minimum crushing strength not less than 35 kg/ sq cm in foundation and plinth in cement mortar 1 : 6 (1 cement : 6 fine sand)

Materials

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Sign and Seal of contractor

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Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Brick shall conform to M-15. Cement mortar shall conform to M-11.

2.0. Workmanship

2.1. Proportion:

2.1.1. The proportion of the cement mortar shall be 1:6 (1 cement: 6 fine sand) by volume.

2.2. Wetting of bricks:

2.2.1. The bricks required for masonry shall be thoroughly wetted with clean water for about two hours before use or as directed. The cessation of bubbles, when the bricks are wetted with water is as indication of through wetting of bricks.

2.3. Laying:

2.3.1. Bricks shall be laid in English bond unless directed otherwise. Half or cut bricks shall not be used except when necessary to complete to bond; closures in such case shall be cut to required size and used near the ends of walls.

2.3.2. A layer of mortar shall be spread on full width for suitable length of the lower course. Each brick shall first be properly bedded and set home by gently tapping with handle of trowel or wooden mallet. Its inside face shall be flushed with mortar before the next brick is laid and pressed against it. On completion of course, the vertical joints shall be fully filled from the top with mortar.

2.3.3. The walls shall be taken up truly in plumb. All courses shall be laid truly horizontal and all vertical joint shall be truly vertical. Vertical joints in alternate course shall generally be directly one over the other. The thickness of brick course shall be kept uniform.

2.3.4. The brick shall be laid with frog up wards. A set of tools comprising of wooden straight edges, man son's spirit level, square half meter rub, and pins, string and plumb shall be kept on the site of work for frequent checking during the progress of work.

2.3.5. Both the faces of walls of thickness greater than 23 cms. Shall be kept in proper place. All the connected brick work shall be kept not more than one meter over the rest of the work. Where this is not possible, the work shall be raked back according to bond (and not left toothed) at an angle not steeper than 45degrees.

2.3.6. All futures, pipes, outlets of water, hold fasts of doors and windows etc. Which are required to be built in wall shall be embedded in cement mortar

2.4. Joints:

2.4.1. Bricks shall be so laid that all joints are quite flush with mortar. Thickness of joints shall not exposed 12 mm. The face joints shall be raked out as directed by raking tools daily during the progress of work, when the mortar is still green so as to provide key for plaster or pointing to done.

2.4.2. The face of brick shall be cleaned the very day on which the work is laid and all mortar dropping removed.

2.5. Curing:

2.5.1. Green work shall be protected from rain suitably. Masonry work shall be kept moist on all the faces for a period of seven days. The top of masonry work shall be kept well wetted at the close of the day.

2.6. Preparation of foundation bed:

2.6.1. If the foundation is to be laid directly on the excavated bed, the shall be leveled, cleared of all loose materials, cleaned and wetted before stating masonry, If masonry is to be laid on concrete footing, the top of concrete shall be cleaned and moistened. The contractor shall obtain the engineer's approval for the foundation bed before foundation masonry is started. When pucca flooring is to be provided flush with the top to plinth, the inside plinth offset shall be kept lower than the outside plinth top by the thickness of the flooring.

3.0. Mode measurements & payment

3.1. The measurements of this item shall be taken for the brick masonry fully completed in foundation up to plinth. The limiting dimensions not exceeding those shown on the plinths or as directed shall be final. Battered tapered and curved portions shall be measured.

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3.2. No deduction shall be made from the quantity of brick work, for any extra payment made for embedding in masonry or making holes in respect of following items:

- (1) Ends of joists, beams, posts, girders, purlins, trusses, corbel, steps etc. Where cross sectional area does not exceed 500Sq.Cm.
- (2) Openings not exceeding 1000Sq.Cm.
- (3) Wall plates and bed plates, bearing of slabs, chajjas and the like whose thickness does not exceed 10 Cms. And the bearing does not extend to the full thickness of wall.
- (4) Drainage holes, and recesses for cement concrete blocks to embed hold fasts for doors, windows etc.
- (5) Iron fixtures, pipes up to 300 mm. Dia hold fasts, and doors and windows built into masonry and pipes etc. For concealed wiring.
- (6) Forming chases of section not exceeding 350 -Sq. Cm. In masonry.

3.3. Apertures for fire places shall not be deducted nor shall be paid for separately.

The rate shall be for a unit of one cubic meter.

Item no. 36.

Masonry work using Aerated light weight concrete block having crushing strength not less than 35 kg/sqcm for super structure above plinth level laid with approved block laying polymer modified adhesive mortar all complete as per direction of engineer in charge and Technical Specification . Ground Floor

Workmanship

6.14 AUTOCLAVED AERATED CONCRETE BLOCK MASONRY WORK

6.14.1 Terminology For the purpose of, Autoclave Aerated Concrete Block masonry work, the following definitions shall apply

1. Autoclaved -Steam curing of concrete Products, sand lime bricks, asbestos cement products, hydrous calcium silicate insulation Products, or cement in an autoclave at maximum ambient temperatures generally between 1700C to 2150C.
2. Block - A concrete masonry unit, any one of the external dimensions of which is greater than the corresponding dimension of a brick as specified in IS : 3952-1978 and of such size and mass as to permit it to be handled by one man. Furthermore, to avoid confusion with slabs and Panels, the height of the block shall not exceed either its length or six times its width.
3. Block Density - The density calculated by dividing the mass of a block by the overall volume, including holes or cavities and end recesses..
4. Drying Shrinkage - The difference between the length of specimen which has been immersed in water and then subsequently dried to constant length, all under specified conditions; expressed as a percentage of the dry length of the specimen.
5. Gross Area-The total area occupied by a block on its loading face, including areas of the cavities and end recesses.
6. Height -The vertical dimension of the exposed face of a block, excluding any tongue or other device designed to provide mechanical keying
7. Length - The horizontal dimension of the exposed face of a block excluding any tongue or other device designed to provide mechanical keying.
8. Width -The external dimension of a block at the bedding plane, measured at right angles to the length and height of the block.

6.14.2 Dimensions & Tolerances: Autoclave Aerated Concrete Block shall be made in sizes and shapes to fit different concrete needs. They include stretcher, corner, double corner or pier, jamb, header, bull nose, partition block and concrete floor units. Autoclave Aerated Concrete Block shall be referred to by its normal dimension the term 'normal' means that the dimension includes the thickness of the mortar joints. The actual dimension shall be 10mm short of the normal dimension (or 6mm short in special areas finer joints as specified).

6.14.2.1 The normal dimension of the concrete block shall be as follows:- Length : 400, 500 or 600 mm Height : 200, 250 or 300 mm Width : 100, 150, 200 or 250 mm In addition, Autoclave Aerated Concrete Block shall be manufactured in half length of 200, 250 or 300 mm correspond to the full lengths.

6.14.2.2 The nominal dimensions of the units are so designed that taking account of the thickness of mortar joints, they will produce wall length sand heights which will conform to the principles of modular co-ordination.

6.14.2.3 Block of sizes other than those specified above, may also be used if so specified in the case of special Autoclave Aerated Concrete Block such as jallie or screen wall and ornamental block ,the specified size may not necessarily apply.

6.14.2.4 The maximum variation in the length of the Autoclave Aerated Concrete Block shall not be more than plus/minus 5mm and maximum variation in the height and width of Autoclave Aerated Concrete Block, not more than plus/minus 3mm.

6.14.2.5 The faces of Autoclave Aerated Concrete Block shall be flat & Rectangular, opposite faces shall be parallel and all arises shall be square. The bedding surfaces shall be at right angle to the face of the Blocks.

6.14.2.6 The Autoclave Aerated Concrete Block with special faces shall be manufactured and supplied if so specified.

6.14.3 The autoclaved Autoclave Aerated Concrete Block shall be classified in two grades according to their compressive strength as indicated in table

S. No.	Density in oven dry condition (Kg/m ²)	Compressive Strength (Min)		Thermal Condition in Air dry condition (W/m.k)
		Grade-I (N/mm ²)	Grade-II (N/mm ²)	
1	451 to 550	2.00	1.50	0.21
2	551 to 650	4.00	3.00	0.24
3	651 to 750	5.00	4.00	0.30
4	751 to 850	6.00	5.00	0.37
5	851 to 1000	7.00	6.00	0.42

6.14.4.1 Cement complying with any of the Indian Standard may be used as per the direction of the manufacturer.

6.14.4.2 Use of Fly ash conforming to IS 3812-1981 may be permitted to a limit of 20% in cement conforming to IS 269-1976.

6.14.4.3 The lime shall satisfy the requirement for class C lime specified as IS 712-1973.

6.14.4.4 The aggregate used for the manufacture of Autoclave Aerated Concrete Block shall conform to the following requirements (a) Sand-Conforming to IS 383-1970 except for the grading which may be made to suit the product and silica content shall not be less than 80%. (b) Fly ash – Conforming to IS 3812-1981 with loss on ignition not more than 6%.

6.14.4.5 The water used in the manufacture of Autoclave Aerated Concrete Block shall be free from matter harmful to concrete or reinforcement or matter likely to cause efflorescence in the block and shall meet the requirements of IS 456-2000.

6.14.4.6 Additives and Admixtures may be added either as additives to the cement during manufacturing or as additive or admixtures to the concrete mix. Additive or admixtures used in the manufacture of concrete block may be (a) Accelerating , water reducing and air –entraining admixtures conforming to IS 9103-1979 (b) Water proofing agent conforming to IS 2645-1975 (c) Colouring pigments

6.14.5 Physical requirements

6.14.5.1 All Autoclave Aerated Concrete Block shall be sound, free of cracks or other defects which interfere with the proper placing of block units, impair the strength or performance of the construction.

6.14.5.2 Where block units are to be used in exposed wall construction, the face or faces that are to be exposed shall be free of chips, cracks or other imperfections except that if not more than 5% of a consignment contains slight cracks or small chippings not larger than 25mm, this shall not be deemed grounds for rejection.

6.14.5.3 Dimensions- The overall dimension of the block units when measured shall be in accordance with para 6.14.2.1 subjected to the tolerances mentioned in para 6.14.2.4

6.14.5.4 Block Density - The Block density shall conform to the requirements specified in table of para 6.14.3, when tested accordance with para 6.14.6 (1)

6.14.5.5 Compressive Strength - The min. Compressive strength being the average of twelve block units shall be as prescribed in table of para 6.14.3, when tested accordance with para 6.14.6(2) 6.14.5.6 Thermal Conductivity - The thermal conductivity shall be not exceed the values specified in table of para 6.14.3 when tested accordance with para 6.14.6(3)

6.14.5.7 Drying Shrinkage – the drying shrinkage shall be not more than 0 .05% for grade –1 block and 0.10% for grade-2 block when tested accordance with para 6.14.6(4) 6.14.6 Tests 1. Block Density- The block density shall be determined in the manner described in IS 6441 (part-1) -1972 2. Compressive Strength- The compressive strength of block shall be determined in accordance with IS 6441 (part-5) -1972 3. Thermal Conductivity- The thermal conductivity of block shall be determined in accordance with IS 3346 -1980 4. Drying Shrinkages-The drying shrinkage of block shall be determined in the manner described in IS 6441 (part-2) -1972

6.14.6 Tests 1. Block Density- The block density shall be determined in the manner described in IS 6441 (part-1) -1972 2. Compressive Strength- The compressive strength of block shall be determined in accordance with IS 6441 (part-5) -1972 3. Thermal Conductivity- The thermal conductivity of block shall be determined in accordance with IS 3346 -1980 4. Drying Shrinkages-The drying shrinkage of block shall be determined in the manner described in IS 6441 (part-2) -1972

6.14.7 Sampling

6.14.7.1 Lot - In any consignment, all the blocks of the same size and from the same batch of manufacture shall be grouped together into a minimum number of groups of 10000 blocks or less. Each such group shall constitute a lot.

6.14.7.2 From each lot, a sample of 24 blocks shall be selected at random. The required numbers of Blocks shall be taken at regular intervals during the loading of the vehicle or unloading the vehicles depending on whether sample is taken before delivery or after delivery. When this is not practicable, 255 SUB HEAD 6.0 : MASONRY WORK sample shall be taken from the stack in which case the required number of blocks shall be taken at random from across the top of the stacks, the sides accessible and from the interior of the stacks by opening trenches from the top.

6.14.7.3 The sample of blocks shall be marked for future identification of the consignment it represents. The blocks shall be kept under cover and protected from extreme conditions of temperature, relative humidity and wind until they are required for test. The tests shall be undertaken as soon as practicable after the sample has been taken.

6.14.8 Number of tests

6.14.8.1 All the 24 Blocks shall be checked for dimensions and inspected for visual defects.

6.14.8.2 Out of the 24 blocks, 12 blocks shall be subjected to the test for compressive strength, 3 blocks to the test for density, 3 blocks to the test for thermal conductivity and 3 blocks to the test for drying shrinkage. The remaining 3 blocks shall be reserved for re-test for drying shrinkage if a need arises.

6.14.8.3 The samples of AAC blocks (each sample consisting of 6 specimen) shall be chosen randomly from the lot procured and tested for various parameters specified in para 6 above. One samples shall be tested for every 100 cum or part thereof. However, minimum one sample shall be tested from each lot received at site if the quantity procured in the lot is less than 100 cum. If required, Engineer-in-Charge or his authorized representative shall inspect the factory during production of the material for this work and also collect

samples (of materials used for making AAC blocks and precast AAC blocks) from the factory itself. The contractor shall consider this contingency also while placing the order with one of the approved firms. Nothing extra shall be payable on this account.

6.14.9– Criteria for conformity

6.14.9.1 The number of blocks with dimensions outside the tolerance limit and or with visual defects, among those inspected, shall not be more than two.

6.14.9.2 For density, the mean value shall be within the range specified in Table of para3

6.14.9.3 For compressive strength, the mean value, say X shall be determined. The test results shall be grouped into groups of 4, individual values of ranges shall be determined, the average range a calculated from these values and shall satisfy the following condition: $X - 0.6 R >$ minimum value specified in Table of para3.

6.14.9.4 For thermal conductivity, the mean value shall be equal to or less than the value specified in Table of para3.

6.14.9.5 For drying shrinkage, all the test specimens shall satisfy the requirements of the test. If one or more specimens fail to satisfy the requirements, the remaining 3 blocks shall be subjected to these tests. All these blocks shall satisfy the requirements.

6.14.10 Manufacturer's Certificate

6.14.10.1 The manufacturer shall satisfy himself that the masonry units conform to the requirements of this specification and, if requested, shall supply a certificate to this effect to the purchaser or his representative.

6.14.11 Independent Tests

6.14.11.1 If the purchaser or his representative requires independent tests, the samples shall be taken before or immediately after delivery, at the option of the purchaser or his representative and the tests shall be carried out in accordance with this specification.

6.14.11.2 The manufacturer shall supply free of charge the units required for testing.

6.14.12 Storage

6.14.12.1 General requirements of storage of autoclaved cellular (aerated) concrete blocks shall be as described in IS : 4082-1977*.

6.14.13 Marking

6.14.13.1 Each lot of concrete masonry units manufactured in accordance with this specification shall be suitably marked with information- (i) The identification of the manufacture (ii) The grade and block density of the unit (iii) The month and year of manufacturing Each block may also be marked with the ISI Certification mark.

6.14.14 The R.C.C bend shall be provided on 150mm /230mm/300mm thick masonry to increase the strength and compatibility . The RCC bend shall be provided at sill level and at lintel level over throughout the wall. This thickness of the bend shall be approved by the Engineer in charge or as specified in drawing. The payment of RCC bend and reinforcement shall be paid separately. Autoclave Aerated Concrete Block masonry shall be provided with polymer modified adhesive mortar. The polymer modified adhesive mortar shall be provided @ 30 kg per cum or with cement mortar 1:4 (1 cement : 4 coarse sand).

6.14.15. Autoclave Aerated Concrete Block with 100 mm thick masonry shall be provided with two number 6mm dia reinforcement steel bar at every third course. The payment of reinforcement shall be paid separately.

6.14.16. Autoclave Aerated Concrete Block confirming the IS Code – 2185 (Part-3) 1984 (Reaffirmed 2005)

6.14.17 Measurements

6.14.17.1 Autoclave Aerated Concrete Block Masonry shall be measured in cubic metres unless otherwise specified. Any extra work over the specified dimensions shall be ignored. Dimensions shall be measured correct to the nearest 0.01 metre. i.e. 1 cm. Areas shall be calculated to the nearest 0.01 sqm and the cubic contents shall be worked out to the nearest 0.01 cubic metres. Note : (i) Autoclave Aerated Concrete Block work in parapet walls, mummy, lift machine room and water tanks constructed on the roof upto 1.2 m height above roof shall be measured together with the corresponding work of the floor next below.

6.14.17.2 No deductions or additions shall be done and no extra payment made for the following: Note: Where minimum area is defined for deduction of an opening, void or both, such areas shall refer only to opening or void within the space measured. (a) Ends of dissimilar materials (that is, joists, beams, lintels, posts, girders, rafters, purlins, trusses, corbels, steps etc.); up to 0.1 m² in section; (b) Opening up to 0.1 m² in area (see Note); (c) Wall plates, bed plates, and bearing of slabs, chajjas and the like, where thickness does not exceed 10 cm and bearing does not extend over the full thickness of wall; (d) Cement concrete blocks as for hold fasts and holding down bolts; (e) Iron fixtures, such as wall ties, pipes upto 300 mm diameter and hold fasts for doors and windows; (f) Chases of section not exceeding 50 cm in girth; and (g) Bearing portion of drip course, bearing of moulding and cornice. Note: In calculating area of an opening, any separate lintel or sills shall be included with the size of the opening but end portions of lintel shall be excluded. Extra width of rebated reveals, if any, shall also be excluded.

6.14.17.3 String courses, projecting pilasters, aprons, sills and other projections shall be fully described and measured separately in running metres stating dimensions of each projection. 6.14.17.4 Square or rectangular pillars shall be measured separately in cubic metres

6.14.17.5 Circular pillars shall be measured separately in cubic metres as per actual dimensions. 6.14.17.6 Autoclave Aerated Concrete Block work curved on plan shall be measured like the block work in straight walls and shall include all cutting and wastage of blocks, tapered vertical joints and use of extra mortar, if any. Block work curved on plan to a mean radius not exceeding six metres shall be measured separately and extra shall be payable over the rates for block work in straight walls. Nothing extra shall be payable if the mean radius of the block work curved in plan exceeds six metres.

6.14.17.7 Tapered walls shall be measured net as walls and extra payment shall be allowed for making tapered surface for block work in walls. 6.14.18 Rate The rate shall include the cost of materials and labour required for all the operations described. The rate shall also include the following: (a) Raking out joints or finishing joints flush as the work proceeds; (b) Preparing tops of existing walls and the like for raising further new block work. (c) Rough cutting and waste for forming gables, splay at eaves and the like. (d) Leaving holes for pipes upto 150 mm dia. And encasing hold fasts etc. (e) Rough cutting and waste for block work curved in plan and for backing to stone or other types off acing. (f) Embedding in ends of beams, joists, slabs, lintels, sills, trusses etc. (g) Bedding wall plates,

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lintels, sills, roof tiles, corrugated sheets, etc. In or on walls if not covered in respective items (h) Leaving chases of section not exceeding 50 cm in girth or 350 sq cm in cross-section; and (i) Block on edge courses, cut brick corners, splays reveals, cavity walls, brick works curved on plan to a mean radius exceeding six metres.

The Location and levels shall be followed as per boq item.

Mode of measurement & payment

The rate shall be for a unit of one cubic meter.

Item no. 37.

Masonry work using Aerated light weight concrete block having crushing strength not less than 35 kg/sqcm for super structure above plinth level laid with approved block laying polymer modified adhesive mortar all complete as per direction of engineer in charge and Technical Specification. 1st Floor

Workmanship

The relevant specifications of item No.36 shall be followed

Mode of Measurement & Payment

The relevant specifications of item No. 36 shall be followed:

Item no. 38.

Masonry work using Aerated light weight concrete block having crushing strength not less than 35 kg/sqcm for super structure above plinth level laid with approved block laying polymer modified adhesive mortar all complete as per direction of engineer in charge and Technical Specification. 2nd Floor

Workmanship

The relevant specifications of item No.36 shall be followed

Mode of Measurement & Payment

The relevant specifications of item No. 36 shall be followed:

Item no. 39.

Masonry work using Aerated light weight concrete block having crushing strength not less than 35 kg/sqcm for super structure above plinth level laid with approved block laying polymer modified adhesive mortar all complete as per direction of engineer in charge and Technical Specification. 3rd Floor

Workmanship

The relevant specifications of item No.36 shall be followed

Mode of Measurement & Payment

The relevant specifications of item No. 36 shall be followed:

Item no. 40.

Double skin modular wall panel system made of 0.8 mm thick epoxy polyester Powder coated (NLT 60 microns) GPSP sheets on both sides with PUF as infill of density 40 ± 2 kg /m³ and floor track to accommodate the Epoxy floor flush with the wall panel.

1. Material & workmanship

The double skin modular wall panel system shall be combines durable GPSP sheets, efficient PUF infill for insulation, and epoxy flooring integration through a dedicated floor track

0.8 mm thick sheets made of GPSP (Galvanized Pre-painted Steel) with epoxy polyester powder coating and coating thickness is not less than 60 microns, ensuring durability and resistance to corrosion. Polyurethane Foam (PUF) with a density of 40 ± 2 kg/m³. PUF is often used for its thermal insulation properties and structural integrity. A specialized track or channel designed to integrate the wall panels with the epoxy floor, creating a seamless and flush transition.

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These panels shall be GPSP sheets on both sides and PUF infill effective thermal insulation to meet the standard of maintaining internal temperatures and reducing energy ,it will be Epoxy polyester powder coating ensures longevity and resistance to corrosion, suitable for environments requiring hygiene and cleanlines.

Mode of measurements and payment

The rate includes all labours, materials, tools and plant etc. Required for satisfactory completion of this item.
The rate shall be for a unit of sqm.

Item no. 41.

46 mm thick flush doors mm thick flush doors made of 0.8 mm thick powder Coated GPSP sheet with honeycomb kraft paper as infill, 1.2 mm thick GPSP powder coated door frames, with double glazing glass and hardwares like SS push plate,IHMS make Std arm door closure, SS D handle, SS ball bearing butt hinges, concealed tower bolt for the double doors, Automatic door bottom drop seal, 1.2mm thick SS 304 kick plate of height 300mm, both side operated lock and key etc

1. Material & workmanship

46 mm thick flush doors.,0.8 mm thick GPSP (Galvanized Pre-painted Steel) sheet with powder coating.Honeycomb Kraft Paper.Double glazing glass.,SS Push Plate,IHMS Make Std Arm Door Closure,SS D Handle,SS Ball Bearing Butt Hinges,Concealed Tower Bolt ,Automatic Door Bottom Drop Seal, .2 mm thick stainless steel 304 kick plate of height 300 mm,Allows locking and unlocking from both sides for convenience and security.1.2 mm thick GPSP powder coated door frames.

The flush doors you described are designed with a focus on durability, insulation, security, and functionality. They incorporate high-quality materials like GPSP sheets, stainless steel hardware, and specialized infill for optimal performance in diverse environments,GPSP sheets and stainless steel components provide durability and resistance to corrosion with Honeycomb Kraft Paper infill and double glazing glass contribute to thermal and acoustic insulation.And Both side operated locks, tower bolts, and durable materials enhance security.Along with Hardware like door closures, handles, and hinges ensure smooth operation and longevity.Powder coating and stainless steel components give a modern and clean appearance.

Mode of measurements and payment

The rate includes all labours, materials, tools and plant etc. Required for satisfactory completion of this item.
The rate shall be for a unit of sqm.

Item no. 42. Providing and fixing chicken wire mesh of gauge 0.18mm and 200 mm wide with necessary screws and nail at joints cracks of brick work R.C.C work as per drawing and specification and direction of Engineer incharge.

Workmanship

It shall be thick Gauge: 0.18 mm and width mesh 200.The mesh shall be typically made of mild steel. Necessary screws and nails suitable for the substrate (brickwork or RCC) and mesh material. The joints and cracks in the brickwork or RCC shall be clean, free from dust, loose particles.Cut the chicken wire mesh into appropriate lengths as per the dimensions specified in the drawings and as required for the joints and cracks.Place the chicken wire mesh over the joints in the brickwork or RCC where reinforcement is needed. The mesh in place using screws or nails. And fasteners penetrate into the substrate sufficiently to provide a strong anchorage.Overlap adjoining sections of mesh shall be 150mm ,.

Mode of measurement &payment

The rate shall be for a unit of one sqm.

Item no. 43.

Providing and fixing 18mm thick gang saw cut mirror polished premoulded and prepolished) Granite of any colour and shade as per selection of client for wall lining (veneer work), /bands 200mm wide backing filled with a grout of average 12 mm thick in polymer modified adhesive mortar including secured to the backing by means of cramps, hold fastners ,copper pins 7.5 cm long 6

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mm diameter for securing adjacent stones in stone wall lining in adhesive mortar including making the necessary chases complete in all respect.

WORKMANSHIP

WALL LINING/VENEER WORK.

Unless and otherwise specified in the nomenclature of the item, the marble slabs used for wall lining /veneer work shall be gang saw cut (polished & machine cut). Back shall not be polished/ cut in order to ensure a good grip with the hearting of backing. The cut slabs shall be of the thickness as specified with a tolerance permissible . The tolerance in wall lining when straight edge of 3 m length is placed should not be more than 2 mm. Laying The stone shall be wetted before laying. They shall then be fixed with **12 mm thick in polymer modified adhesive mortar including secured to the backing by means of cramps** in position without the use of chips or under pinning of any sort. Care shall be taken to match the grains of veneer work as directed by the Engineer-in-Charge. For purpose of matching the grains, the marble slabs shall be selected judiciously having uniform pattern of veins/streaks. Preferably the slabs shall be those got out of the same block from the quarry. The area to be veneered shall be reproduced on the ground and the marble slabs laid in position and arranged in the manner to give the desired matching of grains. Any adjustment needed for achieving the best results shall be then carried out by replacing or interchanging the particular slabs. Special care shall be taken to achieve the continuity of grains between the two slabs one above the other along the horizontal joints. This shall then be got approved by the Engineer-in-Charge and each marble slabs numbered properly and the same number shall be marked on a separate drawing as well as on the surface to be actually veneered, so as to ensure the fixing of the particular slabs in the correct location. For the facing of the columns also the same procedure as mentioned above shall be followed.

Where so desired, the adjoining stones shall be secured to each other by means of copper pins 75 mm long and 6 mm diameter .

The stones shall be secured to the backing by means of cramps. The material for cramps shall have high resistance to corrosion under conditions of dampness and against the chemical action of mortar or concrete in which cramps are usually embedded. Cramps shall be of 25 × 6 mm and 30 cm long in case of backing of stone masonry walls and brick masonry walls thicker than 230 mm. In case of backing with brick masonry walls 230 mm or less thick or RCC members cramps shall be of 25 × 6 mm and length as per requirement made out of gun metal. Generally the outer length of cramp in half brick work backing shall be 115 mm and in one brick work backing it shall be 150 mm. Typical shape & details of cramps for such backing. This can be modified as directed by the Engineer-in-Charge if so, required at site. Cramps shall be spaced not more 60 cm apart horizontally. Alternatively the stone may be secured to the backing by means of stone dowels 10 x 5 x 2.5 cm.

The adjoining stones shall be secured to each other by means of gun metal cramps or copper pins of the specified size. Cramps may be attached to its or top and bottom or sides, top and bottom. The general arrangement of cramps required for fixing facing unit to the wall. The actual number of cramps and their sections, however, shall be as per requirements of design to carry the loads.

Where cramps are used to hold the unit in position only, the facings shall be provided with a continuous support on which the stones rest at the ground level and other storey levels, the support being in the form of projection from or recess into the concrete floor slab, or a beam between the columns or a metal angle attached to the floor slab or beams. These supports shall preferably be at vertical intervals not more than 3.5 m apart and also over the heads of all openings. Such supports shall also be provided where there is transition from thin facing below to thick facings above.

Alternatively cramps may be used to hold the units in position and in addition to support the units thus transferring the weight of the units to the backing. Such cramps should be properly designed as per IS 4101 (Part 1).

The cramps may be of copper alloyed with zinc, tin, nickel, lead or stainless steel.

The pins, cramps and dowels shall be laid in **12 mm thick in polymer modified adhesive mortar including secured to the backing by means of cramps** and their samples got approved by the Engineer-in-Charge and kept at site.

Joint All joints shall be fill **12 mm thick in polymer modified adhesive mortar including secured to the backing by means of cramps**. Special care shall be taken to see that groundings for veneer work are full of **12 mm thick in polymer modified adhesive mortar** If any hollow groundings are detected by tapping the face stones, these shall be taken out and relaid. The thickness of the face joints shall be uniform, straight and as fine as possible, not more than 1.5 mm and in the face joint, the top 6 mm depth shall be filled with mortar specified for the pointing.

Mortar The mortar used for jointing slabs shall be **12 mm thick in polymer modified adhesive mortar including secured to the backing by means of cramps**.

Measurements

The length and breadth shall be measured correct to a cm. In case of radially dressed or circular slabs used in the work, the dimensions of the circumscribing rectangles of the dressed stone used in the work, shall be measured & paid for.

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The area shall be calculated in sqm nearest to two places of decimal. Marble work in lining upto 4 cm thickness shall be paid by area under veneer work and lining of greater thickness paid by volume under plain marble work.

Rate The rate includes the cost of materials and labour required for all the operations described above except for the cost of providing and fixing of dowel and cramps which shall be paid for separately, unless otherwise stipulated in the item of work. When factory made finished slabs and tiles are used, no further finishing as mentioned in para shall be required nor anything extra shall be payable.

Mode of measurement & payment

The rate shall be for a unit of one sqm.

Item no. 44.

Providing and fixing 18mm thick gang saw cut mirror polished premoulded and prepolished) machine cut Granite of any colour and shade as per selection of client for kitchen platforms, vanity counters, window sills , facias and similar locations of required size of approved shade, colour and texture laid over 20mm thick base cement mortar 1:4 (1 cement : 4 coarse sand) with joints treated with white cement, mixed with matching pigment, epoxy touch ups, including rubbing, curing, moulding and polishing to edges to give high gloss finish, providing opening of required size & shape for wash basin/sink etc. Complete at all levels.

Workmanship

The relevant specifications of item No.114 shall be followed

Mode of Measurement & Payment

The relevant specifications of item No. 114 shall be followed:

Item no. 45.

Design, manufacture, supply and installation at site Glass Fiber Reinforced concrete (GRC) screens/jali, produced in accordance with Pre Cast Institute(U S A) Manual 128 EDN 4, conforming to size & Thickness as per drawing. Product manufactured using composition of alkali Resistant Glass Fiber of Make NES Japan or CEMFIL or equivalent, High silica sand and white cement as raw materials conforming to relevant Indian and ASTM Standards, fixing with 6 inch Hilti Fastner with every 2 feet gap as required. (M S frame if required is considered in relevant item).

Material and workmanship: Comprise alkali-resistant glass fiber (from NES Japan, CEMFIL, or equivalent), high silica sand, and white cement. Ensure all raw materials conform to relevant Indian and ASTM standards for quality and performance. Ensure the site is prepared according to installation requirements, including proper alignment and structural support. Fix the GRC screens/jali using 6-inch Hilti fasteners, spaced appropriately (e.g., every 2 feet), ensuring secure attachment. Align each screen/jali precisely according to the approved drawings and design specifications. Incorporate MS frames where required, ensuring compatibility and structural integrity.

Mode of measurement & payment

The rate shall be for a unit of one sqm.

Item no. 46. Flush Door (Laminated) Providing and fixing of 35mm solid cored flush door with 1mm thick laminate in approved shade as per selection on both side as shown in the drg. All exposed edges covered with wooden lipping of min 4mm th duly painted and finished matching shade of laminate. Rate shall Include Frame of WPC 125x65mm size comprising of virgin PVC polymer of K value 58- 60 (Suspension Grade), , SS Handle, Lock , Door Stopper, Door Closer, S.S. heavy duty hinges etc. All materials and labour etc. Complete as per detail drawing and instruction of engineer-in charge and consultant.

Material & workmanship

Flush Door shall be 35mm thick with solid core with 1mm thick on both side of door in approved shade selected by the engineer incharge. Flush door shall be Protect exposed edges of the door with 4mm thick wooden lipping .Frame shall be material of WPC with Laminate of size 125mm x 65mm. Hardware shall be Stainless Steel.

Mode of measurement & payment

The rate shall be for a unit of one sqm.

Item no. 47.

Providing and fixing Hollow metal fire rated doors shutter with frame and hardware fittings etc complete as per specifications. Door frame shall be double rebate profile of minimum size 154mm X 77 mm made out of 1.60mm minimum thick galvanized steel sheet. The frames should be finished with Thermosetting Powder Coating in desired RAL Shade. All provision should be mortised, drilled and tapped for receiving appropriate hardware. Frames should be provided with back plate bracket and anchor fasteners for installation on a finished plastered masonry wall opening. Door leaf shall be minimum 49mm thick fully flush double skin door with or without vision lite. All doors NSD 12049 shall be factory prepped for receiving appropriate hardware and provided with necessary reinforcement for hinges, locks, and door closers. For pair of doors astragals has to be provided on the meeting stile for both active and inactive leaf.

Material & workmanship

Door Shutter shall be Hollow metal construction for fire resistance, minimum thickness of the door leaf should be 49mm, Fully flush double-skin door configuration. Door frame shall be Double rebate profile made of minimum 1.60mm thick galvanized steel sheet, Frame size: Minimum 154mm x 77mm, Finished with Thermosetting Powder Coating in desired RAL shade for durability and aesthetics, Mortised, drilled, and tapped to receive hardware fittings and shall be provision with back plate bracket and anchor fasteners for installation on finished plastered masonry wall openings and Hardware Accessories shall be Factory prepped to receive appropriate hardware as following hinges, locks, door closers. Shall be Verify dimensions and conditions of the wall openings where the fire-rated doors will be installed and Install the galvanized steel frames using back plate brackets and anchor fasteners. Ensure frames are plumb, level, and securely anchored to the masonry wall openings and Hang the hollow metal door shutters onto the installed frames, ensuring proper alignment and smooth operation after that Install hinges, locks, door closers, and any other specified hardware fittings according to manufacturer instructions and fire safety regulations make necessary adjustments to ensure doors close properly and lock securely.

Mode of measurements & payment

No payment shall be made for extra necessary required items etc. The rate shall be for a unit of per sqm

Item no. 48.

Providing and fixing Hollow metal doors shutter with frame and hardware fittings etc complete as per specifications. Door frame shall be double rebate profile of minimum size 100mm X 58 mm made out of 1.20mm minimum thick galvanized steel sheet. The frames should be finished with Thermosetting Powder Coating in desired RAL Shade. All provision should be mortised, drilled and tapped for receiving appropriate hardware. Frames should be provided with back plate bracket and anchor fasteners for installation on a finished plastered masonry wall opening. Door leaf shall be minimum 47mm thick fully flush double skin door with or without vision lite. All doors NSD 12049 shall be factory prepped for receiving appropriate hardware and provided with necessary reinforcement for hinges, locks, and door closers.

Door frame shall be Double rebate profile with minimum size 100mm X 58mm. Made from 1.20mm minimum thick galvanized steel sheet. Frames finished with Thermosetting Powder Coating in desired RAL Shade for durability and aesthetic appeal including All provisions mortised, drilled, and tapped and Frames equipped with back plate bracket and anchor fasteners for secure installation on finished plastered masonry wall openings. Ensure frames are correctly aligned and anchored to support the door assembly. Door leaf shall be Minimum 47mm thick fully flush double skin door with vision lite (glass window) as per design requirements including hardware fittings (hinges, locks, door closers, etc.) Suitable for the door's function and security requirements.

Mode of measurements & payment

No payment shall be made for extra necessary required items etc. The rate shall be for a unit of per sqm

Item no. 49.

Restroom Cubical: providing and installing ZMS SS Series Restroom Cubicles with all necessary tools hardware, labour, as per the company specs. Providing & Fixing BESCO Cubicle partition system for toilet by using following Materials 12mm thick compact laminate with core of phenol resin treat papers with black color top layer treated with special melamine resin. Adjustable legs with bottom cap of SS 316, door lock with, gravity hinges with cover – combination of mild steel and Nylon PA6 And used following Accessories Accessories Include: 1. Alumuniumtop Rail (Stainless Steel Grade 304 with Satin Finish)2. SS Coat Hook with Door Stopper Option (Stainless Steel Grade 304 with Satin Finish)3. SS Gravity Hinges (Stainless Steel Grade 304 with Satin Finish)4. SS Latch cum Occupancy Indicator (Stainless Steel Grade 304 with Satin Finish)5. SS "U" Channel (Stainless Steel Grade 304 with Satin Finish)6. SS "F" Channel (Stainless Steel Grade 304 with Satin Finish)7. SS Palm Design Adjustable Foot (Stainless Steel Grade 304 with Satin Finish)8. SS Screws & Inserts(Stainless Steel Grade 304 with Satin Finish) 9. Rubber Lining for Door Stopper Brand.

Workmanship

Restroom Cubical shall have 12mm thick compact laminate with a core of phenol resin-treated papers and Top layer treated with special melamine resin in black color. For structural support and stability for the cubicle partitions will be provide Aluminum Top Rail Stainless Steel Grade 304 with Satin Finish and for hanging items and serves as a door stopper will be provide SS Coat Hook with Door Stopper Option, for smooth opening will be provide SS Gravity Hinges, for occupied or vacant and provides secure locking will be provide SS Latch cum Occupancy Indicator. For securing , height adjustment and aligning and fixing hardware shall be the cubicle partitions SS "U" Channel, SS "F" Channel, SS Palm Design Adjustable Foot, SS Screws & Inserts, Rubber Lining for Door Stopper. Partition Installation- Assemble the 12mm thick compact laminate panels with the necessary hardware, ensuring proper alignment and fit , Securely fix the aluminum top rail, SS coat hooks, gravity hinges, latch cum occupancy indicators, SS "U" channel, SS "F" channel, palm design adjustable foot, and other accessories using SS screws and inserts. Install adjustable legs with SS 316 bottom caps to ensure stability and accommodate variations in floor levels. Test each cubicle for proper functioning of hinges, locks, occupancy indicators, and other hardware. ensure all panels and hardware are aligned correctly and that the finish meets aesthetic standards.

Mode of measurements & payment

No payment shall be made for extra necessary required items etc. The rate shall be for a unit of per sqm

Item no. 50.

Providing, supplying, fixing, fabricating, erecting, aligning the structural steel like pivot ,tubular 'T','I' section, angle, plate ,beam, channel section, Bar , hollow box or Z purlins , for built up purlins, roof trusses, columns, side runners, tie beams, sag rods, base plates gusset plates, cap plates, bearing bracing, gantry girders, rails, require support, pipes, including all welded or bolted steel structures of various types with approved I.S.I. mark electrodes, bolts, anchor bolts including cost of thread, Anchor plate cleats etc. In RCC or masonry work, including cutting, bending, welding ,fixing, supplying , Fabricating Decorative fevisted section or any structured member required to complete the job for Trusses, Canopy, doors, Frame, Railing, Entrance gate, pergola, Decorative hanging light , for Electrical, water supply and HVAC structure New window, parking shed or space frame or any other required specified area as shown on drawing and detailed specification or as per design incl. Three coats of approved brand primer and two coats of paints, necessary scaffolding, tools tolerance etc. Complete as directed by Engineer In Charge. (Payment will be made for weight of metal used in the work) (Work for all the floors/all heights)

Materials

The structured steel work shall conform to M-22. Red lead paint shall conform to I.S : 102-1962.

Workmanship

The steel sections as specified or required, shall be cut, square and to correct lengths, as per drawings and design. The cut ends exposed to view shall be finished smooth. No two pieces shall be welded or otherwise jointed to make up the required length of member, except as indicated in the drawing or as directed. All straightening and shaping to form shall be done by application of pressure and not by hammering. Any bending or cutting shall be carried out in suet] a manner as not to impair the strength of the metal. All operations shall be done in cold state unless other wise directed/permitted.

Steel welding or bolted in built up sections, framework.

The steel structure as shown in the drawings or as per direction of the Engineer-in-charge shall be laid out on a level platform to full scale and to full size in parts. A steel tape shall be used for measurements to ensure maximum accuracy.

Wooden templates 12 mm. To 19 mm. Thick or metal sheet template shall be made to correspond

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to each connecting gussets plate. The templates shall be laid on the steel members and holes of the steel members shall also be marked for curing. The base of steel column and the position of Anchor bolts shall be carefully set out

All stiffeners shall be formed by pressure and where practicable the metal shall not to be cut and welded in making these. In major work, or where so specified, shop drawings giving complete details and information for the fabrication of the component parts of the structure including location, type, size, (origin and details of weld, bolts or weld shall be prepared in advance of the actual fabrication and as distinctly marked or stenciled with paint with the identification mark as given in the shop drawings. The bars shall be thickened at the ends, so as to provide for screwed threads and gradually tapered off to meet their normal section.

Great accuracy shall be observed in fabrication of various member, so that these can be assembled without being unduly packed, stained, or forced into position and when built up, shall be true and free from twists, wrinkles, buckles, or open joints.

Before making holes in individual members for fabrication the steel work intended to be welded or bolted together shall be assembled or clamped properly and tightly so as to ensure close abutting or lapping of the surfaces of the different members. All stiffeners shall bear tightly both at top and bottom without being drawn or caulked. The abutting joints shall be cut or crossed true and straight and fitted close together. Web splice plates and stiffeners under stiffened shall be cut to fit within 3 mm. Or flange Angles Web plates of Girders shall have no cover. Plates, shall have their ends flush with the top of angles forming the flanges unless otherwise required. The web plates when spliced shall have clearance of not more than 6 mm. The erection, clearance for created ends of members connecting steel shall preferably be not greater than 1.5 mm. The erection clearance at the ends of beams without web cleats shall not be more than 3 mm. At each end but where for a practical reason greater clearance is necessary, suitably designed seating shall be provided.

Plans and rollers shall be accurately tuned to gauge. These shall be straight and smooth and free from flaws. The roller bearing shall be provided with adequate arrangements for holding the girders or truss resting on it. In columns caps and bases, the ends of shafts together with the attached gussets Angles, channels etc after weld together shall be accurately mechanized so that the parts connected butt against each other over the entire surfaces of contact connecting angles or channels shall be fabricated and placed in position with greater accuracy so that they are not unduly reduced in thickness by machining. The ends of bearing stiffeners shall be mechanized or ground to fit tightly both at the top and bottom. All holes shall generally be drilled to the required size and at required position. Sub punching shall be permitted provided it is done 3 mm. Or less in diameter and reamer thereafter to the required size. The holes for welds and bolts shall be larger by 0.4 to 6 mm. Than the nominal diameter of welds or bolts depending upon the diameter of welds.

Holes shall have their axis perpendicular to the surface bored through. The drilling or reaming shall be free

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From burrs, and the holes should be clean and accurate holes for counter sunk bolts shall be made in such a manner that their heads fit flush with the surface after fixing. The fabrication work shall be completed in workshop as far as it is practicable to do so. Site joints shall be done with welds and fitted bolts or black bolts, as shown in the drawings or as directed. Generally the following principles shall govern the use of reverts turned and fitted bolts, and block bolts.

(i) Welds and turned and fitted bolts shall be used where the connections is such that slip under load has to be avoided.

(ii) Black bolts may be used very sparingly where a force is carried through a connection without impact, vibration or reversal or stresses.

Welding:

The parts assembled for welding shall be in close contact with each other and the bearing stiffeners shall bear tightly both at top and bottom without being drawn or caulked. Members to be welded shall be properly pinned or bolted and rigidly held to gather while welding. Drifting of holes shall not be permitted. Except to draw the parts together and the drifting tools so used shall have maximum diameter not exceeding, the nominal diameter of welds or bolts. Drifting done during assembling shall not distort the metal or enlarge the holes.

The shanks of welds shall project beyond the plate-surface sufficiently so as to fill hole thoroughly and form the required head after welding.

The welding shall be done by hydraulic or pneumatic process. However, where such facilities are not available, hand welding may be permitted. The weld shall be heated red hot, care being taken to control the temperature of heating so as not to burn the steel. Rivets of diameter less than 10 mm. May be fitted cold. Welds shall be of heat finish with heads full and of equal size. All loose, burnt or badly formed reverts with concentric or deficient heads shall be cut out and replaced. The heads of welds shall be central to shanks and shall grip the assembled member firmly. In cutting out welds, care shall be taken so as not to injure assembled members, caulking or reequipping shall not be permitted.

For testing welds, a hammer weighing approximately 0.25 kg shall be used. Both heads of the welds shall be tapped, slack welds will give a hollow sound and a jar.

All weld heads shall be painted with red lead paint within a week of their fixing.

2.0.1. All bolt heads and nuts shall be hexagonal and of equal size unless specified otherwise. The screwed heads shall conform to I.S. 1363-1960 and the threaded surface shall not be tapered. The bolts shall be of such length so as to project two clear threads beyond the nuts when fixed in position and these shall fit in the holes without any shakes. The nut shall be fit in the threaded ends of bolts properly.

Where turned and fitted bolts are required to be used in place of welds shall be provided with washers not less than 6 mm. Thick so that the nut when tightened shall not bear on the unthreaded body of the bolt. Tapered washers shall be provided for all heads and nuts bearing on leveled surfaces. The threaded portion of the bolt shall not be within the thickness of the parts bolted together, the faces of the bolt heads and nuts abutting against steel members shall be machine finished. Where there is a risk of the nut being removed or becoming loose due to vibrations or reversal of stresses, these shall be secured from slackening by use of locknuts, spring washers, cross-cutting or hammering down of threads as directed.

Bolts, nuts, and washers shall be thoroughly cleaned and dipped in double boiled linseed oil before use. The whole steel work shall be painted with a coat of priming coat of red lead, as per relevant specification of painting.

1.1. Welding shall generally be done by electric process. Gas welding shall be resorted to, using oxyacetylene flame with specific prior approval. Gas welding shall not be permitted for structural steel work.

1.2. The work shall be done as shown in the shop drawings which should clearly indicate various details of the joints to be welded, shop and site welded as well as type of electrodes to be used, symbol for welding on plans and shop drawings shall be according to I.S. 813-1961. As far as possible every effort shall be made to limit the welding that must be done after improper welding that is likely to be done due to heights and difficult positions on scaffoldings etc. The welding work shall conform to I.S. 816-1969.

1.3. Preparation of surfaces : Surfaces which are to be welded together shall be free from loose mill scale, rust, paint, grease or other foreign matter. A coating of boiled linseed oil shall be permitted.

1.4. Assembly for welding : Before welding is commenced, the plates shall first be brought together and firmly clamped or spot welded at specified distance. This temporary connection has to be strong enough to hold the plates accurately in place without displacement.

1.5. Precautions : All operations connected with welding and cutting equipment shall conform to safety requirement given in I.S.818-1968.

The following points shall be borne in mind during the process of welding:

(b) Arc length, voltage and amperage shall be suited to the thickness of material type of groove and

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other circumstances of the work.

(c) The segments of welding shall be such that where possible the members which offer the greatest resistance to compression are welded first.

1.6. The defective welds which shall be considered harmful to the structural strength shall be cut out and reworked.

1.7. Finished welds and adjacent parts shall be protected with clean boiled linseed oil and after all slag has been removed. Welds and adjacent parts shall be painted after they are approved.

1.8. All the members shall be thoroughly cleaned of rust-scales, dust etc. and given a priming coat of red lead paint before fixing them in position.

Mode of measurements & payment

The steel work shall be measured in general as under:

(a) All work shall be measured on the basis of finished dimensions as fixed at site and measured net unless specified otherwise.

(b) The weight of steel sections, steel rods, and steel strips in finished work shall be calculated on the standard weight on the same basis on which steel is supplied to Contractor by department or those given in relevant I.S. : if steel is arranged by the contractor.

(c) The weight of steel plates and strips shall be taken from relevant I.S. based on 7.35 kg./ sq. Meter for every millimeter sheet thickness if steel is supplied to the contractor by department.

(d) Unless otherwise specified, weight of cleats, brackets, packing pieces, bolts, nuts, washers, distance pieces, separators, diaphragm gusset (taking overall square dimensions) fish plates etc. shall be added to the weight of respective items.

(e) In welded work allowance is to be made for weight of weld metal. No deductions shall be made for weld metal or bolt holes excluding holes for anchor or holding down bolts.

(f) For forged steel and steel castings, weight shall be calculated on the basis of 7850 kg./cum.

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(g) Unless otherwise specified, no allowance shall be made for the weld metal in case of welded steel structure.

(i) Dimensions other than cross sections and thickness of plates shall be measured to nearest 0.001m

(j) Mill tolerance shall be ignored when weight is determined by calculation.

3.1. The rate includes cost of all material, labour, erection, hoisting scaffolding, protective measure, required for proper completion of the item of work. This shall also include conveyance and delivery handling, loading, unloading and storing etc. Required for completing the item described above including necessary wastage involved.

3.2. The rate shall be for a unit of one quintal.

Item no. 51.

Design, manufacture and installation of 12 mm dpi system, a complete assembly of extruded Multi / Micro cellular profile UV extruded/protected polycarbonate panels incorporated into a complete system. The Polycarbonate panel system consists coextruded UV protected Multi / Micro cellular structure polycarbonate panel with width of 1040 mm to ensure best performance for wind uplift, vibration, oil canning and visual appearance. Panels shall be manufactured with vertical standing seam with standing seam height of 10 - 15mm at both sides of the panel. Panels shall be fixed on Purlins with the Z - Type Stainless Steel Fastener/retention clips and connectors. Each fastener shall be min 1mm thick of SS 304 Grade and secured to supporting frame/structure with min 3 numbers of self-drilling screws so that the Pull Out Load of Fastener exceeds 7000 N (7 KN) when tested as per ISO 6892: 1998 and IS 1608: 2005. Snap-on connectors to interlock the panels shall have 2-4 teeth grip-lock locking mechanism to ensure maximum uplift capability. Panel shall be fixed with additional End cap/Aluminum U / F Profile / Glazing Bar (mill finish) for ends as required. Panel shall be fixed over structural steel / MS purlin (paid separately) by trained & factory authorised installer under direct supervision to complete entire project installation according to the detail technical specifications as per approved architectural drawings.

WORKMANSHIP

Polycarbonate panels shall be Coextruded UV protected Multi/Micro cellular structure. Panel Width shall be 1040 mm for optimal performance against wind uplift, vibration, oil canning, and visual appearance. Panels feature a vertical standing seam with a height of 10-15 mm on both sides for enhanced structural strength and aesthetic appeal. Panel shall be fastened with Z-Type Stainless Steel 304 grade 1mm thick Clips. For supporting frame/structure using a minimum of 3 self-drilling screws per fastener. Each fastener must exceed 7000 N (7 KN) as per ISO 6892:1998 and IS 1608:2005 standards. Locking with Snap-on connectors with a 2-4 teeth grip-lock locking mechanism. Used to finish ends of panels and ensure a neat, sealed appearance. Panels shall be fixed over structural steel purlins. Installation Team should be well Trained and to installation under direct supervision by engineer in charge.

Mode of measurements & payment

No payment shall be made for extra necessary required items etc. The rate shall be for a unit of per sqm

Item no. 52.

Providing and fixing stainless steel (Grade 304) railing made of Hollow tubes, channels, plates etc., including welding, grinding, buffing, polishing and making curvature (wherever required) and fitting the same with necessary stainless steel nuts and bolts complete, i/c fixing the railing with necessary accessories & stainless steel dash fasteners, stainless steel bolts etc., of required size, on the top of the floor or the side of waist slab with suitable arrangement as per approval of Engineer-in charge, (for payment purpose only weight of stainless steel members shall be considered excluding fixing accessories such as nuts, bolts, fasteners etc.

WORKMANSHIP

STAINLESS STEEL RAILING

The stainless steel of 304 grade of as per IS 6911 : 2017 shall be used for further fabrication of railing as per Architectural Design.

(a) Stainless steel of 304 grade is most common in 300 series of Austenitic stainless steel.

(b) It is still sometimes referred to by its old name 18/8 which is derived from the nominal composition of type 304 being 18% chromium and 8% nickel.

(c) Fabrication of all stainless steel sections should be done only with tools dedicated to stainless steel materials. Tooling and work surfaces must be thoroughly cleaned before use. These precautions are necessary to avoid cross contamination of stainless steel by easily corroded metals that may discolour the surface of the fabricated product. Some specific hints are as under:

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(i) Remove all moisture by blowing with dry air or heating with a torch.

(ii) Eliminate organic contaminants like oil, paints, anti-spatter compounds, grease, pencil marks, cutting compounds, adhesive from protective paper, soap used for leak testing etc.

(iii) Stainless steels cannot be flame cut with a torch. Acceptable results are achieved with an arch plasma cutter.

(iv) Be particularly careful to avoid zinc contamination. Do not use brushes or tools previously used on galvanized steel.

(v) Use only stainless steel wire brushes and use these brushes only on stainless steel.

Fixing Fixing with railing with necessary accessories & stainless steel dash fasteners, stainless steel bolts etc. Of required size, on the top of the floor or the side of waist slab with suitable arrangement as per approval of Engineer-in-charge.

Measurements Only weight of stainless steel members shall be considered in kg, excluding fixing accessories such as nuts, bolts, fasteners etc.

Rate The rate shall include the cost of materials and labour involved in all the operations described above. Nothing extra shall be paid for fixing arrangements i.e. Drilling, nut & bolts etc.

Mode of measurements & payment

No payment shall be made for extra necessary required items etc. The rate shall be for a unit of per KG.

Item no. 53.

Providing and fixing carbon steel galvanised (minimum coating 5 micron) dash fastener of 10 mm dia double threaded 6.8 grade (yield strength 480 N/mm²), counter sunk head, comprising of 10 mm dia polyamide PA 6 grade sleeve, including drilling of hole in frame , concrete/ masonry, etc. As per direction of Engineer-in-charge. Size 10x120mm

Dash Fastener shall be Carbon steel, galvanized with a minimum coating of 5 microns to protect against corrosion. And strength will be 6.8 (yield strength of 480 N/mm²), Diameter will be 10 mm double threaded for secure anchoring and Length 120 mm. Head will be Countersunk head for flush installation. with Polyamide PA 6 grade sleeve with a diameter appropriate for the fastener size (10 mm).

Mode of measurements & payment

No payment shall be made for extra necessary required items etc. The rate shall be for a unit of per numbers.

Item no. 54.

Item no. 55. Cement concrete flooring 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate) finished with a floating coat of neat cement, including cement slurry, but excluding the cost of nosing of steps etc. Complete. 11.3.1- 40 mm thick with 20 mm nominal size stone aggregate 11.13.1 Providing and fixing glass strips in joints of terrazo/cement concrete floors.- 40 mm wide and 4 mm thick

11.2.1 Cement Concrete Cement concrete of specified mix grade shall be used and it shall generally conform to the specifications described under sub head 4.0 .

11.2.2 Base Concrete

11.2.2.1 Flooring shall be laid on base concrete where so provided. The base concrete shall be provided with the slopes required for the flooring. Flooring in verandah, Courtyard, kitchens & baths shall have slope ranging from 1 : 48 to 1 : 60 depending upon location and as decided by the Engineer-in- Charge. Floors in water closet portion shall have slope of 1:30 or as decided by the Engineer -incharge to drain off washing water. Further, necessary drop in flooring in bath, WC, kitchen near floor traps ranging from 6 mm to 10 mm will also be provided to avoid spread of water. Necessary margin to accommodate this drop shall be made in base concrete. Plinth masonry off set shall be depressed so as to allow the base concrete to rest on it.

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11.2.2.2 The flooring shall be commenced preferably within 48 hours of the laying of base concrete. The surface of the base shall be roughened with steel wire brushes without disturbing the concrete. Immediately before laying the flooring, the base shall be wetted and a coat of cement slurry @ 2 kg of cement spread over an area of one sqm so as to get a good bond between the base and concrete floor. 11.2.2.3 If the cement concrete flooring is to be laid directly on the RCC slab, the top surface of RCC slab shall be cleaned and the laitance shall be removed and a coat of cement slurry @ 2 kg of cement spread over an area of one sqm so as to get a good bond between the base and concrete floor

11.2.3 Thickness The thickness of floor shall be as specified in the description of the item. 11.2.4 Laying

11.2.4.1 Panels : Flooring of specified thickness shall be laid in the pattern including the border as given in the drawings or as directed by the Engineer-in-Charge. The border panels shall not exceed 450 mm in width and the joints in the border shall be in line with panel joints. The panels shall be of uniform size and no dimension of a panel shall exceed 2 m and the area of a panel shall not be more than 2 sqm. The joints of borders at corners shall be mitred for provision of strips.

11.2.4.2 Laying of Flooring with Strips : Normally cement concrete flooring shall be laid in one operation using glass/aluminium/PVC/brass strips/stainless steel strips or any other strips as required as per drawing or instructions of the Engineer-in-Charge, at the junction of two panels. This method ensures uniformity in colour of all the panels and straightness at the junction of the panels. 4 mm thick glass strips or 2 mm PVC strips or 2 mm aluminium or brass strips shall be fixed with their tops at proper level, giving required slopes. Use of glass and metallic strips shall be avoided in areas exposed to sun. Cost of providing and fixing strips shall be paid for separately. Concreting : Cement concrete shall be placed in the panels and be levelled with the help of straight edge and trowel and beaten with thapy or mason's trowel. The blows shall be fairly heavy in the beginning but as consolidation takes place, light rapid strokes shall be given. Beating shall cease as soon as the surface is found covered with a thin layer of cream of mortar. The evenness of the surface shall be tested with straight edge. Surface of flooring be true to required slopes. While laying concrete, care shall be taken to see that the strips are not damaged/disturbed by the labourers. The tops of strips shall be visible clearly after finishing with cement slurry.

11.2.4.3 Laying of Flooring without Strips : Laying of cement concrete flooring in alternate panels may be allowed by the Engineer-in-Charge in case strips are not to be provided. Shuttering : The panels shall be bounded by angle iron or flats. The angle iron/flat shall have the same depth as the concrete flooring. These shall be fixed in position, with their top at proper level giving required slopes. The surface of the angle iron or flats, to come in contact with concrete shall be smeared with soap solution or non-sticking oil (Form oil or raw linseed oil) before concreting. The flooring shall butt against the unplastered masonry wall. Concreting : The concreting shall be done in the manner described under

11.2.4.2. The angle iron/ flats used for shuttering, shall be removed on the next day of the laying of cement concrete. The ends thus exposed shall be repaired, if damaged with cement mortar 1 : 2 (1 cement : 2 coarse sand) and allowed to set for minimum period of 24 hours. The alternate panels shall then be cleaned of dust, mortar, droppings etc. And concrete laid. While laying concrete, care shall be taken to see that the edges of the previously laid panels are not damaged and fresh mortar is not splashed over them. The joints between the panels should come out as fine straight lines.

11.2.5 Finishing

11.2.5.1 The finishing of the surface shall follow immediately after the cessation of beating. The surface shall be left for some time, till moisture disappears from it or surplus water can be mopped up. Use of dry cement or cement and sand mixture stiffening the concrete to absorb excessive moisture shall not be permitted. Excessive trowelling shall be avoided. 11.2.5.2 Fresh cement shall be mixed with water to form a thick slurry and spreaded @ 2 kg of cement over an area of one sqm of flooring while the flooring concrete is still green. The cement slurry shall then be properly processed and finished smooth

11.2.5.3 The edges of sunk floors shall be finished and rounded with cement mortar 1:2 (1 cement : 2 coarse sand) and finished with a floating coat of neat cement.

11.2.5.4 The junctions of floor with wall plaster, dado or skirting shall be rounded off where so specified.

11.2.5.5 The men engaged on finishing operations shall be provided with raised wooden platform to sit on so as to prevent damage to new work.

11.2.6 Curing The curing shall be done for a minimum period of ten days. Curing shall not be commenced until the top layer has hardened. Covering with empty gunnies bag shall be avoided as the colour of the flooring is likely to be bleached due to the remanents of cement dust from the bags.

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11.2.7 Precautions Flooring in lavatories and bath room shall be laid only after fixing of water closet and squatting pans and floor traps. Traps shall be plugged while laying the floors and opened after the floors are cured and cleaned. Any damage done to W.C.'s squatting pans and floor traps during the execution of work shall be made good. During cold weather, concreting shall not be done when the temperature falls below 4°C. The concrete placed shall be protected against frost by suitable covering. Concrete damaged by frost shall be removed and work redone. During hot weather, precautions shall be taken to see that the temperature of wet concrete does not exceed 38° C. No concreting shall be laid within half an hour of the closing time of the day, unless permitted by the Engineer-in-Charge. To facilitate rounding of junction of skirting, dado and floor, the skirting/dado shall be laid along with the border or adjacent panels of floor. 11.2.8 Measurement Length and breadth shall be measured before laying skirting, dado or wall plaster. No deduction shall be made nor extra paid for voids not exceeding 0.20 sqm. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 sqm. The flooring done either with strips (in one operation) or without strips (in alternate panels) shall be treated as same and measured together. 11.2.9 Rate The rate shall include the cost of all materials and labour involved in all the operations described above including application of cement slurry on RCC slab or on base concrete including roughening and cleaning the surface but excluding the cost of strips which shall be paid separately under relevant item. Nosing of steps where provided shall be paid for separately in running metre. Nothing extra shall be paid for laying the floor at different levels in the same room or courtyard and rounding off edges of sunk floors. In case the flooring is laid in alternate panels, nothing extra shall be paid towards the cost of shuttering used for this purpose.

Mode of measurements & payment

No payment shall be made for extra necessary required items etc. The rate shall be for a unit of per sqm.

Item no. 56.

Providing and laying mirror polished Kota stone slab flooring over 20mm (Average) thick base of cement mortar 1:6 (1-cement:6-coarse sand) laid over and jointed with grey cement slurry mixed with pigment to match the shade of slab including rubbing and mirror polishing etc. complete. (A) 25mm thick (work for all the floors)

1.0. Materials

1.1. Water shall conform to M-1. Lime mortar shall conform to M-10. Cement mortar shall conform to M-11 Polished kota stone shall conform to M-49,

2.0. Workmanship

2.1. Each slab shall be cut to the required size and shape and fine chisel dressed at all the edges. The sides trust dressed shall have a full contract if a straight edge is laid along. The sides shall be table rubbed with coarse sand before paving. All angles and edges of the slabs shall be true square and free from chippings and giving a plane surface. The thickness shall be 25 mm. (Average) as specified in the item but not less than 20 mm. At any place of the slab.

2.2. Bedding for the Kota stone slabs shall be of cement mortar 1:6 (1 cement:6 coarse sand) or L.M. 1:1.5 of average thickness 20 mm given in the description of the item. Sub grade shall be cleaned, wetted and mopped Mortar of the specified mix and thickness shall then be spread on an area sufficient to

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Receive one kota stone slab. The slab shall be washed clean before laying. It shall be laid on top, pressed, tapped gently to bring it in level with the other slabs. If shall then be lifted and laid aside. Top surface of the mortar shall then be corrected by adding fresh mortar at hollows or depressions. The mortar shall then be allowed to harden bit. Over this surface, cement slurry of honey-like consistency shall be applied. The slab shall then be gently placed in position and tapped with wooden mallet till it is properly padded in level with and close to the adjoining slab. The joint shall be as fine as possible. The slabs fixed in the floor adjoining, the walls shall enter not less than 10 mm. Under the plaster, skirting or dedo. The junction between the wan and floor shall be finished neatly. The finished surface shall be true to levels and slopes as directed

2.3. The floor shall be kept wet for a minimum period of 7 days so that bedding and joints set properly

2.4. Polishing shall be normally commenced after 14 days of laying the stone slab. First polishing shall be done with carborundum stones of 120 grade grit fitted in the heavy machine and then second polishing shall be done with carborundum stone of 220 to 350 grade grit fitted in heavy machine. Water shall be properly used during polishing. The stone shall then be washed clean with water. When directed by the Engineer-in-charge, wax polish of approved quality shall be applied on the surface with the help of soft cloth over a clean and dry surface. Then the polishing machine fitted with bobs shall be run over it.

2.5. The holes required for Nahni traps, pipes and any other fittings shall be made, without any extracost.

3.0. Measurement & payment

3.1. The rate shall include the cost of all materials and labour involved in all the operations described above. The kota stone flooring shall be measured in square meters correct to two places decimal, length and breadth shall be measured correct to a centimeter and between the finished face of skirting dedo plaster and no deduction shall be made nor extra paid for any opening in floor of areas up to 0.1sq

The rate shall be for a unit of one sq.meter

Item no. 57.

Providing and laying mirror polished kota stone slab 25mm thick in risers of steps, skirting Dado and pillars laid on 10mm thick cement mortar 1:3 (1-Cement :3 coarses and) and jointed with grey cement slurry mixed with pigment to match the shade of slab including rubbing and mirror polishing etc. Complete. (work for all the floors)

Materials

Water shall conform to M-1. Cement mortar shall conform to M-11. Kota stone slab 25 mm thick shall conform to M-49.

Workmanship

2.0. The relevant specifications of item No. 112 shall be followed except that the kota stone fixed for risers of steps, dedo or skirting in C.M. 1:3 and the polishing shall be done manually instead of machine polishing.

3.0. Mode of measurements and payment

3.1. The risers of steps, skirting or dedo shall be measured in sq. Meter. Length shall be measured along the finished faces of risers, skirting or dedo. Height shall be measured from finished level of treads of floor to top. Lining of pillars shall be measured under this item.

The rate shall be for a unit of one sq.meter.

Item no. 58. Extra for marble stone flooring in treads of steps and risers using single length up to 2.00 metre.

Workmanship

The relevant specification of item shall be followed as above

Mode of measurements & payment

The relevant specifications of item no as per BOQ shall be followed.

The rate shall be a unit of one sqm

Item no. 59. Providing & laying Light & Dark Colored Polished Granite slab (16-18mm thick) flooring For Staircase Tread, Landing over 20 mm (average) thick base of Cement Mortar (1-Cement : 6-Sand) using cementitious Adhesive Materials as per EIC instruction. Granite slab shall be laid and jointed with grey cement slurry. The size of granite should be in full length of Riser and Tread as per design. Rates are including rubbing, polishing Moulding /Rounding of edges, making two lines of Grooves on each tread for antislip, laying and removing of floor protection sheet etc. Complete. (work for all the floor Staircase).

WORKMANSHIP

Granite Stone

Registrar

Sign and Seal of contractor

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It shall be of any colour and size as directed by Engineer-in -Charge. Granite shall be plain machine cut and mirror polished. The stone shall be smooth and of even surface without holes or pits.

SIZES AND TOLERANCES The size of marble blocks, slabs and tiles shall be as mentioned in Table

TABLE

Sl.No	Type	Length	Width	Thickness
1.	Blocks	30 to 250	30 to 100	30 to 90
2.	Slabs	70 to 250	30 to 100	2 to 15
3.	Tiles	10 to 60	10 to 60	0.8 to 2.4

(1) All dimensions are in centimetre.

(2) The length and width, of the blocks shall be in multiple of 30 cm.

(3) Length and width of slab shall be in multiple of 10 cm. And thickness in multiple of 1 cm.

(4) Tiles shall be square cut and linear dimensions in multiple of 10 cm.

(5) Only slabs and tiles shall be machine cut and factory made.

(6) For 8 mm thick tiles, special precautions will be required for fixing them like using special adhesive as per manufacturer's specifications. Such tiles are not suitable for outside veneering work exposed to rains/sun if used in large areas in continuous stretches. For tiles of thickness 20 mm and above cramps may be provided if approved by Engineer-incharge.

Tolerance

The following tolerances shall be allowed in the dimension of blocks, slabs and tiles:

Type	Tolerance
Blocks	
(a) Length	+ 2 per cent
(b) Width	+ 2 per cent
(c) Thickness	+ 2 per cent
Slabs	
(a) Length	+ 2 per cent
(b) Width	+ 2 per cent
(c) Thickness	+ 3 per cent
Tiles	
(a) Linear dimension	+ 3 per cent
(b) Thickness	+ 1 per cent

The sizes other than those mentioned above may be provided as directed by the Engineer-incharge and nothing extra shall be payable on this account.

PHYSICAL PROPERTIES

The physical properties of marble for blocks, slabs and tiles and method of tests are mentioned in Table.

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TABLE 8.2
Physical Properties of Marble & Granite

Characteristic	Marble		Granite	
	(1) Moisture absorption after 24 hrs immersion in cold water	Max. 0.4%	IS 1124	Max. 0.50% by weight
(2) Hardness	Min. 3	Mhos scale	-	-
(3) Specific Gravity	Min. 2.5	IS 1122	Min. 2.6	IS 1122

Approval of Sample Before starting the work, the contractor shall get samples of marble approved by the Engineer-in-Charge. Approved samples shall be kept in the custody of the Engineer-in-Charge and the marble supplied and used on the work shall conform to samples with regard to soundness, colour, veining and general texture.

SAMPLING In any consignment all the blocks/slabs/tiles of the same group, size and finish shall be grouped together to constitute a lot. Sample shall be selected and tested separately for each lot for determining its conformity or otherwise to the requirements of the specification. The number of blocks/slabs/tiles to be selected for the samples shall depend upon the size of the lot and shall be in accordance with the Table 8.3.

TABLE 8.3
Sample Size and Criteria for Conformity

<i>Number of Blocks slabs/Tiles in the lot</i>	<i>Number of blocks slabs/ Tiles to be selected in sample</i>	<i>Permissible number of defectives</i>	<i>Sub Sample size in no.</i>
(1)	(2)	(3)	(4)
Up to 25	3	0	2
26 to 100	5	0	2
101 to 200	8	0	3
201 to 500	13	0	4
501 to 1000	20	1	5

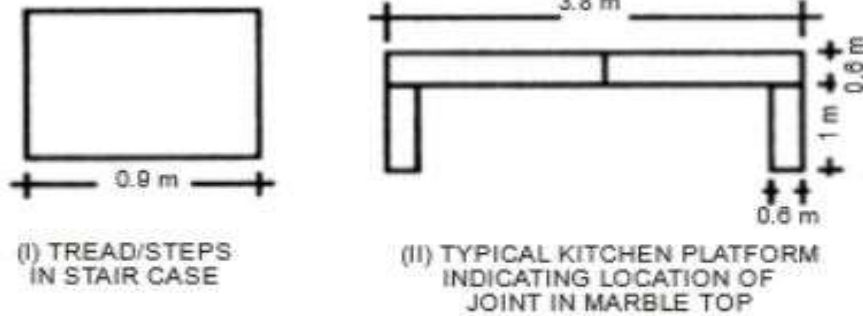
Note: The blocks/slabs/tiles in the sample shall be taken at random and in order to ensure to randomness of selection, random tables may be used.

Explanation 1 : All the blocks/slabs/tiles, selected in the sample, shall be examined for dimensions workmanship and general requirements. Any block/slab/tile failing in any one or more of the above requirements shall be considered as defective. A lot shall be considered as conforming to these requirements if the number of defectives obtained is not more than permissible no. Of defectives given in Col. 3 of table 8.3

Explanation 2 : The lot having been found satisfactory with respect to dimensions, workmanship and general requirement shall be tested for physical properties of the marble. For this purpose a sub sample of the size given in Col. 4 of Table 8.3 shall be selected at random. These blocks/slabs/tiles in the sub sample shall be tested for moisture absorption, hardness and specified gravity. The lot shall be considered having satisfied the requirements of the physical properties if none of the blocks/ slabs/tiles tested for the requirements fails in any of these tests.

MARBLE WORK - TABLE RUBBED AND POLISHED (PLAIN WORK) Marble work in steps, jambs, columns and other plain work shall be as specified below: Joints in staircase treads, kitchen platforms shall be permitted only at curvature or when width/ length is more than 0.6/2 mtrs. Respectively. Number of joints in each direction shall not be more than one number for every 2 mtrs. Length beyond the initial 2.00 m length. Additional joints due to curvature or for providing fixture shall be provide judiciously as given in sketch 'A' below.

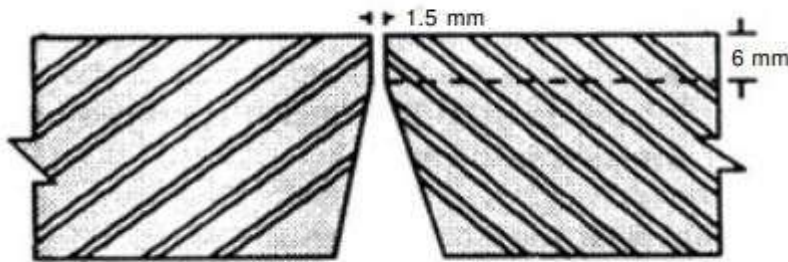
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SKETCH (A)

Dressing, Cutting and Rubbing Every marble stone shall be gang saw/machine cut to the required size and shape, chisel dressed machine finished on all beds and joints, so as to be free from any waviness and to give truly vertical, horizontal, radial or circular joints as required. The exposed faces and sides of stones forming joints upto 6mm. From the face shall be fine tooled machine cut such that a straight edge laid along the face of the stone is in contact with every point on it. All window sills, tread of steps, counters vanities moulding edges etc. Shall be machine cut & polished to give high gloss mirror finish as per direction of Engineer-in-Charge. These surfaces shall then be rubbed smooth. All visible angles and edges shall be true, square and free from chipping. Beyond the depth of 6 mm from face, the joints shall be dressed with a slight splay so that the thickness of joint increases, in an inverted V shape as shown in Fig. Below. The surfaces of the stones coming in contact with backing need not be chisel dressed

EXTERNAL FACE



INVERTED V-SHAPE JOINT

A sample of dressed and rubbed stone shall be prepared for approval and it shall be kept on worksite after being approved by the Engineer-in-Charge.

Mortar The mortar used for jointing shall be as specified.

Laying All marble stones shall be wetted before placing in position. These shall then be floated on mortar and bedded properly in position with wooden mallets without the use of chips or under pinning of any sort. The walls and pillars shall be carried up truly in plumb or battered as shown in the drawings. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. In case of work without backing of brick work or coursed rubble masonry, face stone shall be laid in headers and stretchers alternatively unless otherwise directed. The headers shall be arranged to come as nearly as possible in the middle of stretchers above and below. Stone shall be laid in regular courses of not less than 15 cm in height and all courses shall be of the same height unless otherwise specified. For work facing with backing of brick work or coursed rubble masonry, face stone shall be laid in alternate courses of header and stretchers unless otherwise directed. Face stone and bond stone courses shall have break joint on the face of atleast half the height of the standard course and the bond shall be carefully maintained through out. All the connected masonry in a structure shall be carried up nearly at one uniform level throughout but where breaks are unavoidable the joints shall be made in good long steps so as to prevent cracks developing between new and old work. When necessary jib crane or other mechanical appliances shall be used to hoist the heavy pieces of stones and place these in to correct positions, care being taken that the corners of the stone are not

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damaged. Stone shall be covered with gunny bags, before putting chain or rope is passed over it, and it shall be handled carefully. No piece which has been damaged shall be used in work. The matching of grains shall be carried out as directed by the Engineer-in-Charge.

Bond Stone Bond or through stones running right through the thickness of walls, shall be provided in walls upto 60 cm thick and in case of wall above 60 cm thickness a set of two or more bond stones overlapping each other by atleast 15 cm shall be provided in a line from face to back. At least one bond stone or a set of bond stones shall be provided for every 0.5 sqm of the wall surface. All bond stones shall be marked suitably as directed by the Engineer-in-Charge. **8.5.5 Joints** The depth of joints 6 mm from the face shall be uniform and as fine as possible but shall be not more than 1.5 mm thick on the exposed face. Beyond the depth of 6 mm from face, the thickness of joints shall increase in an inverted V shape so as to give good mortar bond between two stones. The inverted portion of the joints shall be filled with bedding mortar and the face 6 mm portion with pointing mortar.

Curing The work shall be kept constantly moist on all faces for a period of atleast seven days.

Finishing After the marble work is cured, it shall be rubbed with carborandum stone of different grades no. 60, 120 and 320 in succession or with electrical rubbing machines rubbed with carborandum items 0 to 6 nos.in succession, so as to give a plane true and highly smooth surface. It shall then be cleaned with a solution of oxalic acid, washed and finished clean.

Protection Green work shall be protected from rain by suitable coverings. The work shall also be suitably protected from damage during construction.

Scaffolding Double scaffolding having two sets of vertical supports shall be provided where necessary. The supports shall be sound and strong, tied together by horizontal pieces over which the scaffolding plank shall be fixed.

Tolerances As per para 8.2 Note: The above Para 8.5. Also applies to the Ashlar masonry referred in Chapter No. 7.0 - Stone Work.

Measurements For plain work: Measurements shall be taken correct to a cm in length and breadth and correct to 0.5 cm in thickness.

In the case of radially dressed or circular stone used in the work, the dimensions of the circumscribing rectangle of the dressed stone, shall be measured correct to a centimetre and thickness, correct to 0.5 cm. The cubical contents shall be calculated in cubic decimetre nearest to two places of decimal.

The marble work in arches and domes shall be measured as for plain work, but extra shall be allowed for such work over the rate for plain work.

Fixing with Adhesive Cementitious adhesive materials as specified by the Engineer in Charge jointing with Grey cement slurry used for jointing the granite slabs.

Sunk or moulded work in marble shall be measured by volume as per plain marble work or work in arches or domes as the case may be on the basis of circumscribed rectangular block of the finished work but extra shall be paid for such work over the rate for plain work for work in arches and domes. For the purpose of extra payment, volume of every stone sunk or moulded shall be considered.

Rate The rate includes the cost of materials and labour required for all the operations i/c cutting of recesses in wall cutting moulding corners edge rounding finishing & polishing as specified

The rate shall be for a unit of one sq.meter

Item no. 60.

Providing & laying Granite slab (16-18mm thick - river wash) in riser of steps dedo, Skirting and pillars laid 15 mm thick Cement Mortar 1:3 (1Cement:3 Coarse Sand) using cementitious Adhesive Materials as per EIC instruction. Granite slab shall be jointed with the Grey Cement Slurry Rates are including rubbing, polishing Moulding / Rounding of edges, laying and removing of floor protection sheet etc. Complete.(work for all the floors)

Workmanship

2.1. The relevant specifications of item No. 114 shall be followed except that the granite fixed for risers of steps, dedo or skirting in C.M. 1:3 and the polishing shall be done manually instead of machine polishing.

3.2. Mode of measurements and payment

3.3. The risers of steps, skirting or dedo shall be measured in sq. Meter Length shall be measured along the finished faces of risers, skirting or dedo. Height shall be measured from finished level of treads of floor to top. Lining of pillars shall be measured under this item.

The rate shall be for a unit of one sq.meter.

Item no. 61.

Providing and laying Glazed Vitrified tiles Matt/Antiskid finish of size 600mmx600mm in floor / skirting (thickness to be specified by the manufacturer) with water absorption less than 0.08% and conforming to IS:15622, of approved brand & manufacturer, in all colours and shade, laid with cement based high polymer modified quick set tile adhesive (water based) conforming to IS : 15477, in average 6 mm thickness, including grouting of joints. The tiles must be cut with the zero chipping diamond cutter only. Laying of tiles will be done with the notch trowel, plier, wedge, clips of required thickness, leveling system and rubber mallet for placing the tiles gently and easily.

Workmanship

2.0. Bedding :

2.0.1. The sub grade shall be cleaned, wetted and mopped. The bedding shall then be laid evenly over the surface tamped and corrected to desired level and allowed to harden enough to offer a rigid cushion to tiles and to enable the monsoon to place wooden planks across and squat on it.

2.1. The Glazed vitrified tile shall be laid with cement based high polymer modified quick set tile adhesive (water based) conforming to IS : 15477, in average 6 mm thickness, including grouting of joints. Fixing tiles.

2.2. 2.2.1. The tiles before laying shall be soaked in water for at least two hours. The Glazed vitrified tile shall be laid with cement based high polymer modified quick set tile adhesive (water based) conforming to IS : 15477, in average 6 mm thickness, including grouting of joints. Fixing tiles. The tiles shall be well pressed and gently tapped with a wooden mallet till they are properly bedded and in level with the adjoining tiles. There shall be. No hollows in bed or joints. The joints between the tiles shall be as thin as possible in straight line or as per pattern.

2.2.2. The tiles shall not have staggered joints. The joints shall be true to centre line both ways. The Nahni trap coming in the flooring shall be so positioned that its grating shall replace only one tile as far as possible. Where full size tiles cannot be fixed they shall be cut (Swan) to the required size and the edges rubbed smooth to ensure straight and true joints. The joints shall be filled with cement based high polymer modified quick set tile adhesive with wire brush or trowel to a depth of 5 mm. And loose material removed. White cement shall be used for pointing the joints. After fixing the tiles finally in an even plane the flooring shall be kept wet and allowed to nature undisturbed for 7 days.

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2.3. Cleaning:

2.3.1. The surplus cement based high polymer modified quick set tile adhesive that may have come out of the joints shall be cleaned off before it sets. Once the floor has set, it shall be carefully washed, cleared by dilute acid and dried. Proper precautions and measures shall be taken to ensure that the tiles are not damaged in any way till the completion of the construction.

3.0. Mode of measurements & payment

3.1. The work done shall be measured in sq. Mt. For visible area of work done. The length and width of the flooring shall be measured not between the faces of skirting or dedos or plastered face of wall as the case may be. The paving under dedo or skirting shall not be measured. No deduction shall be made not extra paid for any opening in the floor of area-up to 0.1 sq.mt. Nothing extra shall be paid for laying the floors at different levels in the samerooms.

The rate shall be for a unit of one sq.meter.

Item no. 62.

Providing and laying Glazed Vitrified tiles Matt/Antiskid finish of size 800mmx800mm in floor / skirting (thickness to be specified by the manufacturer) with water absorption less than 0.08% and conforming to IS:15622, of approved brand & manufacturer, in all colours and shade, laid with cement based high polymer modified quick set tile adhesive (water based) conforming to IS : 15477, in average 6 mm thickness, including grouting of joints The tiles must be cut with the zero chipping diamond cutter only . Laying of tiles will be done with the notch trowel, plier, wedge, clips of required thickness, leveling system and rubber mallet for placing the tiles gently and easily.

Here's an expanded description tailored to the installation of 800mm x 800mm glazed vitrified tiles with a matt/antiskid finish:

Workmanship

The relevant specifications of item No. 116 shall be followed except that the glazed vitrified tile size 800x800mm should be followed in this item

Mode of measurements and payment

The rate shall be for a unit of one sq.meter.

Item no. 63.

Providing and laying Ceramic tiles 6mm thick in flooring treads of steps and landing laid on a bed of 12mm thick cement mortar 1:3 (1- cement : 3- coarse sand) finishing with flush pointing in white cement.

Workmanship

2.4. Bedding :

2.4.1. The sub grade shall be cleaned, wetted and mopped. The bedding shall then be laid evenly over the surface tamped and corrected to desired level and allowed to harden enough to offer a rigid cushion to tiles and to enable the monsoon to place wooden planks across and squat onit.

2.4.2. The ceramic tiles shall be laid on cement mortar bedding of 12 mm. Thick in C.M. 1:3. The mortar shall have sufficient plasticity for laying and there shall be no hard lumps that would interfere with the evenness of bedding. The base shall be cleared and well wetted. The mortar shall then be spread in thickness not less than 10 mm. At any place and average 12 mm. Thickness. The proportion of the cement mortar shall be as specified in the item.

2.5. Fixing tiles:

2.5.1. The tiles before laying shall be soaked in water for at least tow hours. Neat gray cement grout at 33 kg/Cement/Sq. Mt. Of honey like consistency shall be spread over the mortar bedding as directed. The edges of the tiles shall be smeared with neat cement slurry. The tiles shall be well pressed and gently tapped with a wooden mallet till they are properly bedded and in level with the adjoining tiles. There shall be. No hollows in bed or joints. The joints between the tiles shall be as thin as possible in straight line or as per pattern.

2.5.2. The tiles shall not have staggered joints. The joints shall be true to centre line both ways. The Nahni trap coming in the flooring shall be so positioned that its grating shall replace only one tile as far as possible.

Where full size tiles cannot be fixed they shall be cut (Swan) to the required size and the edges rubbed

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smooth to ensure straight and true joints. The joints shall be filled with grey cement grout with wire brush or trowel to a depth of 5 mm. And loose material removed. White cement shall be used for pointing the joints. After fixing the tiles finally in an even plane the flooring shall be kept wet and allowed to nature undisturbed for 7days.

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2.6. Cleaning:

2.6.1. The surplus cement grout that may have come out of the joints shall be cleaned off before it sets. Once the floor has set, it shall be carefully washed, cleared by dilute acid and dried. Proper precautions and measures shall be taken to ensure that the tiles are not damaged in any way till the completion of the construction.

3.2. Mode of measurements & payment

3.3. The work done shall be measured in sq. Mt. For visible area of work done. The length and width of the flooring shall be measured not between the faces of skirting or dedos or plastered face of wall as the case may be. The paving under dedo or skirting shall not be measured. No deduction shall be made not extra paid for any opening in the floor of area-up to 0.1 sq.mt. Nothing extra shall be paid for laying the floors at different levels in the same rooms.

The rate shall be for a unit of one sq.meter.

Item no. 64.

Providing and laying Ceramic tiles 6mm thick in skirting risers of steps and dedo on 10mm thick cement plaster 1:3 (1-cement : 3- coarse sand) and jointed with white cement slurry

Workmanship

The relevant specifications of item No. 118 shall be followed except that the ceramic tile fixed for risers of steps, dedo or skirting in C.M. 1:3 with 10mm thick cement mortar.

Mode of measurements and payment

The risers of steps, skirting or dedo shall be measured in sq. Meter Length shall be measured along the finished faces of risers, skirting or dedo. Height shall be measured from finished level of treads of floor to top. Lining of pillars shall be measured under this item.

The rate shall be for a unit of one sq.meter.

Item no. 65.

Providing and laying under floor screeding Cement mortar 1:4 (1cement : 4 coarse sand)

Workmanship

The substrate Should be clean, free from dust, oil, debris, and loose particles. It should also be adequately cured and dampened before application. Mixing the Cement Mortar shall be mixing ratio of 1 part cement to 4 parts coarse sand (1:4 ratio). Mix dry ingredients thoroughly in a clean container or mixing tray to ensure uniform distribution. Gradually add clean water to the dry mix while continuously mixing to achieve a workable consistency. The cement mortar shall be application immediately after mixing to prevent premature drying. Spread the mortar evenly over the prepared surface using a shovel or trowel. Once the mortar is spread, use a leveling tool (spirit level or laser level) to achieve a smooth, flat surface. Compact the mortar by tamping or using a wooden float to ensure good bonding with the substrate and eliminate air voids. eather the edges to ensure a smooth transition with adjacent surfaces or wall. After finishing, protect the freshly laid screed from direct sunlight, wind, and rapid drying by covering it with damp hessian or polythene sheets. Maintain adequate moisture for a minimum of 7 days to allow the cement to cure properly and develop sufficient strength.

Mode of measurements & payment

The rate shall be for a unit of one cum.

Item no. 66.

Providing and laying C.C. pavement of mix M-25 with ready mixed concrete from batching plant. The ready mixed concrete shall be laid in panels and finished with screed board vibrator, vacuum dewatering process and finally finished by floating, brooming with wire brush etc. Complete as per specifications and directions of Engineer-in charge. Cement content considered in this item is @ 380 kg/cum.

Workmanship

The relevant specifications of item No. 14 shall be followed except the Cement concrete to be compacted by screed board vibrator of the type approved by Engineerin-Charge and by vaccum dewatering process complete as per directions of Engineer-in-charge.

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Mode of Measurement & Payment

The relevant specifications of item No. 14 shall be followed:

Item no. 67.

Providing and fixing conductive vinyl flooring of 2mm thick homogeneous flooring with veined surface pattern and non directional ship texture as per EN649. The tile size should be 615mm x615mm. The floor should be residual indentation of 0.035mm as per EN 433, the light fastness >6 as per ISO105-B02 and electrical resistance should be $5 \times 10^4 < R < 10^6 \Omega$ as per EN1081 for EC. The product should also confirm to Class Bfl-s1 in flammability test as per EN13501-1, slip resistance of R9 as per DIN 51130, dynamic coefficient of friction with class DS as per EN13893. The wear group of sheet is M as per EN 660-2. Flooring should have excellent chemical resistance as per EN423. The joints to be welded with hot welding coils.

Material and Workmanship.

Flooring shall be 2mm Thick Homogeneous Conductive vinyl flooring with Veined surface pattern and it will be Non-directional ship texture. Performance Standards will be meet Residual Indentation $\leq 0.035\text{mm}$ (as per EN 433), Light Fastness > 6 (as per ISO 105-B02), Electrical Resistance $5 \times 10^4 < R < 10^6 \Omega$ (as per EN 1081), flammability class Bfl-s1 (as per EN 13501-1), Slip Resistance R9 (as per DIN 51130), Dynamic Coefficient of friction class DS (as per EN 13893), Wear Group M (as per EN 660-2) & Chemical Resistance Excellent (as per EN 423) and Joints to be welded with hot welding coil.

Mode of measurements & payment

The rate shall be for a unit of one sqm.

Item no. 68.

Providing and application of self levelling compound in the average thickness 3-4mm with two coats of primer of approved manufacturer in the packaging of 25 kg bags, The work shall be carried out as per manufacturers specifications and as per direction of Engineer in charge.

Material and Workmanship.

Self-Leveling Compound shall be Average Thickness 3-4mm Self-leveling compound is a specialized material. Two Coats of Primer will be Applied before the self-leveling compound, Primer should be from an approved manufacturer. Primers are essential to ensure proper adhesion of the self-leveling compound to the substrate and application process will be follow the directions provided by the Engineer in charge,

Mode of measurements & payment

The rate shall be for a unit of one sqm.

Item no. 69.

Providing and application of Epoxy Flooring in the average thickness 3-4mm with prime finish of approved manufacturer catalogue, The work shall be carried out as per manufacturers specifications and as per direction of Engineer in charge.

Material and Workmanship.

1. Epoxy Flooring shall be Average Thickness 3-4mm with consists of epoxy resin and a hardening agent. The epoxy flooring will include a prime finish The prime finish helps to enhance adhesion and performance of the epoxy coating to the substrate.

Mode of measurements & payment

The rate shall be for a unit of one sqm.

Item no. 70.

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Cutting holes in RCC wall, slab by diamond core cutting machine upto 150mm dia for passing drain pipes etc and repairing the hole after insertion of drain pipe etc with GP2 grout.

Workmanship

Choose the appropriate diamond core bit size (up to 150mm in this case) for the desired hole diameter. Mount the core cutting machine securely to prevent movement during operation. Ensure the machine is connected to a stable power source and all controls are functioning correctly. The core cutting machine and slowly advance the diamond core bit into the RCC wall or slab. Apply steady pressure and use water or a suitable coolant to keep the core bit and cutting area cool and to minimize dust. Once the core bit has cut through the RCC, retract the core cutting machine and remove the core from the hole. Handle the extracted core carefully to avoid any damage. Clean the hole thoroughly to remove any debris and ensure a smooth surface for the drain pipe or conduit to be inserted. Insert the pipe or conduit carefully into the hole, ensuring it fits snugly and aligns correctly with the plumbing or drainage system. Prepare GP2 grout according to manufacturer instructions, ensuring the mix is of the correct consistency. Fill the space around the inserted drain pipe or conduit with GP2 grout to secure it in place and provide structural support. Smooth out the surface of the grout to ensure it blends seamlessly with the surrounding RCC. Clean up any excess grout or debris from the work area. Dispose of waste materials properly according to environmental regulations.

Mode of measurements and payment

The rate shall be for a unit of each.

Item no. 71. Providing and fixing on wall face unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A, including jointing with seal ring conforming to IS : 5382, leaving 10 mm gap for thermal expansion, (i) Single socketed pipes. 12.41.2) 110 mm diameter

Material and Workmanship

The pipe should be given adequate support at all times. Pipes should be stored on a reasonably flat surface free from stones and sharp projections so that the pipe is supported throughout its length. In storage, pipe racks should be avoided. Pipe should not be stacked in large piles, especially under warm temperature conditions as the bottom pipes may distort, thus giving rise to difficulty in jointing. Socket and spigot pipes should be stacked in layers with sockets placed at alternate ends of the stacks to avoid lopsided stacks.

20 1.21.1.1 It is recommended not to store pipe inside another pipe.

1.21.1.2 On no account should pipes be stored in a stressed or bent condition or near the sources of heat.

1.21.1.3 Pipes should not be stacked more than 1.5 m high. Pipes of different sizes and classes should be stacked separately.

1.21.2 The ends of pipe should be protected from abrasion particularly those specially prepared for jointing either spigot or socket solvent welded joints or shouldered for use with couplings.

1.21.3 In tropical conditions, pipes should be stored in shade. In very cold weather, the impact strength of PVC is reduced making it brittle and more care in handling shall be exercised in wintry condition.

1.21.4 If due to unsatisfactory storage of handling a pipe becomes kinked, the damaged portion should be cut out completely. Kinking is likely to occur only on very thin walled pipes.

Fixing and Jointing Pipes shall be either fixed on face of wall or embedded in masonry as required in the description of the item. Plain pipes shall be secured to the walls at all joints with PVC Pipes clips by means of 50 x 50 x 50 mm hard wood plugs, screwed with M.S. screws of required length i/c cutting brick work and fixing in cement mortar 1:4 (1 cement : 4 coarse sand). The clips shall be kept about 25 mm clear off finished face of wall, so as to facilitate cleaning of pipes. Pipes shall be fixed perfectly vertical or to the lines as directed. The pipes shall be fitted to fittings with seal ring conforming to IS 5382 allowing 10 mm gap for thermal expansion.

12.26.6 Installation in Wall/Concrete The walls/concrete slots should allow for a stress free installation. Pipes and fittings to be inserted into the slots without a cement base have to be applied first with a thin coat of PVC solvent cement

Followed by sprinkling of dry sand (medium size). Allow it to dry. The process gives a sound base for cement fixation. This process is repeated while joining PVC material to CI/AC materials.

12.26.7 Fittings Fittings used shall be of the same make as that of the PVC pipes Injection moulded or fabricated by the manufacturer and shall have a minimum wall thickness of 3.2 mm. The fittings shall be supplied with grooved socketted ends with square grooves and provided with Rubber Gasket conforming to IS 5382. The plain ends of the fittings should be chamfered. The fittings shall be joined with the help of Rubber lubricant. The details of fittings refer IS 13592.

12.26.8 Measurements The fittings shall be measured by numbers. The pipes shall be measured net when fixed correct to a cm. Excluding all fittings along its length.

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12.26.9 Rate The rate shall include the cost of all materials and labour involved in all the operations described above including jointing but excluding the supply and fixing of wall plugs and PVC clips which shall be paid for separately

Mode of measurements and payment

The rate shall be for a unit of metre.

Item no. 72. S Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A, including jointing with seal ring conforming to IS : 5382, leaving 10 mm gap for thermal expansion. 12.42.2)Single Push Fit Coupler. 12.42.2.2) 110 mm dia

Workmanship

The relevant specifications of item No. 71 shall be followed

Mode of Measurement &Payment

The rate shall be for a unit of each.

Item no. 73. Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A, including jointing with seal ring conforming to IS : 5382, leaving 10 mm gap for thermal expansion. 12.42.4)Single tee without door. 12.42.4.1) 75x75x75 mm

Workmanship

The relevant specifications of item No. 71 shall be followed

Mode of Measurement &Payment

The rate shall be for a unit of each.

Item no. 74. Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A, including jointing with seal ring conforming to IS : 5382, leaving 10 mm gap for thermal expansion. 12.42.5)Plain bend 87.5 deg. 12.42.5.2) 110 mm dia

Workmanship

The relevant specifications of item No. 71 shall be followed

Mode of Measurement &Payment

The rate shall be for a unit of each.

Item no. 75. Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A, including jointing with seal ring conforming to IS : 5382, leaving 10 mm gap for thermal expansion. 12.42.6)Shoe (Plain) 87.5 deg. 12.42.6.2) 110 mm dia

Workmanship

The relevant specifications of item No. 71 shall be followed

Mode of Measurement &Payment

The rate shall be for a unit of each.

Item no. 76. Providing and fixing unplasticised -PVC pipe clips of approved design to unplasticised - PVC rain water pipes by means of 50x50x50 mm hard wood plugs, screwed with M.S. screws of required length, including cutting brick work and fixing in cement mortar 1:4 (1 cement : 4 coarse sand) and making good the wall etc. Complete.12.43.2) 110 mm

Workmanship

The relevant specifications of item No. 71 shall be followed

Mode of Measurement &Payment

The rate shall be for a unit of each.

Item no. 77. S Providing and fixing to the inlet mouth of rain water pipe cast iron grating 15 cm diameter and weighing not less than 440 grams.

Workmanship

The relevant specifications of item No. 71 shall be followed

Mode of Measurement & Payment

The rate shall be for a unit of each.

Item no. 78. Suspended on inter locking metal grid of hot dipped galvanized steel sections (galvanized @ 120 grams/ sqm, both side inclusive) consisting of main "T" runner with suitably spaced joints to get required length and of size 24x38 mm made from 0.30 mm thick (minimum) sheet, spaced at 1200 mm center to center and cross "T" of size 24x25 mm made of 0.30 mm thick (minimum) sheet, 1200 mm long spaced between main "T" at 600 mm center to center to form a grid of 1200x600 mm and secondary cross "T" of length 600 mm and size 24x25 mm made of 0.30 mm thick (minimum) sheet to be interlocked at middle of the 1200x600 mm panel to form grids of 600x600 mm and wall angle of size 24x24x0.3 mm and laying false ceiling tiles of approved texture in the grid including, required cutting/making, opening for services like diffusers, grills, light fittings, fixtures, smoke detectors etc. Main "T" runners to be suspended from ceiling using GI slotted cleats of size 27 x 37 x 25 x 1.6 mm fixed to ceiling with 12.5 mm dia and 50 mm long dash fasteners, 4 mm GI adjustable rods with galvanised butterfly level clips of size 85 x 30 x 0.8 mm spaced at 1200 mm center to center along main T, bottom exposed width of 24 mm of all T-sections shall be pre-painted with polyester paint, all complete for all heights as per specifications, drawings and as directed by Engineer-in-charge. 12.52.1) GI Metal Ceiling Lay in plain Tegular edge Global white color tiles of size 595x595 mm, and 0.5 mm thick with 8 mm drop; made of G I sheet having galvanizing of 100 gms/sqm (both sides inclusive) and electro statically polyester powder coated of thickness 60 microns (minimum), including factory painted after bending.

Item no. 79. Providing and fixing eco-friendly light weight calcium silicate false ceiling tiles having Tegular edge & 15 mm Thick Densified edges on the Tile Periphery for Extra Strength The Light weight calcium silicate ceiling tiles shall have , light reflection 85% non-combustible as per B.S. 476 part IV, 100% humidity resistance and also having thermal conductivity 0.043° w/m KC. for the best thermal Insulation . The Light weight calcium Silicate tile shall be of approved texture Fine fissured/ Spintone /Cosmos having NRC value of 0.5 & Globe having NRC value of 0.75 NRC or equivalent of size 595 X 595 mm to be laid on true horizontal level suspended inter locking metal grid of hot dipped galvanized steel sections (galvanizing @120 grams per sqm including both side) consisting of main 't' runner suitably spaced at joints to get required length and size of 24x38mm made from 0.30 mm thick (minimum) sheet, 1200mm centre to centre, and cross 'T' of size 24x28mm made out of 0.33mm (Minimum) sheet spaced 1200mm along space etc. An additional 4mm thick PVC strip of 40mm width is to be stuck on the interior side of the C channel using PVC solvent adhesive complete as per direction of Engineer in charge, manufactures at the back side so that 'L' shape outer PVC beading can be removed when required for replacement of broken glass etc. Complete as per direction of etc. Complete as per direction of Engineer in charge and manufacture's specification. Installation with 25mm long dry wall screws @ 230mm interval and laying 15mm thick Densified edges light weight calcium silicate ceiling tiles of approved texture (Fine Fissured /Cosmos /Spintone) in the grid including, cutting /making opening for services like diffusers, grills, light fittings, fixtures, smoke detectors etc., wherever required, Main 'T' runners to be suspended from ceiling using G.I. slotted cleats of size 25X35X1.6mm fixed to ceiling with 12.5mm dia and 50mm long dash fasteners, 4mm G.I. adjustable rods with galvanized steel level clips of size 85X30X0.8mm, spaced at 1200mm centre to centre long main 't' bottom exposed with 24mm of all T-sections shall be pre-painted with polyester baked paint, for all heights, as per specifications, drawings and as directed by engineer-in charge. Note:- Only calcium silicate false ceiling area will be measured from wall to wall. No deduction shall be made for exposed frames/opening (cut outs) having area less than 0.30 sqm. The calcium silicate ceiling tiles shall have NRC. Value of 0.50 (Minimum) for Fine fissured/Spintone/Cosmos and 0.75 NRC for Globe, light reflection 85% non-combustible as per B.S. 476 part IV, 100% humidity resistance and also having thermal conductivity. 0.043° w/m KC. for the best thermal Insulation

Workmanship**26.16 ECO FRIENDLY LIGHT WEIGHT CALCIUM SILICATE FALSE CEILING (TEGULAR EDGED) 26.16.1 Materials**

26.16.1.1 Tiles Eco friendly light weight calcium silicate tiles shall be made from Non-cementitious hydrated wet moulded calcium silicate slurry/mixture, reinforced with fibers and natural fillers. Free from formaldehyde and other harmful materials. Does not contain any toxic ingredients. Shall have appropriate recycled material contents. The Ceiling Tiles shall be of appropriate class and of finished thickness as specified in the description of the item .Only selected tiles of uniform width shall be used. Unless otherwise specified in the description of the item or shown in the drawings, the width of tiles selected for use shall not be less than 595 X 595 mm in size and shall be 15 mm thick integral densified tegular edged type, light weight wet moulded calcium silicate. Where width of room/ corridor is in multiple of standard width of tiles, same pattern shall be maintained throughout the length. Where the width of rooms/ corridor is not in multiple of standard width of tiles, borders with appropriate width and material of boards shall be provided in design approved by the Engineer-in-charge and maintained uniformly throughout of the length/ width of room/ corridor. Eco Friendly Light Weight Calcium silicate tiles shall have the following properties:

- Surface: All tiles are prime coated on both sides. Standard finish in two coats white dispersion type, solvent free paint.
- Dimensions: 595mmx595mmx15mm thick tegular edged. Size referred to are always module sizes. The nominal panel size may differ depending on the suspension system used.
- Thickness: 10 mm thick in the center and 15mm thick all around on edge resting portion with integral densified edge.
- Density of material: 350 kg per cum in the central 10 mm thick portion and 450 kg cum on the edges, (Average 370 kg per cum as per ECBC Code 2007).
- Relative humidity: 100% RH resistant.
- Fire resistance: Non-combustible as per BS:476 Part-4. Fire performance: as per BS:476 (Part-6) for fire propagation and BS 476 (Part 7) for Surface spread of flame.

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(g) Thermal conductivity: 0.048 W/m- K - 0.052 W/m- K as per ECBC Code 2007 and ASTM 518-1991. (h) Recycled Content: Shall have 46-50% recycled content out of which 18-20% should be FLYASH.

(i) Acoustic control: Sound Attenuation 30-32db Noise reduction coefficient (NRC) Plain & Designer tile: 0.10-0.15. For Pin Hole/Texture pattern tiles: 0.20-0.30. Pin hole/Texture fully perforated tile: 0.30-0.40. For 5mm fully perforated 0.40-0.50. For 5mm fully perforated with 50mm/48gsm glass wool 0.65-0.85.

(j) Light reflectance: >85%.

(k) Weight: 5 - 5.5Kg/m².

(l) Suspension system: Suspension system shall be made of roll-formed hot-dipped galvanized steel.

26.16.1.2 Frame

Frame is made up of interlocking metal T-grid of hot dipped galvanized steel sections of 0.33mm thick (Galvanized @ 120 gms/m² including all sides) comprising of main T runners of size 24 x 38mm of length 3000mm, cross T of size 24 x 32 mm of length 1200mm and secondary intermediate cross T of size 24 x 32mm of length 600mm to form grid modules of size 600 x 600mm. This grid shall be suspended from ceiling using galvanized mild steel members (Galvanized @ 80 gms/m² including all sides) i.e. 12x50mm long dash fasteners, 6mm dia fully threaded hanger rod upto 1000 mm length and L-shaped level adjuster of size 76 x 25 x 25x 1.6mm fixed with grid and Z cleat of size 25x37x25x1.6mm thick with precut hole on both 25mm flange to pierce into 12x50mm or even bigger dash fastener if require. Frame also consist of galvanized iron perimeter wall angle of size 24 x 24 x 0.40mm of length 3000mm to be fixed on periphery wall/ partition with the help of plastic rawl plugs at 450mm centre to centre and 40mm long dry wall SS screws. The bottom surface of the frame shall be checked and corrected to true plans and slopes.

26.16.2 Fixing

Outer wall angle shall be fixed accurately and truly at required height and level, parallel and close to the wall. Thereafter all the T members shall be placed and fixed carefully to form the grid. The grid comprises of main T-runners at 1200mm centres securely fixed to the structural soffit by approved and adjustable hanger rods at 1200mm maximum centres and not more than 150mm from spliced joints of main T-runners. The last hanger at the end of each runner should not be greater than 600mm from the adjacent wall. Similarly, cross T-runners of 1200mm length shall be placed at 600mm centre to centre. 600x600mm modules to be formed by fitting 600mm long flush fitting cross Tees (secondary cross T) centrally between 1200mm cross T-runners. The tiles shall then be placed properly in the grids as per required pattern, texture and design/ drawing and as per directions of the Engineer-in-Charge. If required, level of the false ceiling grid shall be checked after placing of calcium silicate tiles and necessary adjustment shall be made wherever required through level adjuster.

26.16.3 Precaution:

(a) All wet trades such as plastering, conduiting and painting etc, be completed prior to start of false ceiling works.

(b) Air conditioning duct work is to be completed preferably even before the suspension of the grid section.

(c) Electrical chasing or drawing lines & cables, etc are to be in place before start of false ceiling work.

(d) No unauthorized weight is put on false ceiling. Lighting fixtures, diffusers are to be suspended independently with proper chain/wire & dash fasteners as directed by Engineer In Charge/ manufacturer guide line.

(e) The area is dry prior to ceiling installation work.

26.16.4 Finishing

Care should be taken while placing Light Weight calcium silicate tiles into the grid so that there will be no displacement to grid and stains/ dirty marks put by the workers. (worker should preferably wear clean soft cotton gloves while placing tile).

26.16.5 Measurements

Length and breadth shall be measured correct to a cm. Areas shall be worked out to nearest 0.01sqm. The superficial area of the finished work ceiling shall be measured in square meters. No deduction in measurements shall be made for openings of areas upto 0.36 Sqm. Nothing extra shall be payable either for any extra material or labour involved in forming such openings. For openings exceeding 0.36 sqm in area, deductions in measurements for the full opening in multiple of area of each tile (0.36 Sqm) will be made.

26.16.6 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above. The rate shall be for a unit of sqm.

26.16.7 MTC:

Manufacturers test certificate/ report of invoice to be submitted for every delivery challan by suppliers.

Item no. 80.

Wall and Ceiling Cladding Using EGP Steel Sheet Panels backed with Gypsum Board and Jointless Finish with Anti Fungal & Anti Bacterial paint prefabricated Walls & Ceiling Precisely pre-fabricated wall & ceiling cladding using Steel Sheet of approx 1.6 mm with EGP of approx 300 microns. Wall sloping & ceiling panels backed by 12mm thick gypsum plaster board to provide strength to withstand jerks and avoid damage.

1. ****Material and Workmanship**

Wall and Ceiling shall be Precisely Pre-fabricated Approximately 1.6 mm thick EGP (Electro-Galvanized Painted) steel sheets Panels with EGP Coating Approximately 300 microns thickness. Backing Material shall be 12mm thick Gypsum Board, The gypsum board will be provide structural support to the steel panels, making the cladding robust enough to withstand jerks and prevent damage. The cladding system will be aesthetically jointless. paint will be Anti-Fungal & Anti-Bacterial Paint.

Mode of Measurement & Payment

The rate shall be for a unit of sqm

Item no. 81.

Providing corrugated G.S. sheet roofing including vertical / curved surface fixed with polymer coated J or L hooks, bolts and nuts 8 mm diameter with bitumen and G.I. limpet washers or with G.I. limpet washers filled with white lead, including a coat of approved steel primer and two coats of approved paint on overlapping of sheets complete (up to any pitch in horizontal/ vertical or curved surfaces), excluding the cost of purlins, rafters and trusses and including cutting to size and shape wherever required. 12.1.1) 1.00 mm thick with zinc coating not less than 275 gm/m² Providing ridges or hips of width 60 cm overall width plain G.S. sheet fixed with polymer coated J or L hooks, bolts and nuts 8 mm dia G.I. limpet and bitumen washers complete.

Material & Workmanship

C.G.S. Sheets

These shall be of the thickness specified in the description of the item and shall conform to IS 277. The sheets shall be of 275 grade of coating (See Appendix-A) unless otherwise specified in the description of item.

The sheets shall be free from cracks, split edges, twists, surface flaws etc. They shall be clean, bright and smooth. The galvanising shall be non-injured and in perfect condition. The sheets shall not show signs of rust or white powdery deposits on the surface. The corrugations shall be uniform in depth and pitch and parallel with the side.

12.1.2 Purlins Purlins of the specified material or M.S. rolled sections of requisite size shall be fixed over the principal rafters. These shall not be spaced at more than the following distances.

The top surfaces of the purlins shall be uniform and plane. They shall be painted before fixing on top. Embedded portions of wooden purlins shall be coal tarred with two coats.

12.1.3 Slope Roof shall not be pitched at a flatter slope than 1 vertical to 5 horizontal. The normal pitch adopted shall usually be 1 vertical to 3 horizontal.

12.1.4 Laying and Fixing

12. 1.4.1 The sheets shall be laid and fixed in the manner described below, unless otherwise shown in the working drawings or directed by the Engineer-in-Charge.

12.1.4.2 The sheets shall be laid on the purlins to a true plane, with the lines of corrugations parallel or normal to the sides of the area to be covered unless otherwise required as in special shaped roofs.

12.1.4.3 The sheets shall be laid with a minimum lap of 15 cm at the ends and 2 ridges of corrugations at each side. The above minimum end lap of 15 cm shall apply to slopes of 1 vertical to 2 horizontal and steeper slopes. For flatter slopes the minimum permissible end lap shall be 20 cm. The minimum lap of sheets with ridge, hip and valley shall be 20 cm measured at right angles to the line of the ridge, hip and valley respectively. These sheets shall be cut to suit the dimensions or shapes of the roof, either along their length or their width or in a slant across their lines of corrugations at hips and valleys. They shall be cut carefully with a straight edge chisel to give a smooth and straight finish.

12.1.4.4 Lapping in C.G.S. sheets shall be painted with a coat of approved steel primer and two coats of painting with approved paint suitable for G.S. sheet, before the sheets are fixed in place.

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12.1.4.5 Sheets shall not generally be fixed into gables and parapets. They shall be bent up along their side edges close to the wall and the junction shall be protected by suitable flashing or by a projecting drip course, the later to cover the junction by at least 7.5 cm.

12.1.4.6 The laying operation shall include all scaffolding work involved.

12.1.4.7 Sheets shall be fixed to the purlins or other roof members such as hip or valley rafters etc. With galvanised J or L hook bolts and nuts, 8 mm diameter, with bitumen and G.I. limpet washers or with a limpet washer filled with white lead as directed by the Engineer-in-Charge. While J hooks are used for fixing sheets on angle iron purlins, and L hooks are used for fixing the sheet to R.S. joists, timber or precast concrete purlins. The length of the hook bolt shall be varied to suit the particular requirements.

The bolts shall be sufficiently long so that after fixing they project above the top of the nuts by not less than 10 mm. The grip of J or L hook bolt on the side of the purlin shall not be less than 25 mm. There shall be a minimum of three hook bolts placed at the ridges of corrugations in each sheet on every purlin and their spacing shall not exceed 30 cm. Coach screws shall not be used for fixing sheets to purlins.

12.1.4.8 The galvanised coating on J or L hooks, and bolts shall be continuous and free from defects such as blisters, flux stains, drops, excessive projections or other imperfections which would impair serviceability. The galvanised coating should conform to IS 1367 (Pt. XIII) The mass of coating per square meter of the surface shall be as under

12.1.4.9 Where slopes of roofs are less than 21.5 degrees (1 vertical to 2.5 horizontal) sheets shall be joined together at the side laps by galvanised iron bolts and nuts 25 x 6 mm size, each bolt provided with a bitumen and a G.I. limpet washer or a G.I. limpet washer filled with white lead. As the overlap at the sides extends to two corrugations, these bolts shall be placed zig-zag over the two overlapping corrugations, so that the ends of the overlapping sheets shall be drawn tightly to each other. The spacing of these seam bolts shall not exceed 60 cm along each of the staggered rows. Holes for all bolts shall be drilled and not punched in the ridges of the corrugations from the underside, while the sheets are on the ground.

12.1.5 Wind Tie Wind ties shall be of 40 x 6 mm flat iron section or of other size as specified. These shall be fixed at the eaves of the sheets. The fixing shall be done with the same hook bolts which secure the sheets to the purlins. The ties shall be paid for separately unless described in the item of roofing.

12.1.6 Finish The roof when completed shall be true to lines, and slopes and shall be leak proof.

12.1.7 Measurements

12.1.7.1 The length and breadth shall be measured correct to a cm. Area shall be worked out in sqm correct to two places of decimal.

12.1.7.2 The superficial area of roof covering shall be measured on the flat without allowance for laps and corrugations. Portion of roof covering overlapping the ridge or hip etc. Shall be included in the measurements of the roof.

12.1.7.3 Roof with curved sheets shall be measured and paid for separately. Measurements shall be taken on the flat and not girthed.

12.1.7.4 No deduction in measurement shall be made for opening upto 0.4 sqm and nothing extra shall be allowed for forming such openings. For any opening exceeding 0.4 sqm in area, deduction in measurements for the full opening shall be made and in such cases the labour involved in making these openings shall be paid for separately. Cutting across corrugation shall be measured on the flat and not girthed. No additions shall be made for laps cut through.

12.1.8 Rate The rate shall include the cost of all the materials and labour involved in all the operations described above including a coat of approved steel primer and two coats of approved steel paint on overlapping of C.G.S. sheets. This includes the cost of roof sheets, galvanised iron J or L hooks, bolts and nuts, galvanised iron seam bolts and nuts, bituminous and galvanised iron limpet washers etc.

Mode of Measurement & Payment

The rate shall be for a unit of sqm

Item no. 82.

Providing ridges or hips of width 60 cm overall width plain G.S. sheet fixed with polymer coated J or L hooks, bolts and nuts 8 mm dia G.I. limpet and bitumen washers complete.

Material & Workmanship

2 RIDGES AND HIPS OF PLAIN GALVANISED STEEL SHEETS

12.2.1 Ridges and Hips Ridges and hips of C.G.S. roof shall be covered with ridge and hip sections of plain G.S. sheet with a minimum lap of 20 cm on either side over the C.G.S. sheets. The end laps of the ridges and hips and between ridges and hips shall also be not less than 20 cm. The ridges and hips shall be of 60 cm overall width plain G.S. sheet, 0.6 mm or 0.8 mm thick as given in the description of the item and shall be properly bent in shape

12.2.2.1 Ridges shall be fixed to the purlins below with the same 8 mm dia G.I. hook bolts and nuts and bitumen and G.I. limpet washers which fix the sheets to the purlins.

12.2.2.2 Similarly, hips shall be fixed to the roof members below such as purlins, hip and valley rafters with the same 8 mm dia G.I. hook bolts and nuts and bitumen and G.I. limpet washers which fix the sheets to those roof members. At least one of the fixing bolts shall pass through the end laps of ridges and hips, on either side. If this is not possible extra hook bolts shall be provided.

12.2.2.3 The end laps of ridges and hips shall be joined together with C.G.S. sheet by galvanised iron seam bolts 25 x 6 mm size each with a bitumen and G.I. washer or white lead as directed by the Engineer-in-Charge. There shall be at least two such bolts in each end lap.

12.2.2.4 Surface of C.G.I. sheets of ridge and hip sections and the roofing sheets which overlap each other shall be painted with a coat of approved primer and two coats of approved paint suitable for painting G.S. Sheets before they are fixed in place.

12.2.3 Finish The edges of the ridges and hips shall be straight from end to end and their surfaces should be plane and parallel to the general plane of the roof. The ridges and hips shall fit in squarely on the sheets.

12.2.4 Measurement The measurements shall be taken for the finished work in length along the centre line of ridge or hip, as the case may be, correct to a cm. The laps in ridges and hips and between ridges and hips shall not be measured.

12.2.5 Rate The rate shall include the cost of all labour and materials specified above, including painting, cost of seam bolts and any extra G.I. hook bolts, nuts and washers, required.

Mode of Measurement & Payment

The rate shall be for a unit of metre

Item no. 83. Providing 10 mm thick Cement Plaster in single coat on brick/concrete Ceiling for interior plastering finished even and smooth in(i) Cement mortar 1:3 (1-cement :3- sand) as required to receive specified architectural finish (like Grooves, pattern if any, drip mould etc.) To correct line, plumb .etc - **basement Floor**

1.0. Materials

1.1. Water shall conform to M-1. The cement mortar of proportion 1:3 shall conform to M-13.

2.0. Workmanship

2.1. Scaffolding:

Wooden bullies, bamboos, planks, trestles and other scaffolding shall be sound. These shall be properly examined before erection and use. Stage scaffolding shall be provided for ceiling plaster which shall be independent of the walls.

2.2. Preparation of back-ground:

2.2.1. The surface shall be cleaned of all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing. Smooth surface shall be toughened by wire brushing if it is not hard and by hacking if it is hard. In case of concrete surface, if a chemical retarded has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the readers if left on the surface. Trimming of projections on brick/concrete surfaces where necessary shall be carried out to get an even surface.

2.2.2. Raking of joints in case of masonry where necessary shall be allowed to dry out for sufficient period before carrying out the plasterwork.

2.2.3. The work shall not be soaked but only damped evenly before applying the plaster. If the surface becomes dry, such area shall be moistened again.

2.2.4. For external plaster, the plastering operation shall be started from top floor and carried downwards. For internal plaster, the plastering operations may be started wherever the building frame and cladding work are ready and the temporary supports of the ceiling resting on the wall of the floor have been removed. Ceiling plaster shall be completed before starting plaster towards.

2.3. Application of plaster:

2.3.1. The plaster about 15x15 cms. Shall be first applied horizontally and vertically at not more than 2 meters intervals over the entire surface to serve as gauge. The surfaces of these gauges shall be truly in plane of the finished plastered surface. The mortar shall then be applied in uniform surface slightly more than the specified thickness, then brought to a true surface by working a wooden straight edge reaching across the gauges with small upward and sideways movements at a time. Finally, the surface shall be finished off true with a trowel or wooden float according as a smooth or a smooth or a sandy granular texture is required. Excessive troweling or overworking the float shall be avoided. All corners, arises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Hounding or chamfering, corners, arises junctions etc. Shall be carried out with proper templates to be size required.

2.3.2. Cement plaster shall be used within half an hour after addition of water. And mortar or plaster which is partially set shall be rejected and removed forthwith from the site.

2.3.3. In suspending the work at the end of the day, the plaster shall be left out clean to the line both horizontally and vertically, when recommencing the plaster, the edges of the old work shall be scraped clean and wetted with cement putty before plaster is applied to the adjacent areas to enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of the wall and nearer than 15 cm. To any corners or arises. It shall not be closed on the body of features such as plaster bands and cornices not at the corners or arises. Horizontal joints in plaster work shall not also occur on parapet tops and copings as these invariably lead to leakage. No portion of the surface shall be left out initially to be packed up later on.

2.3.4. Each coat shall be kept damp continuously till the next coat is applied or for a minimum period of 7 days. Moistening shall commence as soon as plaster is hardened sufficiently. Soaking of walls shall be avoided and only as much water as can be readily absorbed shall be used, excessive evaporation on the sunny or windward side of building in hot air or dry weather shall be prevented by hanging matting or gunny bags on the outside of the plaster and keeping them wet.

3.0. Mode of measurements & payment

3.1. The rate shall include the cost of all materials, labour and scaffolding etc. Involved in the operations described under workmanship.

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3.2. All plastering shall be measured in square meters unless otherwise specified. Length breadth or height shall be measured correct to a centimeter.

3.3. Thickness of the plaster shall be exclusive of the thickness of the key i.e. Grooves or open joints in brick work, stone work etc. Or space between laths. Thickness of plaster shall be average thickness with minimum 10 mm. At any point on this surface.

3.4. This item includes plastering up to floor two level.

3.5. The measurement of wall plastering shall be taken between the walls or partition (dimensions before plastering being taken) for length and from the top of floor or skirting to ceiling for height. Depth of cover of cornices if any shall be deducted.

3.6. Soffits of stairs shall be measured as plastering on ceilings, following soffits shall be measured separately.

3.7. For jambs, soffits, sills etc. For openings not exceeding 0.5 sq. Met each in area for ends of joints beams, posts, girders, steps etc. Not exceeding 0.5 sq. Mt each in area and for openings exceeding 0.5 Sq. Mt and not exceeding 3.00 sq. Mt. In each area deductions and additions shall be made in the following manners.

(a) No deductions shall be made for ends of joints, beams, post etc. and openings not exceeding 0.5 sq. Mt each and no addition shall be made for reveals, jambs, soffits, sills etc. Of these openings, for finish to plaster around ends of joints, beams posts etc.

(b) Deduction for openings exceeding 0.5 sq. Mt but not exceeding 3 sq.mt. Each shall be made as follows and no addition shall be made for reveals, jambs, soffits, sills etc. Of these openings, (i) When both faces of all wall are plastered with same plaster, deduction shall be made for one face only, (ii) When two faces of wall are plastered with different types of plasters or if one face is plastered and the other pointed, deductions shall be made from the plaster or pointing on the side of frame for door, window etc. On which width of reveals is less than that on the other side but no deductions shall be made on the other side. Where width of reveals on both faces of all are equal, deductions of 50% of area of opening on each face shall be made from areas of plaster and / or pointing as the case maybe.

3.8. For openings having door frames equal to or projecting beyond the thickness of wall, full deduction for opening shall be made from each plastered face of the wall.

The Location, type of component of wall/ceiling and levels shall be followed as per boq item. Including Grooves, pattern if any, drip mould etc and no extra payment will be applicable.

3.9. The case of openings of area above 3 sq. Mt. Each, deduction shall be made for openings but jambs, soffits and sills shall be measured.

The rate shall be for a unit of One sq. meter.

Item no. 84.

Providing 10 mm thick Cement Plaster in single coat on brick/concrete Ceiling for interior plastering finished even and smooth in (i) Cement mortar 1:3 (1-cement :3- sand) as required to receive specified architectural finish (like Grooves, pattern if any, drip mould etc.) To correct line, plumb .etc - **Ground Floor**

Workmanship

The relevant specifications of item No. 83 shall be followed.

Mode of Measurement & Payment

The relevant specifications of item No. 83 shall be followed:

Item no. 85.

Providing 10 mm thick Cement Plaster in single coat on brick/concrete Ceiling for interior plastering finished even and smooth in (i) Cement mortar 1:3 (1-cement :3- sand) as required to receive specified architectural finish (like Grooves, pattern if any, drip mould etc.) To correct line, plumb .etc - **first Floor**

Workmanship

The relevant specifications of item No.83 shall be followed.

Mode of Measurement & Payment

The relevant specifications of item No. 83 shall be followed:

Item no. 86.

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Providing 10 mm thick Cement Plaster in single coat on brick/concrete Ceiling for interior plastering finished even and smooth in(i) Cement mortar 1:3 (1-cement :3- sand) as required to receive specified architectural finish (like Grooves, pattern if any, drip mould etc.) To correct line, plumb .etc – 2nd Floor

Workmanship

The relevant specifications of item No.83 shall be followed.

Mode of Measurement &Payment

The relevant specifications of item No. 83 shall be followed:

Item no. 87.

RA

Providing 10 mm thick Cement Plaster in single coat on brick/concrete Ceiling for interior plastering finished even and smooth in(i) Cement mortar 1:3 (1-cement :3- sand) as required to receive specified architectural finish (like Grooves, pattern if any, drip mould etc.) To correct line, plumb .etc - Terrace Floor

Workmanship

The relevant specifications of item No. 83 shall be followed.

Mode of Measurement &Payment

The relevant specifications of item No. 83 shall be followed:

Item no. 88.

Providing 15 mm thick Cement Plaster in single coat on brick/concrete wall/ for interior plastering finished even and smooth in(i) Cement mortar 1:4 (1-cement :4- sand) as required to receive specified architectural finish (like Grooves, pattern if any, drip mould etc.) To correct line, plumb .etc – Basement Floor

1.0. Materials &workmanship

1.1. The relevant specifications of item No. 83 shall be followed except that the proportion of mortar is C.M. 1 :4 instead of C.M.1:3.and thickness 15mm instead of 10mm.

2.0. Mode of measurements &payment

2.1. The mode of measurements and payment shall be the same as for item No. 83

2.2. The rate shall be for a unit of One sq.meter.

Item no. 89.

Providing 15 mm thick Cement Plaster in single coat on brick/concrete wall/ for interior plastering finished even and smooth in(i) Cement mortar 1:4 (1-cement :4- sand) as required to receive specified architectural finish (like Grooves, pattern if any, drip mould etc.) To correct line, plumb .etc - Ground Floor

Workmanship

The relevant specifications of item No.88 shall be followed.

Mode of Measurement &Payment

The relevant specifications of item No. 88 shall be followed:

Item no. 90.

Providing 15 mm thick Cement Plaster in single coat on brick/concrete wall/ for interior plastering finished even and smooth in(i) Cement mortar 1:4 (1-cement :4- sand) as required to receive specified architectural finish (like Grooves, pattern if any, drip mould etc.) To correct line, plumb .etc - First Floor

Workmanship

The relevant specifications of item No.88 shall be followed.

Mode of Measurement &Payment

The relevant specifications of item No.88 shall be followed:

Item no. 91.

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Providing 15 mm thick Cement Plaster in single coat on brick/concrete wall/ for interior plastering finished even and smooth in(i) Cement mortar 1:4 (1-cement :4- sand) as required to receive specified architectural finish (like Grooves, pattern if any, drip mould etc.) To correct line, plumb etc – 2nd Floor

Workmanship

The relevant specifications of item No.88 shall be followed.

Mode of Measurement &Payment

The relevant specifications of item No. 88 shall be followed:

Item no. 92.

Providing 15 mm thick Cement Plaster in single coat on brick/concrete wall/ for interior plastering finished even and smooth in(i) Cement mortar 1:4 (1-cement :4- sand) as required to receive specified architectural finish (like Grooves, pattern if any, drip mould etc.) To correct line, plumb etc – 3rd Floor

Workmanship

The relevant specifications of item No.88 shall be followed.

Mode of Measurement &Payment

The relevant specifications of item No. 88 shall be followed:

Item no. 93.

20mm thick Double coat Sand Faced / Mala cement plaster on Exterior walls at for various floors, levels and height as below and shown in the drawing consisting of 12mm thick backing coat of C.M. 1:3 (1-cement :3-sand) and 8mm thick finishing coat of C.M. 1:2 (1-cement :2-sand) etc. Complete. As required to receive specified architectural finish like Vata, Grooves, pattern if any, drip mould etc. To correct line, level and plumb .

1.0. Materials

1.1. Water shall conform to M-1. Cement mortar shall conform tom-11.

2.0. Workmanship

2.1. The work shall be carried out in the coats. The backing coat (base coat) shall be 12 mm. Thick in C.M. 1:3. The relevant specifications of item No. 83 shall be followed except that the thickness of back coat shall be 12 mm. Average. Before the first coat hardens its surface shall be beaten up by edges of wooden tapers and close dents shall be made on the surface. The subsequent coat shall be applied after this coat has been allowed to set for 3 to 5 days, depending upon the weather conditions. The surface shall not be allowed to dry during this period.

2.2. The second coat shall be completed to 8 mm. Thickness in C.M. 1:2 as described above, including raising sand facing by bushing. The sample of sand face shall be got approved before the work is started. The whole work shall be carried out uniformly as per sample approved.

2.3. Curing:

The curing shall be started overnight after finishing of plaster. The plaster shall be kept wet for a period of 7 days. During this period, it shall be protected from all damages.

3.0. Mode of measurement &payment

3.1. The relevant specifications of item No. 83 shall be followed except that the sand face plaster on outside up to 10 m. Above ground level shall be measured under this item.

The rate shall be for a unit of One sq.meter.

Item no. 94.

Providing 20mm thick cement plaster in single coat on single wall for basement wall/ under plinth exterior surface in cement mortar 1:3 (1cement: 3sand) including providing and mixing water proofing material in cement mortar work in doses by weight of cement as per manufacturer specifications

1.0. Materials &workmanship

1.1. The relevant specifications of item No. 83 shall be followed except that the thickness of cement plaster shall be 20 mm. The plastering work shall be in single coat on rough side of half brick wall for interior plastering up to floor two level, finished even and smooth in C.M.1:3.

2.0. Mode of measurements &payment

2.1. The relevant specifications of item No. 83 shall be followed.

The rate shall be for a unit of One sq.meter.

Item no. 95.

Registrar

Sign and Seal of contractor

Page: 89

Applying two coats of putty & two coats of primer of approved brand and manufacture on new wall surface to give an even shade including thoroughly brushing the surface free from mortar dropping and other foreign matter and sand papered smooth.

1.0. Materials

1.1. Putty and primer shall be of approved brand and manufacture. The Putty and primer shall conform to I.S. :428-1969.

2.0. Workmanship

2.1. Scaffolding

Where scaffolding is required, it shall be erected in such a way that as far as possible no pail of scaffolding shall rest against the surface. A properly secured and well tied suspended platform (Joola) may be used. Where ladders are used, pieces of old gunny bags shall be tied at top and bottom to prevent scratches to the walls and floors. , proper stage scaffolding shall be erected where necessary.

2.2. Preparation of surface:

2.2.1. The undecorated surface to be putty shall be thoroughly brushed from dust, dirt, grease, mortar dropping and other foreign matter and sand papered smooth. New plaster surface shall be allowed to dry for at least 2 months before application.

2.2.2. All unnecessary nails shall be removed. Pitting in plaster shall be made good with plaster again with a fine grade sand paper and made smooth. A coat of putty shall be applied over the patches. The surface shall be allowed to dry thoroughly before the regular coat of putty is allowed. The surface affected by moulds, moss, fungi, algae lichens, efflorescence etc. Shall be treated in accordance with I.S; 2395 (Part 01) 1966. Before applying putty, any unevenness shall be made good by applying putty made of plaster of paris mixed with water on entire surface including filling up the undulation and then sand papering the same after it is dry.

2.3. Application of putty.

2.3.1. . All loose particles shall be dusted of after rubbing. Minimum tow coats of putty shall be applied with patti s in horizontal strokes followed immediately by vertical strokes which together shall constitute one coat. The subsequent coats shall be applied after a time interval of at least 24 hours between consecutive coats to permit proper drying of the proceeding coat. The finished surface shall be even and inform without patches, brush marks,.

2.3.2. Sufficient quantity of putty shall be mixed to finish one room at a time. The application of a coat in each room shall be finished in one operation and no work shall be striated in any room which cannot be completed on the sameday.

2.3.3. Patti and troble shall be used. After day's work applicable tool and tackels shall be thoroughly washed in hot water with soap solution and hung down to dry. Old tool and tackles which are dirty and caked with putty shall not be used on the work.

2.4. Protective measurements : The surfaces of doors, windows, floors, articles of furniture etc. And such other parts of the buildings as are not to be putty shall be protected form being splashed upon. Such surfaces shall be cleaned of putty splashes if any.

2.0. Priming coat:

2.0.1. A priming coat of distemper primer of approved manufacture and shade shall be applied over the Papered surface in case of new work on undecorated surface. Primer is done after the wall surface dries completely, the primer shall be applied.

2.0.2. Application of primer shall be done as under: The primer shall be applied with a brush on the clean dry and smooth surface. Horizontal strokes shall be given first and vertical strokes shall be applied immediately afterwards. This entire operation will constitute on coat. The surface shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to dry for at least 48 hours before oil bound distemper or paint is applied.

3.0. Mode of measurements and payment

(135)

3.1. Priming coat of primer, scraping of surface spoiled by struck roots, removal of oil and grease spots, treatment for infraction of effloresces., mould moss, fungi, algae and lichen and patch repairs to plaster shall be included in this item for which nothing extra shall be paid.

3.2. All the work shall be measured net in the decimal system as in place subject to the following limits unless otherwise stated hereinafter:

(a) Dimensions shall be measured to the nearest 0.01m.

(b) Area in individual items shall be worked out to the nearest 0.01 sq. M. All work shall be made for ends of joints, beams, posts etc., and openings, not exceeding 0.5 sq.mt. Each and no addition shall be made for reveals, jambs, soffits, sills etc. Of these openings not for finish around ends of joints, beams, postsetc.

3.3. Deductions of opening exceeding 0.5 sq.m. But not exceeding 3 sq. M. Each shall be made as follows and net addition shall be made for reveals, jambs, soffits etc. Of these openings:

(a) When both the faces of wall are provided with same finish, deductions shall be made for one face only.

(b) When each face of wall is provided with different finish, deduction shall be made for that side of frame for doors, windows etc. On which width of reveals is less than that of the other side but no deduction shall be made on the other side. Where the width of reveals on the both the faces of wall are equal, deduction of 50% of area of opening on each face shall be made from area of finish.

(c) When only one face of wall is treated and the other face is not treated, full deductions shall be made if the width of the reveal on treated side is less than that on untreated side but if the width of the reveal is equal or more than that on untreated side neither deductions nor additions to be made for reveals, jambs, soffits, sills etc.

3.4. In case of opening of area exceeding 3 sq. M. Each deduction shall be made for openings but jambs, sills and soffits shall be measured.

3.5. No deductions shall be made for attachments such as casings, conduits, pipes, electric wiring and the like.

3.6. Item includes removing nails, making good holes, patches with materials similar in composition of distemper.

3.7. The rate includes cost of all materials, labours, scaffolding, protective measures etc. Involved in all the operations described above. This shall also include conveyance, delivery, handling, unloading, storing work etc

2.8. The rate shall be for a unit of one sq. Meter

Item no. 96.

Wall painting (Three coats) with plastic emulsion paint of approved brand & manufacture on under coated wall surface to give an even shade including thoroughly brushing the surface free from mortar dropping and other foreign matter and sand papered smooth.

1.0. Materials

Water shall conform M-1. The plastic emulsion shall conform to I.S.: 5411-1969 (part-I).

2.0. Workmanship

2.1. Scaffolding : Wherever scaffolding is necessary it shall be erected in such a way that as far as possible on part of scaffolding shall rest against the surface to be white or colour washed. A properly secured strong and well tied suspended platform (Zoola) may be used for white washing. Where ladders are used pieces of old gunny bags shall be tied at top and bottom to prevent scratches to the floors and walls. For white washing of ceilings, proper stage scaffolding shall be erected where necessary.

2.5. Preparation of surface:

2.5.1. The undecorated surface to be paint shall be thoroughly brushed from dust, dirt, grease, mortar dropping and other foreign matter and sand papered smooth. New plaster surface shall be allowed to dry for at least 2 months before application.

2.5.2. All unnecessary nails shall be removed. Pitting in plaster shall be made good with plaster again with a fine grade sand paper and made smooth. A coat of putty shall be applied over the patches. The surface shall be allowed to dry thoroughly before the regular coat of paint is allowed. The surface affected by moulds, moss, fungi, algae lichens, efflorescence etc. Shall be treated in accordance with I.S; 2395 (Part 01) 1966. Before applying putty, any unevenness shall be made good by applying putty made of plaster of paris mixed with water on entire surface including filling up the undulation and then sand papering the same after it is dry.

2.2. Preparation of Mix:

This shall be done as per manufacture's instructions. The thinning of emulsion is to be done with water and not with turpentine. The quantity of thinner to be added shall be as per manufacturer instructions.

2.3. Application :

2.3.1. Before pouring into small containers for use, the paint shall be stirred thoroughly in item container. When applying also, the paint shall be continuously stirred in the smaller container, so that its consistency is kept uniform.

2.3.2. The paint shall be laid on evenly and smoothly by means of crossing and laying off the crossing and consist of covering the area over with paint, brushing the surface hard for the first time over and then, brushing alternately in opposite direction two or three times and then finally brushing lightly in direction at right angles to the same. In this process, no brush Marks shall be left after the laying off is finished. No hair marks from the brush or clogging of paint puddles in the corners of panels, angles of moldings, etc. Shall be left on the work. The full process of crossing and laying off will constitute one coat.

2.3.3. The paint shall be applied with brush or rollers. For undecorated surfaces, the surface shall be treated with minimum three coats of paint. The second or subsequent coat shall not be started until the proceeding coat as become sufficiently hard to resist marking by brushing being used.

2.3.4. The surface on finishing shall present a flat velvety smooth finish. It shall be even and uniform in shade without patches, brush marks, paint drop etc.

2.4. Precautions :

(a) Old brushes if they are to be used with emulsion paints, shall be completely dried of turpentine or oil paint by washing in warm soap water. Brushes shall be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush.

(b) In the preparation of wall for plastic emulsion painting, no oil base putty shall be used in filling cracks, holes etc.

(c) Splashes on floors etc. Shall be cleaned out without delay as they will be difficult to remove after hardening.

(d) Washing or surfaces treated with emulsion paint shall not be done within 3 to 4 weeks of application

2.5. Protective payment : The relevant specifications of item No. Shall be followed.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No. Shall be followed.

3.2. The rate shall be for a unit of One sq. meter.

Item no. 97.

Painting two coats (excluding priming coat) on new steel and other metal surface with synthetic enamel paint, brushing to give an even shade including cleaning the surface of all dirt, dust and other foreign matter.

Materials

Synthetic enamel paint shall conform to I.S. 1932-1964..

2.0. Workmanship

2.1. General : The materials required for work of painting work shall be obtained directly from approved manufactures or approved dealer and brought to the site in maker's drums; kegs. Etc. With seal unbroken.

2.1.1. All materials not in actual use shall be kept properly protected, lids of containers shall be kept closed and surface of paint in open or partially open containers covered with a thin layer of turpentine to prevent formation of skin. The materials which have become state or flat due to improper and long storage shall not be used. The paint shall be stirred thoroughly in its container before pouring into small containers. While applying also, the paint shall be continuously stirred in smaller container. No left over paint shall be put back into stock tins. When not in use the containers shall be kept properly closed.

2.1.2. If for any reasons, things is necessary, the brand of thinner recommended by the manufacturer shall be used.

2.1.3. The surface to be painted shall be thoroughly cleaned and dusted. All rust, dirt and grease shall be thoroughly removed before painting is started. No painting on exterior or other exposed part of the work shall be carried out in wet, damp or otherwise unfavorable weather and all the surfaces shall be thoroughly dry before painting work is started.

2.2. Application of paint:

2.2.1. Brushing operations are to be adjusted to the spreading capacity advised by the manufacture of particular paint. The paint shall be applied evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the - laying off is finished. The full process of crossing and laying off will constitute one coat.

2.2.2. Each coat shall be allowed to dry completely and lightly rubbed with very fine grade of sand-paper and loose particles brushed off before next coat is applied. Each coat shall vary slightly in shade and shall be got approved from Engineer-in-charge before next coat is started.

2.2.3. Each coat the last shall be lightly rubbed down with sand paper of fine pumice stone and cleaned of dust before the next coat is applied. No hair marks from the brush or clogging of paint puddles in the corners of panels, angles of moldings etc. Shall be left on the work.

2.2.4. Special care shall be taken while painting over bolts, nuts, rivets, overlaps etc. Approved best quality brushes shall be used.

3.0. The new steel and other metal surface shall be measured under this item.

3.1. All the work shall be measured net in the decimal system, as executed subject to the following limits unless otherwise stated hereinafter.

(a) Dimensions shall be measured to the nearest 0.01 meter.

(b) Areas shall be worked out to the nearest 0.01 sq. meter.

3.2. No deductions shall be made for openings not exceeding 0.5 sq. Mt. Each and no addition shall be made for painting to beddings, moldings, edges, jambs, soffits, sills etc. Of such opening.

3.3. In case of fabricated structural steel and iron work, priming coat of paint shall be included with fabrication. In case of trusses if measured in sq. M. Compound girders, stanchions, lattices, grader and similar work, actual area shall be measured in sq. M. And no extra shall be paid for painting on bolts heads,

Nuts, washers etc. No addition shall be made to the weight calculated for the purpose of measurements of steel and iron works for paint applied on shop or at site.

3.4. The different surfaces shall be grouped into one general item, areas of uneven surfaces being converted into equivalent plain areas in accordance with the table given as per Annexure-II for payment.

The rate shall be for a unit of One sq.meter..

Item no. 98.

Finishing walls with textured exterior paint of required shade :New work (Two or more coats applied @ 3.28 ltr/10 sqm) over and including priming coat of exterior primer applied @ 2.20kg/10 sqm.

1.0. Materials

1.1. The water shall conform to M-1. Textured exterior paint shall conform to I.S.5410-1969.

2.0. Workmanship

2.1. Scaffolding : The relevant, specifications of item No. 96 shall be followed.

2.2. Preparation of surface:

The relevant specifications of item No. 96 shall be followed except that the word emulsion paint shall be substituted with texture exterior paint. The surface shall be thoroughly wetted with clean water before textured exterior paint is applied.

2.3. Preparation of paint: Portland cement paint shall be prepared by adding paint powder to water and stirring to obtain a thick paste, which shall then be diluted to a brush able consistency. Generally, equal volumes of paint powder and water make a satisfactory paint. In all cases, The manufacture's instructions shall Site followed. The paint shall be mixed in such quantities as can used up within an hour of mixing as otherwise the mixture will set and thickness, affecting flowing and finish. The lids of cement paint drums shall be kept tightly when not in use.

2.4. Application of Paint:

2.4.1. No painting shall be done when the paint is-likely to be exposed to a temperature of below 7⁰ c within 48 hours after application.

2.4.2. When weather conditions are such as to cause be carried out in the shadow as far as possible. This helps the proper hardening of the paint film by keeping the surface moist for a longer period.

2.4.3. To maintain the uniform mixture and to prevent segregation, the paint shall be stirred frequently in the bucket.

2.4.4. For undecorated surfaces, the surface shall be treated with minimum two coats of texture exterior paint. Not less than 24 hours shall be allowed between two coats. Next coat shall not be started until the proceeding coat has become sufficiently hard to resist marking by the brush being used. !N hot dry weather, the proceeding coat shall be slightly moistened before applying the subsequent coat.

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2.4.5. The finished surface shall be even and uniform in shade, without patches, brush marks, paint dropsetc.

2.4.6. The cement paint shall be applied with a brush with relatively short stiff hog or fiber bristles. The paint shall be brushed in uniform thickness and shall be free from excessively heavy brush marks. The lamps shall be brushed out.

2.4.7. Texture exterior paint shall not be applied on surface already treated with white wash, colour wash, distemper dry or oil bound varnishes, paint etc. It shall not be applied on gypsum, wood and metal surfaces.

2.5. Curing : Painted surfaces shall be sprinkled with water two or three times a day. This shall be done between coats and for at least two days following the final coat. The curing shall be started as soon as the paint has hardened so as not to be damaged by the sprinkling of water say about 12 hours after the application.

2.6. Protection measures shall be taken as per item No. 96.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No. 96. Shall be followed.
The rate shall be for a unit of One sq.meter.

Item no.99

Terracotta tiles 20 mm thickness Maximum Length: 1500 mm, Height: 500 mm. The tiles would be back ventilated, with selfdraining open joint system. Tiles shall be double-leaf construction and have labyrinth top and bottom returns to prevent easy water access behind tiles. Water absorption to be in between 3% to 6% conforming to ISO 10545 - 3, average bending tensile strength of tile ≥ 18 mm shall be ≥ 4500 N conforming to ISO 10545-4, Freeze / Thaw resistance conforming to ISO 10545-12, Chemical resistance conforming to ISO 10545-13, Modulus of rupture shall be ≥ 16 mpa conforming to ISO 10545-4, resistance to thermal shock shall be conforming to ISO 10545-9, Chemical resistance shall be no less than ULB level conforming to ISO 10545-13, Resistance to stains shall be conforming to ISO 10545-14. The tiles shall be of approved Colour and finish. The tolerance allowed in length is ± 1 mm, height of front side is ± 2 mm, height of back side is $+2$ mm & -3 mm, thickness is ± 1.5 mm, straightness of side is ± 2 mm, vertical flatness is ± 2 mm, diagonal flatness is ± 2 mm as per ISO 10545-2. Aluminum support system: The support system consists of extruded Anodized Aluminum vertical Full T- & Half T Tracks of Alloy 6063T5. The dimension of T Tracks would be 102x53x2 mm and maximum length of 5000 mm. A vertical black PVC gasket (max. Length 5000 mm) would be slide on the T-Track between two tiles at vertical joint for proper alignment and extra support. The T-Track is to be mounted on extruded anodized Aluminum dead-load and wind load Wall Bracket of Alloy 6063T5. The dimension of it would be 100/120 X 70/90 X 50 X 4 mm. The extruded Aluminum Clips of Alloy 6063T5 and thickness 2mm would be fastened on the prepunched T Track on which the Terracotta tiles are to be mounted. The vertical aluminum T-tracks with gaskets and tile clips shall serve to hold Terracotta Pure Natural Clay tiles. The Clay tiles will be resting on a double bulb rubber gasket fixed to the Aluminum extrusion clips to enable the tiles to have expansion contraction movement. System is designed to accommodate thermal movement. Terracotta tiles shall be removable, without breakage or disruption to adjacent tiles. The clips shall be concealed. Fastening devices: stainless steel screws, anchor fasteners, nut & bolts all complete. The basic design of the aluminum support system for TILES must be based upon the open ventilated facade principle. Building components must be designed to accommodate imposed loads from the aluminum support system and terra cotta tile. Building components must be designed so their deflection under imposed loading will not cause deflection of aluminum support system of exceed specified tolerances. Terracotta Cladding

Material & Workmanship

Terracotta Tiles shall be Dimensions Thickness: 20 mm, Maximum Length: 1500 mm, Maximum Height: 500 mm and will be Water absorption: 3% to 6% (conforming to ISO 10545-3), Average bending tensile strength ≥ 4500 N (conforming to ISO 10545-4) Freeze/Thaw resistance (conforming to ISO 10545-12), Modulus of rupture ≥ 16 mpa (conforming to ISO 10545-4), Resistance to thermal shock (conforming to ISO 10545-9), Chemical resistance (conforming to ISO 10545-13) and Resistance to stains (conforming to ISO 10545-14) Frame shall be Extruded Anodized Aluminum and its components will be Vertical Full T-Tracks and Half T-Tracks (Alloy 6063T5), dimensions 102x53x2 mm, maximum length 5000 mm, Dead-load and wind load Wall Brackets (Alloy 6063T5), dimensions 100/120 x 70/90 x 50 x 4 mm and Aluminum Clips (Alloy 6063T5), thickness 2 mm and Vertical black PVC gaskets (maximum length 5000 mm) for alignment and support between tiles at vertical joint and Double bulb rubber gaskets fixed to aluminum extrusion clips to accommodate thermal movement of tile, this system include stainless steel screws, anchor fasteners, nut & bolts no extra cost Payble.

Mode of Measurement & Payment

The rate shall be for a unit of sqm.

Item no.100

.Providing and fixing of Anodised Aluminium (Matt finish) frame work as per IS 1868 (1996) (Horizontal and verticals, Styles and rails, ball bearing) for Doors/ window/ventilation/aluminum partition with required Domal sections including fixing all items and hinged / pivoted arrangements for operation of shutters and labour cost for fixing of door fittings and locks including all items and contingencies described above complete (Aluminium beadings and glazing clips & section measured under this item only) NOTE : All fitting works shall be carried out as per I.S. specifications including cost of necessary welds, screws, lugs, scaffolding, rubber gaskets etc., complete all generally as per drawings. The sizes of the components should confirm as per details in drawings. Providing and fixing at all heights / in all floors with all leads. Colour Anodised Aluminium doors / windows / partitions manufactured from best extruded Aluminium sections confirming to ISI cut to length, joints mitred and corners grinded with joints water proof the outer frame and shutter frame stiffened with corner angle and strips provided for in the frame for fixing the frame to R.C.C Columns / masonry/Granite Frame on sides, R.C.C lintels/Granite Frame on top and P.C.C sills or floor at bottom, the frame work fixed with standard approved fastenings all generally as per details shown in drawings and specification with all the sections pretreated for removal of any rust & scales and prevention of further rust/scale formation and coated with greasy materials for non-adherence of mortar or any other sticky materials and this coat to be removed after installations 1)Sheet metal screws, wool pile and aluminium angle corner cleat of required thickness and of full width, etc. For assembling the frame and shutter; 2)Glazing clips for receiving infill panel for Double Glazed Unit (DGU), any type of Glass, Compact Sheet, Louvers; 3) Best quality wool pile where ever shutter touches the frame; 4) Anchor fasteners for fixing the frame assembly to the RCC or Granite or masonry surfaces etc. Complete.

Note:-As per drawings and design supplied by architect and instruction given by authority and E.I.C.

25.0 STRUCTURAL GLAZING ALUMINIUM COMPOSITE PANEL**25.1 Materials (General)**

25.1.1 Materials and components used shall be of the first / superior quality and suitable for the purpose.

25.1.2 All materials shall be free from any defects that may impair the strength, functioning/ performance or appearance of the curtain wall or adjacent construction.

25.1.3 Fasteners

25.1.3.1 The type, size, alloy, quantity and spacing of all anchor fasteners and/or anchorage devices shall be as required for the specified performance standards.

25.1.3.2 Bolts, anchors and other fastening devices like screws, nuts, washers etc. Shall be of approved types as required for the strength of the connections, shall be self-locking, unless otherwise specified. These shall be of austenitic stainless steel of specified grade and shall be torque tightened, wherever required, to achieve the maximum torque tension relationship in the fasteners. Washers, nuts and all accessory items shall be of the same material as fasteners. The rivets/ nuts, bolts and washers for fixing insulation layer to the shadow box or with fire-stops (barriers)-cum-smoke seal shall be stainless steel of approved grade. Type of fasteners Grade of stainless steel Anchor fasteners Stainless steel grade 316 Screws, Nuts, Bolts, Washers Stainless steel grade 304 Rivets, toggles and the like Stainless steel grade 304

25.1.3.3 The anchor fasteners shall not be provided using PVC sleeves. Only expandable type self locking fasteners shall be provided.

25.1.4 Aluminium extrusions

25.1.4.1 In general aluminium alloy for extrusions shall be 6063 T5 or T6 grade as per B.S.1474. However, the grade and tempering specifications shall be as recommended by the supplier for each application.

25.1.4.2 All extruded aluminium sections shall be anodized in approved colour to a minimum thickness of 20 microns or shall be PVDF coil / spray coated in approved colour and shade with metallic colours to a minimum thickness of 35 microns. The colour and the finish shall be uniform and free of streaks. The aluminium sections, before coating, shall be suitably cleaned, rinsed, buffed properly and sealed and protected after anodizing / PVDF coating, till the completion of the work. 25.1.4.3 All surfaces of the aluminium sections designed to receive the sealants shall be finished properly to match the finish of the parent section as used for initial testing of sealant and aluminium surface adhesion. Further, it shall be ensured that the entire aluminium surface has adequate sealant contact and adhesion.

25.1.4.4 Sill sheets, plates and extrusions shall be visually flat under all lighting conditions.

25.1.4.5 The members of aluminium extruded sections for mullions, transoms, members of sub frames & sash frames shall be in single piece and not be splice jointed in the panel length and height. 25.1.5 Aluminium flashing

25.1.5.1 All flashings shall be made from 1.0 mm thick solid aluminium sheet transparent anodized to a minimum thickness of 10 microns. It shall be fixed using stainless steel screws dipped in weather silicone sealant.

25.1.6 Aluminium composite panels

25.1.6.1 The soffits of the canopies / walkways / entrance canopies etc., required as per the architectural drawings, shall be covered with aluminium composite panel material. The top of the canopies / walkways / entrance canopies shall be covered with zincalume sheets. The aluminium composite panel and zincalume sheets shall be bent to the required profile and fixed as per the approved shop drawings prepared on the basis of architectural drawings.

25.1.7 Brackets

25.1.7.1 The brackets shall be fixed with high degree of accuracy to achieve the elevation as per the architectural drawing. The brackets shall have suitable lengths and sections to align curtain glazing in one face, as required as per the architectural drawings. Nothing extra shall be payable on this account. The brackets shall be fabricated from M.S rolled sections / plates to have the design strength. The quality of the weld shall also be ensured as per the standards. These shall be provided corrosion protection treatment by Hot Dipped Galvanizing. The mass of the zinc coating to be not less than 610 gm. Per sqm of steel area to be galvanized. Slots of elliptical or circular shape in the brackets shall be pre-drilled / machine punched and not flame cut and it shall be done before galvanizing. The surface of the brackets shall be serrated for additional grip before galvanizing. Washers made of serrated plates of the corresponding material shall also be provided for additional grip. The directions of the serration and the slot shall be such that they allow movements as per the design requirement and at the same time prevent any movement in the other direction. Each bracket shall be fixed to the R.C.C using anchor fasteners of suitable capacities and in numbers as required as per the design requirements. The brackets shall be fixed to the structural steel members of the building using stainless steel bolts & nuts / fasteners of required capacity and in numbers as per the design requirement. The holes of the required sizes shall be pre- drilled in RCC/ structural steel for fixing anchor fasteners/ bolts etc. Nothing extra shall be payable on this account.

25.1.8 Fittings

25.1.8.1 All hardware and fittings such as patch fittings, handles, locks, stay-arms, floor springs, friction stays etc. For doors , windows and open able panels shall be heavy duty and of approved make as specified.

25.1.8.2 Hinges for open able panels shall be heavy duty top hung stainless steel friction hinges selected for specified wind load and dead loads.

25.1.8.3 All fittings and locks shall be as specified.

25.1.8.4 Each open able panel of the Curtain glazing shall be provided with the fittings as specified in item nomenclature.

25.2 SEALANTS & GASKETS

25.2.1 Selection of sealants

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25.2.1.1 The compatibility and sequence of installation for all sealants must be carefully considered in all proposals in order to ensure the required curing and performance.

25.2.1.2 Sealants must not degrade and / or fail under any or all design conditions including wind, thermal and seismic movements, exposure to water and humidity, ultraviolet exposure and / or other adverse environmental conditions.

25.2.1.3 The designations of sealant types specified herein are intended for general design guidance only.

25.2.1.4 Final selection for the sealant types shall be based on their conformity with the Performance Requirements specified herein and as per the recommendations of the sealant manufacturer. It may use sealant of equivalent grade and characteristics, manufactured by the manufacturer other than those specified herein, based on recommendations of those sealant manufacturers for specified use but with the prior approval of the Engineer-in-Charge. The contractor shall submit the documentary evidence in this regard.

25.2.1.5 All precautions shall be taken during design of structural silicone bite and also during fabrication of the curtain glazing system to prevent failure of sealant during the guarantee period of 10 years after the date of completion of work and even beyond, upto the expected service life of the curtain wall.

25.2.1.6 Sealants and gaskets shall not leach, discolour, stain or dry.

25.2.2 Structural silicone sealant

25.2.2.1 The sealant manufacturer shall design the silicone bite for the design loads as specified and likely to come during the life of the curtain glazing system for arriving at bite size of the structural silicone sealant.

25.2.2.2 The structural silicone sealant bite as designed by the sealant manufacturer and as per the approved shop drawings shall be provided.

25.2.2.3 The Structural sealant shall be two part pump-filled Silicone sealant DC 983 of Dow Corning or equivalent recommended by manufacturer. The weather silicone sealant shall be one-part Silicone sealant DC 795 of Dow Corning or equivalent of other approved brand as per the list of approved materials.

25.2.2.4 The structural sealant to be used as specified for all exposed and concealed metal to metal (including tight or butt type metal to metal assembly prior to assembly) or glass to glass shall be 2- part silicone sealant, conforming to the manufacturer's recommendations for the specific uses and performance criteria. The sealant shall be applied using two-part pump for the same. All the sealing shall be done in a clean and controlled environment as specified by the silicone sealant manufacturer.

25.2.3 Weather silicone sealant

25.2.3.1 The grade of weather silicone sealants wherever required like for concealed metal to metal, metal to glass and metal to concrete/ masonry such as embedment and lapping of flashings etc. Where elements are to be installed or embedded, the weather sealant shall be of grade 795 of Dow Corning or equivalent for the other approved brand, as per the recommendations of the sealant manufacturers. Also, the gap between the aluminum sections and the glass, if so required, shall be filled with weather sealant as specified above including providing and fixing backer rod wherever required as per the approved shop drawings. The weather silicone sealant shall be of approved colour and shade. The weather silicone sealant for fixing the butt jointed glass for the fixed partitions shall be transparent in colour DC 791 of Dow Corning or equivalent of other approved brands.

25.2.4 Compatibility

25.2.4.1 All sealants must be non-staining and compatible with adjoining sealants, backup materials, substrate materials and their respective finishes and/or applied colour coatings. Care shall be taken to ensure that two different types of sealant should not come in contact with each other unless compatibility is satisfied as per manufacturer's specifications. CPWD SPECIFICATIONS 2019 1264 25.2.5 Caulking compound

25.2.5.1 Dow Corning weather silicone sealant – 795 or equivalent as approved by the Engineer-in-charge, (of approved colour and shade to match adjacent material wherever exposed and visible) for use around frame/ flashings or between frame/flashings and RCC/ masonry surface.

25.2.6 Gaskets

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25.2.6.1 Gaskets and seals shall be of approved quality compatible with substrates, finishes and other components they are in contact with. All gaskets exposed directly on the exterior face shall be silicon gaskets, which are UV resistant. They shall not degenerate, discolour or leach on exposure to solar radiations/ rains/ pollutants etc.

25.2.6.2 Manufacturers' test Certificate shall be submitted as specified.

25.3 GLASS

25.3.1 General

25.3.1.1 All glass and glazing materials shall be as specified.

25.3.1.2 Vision and spandrel glass shall have characteristics as specified. The performance characteristics of glass panels, have to be ensured within the constraints of aesthetic requirements like colour, shade, reflectivity etc. And performance requirements like light transmission, U value, shading coefficient, relative heat gain etc. As specified. Minor variations in the characteristics of glass on superior side may be allowed, but without any extra cost to the Department on this account.

25.3.2 Installation

25.3.2.1 Install glass panels and carry out glazing work as indicated on the drawings and as specified herein.

25.3.2.2 All glass panels shall be of accurate sizes as required.

25.3.2.3 All glass panels shall have clear undamaged edges and surfaces, which are not disfigured.

25.3.2.4 Any glass panel that does not fit in the curtain glazing system shall be rejected. Therefore, all care and precautions shall be taken while procuring the glass panels from the manufacturer / processors of the glass. No claims of any kind or any hindrance shall be entertained from the contractor on this account.

25.3.2.5 Glass panels shall not be in direct contact with the aluminum framework. 25.3.3 Identification

25.3.3.1 Permanent identification marking on glass shall be accomplished by a technique selected by the manufacturer. The location of the marking shall be proposed by the Manufacturer and approved by the Engineer – in - Charge. All glass shall be delivered to site with the manufacturer's / processor's label of identification attached.

25.3.4 Selection of Glass

25.3.4.1 Each type of glass shall be obtained from only one manufacturer and preferably in one lot. 25.3.5 Insulated Glazed Units (igus) in the vision panels

25.3.5.1 Insulated glazed units shall be obtained only from approved manufacturers/ processors as per the approved list.

25.3.5.2 Insulated units shall be factory assembled, with multiple panes, hermetically sealed, separated by and sealed to spacer tubes perforated on inner exposed face forming airtight dehydrated airspace inside the insulated units. The igus shall be assembled (prepared) by the manufacturer/ processor of the glass as per the approved list, in their dedicated workshops/ factory.

25.3.6 Laminating units

25.3.6.1 The glasses shall be laminated with interlayer of Polyvinyl butyral (PVB) sheet of specified thickness

25.3.6.2 The interlayer material (PVB) shall be clear or as specified with no tendency to bubble, discolour or lose physical and mechanical properties after laminating glasses.

25.3.6.3 The laminated panels shall be free of foreign substances, air or glass pockets and shall not delaminate at edges.

25.3.7 Precaution in storing and handling glasses

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25.3.7.1 The glass manufacturer/ processor shall take necessary precautions as stated below besides any other precautions not specifically mentioned herein:

25.3.7.1.1 The reflective/ low E coating on the glass shall be protected against scratches, surface corrosion, staining and/ or any other abrasion.

25.3.7.1.2 The glasses shall not be stored without a clean inter-leaving material. Also they should not slide against each other.

25.3.7.1.3 The glass shall be protected from weld or grinding splatter.

25.3.7.1.4 The reflective/ low E coating shall be protected against contact with acids or strong alkalies. The cleaners to be used for cleaning the surface shall be as per the manufacturer's recommendations. The glass shall be protected against moisture from humidity, which can stain glass as well as coating.

25.3.7.1.5 Reflective/ low E coating shall also be protected against splashes from paints etc.

25.4 METAL COATINGS

25.4.1 Anodizing / PVDF coating

25.4.1.1 Aluminium extruded sections shall be satin finish colour anodized to minimum 20 microns thickness, as per the approved colour and shade or PVDF coil / spray coated to approved metallic colour and shade to minimum 35 microns thickness.

25.4.2 Galvanizing

25.4.2.1 The brackets for the curtain glazing system shall be hot dipped galvanized. The mass of the zinc coating to be not less than 610 gm. Per sqm of steel area to be galvanized.

25.4.3 Samples

25.4.3.1 Three samples shall be prepared, which shall define the colour and gloss of anodizing and submit them for approval.

25.4.4 Matching of finish

25.4.4.1 Wherever the same colour finish is specified for extruded aluminium sections and composite aluminium sheets. It shall be ensured that the colour of both is matched as closely as possible.

25.5 STANDARDS

25.5.1 In general, it shall be followed either of the latest Indian/ International Standards as applicable for this sub head.

25.6 DESIGN

25.6.1 Architectural drawings and specifications only indicate the required basic dimensions, and performance criteria.

25.6.2 It shall be ensured that proper structural analysis and design for various load cases and their combination. This shall include designing and proper sizing of all sections meeting structural and architectural requirements. The anchor assemblies shall meet the performance and design requirements including installation of all inserts, fasteners, clips, bracing and framework as required for the proper anchorage to the structure, unless otherwise specified.

25.6.3 Design of the curtain glazing system shall comply with all Government codes and regulations. The Contractor shall design the entire curtain glazing system for dead loads, wind loads, seismic loads, storm, air pollution, thermal stresses, building movements and consequent deflections without compromising the performance characteristic. Further, the individual members of the structural framing shall not deflect beyond permissible limits as specified. The design shall comply with the requirements of the relevant National Building Code and Indian Standard Code/ International Standards, unless specified otherwise.

25.6.4 The curtain glazing system and its elements shall not sustain permanent deformation or failure under loading equivalent to 1.5 times the design wind pressure.

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25.6.5 The specified deflections must be reduced if they are in any way detrimental to curtain glazing system and building.

25.6.7 It shall be ensured that the elevations are strictly as per the architectural drawings and that the intent of the architectural design is retained. Visual appearance shall be a key consideration for acceptance of work.

25.7 SHOP DRAWINGS

25.7.1 Submittals

25.7.1.1 The contractor shall prepare shop drawings based on approved design and submit the same to the Engineer –in-charge for approval.

25.7.1.2 The review of the shop drawings shall be limited to their conformity to the architectural and structural design concept & specifications.

25.7.1.3 No fabrication shall be taken up until the shop drawings and all other related submittals, documentation, certification, samples and the mock-up for that work have been reviewed and approved by the Engineer-in-charge.

25.7.2 Scope of shop drawings

25.7.2.1 Shop drawings shall incorporate scaled and dimensioned plans, elevations, sections and complete size details for all the works.

25.7.2.2 The shop drawings shall indicate the required dimensional profiles and modules, function, design and performance standards and in general cover all dimensions and details required to fabricate and install the curtain glazing system.

25.7.2.3 The contractor shall verify and co-ordinate the shop drawings with all applicable and interrelated trades, drawings and specifications.

25.7.2.4 All dimensions / modules, etc., shall be field checked and the drawings shall be modified, if required, based on actual measurements at site.

25.7.2.5 Details shall show and specify all metal sections, types of finishes, areas to be sealed and sealant materials, gaskets, applicable construction materials including fasteners and welds, all anchorage assemblies and components, fabrication and erection tolerances for the work.

25.7.2.6 All details shall be subject to the approval of the Engineer-in-Charge, after incorporating all the modifications suggested by the Engineer-in-Charge.

25.7.3 Section profiles

25.7.3.1 Profile adjustments, if required as per the site conditions may be allowed by the Engineer-in-Charge subject to meeting the architectural / performance requirements. However, this shall be carried out only with the written approval of the Engineer-in-charge provided that the general design and intent of the drawings and specifications are also maintained. Also, if any new / non-standard aluminium extruded section is required as per the site requirement and / or the architectural drawings for functional and / or aesthetic reasons, the contractor shall procure the same from the approved manufacturers for the aluminium sections, even if it entails preparing new die, etc. Nothing extra shall be payable on this account.

25.8 DOCUMENTATION AND CERTIFICATION

25.8.1 The manufacturer's certificate for compliance of the various components/ materials for the works (under this sub head) as per the manufacturer's specifications for the various characteristics. A copy of the manufacturer's test report for each lot of material procured and supplied for the work shall also be obtained from the respective manufacturers and submitted to the Engineer-in-Charge for the record.

25.8.1.1 Glass and glazing documentation

25.8.1.1.1 Before taking up the work, the glass manufacturer / processor shall submit written certification for the review of the Engineer-in-Charge and record, stating that all glass (properties as specified such as U value, shading coefficient, light transmission, solar factor, relative heat gain etc.) And glazing requirements (including heat strengthening/ toughening, reflective soft coating, low E coating, lamination, fabrication of igus including sealants) as per the shop drawings are recommended by them for use related to their specific applications and design parameters and that they are in conformity with the specifications.

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25.8.1.1.2 Tests shall be carried out for glass, including properties after processing, for each lot supplied, by the glass manufacturer / processor in his factory /laboratory or any other accredited laboratory and the copies of the test results shall be obtained by the contractor and submitted to the Engineer-in-Charge for the record.

25.8.1.2 Sealant Documentation

25.8.1.2.1 All sealant applications must be clearly designated on shop drawings. 25.8.1.3 Quality control documentation

25.8.1.3.1 The methodology and quality assurance statement shall be submitted for quality control procedures for the review and approval of the Engineer-in-Charge before taking up the work to ensure the design integrity and performance of the curtain glazing, aluminium composite panel cladding and aluminium work (PVDF coated).

25.8.1.3.2 The Engineer-in-Charge or his authorized representatives may visit the plant / workshop / factory to inspect material, fabrication and quality assurance procedures.

25.9 SAMPLES AND MOCK-UP AT SITE

25.9.1 Submittals The samples of the following materials together with detailed technical data / catalogues shall be submitted for review and approval of the Engineer-in-Charge along with the shop drawings..

25.9.1.1 Aluminium Composite Panel : Each type and thickness 600mmx600mm

25.9.1.2 Aluminium extrusions : Each section: 500mm long.

25.9.1.3 Glass : Each type 600 mm x 600 mm.

25.9.1.4 Gaskets, separators, glass setting blocks / spacer tape, etc : Each section or unit, backer rods, 300mm long or unit.

25.9.1.5 Bracket, fasteners and Connecting devices : Each type and size.

25.9.1.6 Finish samples : After approval of the final finish coating, the Engineer-in-Charge shall be provided with three (3) approved samples.

25.9.1.7 Ironmongery and accessories, as applicable.

25.9.1.8 Finished flashing samples

25.9.1.9 Finished samples of shadow boxes, fire stop (barrier)-cum smoke seals

25.9.1.10 Structural and weather silicone sealant

25.9.2. Mock-up at site Before the fabrication and site installation is taken up and after the approval of shop drawings by the Engineer-in-Charge, a mock-up shall be prepared of his proposed curtain glazing system for a size of panel not exceeding 6 sqm. The mock-up shall be essentially put up at site for final approval of all materials and installation details by the Engineer-in-Charge. The mock up shall not form part of the work and shall not be paid for. It shall be dismantled and taken away by the contractor at his own cost, with the prior permission of the Engineer-in-Charge. Nothing extra shall be payable on this account.

25.10 STORAGE, PROTECTION AND PROGRAMME

25.10.1 A schedule of procedure shall be submitted for inspection during installation so as to control and assure quality on the job site.

25.10.2 A detailed method statement shall be submitted for the protection of the surface of the curtain glazing, aluminium composite panel cladding and aluminium work (PVDF coated), etc during delivery and erection, with description as to when the protection can be removed. The protection paper shall be kept for a period as recommended by Engineer-in-Charge and shall be replaced with the fresh protection paper, if so required. Further, it shall not have acid content, which in any manner may affect the substrate.

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25.10.3 Delivery and Storage of Materials: All materials delivered to site shall be stored in allocated spaces where the stored materials shall not get exposed to rainwater, moisture or damage, and shall permit easy access to and handling of the materials. Materials shall be stored neatly and properly stacked.

25.10.3.1 Factory made glazing units and/or their components shall be transported, handled and stored in a manner to preclude damage of any nature.

25.10.3.2 Necessary materials, required for erection at the site shall be delivered in labeled containers by the manufacturer / supplier.

25.10.3.3 All units or components, which are cracked, bent, chipped, scratched or otherwise defective and unsuitable for installation shall be removed and replaced by the contractor. Nothing extra shall be payable on this account.

25.11 PERFORMANCE REQUIREMENTS All components, assemblies and completed work shall conform to the various performance standards as applicable in respect of thermal movement of the curtain glazing, allowance for vertical and horizontal expansion and building movement and related building tolerance etc. The design and installation of the curtain glazing system shall accommodate all inherent building movements and deflections and the fabrication and installation tolerances of all related work not involved in this section without the loss of, or any detrimental effect to, the performance requirements herein specified. The contractor shall verify and coordinate all such movements and tolerances with the Engineer-in-Charge before designing the components of the curtain glazing system so that movements and deflections in the structure do not at any time affect the integrity and safety of curtain glazing system and vice versa.

25.11.1 Thermal property

25.11.1.1 All insulation materials, fire-stops (barriers)-cum-smoke seal shall comply with the current requirements of the Fire Officer, MIDC and other authorities.

25.11.2 Structural properties

25.11.2.1 The curtain glazing system shall be anchored to the R.C.C floor through serrated Hot Dipped Galvanized M.S brackets. As far as possible, the contractor shall take all precautions to avoid cutting through any reinforcement bars while fixing the brackets. The cost includes provision of sleeves/ leave slots at appropriate locations during casting of the concrete itself for making provision for fixing brackets for the curtain glazing system and to avoid chipping/ dismantling of concrete. The slot shall be filled up with concrete of the same grade in a workman like manner, after fixing the brackets. Any defect in alignment/ plumb in the building face shall be rectified by chipping/ dismantling of the concrete/ masonry and repairing the same as specified to achieve the required alignment of the curtain wall as specified. Any change in lengths of bracket/s required on this account and the consequent requirement of their sections and sizes shall be carried out. Nothing extra shall be payable on this account.

25.11.2.2 No holes shall be burned, filed or drilled in any structural steel/ RCC members unless expressly approved by the Engineer – in – Charge.

25.11.2.3 Member shapes and/or profiles if schematically shown on the Architectural drawings are not necessarily the exact shapes required or best suited for the particular conditions. Final shapes and locations shall be as designed by the contractor and are subject to the review and approval of the Engineer – in – Charge.

25.11.2.4 All framing members shall be shop fabricated and finished as specified.

25.11.3 Concrete tolerances

25.11.3.1 While fixing the brackets for curtain glazing system, the contractor shall take into account the variation in the concrete and the masonry faces to which the structural framework of the curtain glazing system is to be fixed and such variations shall be adjusted in the lengths of brackets to align them in perfect plumb. The bracket shall be designed accordingly. Nothing extra shall be payable on this account.

25.11.4 Fire stops (barriers)-cum-smoke seal and interface with building

25.11.4.1 Gaps between the building face and the curtain glazing system at soffit level between the successive floors shall be closed as specified with fire-stops (barriers)-cum-smoke seal. It shall have the required fire resistance to be approved by Fire Officer. Suitable gap for accommodating deflections of the aluminium framing of curtain glazing system as per the approved shop drawings shall be maintained between the fire-stops (barriers)-cum-smoke seal and the curtain glazing system. This smoke seal shall however be provided using backer rod and weather silicone sealant as specified and as approved by the Engineer-in-Charge.

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25.11.4.2 The fire-stops (barriers)-cum-smoke seal shall consist of 1 mm thick plain G.I. sheet tray with 100 mm thick layer of non inflammable heat insulating material, rock wool, having density of minimum 64 Kg. Per Cum. Of the make as approved by the Engineer-in-Charge. The rock wool layer shall be attached to G.I sheet using stainless steel rivets/ nuts, bolts and washers. The tray shall be fixed to the RCC / Masonry surface by using stainless steel screws dipped in weather silicone sealant as per the approved shop drawings. Screws with plastic sleeves shall not be allowed to be used for the above fixing.

25.11.4.3 An aluminium flashing of 1.0 mm thick shall be permitted transparent anodized (10 micron thickness) solid aluminium sheet of the approved design and profile at the window sill level and also fill the gap between the aluminum flashing and the curtain glazing using weather silicone sealant as specified and as approved by the Engineer-in-Charge. Also, the fasteners/ screws to be used for fixing flashing shall be dipped in weather silicone sealant before using.

25.11.5 Acoustics

25.11.5.1 Gaps between the mullions and the partitions of the cabins shall be suitably closed by double skin partition as directed by the Engineer-in-Charge including allowing for permissible deflections of mullions as per design requirements but without affecting the partitions and the curtain glazing system. The payment for this partition work shall be made under relevant item. 25.11.5.2 Provisions shall also be made to prevent metal to metal rubbing, any rattling, noise due to thermal changes and wind pressure by using Teflon separators and shims.

25.11.6 Visual appearance

25.11.6.1 It shall be ensured that the elevations are strictly as per the Architectural drawings and that the intent of the architectural design is retained. Visual appearance shall be a key consideration for acceptance of work.

25.12 CURTAIN GLAZING AND ALUMINIUM COMPOSITE PANEL CLADDING SYSTEMS

25.12.1 General

25.12.1.1 Movement of building components to which the curtain glazing system is attached including long term and short term movements due to thermal effect, structural effect, wind pressure, seismic forces, erection or dead loads, creep, column shortening, deflection, torsion and vibrations etc shall be free and noiseless. This shall be achieved without any strain or stress being transferred to the glass, without buckling of any components, without excessive stress to any members or assemblies and without compromising on any of the performance requirement of the curtain wall.

25.12.2 Waterproofing

25.12.2.1 Following precautions shall be taken by the contractor to ensure that the curtain glazing system is completely water tight during its guarantee period as well as expected service life besides any other precautions not specifically mentioned herein:

25.12.2.1.1 A drainage system must be incorporated into the curtain glazing system. The curtain glazing system shall have provision for air pressure equalization (all the internal spaces shall be vented by acceptable means to ensure air pressure equalization) so that water leakage and condensation, if any shall be drained or discharged to exterior face of the curtain glazing.

25.12.2.1.2 Care should be taken that the sections of the aluminum extrusions used for structural framing of curtain glazing provide for proper drainage of water that in-filters into the system by gravity and for this the section should have proper slope and weep holes as required. These shall be clearly indicated on the shop drawings.

25.12.2.1.3 Movement of water on exposed faces must be controlled to ensure that water is not retained and that elements will not be damaged or corroded by water and to minimize the potential for algae and fungal growth as a result of standing or trapped water.

25.12.2.1.4 EPDM gaskets of the quality as specified and of required size and thickness shall be provided at all required locations to prevent ingress of water or moisture. The same shall be indicated on the shop drawings also.

25.12.2.1.5 EPDM gaskets of the quality as specified and of required size and thickness shall be provided at all required locations to prevent ingress of water or moisture. The same shall be indicated on the shop drawings also.

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25.12.2.1.6 Aluminium sheet flashing using 1.0mm thick transparent anodized (10 microns) aluminium sheet wherever required shall be provided including sealing the gap between the flashing and the other material like RCC, masonry, aluminium etc. By using weather silicone sealant as specified.

25.12.3 Mullions and transoms

25.12.3.1 The sections of mullions and transoms shall be designed to restrict deflection under dead loads, wind load, seismic loads etc. As specified and shall be rigid and stable enough to support and retain the in-fill panels in position under all conditions. The mullions and transoms shall also be designed for additional horizontal loads from the cleaning equipment and process besides horizontal live loads as specified.

25.12.4 Spandrel units

25.12.4.1 Spandrel shall be of glass having same colour matching with vision areas after using a shadow box as specified.

25.12.4.2 Structural spandrel wall, fins, slab or beam, aluminium frame work, anchor fasteners, brackets, shadow boxes, fire stop(barrier)-cum-smoke seals and other construction shall not be visible through the glass in the spandrel portion of the curtain glazing from the exterior and shall be fully concealed behind the shadow box.

25.12.4.3 A shadow box shall be provided at a distance of minimum 50 mm behind the spandrel glass panel to ensure that the insulation panel material does not come in contact with the soft coating of the spandrel glass to prevent any damage to the coating on account of any chemical reaction or otherwise. It shall consist of an approved black fibre glass non-woven tissue stuck on surface #1 of 50 mm thick semi-rigid fibre glass wool insulation panel of minimum density of 48 kg per cum., and 1.5 mm thick transparent anodized (10 microns) solid aluminium sheet tray, on surface #2 by using suitable stainless steel rivets/ nuts, bolts and washers to hold the insulation panel in position. The periphery shall be properly sealed. Surface #1 shall be adequately protected against damage until spandrel glazing is done. Further, care shall be taken that the aluminium sheet backing of the shadow box does not heave or warp due to thermal stresses and/or its self-weight. Proper gaps at the edges of the tray shall be provided to accommodate movements on account of thermal stresses besides making elliptical slots if required to facilitate movements. The shadow box shall be fixed to the structural framing of the curtain glazing by using stainless steel screws. The fixing arrangement shall be as per the approved shop drawings.

25.12.5 Ventilators, open able windows and doors

25.12.5.1 Ventilators, openable windows and doors shall be provided at positions as shown on the architectural drawings. The openable panels when in closed position shall remain watertight under all weather conditions and pass the water tightness tests as specified. Besides, the openable panels shall appear similar to the fixed ones from outside.

25.12.5.2 All hardware and accessories shall be provided and fixed by the contractor and shall be as specified.

25.12.6 Coping and soffit trimmer

25.12.6.1 All coping and soffit panels shall have aluminium structural frame fixed rigidly to the structure.

25.12.6.2 Effective drainage system shall be provided to drain out the water that may penetrate through the joints, on to the exterior face of the curtain glazing.

25.12.6.3 Coping and soffits shall be visibly flat in all lighting conditions.

25.13 MEASUREMENTS All the aluminium sections including snap beadings fixed in place shall be measured in running meter along the outer periphery of composite section correct to a millimeter. The weight calculated on the basis of actual average (average of five samples) weight of composite section in kilogram correct to the second place of decimal shall be taken for payment (weight shall be taken after anodizing). The weight of cleat shall be added for payment. Neither any deduction nor anything extra shall be paid for skew cuts. The height and width of double glazed/single glazed unit (the area of glass unit outside the snap beading shall only be measured) as fixed in place shall be measured correct to one centimeter and area calculated in sqm. Correct to second place of decimal shall be taken for payment.

25.14. RATE

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25.14.1. Rate shall include cost of all inputs of labour, materials including wastages, T & P, equipments, other enabling temporary structures and services and all other incidental charges, if any, not specifically mentioned here, but as required for complete design, proof checking, engineering, fabrication, assembling, delivery, anchorage, installation, protection of curtain glazing, aluminium composite panel cladding and aluminium work (PVDF coated), etc. And making the system water tight (wherever specified), all complete, all in accordance with the true intent and meaning of the specifications and the drawings taken together, regardless of whether the same may or may not be particularly shown on the drawings and / or described in the specifications, provided that the same can be reasonably inferred there from. The curtain glazing, aluminium composite panel cladding and aluminium work (PVDF coated) shall have framing which shall be structurally and mechanically designed to achieve the architectural elevations as well as performance parameters specified herein. Anchorage shall include all supporting brackets & anchor fasteners, as required to rigidly secure the structural framing to the RCC / Masonry / structural steel members of the building.

25.14.2. The curtain glazing, aluminium composite panel cladding and aluminium work (PVDF coated), etc. Work shall include but will not necessarily be limited to the following:

25.14.2.1 Frames, fixed glazed / vision panels, spandrels, hard wares, open able panels, as in the drawings inclusive of all accessories and fittings. Glass wool insulation panel (shadow box), fire stop (barrier) - cum - smoke seals, splice plates, connectors, sleeves, anti-buckling clips etc.

25.14.2.2 Anodized aluminium work for framing of curtain glazing as well as other aluminium work (PVDF coated) for trellis, louvers, fins, box sections, capping, strip etc wherever indicated in the schedule of quantities and drawings. Glazes doors.

25.14.2.3 Structural, weather and other silicone sealants within and all round the perimeter of all the work under this sub head for fabricating igus, holding the glass to the aluminium & glass to glass and to provide water tightness to the curtain glazing.

25.14.2.4 EPDM / silicone gaskets, trims, shims, setting blocks, double sided spacer tape, spacer blocks, weathering strips etc.

25.14.2.5 All sealing and flashings including sealing at junctions with the building members.

25.14.2.6 All brackets, anchor fasteners, screws, inserts, nuts, bolts & washers, and attachments required for complete installation and fixing to the RCC, masonry and/or the structural steel members of the building.

25.14.2.7 All accessories, fasteners, screws, nuts and bolts, toggles, rivets etc. And other items implied in the drawings and the specifications though are not specifically indicated.

25.14.2.8 Isolation of all dissimilar metal surfaces as well as moving surfaces by use of TEFLON (PTFE) separators.

25.14.2.9 Engineering proposals, design, drawings and Architectural data.

25.14.2.10 Shop drawings, engineering data and structural calculations (analysis & design) of all systems including aluminium structural framing, fasteners, sealants etc.

25.14.2.11 Scheduling and monitoring of the work.

25.14.2.12 Cost of all samples of the individual components, mock-ups at site and field tests.

25.14.2.13 Coordination with work of other agencies.

25.14.2.14 Protection during storage and construction until handing over the building for occupation etc.

25.14.2.15 All final exterior and interior cleaning of the curtain glazing, aluminium composite panel cladding and aluminium work (PVDF coated) etc. Before handing over the building for occupation.

25.14.2.16 Hoisting, staging, scaffolding and temporary enabling structural work/services, cranes and cradles etc.

25.14.2.17 Specified tests, inclusive of necessary records, reports, logbook etc.

25.14.2.18 Design and performance guarantee in the enclosed format.

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25.14.2.19 Construction monitoring for regular quality control and technical inspection to ensure the work conforms to the approved shop drawings and details (including any modifications made after field testing) and acceptable standards of quality including monitoring the progress of the work.

The rate shall be for a unit of One sq.kg .

Item no. 101

Providing and fixing Clear Float Glass of any size, any shape and specified thickness and SHGC value 86 % in frame and shutter work with necessary cutting of glass as per drawing & specifications including providing and fixing EPDM quality rubber/silicon sealant/structural sealant of 3M tape on the periphery of the glass as per the required thickness etc. Complete a tall floors/all levels/all heights as per the directions of Architect. Actual installed quantity shall be measured and paid. Rate shall be inclusive of all type of wastage. (a) 6 mm thick

Materials

1.0. The glass shall conform to M-38. Glass of selected quality shall be 6 mm.thick.

Putty shall conform to I.S.419-1967.

2.0. Workmanship

The glass shall be sheet glass of selected quality of 6 mm. Thick.

2.1. The size of glass for glazing shall allow a clearance of 2.5 mm. Between the edges of glass and the wood or metal surrounds. The clearance may be increased, provided the depth of the rebate of groove is sufficient to provide not less than 1.5 m. Cover to the glass. The detailed process of glazing shall be as specified in I.S.3548-1966.

2.2. All stains from the surface of glass shall be removed and cleaned with thinner or spirit without any extrapayment.

3 EPDM- GASKETS The EPDM Gaskets shall be of size and profile as shown in drawings and as called for, to render the glazing, doors, windows, ventilators etc. Air and water tight. Samples of gaskets shall be submitted for approval and the EPDM gasket approved by Engineer- in- Charge shall only be used. The contractor shall submit documentary proof of using the above material in the work to the entire satisfaction of Engineer-in-Charge. The EPDM gasket shall meet the requirements as given in Table 21.5 below: TABLE 21.5 21.4 SEALANT 21.4.1 The sealants of approved grade and colour shall only be used. The silicone for perimeter joints (between Aluminium section and RCC/Stone masonry) shall be of make approved by the Engineer in Charge

4 Method of Application Surface Preparation : Clean all joints and glazing pockets by removing all foreign matter and contaminants such as grease, oil, dust, water, frost, surface dirt, old sealants or glazing compounds and protective coatings. 21.4.3 Masking Areas adjacent to joints shall be masked to ensure neat sealant lines. Masking tape shall not be allowed to touch clean surfaces to which the silicone sealant is to adhere. Tooling shall be completed in one continuous stroke immediately after sealant application and before a skin forms and masking shall be removed immediately after tooling.

5 21.4.4 Application Install backer rod of appropriate size and apply silicone sealant in a continuous operation using a positive pressure adequate to properly fill and seal the joint. The silicone sealant shall be tooled with light pressure to spread the sealant against backing material and the joint surfaces before a skin forms. A tool with convex profile shall be used to keep the sealant within the joint. Soap or water shall not be used as a tooling aid. Remove masking tape as soon as silicone joint is tooled..

5.0. Mode of measurement &payment

5.1. All measurements of cutting shall, unless otherwise stated, be held to include the consequent waste.

5.2. Each pane' of glass shall be measured to the nearest 0.6 cms. Both in width and height/length.

5.3. Irregular shaped or circular panes shall be measured as the smallest rectangular area from which the irregular or circular pane can be cut.

5.4. The rate includes cost of materials, labour required for completion of the item including hoisting, carriage, temporary erections like scaffolding etc.

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5.5. The rate also includes :

- (i) The wastages and breakage involved in the process.
- (ii) Straight cutting on glass and glazing sheets.
- (iii) Cost of subsidiary materials required for proper fixing and functioning of glass i.e. Nails, spirit, putty, teak wood beading glass, pins, etc. complete.

The rate shall be for a unit of sq. meter.

Item no. 102.

Providing and fixing fly proof stainless steel grade 304 wire gauge, to windows and clerestory windows using wire gauge with average width of aperture 1.4 mm in both directions with wire of dia. 0.50 mm all complete with Aluminium beading.

FLY PROOF WIRE GAUZE Workmanship

Wire gauge/Wire Cloth which shall generally conform to IS 1568 shall be regularly woven with equally spaced galvanised mild steel wires in both warp and weft directions. The wire cloth shall be properly selvaged by one or more wires in each edge.

The following wire gauze shall be used :

- (i) Galvanised mild steel wire gauze of 1.40mm average aperture width woven with 0.63mm nominal dia shall be used.
- (ii) Stainless steel (Grade 304) gauze of 0.5 mm dia wire and 1.4mm aperture on both sides.

The wire gauze shall be bent at right angles in the inner face of steel frame of stiles and rails, turned back and fixed tight with blue tacks at about 75mm centres, fixed alternately in the two faces of the inner face of frame. Over this, M.S. Flat of size 15x3 mm with nuts & bolts fixed alternately in the two faces of the frame at about 75mm centres.

10.21.1 Measurement The length and breadth of finished wire gauze on inner face of frame shall be measured correct to the nearest cm and area worked out in square metres correct to two places of decimal.

10.21.2 Rates The rate includes cost of all operation described above.

The rate shall be for a unit of sq. meter

Item no.103

Providing and fixing 12 mm thick frameless toughened glass door shutter of approved brand and manufacture, including providing and fixing top & bottom pivot & spring type fixing arrangement and making necessary holes etc. For fixing required door fittings, all complete as per direction of Engineer-in-charge (Door handle, lock and stopper etc. to be paid separately).

12MM THICK FRAMELESS TOUGHENED GLASS DOOR SHUTTER

21.14.1 Material This is a clear 12mm toughened safety glass frameless shutter having a consulate top and bottom self closer mechanism with a pivot connecting to a discrete metal patch fitting at the top and bottom corners to the door.

21.14.2 Application The 12mm thick clear toughened safety glass frameless shutter is fixed with the help of corner patch fittings. The corner patch fittings are simply a bolt through glass metal fitting requiring a corner cut out and hole in the glass. These discrete corner patch fittings provide a sleek and clean frameless look. The lock body patch fitting can also be installed where there is a necessity to provide locking arrangements for frameless shutter. The maximum size of frameless doors shutters using corner patch fittings should not exceed from 1000mm X 2400mm. Bigger size doors should not be fixed with these fittings. The figure 21.18.1 shows the fixing of frameless door shutters with top and bottom corner patch fittings.

21.14.3 Installation The frameless toughened glass door shutters of required thickness as specified in the item should be installed with the help of 304 grade stainless steel patch fittings of approved brand and manufacturer. These fittings should be complete in all respect with top and bottom pivots and double action hydraulic floor spring types fixing arrangement. These fittings should be based on a modular system, consisting of a base

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unit, functional inserts, and clip-on covers in a wide range of finishes. The fittings should be suitable to support the weight of the complete glass door in such a way that the movement of the door is smooth and free. The fittings should be got approved from the engineer-in-charge and all the fixings etc. Shall be done as per manufacturer specification and corresponding codes described in the description of the fitting.

21.14.4 Measurement The finished final length/ height and width of the glass door should be measured correct to two places of decimal and overall area in sqm correct to two places of decimal should be calculated for payment.

21.14.5 Rate The rate shall include the cost of all the materials, labours involved in all the operations above and as described in the nomenclature of item and particular specification.

Mode of Measurement & Payment

The rate shall be for a unit of sqm

Item no.104.

Supply of Aluminium Ventilated Façade / Louver System of approved colour consisting of panel 50 mm wide x 50mm depth x 0.6mm thick panel length up to 5mtrs coil coated on a continuous paint line double baked and roll formed from enameled corrosion Resistance Aluminum Alloy AA3005 / AA5050 for higher strength and good Roll forming characteristics. Panels shall be mounted in a module of 100 mm on a mullion profile grooved (Slotted Fastening Profile) by means of Clamp, Locking Pop and Pop Weld (Gap will be 50 mm between two panels). Slotted Fastening Profile shall be fixed at 150 mm from panel ends and at a distance of maximum 1200 mm center to center across the panel span and Slotted Fastening Profile shall be fixed to a suitable sub-structure by means of Square Brackets. Paint Finish: Panel shall be stove enamelled and finished with Luxacote, a patented special three layered coating system (consisting of first a conversion layer of thickness 800-2000mg/sq mtr, a polyurethane basecoat of 16-20 microns, and a special top coat of polyamide particles of 8-12 microns thick to provide excellent abrasion and damage resistance) in a continuous coil coating process of the approved colour on the exposed side and the reverse side with epoxy.

Aluminium Ventilated Façade / Louver System. Shall be Enameled corrosion-resistant Aluminum Alloy AA3005 / AA5050 and its dimensions shall be 50 mm wide x 50 mm depth x 0.6 mm thick, panel length up to 5 meters with Double baked coil coated on a continuous paint line and should have Stove enamelled with Luxacote, a three-layered coating system. its Conversion layer should be 800-2000 mg/sq mtr thickness. It shall be Polyurethane basecoat: 16-20 microns thickness. Polyamide particles, 8-12 microns thick for abrasion and damage resistance. Panels shall be mounted in a module of 100 mm using a mullion profile grooved. Panels should be fixed with Clamp, Locking Pop, and Pop Weld. Gap will be 50 mm between two panels. Slotted Fastening Profile fixed 150 mm from panel ends. Maximum distance of 1200 mm center to center across the panel span. Slotted Fastening Profile fixed to a suitable sub-structure using Square Brackets.

Mode of measurements and payment

The relevant specifications of item shall be followed as above.

The rate shall be for a unit of One sq. Meter

Item no.105.

Supplying and laying composite 1.5mm thick, pre-applied, fully bonded HDPE membrane with double side adhesive which results in adhesive-to-adhesive bond - Prebond Pro or equivalent over P.C.C. conforming to BS 8102 & IS 16471:2017, requirements of UG waterproofing structures, with the turnkey execution to be done by the manufacturer through its in-house subsidiary execution company and with 10 years composite warranty against leakages, to be provided by the principal manufacturer. The system should be fully bonded to the Raft and consists of highly resilient HDPE film, self-adhesive polymer layer and weather protective layer. Typical application includes surface preparation by removing loose aggregates from PCC, foreign material, cleaning the surface etc., cutting membrane to convenient length, carefully aligning the membrane over blind concrete and rolling it out with print coated side facing up, laying adjacent sheets by keeping overlap of 75 mm, end overlaps to be treated using double sided tape and sealed tape etc. The membrane shall be continued over the vertical surface upto top of the Raft and fixed to shutter using double side adhesive tape. For application on confined retaining walls membrane shall be continued over the vertical surface and fixed by PVC roundels / shot guns at selvedge portion. The membrane shall have Tensile strength > 25 Mpa as per ASTM D 412 Modified, Elongation > 500% as per ASTM D 412 Modified, Puncture resistance > 1000 N as per ASTM E 154, Hydrostatic head resistance > 70m head of water as per ASTM D 5385, Low Temperature Flexibility: -25 deg C, Lap Peel Adhesion-880 N/m as per ASTM D1876, Peel Adhesion to Concrete > 1500 N/m as per ASTM D 903 Modified, UV Exposure > 45 Days.

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Material and Workmanship

HDPE membrane shall be 1.5mm thick HDPE membrane with a fully bonded, double-sided adhesive system with Consists of Highly resilient HDPE film and Self-adhesive polymer layer with Weather protective layer. Conforms to BS 8102 and IS 16471:2017 for underground waterproofing structures. Membrane Shall be Tensile Strength: > 25 mpa (ASTM D 412 Modified), Elongation: > 500% (ASTM D 412 Modified), Puncture Resistance: > 1000 N (ASTM E 154), Hydrostatic Head Resistance: > 70 m head of water (ASTM D 5385), Low Temperature Flexibility: -25°C & UV Exposure: > 45 days. Remove loose aggregates and foreign material from PCC (Plain Cement Concrete). Clean the surface thoroughly and Cut membrane to convenient lengths and Align membrane over the PCC, ensuring the print-coated side faces up and Roll out the membrane, ensuring proper alignment and minimal wrinkles. Overlaps shall be 75 mm between adjacent sheets, Treat end overlaps using double-sided tape and sealed tape for watertight seals and Vertical Surfaces shall be Continue membrane over vertical surfaces up to the top of the raft and Fix to shuttering using double-sided adhesive tape, Continue membrane over vertical surfaces and Secure using PVC roundels or shotguns at the selvedge portion.

Mode of measurements and payment

The relevant specifications of item shall be followed as above.

The rate shall be for a unit of One sq. Meter

Item no.106.

Providing and laying of minimum 1.5 mm thick SBS modified self adhesive Samshield XL or equivalent waterproofing membrane topped with samshield HDPE valeron film, having tensile strength of L/T 3.5N/mm² as per ASTM D412 and with minimum elongation L/T of 180% (as per ASTM D 412). The membrane shall have puncture resistance of >200 N (as per ASTM E154). Hydrostatic pressure > 60 m (6BAR) No leakage as per DIN 1048, including cleaning the surface, priming the surface with cold applied bituminous primer @ 4-6 sqmtr/litre, properly sealing the joints & maintaining 75 mm overlap between the membrane selvedge & 100 mm overlap on the end joints of the membrane over the slab etc. The system includes base preparation of cleaning, brushing and removal of flaky materials, grouting the porous area with cementitious grout, proper coving between slab and wall junctions. The waterproofing system should be applied directly by the manufacturer approved applicator with 10 years of warranty against leakage.

Material and Workmanship

Membrane shall be minimum 1.5 mm thick SBS modified self-adhesive waterproofing membrane topped with HDPE film. It will be SBS modified self-adhesive membrane (Samshield XL or equivalent) and Topped with HDPE (Valeron film). It will be Thickness: Minimum 1.5 mm, Tensile Strength will be Longitudinal (L): $\geq 3.5 \text{ N/mm}^2$ (ASTM D412), Transverse (T): $\geq 3.5 \text{ N/mm}^2$ (ASTM D412). Elongation will be Longitudinal (L): $\geq 180\%$ (ASTM D412) and Transverse (T): $\geq 180\%$ (ASTM D412) and Puncture Resistance will be > 200 N (ASTM E154) and Hydrostatic Pressure Resistance: > 60 m (6 BAR) without leakage (DIN 1048). and now Clean the surface thoroughly, removing loose debris and flaky materials and Brush and clean the surface to ensure good adhesion and Grout porous areas with cementitious grout where necessary Ensure proper coving between slab and wall junctions. Prime the prepared surface with cold applied bituminous primer at a rate of 4-6 sqm/litre. Allow primer to dry as per manufacturer's instructions. Cut membrane to suitable lengths as per area requirements. Apply the self-adhesive membrane directly to the primed surface, ensuring firm adhesion. Maintain a minimum 75 mm overlap between membrane selvages and a 100 mm overlap at end joints over the slab. Properly seal joints and overlaps to ensure waterproof integrity.

Mode of measurements and payment

The relevant specifications of item shall be followed as above.

The rate shall be for a unit of One sq. Meter

Item no.107.

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Providing and laying water proofing treatment to vertical and horizontal surfaces of depressed portions of W.C kitchen and the like consisting of :
i) 1st course of applying cement slurry @ 4.4 Kg/sqm mixed with water proofing compound conforming to IS 2645 in recommended proportions including rounding off junction of vertical and horizontal surface. ii) 2nd course of 20 mm cement plaster 1: 3 (1 cement :3 coarse sand) mixed with water proofing compound in recommended proportion including rounding off junction of vertical and horizontal surface. iii) 3rd course of applying blown or residual bitumen applied hot at 1.7 kg. Per sqm of area. iv) 4th course of 400 micron thick PVC sheet. (Overlaps at joints of PVC sheet should be 100 mm wide and pasted to each other with bitumen @ 1.7 kg/sqm.)

22.3 WATER PROOFING TREATMENT TO VERTICAL AND HORIZONTAL SURFACE OF DEPRESSED PORTION OF WC, KITCHEN AND THE LIKE

22.3.1 Before the Water Proofing Treatment Before the water proofing treatment, the internal plaster of ceiling and walls of WC block leaving the portion for dado/skirting should be completed. Grooving / chasing for doing the concealed work of GI/CI pipes/Electrical conduits should be completed. Cleaning the depressed/sunken portion of WC of all debris, extra mortar sticking to the vertical and horizontal surface etc. Necessary holes for 'P' trap /Nhani trap/Water escape pipe etc should be completed.

22.3.2 Preparing Surface and Fixing Pipes and Fittings Before the water proofing treatment work, proper key in the concrete surface should be provided. The depressed/sunken portion should be hacked by a hacking tool, after the concrete slab is cast and when this concrete is still green. The vertical surfaces of the depressed /sunken portion should be hacked with a hacking tool just after the shuttering is removed. In case of old work, the water proofing treatment on such surfaces shall be permitted after making proper spatter dash key. Fixing the 'P' trap in position and all other pipes work including the water escape pipe shall be fixed properly and the holes should be plugged carefully before taking up the water proofing work.

22.3.3 1st Course Cement duly blended with water proofing compound as explained in clause 22.1 shall be used for preparing the cement slurry. The consistency of the slurry should be such that 4.4 kg. Of blended cement with water proofing compound is used per sq. Metre area of surface to be treated. The slurry should be started from the vertical faces towards the bottom of the floor. Particular care should be taken to see that the slurry is applied to corners without leaving any gap.

22.3.4 2nd Course Immediately on applying the blended cement slurry on the surface to be treated cement plaster 20 mm thick in CM 1:3 (1 blended cement: 3 coarse sand) shall be applied both on vertical and horizontal surfaces taking particular care to complete the entire depressed/sunken portion of WC within a day so that the plaster can be done without any joint. Junctions shall be properly rounded. The surfaces of the plaster shall be left rough but finished in one plain and cured for a week. On completion of the curing period both horizontal and vertical surfaces shall be cleaned properly and gently and allowed to dry.

22.3.5 3rd Course Only after the surface is completely dried the blown or residual bitumen shall be applied @ 1.7 kg. Of bitumen per sqm area.

22.3.6 4th Course PVC sheet 400 micron thick shall be spread evenly without any kink immediately, so that the PVC sheet sticks to the surface firmly. PVC sheet shall be continued to be laid over the main slab upto 100 mm. Overlapping of PVC sheet should be done with a minimum overlap of 100 mm, duly pasting the overlapped sheet with an application of bitumen @ 1.7 kg./ sqm. The projections of pipes and 'P' trap outlet etc. Inside the depressed/sunken portion of WC shall also be clad with water proofing treatment layer upto a height of 150 mm, using a coat of bitumen with PVC sheet complete. The surfaces of depressed/sunken portion of WC shall not be left without covering with specified filling material and base concrete, otherwise the PVC sheet layer may be tampered by the labour working in the vicinity. Fixing up of WC pan, filling specified material and the top base concrete should be done as early as possible and the top horizontal layer of water proofing may be taken up later i.e. Just before laying the floor tiles.

22.3.7 Measurement Length and breadth shall be measured along the finished surface correct to a cm. And area shall be worked out to nearest 0.01 sqm. No payment however shall be made for the 100 mm overlap of PVC Sheet over the roof slab.

22.3.8 Rate The rate shall include the cost of labour and materials involved in all operations described above.

Mode of Measurement & Payment

The rate shall be for a unit of One sq. meter

Item no.108.

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Terrace Waterproofing Works : Providing and applying single component PU based cold applied seamless waterproofing membrane over the primed surface with PU/Epoxy primer Layer on RCC mother slab, Insulation Layer: Spray applying an average minimum 65mm thick GRIHA enlisted CFC & HCFC free spray applied polyurethane foam and 2 coats of a single component PU based cold applied seamless waterproofing membrane over PU foam , 150 gsm Geotextile (non-woven polyester) over the entire membrane on horizontal areas maintaining proper overlaps and an avg of 100 mm thick M20 grade PP fiber reinforced concrete screed with Min. 75 mm thick at the rain water outlets, laid to a slope of 1 : 120, including saw cutting (approx 6mm W x 30mm D) at 3MX4M pannels within 24 hours of concrete placement and filling the groove with Expanded Polythylene backer rod keeping the top approx 10 mm depth open and sealing the groove on the top after 28 days of concrete placement with PU sealant or equivalent, and making angle fillet of 100mmx100mm using M20 grade concrete at the corners, compaction , curing for 7 days etc complete

Workmanship

Terrace waterproofing with multiple layers and materials shall be PU based cold applied seamless waterproofing membrane, PU/Epoxy primer, spray applied polyurethane foam (CFC & HCFC free), geotextile (non-woven polyester), M20 grade PP fiber reinforced concrete screed, PU sealant, Expanded Polyethylene backer rod, M20 grade concrete for angle fillet.

Surface Preparation: Prepare the RCC mother slab by cleaning and priming with PU/Epoxy primer layer.

Spray apply an average minimum 65 mm thick GRIHA enlisted CFC & HCFC free spray applied polyurethane foam and fill irregularities on the substrate.

First Layer: Apply the first coat of single component PU based cold applied seamless waterproofing membrane over the primed surface.

Second Layer: Apply a second coat of the same waterproofing membrane over the PU foam layer. Ensure seamless waterproofing and protection against water ingress.

Geotextile Layer: Install 150 gsm non-woven polyester geotextile over the entire membrane on horizontal areas. Maintain proper overlaps to prevent water penetration and enhance durability.

Concrete Screed: Lay an average 100 mm thick M20 grade PP fiber reinforced concrete screed. and Lay to a slope of 1:120 towards rainwater outlets. Provide a minimum 75 mm thickness at rainwater outlets. Saw cut panels approximately 6 mm wide and 30 mm deep within 24 hours of concrete placement . Fill the saw-cut grooves with Expanded Polyethylene backer rod, leaving approximately 10 mm depth open. Seal the grooves with PU sealant or equivalent after 28 days of concrete placement.

Construct 100 mm x 100 mm angle fillet using M20 grade concrete at the corners. Provide structural support and ensure waterproofing integrity at corners.

Ensure proper compaction of all layers to achieve desired thickness and density. Cure the entire waterproofing system, including concrete screed, for a minimum of 7 days.

Mode of Measurement & Payment

The rate shall be for a unit of One sq. meter

Item No. 109.

Preparation and consolidation of sub grade with power road roller of 8 to 12 tonne capacity after excavation earth to an average of 22.5cm depth dressing to camber and consolidating with road roller including making good the undulations etc. And re-rolling the sub grade and disposal of surplus earth lead upto any lead.

Workmanship

16.2 SUB-GRADE : PREPARATION AND CONSOLIDATION

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16.2.0 In sub-grade composed of clay, fine sand or other soils that may be forced up into the coarse aggregate during rolling operation, an insulation layer of suitable thickness of granular materials or over size brick aggregate not less than 10 cm thick shall be provided for blanketing the sub-grade, which shall be paid for separately, unless otherwise specified in the agreement. In slushy soils or in areas that are water logged, special arrangements shall be made to improve the sub-grade and the total pavement thickness shall be designed after testing the properties of the sub-grade soil. Necessary provision for the special treatment required shall be made in the project and paid for separately.

16.2.1 Preparation of Sub-Grade

The surface of the formation for a width of sub-base, which shall be 15 cm more on either side of base course, shall first be cut to a depth equal to the combined depth of sub-base and surface courses below the proposed finished level (due allowance being made for consolidation). It shall then be cleaned of all foreign substances. Any ruts or soft yielding patches that appear due to improper drainage conditions, traffic hauling or from any other cause, shall be corrected and the sub-grade dressed off parallel to the finished profile.

16.2.2 Consolidation

The sub-grade shall be consolidated with a power road roller of 8 to 12 tonnes. The roller shall run over the sub grade till the soil is evenly and densely consolidated and behaves as an elastic mass (the roller shall pass a minimum of 5 runs on the sub grade). All undulations in the surface that develop due to rolling shall be made good with material or quarry spoils as the cases may be and the sub-grade is rerolled.

16.2.3 Surface Regularity

The finished surface shall be uniform and conform to the lines, grades and typical cross-section shown in the drawings, when tested with the template and straight edge, the variation shall be within the tolerances specified in Table 16.11.

TABLE 16.11
Permissible Tolerances of Surface Evenness of Sub Grade

<i>Longitudinal profile maximum permissible undulation when measured with a 3 metre straight edge</i>	<i>Cross profile maximum permissible variation from specified profile when measured with a camber template</i>
24 mm	15 mm

Where the surface irregularity of the sub grade falls outside the specified tolerances, the contractor shall be liable to rectify these with fresh material or quarry spoils as the case may be, and the sub grade rerolled to the satisfaction of Engineer-in-Charge.

16.2.4 Measurements

The length and width shall be measured correct to a cm. The area shall be worked out in square metre, correct to two places of decimal.

16.2.5 Rate

The rate for preparation and consolidation of sub grade shall include the cost of materials and labour involved for all the operations mentioned in above unless otherwise specified.

Mode of Measurement & Payment

The rate shall be for a unit of One sq. meter

Item No. 110..

Construction of granular Sub base providing coarse graded material, spreading in uniform layers with motor grader on prepared surface mixing by mix in place method with front end loader at OMC and compacting with vibratory roller to achieve the desired density, complete as per specification and direction of engineer in charge- With material conforming to Grade - I (size range 75mm to 0.075mm) having CBR Value -30.

Workmanship

16.62. GRANULAR SUB-BASE

Registrar

Sign and Seal of contractor

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16.62.1. Scope This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer-in-charge.

16.62.2. Materials

16.62.2.1. The material to be used for the work shall be natural sand, crushed gravel, crushed stone, crushed slag or combination thereof depending upon the grading required. Use of materials like brick metal, Kankar and crushed concrete shall be permitted in the lower sub-base. The material shall be free from organic or other deleterious constituents and shall conform to the grading given in Table 16.44 and physical requirement given in Table 16.45 Gradings III and IV shall preferably be used in lower sub-base. Grading V and VI shall be used as a sub-base-cum-drainage layer. The grading to be adopted for a project shall be as specified in the Contract. Where the sub-base is laid in two layers as upper sub-base and lower sub-base, the thickness of each layer shall not be less than 150 mm.

16.62.2.2 If the water absorption of the aggregate determined as per IS : 2386 (Part 3); if this value is greater than 2 per cent, the aggregate shall be tested for Wet Aggregate Impact Value (AIV) (IS: 5640). Soft aggregates like Kankar, Brick ballast and laterite shall also be tested for Wet AIV (IS: 5640)

TABLE No. 16.44
GRADING FOR GRANULAR SUB-BASE MATERIALS

IS Sieve Designation	Percent by Weight Passing the IS Sieve					
	Grading I	Grading II	Grading III	Grading IV	Grading V	Grading VI
75.0 mm	100	--	--	--	100	--
53.0 mm	80-100	100	100	100	80-100	100
26.5 mm	55-90	70-100	55-75	50-80	55-90	75-100
9.50 mm	35-65	50-80	--	--	35-65	55-75
4.75 mm	25-55	40-65	10-30	15-35	25-50	30-55
2.36 mm	20-40	30-50	--	--	10-20	10-25
0.85 mm	--	--	--	--	2-10	--
0.425 mm	10-15	10-15	--	--	0-5	0-8
0.075 mm	<5	<5	<5	<5	--	0-3

TABLE No. 16.45
PHYSICAL REQUIREMENTS FOR MATERIALS FOR GRANULAR SUB-BASE

Aggregate Impact Value (AIV)	IS:2386 (Part 4) or IS:5640	40 Maximum
Liquid Limit	IS:2720 (Part 5)	Maximum 25
Plasticity Index	IS:2720 (Part 5)	Maximum 6
CBR at 98% dry density (at IS:2720-Part 8)	IS:2720 (Part 5)	Minimum 30 unless otherwise specified in the Contract

16.62.3 Construction Operations

16.62.3.1. Preparation of Sub-Grade: The surface of the sub grade to receive the Granular Sub-base shall be prepared to the specified lines and crossfall (Camber) as necessary and made free of dust and other extraneous materials. Any ruts or soft yielding places shall be corrected in an approved manner and rolled with 80 – 100 kn smooth wheeled roller until firm surface is obtained if necessary by sprinkling water. Weak places shall be strengthened, corrugations removed and depressions and pot holes made good with suitable materials, before spreading the aggregate for GSB. Where the existing surface over which the sub base of GSB is to be laid is black topped, to ensure effective internal drainage, furrows 50 mm x 50 mm (depth of furrows increased to reach bottom of bituminous layer where necessary) at one metre intervals shall be cut in the existing bituminous surface at 45 degrees to the central line of the carriageway at one metre intervals in the existing road before the GSB is laid.

16.62.3.2 Spreading and compacting: The sub-base material of grading specified in the Contract and water shall be mixed mechanically by a suitable mixer equipped with provision for controlled addition of water and mechanical mixing. So as to ensure homogenous and uniform mix. The required water content shall be determined in accordance with IS:2720 (Part 8). The mix shall be spread on the prepared sub-grade with the

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help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation, or other means as approved by the Engineer-in-charge.

Moisture content of the mix shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted so that, at the time of compaction, it is from 1 to 2 per cent below the optimum moisture content (OMC).

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kn weight may be used. For a compacted single layer upto 200 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kn static weight capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall or on super elevation. For carriageway having crossfall on both sides, rolling shall commence at the edges and progress towards the crown. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour. Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS : 2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

16.62.4 Measurements

Granular sub-base shall be measured as finished work in position in cubic metres. The length and breadth shall be measured to the nearest centimetre. The depth of consolidated layer shall be computed to nearest half centimetre by taking average of depths at the centre and at 30 cm from the left and right edges at a cross section taken at 100 metre interval or less as decided by the Engineer-in-Charge by making small pits. The consolidated cubical contents shall be calculated in cubic metres correct to two places of decimal. The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

16.62.5. Rate

The Contract unit rate for granular sub-base shall be payment in full for carrying out the required operations including all labour, tools, equipments, machinery and incidentals to complete the work to the specifications as described above

Mode of Measurement & Payment

The rate shall be for a unit of One cum.

Item No. 111.

Construction of dry lean cement concrete sub base over a prepared sub-grade with coarse and fine aggregate conforming to IS:383, the size of coarse aggregate not exceeding 25 mm, aggregate cement ratio not to exceed 15:1, aggregate gradation after blending to be as per specifications, cement content not to be less than 150 Kg/cum, optimum moisture content to be determined during trial length construction, concrete strength not to be less than 10 Mpa at 7 days, mixed in a batching plant, transported to site, for all leads & lifts, laid with a mechanical paver, compacting with 8-10 tonne vibratory roller, finishing and curing etc. Complete as per direction of Engineer in- charge.

1.2. Materials

1.3. Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6 stone aggregate 25 mm..

2.2. Workmanship

2.3. Relevant Specifications of item No7 shall be followed except that cement concrete shall be mixed in the preparation of 15:1 aggregate:cement ration instead of 1:3.6 by volume.and cement content will not to be less than 150kg/cum

3.2. Mode of measurement and payment

3.3. The concrete shall be measured for its length, breadth and depth, limiting dimensions to those specified on plans or as directed

The rate shall be for a unit of one cubic meter

Item no.112.

Providing and fixing pre-cast Rubber Dye/ steel Dye interlocking concrete block 60mm thick with grade of concrete M300 pneumatic compressed/ vibrated mechanically and as per approved design Confirming to IS15658:2006 including 35mm Sand layer for levelling and filling the joint with sand in proper line and level as per guidelines of IRC : SP 63-2018 etc. Complete.

Workmanship

Material:

Providing and fixing pre-cast interlocking concrete blocks. Shall be Pre-cast rubber dye or steel dye interlocking concrete blocks, grade of concrete M300 Conforming to IS15658:2006 With 35mm sand layer for leveling and joint filling with sand as per IRC SP 63-2018 guidelines.

Excavate and prepare the subgrade to the required dimensions and levels. Compact the subgrade thoroughly to achieve the specified density. Spread a 35mm thick layer of sand uniformly over the prepared subgrade. Level the sand layer to provide a smooth and even base for laying the concrete blocks. Use pre-cast rubber dye or steel dye interlocking concrete blocks with a thickness of 60mm. Lay the blocks in accordance with the approved design and layout. Ensure proper interlocking of blocks to achieve structural stability. Maintain proper alignment, line, and level as per design specifications. Fill the joints between the concrete blocks with sand. Compact the sand-filled joints to ensure proper settling and stability of the blocks. Clean excess sand from the surface of the blocks after joint filling.

Mode of Measurement & Payment

The rate shall be for a unit of One sqm.

Item no.113.

Providing and fixing pre-cast concrete kerb stone of gray cement based concrete block 30cm length, 30cm height and 15cm thick of M200 grade concrete as per approved design and including excavation for fixing in proper line and level, filling the joint with C:M 1:3 (1 cement: 3 fine sand) etc complete.

Workmanship

16.58 KERB STONE (PRECAST)

16.58.1 Laying

16.58.1.1 Trenches shall first be made along the edge of the wearing course of the road to receive the kerb stones of cement concrete of specified grade. The bed of the trenches shall be compacted manually with steel rammers to a firm and even surface and then the stones shall be set in cement mortar of specified proportion.

16.58.1.2 The kerb stones with top 20 cm. Wide shall be laid with their length running parallel to the road edge, true in line and gradient at a distance of 30 cm. From the road edge to allow for the channel and shall project about 12.5 cm. Above the latter. The channel stones with top 30 cm. Wide shall be laid in position in chamber with finished road surface and with sufficient slope towards the road gully chamber. The joints of kerb and channel stones shall be staggered and shall be not more than 10 mm. Wherever specified all joints shall be filled with mortar 1:3 (1 cement : 3 coarse sand) and pointed with mortar 1:2 (1 cement: 2 fine sand) which shall be cured for 7 days.

16.58.1.3 The necessary drainage openings of specified sizes shall be made through the kerb as per drawings or as directed by the Engineer-in-Charge for connecting to storm water drains.

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16.58.2 Finishing

Berms and road edges shall be restored and all surplus earth including rubbish etc. Disposed off as directed by the Engineer-in-charge. Nothing extra shall be paid for this.

16.58.3 Measurements

It shall be measured in cubic meters with Length of the finished work (for specified width and height of stone) shall be measured in running metre along the edge of the road correct to a cm.

16.58.4 Rate

The rate shall include the cost of all the materials and labour involved in all the operations described above

Mode of Measurement & Payment

The rate shall be for a unit of One cum.

Item no.114.

Providing and laying design mix cement concrete of M-30 grade, in roads/ taxi tracks/ runways, using cement content as per design mix, using coarse sand and graded stone aggregate of 40 mm nominal size in appropriate proportions as per approved & specified design criteria, providing dowel bars with sleeve/ tie bars wherever required, laying at site, spreading and compacting mechanically by using needle and surface vibrators, levelling to required slope/ camber finishing with required texture, including steel form work with sturdy M.S. channel sections, curing, making provision for contraction / expansion, construction & longitudinal joints (10 mm wide x 50 mm deep) by groove cutting machine, providing and filling joints with approved joint filler and sealants, complete all as per direction of Engineer-in-charge (Item of joint fillers, sealants, dowel bars with sleeve/ tie bars to be paid separately). Cement content considered in M-30 is @ 410 kg/cum. Cement concrete manufactured in automatic batching plant (RMC plant) i/c transportation to site in transit mixer.

Workmanship

16.36 CEMENT CONCRETE PAVEMENT (UNDER ORDINARY CONDITIONS)

Specifications of item below to be followed except that cement concrete of grade 1:2:4 or specified otherwise to be prepared and compacted.

16.37 CEMENT CONCRETE PAVEMENT UNDER CONTROLLED CONDITIONS

16.37.1 Materials

16.37.1.1 Cement

(a) Cement used on work shall be as per sub head cement concrete of CPWD specifications 2019 (Vol. – I).

16.37.1.2 Water : Water used on work shall conform to SH: cement concrete of CPWD, Specification 2019- Vol. I.

16.37.1.3 Coarse Aggregate : These shall be crushed or broken from hard stones obtained from approved quarry. These shall be clean strong, durable of fairly cubical shape and free from soft, friable, thin elongated and laminated disintegrated pieces. These shall also be free from dirt, organic deleterious and any other foreign matter and adherent coatings and shall satisfy the physical requirements laid down in para 16.37.19 under quality control.

16.37.1.4 Fine Aggregate : This shall be coarse sand conforming to CPWD Specification 2019 Vol. I. 16.37.1.5 Grading of Mixed Aggregates : The grading of all aggregates (coarse and fine aggregates) to be used in the work shall be determined in the laboratory. The coarse and fine aggregates shall be mixed in suitable proportions so that the grading of the mixed aggregates shall be in the range indicated in Table 16.32.

5 16.37.2 Mix Design

16.37.2.1 The mix shall be approved by Engineer-in- Charge so as to obtain the following mean strength that exceeds the minimum specified flexural strength by 1.64 times the designed standard deviation. Minimum works beam flexural strength at 28 days = 300 kg/sqm. For M-30 or specified in item Designed standard deviation = 60 kg/sqm. For M-30 or for specified grade(s) Design flexural strength at 28 days = $300+60 \times 1.64$ Water cement ratio by weight = 398.4 kg/sqm. $(f + 1.64 s)$ says 400 kg. Water cement ratio by weight = 0.5 Minimum slump not more than 25 mm

16.37.2.2 For the purpose of tendering the contractor shall base his rate on the assumption that the quantity of cement used for one cum. Of finished concrete shall be 340 kg. Or M - 30. If the actual quantity of cement required to be used as a result of the laboratory test is different from that assumed above, necessary adjustment in the cost due to short cement used shall be made on the basis of issue rate of cement including storage charges plus 2.5% for handling charges. However, under no circumstances the quantity of cement to be used shall either exceed 350 kg./cum or fall below 330 kg. Per cum of finished concrete.

16.37.3 Statistical Field Check

16.37.3.1 Samples of concrete shall be taken at the mixer and works beams, made, cured and tested in accordance with IS 1199 and IS 516.

16.37.3.2 When a mix is used for the first time, it is important to get a large number of results, as soon as possible, in order to establish the level of control and then suitability of the mix proportions. A sample of concrete shall be taken at random on eight separate occasions during each of the first five days of using that mix. From each sample two beams shall be made one for test at 7 days and the other for test at 28 days.

16.37.3.3 The work beam results shall be examined both individually and in consecutive (but not overlapping) sets of four, for which the average and the range of each set is calculated. The mix proportions shall be modified to increase the strength, if in the first ten consecutive (but not overlapping) sets any of the following conditions are not satisfied. (I) Each sample has a test strength not less than the minimum specified strength i.e. 30 kg/sq. Cm. (or otherwise specified in item). OR (II) (a) Not more than two individual results (Not more than one of first twenty) of the 40 beams tests shall fall below the minimum work beam strength but they shall not be less than 80% of the specified beam strength of 30 kg./sq. Cm (or otherwise specified in item) or the minimum specified strength minus 1.35 times the standard deviation whichever is greater. (b) No value of the range in any set shall exceed 3 times the designed standard deviation. (c) The average for all samples (10 sets) shall not be less than the minimum specified strength i.e. 30 kg/sq. Cm (or otherwise specified in item) plus 1.64 times the designed standard deviation 60 kg./sq.cm M-30.

16.37.3.4 If either of these conditions (16.37.3.3 I or 16.37.3.3 II) are not satisfied, the mix shall be modified and the procedure described above shall be repeated till results satisfying the above criterias are obtained.

16.37.3.5 Subsequently samples shall be taken at the rate of one for every 30 cubic metre of concrete laid. Eight beam specimen shall constitute one sample. A set of 4 specimen shall be tested after 7 days and another set of 4 specimen shall be tested after 28 days. These test results shall be checked individually and in sets of four as the work progresses. If at any stage it is found that either of conditions 16.43.4.3,I or 16.4.3,II are not satisfied, the overall average and the standard deviation of the previous consecutive 40 beam test results including the non-complying set shall be calculated. If the overall average strength minus 1.64 times the standard deviation is more than the specified beam strength (30 kgm/sq.cm) (or otherwise specified in item) the concrete shall be accepted. But if it is less than the concrete work corresponding to these 40 beams tests shall be rejected and the mix proportion shall be modified forth with for further work. The rejected work shall be replaced by the contractor immediately at his own cost and expense.

16.37.3.6 The statistical field checks described in 16.37.3.1 to 16.37.3.2 are meant to control the quality of concrete. The standard of acceptance of concrete shall be governed by the provision of para 16.37.3.3 to 16.37.3.5.

16.37.4 Slump Test The test shall be carried out as per IS 1199. A slump test shall be carried out at each mixer at least one in fifty batches mixed or more frequently if directed by the Engineer- in-Charge. Any batch from which slump test is being made shall not be transferred to the place of laying till the slump test has been completed. Not only the batch which gives a slumps in excess of that specified shall be rejected but the concrete already laid immediately preceding the batch tested upto the nearest last transverse joint may be rejected by the Engineer-in-Charge or his subordinate, if he is satisfied that such preceding batches were substandard in this respect. The decision of the Engineer-in-Charge in this respect shall be final and binding on the contractor. Such rejected concrete shall be removed by the contractor immediately and replaced with proper slump concrete at his cost and expense.

16.37.5 Steel Forms

16.37.5.1 All side forms shall be of mild steel. The steel forms shall be of M.S. Channel sections and their depth shall be equal to the thickness of the pavement.

16.37.5.2 The side forms shall have a length of at least 3.0 metres except on curves of less than 4.5 metres radius where shorter lengths may be used. When set to grade and stacked in place the maximum deviation of the top surface of any section from a straight line shall not exceed 3 mm. The method of connection between sections shall be such that the joint formed shall be free from play or movement in any direction. The use of bent, twisted or worn out forms shall not be permitted. At least three stake pockets for bracing pins or stakes shall be provided for each 3.0 M length of forms. Bracing and supports must be ample to prevent the springing of forms under pressure of concrete or weight or thrust of the machinery (like screed vibrator) operating on the forms. Support to the forms shall be sufficiently rigid to hold them in position during the entire operation of laying and compacting and finishing and that they shall not at any time deviate more than 3 mm from straight edge 3 metres in length. Forms which show a variation from the required rigidity of the alignment and levels shown on the plans shall be reset or removed as directed. The length and number of pins or stakes shall be such as to maintain the forms at the correct line and grade.

16.37.5.3 The supply of forms shall be sufficient to permit their remaining in place for at least 12 hrs. After the concrete has been placed or longer, if in the opinion of the Engineer-in-Charge, it is necessary.

16.37.5.4 The top line of the forms is not to vary from the correct level or alignment and the levels and alignment of the forms are to be checked and corrected as necessary immediately prior to the placing of concrete. The top edges and faces of the forms are to be carefully cleaned and maintained in clean condition.

16.37.5.5 While removing the steel forms, care shall be taken to withdraw them gradually, any damage to the bull nosed edges shall be made good while the concrete is still green.

16.37.5.6 Setting of Forms (a) Setting of forms shall be according to the slab plan subject to the approval of Engineer-in-charge and concreting shall not commence until the setting of forms is approved. (b) Forms shall be set for at least 50 metres in advance of the point where the concrete is being laid and shall not be removed until at least 12 hrs. Of placing of the concrete or longer if in the opinion of Engineer-in-Charge is necessary. (c) After setting, the working faces shall be thoroughly oiled by using approved oil before concrete is placed against them. (d) The pavement joints of overlay layer would overlap with the joints of underlay cement concrete. 16.37.6 Batching and Mixing As detailed in SH: 5 of reinforced cement concrete work of CPWD specifications 2019.

16.37.7 Placing of Concrete As detailed in SH: 5 of reinforced cement concrete work of CPWD specifications 2019.

16.37.8 Compaction of Concrete

16.37.8.1 Compaction shall be carried out by electrically (or) diesel operated needle and screed vibrators as stipulated hereafter. Needle vibrator should be used all over the area for obtaining initial compaction of concrete. These should be of diameter not less than 4.5 cm. If the vibrator are pneumatic the pressure must not be below 4 kg/sq.cm. If electrically operated, they should have a minimum frequency of 3500 impulses per minute.

16.37.8.2 There should be at least three needle vibrators working in any bay. A vibrating screed consisting of a steel or timber section weighing not less than 15 kg. Per metre with a tamping edge of not less than 7 cm width and having a vibrator mounted thereon shall follow needle vibrators to obtain full compaction. The face of the wooden tamping edge of the screed shall be lined with M.S. Plate rigidly fixed by means of counter sunk screw. Where screed vibrators are used for compaction, a standby unit shall always be maintained ready for use, should the other one go out of order. Where electrically driven vibrators are employed, a standby diesel pneumatic unit shall be kept ready for use in case of power failure. At the discretion of the Engineer-in-Charge, for compaction at edges and joints, vibrators may be supplemented by hand tamping and rodding for securing satisfactory results. Under no circumstances, honey combing of concrete at joints or elsewhere shall be permitted.

16.37.8.3 When using screed vibrator for compaction it should not be dragged over the concrete. During the initial passes it shall be lifted to the adjacent forward position in short steps, subsequently, it shall be slowly slid over the surface with its axis slightly tilted away from the direction of sliding and the operation repeated until a close, dense surface is obtained.

16.37.8.4 Concreting shall be carried out in one operation between the expansion joints and construction joints without any break at the dummy joints.

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16.37.8.5 Concrete shall be deposited on the base as near the joints as possible without touching them. It shall then be shoveled against the sides, maintaining equal pressure and deposited approx. 50 mm higher than the depth of the joints, care being taken that it is worked well around the joints. The concrete shall not be dumped from the bucket directly upon or against the joints.

16.37.8.6 Workmen shall not be allowed to walk on freshly laid concrete and proper cat walk shall be provided with independent supports beyond concreting bays.

16.37.9 Finishing of Concrete

16.37.9.1 During compaction, any low or high spots shall be made up by adding or removing concrete. After longitudinal floating has been completed but while concrete is still plastic, the slab surface shall be tested for trueness with a 3 m straight edge. Any depressions or high spots showing departure from the true surface shall be immediately rectified. High spots shall be cut down and refinished. Depressions shall be enlarged to about 8-10 cm and filled up with fresh concrete, compacted and finished.

16.37.9.2 The straight edge testing the refloating is to continue until the entire surface: (a) is free from observable departure from the straight edge, (b) conforms to the required levels and across section, and (c) shall conform to the specified surface when the concrete has hardened.

16.37.9.3 The foregoing work is to be carried out while the concrete is still plastic and workable.

16.37.10 Belting

16.37.10.1 Just before concrete becomes non-plastic, the surface shall be belted with a two ply canvas belt not less than 20 cm wide and at least 1 metre longer than the width of the slab. Hand belts shall have suitable handles to permit controlled uniform manipulation. The belt shall be operated with short strokes transversed to the centre line of the pavement and with rapid advance parallel to the centre line.

16.37.11 Brooming

16.37.11.1 After belting and as soon as the surplus water, if any, has risen to the surface, the pavement shall be given a broom finish with an approved steel or fiber broom not less than 45 cm wide. The broom shall be pulled gently over the surface of the pavement from edge to edge. Adjacent strokes shall be slightly overlapped. Brooming shall be perpendicular to the centre line of the pavement and so executed that the corrugations formed shall be uniform in character and width and not more than 1.5 mm deep.

16.37.11.2 Brooming shall be completed before the concrete reaches such a stage that the surface is likely to be torn or unduly roughened by the operation. The broomed surface shall be free from porous or rough spots, irregularities, depressions, and small pockets such as may be caused by accidental disturbing of particles of coarse aggregates embodied near the surface. The brooming shall be of uniform pattern all through.

16.37.11.3 Edging : After belting/brooming has been completed but before the initial setting of concrete, the edges of the slab shall be carefully finished with an edger of 6 mm radius, and the pavement edges shall be left smooth and true to line.

16.37.12 Honey Combing

16.37.12.1 The side forms shall not be removed until 12 hours or such longer period as the Engineer-in-Charge may decide after the laying of concrete.

16.37.12.2 As soon as the side forms are removed, any minor honey combed area shall be filled with mortar composed of one part of cement and two parts of fine aggregate. Major honey combing areas or segregated concrete or other defective work or areas damaged by removal of the forms or concrete damaged by rain or due to any other reason whatsoever shall be considered as defective work and shall be removed and replaced by the contractor at his own expense. The total area of honey combed surface shall not exceed 4 per cent of the area of the slab side. However, no individual honeycomb patch shall exceed 0.1 sqm. Engineer-in-Charge's decision as to whether the concrete is defective or not shall be final and binding.

16.37.13 Surface Accuracy

16.37.13.1 After the concrete has sufficiently hardened after about 12 hours and not later than 24 hours, the surface shall be tested again for high spots. All high spots shall be marked and those exceeding 3 mm shall be ground down immediately. Care shall be taken to see that the grinding does not in any way damage the concrete surface.

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16.37.13.2 The final surface finish is to be such that when tested with a profilograph/roughness indicator/or a 3 metre long straight edge or an equivalent mechanical unevenness indicator placed anywhere within the same or adjoining slab in any direction on the surface, there shall be no variation greater than 3 mm.

16.37.13.3 If the surface irregularity exceeding 3 mm still remains despite grinding as per para 16.37.13.2 the concrete shall be removed to its full depth. The area of concrete to be removed shall be complete slab between the nearest joints, where the defective slab is less than 4.5 metres from the expansion joint, the whole area upto the expansion joint shall be removed to the full depth. The concrete so removed shall not be reused in the work. Fresh concrete shall be laid in the manner already de-scribed in above paras and shall again be subject to test for surface accuracy and other quality control measures. Nothing extra shall be paid on this account.

16.37.13.4 Every slab shall bear an impression not exceeding 3 mm in depth comprising the number allotted to the slab and the date on which it is laid. This impression shall be formed by the contractor when the concrete is green so as to leave permanent mark on setting.

16.37.13.5 Initial Curing

16.37.13.5.1 Immediately after completion of the finishing operations, the surface of the pavement shall be entirely covered with wetted burlap, cotton or jute mats. The mats used shall be of such length (or width) that as laid they shall extend at least 45 cm beyond the edges of the slab. The mats shall be placed so that the entire surface and both edges of the slab are completely covered. This covering shall be placed as soon as, in the judgment of the Engineer- in-Charge the concrete has set sufficiently to prevent damage to the surface prior to being placed, the mats shall be thoroughly saturated with water and shall be placed with the wettest side down. The mats shall be so placed and weighed down as to cause them to remain in intimate contact with the surface covered, and the covering shall be maintained full wetted and in position for 24 hours after the concrete has been placed or until the concrete is sufficiently hard to be walked on without suffering damage. Water shall be gently sprayed so as to avoid damage to the fresh concrete. If it becomes necessary to remove a mat for any reason, the concrete slab shall not be exposed for a period of more than half an hour.

16.37.13.5.2 Worn burlap or burlap with holes shall not be permitted. Burlap reclaimed from previous use other than curing concrete shall be thoroughly washed prior to use for curing purposes. If burlap is obtained in strips, shall be laid to overlap by at least 150 mm.

16.37.14 Burlap shall be placed from suitable bridges. Walking on freshly laid concrete to facilitate placing burlap shall not be permitted.

16.37.15 Final Curing

16.37.15.1 Upon the removal of the burlaps, the slab shall be thoroughly wetted and then cured as follows:- All joints shall be filled with filler in order to prevent the edges of joints from getting damaged and entry of clay materials into the joints during final curing. Exposed edges of the slab shall be banked with a substantial berm of earth. Upon the slab shall then be laid a system of transverse and longitudinal dykes of clay about 50 mm high immediately covered with a blanket of sandy soil free from stones to prevent the drying up and cracking of clay. The rest of slab shall then be covered with sufficient sandy soil so as to produce a blanket of earth not less than 40 mm deep after wetting. The earth covering shall be thoroughly wetted while it is being placed on the surface and against the sides of the slab and kept thoroughly saturated with water for 21 days and thoroughly wetted down during the morning of the 22nd day and shall thereafter remain in place until the concrete has attained the required strength and permission is given by the Engineer-in-Charge. Thereafter the covering shall be removed and the pavement cleaned and swept. If the earth covering becomes displaced during the curing period, it shall be replaced to the original depth and resaturated.

16.37.15.2 Contractor shall appoint chowkidars at his expense to prevent workmen, cattle, etc., straying on the pavement concrete.

16.37.15.3 Concrete shall not be subjected to any load or weight of any plant until at least 28 days after laying.

16.37.16 Construction Joints

16.37.16.1 Construction joints shall be provided as shown in the drawing and also at places where concreting is stopped due to unforeseen circumstances. The joints shall be straight and vertical through the full thickness of the slab. While concrete in adjacent bay is still green, flats of suitable size shall be drawn along the edge and a groove of size 10 mm × 25 mm deep shall be neatly formed and finished. The edges of the groove shall be full nosed. After curing of concrete is complete, this groove shall be thoroughly cleaned of all sand dust and shall be perfectly dried and filled with hot poured sealing compound conforming to grade B of IS 1834. Before filling with sealing compound the faces of concrete of the joint shall be coated with primer of approved brand to a depth of 25 mm at the rate of 2.6 liters per 10 square meters. Bitumen emulsion shall not be used as primer. 16.37.17 Dummy Joints

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16.37.17.1 The joints shall be 10 mm wide and shall extend vertically from the surface of the slab to a depth equal to 1/3rd of the thickness of the slab but not less than 4 cm in any case. The joint may be formed by depressing into the soft but compacted concrete a high tensile M.S. or other approved Tee or flat bar of depth not less than required depth of the joint plus 25 mm. The bar used for forming the groove shall be coated with soft soap or other suitable lubricant to facilitate its removal when the steel Tee or flat is removed joints shall be neatly formed with proper tools and mortar/fine material from the slab itself. No additional cement mortar (rich or otherwise) shall be used. 16.37.17.2 Cutting or sawing by a saw mounted on a movable frame and driven mechanically shall also be permitted as a method for making the joint. In this case the width may be reduced to 6 mm. Any other method for making joints can be followed with the prior approval of the Engineer-in-Charge.

16.37.17.3 In all cases, except where cutting is done with saw, the joint edges shall be bullnosed. Care should be taken to see that the edges of the grooves are not damaged.

16.37.17.4 The grooves shall be filled with hot poured sealing compound conforming to Grade B of IS:1834. Prior to filling with sealing compound, the joints shall be cleaned by compressed air and primed with Shalijet primer or equivalent at the rate specified in Para 16.37.16.1

16.37.17.5 All joints shall be sealed as soon as practicable after 28 days of casting of cc pavement. Joints shall be sealed flush with the adjacent pavement surface in summer and 3-4 mm below finished concrete surface in winter. The pavement shall be opened to traffic only after joint sealing over the entire pavement. To prevent tackiness or pickup under traffic, the exposed surfaces of the sealing compound shall be dusted with hydrated lime, if directed by Engineer-in-Charge, for which nothing extra shall be paid to the contractor.

16.37.17.6 In case of sudden rain or storm, the work can be concluded at the dummy joints but these will then be formed as construction joints.

16.37.17.7 Before sealing of joints, it may be ensured that the groove extends fully across the bay between consecutive longitudinal joints, in the case of transverse joints and is continuous in the case of longitudinal joints. Any concrete or other foreign matter must be removed from the groove.

16.37.18 Concreting during Rains

16.37.18.1 To prevent damage to freshly laid concrete during monsoon, or sudden rains, the contractor shall provide an adequate supply of tarpaulins or other water proof covering material. Any concrete damaged by rain shall be removed and replaced by the contractor at his own cost as directed by the Engineer-in-Charge.

16.37.19 Quality Control The following quality control tests shall be carried out at frequencies specified against each as in Table 16.33.

16.37.20 Equipments

16.37.20.1 Equipments as per list at Appendix C shall be provided by the contractor in the field testing laboratory. Nothing extra shall be paid to him on this account. Records as required shall be maintained at site. All tests details in support of mix design shall be maintained as part of records of the contract and shall be signed both by the contractor and the Engineer-in-Charge. The contractor shall provide all labour, materials and equipment required for all tests to be carried out at his own cost.

16.37.20.2 The Engineer-in-Charge reserves the right to test any part of concrete laid regarding quality soundness, compactness, thickness, strength and finish of the concrete, at any time before the expiry of the "Defect liability period" notwithstanding that necessary tests had been carried out and found satisfactory at the time of execution.

S.No	Test	Test Method	Frequency	Acceptance Criteria
1	2	3	4	5
(i)	COARSE AGGREGATE	(a) Flakiness index IS 2386 (Pt.1) Before approval of the quarry and at every subsequent change in the source of supply and one test per 100 cum of aggregates	Not more than 15%	(b) Impact value IS 2386 (Pt.4) -do- Not more than 30% (c) Los angles abrasion value. IS 2386 (Pt.4) -do- Not more than 40% (d) Deleterious materials. IS 2386 (Pt.2) Before approval of the quarry and at every subsequent change in the source of supply As per table 1 of IS 383 (e) Moisture content. IS 2386 (Pt.3) Regularly as required subject to a min. One test per day -do- (ii) FINE AGGREGATES (a) Silt content. CPWD specifications 2019, Vol. I, SH: CC One test per 15 cum Not more than 8% (b) Gradation of sand IS 2386 (Pt.1) -do- Fineness modulus between 2.5 to 3.9 (c) Deleterious materials. IS 2386 (Pt.2) Before approval of the quarry and at every subsequent change in the source of supply As per table 1 of IS 383 (d) Moisture content. IS 2386 (Pt.3) Regularly as required subject to a min. 2 test/day -do- (iii) MIXED AGGREGATES (a) Grading IS 2386 (Pt. 1) 1 test per 15 cum As per para 16.37.1.5 (iv) Slump test of concrete IS 1199 At least once in 50 batches at each mixer or more frequently if directed by the Engineer-in-Charge Not more than 25 mm (v) Flexural strength IS 516 One test of sample consisting of eight specimen for every 30 cum of concrete As per para 16.37.3.5. (vi) Surface accuracy As prescribed Regularly As per para 16.37.13

TABLE 16.33

16.37.20.3 All defective unsound sub-standard work and concrete of sub-standard strength and quality etc. As established vide paras 16.37.3 shall be rejected and shall be replaced by the contractor at his own expense in the manner as detailed in para 16.37.3. Where due to operational or any other reason such replacement does not become possible (decision of Engineer-in-Charge in this respect being final and binding on the contractor), the cost of removal and replacement of such rejected work shall be recovered from the contractor whether such rejected work is subsequently replaced by the Government or not.

16.37.21 Defects Liability Period

16.37.21.1 This period shall be reckoned in the case of this work as one year from the date of completion of work and it shall be the liability of the contractor to repair, strengthen or reconstruct any portion of the work which has shown damage or any defect, arising out of any bad workmanship or defective material used in the work during this period. In the case of this rectification not being commenced by the contractor within 7 days from the date of notice from the Engineer-in-Charge and completed expeditiously the Engineer-in-Charge reserves the right to get the repair work executed at the risk and cost of the contractor. 1

6.37.22 Measurements

16.37.22.1 For the purpose of ascertaining the quantity of concrete in the pavement, thickness shall be measured by means of a scale correct to the nearest 2 mm. The thickness of the concrete pavement slabs shall be taken on either side of the pavement at each dummy joint at four corners of the slab immediately after removal of the side forms. In case the average thickness of the slab exceeds the specified thickness, payment shall be restricted to the specified thickness.

16.37.22.2 The dimensions of each slab of pavement shall be measured as follows to the nearest 5 mm. (a) Length (i) Between the end of a pavement to the centre line of the expansion joints. (ii) Between the centre lines of consecutive expansion joints. (b) Width (i) Between the edge of a pavement and the centre line of the construction joints. (ii) Between the centre lines of construction joints and expansion joints. (iii) Between the centre lines of consecutive construction joints. Note : The quantity of concrete in the pavement slab shall be worked out by multiplying the area of the slab and its average thickness or specified thickness whichever is less. No deduction shall be made for any joints in the concrete slab.

16.37.22.3 Measurements of concrete slabs shall be recorded jointly by the Engineer-in-Charge or his authorised subordinate and the contractor or his authorised agent.

16.37.23 Rate The rate of the item for concrete in pavement shall include the cost of all materials and labour including charges for machinery tools & plants required in all the operations described above. The rate also includes all cost of setting up the laboratory at site and carrying out the quality control measures/tests enumerated above by the contractor at his own cost in the presence of Engineer-in-charge or his authorized representative and submission of test results on completion of tests to the Engineer-in-Charge thereof

Mode of Measurement & Payment

The rate shall be for a unit of One cum.

Item no.115.

Parking Signs :-Providing and fixing sing boards made out of 2mm aluminium sheet; size 60 x 60cms. Square plus 60 x 20cms rectangular additional plate as as per the design of IRC-67-1977 pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T.Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends.the details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. For each leg. Including excavation curing etc. Complete under the supervision of engineer in charge.(A) Engineer Grade(VR)

Workmanship

Material

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Providing and fixing parking signs made of 2mm aluminium sheet, including reflectorized retro reflective sheeting as per M.O.S.T. specifications, including suitable stand posts and frames. Shall be made with 2mm thick aluminium sheet with Square board: 60 x 60 cm with epoxy primer and paint with Rectangular additional plate: 60 x 20 cm, along with retro reflective sheeting, use iron angle for stand posts and frames fix in 1:2:4 CC blocks for foundation. IRC-67-1977 for sign board design and M.O.S.T. specifications for reflectorization., aluminium sheet should be Pre-treated with phosphating process and acid etching and One coat of epoxy primer and Two coats of best quality epoxy paint. Apply retro reflective sheeting as per latest M.O.S.T. Angle size should be 35 x 35 x 3 mm for angles, 75 x 75 x 6 mm for bends with proper Paint with best quality epoxy coatings in black and white colors. And 3.1 meters long for stand posts.

Excavate pits for each leg of the stand post and Concrete shall be 1:2:4 CC blocks of size 45 x 45 x 60 cm for each leg. Fix the sign boards securely on the stand posts as per the instruction of the engineer-in-charge. Install under the supervision of the engineer-in-charge, ensuring proper alignment and installation quality. Cure the foundation and any concrete work as per standard curing practices.

Mode of Measurement & Payment

The rate shall be for a unit of each.

Item no. 116

Providing and fixing retro Reflective Engineering grade Board using C.R.C. (M.S.) Sheet 2mm, angle iron 75 x 75 x 6mm. Descaling and degreasing the board as per requirement using epoxy primer epoxy paint and carrying retro reflective process by screen painting as directed etc. Complete including transporting and fixing in C.C. 1:4:8 with necessary excavation curing etc. Complete as per I.R.C type design. (A) Engineer Grade

Workmanship

Material

CRC (M.S.) sheet, angle iron, epoxy primer, epoxy paint, retro reflective screen paint, concrete (C.C. 1:4:8).

In Board Fabrication board shall be CRC (M.S.) sheet 2mm thick for the board with Descale and degrease the board surface as required including epoxy primer to the descaled and degreased surface and epoxy paint over the primer. Angle iron shall be size 75 x 75 x 6mm for framing the board. It will be Prepare and paint the angle iron frame with epoxy coatings.

Excavate pits for each board location. Concrete Mix shall be use C.C. 1:4:8 (cement:sand:aggregate) for the foundation and Securely fix the retro reflective engineering grade boards onto the angle iron frame and install them in the concrete foundation.

Mode of Measurement & Payment

The rate shall be for a unit of each.

Item no. 117

Facility Informatory Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 80 x 60 cms rectangular as per design of IRC-67-2012. Pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with Micro Prismatic Grade retro reflective sheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T. Specifications; 3.6mtr long stand post of 75 x 75 x 6mm / 65NB Circular MS Pipe

As required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with best quality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 Cms. For each leg, including excavation, curing etc. complete under the supervision of engineer in charge. A warranty for 10 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (A) Class-C Type-11 Retro Reflective sheeting

Workmanship

Material : Rectangular 80 x 60 cm -2mm aluminium sheet or 4mm ACP with Pre-treated with phosphating process and acid etching and one coat of epoxy primer, epoxy paint, and for Reflectorization shall be use micro prismatic grade retro reflective sheeting (Type-11 as per ASTM D-4956 and latest M.O.S.T. specifications), 75 x 75 x 6mm angle iron or 65NB circular MS pipe, 35 x 35 x 3mm angle iron, foundation concrete block shall be mix concrete 1:2:4 (1:2:4 CC block). Post shall be 3.6 meters long 75 x 75 x 6mm angle iron or 65NB circular MS pipe and size 35 x 35 x 3mm

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angle iron for frame fabrication with Paint angle iron components with best quality epoxy coatings in black and white colors.- Excavate pits for each leg of the stand post. Concrete Mix shall be Use 1:2:4 CC block (cement:sand:aggregate) for the foundation Securely fix the sign boards onto the stand posts and install them in the concrete foundation.

Mode of Measurement & Payment

The rate shall be for a unit of each.

Item no. 118

Painting road surface marking with adequate nos of coats to give uniform finish with ready mixed road marking paint conforming to IS : 164, on bituminous surface in white/yellow shade, including cleaning the surface of all dirt, scales, oil, grease and foreign material etc.complete. New work (Two or more coats)

1.0. Materials

1.1. Ready mixed the Japan paint shall conform to I.S.341-1952.

2.0. Workmanship

2.1. The letters and figures shall be to the heights and widths as per approved drawings or as directed. These shall be stenciled or drawn in pencil and got approved before painting. They shall be of uniform size and finished neatly. The edges shall be straight or in pleasant smooth curves,

3.0. Mode of measurements and payment

3.1. The rate shall be for a unit of sqm.

Item no.119

Earthwork for embankment including breaking clods,dressing with all lead and lift and including watering rolling and consolidation of subgrade in layers at O.M.C.to required dry density including filling the depression which occur during the process using power roller 8Tto10T. (E) From Borrow area within all lead.

1.2. General

1.3. The earth filling shall be free from all roots, grass, shrubs, rank vegetation, brushwood, tress, sapling and rubbish..

2. Embanking

Filling with earth shall be done in regular horizontal layers each not exceeding 20 cm in depth. All lumps and clods exceeding 8 cm in any direction shall be broken. Each layer shall be watered and consolidated with steel rammer or ½ tonne roller. Where specified, every third and top must layer shall also be consolidated with power roller of minimum 8 tonnes. Wherever depth of filling exceeds 1.5 metre vibratory power roller shall be used to consolidate the filing unless otherwise directed by Engineer-in-charge. The top and sides of filling shall be neatly dressed. The contractor shall make good all subsidence and shrinkage in earth fillings, embankments, traverses etc. During execution and till the completion of work unless otherwise specified.

3Mode of measurements & payment

The length and breadth of excavation or filling shall be measured with a steel tape correct to the nearest cm. The depth of cutting or height of filling shall be measured, correct to 5 mm, by recording levels before the start of the work and after the completion of the work. The cubical contents shall be worked out to the nearest two places of decimal in cubic metres..

The rate shall be for a unit of one cubic meter

Item no. 120

Carriage of materials including Loading, unloading and stacking complete. Earth for an average distance of 25 KM

Material and Workmanship

The carriage and stacking of materials shall be done as directed by the Engineer-in- Charge.

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Any tools and plants, required for the work shall be arranged by the Contractor. The carriage of materials includes loading within a lead of 50 metres, unloading and stacking within a lead of 50 metres.

1.1 RESPONSIBILITY FOR LOSS OR DAMAGE Loading, carriage, unloading and stacking shall be done carefully to avoid loss or damage to the materials. In case of any loss or damage, recovery shall be effected from the Contractor at twice the Departmental issue rates of the materials. If the departmental issue rates of the materials are not available then the recovery shall be effected at twice the prevailing market rates as determined by the Engineer-in-Charge.

1.2 MODE OF CARRIAGE Depending upon the feasibility and economy, the Engineer-in -Charge shall determine the mode of carriage viz. Whether by mechanical or animal transport or manual labour.

1.3 LEAD

1.3.1 All distances shall be measured over the shortest practical route and not necessarily the route actually taken. Route other than shortest practical route may be considered in cases of unavoidable circumstances and as approved by Engineer-in-Charge alongwith reasons in writing.

1.3.2 Carriage by manual labour shall be reckoned in units of 50 metres or part thereof.

1.3.3 Carriage by animal and mechanical transport shall be reckoned in one km unit. Distances of 0.5 km or more shall be taken as 1 km and distance of less than 0.5 km shall be ignored. However, when the total lead is less than 0.5 km, it will not be ignored but paid for separately in successive stages of 50 metres subject to the condition that the rate worked on this basis does not exceed the rate for initial lead of 1 km by mechanical/ animal transport

3.0. Mode of measurements and payment

3.1. The rate shall be for a unit of cum.

Item no. 121

Supplying and stacking at site dump manure from approved source, including carriage (manure measured in stacks will be reduced by 8% for payment) : Screened through sieve of I.S. designation 20mm

1. General:

Manure to be screened through a sieve of I.S. designation 20mm. Manure must be free from contaminants and harmful substances detrimental to plant growth. Stack the manure neatly at designated areas on-site.

2.. Measurement and Payment: Measurement based on the volume of manure stacked at the site .

The rate shall be for a unit of one cubic meter

Item No. 122

Fine dressing of the ground

"Fine dressing of the ground" typically refers to the process of preparing the ground surface to achieve a smooth and even finish. This is often done in preparation for various types of construction, landscaping, or agricultural activities. Here's a detailed outline of what it involves:

Workmanship

Clear the area of debris, vegetation, rocks, and any other obstructions. Ensure the sub-grade is properly compacted and leveled to the desired elevation. Address any soil irregularities or high spots by scraping or adding appropriate soil materials Ensure the surface is uniformly leveled to avoid any depressions or unevenness

Mode of Measurement & Payment

The rate shall be for a unit of one sqm.

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Item no.123.

Spreading of sludge, dump manure and / or good earth in required thickness as per direction of Engineer -in-charge (Cost of sludge, dump manure and / or good earth to be paid separately).

Workmanship

Use dump manure screened through a sieve of I.S. designation 20mm to ensure quality and suitability for agricultural or landscaping purposes. Utilize appropriate equipment such as bulldozers, graders, or loaders for efficient spreading. Maintain a smooth and even surface by properly grading and leveling the spread material

Mode of Measurement & Payment

The rate shall be for a unit of cum.

Item no.124.

Mixing earth and sludge or manure in the required proportion specified or directed by the Engineer -in-charge.

Workmanship

Use suitable equipment such as bulldozers, loaders, or hand mixers capable of handling the required volume and ensuring thorough blending. Layer earth and sludge/manure alternately in the mixing area to facilitate even distribution during mixing.

Mode of Measurement & Payment

The rate shall be for a unit of cum.

Item no.125.

Grassing with selection No.1 grass including watering and maintenance of the lawn for 30 days or more till the grass forms a thick lawn, free from weeds and fit for mowing including supplying good earth, if needed -With grass Turf

Workmanship

Grassing with selection No.1 grass including watering and maintenance of the lawn for 30 days or more till the grass forms a thick lawn, free from weeds and fit for mowing including supplying good earth, if needed -With grass Turf

Mode of Measurement & Payment

The rate shall be for a unit of sqm.

Item no.126.

Preparation of beds for hedging and shrubbery by excavating 60 cm deep and trenching the excavated base to a further depth of 30 cm, refilling the excavated earth after breaking clods and mixing with sludge or manure in the ratio of 8:1 (8 parts of stacked volume of earth after reduction by 20% : one part of stacked volume of sludge or manure after reduction by 8%), flooding with water, filling with earth if necessary, watering and finally fine dressing, leveling etc. including stacking and disposal of materials declared unserviceable and surplus earth by spreading and leveling as directed, within a lead of 50 m, lift up to 1.5 m complete (cost of sludge, manure or extra earth to be paid for separately).

Workmanship

Excavate the area to a depth of 60 cm using appropriate earthmoving equipment. Fill the excavated area with the earth removed, ensuring it is broken down into smaller clods for easier mixing. Mix sludge or manure in the ratio of 8:1 with the stacked volume of earth (after reduction by 20% for payment purposes). This ensures organic enrichment and fertility improvement. Flood the area with water to settle the soil and facilitate proper blending of the earth and organic materials and Water the mixed bed thoroughly to ensure moisture penetration throughout the prepared area. After watering, perform fine dressing by leveling the surface evenly to create a smooth and uniform bed. Use appropriate tools to achieve the desired slope or contour as per landscape design requirements. Dispose of any unserviceable materials such as large clods, debris, or surplus earth. Stack and spread surplus earth as directed within a lead of 50 meters and up to a lift of 1.5 meters, ensuring proper leveling and compaction.

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Mode of Measurement & Payment
The rate shall be for a unit of cum.

Item no.127.

Supplying & Stacking of Selection No.1 doob grass turf at site fresh & free from weeds having proper roots in green including loading, unloading, carriage and all taxes paid etc.and as per direction of Engineer - in -charge.

Workmanship

Supplying & Stacking of Selection No.1 doob grass turf at site fresh & free from weeds having proper roots in green including loading, unloading, carriage and all taxes paid etc.and as per direction of Engineer - in -charge.

Mode of Measurement & Payment
The rate shall be for a unit of sqm.

Item No. 128

Providing and fixing white vitreous china pedestal type water closet (European type) with seat and lid, 10 litre low level white vitreous china flushing cistern & C.P. flush bend with fittings & C.I.brackets, 40 mm flush bend, overflow arrangement with specials of standard make and mosquito proof coupling of approved municipal design complete, including painting of fittings and brackets, cutting and making good the walls and floors wherever required : :W.C. pan with ISI marked white solid plastic seat and lid

Materials

White vitreous china pedestal type water closet (European type) with seat and lid shall conform to M-. Cement mortar shall conform to M-11.

2.0. Workmanship

2.1. The closet shall be fixed to the floor by means of 75 mm. Long 6.5 mm. Diameter counter sunk bolts and nuts embedded in the floor concrete using rubber or before washers so as not to allow any lateral displacement The joint between the trap of W.C. and soil pipe shall be made with C M. 1:1 (1 cement : 1 fine sand). 10 litre low level white vitreous china flushing cistern & C.P. flush bend with fittings & C.I.brackets, 40 mm flush bend, overflow arrangement with specials of standard make and mosquito proof coupling of approved municipal design complete, including painting of fittings and brackets, cutting and making good the walls and floors wherever required

3.0. Mode of measurements and payment

3.1. The rate shall include the cost of all materials and labour involved in all the operations described under workmanship.

3.2. The rate includes cost of all labour for fixing pans and seat and cover, inlet, connections etc. Complete including testing the same. The payment of seat and cover shall be made separately.

The rate shall be for a unit of One number.

Item No. 129

Providing and fixing white vitreous china wall mounting water closet of size of approved shape including providing & fixing coneled cistern with dual flush fitting, of flushing capacity 2 litre/ 4 litre (adjustable to 4 litre/8 litres), including seat cover, and cistern fittings, nuts, bolts and gasket etc complete.

Materials

White vitreous china wall mounting water closet shall conform to M-. Cement mortar shall conform to M-11.

2.2. Workmanship

2.3. Fixing coneled cistern with dual flush fitting, of flushing capacity 2 litre/ 4 litre (adjustable to 4 litre/8 litres), including seat cover, and cistern fittings, nuts, bolts and gasket etc complete before washers so as not to allow any lateral displacement The joint between the trap of W.C. and soil pipe shall be made with C M. 1:1 (1 cement : 1 fine sand).

3.3. Mode of measurements and payment

3.4. The rate shall include the cost of all materials and labour involved in all the operations described under workmanship.

3.5. The rate includes cost of all labour for fixing pans and seat and cover, inlet, connections etc. Complete including testing the same. The payment of seat and cover shall be made separately.

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The rate shall be for a unit of One number

Item No. 130

Providing and fixing white vitreous china battery based infrared sensor operated urinal of approx. Size 610 x 390 x 370 mm having pre & post flushing with water (250 ml & 500 ml consumption), having water inlet from back side, including fixing to wall with suitable brackets all as per manufacturers specification and direction of Engineer-in-charge.

Materials: The white vitreous china battery based infrared sensor operated urinal of approx. Size 610mm. X 390 mm.x370 mm.

Workmanship

2.0. The urinals shall be fixed in position by using wooden plugs and screws and shall be at a height 65 cms. From the Moor level to the top of the lip of urinal, unless otherwise directed. The wooden plugs shall be of 50 mm. X 50 mm. At base tapering to 38 mm. X 38 mm. At top 50 mm. In length shall be fixed in wall in steel waste pipe which shall discharge in the channel or floor a tap. The connection between the urinal and flush or waste pipe shall be made by means of putty or white lead mixed with chopped hemp.

3.0. Mode of measurements and payment

3.1. The rate shall includes cost all labours, materials, tools and plants etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One number

Item No. 131

Providing and fixing white vitreous china wash basin under counter basin, with including 32 mm CP brass waste coupling, including painting of fittings and brackets, cutting and making good the walls wherever required all complete.

1.0. Materials

1.1. The white vitreous china wash basin under counter basin shall be 550 mm. X 400mm. Of 1st quality and make as approved by the Engineer-in-charge. The wash basin shall conform to IS-59.

2.0. Workmanship

2.1. The washbasin shall be fixed on the wall as and where directed. The wash basin shall be supported on a pair of M.S. or C.I. brackets fixed in C.M. 1:3 (1 cement : 3 sand). The bracket shall conform to I.S. : 775-1962. The wall plaster on the rear shall be cut to rest the top edge of the washbasin. After fixing the basing, plaster shall be made good and surface finished to match the existing one.

2.2. The brackets shall be painted white with ready-mixed paint.

2.3. The C.I. brass trap and union shall be connected to 32 mm. Dia. Waste pipe which shall be suitably bent towards the wall and which shall discharge into an open drain leading to a gully trap or direct in to gully-trap on the ground floor and shall be connected to a waste pipe through a floor trap on the upper floors. C.P. brass trap and union may not be provided where the surface drain or a floor trap is placed directly under the basin and the waste is discharged in to vertically.

2.4. The height of the front edge to the wash basin from the floor level shall be 80cms.

2.5. The necessary inlet, outlet connections and fittings such as pillar cocks, CP dress waste trap waste pipe, stop cock, chain wish rubber plug etc. Shall be fixed.

2.6. The payment of fittings shall be made separately under separate items.

Mode of measurements & payment

3.0. The rate includes cost of all labour, materials, tool3 and plant etc. Required for satisfactory completion of this item as specified in workmanship.

3.1. The rate shall be for a unit of One number.

Item No. 132

Providing and fixing 32mm C.P brass bottle Trap of approved quality & make as per the direction of engineer-in-in charge.

Materials :The 32mm C.P brass bottle Trap shall be approved make and of best quality. The bottle trap shall be provided with coupling.

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2.0. Workmanship

The bottle trap shall be fixed on wash hand basin with wooden gullies and screws as directed. The work shall be carried out in best workman like manner.

3.0. Mode of measurements and payment

3.1. The rate includes cost of all materials and labour involved for satisfactory completion of this item.

3.2. The rate shall be for a unit of One number.

Item No. 133

Providing and fixing stainless steel A ISI 304 (18/8) kitchen sink as per IS 13983 with C.I. Brackets and stainless steel plug 40 mm including painting of fittings and brackets, cutting and making good the walls wherever required.17.10.2)Kitchen sink without drain board. 17.10.2.1) 610 x 510 mm bowl depth 200 mm.

1.0. Materials

1.1. Stainless steel A ISI 304 (18/8) kitchen sink as per IS 13983 610 mm. X 510 mm. X 200 mm. Size shall conform to .

2.0. Workmanship

2.1. The kitchen sink shall be supported on a pair of M.S. or C.I. brackets fixed in cement mortar 1:3 (1 cement : 3 coarse sand). The M.S. or C.I. brackets shall conform to I.S. 775-1962. The wall plaster on the rear shall be cut to rest over the top edge of the sink. After fixing the sink, plaster shall be made good and the surface finished to match with the existing one.

2.2. The C.P. brass trap and union shall be connected to 40 mm. Nominal bore galvanised mild steel waste pipe which shall be suitably bent towards the wall and which shall discharge into an open drain leading to gully-trap or direct into the gully-trap on the ground on floor and shall be connected to a waste pipe through a floor trap on the upper floors. C.P. brass trap and union may not be provided where surface drain or a floor trap is placed directly under the sink and the waste is discharged to itvertically.

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- 2.3. The height of front edge of the wash basin from the floor, level shall be 80 cms.
- 3.0. Mode of measurements & payment
 - 3.1. The rate includes cost of all labour, materials, tools and plant and other equipment required for satisfactory completion of this item as described in workman ship.
 - 3.2. The rate shall be for a unit of One number.

Item No. 134

Providing and fixing P.V.C. waste pipe for sink or wash basin including P.V.C. waste fittings complete. 17.28.1) Semi rigid pipe. 17.28.1.2) 40MM dia

- 1.0. Materials
 - 1.1. The P.V.C. waste pipe shall be of 40 mm. Dia. And of best quality and make as approved by the Engineer-in-charge
- 2.0. Workmanship
 - 2.1. P.V.C. waste pipe shall be connected to 40 mm dia waste pipe which shall be suitably bent towards the wall which shall discharge into drain through a floor trap The P.V.C. waste pipe shall be provided for wash basin or sink as the case maybe.
- 3.0. Mode of measurement & payment
 - 3.1. The rate includes all labours and providing P.V.C. waste pipe and union including including P.V.C. waste fittings complete.
 - 3.2. The rate shall be for a unit of One number.

Item No. 135

Providing and fixing approved make, size and quality looking mirror of superior glass complete with 6 mm thick back ply/hard board ground fixed to wooden cleats on walls, allround polished 2nd class teak wood beading of size 40x20mm etc complete.

- 1.0. Materials
 - 1.1. The 600 mm. X 450 mm. Size mirror shall be of superior glass with edge rounded and beveled as specified. It shall be free from flaws specks, or bubbles and its thickness shall not be less than 6 mm. The glass for the mirror shall be uniformly silver plated at the back and shall be free from silvering defects Silvering shall have a protective uniform covering of red lead paint. The 6 mm thick ply wood shall conform to M-37. The 6 mm. Thick A.C. sheets shall conform to M-24.
- 2.0. Workmanship
 - 2.1. The mirror of 600 mm. X 450 mm. Size mounted on A.C. Sheet or plywood 6 mm thick with C.P. brass clips shall be fixed as directed, by fixing wooden plugs in wall and C.P brass screws and washers. The work shall be carried out in best workman like manner.
- 3.0. Mode of measurements & payment
 - The rate includes cost of all labour and materials, tools and plant etc. Required for satisfactory completion of this item.
 - The rate shall be for a .unit of One number.

Item No. 136

Hubless Centrifugally Cast (Spun) Iron Pipes and Fittings soil, waste and ventilating pipes, fittings and accessories shall conform to IS 15905.

The hubless centrifugally cast (spun) iron pipes shall have plain both ends (spigot type), without sockets. The pipes and fittings shall be true to shape, smooth and cylindrical, their inner and outer surface being as nearly as practicable concentric. They shall be sound and shall be free from cracks, taps, pinholes and other imperfections and shall be neatly dressed and carefully fettled. All pipes and fittings shall emit a clear ringing sound when struck with a light hand hammer.

The ends of pipes and fittings shall be reasonably square to their axis. The hubless centrifugally cast iron pipes shall be 3.0 metre or more in length.

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All pipes and fittings shall be coated internally and externally with the epoxy coating material at the factory, the fitting being preheated prior to total immersion in a bath containing a uniformly heated composition. The coating material shall have good adherence and shall not scale off.

The tolerance in diameter of pipes shall be as prescribed in Table-17.2A below :

Table-17.2A

Table-17.2A
External Diameters and Tolerances

Sl. No.	Nominal size DN (in mm)	External Diameter DE (in mm)	Tolerance on External diameter DE (in mm)
(1)	(2)	(3)	(4)
1	50	58	+2 -1
2	75	83	+2 -1
3	100	110	+2 -2
4	150	160	+2 -2
5	200	210	+2.5 -2.5

The thickness of fittings and spigot dimensions shall conform to the thickness and dimensions specified for the corresponding sizes of straight pipes. The nominal & minimum thicknesses of pipes & fittings shall be as per Table-2 below:

Table-2
Nominal & Minimum Thickness of Pipes & Fittings

Sl. No.	Nominal size (DN)	Thickness 'e' mm			
		Pipe		Fittings	
		Nominal	Minimum	Nominal	Minimum
(1)	(2)	(3)	(4)	(5)	(6)
i)	50	3.5	3.0	4.2	3.0
ii)	75	3.5	3.0	4.2	3.0
iii)	100	3.5	3.0	4.2	3.0
iv)	150	4.0	3.5	5.3	3.5
v)	200	5.0	4.0	6.0	4.0

The access door fittings shall have no dead spaces in which filth may accumulate. Doors shall be provided with 3 mm rubber insertion packing and when closed and bolted, these shall be water tight.

Joints: The pipes and fittings may assembled using various types of joints, The joints are intrinsic components of the drainage, whose characteristics and tolerances shall be specified in the manufactures catalogues.

Taking into account the different applications of cast iron pipe work systems, various joint designs are permitted provided that they satisfy the requirement to this standard. The joints shall incorporate one or more EPDM rubber gasket(s) to ensure leak tightness and prevent direct contact between the ends of pipes, fittings and accessories.

Materials for coupling of clamping components shall usually be made from:

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(a) Ductile iron of grade 500/7 as per IS 1865, or

(b) Stainless steels in accordance with IS 1570 (Part 5) in order to ensure resistance to corrosion and a stabilization against the austenitic stainless steel with at least 17 percent chrome and 9 percent nickel of equivalent, or from material of comparable resistance.

(c) Ductile iron couplings of clamping components shall be coated internally and externally.

(d) All parts of the joints shall free from defects likely to compromise their suitability for use.

3.1. Mode of measurements & payment

The rate includes cost of all labour and materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a .unit of meter.

Item No. 137

Hubless centrifugally cast (spun) iron pipes epoxy coated inside & outside IS:15905.

Workmanship

The relevant specifications of item No.136 shall be followed

Mode of Measurement & Payment

The rate shall be for a .unit of one.

Item No. 138

Providing and fixing shielded coupling for Hubless centrifugally cast iron pipe. 100 mm SS 304 grade coupling with EPDM rubber gasket

Workmanship

The relevant specifications of item No.136 shall be followed

Mode of Measurement & Payment

The rate shall be for a .unit of one.

Item No. 139

Hubless centrifugally cast (spun) iron pipes epoxy coated inside & outside IS:15905

Workmanship

The relevant specifications of item No.136 shall be followed

Mode of Measurement & Payment

The rate shall be for a .unit of one.

Item No. 140

Providing and fixing CP with glass bottle liquid soap dispenser, of with nozzle and piston arrangement all complete as directed by the Engineer-in-Charge.

1.0. Materials

2.0. The CP with glass bottle liquid soap dispenser, shall conform as per Engineer -In Charge.

2.1. Workmanship

2.2. The CP with glass bottle liquid soap dispenser, shall be fixin with screw and hold up with ss stips with nozzle and piston arrangement all complete as directed by the Engineer-in-Charge..

3.0. Mode of measurements and payment

Registrar

Sign and Seal of contractor

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- 3.1. The rate includes cost of all labour, materials, tools and plants etc. Required for satisfactory completion of this item including lead, jointing and testing.
- 3.2. The rate shall be for a unit of one number.

Item No. 141

Providing and fixing S.S grating (with or without hole) for floor or Nahani trap. (Make Jayana Model No TR 102 / Chilly or Equivalent).100mm dia

- 1.1. Materials
- 2.3. The PVC SWR nahni trap IS 14735 Nahni trap shall conform .
- 2.4. Workmanship
- 2.5. The Nahni trap with 100 mm. Dia with jali shall be fixed as per drawing or as directed.
- 2.6. The Nahni trap shall be jointed with Pipe, required. Dia. With lead joints. The lead joints shall be done in conformation with I.S.782.-1976.
- 3.3. Mode of measurements and payment
- 3.4. The rate includes cost of all labour, materials, tools and plants etc. Required for satisfactory completion of this item including lead, jointing and testing.
- 3.5. The rate shall be for a unit of one number.

Item No. 142

Providing and fixing G.I floor drain consisting of 100x50mm G.I elbow (grating and G.I pipe to be paid separately), complete as per instructions

- 1.2. Materials
- 2.7. The G.I floor drain consisting of 100x50mm G.I elbow, shall conform as per Engineer -In Charge.
- 2.8. Workmanship
- 2.9. The G.I floor drain consisting of 100x50mm G.I elbow, shall be fixing with related arrangement all complete as directed by the Engineer-in-Charge..
- 3.6. Mode of measurements and payment
- 3.7. The rate includes cost of all labour, materials, tools and plants etc. Required for satisfactory completion of this item including lead, jointing and testing.
- 3.8. The rate shall be for a unit of one number.

Item No. 143

Providing and fixing 100mm dia C.I Hubless inlet fitting consisting of 100mm dia main G.I pipe with multiple G.I. sockets (Inlets) of required diameter welded to it (as per site requirement) and fixing the same to C.I trap and setting in cement concrete, complete as per instructions of the Engineer in charge.

- 1.3. Materials
- 2.10. The 100mm dia C.I Hubless inlet fitting, shall conform as per Engineer -In Charge.
- 2.11. Workmanship
- 2.12. The 100mm dia C.I Hubless inlet fitting consisting of 100mm dia main G.I pipe with multiple G.I. sockets (Inlets) of required diameter welded to it (as per site requirement) and fixing the same to C.I trap and setting in cement concrete, shall be fixing with related arrangement all complete as directed by the Engineer-in-Charge..
- 3.9. Mode of measurements and payment
- 3.10. The rate includes cost of all labour, materials, tools and plants etc. Required for satisfactory completion of this item

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including lead, jointing and testing.

3.11. The rate shall be for a unit of one number.

Item No. 144

Providing and fixing of G.I pipe wall/ floor , cutting chases and making good with complete. 32mm ,40 & 50mm.

Pipes-Galvanised Iron

The pipes (tubes) shall be galvanised mild steel hot finished seamless (HFS) or welded (ERW) HRIW or HFW screwed and socketed conforming to the requirements of IS 1239 Part-I for medium grade. They shall be of the diameter (nominal bore) specified in the description of the item, the sockets shall be designated by the respective nominal bores of the pipes for which they are intended.

Galvanising shall conform to IS 4736 : The zinc coating shall be uniform adherent, reasonably smooth and free from such imperfections as flux, ash and dross inclusions, bare patches, black spots, pimples, lumping runs, rust stains, bulky white deposits and blisters. The pipes and sockets shall be cleanly finished, well galvanised in and out and free from cracks, surface flaws laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut cleanly and square with the axis of the tube.

The dimensions and weights of pipes and sockets and tolerances shall be as prescribed in Appendix 'C'. CPWD SPECIFICATIONS 2019 956

All screwed tubes and sockets shall have pipe threads conforming to the requirements of IS 554. Screwed tubes shall have taper threads while the sockets shall have parallel threads.

All tubes shall withstand a test pressure of 50 Kg/sq.cm without showing defects of any kind.

Fittings : The fittings shall be of mild steel tubular or wrought steel fittings conforming to IS 1239 (Part-2) or as specified. The fittings shall be designated by the respective nominal bores of the pipes for which they are intended.

18.7 LAYING AND JOINTING G.I. PIPES (INTERNAL WORK)

18.7.0 For internal work the galvanised iron pipes and fittings shall run on the surface of the walls or ceiling (not in chase) unless otherwise specified. The fixing shall be done by means of standard pattern holder bat clamps, keeping the pipes about 1.5 cm clear of the wall. When it is found necessary to conceal the pipes, chasing may be adopted or pipes fixed in the ducts or recess etc., provided there is sufficient space to work on the pipes with the usual tools. The pipes shall not ordinarily be buried in walls or solid floors. Where unavoidable, pipes may be buried for short distances provided adequate protection is given against damage and where so required joints are not buried. Where directed by the Engineer-in-Charge, a M.S. tube sleeve shall be fixed at a place the pipe is passing through a wall or floor for reception of the pipe and to allow freedom for expansion and contraction and other movements. In case the pipe is embedded in walls or floors it should be painted with anticorrosive bitumastic paints of approved quality. The pipe shall not come in contact with lime mortar or lime concrete as the pipe is affected by time. Under the floors the pipes shall be laid in layer of sand filling as done under concrete floors.

All pipes and fittings shall be fixed truly vertical and horizontal unless unavoidable. The pipes shall be fixed to walls with standard pattern holder bat clamps of required shape and size so as to fit tightly on the pipes when tightened with screwed bolts, these clamps shall be embedded in brick work in cement mortar 1:3 (1 cement: 3 coarse sand), and shall be spaced at regular intervals in straight lengths as shown in Table 18.12. The clamps shall be fixed at shorter lengths near the fittings as directed by the Engineer-in-Charge. For G.I. pipes 15 mm diameter, the holes in the walls and floors shall be made by drilling with chisel or jumper and not by dismantling the brick work or concrete. However, for bigger dimension pipes the holes shall be carefully made of the smallest size as directed by the Engineer-in-Charge. After fixing the pipes the holes shall be made good with cement mortar 1:3 (1 cement: 3 coarse sand) and properly finished to match the adjacent surface

Unions will be provided to facilitate connections additions and alterations as well as for maintenance and for change of pipes. The locations where unions are to be provided will be decided with prior written approval of the Engineer-in-Charge.

18.7.1 Measurements The lengths shall be measured in running metre correct to a cm for the finished work, which shall include G.I. pipe and G.I. fittings such as bends, tees elbows, reducers, crosses, plugs, sockets, nipples and nuts, but exclude brass or gun metal taps (cocks), valves, unions, lead connection pipes and shower rose. All pipes and fittings shall be classified according to their diameters, method of jointing and fixing substance, quality and finish. In case of fittings of an equal bore the pipe shall be described as including all cuttings and waste. In case of fittings of unequal bore, the largest bore shall be measured. Pipes laid in trenches (or without supports) and pipes fixed to walls, ceilings, etc. With supports shall be measured separately.

The rate includes all labours, materials, tools, tackles, plants etc required for satisfactory completion of this item

3.0. The rate includes cost of all labour, materials, tools and plants etc. Required for satisfactory completion of this item including lead, jointing and testing.

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3.1. The rate shall be for a unit of meter.

Item No. 145

Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply, including all CPVC plain & brass threaded fittings, including fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and testing of joints complete as per direction of Engineer in Charge.

Internal work – Exposed on wall. 20mm,25mm,32mm,40mm nominal outer dia pipe.

Workmanship

18.9 CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPES

18.9.1 CPVC pipes & fittings used in hot & cold potable water distribution system shall conform to requirement of IS 15778. The material from which the pipe is produced shall consist of chlorinated polyvinyl chlorides. The polymer from which the pipe compounds are to be manufactured shall have chlorine content not less than 66.5%.

The internal and external surfaces of the pipe shall be smooth, clean and free from grooving and other defects. The pipes shall not have any detrimental effect on the composition of the water flowing through it. SDR 13.5 Shall be Followed.

18.9.2 Dimensions of Pipes The outside diameter as per mentioned in boq item.

18.9.2.1 Diameter : of Pipes The outside diameter as per mentioned in boq item

18.9.2.3 Wall Thickness : The wall thickness of the pipes shall be as per SDR 13.5. Wall thickness shall be measured by any of the three methods given in IS 12235 (part 1). To check the conformity of the wall thickness of the pipe throughout its entire length, it is necessary to measure the wall thickness of the pipe at any point along its length. This shall be done by cutting the pipe at any point along its length and measuring the wall thickness as above. Alternatively, to avoid destruction of the pipe, non destructive testing methods such as the use of ultrasonic wall thickness measurement gauges shall be used at any four points along the length of the pipe.

Tolerance on Wall Thickness

(a) For pipes of minimum wall thickness 6 mm or less, the permissible variation between the minimum wall thickness (e_{min}) and the wall thickness at any point (e), ($e - e_{min}$) shall be positive in the form of $+y$, where $y=0.1 e_{min}+0.2$ mm.

(b) For pipes of minimum wall thickness greater than 6mm, the permissible variation of wall thickness shall again be positive in the form of $+y$, where y would be applied in two parts.

(c) The average wall thickness shall be determined by taking at least six measurements of wall thickness round the pipe and including both the absolute minimum and absolute maximum measured values. The tolerance applied to this average wall thickness from these measurements shall be within the range $0.1 e_{min}+0.2$ mm

(d) The maximum wall thickness at any point shall be within the range $0.15e_{min}$ (see Table 18.16). (e) The results of these calculations for checking tolerance shall be rounded off to the next higher 0.1 mm.

18.9.2.4 Effective Length (L_e) : If the length of a pipe is specified, the effective length shall not be less than that specified. The preferred effective length of pipes shall be 3, 5 or 6 m. The pipes may be supplied in other lengths where so agreed upon between the manufacturer and the purchaser.

18.9.3 Pipe Ends The ends of the pipes meant for solvent cementing shall be cleanly cut and shall be reasonably square to the axis of the pipe or may be chamfered at the plain end.

18.9.4 Physical and Chemical Characteristics

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18.9.4.1 Visual Appearance : The colour of the pipes shall be off-white. Slight variations in the appearance of the colour are permitted. The internal and external surface of the pipe shall be smooth, clean and free from grooving and other defects.

18.9.4.2 Opacity : The wall of the plain pipe shall not transmit more than 0.1 per cent of the visible light falling on it when tested in accordance with IS 12235 (Part 3). 18.9.4.3 Effect on Water : The pipes shall not have any determinate effect on the composition of the water flowing through them, when tested as per 10.3 of IS 4985.

18.9.4.4 Reversion Test : When tested by the method prescribed in IS 12235 (Part 5/ Sec 1 and Sec 2), a length of pipe 200 ±20 mm long shall not alter in length by more than 5 per cent. 18.9.4.5 Vicat Softening Temperature : When tested by the method prescribed in IS 12235 (part 2), the Vicat softening temperature of the specimen shall not be less than 110°C. 18.9.4.6 Density : When tested in accordance with IS 12235 (Part 14), the density of the pipes shall be between 1450kg/m³ and 1650kg/m³ .

18.9.5 Mechanical Properties

18.9.5.1 Hydrostatic Characteristics : When subject to internal hydrostatic pressure test in accordance with the procedure given in IS 12235 (part 8/Sec 1), the pipe shall not fail during the prescribed test duration. The temperatures, duration and hydrostatic (hoop) stress for the test shall conform to the requirements given in Table 18.17. The test shall be carried out not earlier than 24 h after the pipes have been manufactured

18.9.5.2 Thermal Stability by Hydrostatic Pressure Testing : When subject to internal hydrostatic pressure test in accordance with the procedure given in IS 12235 (Part 8/Sec 1),

18.9.5.3 Resistance to External Blow at 0°C : When tested by the method prescribed in IS 4985, , the pipe shall have a true impact rate of not more than 10 per cent

18.9.5.5 Tensile Strength : When tested by the method prescribed in IS 12235 (Part 19), the tensile strength at yield shall not be less than 50 mpa at 27 ± 2°C. 18.9.6 Sampling and Criteria for Conformity The sampling procedure and criteria for conformity shall be as given in Annexure F. 1

8.9.7. Marking

18.9.7.1 Each pipe shall be clearly and indelibly marked in ink/paint or hot embossed on white base at intervals of not more than 3 m. The marking shall show the following: (a) Manufacturer's name or trade-mark (b) Outside diameter, (c) Class of pipe and pressure rating, and (d) Batch or lot number 18.9.7.2 BIS Certification Marking : Each pipe may also be marked with the Standard Mark.

18.9.8 Fittings The fittings shall be as follows: (a) Plain CPVC solvent cement fittings from size 15 mm to 160 mm. (b) Brass threaded fittings. (c) Valve from size 15 mm to 160 mm (d) Brass Threaded Fittings: All types of one end brass threaded male/female adaptors in various fittings like coupler, socket, elbow, tee are available for transition to other plastic/metal piping and for fixing of CP fittings. Ball, Gate valves in CPVC are available in all dimensions. All fittings shall carry the following information: (1) Manufacturer's name/trade mark. (2) Size of fitting

18.9.9 Piping Installation Support and Spacing

18.9.9.1 Concealed Piping: Pipes can be concealed in chases. The pipes and fitting are to be pressure tested prior to concealing the chases. To maintain alignment of CP fittings while joining, all alignment of fittings and pipe shall be done correctly.

18.9.9.2 External Installations: For pipes fixed in the shafts, ducts etc. There should be sufficient space to work on the pipes. Pipes sleeves shall be fixed at a place the pipe is passing through a wall or floor so as to allow freedom for expansion and contraction. Clamping of the pipe is done to support it while allowing the freedom for movement. All pipes exposed to sunlight shall be painted with a water based acrylic paint emulsion to enhance UV protection. Pipes in trenching shall be laid in accordance to the Good Plumbing practices followed for Metal piping.

18.9.9.3 Expansion LOOP: CPVC systems, like all piping materials, expand and contract with changes in temperatures. CPVC pipes shall expand 7.5 cm per 30 m length for a 400C temperature change. Expansion does not vary with Pipe size. Thermal expansion can be generally be accommodated at changes in direction. On a long straight run, an offset or loop based on the following chart is required.

18.9.10 Testing All water supply systems shall be tested to hydrostatic pressure test. The pressure tests are similar to the test pressure used for other plastic/metal pipes. System may be tested in sections and such section shall be entirely checked on completion of connection to the overhead tank or pumping system or mains.

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18.9.11 Measurements The net length of pipes as laid or fixed shall be measured in running meters correct to a cm for the finished work, which shall include CPVC pipe and fittings including plain and Brass threaded fittings and jointing solvent cement.

STORAGE CPVC pipes of all sizes are packed in polyethylene packing rolls and both the ends of the packed roll are sealed with air bubble film cap in order to provide protection during handling and transportation. After packing, the whole bunch of pipes is tightened with polypropylene/ HDPE strapping. Each role is then marked with size/type of the pipe, lot number and quantity. The packed pipe rolls are stored in their respective racks in properly covered storage area. Apart from providing protection during handling and transportation, the packing rolls also protect the pipe from ultra violet rays.

E-2 INSTALLATION

E-2.1 Visually inspect pipe ends before making the joint. Use of a chamfering tool will help identify and crakes, as it will catch on to any crack.

E-2.2 Pipe may be cut quickly and efficiently by several methods. Wheel type plastic tubing cutters are preferred. Ratchet type cutter or fine tooth saw are another options. However, when using the ratchet cutter be certain to score the exterior wall by rotating the cutter blade in circular motion around the pipe. Do this before applying significant downward pressure to finalize the cut. This step leads to a square cut. In addition, make sure ratchet cutter blades are sharp. Cutting tubing as squarely as possible provides optimal bonding area within a joint.

E-2.3 Burrs and filings can prevent proper contact between the tube and fittings during the assembly, and should be removed from the outside and inside of the tube. A chamfering tool is preferred, but a pocket knife or file is also suitable for this purpose.

E-2.4 Use only CPVC cement/Adhesive solvent jointing. Use CPVC cement/Adhesive solvent, which is fully recommended by the manufacturer.

E-2.5 When using adhesive solution/solvent cement be certain of proper ventilation.

E-2.6 When making a join, apply a heavy, even coat of cement to the pipe end. Use the same applicator without additional cement to apply a thin coat inside the fitting socket. Too much cement can cause clogged waterways. Do not allow excess cement to puddle in the fitting and pipe assembly. This could result in a weakening of the pipe wall and possible pipe failure when the system is pressurized.

E-2.7 Rotate pipe one-quarter to one-half turn while inserting it into the fitting socket and remove the excess adhesive solution/solvent cement from the joint with clean rag.

E-2.8 When making a transition connection to metal threads, use a special transition fitting or CPVC male threaded adapter whenever possible. Do not over-torque plastic threaded connections. Hand tight plus one-half turn should be adequate.

E-2.9 Hang or strap CPVC systems loosely to allow for thermal expansion. Do not use metal straps with sharp edges that might damage the tubing.

E- 2.10 CPVC stub outs for lavatories, closets and sinks are appropriate. However, on areas where there is a likelihood that movement or impact abuse will occur, metal pipe nipples may be amore appropriate stub-out material. Showerheads, tub spouts and outside still cocks are examples.

E-2.11 When connected to a gas water heater, CPVC tubing should not be located within 50 cm of the flue. For water heaters lacking reliable temperature control, this distance may be increased up to 1 m a metal nipple or flexible appliance connector should be utilized. This measure eliminates the potential for damage to plastic piping that might result from excessive radiant heat from the flue

Mode of Measurement &Payment

The rate shall be for a unit of mtr.

Item No. 146

Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply, including all CPVC plain & brass threaded fittings, i/c fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and the cost of cutting chases and making good the same including testing of joints complete as per direction of Engineer in Charge. Concealed work, including cutting chases and making good the walls etc 15 mm,20mm and 25mm nominal outer dia Pipes

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Workmanship

The relevant specifications of item No.145 shall be followed

Mode of Measurement & Payment

The relevant specifications of item No. 145 shall be followed:

Item No.147

Providing and fixing gun metal gate valve with C.I. wheel of approved quality (screwed end) : Make SANT/ Zoloto/Leader/Audco. 20 mm,25mm,32mm,,25mm,32mm,40mm& 80mm dia. Nominal bore

1.0. Materials : The gun metal gate valve with C.I. wheel valve, shall conform to I.S. : 778-1964. The gate valve with C.I. wheel valve, with necessary specials, union, nipples etc shall be of tested quality.

2.0. Workmanship

15mm dia the gun metal gate valve with C.I. wheel valve shall be fully cleared of all foreign matter before fixing. The fixing of shall be done by means of with necessary specials, union, nipples etc., to complete the job the same specifications as in case of socket and spigot flanges in case of flanged pipes. The joining shall be done leakproof.

3.0. Mode of measurements and payment

The rate includes all labours, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One number.

Item No. 148

Supply and fixing of 15mm CP brass Health Faucet with wall flange and suitable hose length CP brass extension pipe all of approved engineer-in-charge.

1.0. Materials

1.1. 15mm C.P brass hand held abluion fitting (health faucet) shall confirm to I S. 2556-1972 part - XI and of best quality and makes as approved by engineer-in-charge. One meter long flexible tube and wall hook As directed.

Workmanship

15mm C.P brass hand held abluion fitting (health faucet) shall be fixed as directed with one meter long flexible tube and wall hook, all complete

Mode of measurements and payment

The rate includes all labours and materials, tools and plant etc. Required for satisfactory completion of this item

The rate shall be for a one number

Item No. 149

Supply and fixing of 15mm CP brass 2 -Way Bib Cock (single lever) with wall flange and suitable length CP brass extension pipe all of approved engineer-in-charge.

Materials : 15 mm. Dia CP brass 2 -Way Bib Cock (single lever) with bright polished finished shall conform to I.S.781- 1977. The bib cock shall be best Indian make and quality.

2.0. Workmanship

2.1. The CP brass 2 -Way Bib Cock (single lever) 15 mm. As specified above shall be fixed as directed. The threaded portion shall be smeared with white or red lead and around with a few turns of fine spun yarn round the screwed end of the pipe. The bib cock shall be then screwed and fixed to water tight position.

3.0. Mode of measurements and payment

3.1. The rate includes cost of all labour, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One Number

Item No. 150

Providing and fixing C.P. brass pressmatic wall pillar cock (auto closing) mounted tap with wall flange.

1.2. Materials

1.3. The white glazed earthenware wash basin shall be 550 mm. X 400mm. Of 1st quality and make as approved by the Engineer-in-charge. The wash basin shall conform to IS-59.

2.7. Workmanship

2.8. The washbasin shall be fixed on the wall as and where directed. The wash basin shall be supported on a pair of M.S. or C.I. brackets fixed in C.M. 1:3 (1 cement : 3 sand). The bracket shall conform to I.S. : 775-1962. The wall plaster on the rear shall be cut to rest the top edge of the washbasin. After fixing the basing, plaster shall be made good and surface finished to match the existing one.

2.9. The brackets shall be painted white with ready-mixed paint.

2.10. The C.I. brass trap and union shall be connected to 32 mm. Dia. Waste pipe which shall be suitably bent towards the wall and which shall discharge into an open drain leading to a gully trap or direct in to gully-trap on the ground floor and shall be connected to a waste pipe through a floor trap on the upper floors. C.P. brass trap and union may not be provided where the surface drain or a floor trap is placed directly under the basin and the waste is discharged in to vertically.

2.11. The height of the front edge to the wash basin from the floor level shall be 80cms.

2.12. The necessary inlet, outlet connections and fittings such as pillar cocks, CP dress waste trap waste pipe, stop cock, chain wish rubber plug etc. Shall be fixed.

2.13. The payment of fittings shall be made separately under separate items.

Mode of measurements & payment

3.2. The rate includes cost of all labour, materials, tool3 and plant etc. Required for satisfactory completion of this item as specified in workmanship.

3.3. The rate shall be for a unit of One number.

Item No. 151

Providing and fixing C.P. brass long body bib cock of approved quality conforming to IS standards and weighing not less than 690 gms. 15 mm nominal bore

Materials : 15 mm. Dia CP brass long body bib cock) with bright polished finished shall conform to I.S.781- 1977. The bib cock shall be best Indian make and quality.

2.2. Workmanship

2.3. The CP long body bib cock 15 mm. As specified above shall be fixed as directed. The threaded portion shall be smeared with white or red lead and around with a few turns of fine spun yarn round the screwed end of the pipe. The bib cock shall be then screwed and fixed to water tight position.

3.2. Mode of measurements and payment

3.3. The rate includes cost of all labour, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One Number

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Item No. 152

Providing and fixing C.P. brass long nose bib cock of approved quality conforming to IS standards and weighing not less than 810 gms. 15 mm nominal dia

Materials : 15 mm. Dia CP brass long nose bib cock with bright polished finished shall conform to I.S.781- 1977. The bib cock shall be best Indian make and quality.

2.4. Workmanship

2.5. The long nose bib cock 15 mm. As specified above shall be fixed as directed. The threaded portion shall be smeared with white or red lead and around with a few turns of fine spun yarn round the screwed end of the pipe. The bib cock shall be then screwed and fixed to water tight position.

3.4. Mode of measurements and payment

3.5. The rate includes cost of all labour, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One Number

Item No. 153

Providing and fixing C.P. brass stop cock (concealed) of standard design and of approved make conforming to IS:8931 . 15 mm nominal bore

Materials : 15 mm. Dia CP brass stop cock (concealed with bright polished finished shall conform to I.S.781- 1977. The bib cock shall be best Indian make and quality.

2.6. Workmanship

2.7. The stop cock (concealed 15 mm. As specified above shall be fixed as directed. The threaded portion shall be smeared with white or red lead and around with a few turns of fine spun yarn round the screwed end of the pipe. The bib cock shall be then screwed and fixed to water tight position.

3.6. Mode of measurements and payment

3.7. The rate includes cost of all labour, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One Number

Item No. 154

Providing and fixing uplasticised PVC connection pipe with brass ions : 45 cm length 15 mm nominal dia

1.2. Materials

1.3. The uplasticised P.V.C. waste pipe shall be of 15 mm. Dia. And of best quality and make as approved by the Engineer-in-charge

2.2. Workmanship

2.3. Uplasticised P.V.C. waste pipe shall be connected to 15 mm dia waste pipe which shall be suitably bent towards the wall which shall discharge into drain through a floor trap The uplasticised P.V.C. waste pipe shall be provided for wash basin or sink as the case maybe.

3.3. Mode of measurement & payment

3.4. The rate includes all labours and providing P.V.C. waste pipe and union including including P.V.C. waste fittings complete.

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3.5. The idle shall be for a unit of One number.

Item No. 155

Providing and fixing C.P. brass angle valve for basin mixer and geyser points of approved quality conforming to IS:8931 a) 15 mm nominal bore

Materials : 15 mm. Dia CP brass angle valve with bright polished finished shall conform to I.S.781- 1977. The bib cock shall be best Indian make and quality.

2.8. Workmanship

2.9. The angle valve 15 mm. As specified above shall be fixed as directed. The threaded portion shall be smeared with white or red lead and around with a few turns of fine spun yarn round the screwed end of the pipe. The angle valve shall be then screwed and fixed to water tight position.

3.8. Mode of measurements and payment

3.9. The rate includes cost of all labour, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One Number

Item No. 156

Providing and fixing on terrace (at all floor levels) polyethylene water storage tank, ISI : 12701 marked, with cover and suitable locking arrangement and making necessary holes for inlet , outlet and overflow pipes but without fittings and the base support for tank.

Materials : polyethylene water storage tank, ISI : 12701 marked, with cover and suitable locking arrangement. The polyethylene water storage tank, ISI : 12701 marked, with cover and suitable locking arrangement shall be best Indian make and quality.

2.10. Workmanship

3.10. The polyethylene water storage tank, ISI : 12701 marked, with cover and suitable locking arrangement as specified above shall be fixed as directed. Fixing on terrace (at all floor levels) polyethylene water storage tank, ISI : 12701 marked, with cover and suitable locking arrangement and making necessary holes for inlet , outlet and overflow pipes but without fittings and the base support for tank

3.11. Mode of measurements and payment

3.12. The rate includes cost of all labour, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One Number

Item No.157

Supply ,Erection , Testing & Commissioning of Automatic water level control panel & related accessories for pumping automation with consisting of automatic water level controller , level sensor with stainless steel probe, motorized butterfly valve (wafer type) PN 1.0 with Electrical Actuator motorized valve controller with complete in all respect. Make : Zoloto - 1078D / Castle / Advance

Materials : Automatic water level control panel & related accessories for pumping automation with consisting of automatic water level controller , level sensor with stainless steel probe, motorized butterfly valve shall be best Indian make and quality.

2.11. Workmanship

3.13. The Automatic water level control panel & related accessories for pumping automation with consisting of automatic water level controller , level sensor with stainless steel probe, motorized butterfly valve as specified above shall be fixed as directed testing & Commissioning of Automatic water level control panel & related accessories for pumping automation with consisting of automatic water level controller , level sensor with stainless steel probe, motorized butterfly valve (wafer type) PN 1.0 with Electrical Actuator motorized valve controller with complete in all respect

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3.14. Mode of measurements and payment

3.15. The rate includes cost of all labour, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One set.

Item No. 158

Providing and fixing Stainless Steel pipe and fitting of grade 316L as per IS 6911:2017 and conforming to EN-10312 standards complete with press type fitting (fitting shall be paid for separately) i/c fixing of the pipe with clamps at 1.00 m spacing including cutting and making good the walls including testing of joints complete as per direction of Engineer-in-charge. (The pipe length inserted in the fitting shall not be measured for payment) Internal work - Exposed on wall 22 mm ,28mm,35mm &42 mm outer dia pipe.

Workmanship

The relevant specifications of item No.144 shall be followed instead of fixing exposed Stainless Steel pipe and fitting of grade 316L as per IS 6911:2017 and conforming to EN-10312 standards complete with press type fitting

Mode of Measurement &Payment

The relevant specifications of item No. 144 shall be followed

Item No. 159

Providing and fixing Stainless Steel pipe and fitting of grade 316L as per IS 6911:2017 and conforming to EN-10312 standards complete with press type fitting (fitting shall be paid for separately) i/c fixing of the pipe with clamps at 1.00m spacing and also including cutting of chases and making good the walls including testing of joints complete as per direction of Engineer -in-charge. (The pipe length inserted in the fitting shall not be measured for payment) Internal work - Concealed Pipe 15 mm,22mm outer dia pipe

Workmanship

The relevant specifications of item No.144 shall be followed instead of fixing concealed Stainless Steel pipe and fitting of grade 316L as per IS 6911:2017 and conforming to EN-10312 standards complete with press type fitting

Mode of Measurement &Payment

The relevant specifications of item No. 144 shall be followed

Item No. 160

Providing and fixing required Stainless Steel Fitting of press fit design of grade 316L as per IS 6911:2017 and conforming to EN-10312 standards with V-profile and with O-ring sealing gasket of EPDM material of required dia as per direction of Engineer-in-charge. Coupling/Socket- Exposed on wall 22 mm ,28mm,35mm &42 mm outer dia pipe.

Workmanship

The relevant specifications of item No.167 shall be followed instead Stainless Steel Fitting of press fit design of grade 316L as per IS 6911:2017 and conforming to EN-10312 standards with V-profile and with O-ring sealing gasket of EPDM material of mentioned dia in boq

Mode of Measurement &Payment

The relevant specifications of item No. 167 shall be followed

Item No. 161.

Providing and fixing required Stainless Steel Fitting of press fit design of grade 316L as per IS 6911:2017 and conforming to EN-10312 standards with V-profile and with O-ring sealing gasket of EPDM material of required dia as per direction of Engineer-in-charge . Reducer For 22mm x 15 mm outer dia pipe

Workmanship

The relevant specifications of item No.167 shall be followed instead reducer Stainless Steel Fitting of press fit design of grade 316L as

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per IS 6911:2017 and conforming to EN-10312 standards with V-profile and with O-ring sealing gasket of EPDM material of mentioned dia in boq

Mode of Measurement & Payment

The relevant specifications of item No. 167 shall be followed

Item No. 162.

Providing and fixing required Stainless Steel Fitting of press fit design of grade 316L as per IS 6911:2017 and conforming to EN-10312 standards with V-profile and with O-ring sealing gasket of EPDM material of required dia as per direction of Engineer-in-charge. Female Thread Connector/ Adapter For 15 mm outer dia x 1/2" mm nominal dia threaded

Workmanship

The relevant specifications of item No.167 shall be followed instead connector /adeptor Stainless Steel Fitting of press fit design of grade 316L as per IS 6911:2017 and conforming to EN-10312 standards with V-profile and with O-ring sealing gasket of EPDM material of mentioned dia in boq

Mode of Measurement & Payment

The relevant specifications of item No. 167 shall be followed

Item No. 163

Providing and fixing required Stainless Steel Fitting of press fit design of grade AISI 304 conforming to JWWA G116 standard with V-profile or M-profile and with O-ring sealing gasket of EPDM material of required dia as per direction of Engineer-in-charge. Valve Connector For 22.22 mm outer dia x 15 mm , 28.58 mm outer dia x 25 mm , 34.00 mm outer dia x 32 mm nominal dia threaded

Workmanship

The relevant specifications of item No.167 shall be followed instead Valve Connector Stainless Steel Fitting of press fit design of grade AISI 304 conforming to JWWA G116 standard with V-profile or M-profile and with O-ring sealing gasket of EPDM material of mentioned dia in boq

Mode of Measurement & Payment

The relevant specifications of item No. 167 shall be followed

Item No. 164

ACTIVATION Manual 50 Lph RO FILTRATION five Stage RO purification, Sediment, carbon and UV AUTO-OFF WATER FLOW No DRAINAGE TYPE Built in drain, Fixed drip tray EXTERIOR Brushed Stainless Steel inner shel thicken Stainless Steel-304 inlet connection 0.5" B.S.P Insulation ,50MM PUFF insulation, Reciprocating Hermetic Type compressor, R134a Refrigerent, fin tube type condenser, cooling capacity 200LPH, storage 200 ltr. Make. Oasis wfs/ Blue star/ voltas

Materials 50 Lph RO FILTRATION five Stage RO purification, Sediment, carbon and UV AUTO-OFF WATER FLOW No DRAINAGE TYPE

Built in drain, Fixed drip tray EXTERIOR Brushed Stainless Steel inner shel thicken Stainless Steel-304 inlet connection 0.5" B.S.P

Insulation ,50MM PUFF insulation, Reciprocating Hermetic Type compressor, R134a Refrigerent, fin tube type condenser, cooling capacity 200LPH, storage 200 ltr.shall be best Indian make and quality.

2.12. Workmanship

3.16. The 50 Lph RO FILTRATION five Stage RO purification, Sediment, carbon and UV AUTO-OFF WATER FLOW No DRAINAGE TYPE Built Registrar

Sign and Seal of contractor

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in drain, Fixed drip tray EXTERIOR Brushed Stainless Steel inner shell thickened Stainless Steel-304 inlet connection 0.5" B.S.P Insulation, 50MM PUFF insulation, Reciprocating Hermetic Type compressor, R134a Refrigerant, fin tube type condenser, cooling capacity 200LPH, storage 200 ltr. as specified above shall be fixed as directed testing & Commissioning of 50 Lph RO FILTRATION five Stage RO purification, Sediment, carbon and UV AUTO-OFF WATER FLOW No DRAINAGE TYPE Built in drain, Fixed drip tray EXTERIOR Brushed Stainless Steel inner shell thickened Stainless Steel-304 inlet connection 0.5" B.S.P Insulation, 50MM PUFF insulation, Reciprocating Hermetic Type compressor, R134a Refrigerant, fin tube type condenser, cooling capacity 200LPH, storage 200 ltr.

3.17. Mode of measurements and payment

3.18. The rate includes cost of all labour, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One number.

Item No. 165

Supply, installation, testing and commissioning of solar water heating system, suitable for following specifications and capacities, complete with necessary storage tanks, accessories, insulation, GI piping, valves, gaskets, support brackets, CC foundation where ever necessary as required for 300 ltrs capacity System output temperature - 60 degree C The solar panels shall confirm to BIS - 12933 part- I Circulation type / thermo syphon system the stainless steel water tank made of stainless steel of 304 grade and 2mm thick, duly insulated with 100mm thick rock wool of 48Kg /Cum density, duly clad with aluminium sheet of 24SWG thickness Support stand made of 50x50x5mm angle iron on suitable 1:2:4 CC foundation block. The GI pipes with accessories shall be insulated with 50mm thick rock wool of 48Kg/ cum, duly clad with aluminium sheet of 26 SWG thickness (For Hot water lines) Suitable capacity of power backup with a facility to switch on automatically in cloudy condition and also with auto / manual selection arrangement 200 LPD

Materials : of solar water heating system, suitable for following specifications and capacities, complete with necessary storage tanks, accessories, insulation, GI piping, valves, gaskets, support brackets, CC foundation where ever necessary as required for 300 ltrs capacity System output temperature - 60 degree C The solar panels shall confirm to BIS - 12933 part- I Circulation type / thermo syphon system the stainless steel water tank made of stainless steel of 304 grade and 2mm thick, duly insulated with 100mm thick rock wool of 48Kg /Cum density, duly clad with aluminium sheet of 24SWG thickness Support stand made of 50x50x5mm angle iron on suitable 1:2:4 CC foundation block. The GI pipes with accessories shall be insulated with 50mm thick rock wool of 48Kg/ cum, shall be best Indian make and quality.

2.13. Workmanship

3.19. The of solar water heating system, suitable for following specifications and capacities, complete with necessary storage tanks, accessories, insulation, GI piping, valves, gaskets, support brackets, CC foundation where ever necessary as required for 300 ltrs capacity System output temperature - 60 degree C The solar panels shall confirm to BIS - 12933 part- I Circulation type / thermo syphon system the stainless steel water tank made of stainless steel of 304 grade and 2mm thick, duly insulated with 100mm thick rock wool of 48Kg /Cum density, duly clad with aluminium sheet of 24SWG thickness Support stand made of 50x50x5mm angle iron on suitable 1:2:4 CC foundation block. The GI pipes with accessories shall be insulated with 50mm thick rock wool of 48Kg/ cum, as specified above shall be fixed as directed testing & Commissioning of of solar water heating system, suitable for following specifications and capacities, complete with necessary storage tanks, accessories, insulation, GI piping, valves, gaskets, support brackets, CC foundation where ever necessary as required for 300 ltrs capacity System output temperature - 60 degree C The solar panels shall confirm to BIS - 12933 part- I Circulation type / thermo syphon system the stainless steel water tank made of stainless steel of 304 grade and 2mm thick, duly insulated with 100mm thick rock wool of 48Kg /Cum density, duly clad with aluminium sheet of 24SWG thickness Support stand made of 50x50x5mm angle iron on suitable 1:2:4 CC foundation block. The GI pipes with accessories shall be insulated with 50mm thick rock wool of 48Kg/ cum,

3.20. Mode of measurements and payment

3.21. The rate includes cost of all labour, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One number.

Item No. 166

Supply of wall hanging smart tap, versafiller water cooler with bottle filler facility, made by stainless steel top and heavy duty galvanized steel frame. With cooling capacity 60LPH, ADA Compliant, size 960(H) x 413(W) x 473(D)(in mm) , SS bubbler guard , operated between 50 to 120 PSI, Chiller unit Suitable to R134a Refrigerant, with-non flamable foam Adjustable thermostat control, suitable for 220-230v/50-60 hz A/C Supply Complete with all accessories which include MD-CU29 Push Pad, which is an EPA registered antimicrobial copper that fights off microorganisms which include MRSA and e-coli. Key Versafiller moulded components shall contain Freshield, which utilises a silver-based antimicrobial compound that reduces the growth of micro-organisms and mildew to protect the surfaces from discolouration, odours and degradation The online water cooler certified with UL, NSF-USA, TUV, GRIHA-Green building, ANSI/NSF 61, CABO/ANSI A117.1, ADA, CE , WRAS certification, Mechanical Operation at both dispencing point with UV light and to be placed at different location of buidling. Installing the Water Fountain for proper functioning and aesthetic view as directed by the engineer-in-charge without any extra cost. Make- Oasis/Filtrin/sunrock/Murdock.

Materials , versafiller water cooler with bottle filler facility, made by stainless steel top and heavy duty galvanized steel frame. With cooling capacity 60LPH, ADA Compliant, size 960(H) x 413(W) x 473(D)(in mm) , SS bubbler guard , operated between 50 to 120 PSI, Chiller unit Suitable to R134a Refrigerant, with-non flamable foam Adjustable thermostat control, suitable for 220-230v/50-60 hz A/C Supply.shall be best Indian make and quality.

2.14. Workmanship

3.22. The , versafiller water cooler with bottle filler facility, made by stainless steel top and heavy duty galvanized steel frame. With cooling capacity 60LPH, ADA Compliant, size 960(H) x 413(W) x 473(D)(in mm) , SS bubbler guard , operated between 50 to 120 PSI, Chiller unit Suitable to R134a Refrigerant, with-non flamable foam Adjustable thermostat control, suitable for 220-230v/50-60 hz A/C Supply as specified above shall be fixed as directedtesting & Commissioning of versafiller water cooler with bottle filler facility, made by stainless steel top and heavy duty galvanized steel frame. With cooling capacity 60LPH, ADA Compliant, size 960(H) x 413(W) x 473(D)(in mm) , SS bubbler guard , operated between 50 to 120 PSI, Chiller unit Suitable to R134a Refrigerant, with-non flamable foam Adjustable thermostat control, suitable for 220-230v/50-60 hz A/C Supply Complete with all accessories which include MD-CU29 Push Pad, which is an EPA registered antimicrobial copper that fights off microorganisms which include MRSA and e-coli. Key Versafiller moulded components shall contain Freshield, which utilises a silver-based antimicrobial compound that reduces the growth of micro-organisms and mildew to protect the surfaces from discolouration, odours and degradation The online water cooler certified with UL, NSF-USA, TUV, GRIHA-Green building, ANSI/NSF 61, CABO/ANSI A117.1, ADA, CE , WRAS certification, Mechanical Operation at both dispencing point with UV light and to be placed at different location of buidling. Installing the Water Fountain for proper functioning and aesthetic view as directed by the engineer-in-charge without any extra cost. Make- Oasis/Filtrin/sunrock/Murdock.

3.23. Mode of measurements and payment

3.24. The rate includes cost of all labour, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One number.

Item No. 167

Providing and fixing G.I. pipes complete with G.I. fittings including trenching and refilling etc40 mm diameter pipe & 50 mm diameter pipe .: The rate shall be for unit of one metre.

LAYING AND JOINTING OF G.I. PIPES (EXTERNAL WORK)

The specifications described in 18.4 shall apply, as far as applicable.

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18.6.1 Trenches The galvanised iron pipes and fittings shall be laid in trenches. The widths and depths of the trenches for different diameters of the pipes .

At joints the trench width shall be widened where necessary. The work of excavation and refilling shall be done true to line and gradient in accordance with general specifications for earth work in trenches.

When excavation is done in rock, it shall be cut deep enough to permit the pipes to be laid on a cushion of sand minimum 7.5 cm deep.

18.6.2 Cutting and Threading Where the pipes have to be cut or rethreaded, the ends shall be carefully filed out so that no obstruction to bore is offered. The end of the pipes shall then be carefully threaded conforming to the requirements of IS 554 with pipe dies and tapes in such a manner as will not result in slackness of joints when the two pieces are screwed together. The taps and dies shall be used only for straightening screw threads which have become bent or damaged and shall not be used for turning of the threads so as to make them slack, as the later procedure may not result in a water tight joint. The screw threads of pipes and fitting shall be protected from damage until they are fitted.

18.6.3 Jointing The pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over. Teflon Tape should be used on threads instead of 'Dhaaga/ Safeda'. The end shall then be screwed in the socket, Tee etc. With the pipe wrench. Care shall be taken that all pipes and fittings are properly jointed so as to make the joints completely water tight and pipes are kept at all times free from dust and dirt during fixing. Burr from the joint shall be removed after screwing. After laying, the open ends of the pipes shall be temporarily plugged to prevent access of water, soil or any other foreign matter.

18.6.4 Thrust Blocks (Fig. 18.8) In case of bigger diameter pipes where the pressure is very high, thrust blocks of cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate of 20 mm nominal size) of adequate size and shape shall be provided on all bends to transmit the hydraulic thrust to the ground, spreading it over a sufficient areas, depending upon the type of soil met with.

18.6.5 Painting The pipes shall be painted with two coats of anticorrosive bitumastic paint of approved quality.

18.6.6 Testing of Joints The pipes and fittings after they are laid and jointed shall be tested to hydraulic pressure of 6 Kg/ sq. Cm (60 meter). The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw off taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually. Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least half an hour. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing. Pipes or fittings which are found leaking shall be replaced and joints found leaking shall be redone, without extra payment.

18.6.7 Trench Filling The pipes shall be laid on a layer of 7.5 cm sand and filled up to 15 cm above the pipes. The remaining portion of the trench shall then be filled with excavated earth as described in 20.3.7. The surplus earth shall be disposed off as directed.

18.6.8 Measurements The lengths shall be measured in running metre correct to a cm for the finished work, which shall include G.I. pipe and G.I. fittings such as bends, tees, elbows reducers, crosses, plugs, sockets, nipples and nuts, but exclude brass or gun metal taps (cocks), valves, unions, lead connection pipes and shower rose. All pipes and fittings shall be classified according to their diameters, method of jointing and fixing substance quality and finish. In case of fittings of an equal bore the pipe shall be described as including all cuttings and wastage. In case of fittings of unequal bore the largest bore shall be measured. Note: G.I. unions shall be paid for separately in external work as well as in internal work. Digging and refilling of trenches shall either be measured separately as specified in the appropriate clauses of excavation and earth work or clubbed with main item.

18.6.9 Rate The rate shall include the cost of labour and materials involved in all the operations described above. The rate shall not include excavation in trenches, painting of pipes and sand filling all round the pipes, unless otherwise specified.

Workmanship

The relevant specifications of item No.144 shall be followed

Mode of Measurement &Payment

The relevant specifications of item No.144 shall be followed

Item No. 168

Painting G.I. pipes and fittings with two coats of anti-corrosive bitumastic pant of approved quality : 40 mm and 50mm diameter pipe.

Workmanship

The relevant specifications of item No.167 shall be followed

Mode of Measurement &Payment

The relevant specifications of item No.167 shall be followed

(183)

Item No. 169

Providing and filling sand of grading zone V or coarser grade all-round the G.I. pipes in external work. 40 mm and 50mm diameter pipe

Workmanship

The relevant specifications of item No.167 shall be followed

Mode of Measurement & Payment

The relevant specifications of item No.167 shall be followed

Item No. 170

Providing and fixing brass ferrule with C.I. mouth cover including boring and tapping the main : 25 mm nominal bore

Materials : C.I. mouth cover, with cover and suitable locking arrangement shall be best Indian make and quality.

2.15. Workmanship

The C.I. mouth cover, with cover and suitable locking arrangement as specified above shall be fixed as directed. Fixing brass ferrule with C.I. mouth cover including boring and tapping the main : 25 mm nominal bore

3.25.

3.26. Mode of measurements and payment

3.27. The rate includes cost of all labour, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One Number

Item No. 171

Providing and fixing of cast iron sluice valves (with cap) complete with bolts, nuts, rubber insertions etc. (the tail pieces if required will be paid separately): 100 mm diameter Class II

1.0. Materials : cast iron sluice valves (with cap), shall conform to I.S. : 778-1964. The gate valve with C.I. wheel valve, with necessary specials, union, nipples etc shall be of tested quality.

2.1. Workmanship

100mm dia the cast iron sluice valves (with cap) with C.I. wheel valve shall be fully cleared of all foreign matter before fixing. The fixing of shall be done by means of with necessary specials, union, nipples etc., to complete the job the same specifications as in case of socket and spigot flanges in case of flanged pipes. The joining shall be done leakproof.

3.1. Mode of measurements and payment

The rate includes all labours, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One number.

Item No. 172

(183)

Constructing masonry Chamber 30x30x50 cm inside, in brick working cement mortar 1:4 (1 cement :4 coarse sand)for stop cock, with C. I. Surface box 100x100 x75 mm (inside) with hinged cover fixed in cement concrete slab 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size), i/c necessary excavation, foundation concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40mm nominal size) and inside plastering with cement mortar 1:3 (1 cement : 3 coarse sand) 12mm thick, finished with a floating coat of neat cement complete as per standard design : With common burnt clay F.P.S.(non modular) bricks of class designation 7.5

1.0. Materials : Water shall conform to M-1. Cement shall conform to M-3. Coarse sand shall conform to M-5. Brick shall conform to M-15. Stone aggregate shall conform to M-12. Brick bat shall conform to M-14 M.S. bar shall conform to M-18.

2.0. Workmanship

2.1. C.I. inspection chamber with provision of C.I. bends of specified size with bolts, nuts and felt washers for underground drain shall be enclosed in masonry chamber which shall be constructed as under:

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2.2. The excavation shall be done true to dimensions and level shown in one the plans or as directed.

2.3. Bed concrete shall be 15. Cms, thick C.C. 1:5:10 (1 cement : 5 coarse sand : 10 graded brick bat aggregates. The projection of bed concrete beyond the masonry waifs shall be 7.5cms.

2.0.1. Masonry walls Bricks shall be laid in English bond unless directed otherwise. Half or cut bricks shall not be used except when necessary to complete to bond; closures in such case shall be cut to required size and used near the ends of walls.

2.0.2. A layer of mortar shall be spread on full width for suitable length of the lower course. Each brick shall first be properly bedded and set home by gently tapping with handle of trowel or wooden mallet. Its inside face shall be flushed with mortar before the next brick is laid and pressed against it. On completion of course, the vertical joints shall be fully filled from the top with mortar.

2.0.3. The walls shall be taken up truly in plumb. All courses shall be laid truly horizontal and all vertical joint shall be truly vertical. Vertical joints in alternate course shall generally be directly one over the other. The thickness of brick course shall be kept uniform.

2.0.4. The brick shall be laid with frog up wards. A set of tools comprising of wooden straight edges, man son's spirit level, square half meter rub, and pins, string and plumb shall be kept on the site of work for frequent checking during the progress of work.

2.0.5. Both the faces of walls of thickness greater than 23 cms. Shall be kept in proper place. All the connected brick work shall be kept not more than one meter over the rest of the work. Where this is not possible, the work shall be raked back according to bond (and not left toothed) at an angle not steeper than 45 degrees.

2.0.6. All futures, pipes, outlets of water, hold fasts of doors and windows etc. Which are required to be built in wall shall be embedded in cement mortar

2.0. Coverslab:

2.0.1. The cover slab of R.C.G. 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm. Nominal size) 15 cms. Thick reinforced with 10 mm. Bars at 15 cms. C/C both ways, surface and edges finished fair. Full bearing equal to the width to the width of wall shall be given to the slab on all sides. The frame of manhole cover shall be embedded firmly in R.C.C. slab so that the top of the frame remains flush with the top of R.C.C. slab.

3.0. Mode of measurements and payment

3.1. The earth work in excavation, providing and laying C.I. inspection chamber and bends shall be measured and paid for separately.

3.2. The rate shall be for a unit of One number.

Item No. 173

Constructing masonry Chamber 60x60x75 cm inside, in brick working cement mortar 1:4 (1 cement : 4 coarse sand) for sluice valve, with C. I. Surface box 100 mm top diameter, 160 mm bottom diameter and 180 mm deep (inside) with chained lid and RCC top slab 1:2:4 mix (1 cement : 2 cement : 2 coarse sand : 4 graded stoe aggregate 20mm nominal size) i/c necessary excavation, foundation concrete 1:5:10 (1 cement : 5 dine sand : 10 graded stone aggregate 40mm nominal size) and inside plastering with cement mortar 1:3 (1 cement : 3 coarse sand) 12mm thick, finished with a floating coat of neat cement complete as per standard design : With common burnt clay F.P.S.(non modular) bricks of class designation 7.5

Workmanship

The relevant specifications of item No.172 shall be followed except that size as per boq items

Mode of Measurement & Payment

The relevant specifications of item No.172 shall be followed

Item No. 174

Constructing masonry Chamber 90x90x100 cm inside, in brick working cement mortar 1:4 (1 cement : 4 coarse sand) for sluice valve, with C.I. surface box 100mm top diameter, 160 mm bottom diameter and 180 mm deep (inside) with chained lid and RCC top slab 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) , i/c necessary excavation, foundation concrete 1:5:10 (1 cement : 5 dine sand

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: 10 graded stone aggregate 40 mm nominal size) and inside plastering with cement mortar 1:3 (1 cement : 3 coarse sand) 12 mm thick, finished with a floating coat of neat cement complete as per standard design : With common burnt clay F.P.S.(non modular) bricks of class designation 7.5

Workmanship

The relevant specifications of item No.172 shall be followed except that size as per boq items.

Mode of Measurement & Payment

The relevant specifications of item No.172 shall be followed

Item No. 175

Providing and fixing C.I. double acting air valve of approved quality with bolts, nuts, rubber insertion etc. Complete (The tail pieces, tapers etc if required will be paid separately) : 100 mm dia

1.0. Materials : C.I. double acting air valve, shall conform to I.S. : 778-1964. The gate valve with with bolts, nuts, rubber insertion etc shall be of tested quality.

2.2. Workmanship

100mm dia the C.I. double acting air valve) with quality with bolts, nuts, rubber insertion etc shall be fully cleared of all foreign matter before fixing. The fixing of shall be done by means of with necessary specials, union, nipples etc., to complete the job the same specifications as in case of socket and spigot flanges in case of flanged pipes. The joining shall be done leakproof.

3.2. Mode of measurements and payment

The rate includes all labours, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One number

Item No. 176

Providing push-on-joints to centrifugally (Spun) cast iron or Ductile Iron pipes including testing of joints and including the cost of rubber gasket. 100 mm dia Pipes

1.0. Materials : C.I. or ductile pipe, shall conform to I.S. : 778-1964. The C.I. or ductile pipe, with push-on-joints to centrifugally (Spun) cast iron or Ductile Iron pipes including testing of joints and including the cost of rubber gasket shall be of tested quality.

2.3. Workmanship

100mm dia the C.I. or ductile pipe) with push-on-joints to centrifugally (Spun) cast iron or Ductile Iron pipes including testing of joints and including the cost of rubber gasket shall be of tested quality shall be fully cleared of all foreign matter before fixing. The fixing of shall be done by means of with necessary specials, union, nipples etc., to complete the job the same specifications as in case of socket and spigot flanges in case of flanged pipes. The joining shall be done leakproof.

3.3. Mode of measurements and payment

The rate includes all labours, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One number

Item No. 177

Providing and laying S & S centrifugally cast (Spun) pipes conforming to IS : 8329. 100 mm dia Ductile Iron class K-9 pipes

Workmanship

The relevant specifications of item No.176 shall be followed except that Ductile Iron Pipe should be K-9 and conforming to IS : 8329

Mode of Measurement & Payment

The relevant specifications of item No.176 shall be followed

Item No. 178

Disinfecting CI water mains by flusing with water containing bleaching powder at 0.5 gms per ltrs of water and cleaning the same with fresh water, operation to be repeated three times including getting the sample of water from the disinfected main tested in the municipal laboratory. 150 mm dia meter CI pipe.

Workmanship

The relevant specifications of item No.176 shall be followed except that CI water mains by flusing with water containing bleaching powder at 0.5 gms per ltrs of water and cleaning the same with fresh water, operation to be repeated three times including getting the sample of water from the disinfected main tested in the municipal laboratory

Mode of Measurement & Payment

The relevant specifications of item No.176 shall be followed

Item No.179

Providing and fixing chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply including all CPVC plain & brass threaded fittings. This includes jointing of pipes & fittings with one step CPVC solvent cement, trenching, refilling & testing of joints complete as per direction of Engineer in Charge. 25 mm,50mm,80mm,100mm nominal outer dia Pipes.

Workmanship

The relevant specifications of item No.145 shall be followed

Mode of Measurement & Payment

The relevant specifications of item No.145 shall be followed

Item No. 180

Providing and fixing SS TANK 400LTR

1.0. Materials : SS TANK 400LTR, shall conform to I.S

2.4. Workmanship

SS TANK 400LTR with shall be fully cleared of all foreign matter before fixing. The fixing of shall be done by means of with necessary specials, union, nipples etc., to complete the job the same specifications as in case of socket and spigot flanges in case of flanged pipes. The joining shall be done leakproof.

3.4. Mode of measurements and payment

The rate includes all labours, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One number.

Item No. 181

Supply and fixing of DWC (Double Wall Corrugated) Pipe soil / waste pipe under ground drainage system (SN 8) soil and waste pipes jointed with rubber ring with good quality lubricant with solvent cement. As per IS - 16098-II for pipes and IS fittings, inclusive of all necessary specials like bends, tees, offsets, junctions, etc., laid under floor/under ceiling/on walls with suitable clamps and specials curing, necessary chasing, jointing and restoring to original conditions, testing etc. As directed by Engineer -in- Charge. Make Astral / Prince / Supreme 150 mm,200mm,250mm diameter .

1.0. Materials : DWC (Double Wall Corrugated) Pipe, bends, tees, offsets, junctions, etc., laid under floor/under ceiling/on walls with suitable clamps, shall conform to As per IS - 16098-II

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2.5. Workmanship

DWC (Double Wall Corrugated) Pipe shall be fully cleared of all foreign matter before fixing. The and fixing of DWC (Double Wall Corrugated) Pipe soil / waste pipe under ground drainage system (SN 8) soil and waste pipes jointed with rubber ring with good quality lubricant with slovent cement. As per IS - 16098-II for pipes and IS fittings, inclusive of all necessary specials like bends, tees, offsets, junctions, etc., laid under floor/under ceiling/on walls with suitable clamps and specials curing, necessary chasing, jointing and restoring to original conditions, testing etc. As directed by Engineer -in- Charge.the job the same specifications as in case of socket and spigot flanges in case of flanged pipes. The joining shall be done leakproof.

3.5. Mode of measurements and payment

The rate includes all labours, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One number.

Item No. 182

Providing and laying cement concrete 1:5:10 (1 cement : 5 coarse sand: 10 graded stone aggregate 40 mm nominal size) all-round S.W. pipes including bed concrete as per standard design: 150 mm,200mm,250mm diameter .

1.4. Materials

1.5. Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6 stone aggregate 40 mm.

Nominal size shall conform tom-12.

2.4. Workmanship

Relevant Specifications of item No7 shall be followed except that cement concrete shall be mixed in the preparation of 1:5:8 instead of 1:3.6 by volume. The concrete work shall be done in trenches for bedding of pipes of. Dia mentioned in above items. The width of concrete shall be 300,450,600 mm. And the thickness of bedding shall be 166 mm. Average.

3.4. Mode of measurement and payment

3.5. The relevant specifications of item no.7 shall be followed.

The rate shall be for a unit of One running meter

Item No. 183

Providing and fixing square-mouth S.W. gully trap class SP-1 complete with C.I. grating brick masonry chamber with water tight C.I. cover with frame of 300 x300 mm size (inside) the weight of cover to be not less than 4.50 kg and frame to be not less than 2.70 kg as per standard design : 180x150 mm size P type With common burnt clay . (non modular) bricks of class designation 7.5 .

Materials : Water shall conform to M-1. (2) Cement mortar of proportion 1:5 shall conform to M-

11. (3) Burnt brick shall conform to M-15. (4) The S.W. Galley trap of 150 mm. X 100 mm. Size shall confirm to.M-70a.

2.0. Workmanship

2.1. Excavation for gully trap shall be done true to dimensions and levels as indicated on plans or as directed. The excavation work shall generally be done as per relevant specifications of item 2.of earth work.

2.2. Fixing:

2.2.1. The gully trap shall be fixed over cement concrete 1:5:10 (l cement : 5 sand : 10 graded brick bats aggregate 40 mm nominal size) foundation. 650 square and 100 mm. Thick The depth of top of concrete below the ground level shall be 675 mm. The jointing of gully outlet to the branch drain shall be done .

2.3. Brick masonry chamber : After fixing and testing gully and branch drain, a brick masonry 300 x 330 mm. Inside with bricks in CM 1:5 (1 cement : 5 sand) shall be built with a 100 mm. Brick work round OH; gully trap from the top of bed concrete up to ground level. The space between the chamber walls and

The trap shall be filled with cement concrete 1:5:10. The upper portion of the chamber i.e. Above the top level of the trap shall be plastered inside with cement mortar 1:3 (1 cement: 3 sand) finished with floating coat of neat cement. The corners and bottom of the chamber shall be rounded of so as to slope towards the grating.

2.4. C.I. cover with frame 300 mm, x 300 mm. (inside) size shall then be fixed on the top of the brick masonry with C.c. 1:2:4 (1 lent : 2 coarse sand : 4 graded aggregate 20 mm. Nominal size) 40 mm. Thick and rendered smooth. The finished top of the cover shall be left about 40 mm. Above the adjoining ground level so as to exclude the surface water from entering the gulleytrap.

3.0. Mode of measurements & payment

3.1. The rate includes cost of all labour, materials, tools and plant etc. Required for satisfactory completion of this item as described above.

The rate shall be for a unit of one number basis

Item No. 184

Providing and laying non-pressure NP2 class (light duty) R.C.C. pipes with collars jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand) including testing of joints etc. Complete :. 150 mm, 250mm, 300mm dia. R.C.C. pipe

Workmanship and Material

19.2.2 Cement Concrete Pipes (with and without Reinforcement) (Light Duty, Non-Pressure)

The pipes shall be with or without reinforcement as required and shall be of class not lesser than NP2. These shall conform to IS 458 and shall be capable of withstanding a test pressure of 0.07 mpa (7 m head). The reinforced cement concrete pipes shall be manufactured by centrifugal (or spun) process while un-reinforced cement concrete pipes by spun or pressure process. All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding.

Concrete used for the manufacture of un-reinforced and reinforced concrete pipes and collars shall not be leaner than 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate). The maximum size of aggregate should not exceed one third of the thickness of the pipe or 20 mm whichever is smaller for pipes above 250 mm internal diameter. But for pipes of internal diameter 80 to 250 mm, the maximum size of aggregate should be 10mm. The reinforcement in the reinforced concrete pipes shall extend throughout the length of the pipe. The circumferential and longitudinal reinforcements shall be adequate to withstand the specified hydrostatic pressure and further bending stresses due to the weight of water when running full across a span equal to the length of pipe plus three times its own weight.

The dimensional requirements of concrete pipes are given in Appendix I. The minimum clear cover for reinforcement in pipes and collars shall be as given in Table 19.3.

TABLE 19.3

TABLE 19.3

Sl. No.	Precast concrete pipe/collar	Minimum clear cover, mm
(i)	Barrel wall thickness	
(a)	Upto and including 75 mm	8
(b)	Over 75 mm	15
(ii)	At spigot steps	5
(iii)	At end of longitudinal	5

Note : An effective means shall be provided for maintaining the reinforcement in position and for ensuring correct cover during manufacture of the unit. Spacers for this purpose shall be of rust proof material or of steel protected against corrosion.

19.2.2.1 Laying and Jointing Cement Concrete Pipes and Specials

(i) Trenches: Where the pipes are to be bedded directly on soil, the bed shall be suitably rounded to fit the lower part of the pipe, the cost for this operation being included in the rate for laying the pipe itself.

(ii) Loading, transporting and unloading of concrete pipes shall be done with care. Handling shall be such as to avoid impact. Gradual unloading by inclined plane or by chain pulley block is recommended. All pipe sections and connections shall be inspected carefully before being laid. Broken or defective pipes or connections shall not be used. Pipes shall be lowered into the trenches carefully. Mechanical appliances may be used. Pipes shall be laid true to line and grade as specified. Laying of pipes shall proceed upgrade of a slope.

(iii) If the pipes have spigot and socket joints, the socket ends shall face upstream. In the case of pipes with joints to be made with loose collars, the collars shall be slipped on before the next pipe is laid. Adequate and proper expansion joints shall be provided where directed.

(iv) In case where foundation conditions are unusual such as in the proximity of trees or holes, under existing or proposed tracks manholes etc. The pipe shall be encased all-around in 15 cm thick cement concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size) or compacted sand or gravel.

(i) In cases where the natural foundation is inadequate the pipes shall be laid either in concrete cradle supported on proper foundations or on any other suitably designed structure. If a concrete cradle bedding is used the depth of concrete below the bottom of the pipe shall be at least 1/4th of the internal dia of the pipe subject to the min. Of 10 cm and a maximum of 30 cm. The concrete shall extend up the sides of the pipe at least to a distance of 1/4th of the outside diameter of pipes 300 mm and over in dia. The pipe shall be laid in this concrete bedding before the concrete has set. Pipes laid in trenches in earth shall be bedded evenly and firmly and as far up the haunches of the pipe as to safely transmit the load expected from the backfill through the pipe to the bed. This shall be done either by excavating the bottom of the trench to fit the curve of the pipe or by compacting the earth under around the curve of the pipe to form an even bed. Necessary provision shall be made for joints wherever required.

(vi) When the pipe is laid in a trench in rock hard clay, shale or other hard material the space below the pipe shall be excavated and replaced with an equalising bed of concrete, sand or compacted earth. In no place shall pipe be laid directly on such hard material.

(vii) The method of bedding and laying the pipes under different conditions are illustrated.

(viii) When the pipes are laid completely above the ground the foundations shall be made even and sufficiently compacted to support the pipe line without any material settlement. Alternatively the pipe line shall be supported on rigid foundations at intervals. Suitable

arrangements shall be made to retain the pipe line in the proper alignment, such as by shaping the top of the supports to fit the lower part of the pipe. The distance between the supports shall in no case exceed the length of the pipe. The pipe shall be supported as far as possible close to the joints. In no case shall the joints come in the centre of the span. Care shall be taken to see that super imposed loads greater than the total load equivalent to the weight of the pipe when running full shall not be permitted. Suitably designed anchor blocks at change of direction and grades for pressure lines shall be provided where required.

(ix) Jointing: Joints are generally of rigid type. Where specified flexible type joints may also be provided.

(a) Rigid Spigot and Socket Joint: The spigot of each pipe shall be slipped home well into the socket of the pipe previously laid and adjusted in the correct position. The opening of the joint shall be filled with stiff mixture of cement mortar in the proportion of 1:2 (1 cement: 2 fine sand) which shall be rammed with caulking tool. After a day's work any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured.

(b) Rigid Collar Joint: The two adjoining pipes shall be butted against each other and adjusted in correct position. The collar shall then be slipped over the joint, covering equally both the pipes. The annular space shall be filled with stiff mixture of cement mortar 1:2 (1 cement: 2 fine sand) which shall be rammed with caulking tool. After a day's work any extraneous materials shall be removed from the inside of the pipe and the newly made joint shall be cured.

(c) Semi Flexible Spigot and Socket Joint: The joint is composed of specially shaped spigot and socket ends on the concrete pipes. A rubber ring shall be placed on the spigot which shall be forced into the socket of the pipe previously laid. This compresses the rubber ring as it rolls into the annular space formed between the two surfaces of the spigot and the socket, stiff mixture of cement mortar 1:2 (1 cement: 2 fine sand) shall then be filled into the remaining annular space and rammed with a caulking tool. After day's work any extraneous materials shall be removed from the inside of the pipe and the newly made joint shall be cured.

(d) Semi Flexible Collar Joint: This is made up of a loose collar which covers two specially shaped pipe ends . Each end shall be fitted with a rubber ring which when compressed between the spigot and the collar, seal the joint. Stiff mixture of cement mortar 1:2 (1 cement: 2 fine sand), shall then be filled into the remaining annular space and rammed with a caulking tool. After day's work, any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured.

(e) Internal Flush Joint : This joint is generally used for culvert pipe of 60 cm dia and over. The ends of the pipe are specially shaped to form a self centering joint with an internal jointing space 1.3 cm wide the finished joint is flush with both inside and outside with the pipe wall . The jointing space is filled with cement mortar 1:2 (1 cement: 2 fine sand) mixed sufficiently dry to remain in position when forced with a trowel or rammer. After day's work, any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured.

(f) External Flush Joint : This joint is suitable for pipes which are too small for jointing from inside. This joint is composed of specially shaped pipe ends. Each end shall be butted against each other and adjusted in correct position. The jointing space shall then be filled with cement mortar 1:2 (1 cement: 2 fine sand) sufficiently dry and finished off flush. Great care shall be taken to ensure that the projecting ends are not damaged as no repairs can be readily affected from inside the pipe.

(x) In all pressure pipe lines the recess at the end of the pipe line shall be filled with jute braiding dipped in hot bitumen or other suitable approved compound. Pipes shall be so jointed that the bitumen ring of one pipe shall set into the recess of the next pipe. The ring shall be thoroughly compressed by jacking or by any other suitable method. The number of pipes that shall be jacked together at a time shall depend on the diameter of the pipes and the bearing capacity of the soil, for small pipes up to 25 cm diameter, six pipes can be jacked together at a time. The quantity of jute and bitumen in the ring shall be just sufficient to fill the recess in the pipe when

pressed hard by jacking or by any other suitable method. Before and during jacking care shall be taken to see that there is no offset at the joint.

(xi) Testing: For pressure pipes, the completed pipeline shall be tested for pressure (Known as site test pressure) which shall not be less than the maximum pipeline operating pressure plus the calculated surge pressure, but in no case shall it exceed the hydrostatic test pressure. For non-pressure pipes the joints shall be tested.

(xii) Refilling of Trenches: In case where pipes are not bedded on concrete special care shall be taken in refilling, trenches to prevent the displacement and subsequent settlement at the surface resulting in uneven street surfaces and dangers to foundations etc. The backfilling materials shall be packed by hand under and around the pipe and rammed with a shovel and light tamper. This method of filling will be continued up to the top of pipe. The refilling shall rise evenly on both sides of the pipe and continued up to 60 cm above the top of pipe so as not to disturb the pipe. No tamping shall be done within 15 cm of the top of pipe. The tamping shall become progressively heavier as the depth of the backfill increases.

(xiii) Measurements : The lengths of pipes shall be measured in running metres nearest to a cm as laid or fixed, from inside of one manhole to the inside of the other manhole. The length shall be taken along the centre line of the pipes over all fittings such as bends, collars, junctions, etc. Which shall not be measured separately. Excavation, refilling, shoring and timbering in trenches, and cement concreting wherever required shall be measured separately under relevant items of work. The Location ,dia and levels shall be followed as per boq item.

(xiv) Rate: The rate shall include the cost of materials and labour involved in all the operations described above.

The rate shall be for a unit of One running meter

Item No. 185

Providing and laying non-pressure NP3 class (Medium duty) R.C.C. pipes including with collars jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand) including testing of joints etc. Complete : 450 mm dia. R.C.C. pipe

NON PRESSURE NP-3 CLASS (MEDIUM DUTY)/ NP-4 CLASS (HEAVY DUTY) R.C.C. PIPES

19.19.1 The pipes shall be with reinforcement as required and shall be of class not lesser than NP2. These shall conform to IS 458 and shall be capable of withstanding a test pressure of 0.07 mpa (7 m head). The reinforced cement concrete pipes shall be manufactured by centrifugal (or spun) process or vibrated casting process. All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding. Concrete used for the manufacture of reinforced concrete pipes and collars shall be as per design mix. The concrete quality (concrete mix, maximum water-cement ratio, minimum cement content. Etc) shall be as per IS 456 for at least very severe environment exposure condition with minimum cement content 260 kg/m³. The maximum size of aggregate should not exceed one third of the thickness of the pipe or 20 mm whichever is smaller for pipes above 250 mm internal diameter. But for pipes of internal diameter 80 to 250 mm, the maximum size of aggregate should be 10mm. The reinforcement in the reinforced concrete pipes shall extend throughout the length of the pipe. The

circumferential and longitudinal reinforcements shall be adequate to withstand the specified hydrostatic pressure and further bending stresses due to the weight of water when running full across a span equal to the length of pipe plus three times its own weight.

The Design/ dimensional requirements of concrete pipes are given in Appendix I A (collar for NP2 pipe) and I B (for NP-2 pipe), Appendix I C (Collar for NP-3 & NP-4 pipe), Appendix I D and 1 E (for NP-3 pipe), Appendix I F and I G (for NP-4 pipe). The minimum clear cover for reinforcement in pipes and collars .

Note : An effective means shall be provided for maintaining the reinforcement in position and for ensuring correct cover during manufacture of the unit. Spacers for this purpose shall be of rust proof material or of steel protected against corrosion.

Sl . No. Precast concrete pipe/collar Minimum clear cover, mm (i) Barrel wall thickness (a) Upto and including 75 mm 8 (b) Over 75 mm 15 (ii) At spigot steps 5 (iii) At end of longitudinal 5

19.19.2 Laying and Jointing Cement Concrete Pipes and Specials

19.19.2.1 Trenches: Where the pipes are to be bedded directly on soil, the bed shall be suitably rounded to fit the lower part of the pipe, the cost for this operation being included in the rate for laying the pipe itself.

(ii) Loading, transporting and unloading of concrete pipes shall be done with care. Handling shall be such as to avoid impact. Gradual unloading by inclined plane or by chain pulley block is recommended. All pipe sections and connections shall be inspected carefully before being laid. Broken or defective pipes or connections shall not be used. Pipes shall be lowered into the trenches carefully. Mechanical appliances may be used. Pipes shall be laid true to line and grade as specified. Laying of pipes shall proceed upgrade of a slope.

(iii) If the pipes have spigot and socket joints, the socket ends shall face upstream. In the case of pipes with joints to be made with loose collars, the collars shall be slipped on before the next pipe is laid. Adequate and proper expansion joints shall be provided where directed.

(iv) In case where foundation conditions are unusual such as in the proximity of trees or holes, under existing or proposed tracks manholes etc. The pipe shall be encased allaround in 15 cm thick cement concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size) or compacted sand or gravel.

(v) In cases where the natural foundation is inadequate the pipes shall be laid either in concrete cradle supported on proper foundations or on any other suitably designed structure. If a concrete cradle bedding is used the depth of concrete below the bottom of the pipe shall be at least 1/4th of the internal dia of the pipe subject to the min. Of 10 cm and a maximum of 30 cm. The concrete shall extend up the sides of the pipe at least to a distance of 1/4th of the outside diameter of pipes 300 mm and over in dia. The pipe shall be laid in this concrete bedding before the concrete has set. Pipes laid in trenches in earth shall be bedded evenly and firmly and as far up the haunches of the pipe as to safely transmit the load expected from the backfill through the pipe to the bed. This shall be done either by excavating the bottom of the trench to fit the curve of the pipe or by compacting the earth under around the curve of the pipe to form an even bed. Necessary provision shall be made for joints wherever required.

(vi) When the pipe is laid in a trench in rock hard clay, shale or other hard material the space below the pipe shall be excavated and replaced with an equalising bed of concrete, sand or compacted earth. In no place shall pipe be laid directly on such hard material.

(vii) The method of bedding and laying the pipes under different conditions.

(viii) When the pipes are laid completely above the ground the foundations shall be made even and sufficiently compacted to support the pipe line without any material settlement. Alternatively the pipe line shall be supported on rigid foundations at intervals. Suitable arrangements shall be made to retain the pipe line in the proper alignment, such as by shaping the top of the supports to fit the lower part of the pipe. The distance between the supports shall in no case exceed the length of the pipe. The pipe shall be supported as far as possible close to the joints. In no case shall the joints come in the centre of the span. Care shall be taken to see that super imposed loads greater than the total load equivalent to the weight of the pipe when running full shall not be permitted. Suitably designed anchor blocks at change of direction and grades for pressure lines shall be provided where required.

19.19.2.2 Jointing: Joints are generally of rigid type. Where specified flexible type joints may also be provided.

(a) Rigid Spigot and Socket Joint The spigot of each pipe shall be slipped home well into the socket of the pipe previously laid and adjusted in the correct position. The opening of the joint shall be filled with stiff mixture of cement mortar in the proportion of 1:2 (1 cement: 2 fine sand) which shall be rammed with caulking tool. After a day's work any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured.

(b) Rigid Collar Joint The two adjoining pipes shall be butted against each other and adjusted in correct position. The collar shall then be slipped over the joint, covering equally both the pipes. The annular space shall be filled with stiff mixture of cement mortar 1:2 (1 cement: 2 fine sand) which shall be rammed with caulking tool. After a day's work any extraneous materials shall be removed from the inside of the pipe and the newly made joint shall be cured.

(c) Semi Flexible Spigot and Socket Joint The joint is composed of specially shaped spigot and socket ends on the concrete pipes. A rubber ring shall be placed on the spigot which shall be forced into the socket of the pipe previously laid. This compresses the rubber ring as it rolls into the annular space formed between the two surfaces of the spigot and the socket, stiff mixture of cement mortar 1:2 (1 cement: 2 fine sand) shall then be filled into the remaining annular space and rammed with a caulking tool. After day's work any extraneous materials shall be removed from the inside of the pipe and the newly made joint shall be cured.

(d) Semi Flexible Collar Joint: This is made up of a loose collar which covers two specially shaped pipe ends. Each end shall be fitted with a rubber ring which when compressed between the spigot and the collar, seal the joint. Stiff mixture of cement mortar 1:2 (1 cement: 2 fine sand), shall then be filled into the remaining annular space and rammed with a caulking tool. After day's work, any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured.

(e) Internal Flush Joint This joint is generally used for culvert pipe of 60 cm dia and over. The ends of the pipe are specially shaped to form a self centering joint with an internal jointing space 1.3 cm wide the finished joint is flush with both inside and outside with the pipe wall .The jointing space is filled with cement mortar 1:2 (1 cement: 2 fine sand) mixed sufficiently dry to remain in position when forced with a trowel or rammer. After day's work, any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured.

(f) External Flush Joint : This joint is suitable for pipes which are too small for jointing from inside. This joint is composed of specially shaped pipe ends. Each end shall be butted against each other and adjusted in correct position. The jointing space shall then be filled with cement mortar 1:2 (1 cement: 2 fine sand) sufficiently dry and finished off flush. Great care shall be taken to ensure that the projecting ends are not damaged as no repairs can be readily affected from inside the pipe.

19.19.2.3 In all pressure pipe lines the recess at the end of the pipe line shall be filled with jute braiding dipped in hot bitumen or other suitable approved compound. Pipes shall be so jointed that the bitumen ring of one pipe shall set into the recess of the next pipe. The ring shall be thoroughly compressed by jacking or by any other suitable method. The number of pipes that shall be jacked together at a time shall depend on the diameter of the pipes and the bearing capacity of the soil, for small pipes up to 25 cm diameter, six pipes can be jacked together at a time. The quantity of jute and bitumen in the ring shall be just sufficient to fill the recess in the pipe when pressed hard by jacking or by any other suitable method. Before and during jacking care shall be taken to see that there is no offset at the joint.

19.19.2.4 Testing: For pressure pipes, the completed pipeline shall be tested for pressure (Known as site test pressure) which shall not be less than the maximum pipeline operating pressure plus the calculated surge pressure, but in no case shall it exceed the hydrostatic test pressure. For non pressure pipes the joints shall be tested as per procedure laid down under above.

19.19.2.5 Refilling of Trenches: In case where pipes are not bedded on concrete special care shall be taken in refilling, trenches to prevent the displacement and subsequent settlement at the surface resulting in uneven street surfaces and dangers to foundations etc. The backfilling materials shall be packed by hand under and around the pipe and rammed with a shovel and light tamper. This method of filling will be continued up to the top of pipe. The refilling shall rise evenly on both sides of the pipe and continued up to 60 cm above the top of pipe so as not to disturb the pipe. No tamping shall be done within 15 cm of the top of pipe. The tamping shall become progressively heavier as the depth of the backfill increases.

19.19.3 Measurements The lengths of pipes shall be measured in running metres nearest to a cm as laid or fixed, from inside of one manhole to the inside of the other manhole. The length shall be taken along the centre line of the pipes over all fittings such as bends, collars, junctions, etc. Which shall not be measured separately. Excavation, refilling, shoring and timbering in trenches, and cement concreting wherever required shall be measured separately under relevant items of work.

19.19.4 Rate: The rate shall include the cost of materials and labour involved in all the operations described above.

Item No. 186

Constructing brick masonry manhole in cement mortar 1:4 (1 cement :4 coarse sand) with R.C.C. top slab with 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size), foundation concrete 1:4:8 mix (1 cement : 4 coarse sand : 8 graded stone aggregate 40mm nominal size), inside plastering 12mm thick with cement mortar 1:3 (1 cement : 3 coarse sand) finished with floating coat of neat cement and making channels in cement concrete 1:2:4 (1cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) finished with a floating coat of neat cement complete as per standard design : Inside size 90x80 cm and 45 cm deep including C.I. cover with frame (light duty) 455x610 mm internal dimensions, total weight of cover and frame to be not less than 38 kg (weight of cover 23 kg and weight of frame 15 kg) : With common burnt clay (non modular) bricks of class designation 7.5.

Workmanship

The relevant specifications of item No.172 shall be followed except that size as per boq items

Mode of Measurement & Payment

The relevant specifications of item No.172 shall be followed

Item No. 187

Extra for depth for manholes Size 90x80 cm With common burnt clay (non modular) bricks of class designation 7.

1.0. Materials and Workmanship

The relevant specifications of item No. 186 shall be followed for excavation same, except that the depth of manhole shall be done 0.1 M. Or part there of more then 0.90 meter up to 1.5 M. The extra payment shall be made for additional depth of 0.1 M. Or part thereof manhole done over and above the depth 0.90meter.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 186 shall be followed except that the extra rate shall be paid for every additional depth of 0.1. M. And part there of shall be paid over and above the rate of item No. 239

2.2. The rate shall be for a unit of One number.

Item No. 188

Constructing brick masonry circular type manhole 0.91m internal dia at bottom and 0.56m dia at top in cement mortar 1:4 (1 cement :4 coarse sand), in side cement plaster 12 mm thick with cement mortar 1:3 (1 cement : 3 coarse sand) finished with a floating coat of neat cement, foundation concrete 1:3:6 mix (1 cement : 3 coarse sand : 6 graded stone aggregate 40mm nominal size), and making necessary channel in

cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) finished with a floating coat of neat cement, all complete as per standard design : 0.91 m deep with S.F.R.C. cover and frame (heavy duty, HD-20 grade designation) 560mm internal diameter conforming to I.S. 12592, total weight of cover and frame to be not less than 182kg., fixed in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) including centering, shuttering all complete. (Excavation, foot rests and 12mm thick cement plaster at the external surface shall be paid for separately) With common burnt clay F.P.S. (non modular) bricks of class designation 7.5

Workmanship

The relevant specifications of item No.186 shall be followed except that size as per boq items

Mode of Measurement &Payment

The relevant specifications of item No.186 shall be followed

Item No. 189

Extra depth for circular type manhole 0.91m internal dia (at bottom) beyond 0.91m to 1.67m

With common burnt clay F.P.S. (non modular) bricks of class designation 7.

Workmanship

The relevant specifications of item No.187 shall be followed except that hieght as per boq items

Mode of Measurement &Payment

The relevant specifications of item No.187 shall be followed

Item No. 190

Constructing brick masonry circular type manhole 1.22m internal dia at bottom and 0.56m dia at top in cement mortar 1:4 (1 cement :4 coarse sand), in side cement plaster 12 mm thick with cement mortar 1:3 (1 cement : 3 coarse sand) finished with a floating coat of neat cement, foundation concrete 1:3:6 mix (1 cement : 3 coarse sand : 6 graded stone aggregate 40mm nominal size), and making necessary channel in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) finished with a floating coat of neat cement, all complete as per standard design : 1.68m deep with S.F.R.C. cover and frame (heavy duty, HD-20 grade designation) 560mm internal diameter conforming to I.S. 12592, total weight of cover and frame to be not less than 182kg., fixed in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) including centering, shuttering all complete. (Excavation, foot rests and 12mm thick cement plaster at the external surface shall be paid for separately) With common burnt clay F.P.S. (non modular) bricks of class designation 7.5

Workmanship

The relevant specifications of item No.188 shall be followed except that size as per boq items

Mode of Measurement &Payment

The relevant specifications of item No.188 shall be followed

Item No. 191

Extra depth for circular type manhole 1.22m internal dia (at bottom) beyond 1.68m to 2.29m With common burnt clay F.P.S. (non modular) bricks of class designation 7.5

Workmanship

The relevant specifications of item No.189 shall be followed except that height as per boq items

Mode of Measurement & Payment

The relevant specifications of item No.189 shall be followed

Item No. 192

Constructing brick masonry circular type manhole 1.52m internal dia at bottom and 0.56m dia at top in cement mortar 1:4 (1 cement :4 coarse sand), in side cement plaster 12 mm thick with cement mortar 1:3 (1 cement : 3 coarse sand) finished with a floating coat of neat cement, foundation concrete 1:3:6 mix (1 cement : 3 coarse sand : 6 graded stone aggregate 40mm nominal size), and making necessary channel in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) finished with a floating coat of neat cement, all complete as per standard design : 2.30m deep with S.F.R.C. cover and frame (heavy duty, HD-20 grade designation) 560mm internal diameter conforming to I.S. 12592, total weight of cover and frame to be not less than 182kg., fixed in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) including centering, shuttering all complete. (Excavation, foot rests and 12mm thick cement plaster at the external surface shall be paid for separately) With common burnt clay F.P.S. (non modular) bricks of class designation 7.5

Workmanship

The relevant specifications of item No.190 shall be followed except that size as per boq items

Mode of Measurement & Payment

The relevant specifications of item No.190 shall be followed

Item No.193

Extra depth for circular type manhole 1.52m internal dia (at bottom) beyond 2.30 m: With common burnt clay F.P.S. (non modular) bricks of class designation 7.5

Workmanship

The relevant specifications of item No.191 shall be followed except that height as per boq items

Mode of Measurement & Payment

The relevant specifications of item No.191 shall be followed

Item No. 194

Providing M.S. foot rests including fixing in manholes with 20x20x10 cm cement concrete blocks 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size) as per standard design : With 20x20 mm square bar

Workmanship

The relevant specifications of item No.7 shall be followed except that block size as per boq items

Mode of Measurement &Payment

The relevant specifications of item No.7 shall be followed

Item No. 195

Constructing brick masonry road gully chamber 50x45x60 cm with bricks in cement mortar 1:4 (1 cement : 4 coarse sand) including 500x450 mm pre-cast R.C.C. horizontal grating with frame complete as per standard design : With common burnt clay F.P.S. (non modular) bricks of class designation 7.5

Workmanship

The relevant specifications of item No.172 shall be followed except that size as per boq items

Mode of Measurement &Payment

The relevant specifications of item No.172 shall be followed

Item No. 196

Excavating trenches of required width for pipes, cables, etc including excavation for sockets, and dressing of sides, ramming of bottoms, depth upto 1.5 m including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20 cm in depth, including consolidating each deposited layer by ramming, watering, etc. And disposing of surplus excavated soil as directed, within a lead of 50 m : All kinds of soil Pipes, cables etc. Exceeding 80 mm dia. But not exceeding 300 mm dia.

Workmanship

The relevant specifications of item No.2 shall be followed except that size as per boq items

Mode of Measurement &Payment

The relevant specifications of item No.2 shall be followed

The rate shall be for a unit of metre.

Item No. 197

Boring/drilling bore well of required dia for casing/ strainer pipe, by suitable method prescribed in IS: 2800 (part I), including collecting samples from different strata, preparing and submitting strata chart/ bore log, including hire & running charges of all equipments, tools, plants & machineries required for the job, all complete as per direction of Engineer -in-charge, upto 90 metre depth below ground level.All types of soil. 400 mm dia

1.0. Materials and Work:

The DTH method is used for fast and economical drilling in hard formations. Compressed air is utilized for rapid impacting action by the hammer to the bit thus crushing the formation into small chips which are flushed out through the annular space between the bore and the drill pipes by the upcoming compressed air.

Note:- The drilling bits generally used during the drilling by direct circulation method and by reverse circulation method are tricone rock roller bits, diamond drilling bits, reaming bits and thin wall core bits. Their use depends upon the type of soil formations such as soft, medium hard and hard formations. The bits used for percussion drilling are California pattern bits and for DTH drilling are button bits and drag bits..and drop and lowering the 175mm UPVC pipe in the bore and further drilling of 165 mm dia bore hole. The length and diameter of the casing pipe is selected on basis of static water level, the draw down, and length of slotted/strainer pipes are selected according to the actual requirement according to the strata met with the expected discharge and the depth of tubewell, the casing pipes shall generally conform to IS 4270 : 1983, the slotted/strainer pipes shall conform to IS 8110 : 1985 and the u-PVC casing pipes and screen shall conform to IS 12818 : 2010.

Mode of measurements and payment

The rate includes all labours, materials, tools and plant etc. Required for satisfactory completion of this item.
The rate shall be for a unit of metre.

Item No. 198

Boring/drilling bore well of required dia for casing/ strainer pipe, by suitable method prescribed in IS: 2800 (part I), including collecting samples from different strata, preparing and submitting strata chart/ bore log, including hire & running charges of all equipments, tools, plants & machineries required for the job, all complete as per direction of Engineer -in-charge, beyond 90 metre & upto 150 metre depth below ground level.

400 mm dia)

Workmanship

The relevant specifications of item No.197 shall be followed except that depth as per boq items

Mode of Measurement & Payment

The relevant specifications of item No.197 shall be followed
The rate shall be for a unit of metre.

Item No. 199

Supplying, assembling, lowering and fixing in vertical position in bore well, ERW (Electronic Resistance Welded) EE 410 mild steel pipes of required dia , conforming to IS: 4270, of required and approved make , including painted with outside surface with two coat of anticorrosive paint approval brand and manufacture, including hire and labour charges, fittings & accessories etc. All complete, for all depths, as per direction of Engineer -in-charge 200 mm nominal size dia having minimum wall thickness 5.4 mm

1.0. Materials

The casing pipe is installed selected on basis of static water level, the draw down, the discharge expected from the well and the size of pump

to be installed.

Mode of measurements and payment

The rate includes all labours, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of nos.

Item No. 200

Supplying, assembling, lowering and fixing in vertical position in bore well, ERW (Electronic Resistance Welded) EE 410 plain slotted (having slot of size 1.6/3.2 mm) steel threaded and socketed / plain bevel ended pipe m(type A) of required di conforming to IS: 8110, of required and approved make , having wall thicknes not less than 5.40 mm , icluding painted with outside surface with two coat of anticorrosive paint approval brand and manufacture, including hire and labour charges, fittings & accessories etc. All complete, for all depths, as per direction of Engineer -in-charge. 200 mm nominal size

1.0. Materials

The casing pipe is installed selected on basis of static water level, the draw down, the discharge expected from the well and the size of pump to be installed.

Mode of measurements and payment

The rate includes all labours, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of nos.

Item No. 201

Development of tube well in accordance with IS : 2800 (part I) and IS: 11189, to establish maximum rate of usable water yield without sand content (beyond permissible limit), with required capacity air compressor, running the compressor for required time till well is fully developed, measuring yield of well by "V" notch method or any other approved method, measuring static level & draw down etc. By step draw down method, collecting water samples & getting tested in approved laboratory, i/c disinfection of tubewell, all complete, including hire & labour charges of air compressor, tools & accessories etc., all as per requirement and direction of Engineer-in-charge.

.9 DEVELOPMENT OF TUBE WELL

23.9.1 The drilled well shall be developed by any of the methods specified in IS 11189: 1985 depending upon the site conditions in order to get maximum sand free yield. The development process shall be continued until the stabilization of sand and gravel pack has taken place.

23.9.2 The development shall be started as far as possible, from the bottom of the screen because with this the compaction takes place as the work progresses upwards and the overlaying material can move downwards, without much possibility of bridging and should a bridge develop, the development action would usually break it up.

23.9.3 The development of the tubewell by over pumping should be done at 15 percent to 25 percent higher discharge than the expected discharge from the tubewell, The final discharge should be free from sand with a maximum tolerance of 20 parts of sand in one million parts of water by volume after 20 minutes of starting the pump.

23.9.4 In case of tubewell for drinking water, the discharge shall be totally sand free. If the discharge is not sand free after 20 minutes of starting the pump, the well shall be redeveloped. In case the discharge is still not sand free even after re-development, the pump set of lesser discharge capacity may be installed to get sand free water suitable for drinking. The turbidity and hardness of water of wells used for drinking purposes, shall be as specified in IS 10500: 1983.

23.9.5 Methods of Development:

23.9.5.1 Numerous methods of development are available. An important factor in any method is that the development work be started slowly and gently and increased in vigor as the well is developed. All but one method of well development require the application of sufficient energy to disturb the natural formation or filter pack so as to free the fines and allow them to be drawn into the well, and to cause the coarser fractions to settle around and stabilize the screen. This is usually accomplished by the, surging of water into and out of the well and the formation. The exception is hydraulic jetting; which depends upon a high velocity water jet discharging through the screen. The jets disturb both filter and formation and the water, following the path of least resistance, returns to the well above and below the jets, carrying the fines into the well.

23.9.5.2 Determination of the adequacy of development is largely a matter of experience and judgment but as a general rule if interrupted over pumping or raw hiding is used as a final method of development the degree of development may be estimated from sand samples on each resumption of pumping. On initiation of interrupted pumping, samples shall be taken as frequently as possible as soon as discharge starts at each new rate of pumping. Sampling of this type at each rate of discharge will show the time required for maximum sand content to occur and will serve as a guide to subsequent sampling and development.

23.9.5.3 Shortly after the period in which maximum sand content Occurs in the discharge for each new rate of pumping, the discharge will become practically sand free until the well is again surged. As raw hiding continues, the maximum amount of sand content will decrease at each discharge time interval until water of low sand content is discharged. The known methods of well development are listed as follows: (a) Over pumping, (b) Compressed air, (c) High velocity jetting, (d) Surge block, and (e) Explosives.

23.9.5.4 Over Pumping

23.9.5.4.1 Continuous over pumping- The simplest and most common method is removing fines from the formation close to the well screen is by over pumping. By this it is meant, pumping the well at higher capacity than it will be pumped when in regular service say not less than 50 percent above the designed discharge. When the water is pumped out of the well, there is a tendency of the sand to move in the direction of the well end, and with steady pull in this direction, the finer sand grains will wedge against each other and bridge across openings or voids between coarse grains to a very considerable degree. The only way in which this can be prevented is by 'back washing' which is keeping the water as agitated as far as possible. The method consist in starting and stopping the pump intermittently to produce relatively rapid changes in the pressure heads in the well. This shall be done more effectively with the help of turbine pumps. The pump is operated with the fullest capacity until it has produced maximum draw- down. It is then stopped, the water recedes rapidly out of the column of the pump and the well is permitted to return to its normal static water level. The procedure is repeated many times until the well is sand free. Note:- Care shall be taken not to start the pump when the shaft is rotating in reverse direction, as this is likely to cause damage to the pump shafts.

23.9.5.4.2 Interrupted over pumping - The development process shall include development by interrupted pumping. The pumping shall be done with a pump capable of pumping at rates up to two times the design capacity. The pumping should be carried out in at least five steps. These steps shall include pumping with no check valve or foot valve present. Pumping shall be conducted in five minute cycles, and shall continue a minimum of two hours or until such time as acceptable standards are attained.

23.9.5.5 Compressed Air- One of the most commonly used method of developing a tube well is by compressed air. It shall be used either by back-washing method or by open well or surging method, 23.9.5.5.1 Back Washing Method:

23.9.5.5.1.1 In the back washing method a 3-way valve is turned to deliver air down the air-line, with the air cock usually open. This pumps water out of the well through the discharge pipe. When the water becomes clear, the supply of air is cut off and the water in the well is allowed to regain its static level. The air cock is then closed and the 3-way valve is turned, so that the air supply is directed down the bypass to the top of the well. This forces the water down out of the casing and back through the screen, breaking down the 'Bridge' of the sand grains. When the water has lowered to the bottom of the drop-pipe, it will not go further, because the air will escape out through the pipe.

23.9.5.5.1.2 When the air is heard escaping out of the discharge pipe, or when the pressure stops increasing, the supply of air is cut off, and the air cock is opened again to allow the water to reach static level. The 3-way valve is turned and the air supply again directed down the air line to pump the well. This procedure is repeated until the well is thoroughly developed. It is advisable to run a bailer, if practicable. For final cleaning of the

well before installing the pump. The diameter of the drop pipe is usually kept about 5 cm less than that of the well pipe and that of the air line usually varies from 2 to 6 cm. The hook-up of the equipment for closed well method is shown in Fig. 23.11. 23.9.5.5.2 Open well method:

23.9.5.5.2.1 This method of development is a combination of surging and pumping. Large volume of air is released suddenly into the well pipe which produces a strong surging action. Pumping is done as with an ordinary air lift. The success of this method depends on the skillful application of alternating the surging and pumping as per requirements of the well. The necessary equipments for this method of development consists of: (a) Air compressor with air receiver of adequate size (b) Drop-pipe and airline in well with suitable means for raising and lowering each independently of the other.

23.9.5.5.2.2 Normally the well pipe itself is used in place of drop pipe but as the washed material has also to be pumped out along with the water, if required a separate discharge/educator pipe may be used so that velocity of water pumped out may be sufficiently great to carry with it all the clogged material from the well. Use of drop pipe becomes necessary in case of deep wells: (a) Flexible high pressure hose and pipe line to connect between tank and airline in well (b) The compressor should be fitted with unloaded and the tank must have a relief valve to safeguard against accidental overloading and (c) Miscellaneous small fitting, such as pressure gauge and a quick-opening valve at the outlet of the tank.

23.9.5.5.2.3 In order that development by this method may be fully successful, it is necessary to have a ratio of submergence of at least 60 percent. The efficiency of development reduces rapidly with submergence less than 80 percent should the air line be too deeper submerged in proportion to the net height of the lift, an uneconomically high pressure will be required to force the air out. The discharge of the compressor shall be piped direct to the tank without any valve in the line. The discharge from the tank to the well shall be the full size of the airline in the well, or if long, the next larger size, and shall be fitted with a quick opening valve near the tank. A high-pressure hose is used between the discharge pipe from the tank and the airline in the well. This hose shall be at least 4.5 to 6 m long to allow sufficient space for moving the drop pipe and air line up and down. Before blowing water or drilling mud out of the well, the air-lift shall be operated slowly for a time to make sure that the screen is sufficiently open so that water will come into the well freely, otherwise damage to the screen may take place.

23.9.5.5.2.4 At the start of development the drop pipe is lowered within 600 mm or so of the bottom of the screen, and the airline is placed, so that it is inside the drop pipe by 300 mm or more. If there is plenty of submergence airline needs to be lowered only for enough to get 60 or 70 percent submergence. The air is turned into the airline and the well is pumped in the manner of a regular air lift, until the water appears to be free from sand. The valve between the tank and the airline is then closed, allowing the tank to be pumped full of air up to required pressure. In the meantime, the airline is lowered so that it is 300 mm or so below the drop pipe. The quick opening valve is then thrown open, allowing the air in the tank to rush into the well. There will be a brief but forceful surge of the water and then a 'head' of water will 'shoot' partly from the drop pipe. If the airline is pulled back into the drop pipes as soon as the first heavy load of air has been shot into the well, it will produce a strong reversal of flow up the drop pipe which will quite effectively agitate the water-bearing formation.

23.9.5.5.2.5 The well is then allowed to pump as an air lift for a short time, and then another 'head' is shot. Repeating until the absence of further sand, etc, shows that the development is complete at this point. This procedure may be repeated in stages at convenient places in the screens, which will complete the work and clean out loose sand which might have settled at the bottom of the well. The compressor shall be capable of developing sufficient pressure to overcome initial head of water in the air line. The recommended size of pumping pipe, and the size of the airline with the pumping rate is given below for guidance. This method has its own limitations where the yield is very weak and the draw down rapid or where submergence is low. Hook-up for open well method .

23.9.5.6 High Velocity Jetting:

23.9.5.6.1 Jet development is a recent addition to other common methods of developing wells. In this method water jets projected at high velocity out through well screen openings effectively loosen fine sand, silt and drilling mud from the water bearing formation. The loosened material moves inside the well screen and is removed from the well by pumping or bailing. The jetting tool consists of an attachment fitted with two or more evenly spaced horizontal nozzles having 6.2, 9.5 or 12.7 mm orifices. The bottom of the tool is closed and the depth of setting, the choice of the nozzle depends largely on the capacity of the high pressure pump. The main item of equipment needed for this method are the jetting tool, high pressure pump, hoses and connections, 5 cm dia pipe line and a source of water. The size of the pipe for feeding water to the nozzles should be large enough to keep friction losses to a reasonable value. It generally ranges from 4.0 to 7.5 cm depending upon the length of the pipe and discharge it has to carry. The diameter of the jetting tool shall be about 25mm less than the inside diameter of the screen. The normal jet discharge (per nozzle) and velocity is as indicated below:

23.9.5.6.2 The procedure consists of operating a horizontal water jet inside the well in such a way that the high velocity stream of water shoot out through the screen openings. By slowly rotating the jetting tool and gradually raising and lowering it, the entire surface on the outside of screen gets the vigorous action of the jet. Fine sand, silt and clay are washed out of the water-bearing formation and the turbulence created by the jet rings these fine materials back into the well through screen openings above and below the point of operation. Wherever possible, it is desirable to pump the well lightly at the same time as the high velocity jet is working by using air compressor. The water so pumped can be reused for jet-development after pumping it into a setting tank.

23.9.5.7 Surge Blocks:

23.9.5.7.1 An effective method for developing the well is surging created by the rapid up and down motion of a plunger, operated in the casing pipe provided above the screened portion of the well. The rapid motion of the plunger causes forceful reversal of the movement of water, which prevents the bridging of finer particles. The repeated application of the surging force draws fine particles from the aquifer and thus porosity and permeability of the zone around the screen is increased. A surge plunger is most used tool for development particularly in wells drilled by cable tool methods and tubewells of natural gravel pack well where strainers have been used.

23.9.5.7.2 Yet there is another method which is called 'Swabbing' in which the swab is lowered into the casing to any selected point and then pulled upwards to produce an inward flow. Swabbing therefore, helps in taking out the fine material drill in consolidated rock aquifers, but are very seldom used in screened wells. Sand pumps may also accomplish effective development of shallow wells with cable tool methods.

23.9.5.7.3 Where the aquifer contains many clay streaks use of plunger block is not recommended because this can cause the clay to plaster over the strainer surface and thus clog the strainer resulting in reduced discharge. Sometimes the strainer give away due to high differential pressure when the strainer is clogged with clay. After the sand has been drawn in by the surge block the well is cleaned by using a hailer and the process is repeated till the well is totally sand free. Total time involved for developing may range from four hours for a small well to 3-4 days on large well with longer screen. The size of the plunger shall be kept such that it does not fit in the casing pipe. It shall be able to pass within the pipe and its fittings freely. The plunger may be run on a continuous string of pipe or a part string with a cable adopter at the top. The surging plunger is lowered into the casing about five metres below the water. The movement of the plunger should be restricted in the portion above the screen in the casing pipe. After lowering, it is stroked to produce surging effect. The stroking may come off the beam of a percussion drill or off a cat head or by hand tripping. Some time, hoisting mechanism is used for this. Initially, the surging shall be stated slightly and gradually increased till it reaches the maximum limit of the system. Through bailing between the runs of the plunger is very important for efficient development. The surging and bailing out is carried out till little sand is driven into the well. In case of wells with long screens, surge plunger may, however, be operated inside the screen for effective development

23.9.5.8 Explosives - These are sometimes employed to develop and enlarge cervices and fissures in tubewells drilled in hard rocks. Charges of 14 to 230 kg are used according to the hardness of the rock and the depth at which the charge is to be detonated.

23.9.6 Criteria for Proper Development of Tubewells - Development work is an essential operation in the completion of drilling job. It consists of steps to remove the finer material and opening up the passage in the formation so that water can enter the well through the screen more freely. Proper development is said to have been satisfactorily done when: (a) The stabilization of the sand formation has taken place, that is, there is no further sinking of gravel and the discharge is sand free; and (b) Permeability of the formation is increased by removing finers utilizing proper development method.

23.9.7 After completion of development by over- pumping, the well shall be tested for its performance that is yield characteristics and efficiency. This shall be achieved by conducting a step draw down test-determine draw downs at the end of the hour by pumping at 3 to 4 different rates of discharge.

Mode of measurements and payment

The rate includes all labours, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of HOUR.

Item No. 202

Providing and fixing factory made precast RCC perforated drain covers, having concrete of strength not less than M-25, of size 1000 x 450x50 mm, reinforced with 8 mm dia four nos longitudinal & 9 nos cross sectional T.M.T. hoop bars, including providing 50 mm dia perforations @ 100 to 125 mm c/c, including providing edge binding with M.S. flats of size 50 mm x 1.6 mm complete, all as per direction of Engineer-in-charge.

2.1. Precast RCC perforated drain covers:

2.1.1. The cover slab of R.C.G. 1:1:2 (1 cement: 1 coarse sand: 2 graded stone aggregate 20 mm. Nominal size) 15 cms. Thick reinforced with 8 mm. Bars at 10 cms. C/C both ways, surface and edges finished fair. Providing 50 mm dia perforations @ 100 to 125 mm c/c, including providing edge binding with M.S. flats of size 50 mm x 1.6 mm complete .Full bearing equal to the width to the width of wall shall be given to the slab on all sides. The frame of manhole cover shall be embedded firmly in R.C.C. slab so that the top of the frame remains flush with the top of R.C.C.slab.

3.3. Mode of measurements and payment

3.4. The earth work in excavation, providing and laying C.I. inspection chamber and bends shall be measured and paid for

separately.

The rate shall be for a unit of One number

Item No. 203

Providing and fixing suitable size threaded mild steel cap or spot welded plate to the top of bore well housing/ casing pipe, removable as per requirement, all complete for borewell of: 200 mm dia

Materials : suitable size threaded mild steel cap shall be best Indian make and quality.

2.16. Workmanship

3.28. Fixing suitable size threaded mild steel cap or spot welded plate to the top of bore well housing/ casing pipe, removable as per requirement, all complete for borewell of: 200 mm dia

3.29. Mode of measurements and payment

3.30. The rate includes cost of all labour, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One Number

Item No. 204

Providing and fixing M.S. clamp of required dia to the top of casing housing pipe of tubewell as IS 2800 (Part I) , including necessary bolts & nuts of required size complete, 200 mm clamp

Materials : M.S. clamp shall be best Indian make and quality.

2.17. Workmanship

The fixing M.S. clamp of required dia to the top of casing housing pipe of tubewell as IS 2800 (Part I) , including necessary bolts & nuts of required size complete, 200 mm clamp

3.31. Mode of measurements and payment

3.32. The rate includes cost of all labour, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One Number

Item No. 205

Providing and fixing Bail plug/ Bottom plug of required dia to the bottom of pipe assembly of tubewell as per IS:2800 (part I) 200 mm dia

Materials : Bail plug/ Bottom plug shall be best Indian make and quality.

2.18. Workmanship

The fixing Bail plug/ Bottom plug of required dia to the bottom of pipe assembly of tubewell as per IS:2800 (part I) 200 mm dia

3.33. Mode of measurements and payment

3.34. The rate includes cost of all labour, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of One Number

Item No. 206

Gravel packing in tubewell construction in accordance with IS: 4097, including providing gravel fine/ medium/ coarse, in required grading & sizes as per actual requirement, all complete as per direction of Engineer-in-charge.)

Gravel Sizes: The gravel conforming to this standard as per IS 4097 : 1967 shall be Sevalia gravel of size 4mm to 6mm.

The particle size distribution of gravel shall be determined by screening through standard sieves in accordance with IS: 460-1985. The percentage distribution of the sizes shall be determined from a graph in which the percentage of material passing through each sieve is plotted against the standard aperture of that sieve. Any size, say D20, will thus indicate that the cumulative weight of all the grains smaller than this size is 20 percent of the total weight of the test sample. The uniformity coefficient of the gravel, that is, the ratio of its d20to d10sizes shall not exceed 2. A material with uniformity coefficient less than 2 shall be classified as uniform and if greater than 2 it shall be taken as non-uniform. The limiting sizes given in above table are the minima and maxima, and the stacks containing smaller or bigger sizes as shown by sieve analysis shall be rejected. The gravel shall have a hardness of not less than 5 in Moh's scale

Mode of measurements and payment

The rate includes all labours, materials, tools and plant etc. Required for satisfactory completion of this item.

The rate shall be for a unit of cum.

Item No. 207

Providing and fixing G.I. pipes complete with G.I. fittings and clamps, i/c cutting and making good the walls etc. 50 mm dia nominal bore.

Workmanship

The relevant specifications of item No.144 shall be followed except that depth as per boq items

Mode of Measurement &Payment

The relevant specifications of item No.144 shall be followed

The rate shall be for a unit of metre.

TECHNICAL SPECIFICATION Animal House and Green House(MEP)

**TENDER DOCUMENT FOR CONSTRUCTION OF GUJARAT
BIOTECHNOLOGY UNIVERSITY (GBU) - GUJARAT**

Tender No.

Client

Architect

GBU



Construction of Gujarat Biotechnology University

at

Gandhinagar (Gujarat)

Tender No.

**Technical Specifications Animal House
and Green House (MEP)**

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FIRE FIGHTING TECHNICAL SPECIFICATIONS ITEM NO. 208-218

2.1 Internal Hydrant (Landing Valve)

Landing valve shall be of the type approved by the relevant fire authority applicable as per Indian standard or equivalent. The landing valve shall comply with the requirements of IS 5290 or approved equivalent. Landing valve shall be fitted to a Tee connection on the wet riser at the landing.

Outlet shall be fitted with a removable SS plug secured by a chain with hand wheel.

Landing valves at lower floors shall incorporate SS Orifice plates to limit the maximum pressure as required by NBC-2016/Fire Authority.

At each landing and other locations as shown on the drawings one single headed SS landing valves (connected to the Fire Riser) with 63 mm dia outlet and 80 mm inlet (I.S.5290). Each landing valve shall be with one shut off butterfly valve.

The valve shall have flanged inlet and instantaneous type outlets and shall be fixed at a height of 1000 mm from the finished floor.

Contractor shall provide for each internal fire hydrant station two numbers of 63 mm dia. 15 m long reinforced rubberized fabric hose pipes with SS male and female instantaneous type coupling machine wound with SS wire (hose to I.S. 636 Type 2 and couplings to I.S. 903 with I.S. Certification), fire hose reel with 20 mm hose 30-meter-long, SS branch pipe with nozzle I.S. 903 and SS Fire man's axe as per NBC 2016. one 6 kg ABC and one 4.5 kg Co2 fire extinguisher.

2.2 First Aid Hose Reel Equipment

First aid hose reel shall comprise reel, hose guide fixing bracket, hose tubing globe valve, stop cock and shut off nozzle. This shall conform to IS: 884 -1969. The hose tubing shall conform to IS: 1532 - 1969.

Hose tubing shall be 20mm dia and 30 m long. The nozzle and globe valve shall be of 20mm size.

The reel shall be of rigid construction using heavy duty CRCA steel. It shall rotate freely on leak proof bearings and be fitted with pivoted nylon rollers to allow easy run-out of the hose.

Hose reel shall be connected directly to the wet riser and installed in the Fire Hose Cabinet.

The approved shutoff nozzle shall be 5mm bore. It shall be adjustable for jet or spray pattern with complete shut-off.

Fire Hose Cabinets for all internal as well as external fire hydrants shall be provided. Hose cabinets shall be fabricated from 2mm CRCA Sheet of fully welded construction hinged double front door partially glazed with L&K locking arrangement, stove enameled finish in Fire red colour with 100 mm high letters "FIRE HOSE" painted on it prominently.

Branch line from Wet riser to Hose Reel shall incorporate SS Orifice plate to limit the maximum pressure as required by NBC/Fire Authority.

2.3 Hose Pipe, Branch Pipes and Nozzles

2.4.1 Hose Pipe

Hose pipes shall be rubber lined woven jacketed and 63mm in diameter. They shall conform to type 2 (Reinforced rubber lined) of IS: 636 - 1979. The hose shall be sufficiently flexible and capable of being rolled.

Each run of hose pipe shall be complete with necessary SS coupling at the ends to match with the landing valve or with another run of hose pipe or with branch pipe. The coupling shall be of instantaneous spring lock type.

2.4.2 Standard Branch Pipes

Branch pipe shall be of SS 63mm dia and be complete with male instantaneous spring lock type coupling for connection to the hose pipe. The branch pipe shall be externally threaded to receive the nozzle.

Branch pipes shall be conform to IS: 903 -1985

2.4.3 Nozzle

The nozzle shall be SS 16mm in (Internal) diameter. The screw threads at the inlet connection shall match with the threading on the branch pipe. The inlet end shall have a hexagonal head to facilitate screwing of the nozzle on to the branch pipe, with nozzle spanner.

Nozzles shall conform to IS: 903 -1985

2.4.4 Fire Hose Cabinet

Fire Hose Cabinet will accommodate the landing valve, hose pipe, hose reel fire man axe, portable extinguisher etc. This shall have lockable, centre opening, glazed doors as per Indian standards or equivalent.

Fire Hose Cabinet may be provided of steel frame structure.
The hose cabinet shall be painted red and stove enameled.

2.4.5 Fire Brigade Connections

Stainless Steel collecting head with three or four 63 mm instantaneous type inlets with built in check valves and 150 mm diameter outlet connected to the fire tank, wet riser or sprinkler riser shall be provided for each building. Collecting head shall be installed on a stand post and provided with horizontal C.I. reflux valve. Etched Stainless Steel label plates with 100 mm high letters shall be provided at each fire brigade connection. The plates should be firmly fixed to the Fire Brigade connection and support system. Fire Brigade inlet connections must be provided in accessible locations generally in front side of the premises and must be free of traffic and parking and other obstructions.

2.4 MS Pipes & Fittings

2.5.1 Pipes

All fire pipes within and outside the building in underground / exposed locations shall be as follows:

MS pipes 150 mm dia. and below conforming to IS: 1239 part-1, minimum 5.4 mm thick heavy grade, C class.

MS pipes 200 mm dia. and above conforming to IS: 3589, minimum 6.35mm thick, grade 330.

All pipes above ground and in exposed locations shall be painted with two coat of zinc chromate primer and two or more coats of synthetic enamel paint of approved shade.

M.S. pipes when buried underground shall be painted with two coats of approved primer and wrapped with one/two layer of 4 mm thick PYPKOTE sheet or equivalent as per manufacturer's specifications

All underground pipes are to be laid not less than 1m below ground level.

2.5.2 Fittings

(a) All GI and MS fittings shall be as per IS 1239 part-2 – For Infrastructure.

Pipe fittings viz, tees, bends, couplings, flanges, reducers etc. and all such connecting device that are needed to complete the piping work in its totality.

Socket welded for up to 50 mm dia pipe.

(b) For Internal Pipes: -

Above 50 mm pipes fittings shall be joined with grooved fitting and couplings (UL Listed & FM Approved). Grooving on pipe shall be done using Grooving machine of same manufacturer as Grooved fittings.

Forged steel fittings of approved type with "V" groove for welded joints will be used in exceptional cases only with approval of CLIENT CONSULTANT. 37.5 bevel end should be provided for grooving. When two pipes will be joint, it will be 75 degree and gap between both pipes should be checked properly with tapper gauge as directed by CLIENT CONSULTANT.

Welded joints shall be permitted as an exception with approval of CLIENT CONSULTANT.

Welder should be 6G certified.

Fabricated fittings shall not be permitted under normal circumstances.

All fittings shall be able to withstand a pressure of 150% of the maximum working pressure.

2.5 Jointing

2.6.1 Joints Screwed and V Groove

Joint for GI and Grooved Fittings steel pipes and fittings shall be metal to metal joints using Teflon tapes on threads for pipes up to 50mm diameter. Only forged

socket screwed fittings to be used. All fittings shall have manufacturer's trade mark stamped on it.

Fabricated fittings shall not be used under any circumstances.

For pipes and fittings jointed with forged screwed fittings, care shall be taken to remove burr from the end of the pipe after cutting by a round file.

Pipes above 50 mm shall be joined with grooved fittings.

2.6.2 Grooved End Fittings

Fittings shall be cast of ductile iron with grooved ends for direct connection into grooved piping systems (UL Listed & FM Approved):

- 1) Mechanical Couplings: UL Listed & FM Approved Manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12. Gaskets shall be pressure-responsive synthetic rubber, grade to suit the intended service, conforming to ASTM D-2000. Mechanical Coupling bolts shall be zinc plated (ASTM B-633) heat treated carbon steel track head conforming to ASTM A- 449 and A-183, minimum tensile strength 110,000 psi (758450 kPa).

Standard rigid joints Housings shall be cast with offsetting, angle pattern bolt pads to provide system rigidity and support and hanging in accordance with NFPA 13

Couplings should not require Torque while tightening up to 12" & Tongue & Recess Coupling are not allowed.

- 2) Grooved End Fittings: UL Listed & FM Approved Fittings shall be cast of ductile iron conforming to ASTM A-536, Grade 65-45-12 (Fire Lock®), forged steel conforming to ASTM A- 234, Grade WPB 0.375" wall (9,53 mm wall), or fabricated from Std. Wt. Carbon Steel pipe conforming to ASTM A-53, Type F, E or S, Grade B. Fittings provided with an alkyd enamel finish or hot dip galvanized to ASTM A-153. Zinc electroplated fittings and couplings conform to ASTM B633.
- 3) Bolted Branch Outlet: UL Listed & FM Approved Branch reductions on 2"(DN50) through 8"(DN200) header piping. Bolted branch outlets shall be manufactured from ductile iron conforming to ASTM A-536, Grade 65-45-12, with synthetic rubber gasket, and heat-treated carbon steel zinc plated bolts and nuts conforming to physical properties of ASTM A-183

For valves connection, coupling shall be used as per approved makes to make connection especially in pump room.

2.6.3 Welded Joints (Exceptions only)

Use Fittings of approved type with "V" groove end for welded joints in 50mm diameter and above, in case grooved fitting can't be used.

Joints between MS pipes and fittings shall be made with the pipes and fittings having groove and fittings.

Welded joints are not permissible normally.

2.6 Flanges

Flanges shall be provided on both ends of any fabricated fittings e.g. bends tees etc. of 50 mm dia or larger diameter wherever necessary. Generally, usage of flanged fittings shall be avoided unless necessarily required.

Flanges shall be provided for jointing all types of valves, appurtenances, pumps, connections with other type of pipes to water tanks and other places necessary and required as good for engineering practice.

Flanges shall be as per ASME/ANSI B16.5 with appropriate number of G.I. nuts and bolts, 3 mm insertion neoprene gasket complete.

Unions are to be provided on pipes lines 50 mm and below, near valves and assemblies and as required as per site conditions. All Unions when used shall be with socket welded ends. Usage of unions shall be avoided wherever the pressure exceeds 7 kg/cm² and break up flanges are recommended at these locations.

All couplings and fittings shall be provided by a single source supplier.

2.7 Valves

Valves shall be of same manufacturer for all systems, including valves furnished with equipment.

For flanged valves, companion flanges are to be provided of same PSI rating/class of valve being used.

All valves are to be provided with rating not less than 16kg/cm² working pressure for fire systems or as indicated otherwise.

Valves to be provided as required for complete isolation of equipment, branches from the main lines, arranged so as to give complete and regulation control of piping systems throughout the building. Valves to be provided with neat appearance and grouping, so that all parts are easily accessible for maintenance.

Each valve are to be marked at the factory with the following minimum information, engraved, stamped or cast on each valve or metal tag permanently attached to the valve.

1. Manufacturer's name.
2. Catalogue or Figure number.
3. Size and pressure class.
4. Arrows shall indicate direction of flow on check, globe, angle, non-return eccentric plug and butterfly valves.
5. Valves shall be ISI marked.

All the valves up to 50mm dia. shall be of gunmetal/bronze body with screwed ends and shall be provided with unions on both the sides for removal and repair, unless instructed otherwise.

All the valves above 50mm dia shall be of CI body with flanged ends and shall be provided with flanges on both the sides for removal and repair, unless instructed otherwise.

Wherever possible, install valves accessible from floor level. Provide operating handles for all valves and cocks. Provide adequate clearance for easy operation.

Face to Face dimensions of the valves shall be as per ASME/ANSI B 16.10.

2.8 Check Valve

All check valves 50mm and smaller shall be of bronze body and disc, threaded ends or as required by the piping system in which they are installed.

All check valves 65mm and larger shall be of cast iron body with stainless steel trim and shall be of flanged end as required by the piping system in which they are installed.

All check valves shall be swing check type.

2.9 Butterfly Valve

Butterfly valves 80mm dia. and above shall be Cast Iron butterfly valve to be used for isolation. The valves shall be bubble tight, resilient seated suitable for flow in

either direction and seal in both directions with accompanying flanges and steel handle.

Butterfly valves shall be of best quality conforming to IS: 13095 of PN20 class with position indicator.

Provide wafer type C.I. double flanged butterfly valves of required sizes and of rating.

Butterfly valves shall be high performance valves manufactured of ductile iron body SS-316 stainless disc and stainless steel stem with EN-8/ SS-410 shaft.

Joints for double flanged butterfly valves shall be made with suitable tail/socket pieces on the pipeline and flanges joints made with appropriate number of bolts, nuts and washers with 3 mm thick insertion rubber gasket.

Provide the following butterfly valve accessories:

Valves 150 mm and smaller shall have nine position levers.

Position indicator on all butterfly valves.

For valves without full access provide enclosed extension stems to allow operation.

2.10 Sluice Valve

Sluice Valves (80 mm dia. and above) shall be C.I. double flanged sluice valves with rising stem. Each sluice valve shall be provided with wheel in exposed positions and cap top for underground valves. Contractor shall provide suitable operating keys for sluice valves with cap tops.

Sluice valves shall be of approved makes conforming to IS: 780/PN16 class.

Sluice valves shall be high performance valves manufactured of ductile iron body, SS-316 stainless disc and stainless steel stem with EN-8/ SS-410 shaft

Joints for double flanged sluice valves shall be made with suitable tail/socket pieces on the pipeline and flanges joints made with appropriate number of bolts, nuts and washers with 3 mm thick insertion rubber gasket.

2.11 Safety Relief and Pressure Reducing Valves

All safety and relief valves to be properly rated and installed in accordance with relevant standards.

Use bellow type pressure reducing devices or orifice plates judiciously to limit the pressure in the high pressure areas as per the requirements and keep the pressure within the permissible and operable limits in compliance to fire authority in the entire system.

2.12 Air Valve

25 mm dia. screwed inlet C.I. single acting air valve shall be necessarily provided on all high points in the system.

2.13 Installation Testing Valve

Alarm valve shall be provided in the sprinkler system, to indicate the flow of water in the sprinkler system.

Installation Testing Valves assembly shall be installed on the sprinkler system.

Contractor shall submit detailed shop drawings showing the exact location, details of installation of the valve and alarm complete in all respects.

Installation valve shall comprise of a cast/ductile iron sluice valve with gunmetal trim, pressure gauge, pressure relief valve, double seated clapper check valves as alarm valve with pressure gauge, test valve and orifice assembly and drain pipe with pressure gauge, bye pass on check valve to regulate differential pressure and false alarm, turbine water gong including all accessories necessary and required and as supplied by original equipment manufacturer and required for full and satisfactory performance of the system.

2.14 Orifice Plates

Orifice Plates fabricated made of 6mm/8mm thick stainless steel of required size shall be provided to reduce pressure at strategic locations as per requirements and as per relevant I.S. code. The Contractor shall submit detailed hydraulic calculations for the orifice plates for approval before installation as per location & pressure condition.

2.15 Drain Pipe

80 mm dia black steel pipe conforming to IS: 1239 (heavy class) with gunmetal full way valve for draining any water in the system in low pockets shall be provided.

Flange and blind flange shall be provided after the valve to ensure accidental opening of drain valve.

2.16 Testing of Valves

Test valve bonnets for tightness. Test and operate the valves from closed-to-open-to-closed position while valve is under test pressure.

Test automatic valves including solenoid, pressure relief valves, safety valves and temperature and pressure relief valves for proper operation at settings indicated.

Ensure that valves are field checked for packing and lubricated.

Test all valves, air relief valves, safety relief valves, safety valves and temperature and pressure relief valves three times.

2.17 Strainers

Strainers shall be bucket type with CI/MS body of class 150. The flanged ends shall be conforming to Indian Standard and it shall have perforated S/S (AISI-304) sheet with large screen area.

Vendor to submit the strainer flow graph for approval.

It shall be of compact shape and size as per approval and should be easy to install and repair.

2.18 Hangers and Supports

All hangers, supports, anchors, inserts and guides shall be in accordance with the British Standard BS 3974, MSS SP-58, MSS SP-59, RAL-GZ 656 or equivalent and to the relevant NFPA Standards

Dielectric Protection. Furnish acceptable protection or copper plated hangers between ferrous and nonferrous metal pipe and hangers on all water piping.

All supports used for firefighting system shall be UL listed and FM approved.

Horizontal Piping Hangers

Provide one of the following types of hangers for horizontal piping manufactured by one of the approved makes.

Provide clevis type supports.

Provide sprinkler type supports.

Provide trapeze hangers where several pipes can be installed parallel and at the same level, and fabricate from structural steel shapes.

Use roller chairs or pipe-roll stands where provision for expansion is required.

Spacing shall not be farther than the closest interval required for any size pipe supported thereby, or as necessary to prevent damage or failure to the structure.

Where there is doubt of the structural capacity for concentrated loads necessary structural calculations shall be carried out and the load distributed sufficiently.

Floor Supports:

Contractor to fabricate galvanized steel frame to suit the site conditions to the Engineer's approval.

Wall Supports.

Provide one of the following means of supporting horizontal piping from wall:

Provide wall mounted cantilever type steel supports fabricated from galvanized structural steel of at least 240 MPa yield strength.

Galvanized steel frame designed to suit the site conditions to the Engineer's approval.

The dimensions of steel members to be used for brackets shall be suitable for the supported load and to Engineer's approval.

Vertical Piping Supports:

Vertical pipe supports shall be steel riser pipe-clamps.

Manufacturer's rated maximum loading for each size pipe shall be used (with minimum 50% safety factor) for spacing of supports.

Bolt clamp securely to pipe, reset clamp-end extension on building structure.

Beam Clamps:

Non-"C-Style" beam clamps shall be malleable iron for up to 9.5 mm hanger rods, forged-steel for hanger rod size 9.5 mm and above.

"C-Style" beam clamps shall be adjustable hanger rod type, malleable iron with set screw, jam nut, retaining clip, FM and UL approved.

Where beam configuration does not allow horizontal movement of C-clamp when set screw and jam nut are positioned, retaining clips may be omitted.

Inserts and Expansion bolts:

Furnish and set inserts in concrete forms.

For pipes 200 mm and over or equivalent group of pipes on trapeze, use two or more inserts to prevent exceeding maximum loading.

As an alternative to the above mentioned inserts the Contractor may use expansion bolts. If the Contractor uses expansion bolts, the maximum spacing between supports may need to be reduced so as not to exceed the maximum loading and the expansion bolt locations shall be determined in coordination with the structural elements.

Manufacturer:

All supports and clamps shall be from one of the approved manufacturers. Unless otherwise indicated, all supports, clamps or frames shall be protected against corrosion by galvanizing as per ASTM B 633 or coated as per ISO 12944.

Supports/clamps or frames used outside the building shall be hot dipped galvanized as per ASTM A 123, ASTM A 153 or coated as per ISO 12944.

INSTALLATION / APPLICATION / PERFORMANCE /ERECTION

Provide hangers to support the required loads.

Hang pipe from substantial building structure. Piping shall not be hung from other piping. All rigid hangers shall provide a means of vertical adjustment after erection.

Do not suspend pipe from metal roof deck.

“C” clamps shall be installed as per manufacturer's recommendations.

HORIZONTAL PIPING SUPPORT SCHEDULE

Support horizontal piping on threaded, galvanized, hot rolled steel rod hangers.

Where proprietary hangers are being used, the threaded rod size shall be as required for the hanger.

The maximum spacing shall be based on the load carrying capacity of the hanger, after allowing a safety factory of 50% on the insulated full pipe weights.

Steel Pipe - Maximum Spacing Between Single Pipe Supports:

Nominal Pipe Size, mm

20	25	32	40	50	65	80	100	125	150	200	250	300
Maximum Span Metres												
1.8	2.1	2.7	3.0	3.0	3.3	3.3	3.6	3.8	4.2	5.0	5.0	5.5
Minimum Rod Diameter, Millimeters												
6.4	9.5	9.5	9.5	9.5	13	13	16	16	16	19	24	28

Support steel piping 300 mm and larger at 6 m intervals or less to ensure even distribution of loading on structural members.

The spacing specified herein is included to limit deflection in the pipe to an acceptable minimum. Shorten intervals as necessary so as not to exceed the support manufacturer's maximum recommended safe load values in accordance with BS 3974.

Trapeze Hanger. Spacing shall not be farther than the closest interval required for any size pipe supported thereby, or as necessary to prevent damage or failure to the structure. Provide additional framing as required to transfer loads to adequate structure.

Supporting rods over 450 mm long shall be braced at every fourth hanger with diagonal bracing attached to the structure.

The Contractor shall select support distances such that the precast structure is not subjected to excessive point loads. The Contractor will be required to submit calculations to demonstrate that the proposed loads can be safely supported from the structure.

VERTICAL PIPING SUPPORT

Support vertical piping with steel riser clamps. Make adequate provision for expansion, contraction, and lateral stability by using sliding devices or spring-type installations. Also, account for vertical expansion and lateral movement of the building structures.

Support steel pipe at a minimum of every floor as required to relieve joint stresses.

The space between the vertical pipe supports shall be same as specified for horizontal pipe supports.

Where required, furnish and install heavy anchorage to the pipe against movement from expansion and contraction and secure the approval of the Consultant for the method of installing the anchorage before the work.

Horizontal piping shall be supported at intervals not greater than 3 m spacing and at all changes of direction.

Pipes shall be hung by means of expandable anchor fastener of approved make and design. The hangers and clamps shall be fastened by means of galvanized nuts and bolts. The size/diameter of the anchor fastener and the clamp shall be suitable to carry five times of the weight of water filled pipe plus 250 pounds' pressure.

2.19 Pressure Gauge

Pressure gauge shall be 110 mm dia gunmetal Bourden type with stainless steel isolation cock, tapping and connecting pipe and nipple. The gauge shall be installed at appropriate level and height for easy readability. Pressure gauges shall read 0-20 Kg/sqcm.

2.20 Pipe Sleeves

Contractor has to furnish, install and be responsible for the location of proper sleeves for all pipes passing through floor, walls, partitions or other building construction. Where sleeves occur in concrete construction, they shall be set before concrete is poured.

Sleeves and anchors are to be set in a suitable manner so that they will not become displaced. Sleeves for piping passing through walls and floors in concealed spaces shall be cut flush with walls or floor. All sleeves shall be heavy duty M.S pipe, and of such a size as to permit piping and piping insulation to pass through sleeve.

Sleeves passing through foundation or exterior walls, or where seepage may occur, shall be thoroughly waterproofed by removing all loose material and caulking with oakum and lead wool tightly around pipe or exterior as well as interior surface. Finish off interior surface with cement. Finish off exterior surface with two layers of felt, mopped on with hot asphalt, making for an absolutely waterproof installation. All waterproofing must be performed before any backfilling is done.

On all pipes passing through fire rated walls and ceilings, in finished areas, and where pipes are exposed to view, furnish and install plates on each side of the wall. Plate shall be large enough to cover sleeve opening and pass insulation. Clamp plate firmly to pipe by means of setscrews.

Sleeves passing through walls and floors between rooms shall be filled from both ends of sleeve with fireproof insulation material of a fire rating equal to that of the wall or floor.

2.21 Hydrant/Valve Chambers [IN GROUND]

Contractor shall provide suitable brick masonry chambers in cement mortar 1:5 (1 cement: 5 coarse sand) on cement concrete foundations 150 mm thick 1:5:10 mix (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) 12 mm thick cement plaster inside and outside finished with a floating coat of neat cement inside with cast iron surface box as approved or as specified in Schedule of Quantities and in drawings including excavation, backfilling complete.

Valve chambers shall be of following size: -

- I. 120 x 120 cms x 100 cms
- II. 90 x 90 cms x 100 cms

2.22 Flow Switches [Sprinkler System]

Provide REED type flow switches for

Water flow alarm switches shall be UL listed and FM approved with pneumatic retard mechanism.

Alarm switches shall be installed and coordinated with fire alarm system.

Flow switch shall be provided on sectional mains and branch lines of sprinkler systems where necessary and required and directed by the Consultant.

Flow switch should be suitable to actuate within 90 seconds of opening of a single sprinkler and shall be suitable for connection to a central Annunciation Panel. Wiring up to modem / smoke detector will be included.

2.23 Testing Assembly

Prefabricated, assembly consisting of a grooved end body, flow switch, inspectors test valve and pressure gauge.

2.24 Sprinklers [Quartz Bulb Type]

All sprinkler heads shall be UL listed and FM approved. Sprinklers shall be rated for ordinary temperatures (68 deg. C) except as required near kitchen heaters or locations where elevated temperatures may normally be expected or as otherwise indicated in the drawings or required by the local fire regulations. The temperature rating of a sprinkler should not be less than 30 deg. centigrade greater than the highest anticipated temperature of the location of the installation.

Sprinklers shall not be painted. They shall not be altered in any respect nor have any type of ornamentation or coating.

All the sprinkler shall be of conventional pendant type sprinklers. Upright sprinkler shall be mandatorily provided inside the false ceiling wherever the depth between the structural slab and false ceiling is more than 800mm. Side wall sprinklers shall also be used as per suitability.

Open Nozzles for Water Curtain

To be installed as per manufacturers. These shall be operated automatically.

2.25 Sprinkler Cabinets

Provide spare sprinkler emergency cabinet and spare stock of sprinklers heads conforming to NFPA 13. Contractor shall provide no less than 24 spare heads of each type and/or temperature rating.

Sprinkler cabinet shall be constructed of 2mm CRCA sheet with prime coat and manufacturer's baked enamel finish in color selected by the Consultant. Cabinet(s) shall be located in Fire Pump Room(s). Final location shall be as directed by Consultant in charge.

2.26 Fire Extinguishers

6kg multi-purpose ABC dry chemical type as per IS: 15683:2006 of approved make/type in red glossy polyester coated cylinder with pressure gauge and nozzle shall be used throughout.

4.5kg Carbon Dioxide as per IS: 15683:2006 of approved make/type in red glossy polyester coated cylinder with discharge horn and wall bracket shall be used in specified areas.

5kg inert Fire Extinguishers: Provide fire extinguishers in accordance with local fire authority, where indicated on the drawings, and in each mechanical, electrical equipment and elevator machine room.

2.27 Hydrant, Sprinkler, Jockey & Water Curtain Pump

Fire pumps, Sprinkler pumps & Jockey pumps, associated controllers, and transfer switches shall be provided by a single source supplier.

Pump shall be capable of delivering 150% of rated capacity at not less than 65% of rated head. Pump shall be fire authority approved and the unit shall be design proven in fire protection services.

Pump sets shall be single stage/multistage horizontal centrifugal single outlet with cast iron body and bronze dynamically balanced impellers. Connecting shaft shall be stainless steel with bronze sleeves and grease lubricated bearings.

Pumps shall be connected to the drive by means of spacer type love joy couplings, which shall be individually balanced dynamically with bearings.

The pump coupling joining the prime movers with the pump shall be provided with a sheet metal coupling guard.

All pumps shall be provided with approved type mechanical seals.

The pump and motor shall be floor mounted on a cast iron floor pedestal frame.

2.28 Electric Motor

Electrically driven pumps shall be provided with totally enclosed fan cooled induction motors. For fire pumps the motors should be rated not to draw starting current more than 3 times normal running currents.

Motors for fire protection pumps shall be at least equivalent to the horse power required to drive the pump at 150 % of its rated discharge and be designed for continuous full load duty and shall be design proven in similar services.

Motors shall be wound for class H insulation and winding shall be vacuum impregnated with heat and moisture resistant varnish glass fibre insulated.

Motors shall be suitable for 415+ 10% phase, 50 cycles, AC supply and shall be designed for 38 deg C temperature. Motors shall conform to the relevant I.S. Standards.

Motors shall be capable of handling the required starting torque of the pumps.

The pump shall be direct driven and the speed of the motor shall be compatible with the speed of the pump.

Technical data sheet to be provided for all pumps, equipment's and all fire components for CLIENT CONSULTANT/Consultants approval before procurement.

2.29 Diesel Engine

Diesel engine shall be of suitable multi cylinders single/twin outlets with individual head assemblies as per approved fire regulations. The engine shall be water-cooled and shall include heat exchanger and connecting piping, strainer; isolating & pressure reducing valves, by pass line complete in all respects.

Engine shall be direct ignition type matching the pump speed for direct drive and with electronic governor.

The speed of the engine shall match the pump speed for direct drive.

The engine shall be capable of being started without the use of works, cartridge heater, plugs or either at engine room temperature of 7 deg. C. and shall take full load within 15 seconds from the receipts of the signal to start.

The engine shall efficiently operate at 40 deg, ambient temperature at 50 meters above means sea levels.

Noise level of the engine shall not exceed 90 DBA (free field sound pressure) at 3 meters means distance.

The engine shall be self starting type up to 4 deg C and shall be provided with one 24 volts heavy duty DC battery, started, cut-out, battery leads complete in all respects. One additional spare battery shall be provided. The battery shall have a capacity of 180 to 200 ampere hours and 640 amps cold craning amperage.

A battery re- charge of 10 to 15 amperes capacity with tickle and booster charging facility and regulator shall be provided.

The engine shall be provided with an oil bath or dry type air cleaner as per manufacture's design.

Engine shall be suitable for running on high-speed diesel oil.

The system shall be provided with a control panel with push button starting arrangement also wired to the engine on a differential pressure gauge.

The entire system shall be mounted on a common structural base plate with anti-vibration mountings and flexible connections on the suction and delivery piping.

One self-supported one-day oil tank fabricated from 4mm thick MS sheet electrically welded with a capacity of 8 hours working load but not less than 500 liter shall be provided. Preferably in base frame of pumping set. Level indicating gauge glass on the day oil tank and low fuel level indications on the control panel shall also be provided.

One insulated exhaust pipe with suitable muffler (residential type) to discharge the engine gases to outside open air.

All other accessories, fittings & fixtures necessary and required for a complete operating engine set shall be provided.

Contractor shall provide requirements, if any, for any ventilation of the pump room.

The materials of construction for the major components are as are as follows:

Casting	: Cast iron
Impeller	: Bronze
Shaft	: EN-8
Wear Rings	: Bronze
Gland Packing	: Graphite Asbestos
Type of Bearing	: Ball bearing/ Roll Bearing
Type of coupling	: Flexible couplings

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2.30 Air Vessel

Air vessel shall be minimum 450 mm dia x 2000 mm high fabricated from 10 mm M.S plate with dished ends and tested to minimum 20 kg/sq cm pressure with suitable supporting leg. Air vessel shall be provided with a 100 mm dia flanged connection from pump header, one 25 mm dia drain with one gunmetal valve and pressure relief valve.

2.31 Operating Conditions

The fire pumps shall operate on drop of pressure in the mains. The pump operating sequence shall be arranged in a manner to start the pump automatically but should be stopped manually by starter push buttons only.

Jockey pump shall start and stop through pressure switch automatically.

Jockey pump shall stop when main pump starts.

Main pumps shall start automatically on fall of pressure but stopping automatically/manual.

Diesel pump – Start Automatic – Stop Manually.

Automatic transfer switch (es) shall be factory mounted and inter wired with the fire pump controller. The controller and transfer switch shall be capable of

interrupting a short circuit current at least equal to the available short circuit current in the controller supply circuit.

Ratings shall suite the electricity demand and meet the requirement of local Fire Authority.

Contacts shall be silver plated, arching type with arc barriers and arc chutes.

Accessories will be as under:

- a. Test switch in cover.
- b. Green pilot light to indicate "Normal" position.
- c. Amber pilot light to indicate "Emergency" position.
- d. Push-to-test emergency indicating pilot light with long life lamps and fuses.
- e. Adjustable time delay on retransfer to normal:
- f. 0-25 minutes plus 5 minutes unloaded running time for the generator. The time delay shall be by passed automatically upon failure of the emergency source.
- g. Number of closed auxiliary contacts shall be 1 on normal, 1 on emergency.

Isolating means shall be a manually operable, moulded case switch, horsepower rated and suitable for the interrupting of the motor locked rotor current

Provide an isolating switch ahead of the emergency input terminals of the automatic transfer switch.

Provide auxiliary contacts for remote audible and visual signals indicating that the switch is in the open position.

Withstand rating shall not be less than the transfer switch rating.

If required by the project conditions the entire assembly shall be delivered in parts and assembled in place under the supervision of the authorized manufacturer's representative.

Pump casing to spill over to the floor drain.

Fire pump flow measuring system/devices approved by local fire authority.

Item No. 219-260

HVAC SYSTEM FOR ANIMAL FACILITY BUILDING

1 GENERAL:

Heating, ventilation, and air conditioning (HVAC) system proposed for Animal Facility is designed to maintain the space temperature, humidity, Air-change rates at the required set point and maintain relative pressure differentials between spaces to prevent of cross contamination.

This report outlines the basis of preliminary design and summary of heat load estimation requirements and HVAC work for the upcoming building small animal facility building in GBU Gandhinagar.

2 COOLING REQUIREMENTS:

Cooling load at any time depends on building Structure, type of Glass, weather, occupancy, lighting, equipment load and Fresh Air (Ventilation). To maintain the required cleanliness we need to maintain difference pressure among different zones.

Air conditioning system design for Animal facilities shall be designed with special attention to air quality, room acoustics, supply air temperature, supply air humidity, airflow quantities, air velocity, and air diffusion and distribution within the space to provide summer, monsoon & winter thermal environmental control with optimum operating cost is proposed for this project.

Proposed building coming up shall be air conditioned using common **Air cooled central water chilling plant**. The Plant and Air Handling units will be placed on terrace. The exhaust fans will be placed in respective zones.

Considering 80% diversity on above load, proposed Capacity of Air cooled chillers shall be 3 x 140TR (2 Working and one stand by) with screw compressors and the capacity of

Air conditioning shall have central variable flow chilled water recirculation system for maximum energy conservation.

Pressure differential zones shall be created with the help of AHUs and exhaust fans (with VFDs) in Air Distribution & shall prevent cross contamination between individual spaces, air shall flow from areas of least contamination to areas of higher contamination potential, i.e., from "clean" to "dirty" areas.

Supply air grills / diffusers shall be located at ceiling level or close to ceiling level & the return / exhaust shall be at 300mm above finished floor level.

The central air conditioning system consisting of water chilling units associated with chilled water pumps with variable frequency drive, air handling units **with** variable frequency drive, chilled water piping with valves, air distribution system with grilles & diffusers, electrical panel, wiring, control wiring and earthing.

Individual room temperature & humidity sensors, for animal holding rooms, shall be located inside the general exhaust ductwork from each room at an accessible location.

9 Design Parameters:

9.1 Water Chilling Machine

Performance rating of the water chilling machine shall be based on the following design parameters:

Temperature of chilled water entering chiller	:	54° F (12.2° C)
Temperature of chilled water leaving chiller	:	44° F (6.67° C)
Fouling factor for chiller in FPS unit	:	0.0005
Ambient temperature for Air cooled condenser.	:	DB 108 °.F / WB 83
Refrigerant	:	HFC (R134a)
Minimum COP at ARI conditions (100% load)	:	2.90

9.2 Design parameter for selection of **Air Handling Unit** and its components shall be:

Maximum face velocity across pre-filters & fine filters	:	1.78 m/sec (350 fpm)
Maximum face velocity across cooling coils	:	2.54 m/sec (500 fpm)
Maximum fan outlet velocity	:	9.14 m/sec (1800 fpm)
Maximum fan speed	:	
a. Fan above 450 mm dia	:	1000 RPM
b. Fan up to and including 450 mm dia	:	1450 RPM
Maximum fan motor speed	:	1450 RPM

9.3 **Piping** shall be sized for the following design parameters:

Maximum velocity	:	1.2 m/Sec (4 fps) for piping 50 mm & under diameter.
	:	2.5 m/Sec (8.2 fps) for piping over 50 mm diameter.
Maximum friction	:	15 k Pa per 30 m Run (5 ft per 100 ft Run)

9.4 Design parameter for **Duct design** shall be:

Maximum flow velocity in ducts for air conditioning	:	7.5 m / sec (1500 fpm)
Maximum flow velocity in ducts for ventilation in pump room, boiler room, generator room, toilet exhaust & Kitchen exhaust.	:	7.5 m / sec – 12.5 m / Sec (1500 – 2500 FPM)
Maximum friction	:	0.65 Pa / M run (0.08 inch WG/100 ft run)

9.5 **Exhaust / Ventilation Fan:**

Maximum fan outlet velocity for fan : 9.14 m/sec (1800 fpm)
up to 450 mm dia

Maximum fan outlet velocity for fan : 12 m/sec (2400 fpm)
above 450 mm dia

Maximum fan speed for fans up to : 1440 RPM
450 mm dia

Maximum fan speed for fans above : 1000 RPM
450 mm dia.

9.6 Filtration:

For 100% fresh air at air handling units: three stage filtration shall be provided - Washable synthetic type air pre filters having 90% efficiency down to 10 microns, fine filter shall be 99% down to 5 microns and HEPA filters shall be provided for final stage filtration. HEPA Filter efficiency shall be at least 99.99% down to 0.3microns

To capture airborne animal hair/ dander and particulate count Washable synthetic type pre filters will be provided in ducted return / exhaust at 300mm above finished floor level.

9.7 Pressure relationships:

The HVAC system shall be adaptable so that pressure relationships can be modified as required over the life of the facility. Dirty elevator shafts shall have negative air pressurization in relation to all surrounding areas but shall be positive as compared to ambient.

Clean corridor will have positive pressure as compared to surrounding areas. Animal spaces shall be protected against contamination from outside sources, including particulates brought in from outside by the HVAC air flow. Animal rooms shall remain at a negative air pressure relative to clean corridors and other non-animal spaces.

Mud rooms are typically located between the clean corridor shall act as air lock & shall have change room Air shower, etc. it will have two sets of doors, one door to the clean corridor / protected area and one door to the common corridor. These two doors are interlocked so that only one door can be opened at a time. Mud room shall be negatively pressurized as compared to clean corridor and positively pressurized as compared to common corridor. Mud room shall be provided with both supply and exhaust air grilles

9.8. Exhaust :

Each zone will have dedicated exhaust fan and all exhaust fans shall be SISW type, shall have VFDs for control of air flow and duct static pressure. IVC if any will be connected to exhaust ducts.

9.9. **Redundancy:** Looking at the criticality of application - long duration tests, difficult to repeat, we cannot afford to have failure of HVAC system so we will have two working and one stand by concept for chillers and pumps and each AHU & Exhaust fan shall have standby.

9.10. **BMS:** Building management system is proposed to control and monitor complete HVAC system of the building.

Data Point Summary -NIAB						
S.No.	Description	AI	DI	AO	DO	Field Device
1	<u>Water Chilling Units (3 Nos)</u>					
1.1	Chiller Start/Stop Command				3	To Chiller Panel
1.2	Chiller Auto Manual Status		3			From Chiller Panel
1.3	Chiller Run Status		3			From Chiller Panel
1.4	Chiller Trip Fault Status		3			From Chiller Panel
1.5	S & R & header Chilled Water Temp.	8				Immersion type temp. sensor
1.6	Chilled Water Flow Rate	3				Electromagnetic Type Flow meter
1.7	Chiller - butterfly Valves open/close command & Status		3			Motorized valve
1.8	Ambient Temperature + RH Feedback	3				Ambient T+RH Sensor
		14	12	0	3	
2	<u>Chilled water Primary Pumps(3 Nos)</u>					
2.1	Pump ON/OFF Command				3	Pump panel
2.2	Pump Run Status		3			From Water DP Switch
2.3	Pump Trip Status		3			From Pump MCC
2.4	Pump Auto/Manual Status		3			From Pump MCC
		0	9	0	3	
3	<u>Secondary Pumps with VFD (2 Nos)</u>					
3.1	Chilled Water Pump ON/OFF Command				2	To Pump MCC
3.2	Chilled Water Pump Run Status		2			DP switch
Data Point Summary -						
S.No.	Description	AI	DI	AO	DO	Field Device
3.3	Chilled Water Pump Trip Status		2			From Pump MCC
3.4	Chilled Water Pump Auto/Manual Status		2			From Pump MCC
3.5	Chilled Water Pump VFD Modulation			2		To Pump MCC
3.6	Differential Pressure Feedback	2				From DP Transmitter

		2	6	2	2	
4	<u>Air Handling Units 32 Nos (2 fan,HRW /HP)</u>					
4.1	AHU ON/OFF Command Supply fan With VFD				16	To AHU Panel
4.2	AHU ON/OFF Command Exhaust fan With star/delta				16	To AHU Panel
4.3	HRU ON/OFF Command With DOL				16	To AHU Panel
4.4	AHU supply & exhaust Air flow / Run Status		32			DP Switch across Air
4.5	AHU supply, exhaust & HRU Trip Status		48			From MCC Panel
4.6	AHU Auto/Manual Status		16			From MCC Panel
4.7	Strip heater status On/ OFF		16		16	To AHU Panel
4.8	Strip heater status Trip Status		16		16	To AHU Panel
4.9	UVGI status On/ OFF		16			To AHU Panel
4.10	Supply Air temperature + RH Feedback	32				Duct Temperature Sensor
4.11	Return Air temperature + RH Feedback	32				Duct Temperature Sensor
4.12	Room temperature + RH Feedback	16				Wall Mount Temperature Sensor
4.13	Motorized valve (Cooling)			32		Motorized Valve Modulation
4.14	Motorized supply & return Air Damper Control On/OFF				32	Damper actuator
		80	144	32	112	
	* Every zone has 2 AHUs, both AHUs shall be interlocked so that only one AHU is operational					
	* Operational AHUs damper should open, standby AHUs dampers should be closed					
7	<u>Panels - 1 nos</u>					
7.1	Incomer Breaker Status		1			Voltage free contact
7.2	Incomer Trip Status		1			Voltage free contact
7.3	Incoming energy analyser monitoring - 1 nos					Software integration with BMS
7.4	KWh meter monitoring - 1 nos					Software integration with BMS
			2			
	Grand Total	96	317	34	200	

Annexure 1

Sno	AHU No.	Description	Area		Min Fresh Air ACH		summer		Monsoon		Supplement heat Summer	Supplement heat Monsoon	Winter heating	Heating equipment selected		Required AHU capacity	Selected AHU capacity		Type	Selected Exhaust Fan
			Sqft	@	CFM	TR	cfm	TR	cfm	KW	KW	KW	KW (Collar)	KW (AHU)	CFM	CFM	TR		CFM	
1	AHU1	GF QUARANTINE ROOM	129	20	379	3.1	388	3.1	280	0.2	0.55	-	0.73	0.5	9	400	2 # x 7500 CFM	61	HRW 7500/7500	Double Fan AHU
2		GFANIMAL ROOM MICE	387	20	1136	9.9	702	8.6	603	0.2	0.50	-	1.79	0.5		1200				
3		GFANIMAL ROOM	387	20	1136	9.9	702	8.6	603	0.0	0.50	-	1.79	0.5		1200				
4		GFANIMAL ROOM	387	20	1136	9.9	702	8.6	603	0.0	0.50	-	1.79	0.5		1200				
5		GFANIMAL ROOM	387	20	1136	9.9	1017	9.1	751	0.0	1.35	-	2.52	0.5		1200				
6		GFLABORATORY AREA	382	20	1120	8.4	590	8.2	492	0.3	0.50	-	1.77	0.5		1200				
7		PROCEDURE ROOM	126	20	369	3.7	382	3.1	349	0.3	0.16	-	0.58	0.5		400				
8		SURGICAL ROOM	126	20	369	3	240	3	191	0.5	0.25	-	0.61	0.5		400				
9		EHTUNESI A	88	20	259	2	204	2	162	0.0	0.21	-	0.44	0.5		300				
10	AHU2	GFCLEAN CORRIDOR	1044	20	3062	24.0	2205	23.4	1544	3.4	3.35	-	5.68	0	9	3100	2 # x 4450 CFM	35	HRW 4450/3100	Double Fan AHU
11		GF AIR SHOWER	387	20	1135	9.5	1249	9.3	815	1.1	2.20	-	2.64	0		1200			CS inline	1#x1200
12		AIR LOCK	48	20	142	1.1	86	1.1	73	0.1	0.4	-	-0.2	0		150			CS inline	1#x150

13	AHU3	GF ANTE ROOM	108	20	717	5.9	511	5.5	336	3.9	0.89	-1.34	0	15	600	2 # x 3100 CFM	25	CS inline	1#x600
14		GFAUTOCLAVE FEED STORAGE	215	6	189	1.5	174	1.5	158	3.9	0.1	0	0		200			HRW3100/2700	Double Fan AHU
15		GFSTARILE STORE	344	6	303	2.6	285	2.4	259	3.9	0.1	0	0		300				
16		GFAUTOCLAVE UNLOAD STARILE STORAGE	603	20	1768	14.6	1812	14.2	1658	2.33	1	-3	0		2000				
17	AHU4	GFAUTOCLAVE LOADING /CAGE WASHING	1011	20	2967	24.4	2346	22.9	1974	0.00	2	-5	0	5	2500	2 # x 2500 CFM	25	HRW 2500 /2500	Double Fan AHU
18	FCU1	GFOFFICE SPACE	204	1.5	45	1.1	569	1.1	377	0.00	0.97	-0.41			600	600	1.5	--	--
19	FCU2	GFOFFICE SPACE	118	1.5	26	0.5	212	0.5	153	0.00	0.30	-0.14			400	400	1	--	--
20	FCU3	Incharge Room	97	1.5	21	0.3	67	0.3	65	2.65	0.01	-0.03			400	400	1	--	--
21	Non AC	GFBIO. WASTE	75	20	221													CS inline	1#x300
22	Non AC	GFDE HUSK ROOM	97	20	284													CS inline	1#x300
23	Non AC	GFBADDIN G AREA	86	20	253													CS inline	1#x300
24	--	GFCHANG E ROOM	113	8	133													CS inline	1#x200
25	--	GFSERVIC E AREA	91	6	80													CS inline	1#x100
26	Non	GFFEED	161	12	284													CS inline	1#x300

	AC	STORAGE																	
27	Non AC	GDIRTY CORRIDOR	1592	12	2803													CS inline	2#x1500
28	Non AC	GF ENTRANCE AREA	215	2	95													--	--
29	FCU4	RECEPTION AREA	54	1.5	24	0.54	236	1	159	0	0.39	-0.17			400	400	1	FCU	
30	AHU 5	FF CLEAN CORRIDOR (LHS)	882	20	2604	20.3	1912	19.8	1371	2.9	2.74	-4.64		5	2000	2000	21	HRW 2000/2000	Double fan AHU
31	AHU 6	FF CLEAN CORRIDOR (RHS)	226	20	667	6.0	485	5.1	354	0.8	0.66	-1.17		2	500	500	6.0	HRW	
32	AHU 7	FF ANIMAL ROOM	646	20	1906	16.7	1909	15.3	1402	0.9	2.57	-3.75	1	6	1950	4250	39	HRW	Double fan AHU
33		FF ANIMAL ROOM	387	20	1143	11.1	1020	9.1	800	1.8	1.11	-2.0	1		1050				
34		FF ANIMAL ROOM	398	20	1175	10.6	1241	9.6	887	0.8	1.80	-2.3	1		1250				

35	AHU 8	FF EXPERIMENTAL	409	20	1207	10.5	1230	9.8	870	0.5	1.82	- 2.33	1	20	1300	16300	111	HRW	Double fan AHU
36		FF MICRO MANIPULATION	420	20	1239	10.8	1251	10.0	886	0.6	1.85	- 2.39	1		1300				
37		FF ANIMAL ROOM	376	20	1109	10.4	1949	10.2	1739	0.0	1.06	-1.9	1		2000				
38		FF ANIMAL ROOM	376	20	1109	11.1	894	8.7	679	2.2	1.09	-1.9	1		1000				
39		FF TRANSGENIC ROOM	387	20	1143	7.86	1550	9.88	1108	0.0	2.2	- 2.42	1		1600				
40		FF TRANSGENIC ROOM	387	20	1143	7.86	1571	9.91	1130	0.0	2.2	- 2.42	1		1600				
41		FF TRANSGENIC ROOM	280	20	826	5.72	1293	7.43	934	0.0	1.8	- 1.82	1		1400				
42		FF TRANSGENIC ROOM	387	20	1143	7.86	1571	9.91	1130	0.0	2.2	- 2.42	1		1600				
43		FF TRANSGENIC ROOM	387	20	1143	10.00	1259	9.46	949	1.1	1.6	- 2.18	1		1400				
44		FF TRANSGENIC ROOM	387	20	1143	10.00	1259	9.46	949	1.1	1.6	- 2.18	1		1400				
45		FF POST - SURGERY TRANSGENIC ROOM	387	20	1143	9.96	713	8.67	591	3.8	0.6	- 1.84	1		800				
46		FF MULIPURPOSE	145	20	429	4.7	354	3.4	279	1.2	0.38	-0.7	1		500				
47		FF CRY PRESERVATION	108	20	318	3.8	252	2.5	207	1.2	0.23	-0.5	1		400				
48	FCU	FF REST ROOM	189	20	559	5.9	433	4.4	338	1.5	0.48	-1.0	--	--	800	--	2		

49		AIR LOCK	54	20	159	1.3	185	1.3	125	0.0	0.30	-	0.33	--	--	200	--	--		
Block Total						329		311										329		
Diversity @ 80%						263		249										262.8		
capacity considering 2 machines working						131.5		124										131.4		
Say						140												140		
Proposed capacity			3 x 140TR (2 working +1 stand by)																	

Additional Conditions & Specifications

1. The entire job will be executed by a specialized HVAC Contractor on turnkey basis for:
 - a) Detailed design to ensure maintenance of specified conditions.
 - b) Preparation and Approval of detailed Drawings.
 - c) Fabrication/ supply of required equipment/ fabricated items/ materials after factory testing.
 - d) Erection/ Testing/ Commissioning/ Coordination with other execution Agencies.
 - e) Ensuring proper workmanship by deploying skilled personnel/supervisor/ Engineer and use of proper erection tools and machinery.
 - f) After Completion of Job, subsequent comprehensive operation and maintenance backed by proper preventive maintenance as per Manufacturers recommendations and as per site requirements.
2. The entire work will be executed in conformity with the General Specification for HVAC Works 2004 of CPWD, with latest amendments (up to the stipulated date of submission of tender). These are printed publications available for purchase and the tenderer should procure these documents before tendering. Besides technical specifications, this lays down commercial and financial conditions also. The electrical work shall be executed as per CPWD electrical specifications, internal, external, substation in force with latest amendments.
3. Wherever an item is not covered by the CPWD Specifications, the same will be as per Manufacturers specifications/ specifications as approved by the Engineer-in-Charge.

4. Specifications as per BOQ/ Additional Specifications will supersede the CPWD Specifications.

5. **Technical Deviations allowed from CPWD Specifications:**

Refer to Design Parameters of Chilling Unit. With reference to Clause IV e, Va, Vb, Ve, the technical parameters will be as per BOQ and the Manufacturers Design.

Condenser/ Chiller Testing: The test Pressure shall be as per Manufacturers standard Pressure.

Condenser chiller water box: With reference to clause 5.5.3.2, vi, and 5.6.3.2 ix, water box shall be single/ multi pass flow.

AHUs: With reference to Chapter VI of CPWD HVAC specifications, the following improvements are required to ensure longer life, rust free operation and better efficiency. Refer Clause 6.2.3:

Cooling Coil:

Copper Headers with purge/ drain connections. AHRI certified coils.

Chilled water pipe insulation:

Refer clause 11.2 to 11.5 of CPWD HVAC specification. Since a huge quantity of chilled water pipe will be insulated, it is better to go for factory pre insulated pipe for seamless insulation, quality and speedier execution. Factory Pre insulated pipes will be used in place of the above specified CPWD specifications.

6. Specification for factory pre-insulation:

The pipe shall be MS ERW.

The pipe insulation shall be Polyurethane Foam with 36 Kg/cum minimum density, 90 % minimum closed cell content, minimum compressive strength of 40 psi and initial thermal conductivity not exceeding 0.14 BTU/hr.sft ° F. The insulation shall completely fill the annular space between the service pipe and the jacket and shall be bonded to both the service pipe and jacket.

The insulation shall be provided with minimum thickness specified below:

Pipe size (mm)	Minimum insulation thickness(mm)
<150	30
150 and above	50

i. Fittings:

Fittings shall be fabricated at site over the pipe and correct quantity of PUF to be poured manually.

ii. Field Joint Insulation:

Field joint insulation shall be PUF Poured manually in a site fabricated GI cladding fixed around the joint.

Note:

Site fittings/ Joints insulation shall be done by the Manufacturer of the Pre-insulated Pipes.

7. Specification of Duct Insulation:

Chemically cross linked, closed cell polyethylene foam (XLPE)

Density : 33 +/- 3 Kg/ M³

Closed Cell : > 90 %

Temperature Range : -40 to 110 Deg C

Aging : No effect.

Odour : Neutral

Thermal conductivity: not exceeding 0.035 w/mk at average temp of 40 Deg C.

Fire Rating : Class I as per BS-746 Part 7

UL : Certified

Smoke Emission : AS 1530-3199: not exceeds 1

Flammability : Self extinguishing.

The insulation shall be cladded with factory laminated 30 micron Aluminum foil
Single layer upto 15 mm thickness.

Fire Approval By : CBRI Roorkee.

8. DUCTWORK – Ducting work on each floor shall be GI as per CPWD specs chapter 9.

9. BMS Compatibility:

The AC plant will have a BMS System for monitoring and Control of various equipment, BMS system shall. All the switch gear, equipment and valves etc will be BMS compatible.

10. Power Supply to AHUS:

Electrical Power supply cable/ incoming isolator to AHU/ FCUs is in Electrical contractors scope.

Wiring from isolator to AHU starter panels, termination etc is in the scope of tender work.

11. Variation of Quantities with reference to BOQ Quantities:
The BOQ quantities are estimated quantities. The work will be executed as per approved drawings based on actual site requirements. The actual quantities may differ from BOQ quantities. The work will be executed as per actual quantities with plus/ minus deviation as permitted under conditions of the contract.
12. Foundations of equipment and connected Civil Works:
The AC contractor will execute all these works within tendered rates.
13. This is a turnkey job.
Even if certain items are not included in the BOQ, but are required for comprehensive completion of the job, the AC Contractor will do the same without any extra cost.
14. Operation and Maintenance:
After completion of the main job, the Contractor will provide comprehensive operation and maintenance with the deployment of required skilled personnel, supervisor and Engineer as required on the basis of quoted rates and terms and conditions of the agreement for operation and maintenance part for which a supplementary agreement will be drawn. All cost to be included except cost of water and electricity. The staff will wear proper uniform, shoes and provided with mobile phones within tendered rates. The work will be executed as per Manufacturers recommendations and direction of the Engineer-in-charge primarily guided by preventive maintenance considerations. All servicing, cleaning, painting, minor/ major repairs, replacement of parts etc. will be included. In case of any mishap or accident, the Department will not take any responsibility and the Contractor will bear all such financial or otherwise responsibility.
15. Quantum of staff for Maintenance:
The contractor will employ following minimum staff for round the clock operation, 365 days a year. (This will include necessary leave reserve also)
3 shifts, each shift
one operator
one helper
16. HVAC vendor shall offer the factory testing and inspection as given below. The cost testing and inspection shall be considered by HVAC Vendor accordingly. Boarding and lodging expenses shall be born by department.
 - One chiller shall be tested for performance at 100%, 75%, 50% and 25% at AHRI Conditions.
 - All other materials shall be supplied with test certificates.)
17. Axial flow fan rpm should not exceed 1450, irrespective of fan dia.
18. Civil work like making cutouts in wall for routing duct, chilled water pipe, cable, etc is also part of tender work, the scope also includes finishing the cutout with sand cement plaster and paint.
19. Client will not issue any form C, contractor will issue form " C"
20. There must be an arrangement for the two connections along the each long wall for IVC AHU duct to the main exhaust ducting to connect 89 mm size of IVC exhaust pipe. This opening must have close and opening arrangement as per the requirements during operations.

21. Pressure zoning should be maintained as mentioned:

Clean corridors 12 -15pa,

Animal rooms 10-12pa

and dirty/service corridor 0-5pa

with min 12-15 air changes per hour in animal rooms strictly and may be decreased in other service areas.

22. DIFFERENTIAL PRESSURE: Provide individual Magnahelic Gauges across each zone.

23. There must be a mechanism of 100% fresh air and 100% exhaust through proper exhaust system.

24. **VALIDATION:** Before the animal facility can be used, the HVAC system chillers system must be validated by checking all essential parameters for temperature, humidity, and leakage, noise control etc., by the turnkey contract before handover the system

Lab Equipment TECHNICAL SPECIFICATIONS ITEM NO. 281-287

281 Supply , installation ,testing and commissioning of Static/ Dynamic passbox wall / floor mounting with inclination at a height of 4 feet from FFL, for controlling the ingress of particulate contamination into clean room and other controlled environments, to maintain the integrity of products and process , made of industrial grade electro -galvanized steel with base surface constructed of stainless steel and with suitable acrylic doors to provide a clear view of the internal chamber with following specifications confirming to relevant Indian / international standards for clean room facilities etc., complete as required

TECHNICAL SPECIFICATIONS.

Type : front open

Direction of flow : Vertical / re- circulatory

Cleanliness : Confirming to ISO , Class V
(ISO 14644-1:1999 (E))

Particle retention : 0.3 micron and above

Noise level : 65 db on scale ' A' + 5

Velocity : 90FPM + 20 %

Illumination: florescent tubes with diffusers .

Pressure differential : 0-25mm inclined manometers / magnetic gauge

Power supply : 230V , AC , single phase , 50Hz

Pre-filters : 10-15 micron rating

Intermediate filters : 3 micron and above

Efficiency : 99.999% upto 0.001micron

Blower assembly : Statically and dynamically balanced .

Blower system suitable for 230V AC supply

Accessories : 8/15Watt U.V. lights in two rows along with hour meter

Door inter locking arrangement : Electro - magnetic type

a) Static type

b) Dynamic type

Air Curtain

282 Supply , installation , testing and commissioning of Air Curtain, Horizontal air intake centrifugal type , with air valocity 18m /s with regulation facility for high and low speed suitable for 280 x 275 mm (Height x Depth dimensions) , 230V AC as required .

Air Shower

283 Supply, installation, testing and commissioning of air shower equipment to supply class 100 HEPA filtered air at high velocity etc., complete as required.

TECHNICAL SPECIFICATIONS.

Filtration : 2 stage

(a) EU6 – prefilter 95% down to 5 micron for return air and fresh air intake

b) EU 14- HEPA filter 99.999% down to 0.3micron at supply position

Construction : Stainless steel 304, door with double walled with flush glass view panels and door closer

Blower assembly : Statically and dynamically balanced motor blower Power supply : 3 phase , 415V , AC , 50Hz

Air cleanliness : Confirming to ISO class 5
(ISO:14644-1:1999(E))

Velocity : 18 to 20 MPS

Control system :

a) To ensure that both the doors not to open at same time and both the doors to be locked during the time air flow is on

b) Time setting for air shower operation

(30 seconds to 5 minutes)

c) Automatic / manual mode .

d) Emergency stop

Accessories : All required accessories for air shower.

a) 750mm x 850mm x 1950 mm (Suitable for one person) in first floor

b) 750mm x 1200mm x 1950 mm (Suitable for two persons) in ground floor

284 Supply, installation, testing and commissioning of Ceiling Suspended Laminar Air Flow (CLAF) etc., complete as required.

Specifications :

Air Velocities : 0.45 ± 0.05 mps

Air Flow : Vertical

Noise Level : Less than 67 dB

Vibration Level : Minimum

Light intensity : > 300 lux

Power Supply : 230V AC 1-Ø 50HZ

Two Stage filtration : EU6 – Prefilter (95% down to 5 micron)

EU14 - HEPA Filter (99.999% down to 0.3 micron) at supply position

Motor-blower : Statically & Dynamically balanced Motor-blower with suspension arrangement to reduce noise level

Work Table : SS work table with due reinforcement

Side panels : Glass side panels

Lights : Fluorescent Lights with Milky White Diffuser

Pressure Gauge : Differential Pressure Gauge

Timer : Clean Down Timer with Operation Hold indicator

DOP Test Port

STANDARD FEATURES

Cabinet made from Stainless Steel 304, Thickness - 20 SWG

Finish - Matt

Pre-Filter - 5 microns

HEPA Filter – 0.3 microns

UV lamp

Hanging rods with eye bolts

Work table - 1 no

PVC Curtains - 4 sides

DOP port

Magnahelic Gauge

TECHNICAL FEATURES

AIR FLOW : Designed for 0.45m/s to 0.65 m/s.

PRE-FILTERS:

Type : Box type

Media : Synthetic, Non-oven Polyester fibre,

Casing : Aluminium

Gasket : Neoprene

Retention : 5 Micron

Efficiency : 95%

Pressure drop : 6 to 8 mm

HEPA FILTER:

Type : Box type, Minipleat type

Media : Ultra clean glass fibre paper-imported

Casing : Aluminium

Gasket : Neoprene

Retention : 0.3 Micron

Efficiency : 99.9997%

Pressure drop : 25 mm of W.c.

IMPELLERS:

High performance noise abated statically and dynamically balanced.

MOTOR –BLOWERS:-

Volts : 230 V

Hz : 50

Amps : 3.5

Watts : 250

RPM : 1440

PRESSURE GAUGE:

Housing : Die casting aluminum case and bezel, with acrylic cover

Accuracy : +/- 2 % of full scale

Pressure limits : 15 psi

Temperature : 20 to 140 Degree F

Size : 4 " dia

Weight : 510 gram

Range : 0-25 mm

CLEANLINESS LEVEL : Class 100

NOISE LEVEL : 65 +/- 5 db

POWER SUPPLY : 230 v AC, 50Hz,

STANDARDS:-

US FED STD 209 E

ISO 14644-1

IEST- RP-CC-002-2

BSI

- a i) Work Area Dimension (L x W x H) : 1035x760x665 MM
- ii) Hepa Filter Area (L X W) : 915 x 610 MM
- b i) Work Area Dimension (L x W x H) : 1950x1065x665 MM
- ii) Hepa Filter Area (L X W) : 1830 x 915 MM

AUTOCLAVE

285 Supply, installation, testing and commissioning of double door , Semi Automatic Horizontal High Pressure, High Vacuum Steam Sterilizer autoclave of following inner chamber sizes as per specifications ., complete as required

- a a) 3 ft (W) x 3ft (H) x 5ft (D)
- b b) 3 ft (W) x 3ft (H) x 4ft (D)

286 Supply, installation, testing and commissioning of wall mounted emergency EYE WASH / FACE WASH STATION with eye wash flow rate of 9-11ltrs / min with accessories as per specifications complete as required.

287 Supply, installation, testing and commissioning of automatic cage & bottle washing machine of dimensions 2050 x 850 x 2050 h mm (80.7" x 33.5" x 80.7") with On board exhaust fan, Electrically heated unit kit Electrically driven unit upgrade (valves and arms movement) and Validation Protocol Document (IQ, SAT, OQ, PQ) etc., complete as required as per specifications

GENERAL CONDITIONS – ELECTRICAL & LOW VOLTAGE WORKS

1. GENERAL

A new GBU Gandhinagar Complex comprising of SAC, Housing Blocks, Hostel Blocks, Director Residence Common Amenities and Service blocks (ESS, UGT, STP, ETP, WTP) External development etc. is proposed to be constructed at Gandhinagar Gujarat.

2. SCOPE OF WORK

The scope of work shall cover internal Electrical Installations, ESS and external electrical Installation works complete as required for Electrification of proposed complex of **GBU at Gandhinagar**. It shall covers designing of complete Electrical system for the entire complex, preparation of shop drawings, supply of all equipment, material, electrical Fixtures & Accessories required, installation, testing and commissioning of all electrical installations for the project for the following, but not limited to, main items/systems:

2.1 ESS & External Electrical Installation

- i.
 - b. LT Panel
 - f. All Associated Equipment & accessories required.
- ii. DG Sets including PLC/AMF panels for Auto Synchronizing, Auto Load Management & Load sharing etc.
- iv. Lightening Protection System & Earthing Network
- v. 1.1 kV LT power cables
- vi. Solar Power Generation System
- vii. Electrical distribution comprising of feeder cables from ESS to individual block, services, Main panel, Rising Mains etc. Separate distribution shall be provided for Lighting load, Power/AC Load & UPS load. Separate LT panels at each floor shall be provided for feeding HVAC load of AHUs, FCUs, Split ACs and Ventilation Fans.

The Electrical distribution should include - Emergency power supplying distribution system as per NBC 2016 for critical requirement for functioning of fire and life safety system and equipment, shall be planned for efficient and reliable power and control supply to the following systems and equipment where provided:

- i. Fire pumps
- ii. Pressurization and smoke venting; including its ancillary systems such as dampers and actuators;
- iii. Fireman's Lifts (including all lifts).
- iv. Exit Signage Lighting;
- v. Emergency Lighting;

- vi. Fire Alarm System;
- vii. Public Address (PA) System (relating to emergency voice evacuation and annunciation);
- viii. Lighting in fire command centre and security room.
- x. Any other system as required

2.2 Internal Electrical Installations

It shall include the following items of work to be carried out simultaneously with the civil work within the buildings:

- i. Wiring for 6A Light Points and socket Outlets
- ii. Wiring for Call Bell, Fan & Exhaust Points.
- iii. Wiring for 16A/20A Power socket outlets.
- iv. Wiring for 3 Phase Power socket Outlets
- v. 1.1 KV L.T. Cables and Sub main wiring.
- vi. M.V. Panels/ Floor Panels and Double Door MCB Type Distribution Boards.
- vii. Supply and Installation of LED Light fittings, fans, Exhaust Fans & fixtures
- viii. Earthing & Lighting Arrestor
- ix. Telephone
- x. Cable TV
- xii. LAN Networking
- xiii. CCTV System
- xiv. Testing and commissioning of all electrical installations

The scope of work shall also include any other item or item of work, equipment, material or accessories not specifically mentioned above but is required for the satisfactory completion & trouble free operation & maintenance of electrical equipment/ work. This shall also include spares required for commissioning of the equipment/work.

The work shall be carried out as per standard specifications of PWD/CPWD/GWSSB relevant drawings and as per item description and as per directions of Engineer In Charge.

2.3 SPECIAL CONDITIONS FOR ELECTRICAL SERVICES:

a) GENERAL

The design and workmanship shall be in accordance with the best engineering practices, to ensure satisfactory performance and service life. The requirement offered by the contractor shall be complete in all respects.

- b) The contractor shall obtain all sanctions (electrical loads, approval of drawing/ ESS/ D.G.'s estimator/ approval of meter room etc. from the concerned authorities and permits required for the electrical installation work. All actual fee payable in this regard will be reimbursed against

receipt/documentary evidence. On completion of work, the contractor shall obtain NOC from SEB & Director of Safety of the concerned state; a copy of the same shall be delivered to Consultant / Engineer In Charge.

The Consultant shall have full power regarding the materials or work to be got tested through independent agency at the EPC contractor's expenses in order to prove their soundness and adequacy. The contractor will rectify the defects/suggestions pointed out by Consultant / independent agency at his own expenses.

The installation shall comply in all respects with the requirements of Indian Electricity Act 1910, Indian Electricity Rules (IER) 1956 and other related Laws and Regulations as amended up to date, there under and special requirements, if any, of the State Electricity Boards etc. The bidder is liable to furnish the list of authorized licensed persons/ employed/deputed to carry out the works/performance the assigned duties to fulfill the requirement of Rule No.3 of IER 1956 as amended up to date.

2.4 DRAWINGS

i. **Tender Drawings:**

The tender drawings are meant to give general idea to bidder regarding the nature of scope & works to be executed. Any information/data not shown in tender drawings shall not relieve the contractor of his responsibility to carry out the work as per the specifications & terms of the EPC contract. Additional information required by the bidder/tenderer for successful completing the work shall be obtained at his end.

- ii. **Shop Drawings:** The contractor shall prepare detailed coordinated electrical shop drawing indicating Light Points, Power Points, Cal Bell points, Ceiling Fan, Exhaust Fan Points, Switch Boards, Distribution Boards (Light, Power & UPS), Lighting Fixtures, Convenience outlets, Single Line Diagram for complete HT/ LT electrical scheme, DG Sets, HT Panel, Transformers, LT Panels, Capacitor Panels, RTCC Panels, PCC Panel, UPS Units, UPS Incoming/ Outgoing panels, Lift Panels, Rising Mains, HT/ LT Cable Schedules, Solar PV System, Earth Pit Layout, Earth Strip routes, HT/ LT Cable Routes, Street Light Layout & Street Cable routes, Schematic Diagrams & Floor wise Shop Drawings for all LV works namely, Telephone, LAN, Wifi, CCTV, Access Control, Fire Alarm, Public Address System, Information Display System, Boom Barriers etc. with other relevant services and submit to the Consultant for approval or the Engineer-in- Charge before commencing the work.

GA Drawings, SLD & Control wiring diagrams, Room trench details for all HT & LT Panels, Capacitor Panels, UPS panels, Floor Electrical Panels, Transformers, DG Sets, UPS Units, Rising Mains etc. shall be prepared & submitted. The shop drawings shall indicate all setting out details and physical dimensions of all equipment/items/ components with wiring and cable details, cable schedule and routes, manhole trap and fixing details as well as for conduit indicating run and size of wire/cables, outlet/pull/junction boxes etc. with fixing details etc. for the above mentioned work. All work shall be carried out on the approval of these drawings. However, approval of these drawings shall not relieve the contractor of his responsibility for providing maintenance free and fool proof system including any missing component/accessories to meet the intent of the specifications. Contractor will submit 2 prints for preliminary approval and finally six prints for distribution. The recommended location/ position of the all equipment as shown on the layout drawings will be adhered to unless

stated otherwise.

iii. **As-Built Drawings:**

On completion of the work and before issue of certificate of virtual completion, the contractor shall submit to the Consultant, 4 Sets of 'As Built' drawings (in AutoCAD & PDF format) along with soft copy of the executed works incorporating all such changes and modifications during engineering and execution along with Operation and Maintenance Manuals, Warranty & Guarantee Certificates from Original Equipment Manufacturers (OEM), authorized Suppliers & Vendors, as applicable.

These drawings must provide:

- ☑ Run and size of conduit, inspection and pull boxes including routing and locations.
- ☑ Number and size of conductor in each conduit.
- ☑ Locations and rating of sockets and switches controlling the light and power outlet.
- ☑ A complete wiring diagram as installed and schematic drawings showing all connections in the complete electrical system.
- ☑ Location of outlets of various services, junction boxes, light fixtures.
- ☑ Location of all earthing stations route and size of all earthing conductors.
- ☑ Layout and particulars of all cables.
- ☑ Location and details of Transformers, HT/ LT Panels, Feeder Pillars, capacitor control panels etc.
- ☑ UPS panel, and relay panels with description detailed control wiring diagram.
- ☑ Location of transformer and its details and control wiring diagram.
- ☑ Location of Hume pipe and manhole including HT/LT cable layout and scheduling
- ☑ Location of DG Sets, Exhaust and auxiliary equipment with schematic drawings.
- ☑ Layout of cable trays with support and their fixing details.
- ☑ Location of all earthing station, route and size of all earthing conductor.\
- ☑ Layout and particulars of rising mains with fixing details.

The contractor shall submit 2 sets of samples of each type of accessories and apparatus, proposed to be used in the installation at site for approval (drawings or samples) as required shall be submitted by contractor and the choice of selection out of the approved list lies with the Consultant. For all non-specified items, approval of the Consultant shall be obtained prior to procurement of the same.

2.5 MANUFACTURER'S INSTRUCTIONS

Where manufacturers have furnished specific instructions, relating to the material/ equipment to be used on this job, covering points not specifically mentioned in this document, manufacturers' instructions should be followed.

2.6 MATERIALS AND EQUIPMENT

All the materials and equipment shall be of the approved make and design. Unless otherwise called for any approval by Consultant Engineer-in-Charge, only the best quality materials and equipment shall be used.

2.7 GENERAL DETAILS

a) Space Heaters & Lighting.

One of more adequately rated heaters thermostatically controlled with On-Off switch and fuse shall be provided to prevent condensation in any panel compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation. CFL lamp shall be provided in any panel compartment.

b) Fungistatic Varnish

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

c) Ventilation Opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

d) Degree of Protection

The enclosures of the Control Cabinets, Junction Boxes and Marshalling Boxes, Panels etc. to be installed shall provide degree of protection as called for in specifications / General arrangement, whenever it is not mentioned it shall be as given below:

- ☒ Installed out door: IP-55.
- ☒ Installed indoor in air-conditioned area: IP-52.
- ☒ Installed in covered area: IP-52.
- ☒ Installed indoor in non-air-conditioned area where possibility of entry of water is limited: IP-42.
- ☒ For L.T. switchgear (AC and DC distribution boards): IP-52.

The degree of protection shall be in accordance with IS: 13947 (Part-I)/IEC-947 (Part-I). Type test report for degree of protection test, on each type of the box shall be submitted for approval.

2.8 Rating Plates, Name Plates and Labels

Rating Plates, Name Plates and Labels are to be provided & attached permanently in a conspicuous position to all equipment & items installed in various buildings. A rating plate of non-corrosive material engraved with manufacturer's name, year of manufacture, equipment name, diagram, type or serial number etc. together with details of the loading conditions of equipment. The rating plate of each equipment shall be according to relevant BIS & IEC norms, as applicable.

All such nameplates, instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

2.9 First Fill of Consumables, Oil and Lubricants

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, welding/ soldering/ brazing material for all copper/ G.I. earthing and essential chemicals etc. which will be required to put the equipment/ scheme covered under the scope of the specifications, into successful operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.

2.10 DESIGN IMPROVEMENTS / DEVIATIONS

The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. If for any reason, Contractor wishes to deviate from specification, prior permission from Consultant will be sought.

If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly in the specification.

3. QUALITY ASSURANCE PROGRAMME

To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Purchaser's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be outlined by the Contractor and shall be finally accepted by the Purchaser after discussions before the award of Contract. A quality assurance programme of the contractor shall generally cover the following:

- ☑ His organization structure for the management and implementation of the proposed quality assurance programme.
- ☑ Documentation control system.
- ☑ Qualification data for bidder's key personnel.
- ☑ The procedure for purchases of materials, parts components and selection of sub- contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
- ☑ System for shop manufacturing and site erection controls including process controls and

fabrication and assembly control.

- ☒ Control of non-conforming items and system for corrective actions.
- ☒ Inspection and test procedure both for manufacture and field activities.
- ☒ Control of calibration and testing of measuring instruments and field activities.
- ☒ System for indication and appraisal of inspection status.
- ☒ System for quality audits.
- ☒ System for authorizing release of manufactured product to the Purchaser.
- ☒ System for maintenance of records.
- ☒ System for handling storage and delivery.
- ☒ A quality plan-detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

The Purchaser or his duly authorized representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Contractor/his Vendor's quality management and control activities.

3.1. QUALITY ASSURANCE DOCUMENTS

The Contractor shall be required to submit the following Quality Assurance documents within three weeks after dispatch of the equipment:

- ☒ All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication and reports including radiography interpretation reports.
- ☒ Welder and welding operator qualification certificates.
- ☒ Welder's identification list, listing welders and welding operator's qualification procedure and welding identification symbols.
- ☒ Raw material test reports on components as specified by the specification and/or agreed to in the quality plan.
- ☒ Stress relief time temperature charts/oil impregnation time temperature charts.
- ☒ Factory test results for testing required as per applicable codes/ mutually agreed quality plan/ standards referred in the technical specification.
- ☒ The quality plan with verification of various customer inspection points (CIP) as mutually and methods used to verify the inspection and testing points in the quality plan were performed satisfactorily.

4. INSPECTION, TESTING AND INSPECTION CERTIFICATE

- ☒ The major item such as HT Panel, Transformers, LT Panels, APFC Panels, DG Sets, Rising Mains/Bus Ducts, Power Cables, LAN Cables etc. shall be tested at Manufacturer works before dispatch in

presence of Consultant/Department Representative.

- The Consultant or duly authorized representative shall have at all reasonable times free access to the Contractor's/ Manufacturer's premises or works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection, if part of the works is being manufactured or assembled at other premises or works, the Contractor shall obtain permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. Inspection may be made at any stage of manufacture, dispatch or at site at the option of the Purchaser and the equipment if

found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

- ② All equipment being supplied shall conform to type tests and shall be subject to routine tests in accordance with requirements stipulated under respective sections. Bidder shall submit the type tests reports for approval. The Contractor shall intimate the Consultant the detailed programme about the tests at least three (3) weeks in advance in case of domestic supplies. If for any item type test is pending payment would be made on successful completion of type/routine test(s) actually carried out as per Consultant instructions.
- ② The Contractor shall give the Consultant thirty (30) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account. The Consultant, unless witnessing of the tests is virtually waived off, will attend such tests within thirty (30) days of the date of which the equipment is notified as being ready for test/ inspection, failing which the Contractor may proceed with the test which shall be deemed to have been made in the presence of Consultant and he shall forthwith forward to the Consultant duly certified copies of tests in triplicate.
- ② The Consultant shall within fifteen (15) days from the date of inspection as defined shall inform in writing to the Contractor of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and make the necessary modifications accordingly.
- ② When the factory tests have been completed at the Contractor's or Sub-contractor's works, the Consultant shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Consultant, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the Consultant. Failure of the issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificate shall not bind the Consultant to accept the equipment should, it, on further tests after erection, is found not to comply with the Specification. The equipment shall be dispatched to site only after approval of test reports and issuance of clearance by the Consultant.
- ② The contractor shall arrange all necessary tools and testing facilities for inspection purpose including arrangement of air travel (inland as well as abroad), conveyance, lodging, boarding and other miscellaneous expenses etc. Consultant shall depute its inspection engineers (2 or more as decided by Consultant) after receipt of inspection call from the contractor. All such expenses incurred by the contractor towards inspection of equipment by Consultant inspection engineers shall be borne

by the contractor & no extra payment whatsoever shall be paid/ reimbursed to the contractor on this account.

- ☐ For tests whether at the premises or at the works of the Contractor or of any Sub- Contractor, the Contractor except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be required by Consultant or this authorized representative to carry out effectively such tests of the equipment in accordance with the Specification.
- ☐ The inspection by Consultant and issue of Inspection Certificate thereon shall in no way absolve the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.
- ☐ The Consultant will have the right of having at his own expenses any other tests(s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests to satisfy that the material comply with the specifications.
- ☐ The Consultant reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipment for these tests shall be provided by the Contractor.

5. TESTS

5.1. Charging Tests

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Consultant and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The pre-commissioning tests to be performed as per relevant I.S. given and shall be included in the Contractor's quality assurance programme.

5.2. Commissioning Tests

- ☐ The available instrumentation and control equipment will be used during such tests and the Contractor will calibrate all such measuring equipment and devices as far as practicable. However, unmeasurable parameters shall be taken into account in a reasonable manner by the Contractor for the requirement of these tests. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable. The Contractor will apply proper corrections in calculation, to take into account conditions, which do not correspond to the specified conditions.
- ☐ All instruments, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.
- ☐ Pre-commissioning test shall be carried out as per relevant IS and/or as specified in the relevant clause.
- ☐ The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning of the equipment.

6. PACKAGING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of availability of Railway wagon/truck/trailer sizes in India should be taken account of the Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharf age and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. Consultant takes no responsibility of the availability of any special packaging/transporting arrangement.

7. PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

8. FINISHING OF METAL SURFACES

8.1. General

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts and bolts and spring washers shall be electro galvanized. All steel conductors used for earthing/grounding (above ground level) shall be galvanized according to IS: 2629.

8.2. Hot Dip Galvanizing

- ☐ The minimum weight of the zinc coating shall be 700 gm/sq.m and minimum thickness of coating shall be 85 microns.
- ☐ The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.
- ☐ After galvanizing drilling or welding shall be performed on the galvanized parts of the earthing materials. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.
- ☐ The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.
- ☐ Sharp edges with radii less than 2.5mm shall be able to withstand four immersions of the Standard

Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.

- Coating thickness,
- Uniformity of zinc,
- Adhesion test,
- Mass of zinc coating.

☒ Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

8.3. Painting

☒ All sheet steel work shall be degreased, pickled, phosphate in accordance with the IS- 6005 “Code of practice for phosphating iron and sheet”. All surfaces which will not be easily accessible after shop assembly shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swaf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

☒ After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, staving type zinc chromate primer. The first coat may be “flash dried” while the second coat shall be shoved.

☒ Powder coating/electrostatic painting of approved shade shall be applied.

☒ The exterior color of the paint shall be as per shade no. 697 of IS-5 or as approved by Engineer-in-charge and inside shall be white or as approved by Engineer-in-charge. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments, if required.

☒ In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures like electrostatic painting etc. the procedure shall be submitted along with the Bids for Consultant review and approval.

9. HANDLING, STORING AND INSTALLATION

☒ In accordance with the specific installation instructions as shown on manufacturer’s drawings or as directed by the Purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented.

☒ Contractor shall follow the unloading and transporting procedure at site, as well as storing, testing and commissioning of the various equipment being procured by him separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the

manufacturer's Engineer(s) and shall extend full co-operation to them.

- ☒ In case of any doubt/ misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the Consultant. Contractor shall be held responsible for any damage to the equipment consequent for not following manufacturer's drawings/instructions correctly.
- ☒ Where assemblies are supplied in more than the one section, Contractor shall make all necessary connections between sections. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.
- ☒ The Contractor shall submit to the Consultant every week, a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.
- ☒ The Contractor shall be fully responsible for the equipment/material until the same is handed over to the Consultant in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by Consultant, as well as protection of the same against theft, element of nature, corrosion, damages etc.
- ☒ The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment, which require indoor storage.
- ☒ The words 'erection' and 'installation' used in the specification are synonymous.
- ☒ Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.
- ☒ The minimum phase to earth, phase to phase and section clearance along with other technical parameters for the various voltage levels shall be maintained as per relevant IS.

10. PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

11. DESIGN CO-ORDINATION

The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub- assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

12. DESIGN COORDINATION MEETING

The Contractor will be called upon to attend design co-ordination meetings with the Engineer, and the Consultant / MoHFW during the period of Contract. The Contractor shall attend such meetings at his own cost at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during those discussions.

13. TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipments.

14. SAFETY CODES & PRECAUTIONS

The Contractor at his own expenses shall arrange for safety provisions as required to comply with the statutory regulations, ISI recommendations and CPWD codes.

The contractor shall provide necessary barriers, warnings, signals and other safety measures to avoid accidents. He shall indemnify Consultant against any claims arising out of negligence in this respect.

15. REGULATIONS AND STANDARDS

All equipments their installation, testing and commissioning shall conform latest Gujarat R&B/CPWD/ IS specifications in all respects. Indian Standard Code of Practice for Electrical Wiring Installation IS:732-1989. It shall also be in conformity with Indian Electricity Rules and the Regulations, National Electric Code, National Building Code 2016, ECBC, latest CPWD specifications amended up to date and requirements of the Local Electric Supply Authority. In general, all materials equipment and workmanship shall conform to the Indian Standards specifications and code. Mode of all measurement will be as per latest CPWD norms/ specifications including amendments. Some of the applicable codes/standards are as under:

- | | | |
|----|--|------------------------------------|
| a) | CPWD General specifications for electrical works | Part-I (Internal) 2023 |
| b) | CPWD General specifications for electrical works | Part-II (External) 2023 |
| c) | CPWD General specifications for electrical works | Part-III (Lifts & Escalators) 2005 |
| d) | CPWD General specifications for electrical works | Part-IV (Substation) 2013 |
| e) | CPWD General specifications for electrical works | Part VII (DG Sets) 2013 |
| f) | CPWD Specification/norms for measurement | Latest revision |
| g) | NEC-2023, ECBC-2017, NBC-2016 | |
| g) | High Voltage Switch gear and control gear | |
| h) | Low Voltage Switch gear and control gear | |
| i) | Degree of protection for Enclosure | |

- j) Guide for improvement of Power Factor
 - k) Recommendations on Safety Procedures & Practices in Electrical Works
 - l) Code of practice for selection, Installation and maintenance of Transformers.
 - m) Code of practice for Electrical wiring Installations .
 - n) Oil Type Power Transformers IS/IEC62271-202:2014
- IS/ IEC 61439 (1-5) IS/IEC 60529:2001 IS 7752-Part-1 :1975 IS 5216 Part 1-2 IS 10028 Part-2

:1981 IS 732 IS 11171:1985

- h) Guide for uniform system of marking and identification of conductor and apparatus terminals. IS 11353 -1985
 - i) Low voltage switchgear and control gear assemblies IS/IEC 61439
 - j) Specification for low voltage switchgear and control gear assemblies IS 8623 (Part -2- 1993)
 - l) Code of practice for selection, Installation and maintenance of switchgear and control gear. IS 10118 Part - 1 - 4
 - n) PVC insulated (heavy duty) electric cables IS 1554
 - o) PVC insulated cables for working voltages up to and including 1100V. IS 694
 - p) Conduit for electrical installations IS 9537
 - q) Accessories for rigid steel conduits for electrical wiring IS 3837
 - r) Boxes for the enclosure of electrical accessories IS 14772
 - s) General and safety requirements for luminaries IS 1913
 - t) Code of practice for earthing IS 3043
 - u) Electrical accessories – circuit breakers for over current protection for household and similar installations. IS 8828
 - v) Low Voltage switchgear and control gear IS 13947 Part 1 – 5
 - w) Residual current operated Circuit Beakers IS 12640
 - x) Current Transformers IS 2705
 - y) Voltage Transformers IS 3156
 - z) Direct acting indicating analogue electrical measuring instruments and their accessories IS 1248 part – 1 to 9
- A1 Control Switches (switching device for control and auxiliary circuits including contactor relays) for voltages up to and including 1000V AC and 1200 V DC.

IS 13947 & IS 13 In case of contradiction in specification the priority of the documents shall be as follow CPWD/ IS Specifications, Drawings, Technical Specifications.

Item No:- 434

16.3 LT PANELS- TTA

**LOW VOLTAGE SWITCHGEAR AND TESTED ASSEMBLY (TTA PANELS)
(Applicable for Main LT Panel and Emergency Panels)**

GENERAL

This section covers the detailed requirements of medium voltage switchboard for 415 volts 3 phase, 50 Hz, 4 wire system.

STANDARDS & CODES

Updated and current Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract.

Low Voltage Switchgear Assemblies	IEC61 439-1 & 2
Low Voltage switchgear & control gear	IEC 60 947 /IS 13947: 1993

Part I	:	General rules
Part II	:	Circuit Breakers
Part III	:	Switches, disconnectors, switch disconnectors and fuse combination units
Part IV	:	Contactors and Motor starters
Part V	:	Control circuit devices and switching elements

Degree of Protection of Enclosures for low voltage switchgear. IEC60529 /IS 2147: 1962

Internal arc – IEC 61641

SWITCHBOARDS

General

The LV switchboards shall be **as per the standards IEC 61439-1 & 2**. The switchboards and the associated equipment including switchgear, control gear, Busbar supports, Busbar orientation, Busbar links etc shall be identical in construction to the assembly which has undergone the type test. The drawings of the type-tested assemblies shall be made available for inspection. Type test certificate for all panels to be furnished by the contractor.

The designs of the switchboards should be with switchgear manufacturer, and all the mechanical drawings must be available in the factory beforehand.

Switchboards shall have a short circuit level withstand as per Schedule of Quantities and drawings. Panel shall be tested of design as per Seismic Zone 5 as per ICC ES AC-156 1893 requires compliance against 3.2 g acceleration. The enclosures shall be designed to take care of normal stress as well as abnormal electro-mechanical stress due to short circuit conditions. All covers and doors provided shall offer adequate safety to operating persons and provide ingress protection of IP54 till 2500A above it IP42. Ventilating openings and vent outlets, if provided, shall be arranged such that same ingress protection of IP 54 is retained. Suitable pressure relief devices shall be provided to minimize danger to operator during internal fault conditions.

The Panel Should be Ethernet/RS485 ready, all ACB, MCCB and Ethernet/RS 485 Gateway Module for Energy Meter shall be connected over IP network using Din Rail Mounted Managed Ethernet Switch in such a way that all electrical panel data shall be able to be communicated to SCADA via single ethernet port from the panel.

The switchboard along with ACBs and connections should have been be type tested design at **CPRI**/Independent international test house for short circuit, temperature rise, protective earth short circuit test and dielectric tests of the ratings required.

Panel shall be rated for Impulse withstand capability not less than that of highest rating of switchgear inside the panel. For operator safety IP2 X (touch proof) protection to be available even after opening the feeder compartment door. The compartmentalization to be achieved by using metal separators, use of PVC sheet / Hylem sheets shall not be allowed.

Main switchboard shall be form 4b, for form of separation only metallic covers shall be used, Hylem / PVC sheets shall not be allowed, rest of the panels shall be minimum conform to form 4b design.

All ACB, MCCB of Main LT panel and Incomer MCCBS shall have inbuilt earth fault protection.

Switchboard Configuration

The Switchboard shall be configured with Air Circuit Breakers, MCCB's, MCB's and other equipment as called for in the schedule of quantities.

The MCCBs shall be arranged in multi-tier formation whereas the Air Circuit Breakers shall be arranged in Single or Double tier formation only to facilitate operation and maintenance.

The Switchboards shall be of adequate size with a provision of spare space to accommodate possible future additional switch gear.

The switchgear devices and the enclosure design should be of same manufacturer having valid Type Test Certificate.

All ACB / MCCB of Main LT panel shall be EDO/ Plugin type respectively.

All breakers in Main LT panel, Emergency panels and Incomers of other panels shall be of Four Pole Only.

All Tested Assemblies (TTA) (Main LT panel and panels with incomers with 800Amps and above) shall be assembled and manufactured at authorized OEMs factory and FAT shall be done at authorized OEMs premises. All electrical panels in Sub-stations, MDBs and Panels with I/C rating above 630A should be TTA panels. Panels manufactured by OEM or other Authorised manufacturers with more 5 years experience are accepted. However, the breaker type and model shall be as per NIT Specs/makes.

Constructional Features

The Switchboards shall be metal clad totally enclosed, floor mounted free-standing type of modular extensible design suitable for indoor mounting.

Switchboards construction shall employ the principle of compartmentalized and segregation for each circuit.

Incomer and bus section panels or sections shall be separate and independent and shall not be wired with sections required for feeder. The incomer panel shall be suitable for receiving bus trunking or MV cable of size specified.

Switchboards shall be made up of requisite vertical sections, which when coupled together, shall form continuous dead front switchboards.

Switchboard shall be readily extensible on both sides by addition of vertical sections after removal of the end covers.

The switchboards shall be designed for use in high ambient temperature and humid tropical conditions as specified. Ease of inspections, cleaning and repairs while maintaining continuity of operation shall be provided in the design.

Neoprene gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide a degree of protection of IP 42/IP 54 as stipulated in schedule of quantities. The unused openings within the switchboards shall be closed using suitable grommets.

Degree of Protection shall be IP54 Upto 2500A and IP42 above 2500A

Special care to be taken to ensure effective earthing of the frame and doors of the switchboards

Each vertical section shall be provided with a rear or side cable chamber housing the cable end connections and power/control cable terminations. There should be generous availability of space for ease of installation and maintenance with adequate safety for working in one vertical section without coming into contact with any live parts. The design of the switchboard shall allow standard extension chambers if required to accommodate cables.

Some switchboards may be required to be installed against the wall, for such application-documented designs shall be available.

Switchboard panels and cubicles shall be fabricated with CRCA Sheet Steel of thickness not less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be fabricated from CRCA sheet steel of thickness not less than 2 mm. Joints of any kind in sheet metal shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal. All busbar support, locks and hinges and panel structure should be provided by the Switchgear Manufactures.

All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned. Switchboard shall be provided with "Danger Notice Plate" conforming to relevant Indian Standards.

Internal arc tests as per IEC 61641, 0.5 sec as per system design fault level at HBB, VBB and cable chamber. Copies of the test certificates shall be submitted along with the tender.

Copies of the test certificates shall be submitted along with the tender.

Switchboard Dimensional Limitations

The overall height of the switchboard shall be limited to 2400 mm for all the Busbar ratings and type of switchboards. Panel should have integral base frame of 75mm, hence total panel height should not be more than 2475mm.

The height of the operating handle, push buttons etc shall be restricted between 300 mm and 2000 mm from finished floor level.

Other dimensional limits if any are specified separately.

Switchboard Compartmentalization

For compartmentalized switchboards, separate totally enclosed compartments shall be provided for horizontal busbars, vertical busbars, ACBs, MCCBs, and cable alloys.

The main board shall be with Form 4b Construction with metallic shrouding only, FRP is not acceptable.

Earthed metal or insulated shutters shall be provided between drawout and fixed portion of the ACB such that no live parts are accessible with equipment drawn out. Degree of protection within compartments shall be atleast IP 2X.

Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker in "ON" and "OFF" position.

For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, busbars and connections.

For Some MCCB feeders for critical loads like UPS it may be required to have operation only after opening the door, all other facilities like pad lockable rotary handle to be provided for such feeder. It shall be possible to do this change during execution of order

Each switchgear cubicles shall be fitted with label in front and back identifying the circuit, switchgear type, rating and duty. All operating device shall be located in front of switchgear only.

A horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.

Separate cable compartments running the height of the switchboard in the case of front access boards shall be provided for incoming and outgoing cables.

Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top. The construction shall include necessary and adequate and proper support shall be provided in cable compartments to support and clamping the cable in the cable alley / cable chamber.

Switchboard Bus Bars

Busbars shall be made of high conductivity, high strength Aluminum Busbars not less than 60% conductivity shall be of rectangular cross sections , not more than 10mm thickness better suitable for full load current for phase bus bars and half/ full rated current for neutral bus bar as per the tested design of OEM considering temperature rise and Short Circuit test reports or as stipulated in schedule of quantities. Busbar shall be suitable to withstand the stresses of fault level as specified in schedule of quantities. Main Horizontal busbar and Neutral should be in same compartment.

The bus bar system may comprise of a system of main horizontal bus bars and auxiliary vertical bus bars run in bus bar alloy on either side in which the circuit could be arranged with front access for cable entrances

The bus bars shall be supported on non-breakable, non-hygroscopic epoxy resin or glass fiber reinforced polymer insulated supports able to withstand operating temperature as per Type Test Report of at regular intervals, to withstand the forces arising from a fault level as stipulated in schedule of quantities. The

material and the spacing of the Busbar supports should be same as per the type tested assembly

Auxiliary buses for control power supply, space heater power supply or any other specified service shall be provided. These buses shall be insulated, adequately supported and sized to suit specific requirement. The material for auxiliary supply bus will be insulated electrolytic copper. Wires.

Clearances between phases should be in line with IEC.

Switchboard Interconnection

All connection and tap offs shall be through adequately sized connectors appropriate for fault level at location. This shall include tap off to feeders and instrument/control transformers.

For unit ratings up to 250 amps, PVC insulated 105 dg withstand, copper conductor wires of adequate size to carry full load current shall be used. The terminations of such interconnections shall be crimped. Solid connections shall be used for all rating of above 250 amps.

All connections, tapings, clamping, shall be made in an approved manner to ensure minimum contact resistance. All connections shall be firmly bolted and clamp with even tension. Before assembly joint surfaces shall be filed or finished to remove burrs, dents and oxides and silvered to maintain good continuity at all joints. All screws, bolts, washers shall be zinc plated. Only 8.8 grade nuts and bolts shall be used for busbar connections.

Drawout Features

Air Circuit Breakers shall be provided in fully draw out cubicles, unless otherwise stated. These cubicles shall be such that draw out is possible without disconnection of the wires and cables. The power and control circuits shall have self-aligning and self-isolating contacts. Mechanical latches shall be integrated in ACB at service, test and isolated position to ensure that Breaker is firmly latched in respective position. It shall not be possible to move the breaker from the position unless latch is manually operated.

Instrument Accommodation

All voltmeter and ammeter and other instruments shall be flush mounted type of size 96 sq. mm conforming to class 1 to IS 1248 for accuracy. All voltmeter shall be protected with MPCBs.

Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switchboard. For MCCBs, instruments and indicating lamps can be provided on the compartment doors. The current transformers for metering and for protection shall be mounted on the solid copper/aluminum busbars with proper supports.

On all the incomers of switch boards ON/OFF indicators lamps shall be provided suitable for operation on AC 230 volts supply. All lamps shall be protected by MCBs. Panel shall be rated for Impulse withstand capability equal to 12KV for ACB and 8kV for MCCB.

For Incomer and important outgoing feeders comprehensive power meters shall be provided which shall display A, V, Pf, Hz, Kw, KVA, KVAR, Kwh, Kvarh, average and maximum values, demand values, THD on current and Voltages, Individual harmonics up to 31st level. Also add on modules for RS485 port,

programmable contacts, analogue output etc to link to SCADA system.

Wiring

All wiring for relays and meters shall be with PVC insulated copper conductor wires. The wiring shall be coded and labeled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 2.5 sq. mm. Runs of wires shall be neatly bunched and suitably supported and clamped. Means shall be provided for easy identification of wires. Identification ferrules shall used at both end of wires. All control wires meant for external connections are to be brought out on a terminal board. The cables and control wires shall be suitable for withstanding 105 deg C.

Space Heaters

Anti- condensation heaters shall be fitted in each cubicle together with an ON/OFF isolating switch suitable for electrical operation at 230 volts A.C 50 Hz single phase of sufficient capacity to raise the internal ambient temperature by 50 C. The electrical apparatus so protected shall be designed so that the maximum permitted rise in temperature is not exceeded if the heaters are energized while the switchboard is in operation. As a general rule, the heaters shall be placed at the bottom of the cubicle.

Ventilation Fans

The Switchboard shall be provided with panel mounting type ventilation fans in each panel with switchgear rated for 4500 amp and above. The fan shall be interlocked with switchgear operation. The degree pf enclosure protection to be maintained even with Fans.

Earthing

Continuous earth bus sized for prospective fault current to be provided with arrangement for connecting to station earth at two points. Hinged doors / frames to be connected to earth through adequately sized flexible braids.

Sheet Steel Treatment And Painting

Sheet steel used in the fabrication of switchboards shall undergo a rigorous cleaning and surface treatment seven tank process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process after which a coat of primer paint compactively with the final paint shall be applied over the treated surface. Final paint coat of oven baked powder coating, of minimum 50 micron thickness, of sheet approved by Engineer-in-Charge shall then be provided.

Name Plates And Labels

Suitable engraved white on black name plates and identification labels of metal for all Switchboards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

Type test reports.

Switchboard configurations offered shall be CPRI /Independent international test house tested for all the tests as per IEC61439-1 & 2 and internal arc tests. Copies of the test certificates shall be submitted with the tender.

Testing at Works

Copies of type test carried out at ACB/ MCCB manufacturers works and routine tests carried out at the

switchboard fabricators shop shall be furnished along with the delivery of the switchboards. Engineer-in-Charge reserves the right to get the switchboard inspected by their representative at fabricators works prior to dispatch to site to witness the followings.

- a) Physical variation and dimensional check
- b) Verification of bill of material
- c) Functional check
- d) HV test
- e) IR test

AIR CIRCUIT BREAKER (ACB) (For Main LT Panels & Emergency Panel)

GENERAL:

ACB shall comply with standards IS/IEC 60947-1 & 2.

ACB shall have a rated operational voltage of 415V AC, rated insulation voltage of 1000 volts AC, rated impulse voltage of 12kV.

ACB shall be of 3pole or 4pole (as per BOQ), air break, molded case design for longer life along with less maintenance requirement

All ACBs shall preferably be of single frame size up to 2500A to optimize requirement for spares management.

ACB shall have a Ready to close mechanism preferably having a ready to close mechanical indication as spring charged on front of ACB. All EDO ACBs ready to close indication contact which shall be used to give a single indication via indicating lamps on panel door if ACB is ready to be closed, after checking all the given conditions (UV release energized, Shunt release de-energized, spring charged, Breaker is not "ON", Breaker has not tripped on fault, Breaker is not mechanically interlocked with other breaker and ACB is not racked in completely in-service position) ensuring safety for user and electrical distribution.

ACB shall comply with the environmental directives like RoHS.

PERFORMANCE:

ACB shall have the breaking performance $I_{cs} = I_{cu} = I_{cw}$ (1sec) = 65kA/50kA as per fault level mentioned in BOQ/SLD. Fault level shall be 50KA for LT panels and 25 KA for 3 seconds for HT Panels.

The operating mechanism of ACB shall be of the Open/Closed/Open stored-energy spring type. The closing time shall be less than or equal to 60ms, and of fast opening type with break time of breaker should be <30ms to ensure higher life of distribution cables.

ACCESSORIES & AUXILIARIES:

Shunt trip and closing coil (having common AC/DC supply upto 250V) shall be suitably continuous rated. For Incomer ACBs delayed type under voltage release shall be used to avoid nuisance tripping

during voltage surges.

ACBs shall have minimum 4 change-over auxiliary contacts, available to be used for indication and interlocking, rated at minimum 10A 240/380V 50 Hz and shall be wired on chassis/cradle. There should be facility to add one more set of 4 contacts if required.

ACB shall be provided with two programmable contacts for fault/Alarm indications on panel door via LED lamps. It shall be possible to program the contacts for pre- overload alarm and pre earth alarm. Panel builder shall wire these contacts to LED lamps on panel's front door. Suitable modules shall be considered for the same.

Pre- wired Fault trip contact should be provided with Release as standard.

Indication lamps for ON/OFF/Trip/Ready to Close Spring Charge and pre earth fault to be provided on front door of ACB feeder.

Spring charge indication required for EDO ACB only

SAFETY:

Draw-out ACBs shall preferably be provided with a mechanical latch on chassis which latches the ACB at Connected-Test-Disconnected positions while racking in and racking out the circuit breaker. This feature will help the operator in placing the circuit breaker at right position inside the chassis and can help in avoiding the accident.

Interlocks:

The racking handle shall be stored on the air circuit breaker in such a manner as to be accessible without defeating the door interlocking.

TERMINATIONS:

All air circuit breaker shall be fully tropicalized as standard & suitable for terminating copper or aluminum bus bars. Both fixed & draw-out circuit breakers shall have single pole-pitch.

PROTECTIONS:

Air circuit breaker shall be provided with microprocessor release, which should be self-powered type without the need of any auxiliary power supply during normal operation of the breaker.

Wherever communication is required Breaker release will be supplied with 24V DC auxiliary power supply.

The circuit breaker control unit shall measure the true r.m.s value of the current

Circuit breaker trip unit shall have a display for measurement & protection of current, voltage, power factor and energy. It shall be possible to view last 10 trip cause on trip unit with real date and time stamping along with interrupted value. One 96x96 MFM display unit shall be provided with each circuit breaker which displays all current/voltage and energy data at panel.

All trip units provided shall have thermal memory and password protection feature as standard

All trip units shall be EMC/EMI tested

The protection release shall have following protections as standard: -

- a. Adjustable over load current (I_r) settings from 40% to 100% of rating of ACB (I_n). Over load time setting (t_r) from 0.5s, 1s, 2s, 4s.....24s as field selectable curves.
- b. Short circuit setting (I_{sd}) from 1.5 to 10 times of I_r setting, Short circuit time delay adjustable from 0 to 400msec.
- c. Instantaneous (I_i) protection with an adjustable pick-up and an OFF position.
- d. Earth fault setting adjustable in absolute Ampere with time delay settings from 0 to 400ms.

Separately powered, individual fault trip indication LEDs (For overload, short circuit, earth fault and trip unit failure. shall be available on the trip unit which shall function even if the display fails.

I2t ON / I2t OFF options shall be available for short-circuit & earth fault protections which can be used to ensure discrimination with upstream circuit breaker or fuse

The trip unit shall have integral test facility to verify the healthiness and to avoid external calibration.

All Incomer ACBs of Main LT panel shall have release with following functions :Protection for O/C, S/C, E/F and Metering/protection for Current- I_1 , I_2 , I_3 , I_n , I_{avg} , I_{max} , Voltage- V_{ph} , V_{line} , Power- KW,KVA,KVAR, Power factor, Energy –KWh, KVAh, KWAh, Demand current- Ph & Neutral, Demand power-KWh, Under & over frequency, current unbalance, reverse power, phase seq. reversal, Last 20 faults 10 events with date and time stamping, Last 10 alarms with date and time stamping, Current and Voltage Harmonics till 27th, fault current Oscillograph waveform.

All Outgoing ACBs of Main LT panel shall have release having release with following functions :Protection for O/C, S/C, E/F and Metering for RMS values of highest current, Bargraph for % loading, Ammeter, Current- I_1 , I_2 , I_3 , I_n , I_{avg} , I_{max} , Voltage- V_{ph} , V_{line} , Power- KW,KVA,KVAR, Power factor, Energy –KWh, KVAh, KWAh, Demand current- Ph & Neutral, Demand power-KWh.

It shall be possible to change the protection settings on line and the circuit breaker need not be switched off while adjusting the settings.

All ACBs in main LT panel shall be provided with zone selective interlocking which helps in reducing the thermal and dynamic stress on installation during short circuit and ground faults. The releases shall be suitable to communicate between incomer breaker and outgoing breakers enabling zone selective interlocking. The manufacturer shall supply all equipment like ZSI module, power supply and wiring connectors to implement ZSI.

It shall be possible to view the percentage/actual loading of three phases at once on trip unit via LEDs or LCD display to help the user in identifying the current load balancing of the network. This will help in preventing the deterioration of loads affected by load balancing by identification of the balancing related issue.

All 4 Pole ACBs shall have fully rated neutral equal to rating of the breaker & shall be protected

against over-load faults with provisions for settings neutral unprotected, neutral protection at 0.5In and neutral protection at 1.0 In to ensure precise neutral protection.

COMMUNICATION:

The advanced communication system needed for the project shall be able to show the basic data inside the trip unit of the ACB without using any external software. This is required for two purposes

- a) Communication testing of the circuit breakers at panel builder's shop floor and generating the communication check report
- b) Basic parameters (A, V, kWh, no. of operations etc.) viewing on Ethernet/RS 485 network from anywhere in LAN network and from any laptop, computer or smart phone
- c) Easy replacement of the Ethernet modules without the involvement of system integrators, in case the modules become faulty.

Specifications for communication

All ACBs shall be provided with individual Modbus TCP Ethernet ports modules/RS 485 for better speed of data transfer.

One display module/HMI or Breaker release for each circuit breaker, shall be able to provide following information's. It shall contain the following information about circuit breakers

- a. Metering data.
- b. Circuit breaker load profile i.e. circuit breaker has seen how much current for how many hours (e.g. Upto 70% for how many hours, Upto 90% for how many hours etc.)
- c. Circuit breaker number of ON/OFF operations and number of trip operations counter
- d. It shall be possible to control the circuit breaker from the module

Panel builder shall provide circuit break communication test report having the following data

Circuit breaker communication check (Ok/Not Ok)

Circuit breaker settings at the time of communication test. Settings on the circuit breaker, at the time of communication test, shall be same as recommended by the consultant. Modbus and Modbus TCP ports

Analog and Digital inputs

It shall be able to take the data from all Modbus or Modbus TCP meters, ACB Ethernet/RS485 modules, MCCB Ethernet/RS485 modules etc. and share to SCADA or EMS Software

Each release shall be accessible via browser to view the following

- i. Current, voltage and energy data measurement
- ii. Circuit breaker number of operation measurement
- iii. Circuit breaker control (ON/OFF)
- iv. Email notifications for undesired events like circuit breaker tripping on electrical fault, circuit breaker tripping on overload/short circuit/earth fault/trip unit failure etc.
- v. It shall be possible to send the energy consumption daily reports by Email or FTP directly from inbuilt web-pages of SCADA/EMS

- vi. Circuit breaker ready to close and spring charge status
- vii. Circuit breaker settings
- viii. Circuit breaker last 20 trip and 128 minimum event history

Architecture

Each ACB release should give its data over Ethernet/RS485 and the same shall be connected to a common Ethernet network.

MOLDED CASE CIRCUIT BREAKER (MCCB) (For Main LT Panels & Emergency Panel)

GENERAL:

MCCBs shall comply with standards IS/IEC 60947-1 & 2. The breaking capacity performance certificates shall be available for category A to the above mentioned standards.

MCCB shall have a rated operational voltage (U_e) of 415V, insulation voltage (U_i) of 800 V (AC 50/60 Hz) & impulse voltage (U_{imp}) of not less than 8kV.

MCCBs shall be current limiting type preferably having an encapsulated double/single break design (Breaking Mechanism as per OEM) having two fixed contacts, one moving contacts and two arc chutes per pole. The design is required to minimize the effects of short circuit currents i.e. limit the let through energy and improve the life of cables.

MCCB shall not have any line load bias

MCCB shall comply with the environmental directives like RoHS.

MCCBs in main panel shall have zone selective interlocking feature. Mechanical life shall be 10000 operations

PERFORMANCE:

The MCCBs shall have a rated service breaking capacity (I_{cs}) equal to the ultimate breaking capacity (I_{cu}) at 415V and as per system fault levels (refer SLD).


The limiting capacity of a circuit breaker is expressed by two curves which are a function of the prospective short-circuit current (the current which would flow if no protection devices were installed): The thermal stress (A_2s), i.e. the energy dissipated by MCCB during fault should be as low as possible. Cable selection to be done as per

Maximum permissible cable stresses for which manufacture should produce current limiting and energy limiting curves of MCCB's.

SAFETY:

For maximum safety, the power contacts shall be insulated in an enclosure made of a thermosetting material from other functions such as the operating mechanism, the case, the trip unit and auxiliaries (ON/OFF/Trip

Contact, Shunt, Under Voltage etc.). All poles shall operate simultaneously for circuit breaker opening, closing and tripping.

MCCBs shall be actuated by a toggle or rotary-handle that clearly indicates the three distinctive positions: ON, OFF and TRIPPED. MCCB shall clearly indicate the suitability for isolation in the name plate identified by the symbol . MCCBs shall be equipped with a “push to trip” button in front to test operation and simultaneous opening of all poles together.

MCCBs shall be designed to prevent access to live parts when the cover is removed, means main current path of the circuit breaker should be isolated from auxiliary section i.e. MCCB shall offer class -II /double insulated front face as per IEC standards 61140 and 60664-1

The electrical life of MCCBs shall be 8,000 operations up to 250A & 4000 operations up to 630A.

All MCCBs provided shall be of single frame size upto 250A to reduce the requirement of spares management.

All MCCBs termination should be done using circular lugs being bolted to MCCB, to enhance safety and reliability of the terminations. In case spreaders/rear connectors are used in between MCCB and bus bar/lugs then the spreaders shall be terminated with the MCCB connectors.

AUXILIARIES AND ACCESSORIES:

Following separate Field installable auxiliary contacts for signaling ON/OFF indication shall be provided with all MCCBs

Rotary handle shall ensure IP40 for direct type and IP 54/55 for extended Rotary handle.

MCCB shall have provision for Rear connection - MCCB mounting on a back plate with suitable holes enables rear connection. The rear connections are simply fitted to the device connection terminals.

PROTECTIONS REQUIREMENTS:

All MCCBs upto 250A shall be thermal magnetic type with adjustable overload settings from 0.67 to 1 times In and fixed/adjustable magnetic settings.

All MCCBs above 250A upto 630A shall be self powered microprocessor based type to have wide range of settings and advanced information over and above thermal magnetic trip units

- a. LED indication on trip unit shall be there for trip unit ON indication
- b. Test port on trip unit shall be there for testing the trip unit
- c. Overload alarm indication LED shall be there on trip unit
- d. Overload settings adjustment from 25% to 100% shall be possible. It shall also be possible to do the fine adjustment of overload settings in at least 5 steps. e.g. if overload settings selected from dial is at 250A. It shall be possible to set it at 92% or 93% or 94% or 95% or 96% etc. of 250A for accurate settings.
- e. It shall be possible to set the overload time delay from 0.5 to 10 secs at 6xIr

- f. Short circuit settings shall be adjustable from 1.5 to 10 times I_r . Fine adjustment of settings shall also be possible. Short circuit time delay shall be adjustable from 0.1 to 0.4 secs. It shall be possible to switch the I2t protection ON or OFF to achieve discrimination between upstream fuse or circuit breaker
 - g. Instantaneous settings shall be adjustable from 6 I_n to 10 I_n
 - h. Earth fault protection shall be adjustable from 20% to 70% or OFF. It shall be possible to switch the I2t protection ON or OFF to achieve discrimination between upstream fuse or circuit breaker
- In case of 4 pole microprocessor based MCCBs neutral shall be protected & adjustable as a Neutral unprotected / Neutral protected at 0.5 I_n / Neutral protected at I_n .

All MCCBs in main LT panel's shall have inbuilt earth fault protection shall also be provided.

All MCCBs with earth fault shall display the type of fault (overload, short circuit, earth fault, instantaneous tripping), the phase concerned and interrupted current value, on occurrence of fault. All MCCBs shall be provided with external power supply recommended by manufacturer, so that the display of the reason of fault shall also not switch OFF after the tripping of MCCB

All MCCBs with earth fault protection shall store last 10 trip histories with date and time stampings. The history shall be viewable on display modules or communication or shall be downloadable using MCCB test port.

METERING:

MCCBs with digital panel meters and CTs are acceptable, should be capable of measuring the following data

- a. ON, OFF and Trip status, total number of operations, load profile
- b. current, voltage, energy, power, power factor and THD for current and voltage
- c. Last 10 trip histories with date and time stamping.

COMMUNICATION:

The advanced communication system needed for the project shall be able to show the basic data inside the trip unit of the MCCB without using any external software. This is required for two purposes

- d) Communication testing of the circuit breakers at panel builder's shop floor and generating the communication check report
- e) Basic parameters (A, V, kWh, no. of operations etc.) viewing on Ethernet /RS485network from anywhere in LAN network and from any laptop, computer or smart phone
- f) Easy replacement of the Ethernet/RS485 modules without the involvement of system integrators, in case the modules become faulty.

Specifications for communication

All MCCBs shall be provided with individual Modbus TCP/Ethernet ports/modules for better speed of data transfer

- e. Metering data.
- f. Circuit breaker load profile i.e. circuit breaker has seen how much current for how many hours (e.g. Upto 70% for how many hours, Upto 90% for how many hours etc.)

- g. Circuit breaker number of ON/OFF operations and number of trip operations counter
- h. It shall be possible to control the circuit breaker from the module

Item No:- 309-317

LT PANELS – Non TTA

(Applicable for panels other than Main TTA LT Panel and Emergency Panels)

GENERAL

Medium Voltage power control centers (generally termed as switchboard panels) shall be in sheet steel clad cubicle pattern, free floor standing type, totally enclosed, compartmentalized design having multi-tier arrangement of the incomers and feeders as per details given in the schedule of quantities. The panels shall be of extensible type with provision of bus bar extensions. All panels shall conform to the requirements of the latest addition of IS and shall be suitable for 415 V, 3 phase AC supply or 230 V single phase AC supply as required.

CONSTRUCTION

All switch board panels or power control centers of free standing type shall have a bus bar chamber at the top and the cable compartment at the bottom or as approved by the Developer/Consultants depending upon the specific requirements of the job. The space between the bus chamber and cable compartment shall be suitably compartmentalized to accommodate either air circuit breakers or molded case circuit breaker of various ratings. The cable terminations shall be carried out on the rear side of the panels for which adequate space and clamping arrangements shall be provided. Where panels have to be installed with very little access space at the rear, the cable terminations shall be carried out in suitable cable alleys provided on the front of the panel. All the live parts shall be properly shrouded with Bakelite barriers. All the equipment shall be accessible from the front. However, protection relays, KWH meters, etc. may be mounted on the rear side/front side. Arrangements and marking of bus bars, main connections and wiring shall be in accordance with latest IS code. The structure of the panel shall be robust and provided with adequate bracing's to withstand the operation of the equipment and stresses due to system short circuit. The panels shall be fabricated out of best quality heavy gauge sheet steel. The panel shall be machine pressed with punched

openings for meters, indicating lamps etc. The external covers provided should have been subjected to minimum mechanical impact of IK09/10 as per IEC to ensure specified degree of protection.

The enclosure system shall be Modular in nature with bolted on construction. Enclosure parts/kits shall be interchangeable to reduce downtime during modification or maintenance work. Enclosure system and switchgear components shall be from same manufacturer.

DIMENSIONS

All power control centers shall have dimensions of not more than that given on the layout drawings. Panels arranged side by side shall have the same height and depth. The height of the panel should be limited to 2400 mm. All the operating levers, handles etc. of the highest unit shall not be at a height more than 1700 mm from F.F.L. For all incoming cables a removable gland plate will be provided in the panel and a minimum distance of 300 mm will be provided between the gland plate and the nearest terminal for proper dressing and termination of the cable. All the components of a module will be mounted on a component plate using the machine screws and taped holes (excepting the components mounted on the door). These component plates should be fixed with bolts for easy replacement. Standardization will be adopted while making these plates so that the component plates of the same size modules can be changed from one module to another. In case of panel of lengths more than 4 meters the fabrication of any single section will be limited to a maximum length of 4 meters for the purpose of shipping and shifting at the site. These sections will be assembled at the location of installation with the help of nuts and bolts. While making these sections consideration will be given to the place of sectionalizing and select the location where the minimum electrical connections are transferred from one section to another. All the hardware used in the assembly will be electroplated for protection and neat appearance.

BUS BARS

The bus bars shall be suitable for 4 wire, 415 Volts, 50 Hz, system. The main bus bar shall be made of high conductivity electricity conductor grade electrolytic AL 91E Aluminum and shall be liberally sized. In case of copper bus bar it shall be electrically conductor grade electrolytic copper and at the time of joining of two copper buses tinning will be done on the copper strips ends to a length equal to the lap length of the joint plus one each. The bus bars shall have uniform cross section throughout. The bus bars shall be capable of carrying the rated current at 415 Volts continuously. The bus bar will run in a separate bus bar chamber using bus insulators made of non-deteriorating, vermin proof, non hygroscopic materials such as epoxy fiber, reinforced polyester or molding compound. The interval between the two insulators will be designed after considering:

- a. Strength and safe load rating of the insulator,
- b. The vibrating force generated during a fault,
- c. A Factor of safety of 1.8
- d. A set of insulators at both ends of the bus.

The size of the bus bar calculations must be approved by the consultants. The bus bars shall be designed to withstand a temperature rise of 45o above the ambient. To limit the temperature rise in the bus bar chamber a set of louvers can be provided at strategically places considering the air circulation. The louvers provided will have a brass wire mesh covering from inside with more than 100 openings per sq. inch. The overall

temperature of bus bar shall not exceed 85°C in any case. A current density of 1.0 Amps/Sq. mm shall not be exceeded for Aluminum bus bars.

All the bus bars shall be insulated with PVC heat shrinking sleeves suitably throughout (except at joints) the length. The electro galvanized high tensile steel nuts, bolts, plain or spring washers of suitable size will be used in connecting the various section of the bus bar. A minimum of 1.6 times the width of bus bar will be the lapping length of each joint.

EARTHING

The panels shall be provided with an aluminum or copper earth bus of suitable size running throughout the length of the switchboard. Suitable earthing eyes/bolts shall be provided on the main earthing bus to connect the same to the earth grid at the site. Sufficient number of star washers shall be provided at the joints to achieve earth continuity between the panels and the sheet metal parts.

INTERLOCKING

The panels shall be provided with the following interlocking arrangement.

- a. The door of the switch-fuse compartments is so interlocked with the switch drive or handle that the door can be opened only if the switch is in 'OFF' position. De-interlocking arrangement shall also be provided for occasional inspection.
- b. It shall not be possible for the breaker to be withdrawn when in 'ON' position.
- c. It shall not be possible for the breakers to be switched on unless it is either in fully inserted positions or for testing purposes in fully isolated position.
- d. The breaker shall be capable of being raked in to 'testing' 'isolated' and 'maintenance' positions and kept locked in any of these position.
- e. A safety latch to ensure that the movement of the breaker as it is withdrawn, is checked before it is completely out of the cubicle shall be provided.

PROTECTION & INSTRUMENTATION

Protection and instrumentation shall be as per standard specifications.

All ACBs, MCCBs of Main LT Panel and Incomer MCCBs shall have inbuilt Earth Fault Protection.

CONTROL WIRING

The control wiring of all the panels will be done with PVC single core flexible copper wires of cross section 1.5 sq. mm and 2.5 sq. mm. All the wiring involving current transformers or circuits with currents of more than 5 Amps will be wired with 2.5 sq. mm cross section wire and the others with 1.5 sq. mm. Similarly all the interconnecting between the incoming bus and the outgoing of 100 Amps and above rating shall be done by insulated copper strips of suitable sizes and equipment below 100 Amps rating shall be wired with insulated copper conductors. All of the control wiring will be done by properly dressing all the wires in a laminar manner either in a PVC duct of liberal size or bunched together by PVC strapping tapes at a distance not exceeding 150 mm. Each wire will terminate with a copper ferule crimped to the wire. The PVC ferules will be used to identify each wire of the circuit and the same number will be marked on the drawing for the corresponding wire. Only one outgoing wire will be connected to one connector. When the control wiring is crossing from fixed parts to moving parts such as door etc. the wire will be run in PVC sleeve of suitable size and the same will be mechanically clamped at both the ends i.e. one end of the fixed part and the other on the

moving part. Under no circumstances the wiring should be under any kind of stress for which sufficient length of control wiring in the PVC sleeve should be provided. All the potential circuits shall be protected by fuses mounted near the tap off point from the main connections.

SURFACE TREATMENT

The each part of the fabricated panel will be subjected to seven tank treatment and all sheet metal accessories and components of power control centers and switchboard panels shall be thoroughly cleaned, degreased, de-rusted and hot dip phosphatized before red oxide primer is applied. The panel shall be stove enameled gray shade finish and the Interior surfaces of the panel shall be painted to an off-white shade.

ENCLOSURE

The panel enclosure shall be totally dust and vermin proof and shall be suitable for indoor installation. All the cubical will be adopted with front located, outward openings, lockable doors having hidden hinges and a bolted back cover both using no deteriorating neoprene rubber gasket. Enclosure design shall be in accordance with degree of protection IP 54 as per latest IS code. All the nut bolts handles, meters, knobs etc. appearing from outside of the panel should be in symmetry so as to give a neat appearance.

NAME PLATE

The panel as well as the feeder compartment doors shall be provided with name plate giving the switchboard/feeder descriptions as indicated on the drawings. The above shall be mounted in metal holder with a clear plastic sheet on inside surface of the front door.

TESTING

The power control centers shall be tested at factory after assembling of all components and completion of all interconnections and wiring. Tests shall be conducted in accordance with the requirements of BS:3659.

Insulation Test

- a. Insulation of the main circuit, i.e. the insulation resistance of each pole to the earth and that between the poles shall be measured.
- b. Insulation resistance to earth of all secondary wiring should be tested with 1100 Volt magger. Insulation test shall be carried out both before and after high Voltage test. High Voltage Test A High Voltage test with 2.5 KV for one minute shall be applied between the poles and earth. Test shall be carried out on each pole in turn with the remaining poles earthed, all units raked in position and the breakers closed. Original test certificate shall be submitted along with panel.

STORING, ERECTION AND COMMISSIONING

The panels shall be stored in a well ventilated, dry place, with a suitable polythene covers shall be provided for necessary protection against moisture.

Erection

Switch boards shall be installed on suitable foundation. Foundation shall be as per the dimensions supplied by the panel manufacturer. The foundation shall be flat and leveled. Suitable grouting holes shall be provided in the foundation. Suitable MS base channel shall be embedded in foundation on which the panel can be directly installed. The switch boards shall be properly aligned and bolted to the foundation by at least four

bolts. Cables shall be terminated on the bottom plate or top plate as the case may be, by using high quality brass compression glands. The individual cables shall then be led through the panel to the required feeder compartments for necessary terminations. The cables shall be clamped to the supporting arrangement. The switchboard earth bus shall be connected to the local earth grid.

Pre-commission Tests

Panels shall be commissioned only after the successful completion of the following tests.

The tests shall be carried in the presence of Developer/Consultant or their representatives.

All main and auxiliary bus bar connections shall be checked and tightened.

All wiring termination and bus bar joints shall be checked and tightened.

Wiring shall be checked to ensure that it is according to the drawing.

All wiring shall be tested for insulation resistance by a 1000 Volts magger.

Phase rotation tests shall be conducted

Suitable injection tests shall be applied to all the measuring instruments to establish the correctness and accuracy of calibration and working order.

All relays and protective devices shall be tested for correctness of settings and operation by introducing a current generator and an Ammeter in the circuit.

METERING, INSTRUMENTATION AND PROTECTION

Ratings, type and quantity of meters, instruments and protective devices shall be as per Bill of Quantities.

Current Transformers

CTs shall conform to latest IS codes in all respects. All CTs used for medium Voltage application shall be rated for 1 kV. CTs shall have rated primary current, rated burden and class of accuracy as specified in schedule of quantities/drawings. Rated secondary current shall be 5A unless otherwise stated. Minimum acceptable class for measurement shall be 0.5 to 1 and for protection class 10. CTs shall be capable of withstanding magnetic and thermal stresses due to short circuit faults. Terminals of CTs shall be paired permanently for easy identification of poles. CTs shall be provided with earthing terminals for earthing chassis, frame work and fixed part of metal casing (if any). Each CT shall be provided with rating plate indicating:

- Name and make
- Serial number
- Transformation ratio
- Rated burden
- Rated Voltage

- Accuracy class

CTs shall be mounded such that they are easily accessible for inspection, maintenance and replacement. Wiring for CT shall be with copper conductor PVC insulated wires with proper termination works and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

Potential Transformer

PTs shall conform to latest amendment up to to date IS Codes.

Measuring Instruments

Direct reading electrical instruments shall conform to latest IS codes in all respects. Accuracy of direct reading shall be 1.0 of Voltmeter and 1.5 for Ammeters. Other instruments shall have accuracy of 1.5. Meters shall be suitable for continuous operation between -100C and +5000C. Meters shall be flush mounting and shall be enclosed in dust tight housing. The housing shall be of steel or phenolic mould. Design and manufacture of meters shall ensure prevention of fogging of instrument glass. Pointer shall be black in colour and shall have Zero position adjustment device operable from outside. Direction of deflection shall be from left to right. Selector switches shall be provided for Ammeters and Volt meters used in three phase system.

AIR CIRCUIT BREAKER (ACB) (For Panels other than Main LT Panels & Emergency Panel)

GENERAL:

ACB shall comply with standards IS/IEC 60947-1 & 2.

ACB shall have a rated operational voltage of 415V AC, rated insulation voltage of 1000 volts AC, rated impulse voltage of 12kV.

ACB shall be of 3pole or 4pole (as per Design/Requirement), air break, molded case design for longer life along with less maintenance requirement.

All ACBs shall preferably be of single frame size up to 2500A to optimize requirement for spares management.

ACB shall have a Ready to close mechanism preferably having a ready to close mechanical indication on front of ACB.

All EDO ACBs ready to close indication contact which shall be used to give a single indication via indicating lamps on panel door if ACB is ready to be closed, after checking all the given conditions (UV release energized, Shunt release de-energized, spring charged, Breaker is not "ON", Breaker has not tripped on fault, Breaker is not mechanically interlocked with other breaker and ACB is not racked in completely in service position) ensuring safety for user and electrical distribution.

ACB shall comply with the environmental directives like RoHS .

ACB Should give ON, OFF, Trip, Ready to close data over Modbus to BMS/SCADA.

PERFORMANCE:

ACB shall have the breaking performance $I_{cs} = I_{cu} = I_{cw} (1sec) = 50kA$ or as per Design

calculation/SLD.

ACB shall have minimum Mechanical and electrical life as per OEM Design.

The operating mechanism of ACB shall be of the Open/Closed/Open stored-energy spring type. The closing time shall be less than or equal to 60ms, and of fast opening type with break time of breaker should be <30ms to ensure higher life of distribution cables.

ACCESSORIES & AUXILIARIES:

Shunt trip and closing coil (having common AC/DC supply upto 250V) shall be continuous rated. For Incomer ACBs delayed type under voltage release shall be used to avoid nuisance tripping during voltage surges.

ACBs shall have minimum 4 change-over auxiliary contacts, available to be used for indication and interlocking, rated at minimum 10A 240/380V 50 Hz and shall be wired on chassis/cradle. There should be facility to add one more set of 4 contacts if required Pre wired Fault trip contact should be provided with Release as standard.

Indication lamps to be provided on front door of ACB feeder shall be as shown below: - Spring charge indication required for EDO ACB only

SAFETY:

Draw-out ACBs shall preferably be provided with a mechanical latch on chassis which latches the ACB at Connected-Test-Disconnected positions while racking in and racking out the circuit breaker. This feature will help the operator in placing the circuit breaker at right position inside the chassis and can help in avoiding the accident.

The racking handle of the breaker shall be stored on the air circuit breaker in such a manner as to be accessible without defeating the door interlocking.

TERMINATIONS:

All air circuit breakers shall be fully tropicalized as standard & suitable for terminating copper or aluminium bus bars. Both fixed & draw-out circuit breakers shall have single pole-pitch.

PROTECTIONS:

Air circuit breaker shall be provided with microprocessor release, which should be self-powered type without the need of any auxiliary power supply during normal operation of the breaker.

The circuit breaker control unit shall measure the true r.m.s value of the current

Circuit breaker trip unit shall have a Graphical 4 Line LCD/OLED display for measurement of current and voltage. It shall be possible to view last 20 trip histories with real date, time stamping and interrupted fault value.

All trip units provided shall have thermal memory as standard

All trip units shall be EMC/EMI tested

The protection release shall have following protections as standard: -

- a. Adjustable over load current (I_r) settings from 40% to 100% of rating of ACB (I_n). Over load time setting (t_r) from 0.5s, 1s, 2s, 4s.....24s as field selectable curves.
- b. Short circuit setting (I_{sd}) from 1.5 to 10 times of I_r setting, Short circuit time delay adjustable from 0 to 400 msec.
- c. Instantaneous (I_i) protection with an adjustable pick-up and an OFF position.
- d. Earth fault setting adjustable in absolute Ampere with time delay settings from 0 to 400ms.

Separately powered, individual fault trip indication LEDs (For overload, short circuit, earth fault and trip unit failure) shall be available on the trip unit which shall function even if the display fails. I2t ON / I2t OFF options shall be available for short-circuit & earth fault protections which can be used to ensure discrimination with upstream circuit breaker or fuse.

The trip unit shall have integral test facility to verify the healthiness and to avoid external calibration.

It shall be possible to change the protection settings on line and the circuit breaker need not be switched off while adjusting the settings.

All ACBs in shall surely be provided with zone selective interlocking which helps in reducing the thermal and dynamic stress on installation during short circuit and ground faults. The releases shall be suitable to communicate between incomer breaker and outgoing breakers enabling zone selective interlocking. The manufacturer shall supply all equipment like ZSI module, power supply and wiring connectors to implement ZSI.

It shall be possible to view the percentage/actual loading of three phases at once on trip unit via LEDs or LCD display to help the user in identifying the current load balancing of the network. This will help in preventing the deterioration of loads affected by load balancing by identification of the balancing related issue.

All 4 Pole ACBs shall have fully rated neutral equal to rating of the breaker & shall be protected against over-load faults with provisions for settings neutral unprotected, neutral protection at $0.5I_n$ and neutral protection at $1.0 I_n$ to ensure precise neutral protection.

MOLDED CASE CIRCUIT BREAKER (MCCB) (For Panels other than Main LT Panels & Emergency Panel)

GENERAL:

MCCBs shall comply with standards IS/IEC 60947-1 & 2. The breaking capacity performance certificates shall be available for category A to the above-mentioned standards.

MCCB shall have a rated operational voltage (U_e) of 415V, insulation voltage (U_i) of 800 V (AC 50/60 Hz) & impulse voltage (U_{imp}) of not less than 8kV.

MCCBs shall be current limiting type. The design is required to minimize the effects of short circuit currents i.e. limit the let through energy and improve the life of cables.

MCCB shall not have any line load bias


MCCB shall comply with the environmental directives like RoHS.

PERFORMANCE:

The MCCBs shall have a rated service breaking capacity (Ics) equal to the ultimate breaking capacity (Icu) at 415V and as per system fault levels (refer SLD).

The limiting capacity of a circuit breaker is expressed by two curves which are a function of the prospective short-circuit current (the current which would flow if no protection devices were installed): The thermal stress (A^2s), i.e. the energy dissipated by MCCB during fault should be as low as possible. Cable selection to be done as per Maximum permissible cable stresses for which manufacture should produce current limiting and energy limiting curves of MCCB's.

SAFETY:

For maximum safety, the power contacts shall be insulated in an enclosure made of a thermosetting material from other functions such as the operating mechanism, the case, the trip unit and auxiliaries (ON/OFF/Trip Contact, Shunt, Under Voltage etc.). All poles shall operate simultaneously for circuit breaker opening, closing and tripping. MCCBs shall be actuated by a toggle or rotary-handle that clearly indicates the three distinctive positions: ON, OFF and TRIPPED. MCCB shall clearly indicate the suitability for isolation in the name plate identified by the symbol .

MCCBs shall be equipped with a "push to trip" button in front to test operation and simultaneous opening of all poles together.

MCCBs shall be designed to prevent access to live parts when the cover is removed, means main current path of the circuit breaker should be isolated from auxiliary section i.e. MCCB shall offer class -II/ double insulated front face as per IEC standards 61140 and 60664-1

The electrical life of MCCBs shall be 8,000 operations up to 250A & 4000 operations up to 630A.

All MCCBs termination shall be done using circular lugs being bolted to enhance safety and reliability of the terminations. In case spreaders/rear connectors are used in between MCCB and bus bar/lugs then the spreaders shall be terminated with the MCCB connectors.

AUXILIARIES AND ACCESSORIES:

Following separate Field installable auxiliary contacts for signaling different functions shall be provided with all MCCBs

- a. open/closed position contact
- b. trip signaling contact
- c. Electrical fault trip signaling contact

Rotary handle shall ensure IP40 for direct type and IP 54/55 for extended Rotary handle.

MCCB shall have provision for Rear connection - MCCB mounting on a back plate with suitable holes enables rear connection. The rear connections are simply fitted to the device connection terminals.

PROTECTIONS REQUIREMENTS:

MCCBs shall have thermal magnetic trip units upto 250A and microprocessor trip units above 250A.

Thermal magnetic trip units shall have variable overload settings from 0.8 to 1 Ir and fixed/adjustable short circuit settings

Microprocessor trip units shall have variable overload settings from 0.5 to 1 Ir and variable short circuit settings from 2 to 10Ir

In case of 4 pole microprocessor based MCCBs neutral shall be protected & adjustable as a Neutral unprotected / Neutral protected at 0.5 In/ Neutral protected at In.

MCCB's should be provided with auxiliary contacts for signaling different functions, as: open/ closed position, fault signal and shunt trip coil for remote/emergency tripping of MCCB.

Where ever it is required based on electrical distribution network need, MCCB shall have inbuilt Earth Fault Protection. MCCB Earth Fault Protection should have following settings and features:

- a. Selection of Ir MCCB rating
- b. Earth fault sensitivity selection from 20% – 60% In.
- c. The time delay selection in case of Earth Fault from 0.5 to 3 Sec/ instantaneous.
- d. There shall be a separate fault differentiation indication (LED) for Over current and Earth fault. Indication for over current and earth fault tripping shall be extended to the panel door via indication lamps
- e. Separate LED shall be there to show healthiness of earth fault protection system
- f. EF protection module shall be suitable for 3P 4W system. It shall take the input from neutral for correct earth fault protection.
- g. Earth fault module shall have auxiliary contacts for earth fault signaling.

MEASURING INSTRUMENTS, METERING & PROTECTION

☐ GENERAL

Direct reading electrical instruments shall be in conformity with IS 1248. The accuracy of direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meter shall be suitable for continuous operation between -10 degree Centigrade to + 50 degree Centigrade. All meters shall be of flush mounting type of 96mm square or circular pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instrument glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories within the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings.

The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside. The direction of deflection shall be from left to right.

Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three-phase supply.

The specifications herein after laid down shall also cover all the meters, instrument and protective devices required for the electrical work. The

ratings type and quantity of meters, instruments and protective devices shall be as per the schedule of

quantities.

16.5.1 DIGITAL AMMETERS

Ammeters shall be standard digital type. The ammeters shall be calibrated as per the latest edition of IS:1248. Ammeters shall be instrument transformer operated, and shall be suitable for 5A secondary of instrument transformer. The scales shall be calibrated to indicate primary current, unless otherwise specified. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy.

16.5.2 DIGITAL VOLTMETERS

Voltmeters shall be standard digital type. The ammeters shall be calibrated as per the latest edition of IS:1248. The range for 415 volts, 3 phase voltmeters shall be 0 to 500 volts. Suitable selector switch shall be provided for each voltmeter to read voltage between any two lines of the system. The voltmeter shall be provided with protection fuse of suitable capacity.

16.5.3 CURRENT TRANSFORMERS

Current transformers shall be in conformity with IS: 4201 - 1983 as amended up to date in all respects. All current transformers used for medium voltage applications shall be rated for 1kV. Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated acceptable minimum class of various applications shall be as given below:

Measuring	:	Class 0.5 to 1
Protection	:	Class 5P10.

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 50KA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT's shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

All Current Transformer shall be Cast resin type

16.6 MISCELLANEOUS

- ☒ Control switches shall be of the heavy-duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.
- ☒ Indicating lamps shall be of the filament type of low watt consumption, provided with series resistor where necessary, and with translucent lamp covers, bulbs & lenses shall be easily replaced from the front.
- ☒ Push buttons shall be of the momentary contact, push to actuate type fitted with self-reset contacts & provided with integral escutcheon plates marked with its functions.

ENERGY METERS.

HT Panels

Power Quality Analyser - High end power quality analyser with Class 0.2 active energy Accuracy with Sag/Swell - Waveform capture and Individual harmonics monitoring upto 63rd. Power Quality analyser needs to be capable of Disturbance direction detection with onboard dual Ethernet Port communication OR Meters of approved makes/manufacturers with ethernet port shall be acceptable.

Basic Parameters	<ul style="list-style-type: none"> * Current, voltage, frequency * Active, reactive, apparent power Total and per phase * Power factor Total and per phase * Current measurement range (auto ranging) 0.05 - 10A
Energy Parameters	<ul style="list-style-type: none"> * Active, reactive, apparent energy * Settable accumulation modes
Demand Parameters	<ul style="list-style-type: none"> * Current Present and max. values * Active, reactive, apparent power - Present and max. values * Predicted active, reactive, apparent power * Synchronization of the measurement window * Setting of calculation mode - Block / sliding
Power Quality Parameters	<ul style="list-style-type: none"> * Total Harmonic Distortion Current and voltage * Individual harmonics - Upto 63rd * Waveform capture * Detection of voltage swells and sags * Disturbance Direction detection
Sampling Rate / Cycle	Minimum 256 Samples / Cycle
Data Recording	512MB of standard non-volatile memory. 10 MB of standard non-volatile memory dedicated to capture billing data, events, and waveforms. Logs of Min/max of instantaneous values, Event logs, Trending/ forecasting, SER (Sequence of event recording).
Class Accuracy	Active Energy - Class 0.2S IEC 62053-22 , Reactive Energy Class - 0.5S IEC 62053-24, Power Factor - Class 0.5 as per IEC 61557-12
PQ Standards	PQ compliance reporting as per IEC 61000-4-30 Class S, - IEC 62586 PQI-S
Communication	Onboard Dual Ethernet port for daisy chaining over Ethernet. Meters need to have Modbus Mastering capability by connecting Slave devices over RS485 port

Time Synchronization	GPS clock (RS485) or IRIG-B (digital input) to +/- 1 millisecond.
Digital IO	Standard: 3 digital status inputs for Breaker ON/OFF/ Trip monitoring & 1 KY (form A) energy pulse output for interfacing with other systems. Expandable DI/DO, ADI/ADO capability
Display	Bright LCD color display with meter dimension 96 X 96 mm only

FOR LT PANEL other than Main LT Panels

Multifunction Meter - Multifunction meters with Power and harmonics monitoring capturing abnormalities in the system with date and time stamp	
Basic Parameters	<ul style="list-style-type: none"> * Current - Average line current of 3-phase, per-phase, and calculated neutral current * Voltage Average voltage of L-L, L-N parameters, and per-phase * Frequency * Displacement power factor Average and per-phase signed * True power factor Average and per-phase signed * % unbalance among the phase for I, V L-N, V L-L
Energy & Power Parameters	<ul style="list-style-type: none"> * Real, reactive, and apparent power Total and per-phase value * Accumulated Active, Reactive and Apparent Energy, Received and Delivered registers, Net and absolute energy values, time counters
Demand Parameters	<ul style="list-style-type: none"> * Current average, Active power, Reactive power, Apparent power - Present, Last, Predicted, Peak, and Peak Date Time * Demand sync methods Thermal, Timed, Command Sync, and Clocked Sync * Demand calculation mode Sliding, fixed and rolling block * Demand intervals - settable from 1 to 60 minutes
Power Quality Parameters	THD as per IEC 61557-12 for THD and individual harmonics up to 15th over communication
Sampling Rate / Cycle	Minimum 64 Samples / Cycle
Class Accuracy	Active energy - Class 0.5S as per IEC 62053-22
Communication	RS 485 port Modbus RTU and disabling RS485 port against unauthorized access.
Calibration LED	configurable from 1 to 9999000 pulses/k_h (kWh, kVAh, or kVARh)

Min/Max values	instantaneous parameters with timestamp
Display	Bright red color LED display with meter dimension 96 X 96 mm only

Item No:- 341-364

16.7 LT CABLES

☐ GENERAL

LT Cables shall be supplied, inspected, laid tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications as per given below. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drums.

Total number of runs and size of LT power cables shall be designed so that the distribution losses do not exceed 3% of the total power usage in the system as per ECBC norms.

CODES OF PRACTICE GUIDE		
S.NO.		
1	IS 694 : 1990 IEC 60227 - 1 to 5 : 1979	PVC insulated cables for working voltages up to and including 1100 V
2	IS 694 : 2010	Polyvinyl chloride insulated sheathed and unsheathed cables with rigid and flexible conductor for rated voltages up to and including 450/750 V : Part general requirements(fourth revision)
3	IS: 7098: 1988 (Part-I)	XLPE insulated (heavy duty) electric cables. For working Voltages up to and including 1100 V (third revision)
4	IS 4288 : 1988	PVC insulated (heavy duty) electric cables with solid aluminium conductors for voltages up to and 1100 V (second revision)

☐ CABLE CONDUCTOR MATERIAL

- a) The LT Power cables shall be XLPE insulated, PVC sheathed, **copper conductor armoured** cable for sizes **up to & including 16 sqmm**, unless otherwise stated.
- b) For LT Power cable sizes above 16 sqmm, cables shall be XLPE insulated, PVC sheathed, Aluminium conductor armoured cables, unless otherwise stated.
- c) LT Control cables shall be XLPE insulated PVC sheathed type copper conductor armoured cables, unless otherwise stated.
- d) All LT Power & Control cables shall conform to IS: 7098: 1988 (Part-I) with up to date amendments.

❑ **INSTALLATION OF CABLES**

Cables shall be laid directly in ground, pipes, masonry ducts, on cable tray, surface of wall/ceiling etc. as indicated on drawings and/or as per the direction of Engineer In Charge. Cable laying shall be carried out strictly as per CPWD specifications.

❑ **INSPECTION**

All cables shall be inspected at site and checked for any damage during transit.

❑ **JOINTS IN CABLES**

The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoiding of cable joints. This apportioning shall be got approved from Engineer-in-Charge before the cables are cut to lengths.

❑ **LAYING CABLES IN GROUND**

Cables shall be laid by skilled experienced workmen, using adequate rollers to minimize stretching of the cables. The cable drums shall be placed on jacks before unwinding the cable. With great care it shall be unrolled on over wooden rollers placed in trenches at intervals not exceeding 2 meter. Cables shall be laid at depth of 0.75 meters below ground level for LT Cables and 1.20 meter below ground level for HT cable. A cushion of sand total of 250 mm shall be provided both above and below the cable, joint boxes and other accessories. Cable shall not be laid in the same trench or alongside a water main.

The cable shall be laid in excavated trench over 80mm layer of sand cushion. The relative position of the cables, laid in the same trench shall be preserved. At all changes in direction in horizontal and vertical planes, the cables shall be bent smooth with a radius of bent not less than 12 times the diameter of cables. Minimum 3 meter long loop shall be provided at both ends of cable.

Distinguishing marks may be made on the cable ends for identifications of phases. Insulation, tapes of appropriate voltage and in red, yellow and blue colours shall be wrapped just below the sockets for phase identifications.

❑ **CABLE ROUTE MARKERS:**

Cable route marker shall be provided at regular intervals as per CPWD specifications. Cost of cable route markers is deemed to be included in the cost of cables/cable laying.

❑ **PROTECTION OF CABLES:**

The cables shall be protected by bricks laid on the top layer of the sand for the full length of underground cable. Where more than one cable is laid in the same trench, the bricks shall cover all the cables and shall project a minimum of approximately 80mm on either side of the cables. Cable under road crossings and any other places subject to heavy traffic shall be protected by running them through Hume Pipes of suitable size. Hume Pipes for road crossing of the cables shall be laid at a depth of 1000 mm.

❑ **EXCAVATION & BACK FILL**

All excavation and back fill required for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layer not exceeding 150mm. Each layer shall be properly rammed and consolidated before laying the next layer.

The Contractor shall restore all surfaces, road ways, side walks, curbs, wall or the works cut by excavation to their original condition to the satisfaction of the Engineer-in-Charge.

☒ **LAYING OF CABLES ON CABLE TRAY/SURFACE OF WALL/ CEILING**

Cable shall be laid on perforated M.S. Cable tray/ladders. Cables shall be properly dressed before cable ties/clamps are fixed. Wherever cable tray is not proposed, cables shall be fixed on surface of wall or ceiling slab by suitable MS clamps/saddles. Care shall be taken to avoid crossing of cable.

☒ **CABLES ON HANGERS OR RACKS**

The Contractor shall provide and install all iron hangers racks or racks with die cast cleats with all fixings, rag bolts or girder clamps or other specialist fixing as required. Where hangers or racks are to be fixed to wall sides, ceiling and other concrete structures, the Contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good.

The hangers or racks shall be designed to leave at least 25mm clearance between the cables and the face to which it is fixed. Multiple hangers shall have two or more fixing holes. All cables shall be saddled at not more than 150mm centres. These shall be designed to keep provision of some spare capacity for future development.

☒ **CABLES TAGS**

Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Tray tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 metres.

☒ **TESTING OF CABLES**

Prior to installation burying of cables, following tests shall be carried out. Insulation test between phases, phase & neutral, phase & earth for each length of cable.

- i. Before laying.
- ii. After laying.
- iii. After jointing.

Along with the test as prescribed in IS Code, cross sectional area shall also be checked. On completion of cable laying work, the following tests shall be conducted in the presence of the Engineer in Charge.

- i. Insulation Resistance Test (Sectional and overall).
- ii. Continuity Resistance Test.
- iii. Earth Test.

All tests shall be carried out in accordance with relevant Indian Standard code of practice and Indian Electricity Rules. The Contractor shall provide necessary instruments, equipments and labour for

conducting the above tests & shall bear all expenses of conducting such test

Item No:- 339-340

16.8 CABLE TRAY

☐ Ladder Type Cable Tray

Ladder type cable tray shall be fabricated out of double bended channel section longitudinal members with single bended channel section rungs of cross members welded to the base of the longitudinal members at a centre to centre spacing of 250 mm. The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. These may be galvanized or painted to the desired lengths.

☐ Perforated Type Cable Tray

- i. The cable tray shall be fabricated out of slotted/perforated M.S. Sheet as channel section single or double bended. The channel section shall be supplied in convenient length and assembled at site to the desired lengths. All cable trays shall be hot dipped galvanized only as per relevant IS Codes.
- ii. Typically, the dimensions, fabrication details etc. are shown in CPWD General Specification for Electrical Works - Part II -External, 2023 as amended up to date. The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section.
- iii. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In order to maintain proper earth continuity bond, the paint on the contact surfaces between the coupler plates and cable tray shall be scraped and removed before the installation.
- iv. The maximum permissible uniformly distributed load for various sizes of cables trays and for different supported span are as per CPWD General Specification of Electrical Work Part II -2023. The sizes shall be specified considering the same.
- v. The width of the cable tray shall be chosen so as to accommodate all the cable in one tier, plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100mm. The overall width of one cable tray shall be limited to 800mm.
- vi. Factory fabricated bends, reducers, tee/cross junctions, etc. shall be provided as per good engineering practice. (Details are typically shown in figure 3 of CPWD General Specification of Electrical Work Part II -2023) or as amended up to date. The radius of bend, junctions etc. shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.
- vii. The cable tray shall be suspended from the ceiling slab with the help of 10mm dia MS rounds or 25 mm X 5 mm flats at specified spacing as per CPWD General Specification of Electrical Work Part II - 2023 or as amended up to date. Flat type suspenders may be used for channels up to 450mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angles 50mm x 50mm x 5mm at the bottom end as specified. These shall be grouted to the ceiling slab at the other end through an effective means, as approved by the PMC/Consultant to take the weight of the cable tray with the cables.
- viii. The entire tray (except in the case of galvanized type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint. The cable tray shall be bonded to the earth Terminal of the switch bonds at both ends. The cable trays shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross- joints, etc, and paid for

accordingly.

Item No:- 381-390

17. EARTHING & LIGHTENING PROTECTION SYSTEM

Earthing system shall conform to CPWD General Specifications for Electrical Works (Part I- Internal), 2023. Earthing system shall comprise of suitable nos. of Earhpits with GI & Copper Plate electrodes, G.I. pipe as per IS-3043 & CPWD specifications.

Neutral Earthing with suitable size Copper strips and Copper plate earhpits for Transformer, DG Sets and other equipment as specified by OEMs shall be provided. earthing of all sus. The body earthing for transformers, HV & MV panels shall be done to a common earth bus connected to two separate and distinct earth electrodes.

For a single transformer Sub-station, the total number of earth electrodes shall be 4 (2 for neutral and 2 for connection to a common earth bus for body earthing). For a two transformer Sub-station total number of earth electrodes shall be 6 (4 for neutral earthing, two each for two transformers, and 2 for connection to a common earth bus for body earthing).

17.1. ELECTRODES

The earth electrodes shall be as per CPWD General Specifications for Electrical Works (Part I-Internal), 2023.

17.2. LOCATION OF EARTH ELECTRODES

Distance of earth electrode from any building and other earth electrode shall be as per CPWD specification & IS codes. Care shall be taken that the excavation of earth electrode may not affect the column footings or foundation of the building. In such cases electrodes may be farther away from the building. The location of the electrode earth will be a place where the soil has reasonable chance of remaining moist. As far as possible, entrances, pavements and road ways, are to be definitely avoided for locating the earth electrode.

17.3. WATERING ARRANGEMENT

Method of watering arrangement shall comply with CPWD general specifications.

17.4. SIZE OF EARTH LEAD

The recommended sizes of copper earth bus lead in case of Sub-stations shall be in accordance with General Specifications for Electrical Works (Part I-Internal), 2023 amended upto date. The minimum size of earth lead shall be 25 mm x 5 mm copper or equivalent GI strip.

17.5. INSTALLATION

All joints shall be riveted and sweated. Joints in the earth bar shall be bolted and the joints faces tinned. Where the diameter of the bolt for connecting earth bar to apparatus exceeds one quarter of the width of the earth bar, the connection to the bolt shall be made with a wider piece of flange of copper jointed to earth bar. These shall be tinned at the point of connection to equipment and special care taken to ensure a permanent low resistance contact to iron or steel. All steel bolts, nuts, washers etc. shall be cadmium plated, main earth bars shall be spaced suffi

ciently on the surface to which they are fixed such as walls or the side trenches to allow for ease of connections. Copper earthing shall not be fixed by ferrous fittings. The earthing shall suitably be protected from mechanical injury by galvanized pipe wherever it passes through wall and floor. The portion within ground shall be buried at least 60 cm deep. The earthing lead shall be securely bolted and soldered to plate or pipe as the case may be. In the case of plate earthing the lead shall be connected by means of a cable socket with two bolts and nuts. All washers shall be of the same materials as the plate or pipe. All iron bolts, nuts and washers shall be galvanized.

17.6. TESTING

After installation, the tests as specified in CPWD General Specifications for Electrical Work (Part I-Internal), 2023 shall be carried out and results recorded

17.7. LIGHTENING PROTECTION SYSTEM

Lightening Protection System shall be provided for all buildings, blocks and facilities constructed under this contract as per IS/IEC-62305:2010 amended up to date and NBC 2016.

18. SAFETY REQUIREMENTS

Safety provisions shall be generally in conformity with appendices (A) and (C) of CPWD General Specifications of Electrical Works (Part I-Internal), 2023. In particular following items shall be provided:

(a) Insulation Mats

Insulation mats conforming to IS 15652: 2006 shall be provided in front of of all HT & LT Panels as well as other control equipments as specified.

(b) First Aid Charts and First Aid Box

Charts (one in English, one in Hindi, one in Regional language), displaying methods of giving artificial respiration to a recipient of electrical shock shall be prominently provided at appropriate place. Standard first aid boxes containing required materials should be provided in each sub-station.

(c) Danger Plate

Danger Plates shall be provided on HV and MV equipments. MV danger notice plate shall be 200 mm x 150 mm made of mild steel at least 2 mm thick vitreous enameled white on both sides and with the descriptions in signal red colour on front side as required. Notice plates of other suitable materials such as stainless steel, brass or such other permanent nature material shall also be accepted with the description engraved in signal red colour.

(d) Fire Extinguishers

Portable CO₂ conforming to IS 2878: 1976/ chemical conforming to IS 2171: 1976 extinguishers, HCFC Blend A (P-IV) shall be installed in the sub-station at suitable places. Other extinguishers recommended for electric fires may also be used.

(e) Fire Buckets: Fire buckets conforming to IS 2546: 1974 shall be installed with the suitable stand for storage of water and sand.

(f) Tool Box

A Standard tool box containing necessary tools required for operation and maintenance shall be provided in the sub-station.

(g) Caution Board

Necessary number of caution boards such as “Man on Line” ‘Don’t Switch on’ etc. shall be available in the sub-station.

(h) Key Board A keyboard of required size shall be provided at a proper place containing castle keys, and all other keys of sub-station and allied areas

Item No:- 289-308, 318-338, 365-380, 391, 421-423

19. INTERNAL ELECTRIFICATION OF BUILDING

19.1. SCOPE

The electrical Installation work shall be carried out in accordance with Indian Standard Code of Practice for Electrical Wiring Installation IS: 732-1989 and IS: 2274-1963. It shall also be in conformity with the current Indian Electricity rules and regulations and requirements of the Local Electricity Supply Authority and Fire Insurance regulations, so far as these become applicable to the installation. Electrical work in general shall be carried out as per following CPWD Specifications with up to date amendment.

- ☒ Specifications for Electrical Works Part-I (Internal) by CPWD-2023 with latest revision
- ☒ Specifications for Electrical Works Part-II (External) by CPWD-2023 with latest revision

Wherever these specifications calls for a higher standard of material and or workmanship than those required by any of the above mentions regulations and specification then the specification here under shall take precedence over the said regulations and standards.

19.2.DISTRIBUTION BOARDS

- ☒ 6/16 A Raw Power points- 4 nos.
- ☒ 6/16 A UPS power points – 2 Nos. shared between Two seats
- ☒ Data points – 2 Nos. shared between Two seats
- ☒ Dimmer Lights as per requirement
- ☒ Light fittings as per required Lux level (NBC- 2016, ECBC)
- ☒ Data & UPS Power points for Projector / Monitor

As a general practice MCB type double door DB shall be used. Provision of Vertical type MCB DBs is to be considered in areas where 3-phase outlets are also required:

Provisions in MCB DB:

- i) Recess/ surface type with integral loose wire box.
- ii) Phase/neutral/ earth terminal blocks for termination of incoming & outgoing wires.
- iii) DIN channel for mounting MCBs.
- iv) Arrangement for mounting incomer MCB/RCCB/RCBO/MCCB as required.
- v) Copper Bus Bar.
- vi) Earthing terminals.
- vii) Interconnection between terminal block / incoming switch/bus bar/neutral/terminal block/ earth terminal connector with specified size of FRLS pre insulated copper conductor cable duly fitted with copper lugs/ thimbles.
- ix) Termination block should be suitable for termination of conductor/ cable of required size but minimum rated cross section of the terminal blocks should be 6 sq. mm.
- x) Terminal block shall be made of flame retardant polyamide material.
- xi) Coloured terminal blocks and FRLS wires for easy identification of RYB phases, Neutral and Earth.
- xii) DB shall be provided with a detachable cassette for safe removal of MCBs, RCCBs. Terminal connectors from the DB without loosening the internal cable connections of phase and neutral circuits.
- xiii) The DB shall have peel able poly layer on the cover for protection from cement,

plaster, paints etc during the construction period.

- xiv) Detachable plate with knock out holes shall be provided at the top/ bottom of board. Complete board shall be factory fabricated and pre-wired in factory, ready for installation at site. The box and cover shall be fabricated from 1.6 mm sheet steel, properly pretreated, phosphotized with powder coated finish.
- xv) DB shall be of double door construction provided with hinged cover in the front.
- xvi) DB doors shall be suitably earthed.

Distribution Board shall be standard type. Distribution boards shall contain miniature circuit breakers. Miniature circuit breakers shall be quick make and quick break type with trip free mechanism. MCB shall have thermal and magnetic short circuit protection. All miniature circuit breakers shall be of minimum 10 kA rated rupturing capacity unless otherwise specified.

Neutral busbars shall be provided with the same number of terminals, as there are single ways on the board, in addition to the terminals for incoming mains. An earth bar of similar size as the neutral bar shall also be provided. All live parts shall be screened from the front. Ample clearance shall be provided between all live metal and the earth case and adequate space for all incoming and outgoing cables. A circuit identification card in clear plastic cover shall be provided for each distribution board.

MCB's shall be provided on the phase of each circuit. The individual banks of MCB's shall be detachable. There shall be ample space behind the banks of MCB's to accommodate all the wiring. All the distribution boards shall be completely factory wired, ready for connections. All the terminals shall have adequate current rating and size to suit individual feeder requirements. Each circuit shall be clearly numbered from left to right to correspond with wiring diagram. All the switches and circuits shall be distinctly marked with a small description of the service installed.

Earth Leakage Circuit Breaker/Residual Current Circuit Breaker shall be provided in each Distribution Board as required. Earth Leakage Circuit Breaker shall be current operated type and of 30 mA sensitivity unless otherwise specified. It shall also provide over-current and short circuit protection i.e. it shall be MCB-cum-RCCB (Residual Current Circuit Breaker). In case ELCB doesn't have inbuilt short circuit protection, same rating MCB have to be provided for short circuit protection along with ELCB. Cost of this MCB is deemed to be included in the cost of ELCB. ELCB shall be housed within the Distribution Board.

Distribution Boards shall be ready for connections and shall be inspected in the factory by Electrical Engineer- In charge before dispatch.

Before procurement of Distribution Boards, MCB's, ELCB's (incomer and outgoings) etc., the contractor has to take approval of the DB Schedule/Drawings of each DB from the Electrical Engineer In Charge. The whole unit i.e. Distribution Board, MCB's, ELCB's etc. shall come from the manufactures premises/workshop. After inspection and clearance from the Consultant Electrical Engineer the same may be dispatched to site for installation. However if a single component (such as ELCB or MCB or DB) is required for any reason such as replacement, increase in no. of circuits in the DB, change in the load of existing circuit, change in the total load on a particular DB etc., the same may be ordered separately.

19.3. METALLIC CONDUIT WIRING SYSTEM.

19.3.1. TYPE AND SIZE OF CONDUIT

All conduit pipes shall be of approved gauge (not less than 16 SWG for conduits of sizes up to 32 mm diameter and not less than 14 SWG for conduit of size above 32mm diameter) solid drawn or reamed by welding finished with black stove enameled surface. All conduit accessories shall be of threaded type and under no circumstances pin grip type accessories shall be used. The maximum number of PVC insulated 650/1100 volts grade copper conductor cable that can be drawn in conduit of various sizes shall be as per IS Code. No steel conduit less than 20mm in diameter shall be used.

19.3.2. CONDUIT JOINTS.

Conduit pipes shall be joined by means of threaded couplers, and threaded accessories only. In long distance straight run of conduits, inspection type couplers at reasonable intervals shall be provided or running threads with couplers and jam nuts shall be provided. In the later case the bare threaded portion shall be treated with anti-corrosive preservative. Threads on conduit pipes in all cases shall be between 13 mm to 19 mm long sufficient to accommodate pipes to full threaded portion of couplers or accessories.

Cut ends of conduit pipe shall have neither sharp edges nor any burrs left to avoid damage to the insulation of conductor while pulling them through such pipes.

19.3.3. PROTECTION AGAINST CONDENSATION.

The layout of conduit should be such that any condensation or sweating inside the conduit is drained out. Suitable precaution should also be taken to prevent entry of insects inside the conduit.

19.3.4. PROTECTION OF CONDUIT AGAINST RUST.

The outer surface of conduit including all bends, unions, tees, junction boxes etc. forming part of conduit system shall be adequately protected against rust when such system is exposed to weather by being painted with two coats of oxide paint applied before they are fixed. In all cases, no bare threaded portion of conduit pipe shall be allowed. Unless such bare thread portion of conduit is treated with anticorrosive preservative or covered with approved plastic compound.

19.3.5. PAINTING OF CONDUIT AND ACCESSORIES.

After installation, all accessible surface (if any) of conduit pipes, fittings etc. shall be painted with two coats of approved enameled paint or aluminium paint as required to match the finish of surrounding wall, trusses etc.

19.3.6. SURFACE CONDUIT

Conduit pipes shall be fixed by saddles, secured to suitable approved plugs with screws in an approved manner at an interval of not more than one meter, but on either side of the couplers or bends or similar fittings, saddles shall be fixed at a distance of 30 cm from the center of such fittings. Where conduit pipes are to be laid along the trusses, steel joists etc. the same shall be secured by means of saddles or girder clips or clamps as required by the Engineer-in-charge. In long distance straight run of conduit, inspection type couplers at reasonable intervals shall be provided, or running threads with couplers and jam nuts shall be provided. Fixing Outlet Boxes Only portion of the switch box shall be sunk in the wall, the other portion being projected out for suitable entry of conduit pipes into the box.

19.3.7. RECESS CONDUIT

The chase in the wall shall be neatly made and of ample dimensions to permit the conduit to be fixed in the manner desired. In the case of building under construction, conduit shall be buried in the wall before plastering and shall be finished neatly after erection of conduit. In case of exposed brick/rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work. Entire work of chasing the wall, fixing the conduit in chases, and burring the conduit in mortar before plastering shall form part of point wiring work.

The conduit pipe shall be fixed by means of staples or by means of saddles not more than 60cm apart or by any other approved means of fixing. Fixing of standard bends and elbows shall be avoided as far as practicable and all curves maintained by bending the conduit pipe itself with the long radius, which shall permit easy drawing in of conductors. All threaded joints of conduit pipe shall be treated with some approved preservative compound to secure protection against rust. Suitable inspection boxes to the barest minimum requirements shall be provided to permit periodical inspection and of facilitate replacement of wires, if necessary. These shall be mounted flush with the wall. Suitable ventilating holes shall be provided in the inspection box covers. Wherever the length of conduit run is more than 10 meters, then circular junction box shall be provided.

19.3.8. METAL OUTLET BOXES & COVERS.

The switch box shall be made of modular metal boxes with suitable size modular cover plates. Modular metal box shall be made of mild steel on all sides except on the front. The metal box (other than modular type) shall be made of metal on all sides except on the front. Boxes shall be hot dip galvanized mild steel. Metal boxes up to 20 x 30 cm size M.S. box shall have wall thickness of 18 SWG and MS boxes above 20 x 30 cm size shall be of 16 SWG. The metallic boxes shall be painted with anticorrosive paint before erection. Clear depth of the box shall not be less than 60mm. All boxes shall be covered from top with Phenolic laminated sheet of approved shade. These shall be of 3 mm thick synthetic phenolic resin bonded laminated sheet as base material and conform to grade P-I of IS: 2036-1994.

19.3.9. ERECTION AND EARTHING OF CONDUITS.

The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit after erection shall be tested in presence of Engineer In Charge for mechanical and electrical continuity throughout and permanently connected to earth conforming to the requirement by means of special approved type of earthing clamp effectively fastened to conduit pipe in a workmen like manner for a perfect continuity between the earth and conduit.

19.4. NON-METALLIC CONDUIT WIRING SYSTEM

19.4.1. Scope

This chapter covers the detailed requirements for wiring work in non-metallic conduits. This chapter covers both surface and recessed types of wiring work.

19.4.2. Application

- ☐ Recessed conduit work is generally suitable for all applications. Surface conduit work may be adopted in places like workshops etc. and where recessed work may not be possible

to be done. The type of work shall be as specified in individual works.

☒ Flexible non-metallic conduits shall be used only at terminations, wherever specified.

☒ **Special Precautions-**

- i. If the pipes are liable to mechanical damages, they should be adequately protected.
- ii. Non-metallic conduit shall not be used for the following applications:-
- iii. In concealed/inaccessible places of combustible construction where ambient temperature exceeds 60 degrees C.
- iv. In places where ambient temperature is less than 5 degrees C.
- v. For suspension of fluorescent fittings and other fixtures.
- vi. In areas exposed to sunlight.

19.4.3. Materials

Conduits

- ☒ All non-metallic conduit pipes and accessories shall be of suitable material complying with IS 2509 : 1973 and IS 3419 : 1989 for rigid conduits and IS 9537 (Part 5) : 2000 for flexible conduits. The interior of the conduits shall be free from obstructions. The rigid conduit pipes shall be ISI marked.
- ☒ The conduits shall be circular in cross-section. The conduits shall be designated by their nominal outside diameter. The dimensional details of rigid non-metallic
- ☒ No non-metallic conduit less than 20 mm in diameter shall be used.
- ☒ The maximum number of PVC insulated aluminium/copper conductor cables of 650/1100 V grade conforming to IS 694 : 1990 that can be drawn in one conduit of various sizes as per CPWD specification. Conduit sizes shall be selected accordingly.
- Heavy Duty PVC conduit shall be used in the wiring.

S.No	Size of Conduit	Outer Dia. Of Conduit	Inner Dia. Of Conduit	Minimum Thickness
1	20 MM	20 MM +- 0.3	15.8 MM	1.95 MM
2	25 MM	25 MM +- 0.4	20.6 MM	2.0 MM
3	32 MM	32 MM +- 0.4	26.6 MM	2.5 MM

Conduit Accessories

- ☒ The conduit wiring system shall be complete in all respect including accessories.
- ☒ Rigid conduit accessories shall be normally of grip type.
- ☒ Flexible conduit accessories shall be of threaded type.
- ☒ Bends, couplers etc. shall be solid type in recessed type of works, and may be solid or inspection type as required, in surface type of works.
- ☒ Saddles for fixing conduits shall be heavy gauge non-metallic type with base.
- ☒ The minimum width and the thickness of the ordinary clips or girder clips shall be as per CPWD specification.
- ☒ For all sizes of conduit, the size of clamping rod shall be 4.5 mm (7 SWG) diameter.

Outlets

- ② The switch box shall be made of either rigid PVC molding, or mild steel, or cast iron on all sides except at the front. The regulator boxes shall however be made only of mild steel or cast iron.
- ② PVC boxes shall comply with the requirements laid down in IS 14772 : 2000. These boxes shall be free from burrs, fins and internal roughness.
- ② The thickness of the walls and base of PVC boxes shall not be less than 2 mm.
- ② The clear depth of PVC boxes shall not be less than 60 mm.
- ② 3 mm thick phenolic laminated sheet covers for all types of boxes shall be as per requirements.

19.4.4. Installation

Common Aspects for Both Recessed and Surface Conduit Works

- ② The erection of conduits of each circuit shall be completed before the cables are drawn in.
- ② Conduit Joints
 - o All joints shall be sealed/cemented with approved cement. Damaged conduit pipes/fittings shall not be used in the work. Cut ends of conduit pipes shall have neither sharp edges nor any burrs left to avoid damage to the insulation of conductors while pulling them through such pipes.
 - o The Engineer-in-charge, with a view to ensuring that the above provision has been carried out, may require that the separate lengths of conduit etc.
 - ② after they have been prepared shall be submitted for inspection before being fixed.
 - ② All bends in the system may be formed either by bending the pipes by an approved method of heating, or by inserting suitable accessories such as bends, elbows or similar fittings, or by fitting non-metallic inspection boxes, whichever is most suitable. Where necessary, solid type fittings shall be used.
 - ② Radius of bends in conduit pipes shall not be less than 7.5 cm. No length of conduit shall have more than the equivalent of four quarter bends from outlet to outlet.
 - ② Care shall be taken while bending the pipes to ensure that the conduit pipe is not injured, and that the internal diameter is not effectively reduced.
- ② All switches, plugs, fan regulators etc. shall be fitted in flush pattern.

Additional Requirements for Surface Conduit Work

- ② Conduit pipes shall be fixed by heavy gauge non-metallic saddles with base, secured to suitable approved plugs with screws in an approved manner, at an interval of not more than 60 cm, but on either side of couplers or bends or similar fittings, saddles shall be fixed at a closer distance from the centre of such fittings.
- ② Slotted PVC saddles may also be used where the PVC pipe can be pushed in through the slots.
- ② Where the conduit pipes are to be laid along the trusses, steel joists etc. the same shall be secured by means of saddles or girder clips as required by the Engineer in-charge. Where it is not possible to use these for fitting, suitable clamps

with bolts and nuts shall be used.

- ☒ If the conduit pipes are liable to mechanical damage, they shall be adequately protected.

19.4.5. Earthing Requirements

- ☒ A protective (earth) conductor shall be drawn inside the conduit in all distribution circuits to provide for earthing of non-current carrying metallic parts of the installation. These shall be terminated on the earth terminal in the switch boxes and/or earth terminal blocks at the DBs.
- ☒ Gas or water pipe shall not be used as protective conductors (earth medium).

19.5. SWITCHES.

All 6 and 16 Amp switches shall be modular type of 240 volts A.C. grade. All switches shall be fixed on modular metal boxes. All 6 Amp socket shall be 3 pin type and 16 Amp socket shall be 5/6 pin type (unless otherwise specified) suitable for 16/6 Amp. All modular switches, sockets, telephone outlets, TV outlet etc. shall be in off white finish unless otherwise specified. The switches controlling the lights or fans shall be connected to the phase wire of the circuit. Switch boards shall be located at 1200 mm above finished floor level unless otherwise indicated on drawings or directed by Engineer-In-Charge.

In case of computer power points, Data points, telephone points etc. to be fixed on laminated partition board (furniture), same shall be fixed on laminated board (portion of laminated board meant for fixing power points) with base plate/cover plate as applicable, duly fixed with screws.

One modular switch may control maximum one, two or three light points as per requirement and as directed by Engineer-In-Charge. One light point controlled by 2 switches shall be provided in the staircases as directed by Engineer-In-Charge. Depending on area of rooms, halls etc. one or more than one switchboards shall be provided as directed by Engineer-In-Charge. At least one number 6A Socket with Switch shall be provided in each switchboard as directed by Engineer-In-Charge. Suitable power points and light points shall be provided for urinal sensors and hand dryers in the toilets as directed by Engineer-In-Charge. 10% Light fixtures shall be provided and operated with UPS supply with switches fed from UPS Distribution Boards.

19.5.1. COVER PLATE

All modular switches, sockets, telephone outlets etc. shall be fixed on modular metal boxes with modular base plates and modular cover plates on top.

19.5.2. 6.4.13 WALL SOCKET PLATE

Each outlet shall have a switch located beside the socket preferably on the same cover plate/modular base. The earth terminal of the socket shall be connected to the earth wire.

19.6.WIRING

All PVC insulated copper conductor wires shall conform to relevant IS Codes. All wires/ cables shall be stranded type irrespective of its size.

All internal wiring shall be carried out with PVC insulated Cu wires of 650/1100 Volts grade. The circuit wiring for points shall be carried out in looping in system and no joint shall be allowed in the length of

the conductors. Circuit wiring shall be laid in separate conduit originating from distribution board to switch board for light/fan. A light/fan switchboard may have more than one circuit but shall have to be of same phase. Looping circuit wiring shall be drawn in same conduit as for point wiring.

Each circuit shall have a separate neutral wire. Neutral looping shall be carried out from point to point or in light/fan switchboards. A separate earth wire shall be provided along with circuit wiring for each circuit. For point wiring red/yellow/blue colour wire shall be used for phase and black colour wire for neutral.

Circuit wiring shall be carried out with red, yellow or blue colour PVC insulated wire for RYB phase wire respectively and black colour PVC insulated Copper wire for the neutral wires. Green/Green-Yellow Colour copper wire shall be used as earth continuity conductor and shall be drawn along with other wires. No wire shall be drawn into any conduit until all work of any nature, that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire.

Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture, dust and dirt. Drawing and jointing of copper conductor wires and cables shall be as per CPWD specifications for Electrical works (Part - I) 2023

Maximum number of PVC insulated 650/1100 V grade aluminium/copper conductor cable conforming to IS : 694 - 1990

										Nominal	25mm
32mm	38mm		51mm		64mm		Cross- Sectional area of conductor				
in Sq.mm.	S	B	S	B	S	B	S	B	S	B	

1	4	5	6	7	8	9	10	11	12	13	

1.5	10	8	18	12	-	-	-	-	-	-	
2.5	8	6	12	10	-	-	-	-	-	-	
4	6	5	10	8	-	-	-	-	-	-	
6	5	4	8	7	-	-	-	-	-	-	
10	4	3	6	5	8	6	-	-	-	-	
16	2	2	3	3	6	5	10	7	12	8	
25	-	-	3	2	5	3	8	6	9	7	
35	-	-	-	-	3	2	6	5	8	6	
50	-	-	-	-	-	-	5	3	6	5	
70	-	-	-	-	-	-	4	3	5	4	

NOTE :

1. The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.
2. The columns headed 'S' apply to runs of conduits which have distance not exceeding 4.25m between draw in boxes and which do not deflect from the straight by an angle of more

than 15 degrees. The columns headed 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.

3. Conduit sizes are the nominal external diameters.

19.6.1. JOINTS.

All joints shall be made at main switches, distribution board socket and switch boxes only. No joint shall be made in conduits and junction boxes. Conductors shall be continuous from outlet to outlet.

19.6.2. LOAD BALANCING

Balancing of circuits in three-phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

19.6.3. COLOUR CODE FOR CIRCUIT WIRING.

Colour code for circuit and sub main wiring installation shall be Red, Yellow, and Blue for three phases. Black for neutral and yellow/green or green only for earth in case of insulated earth wire.

19.6.4. CLASSIFICATION OF POINTS.

☒ General

Classification and measurement of Point wiring shall be as per CPWD specification for Electrical Works (Part-I- Internal) 2023.

☒ Point Wiring (Modular)

Definition of Point Wiring

A point (other than socket outlet point) shall include all work necessary in complete wiring to the light points/fan/exhaust fan/call bell point from the controlling switch/MCB. The scope of wiring for a point shall, however, include the wiring work necessary in tapping from another point in the same distribution circuit i.e. from first switch board (wiring from distribution board to first switch box is covered in the circuit wiring and is not in the scope of point wiring) to subsequent switch board(s) in the same distribution circuit. The point wiring includes all materials specified below including chasing the wall (in case of recessed wiring in wall), fixing the conduit and making the wall good as it originally was. It also includes supply, drawing, testing and commissioning of wires.

☒ Scope of point wiring

Following shall be deemed to be included in point wiring.

- (a) Supply & fixing conduit & conduit accessories for the same and wiring cables (including supplying and drawing wires) between the switch box and the point outlet.
- (b) All fixing accessories such as clips, nails, screws, phil plug, rawl plug etc. as required.
- (c) Modular switches, modular base plates and modular cover plates over the same. regulators, sockets with Metal boxes etc. in recessed or surface .
- (d) Outlet boxes, junction boxes, pull-through boxes etc. but excluding modular metal boxes if any, provided the switchboards for loose wires/conduit terminations.
- (e) In case of recessed wiring in wall the scope includes chasing of wall, fixing the conduit and making the wall good as it originally was.

- (f) Control modular switch (5/6A) as specified.
- (g) Ceiling rose or connector (in case of points for ceiling/ exhaust fan point, prewired light fittings and call bells).
- (h) Connections to ceiling rose, connector, socket outlet, lamp holder, switch etc.
- (i) Interconnecting wiring between points on the same circuit, in the same switch box or from another. Interconnecting wiring from first switch board to subsequent switch board(s).
- (j) Protective (loop earthing) conductor as required from one metallic switch box to another in the distribution circuits, and from switchboard to each point (light/fan/exhaust fan/call bell etc).
- (k) Bushed conduit where wiring cables pass through wall etc.
- (l) Ceiling rose (in the case of pendants except stiff pendants).
- (m) Lamp holder (in the case of goose neck type wall bracket, batten holder and fittings which are not pre wired).
- (n) Back Plate (in the case of stiff pendants).

19.6.5. Circuit and Submain Wiring

② Circuit Wiring

Circuit wiring shall mean the wiring from the distribution board up to the tapping point for the nearest first point of that distribution circuit i.e. up to the nearest first switch box.

② Submain wiring

Submain wiring shall mean the wiring from one main/distribution switchboard to another.

19.6.6. Power Plug Wiring

6A Plug Wiring

Wiring for all 6 A Socket Outlets shall be done with 2 X 2.5 sqmm PVC insulated copper wire in suitable size PVC Conduit (including supplying and fixing PVC Conduit) along with the earth wire. Up to 3 points may be connected to one circuit.

16A Power Plug Wiring

Wiring for all 16 A Socket Outlets shall be done with 2X4 sq mm PVC insulated copper wire in suitable size PVC Conduit (including supplying and fixing PVC Conduit) along with the earth wire, directly from the MCB- Distribution Board or from one power socket outlet to another in case of computer power points. Looping shall not be done in general 16A power points (other than computer power points).

One 16A Power outlet per 10 sq mtr of whole covered area of each floor including common area shall be Considered while designing the power point scheme.

Wiring for 20A Metal Clad Socket Outlets

Wiring for all 20A Metal Clad Socket Outlets/ Geyser point shall be done with 2X6 sq. mm PVC insulated copper wire in suitable size MS Conduit (including supplying and fixing MS Conduit) along with the earth wire directly from the MCB- Distribution Board. Measurement of wiring for 20A Metal Clad Socket outlet shall be done on linear basis i.e. complete wiring directly from MCB- Distribution Board to the socket outlet.

19.6.7. CONDUCTOR SIZE.

Wiring shall be carried out with following sizes of PVC insulated stranded single core copper conductor wire/cable.

- i. Light Point. - 1.5 sq.mm
- ii. Ceiling /Cabin/Exhaust Fan Point - 1.5 sq.mm
- iii. Call Bell Point - 1.5 sq.mm
- iv. 6A Plug Point/ UPS Computer outlets (up to 3 outlets on one ckt.) - 2.5 sq.mm
- v. Circuit Wiring - 2.5 sq.mm
- vi. General Power Point – 4 sq.mm
- vii 20A Industrial Socket Outlet – 6 Sqmm
- viii Special Power Point – 6 Sqmm
- ix A/C Box with 32A MCB- 6 Sqmm

19.7.LIGHTING FIXTURE AND FANS

19.7.1. GENERAL

- a. The Contractor shall supply and install all LED Lighting fixtures as per IS 4347.
- b. All fixtures shall be delivered to the building complete with suspension accessories, canopies, hanging devices, sockets, holders, reflectors, ballasts, diffusing material, louvers, plaster frames, recessing boxes, etc. all wired and assembled as indicated.
- d. Full size shop detail drawings of special fixture or lighting equipment, where called for in the fixtures, shall be submitted to the Engineer In Charge for approval.
- d. Fixtures, housing, frame or canopy, shall provide a suitable cover for fixture outlet box or fixture opening.
- e. Fixtures shall comply with all applicable requirements as herein outlined unless otherwise specified or shown on the Drawings.
- f. Manufacturer's name and catalogue number of light fixtures, fans, switchgears etc. shall be strictly adhered.
- g. Fixtures shall bear manufacturer's name and the factory inspection label.
- h. Fixtures shall be completely wired and constructed to comply with the IEE wiring regulations requirements for lighting fixtures, unless otherwise specified.
- i. Revamping the fixture shall be possible without having to remove the fixture from its place.
- j. Lamps of the proper type, wattage and voltage rating shall be furnished and installed in each fixture.
- k. For Labs, ICU, CCU and other Critical Areas, Clean Room LED Light Fixtures shall be provided to maintain requisite Lux level as per NBC 2016, ECBC and as directed by Engineer-In-Charge.

19.7.2. INSTALLATION

Fixtures shall be installed at mounting heights as detailed on the Drawings or as instructed on site by the Engineer-In -charge.

Pendent fixtures within the same room or area shall be installed plumb and at a uniform height from the finished floor. Adjustment of height shall be made during installation.

Flush mounted recessed fixtures, shall be installed so as to completely eliminate leakage of light within the fixture and between the fixture and adjacent finish.

Fixtures mounted outlet boxes shall be rigidly secured to a fixture stud in the outlet box. Hickeys or extension pieces shall be installed where required to facilitate proper installation.

Fixtures located on the exterior of the building shall be installed with non-ferrous metal screws finished to match the fixtures.

19.7.3. LED Light Fixtures -GENERAL

LED Lighting fixtures shall provide luminous efficacy of more than 100 Lumens/Watt, including Driver & accessories. LED Light Fixtures shall have inbuilt harmonic mechanism to mitigate harmonics.

19.7.4. BALLASTS/ Driver

Ballasts/ Driver shall be electronic type and having high power factor type. Ballasts shall have manufacturer's lowest sound level and case temperature rise rating.

19.7.5. TESTING

After all lighting fixtures are installed and are connected their respective switches, test all fixtures to ensure operation on their correct switch in the presence of the engineer.

All non-operating fixtures or ones connected to the wrong or inconveniently located switch shall be correctly connected as directed by the Engineer In- charge. Stickers are to be placed on each light fixture w.r.t. controlling switch of respective light.

19.7.6. CEILING FANS

All ceiling fans shall be provided with suspension arrangement in the concrete/slab/roof members. Contractor to ensure that provision are kept at appropriate stage at locations shown on the drawing. Fan box with MS hook shall be as per CPWD specification. Ceiling fan shall be Heavy Duty, double ball bearing type, copper wound motor complete with canopy, down rod, blades etc. and shall conform to relevant IS Standards. Ceiling Fans shall be white in colour. Ceiling fan shall be provided with electronic regulator. Electronic Regulator shall be suitable for 240 volts A.C supply 50 Hz and shall be of continuous duty type and with BEE Star rating. Ceiling Fans shall be 5-Star BEE rated & comply to ECBC norms.

19.7.7. EXHAUST FANS

Exhaust fans shall be heavy-duty type with double ball bearing and conforming to IS 2312 (latest revision). Exhaust fan shall be complete with copper wound motor, capacitor, Louver/shutter, frame and mounting bracket. Exhaust fan shall be suitable for operation on 240 volts single phase A.C supply with BEE 5- star rating & comply to ECBC norms.

19.8. TELEPHONE SYSTEM

19.8.1. Telephone point wiring

- (a) The point wiring shall be carried out with four pair Cat6A LAN cable, in the PVC conduit Minimum Dia. of Conduit for Internal/External one Telephone Wiring -

20mm.

If more than one telephone point has to be provided at one point, multi CAT6A Cable shall be used in suitable size of conduit.

- (b) The point shall commence from the main telephone Rack and would terminate at outlet box of point.
- (c) Fixing of conduit, conduit accessories draw out boxes and outlet box etc. in concealed/surface conduit works as that of wiring for light fixtures shall be applicable for telephone wiring conduit system also.
- (d) Joint in telephone wiring (between Rack and outlet box of point) shall not be allowed and the contractor should bear the wastages of wire if resulted due to this special requirement of telephone system.
- (e) External/Internal telephone and intercom wiring can be drawn in the same conduit, provided after drawing wires, 50% of conduit cross sectional area is free. However, independent armoured Cat 6A wire shall be used for external intercom.
- (f) To identify telephone wire/cable, PVC indication numbers shall be put on both ends of wire/cable just before termination.

19.8.2. Telephone Rack

The Telephone Cat 6A cables can also be terminated in the existing LAN Rack of suitable space.

19.8.3. Telephone Instruments:

Telephone Instruments shall be provided at various locations in the Institutional and Residential as directed by Engineer-In-Charge.

Item No:-433

21. DIESEL GENERATOR SETS & ASSOCIATED WORK

21.1. SCOPE OF WORK:

This specification covers the design, manufacture, assembly, packing, dispatch, transportation, supply, erection, testing, commissioning, performance and guarantee testing of Diesel Gen-Sets with Acoustic Enclosure, complete in all respects with all equipment, fitting and accessories for efficient and trouble free operation as specified here under. All DG Sets shall be provided with Residential Type Silencers.

The Scope of work shall also include labour, tools, tackles and plants, hardware and consumables, steel fabrication and items as prescribed below:

- ☑ Diesel Engine and Alternator set complete with base frame and accessories.
- ☑ DG Set shall be with PCCM / Synchronizing relay suitable for auto /manual / By pass arrangements.

- Engine mounted engine control integral panel duly wired upto terminal box for engine safeties with sensors and protection for inter facing with PLC/Microprocessor based relay and SCADA System.
- ☐ Fuel Oil system including day service oil tank, piping, valves, filters etc. from engine to service day oil tank.
- ☐ Lube oil system with piping etc. (Pre-lube oil pump with controller if required).
- ☐ For types of DG sets, please refer DBR.
- ☐ Exhaust emission shall meet latest CPCB norms without catalytic converter or online scrubber and residential silencer, exhaust piping with mineral wool insulation and aluminum cladding as called for.
- ☐ Steel fabricated structure/support/hanger including fixing, grouting and bolting etc.
- ☐ Painting of steel work.
- ☐ LT Termination Box shall be suitable for suitable size Sandwich busducts through flexible tinned copper busbars of suitable ratings.
- ☐ Copper Control cabling between DG sets and respective LT Panels
- ☐ Exhaust Gas Pipes MS C Class, 6 mm thick with all accessories and hardwares.
 Height of Exhaust pipes shall be provided as per relevant CPCB and CPWD norms.
- ☐ MS Stack structure for supporting DG Exhaust Pipes duly painted with 2 coats of red-oxide primer & enamel paint of approved shade.
- ☐ All DG Sets shall be provided adequate shading with polycarbonate sheets supported on MS structure duly painted.
- ☐ Body & Neutral earthing of DG Sets complete with earth pits and earth strips/wire etc as per IS-3043.
- ☐ All DG Sets shall be tested by an independent test laboratory ICAT (Manesar)/ ARAI, Pune to ascertain that DG Set will generate the net nominal full load at the stipulated ambient temperature conditions. Test Certificates for DG Sets shall be produced.

21.2. CODES & STANDARDS

The design, construction, manufacture, inspection, testing and performance shall comply with all the currently applicable statutes, safety codes, relevant Bureau of Indian Standard (BIS), British Standards (BS), International Electro Technical Commission (IEC) publication, standards amended up to date.

Some of the applicable standards are listed below :

(A)		Generating Set
ISO 8528	Part - I	Application, rating and performances.
	Part - II	Engines
	Part - III	A.C. Generator for generating set
	Part -IV	Control Gear & Switch Gear
	Part - V	Generating Sets
	Part -VI	Test Methods
(B)		Engines

IS 10000 (Naturally Aspirated)	Part - I 1980	Methods of tests for I.C. Engines Part - I- Glossary of terms relating of test methods
	Part - IV- 1980	Declaration of power, Efficiency, fuel consumption, lubricating oil consumption.
	Part - VII- Performance Tests	
	Part - X	Test for smoke level, limit and correction for smoke level for variable speed.
ISO - 3046	Part - V 2001	Performance, Torsional vibrations.
(C) Alternator		
IS 4889/BS - 269		For declaring efficiency of electrical machines.
IS 4722 - 1992		Capability of machine to withstand over current / overload.
IS- 13364	Part I 1992	Alternator - Voltage Regulations upto 20 KVA
IS- 13364	Part II 1992	Alternator - Voltage Regulations above 20 KVA to 80 KVA
IEC 34-1 - 1983		Rotating Electrical machines - Rating & Performance
IP -21	IS - 4691/85	Alternator (Degree of Protection)

(D) Acoustics Enclosure		
IS - 8183		Insulation material for sound absorption.
ISO 3744	1998 (E)	Acoustics - Determination of sound power levels of noise sources.
ISO 9614 -	1983 Part -I	Requirement of grade - II, Accuracy for insulation.
ISO 9614 -	1983 Part -II	Requirement of grade - II, Accuracy for insulation.
(E) Control Panel / AMF Panel		
IS - 2147 1962		Degree of protection.
IS - 4722		H.V. testing for Panel

21.3. DESIGN

The design and workmanship shall be in accordance with the best engineering practices, to ensure satisfactory performance and service life. The equipment offered by the contractor shall be complete in all respects. Any material or accessories, which may not have been specifically mentioned, but which are usual and necessary for the satisfactory and trouble free operation and maintenance of the equipment shall be provided without any extra cost to the purchaser.

The DG Sets shall be mounted on suitable anti-vibration mountings of reputed make to prevent transfer of vibration to the foundation and structures. The DG Set equipment shall be tropicalised and shall be suitable for operating at a hot humid atmosphere at an ambient temperature of 50 deg. C. Any replacement of such item with material and labour will be carried out free of cost within the

warranty period.

The engine alternation set shall be capable of working at ambient temperature between 0°C to 50°C and relative humidity upto 95%.

The operating capacity of each set shall be arrived at after considering a load with power factor of 0.8 lagging, and after taking into consideration suitable de-rating on account of above parameters of the station.

The engine/alternator set shall be capable of taking 10% over-load for a period of one hour during any 12 hours period, while operating continuously at full rated load.

Nominal output voltage of engine/alternator set shall be 415 volts 50 Hz AC Supply with manual adjustment at all conditions of load with coarse and fine controls with a range of $\pm 5\%$.

The frequency shall be maintained at 50 Hz $\pm 2\%$ for the set. The output wave-form shall be sinusoidal at all load conditions.

The engine/alternator set shall be selected for a high degree of performance with over all low fuel consumption for the normal life of the alternator set.

The engine/alternator set shall meet the requirements of all linear & non-linear loads, but over-sizing of the alternator in order to meet the non-linear characteristics of loads is not envisaged.

The Engine shall be capable to minimum 60% bulk load of the rating during transfer of the load from NO Load position without tripping.

SYSTEM OPERATION

The set may be idle for a long time except for periodical test whenever there is a electrical supply failure, the set may required to run continuously for period even exceeding 24 hours.

SYSTEM FEATURE

The entire work shall confirm to Bureau of Indian Standards safety standards; British Standards, and CPWD specifications.

21.4. PERFORMANCE REQUIREMENT

The equipment shall be capable of delivering power continuously at the generator Terminal, a net output not less than the specified value at 0.8-0.95 p.f. excluding auxiliary power (shall be included over and above), when operating under the site ambient conditions described in this specification. Gen Set should be capable of taking 100 % step load & it should be able to take full load in less than 25 sec. from start. (The set shall be suitable for prime duty).

The design parameters of the generator and excitation system shall be chosen that the set is stable while running at any load between no – load and full load and also during starting of motors. It should also have synchronous speed control with load sensing governing system suitable for parallel running of D.G. sets.

Engine should be heavy duty four strokes, turbo charged after cooler 'V' construction/in line electric start. Engine should have minimum lube oil change period 500 Hrs. Bidders are required to offer the Duplex filter system for lube oil and fuel oil in case of non compliance.

The set shall have vibration limit less than 130 microns (as per BS:4999 Part – 142) & noise level shall be meet CPCB norms under all conditions of load. The set shall be dynamically balanced. The

set shall be mounted directly on the inertia foundation or with foundation bolts etc. The efficient residential silencer shall be provided with or without catalytic converter on-line scrubber & the set shall meet EURO-II norms for D.G Sets, for the exhaust. Air inlet shall also be provided.

The engine shall be stationary, compression ignition, totally enclosed, water cooled, 4 stroke direct injection, cold battery starting, turbo charged and low temperature with after cooled Radiator Cooled 1500 RPM in accordance to BS 5514 and IS: 10002 complete with all accessories. The DG engine shall be suitable for quick start & should be able to pick up 100% load within optimum time.

The DG Engine & the batteries shall be designed to take up at least six starting attempts beyond which the system shall be protected by means of an over crank relay. Calculations for battery sizing and battery charger capacity shall be submitted for review of the consultants. The successful bidder will submit shop drawing of the equipments/accessories selected for this work for the approval.

21.5. SERVICE INTERVAL AND OPERATION

The set shall be capable of running at full load for not less than 500 hrs continuously. The change period both for the lube oil, lube oil filters shall be minimum 500 Hours of operations, in the event the change period for above consumables false short below the specified time period as above, bidders are required to quote for duplex type filters with oil make up systems.

21.6. DIESEL ENGINE - CONSTRUCTION

Material of construction of major parts shall be as under or as per manufacturer design.

- ☒ M.S. base frame with anti-vibration mountings.
- ☒ Crankcase – Aluminium alloys.
- ☒ Crank shaft, connecting rods –Forged Alloy Steel.
- ☒ Piston – AL alloy casting.
- ☒ Piston rings – Alloy Steel.
- ☒ Engine Block – Cast Iron
- ☒ Cylinder Liner – Cast Iron

All other material of construction shall be as per relevant standard/code.

One common base frame shall be provided for mounting the engine and alternator complete with electric suspension between D.G set and foundation bolts, leveling lines etc. as required.

All externally mounted hardware shall be high tensile steel only.

The normal speed of the engine shall be 1500 RPM and the direction of rotation shall be clearly marked on the set.

The engine shall be fitted with an exhaust gas driven turbo charger of air / water cooled type complete with its own self contained lubricating system. The turbo-charger shall be positioned at the free end of the engine preferably

The engine shall be fitted with a charge air inter cooler of the air/water type. Air from the turbo-charger compressor passes through the inter cooled and then to the engine manifold. The inter cooler shall

be of tubular construction or as per manufacturer design with aluminum bronze tubes, mild sheet steel and cast iron water headers.

Fuel injection and valves shall not require frequent adjustment while in service.

All filters like fuel, lubrication oil, by pass etc shall be provided in the engine and shall be dry, paper element type.

Starting system shall be 24V DC comprising of SMF batteries (25 plates, 360 AH capacity or as recommended by OEM), Voltage Regulator and arrangement for initial charging of batteries.

Bed Plate

The bed plate shall be fabricated from M.S. channel. The welding shall be radio graphed, and the entire fabrication shall be stress relieved after welding. The bed plate shall have integral well ribbed diaphragms for supporting the main bearing housings.

Crank Case

The crank case shall be steel construction with heavy steel plates to form water compartments around the cylinder. To facilitate access for purpose of inspection, inspection ports shall be provided.

Lube-Oil Priming Pump

An A.C. motor driven intermittent operation lube-oil priming pump shall be provided. This shall also include necessary piping, fitting instruments etc. for lubrication system along with clock timers if required.

Crank Shaft

The crank shaft shall be made of high tensile strength steel forging, and shall have a suitable flange to which the flywheel shall be bolted.

The bearing journals and fillets shall be induction hardened; and fully balanced. Main And Big End

Bearings

The main and big end bearings shall be detachable shells of high grade bearing material, and shall be pre-finished. Connecting Rods

The connecting rods shall be of high grade drop forged steel I - beam section, centre to centre length. The rods shall be rifle drilled for pressure lubrication of piston pin. The rod shall be tapered at piston pin end provided to reduce unit pressures. The piston pin of suitable diameter shall be full floating and made of tubular steel, and retained by a snap ring.

Cylinder Liners

The cylinder liners shall be replaceable wet liners, cast iron alloy, and provided with specially machined grooves in their bores to give an oil retaining surface. These liners shall be easily replaceable without re-boring the block.

Piston

The piston shall be made of forged aluminum alloy, cam ground and machined on outer surface. The piston shall be fitted with an oil scraper ring, and compression rings of hardened cast iron alloy. The

piston shall be oil cooled.

Camshaft

The camshaft shall be of induction hardened steel alloy with gear drive, and one of this shall be provided for each block of cylinders.

Exhaust Manifold

The exhaust manifold shall be multi-branch, of insulated design utilizing Ni-resist casting. Flywheel

The flywheel, which shall conform to requirements of NEMA/ASA/BS codes, shall be made of mild steel statically balanced after machining and shall have graduated markings around the periphery / markings for checking of the valves can also be located on the vibration damper. Barring slots shall be provided around the flywheel rim for hand-barring/ alternatively a suitable barring arrangement should be provided.

Governing System

The governor shall be Isochronous, electronic digital type with a steady state frequency variation of +/- .25%. The transient performance shall comply with ISO 8528-5, Class G3 requirements.

It should be possible to adjust the over speed settings on the governor by means of digital signals Manual adjustments for over speed trip settings are not preferred.

21.7. HEAT EXCHANGER

The DG Set should be equipped with a Heat Exchanger/ Radiator for suitable operation.

21.8. ALARMS/TRIP (AUDIO AND VISUAL)

The following Alarm/Trip indications shall be provided as minimum with first stage as pre alarm & second stage as trip:

- ☐ High water temperature.
- ☐ Low lube oil pressure.
- ☐ Low fuel level.
- ☐ Low coolant level.
- ☐ Over crank
- ☐ Over speed

21.9. OTHER AUXILIARY EQUIPMENT/SERVICES

These shall be complete include the following:-

Silencer

Exhaust Silencer shall be residential type to reduce the noise level. Values for Pressure drop across the silencers to be indicated by the vendor.

Cooling

The engine shall be water cooled heat exchanger type or radiator cooled depending on its capacity. DG Set shall be adequately designed for continuous operation on ambient conditions at 50 deg C.

21.10. INSTALLATION OF GENERATING SET

The engine and alternator shall be mounted on specially designed common MS base plate and frame of

extremely rigid welded construction, so as to provide no deflection.

The engine/alternator set shall be installed over the Dunlop-make, S-type anti-vibration cushy base in order to isolate the transmission of vibrations to the floor or building structures.

The exhaust system shall be designed and installed in such a manner that it avoids excessive stresses on the exhaust manifold of turbocharger, washing spray or any other source.

The exhaust pipe shall pass through an oversized collar, filled with glass wool when crossing floor/wall. All exposed metal parts shall be suitably painted to prohibit corrosion under the climatic conditions at site.

The installation of fuel piping, power distribution and control panels shall be carried out in accordance with the specification of respective items.

21.11. DAY SERVICE FUEL TANK

Day service fuel tank shall be made of 3 mm thick MS sheet of 990 litres capacity or as OEM standard capacity for each set with all accessories such as oil level indicator, inlet pipe connection, outlet pipe connection, trough to collect spilt oil, air vent pipe with air filter, manhole with cover, low level and full level float valve arrangements with all fittings, interconnections between tanks and engine. The tank shall be provided with suitable calibration scale. The Fuel to be used for trials and acceptance tests shall be high speed diesel. First fill of 990 litres HSD per DG set required coolant and lube oil is included in the scope of this contract at no. extra cost.

21.12. FOUNDATION

Foundation shall be casted as per the recommendations of the manufacturer in consultation with the Supplier and as per the requirements of the site. The successful bidder shall submit detailed foundation drawings for approval from client.

21.13. PAINTING

The Contractor shall paint all exposed metal parts and equipment supplied by him. All sheet metal work shall undergo a process of phosphating, passivating and then sprayed with high corrosion resistant primer. The finishing treatment shall be of two coats of synthetic enamel paint of approved color. All piping shall be color coded.

21.14. ALTERNATOR

The alternator shall be brushless synchronous and suitable for 3 phase 415 Volts, 4 wire, 50 Hz, 0.8 PF, 1500 RPM.

The alternator shall be suitable for coupling directly to the diesel engine It shall be Drip proof, screen protected as per IP-23. The alternator shall be single bearing type & self ventilating. The alternators shall be continuously rated and shall have class 'H' insulation with a temperature rise restricted to that of class F designed and built to withstand tropical conditions. It shall generally conform to BS: 5000 (Part - 99) / standards listed above. The alternator shall be suitable for sustaining a 10% overload for 1 hour in any 12 hour period without injury. The terminal arrangement for alternator shall be suitable for Cable connections of adequate size to deliver the full load of the alternator.

The alternator shall also have a solid state type digital voltage regulator (D.V.R.) suitable for single running with control limits of 1% from no load to full load under normal load changes. It shall be of static type and complete with cross current compensation. The regulator shall be provided with voltage adjusting potentiometer, and shall be complete with all alarm contacts, internal wiring, etc.

The Engine and Alternator shall be direct coupled and mounted on a common rigid fabricated steel base frame with suitable vibration isolation system.

21.15. EXCITOR

Self excited, self regulated and providing alternator output regulation at plus or minus 0.25%. The alternator shall be provided with a pilot-excited, permanent magnet- excited generator (PMG) for superior short circuit capabilities. Bidders to specify sustained short circuit current capabilities for up to 10 seconds.

The alternator shall be provided with sealed Barings to give minimum service life of 40,000 Hours. The Bidders to specify the maximum rating of the motor that can be started direct on line without any base load, with 50% base load, restricting the Voltage depth to 20%.

21.16. INSTRUMENTATION

Instrumentation shall be provided and mounted on the Generator Set to monitor the following:

- Engine Speed
- Oil Pressure
- Oil Temperature
- Water Temperature.

A Gauge Board shall be provided with all the indicators grouped together. The generator shall be provided with a microprocessor-based controller with a facility for remote start, remote annunciation, auto / manual synchronizing and remote communication capability. It should be possible to monitor the parameters of the engine and the alternator and display the status of the faults on the DG set if any and generate a complete report on the PC individually or on SCADA network. The following minimum monitoring & protection is required for the alternators.

Alternator Monitoring

- Current. (I1, I2, I3)
- Frequency
- Voltage (L-L & L-N)
- KVA
- KVAR
- Power Factor
- Percentage alternator duty heavily i.e. actual load / KW rating. The Generator shall be protected

against the following electrical faults:

- Overload and short circuit
- Ground fault
- Over current
- Over frequency
- Under frequency
- Under Voltage
- Over Voltage
- Locked Rotor

- ☒ Reverse power protection.

It should be possible to read the data i.e. Parameters and Shutdown status locally on the D.G Set. All the above Parameters should be displayed on The Local Control Panel through appropriate meters and status on faults should be indicated through a facia annunciator. It should be possible to display all the functions as above on a personal computer.

21.17. EXHAUST SILENCER PIPING

Exhaust Piping: The exhaust silencer piping system shall be of heavy duty MS, Class-C pipes, 6 mm thick. The runs forming part of factory assembly on the engine fl exible connections up to exhaust silencer shall be exclusive of exhaust piping item. The work include necessary cladding of exhaust pipe work using 50 mm thick Loosely bound resin (LBR) mattress/ mineral wool/ Rockwool, density not less than 120 kg/m³ and aluminium cladding (0.6 mm thick) for the complete portion. The exhaust pipe work includes necessary supports, foundation etc. to avoid any load & stress on turbo charger / exhaust piping. The exhaust pipe shall be run along the existing wall of the building duly clamped/supported on independent structure for which, the design and Drawing for such structure shall be got approved from the Engineer-in-charge.

- ☒ Exhaust system should create minimum back pressure.
- ☒ Number of bends should be kept minimum and smooth bends should be used to minimize back pressure.
- ☒ Pipe sleeve of larger dia. should be used while passing the pipe through concrete wall & gap should be filled with felt lining.
- ☒ Exhaust piping inside the Acoustic Enclosure/ Genset room should be lagged with asbestos rope along with aluminium sheet cladding / insulated to avoid heat input to the room.
- ☒ Exhaust flexible shall have it's free length when it is installed. For bigger engines, 2 flexible bellows can be used.
- ☒ For engines up to 500 KVA, only one bellow is required. However, if exhaust pipe length is more than 7 m then additional bellow/ provision for expansion should be provided.
- ☒ 'C' Class MS pipes and long bend/elbows should be used.
- ☒ The exhaust outlet should be in the direction of prevailing winds and should not allow exhaust gases to enter air inlet/ windows etc.
- ☒ When tail end is horizontal, 45 Degree downward cut should be given at the end of the pipe to avoid rain water entry into exhaust piping.
- ☒ When tail end is vertical, there should be rain trap to avoid rain water entry. If rain cap is used, the distance between exhaust pipe and rain cap should be higher than diameter of pipe. Horizontal run of exhaust piping should slope downwards away from engine to the condensate trap. Silencer should be installed with drain plug at bottom.

21.18. TESTS AT MANUFACTURER'S WORK

The following tests shall be performed at manufacture's works prior to packing and dispatch to site.

On DG Set

- ☒ Maximum power load capacity.

- ☐ Maximum motor starting capacity
- ☐ Endurance test.
- ☐ Fuel consumption at full load, 50% load, 75% load and 25% load.
- ☐ Engine - Alternator cooling air flow
- ☐ Load acceptance Test

On the Alternator

- ☐ High voltage tests on stator and rotor windings.
- ☐ Insulation resistance of stator and rotor windings.
- ☐ Temperature rise test.
- ☐ Measurement of resistance of stator and rotor windings.
- ☐ Measurement of losses.
- ☐ Mechanical balance.
- ☐ Load rejection and over speed tests.
- ☐ Stator voltage and current tests.
- ☐ Stator phase sequence check.

On the Excitor

- ☐ High voltage tests on stator and rotor winding.
- ☐ Insulation resistance of stator and rotor windings.
- ☐ Temperature rise test.
- ☐ Measurement of resistance of stator & rotor winding
- ☐ Measurement of losses.
- ☐ Response ratio test.
- ☐ Over speed test.
- ☐ Mechanical Balance test.
- ☐ On the Automatic Voltage Regulator
- ☐ Sensitivity test.
- ☐ Response time test

All routine test as per IS/BS codes shall be conducted on alternator, exciter and AVR. DG Panel shall be part of Main L.T. Panel, supplied by the Owner. However DG supplier shall do the coordination and provide all the inputs required for successful operation.

21.19. Battery/ Electrical System

Batteries supplied with Genset are generally dry and uncharged. First charging of uncharged batteries is very important and should be done from authorized battery charging centre. Initial charging should be done for 72-80 hours. Batteries should be placed on stands and relatively at cool place.

Battery capacity and copper cable sizes for various engine capacity are recommended as indicated in the table below. Cable sizes shown are for maximum length of 2 m. If length is more, cable size should be selected in such a way that voltage drop does not exceed 2 V. However capacity as recommended by manufacturer may be taken.

DG Set Capacity	Battery Capacity (AH)	Cable Size Material (Copper) Sq. mm	Electrical System (Volts)
Above 500 KVA	360	70	24
Above 125 KVA upto 500 KVA	180	70	12
Above 82.5.KVA upto 125 KVA	180	50	12
Above 62.5 KVA upto 82.5 KVA	150	50	12
Above 25 KVA upto 62.5 KVA	120	50	12
Upto 25 KVA	88	35	12

Cabling & Bus Trunking-

Power cabling between alternator to Main LT Panel shall be carried out as per recommended cable sizes upto DG set of capacity 750 KVA.

As far as possible, for DG Set of capacity 750 KVA & above connection between alternator to Main LT Panel shall be through Sandwich bus trunking. For exposed/ outdoor bus trunking protection requirement should be IP-66.

While terminating cables, avoid any tension on the bolts/ busbars (if cable is specified). While terminating R, Y& B phase notations should be maintained in the alternator and LT Panel for easy maintenance. Crimped cables should be connected to alternator and control panel through cable glands. Multi-core copper flexible stranded cable of 2.5 Sqmm size should be used for inter connecting the engine controls with the switchgear and other equipments. External wirings, when provided for remote voltage / excitation monitoring/ droop CT etc. shall be screened sheathed type.

Alternator Termination Links-

For proper terminations between links and Cables/switchgear terminals, the contact area must be adequate. The following situations should also be avoided as they lead to creation of heat sources at the point of termination:

- (i) Point contact arising out of improper position of links with switchgear terminals
- (ii) Gaps between busbars / links and terminals being remedied by connecting bolt/stud In such cases the bolt will carry the load current. Normally these bolts / studs are made of MS and hence are not designed to carry currents.

Adequate clearance between busbars / links at terminals should be maintained (IS 4232 may be referred to for guidelines). Improper termination will lead to local heat generation which may lead to failure.

21.20. INSPECTION AND TESTING AT SITE

All pre-commissioning and commissioning test and checks shall be carried out at site. The Contractor shall be required to produce manufacturer's test certificate for the particular batch of materials supplied to him by the manufacturers. The test carried out shall be as per the relevant standards. For examination and testing of materials and the works at site, the Contractor shall provide necessary testing and gauging equipment as required. All such testing and gauging equipment shall be tested for calibration at any approved laboratory as required by the Engineer In Charge. The Contractor shall give notice well in advance to the Engineer In Charge before commencement of any site testing. All materials like consumable stores, fuel oil grease, lubricating oil etc. required for the trails shall be arranged by the contractor. The Contractor shall make all necessary hook-ups to carry out tests at site and shall furnish

necessary fuel. The complete installation should be initially started and checked out for operational compliance by manufacturer's representative.

21.21. TRIALS (AT SITE):-

Preliminary Trials

After completion of erection of generating sets and before carrying out main trials, preliminary site trials shall be conducted in the presence of the Engineer In Charge. Such trials shall include the checking and adjustments of all instrument relays, timers, interlocks and meters. Insulation resistance of stator, rotor and exciter windings shall be checked and reading recorded. A check shall be made for the satisfactory working of all auxiliary motors and their starting accessories supplied with the set. Diesel & lubricating oils for establishing performance at site shall be arranged by the contractor without any extra cost.

Main Trials

The main trials shall include over 8 hours continuous run at available load. D.G. Panel shall be tested for automatic operation by injecting proper current and voltage by a separate source. The satisfactory working of automatic operation shall be tested and necessary adjustments shall be done for relays in the presence of the Engineer In Charge and the results shall be recorded in the test sheet at 30 minutes intervals. Alternator efficiencies as determined in works test shall be used as the basis of calculation for fuel consumption rate. A tolerance of 3% shall be allowed on the fuel oil consumption to cover possible errors in measurement.

Tests providing the satisfactory performance of all safety and operating controls shall be carried out. Governor trials shall be carried out as laid down in ISO: 3046. Alternator insulation resistance and commutation check shall be as per ISO: 3046. Starting time of sets shall be tested at least five times after sufficient time intervals to allow for cold start. On completion of tests, inspection doors shall be removed and running gears inspected and alignment checked.

Any further reasonable trial as suggested by the Engineer In Charge shall be carried out with no extra charges. All instruments, materials and labour required for carrying out the trials shall be provided by the Contractor. Test sheets of trials shall be forwarded in quadruplicate to Engineer In Charge.

21.22. TEST WITNESS

Tests shall be performed in the presence of Engineer In Charge. The contractor shall give at least thirty (30) days advance notice of the date when the tests are proposed to be carried out.

21.23. COOLING TOWERS AND WATER CIRCULATING EQUIPMENT

21.23.1. GENERAL

The various items of the water circulating system shall be complete in all respect and comply with the specification given below. The total sound intensity with all fans in operation shall not practically exceed noise levels as prescribed in CTI, CPWD and other relevant norms, from all around the cooling towers.

21.23.2. COOLING TOWERS (FRP CONSTRUCTION)

The cooling towers shall be of FRP, Vertical induced draft type complete with FRP basin FRP

body, fan and motor assembly, fill media, distribution pipes etc.

21.23.3. GENERAL CONSTRUCTION

The body shall be made of FRP (Fibre glass reinforced plastic) section of equal segments, all bolted together. The surface on both inside and outside shall be smooth, for minimum air resistance. The fan deck shall form an integral part of the body. The structural strength of the body shall be sufficient to withstand wind velocities upto 60 m/sec. Vibrations and earth quake.

The water basin shall also be of FRP. Having an auxiliary suction tank, at the bottom. The basin shall be complete with connections for drain, overflow, makeup water, quickfill and float valve, plus hot dipped galvanized stainer.

The support structure for the tower shall be of mild steel duly hot dipped galvanized. The water diffusion deck shall be of rigid PVC fill in Honeycomb design, arranged in a suitable pattern for ease of replacement. PVC fills shall be of high efficiency. The colour of the cooling tower body shall be of the owner / architect choice.

21.23.4. WATER DISTRIBUTION SYSTEM

The hot water shall be distributed through a sprinkle system consisting of PVC sprinkler pipes, which shall be mounted on the top of the main supply stand pipe. Each cooling tower shall have twin header system coupled with gravity flow distribution system.

21.23.5. FAN ASSEMBLY

The fan shall be of axial flow type with cast aluminium multiple blades of aerofil design and adjustable pitch. The fan assembly shall be statically balanced. The fan outlet velocity shall not be less than 10 m/ s and the tip speed shall be below 4500m / minutes.

The fan shall be directly mounted on the motor or through speed reduction gears. In the latter case, the housing shall be of heavy cast iron, construction with large oil reservoir. The fan motors shall be totally enclosed fan cooled squirrel cage type conforming to IP 55 Protection for outdoor operation.

The fan guard shall be hot dipped galvanized with wire mesh screen to prevent bird nesting during idling period.

21.23.6. LADDER

All towers, whose height exceeds 2.5 mtrs, shall be provided with a ladder, made out of hot dip galvanized MS Tubes.

21.23.7. PUMP SETS

The pump sets shall be mono block type with end suction and top discharge flanged connections directly mounted on the dripproof squirrel cage induction motors and suitable starter as specified.

The impeller shall be of Bronze, single enter shrouded design, and properly balanced. Water seal shall be of mechanical type to minimized water leakage and should be easily serviceable in the field.

Motor and starter shall conform to relevant specifications and of rating given in ' schedule of

quantities'.

21.23.8. MISCELLANEOUS

The following items to be provided:

Water pressure gauge at inlet and outlet of each pump complete with gauge cocks and connected tubing.(To be priced separately)

Vibration isolation pads for each pumps.

Drain line from each pumps up to drain pit, (priced separately).

21.23.9. INSTALLATION AND TESTS

The cooling towers shall be mounted on the beam/ steel structure member, provided by Contractor and shall be unconnected with the roof slab. All nuts / bolts etc. for mounting shall be provided by the Contractor.

On installation of the capacity of the cooling towers shall be checked by measuring water flow rate, water IN and OUT temperature and the ambient W.B. Temperature and then computing the capacity and efficiency.

The pumps sets shall be mounted on cement concrete foundation which shall be provided by HVAC contractor including grouting nuts, bolts, channels etc. shall be provided by the contractor.

On installation the capacity of the pumps shall be checked by measuring water flow. Motor current and pressure difference at inlet and outlet. The reading shall be recorded to compare actual performance with the specified data. Magnetic level switches shall be provided for low level alarm, in each cooling tower.

21.23.10. PIPE WORK

All piping work shall conform to quality standards and shall be carried out as per specifications and details given hereunder:

All pipes in sizes 200 shall M.S. E.R.W. tube (black steel) heavy class as per I.S. 1239-79, Part -1 with amendment-I. All pipes above 150 mm dia. shall be minimum 6.4 mm thick.

The dimensions of the fittings shall conform to I.S. 1239/69 Part-II unless otherwise indicated, in the specifications.

All bends in sizes up to and including 150 mm dia., shall be ready, made of heavy duty, wrought steel of appropriate class.

All bends in sizes 200 mm and larger dia., shall be fabricated from pipes of the same dia and thickness, with a minimum of 4 sections, and having a minimum centre line radius of 1.5 diameter of pipes. All fittings such as branches reducers etc. in all sizes shall be fabricated from pipes of the same dia. And thickness and its length should be at least twice the dia. of the pipe.

The branches may be welded straight to the main line without making a separate fitting, where specified on drawings or required by engineer-in-charge.

Blank ends are to be formed with flanged joints and 6 mm thick blank between flange pair for 150 mm and over, in case where, a future extension is to be made otherwise blank and discs of 6 mm thickness are to be welded on, with additional cross stiffeners from 50mm x 50mm M.S. Heavy angles, for sizes up to 350mm. All ends larger than 400 mm dia. shall have dished ends.

Flanges.

Valve :

All flanges shall be of mild steel as per I.S. 6392/71 and shall be steel slip-on-type, welded to the pipes, flanges thickness shall be to suit class-II pressures.

Flanges may be tack welded into position, but all final welding shall be done with joints dismantled. 3 mm thick gaskets shall be used with all flanges joints. The gaskets shall be filler reinforced rubber as approved by the Engineer-in-charge. Special adhesive compound shall be used between flanges of steam, air and gas lines.

Flanges shall be used as follows :-

Counter flanges for equipment having flanges connections.

Flanged pairs shall be used on all such equipment, which may require to be isolated or removed for service e.g. Pumps, refrigeration machines air handling units etc.

All thread valves shall be provided with nipples and flanged pairs on both sides to permit flange connections, for removal of valves from main line for repair/replacement.

Butterfly Valves

The butterfly valve shall consist of cast iron body preferably in two piece construction.

The discs shall consist of disc pivot and driving stem shall be in one piece centrally located.

The valve seat shall be synthetic material suitable for water duty. It shall line the whole body.

The discs should move in slides bearing on both ends with 'o' ring to prevent leakage.

The handle should have arrangement for locking in any set position.

All gate valves and check valves up to & including 65 mm dia. shall be of gunmetal screwed type, conforming to class 2 of I.S. 778. and shall be with I.S.I marking and certification.

All gate valves and check valves up to 80 mm dia . and above shall be of cast iron flanged type, conforming to class 2 of I.S. 780/69 (for sizes up to 350 mm) and of I.S. 2906/69 (for sizes 350 mm and above) marking and certification.

All gauge cocks shall be of gunmetal plug type, complete with siphon (brass chrome plated).

All drain valves shall be of gunmetal with a hose union connection of one hand.

All valves of the supply of fan coil units shall be of gunmetal ball type with integral water strainers, having (BSP) fpt inlet and flare type MPT outlet connection.

All valves on the return line of fan coil units shall be as in 5.6 but without integral water strainer.

Balancing Valves :

The balancing valves up to 80 mm dia. shall be of gunmetal screwed type confirming to B.S. 5154 or equivalent specifications.

The valves shall be cast gunmetal ASTM B-62 and complete with non rising spindle. PTFE disc seal cast metal hand wheel.

The port opening shall permit precise regulation of flow rate, by accurately measuring the pressure drop across the port.

The valves shall be complete with two ports for connection to a mercury manometer, to measure the pressure drop, as well as a drain port.

The spindle shall have shielded screw to set the flow at the desired level.

The valves shall be used wherever specified.

Strainers :

Jointing

The strainers shall either be pot type or 'Y' type with cast iron or fabricated steel body, tested up to pressure applicable for the valves as shown on the drawings.

The strainers shall have a perforated bronze sheet screen with 3 mm perforation and with a permanent magnet, to catch iron fillings.

Pot strainers shall be provided with flanged connection and 'Y' strainers shall be provided with flanged ends.

The strainers shall be designed to facilitate easy removal of filter screen for cleaning without disconnection of pipe line.

All pipes line shall be welded type.

Square cut plain ends will be welded for pipes up to and including 100 mm dia.

All pipes 125 mm dia or larger will be beveled by 35 deg before welding.

Miscellaneous :

Provide all pipe work as required to make the apparatus connection complete and ready for regular and safe operation. Unless otherwise noted, connect all apparatus and equipment in accordance with manufacture's standard details, as approved by Engineer-in-charge. Unless otherwise specified, pitch the lines of piping as follows:- All condensation drainage, including air handling unit and fan coil unit shall be pitched in the direction of flow to ensure adequate drainage, with an adequate trap seal to prevent leakage of air due to static pressure developed by air conditioning units. Pitch, 20 mm per meter wherever possible, but not less than 10 mm per meter.

Drains from other equipments shall be pitched similarly without trap seal.

Provide valves and capped connections for all low points in piping system, where necessary or required for draining system. Provide isolating valves & drain valves in all risers to permit repairs without interfering with the rest of the system.

Support piping independently of all equipment so that the equipment is not stressed by the piping weight or expansion.

To facilitate the maintenance, repair and replacement.

Provide shut-off valves where indicated and for individual equipment, units at inlet And outlet, to permit unit removal for repairs, without interfering with the remainder of The system. Additional shut-off valves shall be provided as required to enable all systems to be fully sectionalized. By-pass and stop valves shall be provided for all automatic control valves as specified.

Arrange piping for maximum accessibility for maintenance and repair, locate valves for easy access and operation. No valves shall be installed with handles pointing down, unless unavoidable.

Cut the pipes accurately according to measurements, established site & Work into phase without springing or forging.

Pipe supports shall be adjustable for height and prime coated with rust preventive paint & finish coated with grey paint, both as approved by engineer- in-charge. The spacing of Pipe

supports shall not be more than that specified below:- Nominal pipe size mm spacing (meters)

80,100,&125	2.50
150&Above	3.00

Extra supports shall be provided at the bends and at heavy fittings like valves to avoid undue stresses on the pipes. Pipe hangers shall be fixed on walls and ceiling by means of metallic approved dash fasteners.

Insulated piping shall be in such a manner as not to put undue pressure on the insulation, such as providing teak wood block between pipe and support.

Where pipes are to be buried under ground, they should be coated with one coat of bituminous paints. The top of the pipes shall not be less than 75 cms. From the ground level. Where this is not practical permission of engineer-in-charge shall be obtained for burning pipes at lesser depth. The pipes shall be surrounded on all sides by sand cushion of not less than 15 cms. After the pipes have been laid and top sand cushion proved, the trench shall be refilled with the excavated soil, excess soil shall be removed from the site of work by the contractor.

Hangers & Supports :

Hangers & supports shall be provided and installed for the piping and tubing wherever indicated, required or otherwise specified. Wherever necessary, additional hangers and support shall be provided to prevent vibration or excessive deflection of piping and tubing.

All Hangers & supports shall be made of steel or other durable and non-combustible material, given two coat of primer red oxide and then painted with aluminium colour paint. Wood wire or perforated strap iron shall not be used as permanent hangers or supports.

Hangers shall be supported from structural steel, concrete inserts & pipe racks, as specifically approved.

No hangers shall be secured to underside of light weight roof decking and light weight floor glass. Mechanical equipment shall be suspended midway between steel joists and panel points. Drilling or punching of holes in steel joist members will not be permitted.

Sleeves :

Where pipes pass through floors, walls, etc provide Galvanized steel pipe sleeves 50 mm larger than outside diameter of pipe. Where pipes are insulated, sleeves shall be large enough to ample clearance for insulation.

Where pipes pass through outside walls or foundation, the space between pipe and sleeve shall be caulked with lead wool and oakum.

The centre of pipes shall be in the centre of sleeves, and sleeves shall be flush with the finished surface.

Expansion or Contraction :

The contractor shall provide for expansion and contraction of all piping installed by the use of swing connection and expansion loops.

Arrangement and alignment of Piping :

All piping shall be arranged and aligned in accordance with the drawings as specified. Where special conditions are encountered in the field, the arrangement and alignment of piping shall be as directed by the engineer-in-charge. The piping shall be installed in a uniform manner, parallel

to or perpendicular to walls or ceiling, and all changes in directions shall be made with fittings. The horizontal piping shall be run at right angle and shall not run diagonally across rooms or other piping. Wherever possible all piping shall be arranged to provide maximum head room.

All piping shall be installed as directly as possible between connecting points in so far as the work of other trades permits. Where interference occurs with another trade whose work is more difficult to route, this contractor shall reroute his pipes as required to avoid interference, at the discretion of the engineer- in-charge.

All piping shall be carefully installed to provide for proper alignment, slope and expansion.

The stresses in pipe lines shall be guided and pipes shall be supported in such a manner that pipe lines shall not creep, sag or buckle

Anchors and supports shall be provided wherever necessary to prevent any misalignment of piping.

Small tubing gauges, controls or other equipment installed on any apparatus, shall not be coiled nor Excessive in length, but shall be neatly, carefully bent at all change in direction, secured in place and properly fastened to equipment at intervals to prevent sagging.

Testing:

The piping shall be grouped wherever practical and shall be installed uniformly in straight parallel lines in either vertical or horizontal positions.

In general, tests shall be applied to piping before connection of equipment and appliances. In no case shall the piping, appliance be subjects to pressures exceeding their test ratings.

The tests shall be completed and approved before any insulation is applied. Testing of segments of pipe work will be permitted, provided all open ends are first closed, by blank offs or flanges. After tests have been completed the system shall be drained and flushed 3 to 4 times and cleaned of all dust and foreign matter. All strainers, valves and fitting shall be cleaned of all dirt, filling and debris.

All piping shall be tested to hydraulic test pressure of at least one and half times the maximum operating pressure but not less than 10 kg/sq. cm for a period of not less than 12 hours. All leaks and defects in the joints revealed during the testing shall be rectified to the satisfaction of the engineer-in-charge, without any extra cost.

All the piping system shall be tested in the presence of the engineer-in-charge or their authorized representative. Advance notice of test dates shall be given all equipments, labour, materials required for inspection, and repairs during the test shall be provided by the contractor. A test shall be repeated till the entire systems are found to be satisfactory to the above authority. The tests shall be carried out for a part of work if required by engineer-in-charge in order to avoid hindrance in the work of the insulation contractor.

All steam and condensate pipes shall be tested and proven tight under hydrostatic pressure of 20 kg/sq.cm, unless otherwise stated, for a minimum period of 4 hours without drop in pressure.

Miscellaneous piping, tests with air at 10.5kg/sq.cm for a minimum of 24 hours without drop in pressure.

Painting:

All pipes supports, hangers, etc, shall be given two coats of red oxide primer.

All pipes, which are not to be insulated, shall then be given one coat of finish paint, of a type and colour, as per ISI code.

21.23.11. EXHAUST SILENCER PIPING

The Exhaust piping system for the DG set shall be as per CPWD Specifications meeting the requirements of CPCB Norms. The exhaust silencer piping system shall be of heavy duty MS pipes conforming to class B. Suitable length of flexible piping shall be used for connecting the exhaust piping to the engine as per the recommendation of the manufacturer. MS screws flanges and bends shall be used as per site requirements. Exhaust pipe inside the building shall be lagged with heat resistive glass wool of 48 kg / meter cube and then clad with Al. foil all along the pipe.

Exhaust Stack Height- In order to dispose exhaust above building height, minimum exhaust stack height should be as follows:-

(a) For DG Sets up to 1000 KVA - $H = h + 0.2\sqrt{\text{KVA}}$
where H = Height of Exhaust stack, h = Height of building

(b) For DG set above 1000 KVA - 30 M or 3M above the building height, whichever is higher The Exhaust Piping stack shall be supported by suitable MS steel structure with twin aviation light at the top of the exhaust piping.

21.23.12. COOLING TOWER CAPACITIES

The cooling towers of adequate capacity to be installed at the terrace of the complex from where the common header of the cooling towers shall be brought down to the DG room in the basement. Soft water is required to be filled up in makeup water tank for closed circuit cooling of engine. The contractor has to obtain the data from the Manufacturer for the requirement of the cooling tower capacity of the DG sets.

The inlet temperature to the cooling tower shall be of 43.3 degree C or as per design requirements.

The inlet temperature from cooling tower shall be of 32.3 degree C or as per design requirements

There shall be two common cooling tower for the DG sets. On the basis of data the size of common header and Pumps size min two nos with third no. standby shall be designed. the common header shall have temperature meters and butterfly/ Non return valves as required. While designing the Header of DG set shall be taken from the manufacturer.

21.23.13. Synchronization System

The synchronization panel shall be complete in all respects for auto operation of D.G. Sets. The minimum requirement for D.G. set operation shall be as detailed below, however, the vendor shall indicate in details the additional features and facilities being offered by them.

The parallel operation of D.G. set in Synchronization mode shall be completely through Power Control Center Module (PCCM). The PCCM shall be mounted on DG SETs outside the Building (the supplying and fixing of the PCCM is in the scope of Supplying and fixing of DG vendor Set). The PLC for the further operation shall be mounted on the Synchronizing panel with SLC 5/03 processor, kw transducer & suitable input /out put card, 8 channel analog card

Power Monitors – IV . The wiring between the DG Sets, PCCM and Synchronizing Panel is included in the scope.

During the parallel operation, the system take care of the load sharing i.e. active and reactive both for all the D.G. sets. and issue soft commands for voltage / frequency raise / lower, Depending upon the load requirements, the system shall start / stop the D.G. sets.

Monitoring & logging of the electrical data and events through existing P C. This will be achieved by using microprocessor based PC controller or equivalent networking kits & required hardware like GCM, modlon convertor ,communication cable.

Alarms and necessary remedial commands for D.G. and electrical system fault. D.G

synchronizing panels . Local Control and Manual Synchronization (Common for all D.G. Sets Part of the Synchronizing Panel)

The minimum equipment shall be as follows:

- a. DG selector switch
- b. PLC / manual selector switch
- c. Double scale voltmeter
- d. Double scale frequency meter
- e. Synchronoscope
- f. Check synchronization relay
- g. Synchronization lamps
- h. Solo parallel selector switch
- i. Manual synchronization circuit “ON”/”OFF” selector switch
- j. Push buttons & indicating lamps
- k. Control PT
- l. Mimic

The following components shall be provided for each DG Set :

- a. Breaker control Switch except for DG Incomer.
- b. Automatic battery charger having inbuilt Trickle /boost facility selector switch for battery charger
- c. DC digital Ammeter and Voltmeter selector switch
- d. Auto/Manual selector switch for priming pump
- e. Breaker control switch (only for one number bus-coupler required)
- f. Indicating lamps (LED type) for following:
- g. R1Y1B, phase indication
- h. D.G breaker “ON”/”OFF” spring charged
- i. Neutral contactor “ON” /”OFF”
- j. Engine running
- k. Battery charger “ON”
- l. Control supply healthy
- m. Priming pump “ON” /”OFF”

- n. Speed raise /low joystick
- o. Voltage raise / low joystick
- p. 12 window annunciator with alarm Accept/Test/Reset push buttons, Hooter.
- q. Temperature Scanners for RTD and BTD
- r. Beacon light
- s. Hour meter
- t 5 Nos. Under voltage relay for mains feeder
- t. 5 Nos. Over Voltage relay for mains feeder
- u. Stand by Earth fault relay
- v. Reverse power relay (reactive)
- w. Trip circuit supervision relay
- x. Master trip relay
- y. 5 H.P, DOL starter for oil priming pumps for D G Set
- z. Power factor meter (Analog)
- aa. Frequency meter (Digital)
- bb. Ammeter (Digital)
- cc. Voltmeter (Digital)
- dd. KW and KVA meter (Digital)
- ee. Kwh meter (Digital)
- ff. D.C. Ammeter (digital)
- gg. D.C. Voltmeter (digital)
- hh. Breaker Control Switch for bus coupler
- ii. Battery Charger on / off switch with boost and trickle charger facility
- jj. Trickle / booster charger selector, switch
- kk. Push buttons (lot)
- ll. P. T
- mm. Aux. Contactor (lot)
- nn. transducers

21.23.14. Automatic Generator Sequencing

- a) Automatically start & stop gen sets based on plant load or bus on process demand.
- b) Configurable plant bus demand start / stop levels and timers.
- c) On line engine priority sequence configurability from any synch. Unit or PC to equalize run time of all DG Sets.

21.23.15. SYNCHRONISING PANEL

The technical specification and details of the microprocessor based PLC controller for the DG set synchronizing and load sharing shall be as follows:

The microprocessor based PLC panel shall be suitable for use with AVR and electronic speed governor to protect and monitor DG sets.

Double Frequency Meter and Double Voltmeter shall be provided in synchronizing panel.

Synchrony check relay also shall be provided.

The PLC shall be provided with following features and audible alarm:

- o Engine pre glow control
- o Fuel solenoid control
- o Engine starter control
- o KVA controlled cool-down timer
- o Speed monitoring
- o Over speed protection
- o Oil pressure monitoring, alarm and shutdown of the engine.
- o Water temperature monitoring, alarm and shutdown of the engine
- o Battery voltage monitoring
- o Over speed monitoring and alarm.
- o 3 attempt start failure alarm
- o Under/Over Frequency
- o Reserve Power (Inverse time delay)
- o Loss of excitation
- o Over current (inverse time delay)
- o Loss of utility power detection
- o Load surge
- o Current unbalance
- o Voltage unbalance
- o Mains Protection (vector shift, df/dt ROCOL)
- o True RMS power calculations accurate control
- o Configurable loading/unloading ramp rates
- o Isochronous load sharing of up to 4 units using percentage based load sharing
- o Base load control for optimum fuel efficiency
- o Import export control using a watt transducer
- o Soft utility transfer function
- o Digital signal processing to eliminate harmonic issues
- o Adjustable phase window, Voltage and dwell time
- o Safe dead bus closing logic internal to the control
- o Synchronization across generator and mains breakers
- o Multiple short re-closing with adjustable time delay
- o Manual voltage and speed adjusts for manual synchronizing
- o VAR sharing on isolated busses using percentage based reactive load sharing
- o Power factor or VAR control when base loaded
- o Externally adjustable VAR or PF set point levels.
- o The DG set shall start and stop automatically based on plant bus demand.

The PLC system shall be provided with built in relays for protection of the following:

- o Reverse Power
- o Reverse KVAR
- o Over current

- o Under and over voltage
- o Under and over frequency
- o Synchronization check and earth fault relay.

The PLC system shall be suitable for load sharing by sensing active and reactive power.

The PLC system shall comprises of the following:

- o Main processor unit
- o Power module for power supply to the processor and the system
- o Power monitor to monitor voltage, KVA, KVAR, KW, KWH, KVAH, KVARH.
- o 16/32 channel Digital input module
- o 16/32 channel Digital output module
- o EEPROM for main processor unit
- o Computer to PLC communication card with necessary cables.
- o Window based operator interface Software Package
- o Mounting chassis for the equipment

The microprocessor based main processor of the system shall be suitable for 128 digital I/P and 128 O/P and comprises of the following:

The main processor unit shall be suitable for operation on 24 Volts DC with integrated memory. The integrated Ram memory shall be 20 K Words for program, data and constants plus data memory and flash EPROM of 16 K works for backup application program, communication card and real time clock. 4 Nos. discrete combination module (Input/output Module) shall be provided and the same shall be suitable for operation on 24 volts DC system. Combination module shall be with 16/32 inputs and 16/32 output channels as per the actual requirement.

- o 1 No. 2 slot extension rack
- o 1 No. Ram back up battery unit
- o 8/4 Nos. digital input module
- o 8/4 Nos. digital output module

The CPU display unit shall be suitable for 4 lines of 40 characters. The display shall be with back lit LCD. Clarity shall be not less than 5 x 7 pixels. The height of the characters shall be not less than 5 mm. The data entry shall be with the help of 24 function keys. In addition to this there shall be 10 service keys and 12 alphanumeric keys. The system shall be provided with RS 232 communication port.

21.23.16. OPERATION AND COMMUNICATION

The PLC shall monitor the bus bar load continuously. In event of mains failure the PLC shall give signal to select and start the generator, which is closer to the load sensed during the last 60 seconds. In case the load at the time of main failure is more than the highest rating DG set, the PLC shall give command to start 2 Nos. DG sets to suit the load, synchronize the sets and give command to close the breaker on the main LV panel.

If load starts reducing the PLC shall give command to turn off the DG sets through cool down timer. On restoration of main power supply, the PLC shall check the voltage and frequency and if they are stabilized and within the permissible tolerances, the PLC shall give command to shut down the DG sets through cool down timer. The control and monitoring of the cooling tower and fan and feed pump shall be done through PLC control system. Necessary control wiring between cooling tower, pumps and PLC panel shall be carried out within the scope of work.

21.23.17. SYNCHRONIZING MODULE

The synchronizing module shall be a microprocessor based intelligent unit, which shall monitor the electrical parameters and shall be able to communicate with the PLC control unit in the process of synchronizing and load management. The system shall be suitable for dynamic synchronization. The synchronizing module shall be suitable for programming and set the preferred difference between DG set and bus bar.

The synchronization module shall monitor and fulfill the following conditions before the system synchronizes the DG set to mains.

Feed back signal from the DG breaker on main LV panel that the breaker is in open condition.

- o Bus bar voltage is present
- o Generator voltage is present

The frequency regulator in the system shall start when the generator voltage and the bus bar voltage is over 50% of normal voltage. The voltage regulator in the system shall start when the frequency is within 90% of the normal system frequency.

The system shall close the breaker on the power panel without carrying out synchronization when all the below mentioned conditions are fulfilled. Feedback signal from the DG breaker on main LV panel that the breaker is in closed condition.

- o Bus bar voltage is present
- o Generator voltage is present

The synchronizing module shall transmit all monitored electrical parameters to the PLC unit and the PLC unit shall start controlling the synchronization of the DG sets and its load management. The data logging, monitoring and controlling shall be through a PC based SCADA station.

Item No:- 409-420

24. FIRE ALARM SYSTEM

24.1. GENERAL

1.1 The system shall include all materials, equipment and wiring required to install the complete Fire Detection and Alarm System. The system shall include but not be limited to one or more control panels, repeater panels, sensors, call points, audible and visual alarm indicating devices and relays.

The installation shall include the laying of all cables required for connection of the detection, alarm indicating and other devices along with connections to the power supply as appropriate to the design. All cabling shall conform to the requirements and recommendations of the Fire Alarm Control Panel manufacturer.

The system shall be designed such that no more than 80% of the available signalling / detection loop capacity is employed to allow for future requirements.

The bidder should be able to demonstrate their competence to design, install and commission the Fire Alarm System by providing references of executed projects.

Fire Alarm Control Panel (FACP)

The Fire Alarm Control Panel shall be independently certified as complying with requirements of EN54 / UL.

Functional Description

The FACP shall be the central controller of the complete system. It shall receive and process analogue information from the detection devices, provide audible and visual indication of alarm and other conditions to the user, automatically initiate alarm response sequences and provide the user interface for interrogation and user programming of the system.

Updates to the FACP operating software shall be simple to undertake and shall not require the use of replaceable components. The operating program and configuration memory shall be stored in non-volatile memory and shall not rely on batteries for retention.

The FACP shall provide a user interface from which; controls can be operated, manual operations can be carried out, indications are audible and/or visible and system information can be obtained. It shall also be capable of unambiguously indicating the following functional conditions: Quiescent condition, fire alarm

condition, fault warning condition and disablement condition. Furthermore, the fire alarm condition shall always be capable of clearly being indicated without any prior manual intervention at the FACP.

The FACP shall be easy to configure all basic operating characteristics and variables through the user interface on the FACP to satisfy the detection zone and output mapping of the premises. A PC Tool operating under the Windows™ operating system shall also be available to fully program the panel.

The FACP shall support minimum 120 Detector/ devices on the signalling single loop. The FACP shall fully support the sub-addressing capabilities of the relevant input and output devices. **The FACP shall be equipped with a white backlit display (840 Character/240 x 64 pixel resolution/10" Touch screen) graphical LCD Display**

The FACP shall contain of one, one to two or one to four signalling loop drivers depending on the system design requirements. Each signalling loop shall be capable of supplying at least 500mA of power for loop-based sounders or other output devices. The Fire Alarm Control Panel software and hardware loop driver, without modification, shall be compatible with the analogue detectors, call points, input and output devices.

The FACP shall fully support radio based/ wireless devices within each loop. It shall be possible to connect both wireless and wired devices in same loop.

The FACP shall provide a diagnostic monitoring feature for all signalling loop, alarm device output and auxiliary supply output circuits to monitor voltage, current load etc. In addition, diagnostic monitoring of the signalling loop return current pulses shall be provided.

The FACP shall incorporate a real-time clock for time stamping of events in the event history log and for scheduling of time related functions.

It shall be possible to install a network communications card to allow connection of up to 200 control panels, remote terminals, mimic displays or other peripheral devices. The network shall offer peer-to-peer operation and have a fault tolerant capability. The time to propagate a fire alarm condition across the network shall not exceed 3 seconds.

A single FACP shall have the capability for configuration and operation of 200 fire alarm zones. In a network system, the overall system shall have the capability for up to 2000 zones.

It shall be possible to adjust sensitivity settings for all detection devices based on a time clock. It shall be possible to select device modes for both active and inactive time periods for multi-sensor detectors.

It shall be possible to connect optional equipment in accordance with the requirements of EN54-2 Standardised I/O such as mimic panels and remote control terminals/ repeater panels.

It shall be possible to connect remotely to Fire Alarm System through ethernet and access the Fire Alarm System via an internet-based program (web browser)

The housing shall meet IP30 minimum ingress protection classification finished in RAL 7035. It shall not be possible to open the enclosure without a key or special tool.

The Fire Alarm Control Panel shall be capable of networking up to 32 Nodes on a standard network and up to 200 Network Nodes on a secure network

A zoning facility to allow the networked system to share up-to 2000 zones giving non-confusing indication and allowing true peer-to-peer cross panel report, control and site-wide cause and effect functionality.

Simply adding and connecting a network card will allow any node/control panel or remote terminal to be networked. All other nodes on the system will be instantly aware of a panel as soon as it is given a valid network node address, allowing additional panels to be added at any time with a minimum amount of reprogramming with the facility to prevent the transmission of fires or faults during commissioning on network systems.

It shall be possible to connect remotely to Fire Alarm System through ethernet and access the Fire Alarm System via an internet-based program

A PC Configuration Tool shall be available for configuration of the FACP and for retention of configuration data.

The PC Configuration Tool shall operate under Windows™ operating systems.

Software tools available shall have Configuring and programming of FACP, Bitmap format for customer/end-user branding

Power Supplies

All power supplies (integral to the fire alarm control panel or remote) shall be certified to EN54-4 /UL and shall be capable of supporting 72 –hour standby requirements. The FACP shall have a built-in or remote battery temperature sensor.

All power supplies shall be capable of operating from a main supply of 200-240VAC 50/60Hz.

Detectors and Devices

The system shall be compatible with and fully capable of using all the features of the following detection, alarm indicating and other devices.

The Devices shall be independently certified as complying with requirements of **EN 54 / UL**.

The system must utilise digital transmission techniques combined with suitable error checking and fast response capability using flag setting and grouping options.

All devices must use soft/safe or hard addressing methods and shall have non-volatile memory within the main body of the device.

There must be provision on the addressable loop for a capacity dependent on the protocol of at **least 120 detector/ devices** each with a capability for control and monitoring.

Detectors shall incorporate a double dust trap to reduce the incidence of false alarms.

Devices shall incorporate bi-directional short circuit isolators. (For Detectors/Device without inbuilt isolator, Fault Isolator or Isolator base to be provided with each detector/device)

Detectors shall be designed to operate over a system loop voltage range of 17 to 35V DC

Optical Smoke Detectors

The device should provide bi-colour LED status indication with 360 degree cone of view that can flash green if preferred under normal conditions, but which will illuminate red under alarm activation. This option and can be programmed via a PC configuration tool.

Optical detector shall incorporate bi-directional short circuit isolators (For Detectors/Device without inbuilt isolator, Fault Isolator or Isolator base to be provided with each detector/device).

The photoelectric smoke detector shall offer a broad range response capability and be third party certified to **EN54/Vds/ UL**

Smoke detectors shall feature a precision moulded screen to prevent ingress of larger airborne contaminants or insects to the chamber.

Smoke detectors shall offer the option to select one of four sensitivity levels related to the type of application, accessible via programmer or panel.

Detectors shall allow interrogation remotely via the panel or via a hand-held programmer to determine level of contamination and production data.

Multisensor Detectors

The device should provide bi-colour LED status indication with 360 degree cone of view that can flash green if preferred under normal conditions, but which will illuminate red under alarm activation.

Multisensor detector shall incorporate bi-directional short circuit isolators (For Detectors/Device without inbuilt isolator, Fault Isolator or Isolator base to be provided with each detector/device)

The detector shall be third party certified to EN54/Vds/ UL

A multi-criteria detector shall provide software algorithms that integrate the inputs from the individual sensors whilst also offering a choice of minimum five response levels.

The detector shall provide software control to allow response to be switched via the panel to select multi-criteria, smoke only or heat detection only based upon application requirements.

The smoke detection capability shall feature a precision moulded screen to prevent ingress of larger airborne contaminants or insects to the chamber.

Detectors shall employ a single high sensitivity thermistor as the temperature sensing element.

Detectors shall allow interrogation remotely via the panel or via a hand-held programmer to determine analogue values and production data.

Thermal Detectors

The device should provide bi-colour LED status indication with 360 degree cone of view that can flash green if preferred under normal conditions, but which will illuminate red under alarm activation.

Multisensor detector shall incorporate **bi-directional short circuit isolators (For Detectors/Device without inbuilt isolator, Fault Isolator or Isolator base to be provided with each detector/device)**

The heat detector shall offer Class P performance capability, allowing it to be set via software to either a fast Class A1R or higher temperature Class B response level and be third party certified to **EN54/Vds/ UL**

Heat detectors shall employ a single high sensitivity thermistor as the temperature sensing element.

Detectors shall allow interrogation remotely via the panel or via a hand-held programmer to determine analogue values and production data.

Detector Bases

Detector bases shall incorporate an option to lock the detector in place to restrict opportunity for tampering as well as provide a deep base and relay base option.

Each detector base shall have the standard facility for a remote output (for LED etc) which shall be separately controllable from the control panel providing a minimum of 20mA output.

Input / Output Modules

The protocol must utilise digital transmission techniques combined with suitable error checking and fast response capability using flag setting and grouping options

Devices must use soft addressing methods with the address held in non-volatile memory within the main body of the device.

The device shall provide bi-colour LED status indication under panel control that can flash green if preferred under normal conditions, but which will illuminate red under alarm activation.

Devices shall incorporate **bi-directional short circuit isolators (For Detectors/Device without inbuilt isolator, Fault Isolator or Isolator base to be provided with each detector/device)**

The Line Modules must offer low current consumption of less than 500µA in quiescent and nominal 6mA in alarm conditions.

The Line Modules shall be third party certified to EN54/Vds/ UL

The Input Module variants shall provide for both open and short circuit fault supervision of the monitored circuit wiring.

The Output Module variants should include both volt-free changeover relay and fully supervised load switching versions, both rated 30VDC 2A.

Combined multi-way modules shall combine input and output module functionality in the same device but still allowing independent panel control by allocating separate addresses for the circuits.

The device shall allow interrogation remotely via the panel or via a hand-held programmer to determine status and production data.

Line Modules shall be available in a choice of mechanical housings to cater for different application needs, including surface mount and mini “in box” options.

Line Modules shall be provided with pluggable terminal blocks to aid field wiring termination.

Device software shall feature a distinctive Type ID to allow the panel configuration software to identify the device type for group monitoring and control purposes.

Manual Alarm Call Points (MCP)

The protocol must utilise digital transmission techniques combined with suitable error checking and fast response capability using flag setting and grouping options.

The device must use soft addressing methods with the address held in non-volatile memory within the main body of the device.

The device should provide bi-colour LED status indication that can flash green if preferred under normal conditions, but which will illuminate red under alarm activation.

MCP Devices shall incorporate **bi-directional short circuit isolators (For Detectors/Device without inbuilt isolator, Fault Isolator or Isolator base to be provided with each detector/device)**

MCP Devices must offer low current consumption of in both quiescent and alarm conditions.

The MCP shall be third party certified to both EN54/ UL/Vds

All MCP shall be type ‘A’ and must be resettable with a clearly visible alarm flag when operated and employ a custom reset key that provides a positive rotating action to return an operated element to the normal condition.

MCP devices shall allow interrogation remotely via the panel or via a hand-held programmer to determine status and production data.

They shall be designed to operate over a system loop voltage range of 17 to 35V DC.

MCP Devices shall provide capability for both surface and flush mounting and a security cover option should be available.

Wall Sounders

The protocol must utilise digital transmission techniques combined with suitable error checking and fast response capability using flag setting and grouping options.

The device must use soft addressing methods with the address held in non-volatile memory within the main body of the device.

Devices shall incorporate **bi-directional short circuit isolators (For Detectors/Device without inbuilt isolator, Fault Isolator or Isolator base to be provided with each detector/device)**

The Wall Sounder must offer low current consumption of less than 500µA in quiescent and nominal 5mA in alarm conditions.

The Wall Sounder shall be third party certified to **EN54/ UL/Vds**

The Wall Sounder shall provide facility for volume adjustment together with offering a maximum sound pressure output of up to 98dBA.

The Wall Sounder shall provide a choice of tone settings enabled via software selection through the panel configuration.

Sounder tones shall be capable of being synchronised under panel control. The device shall allow interrogation remotely via the panel or via a hand-held programmer to determine status and production data. The Wall Sounder shall be designed to operate over a system loop voltage range of 17 to 30VDC.

The Sounder shall provide a surface mount capability with a back box that incorporates 20mm cable gland connection options.

The Sounder body shall be moulded from impact resistant Red thermoplastic.

Device software shall feature a distinctive Type ID to allow the panel configuration software to identify the device type for group monitoring and control purposes.

Wall Sounder Beacon

The protocol must utilise digital transmission techniques combined with suitable error checking and fast response capability using flag setting and grouping options. The device must use soft addressing methods with the address held in non-volatile memory within the main body of the device.

Devices shall incorporate **bi-directional short circuit isolators (For Detectors/Device without inbuilt isolator, Fault Isolator or Isolator base to be provided with each detector/device)**

The Wall Sounder beacon must offer low current consumption of less than 500µA in quiescent and nominal 9mA in alarm conditions. The Wall Sounder beacon shall be third party certified to EN54 / UL/ Vds. The Wall Sounder beacon shall provide facility for volume adjustment together with offering a maximum sound pressure output of up to 98dBA.

The Wall Sounder beacon shall provide a choice of tone settings enabled via software selection through the panel configuration. The Wall Sounder beacon shall provide a flash rate of 0.5Hz or 1 Hz The device shall allow interrogation remotely via the panel or via a hand-held programmer to determine status and production data. The Wall Sounder beacon shall be designed to operate over a system loop voltage range of 15 to 30VDC. The Sounder shall provide a surface mount capability with a back box that incorporates 20mm

cable gland connection options. The Sounder body shall be moulded from impact resistant Red thermoplastic. Device software shall feature a distinctive Type ID to allow the panel configuration software to identify the device type for group monitoring and control purposes.

Beam Detector

Addressable or conventional type beam detector. All required modules and power supply should be considered for conventional type. Low level system controller shall be provided for carrying out configuration and alignment. The beam detector shall be reflective type, auto aligned and shall be configurable from 8m to 100m. Each system controller shall support two detectors.

The controller shall provide separate fire and fault relays per detector.

The beam detector shall be third party certified to EN54 / UL/ Vds

CLEAN AGENT SYSTEM TECHNICAL SPECIFICATIONS

1 CLEAN AGENT BASED(NOVEC 1230 LOCAL FLOODING SYSTEM FOR ELECTRICAL PANEL

General

The scope covers Supply, Installation, Testing and Commissioning of Automatic clean agent based Novec 1230 local flooding system complete for electrical panels with flexible Fire trace detection tubing, cylinder, valves, integration with Main Fire Alarm Control Panel for status monitoring etc. The scope of work includes, but not limited to the following.

- Providing clean agent Novec 1230 flooding system with flexible fire detection/ discharge tubes inside panels.
- Clean agent storage cylinder valve assembly
- Audio-visual annunciation devices for indicating incidence of fire.
- Any other item required to the successful commissioning of the system.
- Complete system should be LPCB/UL/VDS approved
- Vendor has to submit project specific authorization letter issued by the OEM at time of bidding.
- The Cylinder must be filled in a UL/FM/PESO approved plant owned by the system OEM.

The electrical panel fire suppression system shall be complete with Direct Clean Gas storage cylinders for required capacities, extinguishing agent as specified, fire detection tubing, filling and end-of-line adaptors, pressure switches, control equipment, Clean Agent Cylinder/Valve Assembly, Cylinder Mounting Bracket and all necessary accessories to protect the Electrical panel in case of fire. The system will have an interface with Main Fire Alarm and Control Panel. In case of fire in the concerned panel, indication of Fire/discharge status should come in Main Fire Alarm and Control Panel.

Design Requirements

1. All the detecting devices, alarm, indicating devices, containers and other related equipment shall have required approvals & Authorization.
2. All installations shall conform to LPCB requirements.
3. Clean Agent Novec 1230 should be used with below mentioned properties
 - The Clean Agent should have Zero Ozone Depletion Potential. (ODP = 0)
 - The Clean Agent should not have Global Warming Potential of more than 1 day.
 - The Clean Agent should be a low pressure.

System Equipment

The tube should be UL Listed (UL-521) and shall be installed throughout the Electrical Panel with one end connected to the top of the Clean Agent container valve. The tubing shall be pressurized with Dry Nitrogen to 195 psig. The tube shall burst at temp of 100-120 degree C. Tube should be red colour marked with OEM name and shall perform below three functions:

1. Heat Detection,
2. System Activation and
3. Clean Agent discharge.

Clean agent Container

1. All cylinders shall be approved to DOT (NFPA) and PESO requirements. Containers shall be standard model and size of ease of replacement and addition.
2. Each storage container shall be equipped with a nickel-plated brass valve, a pressure gauge to monitor container pressure, and a quarter-turn ball valve that interfaces with the detection tubing. The quarter-turn ball valve shall be kept closed at all times when the container is not in service.
3. All container valves shall be equipped with a pressure relief valve (rupture disc) device in compliance with DOT requirements.
 - The clean agent based Pre-Engineered automatic direct fire suppression system should be UL/LBCP/VDS approved.
 - Each clean agent pre-engineered automatic system is equipped with its own detection/discharge tubing. Vendor to submit detailed drawings & calculations based on design specifications of Approval agency.
 - The unit shall be a self-contained and shall be equipped with its own non-electric automatic detection system to detect the fire and agent release system into the Electric panel to suppress the fire.
 - The Clean Agent is stored in DOT/PESO approved steel cylinders as a liquefied compressed gas, super-pressurized with Dry Nitrogen to 195psig at 70°C F. The ambient operating temperature range for all system components should be 0 degree C to 54 degree C.
 - Each container is equipped with a nickel-plated brass valve, a pressure gauge to monitor container pressure, and a quarter-turn ball valve that interfaces with the Detection Tubing. In addition, the container valve shall be equipped with a pressure relief (rupture disc) device in compliance with DOT/PESO requirements.
 - Provide wall-mounted painted steel bracket to mount the container/valve assembly in a vertical (upright) position. Each bracket should be equipped with at least two integral quick-clamp straps as per manufacturer standard practice.
 - Distribution of Detection Tubing shall be ensured in each compartment of the Panel viz. Busbar Section, Switchgear Section and Cable Alleys etc. with routing on any two sides. Mounting/ installation of the detection tube to be as per manufacturer design.

Item No:- 424-429

25. CCTV & SURVEILLANCE SYSTEM

The Entire surveillance system is proposed and designed to control and monitors the different buildings

of GBU Gandhinagar Campus. All the buildings shall have IP Based Dome/Bullet Camera indoor/Outdoor type and PTZ Cameras for outdoor surveillance. The different types of cameras shall be provided at locations as mentioned in Design Basis Report.

The Dome Cameras and Bullet Cameras are proposed to be installed at all Entry & Exit Points, corridors, Lift Lobby & staircase entrances in buildings and at all floors.

All the outdoor cameras shall be in IP 66 Housing and Junction box, power supply unit, media converter etc are proposed in dust proof housing The existing LAN network switches would be used for CCTV connectivity and will be connected to central CCTV server & cameras shall have POE connectivity ports. The power supply to LAN switches will be on UPS. The video recording shall be non embedded based recording server of reputed make with video management software.

Control Room shall be located in the Security /Control Room. The wiring inside the building shall be with CAT 6A cable in PVC conduit and Armoured fiber Optic Cable and Outdoor connectivity shall be under ground in HDPE pipes with suitable Manholes for proper Maintenance of the system. PTZ cameras will be placed on roof top and Street light Poles in external areas. The video management server should have **minimum 30 days** storing capacity for all cameras from day 1.

Technical Specification of IP CCTV System

Technical Specification of Dome camera

S.No.	Technical Specification		Compliance YES / NO
1	General		
2	Imaging Device	1/2.8" progressive scan CMOS	
3	Maximum Resolution	2MP - 1920 x 1080P	
4	ONVIF	Profile S, G & T	
5	Minimum Illumination (May vary depending on the lens)	Color : 0.005Lux @F/1.6 B/W : 0Lux @F/1.6(IR on)	
6	IR Range	50m, 04 IR LEDs	
7	Day/Night Method	Auto ICR	
8	Signal-to-Noise Ratio	50 db minimum	
9	Electronic Shutter Range	Auto/Manual, 1/8 ~ 1/30,000s	
10	Dynamic Range	120 db minimum	
11	Back light compensation	HLC, WDR(120dB)	
12	Digital Noise Reduction	3D Noise Reduction	
13	Analytics	Video Motion Detection, People Counter, Loitering, Intrusion, Tampering,	
14	Privacy Zone	4 configurable windows	
15	Region of Interest	8	

16	Image Settings	Compression,3D digital noise reduction (ON/OFF) color, brightness, sharpness, contrast, white balance, exposure control, backlight compensation/WDR	
17	Defog	Yes	
18	Electrical		
19	Network	RJ-45 (10/100Base-T)	
20	Power Input	PoE (802.3af) Class 0 /12VDC	
21	Power Consumption	Max 7W	
22	Local Storage	Micro SDHC Max 256GB	
23	Alarm I/O	1In & 01 Out	
24	Mechanical		
25	Lens	2.7-13.5 mm auto focus motorized optical zoom FOV H: 88°~24°	
26	Video		
27	Video Encoding	H.265, H.264 Smart Codec bit rate control (CBR and VBR)	
28	Video Streams	3 Streams or Better	
29	Frame Rate	Main Stream: up to 2MP (1~25fps)	
30		Sub Stream: up to D1/4CIF(1~25fps)	
31		Third Stream: up to VGA (1~12fps)	
32	Supported Protocols	IPv4, IPv6, TCP/IP, HTTP, HTTPS, UPnP, RTSP/RTP/RTCP, IGMP, SMTP, DHCP, NTP, DNS, DDNS, QoS, SNMP, 802.1X, UDP, ICMP, ARP, TLS	
33	Security	User account and password protection, HTTPS, IP Filter, Digest authentication, TLS1.2 only, Stream encryption, AES-128/256, SSH/Telnet closed, PCIDSS compliance	
34	Supported browser	Chrome/Edge	
35	Snapshot	Full resolution snapshot	
36	Audio		
37	Compresiiion Codec	G 711A, G711U	
38	Interface Type	Line In & Line Out	
39	User		
40	Unicast	10users	
41	Multicast	Unlimited	
42	Security Access	Multiple user access levels with password protection IP filtering, HTTPS, IEEE 802.1x	
43	Environmental		
44	Operating Temperature	-30°C to 60°C	
45	Operating Humidity	0% to 90%, non-condensing	
46	Housing	IP66/67 & IK10	
47	Regulatory		

48	Emissions	FCC PART 15B, EN 55032	
49	Immunity	CE (EN 50130-4)	
50	Safety	UL 62368-1, EN 62368-1	
51	RoHS	CE (EN 63000)	

Technical Specification of Bullet camera

S.No.	Technical Specification		Compliance YES / NO
1	General		
2	Imaging Device	1/2.8" progressive scan CMOS	
3	Maximum Resolution	2MP - 1920 x 1080P	
4	ONVIF	Profile S, G & T	
5	Minimum Illumination (May vary depending on the lens)	Color : 0.005Lux @F/1.6 B/W : 0Lux @F/1.6(IR on)	
6	IR Range	60m, 04 IR LEDs	
7	Day/Night Method	Auto ICR	
8	Signal-to-Noise Ratio	50 db minimum	
9	Electronic Shutter Range	Auto/Manual, 1/8 ~ 1/30,000s	
10	Dynamic Range	120 db minimum	
11	Back light compensation	HLC, WDR(120dB)	
12	Digital Noise Reduction	3D Noise Reduction	
13	Analytics	Video Motion Detection, People Counter, Multi Loitering, Intrusion, Tampering,	
14	Pravicy Zone	4 configurable windows	
15	Region of Intrest	8	
16	Image Settings	Compression,3D digital noise reduction (ON/OFF) color, brightness, sharpness, contrast, white balance, exposure control, backlight compensation/WDR	
17	Defog	Yes	
18	Electrical		
19	Network	RJ-45 (10/100Base-T)	
20	Power Input	PoE (802.3af) Class 0 /12VDC	
21	Power Consumption	Max 7W	
22	Local Storage	Micro SDHC Max 256GB	
23	Alarm I/O	1In & 01 Out	
24	Mechanical		

25	Lens	2.7-13.5 mm auto focus motorized optical zoom FOV H: 80°~24°	
26	Video		
27	Video Encoding	H.265, H.264 Smart Codec bit rate control (CBR and VBR)	
28	Video Streams	3 Streams or Better	
29	Frame Rate	Main Stream: up to 2MP (1~25fps)	
30		Sub Stream: up to D1/4CIF(1~25fps)	
31		Third Stream: up to VGA (1~12fps)	
32	Supported Protocols	IPv4, IPv6, TCP/IP, HTTP, HTTPS, UPnP, RTSP/RTP/RTCP, IGMP, SMTP, DHCP, NTP, DNS, DDNS, QoS, SNMP, 802.1X, UDP, ICMP, ARP, TLS	
33	Security	User account and password protection, HTTPS, IP Filter, Digest authentication, TLS1.2 only, Stream encryption, AES-128/256, SSH/Telnet closed, PCIDSS compliance	
34	Supported browser	Chrome/Edge	
35	Snapshot	Full resolution snapshot	
36	Audio	2-Way Full Duplex	
37	Compression Codec	G 711A, G711U	
38	Interface Type	Line In & Line Out	
39	User		
40	Unicast	10users	
41	Multicast	Unlimited	
42	Security Access	Multiple user access levels with password protection IP filtering, HTTPS, IEEE 802.1x	
43	Environmental		
44	Operating Temperature	-30°C to 60°C	
45	Operating Humidity	0% to 90%, non-condensing	
46	Housing	IP66/67 & IK10	
47	Regulatory		
48	Emissions	FCC PART 15B, EN 55032	
49	Immunity	CE (EN 50130-4)	
50	Safety	UL 62368-1, EN 62368-1	
51	RoHS	CE (EN 63000)	

Technical Specification of PTZ camera

S.No.	Technical Specification	Compliance YES / NO
1	General	

2	Video Format	PAL	
3	Resolution	2MP (1920 x 1080)	
4	Image Device	1/2.8" Progressive CMOS sensor or Better	
5	Minimum Illumination	Color: 0.07 Lux @ F1.6; 0 Lux - IR On	
6	EIS	Yes	
7	WDR	Minimum 120 dB True WDR	
8	Focal range	Wide Min 4/4.5mm to 160/180 mm or Better (30x Optical Zoom)	
9	Angle of View	FOV H: 65°~1.5° or Better	
10	Video		
11	Video Encoder	H.265, H.264, MJPEG dual stream	
12	Main resolution	Stream	2MP @ 25/30fps others 50/60 fps
13	Secondary resolution	Stream	720P/CIF @ 50/60 fps
14	Tertiary resolution	Stream	D1/CIF @ 50/60 fps
15	Protocols	IPv4, IPv6, TCP / IP, HTTP, HTTPS, UPnP, RTSP / RTP / RTCP, IGMP/ Multicast, CIFS / SMB, SMTP, DHCP, NTP, DNS, DDNS, CoS, QoS, SNMP, 802.1X, UDP, ICMP, ARP, TLS	
16	Security	User account and password protection, HTTPS, IP Filter, Digest authentication, TLS1.2 only, Stream encryption, AES128 / 256, SSH / Telnet closed, PCIDSS compliance, FIPS Chipset Built-In	
17	Focus Mode	Full Duplex, G.711, G.726	
18	Defog	Yes	
19	EIS	Yes	
20	S/N Ratio	> 55dB(AGC Close)	
21	Mechanical		
22	Pan Angle	360° Rotation Capability	
23	Tilt Angle	-20° ~90°, auto flip 180°	
24	Pan Speed	0.1°~400°/Sec	
25	Tilt Speed	0.1°~200°/Sec	
26	Preset Speed	400°/Sec	
27	Preset Positions	256	
28	Power failure auto resume	Yes	
29	Wide Dynamic	ON/OFF	
30	Bit rate	20k to 80mbps	
31	Auto Pan Scan	Yes	
32	Privacy Mask	24	
33	Alarm Input / Output	2In / 01Out	

34	Alarm Events	Motion Detect; Video Tamper; Audio Detect; No SD card; SD card error; SD card capacity warning; Network disconnection; IP address conflict; Illegal access	
35	Audio	1 channel input, 1 channel output	
36	Auto tracking	Yes	
37	Analytics	Intrusion, Loiter, Line crossing, Unattended object, Missing object, Face detection	
38	Ethernet	10/100M	
39	Housing	IP66 with IK10 full body rating (including glass face plate),	
40	In-built IR range	200m	
41	In-built IR illuminator	Smart-IR	
42	IR light control	On (Zoom priority/Manual)/Off	
43	Environment	Outdoor IP66 & IK10	
44	Electrical		
45	Power Supply	12V DC/ 24 VAC	
46	PoE	High PoE (Class 5)	
47	Environmental		
48	Operating Humidity	0% ~ 90% (non-condensing)	
49	Operating Temperature	-40°C ~ 70°C	
50	Minimum Users	10	
51	Micro SD Card	Support up to 256 GB	
52	Regulatory		
53	Emissions	FCC PART 15, CE (EN 55032)	
54	Immunity	CE (EN 50130-4)	
55	Safety	UL LISTED TO UL / CSA 62368-1, CE (EN 62368-1), UL / CSA 60950-22, CE (EN 60950-22)	
56	RoHS	CE (EN 50581), EAC (TR EAEU 037 / 2016), UAE (Cabinet Decree No.10 of 2017)	

Technical Specification of Network Storage Management system

S.No.	Technical Specification		Compliance YES / NO
1	No of Desktop Client License	Min 10 concurrent	
2	No of Monitor Per Client Workstation	Min 2 or 4 Monitor per Client Workstation	
3	Recording Performance	2MP resolution 128 Cameras @ 25fps each	

4	Video Stream Supported	Web Client: Live - 64 streams, Playback - 32 streams.	
5		Desktop Client: Live - 256 streams, Playback sessions - 32.	
6		Sync playback - 9 streams.	
7		Mobile App: 16 streams of 1080p HD @ 5 fps each.	
8	Playback Speed	FWD/REV Play x (1, 2, 4, 8, 16) Slow FWD/REV Play x (1/2, 1/4, 1/8)	
9	Archival Support	Yes, 100 mbps	
10	Processor	Intel Xeon Silver 4210 2.2 GHz or Better Xeon	
11	RAM	32GB	
12	OS Drive	Minimum 2 x 240GB SSD in RAID 1	
13	Operating System	Microsoft® Windows 10 or Windows 10 IoT Enterprise or Windows Server 2019	
14	Networks Interface	4 Network Card 1Gbps	
15	Monitor Resolution	Video resolution 1280x1024 pixels, 32 bit	
16	Keyboard Mouse	102-key keyboard and mouse	
17	Storage Hard Drives	12 filed upgradable SATA/SAS hard drives , Each disk capacity up to 20TB	
18	Storage Capacity	240 Raw, Video should be configured in RAID 5 as min,	
19	VIDEO STORAGE DRIVES	Enterprise drive, 7200 RPM SATA/SAS recommended	
20	RAID Controller	Hardware RAID, Data RAID Level: 0, 1, 5, 6, 10	
21	Power Supply	750W Redundant Power Supply	
22	Operating Temperature	10°C to 30°C (50°F to 86°F)	
23	Relative Humidity	10-80% non-condensing	
24	Hardware Chipset Security	TPM2.0	
25	Codec	MPJEG, MPEG4, H.264, H.265	
26	ONVIF	Onvif S, G & T	
27	Audio Support	2 -Way	
28	Screen Layout	Desktop Client - Full, 2x2, 1x5, 3x3, 2x8, 1x12, 4x4. Web Client - 2x2.1x1,1x2,1x3. Mobile app (Phone) - 2x2,2x4,1x2, 1x1. Mobile app (Tablet) - 3x3, 2x2, 1x1	
29	Image Controls	Sharpness, blur, brightness, contrast, hue, saturation, maintain aspect ratio, stretched, original size and picture mirror	
30	Video Search	Time/date timeline, time jump FWD/REV, bookmarks, calendar, preview, film strip, event search and SMART Motion Search	

31	Video Export	Native Format with Clip Player for faster and secure exports. WMV with digital certificate for authentication playable with Windows media player. ASF for faster exporting of longer than an hour backup clips in native compression format	
32	Video Clip Security	Digital Certificate and/or Tool provided to check the clip tampering	
33	Regulatory		
34	Emissions	FCC Part 15 ClassA, EN 55032, EN 55024, EN 61000-3-2, EN 61000-3-2	
35	Safety	UL 60950-1, EN 62383-1, EN 62368-1	
36	RoHS	CE (EN 63000)	

Technical Specification of Video Management System

S.No.	Technical Specification		Compliance YES / NO
1	Platform	VMS should support and run on 64-bit Windows® Server 2019/ Server 2016 / Server 2012 STD	
2	Scalability	VMS shall include a fully scalable enterprise-class media management system to enable simultaneous live monitoring from multiple stations and be configurable for storage both on and off site	
3		The number of recorders and switchers shall be scalable within a network to handle any size of installation.	
4	License	License for cameras and clients should be bundled with the software, keeping in view of future expansion. Any additional server / hardware required to cater to these licenses must be provided at no extra cost. All Camera firmware upgrades to be free during warranty period as well as CAMC period.	
5	Compatibility	Latest standard of ONVIF Profile S, G & T	
6	Redundancy	VMS should support Database redundancy for unforeseen/maintenance scenarios	
7		Support for N+1/N+M Recorder failover and failback automatically or manually	
8	Functionality	Capable of managing pentaplex user operations of attached recording devices simultaneously, including live viewing, recording, playback, archiving of video data to an external storage device, and handling the exchange of data between the server and a remote workstation.	
9		Should also be able to perform System configuration and Alarm management from	

		operator workstation	
10	Configurator	The operator (with Administrator privileges) shall have the option to configure VMS. VMS shall support live updates of all configurations. The following configurations shall be possible:	
11		Option to add/edit/delete Recorders, Cameras, Monitors, Keyboard, Site, Workstation, Partition and Event group.	
12		Associate cameras to a recorder or switcher and map to a site, partition or event group.	
13		Add monitor to a site, partition, event group or keyboard. It shall provide an option to add a digital monitor and associate it with a workstation with provision to configure a digital monitor with a default salvo and startup in full screen.	
14		Support of bulk event association to enable/disable and adjust events for recorders and inputs in bulk.	
15		System Macro Configuration: Option to add/edit/delete macros. Option to restore macros. Execute button option to trigger selected macros provides mechanism for testing written macros.	
16	Recording	Should support Audio / Video recording.	
17		Continuous, scheduled, manual, event and alarm-based recording. All modes shall be disabled and enabled using scheduled configuration.	
18		Different recording speeds (fps) and resolution for each recording mode for each camera shall be possible.	
19		Software Should support ANR (Automatic Network replenishment) Feature where camera should Record to Camera SD card during it gets disconnects from Storage. Once connection is established recording in SD card can be replenished automatically to storage.	
20		The Recording System, once configured, shall run independently of the Video Management system and continue to operate if the Management system is off-line.	
21	Video Compression	Simultaneous use of multiple video compression including H.264, H.265 (including camera dependent smart codec support), MPEG-4 and MJPEG	
22		VMS should support H.265 GPU rendering.	
23	Storage	Multi-level storage: should support multi-level storage (live recording on primary disk, archiving on secondary, and so on).	
24		Should delete video after configurable duration	

		(FIFO based).	
25		Provision to configure different retention periods for every camera.	
26		Should Support NAS/IP SAN through iSCSI transfers.	
27	Archiving	Support for Custom Video Archival period for every camera maximum upto 5 years on FIFO basis	
28	User Logins	VMS Server and Workstation shall have the option of two modes of user logins	
29		Windows Authentication: Uses the Windows logged-in user name.	
30		Active Directory user authentication	
31		User DB Authentication: Uses a preconfigured user name and password	
32	User Management	Users and Roles: Option to add/edit/delete roles and associate to predefined privileges.	
33		Add/edit/delete users and associate users with roles	
34	Viewer	Simultaneous Live view and Playback from different cameras by multiple users.	
35		Viewing screen should be capable of showing 1x1, 2x2, 3x3, 4x4, 5x5, 6x6, 7x7,8x8,1x2, 2+8, and 1+12 layouts of video	
36		Capable of saving current View as a Salvo and/or Shared Salvo to be accessible to other operators.	
37		Capable of selecting a particular camera or salvo by using the mouse to drag it onto the main video viewing screen	
38		Perform Motorized Zoom and focus for all supported cameras (ptz, bullet, dome etc...) remotely from client workstations or control room	
39		Capable of independently adjusting the contrast, brightness, and saturation settings for each camera.	
40		Remote Monitor: This facility shall allow operators to control a remote monitor connected to another workstation and perform review capabilities so that both the local operator and the remote viewer can simultaneously watch the same video	
41		Innovative "One-Click" or "Mouse Drag" 3D PTZ control experience that does away with legacy PTZ controls of continuous clicking	
42		Support for 360° de-warping of fisheye camera into multiple tile views from operator workstation	

43		Operator messaging: allowing operators to communicate with each other. Operators can exchange text, images and annotated video sources. Operators can hand over a video source to another operator using messaging	
44		Surrounding Camera View: VMS Client application shall have facility of surrounding camera view.	
45		In a surround view, video from a specific/intended device shall be playing in the Centre and the other videos will be from surrounding devices.	
46		Every video device can be mapped with 12 cameras.	
47		It shall support setting presets in surrounding cameras.	
48		Scan Sequences: Capable of configuring and running scan sequences. Sequence view shall consist of camera view, which can be cycled on a timed basis. There shall be no limit to number of cameras that can be assigned to a single sequence. There shall be no limit on the number of available sequence views.	
49		Create and save virtual cameras in layout for live viewing by digitally zooming into the field of view of camera. These virtual cameras should not require any additional license and operators should be able to create multiple such views.	
50		Adaptive Network Throttling by auto-switching of camera streams to lower resolution / FPS	
51		Body pixilation and blurring in live view to protect customer and employee privacy from abuse of surveillance data	
52		Option to perform various other operations through the context menu on a particular video (live/recorded/sequence). These operations include: Full screen, point and drag, maintain aspect ratio, toggle text, digital PTZ, start/stop recording, save image.	
53	Bookmarks	Operator should be add/delete bookmarks for Live, Recorded videos	
54		Should have provision to add comments to Bookmarks	
55		Support for bookmark searches based on cameras, time duration, and comments	
56	Time Line	Ability to display/manage the timeline of the recording device, which provides camera recording statistics with Min 8 color recording indications,	

57		Mark in/out (with looping facility), snapshot, time slider, time search, time jump, and play controls.	
58		Timeline control shall also include dedicated buttons for step reverse and step forward and keyboard shortcuts for playback operations.	
59	Event Management	Register event associated video and alert operator	
60		Motion detection and camera tampering events should be alerted to the operator	
61		Ability to slue PTZ cameras to alarm-generated areas	
62		In case of an alarm operator should be able to view the video during pre-alarm, on-alarm, post-alarm, and also view live video from the camera which triggered the alarm through a single 2x2 salvo	
63	Search and Playback	Should be able to search video based multiple filters like Recorders, Cameras, Date/Time, Type/Event	
64		Calendar Search with thumbnail image preview of recording and quick export of video clips	
65		Should have advanced, smart search function performing quick Motion Detection search on recorded video for multiple user defined region of interest	
66		Should support sync playback between multiple recorders	
67		Playback with speeds ranging from 1/64X to 256X.	
68		Support for smooth reverse playback at 2x (Recorder Dependent)	
69		4-Eye dual user authentication for playback	
70		of original video record	
71		Export Clip/Video	The VMS shall export video and audio data optionally in ASF/MOV/WMV format to a CD/DVD drive, a network drive, or a USB drive. The exported data in ASF/MOV/WMV format may be played back using standard software such as Windows Media Player.
72	The VMS shall export video and audio data optionally in its native recording format to a CD/DVD drive, a network drive, or a direct attached drive. Viewer software shall be included with the export.		
73	The video management system shall write a digital signature to the exported video. This shall allow the viewing client to verify, that the imported video has not been tampered. The utility/verification tool shall provide a warning in		

		case that the video has been tampered. This shall be done by means of the checksum of the digital signature.	
74		It shall be possible to password protect the video export. The export can then only be opened and viewed when the corresponding password is entered.	
75		Salvo clip export provide a clip export option to create an instant clip while maintaining the salvo information	
76		Incident management mode: allows export of recording by selecting multiple cameras at different times to create a single clip to play the cameras back in order (sequentially)	
77	Maps	System shall support Map based surveillance.	
78		Maps navigation with site / building / floorplan hierarchy	
79		Easy configuration: Drag and drop a camera on to a floorplan	
80		Provision to Zoom In or Zoom Out the map	
81		Camera alarm indication and alarm status (latest 10) on map	
82		Analyze the alarms and playback the associated video	
83		Perform PTZ and preset actions on relevant cameras	
84		Instant Playback with easy forward/reverse enhanced with calendar selection	
85		Undock Popup View: Drag freely across map to avoid overlapping / covering other icons and views	
86		Full Screen View of Cameras to capture details of HD video	
87	Cyber Security	Enhanced password security – non-recoverable passwords, enforcing complex passwords, password expiry, and no default passwords.	
88		Secured firewall configuration.	
89		Secured Web client – enabled HTTPS and TLS 1.2, and protection from CSRF and XSS attacks.	
90		Restricted folder and Registry access to operators.	
91		Secured Assemblies – Digital signing.	
92		Secure communication with Cameras using TLS 1.2	
93	Report	It shall be possible to get reports on past events by querying the databases.	
94		System Report - Event history reports for cameras, Monitors, Recorders	

95		Operator Log reports based on operator activities like log In / Log Out , creating clip, adding bookmark etc	
96		Health Report	
97		Failover Reports	
98		Configuration reports	
99		Create and save custom reports as per pre define and frequent format with in VMS or Various other format	
100		Log reports shall be exported in RPT, XLS, DOC, RFT, PDF formats and	
101		Email for alarms and failover	
102	Integration with other systems	Seamless integration with electronic access control systems	
103		Integration with video analytics and a data management utility.	
104	OEM Authorization Letter - Manufacturer Authorization Form (MAF)	Vendor has to submit MAF along with the Technical Specification.	
105	VMS Server Specification		
106	Processor	Intel® Xeon® E-2236 3.4GHz, Chipset Intel® C246	
107	OPERATING SYSTEM	Windows® Server IoT 2019	
108	SQL	Express	
109	Power Supply	Dual 350W Hot-plug Redundant Platinum power supplies	
110	SYSTEM MEMORY (RAM) GB	16 GB DDR4	
111	DVD DRIVE	Optional	
112	DISK	Dual (RAID1) 480GB SSDs for OS	
113	VIDEO ADAPTER/CARD	Matrox G200	
114	NETWORK ONNECTION	2 x RJ45	
115	VIRTUAL ENVIRONMENT	As required.	
116	Input Voltage	100~240 VAC 50/60 Hz	

Technical Specification of Professional Display

S.No.	Technical Specification		Compliance YES / NO
1	SCREEN SIZE	65" or 163 cm diagonal	
2	ASPECT RATIO	16:09	

3	RESOLUTION	UHD (3840*2160)	
4	VIEWING ANGLE (HORIZONTAL / VERTICAL)	178°/178° (H/V)	
5	AV IN	Yes	
6	USB INPUT (2.0 SUPPORT)	2*Side (USB2.0)	
7	HDMI INPUT	3*Side (HDMI 2.0)	
8	HEADPHONE OUT	1*Side	
9	RJ-45	1*Side	
10	USB DEVICE SUPPORT	USB Supported HDD	
11	AUDIO OUTPUT POWER (RMS)	20 W (10+10 W)	
12	BLUETOOTH	Yes	
13	INBUILT WIFI	Yes	

Technical Specification of Workstation/Client PC

S.No	Technical Specification		Compliance YES / NO
1	PROCESSOR	Intel® Core™ i7 10700 , Chipset Intel® Q470	
2	OPERATING SYSTEM	Windows® 10 IoT Enterprise	
3	COMPUTER TYPE	WorkStation	
4	SYSTEM MEMORY (RAM)	16 GB (2 x 8 GB)	
5	DVD DRIVE	DVD +/- RW	
6	DISK	500 GB SSD	
7	NETWORK CONNECTION	1 x RJ-45 10/100/1000 Mbps (Rear)	
8	USB	1 x USB 2.0 port with Power Share	
9		1 x USB 3.2 Gen 1 Type-A port	
10		1 x USB 2.0 port	
11		1 x USB 3.2 Gen 2 Type-C port , REAR :- 2 x USB 2.0 ports with Smart Power On	
12		4 x USB 3.2 Gen 1 Type-A ports	
13	Monitor OutPut	2 x DisplayPort 1.4 (Rear)	
14	Audio	1 x 3.5mm Universal Audio Jack (Front)	
15		1 x 3.5mm Line-out re-tasking	
16		Line-in audio port (rear)	
17	Input Voltage	100~240 VAC 50/60 Hz	

Testing & Commissioning :

All CCTV work shall be considered commissioned after checking the installation of CCTV with proper numbered on Cameras and on final drawings, including verification of all VMS features, Analytics etc. All fiber, Copper laying, Media Converter, PoE injector, Fiber splicing, Outdoor (IP 66) Fiber Joint enclosure, storage box at pole etc. shall be the part of the installation of the CCTV system. Nothing extra shall be paid on CCTV system.

Item No:- 407-408

30. IPABX SYSTEM

IP Based IPABX system shall be connected from central location in the campus at GBU Gandhinagar. All the Telephone in the Complex will be IP Based and will use the proposed LAN Network for the communication within the complex as well as for outside the complex. All Rack Panels of Individual buildings shall be connected to Central EPABX system through Optical Fiber Cable to be laid underground in HDPE Pipe of suitable size. Manholes with covers shall be provided in the underground HDPE pipe at suitable lengths for easy pulling & maintenance of cables.

Item No:- 407

SITC of Digital / PCM / TDM EPABX System having SMT design, system with flexible universal slots. Inbuilt Auto attendant facility, Minimum 15 Nos. conference, Analog extension line, Calling GSM, E&M line, PRI / EI & VOIP program me through Analog telephone digital key from Ethernet, public address cord, shall have unrestricted simultaneous dialing facility, QSIG protocol on PRI, 95 / STD / ISD / Local-Locking, Class of Service, Quick Dial-Single Digit dialing of any two external number, Once only ring device, Chairman / Secretary - Do not disturb Facility, Power Down Mode, Hot Line, Hot Outward Dialing, Day Night Mode, Auto Call Back, Barge-in, Call Pick

Up & Call Transfer, Call transfer while Ringing with Voice Guide System, (DISA), Caller ID (CLI), CLI Base ECF, CLI Base routing Internet Ready Port, External Music Port, Call Budgeting, Call Most Calculation (ASMDR), DID Direct Inverse Dialing, External Music Input, Fax Homing, Global Directory Printing with following capacities [[Approved by Competent Authority i.e. not Below the rank of Executive Engineer]-[C] No of Extension 48, No of Junctions 9, 8 Port IP Resource in-built, 4 Port Web base Video Conferencing, No of expandable ports : 128, Operators Console - 01 Compatible : ISDN

Item No:- 408

Providing and erecting IP Phone with display with all IP system supported [[Approved by Competent Authority i.e. not Below the rank of Executive Engineer]

Testing & Commissioning of Passive Components:

All the features of the EPABX system shall be checked to Engineer In Charge. After installation & features verification Commissioning of the EPABX components shall be completed

Item No:- 392-406

31. LAN NETWORKING & WIFI SYSTEM SPECIFICATIONS

General:

RJ 45 data outlets are proposed to be provided for Computers, networking, telephones, Wi-Fi, CCTV etc. as per requirement in rooms and other areas at various floors in all the blocks / Buildings.

The Data Outlet points shall be connected to Rack Panel/Computer hub with 4 pair Cat-6 wiring in recessed conduit / Raceways.

The maximum Length of the Cat 6 cable from end user point to the Hub or Edge switches shall not be more than 90Mtr. Beyond this length Fiber Optic Cable shall be used. UPS Power supply to these computers will also run through conduits/ floor trunking.

The Rack Panel/computer hub at various floors will be connected to Main rack of the building/ block with fiber optic cable through conduit or raceways on surface/in recess. The main server shall be connected to Distribution switch through Optical fiber cable of

40 Gbps and Distribution switch shall be connected to Edge switches of each building/ block with fiber cable of 10 Gbps link in underground HDPE pipe of suitable size in outside connectivity or in cable

raceway/conduit inside the buildings. Brick masonry manholes with covers shall be provided at suitable lengths to facilitate easy wire pulling & Maintenance.

Wireless access points for Wi-Fi connectivity are proposed in Hostel blocks, SAC block, Director Residence etc. All types of hostel shall have only Wi-Fi connectivity whereas other buildings in the complex shall be with wired data outlets along with the Wi-Fi connectivity.

The LAN SYSTEM comprises of Passive components and Active Components. The Technical specifications of both the components are given below:

A. PASSIVE COMPONENTS

PASSIVE PRODUCTS SPECIFICATIONS FOR GBU GANDHINAGAR

Eligible Criteria for OEM		
S.No.	Description	Compliance (Yes / No)
1	The OEM of Passive Network Components should be present in the India for at least last 10 Years. (Document proof Required - Proof of Incorporation should be attached)	
2	Should have Technical / Telephonic support centre in India	
3	OEM must have ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018 or latest	
4	Factory Test report must be provided for the product during supply.	
5	All the components/raw materials used must be RoHS-verified	
6	OEM should have its Manufacturing units, Components and Finished Goods Warehouse & R&D labs in India.	
7'	OEM should have at least four dedicated Presales manpower in India for after sales support	
8'	25-year Performance warranty; Warranty to cover Bandwidth of the specified and installed cabling system	
9'	All networking passive material (Fiber Cable, Copper Cables, Networking Racks and their connectivity components) should be from one OEM make only.	
10	The Proposed OEM should be a member of TIA and BICSI and should have a CDCP, ITIL and a PMI-PMP / RCDD on the OEM's payroll sitting in India whose services can be utilized for this project. Valid Certificates of the OEM employees along with a letter from the OEM HR Department verifying that the employees are in fact sitting in India should be submitted. (Details must be provided).	
12	Quoted product part numbers must be available on OEM's official website	

SITC of CAT6 U/UTP LSZH Cable having minimum technical specification as mentioned below :

S. No.	Parameter	Specification	Compliance (Yes/No)
1	Type	CAT6 U/UTP, 23 AWG solid bard copper, Unshielded Twisted 4 Pair, Category 6, confirming to ANSI-TIA 568.2-D for Category 6 & ISO/IEC 11801 for Class E.	

2	Conductors	Solid bare copper 23 AWG	
3	Pair Separator	+ Shape Spline	
4	Packing	Box of 305 meters	
5	Cable Outer Diameter	6.0 ± 0.2 mm	
6	Delay Skew	< 45 ns	
7	Conductor Resistance	≤ 93.8 Ω/km	
8	Pulling Force	25 lb	
9	Nom. Velocity of Propagation	69%	
10	Temperature Range Storage	-20 °C to +70 °C	
11	Flame Properties	Flammability Test : IEC 60332-1	
		Acid Gas Emission Test : IEC 60754-1	
		Smoke Density Test : ASTM 2843	
12	Jacket Colour	Grey	
13	Regulatory Compliances	Should be ETL channel performance verified on a 04-Connector channel or more, tested upto 350Mhz or more with an MTPL Plug as per ANSI/TIA-568.2-D (Part Code to be mentioned in report and should be submitted along with bid) and UL Listed (Relivent Document to be shared)	
		OEM should be registered under an NRTL approved lab follow-up program	
		The Proposed OEM should be a member of TIA and BICSI and should have a CDCP, ITIL and a PMI-PMP or an RCDD on the OEM's payroll sitting in India whose services can be utilized for this project.	
		The OEM should be CE Certified and its manufacturing facility must adhere to Environmental Management Systems (EMS) through ISO 14001:2015 and adhere to Occupational Health and Safety (OH&S) management system through ISO 45001:2018 (Certificates to be Enclosed)	
14	Test Reports	OEM factory test reports must be provided.	
15	Make & Model	Bidder to specify	
SITC of 24 Port, 1U Category 6 / 6A Staggered Patch Panel, Unloaded having minimum technical specification as mentioned below :			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Quoted Make	To be Specified by the Bidder	
2	Quoted Model	To be Specified by the Bidder	

3	Type	24 Port, 1U Staggered Patch Panel, Unloaded - 1U	
4	Type	24 Port 1U Unloaded ZigZag / Staggered Patch Panel The design reduces Alien Crosstalk to support IEEE 802.3an and ANSI/TIA 568.2-D.	
		Patch panels IDC (IDC of Information Outlet) Connectivity Snap in Type should be at rear end & RJ-45 jack on front panel, 19" rack mountable.	
		Patch panels Ports should be individually replaceable & Consistent port-to-port performance and includes grounding bolt	
5	Availability	Patch Panel should be available with 24 Ports in 1U	
6	Cable management	The panel should have an integrated rear cable management bar that allows bunching of 6 cables and properly dressing the cables and tying them using a Velcro Tape to the rear cable management bar.	
7	Compatibility	Patch Panel should be able to accept Cat6A, Cat6 and Cat5e information outlets for backward and forward compatibility	
8	Height	1U (1.75")	
9	Storage Temperature Range	-40Deg C to +70 Deg C	
10	Operating Temperature range	-10Deg C to +60 Deg C	
11	Humidity	10% - 90% RH	
12	Color and Material	Metal SPCC, Black, plastic inserts, Double layer - 1.5mm, provided with mini cable ties, cage nuts & rare cable management.	
13	Regulatory Compliances	Should be UL/ETL channel performance verified with a MTP link even when termination is within 15 Mtrs. this ensuring eliminating short resonance for 4-connector channel as per ANSI/TIA-568.2-D and ISO/IEC 11801 Standards (Relivent Document from UL/ETL Report for 4 Connector need to be submitted which mentions quoted part code).	
		Shall be UL Listed and tested for corrosion as per ASTM B117: 2019. (Relivent Document to be shared)	

		Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863 and the OEM shall be a Class 1 local supplier as defined in public procurement (Preference to Make in India), .	
14	Test Reports	OEM factory test reports must be provided against each drum / roll of fiber cable.	
15	Make & Model	Bidder to specify	
SITC of Cat6 Modular Jack, Keystone Style having minimum technical specification as mentioned below :			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Type	CAT6 RJ45 Modular Jacks shall meet and exceed channel specification of ANSI/TIA 568.D-2, IEC/ISO 11801 & IEC 60603-7-4 when used as a component in a properly installed UTP channel.	
2	Housing Material	High impact Fire Proof ABS UL94V-0	
3	Front Connection	RJ 45 : PCB, 50μ Phosphor bronze gold over nickel plating contacts	
4	IDC Connector	Phosphor bronze , Tin-plating contacts	
5	PCB Material & Thickness	FR-4, 1.2mm thickness	
6	Termination Interface	Front Mated Connection: 750 Cycles Rear Mated Connection: 200 Cycles	
7	Plug and Outlet Contact force	≥ 100 Grams with FCC Compliant RJ-45 plug	
8	Plug retention Force	≥ 11lbf	
9	Jack wire material and thickness	0.35mm Phosphor bronze gold over nickel plating	
10	IDC Conductor	0.5mm Phosphor bronze , Tin-plating	
11	Contact Compatibility	Accommodates 23 to 26AWG solid	
12	Termination Pattern	TIA / EIA 568 A and B and Shall not have an integrated spring shutter as the shutter malfunctions and causes operational issues.	
13	Storage Temperature :	-40° to +70°C	
14	Electrical Performance	Insulation Resistance : ≥ 500mΩ	
		Contact Resistance : ≤10mΩ	
		Current rating : 1.5 Amps	
		DC Resistance : ≤ 0.1Ω	
		DC/AC Volt Endurance : DC1000V/AC750V 1min	

15	Regulatory Compliances	Should be ETL channel performance verified on a 04-Connector channel or more, tested upto 350Mhz or more with an MTPL Plug as per ANSI/TIA-568.2-D (Part Code to be mentioned in report and should be submitted along with bid) and UL Listed (Relivent Document to be shared)	
		Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863 and the OEM shall be a Class 1 local supplier as defined in public procurement (Preference to Make in India), .	
		The OEM should be CE Certified and its manufacturing facility must adhere to Environmental Management Systems (EMS) through ISO 14001:2015 and adhere to Occupational Health and Safety (OH&S) management system through ISO 45001:2018 (Certificates to be Enclosed)	
		All networking passive material (Fiber Cable, Copper Cables, Networking Racks and their connectivity components) should be from one OEM make only & should be manufactured as per latest TIA/EIA or ISO/ IEC standard and have 25 years of channel performance.	
16	Make & Model	Bidder to specify	

SITC of Shielded Keystone Outlet having minimum technical specification as mentioned below
 :

S. No.	Parameter	Specification	Compliance (Yes/No)
1	Type	Category 6A Shielded Keystone Outlet	
2	Type	Modular Jacks shall meet and exceed channel specification of ANSI/TIA 568.D-2, IEC/ISO 11801 & IEC 60603-7-41 when used as a component in a properly installed within a channel.	
		Shielded	
3	Shield Material	Zinc alloy	
4	Contact Material	Phosphor Bronze, Tin (8Pins- Gold Plating)	
5	Plastic Housing	PC UL94V2	
6	Plastic Parts type	High impact flame retardant plastic	
7	PCB Material & Thickness	FR-4,1.2mm thickness	
8	Features	Small form RJ45 foot print design	

		IDC punch down with 180-degree termination	
		Wiring diagram and conductor cap supplied and the Direction marks on the side of the Keystone Jack	
9	Termination Interface	Plug Insertion Life (RJ45 Contacts) \geq 750 Cycles	
		Durability (IDC Life) 200 termination cycles	
10	Plug and Outlet Contact force	\geq 100 Grams with FCC Compliant RJ-45 plug	
11	Plug retention Force	\geq 11lbf	
12	Jack wire material and thickness	0.35mm Phosphor bronze gold over nickel plating	
13	IDC Conductor	0.5mm Phosphor bronze , Tin-plating	
14	Contact Compatibility	Accommodates 23 to 26AWG solid	
15	Termination Pattern	TIA / EIA 568 A and B	
16	Operating Temperature	-10° to +60°C	
17	Storage Temperature :	-40° to +68°C	
18	Operating Humidity :	10% to 90% PH	
19	Electrical Performance	Insertion Loss: Max. 0.45 dB	
		NEXT: Min. 34 dB	
		FEXT: Min. 29.1 dB	
		RL: Min. 14 dB	
		PSANEXT: Min 56.5 dB	
		PSACRF: Min 53.0 dB	
		TCL: Min 14 dB	
		Insulation Resistance : \geq 500m Ω	
		Contact Resistance : \leq 10m Ω	
		Current rating : 1.5 Amps	
		DC Resistance : \leq 0.1 Ω	
		DC/AC Volt Endurance : DC1000V/AC750V 1min	
20	Regulatory Compliances	Should be ETL Listed in a 04-Connector Shielded Channel Tested upto 635Mhz with MTPL Plug as well as performance testing as per IEEE 802.3bt (All Report should be submitted along with bid) and UL Listed (Relevant Document to be shared)	
		Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863 and the OEM shall be a Class 1 local supplier as defined in public procurement (Preference to Make in India), .	

		The OEM should be CE Certified and its manufacturing facility must adhere to Environmental Management Systems (EMS) through ISO 14001:2015 and adhere to Occupational Health and Safety (OH&S) management system through ISO 45001:2018 (Certificates to be Enclosed)	
		All networking passive material (Fiber Cable, Copper Cables, Networking Racks and their connectivity components) should be from one OEM make only & should be manufactured as per latest TIA/EIA or ISO/ IEC standard and have 25 years of channel performance.	
21	Make & Model	Bidder to specify	
SITC of Cat6 Unshielded LSZH Patch Cords for Work Stations & Rack End having minimum technical specification as mentioned below :			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Type	CAT6 Unshielded LSZH rated Modular Cord shall meet and exceed channel specification of ANSI/TIA 568.2-D, ISO/IEC 11801 Class E, IEC 61156-6 and IEC 61935-2 Standard.	
2	Conductor	Flexible Stranded Bare Copper, 24 AWG	
3	Insulation / Diameter	PE (0.95 ± 0.05 mm)	
4	Feature	Transparent Strain Relief easy latch-cover boot design for easy depression	
		Backward compatible for easy integration with any network component that uses a RJ45 connection	
5	Length	2 / 3 / 5 Meter & Customized length	
6	Connectors	High Grade 50 μ gold plated RJ45 Connectors	
7	Conductor Material	Stranded Bare Copper	
8	Storage Temperature Range :	-20 °C to +70°C	
9	Cable Diameter	5.86 ± 0.3mm	
10	Regulatory Compliances	Should be ETL channel performance verified on a 04-Connector channel or more, tested upto 350Mhz or more with an MTPL Plug as per ANSI/TIA-568.2-D (Part Code to be mentioned in report and should be submitted along with bid) and UL Listed (Relivent Document to be shared)	

		Should be ETL tested for a cabling configuration performance to the requirements of IEEE Std 802.3 for Type 4 remote powering applications	
		OEM should be registered under an NRTL approved lab follow-up program	
		OEM should a minimum on 01 patent in their name. All Related documents to be submitted.	
11	Test Reports	OEM factory test reports must be provided.	
12	Make & Model	Bidder to specify	
SITC of Cat6 LSZH Patch Cords for Uplink having minimum technical specification as mentioned below :			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Make	To be Specified by the Bidder	
2	Type	CAT6 Unshielded LSZH Patch Cord Cable	
3	Type	Modular Cord shall meet and exceed channel specification of ANSI/TIA 568.2-D, ISO/IEC 11801 Class E & IEC 61156-6 Standard.	
4	Conductor	Flexible Stranded Bare Copper, 26 AWG	
5	Insulation	PE (0.95 ± 0.05 mm)	
6	Insulation Thickness	0.16 mm	
7	Feature	Transparent Strain Relief easy latch-cover boot design for easy depression	
		Backward compatible for easy integration with any network component that uses a RJ45 connection	
		Auto lock the jack by inserting the lockable patch cord and to unlock you should use the key.	
		Bright Traceable LED Light for easy Visual Identification	
8	Length	2 / 3 / 5 Meter & Customized length	
9	Connectors	High Grade 50 μ gold plated RJ45 Connectors	
10	Conductor Material	Solid Bare Electrolytic Grade Copper	
11	Operating Temperature Range	-10 °C to +60°C	
	Storage Temperature Range :	-20 °C to +70°C	
	Installation Temperature :	0 °C to +50°C	
12	Sheath Material	LSZH	
13	Cable Diameter	6.23 ± 0.3mm	
14	Electrical Specification :	Conductor DC Resistance : 14Ω / 100m	

		Resistance Unbalance : 4%	
		Impedance : 100Ω ± 15%	
		Frequency : 250MHz	
15	Performance	Patch Cords which will give guaranteed higher bandwidth will be preferred.	
16	Regulatory Compliances	The OEM should be CE Certified and its manufacturing facility must adhere to Environmental Management Systems (EMS) through ISO 14001:2015 and adhere to Occupational Health and Safety (OH&S) management system through ISO 45001:2018 (Certificates to be Enclosed)	
		The OEM shall be recognized by the Department for Promotion of Industry and Internal Trade under the 'Telecommunication & Networking' Industry and 'Network Technology Solutions' sector by Government of India.	
		OEM offered must be in India / SAARC for at-least 10 years or more.Should have Indian Technical Support Centre, Warehouse and RMA centre in India.	
		OEM should a minimum on 01 patent in their name. All Related documents to be submitted.	
17	Test Reports	OEM factory test reports must be provided.	
18	Make & Model	Bidder to specify	
SITC of Field Mount Modular RJ45 Plug for WiFi, CCTV, etc. having minimum technical specification as mentioned below :			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Type	Field Terminate RJ45 Plug complies to Complies to EN 50173 & ISO/IEC 11801, IEC 60512-99-001:2012 & IEC 60512-9-3:2011, Permanent Link & Channel ANSI/TIA-568.2-D for connectivity an IP-enabled IoT devices / PoE enabled devices and support high-speed applications like 5Ghz Wi-Fi and High resolution Video cameras	
2	Termination	Developed under MPTL and designed for use on Solid cable assemblies and strand conductors of sizes from AWG 23 through AWG 26	

3	Housing Material	Zinc – alloy fully shielded	
4	Plug Contact	0.35mm phosphor bronze	
5	Contact Area	Gold over nickel plating	
6	IDC Contact	0.4mm phosphor bronze, Sn over nickel plating	
7	Features	IP20 rated Field Terminable Plug	
		360 degree shielding for better EMI/EMC	
		Qualified Screened Class 6A Component	
		Durability : 1000 mating cycles	
8	Plug Contact	RJ 45 : PCB, 50µ Phosphor bronze gold over nickel plating contacts	
9	IDC Connector	Phosphor bronze , Sn over nickel plating contacts	
10	Power over Ethernet - Applications	PoE+ type I & II IEEE 802.3at IEC 60512-99-001 (2012-08) IEC 60512-9-3 (2011-06)	
11	Operating Temperature Range	-40 °C to +70°C	
12	Regulatory Compliances	Should be ETL channel performance verified on a 04-Connector channel or more, tested upto 635Mhz or more with an MTPL Plug as per ANSI/TIA-568.2-D (Part Code to be mentioned in report and should be submitted along with bid) and UL Listed (Relevant Document to be shared)	
		Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863 and the OEM shall be a Class 1 local supplier as defined in public procurement (Preference to Make in India), .	
		The Proposed OEM should be a member of TIA and BICSI and should have a CDCP, ITIL and a PMI-PMP or an RCDD on the OEM's payroll sitting in India whose services can be utilized for this project.	
		OEM offered must be in India / SAARC for at-least 10 years or more.Should have Indian Technical Support Centre, Warehouse and RMA centre in India.	
13	Test Reports	OEM factory test reports must be provided.	
14	Make & Model	Bidder to specify	
SITC of CAT6A U/UTP LSZH Cable having minimum technical specification as mentioned below			
:			

S. No.	Parameter	Specification	Compliance (Yes/No)
1	Type	CAT6A U/UTP, 23 AWG solid bard copper, Unshielded Twisted 4 Pair, Category 6, confirming to ANSI-TIA 568.2-D for Category 6 & ISO/IEC 11801 for Class Ea.	
2	Conductors	Solid bare copper 23 AWG	
3	Pair Separator	+ Shape Spline	
4	Packing	305 meters in MDF Spool	
5	Cable Outer Diameter	7.03 ± 0.05 mm	
6	Delay Skew	< 45 ns	
7	Conductor Resistance	≤ 93.8 Ω/km	
8	Pulling Force	100N	
9	Nom. Velocity of Propagation	69%	
10	Temperature Range Storage	-20 °C to +70 °C	
11	Flame Properties	Flammability Test : IEC 60332-3-22	
		Acid Gas Emission Test : IEC 60754-2	
		Smoke Density Test : IEC 61034-2	
12	Jacket Colour	Grey / Blue / Yellow	
13	Regulatory Compliances	Should be UL/ETL channel performance verified with a MTP link even when termination is within 15 Mtrs. this ensuring eliminating short resonance for 4-connector channel as per ANSI/TIA-568.2-D and ISO/IEC 11801 Standards (Relivent Document from UL/ETL Report for 4 Connector need to be submitted which mentions quoted part code).	
		OEM should be registered under an NRTL approved lab follow-up program	
		The Proposed OEM should be a member of BICSI and should have a CDCP, ITIL and a PMI-PMP / RCDD on the OEM's payroll sitting in India whose services can be utilized for this project.	
		The OEM should be CE Certifed and its manufacturing facility must adhere to Environmental Management Systems (EMS) through ISO 14001:2015 and adhere to Occupational Health and Safety (OH&S) management system through ISO 45001:2018 (Certificates to be Enclosed)	
14	Test Reports	OEM factory test reports must be provided.	

15	Make & Model	Bidder to specify	
SITC of 24 Port, 1U Category 6 / 6A Staggered Patch Panel, Unloaded having minimum technical specification as mentioned below :			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Quoted Make	To be Specified by the Bidder	
2	Quoted Model	To be Specified by the Bidder	
3	Type	24 Port, 1U Staggered Patch Panel, Unloaded - 1U	
4	Type	24 Port 1U Unloaded ZigZag / Staggered Patch Panel The design reduces Alien Crosstalk to support IEEE 802.3an and ANSI/TIA 568.2-D.	
		Patch panels IDC (IDC of Information Outlet) Connectivity Snap in Type should be at rear end & RJ-45 jack on front panel, 19" rack mountable.	
		Patch panels Ports should be individually replaceable & Consistent port-to-port performance and includes grounding bolt	
5	Availability	Patch Panel should be available with 24 Ports in 1U	
6	Cable management	The panel should have an integrated rear cable management bar that allows bunching of 6 cables and properly dressing the cables and tying them using a Velcro Tape to the rear cable management bar.	
7	Compatibility	Patch Panel should be able to accept Cat6A, Cat6 and Cat5e information outlets for backward and forward compatibility	
8	Height	1U (1.75")	
9	Storage Temperature Range	-40Deg C to +70 Deg C	
10	Operating Temperature range	-10Deg C to +60 Deg C	
11	Humidity	10% - 90% RH	
12	Color and Material	Metal SPCC, Black, plastic inserts, Double layer - 1.5mm, provided with mini cable ties, cage nuts & rare cable management.	

13	Regulatory Compliances	Should be UL/ETL channel performance verified with a MTP link even when termination is within 15 Mtrs. this ensuring eliminating short resonance for 4-connector channel as per ANSI/TIA-568.2-D and ISO/IEC 11801 Standards (Relivent Document from UL/ETL Report for 4 Connector need to be submitted which mentions quoted part code).	
		Shall be UL Listed and tested for corrosion as per ASTM B117: 2019. (Relivent Document to be shared)	
		Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863 and the OEM shall be a Class 1 local supplier as defined in public procurement (Preference to Make in India), .	
14	Test Reports	OEM factory test reports must be provided against each drum / roll of fiber cable.	
15	Make & Model	Bidder to specify	
SITC of Cat6A Modular Jack, Keystone Style having minimum technical specification as mentioned below :			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Type	CAT6A RJ45 Modular Jacks shall meet and exceed channel specification of ANSI/TIA 568.D-2, IEC/ISO 11801 & IEC 60603-7-41 when used as a component in a properly installed UTP channel.	
2	IDC Connector	0.5mm Phosphor bronze , Tin-plating contacts	
3	PCB Material & Thickness	FR-4, 1.2mm thickness	
4	Jack wire material and thickness	0.35mm Phosphor bronze gold over nickel plating	
5	Termination Interface	Front Mated Connection: 750 Cycles	
		Rear Mated Connection: 200 Cycles	
6	Plug and Outlet Contact force	≥ 100 Grams with FCC Compliant RJ-45 plug	
7	Plug Retention Strength	13.5kg	
8	Contact Compatibility	Accommodates 23 to 26AWG solid	
9	Termination Pattern	TIA / EIA 568 A and B and Shall not have an integrated spring shutter as the shutter malfunctions and causes operational issues.	
10	Retention Strenght	5kgs between Jack and Plug	
11	Storage Temperature :	-40° to +68°C	

12	Electrical Performance	Insulation Resistance : $\geq 500m\Omega$	
		Contact Resistance : $\leq 10m\Omega$	
		Current rating : 1.5 Amps	
		DC Resistance : $\leq 0.1\Omega$	
		DC/AC Volt Endurance : DC1000V/AC750V 1min	
13	Regulatory Compliances	Should be UL/ETL channel performance verified with a MTP link even when termination is within 15 Mtrs. this ensuring eliminating short resonance for 4-connector channel as per ANSI/TIA-568.2-D and ISO/IEC 11801 Standards (Relivent Document from UL/ETL Report for 4 Connector need to be submitted which mentions quoted part code).	
		The OEM should be CE Certifed and its manufacturing facility must adhere to Environmental Management Systems (EMS) through ISO 14001:2015 and adhere to Occupational Health and Safety (OH&S) management system through ISO 45001:2018 (Certificates to be Enclosed)	
		OEM offered must be in India / SAARC for at-least 10 years or more.Should have Indian Technical Support Centre, Warehouse and RMA centre in India.	
		All networking passive material (Fiber Cable, Copper Cables, Networking Racks and their connectivity components) should be from one OEM make only & should be manufactured as per latest TIA/EIA or ISO/ IEC standard and have 25 years of channel performance.	
14	Make & Model	Bidder to specify	
SITC of Cat6A Unshielded LSZH Patch Cords for Work Stations & Rack End having minimum technical specification as mentioned below :			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Type	CAT6A Unshielded LSZH Modular Cord shall meet and exceed channel specification of ANSI/TIA 568.2-D, ISO/IEC 11801 Class E & IEC 61156-6 Standard.	
2	Conductor	Flexible Stranded Bare Copper, 24 AWG	
3	Insulation / Diameter	PE (1.05 \pm 0.05 mm)	

4	Feature	Transparent Strain Relief easy latch-cover boot design for easy depression	
		Backward compatible for easy integration with any network component that uses a RJ45 connection	
5	Length	2 / 3 / 5 Meter & Customized length	
6	Connectors	High Grade 50 μ gold plated RJ45 Connectors	
7	Conductor Material	Stranded Bare Copper	
8	Plug Retention Strength	13.5kg	
9	Storage Temperature Range	-20 °C to +70°C	
10	Cable Diameter	5.9 \pm 0.3mm	
11	Electrical Specification :	Conductor DC Resistance : 14 Ω / 100m	
		Resistance Unbalance : 4%	
		Impedance : 100 Ω \pm 15%	
		Frequency : 500MHz Maximum	
12	Performance	Patch Cords which will give guaranteed higher bandwidth will be preferred.	
10	Regulatory Compliances	Should be ETL channel performance verified on a 04-Connector channel or more, tested upto 635Mhz or more with an MTPL Plug as per ANSI/TIA-568.2-D (Part Code to be mentioned in report and should be submitted along with bid) and UL Listed (Relivent Document to be shared)	
		Should be ETL tested for a cabling configuration performance to the requirements of IEEE Std 802.3 for Type 4 remote powering applications	
		OEM should be registered under an NRTL approved lab follow-up program	
		OEM should a minimum on 01 patent in their name. All Related documents to be submitted.	
11	Test Reports	OEM factory test reports must be provided.	
12	Make & Model	Bidder to specify	
SITC of Field Mount Modular RJ45 Plug for WiFi, CCTV, etc. having minimum technical specification as mentioned below :			
S. No.	Parameter	Specification	Compliance (Yes/No)

1	Type	Field Terminate RJ45 Plug complies to Complies to EN 50173 & ISO/IEC 11801, IEC 60512-99-001:2012 & IEC 60512-9-3:2011, Permanent Link & Channel ANSI/TIA-568.2-D for connectivity an IP-enabled IoT devices / PoE enabled devices and support high-speed applications like 5Ghz Wi-Fi and High resolution Video cameras	
2	Termination	Developed under MPTL and designed for use on Solid cable assemblies and strand conductors of sizes from AWG 23 through AWG 26	
3	Housing Material	Zinc - alloy fully shielded	
4	Plug Contact	0.35mm phosphor bronze	
5	Contact Area	Gold over nickel plating	
6	IDC Contact	0.4mm phosphor bronze, Sn over nickel plating	
7	Features	IP20 rated Field Terminable Plug	
		360 degree shielding for better EMI/EMC	
		Qualified Screened Class 6A Component	
		Durability : 1000 mating cycles	
8	Plug Contact	RJ 45 : PCB, 50µ Phosphor bronze gold over nickel plating contacts	
9	IDC Connector	Phosphor bronze , Sn over nickel plating contacts	
10	Power over Ethernet - Applications	PoE+ type I & II IEEE 802.3at IEC 60512-99-001 (2012-08) IEC 60512-9-3 (2011-06)	
11	Operating Temperature Range	-40 °C to +70°C	
12	Regulatory Compliances	Should be ETL channel performance verified on a 04-Connector channel or more, tested upto 635Mhz or more with an MTPL Plug as per ANSI/TIA-568.2-D (Part Code to be mentioned in report and should be submitted along with bid) and UL Listed (Relevant Document to be shared)	
		Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863 and the OEM shall be a Class 1 local supplier as defined in public procurement (Preference to Make in India), .	

		The Proposed OEM should be a member of BICSI and should have a CDCP, ITIL and a PMI-PMP / RCDD on the OEM's payroll sitting in India whose services can be utilized for this project.	
		OEM offered must be in India / SAARC for at-least 10 years or more.Should have Indian Technical Support Centre, Warehouse and RMA centre in India.	
13	Test Reports	OEM factory test reports must be provided.	
14	Make & Model	Bidder to specify	
SITC of Face Plate, UK Style, Almond Color, Square with Shutters having minimum technical specification as mentioned below :			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Quoted Make	To be Specified by the Bidder	
2	Quoted Model	To be Specified by the Bidder	
3	Type	UK Style with Built-in Dust Covers / Shutters	
4	Material	Fire-retardant Plastic, ABS + PC, White color, UK Style.	
5	Acceptability	Should be able to accept Cat6A, Cat6 and Cat5e information outlets, Modules, Keystones and Adaptors to suit all installation requirements	
6	Approvals	UL 94V-0	
7	No. of plates	2 Plates/Pieces Face Plate for better aesthetic look	
8	Mounting screws	Include mounting screws and Label Holders with Plastic covers	
9	Available	Single/Dual/Quad network faceplate	
10	Dimensions	(H x W x D) 86 x 86 x 14.42 mm	
11	Regulatory Compliances	Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863 and the OEM shall be a Class 1 local supplier as defined in public procurement (Preference to Make in India), .	
		The Proposed OEM should be a member of TIA and BICSI and should have a CDCP, ITIL and a PMI-PMP or an RCDD on the OEM's payroll sitting in India whose services can be utilized for this project.	

		The OEM should be CE Certified and its manufacturing facility must adhere to Environmental Management Systems (EMS) through ISO 14001:2015 and adhere to Occupational Health and Safety (OH&S) management system through ISO 45001:2018 (Certificates to be Enclosed)	
12	Make & Model	Bidder to specify	
SITC of Backbox for Face Plate, UK Style having minimum technical specification as mentioned below :			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Quoted Make	To be Specified by the Bidder	
2	Quoted Model	To be Specified by the Bidder	
3	Type	Back Box for UK Style Faceplate	
4	Material	White High impact plastics.	
5	Entry	Adjustable cable entries	
6	Dimensions	38 x 87 x 87 mm	
7	Compatiable	Back box allows for mounting a various ports of Faceplates	
8	Regulatory Compliances	All networking passive material (Fiber Cable, Copper Cables, Networking Racks and their connectivity components) should be from one OEM make only & should be manufactured as per latest TIA/EIA or ISO/ IEC standard and have 25 years of channel performance.	
		The Proposed OEM should be a member of TIA and BICSI and should have a CDCP, ITIL and a PMI-PMP or an RCDD on the OEM's payroll sitting in India whose services can be utilized for this project.	
		The OEM shall be recognized by the Department for Promotion of Industry and Internal Trade under the 'Telecommunication & Networking' Industry and 'Network Technology Solutions' sector by Government of India.	
9	Make & Model	Bidder to specify	
SITC of Reuseable Velcro Tie with Accessories having minimum technical specification as mentioned below :			
S. No.	Parameter	Specification	Compliance (Yes/No)

1	Make	To be Specified by the Bidder	
2	Type	19" Velcro Reusable Ties are perfect for organising your cables and cords at home or in the office.	
3	Feature	They are soft, adjustable and easy to use.	
		Ideal for securing and sorting the cable mess behind your computer, television and stereo.	
		They can also be used to wrap around appliance cords and extension leads for a tidy storage solution.	
		A safe and reusable alternative to cable ties, tapes and wires.	
		Suitable for use on cords of all sizes and small everyday household objects.	
4	Make & Model	Bidder to specify	

1. 12 U Rack

TECHNICAL SPECIFICATION	Compliance (Yes/No)	Remarks
Rack should be 12U Floor Standing Rack (600 x 530)		
Front glass toughened and tinted with easy detachable hinges and rear split perforated doors with "Honeycomb" type of perforation for maximum air circulation and stiffness. Perforation area should be 70% at least of the total door area.		
Rack Should have removable side panels with ventilation provision		
Rack Should have castor wheels set of 4 with front wheels Brake provision		
Rack should have adjustable mounting slots		
Rack should have cable insertion on Top & Bottom panel to provide easy cable entry.		
Rack should have 5 sockets 3pin 5A.PDU-2Nos.		
Rack Should have 2 Fans to maintain the temp of equipment		
Rack should have 3 Trays for equipment		
Rack should have back door with lock.		
Rack should have hardware kit.		
Rack should have compatible with 19" International standards		
Should be RoHS complied and ISO Certified manufacturing plants.		
Earthing kit from top to bottom for proper earthing.		
Confirm to DIN 41494 or EIA 310D standards		

15/12 U Closed wall mount Rack

Standard Compliance	Compliance (Yes/No)
2 Post 19" Closed Wall Mount Rack (15U/12U) with copper & fiber cable management accessories	
1 No. Horizontal PDU with 5/15Amp Universal Sockets with 32Amp MCB	
Front mounting PVC Cable managers/ guide	
Integral Cable management ducts/ arms (on either side) with covers	
Cantilever Tray x 1 (19" / 1U/ 255mm - D)	
Cable retention bobbins X 5 (both sides) + Window Molding x 6	
Cable Hangers (set of 3) x 2 (Right & left side one set each)	
Bar, Earthing 15U	
Mounting Hardware (Pack of 10) x 5	
IP65 Rated Outdoor if used in outdoor environment (Weather resistant)	

2. 42 U Rack

TECHNICAL SPECIFICATION	Compliance (Yes/No)	Remarks
Rack should be 42U Floor Standing Rack (800 x 1000)		
Front glass toughened and tinted with easy detachable hinges and rear split perforated doors with "Honeycomb" type of perforation for maximum air circulation and stiffness. Perforation area should be 70% at least of the total door area.		
Rack Should have removable side panels with ventilation provision		
Rack Should have castor wheels set of 4 with front wheels Brake provision		
Rack should have adjustable mounting slots		
Rack should have cable insertion on Top & Bottom panel to provide easy cable entry.		
PDU 19' Octagonal socket 12 X 5/16 Amp with 16Amp MCB & Indicator with 3MTR cable and Industrial plug.		
Rack Should have 4 Fans to maintain the temp of equipment		
Rack should have 3 Trays for equipment		
Rack should have back door with lock.		
Rack should have hardware kit.		

Rack should have compatible with 19" International standards		
Should be RoHS complied and ISO Certified manufacturing plants		
Earthing kit from top to bottom for proper earthing.		
Confirm to DIN 41494 or EIA 310D standards		

Testing & Commissioning of Passive Components:

All the passive components shall have their Testing reports from the OEM with Batch No. and all standard parameters for GBU Gandhinagar complex. There shall be the proper ferruling and Numbering on the Cat 6A/fiber cables. There shall be proper dressing of the cables and equipment management inside the racks. The splicing of fiber, numbering termination etc. shall be the part of installation of the fiber cables.

The Cat 6A cable installation measurements shall be done through penta scanning with standard parameters and shall have the OEM certification for the installation of all the components.

The optical fiber cable installation shall be checked by the OTDR machine and the reports shall meet all the parameters of the technical data sheet of the Cable and shall have the OEM certification for the installation.

After installation & OEM certification Commissioning of the passive components shall be completed.

B. ACTIVE COMPONENTS

TECHNICAL SPECIFICATIONS FOR ACTIVE COMPONENTS

Technical Specification of Core Switch

S.No.	Technical Specification		Compliance YES / NO
1	Port Density	26 X 1/10G SFP Ports	
		2 x 40/100 G QSFP28 Ports	
2	Power Supply	Redundant Hot Swappable Power Supply - AC/DC	
3	Virtual Chassis/ Stacking Option	Upto 6 Switches or more	
4	RAM	8 GB or better	
5	Flash and Buffer	32GB or better and 32MB Packet Buffer	
6	Switching Capacity and forwarding Rate	900 Gbps or better and 600 Mpps or better	
7	Latency & MTBF	Latency: <650 ns MTBF: 384,636 h	
8	MAC Address	64K	
9	Routes	IPv4 - 32k or better	
		IPv6 - 16k or better	

10	Quality of Service	Support for Egress rate limiting, eight egress queues per port, IEEE 802.1Q, 802.3x, DiffServ, Jumbo frame	
11	Protocol Support	IGMP Snooping V1, V2, V3, MLD, PIM-SM/PIM-SSM/PIM-DM/PIM-Bidirectional, DVMRP,RIPv1 & v2,RIPing ,OSPFv3, RIP, BGPv4, MP-BGP,GRE, IS-IS, ITU-T G.8032, IEEE 802.1s, IEEE 802.3ad/802.1AX Link Aggregation Control Protocol (LACP), Ipv4/Ipv6, DHCP Option 82, BPDU, STP Root Guard, SIP detection, SPB-M or MPLS, IEEE 802.1ae, MIB, NTP, Built-in CPU protection against malicious attacks, The Switch Should have 1+N redundant supervisor manager in Virtual chassis with In-Service Software Upgrade (ISSU), VXLAN, ARP Poisoning detection, Policy based routing (PBR),SDN support through Restful API and OpenFlow 1.3.1	
12	Management	SNMP V1, V2, V3, Web GUI, CLI, USB or equivalent memory card, IPv6 management feature on open standards, IEEE802.1ag, TDM or equivalent standards	
13	Security	Should support Access Control Lists (ACLs), DHCP snooping, IEEE802.1x based port authentication, RADIUS/ TACACS+, SSL, SSH, port mirroring, IEEE 1588, AES, Syslog, MD5, LLDP-MED, BPDU Blocking, BFD, Unified management, control and fabric-mesh virtual chassis technology, Autosensing IEEE 802.1X multi- client, multi-VLAN support for bridging and SPBM/VXLAN services, MAC-based authentication for non-IEEE 802.1X hosts, MAC address lockdown, Prevention from ARP attacks	
14	Resiliency	IEEE802.1q, IEEE802.1d, IEEE802.1s, IEEE802.1w, ITU-T G.8032 ring resilience/ring protection, VRRPv2,	
15	Operating Temperature and Humidity	Temperature: 0 to 45Deg Humidity: 5% to 95% (non-condensing)	
16	Safety Certifications	CE, EN 55022, RoHS	
		US UL 60950, CSA22.2	
		FIPS 140-2, EAL2 & NCPP Certified	
		EN 60825-1/2 Laser	
17	SFP	SFP should be of same make as switch.	
18		Vendor to be present in Gartner Magic Quadrant.	
19		The Switch shall work with on-premises and cloud-based NMS without change in hardware/software/OS Image. The Switch should be EAL2/NDPP certified	
20		Toll free number for support in India	

Technical Specification of Distribution Switch

S.No.	Technical Specification		Compliance YES / NO
1	Port Density	24 x 100/1000 BaseX, SFP and 4 x 1/10G SFP+ 4 x 10/25G SFP28	
2	Power Supply	Redundant Hot Swappable Power Supply - AC/DC	
3	Virtual Chassis/ Stacking Option	Upto 8 Switches or more with 2 x 100G QSFP28 Virtual Chassis/Stacking ports per Switch	
4	RAM	4 GB or better	
5	Flash and Buffer	16 GB or better and 32MB Packet Buffer	
6	Switching Capacity and forwarding Rate	728 Gbps or better and 540 Mpps or better	
7	Macsec Support and MTBF	Macsec Support: All SFP ports should be macsec capable MTBF: 138,559 h	
8	MAC Address	64K	
9	Routes	IPv4 - 144k or better IPv6 - 72k or better	
10	Quality of Service	Support for Egress rate limiting, Eight egress queues per port, IEEE 802.1Q, 802.3x, DiffServ, Jumbo frame	
11	Protocol Support	IGMP Snooping V1, V2, V3, MLD, PIM-SM/PIM-SSM/PIM-DM/PIM-Bidirectional, DVMRP,RIPv1 & v2,RIPing ,OSPFv3, RIP, BGPv4, MP-BGP,GRE, IS-IS, ITU-T G.8032, IEEE 802.1s, IEEE 802.3ad/802.1AX Link Aggregation Control Protocol (LACP), Ipv4/Ipv6, DHCP Option 82, BPDU, STP Root Guard, SIP detection, SPB-M or MPLS, IEEE 802.1ae, MIB, NTP, Built-in CPU protection against malicious attacks, The Switch Should have 1+N redundant supervisor manager in Virtual chassis with In-Service Software Upgrade (ISSU), VXLAN, ARP Poisoning detection, Policy based routing (PBR),SDN support through Restful API and openflow 1.3.1	
12	Management	SNMP V1,V2,V3, Web GUI, CLI, USB or equivalent memory card, IPv6 management feature on open standards, IEEE802.1ag, TDM or equivalent standards, Smart continuous switching technology	

13	Security	Should support Access Control Lists (ACLs), DHCP snooping, IEEE802.1x based port authentication, RADIUS/ TACACS+, SSL, SSH, port mirroring, NTP, IEEE 1588, AES, Syslog, MD5, LLDP-MED, BPDU Blocking, BFD, Unified management, control and fabric-mesh virtual chassis technology, Autosensing IEEE 802.1X multi-client, multi-VLAN support for bridging and SPBM/VXLAN services, MAC-based authentication for non-IEEE 802.1X hosts, MAC address lockdown, Prevention from ARP attacks	
14	Resiliency	IEEE802.1q, IEEE802.1d, IEEE802.1s, IEEE802.1w, ITU-T G.8032 ring resilience/ring protection, VRRPv2, MVRP, VRF and Virtual Network Profiles (VNP), Software-controlled VXLAN hardware VTEP gateway	
15	Operating Temperature and Humidity	Temperature: 0 to 45Deg Humidity: 5% to 95% (non-condensing)	
16	Safety Certifications	CE, EN 55022, RoHS	
		US UL 60950, CSA22.2	
		FIPS 140-2, EAL2 & NDcPP Certified	
		EN 60825-1/2 Laser	
17	SFP	SFP should be of same make as switch.	
18		Vendor to be present in Gartner Magic Quadrant.	
19		The Switch shall work with on-premises and cloud-based NMS without change in hardware/software/OS Image. The Switch should be EAL2/NDPP certified	
20		Toll free number for support in India	

Technical Specification of 24 Port PoE+ Switch

S.No.	Technical Specification		Compliance YES / NO
1	Port Density	24 X 1G RJ-45 PoE+ Ports with 380W power budget	
		2 x 1G/10G SFP+ Ports and 2 x 1G SFP/Base-T Combo Ports upgradable to 2 x 10G SFP+ Ports	
2	Power Supply	Internal Power Supply	
3	Virtual Chassis/Stacking Option	Upto 4 Switches or more	
4	RAM	1 GB or better	
5	Flash	1 GB or better	
6	Switching Capacity and forwarding Rate	128 Gbps or better and 68 Mpps or better	

7	Latency & MTBF	Latency: < 4 μ s MTBF: 1447 k hours	
8	Layer 2 Features	Mac Address:16K or more VLAN: 4K or more System Policies: 1.5K or more Max Jumbo Frame: 9216 bytes Multicast Group: up to 1000	
10	Quality of Service	Auto QoS for switch management traffic, Policy-based QoS, Traffic Prioritization, Priority Queues: Eight hardware-based queues per port, SPQ, WRR	
11	Protocol Support	Static Routing, MSTP, RSTP, PVST+,IPv6 Tunneling, LACP, LAG, IGMPv3, DHCP, DHCP82,DHCP Relay for IPv4/IPv6,Multiple microcode image support with fallback recovery, ARP,SDN support through Restful API and openflow 1.3.1	
12	Management	Loopback IP address support for management per service, Policy- and port-based mirroring, Remote port mirroring, sFlow v5 and Remote Monitoring (RMON), Unidirectional Link Detection (UDLD), Digital Diagnostic Monitoring (DDM), LLDP-MED, NTP, MVRP, SNMP, sflow or equivalent	
13	Security	Dynamic change of authentication (CoA), MAC-based authentication for non-IEEE 802.1X hosts, MAC address lockdown, Prevention from ARP attacks, Web based Authentication, Autosensing IEEE 802.1X multi-client, multi-VLAN support, RFC 1321 MD5, RFC 2284 PPP EAP, RFC 1826/1827/4303/4305 Encapsulating Payload (ESP) and crypto algorithms, RFC 2104 HMAC Message Authentication, Built-in CPU protection against malicious attacks	
14	Resiliency	Unified management, control and virtual chassis technology, Virtual Chassis 1+N redundant supervisor manager, Virtual Chassis In-Service Software Upgrade (ISSU), Smart continuous switching technology, IEEE 802.3ad/802.1AX Link Aggregation Control Protocol (LACP) and static LAG groups across modules	
15	Operating Temperature and Humidity	Temperature: 0 to 45Deg Humidity: 5% to 95% (non-condensing)	
16	Safety Certifications	CE, EN 55022, RoHS, WEEE	
		US UL 60950, CSA22.2	
		FIPS 140-2	
		EN 60825-1/2 Laser, IEC 62368-1	

17	SFP	SFP should be of same make as switch.	
18		Vendor to be present in Gartner Magic Quadrant.	
19		The Switch shall work with on-premises and cloud-based NMS without change in hardware/software/OS Image.	
20		Toll free number for support in India	

Technical Specification of Indoor Access Point

S.No.	Technical Specification	Compliance YES / NO
1	Indoor Wireless Access Point	
2	Proposed solution will be Controller less/HW Controller based/SW Controller based but all the Access Points managed centralized.	
3	The WLAN solution shall propose an Indoor 802.11ax Wifi 6 MU-MIMO indoor dual radio AP Access Point (2.4, 5G)	
4	AP to support 4X4:4 on 5 Ghz and 2X2:2 on 2.4 Ghz.	
5	Access Point shall offer up to 2400 Mbps throughput on the 5Ghz band (low and high bands) and up to 573 Mbps throughput on the 2.4GHz band.	
6	1 x 10/100/1000Base-T autosensing (RJ-45) port and 1x 10BASE-T/100BASE-TX/1000BASE-T/2500BASE-T IEEE 802.3 compliant autosensing (RJ-45) port. Both ports should support 802.3at PoE, 1x USB 2.0 Type C	
7	AP should support ACL, wIPS/wIDS and DPI application, 802.11i, 802.1x	
8	Access Point shall propose a Factory reset button.	
9	Access Point shall support up to 32 SSIDs (16 per radio) with 1024 Clients and should support BLE 5.1/Zigbee Integrated. Single AP can act in dual mode (WLC/Client Serving) with controller to support 256 Access Points in single cluster.	
10	Distributed Radio Management, Radio Dynamic Adjustment (RDA), Transmit Power Control @ 18 dBm(TPC), DFS, VHT20,40,80,160	
11	L2 Roaming	
12	802.11r Roaming, 802.11K, 802.11v	
13	Operating temperature must be 0°C to 50°C	
14	Humidity must be 10% to 90% non-condensing.	
15	WFA, UL2043 Plenum rating, EMI, RoHS, REACH, WEEE	
16	FCC and CE approval and certificates,	
17	The AP shall work with on-premises and cloud based WLC without change in hardware/software/OS Image	
18	Toll free number for support in India	

Technical Specification of Wireless (Wi-Fi) Controller

S.No.	Technical Specification	Compliance YES / NO
	Architecture	

1	Controller should be appliance or server (physical or virtual) based to support upto 4000 AP or more. The proposed solution should be premise based and not cloud based	
	Access Control	
2	Authentication and Encryption For this “large deployment” scenario, the WLAN solution shall include a built-in RADIUS server for 802.1x and MAC authentication that shall not be proposed as a separate product.	
3	The built-in RADIUS server shall support at least following EAP types: EAP-PEAP, EAP-GTC, EAP-TLS, EAP-TTLS.	
4	The wireless LAN solution shall support following link layer encryption standards: WPA2_AES, WPA2_TKIP, WPA_AES, WPA_TKIP, DYNAMIC_WEP, WPA_PSK_AES, WPA_PSK_TKIP, WPA_PSK_AES_TKIP, WPA2_PSK_AES, WPA2_PSK_TKIP.	
5	The wireless LAN solution shall support following 802.1x supplicants: Windows 7, 10, MAC OS, IOS, Android, Chromebook	
6	the wireless LAN solution shall propose a “Guest” management solution based on an embedded and built-in Captive Portal providing web based authentication for guests and visitors.	
7	The Guest management solution shall allow non-IT staff (e.g., a receptionist) to create temporary guest accounts.	
8	the WLAN solution shall allow guest self-registration and employee sponsored access.	
9	the Guest management solution shall allow setting a validity period for an authenticated device, in order to avoid entering credentials each time a guest access the network	
10	the WLAN solution shall support BYOD and be able to provide device onboarding that is as simple as possible and without requiring additional thirdparty components	
11	The on-boarding process of employee devices shall be based on employee corporate accounts.	
12	The BYOD application shall allow setting the validity period for the device, and the maximum number of devices per account.	
13	The licensing model of the BYOD application shall be based on the number of on-boarded devices.	
	Intrusion Detection and Prevention	
14	The WLAN solution have wIDS/wIPS capabilities with no additional and dedicated equipment nor additional license.	
15	The WLAN solution shall be able to identify Interfering APs.	
16	The WLAN solution shall be able to identify and contain Rogue APs.	
17	The WLAN solution shall allow the definition of flexible policies to classify an AP as a Rogue AP.	
18	the WLAN solution shall be able to blacklist a WLAN client, either manually or automatically after a client attack has been detected.	
19	the WLAN solution shall allow to configure a blacklist duration.	
20	the WLAN solution shall allow to configure an authentication failure times threshold.	

	RF Management	
21	The WLAN solution shall allow automatic and/or manual RF management (channel and power).	
22	The WLAN solution shall support Short Guard Interval.	
23	If no band/channel (2.4GHz/5GHz) is overloaded (high medium utilization) or crowded (high client count), an AP shall by default guide a new client to the 5GHz band.	
24	Even if the 5GHz band is not overloaded but is crowded (high client count), an AP shall guide a new client to the 2.4GHz band.	
25	If all bands/channels (2.4GHz/5GHz) are overloaded (high medium utilization) and the 5GHz is crowded, an AP shall guide a new client to the 2.4GHz band.	
26	When a new client discovers multiple APs to associate to, the new client shall be guided to the AP that has the fewest associated clients, thus allowing smart/dynamic load balancing.	
27	The WLAN solution shall deny connection to an AP when the signal of the client becomes too weak and disconnect a client when the signal becomes too weak.	
28	The WLAN solution shall propose APs that have the ability to scan the air in order to provide interfering/rogue APs and wireless attacks detection, and shall not rely on dedicated scanning equipment.	
29	The scanning function of the APs shall not impact active voice or video calls (SIP and H.323).	
	Mobility & LBS	
30	The WLAN solution shall support both Opportunistic Key Caching (802.11k).	
31	The WLAN solution shall comply to the 802.11r standard.	
32	the centralized management function shall allow to display the Wi-Fi coverage quality within a given area ("Heat Map").	

Testing & Commissioning:

All Active components shall have the OEM test reports and shall have the 5 years OEM warranty/ Guarantee Card. All equipment's installation shall be considered completed after verifying all the features of the system as mentioned in the specifications and as per the standards.

All equipment shall be replaced if there is any fault in the hardware or in software within two to three hours. The Agency shall have the spares of the main equipments in the stock so that the work of the complex shall remain smooth & undisturbed. All equipment's installation shall be considered completed after verifying all the features of the system as mentioned in the specifications in the Tender and as per the standards.

Item No:- 431-432

35. SOLAR PV SYSTEM

GENERAL

This section specifies the Design, engineering, supply, delivery to site, installation, testing, commissioning and maintenance of solar power plant as described in the Content.

TECHNICAL SPECIFICATION FOR SOLAR POWER PLANT

S.no	Items Description	Specifications																																				
1. Solar Photovoltaic Modules																																						
1.1	SPV Module	<p>"The Photo Voltaic Module Should be 72 Cell, Poly Crystalline Type with a total array capacity of for "& M4&N4&" SPV Power Plant - Power output under STC should be "&M4&N4&" and having technical specification mentioned below:"</p> <table border="1"> <thead> <tr> <th>S.no</th> <th>Descriptions</th> <th>Specification</th> </tr> </thead> <tbody> <tr> <td>1.1.1</td> <td>Output power Pmax (Watt peak)</td> <td>: 325 Wp, Tolerance 0 ~ + 3 %</td> </tr> <tr> <td>1.1.2</td> <td>Voltage at Pmax</td> <td>: ≤ 38 V</td> </tr> <tr> <td>1.1.3</td> <td>Current at Pmax</td> <td>: ≤ 8.8 Adc</td> </tr> <tr> <td>1.1.4</td> <td>Open circuit voltage</td> <td>: ≤ 46.2 V</td> </tr> <tr> <td>1.1.5</td> <td>Short circuit current</td> <td>: ≤ 8.92 A</td> </tr> <tr> <td>1.1.6</td> <td>Maximum system voltage (Volts)</td> <td>: 1000 V DC</td> </tr> <tr> <td>1.1.7</td> <td>Type of solar PV cell</td> <td>: Poly - Crystalline silicon</td> </tr> <tr> <td>1.1.8</td> <td>Module output</td> <td>: MC4 electronics plug (Male and female)</td> </tr> <tr> <td>1.1.9</td> <td>Efficiency</td> <td>: ≥16%</td> </tr> <tr> <td>1.1.10</td> <td>Warranty</td> <td>: (a)10-year product warranty (b)25-year Linear performance warranty</td> </tr> <tr> <td>1.1.11</td> <td>Compliance</td> <td>: IEC 61215 ,IEC 61701, IEC 61730</td> </tr> </tbody> </table>	S.no	Descriptions	Specification	1.1.1	Output power Pmax (Watt peak)	: 325 Wp, Tolerance 0 ~ + 3 %	1.1.2	Voltage at Pmax	: ≤ 38 V	1.1.3	Current at Pmax	: ≤ 8.8 Adc	1.1.4	Open circuit voltage	: ≤ 46.2 V	1.1.5	Short circuit current	: ≤ 8.92 A	1.1.6	Maximum system voltage (Volts)	: 1000 V DC	1.1.7	Type of solar PV cell	: Poly - Crystalline silicon	1.1.8	Module output	: MC4 electronics plug (Male and female)	1.1.9	Efficiency	: ≥16%	1.1.10	Warranty	: (a)10-year product warranty (b)25-year Linear performance warranty	1.1.11	Compliance	: IEC 61215 ,IEC 61701, IEC 61730
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2. Grid Tie Solar Inverter																																						
2.1(a)	Grid Tie Solar Inverter	<p>Solar Grid Tie String Inverters should have MPPT for optimum generation with wide input voltage range and should have anti-islanding feature. Inverter should have the specifications as mentioned below.</p> <table border="1"> <thead> <tr> <th>2.1.1</th> <th colspan="2">60 KW Grid Tie String Inverter (Three Phase)-</th> </tr> </thead> <tbody> <tr> <td>2.1.1.1</td> <td>Max Input PV Power</td> <td>: 66000</td> </tr> <tr> <td>2.1.1.2</td> <td>Max. DC Power per MPPT</td> <td>: 22000W (530-800V)</td> </tr> <tr> <td>2.1.1.3</td> <td>No. of independent MPPT</td> <td>: 3</td> </tr> <tr> <td>2.1.1.4</td> <td>No. of DC inputs</td> <td>: 4/4/4 for each MPPT</td> </tr> <tr> <td>2.1.1.5</td> <td>Max. input voltage</td> <td>: 1000V</td> </tr> <tr> <td>2.1.1.6</td> <td>MPPT Voltage Range</td> <td>: 250-960V</td> </tr> <tr> <td>2.1.1.7</td> <td>Start-up input voltage</td> <td>: 350V</td> </tr> </tbody> </table>	2.1.1	60 KW Grid Tie String Inverter (Three Phase)-		2.1.1.1	Max Input PV Power	: 66000	2.1.1.2	Max. DC Power per MPPT	: 22000W (530-800V)	2.1.1.3	No. of independent MPPT	: 3	2.1.1.4	No. of DC inputs	: 4/4/4 for each MPPT	2.1.1.5	Max. input voltage	: 1000V	2.1.1.6	MPPT Voltage Range	: 250-960V	2.1.1.7	Start-up input voltage	: 350V												
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	2.1.1.8	DC Reverse-Polarity Protection	:	Yes
	2.1.1.10	Rated AC Power Output	:	60000W
	2.1.1.11	Maximum AC Power Output	:	60000W
	2.1.1.12	Maximum Continuous Output Current (per Phase)	:	90 A
	2.1.1.13	Nominal Grid Voltage	:	3/N/PE, 3/P E, 230 V / 400 V ac
	2.1.1.14	Output frequency Range	:	45/53 HZ
	2.1.1.15	MPPT Efficiency	:	> 99.9%
	2.1.1.17	Product Warranty	:	Standard 10 year warranty
	2.1.1.18	Degree of Protection	:	IP65
	2.1.1.19	Operating temperature	:	-25 to +60 ⁰ C
	2.1.1.20	Noise Level	:	<60 db
	2.1.1.22	Supported Communication Interfaces	:	RS485, Wifi, SD Card, Multi-function relay
	2.1.1.23	SPD	:	MOV : Type III standard / Type II optional
	2.1.1.24	Safety protection	:	Anti-islanding, RCMU, Ground fault monitoring
	2.1.1.25	Compliance	:	IEC 62116, IEC 61727, IEC 61683, IEC 60068 (1, 2, 14, 30), IEC 62109-1/2, IEC 61000.

4. Main AC Distribution Box Panel

5	Main AC Distribution Box Panel	AC Distribution box for combining all above Grid Tie Solar inverter with suitable aluminium bus bar of rating for (RYB), Input and output glands complete with 1 Nos. Class I + II Surge Protective Device, 1 Nos. Multi-Function Meter Class 0.5 complete with CTs, Incomers MCB /MCCB & Outgoing MCCB/ACBs as per required capacity , suitable for cable, IP 55 Enclosure complete all as specified and directed.
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6. Module Mounting Structure

6.1	Module Mounting Structure Suitable for RCC type Roof	Module Mounting Structure with Hot Dip Galvanized Mild Steel 80micron thickness, designed for wind load of 180 KMPH. The following technical specification is as follows:-															
		<table border="1"> <thead> <tr> <th>S.no</th> <th>Descriptions</th> <th>Specification</th> </tr> </thead> <tbody> <tr> <td>6.1</td> <td>Profile of Roof</td> <td>RCC</td> </tr> <tr> <td>6.2</td> <td>Type</td> <td>Fixed tilt structure, Roof mounted</td> </tr> <tr> <td>6.3</td> <td>Configuration</td> <td>4 or 6 Modules As per Site Conditions</td> </tr> <tr> <td>6.4</td> <td>Material</td> <td>Hot Dip Galvanized Mild Steel</td> </tr> </tbody> </table>	S.no	Descriptions	Specification	6.1	Profile of Roof	RCC	6.2	Type	Fixed tilt structure, Roof mounted	6.3	Configuration	4 or 6 Modules As per Site Conditions	6.4	Material	Hot Dip Galvanized Mild Steel
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6.4	Material	Hot Dip Galvanized Mild Steel															

		6.5	Height of Structure	:	As per Site Conditions
		6.6	Fixing type	:	GI/SS304 fasteners
		6.7	Foundation	:	Concrete foundation/Ballast system .Concrete of M15/M 20 grade shall be used.
		6.8	Warranty	:	5 Years

7. Cables

7	LT Cables	Cables suitable for Solar Power Plant as per below Specification			
		S.no	Descriptions		Specification
		7.1	Solar Cable - For String Connections		1 C X 4/6 Sq mm Tinned Copper Cables, UV resistant, Solar Cable , TUV certified; 1800 Vdc
		7.2	AC Cables (Inverter to AC Distribution Box Panel)		4 C X 10/16/25/35 Sq mm m, Power cables Cu conductor, XLPE insulation, un-armoured, PVC outer sheath, 1100V
		7.3	AC Cables (AC Distribution Box Panel to Main LT Panels)		3.5C X 240/300/ Sq mm m, Power cables AL conductor, XLPE insulation, un-armoured, PVC outer sheath, 1100V

8. Cable Tray

8	Cable Trays	8.1	Cable Tray made of perforated sheets /Ladder type of pre-galvanized or hot dip galvanized sheet of minimum 1.2 mm thickness and the cable tray width should be based on cable size and run.
		8.2	25 mm conduit pipe use for Modules interconnection.

9. Earthing System

9	Earthing system with Lighting arrestor	9.1	1CX16 sq mm, Copper conductor Unarmoured Cable for Earthing AC & DC System.
		9.2	Earthing Chemical gel earthing Kit
		9.3	Lighting Arrestor along with Mounting structure.
		9.4	25 X 3/5 Gi Strip for Earthing Lighting Arrestor

10. MISC ITEMS

9.1	MC4 Connectors	MC4 connectors (Male & Females) required for solar power system complete all as directed.
9.2	Misc. Components	Termination kits, lugs, sign boards, conduits, Washers , Nut Bolts required for above said project etc.

*** The Quantities shall be based on actual site conditions which can be estimated after conducting site survey.**

*** Internet Connection should be available on site**

PQ Criteria-

- 1) The Solar inverter & Solar PV Module should be of same make.
- 2) The supplier should have office and service center in the state.
- 4) remote monitoring of system should be provided free for 25 years
- 5) **Standard inverter warranty should be 10 years**
- 6) Inverter should had inbuilt DC SPD inside the inverter.
- 7) The Solar PV Module should be BIS approved.
- 8) the Solar Inverter should IEC Certifications as per MNRE Guidelines
- 9) The Solar Inverter should had Wi-Fi Communication port for transferring the generation date to online portal via Wi-Fi network.

10. FIRE EXTINGUISHERS:

The fire-fighting system for the proposed power plants for the fire protection shall be consisting of:

- CO2 type 4.5 kg fire extinguishers in the control room for fire caused by electrical short circuits.
- Sand buckets in the control room. The installation of fire Extinguishers should confirm to TAC regulations and BIS standards. The fire extinguishers shall be provided in the control room housing the batteries and PCUs.

11. LIGHTENING PROTECTION

There shall be required number of suitable lightening arrestors installed in the array field.

EARTHING PROTECTION

Each array structure of the PV yard should be grounded properly. In addition the lightening arrester/masts should also be provided inside the array field. Provision should be kept for shorting and grounding of the PV array at the time of maintenance work. All metal casing/shielding of plant should be thoroughly grounded in accordance with Indian Electricity Act./IE Rules. Earth resistance should be tested in presence of the representative of Engineer In Charge.

13. DANGER BOARDS

Danger board should be provided as and where necessary as per IE act/IE rules as amended up to date.

14. DRAWING & MANUALS

- 5 copies of Engineering, electrical drawings and installation and O&M manuals are to be supplied with each Plant.
- Bidders shall provide complete technical data sheets for each equipment giving details of the specifications along with make/makes in their bid along with basic design of the power plant and power evacuation, along with protection equipment. Approved ISI and reputed makes for equipment to be used.
- For complete electro - mechanical works, bidders shall supply complete design details and drawings for approval before progressing with the installation work.

15. QUALITY AND ADAPTABILITY OF THE EQUIPMENT:

Bidders must verify the grid behavior, solar insulation levels, and general site conditions on their own before bidding. The bidder shall accordingly ensure that the equipment and the design submitted shall be able to perform as per guaranteed performance levels in the available site conditions. The design of the plant and the equipment offered by the bidders shall be evaluated for its quality and adaptability to the site conditions based on the purchasers past experience, projects earlier executed by the bidders and from other

sources. Bidders must submit detailed technical operational parameters and latest performance indicator

Item No:- 430

TECHNICAL SPECIFICATION - LIFTS

The scope of work shall cover design, supply delivery, installation, testing and commissioning of passenger lifts/ passenger cum bed lifts/Service lifts. All lifts shall be VVVF operated, gearless, central opening and with Machine room. The Lifts shall be with facility for duplex/triplex selective/collective operation. Car enclosure finish shall be SS (as per OEM) scratch proof moon rock/honeycomb. SS handrail not less than 600mm long at 900mm above floor level, to be provided inside the lift car as per requirement. Suitable lights and fans as per requirement shall be provided. Lift car size, Lift well size, Lift pit overhead, entrance width, car height etc. shall be as per NBC 2016 or OEM standards..

Item No:- 430 - SITC of 26 Passenger / 2000 KG Goods Lift, Ground plus 3 upper floors with Rated speed of 1.0 m/sec. with micro price/PLC control and ACVVVF. drive. Location : Animal Facility Block (B+G+2) -(C) With General PLUS ADDITIONAL SPECIAL FEATURES attached herewith. Prem. Cat..

GEAR LESS LIFT DRIVE (MRL) comprising of High Starting torque Lift 3 phase 440 V A. C. Permanent Magnet Synchronous motor of proper rating with high efficiency shall be used.[2] Micro processor based / PLC, ACVVVF, vector control drive with encoder feedback closed loop system shall be used for lift car and door operation which shall be full collective selective operation hall call demand response, UP/DOWN hall stops, Main, Up/ Down Contactor with overload and phase reversal relay and safety controls. [3] Car with M S platform with bracings of adequate size and to sustain the impact load cabin + passenger with safety factor of fire for steel and side panels of Stainless steel of sheet of grade 304 duty. Car ceiling will be S.S. finishes with aesthetic appearance with LED ceiling lights. Car flooring shall be of anti skid PVC with choice of colour of engineer in charge. Car doors shall be of stainless steel grade 304, hairline finish with centre opening / telescopic automatic doors. Car panel will also be S.S. 304 finished with emergency stop device, mechanical door safety device, facility of auto/ attended mode. All car panel buttons and all floor switches must be with brail language as per lift act. [4] All landing doors must be fire rated for 2 hour shall be fully automatic centre opening/ telescopic opening made of hairline finish steel grade of 304 with key holes and infrared curtains with Unlocking facility from outside

[5] Appropriate battery operated emergency light in the car along with alarm switch shall be provided. Also, Emergency Light & Fan should start immediately without any Time Delay as soon as power fails.

[6] Digital scrolling indicator system for up-down arrow along with floor position indicator shall be provided inside the car and at all floors.

[7] Full height infra red curtain with multiple cross / crossing light beams shall be provided.[8] Automatic Rescue Device (ARD) shall be provided accordingly of passenger capacity with Manual Rescue Operation (Manual Cranking Facility).

[9] Audio visual indication in the lift car showing over loading shall be provided such that doors kept open till excess load is removed. [10] Spring buffers/PU Buffers shall be provided.

[11] Car fan as per passenger capacity with automatic sleep timer shall be provided.

[12] Voice annunciator with suitable music shall be provided in lift car.

[13] Self diagnostics system for operational and safety parameters shall be provided in control panel.

[14] Mechanical over speed governor with governor calibration as per actual site parameters and submission of calibration certificate submission, door key holes in the floor doors, fireman switch shall be provided.

[15] Lift machine hoisting arrangement in the lift machine room and monkey ladder for lift pit should be provided by the lift agency, along with the other steel structure works, foundations for the machine etc...

[16] In the hoist way fascia plate shall be provided without any extra cost, where ever required as / if directed by engineer in charge. [17] Permanent wiring with necessary safety devices like RCCB in all circuit, Over Voltage Under Voltage protection and THD eliminator in circuit for lift machine room and lift well with proper numbers of light points, with fixtures, exhaust fan and plug points shall be provided by the agency. Only 3 phase Power Supply shall be made available by department in lift machine room. Necessary Earthing as per Lift Act/Rules shall be arranged

by Lift Agency.

[18] Any civil/ electrical works for additional and alteration in lift shaft and machine room related to erection of lift shall be made by lift agency without any extra cost. (granite/marble fixing around all landing door openings are not in lift agency's scope.)

[19] Agency has to provide all working drawings and documents and liaison services for obtaining all necessary permission from lift inspector and other authorities. [20] acrylic transparent licence/display A4 size holder in lift car. [20A] As per statutory requirement of Govt. Of Gujarat lift & escalator act 2000, lift agency has to provide

1. Car top safety barricade

2. Push & talk communication system.

3. Fireman's switch operation at Ground Floor. 4. carrying out third party lift inspection during/after lift erection and provide report by third party authorized by concern licensing authority 5. agency has to provide third party insurance upto completion of free maintenance period and submit the document for the same. [21] Car Panel Operating Buttons with floor position indicator/buttons must be of Auto Glow type clearly visible when view from inside cabin.

[22] For Physically Handicapped person Full Length Handrails of hairline finish steel grade of 304 should be provided at appropriate height on the Rear & Side Wall Panels in Lift Car.

(B) SPECIAL FEATURES DESCRIPTION OF LIFTS for PREMIUM category- 1. Advanced control system dual 64 bit embedded microprocessor with CANBUS Serial Communication mode including Regenerative power efficient operation, on site programming facility, Anti nuisance, Pte-opening, BMS/RMS with necessary online real time monitoring system having necessary connectivity for remote monitoring & other suitable supporting hardware & software devices to fulfil the purpose. 2. Floor Indication LCD Display with call registration & brail mark with arrival gong and hall lantern & TFT Screen in the car with MP3 Voice Announcer. 3. CAR Panel should be Scratch resistive SS Moonrock finish / Hair Line / Honeycomb for car and all Doors, All landing doors must have fire rating up to 2 hours and car door must have multi-level crisscross beam door protection. 4. To & fro communication system & wiring (i.e. car , control room & guard room) and Each elevator are equipped with remote monitoring system. agency has to provide mobile app and user id and password for monitoring.

ITEM NO:- 435-436

UPS SYSTEM

GENERAL

1.01 SCOPE

- A. The Contractor shall furnish and install a three-phase continuous duty, on-line, double conversion, solid-state uninterruptible power system, hereafter referred to as the UPS. The UPS shall operate in conjunction with the existing building electrical system to provide power conditioning, back-up and distribution for critical electrical loads. The UPS shall consist of, as required by the project, the UPS module, top covered battery rack (s), and inbuilt input isolation transformer, maintenance bypass, parallel card inbuilt and other features as described in this specification.

1.02 RELATED SECTIONS

1.03 SYSTEM DESCRIPTION

Standard UPS system will include a minimum of (1) rectifier, (1) inverter, (1) static bypass, and (1) battery system.

A. Components:

1. Rectifier
2. Inverter
3. Sealed Lead Acid Batteries
4. Battery Charger
5. Automatic Bypass
6. User Interface Panel / Display
7. USB Communication Interface for service use
8. Communication Card Slots (2)
9. Remote Emergency Power Off Contacts
10. Environmental (Building Alarm) Inputs (3)
11. Hardwired Input, Output
12. Internal Maintenance Bypass Isolator
13. Input, Output & Bypass Isolators
14. External Top Covered Battery Racks
15. Inbuilt Isolation transformer before Rectifier (20 – 200kVA)
16. External Isolation transformer before Rectifier (300 – 600kVA)
17. Base Frame for UPS
18. Communications - Mandatory
 1. SNMP/Web adapter
 2. Modbus RTU interface
 3. SNMP & MODBUS Combo Card should be Cybersecurity Certified (UL & IEC Standards both) Certificates to be submitted before manufacturing start.

i.

B. Modes of Operation: The UPS shall operate as an online, double-conversion UPS with the following modes:

1. Normal: During the Normal or Double-conversion Mode the rectifier shall derive power as needed from the commercial AC utility or generator source and supply filtered and regulated DC power to the online inverter. The inverter shall convert the DC power to highly regulated and filtered AC power for the critical loads. The Inverter shall be Three Level latest technology.
2. Battery: Upon failure of the AC input source, the critical load must continue to be supplied by the inverter without switching. The inverter must obtain its power from the battery. There must be no interruption in power to the critical load upon failure or restoration of the AC input source.
3. Recharge: Upon restoration of the AC input source, the rectifier/battery charger must recharge the battery. The inverter shall, without interruption of power, regulate the power to the critical load.
4. High Efficiency or ECO Mode: The static bypass switch will conduct, and the UPS rectifier and inverter will be operated in a “suspended” mode, unless incoming power conditions require conventional double conversion operation. In High Efficiency mode the UPS input and output

filters shall remain in-circuit to provide surge suppression. Transfer time from HE mode to Double Conversion mode, and vice versa, shall be typically less than 4ms.

5. Bypass: The static bypass switch must be used for transferring the critical load to the AC utility supply without interruption, and shall be rated for continuous operation. Automatic re-transfer to normal operation must also be accomplished without interruption of power to the critical load. The static bypass switch must be capable of manual operation via the front panel controls. An optional integrated bypass back-feed protection contactor, in series with the static switch, shall prevent system voltages from bleeding backwards through the static switch and rectifier snubber components to the utility source in the event of a utility failure and shall also open upon detection of a short circuit static bypass SCR.
 6. Internal load testing: The UPS system will be capable of utilising the Internal Capacity Test function, including internally adjustable load testing at the customer site, without the need for a load bank. Testing shall only be initiated using the UPS OEM Engineer's Software Service Tool. This testing is not intended to be performed while the UPS is servicing the critical load.
- ii.

1.04 REFERENCES

- A. The UPS and all components shall be designed, manufactured and tested in accordance with the latest applicable standards as follows. Where a conflict arises between these documents and statements made herein, the statements in this specification shall govern.
 - iii. Safety
 - a. IEC 62040-1 or EN 62040-1
 - iv. Emission and Immunity:
 - b. IEC62040-2
- B. Markings
 - v. CE

1.05 SUBMITTALS – FOR APPROVAL BEFORE MANUFACTURING

- A. UPS Technical Datasheet / Brochure
- B. Manufacturer Certificates (ISO 9001, ISO 14001, ISO 45001)
- C. Manufacturing Capabilities of the UPS OEM in India (with proof for minimum 10 years)
- D. Pointwise Technical Compliance along-with supporting documents, certificates as described in RFP.
- E. Detailed IEC 62040-3 Type test Report from Third Party NABL Accredited Lab or eqv.
- F. UL & IEC Certificate for Communication cards
- G. Third Party Vulnerability Test Reports for Communication cards
- H. Country of Origin certificate
- I. Battery Bank Calculations
- J. Battery product Catalogue
- K. Battery MCCB Technical datasheet
- L. UPS Room Layout
- M. UPS GA Diagram
- N. Top Covered Battery Rack GA Diagram

- O. UPS SLD with Inbuilt Isolation transformer & Input, Output, Bypass, MBS Isolator Description
- P. Battery MCCB Make & Datasheet
- Q. Manufacturers Service Set-up and Toll Free call center number details

1.06 OPERATION AND MAINTENANCE MANUALS

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component products.

1.07 RATINGS

A. System Rating

1. The UPS module(s) shall have an output rating of:
 - a. 0.9 LOAD P.F @ 40 Degree C (KVA / KW RATING AS PER BOQ)
 - b. Isolation Transformer shall be inbuilt at Input side, rating of Transformer should be higher than UPS Rating.

B. System Input

1. Input Voltage Operation Range
 - a. Nominal 400/230 (or 380/220 or 415/240 adjustable) VAC, 4-wire plus ground
 - b. -15% to +20% from nominal at 100% load or better
-50% to +20% from nominal at 50% load or better
2. Input Frequency
 - a. 40 to 72 Hz or better
 - b. auto-sensing
Input Power Factor: 0.99 typical @ 100% loading
3. Input Current Distortion: 5% THD maximum at full rated linear load
4. Inrush Current:
 - a. $\leq 130\%$ of rated current for ≤ 2 cycles

C. System Output, Normal Mode -Nominal Output Voltage, UPS on Utility

1. 400/230, or 380/230 or 415/240VAC, Selectable through front panel or through serial port connection with power management software
2. Voltage regulation: $\pm 1\%$ of selected output voltage in steady state
Transient Voltage Response: Meets Class 1 performance of IEC62040-3 and VFI-SS-111; $\pm 5\%$ for 100% step load change; recovery in $< 20\text{ms}$.
3. Voltage THD:
 1. 2% Total Harmonic Distortion (THD) maximum for rated linear load
 2. 5% THD maximum for a non-linear load
4. Nominal Frequency: 50 or 60 Hz selectable
5. Frequency Regulation:
 1. 50/60 Hz $\pm 3\text{Hz}$, ± 1 to ± 3 Hz selectable
6. Slew rate:

1. 0.8 Hz per second or better
7. Current Overload Capability without Bypass at nominal Load P.F. 0.9:
 1. 111-125% load 10 minutes @ 40 Deg C
 2. 126-150% for 1 min @ 40 Deg C
 3. >151% for 400 ms @ 40 Deg C for (80 to 500DkVA)
8. Bypass:
 1. Automatic bypass shall provide an alternate path to power in the case of overload, inverter failure or other UPS failure
 2. Internal Maintenance Bypass to be provided with Each UPS
 3. Transfer time to and from any internal bypass shall be no-break, when UPS and Utility are in sync
 4. Unit shall be able to detect bypass module failure.
9. Efficiency:
 1. In Normal Mode, 25% to 100% linear load range
 - 20 KVA to 60 KVA : 90% or better (without Transformer losses)
 - 80 KVA to 500 KVA: 95% or better (without Transformer losses)
 2. In High Efficiency mode: upto 98% at 100% linear load (without Transformer losses)

1.08 UPS IN PARALLEL CONFIGURATIONS

- A. UPS modules shall be capable of being paralleled to increase system power levels or to provide redundant power. The UPS shall be field-upgradeable with additional parallel capacity up to 3+0 modules, or for redundant operation, up to 3+1 modules. The parallel system shall have intelligence to automatically recognise the need for capacity and/or redundancy. Parallel systems shall utilise autonomous UPS power modules that do not rely on any control interconnections for synchronized operation. The individual modules shall operate in a peer-to-peer manner to provide automatic load sharing, synchronization, and selective tripping capabilities. "Master-slave" configurations are not acceptable.
- B. The parallel system shall utilise a communications network to provide system information and status, such as operating mode and meter data. This network shall provide individual module information as well as total system information, and individual module information shall be available from any module's front panel display. The loss of this system information network shall not cause the parallel units to transfer to bypass or drop the critical load.

1.09 SYSTEM INPUT & OUTPUT CONNECTIONS

- A. AC Input:
 1. All UPS units shall be capable of utilising hardwired input. Input, Bypass, Output, MBS isolators shall be provided inside the UPS as mandatory
 2. The building/Utility input neutral is required for proper UPS operation.
 3. The Isolation Transformer Neutral to be separately earthed.
 4. UPS Body Earth Should not be same as Isolation Transformer Neutral Earth.
 5. All Connections should be done with Copper Flexible Cables.
- B. AC Output:

1. All UPS units shall be capable of utilising hardwired output
- C. Extended Battery Connection: UPS module will include terminations for External battery. UPS Manufacturer to provide Battery Breaker (MCCB) and Battery terminal caps as Mandatory for additional safety.
- D. Remote Emergency Power Off (REPO) Connection: The UPS shall provide a built-in landing for field connection of a Remote Emergency Power Off circuit. Upon initiation of the REPO circuit, the UPS shall open its input relays, and disengage the battery converter, preventing power from being delivered to the attached loads.
- E. (2) Communication Card Slots: The UPS shall provide (2) communication mini-slots in the front of the UPS allowing for optional plug-in connectivity options, including SNMP/Web interface, 4x relay contacts & RS232 port, and Modbus capabilities. Vendor need to supply SNMP+Modbus Card along with UPS as standard. The Cards should be UL/IEC Certified for cyber security standards. Reports / Certificates should be submitted.
- F. (3) Programmable Input Connections: The UPS shall provide built-in inputs for field connection (environmental input). The inputs shall be parameter programmable to suit the needs of the application.

1.10 USER INTERFACE

- A. Front Panel Display: The UPS shall include a front panel display consisting of a graphical LCD display with backlight, four status LED's, and a six-key keypad. Touch Screen Display is not advisable due to its prone to early failure.
 1. Graphical LCD display: Includes basic language (English and local selectable language), display of unit function and operating parameters. It shall be used to signify the operating state of the UPS, for indicating alarms, for changing operations control parameters and set points.
 2. Four status LED's, which indicate:
 - a. Alarms, with a red LED
 - b. On Battery, with a yellow LED
 - c. On Bypass, with a yellow LED
 - d. Power On, with a green LED
 3. Six-Key Multifunction Keypad: UPS shall have keypad to allow user to adjust UPS parameters, view alarm and inverter logs, change UPS operational modes, and turn the UPS on and off. Keys will be marked as UP, DOWN, LEFT, RIGHT, ESC and ENTER
 4. Meters: When selected, the front display shall show individual screens of input parameters, output parameters or bypass parameters including; voltage, current, frequency, true power, apparent power and power factor. The display shall also show DC Voltage and current.
- B. Power Management Software Package: The UPS shall offer optional communications interface that provides the following communication capabilities:
 1. Monitor and graphically display input and output voltage and other operating characteristics
 2. Notify end-users in the event of a power anomaly via E-mail.

1.11 BATTERIES

- A. Battery Type: Valve Regulated Lead Acid (VRLA), minimum two-year warranted float service life at 25 degrees C

- B. Battery Back-up Time (Runtime): As per BOQ, Battery Calculations to be submitted for consultant approval before start of manufacturing.
- C. Bus Voltage: Nominal bus voltage is 480 VDC, adjustable to 432VDC in case of emergency by service engineer.
- D. Battery Protection:
 - 1. Short Circuit Protection: Over-current protection shall protect the batteries from all short circuit fault conditions
 - 2. Battery Module Protection: Internal battery contactor shall be provided
 - 3. Under-voltage Protection:
 - 1. Inverter cut-off voltage: Battery operation shall be terminated when the battery voltage drops to the 1.67 VPC set point
 - 4. Over-voltage Protection: If the UPS system's battery bus voltage exceeds the predetermined set point then the UPS will disable the charger and alarm a "check battery" condition
- E. Advancement in Battery Management / Superior Battery Management:
 - 1. Battery recharge: After recharging batteries to full capacity, the charger will enter the rest mode to increase the battery lifetime according the A.B.M cycle. Hence, continuous float charging of the battery shall not be required if the A.B.M feature is selected. The active battery charger states are constant-current (charge mode), constant-voltage (float mode) and no-charge (rest mode). The A.B.M feature is user (or service) selectable. If A.B.M is not utilised, the UPS operates as a conventional float charger.
 - 2. Battery Runtime Monitoring: UPS shall monitor batteries and provide status to end user of battery remaining capacity via front panel icon, remote communications, or both. Runtime calculations to be based on load demand and analysis of battery health.
 - 3. Battery Health Monitoring: UPS shall periodically test and monitor battery health and provide warnings visually, audibly and/or remotely when battery capacity falls below 80% of original capacity. Battery testing may also be user initiated via front panel or serial communications.

1.12 ENVIRONMENTAL CONDITIONS

- A. The UPS shall meet IEC 61000-4-6 Level 3, and IEC 62040-2 C3, and FCC A15J for Emissions or better
- B. Ambient Temperature
 - 1. Operating:
 - 1. For all ratings: UPS Shall be able to deliver KW @ 0.9 P.F. also for 40 Degree C Temp.
 - 2. For Higher ratings $\geq 100\text{KVA}$, UPS Shall be able to deliver KVA = KW for 30 Degree C Temp.
 - 3. For Higher ratings $\geq 100\text{KVA}$, UPS Shall be able to deliver KW @ 0.8 P.F. also for 45 Degree C Temp.
 - 4. Preferred temperature for batteries: 25 to 27 deg C.
- C. Relative Humidity
 - 1. Operating: 5 to 95% non-condensing.
 - 2. Storage: 5 to 95% non-condensing.
 - 3. Transportation: 5 to 95% non-condensing

- D. Electrostatic Discharge: The UPS shall be able to withstand a minimum 6 kV or better without damage and without affecting the critical load

PART 2 EXECUTION

2.01 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section.
1. Standard Computer-automated UPS system test as per OEM.
 2. Hipot test

2.02 INSTALLATION

The UPS Manufacturer shall install all equipment per the manufacturer's recommendations under supervision of main contractor's site Incharge

Item No:- 437-466

GENERAL TERMS AND CONDITIONS (MAINTENANCE)

Name of Work: - Comprehensive maintenance of Civil, Electrical and Mechanical services in Gujarat Biotechnology University at Gandhinagar, Gujarat.

General Conditions:

1. Work shall be carried out as per CPWD/State Govt. specifications wherever applicable. Safety procedure as indicated in CPWD specification of Electrical work /Lifts Work/Fire Fighting Work/ Wet Riser work/ D.G Set and Sub Station work/HVAC Work should be followed.
2. The rates quoted shall be inclusive of wages of Supervisor/ Electrician/ Fire Operator/ Fireman/ A.C/E&M Operator /Wireman/ Khallasi etc. i/c relievers, cleaning material, uniform and all taxes and duties etc. as applicable.
3. The contractor shall take all precautions for safety of the workmen. If any accident / mis- happening occurs the department shall not be responsible for the same. If any compensation is to be paid to the victim, the firm shall pay the same and no claim in this account shall be entertained by the department.
4. All the cleaning material i.e. soap, duster etc. shall be arranged by the contractor at his own cost for cleaning of Electrical Installation & fans, switch gears, DB, Main control panel, Water supply pump, Fir Alarm System/ Wet Riser System/Lifts/D.G Set/ Sub Station equipment, A.C Units/Pressurization and Ventilation System etc. If cleaning of installation

is not found satisfactory at any time, a recovery of Rs. 200/- per occasion noticed per Sub Head shall be made from the bill of contractor.

5. In case the department staff is posted or due to some other reasons, the department reserve the right to terminate the contract in full or part thereof.
6. The contractor shall furnish name & contact number of the persons, who should be contacted during emergency.
7. No T&P shall be issued to the contractor.
8. The contractor shall maintain Sub Head wise "attendance register" in support of the attendance of the staff and the same shall be got periodically checked from department authorized representative. Failure to which suitable recovery will be made from the contractor bill as decided by the Engineer-in-charge.
9. The contractor shall prepare a Sub Head wise "fortnightly/Monthly" duty chart with name and duty hours stated therein. The same shall be submitted to the department authorized representative at least seven days in advance.
10. In case of any damage to any equipment due to negligence of the contractor's staff the same will have to be made good by the contractor at his cost. Failure to which suitable recovery will be made from the contractor bill as decided by the Engineer-in-charge.
11. Before the start of contract, the contractor is bound to submit the following details of the workers proposed Sub Head wise to be engaged by him. After receipt of confirmation of their suitability from Engineer-in-charge or his authorized representative, they shall be deployed on duty.
 - i). Name & Postal Address with I.D. proof
 - ii. Photograph with specimen signature.
 - iii). Qualification and experience.
 - iv). If the contractor fails to supply list of the workers, the work shall not be treated as started at site.
12. The contractor shall replace the staff, in the event of misconduct by him.
13. The contractor/ Firm is advised to visit the site of work before quoting the rates, in order to ascertain the quantum and location of works.
14. It shall be entirely the responsibility of the contractor to ensure that no unlawful act is done by his persons while on duty. In case any theft/ loss of departmental property takes place due to the negligence or carelessness of his personnel, the contractor will be held responsible and shall make good the same. The aforesaid terms and conditions shall be read in conjunction with the general rules and directions for the guidance of Contract.
15. **Terms of payment and other facilities for workers.**
 - 15.1 The contractor is bound to distribute the salary/ wages to his worker by 7th of each month, positively, by cheque or ECS as feasible. Payment to the contractor shall be made monthly/ quarterly Subject to availability of funds after receipt of bill complete with all documents.
 - 15.2 The contractor shall deduct worker subscription towards Provident Fund

and ESI, as per rules, he shall deposit the same along with his contribution into the respective accounts of the worker.

- 15.3 The contractor shall take all precaution for safety of the workmen. If any accident / mis- happening occurs, the department shall not be responsible for the same. Consequently any compensation payable shall be at the contractor cost.
- 15.4 (A)The contractor shall provide two sets of summer uniform (shirt, pant & black shoes) and two sets of winter uniform (shirt, pant and woolen jersey) along the badge having name of worker, designation of worker and name of agency within 15 days of start of work. Failing which a recovery @ Rs. 4000/- per worker for summer uniform and @ Rs. 8000/- per worker for winter uniform shall be made from the contractor bill and department will arrange the uniform for the contractor's worker.
- (B) Worker deputed on duty should be in uniform. If any worker found without uniform a recover @ Rs. 100/- per day per worker shall be made from the contractor's bill.
- 15.5 Minimum labour shall be deployed by the contractor as per the list attached.
- 15.6 Recovery shall be made at the following rate if Supervisor/ Electrician/ Fire Operator/ Fireman/ E&M Operator /Wiremen/ Khallasi etc. found absent from his duty.
- a) Supervisor - @1500/- per day
 - b) Electrician-@1200/-per day
 - c) Fire Operator/ Fireman/E&M Operator /Wiremen/AC Mechanic/Computer Operator/Clerk etc @ 1000/- per worker per shift
 - d) Khallasi/MTS @ 800/- per worker per shift.

16 **Terms of Payment for the contractor**

- 16.1 The healthiness of the complete system shall be evaluated on the method detailed in additional terms and condition of individual Sub Head.
- 16.2 Payment to contractor shall be made after production of following proof :
- a) Sub Head wise fortnightly/ monthly labour report.

Inventory as per physically available at site & shall be handed over by the site staff.

Any other addition/alternation in the installation shall be assured to be covered in the scope of the work.

17. The contractor shall have valid Electrical contractor license. The contractor shall obtain all necessary approval from State/Local Body as per law in vogue.
18. The Contractor shall take immediate action to attend any complaint of E & M Services assigned to him through site order book/verbal instructions from Engineer-in-charge or through telephones or through intercom or through Toll free No. or in person or from Authority. In all cases he shall attend the complaints in the specified duration as mentioned below:-
- (a) **No delay complaints:-** The E & M Services in critical areas are to be maintained round the clock without even minor interruptions. Complaints of emergent

nature such as fault of electricity, water supply & HVAC services in critical areas are to be attended with ½ Hours. In case of delay beyond ½ Hours, recovery of Rs. 1000/- per complaint/Failure per hours shall be made from the contractor.

- (b) **Minor Complaints:-** Complaints relating to failure of E & M services in areas except above in
 - (a) are to be attended with in 1 hour, in case of delay beyond 1 hours recovery of Rs. 500/- per complaint/failure per hours shall be made from the contractor.
 - (c) **Major Complaints:-** Complaints of failure of E & M services other than no delay and minor complaints, such as burning/damaged out of cable/switch gears etc. Shall be attended with in 48 hours. failing which recovery of Rs. 1000/- per day per fault shall be made from the contractor. However services in the affected areas should be maintained by alternate way, otherwise penalty shall be made from the contractor as per penalty mentioned in (b) Minor complaints above.
 - (d) For any other type of complaint/defects, the recovery shall be made as per the rate of recovery mentioned in the concerned section/part of NIT.
19. After the expiry of the contract, the firm shall have to hand over complete installation to the department in proper working order. All defect and deficiencies shall have to be rectified by the firm to the entire satisfaction of Engineer-in-charge failing which the work shall be got done at the risk and cost of the firm.
 20. The Contractor shall employ their regular staff in the works and related names of employees shall have to be given by the contractor.
 21. No claim of their employees/ staff employed for subject work in any form shall be entertained by the department.
 22. The Contractor shall employ supervisors having valid Diploma/Degree for Electric Works in General shift.
 23. The contractor shall employ Electrician/Wireman having valid Electrician License/ITI Diploma.
 24. The Extra Item work in the contract shall have to be executed by the contractor as and when required as per instructions of Engineer-in-Charge.
 25. All T&P including ladders, wire drawing equipment, chase cutting, equipment, drilling machine merger insulation earth resistance testing equipment etc. required for the work shall have to be arranged by the contractor.
 26. Comprehensive Maintenance shall include all labour, material, T&P & other sundry material.
 27. The Contractor/Agency shall replace the all wornout material with the same make as that of existing installation. If existing installation make is not available then approval make as per direction of Engineer-in- Charge shall be provided.
 28. Any prevailing taxes, duties, levies imposed by the Central /State government

during the contractual period will not be payable but any new such taxes shall be paid accordingly.

ADDITIONAL TERMS AND CONDITIONS (LIFT)

(A) OPERATION, ROUTINE MAINTENANCE AND PREVENTIVE

MAINTENANCE OF LIFTS

The scope of work covered by Schedule includes:

- 1 The work is to be carried out as per CPWD General Specification for Electrical works (Part 1& 2) & (Part III- Lifts & Escalators) wherever applicable or issued by Gujarat Govt.
- 2 The scope of work comprises Preventive maintenance, day to day maintenance of the Lift as per Manufactures recommendation.
 1. In case of emergency the staff may have to work beyond normal working hours, for which no extra payments shall be made by the department.
 2. The log book, complaint register, maintenance records shall be maintained by the staff of the contractor. All the registers shall be supplied by the firm/contractor.
 3. The watch and ward of the lifts installation and materials will be the responsibility of the contractor.
 4. The general cleaning of the lift, machine room shall be the responsibility of the agency.
 5. The safe custody of plant & machinery shall be the responsibility of the contractor. The up-keep of the machine room will be deemed to be handed over to the contractor after award of work.
 6. Any accident involving damage to human life, lift machinery, equipment etc. due to mal operation of lift, will be the responsibility of the contractor. The firm has to make good the losses, of that by way of replacement of machinery, equipment, compensation to the person etc. Engineer-in-Charge decision in this regard shall be final and binding on the firm.
 7. In case of break down or stopping of lift between the landings on account of any interruption in power supply the rescue operation shall have to be performed by the Contractor Employee.
 8. Any loss due to mal operation of the lift shall be the responsibility of the contractor.
 9. Any loss/ damages to the lift equipments shall be recovered from the contractor. In this respect the decision of Engineer-in-Charge shall be final, and binding on the contractor.

10. Servicemen will attend to all call backs received during normal working hours.
11. The firm shall examine periodically all safety devices governors to ensure in proper working condition.
12. The contractor should be in a position to undertake the works which are otherwise outside the scope of work of this contract – subject to the approval of rates by competent authority of the department.

13. SCHEDULE OF CHECKS

DAILY CHECKS (Use Proforma - I).

Daily Check by Lift Operator and fortnightly by Contractor Engineer.

Landing Locks (a) Movement of car with gate open. (b) Try to open the gate when car is not landing
Car Gate Switch (a) Movement of car with gate open. (b) Open the gate while car is moving.
Door operator safety (on automatic doors)
Emergency stop button works.
Emergency call bell.
Car lights, landing lights and landing call buttons.
Lift locked by
Lift opened by

PROFORMA - I

14. DAILYCHECKS BY LIET OPERATOR

Name of Bldg. _____ Lift No. -----

 Division ----- Sub-Division-----

Date	1 (a)	1 (b)	2 (a)	2 (b)	3	4	5	6	7	8	Remarks	Initials of Operator/JE		
												I	II	III

- 26 No. T & P shall be issued by the dept. to the contractor
- 27 The contract shall have to employ trained and experienced staff.
- 28 In case of Emergency, the staff may\ have to work beyond normal working hours or on holidays, for which nothing extra shall be paid on this account.
- 29 The staff has to maintain good behavior at site; any person found misbehaving shall have to be replaced within 48 hrs. Decision of the Engineer-in-charge or his authorized representative shall be final and binding to the contractor.
- 30 Department shall not be responsible for any injury partial or permanent or death of any worker at site due to accident or malfunctioning of equipment or negligence of the staff. The contractor shall not involve the Deptt. in any obligation above contract.
- 31 All the equipments and installation will be maintained in neat and clean condition.
- 32 The maintenance records, log book, complaint register, worker's diary and attendance register etc. Shall be maintained by the staff of the contractor. Nothing shall be paid on this account.
- 33 The contractor has to arrange consumable materials like cotton waste, old dhoti, soap bar. Duster, fuse, insulation tape etc. All other spares and materials shall be supplied by the Department free of cost for bonafide use on work.
- 34 The department is at liberty to discontinue/cancel the contract agreement any time without giving any notice and without assigning the reason thereof. Decision of Engineer-in-Charge shall be final and binding to the contractor for which no claim on any account shall be entertained by the Department.
- 35 The services of the staff deputed by the contractor can be used occasionally at other sites in case of necessity only for attending to some urgent nature of work on order of client representative, for which no additional payment will be made to the contractor.
- 36 The staff posted at site should wear uniform with having badges of their names & designation during the duty periods and shall be provided by the contractor and nothing shall be paid on this A/c If any staff is found without uniform shall be treated as absent and recovery shall be made accordingly.
- 37 The Lift Supervisor/Operator shall keep a cell phone (having a permanent mobile No. for the period of Agreement) with their and Cell Phone Numbers shall be displayed on each lift Car/Landing Gate.
- 38 The contractor will be responsible for the security & safety of all the equipment's installed in the lift like ARD, Inverter, Annunciation System, I.R. sensor, lift monitoring system, intercom, electrical fixture, fans, and other lift accessories and for this he may obtain the inventory of such item from JE for his record, otherwise the same will be treated as handed over to agency.
- 39 The contractor will ensure that the lifts will be operated only when all the safety systems like door Leveling rated speed of lift, Alarm, intercom & ARD are in working

- condition and will report to client representative of site, if not in healthy condition.
- 40 The contractor will submit check list on safety of all the lifts, duly signed by lift supervisor on daily basis.
- 41 The Contractor has to associate the OEM of lift Agency for Comprehensive maintenance of Lifts.

TERMS AND CONDITIONS

(E.I & Fans/ Street light/ Outdoor lighting)

1. The work shall be carried out as per CPWD / State Govt. Specifications for internal & External Electrical Installations, CPWD Maintenance Manual and as per direction Engineer-in-charge wherever applicable as specified in BOQ.
2. The details of the installations to be maintained by the contractor
 - a) Light points/ Fan pts/ Ex-fan pts./ Call bell pts
 - b) 5 amp power plug points
 - c) 15 amp power plug points
 - d) 20 amp Ind. power plug points
 - e) Fluorescent / CFL light fittings/LED Light fittings.
 - f) All type of light fittings internal & External.
 - g) Ceiling fans
 - h) Ex-fans & Fresh Air Fan.
 - i) Call bells
 - j) SP, SPN, TP & / TPN MCB DB"s with MCB"s
 - k) Different Rating/Capacity Rising Mains. & Tap-off boxes
 - l) 63 /100 amp TP & N Switch units.
 - m) 63/100/125/200/250/400/600 amp. TP/TPN MCCBs
 - n) Streetlights and compound lights with HPSV/HPMV/Metal Halide/CFL/LED fittings control gears/Electronic Driver etc.
 - o) All type of feeder pillars with switch gears/Electrical Panels etc.
 - p) LT UG cables for streetlights, wiring in buildings & Electrical Poles etc.
 - q) Other switch gears/accessories associated with system such as hylam sheet, boxes, screws, washers, nut bolts, etc. as desired by Engineer-in-charge.
3. The contractor has to arrange all the material, for day to day maintenance, like detergent, cloth, soap bar, duster, fuse wire, cable glands, and small piece of wires, thimble lugs, tube holders, insulation tape and all other consumable materials. Nothing extra is payable on account of the materials required to maintain the electrical installation.
4. The contractor has to arrange T & P's required for the work at site.
5. Safety of the staff employed will be the responsibility of the contractor who must insure the staff adequately. This office will not be responsible

for any mishap, injury/ death of the staff.

6. The contractor will maintain attendance register of the staff, which will be checked by the client, authorized representative.
7. All the equipments and installations shall be maintained in neat and clean condition. The watch and ward of installation shall be the responsibility of the contractor.
8. The work may be closed at any time without assigning any reason and no claim of the contractor shall be entertained.
9. The contractor shall submit the name, address & character certificate of the worker/ staff employed by them at the site of work to the Engineer-in-Charge before start of the work.
10. The contractor shall submit the attested photocopy of wireman/ electrician license & show the wiremen's license in original of wireman employed by them to the Engineer-In- Charge before the start of the work.
11. The following items of the works shall be carried out regularly as per periodicity stated below and proper record of works shall be maintained-
 - a) Earth testing - Once in a year.
 - b) Insulation test - Once in a year.
 - c) Cleaning of E.I. - Once in a year.
 - d) Painting of E.I. - Once in 3 year
 - e) Painting outdoors metallic items like MS poles, feeder pillars etc.- Once in a year
 - f) Oiling & greasing of the fan - As & when required & once in a year.
 - g) Checking of regulators, replacement of Carbon brushes etc. when required - Once in a year

1. Preventive Maintenance:-

- (i) To attend day to day complaints of all electrical installations & maintenance at site, maintenance of complaint register and worker diaries.
 - (ii) Taking steps for preventive maintenance.
 - (a) Checking of DB's main board, rising main etc.
 - (b) Checking and cleaning of fans and fittings twice a year or as required.
 - (c) Insulation test during monsoon.
 - (d) Earth test before monsoon i.e. during peak summer season.
 - (iii) Maintenance activities carried out as per schedule should be noted in the maintenance register. When test are carried out the test result should be recorded with appropriate identification reference.
- 2. Staff deployment and their qualifications.-** The contractor shall depute qualified and experienced staff as per requirement. Before starting the work the contractor will

submit list of workers with their qualification and address etc.

In no case the contractor shall reduce this staff strength, otherwise recovery shall be affected. The duty timing can be changed as per the discretion of the Engineer-in-Charge.

The contractor shall depute staff with minimum qualification and experience as detailed here under:-

Wireman-1 Nos.:- Qualification:- He should Passed ITI certificate/ Wireman license with 2 years' experience

Khallasi-1 Nos.- Should physically & mentally fit & must have six months experience in the line.

3. The prescribed complaint register and workers diary shall be provided by the contractor and these shall be neatly maintained by contractor and staff. All complaints are to be attended promptly and the complaints not attended in the same day shall be reported to Client authorized representative and carried forward to next day till these are not attended. The complaint register should be got checked regularly from the Client authorized representative. The completed complaint registers, worker dairy, insulation and earth test register shall be the property of department and shall be deposited with Client authorized representative.
4. The installation shall be handed over, as is where is basis and nothing extra shall be paid towards pre-maintenance as the equipments are in running condition.
5. After the expiry of the contract, the firm shall have to hand over complete, installation to the department in proper working order. All defect and deficiencies shall have to be rectified by the firms to the entire satisfaction of Engineer-in-Charge failing which the work shall be got done at the risk and cost of the firm.
6. The contractor shall maintain the register for DB checking, Fan checking & earth checking.
7. Insulation test shall be done during monsoon season, as per clause of CPWD specifications for Elect. Work Internal – 2013. & CPWD Maintenance Manual / Gujarat PWD specifications/Manuals.
8. Earth continuity test and earth electrode resistance test should be conducted during summer season.
Record the test result giving identification reference. If results are not satisfactory in any part of the Installation, reason should be checked and corrective action should take immediately.
9. The duty time can be changed as per direction of Engineer In Charge.

TERMS AND CONDITIONS

(Water supply pump sets, Wet Riser, Sprinkler & Fire Fighting)

- 1 The work shall be carried out as per CPWD /State Govt. Specification for Wet Riser, Sprinkler System & Fire Fighting works. Amended up to date. Wherever applicable and recommendation of respective manufacturer.
- 2 **Scope of work : The following activities are intended to be covered under this contract:-**
 - a) Operation and maintenance of installation as specified in BOQ & as directed by the Engineer- in-charge or his authorized representative.
 - b) Performing the daily/weekly/six monthly checks as detailed in remedial action for proper maintenance.
 - c) Cleaning of all equipments.
 - d) Watch and ward of all fire fighting equipments (Internal and external both)
 - e) **Conducting of fire drills**

Fire drill shall be carried out weekly for which care taker at site of work shall be informed and shall be involved in conducting fire drill. Operation of the system shall be demonstrated so that all users are confident of the system and aware the duties and responsibilities during fire. All the fire drills shall be recorded in a register.
 - f) **Healthiness of system.**

The healthiness of the system in Automatic Mode shall be checked through daily testing and weekly testing. During the weekly testing a particular block shall be taken up and all internal hydrants and adjoining yard hydrants of the same block shall be operated and checked, for automatic functioning of jockey and main electric pump.

During the subsequent week different blocks shall be selected so as to ensure that all the internal hydrants and yards hydrants of a block is checked once in every month.

The details of such weekly testing shall be conducted in presence of Client to the extent feasible and shall be recorded in register along with date, timing and findings.
3. The contractor shall maintain the log books of pumps and shall be checked by the Client representative.

4. The contractor shall take over the site as per inventory before starting the work and will return the same in working conditions after completion of work.

- 5.
- a) The dismantled material shall be deposited to the department representative at his site store
 - b) The diesel oil for running the engine pump shall be arranged and supplied by the department in 200 Ltrs. Barrels at site store 'free of cost', which will be filled in service tank by the staff deployed by the firm. Nothing extra shall be payable on this account. Contractor shall maintain diesel consumption require at site. Transportation of Deisel from Petrol Pump to site shall be the responsibility of the Contractor.
 - c) Remarks and observations regarding maintenance / malfunctioning of wet riser, yard hydrant, fire fighting pump and panels, accessories recorded in the log book same shall be got rectified by the department at the risk and cost of the firm without entering into any correspondence and necessary recovery shall be made from the bill of the contractor.
1. Experience of the staff deputed shall be as under:-
- a) **Fire pump operator**
 Experienced worker having experience of 5 years in the installation and operation of wet riser / or had undergone certified course in "Fire Fighting System.
 - b) **Khallasi:**
 Khallasi should be physically fit and must have six months experience in this line.

6. MAINTENANCE JOB INVOLVED IN FIRE FIGHTING & SPRINKLERS SYSTEM

Work Involved	
1.	<p><u>Siamese connections</u></p> <p>Operational testing by arranging water from nearest available yard hydrants. External and internal cleaning of cabinet from all sides i/c partitions cleaning the accessories fitted inside the cabinet checking the tightness of nuts bolts, locked close and locked open the slice valve and closing off of Siamese cabinet. Polishing of gunmetal part.</p>
2.	<p><u>Yard Hydrants</u></p> <p>Fully lock open and closing of hydrant valve, applying grease inside the female coupling polishing of gunmetal parts, adding</p>

	<p>the asbestos gland, if required checking the tightness of nuts bolts, cleaning inside and outside the hydrant box, vertical pipe, hydrant valve. Testing and checking of pressure of water.</p>
3.	<p><u>Sprinkler system alarm bell</u></p> <p>To open the valve fully open. Test the bell, its nuts bolts, its tightness attending to leakage if any and close test valve of sprinkler alarm valve.</p>
4.	<p><u>Sprinklers sluice valve</u></p> <p>Cleaning the sluice valve. Fully closing the valve and then fully locked open the valve in its original position. Removing the lod packing and inserting new gland packing if required greasing, checking the tightness of nuts bolts gasket etc.</p>
5.	<p><u>Internal Hydrant</u></p> <p>Polishing of gun metal parts applying grease inside the female coupling, to open and close 2 Nos. head valves (landing valves) checking the tightness of nuts bolts. If found necessary to replace internal rubber seat gasket or flange insertion, clean the dirt and dust from valve.</p>
6.	<p><u>Hose Reel</u></p> <p>Unrolling, re-polling of hose tube to open and close the shut off nozzle, gate valve, tightening of different clamps, nuts bolts, cleaning of complete hose reel, polishing of nozzle applying grease outside adopter.</p>
7.	<p><u>Branch pipe & Nozzle</u></p> <p>Taking outside the branch pipe from shaft (enclosure) cleaning branch pipe nozzle and refixing it in its place.</p>
8.	<p><u>Canvass Hoses</u></p> <p>Taking hose outside the cabinet/ shaft unrolling of fire hose dry it in sum shade dusting it with French chalks powder, polishing of an</p>

	coupling, changing of spring 'O' ring where required of female and coupling, re-rolling and putting it back in to shaft/ cabinet/position.
	Cleaning of clear glasses, cleaning and dusting off the interior of shaft/ cabinet complete as well as exteriors, cleaning of the risers, removing the spiders web etc. & replacement of broken glasses.
10.	<u>Air Vessel</u> Cleaning of exterior of air vessel, draining out of accumulated water from air vessel, replacement f defective pressure gauge, maintenance of small valve checking welded joint/ leakage of air vessel and attending to the leakages by welding etc. as required.
11.	<u>Cut-off valves</u> Cleaning the sluice valve chamber, (where required) by way of removing the garbage, slit from inside the chamber. Fully closing the valve and then they fully open it and lock it in its original position) . Removing the old gland packing, greasing, checking the tightness of nuts bolts as required.
12.	<u>Sprinklers examination and cleaning</u> Cleaning the dust and other foreign materials if any from overhead pipe line and sprinkler heads, applying polish as per requirement on sprinkler heads checking the pressure of pipe line.
13.	<u>None return valve</u> To check for the leakages and to replace the gasket as required.
14.	<u>Drain valve</u> Polishing to open and close it fully, checking of leakages etc.

7. PERIODICAL TESTING AND MAINTENANCE CHARGE

S. No.	System Component	Activity	Duration
1.	Water Tanks	(i) Level check (ii) Running	Daily Daily
2.	Pumps	(ii) Test Flow (iv) Lubrication	Annually Quarterly
3.	Engine	(i) Running (ii) Lubrication (iii) Battery (iv) Fuel Tank	Daily Quarterly Weekly Daily
4.	Motor	(i) Running (ii) Starter (iii) Insulation Resistance	Daily Weekly Once in a year
5.	Piping	(i) Pressure (ii) Flushing	Daily One in a year
6.	Valves (Landing and Isolation)	(i) Operation	Monthly
7.	Control System	(ii) Operation (iii) Connection and system components	Monthly Quarterly

- | | | | |
|-----|---------------------------------|-------------------------------|-----------------------|
| 8. | Hose Reel and Hose pipes | (i) Physical check
Monthly | |
| | | (ii) Operation check | Annually |
| 9. | Fire Brigade Connections/ Inlet | (i) Physical check
Monthly | |
| | | (ii) Operation check | Annually |
| | | (iii) Lubrication | Monthly |
| 10. | Instantaneous | (i) Physical check
Monthly | |
| | | (ii) Lubrication | Once in six
months |

TERMS AND CONDITIONS

Manual/Automatic Fire Alarm & P.A. System

1. The work shall be carried out as per CPWD / Gujarat Govt. Specification for Manual/Automatic Fire Alarm & P.A. System. Wherever applicable & recommendations of respective Manufacturer.
2. **Scope of work: The following activity is intended to be covered under this contract:**
 - a) Maintenance of installation as specified in B.O.Q. or as directed by the Engineer In charge or his authorized representatives.
 - b) Performing the daily / weekly / six monthly checks as detailed in remedial action for proper maintenance.
 - c) Cleaning of all equipments.
 - d) Conducting of fire drills.
For making the users familiar with the system, fire drill shall be carried out local fire service and nodal officer in charge of various parts of the building shall be involved in conducting fire drill. Operation of the system shall be demonstrated so that all users are confident of the system and aware of their duties and responsibilities during fire.
 - e) Healthiness of system
The healthiness of the system in automatic mode shall be checked through weekly testing.

The details of such weekly testing shall be conducted in presence of Client representative to the extent feasible and shall be recorded in register along with date, timing and finding.
 - f) The control room shall be managed round the clock by the contractor.

- g) Remarks and observations regarding maintenance / malfunctioning of fire alarm system & PA system shall be recorded in the log book and to be reported to Engineer-in-charge or his authorized representative immediately in writing.
- h) The contractor shall depute staff with minimum qualification and experience as detailed here under **Technician**
- i) Electrical wireman permit / workman's competency certificate, electrical workman's license (Certificate of competency class II) or any other equivalent certificate with practical experience of 5 years in handling fire alarm system. **Khallasi:-**

Khallasi should be physically fit and must have six months experience in this line.

3. Execution of work

- i) Before starting the work the contractor shall take over the inventory.
- ii) On completion of the work against the agreement the inventory shall be handover as directed by Engineer-in-charge or his authorized representative. In case any short fall or damage to the installation is noticed, the contractor shall make good the same with same make equipment or as directed by the engineer- in-charge, failing to do so, the recovery shall be affected from any payment due to the contractor. The decision of Engineer-in-charge shall be final and binding.

- 4.** Inventory as per physically available at site & shall be handed over by the site staff. Any other addition/ alteration in the installation shall be assured to be covered in the scope of the work.

- 5. The sufficient staff shall be engaged by the contractor for day to day operation & Maintenance at site of work as per details given below:**

6. Comprehensive Maintenance Fire Alarm & PA System

Repair/replacement of all worn out accessories with new accessories i/c supply of accessories of FA & PA system i.e. Main Control Panel, Sector indicator panels, Smoke detector, Heat detector, response indicator, speaker, MCP, Hooter, Talk back unit, Repeater panel, PA System and wire, conduit, complete etc i/c replacement of complete part if required as per direction of Engineer-in-Charge i/c rebate for old worn out part as detailed in inventory of FA & PA system at various Hospital, etc complete as reqd.

TERMS AND CONDITIONS - (Sub-Station equipment & D.G. Sets)

(A) Operation of Sub-Station equipment & D.G. Sets.

1. The Maintenance shall be carried out as per CPWD / Gujarat Govt. specification for Sub-Station & D.G. sets, amended upto date wherever applicable for Maintenance and recommendations of respective manufacturers as specified in BOQ of Comprehensive maintenance of substation equipment & DG Sets and day to day operation & maintenance.
2. Type of work involve (A) Operation; testing, Preventive and routine maintenance of sub-station equipment comprising of transformers; H.T. Panel, LT Panel, emergency panel, APFC Panel, by pass panel etc.
(B) Operation; testing, routine & Preventive maintenance of D.G. Sets AMF Panels etc.
(C) Checking of working of Instruments Daily
(D) Checking of neutral and earth Connections Daily
4. The Contractor's personnel will be required to maintain the log books and other records as prescribed by the department.
5. All installations and Sub Station rooms shall be kept clean and safe from risk of fire/theft/accidents and damage etc.

1. **The following minimum staff shall be engaged by the contractor day to day operation & maintenance at site of work as per details given below:**

S. No.	Type of Staff	Supervisor/ Engineer	No of Skilled workmen	No of Unskilled workmen
1.	Qty.	1 Nos.	03 Nos.	03 Nos.

The duty timing can be changed as per the discretion of the Engineer- in-Charge.

Qualifications:-

- a) Wireman cum operator : License of wireman / ITI certificates with two year experience.
- b) Khallasi : Two year experience in similar work.

2. **Execution of Work**
- 2.1 Before starting the work the contractor shall take over the inventory. And After completion of the work against the agreement, the inventory shall be handed over as per direction of Engineer-in-charge or his authorized representative. In case any short fall or damage to the installation is noticed, the contractor shall make good the same with the same make equipment or as per direction of Engineer-in-charge, failing to do so, the recovery shall be effected from the bill.
- 2.2 The routine preventive maintenance of Sub-Station equipment set shall be

carried out during holiday/Sunday without disturbing the office working of client department.

- 2.3 The following work should be carried out once a year through special technical staff,

General servicing of HT Panel & LT Panel.

All LT panels and HT panels will be opened after getting shut down and cleaned thoroughly. All nut & bolts of LT & HT panel, bus trunking shall be tightened. Proper insulating tape to be used where the PVC insulation is worn out.

- 2.4 Diesel for operation of D.G. Sets will be issued by the department. Contractor will maintain diesel consumption record and consumption of diesel shall be checked by representative of client monthly. If diesel issued to the contractor does not tally with the consumption statement. Necessary recovery shall be made from the bill of contractor for balance diesel. Transportation of diesel from Petrol pump to site shall be the responsibility of contractor.
- 2.5 a) The wireman cum operator shall test the D.G. Set on no load daily in the morning for 5 minutes run and D.G. Set shall operate in case of failure of normal electric supply from supply company.
- a) Cleaning of D.G. Set, checking of battery connection, level of water in radiator & battery etc.
3. Contractor shall provide one no. mobile phone and same is displayed and inform to client department. Contractor shall not change the mobile no during the agreement stipulated period. If mobile is found switch off for more than 4 hours, recovery shall be made @ Rs 100/- play per mobile No.
4. Inventory as per physically available at site & shall be handed over by the site staff.

Any other addition/alteration in the installation shall be assured to be covered in the scope of the work.

5. MAINTENANCE SCHEDULE FOR SUBSTATIONS GENERAL NOTES:-

1. Follow all safety procedures during maintenance activities (see is Code No. 5216 (Pt. 1 & 2) 1982 or Appendix E to CPWD specification for EL Works (pt. I – Internal 2023) for more Details.)
2. Only Authorised persons should be permitted to handle electrical equipment, Names of Authorised persons should be displayed in the main MV panel room (Rule 3 of IE Rules) when maintenance activities are performed, another person should accompany the one carrying out the tasks.
3. ON LINE maintenance should not be undertaken in substations (however there is no bar to carry out dehydration of transformer On) it must be ensured that supply lines concerned are isolated

and proved isolated, considering also any likely back feeding.
Caution boards should be displayed while so as to avoid accidental switching on

4. Supplement this schedule with recommendations of manufacturers of the respective equipments. Proper record of every maintenance activity must be kept as per this Schedule of maintenance. Result of all tests must be also recorded therein However if there is any repair or replacement done, the same should be recorded in the History book.
 5. It is necessary that the Wiremen/Operator should have a thorough knowledge on the equipment and their operation and the distribution system maintained by them. The correct schematic diagram of distribution should be displayed in MV panel rooms of the respective sections of distribution. Detailed literature on the equipments panel wiring diagrams and maintenance instructions or procedures etc. should be collected and kept at site.
- 11. SCHEDULE RELATED NOTES.**
- 11.1 Logging is needed for voltage (HV/MV/ battery), power (MD), temperature (max) of oil, ambient temperature, and PF (and frequency where frequency meter is already installed).
 - 11.2 Wherever facility of recording pf is not already provided, arrange to get it installed early,
 - 11.3 If any panel instrument is defective, get it repaired early.
 - 11.4 Load on each outgoing feeder may be checked by clip on ammeter once in 3 or 4 months, preferable during peak seasons so that redistribution if any needed among the feeders could be further examined and effected
 - 11.5 Inspection of equipment rooms and equipments.
 - 11.6 Clean up equipment room; remove cobwebs birds' nests etc., if any check that the ventilators are clear exhaust fans and fans are operational. The approach to equipment rooms and yards in outdoor installations should be clear.
 - 11.7 Wipe out dirt/dust from external surfaces of equipments.
'CAUTION: Never attempt to clean equipments with exposed (bare) bushing, with supply ON periodicity of cleaning such equipment may be increased to once a month or longer as felt in order so as to avoid frequent switching operations.
 - 11.8 Observe for any abnormal noise, vibration smell (usually due to overheating,) excess temperature etc.if so, investigate the reason immediately. Radiators of transformers, LT SFU/FSUs and main LT cables (near terminations) may be touched externally to feel any undue heating. Apart from smell shine of the PVC may reduce due to local heating. Compound may expel come out of cable boxes due to local heating compound filled cable terminations.(usually old installations).
 - 11.9 Look for oil leakage from transformer radiator/body bushing /valves and attend.
 - 11.10 Check the trip battery. Top up as necessary with distilled water in lead batteries. Check the specific gravity Examine the trend if the voltage readings from log book if the drop is considerable the cause needs to be investigated Clean the battery terminals if

required and apply grease to avoid corrosion.

12. Breather and oil Check :

- 12.1 Silica gel is blue when dry. The transformer breathers due to varied loading over a period of time. When silica gel absorbs moisture while ‘breathing in at lower it turns pinkish. When the breather content is over 50% pinkish, reactive the silica gel (till it turns blue again) by heating directly under the sun on a metal surface or over an electric heater (Caution : be careful not to overfull, not to overheat) Check that air passage is clear in breather, when reactivating the silica gel.
- 12.2 Check the level of oil in conservator tank Arrange to top up with dry tested oil if necessary. Do not over fill beyond the upper limit level so as to allow expansion of oil when warm Oil should not spilt into the breather
Investigate the reason if the level changes too often
- 12.3 Check the colour of oil of it is dark the reason be investigated by testing the oil Darkening may occur due to oxidation reactions of oil accelerated the temperature and presence of contaminants the result may be increase in acidity fall in resistivity an increase in Dielectric dissipation factor (tan delta) and ultimately formation of sludge . Dark brown Colour may also be due to presence of dissolved asphaltenes

13. Test insulating oil:-

- 13.1. Insulating oil used in transformers and OCBs is 1966-1983 indicates the List of various test giving reference to the relevant IS numbers for test procedures some of which are extracted briefly as under:-

Test for	IS Code for test	Permissible limit
i) Electric strength	IS 6792-1992	40 KV for 1 min (min)
ii) Water Content	IS 335- 1993	35 ppm. (max)#
iii) Neutralization	IS 1448 (P2)-1967	0.5 mg. KOH/g
value (total IS 1866-1983 of oil (Max.)* acidity)		Appendix B.

Presence of moisture lowers the electric strength and resistivity of oil and also accelerates deterioration of paper used as insulating material.

* This is the maximum value if the value exceeds 0.3mg/g testing for acidity more frequently will be necessary.

Deteriorated oil needs to be reconditioned by filtration and vacuum dehydration if the oil old and not satisfactory, replacement of oil may have to be considered.

- 13.2. Oil may be tested for sludge content (as per Appendix A to IS 1866-1983) if the oil colour is dark or once in 2 years if otherwise.
- 13.3. Oil in OCBs and oil switches may get carbonaceous material due to during switching. While annually the electric strength should be checked this test is also needed if the breaker has operated

under fault condition carbonaceous materials and moisture may produce tracking in phenolic/paper insulation materials.

10 Annual checks of switchgear (HV and MV) and panels.

14. The team “switch gear” cover SFU/FSU's, MCCB's, CB's/OCB's, in MV side and OCB's/VCB's/ SF6 breakers oil Switches (with or without fuses) isolator etc on HV side. The purpose of this activity in the schedule is to examine the interiors of the panels and the switchgear so as to ensure that right fuses are in position mechanical operations are smooth bushings are not cracked/chipped, electrical contracts are in order and dirt if any is removed . you may need assistance form manufacturer/ his authorized representative for some of the operations This first step is therefore to isolate and where provided to get to service position and the case of withdraw able type items to draw out from the panel.
 - 14.1 Clean the interior thoroughly Check that safety shutters (where provided) have closed properly.
 - 14.2 Examine the moving isolating contacts for discoloration, pitting or sputtering if so examine the fixed contact as well (you may need to manually open the safety shutters).
This problem may arise due to bad alignment of contact. Sometimes, there may be discolored hardened grease, this will require cleaning by suitable solvent and regreasing with approved type of grease,
 - 14.3 Arcing contacts and main contacts should then be similarly examined. Do not use abrasive paper to clean the contacts. If there is any residue/pitting. Check the architects to be intact clean and without any obstructions
 - 14.4 Mechanical linkages should be lubricated wherever required Test for from movements of all operations. In the case of electrically operated breakers, meggar test the motor/ solenoid and check for their free movement Lubricate as necessary.
In the case of outdoor gang operated switch free operation of the switch (and proper alignment of all the 3 phases) should be checked.
 - 14.5 Check that the HRC fuses are in position, and that safety interlock (with the front cover is operational
 - 14.6 Connections at bus bars. Bus ducts and switch gear (including control wiring should be checked Tighten as required. Clean the supports and look for any possibilities of tracking on surface.
 - 14.7 Relays should be tested and settings checked Relay coil insulation should be checked with LT megger
 - 14.8 Plug opening/hole (if any) in switchboards effectively
 - 14.9 Meggar test the panel and check the interior to be free from any foreign matter (like cotton waste/flint, dislodged nuts/ washers/ cut tapes etc.) before energizing again.
 - 14.10. Paint the outdoor steel structure, where provided.
15. Check of safety items & others

- 15.1 Check all safety items (insulating mat Caution boards, danger first aid kit, fire protection items Resuscitator (where provided) first aid chart etc. Check also whether telephone numbers of officer supply agency (licensee) fire brigade and hospital are displayed on a painted board in MV panel room.
- 15.2 Check that the correct schematic diagram of distribution is displayed in MV Panel room.
- 15.3 Test the earth resistance of each electrode (preferably during summer) and also the integrity of earth connections.
- 15.4 Check the trip battery performance from long book readings and charging system for satisfactory condition Batteries (Even maintenance free batteries)may need to be replaced in 3 in 4 years depending in their use Get expert advice from manufacturer before deciding on replacement
- 15.5 Check the condition of spare items: of any kept in store.
- 15.6 Where the substation building is single storied inspect the roof drain before monsoon, so as to avoid water stagnation
- 15.7 Check the cable ducts to be free from extraneous items (rubbish/ water) and that duct cover are intact.

(B) Comprehensive Maintenance: -

Contractor has to arrange all material for the repair & replacement of any defective equipments / accessories such as cables/VCB/Transformer /MCCB/ACB/ wires/MCB /CTs/Relays/Instruments/Fuses/Safety equipments and other material installed in substation. Nothing extra shall be payable on account of repair/replacement of any material / equipment.

B. Maintenance of D.G. Sets.

Technical works:-

Scope of work:-Attending day to day complaint, operation, testing, routine maintenance, preventive maintenance, of D.G. Sets with AMF Panels, other related installation etc.

Routine Maintenance.

- Check the Engine for its smooth running, unusual noise and colour of the smoke from the exhaust.
- Checking of leakage of fuel, lub oil and coolant.
- Checking and adjusting fan belt and water pump belt tension etc.
- Checking air filter to increase their lift as well as proper inflow of air.
- To carry out valve tappet setting as and when reqd.
- End paly checking of crank shaft, accessories drive and turbo charger whenever required.
- To carrying out periodical maintenance check B/C/D.
- To checks proper functioning of various instruments and accessories as and when reqd.
- Diagnosis of various faults and then rectifications.

Electrical Works:-

- Checking ad fault finding of the electrical system associated with the engine.
- General cleaning and greasing of alternator, whenever reqd.
- Checking battery terminal for sulphation and checking its state.
- Checking carbon broster and spring tension if reqd.
- Maintenance of insruments, relays and conectors /
contractors fitted in genset control AMF panel.
- Checking of wiring for its loose and dry connections.
- Checking of rectifier, whenever reqd.
- Checking of rotating diode assembly in brushless alternators.
- Cleaning of contractors of A.C.B's testing of alternator, once in six months.
- Diagnosis of various faults in AMF panel and then their rectification.
Day to Day Complaint, Annual preventive maintenance
of Diesel Engine, AMF Panel, A,B & C periodic maintenance
shall be carried out by respective manufacturer of Engine.

As soon as the complaint lodge even on telephone by the deptt or client deptt. It shall be treated as complaint lodged and shall be attended immediately failing which recovery shall be made from the bill of contractor @ Rs. 1000/- per complaint per set per day if delayed by 24 Hours.

Revord / Log book / Register shall be maintained for each check / action and shall be signed by the representative of Client and shall be provided by the firm. Dismantle material received from the work will be the property of the agency.

TERMS & CONDITIONS

(A) Operation (AC Plant)

SCHDULE OF ANNUAL OPERATION AND MAINTENANCE CONTRACT

1. Staff Deployment & their qualification for operation of AC Plant

Skilled staff deployed at site must have either ITI certificate in refrigeration & air conditioning from

Govt. ITI with minimum three year of experience in operation of AC plants or fifteen year of experience in the same line. Certificate in this regard must submitted before starting the work.

SCOPE OF WORK FOR OPERATION OF CHILLERS & ANCILLARIES

1. Details of the various Operational activities are as blow:-

CHILLERS**DAILY**

Start & Stopping of Chillers.

Recording operating conditions (on applicable Log from) Check oil levels and oil heater.

Weekly

Check Refrigerant levels.

Check for any sign of Refrigerant Leakage

AHU & FCU**DAILY**

Starting and
stopping of
AHU/FCU.

WEEKLY

Cleaning of AHU Filters with Air Blower/ Water

MONTHLY

Cleaning of AHU
Filters with water

QUARTERLY

Cleaning of Cooling coil with water pressure of the AHU/FCU.
Cleaning of Strainers.

Checking alignments of blower and motor pulley. Checking
condition of V belts of the AHU. Checking any abnormal noise
from the motor.

Checking of pressure gauges. Checking of
starter operation. **ANNUALLY**

Cleaning of cooling coil with chemical Annually.

FANS**DAILY**

Starting and
stopping of
fans.

MONTHLY

Checking of fan operation

Checking for vibration, bearing noise, only physical check.
Checking mounting.

Checking impeller
and drive pulleys.
Checking for
corrosion.

Checking motor operation

PUMPS**DAILY**

Starting and stopping of pumps.

QUATERLY

Inspect pump seals and adjust if necessary. Check for any leaks.

If pressure gauges fitted, check operating pressures to ensure strainer clean and pump vented.

Check pump coupling, vibration & footings. Check pump-motor bearings
Clean pump strainers Check starter operation

MOTORS**QUARTERLY**

Check and record the motor running current on all three-phases/
single phase. Lightening lubricate motor bearings.

Check all connections and associated wiring.

COOLING TOWER**DAILY**

Starting and
stopping of
motor.

QUARTERL**Y**

Cleaning of sump.

2. SCOPE OF WORK FOR PREVENTIVE MAINTENANCE SERVICE

Contractor will provide labour & consumable item as detailed in this offer, to carry out the following, maintenance visits

PUMPS

Inspect pump seals and adjust if necessary. Check for any leaks.

If pressure gauges fitted, check operating pressures to ensure strainer clean and pump vented. Check pump coupling, vibration & footing.

Check pump-motor bearings Check starter operation.

To check that vent passages are not blocked.

MOTORS

Check and record the motor running current on all three-phases/ single phase. Lightly lubricate motor bearings.

Check all connections and associated wiring. To check the earthing conductor for continuity.

To clean motor. To make motor free from oil, dust and moisture.

To check the insulation resistance between respective terminals and frame.

CHILLERS

- a) Inspecting the chillers and adjusting safety controls.
- b) Checking operation of controls.
- c) Checking oil and refrigerant levels.
- d) Checking operation of lube system.
- e) Checking the oil return system.
- f) Checking operation of motor and starter.
- g) Recording operating conditions.
- h) Checking log and reviewing chiller and system operation.
- i) Logging and reporting repairs and parts that are required.
- j) Carry out leak test of system.
- k) Complete service inspection report forms.
- l) Check oil heater operation.
- m) Check three-phase voltage and current balance.

COOLING TOWER

Checking of spray nozzles and float valves for water level.

Checking of Fan assembly for oil level, cleanliness, vibration and noise.
Checking splashing of water.

Checking of
sump.

Checking of
Nozzles.

Checking of water quality. pH should be between 6 & 8. NaCl- Below 750 ppm, SO₄- Below 1200 ppm, NaHCO₃- Below 200 ppm, Chlorine- Free residual not to exceed 1 ppm.

To flush & clean cooling tower to minimize the growth of bacteria including Legionella Pneumophila to avoid the risk of sickness or death.

Cleaning of louver, drift eliminators & easily accessible fill surfaces by moderate pressure water nozzles.

To observe, touch and listen to the tower.

To observe the operation of the motor, drive shaft, gear reducer and fan. To check gear reducer oil level. To add oil if reqd.

Check operation of the float valve. Depress the operating level to make sure the valve is operating freely.

Check for any build up of silt on the floor of the cold water basin. To re-lubricate motor.

To check to see that all bolts are tight in the fan and mechanical equipment region. To visually inspect the drift eliminator. To remove any accumulated debris or scale.

AHU

Check fan belt tension & adjust if necessary. Check the condition of drain for free flow.

Check the condition of access door hinges and lubricate if necessary. Check the fan motor running current.

Check function controls and their effect on Air Handling Unit components. Check fan and motor bearings.

Add water and flush condensate drain pan, trap & drain line. Check the condition of Chiller water.

Check the condition of inlet strainer.

Checking motor starter and performing the following tasks:

- a) Running diagnostic check.
- b) Cleaning contacts or recommending replacement.
- c) Meggering the motor.
- d) Checking all terminals and tightening connections.
- e) Checking overloads.

Review the control panel for the following items:

- a) Running diagnostic check of motor control panel.
- b) Checking safety shutdowns operation.
- c) Checking all terminals and tightening connections.
- d) Checking display data accuracy and set points.

Checking condenser for the following items:

- a) Checking the water pressure drop.
- b) Checking flow switch operation.
- c) Cleaning of Condenser tubes. (Chemical will be provided by CONTRACTOR)

Checking the cooler for the following items:

- a) Checking the water pressure drop.
- b) Checking flow switch operation.
- c) Cleaning the refrigerant level.

Checking the system for the following items:

- e) Conducting a leak check and identifying leak sources.
- f) Recording the condition of sight glasses.
- g) Checking the refrigerant cycle to verify the proper operating balance.
- h) Checking condenser water and chilled water heat transfer.

3. Comprehensive and Day to day Maintenance of WTAC/Split AC/Water cooler.

- (a) Comprehensive maintenance and servicing and Day to day maintenance of window type AC/ Split AC/Water Coolers of units, shall be carried out by deploying adequate man power and supplying & filling of suitable refrigerant gases and supplying & replacing of defective parts like compressor, condenser and blower fan blades and motors, Relay, capacitors, filter, PCB, remotes, condenser, copper pipes, copper capillary, drain pipes, control wiring, power wiring, refrigerant pipe insulation and other parts, for proper functioning units complete as etc. reqd.
- (b) Servicing-Annually before starting summer season & as and when required at site Requirement.
- (c) Contractor will stock sufficient spare parts and factory repaired/New compressors and other co site. For attending day to daily complaints.
- (d) If some AC's units are not maintained due to augmentation /remodeling in hospitals. Proportional recovery shall be made for per unit basis.

END OF SPECIFICATIONS