

Annexure -I

TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS

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PREAMBLE

This document contains technical specifications for various civil and other items of works involved or expected in the construction of the proposed project. The general specifications are mentioned in the BOQ itself. Any further clarifications required may be made from this document. Any items of works missing, it shall be carried out as per relevant IS codes of practice MESSR specifications. The units of measurements may be as per IS/FPS system and ultimately to be converted as per the units given in BOQ.

SECTION 1.00 EARTHWORKS**Scope**

This section covers the works specification of earth work in excavation in all kinds of soils including murrum, hard murrum, soft rock (without blasting), hard rock (without blasting), rock (with blasting), filling excavated earth in plinths, and filling in plinth, rubble soling, and brick on edge soling. The rates for all excavation items shall include the following:

- (a) Excavating either straight or curved on plan;
- (b) Clearing away all grass vegetation, saplings, shrubs, brushwood, undergrowth, roots, and trees not exceeding 30 cm girth (measured one metre above ground level) and removing rubbish upto a distance of 250 metres outside the periphery of the area under clearance except in the case of surface dressing which includes for all the foregoing except clearing away of trees;
- (c) Bailing out, pumping out or otherwise removing all water which may accumulate in the excavations, from all causes
- (d) Setting out the work profiles, etc. as well as for all tools and plant;
- (e) All materials and labour required for fencing in and protecting against risk of accidents, to open excavations, etc. and for providing gangways with handrails across open trenches, etc. where necessary.
- (f) Watching and lighting, whenever necessary.
- (g) Forming (or leaving) steps in sides of deep excavations and their removal or covering up, after record of measurements;

Applicable Codes

The following Indian Standard Codes, unless otherwise specified herein, shall be applicable.

In all cases, the latest revision of the codes shall be referred to.

- a) IS -4081:1986 - Safety code for blasting and related drilling operations.
(Reaffirmed 2005)

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- b) IS -1200:1992 - Method of measurement of building works (All parts).
(Reaffirmed 2005)
- c) IS -3764:1992 - Safety code for excavation work.
(Reaffirmed 2005)
- d) IS -3385: - Code of practice for measurement of Civil Engineering works.
- e) IS - 2720:1983 Part II Determination of moisture content.
(Reaffirmed 2006)
- f) IS - 2720:1983 Part VIII Determination of moisture content dry
(Reaffirmed 2006) density relation using light compaction.
- g) IS - 2720:1983 Part XXVIII Determination of dry density of soils, in-
(Reaffirmed 2006) place by the sand replacement method.
- h) IS - 2720:1983 Part XXIX Determination of dry density of soils, in-
place, by the core cutter method.

Drawings

Architect/Consultant will furnish all necessary drawings showing the areas to be excavated, filled, sequence of priorities etc. Contractor shall follow strictly such drawings.

General

Contractor shall provide all tools, plants, instruments, qualified supervisory personnel, labour, materials, and temporary works, consumables, any and everything necessary, whether or not such items are specifically stated herein, for completion of the work.

Contractor shall carry out the survey of the site before excavation and set properly all lines and establish levels for various works such as earthwork in excavation for leveling, basement, foundations, plinth filling, roads, drains, cable trenches, pipelines etc. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to establish reference/grid

lines at 5 m intervals or nearer as determined by Project Engineer based on ground profile. These shall be checked by Project Engineer and thereafter properly recorded.

The area to be excavated / filled shall be cleared of fences, trees, plants, logs, slumps, bush, vegetations, rubbish slush etc. and other objectionable matter. If any roots or stumps of trees are found during excavation, they shall also be removed. The material so removed shall be burnt or disposed off as directed by Project Engineer. Where earthfill is intended, the area shall be stripped of all loose / soft patches, top soil containing deleterious matter / materials before fill commences.

All gold, silver, oil minerals archaeological and other findings of importance, all precious stones, coins, treasures, relics, antiquities and other similar things which may be found in or upon the site shall be the property of owner and Contractor shall duly preserve the same to the satisfaction of Owner and from time to time deliver the same to such person or persons as Owner may from time to time authorize or appoint to receive the same.

1.01 Earth work in excavation up to 1.50 M from existing GL

A. Classification

Any earthwork will be classified under any of the following categories: -

i) Ordinary Soil.

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This shall comprise of vegetable, or organic soil, turf, sand sandy soil, silt, loam, clay, mud, red earth, suede, peat, black cotton soil, soft shale of loose murrum, mud debris, concrete below ground level, a mixture of all these and similar material which yields to the ordinary application of pick, shovel, rake or other ordinary digging implement. Removal of gravel or any other modular material having diameter in any one direction not exceeding 75mm occurring strata shall be deemed to be covered under this category.

ii) Hard Soil

This shall include

- i) Stiff heavy clay, hard shale or compact murrum requiring grifting tool or pick or both and shovel closely applied.
- ii) Gravel, soft laterite, kankar and cobble stone having maximum diameter in any one direction between 75mm and 300mm.
- iii) Soiling of road paths etc. and hard core.
- iv) Macadam surfaces such as water-bound and bitumen/tar bound.
- v) Lime concrete, Stone masonry in lime/cement mortar below ground level.
- vi) Soft conglomerate, where the stones may be detached from the matrix with picks.
- vii) Generally any material which requires the close application of picks or scarifiers to loose and not affording resistance to digging greater than hardest of any soil mentioned in 1 to 6 above.

iii) Ordinary Rock

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- a) Ordinary rock comprising of lime stone, sand stone, hard laterite, fissured rock, conglomerate or other soft or disintegrated rock which may be quarried or split with crow bars.
- b) Un-reinforced cement concrete which may be broken up with crow bars or picks and stone masonry in cement mortar below ground level.
- c) Boulders which do not require blasting having maximum diameter in any direction of more than 300mm found lying loose on the surface of embedded in river bed, soil, talus, slope wash and terrace material of dissimilar origin.

iv) Hard Rock

- A) This shall comprise any rock or cement concrete or RCC for the excavation of which the use of mechanical plant or blasting is required. Boulders requiring blasting.
- B) The earth work in excavation shall be done as per the Architect and structural consultant's drawings upto required depths and levels and alignments in all sorts of soils. The depth of the foundation will be as per the Project Engineer's instructions. The lining work should be done by the contractor. Roots or trees met with during the excavation shall be cut and smeared with coal tar. Excavated earth shall be stacked at least 3 M away from the trenches or as per Project Engineer's instructions, so that it may not damage the sides of the excavated trenches. The sides of the excavated trenches shall be vertical and in straight line and bottom uniformly leveled, watered, consolidated and ready for termite treatment. The maximum lead for stacking the earth shall be 100M, unless otherwise categorically specified in the item description.
- C) In firm soil if the excavation is deeper than 2 m the sides of the trenches shall be made bigger by allowing steps of 50cm on either side so as to keep the slope 0.25 to 1. In loose soft or slushy soil the width of the step shall be suitably increased or the sides sloped or shoring and strutting may be done as per the Project Engineer's instructions.

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- D) For excavation for drain work, the sides and the bottoms should be to the required slope, shape and gradient. The cutting shall be done from top to bottom. Under no circumstances shall undermining or under cutting be allowed. The final surface shall be neatly leveled and well compacted. The earth from the cutting shall be directly used for filling either in plinth or on grounds.
- E) For excavation in trenches for pipes nothing extra shall be payable for the lift irrespective of the depth unless specifically mentioned otherwise in the Schedule of Quantities.
- F) If the trenches are made deeper than specified level due to oversight or negligence of the contractor the extra depth shall be filled up by lean concrete of mix 1:5:10 (1 cement: 5 coarse sand: 10 coarse aggregate of nominal size 40mm) and if the trench is made wider than shown in the drawings the contractor has to make good at his own cost. The foundation trenches shall be free from water and muck, while the foundation work is in progress.
- G) The trenches which are ready for concreting shall be got approved by the Project Engineer.
- H) The excavated stacked earth shall be refilled in the trenches and sides of foundation in 150mm layers and the balance surplus shall be first filled in layers in plinth and the remaining surplus shall be disposed off by uniform spreading within the site/outside the site as directed by the Project Engineer.
- I) Adequate protective measures shall be taken by the contractor to see that the excavation for the building foundation does not affect the adjoining structure's stability and safety. Contractor will be responsible if he has not taken precaution for the safety of the people, property or neighbor's property caused by his negligence during the constructional operations.
- J) To the extent available, selected surplus spoils from excavated materials shall be used as backfill. Fill material shall be free from clods, salts, sulphates, organic & other foreign material. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger

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than 150mm size, mixed with properly graded find material consisting of murrum or earth to fill up the voids and the mixture used for filling.

K) As soon as the work in foundations has been accepted and measured, the spaces around the foundations, structures, pits, trenches etc. shall be cleared of all debris and filled with earth in layers 15cm to 20cm, each layer being watered, rammed and properly consolidated before the succeeding one is laid. Each layer shall be consolidated to the satisfaction of Project Engineer.

L) Mode of measurement for Earthwork in excavation including back filling will be measured in M. CUBE.

i) Lead

Lead for deposition/disposal of excavated material, shall be within the site to a maximum distance of 250 m as instructed by Project Engineer.

ii) All excavation shall be measured net. Dimensions for purpose of payment shall be reckoned on the horizontal area of the excavation at the base for foundations of the walls, columns, footings, tanks, rafts or other foundations structure to be built, multiplied by the mean depth from the surface of the ground in accordance with the drawings. Excavation inside slopes shall not be paid for. Contractor may make such allowances in his rates to provide for excavation in side slopes keeping in mind the nature of the soil and safety of excavation. In soft/slushy soil or in firm soil if the excavation is deeper than 2m the sides of the trenches shall be made bigger by allowing steps of 50cm on either side so as to keep slope 0.25: 1. No extra shall be payable. However, if concreting is proposed against the additional / extra excavation made by the contractor shall be made good by the contractor with concrete of the same class as in the foundations at his own cost.

iii) Backfilling as per specification the side of foundations of columns, footings, structures, walls, tanks rafts, trenches etc. with excavated materials will be paid for separately. It shall be clearly understood that the rate quoted for excavation excluding backfilling shall include stacking of excavated material as directed, excavation/stacking of selected stacked material, conveying it to the place of final backfill, compaction etc. as specified.

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As a rule, material to be back filled shall be stacked temporarily within the basic lead of 250 metres unless otherwise specified in the item.

- iv) The rates quoted shall also include for dumping of excavated materials in regular heaps, bunds, riprap with regular slopes as directed by Project Engineer within the lead specified and leveling the same so as to provide natural drainage.

Rock/soil excavated shall be stacked properly as directed by Project Engineer. As a rule, all softer material shall be laid along the centre of the heaps, the harder and more weather resisting materials forming the casing on the sides and the top. Excavated soft rock or hard rock shall be stacked separately.

- v) The bailing out of water shall also be executed by the contractor at his own cost.

1.02 Earth work in excavation for depth exceeding 1.50 M but not exceeding 3.0 M.

The general specification shall be same as for the item 1.01 given above.

1.03 Earth work in excavation for depth exceeding 3.0 M but not exceeding 4.5 M.

The general specification shall be same as for the item 1.01 given above.

1.04 Earth work in excavation in rocks upto 1.50 M from EGL.

- (A) Unless otherwise stated herein, IS-4081, safety code for blasting and related drilling operations shall be followed.

After removal of over burden, if any, excavation shall be continued in rock to such widths, lengths, depths and profiles as are shown on the drawings or such other lines and grades as may be specified by Project Engineer. As far as possible all blasting shall be completed prior to commencement of construction. At all stages of excavation, precautions, shall be taken to preserve the rock below and beyond the lines specified for the excavation, in the soundest possible condition. The quantity and strength of explosive used, shall be such as will neither damage nor crack the rock outside the limits of excavation.

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All precautions, as directed by Project Engineer shall be taken such that no damage is caused to the adjoining buildings or structure as a result of blasting operations. In case of damage to permanent or temporary structures, contractor shall repair the same to the satisfaction of Project Engineer at his own cost. As the excavation approaches its final lines and levels, the depth of the charge holes and amount of explosives used shall be progressively and suitably reduced.

- (B) Specific permission of Project Engineer will have to be taken by contractor for blasting rock and he shall also obtain a valid blasting license from the authorities concerned. If permission for blasting is refused by Project Engineer the rock shall be removed by wedging, pick barring, heating and quenching or other approved means. All loose/loosened rock in the sides shall be removed by barring wedging, etc. The unit rates for excavation in hard rock shall include the cost of all these operations unless specifically stated in the item description.
- (C) Contractor shall obtain necessary license for storage of explosives fuses and detonators issued to him from Owner's stores or from a supplier arranged by the contractor, from the authorities dealing with explosives. The fees, if any, required for obtaining such license, shall be borne by contractor. Contractor shall have to make necessary storage facilities, for the explosives etc. as per rules and regulations of local, State and Central Government authorities and statutory bodies. Explosives shall be kept dry and shall not be exposed to direct rays of sun or be stored in the vicinity of fire, stoves, steam pipes or heated metal, etc. No explosive shall be brought near the work in excess of quantity required for a particular amount of firing to be done and surplus left after filling the holes shall be removed to the magazine. The magazine shall be built as far as possible from the area to be blasted. Project Engineer's prior approval shall be taken for the location proposed for the magazine.
- (D) In no case shall blasting be allowed closer than 30 metres to any structure or to locations where concrete has just been placed. In the latter case the concrete must be at least 7 days old.
- (E) For blasting operations, the following points shall be observed: -

- i) Contractor shall employ a competent and experienced supervisor and licensed blaster in charge for each set of operation, who shall be held personally responsible to ensure that all safety regulations are carried out.
- ii) Before any blasting is carried out, contractor shall intimate Project Engineer and obtain his approval in writing for resorting to such operations. He shall intimate the hours of firing charges, the nature of explosive to be used and the precautions taken for ensuring safety.
- iii) Contractor shall ensure that all workmen and the personnel at site are excluded from an area within 200M radius from the firing point, at least 15 minutes before firing time by sounding warning siren. The areas shall be encircled by red flags. Clearance signal shall also be given sounding a distinguishing siren.
- iv) The blasting of rock near any existing buildings, equipment or any other property shall be done under cover and contractor has to make all such necessary muffling arrangement. Covering may preferably be done by MS plates with adequate dead weight over them. Blasting shall be done with small charges only and where directed by Project Engineer, a trench shall have to be cut by chiselling prior to the blasting operation separating the area under blasting from the existing structures.
- v) The firing shall be supervised by a Supervisor and not more than six (6) holes at a time shall be set off successively. If the blasts do not tally with the number fired, the misfired holes shall be carefully located after half an hour and when located, shall be exploded by drilling a fresh hole along with misfired hole (but not nearer than 600mm from it) and by exploding a new charge.
- vi) A wooden tamping rod with a flat end shall be used to push cartridges home and metal rod or hammer shall not be permitted. The charges shall be placed firmly into place and not rammed or pounded. After a hole is filled to the required depth the balance of the hole shall be filled with stemming which may consist of sand or stone dust or similar inert material.
- vii) Contractor shall preferably detonate the explosives electrically.

- viii) The explosive shall be exploded by means of a primer which shall be fired by detonating a Fuse Instantaneous Detonator (FID) or other approved cables. The detonators with FID shall be connected by special nippers.
- ix) In the dry weather and normal dry excavation, ordinary low explosive gunpowder may be used. In damp rock, high explosive like gelatin with detonator and fuse wire may be used. Under water or for excavation in rock with substantial accumulated seepage electric detonation shall be used.
- x) Holes for charging explosive shall be drilled with pneumatic drills, the drilling pattern being so planned that rock pieces after blasting will be suitable for handling without secondary blasting.
- xi) When excavation has almost reached the desired level, hand trimming shall have to be done for dressing the surface to the desired level. Any rock excavation beyond an over break limit of 75mm shall be filled up as instructed by Project Engineer, with concrete of strength not less than M10. The cost of filling such excess depth shall be borne by contractor and the excavation carried out beyond the limit specified above will not be paid for. Stepping in rock excavation shall be done by hand trimming.
- xii) Mode of Measurement will be measured in M.CUBE
Volume of rock excavated shall be calculated on the basis of length, breadth and depth of excavation indicated on the drawings. No payment will be made for excavations/over break beyond payment line specified, wherever such measurement is not possible, as in case of stratas intermixed with soil, excavated rock shall be properly stacked as directed by Project Engineer and volume of rock shall be calculated on the basis of stack measurements after making 40% allowance for voids. The measurement of the earth work shall be paid as per the drawing or the requirements of the site as approved by the Project Engineer .
- xiii) The rate quoted for excavation shall include the following jobs:
 - a) Refilling of the trenches and consolidating and spreading shall be done as per the Project Engineer's directions.

- b) Shoring and strutting as demanded by the site conditions and as instructed by the Project Engineer.

1.05 Earth work in excavation in rocks depth exceeding 1.50 M but not exceeding 3.0M.

The general specification is same as item No.1.04.

1.06 Filling in plinth with selected excavated earth.

(A) Plinth above in layers 15 - 30 cm. watered and compacted with mechanical compaction machines. When filling reaches the finished level, the surface shall be flooded with water, if directed by the Project Engineer, for at least 24 hours, allowed to dry and then the surface again compacted as specified above to avoid settlements at a later stage. The finished level of the filling shall be trimmed to the level/slope specified.

(B) Where specified in the item description given in the Schedule of Quantities that the compaction of the plinth fill shall be carried out by means of 1 ton roller to rolled for compaction (If the roller is not accessible, proper ramming shall be ensured with earth rammer). As rolling proceeds water sprinkling shall be done to assist consolidation. Water shall not be sprinkled in case of sandy fill.

(C) Mode of Measurement will be measured in M.CUBE

Payment for filling in plinth with selected excavated material will be made as specified/directed. Payment for this work will be made based on measurement of plinth/dimensions filled. The plinth/ground levels shall be surveyed beforehand for this purpose. The lead shall be 250 M. It shall be measured in M.CUBE.

1.07 Filling in plinth with selected earth for lead exceeding not exceeding 250 M

The general specification is same as item No.1.06.

1.08 Filling excavated earth in ground for land development

- (A) No earth fill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with as directed by Project Engineer.
- (B) Filling shall be carried out as indicated in the drawings and as directed by Project Engineer. If no compaction is called for, the fill may be deposited to the full height in one operation and leveled. If the fill has to be compacted, it shall be placed in layers not exceeding 600mm and leveled uniformly and compacted before the next layer is deposited.
- (C) When field compaction is called for, test shall be carried out at different stages of filling and also after the fill to the entire height has been completed. This shall hold good for embankments as well.
- (D) Contractor shall protect the earthfill from being washed away by rain or damaged in any other way. Should any slip occur, contractor shall remove the affected material and make good the slip at his own cost.
- (E) The fill shall be carried out to such dimension and levels as indicated on the drawings after the stipulated compaction. The fill shall be considered as incomplete if the desired compaction has not been obtained.
- (F) Mode of Measurement will be measured in M.CUBE

It shall be measured in M.CUBE. The rate shall include all operations such as lead and transport, filling and consolidating as directed.

1.09 Filling in plinth and ground with earth brought from outside

- (A) Filling shall be carried out with approved material as described in 1.01 (J). The material and source shall be subject to prior approval of Project Engineer. The approved area, from where the fill material is to be dug, shall be cleared of all bushes, roots plants, rubbish etc., top soil containing salts, sulphate and other foreign material shall be removed. The materials so removed shall be burnt or disposed off as directed by Project Engineer. The contractor shall make necessary access roads to those areas and maintain the same, if such access road does not exist, at his cost.

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- (B) If any material is rejected by Project Engineer, Contractor shall remove the same forthwith from the site at no extra cost to the owner. Surplus fill material shall be disposed off by uniform spreading within the site as instructed by the Project Engineer .
- (C) The compaction shall be carried out as specified in the item No.1.06 for filling in plinth and as per item No.1.08 for filling in ground for land development.
- (D) Mode of Measurement will be measured in M.CUBE.
 Backfilling, plinth filling etc. with borrowed earth -CNS (Cohesive Non-Swelling) will be paid for under specified items. The quoted rate shall include all operations such as clearing, excavation, lead and transport, fill, compaction etc. as specified. Actual quantity of consolidated filling or actual quantity of excavation in the borrow pits (less such top soil which has been excavated and not used for filling) whichever is less shall be measured and paid for in cubic metres. The lead, lift etc. shall be as indicated in the schedule of quantities. The borrowed earth - CNS (Cohesive non-swelling) shall conform to the requirement given below

Sl No.	Property	Specification Range
1.	Grain size analysis	
i)	Clay	15% - 25%
ii)	Silt	35% - 50%
iii)	Sand	30% - 40%
iv)	Gravel	Less than 10%
2.	Consistency limits	
i)	Liquid limit	30% - 50%
ii)	Plastic limit	20% - 25%
iii)	Plasticity index	10% - 25%
iv)	Shrinkage limit	15% and above
3.	a) Swelling pressure when compacted to maximum dry density corresponding to standard Proctor compaction with zero initial compaction moisture constant, for	Less than 0.1kg/sq.cm (10 KN/sq.m)

	<p>no volume change condition.</p> <p>b) Swelling pressure when compacted to maximum dry density corresponding to standard proctor compaction and initial compaction corresponding to optimum moisture content for no volume change condition.</p>	<p>Less than 0.05kg/sq.cm (5 KN/sq.m)</p>
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1.10 Providing and filling local sand in trenches, plinth and surrounding areas.

- (A) At places backfilling shall be carried out with local sand if directed by Project Engineer. The sand used shall be kept flooded with water for 24 hours to ensure maximum consolidation. Any temporary work required to contain sand under flooded condition shall be to contractor's account. The surface of the consolidated sand shall be dressed to require level or slope. Construction of floors or other structures on sand fill shall not be started until Project Engineer has inspected and approved the fill.

(B) Mode of Measurement

Actual quantity of consolidated sand filling shall be measured and paid in M.CUBE.

1.11 Providing and laying rubble soling

- (A) Rubble used for packing under floor, foundations, etc. shall be hard, durable rock, free from veins, flaws and other defects. The size of the rubble shall be 100mm - 150mm unless otherwise specified in the item description in the Schedule of Quantities and the quality shall be got approved by the Project Engineer.
- (B) Rubble shall be laid closely in position on the sub-grade. All interstices between the stones shall be wedged in with smaller stones of suitable size well driven to ensure tight packing and complete filling of interstices. Such filling shall be carried out simultaneously with the placing in position of rubble stone and shall not lag behind.
- (C) Small interstices shall be filled with murrum or gravel as specified, well watered and rammed.

(D) Mode of Measurement

The unit of measurement shall be Sq.m / Cu.M of the work done as per the drawings and/or as specified in the Schedule of Quantities.

1.12 Brick Soling

(A) Bricks shall be laid on edge or flat as per the item specification. The bricks shall be placed as close as possible. Broken bricks shall not be used except for closing the line. Bricks should not show any efflorescence on drying.

(B) The soling pattern shall be as specified in the item specification, it can be plain, diagonal or herring-bone. Suitable slope shall be maintained as specified in the item specification.

(D) Mode of Measurement

This item shall be measured in SQ.M of work done as per the drawings / directed by the Project Engineer . No deduction shall be made for any opening upto 0.1 Sq.m.

1.13 Providing and laying dry stone pitching

(A) Stone subject to marked deterioration by water or weather will not be accepted. The stone shall be hard, durable and fairly regular in shape and its thickness in any one direction shall not be less than the thickness of the pitching as specified in the Schedule of Quantities.

(B) Before laying the pitching the sides of the sloped surface shall be trimmed to the required slope and profiles. The depressions shall be thoroughly filled and compacted. It shall commence from the bottom. The stones shall be placed normal to the slope and the largest dimension is perpendicular to the face of the slope unless such dimension is more than the thickness of the pitching. The largest stones shall be placed at the bottom. The joints between the stones shall be filled with good earth. The earth shall be got approved by the Project Engineer before filling.

(C) Mode of Measurement

It shall be measured in SQ.M/SQ.FT. The rate shall include preparation of base, providing and laying of stones and filling up of joints with approved good earth.

1.14 Providing and laying dry stone pitching with cement pointing

- (A) The general specification shall be same as the item No.1.13 but for the joints between the stones shall be filled with cement mortar of proportion as specified in the item description in the Schedule of Quantities.

(B) Mode of Measurement

Same as item 1.13 but in this the rate includes the pointing also.

1.15 Providing and Filling dry brickbats at all levels

The brickbats shall be of 40-65 mm (average) thickness in size. The brickbats shall be clean and mortar free. They should be washed off dust before it is filled. They shall be filled in places as directed by the Project Engineer.

Mode of Measurement

The bulk volume of the filling shall be measured in M.CUBE. No deduction shall be made for voids.

1.16 Earth work excavation in soft rock upto 1.50 m from existing ground level.

- (A) Technical specification is same as that of item No.1.01 but in soft rock.

- (B) Mode of Measurement - same as that of item No.1.01.

1.17 Earth work excavation in soft rock for depth exceeding 1.5M but not exceeding 3.0 M

(A) The general specification is same as that of 1.02 but in soft rock.

(B) Mode of Measurement - same as that of item No.1.02.

1.18 JUNGLE CLEARENCE:

(A) Clearing jungle including uprooting of rank vegetation, grass, brush wood, trees and saplings of girth up to 30cm measured at a height of 1m above the ground level and removal of rubbish up to distance of 250m outside the periphery of the cleared area. The rate shall be included levelling etc, complete as per the direction of engineer incharge.

(B) Mode of Measurement

Only the cleaned area shall be measured in SQ.M & paid.

The area earmarked for the excavation of footing and plinth for any proposed construction of buildings within the cleared area shall be deducted in the measurements,

since, the rate for the same is included in the excavation of building foundation and plinth beam.

1.19 ANTI TERMITE TREATMENT:

(A) Providing & injecting Anti-termite treatment by a specialized approved agency as per IS specifications, using preferably 1% by weight of chlorpyrifos or Equivalent chemical with a guarantee for ten years etc., complete (only plinth area shall be measured & paid for 4 stage of percentage as like Footing-20%, Plinth-15%, Flooring-45% and External work-20%). Chemical to be bought in sealed containers. Chemicals with ISI mark shall only be used. The chemical shall be chlorpyrifos emulsifiable concentrates confirming to IS 8944.

- i. Treating the bottom and sides of excavation before laying PCC for footing
- ii. Treating the backfill in contact with foundation and plinth before laying PCC for plinth beam

- iii Treating the top surface of filled earth before laying PCC for flooring
- iv. Treating the soil under plinth protection

Mode of Measurement

Only plinth area shall be measured in SQ.M & paid. The ratio of the payment shall be as per the stages mentioned above with the percentage as

i.Footing-20%, ii. Plinth-15%, iii. Flooring-45% and iv. External work-20%.

SECTION 2.00 CONCRETE AND ALLIED WORKS**I. Applicable Codes**

The following codes and standards are made a part of the Specifications. All standards, codes of practices referred to herein shall be the latest edition including all applicable official amendments and revisions.

In case of discrepancy between this specification and those referred to herein, this specification shall prevail.

(a) Materials

1.	IS 269:2013 (Reaffirmed 2004)	:	Specification for ordinary, rapid hardening and low heat portland cement.
2.	IS 455:1989 (Reaffirmed 1995)	:	Specification for Portland blast furnace slag.
3.	IS 1489:1991	:	Specification for portland-pozollana cement.

TECHNICAL SPECIFICATIONS

	(Reaffirmed 2005)		
4.	IS 4031:1996 (Reaffirmed 2005)	:	Methods of physical tests for hydraulic cement.(all Parts).
5.	IS 650:1991 (Reaffirmed 1999)	:	Specification for standard sand for testing of cement.
6.	IS 383:2016	:	Specification for coarse and fine aggregate from natural sources for concrete.
7.	IS 2386 :1963 (Reaffirmed 2002)	:	Methods of test for aggregate for concrete. .(all Parts).
8.	IS 516:1959 (Reaffirmed 2004)	:	Methods of test for strength of concrete.
9.	IS 1199:1959 (Reaffirmed 2004)	:	Methods of sampling and analysis of concrete.
10.	IS 2396(I) IS 5640:1970 (Reaffirmed 2008)	:	Flakiness Index of aggregate.
11.	IS 3025:1987 (Reaffirmed 2003)	:	Methods of sampling and test (Physical and chemical water used in industry).
12.	IS 432 (part I & II):1982 (Reaffirmed 2004)	:	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.
13.	IS 1139 :1985 (Reaffirmed 1990)	:	Specification for hot rolled mild steel and medium tensile steel deformed bars for concrete reinforcement.
14.	IS 1566:1982 (Reaffirmed 2004)	:	Specification for plain hard drawn steel wire fabric for concrete reinforcement.
15.	IS 1785:1983 (Reaffirmed 2008)	:	Specification for plain hard drawn (Part I) steel wire for pre stressed concrete.
16.	IS 1786:2008	:	Specification for cold twisted steel bars for concrete reinforcement.
17.	IS 2090 :1983 (Reaffirmed 2009)	:	Specification for high tensile steel bars used in pre stressed concrete.
18.	IS 4990:2011	:	Specification for plywood for concrete shuttering work.

19.	IS 2645:2003 (Reaffirmed 2005)		Specification for integral cement water-proofing compounds.
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(b) Equipment

1.	IS 1791:1985	:	Specification for batch type concrete mixers.
2.	IS 2438:1963	:	Specification for roller pan mixer.
3.	IS 2505:1992	:	Specification for concrete vibrators immersion type.
4.	IS 2506:1985	:	Specification for screed board concrete vibrators.
5.	IS 2514:1963	:	Specification for concrete vibrating tables.
6.	IS 3366:1965	:	Specification for pan vibrators.
7.	IS 4656:1988	:	Specification for form vibrators for concrete.
8.	IS 2722:1964	:	Specification for portable swing weigh-batchers for concrete (single and double bucket type).
9.	IS 2750:1964	:	Specification for steel scaffolding.

(c) Codes of Practice

1.	IS 456:2000	:	Code of practice for plain and reinforced concrete
2.	IS 1343:1980	:	Code of practice for prestressed concrete.
3.	IS 457:1957	:	Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.
4.	IS 3370 (Part I to IV):2009	:	Code of practice for concrete structures for storage of liquids.
5.	IS 3935:1966	:	Code of practice for composite construction.
6.	IS 320:1980	:	Criteria for design and construction of precast concrete trusses.
7	IS 2204:1962	:	Code of practice for construction of reinforced concrete shell roof.

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8.	IS 2210:1988	:	Criteria for the design of RC shell structures and folded plates.
9.	IS 2751:1979	:	Code of practice for welding of mild steel bars used for reinforced concrete construction.
10.	IS 2502:1963	:	Code of practice for bending and fixing of bars for concrete reinforcement.
11.	IS 3658:1999	:	Code of practice for use of immersion vibrators
12.	IS 3414:1968	:	Code of practice for design and installation of joints in buildings.
13.	IS 4014 (Part I & II):1967	:	Code of Practice for steel tabular, scaffolding
14.	IS 2571:1970	:	Code of practice for laying insitu cement concrete flooring

(d) Construction Safety

1. IS 3696:1987 : Safety code for scaffolds and ladders

(e) Measurement

1.	IS 1200:1992	:	Method of measurement of building works.
2.	IS 3385:2014	:	Code of practice for measurement of civil engineering works.

The above mode of measurements shall be applicable only if it is not given specifically in the tender document.

II. General

The quality of materials, method and control of manufacture and transportation of all concrete work irrespective of mix, whether reinforced or otherwise shall conform to the applicable portions of this specification.

Project Engineer shall have the right to inspect the source/s of material/s the layout and operation of procurement and storage of materials, the concrete batching and mixing equipment, and the quality control system. Such an inspection shall be arranged and engineer's approval obtained, prior to starting of concrete work.

III. Materials

The ingredients to be used in the manufacture of standard concrete shall consist solely of standard type portland cement, clean sand, natural coarse aggregate, clean water and admixtures.

A. Cement

a) If the contractor is instructed to supply cement, then the following points shall be applicable.

i) Unless otherwise specified the cement shall be ordinary portland cement in 50kg bags. The use of bulk cement will be permitted only with the approval of Project Engineer.

ii) A certified report attesting to the conformance of the cement to IS specifications by the cement manufacturer's chemist shall be furnished to engineer if demanded.

iii) Cement held in storage for a period of ninety (90) days or longer shall be tested. Should at any time Project Engineer have reasons to consider that any cement is defective then irrespective of its origin, and/or manufacturers test certificate, such cement shall be tested immediately at contractor's cost at a National Test Laboratory/approved laboratory and until the results of such tests are found satisfactory, it shall not be used in any work. Contractor shall not be entitled to any claim of any nature on this account.

b) If the cement is supplied by the Owner

Contractor will have to make his own arrangements for the storage of minimum 250 MT of cement. If supplies are arranged by owner, cement will be issued in quantities to cover work requirements of one month or more, as deemed fit by Project Engineer and it will be responsibility of contractor to ensure adequate and proper storage. Cement in bulk may be stored in bins or silos which will provide complete protection from dampness contamination and minimise caking and false set. Cement bags shall be stored in a dry and enclosed shed (storage under tarpaulins will not be permitted), well away from the outer walls and insulated from the floor to avoid contact with moisture from ground and so arranged as to provide ready access.

Damaged or reclaimed or partly set cement will not be permitted to be used and shall be removed from the site. The storage bins and storage arrangements shall be such that there is

no dead storage. Not more than 12 bags shall be stacked in any tier. The storage arrangement shall be approved by Project Engineer . Consignments of cement shall be stored as received and shall be consumed in the order of their delivery.

(B) Aggregate

- a) Aggregate in general designates both fine and coarse inert materials used in the manufacture of concrete. Fine aggregate is aggregate all of which passes through 4.75 mm IS sieve. Coarse aggregate is aggregate most of which is retained on 4.75 mm sieve.
- b) All fine and coarse aggregates proposed for use in the work shall be subject to Project Engineer 's approval and after specific materials have been accepted the source of supply of such materials should not be changed without prior approval of Project Engineer .
- c) Aggregates shall, except as noted above, consist of natural sands, crushed stone and gravel from a source known to produce satisfactory aggregate for concrete and shall be chemically inert, strong, hard durable against weathering of limited porosity and free from deleterious materials that may cause corrosion of the reinforcement or may impair the strength and/or durability of concrete. The grading of aggregates shall be such as to produce a dense concrete of specified strength and consistency that will work readily into position without segregation and shall be based on the mix design and preliminary tests on concrete specified later.

d) Sampling and testing

Samples of the aggregates for mix design (mix design if specified or instructed) and determination of suitability shall be taken under the supervision of Project Engineer and delivered to the laboratory, well in advance of the scheduled placing of concrete. Records of tests which have been made on proposed aggregates and on concrete made from this source of aggregates shall be furnished to Project Engineer in advance of the work for use in determining aggregate suitability. The costs of all such test, sampling etc. shall be borne by contractor.

e) Storage of Aggregates

All coarse and fine aggregates shall be stacked in stock separately in stock piles in the material yard near the work site in bins properly constructed to avoid inter mixing of different aggregates. Contamination with foreign materials and with earth during storage and while heaping the materials shall be avoided. The aggregates must be of specified quality not only at the time of receiving at site but more so at the time of loading into mixer. Rackers shall be used for lifting the coarse aggregates from bins or stock piles. Coarse aggregate shall be piled in layers not exceeding 1.20metres in height to prevent coning or segregation. Each layer shall cover the entire are of the stock pile before succeeding layers are started. Aggregates that have become segregated shall be rejected.

f) Specific Gravity

Aggregate except as noted above and for other than light weight concrete shall consist of natural or crushed sand shall conform to IS 383. The sand shall be clean sharp, hard, strong and durable and shall be free from dust, vegetable substances, adherent coating, clay, alkali, organic matter, mica, salt or other deleterious substances, which can be injurious to the setting qualities / strength / durability of concrete.

(C)Machine made Sand

Machine made sand will be acceptable, provided the constituent rock/gravel composition shall be sound, hard dense, non-organic uncoated and durable against weathering and with the prior approval of the Project Engineer .

i) Screening and Washing

Sand shall be prepared for use for such screening or washing, or both, as necessary, to remove all objectionable foreign matter while separating the sand grains to the required size fractions.

ii) Foreign Material Limitations

The percentage of deterious substances in sand delivered to the mixer shall not exceed the following:

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i)	Material finer than 75 micron IS sieve	3.00	15.00
ii)	Shale	1.00	-
lii)	Coal and lignite	1.00	1.00
iv)	Clay lumps	1.00	1.00
v)	Total of all above substances including items (i) to (iv) for uncrushed sand and items (iii) and (iv) for crushed sand	5.00	2.00

iii) Gradation

IS Sieve Designation	percentage passing for			
	Grading Zone I	Grading Zone II	Grading Zone III	Grading Zone IV
10mm	100	100	100	100
4.75mm	90-100	90-100	90-100	90-100
2.36 mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55-90	75-100	90-100
600 micron	15-34	35-59	60-79	80-100
300 micron	5-20	8-30	12-40	15-50
150 micron	0-10	0-10	0-10	0-15

Where the grading falls outside the limits of any particular grading zone of sieves other than 600 micron IS sieve, by total amount not exceeding 5 percent, it shall be regarded as falling within that grading zone. This tolerance shall not be applied to percentage passing the 600 micron IS sieve or to percentage passing any other sieve on the coarser limit of grading zone I or the finer limit of grading zone IV.

iv) Fineness Modulus

The sand shall have a fineness modulus of not less than 2.2 or more than 3.2. The fineness modulus is determined by adding the cumulative percentages retained on the

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following IS sieves sizes 4.75mm, 2.36mm, 1.18mm 600 micron, 300 micron and 150 micron and dividing the sum by 100.

(D) Coarse Aggregate

a) Coarse aggregate for concrete, except as noted above and for other than light weight concrete shall conform to IS 383. This shall consist of natural or crushed stone and gravel and shall be clean and free from elongated, flaky or laminated pieces adhering coatings, clay lumps, coal residue, clinkers slag, alkali, mica, organic matter or other deleterious matter.

b) Screening and Washing

Natural gravel and crushed rock shall be screened and/or washed for the removal of dirt or dust coating, if so demanded by Project Engineer .

c) Grading

Coarse aggregate shall be graded in both cases the grading shall be within the following limits.

IS Sieve Designation	%passing for single sized aggregate of nominal size				
	40mm	20mm	16mm	12.5mm	10mm
63mm	100	-	-	-	-
40mm	85-100	100	-	-	-
20mm	0-20	85-100	100	-	-
16mm	-	-	85-100	100	-
12.5mm	-	-	-	85-100	100
10mm	0-5	0-20	0-30	0-45	85-100
4.75mm	-	0-5	0-5	0-10	0-20
2.36mm	-	-	-	-	0-5

IS Sieve Designation	% passing for graded aggregate of nominal size			
	40mm	20mm	16mm	12.5mm
63mm	100	-	-	-

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40mm	95-100	100	-	-
20mm	30-70	95-100	100	-
16mm	-	-	90-100	-
12.5mm	-	-	-	90-100
10mm	10-35	25-55	30-70	40-85
4.75mm	0-5	0-10	0-10	0-10
2.36mm	-	-	-	-

The pieces shall be angular in shape and shall have granular or crystalline surfaces, friable, flaky and laminated pieces, mica and shale, if present, shall be only in such quantities that will not, in the opinion of Project Engineer affect adversely the strength and/or durability of concrete. The maximum size of coarse aggregate shall as specified in each item description. The maximum size of coarse aggregate shall be the maximum size specified above, but in no case greater than 1/4 of the minimum thickness of the member, provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and fill the corners of the form. Plums above 150mm and upto any reasonable size can be used in plain mass concrete work of large dimensions upto a maximum limit of 20% of volume of concrete when specifically approved by Project Engineer . For heavily reinforced concrete members the nominal maximum size of the aggregate shall be 5mm less than the minimum clear distance between the reinforcing main bars or 5mm less than the minimum cover to the reinforcement whichever is smaller. The amount of fine particles occurring in the free state or as loose adherent shall not exceed 1% when determined by laboratory sedimentation tests as per IS 2386. After 24 hours immersion in water, a previously dried sample shall not have gained more than 10% of its oven dry weight in air, as determined by IS 2386.

d) Foreign Materials Limitations

The percentage of deleterious substance in the coarse aggregate delivered to the mixer shall not exceed the following:

		Percent by weight Uncrushed	crushed
i)	Material finer than 75micron IS sieve	3.00	3.00
ii)	Coal and lignite	1.00	1.00
iii)	Clay lumps	1.00	1.00

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iv)	Soft fragments	3.00	-
v)	Total of all the above substances	5.00	5.00

(E) Water

- a) Water used for both mixing and curing shall be free from injurious amounts of deleterious materials. Potable waters are generally satisfactory for mixing and curing concrete.
- b) In case of doubt, the suitability of water for making concrete shall be ascertained by the compressive strength and initial setting time test specified in IS-456. The sample of water taken for testing shall be typical of the water proposed to be used or concreting, due account being paid to seasonal variation. The sample shall not receive any treatment before testing other than that envisaged in the regular supply of water proposed for use in concrete. The sample shall be stored in a clean container previously rinsed out with similar water.
- c) Average 28 days compressive strength of at least three 15cm concrete cubes prepared with water proposed to be used shall not be less than 90% of the average strength of three similar concrete cubes prepared with distilled water.
- d) The initial setting time or test block made with the appropriate set cement and the water proposed to be used shall not be less than 30 minutes and shall not differ by more than plus minus 30 seconds from the initial setting time of control test block prepared with the appropriate test cement and distilled water. The test blocks shall be prepared and tested in accordance with the requirements of IS 4031.
- e) Where water can be shown to contain an excess of acid, alkali sugar or salt, engineer may refuse to permit its use. As a guide, the following concentrations represent the maximum permissible values:
 - i) To neutralise 200ml sample of water, using phenolphthalein as indicator, it should not require more than 2 ml of 0.1 normal NaOH. The details of test shall be as given in IS 3025:1987.

ii) To neutralise 900ml sample of water using methyl orange as an indicator it should not require more than 10 ml of 0.1 normal HCl. The details of test shall be given in IS 3025:1987.

iii) Percentage of solids when tested in accordance with the method indicated below shall not exceed the following.

	percent	method of test (ref. to clause no. in IS 3025-1987).
Organic	0.02	10 and 11 (organic solids=total solids minus ignited residue)
Inorganic Sulphate (as SO ₄)	0.30	11 (Ignited residue)
Alkali Chlorides (as Cl)	0.05	20
	0.10	24

(F) Brick aggregates

The brickbats shall be of new bricks well burnt, hard, durable and broken to sizes, well graded. It shall be free from dust, the size shall be of 37mm and down. It shall be free from earth and other impurities.

(G) Reinforcement Steel

a) Reinforcement bars, if supplies are arranged by contractor, shall be either plain round mild steel bars grade I as per IS 432 (part I) or medium tensile steel bar as per IS 432 (Part I) or hot rolled mild steel and medium tensile steel deformed bars as per S 1139 or cold twisted steel bars as per IS 1786 as shown and specified on the drawings. Wire mesh or fabric shall be in accordance with IS 1566. Substitution of reinforcement will not be permitted except upon written approval from Project Engineer .

b) Plain round mild steel bars grade II as per IS:432 (part I) may be used with prior approval of Project Engineer in writing and with 10% increase in the reinforcement area but

its use shall not be permitted in structures located in earthquake zones subjected to severe damage (as per IS:1895) and for structures subject to dynamic loading (other than wind loading), such as frames supporting rotary or reciprocating machinery etc.

- c) All reinforcement shall be clean, free from grease, oil, paint, loose mill scale, loose rust, dust, bituminous material or any other substances that will destroy or reduce the bond. All rods shall be thoroughly cleaned before being fabricated. Pitted and defective rods shall not be used.

- 2.01 Providing and laying Brickbat Cement Concrete 1:4:8 (1cement: 4 Coarse Sand: 8 Brickbats of size 37mm and down).

The brickbats, sand and cement shall be of quality as described in the materials section above. The materials shall be mixed in volumetric proportions in concrete mixer only. The concrete shall be laid in layers of 150mm thick and well consolidated with rammer of weight 4.5 to 5.5 kg steel rammers of base area 300 Sq.cm till slurry comes on top before the next layer is laid. Curing shall be done for 7 days. For joints the edge of the concrete shall be finished off with a slope not steeper than 2:1 and well roughened.

Mode of Measurement

This shall be measured in M.CUBE and part thereof. The bed concrete provided for flooring shall be paid for under this item. The rate shall include cost the shuttering to be provided.

- 2.02 Providing and laying Brickbat Cement Concrete 1:5:10 (1Cement: 5 coarse Sand: 10 Brickbats of size 37mm and down)

The general specification is same as for item No.2.01 but for the volumetric proportion of the sand and brickbats is 5 and 10 instead of 4 and 8 respectively.

2.03 PLAIN CEMENT CONCRETE

Providing and laying PCC 1:5:10 Grade using 40/20mm down size aggregates below flooring in foundations, Footing base concrete, flooring foundations, Plinth beam sides, walls or retaining walls, Demolition floor areas, any thickness, size or shape etc, including Centering, base preparation, proper compaction, vibration, curing, tools and tackles, necessary dewatering, etc compaction etc., complete at all levels.

Providing and laying Plain Cement Concrete 1:5:10 (1 cement: 5 Coarse Sand: 10 graded stone aggregate of nominal size 40/20 mm and down)

Mode of Measurement

This shall be measured in M.CUBE and part thereof. The bed concrete provided for flooring shall be paid for under this item. The rate shall include cost the shuttering to be provided

- 2.04 Providing and laying PCC M 1:4:8 Grade using 40/20mm down size aggregates below flooring in foundations, Footing base concrete, flooring foundations, Plinth beam sides, walls or retaining walls, Demolition floor areas, any thickness, size or shape etc etc, including Centering, base preparation, proper compaction, vibration, curing, tools and tackles, necessary dewatering, etc compaction etc., complete at all levels.

Providing and laying Plain Cement Concrete 1:4:8 (1 cement: 4 Coarse Sand: 8 graded stone aggregate of nominal size 40/20 mm and down)

Mode of Measurement

This shall be measured in M.CUBE and part thereof. The bed concrete provided for flooring shall be paid for under this item. The rate shall include cost the shuttering to be provided.

- 2.05 Providing and laying RCC of mix M25 or 1:1:2 by volume for structures upto plinth level.

Mix Design

a) All concrete in the works shall be of volumetric or design mix if specified and as defined in IS 456-2000, Whether reinforced or otherwise, all design mix concrete works to be carried out under this specification shall be divided into the following classifications:

MINIMUM COMPRESSIVE STRENGTH OF 15 CM CUBES AT 7 AND

28 DAYS AFTER MIXING, CONDUCTED IN ACCORDANCE WITH IS 516

Class	Preliminary test N/SQ.M		Work test N/SQ.M		Max size of aggregate MM	Minimum Cement content per cum for design mix only if specified
	at 7 days	at 18 days	at 7days	at 28 days		
M 40	35.0	54.0	27.0	46.0	20	550 kg.
M 35	31.0	45.0	23.5	39.0	20	470 kg.
M 30	28.0	42	20.0	33.0	40 or 20	420 kg.
M 25	3.5	35.0	17.0	28.0	40 or 20	370 kg.
M 20	19.4	29.0	13.5	22.0	40 or 20	320 kg.
M 15	14.0	17.0	10.0	16.0	40 or 20	300 kg.

b) It shall be very clearly understood that whenever the class of concrete such as M 20 is specified it shall be the contractor's responsibility to ensure that minimum crushing strength stipulated for the respective class of concrete is obtained at works. The maximum total quantity of aggregate by weight per 50 kg of cement shall not exceed 450 kg except when otherwise specifically permitted by Project Engineer

c) To fix the grading of aggregates, water cement ratio, workability and the quantity of cement required to give preliminary and works cubes of the minimum strength specified, the proportions of the mix shall be determined by weight / volume. Adjustment of aggregate proportions due to moisture present in the aggregate shall be made. Mix proportioning shall be carried out according to Indian Standard Specifications.

d) Whenever there is a change either in required strength of concrete or water cement ratio or workability or the source of aggregates and/or cement, preliminary tests shall be repeated to determine the revised proportions, of the mix to suit the altered conditions.

e) While fixing the value for water cement ratio for preliminary mixes, assistance may be derived from the graph (appendix IS 456-2000 showing the relationship between the 28 day compressive strengths of concrete mixes with different water cement ratios and the 7 days compressive strength of cement tested in accordance with IS 269-2015).

Preliminary tests

- a) Test specimens shall be prepared with at least two different water/cement ratios for each class of concrete, consistent with workability required for the nature of the work. The materials and proportions used in making preliminary tests shall be similar in all respects to those to be actually employed in the works at the object of these tests is to determine the proportions of cement, aggregates and water necessary to produce concrete of required consistency and to give the specified strength. It will be the contractor's sole responsibility to carry out these tests and he shall therefore furnish to Project Engineer a statement of proportions proposed to be used for the various concrete mixes.
- b) Materials shall be brought to the room temperature and all materials shall be in a dry condition. The quantities of water, cement and aggregates for each mix shall be determined by weight/volume to an accuracy of 1 part in 1000 parts.
- c) Mixing shall be done by a mixer machine as per IS 516-1959 in such a manner as to avoid loss of water. The cement and fine aggregate shall first be mixed dry until the mixture is uniform in color. The coarse aggregate shall then be added, mixed and water added and mixed thoroughly for a period of not less than 3 minutes until the resulting concrete is uniform in appearance. Each mix of concrete shall be such a quantity as to leave about 10% excess concrete after moulding the desired number of test specimens.
- d) The consistency of each mix of concrete shall be measured immediately after mixing, by the slump test in accordance with IS 1199-1959. If in the slump test, care is taken to ensure that no water or other materials is lost, the materials used for the slump test may be remixed with the remainder of the concrete for making the specimen test cubes. The period of remixing shall be as short as possible yet sufficient to produce a homogeneous mass.

- e) Compression tests of concrete cubes shall be made as per IS 516-1959 on 15cm cubes. Each mould shall be provided with a metal base having a plane surface so as to support the mould during filling without leakage. The base plate shall be preferably attached to the mould by springs or screws. The parts of the mould when assembled shall be positively and rigidly held together. Before placing concrete the mould and base plate shall be cleaned and oiled. The dimensions and internal faces of the mould shall be accurate within the following limits:

Height and distance between the opposite faces of the mould shall be of specified size plus minus 0.2mm. The angle between the adjacent internal faces and between internal faces and top and bottom planes of mould shall be 90Deg. plus/minus 5 Deg. The interior faces of the mould shall be plane surfaces with a permissible variation 0.03 mm.

- f) Concrete test cubes shall be moulded by placing fresh concrete in the mould and compacted as specified in IS 516-1959.
- g) Curing shall be as specified in IS 516-1959. The cubes shall be kept in moist air of at least 90% relative humidity at a temperature of 27 Deg. cent. plus minus 2 Deg. cent. for 24 hours plus minus half an hour from the time of adding water to the dry ingredients. Thereafter they shall be removed from the moulds and kept immersed in clean, fresh water and kept at 27 Deg. cent. plus minus 2 Deg. Cent. temperature until required for test. Curing water shall be renewed every seven days. A record of maximum and minimum temperatures at the place of storage of the cubes shall be maintained during the period they remain in storage.

h) Testing of Specimens

The strength shall be determined based on not less than five cubes test specimens for each age and each water cement ratio. All these laboratory test results shall be tabulated and furnished to Project Engineer. The test result shall be accepted by Project Engineer if the average compressive strengths of the specimens are tested subject to the condition that only one out of the five consecutive test may give a value less than the specified strength for that age. The Project Engineer may direct the contractor to repeat the tests if the results are not satisfactory and also to make such changes as he

considers necessary to meet the requirements specified. All these preliminary tests shall be conducted by the contractor at his own cost in an approved laboratory.

Proportioning consistency, batching and mixing of concrete proportions

a) Aggregate

The proportions which shall be decided by conducting preliminary test shall be by volume. These proportions of cement, fine and coarse aggregates shall be maintained during subsequent concrete mixing. The supply of properly graded aggregate of uniform quality shall be maintained over the period of work, the grading of aggregates shall be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions. The different sizes shall be stocked in separate stock piles. The grading of coarse and fine aggregate shall be checked as frequently as possible as determined by Project Engineer, to ensure maintaining of grading in accordance with the samples used in preliminary mix design. The material shall be stock piled well in advance of use.

b) Cement

The cement shall be measured by volume.

c) Water

Only such quantity of water shall be added to the cement and aggregates in the concrete mix as to ensure dense concrete, specified surface finish, satisfactory workability, consistent with the strength stipulated for each class of concrete. The water added to the mix shall be such as not to cause segregation of material or the collection of excessive free water on the surface of the concrete.

The water cement (W/C) ratio is defined as the volume of water in the mix (including the surface moisture of the aggregates) divided by the volume of cement in the mix. The actual water cement ratio to be adopted shall be determined in each instance by the contractor and approved by the Project Engineer.

d) Proportioning by water/cement ratio

The W/C ratio specified for use by Project Engineer shall be maintained. The contractor shall determine the water content of the aggregates as frequently as directed by Project Engineer as the work progress and as specified in IS 2386-1983 (part-III) and the amount of water added at the mixer shall be adjusted as directed by Project Engineer so as to maintain the specified W/C ratio. To allow for the variation in volume of aggregates due to variation in their moisture content suitable adjustments in the volume of aggregates shall also be made.

e) Consistency and slump

Concrete shall be of a consistency and workability suitable for the conditions of the job. After the amount of water required is determined, the consistency of the mix shall be maintained throughout the progress of the corresponding parts of the work and approved tests e.g. slump tests, compacting factory tests, in accordance with IS 1199-1959 shall be conducted from time to time to ensure the maintenance of such consistency.

The following tabulation gives a range of slumps which shall generally be used for various types of construction unless otherwise instructed by the Project Engineer .

SLUMPS FOR VARIOUS TYPES OF CONSTRUCTION

Only sufficient quantity of water shall be added to concrete during mixing to produce a mix of sufficient workability to enable it to be well consolidated, to be worked in to the corners of the shuttering and around reinforcement, to give the specified surface finish, and to have the specified surface strength. The following slumps shall be adopted for different kinds of works:-

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Name of Work	When vibrator used	when vibrator not Used
Mass concrete in foundations, footings retaining walls and pavements	10mm to 25mm	50mm to 75mm
Thin sections of floors of less than 75mm thick	25mm to 40mm	75mm to 100mm
For reinforced cement concrete work:		
Mass concreting in foundations, footings, retaining walls and pavements	10mm to 25mm	80mm
Beams, slabs, columns	25mm to 40mm	100mm to 125mm
Thin shells, folded plates etc.	40mm to 50mm	125mm to 150mm

Sampling and testing concrete in the field

- a) Facilities required for sampling materials and concrete in the field shall be provided by the contractor at no extra cost. The following equipment with operator shall be made available at Project Engineer 's request (all must be in serviceable condition):
 - i) One concrete cube testing machine suitable for 15cm machine suitable for 15cm cubes of 100 tones capacity with provind calibration ring.
 - ii) Twelve cast iron cube moulds of 15 cm size.
 - iii) One Lab. balance to weigh upto 5 kg with sensitivity of 10gm
 - iv) One set of sieves for coarse and find aggregates.
 - v) One set of slump cone complete with tamping rod.
 - vi) A set of measures from 5litre to 0.1litre.

- vii) One electric oven with thermostat upto 120 Deg. Cent.
- viii) One flakiness gauge.
- ix) One elongation index gauge.
- x) One sedimentation pipette.
- xi) One pyconometer.
- xii) Two calibrated glass jar of 1litre capacity.

Arrangement can be made by the contractor to have the cubes tested in an approved laboratory in lieu of a testing machine at site at his expense, with the prior consent of the Project Engineer .

b) At least 6 test cubes of each class of concrete shall be made for every 15.0 cum. of concrete or part thereof. Such samples shall be drawn on each day for each type of concrete. Of each set of 6 cubes, three shall be tested at 7 days age and three at 28 days age. The laboratory test results shall be tabulated and furnished to Project Engineer . Project Engineer will pass the concrete if average strength of the specimens tested is not less than the strength specified, subject to the condition that only one out of three consecutive tests may give a value less than the specified strength but this shall not be less than 90% of the specified strength. The cubes shall be tested on 7th and 28th day from the day of casting of the cubes.

Admixtures

a) Admixtures may be used in concrete only with the approval of Project Engineer based upon evidence that, with the passage of time, neither the compressive strength nor its durability reduced. Calcium chloride shall not be used for accelerating setting of the cement for any concrete containing reinforcement, or embedded steel parts. When calcium chloride is permitted to be used, such as in mass concrete works, it shall be dissolved in water and added to the mixing water in an amount not to exceed 1.5% of the volume of the cement in concrete or as specified. When admixtures are used, the concrete mix shall be corrected accordingly.

Admixtures shall be used as per manufacturer's instructions and in the manner and with the control specified by Project Engineer .

b) Air entraining agents

Where specified and approved by Project Engineer , neutralised vinyl resin or any other approved air-entraining agent may be used to produce the specified amount of air in the concrete mix and these agents shall conform to the requirements of ASTM standard 6260, air entraining admixtures for concrete. The recommended total air content of the concrete is 4% plus minus 1%. The method of measuring air content shall be as per IS 1199.

c) Water reducing admixtures

Where specified and approved by Project Engineer water reducing lignosulfonate mixture shall be added in quantities specified by Project Engineer . The admixtures shall be added in the form of a solution.

d) Retarding admixtures

Where specified and approved by Project Engineer , retarding agents shall be added to the concrete mix in quantities specified by Project Engineer .

e) Water proofing agent

Where specified and approved by Project Engineer , water proofing agent conforming to IS: 2645-2003 shall be added in quantities specified by Project Engineer .

Optional tests

a) Project Engineer may order tests to be carried out on cement, sand, coarse aggregate and water in accordance with the relevant Indian Standards. Tests on cement shall include (i) fineness test (ii) test for normal consistency (iii) test for setting time (iv) test for soundness (v) test for tensile strength (vi) test for compressive strength (vii) test for heat of hydration by experiment and by calculations in accordance with IS:269. Tests on sand shall include (i) sieve test (ii) test for organic impurities (iii) decantation test for determining clay and silt

content (iv) specific gravity test (v) test for unit weight and bulkage factor. Tests on coarse aggregate shall include (i) test for sieve analysis (ii) specific gravity and unit weight of dry loose and rodded aggregate (iii) petrographic examination (iv) soundness and alkali aggregate reactivity (v) deleterious materials and organic impurities (vi) test for aggregate crushing value. Any or all these tests would normally be ordered to be carried out only if Project Engineer feels the materials are not in accordance with the specifications or if the specified concrete strengths are not obtained and shall be performed by contractor at site or at an approved test laboratory. The contractor shall have to pay for all tests ordered.

b) If the works cubes do not give the stipulated strengths Project Engineer reserves the right to ask contractor to dismantle such portions of the work, which in his opinion are unacceptable and re-do the work to the standard stipulated at contractor's cost.

a) Load test on members or any other tests

i) In the event of any work being suspected of faulty material or workmanship or both, Project Engineer requiring its removal and reconstruction may order the contractor that it should be load tested in accordance with the following provisions.

ii) The test load shall be 125% of the maximum superimposed load for which the structure was designed. Such test load shall not be applied before 56 days after the effective hardening of the concrete. During the test, struts strong enough to take the load shall be placed in position leaving a gap under the members. The test load shall be maintained for 24 hours before removal.

iii) If within 24 hours of the removal of the load, the structure does not show a recovery of at least 75 percent of the maximum deflection shown during the 24 hours under load the test loading shall be repeated after a lapse of at least 72 hours. The structure shall be considered to have failed to pass the test if the recovery after the second test is not at least 75 percent of the maximum deflection shown during the second test. The cost of the load test shall be borne by the contractor.

iv) Any other tests e.g. taking out in approved manner concrete cores, examination and tests on such cores removed from such parts of the structure as directed by Project Engineer, sonic testing etc. shall be carried out by contractor if so directed.

v) Should the results of any test prove unsatisfactory, or the structure shows signs of weakness, undue deflection or faulty construction the contractor shall remove and rebuild the member or members involved or carryout such other remedial measures as may be required by Owner. The contractor shall bear the cost of so doing, unless the failure of the member or members to fulfill the test conditions is proved to be solely due to faulty design.

Concrete in alkali soils and alkaline water

Where concrete is liable to attack from alkali salts or alkaline water, special cements containing low amount of tricalcium aluminate shall be used, if so specified in the drawings. Such concrete shall have a minimum 28days compressive strength of 250 kg. per Sq.cm and shall contain not less than 370 kg of cement per cubic metre of concrete in place. If specified, additional protection shall be obtained by the use of a chemically resistant stone facing or a layer of plaster of paris covered with suitable fabric, such as jute thoroughly impregnated with tar.

Preparation prior to concrete placement

a) Before the concrete is actually placed in position, the insides of the form work shall be inspected to see that they have been cleaned and oiled. Temporary opening shall be provided to facilitate inspection, especially at bottom of columns and walls forms to permit removal of saw dust, wood shavings, binding wire, rubbish dirt etc. Openings shall be placed or holes drilled so that these materials and water can be removed easily. Such openings/holes shall be later suitably plugged.

b) The various agencies shall be permitted ample time to install drainage and plumbing lines in floor and trench drains, conduits, hangers, anchors, inserts, sleeves, bolts frames and other miscellaneous embedment to be cast in the concrete as indicated on the drawings or as is necessary for the proper execution of the work. Contractor shall cooperate fully with all such agencies and shall permit the use of scaffolding form work etc. by other agencies at no extra cost.

- c) All embedded parts, inserts etc. supplied by Owner or contractor shall be correctly positioned and securely held in the forms to prevent displacement during depositing and vibrating of concrete.
- d) Anchor bolts shall be positioned and kept in place with the help of proper manufactured templates. The use of all such templates, fixture etc. shall be deemed to be included in the rates.
- e) Slots, openings, holes, pockets etc. shall be provided in the concrete work in the positions indicated in the drawings or as directed by Project Engineer .
- f) Prior to concrete placement all work shall be inspected and approved by Project Engineer and if found unsatisfactory, concrete shall not be poured until after all defects have been corrected at contractor's cost. Cat ladders shall be provided on the reinforcement to facilitate labour movement.
- g) Approval by Project Engineer for all materials and work as required herein shall not relieve contractor from his obligation to produce finished concrete in accordance with the drawings and specifications.
- h) No concrete shall be placed in wet weather or on water covered surface. Any concrete that has been washed by heavy rains, the work shall be entirely removed, if there is any sign of cement and sand having been washed from the concrete mixture. To guard against damage which may be caused by rains, the works shall be covered with tarpaulins immediately after the concrete has been placed and compacted. Any water accumulating on the surface of the newly placed concrete shall be removed by approved means and no further concrete shall be placed thereon until such water is removed. To avoid flow of water over/around freshly placed concrete, suitable drains and sumps shall be provided.
- i) Immediately before concrete placement begins, proposed surfaces except framework, which will come in contact with the concrete to be placed, shall be covered with abonding mortar.

Transportation

- a) All buckets, containers or conveyors used for transporting concrete shall be mortar tight. Irrespective of the method of transportation adopted, concrete shall be delivered with the required consistency and plasticity without segregation or loss of slump. However, chutes shall not be used for transport of concrete without the written permission of Project Engineer and concrete shall not be rehandled before placing.
- b) Concrete must be placed in its final position before it becomes too stiff to work. On no account, water shall be added after the initial mixing concrete which has become stiff or has been contaminated within foreign materials shall be rejected and disposed off as directed by Project Engineer .
- c) All equipment used for mixing, transporting and placing of concrete shall be maintained in clean condition. All pans, buckets, hoppers, chutes, pipelines and other equipments shall be thoroughly cleaned after each period of placement.

Procedure for placing of concrete

- a) Before any concrete is placed, the entire placing program, consisting of equipment, layout proposed procedures and methods shall be submitted to Project Engineer for approval if so demanded by Project Engineer and no concrete shall be placed until Project Engineer 's approval has been received. Conveyor for conveying concrete shall be of such size and design as to ensure a practically continuous flow of concrete during depositing without segregation of materials, considering the size of the job and placement location.
- b) Concrete shall be placed in its final position before the cement shall normally be compacted in its final position within thirty minutes of leaving the mixer and once compacted it shall not be disturbed.
- c) Concrete, in all cases, be deposited as nearly as practicable directly in its final position, and shall not be re handled or caused to flow in a manner which will cause segregation, loss of materials, displacement of reinforcement, shuttering or embedded inserts or impair its strength. For locations where direct placement is not possible, and in narrow forms, contractor shall provide suitable drop and elephant trunks to confine the movement of concrete. Special care shall be taken when concrete is dropped from a height especially if reinforcement is in the way, particularly in columns and thin walls.

- d) Except when otherwise approved by Project Engineer , concrete shall be placed in shovels or other approved implements and shall not be dropped from a height more than 1M or handled in a manner which will cause segregation.
- e) The following specification shall apply when placing of concrete by use of mechanical equipment is specifically called for while inviting bids or is warranted considering the nature of work involved. The control of placing shall begin at the mixer discharger, concrete shall be discharged by a vertical drop into the middle of the bucket or hopper and this principle of a vertical discharge of concrete shall be adhered to thoroughly at all stages of delivery until the concrete comes to rest in its final position.
- f) Central bottom dump buckets of a type that provides for positive regulation of the amount and rate of deposition of concrete in all dumping position shall be employed.
- g) In placing concrete in large open areas, the bucket shall be spotted directly over the position designated and then lowered for dumping. The open bucket shall clear the concrete already in place and the height of drop shall not exceed 1M. The bucket shall be opened slowly to avoid high vertical bounce. Dumping of buckets on the swing or in any manner which results in separation of ingredients or disturbance of previously placed concrete will not be permitted.
- h) Concrete placed in restricted forms by wheel barrows, buggies, cars, short chutes or hand shovelling shall be subject to the requirement for vertical delivery of limited height to avoid segregation and shall be deposited as nearly as practicable in its final position.
- i) Where it is necessary to use transfer chutes, specific approval of Project Engineer must be obtained to the type, length, slopes, baffles, vertical terminals and timing of operations, the discharge and without segregation. To allow for the loss of mortar against the sides of the chutes, the first mix shall have less coarse aggregate. During cleaning of chutes the wastewater shall be kept clear of the forms. Concrete shall not be permitted to fall from the end of the chutes by more than 1M. Chutes when approved for use shall have slopes not flatter than 1:3 and steeper than 1:2 chutes shall be of metal or metal lined and of rounded cross section. The slopes of all chute sections shall be approximately the same.

The discharge end of the chutes shall be maintained above the surface of the concrete in the forms.

j) Concrete may be conveyed and placed by mechanically operated equipment e.g. pumps or pneumatic placers only with the written permission of Project Engineer . The slump shall be held to the minimum, necessary for conveying concrete by this method.

k) When pumping is adopted, before pumping of concrete is started, the pipeline shall be lubricated with one or two batches of mortar composed of one part cement and two parts sand. The concrete mix shall be specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.

l) When pneumatic placer is used, the manufacturer's advice on layout of pipeline shall be followed to avoid blockages and excessive wear. Restraint shall be provided at the discharge box to cater for the reaction at this end. Manufacturer's advice shall be followed regarding concrete quality and all other related matters when pumping or pneumatic placing equipment are used.

m) Concreting once started, shall be continuous until the pour is completed. Concrete shall be placed in successive horizontal layers of uniform thickness ranging from 15 to 90mm as directed by Project Engineer . These shall be placed as rapidly practicable to prevent the formation of cold joints or planes of weakness between each succeeding layer within the pour. The thickness of each layer shall be such that it can be deposited before the previous layer has stiffened. The bucket loads or other units of the layer with such overlap as well facilitate spreading the layer to uniform depth and texture with a minimum of shoveling. Any tendency to segregation shall be corrected by shoveling stones into mortar rather than mortar on to stones such a condition shall be corrected by redesign of mix or other means, as directed by Project Engineer .

n) The top surface of each pour and bedding planes shall be approximately horizontal unless otherwise instructed.

o) Compaction

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- i) Concrete shall be compacted during placing the approved vibrating equipment until the concrete has been consolidated to the maximum practicable density, is free of pockets of coarse aggregate and fits tightly against all form surfaces, reinforcement and embedded fixtures. Particular care shall be taken to ensure that all concrete placed against the forms faces and into corners of forms or against hardened concrete at joints is free from voids or cavities. The use of vibrators shall
- ii) be consistent with the concrete mix and caution exercised not to over-vibrate the concrete to the point that segregation results.
- iii) Vibrators shall conform to IS specifications. Type of vibrator to be used shall depend on the structure where concrete is to be placed. Shutter vibrators to be effective, shall be firmly secured to the formwork which must be sufficiently rigid to transmit the vibration and strong enough not to be damaged by it. Immersion vibrators shall have no load frequency, amplitude and acceleration as per IS 2505 depending on the size of vibrator. Immersion vibrators in sufficient numbers and each of adequate size shall be used to properly consolidate all concrete. Tapping or external vibrating of forms by hand tools or immersion vibrators will not permitted.
- iv) The exact manner of application and the most suitable machines for the purpose must be carefully considered and operated by experienced men. Immersion vibrators shall be inserted vertically at points not more than 450mm apart and withdrawn when air bubbles cease to come to the surface. Immersion vibrators shall be withdrawn very slowly. In no case shall immersion vibrators be used to transport concrete inside the forms. Particular attention shall be paid to vibration at the top of a lift e.g. in a column or wall.
- v) When placing concrete layers, which are advancing horizontally as the work progresses, great care shall be exercised to ensure adequate vibration, blending and mixing of the concrete between the succeeding layers.
- vi) The immersion vibrator shall penetrate the layer being placed and also penetrate the layer below with under layer is still plastic to ensure good bond and homogeneity between the two layers and prevent the formation of cold joints.

vii) Care shall be taken to prevent contact of immersion vibrators against reinforcement steel. Immersion vibrators shall not be allowed to come in contact with reinforcement steel after start of initial set. They shall also not be allowed to come in contact with forms or finished surfaces.

viii) Form attached vibrators shall be used only with specific authorisation of Project Engineer .

ix) The surface vibrators will be not permitted under normal conditions. However, for thin slabs vibration by specially designed vibrators may be permitted upon approval of Project Engineer .

x) The formation of stone pockets or mortar bondages in corner and against faces of forms shall not be permitted. Should these occur, they shall be dug out, reformed and refilled to sufficient depth and shape for through bonding as directed by Project Engineer .

p) Placement interval

Except when placing with slip forms each placement of concrete in multiple lift work, shall be allowed to set for at least 24 hours after the final set of concrete and before the start of a subsequent placement.

q) Special provision in placing

When placing concrete in walls with openings and in floors of integral slab and beam construction and other similar-conditions, the placing shall stop when the concrete reaches the top of the opening in walls and bottom horizontal surface of the slab, as the case may be placing shall be resumes before the concrete in place takes initial set, but not until it has time to settle as determined by Project Engineer .

r) Placing concrete through reinforcement steel

When placing concrete through reinforced steel, care shall be taken to prevent segregation of the coarse aggregate. When the congestion of steel makes placing difficult it may be

necessary to temporarily move the top steel aside to get proper placement and restore reinforcing steel to design position.

s) Bleeding

Bleeding of free water, on top of concrete being deposited, in to the forms shall be caused to stop the concrete pour. The conditions causing this defect corrected before any further concreting is resumed.

Curing, protecting, repairing and finishing

a) Curing

i) All concrete shall be cured by keeping it continuously damp for the period of time required for complete hydration and hardening to take place. Preference shall be given to the use of continuous sprays or ponded water continuously saturated covering of sacks, canvas, hessian or other absorbent materials, or approved effective curing compounds applied with spraying equipment capable of producing a smooth, even textured coat. Extra precautions shall be exercised in curing concrete during cold and hot water as outlined hereinafter. The quality of curing water shall be the same as that used for mixing concrete.

ii) Certain types of finish or preparation for overlaying concrete must be done at stage of the curing process and special treatment may be required for specific concrete surface finish.

iii) Curing of concrete made of high alumina cement and supersulphated cement shall be carried out as directed by Project Engineer .

iv) Fresh concrete shall be kept continuously wet for a minimum period of 10 days from the date of placing of concrete following a lapse of 12 to 14 hours after laying of concrete. The curing of horizontal surfaces exposed to the drying winds shall however begin immediately the concrete has hardened. Water shall be applied uniformly to concrete surfaces within 1 hour after concrete has set. Water shall be applied to formed

surfaces immediately upon removal of forms quantity of water applied shall be controlled so as to prevent erosion of freshly placed concrete.

v) Curing shall be assured by use of an ample water supply under pressure in pipes with all necessary appliance of hose, sprinklers and spraying devices. Continuous fine mist spraying or sprinkling shall be used, unless otherwise specified or approved by Project Engineer .

vi) Whenever, by the judgment of Project Engineer , it may be necessary to omit the continuous spray method, a covering of clean sand or other approved means such as wet gunny bags which will prevent loss of moisture from the concrete, may be used. No type of covering will be approved which would stain or damage the concrete during or after the curing period. Covering shall be kept continuously wet during the curing period.

vii) For curing of concrete in pavements, side-walks, floors flat roofs or other level surfaces, the ponding method of curing is preferred. The method of containing the ponded water shall be approved by Project Engineer . Special attention shall be given to edges and corners of the slabs to ensure proper protection to these areas. The ponded area shall be kept continuously filled with water during the curing period.

viii) Surface coating type compounds shall be used only by special permission of Project Engineer , curing compounds shall be liquid type white pigmented. Other curing compounds shall be used on surfaces where future blending with concrete, water or acid proof membrane or painting is specified.

ix) All equipment and materials required for curing shall be on hand and ready for use before concrete is placed.

b) Protecting fresh concrete

Fresh concrete shall be protected from defacements and damage due to construction operation by leaving forms in place for an ample period as specified later in this specification. Newly placed concrete shall be protected by approved means such as tarpaulins from rain, sun and winds. Steps as approved by Project Engineer shall also be taken to protect immature concrete from damage by debris, excessive loading, vibration,

abrasion or contact with other materials etc. that may impair the strength and/or durability of the concrete. Workmen shall be warned against and prevented from disturbing green concrete during its setting period. If it is necessary that workmen enter the area of freshly placed concrete, Project Engineer may require that bridges be placed over the area.

c) Repair and replacement of unsatisfactory concrete

- i) Immediately after the shuttering is removed, the surface of concrete shall be very carefully inspected and all defective areas called to the attention of Project Engineer who may permit patching of the defective areas or also reject the concrete unit either partially or entirely. Rejected concrete shall be removed and replaced by contractor at no additional expense to owner. Holes left by

from bolts etc. shall be filled up and made good with mortar composed of one part of cement to one and half parts of sand passing 2.36mm IS sieve after removing any loose stones adhering to the concrete shall be finished as described under the particular items of work.

- ii) Superficial honey combed surfaces and rough patches shall be similarly made good immediately after removal of shuttering in the presence of Project Engineer and superficial water and air holes shall be filled in. The mortar shall be well worked into the surface with a wooden float. Excess water shall be avoided. Unless instructed otherwise by Project Engineer the surface of the exposed concrete placed against shuttering shall be rubbed down immediately on removal of shuttering to remove fine or other irregularities and necessary care being taken to avoid damage to the surface. Surface irregularities shall be removed by grinding.
- iii) If reinforcement is exposed or the honeycombing occurs at vulnerable positions e.g. ends of beams or columns it may be necessary to cut out the member completely or in part and reconstruct. The decision of Project Engineer shall be final in this regard. If only patching is necessary, the defective concrete shall be cut out till solid concrete is reached (or to a minimum depth of 25mm) the edges being cut perpendicular to the affected surface or with small under cut if possible.

Anchors, tees or dovetail slots shall be provided whenever necessary to attach the new concrete securely in place an area extending several centimeters beyond the edges and

the surfaces of the prepared voids shall be saturated with water for 24 hours immediately before the patching material is placed.

- iv) The use of epoxy for bonding fresh concrete used for repairs will be permitted upon written approval of Project Engineer . Epoxy shall be applied in strict accordance with the instructions of the manufacturer.
- v) Small size holes having surface dimensions about equal to the depth of the hole, holes left after removal of form bottom, grout insert holes and slots cut for repair of cracks shall be repaired as follows. The hole to be patched shall be roughened and thoroughly soaked with clean water until absorption stops.

A 5 mm thick layer of grout of equal parts of cement and sand shall be well brushed into the surface to be patched, followed immediately by the patching concrete which shall be well consolidated with a wooden float. The concrete

patch shall be built up in 10mm thick layers. After an hour or more, depending upon weather conditions, it shall be worked off flush with a wooden float and smooth finish obtained by wiping with hessian, a steel trowel shall be used for this purpose. The mix for patching shall be same material and in the same proportions as that used in the concrete being repaired, although some reduction in the maximum size of the coarse aggregates may be necessary and the mix shall be kept as dry as possible.

Mortar filling by air pressure (guniting) shall be used for repairing of areas too large and/or too shallow for patching with mortar. Patched surfaces shall be given a final treatment to match the color and texture of the surrounding concrete. While cement shall be substituted for ordinary cement, if so directed by Project Engineer , to match the shade of the patch with original concrete.

- vi) The patched area shall be covered immediately with an approved non-staining water saturated material such as gunny bag which shall be kept continuously wet and protected against sun and wind for a period of 24 hours. Thereafter the patched area shall be kept wet continuously by fine spray of sprinkling for not less than 10 days.

- vii) All materials, procedures and operations used in the repairing of concrete and also the finished repair work shall be subject to the approval of Project Engineer . All fillings shall be tightly bonded to the concrete and shall be sound, free from shrinkage cracks after the fillings have been cured and finished.

d) i) Finishing

The type of finish for formed concrete surface shall be follows, unless, otherwise specified by the Project Engineer .

For surfaces against which backfill or concrete is to be placed, no treatment is required except repairing of defective areas.

For surface below grade which will receive water proofing treatment the concrete shall be free of surface irregularities which would interfere with proper application of the waterproofing material which is specified for use.

Unless specified, surfaces which will be exposed when the structure is in service shall receive no special finish, except repairing of damage or defective concrete removal of fins and abrupt irregularities, fillings of holes left by form ties and rods and clean up of loose or adhering debris.

ii) Surfaces which will be exposed to the weather and which would normally be level, shall be sloped for drainage. Unless the drawing specifies such as stair treads, walls shall be sloped across the width approximately 1 in 30 broader surface such as walkways, roads, parking areas and platforms shall be sloped about 1 in 50. Surfaces that will be covered by backfill or concrete sub floors to be covered either concrete topping, terrazzo or quarry tile and similar surfaces shall be smooth screeded and leveled to produce even surfaces. Surface irregularities shall not exceed 6mm. Surfaces which will not be covered by backfill, concrete or tile topping's such as outside decks, floors of galleries and sumps, parapets, gutters, sidewalks floors and slabs shall be consolidated, screeded and floated. Excess water and laitance shall be removed before finishing. Floating may be done with hand or power tools and started as the screeded surface has attained a stiffness to permit finishing operation and these shall be the minimum required to produce a surface uniform in texture free from screed marks or other

imperfections. Joints edges, panels and forms linings shall be of uniform size and be as large as practicable and installed with closed joints. Upon removal of forms the joint marks shall be smoothed of and all blemishes, projections etc. removed leaving the surfaces reasonably smooth and unmarred.

iii) Integral cement concrete finish

When specified on the drawings and integral cement concrete finish of specified thickness for floors and slabs shall be applied either monolithic or bonded as specified on the drawing as per IS 2571-1970.

The surface shall be compacted and then floated with a wood float or power floating machine. The surface shall be tested with a straight edge and any high and low spots eliminated. Floating or trowelling of finish shall be permitted only after all surface water has evaporated. Dry cement or a mixture of dry cement

and sand shall not be sprinkled directly on the surface of the cement finish to absorb moisture or to stiffen the mix.

iv) Exposed concrete finish/rendering

A rubbed finish shall be provided only on exposed concrete surfaces as specified on the drawings. Upon removal of forms all fins and other projections on the surfaces shall be carefully removed, off-sets leveled and voids and damaged sections be immediately saturated with water and repaired by filling with a concrete or mortar of the same composition as was used in the surface.

Then surface shall be thoroughly wetted and rubbed with carborundum or other abrasive. Cement mortar may be used in the rubbing, but the finished surface shall be brush coated with either cement grout after rubbing. The finished surfaces shall present a uniform and smooth appearance.

Mode of Measurement

- i) The unit rate for concrete work under various categories shall be all inclusive except for steel reinforcement which will be measured separately and paid for under the relevant item and no claims for extra payment on account of such items as shuttering, scaffolding, centering, leaving holes, embedding inserts etc. shall be entertained unless separately provided for in the schedule of quantities. No extra claim shall also be entertained due to change in the number position and/or dimensions of holes slots or openings sleeves, inserts or on account of any increased lift or shuttering, scaffolding etc. All these factors should be taken into consideration while quoting the unit rates.
- ii) Payments of concrete will be made on the basis of unit quoted for the respective terms in the Schedule of Quantities. No deduction in the concrete quantity will be made for reinforcements, inserts etc. and opening less than 0.05 cum. where concrete is measured in cft/cum. Where no such deduction for concrete is made, payment for shuttering work provided for such holes, pockets etc. will not be made.
- iii) Payment for beams will be made for the quantity based on the depth being reckoned from the underside of the slabs and length measured as the clear distance between supports. Payment for columns shall be made for the quantity based on height reckoned up to the underside of slabs.

2.06 Providing and laying RCC of M 25 mix for structures up to plinth level.

The general specification is same as per item No.2.05 but for the mix of concrete.

2.07 Providing and laying RCC of M 30 mix for structures up to plinth level.

The general specification is same as per item No.2.05 but for the mix of concrete.

2.08 Providing and laying M 25 concrete in superstructure

The general specification is same as per item No.2.05.

2.09 Providing and laying M 30 concrete in superstructure

The general specification is same as per item No.2.05.

2.10 Deleted**2.11 Precast Concrete**

Precast concrete shall comply with IS 456-2000 and with the following requirements:

- a) All precast units shall be cast on suitable bed or platform with firm foundation and free from wind. Contractor shall be responsible for the accuracy of the level or shape of the bed or platform. A suitable serial number and the date of casting shall be impressed or painted on each unit.
- b) Side shutters shall not be struck ;in less than 24 hours after depositing concrete and no precast unit shall be lifted until the concrete reaches a strength of at least twice the stress to which the concrete may be subjected to at the time of lifting.
- c) The lifting and removal of precast units shall be under-taken without causing shock, vibration or undue bending stresses to or in the units. Before lifting and removal takes place contractor shall satisfy Project Engineer or his representative that the methods he proposes to adopt for these operations shall not over stress or otherwise affect seriously the strength of the precast units. The reinforced side of the units shall be distinctly marked.
- c) All precast work shall be protected from the direct rays of the sun for at least 7 days after casting and during that period each unit shall be kept constantly watered or preferably be completely immersed in water if the size of the unit so permits, otherwise curing practice as given in clause 20 shall be followed.
- e) Slots, openings or holes, pockets etc. shall be provided in the concrete work in the drawings or as directed by the Project Engineer . Any deviation from the approved drawings shall be made good by contractor at his own expense, without damaging any other work sleeves, bolts, inserts, etc. shall also be provided in concrete work where so specified.

2.12 Providing and erecting Formwork for structures up to plinth level

- a) The formwork shall consist of shores, bracings, sides of beams and columns, bottom of slabs etc. including ties anchors, hangers inserts etc. complete which shall be properly designed and planned for the work. False work shall be so constructed that necessary adjustment can be made to compensate for take up and settlements. Wedge may be used at the top or bottom of timber shores but not at both ends to facilitate vertical adjustment or dismantling of the formwork.

b) Design of formwork

The design of formwork as well as its construction shall be the responsibility of contractor. If so instructed, the drawings and/or calculation for the design for the form work shall be submitted to Project Engineer for approval before proceeding with work, at no extra cost. Project Engineer 's approval shall not however relieve contractor of the full responsibility for the design and construction of the formwork. The design shall take into account the entire load vertical and lateral that the forms will be carrying live and vibration loadings.

c) Type of formwork

Formwork may be of timber, plywood, metal or plastic or concrete. For special finishes the formwork may be lined with plywood, steel sheets, oil tempered hard board etc.

Sliding forms and slip forms may be used with the approval of Project Engineer .

d) Formwork requirements

- i) Forms shall conform to the shapes, lines, grades and dimensions including camber of the concrete as called for on the drawings. Ample struts, braces, ties, straps, etc. shall be used to hold the forms in proper position without any

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distortion what so ever until the concrete is set sufficiently to permit removal of forms. Forms shall be strong enough to permit the use of immersion vibrators. In special cases form vibrator may also be used. The shuttering shall be close boarded. Timber shall be well seasoned, free from sap, shakes, loose knots, wormholes, warps or other surface defects in contact with concrete. Faces coming in contact with the concrete shall be free from adhering grout, plaster, paint, projecting nails, splits or other defects. Joints shall be sufficiently tight to prevent loss of water or any fine material from concrete.

ii) Plywood shall be used for exposed concrete surfaces where called for. Sawn and wrought timber may be used for unexposed surfaces. Inside faces of forms for concrete surfaces which are to be rubbed finished shall be planed to remove irregularities or unevenness in the face. Formwork with lingings shall be permitted.

iii) All new and used form timber shall be maintained in a good condition with respect to shape, strength, rigidity, water tightness, smoothness and cleanliness of surfaces. Form timber unsatisfactory in any respect shall not used and if rejected by Project Engineer shall be removed from the site.

iv) Shores supporting successive members shall be placed directly over those below or be so designed and placed that the load will be transmitted directly to them. Trussed supports shall be provided for shores that cannot be secured on adequate foundations.

v) Formwork, during any stage of construction showing sings of distortion or distorted to such a degree that the intended concrete work will not conform to the exact contours indicated on the drawings, shall be repositioned and strengthened. Poured concrete affected by the faulty formwork, shall be removed completely and the formwork be corrected prior to placing of new concrete.

vi) Excessive construction camber to compensate for shrinkage, settlement may impair the structural strength of members and shall not be permitted.

v) Forms shall be so designed that their removal will not damage the concrete. Face formwork shall provide true vertical and horizontal joints, conform to the architectural features of the structure as to location of joints and be as directed by Project Engineer .

viii) Where exposed smooth or rendered concrete finishes are required the forms shall be constructed with special care so that the resulting concrete surfaces require a minimum finish.

e) Formwork for slope surfaces

i) Forms for sloped surfaces shall be built so that the formwork can be placed board-by-board immediately ahead of concrete placement so as to enable ready access for placement, vibration inspection and repair of the concrete.

ii) The formwork shall also be built so that the boards can be removed one by one from the bottom up as soon as the concrete has attained sufficient stiffness to prevent sagging. Surfaces of construction joints and finished surfaces with slopes steeper than 4 horizontal: 1 vertical shall be formed as required herein.

f) Formwork for curved surfaces

i) The contractor shall interpolate intermediate sections as necessary and shall construct the forms so that the curvature will be continuous between sections. Where necessary to meet requirements for curvature, the form timber shall be built up of laminated splices cut to make tight, smooth form surfaces.

ii) After the forms have been constructed, all surface imperfections shall be corrected and all surface irregularities at matching faces of form material shall be dressed to the specified curvature.

g) Formwork for exposed concrete surfaces

i) Where it is desired, directed as shown on the drawings to have original fair face finish of concrete surface without any rendering or plastering, formwork shall be carried out by using wood planks, plywood or steel plates of approved quality and as per direction of the Project Engineer .

ii) The contractor shall use one type of material for all such exposed concrete faces and the forms shall be constructed so as to produce uniform and consistent texture and pattern on the face of the concrete. Patches or forms for these surfaces will not be permitted. The formwork shall be placed so that all horizontal formworks are continuous across the entire surface.

iii) To achieve a finish which shall be free of board marks, the formwork shall be faced with plywood or equivalent material in large sheets. The sheets shall be arranged in an approved pattern. Wherever possible, joints between sheets shall be arranged to coincide with architectural features, sills, window heads or change in direction of the surface. All joints between shuttering plates or panels shall be vertical or horizontal unless otherwise directed. Suitable joints shall be provided between sheets. The joints shall be arranged and fitted so that no blemish or mark is imparted to the finished surfaces.

iv) To achieve a finish which shall give the rough appearance of concrete cast against sawn boards, formwork boards unless otherwise stated shall be of 150mm wide, securely jointed with tongue and grooved joints if required to prevent grout loss with tie rod positions and direction of boards carefully controlled. Sawn boards shall be set horizontally, vertically or at an inclination shown in the drawings. All bolt holes shall be accurately aligned horizontally and vertically and shall be filled with matching mortar recessed 5mm back from the surrounding concrete face.

v) Forms for exposed concrete surfaces shall be constructed with grade strips (the underside of which indicated top of pour) at horizontal construction joints, unless the use of groove strips is specified on the drawings. Such forms shall be removed and reset from lift to lift, they shall not be continuous from lift to lift. Sheeting of reset forms will not be spread and permit abruting regularizes or loss of mortar. Supplementary form ties shall be used as necessary to hold the reset forms tight against the concrete.

- vi) For fair faced concrete, the position of through bolts will be restricted and generally indicated on the drawings.
- vii) Chamfer strips shall be placed in the corners of forms for exposed exterior corners so as to produce 20mm bevelled edges except where otherwise shown in the drawings. Interior corners and edges at formed joints shall not be bevelled unless shown on the drawings. Mouldings for grooves, drip courses and bands shall be made in the form itself.
- viii) The wood planks, plywood and steel plates used in formwork for obtaining exposed surfaces shall not be used for more than 3 times in case of wood planks, 6 times for plywood and 10 times for steel plates respectively. However, no forms will be allowed for reuse, if in the opinion of the Project Engineer it is doubtful to produce desired texture of exposed concrete.
- ix) In order to obtain exposed concrete work of uniform color it shall be necessary to ensure that the sand used for all exposed concrete work shall be approved uniform color. Moreover the cement used in the concrete for any complete element shall be from single consignment.
- x) No exposed concrete surface shall be rendered or painted with cement or otherwise. Plastering of defective concrete as a means of achieving the required finish shall not be permitted, except in the case of minor porosity on surface, the Project Engineer may allow a surface treatment by rubbing down with cement and sand mortar of the same richness and color as for the concrete. This treatment shall be made immediately after removing the formwork.
- xi) The contractor shall also take all precautionary measures to prevent breaking and chipping of corners and edges of completed work until the building is handed over.

h) Bracings struts and props

i) Shuttering shall be braced, strutted, propped and so supported that it shall not deform under weight and pressure of the concrete and also due to the movement of men and other materials. Bamboos shall not be used as props or cross bearers.

ii) The shuttering for beams and slabs shall be so erected that the shuttering on the sides of the beams and under the soffit of slabs can be removed without disturbing the beam bottoms. Repropping of beams shall not be done except where props have to be reinstated to take care of construction loads anticipated to be in excess of shall be left open and built up in sections as placing of concrete from the sides to limit the drop of concrete to 3M or as directed by Project Engineer .

j) Mould Oil

Care shall be taken to see that the faces of form work coming in contact with concrete are perfectly cleaned and two coats of mould oil or any other approved material applied before fixing reinforcement and placing concrete. Such coating shall be insoluble in water, non-staining and not injurious to the concrete. It shall not become flaky or be removed by rain or wash water. Reinforcement and/or other items to be cast in the concrete shall not be placed until coating of the forms is complete; adjoining concrete surface shall also be protected against contamination from the coating material.

k) Chamfers and fillets

All corners and angles exposed in the finished structure shall be formed with moulding to form chamfers or fillets on the finished concrete. The standard dimension of chambers fillets unless otherwise specified shall be 20mm x 20mm. Care shall be exercised to ensure accurate mouldings. The diagonal face of the mouldings shall be planned or surfaced to the same texture as the forms to which it is attached.

l) Wire Ties

Wire ties passing through the walls shall not be allowed. In their place belts through sleeves be used.

m) Reuse of Forms

Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes that may leak suitably plugged and joints examined and when necessary, repaired and the inside retreated to prevent adhesion, to the satisfaction of Project Engineer . Warped timber shall be resized. Contractor shall equip himself with enough shuttering material to complete the job in the stipulated time.

Removal of Forms

i) Contractor shall record on the drawings and in a special register the date upon which the concrete is placed in each part of the work and the date of which the shuttering is removed there from. The contractor shall remove the shuttering after obtaining the approval of the Project Engineer .

ii) In no circumstances shall forms be struck until the concrete reaches a strength of at least twice the stress due to self weight and any construction/erection loading to which the concrete may be subjected at the time of striking formwork.

vi) In normal circumstances (generally where temperatures are above 20 Deg. Cent.) forms may be removed after expiry of the following periods:-

		Ordinary Portland cement concrete	Rapid hardening Portland cement concrete
a)	walls, columns & vertical sides of beams	24 to 48 hours directed by the Project Engineer	24 hours.
b)	Slabs left under	3 days	2 days
c)	Beam soffits props left under	7 days	4 days
d)	Removal of props to slabs:		
	i) Spanning upto 4.5 m	7 days	4 days
	ii) Spanning over 4.5 m	14 days	8 days

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e)	Removal of props to beams & arches		
	i) Spanning upto 6 m	14 days	8 days
	ii)Spanning over 6 m	21 days	12 days

iv) Striking shall be done slowly with utmost care to avoid damage to arises and projections and without shock or vibration, by gently easing the wedges. If after removing the formwork, it is found that timber has been embedded in the concrete, it shall be removed and made good as specified earlier.

v) Reinforced temporary openings shall be provided as directed by Project Engineer to facilitate removal of formwork which otherwise may be inaccessible.

vi) Tie rods, clamps, form bolts, etc. which must be entirely removed from walls or similar structures shall be loosened not sooner than 24 hours nor later than 40 hours after the concrete has been deposited. Ties, except those required to hold forms in place, may be removed at the same time.

Ties, withdrawn from walls and grade beams shall be pulled towards the inside face cutting ties back from the faces of walls and grade beams will not be permitted.

vii) For liquid retaining structures no sleeves for through bolts shall be used nor shall through bolts be removed as indicated above. The bolts, in this case, shall be cut at 25mm depth from the surface and then the hole shall be made good by sand, cement mortar of the same proportions as the concrete just after striking the formwork.

Mode of Measurement

It shall not be measured separately. Rates for concrete/RCC works should include the cost of shuttering as detailed in each item description. The rates shall also include providing and erecting formwork in position as per drawings, applying oil, removal of form after the specified period etc.

2.13 Providing and erecting formwork for structures in super- structure.

The general specification is same as per item No.2.11.

2.14 Supplying and mixing waterproofing compound

The waterproofing compound to be refer make list. It shall be added to cement concrete or cement mortar as instructed by the Project Engineer. The proportion of the compound to be added shall be as per the manufacturer's specifications.

Mode of measurement

The quantity of compound added shall be measured and paid for. The unit shall be as specified in the item specification.

2.15 Providing, fabricating and placing in position reinforcement steel

The quality of the steel shall be as mentioned in the materials section. The bars shall be fabricated as per the drawings. Laps and splices for reinforcement shall be as shown on the drawings. Splices in adjacent bars shall be approved by Project Engineer . The bars shall not be lapped unless the length required exceeds the maximum available lengths of bars at site.

Bending

a) Reinforcing bars supplied bent or in coils, shall be straightened before they are cut to size. Straightening of bars shall be done in cold and without damaging the bars. This is considered as a part of reinforcement bending fabricating work.

b) All bars shall be accurately bent according to the sizes and shapes shown on the detailed working drawings/bar bending schedules. They shall be bent gradually by machine or other approved means. Reinforcing bars shall not be straightened and rebent in a manner that will injure the material, bars containing cracks or splits shall be rejected. They shall be bent cold, except bars of over 32mm in diameter which may be bent hot if specifically approved by the Project Engineer . Bars bent hot shall not be heated beyond cherry red color (not exceeding 845 deg. c) and after bending shall be allowed to cool slowly without quenching. Bars incorrectly bent shall be used only if

the means used for straightening and rebending shall not injure the material. No reinforcement shall be bent when in position in the work without approval whether or not it is partially embedded in hardened concrete. Bars having kinks or bends other than those required by design shall not be used.

Fixing

Reinforcement shall be accurately fixed by any approved means and maintained in the correct position shown in the drawings by the use of block, spacers and chairs as per IS 2502 to prevent displacement during placing and compaction of concrete. Bars intended to be in contact at crossing points shall be strongly bound together at all such points with two No.16 gauge an-healed soft iron wire. The vertical distance required between successive layers of bar in beams or other members shall be maintained by providing of mild steel spacer bars at such intervals that the main bars do not perceptibly sag between adjacent spacer bars.

Cover

- a) Unless indicated otherwise on the drawings, clear concrete cover for reinforcement (exclusive of plaster or other decorative finish) shall be as follows:
- i) At each end of reinforcing bar, not less than 25mm nor less than twice the diameter of the bar whichever is less.
 - ii) For a longitudinal reinforcing bar in a column, not less than 40mm, nor less than the diameter of the bar. In case of columns of minimum dimensions of 20 cm or under, with reinforcing bars of 12mm and less in diameter, a cover of 25mm may be used.
 - iii) For longitudinal reinforcing bars in a beam 25mm nor less than the diameter of the bar.
 - iv) For tensile, compressive, shear, or other reinforcement in a slab or wall not less than 12mm or less than the diameter of such reinforcement.
 - v) For any other reinforcement not less than 12mm nor less than the diameter of such reinforcement.

vi) For footings and other principal structural members in which the concrete is deposited directly against the ground, cover to the bottom reinforcement shall be 75mm. If concrete is poured on a layer of lean concrete the bottom cover may be reduced to 50 mm.

vii) For concrete surfaces exposed to the weather or the ground after removal of forms, such as retaining walls, footing sides and top etc. not less than 50mm for bars larger than 16mm dia and not less than 40mm for bars 16mm dia or smaller.

viii) Increased cover thickness shall be provided, as indicated on the drawings, for surfaces exposed to the action of harmful chemicals (or exposed to earth contaminated by such chemical, acid, alkali, saline atmosphere, sulphurous smoke etc.,

ix) For reinforced concrete members totally or periodically immersed in sea water or subject spray, the cover of concrete shall be 50mm more than those specified in (i) to (v) above.

x) For liquid retaining structures the minimum cover to all steel shall be 40mm or the diameter of the main bars, whichever is greater. In the presence of sea water and soils and waters of a corrosive character the cover shall be increased by 10mm.

xi) Protection to reinforcement in case of concrete exposed to harmful surroundings may also be given by providing a dense impermeable concrete with approved protective coatings, as specified by the Project Engineer .

xii) The correct cover shall be maintained by cement mortar cover blocks. Reinforcement for footings, beams and slabs on sub-grade shall be supported on precast concrete blocks as approved by engineer. The use of pebbles or stones shall not be permitted.

Inspection

Erected and secured reinforcement shall be inspected, jointly measured and recorded and approved by Project Engineer prior to placement of concrete.

Mode of Measurement

TECHNICAL SPECIFICATIONS

Lengths of reinforcement steel shall be measured to the nearest centimetre. Spacers and chairs shall be measured and converted to weight using IS coefficients. The actual quantity of steel embedded in concrete as calculated and approved by Engineer, irrespective of the level or the height at which the work is done shall be taken. The unit rate for reinforcement shall include all wastages, binding wire, etc. for which no separate payment shall be made. Laps as shown in drawings or as approved by Project Engineer and minimum number of chairs and spacer bars required to keep the reinforcement in position shall be paid for. The cost of this quantity of steel plus wastage as specified in clause 5.0- of section VI shall be recovered at issue rate from the contractor, if the supplies are made by the clients.

2.16 Providing and laying RCC M30 in flooring, slab on ground.

Technical specification and mode of measurement are as that of item No. 2.05.

SECTION - 3.00 - MASONRY WORKS

Applicable codes and specifications

TECHNICAL SPECIFICATIONS

- a) The following codes, standards and specifications are made a part of this specification. All standards, tentative specifications, codes of practices referred to herein shall be the latest edition including all applicable official amendments and revisions.

IS 13757: 1993-	Burnt Clay Fly Ash Building Bricks - Specification
IS:1077-1992 -	Common burnt clay building bricks.
IS:3102-1965 -	Classification of burnt clay bricks.
IS:2180-1977 -	Burnt clay building bricks, heavy duty.
IS:3495-1922 -	Method of sampling and testing clay building bricks
IS:2691-1988 -	Burnt clay facing bricks.
IS:2221-1962 -	Code of practice for brick work.
IS:2185-2005 -	Load bearing hollow concrete blocks.
IS:5498-2005 -	Lime-cement-cinder hollow concrete blocks.
IS:3115-1992 -	Lime-cement cinder solid blocks.
IS:1597-1992 -	Code of practice for construction of stone masonry (Part I).

- 3.01 Providing and constructing brick masonry in CM in foundation and up to plinth level

- a) Bricks used in works shall be bricks of specified crushing strength as described in the Schedule of Quantities. They shall have the following general properties:

They shall be sound, hard, homogenous in texture, well- burnt in kiln without being verified, table moulded, deep red, cherry or copper colored, of regular shape and size shall have sharp and square edges and parallel faces. The bricks shall be free from pores, chips, flaws or humps of any kind. Bricks containing un ground particles and which absorb water more than 1/5th of their weight when soaked in water for twentyfour hours shall be rejected. Overburnt or under burnt bricks shall be liable to rejection. These bricks shall give a clear ringing sound when struck.

TECHNICAL SPECIFICATIONS

- b) Samples of bricks shall be submitted before starting the brickwork to the Project Engineer for approval. Bricks supplied shall conform to these approved samples. Brick sample shall be got tested as per IS: 3495-1992 by contractor at no extra cost. Bricks rejected by Project Engineer shall be removed from the site of works within 24 hours.

c)Mortar

- i) Mix for cement mortar shall be as specified in the respective items of work. Gauge boxes for sand shall be of such dimensions that one complete bag of cement containing 50kgs. of cement forms one unit. The sand shall be free from clay shale, loam, alkali and organic matter and of sound, hard, clean and durable particles. Sand shall be approved by the Project Engineer. If so directed by the Project Engineer sand shall be thoroughly washed till it is free of any contamination.
- ii) For preparing cement mortar the ingredients shall first be mixed thoroughly in dry condition. Water shall then be added and mixing continued to give a uniform mix of required consistency. Cement mortar shall preferably be machine mixed, through mixing in a thorough manner may be allowed. The mortar so mixed shall be used within 30 minutes of mixing. Mortar left unused in the specified period shall be rejected.
- iii) The contractor shall arrange for test on mortar samples if so directed by the Project Engineer re tempering of mortar shall not be permitted.

d) Workmanship

- i) All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. The cement mortar for brick masonry work shall be as specified in the respective item of work. Brick work 230mm thick and over shall be laid in English bond unless otherwise specified. While laying bricks shall be pressed into the mortar and shoved into final position so as to embed the brick fully in mortar. Brick shall be laid with frogs uppermost.

TECHNICAL SPECIFICATIONS

- ii) All brick work shall be plumb, square and true to dimensions. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal courses shall be leveled. The thickness of brick courses shall be kept uniform. For walls of thickness greater than 230mm both faces shall be kept in vertical planes. No broken bricks shall be used except as closers. Care shall be taken that the bricks forming the top corners and ends of the wall shall be properly radiated and keyed into position. Holes kept in masonry for scaffolding shall be closed before plastering. All interconnected brickwork shall be carried out at nearly one level (so that there is uniform distribution of pressure on the supporting structure) and no portion of the work shall be left more than one course lower than the adjacent work where this is not possible, the work shall be raked back accordingly to bond (and not saw toothed) at an angle not exceeding 45 deg.
- iii) Bricks shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6mm and not more than 10mm. The face joint shall be raked to a minimum depth of 12mm by raking tools daily during the progress of work when the mortar is still green so as to provide a proper key for the plaster or pointing to be done. Where plastering or pointing is not required to be done the joints shall be uniform in thickness and be struck flush and finished at the time of laying. The face of brickwork shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top. If the mortar in the lower course has begun to set the joints shall be raked out to a depth of 12mm before another course is laid.
- iv) All brick work shall be built tightly against columns, floor slabs or other structural member.
- v) Where drawings indicate that structural steel columns are to be fireproofed with brick work the brick shall be built closely against all flanges and webs with all spaces between the steel and bricks works filled solid with mortar. Steel members partly embedded in brickwork and not indicated to be fireproofed with concrete shall be covered with not less than 12mm thick mortar unless directed otherwise by Project Engineer .

TECHNICAL SPECIFICATIONS

- vi) The work shall be cured for 15 days.
- e) Miscellaneous inserts in masonry e.g. sleeves, wall ties, anchors, conduits, structural sheet, steel lintels etc. shall be installed by the contractor. Furnishing fixing of any of these inserts by the contractor will be paid for separately under steel work. Openings, arches, etc. shall be provided as shown on the drawings chases, pockets etc. shall be provided as shown on the drawings to receive rain water pipes etc. Wall ties and flashings shall be built into the brickwork in accordance with the drawings and specifications.
- f) Mode of measurement
- i) Brick work of thickness one brick i.e. 230mm and above shall be paid in units of M.CUBE.

In all cases, the quantities measured shall be executed after making necessary deductions for openings etc. as given below:-

No deductions shall be done for openings up to 1000 Sq.cm, ends of dissimilar materials, drainage holes, window/door holdfasts, concrete lintel bearings, landing slab bearings, beam bearing, chimney flues, cutouts, iron fixtures, pipes upto 30 cm dia.

- ii) It shall be clearly understood that the rates quoted by the contractor include leaving openings, cutting chases in brickwork as per drawings/instructions of the Project Engineer .
 - iii) The rate includes necessary single or double scaffolding, centering, soaking of bricks, raking out joints and curing the work all complete.
- 3.02 Providing and brick work in CM in superstructure at all levels

The general specification is same as per item No.3.01

TECHNICAL SPECIFICATIONS

- 3.03 Providing and constructing 115mm brick masonry in partition for superstructure in CM

The bricks shall be laid with stretchers. The proportion of the mortar shall be as specified in the item description. The quality of the bricks shall be as specified in the item 3.01. The bricks shall be well soaked in water before using them. The brick work shall be plumb and square. Two Nos. of 6mm dia MS bars or 25mm x 1.2mm deep iron band kept at every third course or as specified of 115mm thick brick work. This shall be provided by the contractor.

Mode of Measurement

The brick work shall be measured in M.SQ. The deductions shall be as specified in the item 3.01. The rate includes necessary single or double scaffolding, centering, soaking of bricks, providing and placing of 2 Nos. of 6mm dia MS bars or 25mm x 1.2mm deep iron band raking out joints and curing the work all complete.

SECTION - 4.00

GI DOORS AND UPVC JOINERIESsss

Applicable Codes

IS: 4351-2003 - Steel Door Frames — Specification.

IS: 2202-1999 - Specification For Steel Doors, Windows And Ventilators

IS 17953 : 2023 - uPVC Profiles for Windows and Doors — Specification

Type tests.

IS: 1761-1960 - Transparent sheet glass for glazing and framing
Purposes.

IS: 3097-006 - Specification for veneered particle boards (Exterior

Grade).

4.01 Providing & Fixing **Galvanized Iron Main Doors**

Door frame shall be of size 100mm x 58mm of 18 SWG, with required rebate of 50mm using GI plates bent to shape with bottom frame in SS. Doors shall be of 48mm thick with GI plates of 22 SWG on both sides infilled with honeycomb structure for stiffness. The door shall be provided with mortice lock, SS handles (D shape), SS Tower bolts of approved make. The door shall be connected with the frame with 4 numbers of SS Butt hinges. The main door shall have view lens with cover. The door frame and door shall be provided with powder coat of thickness 60-65 microns (DFT) finished with necessary base coat, of any of the selected colors such as sun teak/lava teak/Burgundy teak/trunk mahogany/ nest mahogany etc., as per architectural drawings and approval from the architect.

Mode of Measurement

It shall be measured in Sq.m. the rate shall include providing and fixing of pressed steel frame as per above specifications.

4.02 Providing & Fixing Galvanized Iron Inner Doors:

Door frame shall be of size 100mm x 58mm of 18 SWG, with required rebate of 50mm using GI plates bent to shape. ssDoors shall be of 48mm thick with GI plates of 22 SWG on both sides infilled with honeycomb structure for stiffness. The door shall be provided with mortice lock with single bullet normal latch, SS Tower bolts of approved make. The door shall be connected with the frame with 4 numbers of SS Butt hinges. The door frame and door shall be provided with powder coat of thickness 60-65 microns (DFT) finished with necessary base coat, of any of the selected colors such as sun teak/lava teak/Burgundy teak/trunk

mahogany/ nest mahogany etc., as per architectural drawings and approval from the architect.

Mode of Measurement

It shall be measured in Sq.m. the rate shall include providing and fixing of pressed steel frame as per above specifications.

4.03 Providing & Fixing FRP Doors Doors:

Door frame shall be of size 95mm x 65mm, of 2mm thick laminate filled with suitable wooden block, and covered with fibre glass mat all sides with required rebate to receive 30mm thick PVC door shutter using fire resistant grade unsaturated polyester resin and chopped main Doors shutter shall be of 30 mm thick FRP Panel made with fire resistant grade unsaturated polyester resin, moulded to 3mm thick FRP laminate for forming hollow rails and styles, with wooden frame and suitable blocks of seasoned wood inside at required places for fixing of fittings, cast monolithically with 5mm thick FRP laminate. The shutters shall have necessary fittings such as baby latch, tower bolts and hinges made of SS. The size and color of the FRP doors shall be as per Architectural detailed drawings and as directed by the Engineer in charge/Architect.

Mode of Measurement

It shall be measured in Sq.m. the rate shall include providing and fixing of pressed steel frame as per above specifications.

4.04 Providing & Fixing Galvanized Iron Balcony Doors:

Door frame shall be of size 100mm x 58mm of 18 SWG, with required rebate of 50mm using GI plates bent to shape with bottom frame in SS. Doors shall be of 48mm thick with GI plates of 22 SWG on both sides infilled with honeycomb structure for stiffness. The door shall be provided with mortice lock with single bullet normal latch, SS Tower bolts of approved make. The door shall be

connected with the frame with 4 numbers of SS Butt hinges. The door frame and door shall be provided with powder coat of thickness 60-65 microns (DFT) finished with necessary base coat, of any of the selected colors such as sun teak/lava teak/Burgundy teak/trunk mahogany/ nest mahogany etc., as per architectural drawings and approval from the architect.

Mode of Measurement

It shall be measured in Sq.m. the rate shall include providing and fixing of pressed steel frame as per above specifications.

4.05 Providing & Fixing UPVC windows (Sliding):

All UPVC windows shall be made of pure virgin UPVC materials of a defined formulation as per IS 17953-2023. The section shall be free from degradation, UV resistant and each profile shall be marked with standard mark. The mechanical properties of such materials shall be as per IS 13360. The frame shall be of 2.5 track to receive two sliding glass shutters with one SS wire mesh shutter. The size of the frame shall be of 88mm x 50mm with profile thickness of 2.5mm with 1.2mm G.I. reinforcement to receive the fixtures. The shutters shall be of 60mm SASH with 1.2mm G.I. reinforcement. The glass shall be of 5mm thickness plain or as directed by the architect.

Mode of Measurement

It shall be measured in Sq.m. the rate shall include providing and fixing of pressed steel frame as per above specifications.

4.06 Providing & Fixing UPVC windows (Openable):

All UPVC windows shall be made of pure virgin UPVC materials of a defined formulation as per IS 17953-2023. The section shall be free from degradation, UV resistant and each profile shall be marked with standard mark. The mechanical properties of such materials shall be as per IS 13360. The size of the frame shall be of 88mm x 50mm with profile thickness of 2.5mm with 1.2mm G.I.

reinforcement to receive the fixtures. The shutters shall be of 60mm SASH with 1.2mm G.I. reinforcement. The glass shall be of 5mm thickness plain or as directed by the architect.

Mode of Measurement

It shall be measured in Sq.m. the rate shall include providing and fixing of pressed steel frame as per above specifications.

4.07 Providing & Fixing UPVC Ventilators with exhaust fan frame:

All UPVC ventilators shall be made of pure virgin UPVC materials of a defined formulation as per IS 17953-2023. The section shall be free from degradation, UV resistant and each profile shall be marked with standard mark. The mechanical properties of such materials shall be as per IS 13360. The size of the frame shall be of 88mm x 50mm with profile thickness of 2.5mm. The louvers shall be of auto louvers of spacing as per architectural drawings. The glass shall be of 5mm thickness pin headed or as directed by the architect.

Mode of Measurement

It shall be measured in Sq.m. the rate shall include providing and fixing of pressed steel frame as per above specifications.

4.08 Supplying & Fixing Terracotta jolly

Square shaped terracotta jolly of glossy finishing in natural terracotta material of size and color as per Architectural detailed drawings having min dimension on 200mm x200mm x 65 mm (each weight minimum 2.5 kg) laid in position using proper bonding adhesive and sealants of matching color. Chipped, damaged, cracked terracotta jolly should be avoided. The exact size and detailing complete shall be as per the direction of Architect/engineer in charge.

Mode of Measurement

It shall be measured in Sq.m. the rate shall include providing and fixing of pressed steel frame as per above specifications.

4.09 Providing & Fixing Window Grills

Window grills shall be of Mild steel grills of Grade 250 mPa for all window and Ventilator openings. Grills shall be made using 12mm unpolished square rods as per the architectural drawings. The welding shall be of flash butt welding or any other suitable method, which gives the desired results. All the steel surfaces shall be thoroughly cleaned free of rust, dirt, oil, etc.

Mode of Measurement

It shall be measured in Kg. the rate shall include providing and fixing of pressed steel frame as per above specifications.

4.10 Providing & Fixing Head room M.S. Doors:

Door frame shall be of ISA 50x50x6 mm angles with required holdfast at two locations on either side. The shutter frame shall be made with 40mm x 40mm sq. pipe of 2mm thick infills with M.S.sheet of 2mm thickness as per the architectural drawings.

Mode of Measurement

It shall be measured in Sq.m. the rate shall include providing and fixing of pressed steel frame as per above specifications.

4.11 Providing & Fixing M.S Grill Mild steel door for gas room:

Door frame shall be of ISA 40x40x6 mm angles with required holdfast at two locations on either side. The shutter frame shall be made with ISA 25mm x 25mm x 3mm angles with M.S. welded mesh of 25mm sq. with 2mm rods. In

addition to this the shutters shall be provided with SS mesh as per gas room standards and as per the architectural drawings.

Mode of Measurement

It shall be measured in Sq.m. the rate shall include providing and fixing of pressed steel frame as per above specifications.

4.12 Providing & Fixing Fire rated Door:

Providing and fixing Fire rated Door as per Architectural detailed drawings (panel room) specifications. Door leaves: 22 swg (or) 0.7mm thick skin pass galvanized iron sheet with honeycomb kraft paper infill door frame: 18 swg thick skin pass galvanized iron sheet formed to single rebate profile of size and directions made to design and fixed in the masonry with screws as per standard procedure with louvers of 25% area for ventilation, including providing and fixing the patched fittings, etc., complete.

Mode of Measurement

It shall be measured in Sq.m. the rate shall include providing and fixing of pressed steel frame as per above specifications.

4.13 Providing and Fixing Rolling Shutters

geared - manually and motorized Rolling shutter of approved make and type fabricated with 18 gauge section M.S Flats with galvanized pressed steel side guides of one piece construction including providing the grill in the middle of rolling shutter of 1.50m high of design and shape as per architectural drawings pressed steel bottom rail with interlocking arrangement for steel laths, brackets extra strong door suspension pipe shaft with high tension coil type spring made out of spring steel wire, locking arrangement, holdfast, handles, MS cover hood on top necessary accessories and fixing etc. Inclusive of Safety lever locks mild steel with 4 levers and Ball Bearing provide .complete in all respect.

Mode of Measurement

TECHNICAL SPECIFICATIONS

The rates quoted shall be inclusive of providing and fixing of rolling shutter with push and pull arrangement, a coat of approved primer. Fixing lugs to be provided to guide channel to suit actual site conditions or as directed by the Project Engineer at no extra cost. The mechanical arrangement provided for the opening and the closing of the shutter shall be paid for separately in sq.m/sq.ft of the shutter area as specified in the item description.

4.14 Providing and Fixing MS Gate

It shall be as per the drawing. The welding shall be perfect and the junctions shall be ground properly. The gate shall be provided with locking arrangements, hinges and it shall be painted with one coat of primer.

Mode of Measurement

It shall be measured as specified in the item description.

4.15 Providing and Fixing MS Door Frame

It shall be fabricated from structural steel as per the details and drawings. All the members shall be free from rust, flakes, cracks and other fabrication defects. All holes for hinges, bolts, locking plates, etc. shall be provided as per drawings/instructed. The welding shall be smooth. The frame shall be erected and fixed with MS holdfasts of specified size and grouted with cement concrete 1:2:4 (1 Cement : 2 Sand : 4 graded coarse aggregate of nominal size 12mm and down). The frame shall be painted with a coat of primer before erection.

Mode of Measurement

The rate shall include fabrication, erection and painting of the frame. The measurement shall be as specified in the item description.

4.16 Providing and Fixing MS Sheet Door

The frame shall be of MS as specified above. The door shall be as per the Architect's design. The specified gauge MS sheet door shall be welded to the frame. It should have 3 to 6 hinges depending on the shutter size. It shall have fittings as specified in the item/Architect's drawings. The door shall be applied with a coat of primer and 2 coats of synthetic enamel paint of quality as specified.

Mode of Measurement

This shall be measured in sq.m/sq.ft. If the frames are not included in the item then only the shutter area shall be measured and paid for. The rate shall include fabrication, provision, erection of the door, necessary fittings as specified, painting etc. all complete.

4.17. Supply and Fixing of Fiber Manhole: -

Supply and fixing of Fiber Manhole cover-2'0"X2'0", to support 10-ton wheel load over the Plumbing chamfers. Minimum weight of manhole cover=70Kg.Setting in cement mortar 1:3 and launching with cement concrete 1:1.5:3 type B-I cast iron manhole covers and frames, light duty, any type and size as per the architectural drawing. The rate shall be including the fixing of manhole.

Codes: -

Standard designs confirming to IS 1726-1991 are 2.5,10,20,35 Tons.

Mode of Measurement

It shall be measured in NOS.

4.18. Supply and Fixing of Cast Iron Manhole: -

Supply and fixing of Cast Iron Manhole cover-2'6"X2'6", to support 10-ton wheel load over the STP. Minimum weight of manhole cover slab=100Kg.Setting in

cement mortar 1:3 and flaunching with cement concrete 1:1.5:3 type B-I cast iron manhole covers and frames, light duty, any type and size as per the architectural drawing.

Codes: -

Standard designs confirming to IS 1726-1991 are 2.5,10,20,35 Tons.

Mode of Measurement

It shall be measured in NOS.

4.19. GI Manhole cover: -

Supply and fixing of GI Manhole cover-2'6"X2'6", to support 10-ton wheel load over the STP. minimum weight of manhole cover slab=100Kg.Setting in cement mortar 1:3 and flaunching with cement concrete 1:1.5:3 type B-I GI manhole covers and frames, light duty, any type and size as per the architectural drawing.

Codes: -

Standard designs confirming to IS 1726-1991 are 2.5,10,20,35 Tons.

Mode of Measurement

It shall be measured in NOS.

4.20 Providing and Fixing PVC designer(cupboard) door:-

Providing and Fixing of 25mm thk PVC designer(cupboard) door, with 15mm celuka sheet coated(pasted) with 5mm prelam Pvc sheet at both sides and provided with 15mm Square G.I pipe at edges. bed rooms with PVC frames and magnetic locks, SS hinges and all necessary fittings. complete all as per Architectural drawing and as directed by the Engineer in charge.

Thickness: PVC doors can come in a thickness of 25mm,

Material: PVC stands for polyvinyl chloride, a material that contains a plasticizer to make it soft and flexible.

Surface treatment: PVC doors can have a PVC membrane surface treatment.

Base material: PVC doors can be made with a base material like melamine board E1/E2 grade.

Opening style: PVC doors can have a swing opening style.

Surface type: PVC doors can have a surface type like matt, light, high glossy, sparkle sliver, or wood grain.

Accessories: PVC doors can come with accessories like handles and knobs.

Mode of measurement: -

It shall be measured in M.SQ. The rate quoted shall be valid for all levels.

4.21 Providing and Fixing Merino armour façade cladding system: -

Providing and fixing of Merino armour façade cladding system using (50.80MM X 25.40MM X1.20 MM)0.478 kg/along with 6mm thick armour wooden finish inclusive of Aluminum rivets, ficher anchors, necessary hardware's. member shall be fixed into masonry walls/rcc members and including all necessary fittings, complete all as per Architectural drawing and as directed by the Engineer in charge.

Installing laminate wall panels is a relatively straightforward process that can be completed by DIY enthusiasts or professionals. Here are the general steps to install laminate wall panels:

Clean, dry, and free of any debris or old wall coverings

Measure and Cut Panels

Click-and-lock the panels

Trim any excess material

Available size of (50.80MM X 25.40MM X1.20 MM),the Wooden Plain Finish and Wooden Texture Finish, our cladding comes in a thickness as per BoQ mention. The Merino HPL Sheets Armour External Wall Cladding is a versatile and durable product to use.

Mode of measurement: -

It shall be measured in M.SQ. The rate quoted shall be valid for all levels.

4.22 Supplying and Fixing Plinth Protection: -

Supply and fixing of kerb stone for the outer line of plinth protection. The kerb stone(1'0"x3"x1'6") should be placed on the PCC bed of M10 grade of 1'0" wide 3" thick, with the gap of approximately 10mm between each stone. The stone should be levelled and secured in place with additional CM 1:4 inside as required, with required backfilling and compacting around kerbstone using gravel. Any gap between the kerb stones shall be again filled with CM of 1:4. Size of the kerb stone shall be 3"thick and a height of 1'6" and complete as directed by the engineer in charge. The rate shall be inclusive of PCC bed.

Mode of measurement: -

It shall be measured in RUM.

4.23 Supplying and Fixing Laying slab : -

TECHNICAL SPECIFICATIONS

Supply and laying of RCC M20 grade Precast Slab of size 1'6"X1'6"X3" height for plinth protection. The slabs shall be laid over well compacted gravel bed at FGL with suitable pointing at the joints. The rate shall include required earth cutting, levelling, compaction of earth with earth Rammer all included as directed by the engineer in charge.

Mode of measurement: -

It shall be measured in SQM.

SECTION - 5.00 - FINISHING WORKS

Applicable Codes

IS: 2394:1984 - Code of practice for application of lime plaster finish.

IS: 1477:1971 - Code of practice for painting of ferrous metals in buildings and allied finishes (Part I & III).

IS: 427:2005 - Distemper, dry color as required.

IS: 2395:1994 - Code of practice for painting concrete, masonry and plaster surfaces.

IS: 428:2000 - Distemper, oil emulsion, color as required.

5.01. Providing and Applying Cement Plaster

Prepare surface and plaster ceiling/soffits of roof slab/beams, beam sides, Loft and sunshades etc., with 6mm - 10mm thick cement mortar (1:3) including hacking, scaffolding, curing, making grooves, patties, at all levels and all heights (Ground, First, second and Headroom) etc., complete.

Prepare surface and plaster internal walls / columns/ brick masonry / block masonry/intermediate concrete members etc. with 12mm tk in cement mortar (1:4). The rate shall include the making grooves, patties, scaffolding and curing at all levels and all heights (Ground, First, second and Headroom), etc., All the RCC element and wall junction shall be provided with GI mesh for about 22 gauge (0.93 mm) hexagonal type with 150mm wide properly nailed at concrete and wall before plastering.

The surface to be plastered shall be washed with fresh clean water free from all dirt, loose material, grease etc. and thoroughly wetted 6 hours before plastering work is commenced. Concrete surfaces to be plastered will however be kept dry.

The wall should not be too wet but only damp at the time of plastering the damping shall be uniform to get uniform bond between the plaster and the wall. The junction between the brick work and RCC should be fixed with chicken wire mesh/PVC strip as directed before plaster.

The proportion of the mortar shall be as specified under the respective items of work. Cement shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water, sand and cement shall be as mentioned in the specifications for concrete and allied works. The mortar thus mixed shall be used immediately and in no case shall the mortar be allowed to stand for more than 30 minutes after mixing with water. The plaster shall be laid in a single coat. The mortar shall be splashed on the prepared surface with a trowel and finished smooth by trowelling. The plastered surface shall be rubbed with iron plate till the surface shows cement

paste. The work shall be in line and level. Curing of plaster shall be started as soon

as the applied plaster has hardened enough so as not to be damaged. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days.

The plaster shall be carried out on jambs, lintel and sill faces top and undersides, etc. as shown in the drawing or as directed by the engineer.

Mode of Measurement

- a) The quantity of work to be paid for under this item shall be calculated by taking the projected surface of the area plastered after making necessary deductions for openings, doors, windows etc. as given below:-
 - i) No deductions shall be made for opening or end steel joints, beams, post girders etc. upto 0.5sq.m area. No addition shall be made for joints, soffits and sills of such openings. This is applicable to both the sides of the wall.
 - ii) Where openings exceeds 0.5 Sq.m but does not exceed 3 sq.m and also when only one side of the wall is treated and other side is not treated, deduction shall be made if the width of the reveal on the treated sides is less than that on the untreated side but if the width of the reveal is more than no deduction nor addition shall be made for reveals for jambs, soffits, sills etc.
 - iii) For openings more than 0.5 sq.m but not exceeding 3sq.m and also when both the sides of the wall is plastered with the similar plaster, deduction shall be made for one face only. But when both the sides treated with different plaster, then deduction shall made from the side on which the reveal is less and no deduction on the other side.
 - iv) For openings whose respective areas exceed 3 sq.m deduction shall be made for the full opening of the wall treatment on both faces while at the same time jambs, sills and soffits shall be measured in sq.m/sq.ft for payment. In

measuring the jambs deduction shall not be made for the area in contact with the frames of doors, windows etc.

- v) If the average thickness of the plaster is more than the specified thickness due to any account nothing extra shall be paid for the same.
- vi) Nothing extra shall be paid for double scaffolding and the rate is applicable for work at levels as specified in each item description.

5.02 Providing and Applying Cement Plaster 20 mm thick.

Prepare surface & sponge plaster to external walls / columns/ brick masonry / block masonry /intermediate concrete members etc. with 20mm tk in cement mortar (1:4). The rate shall include the making grooves, patties, scaffolding and curing at all levels and all heights (Ground,First,second and Headroom) etc., complete at all levels. All the RCC element and wall junction shall be provided with GI mesh for about 22 gauge (0.93 mm) hexagonal type with 150mm wide properly nailed at concrete and wall before plastering.

The general specification is same as item 5.01 but for the thickness of the plaster. The plaster work shall be carried out in 2 layers, the first layer being 12-14mm thick and second layer being 6 - 7mm thick. The proportions of the mortar for both the layers shall be as specified in the item specification. The first layer shall be splashed against the prepared surface with the trowel to obtain an even surface. The second layer shall then be applied and finished leaving an even and uniform surface, trowel finished unless otherwise directed by the Project Engineer. The plastered surface shall be rubbed with the iron plate till the cement paste comes on the surface.

Mode of Measurement

It is same as specified in item 5.01.

5.03 Providing and Applying Rough Cast Plaster.

TECHNICAL SPECIFICATIONS

This shall be carried out in two layers. The base plaster shall be of 12mm thick and of specified proportion of CM. It shall be roughened to receive the top layer. The top layer shall be 7mm thick. It shall be of 3 parts cement, 6 parts coarse sand and 4 parts of 6mm to 10mm single or crushed stone aggregate. The plaster shall be cured at least for 7 days.

Mode of Measurement

It shall be same as per item 5.01.

5.04 Providing and Applying Waterproof Cement Plaster

The plaster shall be of specified thickness and of mortar proportions. The contractor shall use approved waterproofing admixture made by reputed manufacturer in the mortar for plaster work. The quantity to be used shall be in accordance with the manufacturer's instructions, however subjected to the approval of the Project Engineer .

The use of Calcium Chloride shall be prohibited unless specifically allowed by Project Engineer and shall conform to IS: 2645. The plaster shall be cured atleast for 7 days.

Mode of Measurement

It shall be measured in sq.m/sq.ft. The rate shall include the double scaffolding, plastering and curing. The amount of waterproofing material added shall be measured and paid for separately.

5.05 Providing and Applying Cement Pointing

TECHNICAL SPECIFICATIONS

- a) The dust shall be brushed out of the joints and the wall be washed with water.
 - b) The mortar shall consist of one part of cement to one part of fine sand. Mortar shall be filled into the joints and well pressed with special steel trowels. The joints shall not be touched against after it has once begun to set.
 - c) The joints of the pointed work shall be neat. The lines of false joints shall be allowed.
 - d) The work shall be cured for a week after the pointing is complete. Whenever colored pointing has to be done the coloring pigment of the color required shall be added to cement in proportion as recommended by the manufacturer and as approved by the Project Engineer .
 - e) Mode of Measurement
The area pointed shall be calculated in Sq.m/sq.ft. from dimensions shown on drawings less openings as given in item 5.01 and shall be paid for. The rate quoted shall be applicable for all levels and heights.
- 5.06 Providing and applying White Washing on New Works - 2 or more coats.
- Providing and applying painting for One coat white wash, two coats of putty, One coat primer ,two coat premium emulsion paint of approved make. color as per Architectural recommendations and shade on all ceiling surfaces heights to give an even shade including after thoroughly brushing the surface free from mortar dropping and other foreign matter and also including preparing the surface even and sand papered smooth and scaffolding, all material and labor at all levels and all heights (Ground,First,second and Headroom) etc. complete all as per Architectural drawing and as directed by the Engineer in charge.
- Walls to be thoroughly scrapped with sand paper before white wash is applied. White wash shall be prepared from a good quality fat lime. Lime shall be slaked with water to the consistency of a cream and allowed to remain under water for 2 days. It shall then be strained through a cloth and 2 kg. of clean gum of approved make, as specified in the item specification or by the Project Engineer

, shall be added for every cubic metre of lime and indigo upto 3 gm. per kg. of lime dissolved in water shall then be added and stirred well.

Each coat to be applied with a brush. It shall be applied with a stroke of the brush from the top downwards, another from bottom upwards over the first stroke and similarly one stroke from the right and another from the left over the first brush, before it dries. Minimum three coats shall be applied on the plastered surface for desired finish. If the desired finish is not obtained extra coats shall be applied without any extra cost.

Mode of Measurement

It shall be measured in Sq.m/sq.ft. Deductions shall be carried out as per item 5.01. The rate shall be applicable for carrying out the work at all heights, double scaffolding etc. all complete.

5.07 Providing and Applying Plastic Emulsion Paint

Paint to be used for the various items of work should be of approved make viz. British, Asian, Jenson & Nicholson, ICI or Shalimar as directed. The painting work shall be carried out as directed by the Project Engineer, keeping however in view the recommendations of the manufacturer. Where painting with plastic emulsion is specified, all uneven surfaces shall thoroughly cleaned of all dust dirt and sand papered. One primer coat with cement putty and minimum 2 coats of emulsion paint shall be applied. It shall be applied with rollers. Workmanship shall conform to the requirements of IS: 2395.

Mode of Measurement

The actual quantity of work carried out shall be measured in Sq.m/sq.ft. Deduction for opening etc. shall be made as in the case of cement plaster.

5.08 Providing and Fixing Chicken Wire Mesh

The wire mesh shall be of 24 gauge and it shall be fixed with nails at the junction of brick masonry and RCC elements. The chicken wire mesh shall not sag in between the nails. This shall be done before the application of plaster.

Mode of Measurement

It shall be measured in sq.m/sq.ft. Measurement shall be taken before the application of the plaster. The rate includes for carrying out the work at all heights.

5.09 Providing & Applying Dry Distemper

Distemper shall be of approved make. It shall be applied by a broad stiff brush in two coats over a coat of primer.

The first and second coat shall be applied only after the primer coat has thoroughly dried. The first coat shall be of a lighter tint. The shade of the distemper shall be got approved by the Architect. Water bound and oil bound distemper shall conform to the requirements of IS: 427 and IS: 428 respectively.

5.10 Providing & Applying Color Wash

Color wash shall be applied the same way as white wash. Necessary and approved coloring chemical shall be added to the white wash which has been strained. Only color wash required for the day's work shall be prepared. If the finished surface is powdery and comes off easily or the general appearance is streaky, the work shall be rejected. The contractor has to redo the work at no extra cost.

Mode of Measurement

Same as item No.5.09.

5.11 Providing and Applying Cement Paint

Cement paint shall be approved make and color. It shall be applied by a stiff brush in three or more coats over a coat of primer. The first and second coat shall be applied only after the primer coat has thoroughly dried. The shade of the cement paint shall be got approved by the Architect. It shall be conforming to IS: 428:2000.

Mode of Measurement

It shall be measured in sq.m/sq.ft.

5.12 Providing and Applying Aggregate Plaster.

Aggregate plaster shall be applied on walls at all heights above and below plinth level with 10mm size hard approved variety granite chips or as specified in the item description. Granite chips may be screened, washed and dried properly. The base mortar shall in two layers. The first layer shall be 12mm thick plaster with cement mortar 1:4 with necessary grooves of 10 to 12 mm width as shown in architect's drawing and as directed by Project Engineer .

The top layer shall be cement paste of thickness upto 4mm applied over the plaster surfaces. The cement paste shall be applied on a limited area at a time so that it would become hard before granite chips are applied. The granite chips shall then be applied after properly raking the plastered surfaces by means of floats or trowels, dashing them against the still fresh cement paste already applied. Where uniform texture is not obtained, chips shall be stuck suitably by hand. Care should be taken that application of cement paste shall be done uninterruptedly within one panel so that the joints and patches are avoided. Precautionary steps to be taken to protect the surface already done, during the process of finishing adjoining areas so that the areas completed shall not get stained. Necessary scaffolding, curing, breaking the chips etc. are to be done as per the instruction of the Project Engineer .

Mode of Measurement

TECHNICAL SPECIFICATIONS

It shall be measured in Sq.m/sq.ft.

- 5.13 Providing and laying 20mm thick Cement Plaster in CM 1:3 over Chicken Wiremesh.

It shall be applied on insulated surfaces with cement mortar 1:3 over chicken mesh as per the direction of Project Engineer .

Mode of Measurement

It shall be measured in Sq.m/sq.ft.

- 5.14 Providing and Applying Cement Plaster 10mm/12mm thick in CM 1:3 for Ceiling.

General specifications and mode of measurement is same as that of item No.5.01.

SECTION - 6.00 - FLOORING**Applicable Codes**

IS: 1443:1972 - Code of practice for laying and finishing of cement
Concrete flooring tiles.

IS: 2114:1984 - Code of practice for laying in situ terrazzo floor finish.

IS: 777:1968 - Glazed earthenware tiles.

Notes:

1. Refer respective flooring drawings before quoting the rates.
2. The rates quoted shall include cutting and laying the tiles near the floor traps, sanitary outlets, acid washing, curing etc.
3. Contractor shall do dry laying of tiles on M Sand bed & get it approved before final laying.
4. Contractor shall protect all the flooring works including staircase with 12mm thick POP covering over polythene sheet/floor guard sheet till handing over the building, including removing and disposing off the debris outside the 'Project Site'. Quoted rate shall include the same.
5. Unless otherwise specified all the rates are inclusive of all necessary leads, lifts, scaffolding, staging, curing etc., complete at all levels.
6. For dadoing, contractor shall prepare tile grid marking and get approval before actual laying of tiles.
7. All tiles both floor and wall in toilets/pantry shall be provided with spacers of 2-3mm at joints and to be filled with epoxy sealant.
8. The rate shall inclusive of all levels and all heights (Ground, First, second and Headroom) complete all as per Architectural drawing and as directed by the Engineer in charge.

6.01 Providing and Fixing Kota Stone Shelves

The stones shall be pre-polished on both the sides and the thickness shall be 25 to 30 mm. The stones shall be placed in the brick masonry carries and the same shall be finished properly.

Mode of Measurement

This shall be measured in sq.m. The rate shall include providing kota stones, cutting zarries, placing the shelves, filling zarries, propping them till the CM sets and curing all complete.

6.02 Providing and Laying 19mm thick Cement Mortar in Skirting/Dado

The specification shall be same as the item 6.11 but for the work is to be done on vertical surfaces. It is of two layers the base layer shall be of 12mm thick PCC 1:1:3 (1cement: 1 sand: 3 graded stone aggregate of size 12mm and down). Then it shall be finished smooth.

Mode of Measurement

It shall be measured in sq.m/sq.ft. The rate shall include the chipping of RCC/ Brick work, dividing strips, laying the base and the top layer, curing etc. all complete.

6.03 Providing and Laying step Tiles (300 x 300 mm) for small buildings steps of approved make. size and color, laid over cement mortar 1:6 of average 25mm thick, over which cement slurry will be poured, complete all as per Architectural drawing and as directed by the Engineer in charge (Basic Cost of step Tiles 300mmx300mm - Rs.90/sq.ft - Excluding GST).

6.04 Providing and Laying Full body Vitrified Tiles 1200mmx600mm Skirting (Satin/Gloss finish) (100 mm height) for Hall ,Rooms verandah area and stair case of approved make. color and shade as per Architectural detailed drawings on 12mm thick cement mortar bedding 1:3, including tile spacers of 2 to 5 mm & grouting with Bal Endura etc., complete for Cut to sizes.(Basic cost of Full body Vitrified Tiles1200mmx600mm - Rs.90/sq.ft - Excluding GST).

6.05 Providing and Laying Full body Vitrified (Satin/Gloss finish) Tiles (1200 x 600 mm) for hall area and rooms of approved make. size and color as per Architectural detailed drawings , laid over cement mortar 1:6 of average 25mm thick, over which cement slurry will be poured, including tile spacers of 2 to 5

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mm & grouting with Balendura, washed with Diluted HCl complete. complete all as per Architectural drawing and as directed by the Engineer in charge (Basic Cost of Full body Vitrified Tiles (1200 x 600 mm) - Rs.90/sq.ft - Excluding GST).

6.06 Providing and Laying Ceramic/Granite Tiles in Flooring, Skirting and Dado.

Providing and laying Pre polished 18 mm thk Anti-Skid Granite Stone (steel grey black) stair case steps, jambs, pillars, window-cills, cooking platforms and verandah area of required size, color, quality, shade and required pattern for Staircase Flooring borders, stairs in Landing, treads, risers and skirting as per Architectural detailed drawings. The steps nosing should be pencil rounded or as required by the Architect and the steps should have 50mm wide flamed finish for anti-skidding with necessary groove cutting for making flaming. The rate to be inclusive of bed mortar of CM 1:4, minimum 20mm thick to maintain the finished floor level. All the joints to be grouted with balendura grout matching color to flooring materials, necessary grouting arrangement to hold the blastrade of hand rail, leading & lifting of all materials, required scaffolding, barrier, wastage of materials and required polishing and cleaning after laid etc, complete all as per Architectural drawing and as directed by the Engineer in charge.(Basic Cost of Granite Rs.150-sq.ft - Excluding GST).

Providing and laying Pre polished 10 mm thk Anti-Skid Granite Stone Skirting (steel grey block) stair case steps, jambs, pillars, window-cills, cooking platforms and verandah area of required size, color, quality, shade and required pattern for Staircase Flooring borders, stairs in Landing, treads, risers and skirting as per Architectural detailed drawings. The steps nosing should be pencil rounded or as required by the Architect and the steps should have 50mm wide flamed finish for anti-skidding with necessary groove cutting for making flaming. The rate to be inclusive of bed mortar of CM 1:4, minimum 20mm thick to maintain the finished floor level. All the joints to be grouted with balendura grout matching color to flooring materials, necessary grouting arrangement to hold the blastrade of hand rail, leading & lifting of all materials, required scaffolding, barrier, wastage of materials and required polishing and cleaning after laid etc, complete all as per Architectural drawing and as directed by the Engineer in charge.(Basic Cost of Granite Rs.150-sq.ft - Excluding GST).

The ceramic tiles in flooring and dado shall be of first class quality as specified in the item specification and shall be approved by the Architect. The tiles shall be of standard size without warp and with straight edges, true and even in shape and size and of uniform color. The tiles surface shall of fine grained texture,

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dense and homogeneous. The thickness of the tile and shade shall be as per the item specification. The tiles shall be submerged in water till the bubbles cease.

They should be laid on a base of 32mm for flooring and 12mm thick mortar for skirting and dado bed (cement 1 : 3 sand) and cement 3kg/sq.m) paste. They shall be laid truly vertical on walls and truly horizontal on floors or to slopes as directed. The joint shall be very thin, uniform and perfectly straight. The tiles in dado shall be finished in such a way that, only the tile thickness projects over the finished plaster or as specified otherwise. Where full tiles are not possible, the same should be cut or sawn to the required size and their edge rubbed to ensure straight and true joints. Corner tiles in dado & skirting are to be metered wherever required. After the tiles are laid extra cement grout shall be removed. The joints shall be cleaned with wire brush and then the joint shall be floated with white or grey cement as approved by the Architect. The tiles shall be cleaned after the work is complete.

Mode of Measurement

This shall be measured in sq.m. The rate quoted for flooring and dado work shall be inclusive of angles and corner pieces, cutting tiles for water points, such a way that the point is in the junction of four tiles, electrical points etc. and for chipping of RCC/Brickwork etc. wherever required.

6.07 Providing and Applying 115mm thick Waterproofing Treatment

First a layer of about 20mm thick in CM 1:4 (1 cement: 4 coarse sand) mixed with waterproofing compound of M/s.India Waterproofing Co., Bombay or equivalent shall be laid as instructed by the Project Engineer . Then brickbats shall be laid over this the required slopes and levels as per the drawings and the instructions of the Project Engineer . The surface of the brickbats shall be finished smooth with another layer of water proof plaster and the gaps between the brickbats shall also be filled with CM 1:4 mixed with water proof plaster. Finally the surface is finished smooth and desired patterns are formed on the surface with thread. All openings, sleeves, drains, pipes etc. shall be specially treated and made sure that they are water tight.

Mode of Measurement

TECHNICAL SPECIFICATIONS

The item shall be measured in sq.m/sq.ft. The wall flashing or the watta shall also be measured in sq.m/sq.ft. A guarantee certificate for a period of ten years shall be issued by the contractor for free maintenance of the treated area.

6.08 Providing and Laying Cuddappah Stone in Shelves.

Same as per item 6.06

Mode of Measurement

Same as per item 6.07.

6.09 Providing and Laying Anti-skid Vitrified Floor Tiles (300x 300 mm) for Toilets area of approved make. size and color as per Architectural detailed drawings, laid over cement mortar 1:6 of average 25mm thick, over which cement slurry will be poured, including tile spacers of 2 to 5 mm & grouting with Balendura, washed with Diluted HCl complete all as per Architectural drawing and as directed by the Engineer in charge (Basic Cost of Anti-skid Vitrified tiles (300x 300 mm) - Rs.90/sq.ft - Excluding GST).

Mode of Measurement

The item shall be measured in sq.m/sq.ft.

6.10 Providing and Laying 600 x 300 mm wall full height for all toilets of approved make. size and color as per Architectural detailed drawings laid over tile necessary Adhesive of 6mm, including supplying & fixing of wall tile paste and tile spacers of 2 to 5 mm and grouting with Balendura, washed with Diluted HCL, including 500 mm Micron polythene sheet covering and removing, cutting of tiles as required etc., complete as per Standard Specifications and as Directed by the Engineer in Charge. (Basic Cost of Vitrified tiles 600 x 300 mm - Rs.90/sq.ft - Excluding GST).

Mode of Measurement

It shall be measured in Sq.m/sq.ft

SECTION - 7.00 - STEEL WORK**Applicable Codes**

IS: 4351:2003 - Steel door frames.

IS: 7452:1990 - Hot rolled steel sections for doors, windows and ventilators.

IS: 1341:1992 - Steel Butt Hinges.

IS: 1038:1983 - Steel doors, windows, & ventilators.

7.01 Providing and Fixing Rolling Shutters

The rolling shutters (Mechanically and Partly Grilled Rolling Shutters) shall be of 18 gauge MS solid laths or grill with all the accessories such as top cover (conform to the size indicated in drawings) and shall be of quality specified in the item specification. The rolling slats shall be in one piece and be made of heavy gauge steel sheets minimum 19 swg in thickness. A cylindrical hood shall be provided on the top to enclose the shutter when it is open. The rolling shutters shall be provided with suitable locking arrangements and deep channel guides. In case galvanized rolling shutters are specified the rolling shutter shall be made of hot dip galvanized slats hood, deep channel guides all preferably in one piece. The channels, guides shall be fixed with holding down bolts with PCC 1:2:4 (1 cement : 2 sand : 4 coarse aggregate of nominal size 12mm and down).

In case of hand operated pull and push type rolling shutters and very large gear operated rolling shutters of sizes larger than 10 sq.m in area, they shall be provided with ball bearings for smooth and efficient operation. In case of large

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rolling shutters and depending upon local wind conditions, the rolling shutters should be provided with special locking type of wider channel guides or it shall be provided with central movable channel supports to take up the design wind pressures in the area.

Mode of Measurement

The rates quoted shall be inclusive of providing and fixing of rolling shutter with push and pull arrangement, a coat of approved primer. Fixing lugs to be provided to guide channel to suit actual site conditions or as directed by the Project Engineer at no extra cost. The mechanical arrangement provided for the opening and the closing of the shutter shall be paid for separately in sq.m/sq.ft of the shutter area as specified in the item description.

7.02 Providing & fixing in position Grill and Steel Ladder etc.

This work shall be carried out as per the detailed drawing of the Architect. The MS sections shall be approved quality. The welding shall be perfect and the junctions shall be ground properly. The frames shall be provided with holdfasts and the same shall be grouted with CC blocks of 1:2:4 in brickwork or as detailed in architect's drawings/specifications. It shall be painted with one coat of primer.

7.03 Providing and Fixing MS Gate

It shall be as per the drawing. The welding shall be perfect and the junctions shall be ground properly. The gate shall be provided with locking arrangements, hinges and it shall be painted with one coat of primer.

Mode of Measurement

It shall be measured as specified in the item description.

7.04 Providing and Fixing MS Door Frame

It shall be fabricated from structural steel as per the details and drawings. All the members shall be free from rust, flakes, cracks and other fabrication defects. All holes for hinges, bolts, locking plates, etc. shall be provided as per drawings/instructions. The welding shall be smooth. The frame shall be erected and fixed with MS holdfasts of specified size and grouted with cement concrete 1:2:4 (1 Cement : 2 Sand : 4 graded coarse aggregate of nominal size 12mm and down). The frame shall be painted with a coat of primer before erection.

Mode of Measurement

The rate shall include fabrication, erection and painting of the frame. The measurement shall be as specified in the item description.

7.05 Providing and Fixing MS Sheet Door

The frame shall be of MS as specified above. The door shall be as per the Architect's design. The specified gauge MS sheet door shall be welded to the frame. It should have 3 to 6 hinges depending on the shutter size. It shall have fittings as specified in the item/Architect's drawings. The door shall be applied with a coat of primer and 2 coats of synthetic enamel paint of quality as specified.

Mode of Measurement

This shall be measured in sq.m/sq.ft. If the frames are not included in the item then only the shutter area shall be measured and paid for. The rate shall include fabrication, provision, erection of the door, necessary fittings as specified, painting etc. all complete.

SECTION - 8.00 - ROOFING

- 8.01 Providing, Fabricating & Erecting MS Structural Steel Work for Trusses, Purlins, Girders, Columns, Rafters, Struts, Wind Ties, Bracings etc.

All structural steel materials such as angles, RS joists, flats, tees, plates, channels etc. shall conform to the latest edition of IS 226. All structural steel shall be free from twist before fabrication. Cutting of members shall be done by shearing, cropping, sawing or gas cutting. Contact surfaces of plates and butt joints shall be accurately machined over the whole area so that the parts connected shall butt over the entire surface of contact. Welding of pieces shall be done with the approval of the Project Engineer.

The components parts shall be assembled in such a manner that they are not damaged in any way and specific cambers as shown in the drawing or as directed by the Project Engineer, shall be provided.

For bolted connection, where necessary washers shall be tapered or otherwise suitably shaped to give satisfactory bearing. The threaded portion of the bolt shall project beyond the nut by at least 1.5 thread.

Welding shall be done in accordance with the latest edition of IS 813 and 814, Code of practice for use of Electric Arc Welding for general construction in mild steel. In welding it must be ensured that the base metal is in fused state when filler metal contacts it; filler metal does not overflow upon any unfused base

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metal; base metal is not cut along the weld edges; flowing metal floats the slag, oxide and gas bubbles at the surface behind advance pole. For this current shall be adjusted or the electrode size is changed. Welding shall be free from cracks, discontinuity, under or over size welding thickness.

Surface to be welded shall be free from loose mill scale, rust, grease, paint and any other foreign material. As far as possible avoid the welding at heights and at difficult positions. Generally, fillet welding is preferred. The parts to be welded are brought in as close contact as practicable and rigidly clamped together.

Before erection, steel work shall be thoroughly cleaned of rust, loose scale, dust, selding slag, and shall be given one coat of red oxide primer of approved make and one coat of synthetic enamel paint of approved make as specified in the item before erection and final coat of painting after the erection as directed.

Steel members shall be hoisted and put in position carefully without any damage to the member and to the building and labour. The trusses shall be lifted at such points that they do not buckle or deform or be unduly stressed. The end of the truss which faces the prevailing wind shall be fixed and the other end may be kept free to move. The steel work shall be securely fastened wherever necessary, temporarily braced, to provide for all loads to be carried by the member during erection including the load due to the erection equipment and its operation. No permanent bolting or welding is done until proper alignment has been obtained. The holes for the rivets shall be determined with the help of templates and drilled. Erection clearance of the cleared ends shall not be more than 1.5mm and without cleating end clearance shall not be more than 3mm. Grouting or embedding of structural steel members done after the approval of the alignment, level & position of the members by the Project Engineer.

Important Points

Before the actual execution of the job, the contractor shall prepare fabrication drawings for all structural steel work from the structural drawings supplied to him and determine the exact cutting lengths by marking out on a level platform to full scale.

Welding plant, electrodes and other equipments, scaffolding, labour shall be arranged by the contractor at his cost. Erection equipment of required capacity, sufficient number of spare parts and staff shall be maintained by the contractor at site at his cost.

Mode of Measurement

All structural steel members shall be measured in lengths and are converted into weights as per IS tables. All rivets, bolts shall be measured in kg. and paid for. No deduction shall be made for rivet holes and bolts. Nothing extra shall be paid for wastages.

8.02 Supply and Laying in roofing bare GALVALUME profiled sheet

Supply and Laying in roofing bare GALVALUME profiled sheet made out of 0.6 mm TCT 550 Mpa cold rolled sheet with hot dip metallic coating of aluminum zinc alloy 150gms/sqm having 975/1000mm cover width with 26mm high crest at 195/200mm c/c in lengths as approved by Architect also to suit to site requirements and fixed with necessary suitable imported galvanized carbon steel self-drilling & self-tapping screws of approved make conforming to ASTM 3566-1990 (class- III) of required diameter and length as approved all complete with EPDM sealing washers, foam fillers wherever necessary, butyl sealant at all laps, silicon sealant wherever necessary.

Rate should include cost of plastic caps of approved colour of U.V resistance and button bolts all as per manufacturer's specification all complete as approved by the consultant, including accessories like Apron, Flashing, barge, trim plates, Gutter, down pipes etc., in colour as per architectural recommendations (Only laid area without overlapping will be measured for payment).

Mode of Measurement

The bare galvalume sheet roofing shall be measured in sq.m. It shall include all tools, plants, ladder, scaffolding, triangular pieces in cladding or at gable ends or

at north light, side laps and end laps. The work shall be carried out at all heights without any extra cost.

8.03 Supply, fixing and Installation of puff panel roof sheets

The puff panel roof sheets made up 50mm thick Sandwich PUF panels with 0.5mm thick pre-painted colour coated galvanized steel sheets on both sides with 50mm thick layer polyurethane foam (density 40 \pm 2 kg/m³) insulation manufactured on continuous line. The wall panel will be joined with tongue and groove joint with all accessories like U-flashing, L-flashing made up of PPGI Sheet of thickness 0.5mm. The top finished surface of will have guard film/protection sheet for protection against scratches during handling and transportation complete in all respects to entire satisfaction of Engineer in charge

Mode of Measurement

It shall be measured in sq.m/sq.ft unless specified otherwise.

9.00 ROAD WORKS

Measurements shall be taken of the net finished work, except where otherwise stated. Measurements of materials like stones, aggregates, screenings, sand, etc. shall be taken in bottomless boxes or measuring boxes or in closely packed stacks on level ground. While no special compaction is necessary by ramming's/ hacking or hammering, no attempt at loose stacking will be permitted.

Measurements for finished work for which 'Materials and Labour' rates are to be paid, shall be taken in two stages, viz. measurements of road aggregates etc., in stacks as stated in above, and measurements of the completed work. The former is necessary to ensure that the required quantities of road aggregates have actually been collected and are of the sizes, etc., indicated. Stack measurements shall not, however, absolve the contractor from the responsibility of conforming to the required specification and dimensions, etc., and provision of more materials, if necessary, to make up the thickness, etc., indicated without any extra charge to Government. Rates Consolidation by hand ramming—Hand

TECHNICAL SPECIFICATIONS

ramming carried out in angles, edges, etc. where a roller cannot be worked, is included in the rates.

a) Earthwork shall be measured under Section 3 - Earthwork.

(b) Rolling of formation shall be measured under item 20027

When the work is done in two layers, each layer shall be measured separately.

Mode of measurement: -

It shall be measured in SQM.

GRANULAR SUB BASES & LIGHT WEARING SURFACES

The rates for granular sub base and light wearing surfaces are with low grade aggregates.

Mode of measurement: -

It shall be measured in SQM.

WATER BOUND MACADAM (WBM) SUB BASE & BASE COURSES

The thickness measured shall be the compacted finished thickness.

(b) The rates include forming clay puddle bunds (retaining fillets) on both edges of spread aggregate.

(c) When work is done in two layers, each layer shall be measured separately.

Mode of measurement: -

It shall be measured in SQM.

BITUMINOUS SURFACE DRESSING

Preparation of surface, priming coat, and filling in potholes in repairs, if any, prior to spraying shall be measured separately. (b) Adjustment in quantities of binder and chippings shall be made under items 20021 and 20022 respectively.

ROLLING

The rates for rolling include for watering as necessary and consolidating to the required level, gradient or camber, keeping roller wheels wet, if required, filling in hollows and depressions (any material being supplied by the M.E.S., or paid for as 'Supplied only') and the provision of water, animals, drivers, crew, fuel, labour, tools, etc. (d) Each course or layer rolled shall be measured.

PAVER BLOCKS

Providing and laying 60mm thick factory made chamfered edge cement concrete paver block of M-35 grade with color, design & pattern as per Architectural recommendations in footpath, parks, lawns, drive ways or light traffic parking etc., of required strength, thickness & size/ shape, made by table vibratory method using PU mould, laid in required color & pattern over and including 50mm thick compacted bed of fine sand, compacting and proper embedding/ laying of inter locking paver blocks into the sand bedding layer through vibratory compaction by using plate vibrator, filling the joints with sand and cutting of paver blocks as per required size and pattern, finishing and sweeping extra sand. Thickness: The minimum thickness of a paver block is 50 mm and the maximum is 120 mm. Strength: The minimum compressive strength of a paver block depends on the traffic conditions. For heavy traffic, the minimum compressive strength is 50 N/mm². Dimensions: The dimensions of a paver block include: Width: The width of a paver block is specified by the manufacturer to within ± 2 mm or ± 3 mm. Length: The length of a paver block is specified by the manufacturer to within ± 2 mm or ± 3 mm. Aspect ratio: The maximum aspect ratio of a paver block is $4.0 + 0.2 + 0.2$. Arris/Chamfer: The minimum arris/chamfer of a paver block is $5 \text{ mm} \pm 1 \text{ mm} \pm 1 \text{ mm}$ and the maximum is 7 mm.

Wearing layer: The minimum thickness of the wearing layer of a paver block is 6 mm + 2 mm + 2 mm. Wearing face area: The wearing face area of a paver block should be at least 75% of the plan area. Squareness: The squareness of a paver block should be $\text{nil} \pm 2 \text{ mm} \pm 3 \text{ mm}$. Paver blocks are used to create walkways, home exteriors, and more

Mode of measurement: -

It shall be measured in SQM.

SS HANDRAILS

Fabricating and fixing of SS Grill of 316 grade. Balcony handrails, Staircase handrails square and circular pipe sections. All the joints and sections should be cut to length, welded and grinded wherever necessary etc., complete as per specifications & drawing.

TECHNICAL SPECIFICATIONS

Cuts should be light but deep enough to prevent work hardening by riding on the surface of the material. Chip breakers should be employed to assist in ensuring swarf remains clear of the work. low thermal conductivity of austenitic alloys results in heat concentrating at the cutting edges. this means coolants and lubricants are necessary and must be used in large quantities. Solution treatment or annealing can be done by rapid cooling after heating to 1010-1120 C.

Mode of measurement: -

It shall be measured in RUM.

9.00 STP TANK

DESIGN BASIS: -

Sewage Treatment Plant is designed for a capacity of treating 50,000 Liters/Day @ 3 batches @ 17000 per batch

Raw Sewage Characteristics taken for design basis: -

S. No	Description of the Parameter	Value
1	pH	6.5-8.5
2	BOD (Biological Oxygen Demand)	300mg/lit
3	COD (Chemical Oxygen Demand)	700mg/lit
4	TSS (Total Suspended Solids)	150mg/lit
5	Oil & Grease	50mg/lit

Treated Water Characteristics: -

S. No	Description of the Parameter	Value
1	pH	6.5-8.5
2	BOD (Biological Oxygen Demand)	≤10mg/lit
3	COD (Chemical Oxygen Demand)	≤30mg/lit
4	TSS (Total Suspended Solids)	≤10mg/lit
5	Oil & Grease	≤5mg/lit / Traces

Note: The outlet from Sewage Treatment Plant will match the Pollution Control Board Norms for inland disposal.

PROCESS DESIGN DETAILS: -

Screen Chamber: -

Normal flow designed : 2.5m³/hr
 No. of Screen Chamber : One
 Size Of the screen chamber : 1.0m X 1.0m x 1.3m T. D (Approx) MOC of
 screen chamber : s RCC

Oil Trap Chamber: -

Normal flow designed : 2.5m³/hr
 No. of Screen Chamber : One
 Size Of the screen chamber : 2.5m X 1.0m x 1.0m T. D (Approx) MOC of
 screen chamber : RCC

Collection Tank: -

Normal Flow Designed : 2.5m³/hr
 No. of Tanks : ONE

TECHNICAL SPECIFICATIONS

Volume of the Tank : 34m³
 Size Of the SBR Tank : 2.83m X 3.0m x 4.3m T. D(Approx) MOC
 : RCC

SBR Tank: -

Normal Flow Designed : 8.5m³/hr
 No. of Tanks : ONE
 Retention Time : 4hrs
 Volume of the Tank : 34m³
 Size Of the SBR Tank : 2.83m X 3.0m x 4.3m T. D(Approx) MOC
 : RCC

DESCRIPTION	
Quantity	1 No
Spacing	12mm
MOC	SS.

DESCRIPTION	
Quantity	2Nos (1W+1S)
Flow	8.5m ³ /hr
Motor	1.0 HP
Head	10m
MOC	CI
Type	Submersible or Monobloc
Make	Kirloskar/Equivalent

DESCRIPTION	
Quantity	2Nos (1W+1S)
Flow	8.5m ³ /hr
Motor	1 HP
Head	30m
MOC	CI
Type	Submersible OR Monobloc
Make	Kirloskar

TECHNICAL SPECIFICATIONS

DESCRIPTION	
Quantity	2Nos (1W+1S)
Capacity	50 m ³ / hr
Head	4MWC
Make	A ONE
Motor	2.0HP
Motor Make	Crompton greaves

DESCRIPTION	
Quantity	1 Lot
Flow	5.5m ³ /hr.
Make	Techpro/ Equivalent
Size	225 mm Dia
MOC	EPDM
Medium Of Flow	Air
Type	Disc Type
Dimension Of Bubble	5mm
Temperature Tolerance	85°C
Type Of Arrangement	Retrievable

DESCRIPTION	
Quantity	1 Lot
Flow	3.8m ³ /hr.
Make	Techpro/ Equivalent
Size	300 mm Dia
MOC	EPDM
Medium Of Flow	Air
Type	Disc Type
Dimension Of Bubble	5mm
Temperature Tolerance	85°C
Type Of Arrangement	Retrievable

DESCRIPTION	
Quantity	1 NO
Flow	12 m ³ /hr
Head	10m

TECHNICAL SPECIFICATIONS

Motor	1.0 HP
MOC	CI
Make	Kirloskar/Equivalent
DESCRIPTION	
Quantity	2No's
Flow	8.5 m3/hr
Head	30m
Motor	3.0 HP
MOC	CI
Make	Kirloskar/Equivalent

DESCRIPTION	
Quantity	1 No
Model	SS304, tube type
Capacity	0-10000LPH
Make	Alfaa
Power	0.16kw

DESCRIPTION	
Quantity	1 No.
Diameter	600 mm
Height	1625 mm
Normal Flow	8.5m ³ /hr.
Filtering Media	Graded Pebbles/Sand
M.O.C	FRP
Minimum Pressure	2.0Kg/cm ²
Maximum Pressure	3.5Kg/cm ²
Bursting Pressure	10Kg/cm ²
Valve	Multiport 40 NB
Pipe Line	40mm
Type	Vertical

DESCRIPTION	
Quantity	1 No.
Diameter	600mm
Height	1625mm
Normal Flow	8.5m ³ /hr.

TECHNICAL SPECIFICATIONS

Filtering Media	Graded Pebbles/ Sand/Activated Carbon
M.O.C	FRP
Minimum Pressure	2.0Kg/cm ²
Maximum Pressure	3.5Kg/cm ²
Bursting Pressure	10Kg/cm ²
Valve	Multiport 40NB
Pipe Line	40mm
Type	Vertical

DESCRIPTION	
Quantity	1No
Type	Diaphragm
Capacity	0-6 LPH
Pressure	4 Bar
Max.Suction Pressure	1.5m
Make	I Dose /Equivalent
Storage Tank	50 Liters / PP

DESCRIPTION	
Interconnected Pipes, Fittings and Valves	1 Lot
Make	Finolex/ Equivalent
MOC	UPVC

DESCRIPTION	
Quantity	1 No
Components Make	L&T/Equivalent
Electrical Panel will be supplied for the above mentioned Mechanical Equipments.	

DESCRIPTION	
Quantity	2 No's.
Make	Flow Measures
Size	11/2"

II WATER SUPPLY, SANITARY INSTALLATIONS AND DRAINAGE

2. 0 WATER SUPPLY, SANITARY INSTALLATIONS AND DRAINAGE

2. 1 The contractor shall furnish all labour, materials and equipment, transportation and incidental necessary for supply, installation, testing and commissioning of the complete Plumbing / Sanitary system as described in the Specifications and as shown on the drawings. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract. The Plumbing / Sanitary System shall comprise of following:

- (a) Sanitary Fixtures and Fittings.
- (b) Internal and External Water Supply.
- (c) Internal and External Drainage
- (d) Approval from Local Authorities
- (e) Balancing, testing & commissioning.
- (f) Completion drawings

2. 2 The contractor shall procure and install all pipes, Sockets /Nipples including shut-off valve etc. for mounting sensors/transmitters for the interface to Building Automation System.

2. 3 The contractor shall ensure that senior and experienced plumbers are assigned exclusively for this work. Such plumber(s) should have valid license from the local authorities. The project management shall be done through modern technique. For quality control & monitoring of workmanship, contractor shall assign at least one engineer who would be exclusively responsible for ensuring strict quality control, adherence to specifications and ensuring top class workmanship for the installation.

2. 4 The work shall be in conformity with the Bye-laws, Regulations and Standards of the local authorities concerned. But if these Specifications and Drawings call for a higher standard of materials and / or workmanship than those required by any of the above regulations and standards, then these Specifications and Drawings shall take

precedence over the said regulations and standards. However, if the Drawings and specifications require something which violates the Bye-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation.

- 2.5** The Plumbing / Sanitary Drawings given by the Engineer In-Charge or issued with tenders are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings. The contractor shall follow these drawings in preparation of his shop drawings, and for subsequent installation work.
- 2.6** The contractor shall examine all architectural, structural, plumbing, electrical and other services drawings and check the as-built works before starting the work, report to the Engineer In-Charge any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the Engineer In-Charge without additional cost to the department.
- 2.7** All the shop drawings shall be prepared on computer through Autocad System based on Architectural Drawings and site measurements. Within two months of the award of the contract, contractor shall furnish, for the approval of Engineer In-Charge, the two sets of detailed shop drawings of complete work and materials including layouts for Plant room, Pump room, Typical toilets drawings showing exact location of supports, flanges, bends, tee connections, reducers, detailed piping drawings showing exact location and type of supports, valves, fittings etc; external insulation details for pipe insulation etc.
- 2.8** These shop drawings shall contain all information required to complete the work. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings. Minimum 4 sets of

drawings shall be submitted after final approval along with CD. When he makes any amendments in the above drawings, the contractor shall supply two fresh sets of drawings with the amendments duly incorporated along with check prints, for approval. The contractor shall submit further four sets of shop drawings to the Engineer In-Charge for the exclusive use by the Engineer In-Charge and all other agencies. No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawing for the particular material/equipment / installation.

- 2. 9** Shop drawings shall be submitted for approval four weeks in advance of planned delivery and installation of any material to allow the Engineer In-Charge ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved programme.
- 2. 10** Samples of all materials like valves, pipes and fittings etc. shall be submitted to the Engineer In-Charge prior to procurement for approval and retention by Engineer In-Charge and shall be kept in their site office for reference and verification till the completion of the Project. Wherever directed a mockup or sample installation shall be carried out for approval before proceeding for further installation without any extra cost.
- 2. 11** Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.
- 2. 12** All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be in conformity with list of approved manufacturers.
- 2. 13** Balancing of all water systems and all tests as called for the MESSR Specifications shall be carried out by the contractor through a specialist group, in accordance with the Specifications and ASPE / ASHRAE Guide lines and Standards. The installation shall be

tested and shall be commissioned only after approval by the Engineer In-Charge. All tests shall be carried out in the presence of the representatives of the Engineer In-Charge and nothing extra shall be payable on this account.

- 2. 14** The contractor shall submit completion plans for water supply, internal sanitary installations and building drainage work and other services done under E&M works within 15 days of the date of completion. These drawings shall be submitted in the form of two sets of CD's and four portfolios (300 x 450 mm) each containing complete set of drawings on approved scale indicating the work as - installed. These drawings shall clearly indicate complete plant room layouts, piping layouts and sequencing of automatic controls, location of all concealed piping, valves, controls and other services. In case the contractor fails to submit the completion plans as aforesaid, security deposit shall not be released and these shall be got prepared at his risk and cost
- 2. 15** The CCI/CI/PVC pipe and GI pipe etc. wherever necessary shall be fixed to RCC columns, beams etc. with raw plugs and nothing extra shall be paid for this.
- 2. 16** The variation in consumption of material shall be governed as per MESSR specification and clauses of the contract to the extent applicable.
- 2. 17 PLUMBING WORKS INCLUDES OVERALL PLUMBING WORKS INTERNAL & EXTERNAL:**
- a) Plumbing Fixtures, Chrome Plated Fittings & Accessories.
 - b) Soil, Waste & Vent Pipes & Fittings
 - c) Rainwater Pipes & Fittings
 - d) Internal / External Water Supply System (Cold & Hot)
 - e) External Sewerage & Drainage
 - f) External Rainwater System
 - g) External Flushing Water System
 - h) Drinking Water System

Samples of all materials shall be got approved before placing order and the approved samples shall be deposited with the Engineer. If directed, materials shall be tested in an approved testing laboratory and the contractor shall produce the test certificate in original to the Engineer and the entire charges for original as well as repeated tests shall be borne by the Contractor. If required by the Engineer, the Contractor shall arrange to test portions of the work at his own cost in order to prove their soundness and efficiency. If after any such test the work or portions of work is found in the opinion of the Engineer, to be defective or unsound, the Contractor shall pull down and re-do the same at his own cost. Defective materials shall be removed from site.

2. 18 PLUMBING FIXTURES:

2. 19 Scope

- 2.19.1.** All sanitary fixtures like sanitary ware, CP fittings, bath room accessories, wall flanges, valves and all related to bath room, kitchen utility fittings (CP and sanitary fittings). And also supply small accessory piping and any specialties furnished for fixtures such as adopters, pipe fittings, cement, brick work supports for AWC, CP Extension pieces, Check nuts, screws, washers, gasket etc., waste connector, WC connector, PVC or CP connection pipe, connecting nipple, screws, clamps, white cement wall flanges, washers, sealant and other accessories of this type as required.
- 2.19.2.** The contractor responsibility to install the fittings received from the client engineer in a good condition otherwise contractor shall pay for the entire fittings cost. (Including transportation charges, all taxes, and other accessories)
- 2.19.3.** Scope of installation to be performed by the contractor is outlined below:
- 2.19.4.** The contractor shall hydrostatically test all the sanitary appliances and CP fittings installation including accessories and specialties.
- 2.19.5.** Contractor shall supply all Jointing material as required for all joints. Like screws, washers, sealants, Installation tools, tackles, drilling machine as required to complete the work.
- 2.19.6.** Tile Sanitary fixtures and fittings shall be installed at the correct aligned position as shown on the drawings and as directed by the engineer, and shall fully meet with the aesthetic and symmetrical requirements as required

- 2.19.7.** All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per Project Engineer requirements. Wherever necessary the fittings shall be centered to dimensions' pattern as called for.
- 2.19.8.** Fixture shall be installed by skilled plumber with appropriate tools according to the best trade practice. Manufacturer's instruction shall be followed for the installation of fixtures. Fixtures in all toilets shall be standard height, mounting as called for on the drawings. Fixtures shall be mounted rigid, plumb and true to alignment
- 2.19.9.** All fixtures shall be fixed firmly to the floor / wall with accessories supplied by the manufacturer. Use chrome plated brass cap nuts for fixation screws.
- 2.19.10.** All ferrous accessories used for the installation of sanitary fixtures shall have anti-rust treatment given at the factory.
- 2.19.11.** Refer to interior architectural documents for details of toilet and bathroom accessories. These are part of the finishing works
- 2.19.12.** Contractor shall do mock-up for each type of sanitary ware fittings & fixtures, before final installation.
- 2.19.13.** Care shall be taken in fixing all approved chromium plated (CP) fixtures and accessories so as not to leave any tool marks or damages on the finish. All such fixtures shall be tightened with fixed spanners.
- 2.19.14.** Use of 'Stiltson' type pipe wrenches with toothed jaws shall not be allowed.
- 2.19.15.** All fixtures shall be thoroughly tested after connecting the drainage and water supply system. All fixtures shall be thoroughly finished and any leakage in piping valves and waste fittings corrected to the complete satisfaction of the Engineer.
- 2.19.16.** Upon completion of the work, all labels, stickers, plaster, etc. shall be removed from the fixtures and all fixtures shall be cleaned with soap and water so as to present a neat and clean toilet.

2. 20 MOCK UP AND TRIAL ASSEMBLY

The installation of the sanitary fixtures and shall be as per the shop drawings approved by the Engineer.

The Contractor shall assemble on trial basis at least one set of each type of sanitary fixture and fittings in order to determine precisely the required supply and disposal "connections. Relevant instructions from manufacturer shall be followed as applicable. This trial, assembly shall be developed to facilitate determining the location of punctures, holes, holding devices etc, which will be required for final installation In

position of all sanitary fixtures and fittings. The above assembly shall be subject to final approval by the Engineer.

The fixtures in the trial assembly can be reused for final installation without any additional payments for fixing or dismantling of the fixtures.

- 2.21** Operation & maintenance training to employer's staff, supply of basic minimum spares for equipment's.

TECHNICAL SPECIFICATIONS

W.1 EUROPEAN TYPE PEDESTAL WATER CLOSET

Providing and fixing white vitreous china pedestal type water closet (European type) with seat and lid, 10 litre low level PVC 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

W.2 WASH BASIN:

Providing and fixing of Semi Recessed mitre wall hung wash basin size 460x360 mm, 15 mm C.P. Brass basin mixer tap, 32 mm C.P. brass waste of standard pattern, including 2 nos. angle valve with riser pipes, connectors, adopters, all fittings etc cutting and making good the walls wherever required

2.1 Installation of Wash Basin:

The installation shall consist of an assembly of wash basin, Basin mixer taps, C.I. brackets, C.P. brass union. The wash basin shall be provided with one no. of 15 mm C.P. brass Basin mixer taps. The height of top of the rim of wash basin from the floor level shall be within 750 mm to 800 mm.

The basin shall be supported on a pair of C.I. cantilever brackets conforming to IS 775 and be embedded in cement concrete (1:2:4) block 100 x 75 x 150 mm. Use of M.S. angle or Tee section as bracket is not permitted. Brackets shall be fixed in position before dado work is done.

The wall plaster on the rear shall be cut to rest over the top edge of the basin so as not to leave any gap for water to seep through between wall plaster & skirting of basin. After fixing the basin, plaster shall be made good and surface finished matching with the existing one. The waste water from wash basin shall be discharged directly to a floor trap and finally to the vertical stack

W.3 Kitchen Sink:

- 3.1** 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 :510x1040 mm bowl depth 300 mm.

W.3.1. Method of Measurement and payment

Payment for Sink shall be made on the basis of numbers arrived at by counting the number of Sink laid in position. Rate shall include cost of all materials, labour charges, transportation, cost, scaffolding, charges, taxes, hire charges for tools and plants, finishing charges and curing etc. complete.

W.4 PTMT TOWEL RING

Providing and fixing PTMT towel ring trapezoidal shape 215 mm long, 200 mm wide with minimum distances of 37 mm from wall face with concealed fittings arrangement of approved make and color, weighing not less than 88 gms.

4.1 Method of Measurement and payment

Payment for PTMT Towel Ring shall be made on the basis of numbers arrived at by counting the number of PTMT Towel Ring laid in position. Rate shall include cost of all materials, labour charges, transportation, cost, taxes, hire charges for tools and plants, finishing charges and curing etc. complete.

W.5 PTMT TOWEL RAIL

Providing and fixing PTMT towel rail complete with brackets fixed to wooden cleats with CP brass screws with concealed fitting including wall brackets arrangement of approved make and color.

600 mm long towel rail with total length of 631 mm, width 70 mm and effective height of 69 mm, complete as per standard specifications.

5.1 Method of Measurement and payment

Payment for PTMT Towel Rail shall be made on the basis of numbers arrived at by counting the number of PTMT Towel Rail laid in position. Rate shall include cost of all materials, labour charges, transportation, cost, taxes, hire charges for tools and plants, finishing charges and curing etc. complete.

W.6 BALL VALVE (BRASS) (Upto 50mm size)

Supply and fixing in position the following lever operated, full flow, quarter turn, Ball Valves of Forged Brass body and chrome plated brass ball with chrome plated steel handle with PVC sleeve and PTFE seal tested to 25 Kg / Cm² pressure rating, conforming to BS: 5159 manufacturing standards, including all unions and effecting proper connections.

The ball valve shall be of Brass or Gunmetal as specified conforming to IS 1703. The ball valve shall be of following two classes: —

- a. High Pressure: High pressure float valves are indicated by the abbreviation 'HP' and are designed for use on mains having pressure of 0.175 MPa or above.
- b. Low Pressure: Low Pressure float valves are indicated by the abbreviation 'LP' and are designed for use on mains having a pressure up to. 0.175 MPa.

The ball valves shall be of following nominal sizes 15 mm, 20 mm, 25 mm, 32 mm, 40 mm and 50 mm.

W.7 SINGLE ACTING AIR VALVE W/ BALL VALVE

Supply and fixing in position the following Single Acting Air Valve of large orifice type Cast iron body pressure rating of 10 Kg / Cm² , 16 Kg / Cm² conforming to IS 14845 : 2000 with lever operated, full flow, quarter turn, Ball Valves of Forged Brass body and chrome plated brass ball with chrome plated steel handle with PVC sleeve and PTFE seal tested to 25 Kg / Cm² pressure rating, conforming to BS : 5159 manufacturing standards, and including all unions and effective proper connections.

W.8 SOLENOID VALVE

Supply and fixing in position the following Solenoid Valves with Brass body, SS-304 spring, pressure limit of 12 Kg / Cm² and assembled with NBR seal, Include power cable, control cable, level probe/sensor/ electrode with all fitting & accessories complete set.

Solenoid Valves are compact, general-service, two-way guide type. They are available in brass with a normally closed design and can be oriented in any position. The solenoid enclosure provides protection against dust, while also protecting against seepage of oil and noncorrosive coolants. The Series SBSV-B valves come assembled with an NBR seal, having a maximum process temperature of 176°F (80°C). The series offers a wide range of valve

sizes and flow ranges, with connection sizes from 1/8" to 2" NPT and orifices from 3 mm to 50 mm.

Line Size	1/8 to 2" NPT.
End Connections	Female NPT.
Operating Pressure	1/8 to 1/4": 0 psi (0 bar) to 188.5 psi (13 bar); 3/8 to 2": 7.3 psi (0.5 bar) to 188.5 psi (13 bar).
Pressure Limit	246.6 psi (12 bar).
Wetted Material	
Body	Brass;
Spring	304 SS;
Seal	NBR.
Temperature Limits	
Process	176°F (80°C);
Ambient	32 to 149°F (0 to 65°C).
Power Requirements	
Standard	110 VAC;
Power Consumption	110-VAC
Enclosure Rating	NEMA 13 (IP54).
Electrical Connection	DIN connection.

Other Materials	Nylon.
Mounting Orientation	Any position, best if solenoid vertically above valve.

W.9 UNPLASTICISED POLYVINYL CHLORIDE PIPES AND FITTINGS

Providing and fixing PVC Pipes shall conform to Type A pipes of IS 14735. The internal and external surfaces of the pipes shall be smooth and clean and free from grooving's and other defects. The end shall be clearly cut and shall be square with the axis of the pipe. The end may be chamfered on the plain sides. Slight shallow longitudinal grooves or irregularities in the wall thickness shall be permissible provided the wall thickness remains within the permissible limit.

9.1 Color of Pipe

Surface color of the pipes shall be dark shade of grey or as specified.

9.2 Marking

Each pipe shall be clearly and indelibly marked with the following information's at intervals not more than 3 meter.

- Manufacturer's name or trade mark.
- Nominal outside dia of pipe.
- Type 'A'
- Batch number.

9.3 Diameter and Wall Thickness:

Mean outside diameter, outside diameter at any point and wall thickness for type –A manufactured plain or with socket shall be as given in Table- 1 of IS 14735. UPVC rain water pipes shall be of the dia, specified in the description of the item and shall be in nominal lengths of 2,3,4 or 6 metres either plain or with sliding/grooved socket unless shorter lengths are required at junctions with fittings. Tolerances on specified length shall be + 10 mm and – 0 mm.

9.4 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.

9.5 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.

9.6 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 socketed 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.

9.7 Measurements

The fittings shall be measured by numbers. The pipes shall be measured net when fixed correct to a running metre. including all fittings along its length.

10 Pipes - Centrifugally Cast (Spun) Iron Pipes

- 10.1** The spun iron pipes shall conform to IS 1536. The spun iron pipes shall be of cast iron cast centrifugally and vary in diameters from 80 mm to 750 mm. These shall be of class LA, class

and class B, as specified. Pipes shall be tested hydrostatically at the pressure specified in table.

Specials: The specials shall conform to IS 1538. The hydraulic test pressure of each class shall be as detailed in Table.

<i>Hydrostatic Test pressure for centrifugally cast socket & spigot pipes in MPa</i>		
<i>Hydrostatic Test pressure for works in MPa</i>		
<i>Class</i>	<i>Up to DN 600</i>	<i>DN 700 & above</i>
LA	3.5	1.5
A	3.5	2.0
B	3.5	2.5

<i>Hydrostatic Test pressure for centrifugally cast pipes with screwed on flanges in MPa</i>		
<i>Class</i>	<i>Up to DN 600</i>	<i>DN 700 & above</i>
B	2.5	1.6

<i>Hydrostatic Test pressure for fittings in MPa (N/mm²) (metre head)</i>		
<i>Nominal - Diameter</i>	<i>Fitting without branches or with branches not greater than half the principle diameter.</i>	<i>Fitting with Branches greater than half the Principal Diameter.</i>
Up to and including 300 mm	2.5 (25)	2.5 (25)
Over 300 mm and up to and including 600 mm	2.0 (20)	2.0 (20)
Over 600 mm and up to and including 1500 mm	1.5 (15)	1.0 (10)

11 POLYVINYL CHLORIDE (PVC) PIPES AND FITTINGS

PVC pipes and fittings of Type B for soil and waste discharging system of pressure rating Max 6Kg/cm² shall be used. The pipes shall be supplied in nominal lengths of 2, 3, and 4 or 6 meters as per IS 14735, tolerance on specified lengths shall be +/-10mm. Any physical test requirements shall be as per IS13592-1992.

11.1 HANDLING

Because of their lightweight, there may be a tendency for the PVC pipes to be thrown much more. Reasonable care should be taken in handling and storage to prevent

damage to the pipes. Contractor should hold the fullest responsibility in this case. On no account the pipes should be dragged on the ground. Pipes should be given adequate supports at all times.

11.2 LAYING

The PVC pipes shall be laid under the floors below slab or on walls either buried or exposed as the case may be, as per the specifications and instructions of the Engineer. The minimum thickness of fittings shall be of 3.2 mm. The fittings shall be of injection-moulded type with solvent cement joint. The pipes and fittings shall be capable of withstanding sun's rays. PVC pipes laid below slab or suspended in ceiling shall be supported by angle brackets / MS supports as detailed in the drawings and as per the instruction of the Engineer. The cost of drilling holes in RCC slab, floor, RCC/masonry retaining wall with the core cutting machine and making good the same with approved quality cement concrete etc. is at its own cost. If the pipes laid above the floor level (sunken level), it should be rigidly fixed with PCC bedding and levelled at every 1 metre intervals.

11.3 JOINTING

The jointing of pipes to fittings shall be done as per the manufacturer's instructions / recommendations and as per the Engineer instruction.

The PVC pipes and fittings shall be joined with Solvent Cement and jointing shall be carried out as follows:

1. Cut the spigot end of the pipe square.
2. All burrs from the internal and external surfaces should be removed.
3. The spigot should be marked with a pencil line and a distance equivalent to the socket depth. Clean the surface within the marked area.
4. Apply uniform coat of solvent cement on the external surface to the pipe and a lighter coat on the internal surface of the fitting.
5. Insert the pipe end into the socket of the fitting and push it in upto the mark.

Remove the excess solvent cement and hold the joint firmly in position for 30 seconds to dry. Gluing should be avoided in a rainy or foggy weather.

The other method of jointing shall be by rubber rings. The material of rubber ring should conform to IS 5382-1969. The ring is housed in groove formed in a plastic or metallic

housing. The rubber is compressed and makes a seal between the pipe and housing. Lubricating paste should be applied before compressing the rubber. Where natural rubber 'O' rings are used, mineral oil or petrol or grease should be used.

11.4 TESTING

PVC pipes and fittings shall be tested in accordance with IS 13592 - 1992. The openings of the pipes shall be sealed for the section to be tested. These are of non-pressure pipe and testing carried out by gravity water pressure or smoke test. The water pressure of 0.5Mpa (1.5m of H₂O or 0.15 kg/cm²) shall be maintained for a minimum period of 15 minutes and there should be no leakage at any joint. The Engineer shall examine carefully all the joints for leakage. The cost of equipments and accessories required for testing the system shall be supplied by the contractor at his own cost.

11.5 MODE OF MEASUREMENT PVC PIPES

PVC Pipes shall be measured along pipeline including the specials in running meter (Rm.)

The quoted rate shall include the following:

- i) The cost of pipes, specials and other jointing materials.
- ii) Laying, jointing and curing.
- iii) Testing and making good the defects, if any.

12 S.W. Gully Trap:

- 12.1** Gully traps shall conform to IS 651. These shall be sound, free from visible defects such as fire cracks, or hair cracks. The glaze of the traps shall be free from crazing. They shall give a sharp clear tone when struck with light hammer. There shall be no broken blisters. 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 x 300 mm the cover weighing not less than 4.50 Kg and the frame not less than 2.70 Kg. The grating, cover and frame shall be of sound and good casting and shall have truly square machined seating faces
- 12.2** Fixing S.W. Gully Trap
- 12.3** Excavation: The excavation for gully traps shall be done true to dimensions and levels as indicated on plans or as directed by the Engineer-in-Charge.
- 12.4** Fixing: The gully traps shall be fixed on cement concrete foundation 65 cm square and not less than 10 cm thick. The mix for the concrete will be 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size). The jointing of gully outlet to the branch drain shall be done similar to jointing of S.W. pipes described above.
- 12.5** Brick Masonry Chamber: After fixing and testing gully and branch drain, a brick masonry chamber 300 x 300 mm (inside) in brick work of specified class in cement mortar 1:4 (1 cement: 4 fine sand) shall be built with a half brick thick brick work round the gully trap from the top of the bed concrete up to ground level. The space between the chamber walls and the trap shall be filled in with cement concrete 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size). 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 coarse sand), finished with a floating coat of neat cement. The corners and bottom of the chamber shall be rounded off so as to slope towards the grating. C.I. cover with frame 300 x 300 mm (inside) shall then be fixed on the top of the brick masonry with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) and rendered smooth. The finished top of cover shall be left about 4 cm above the adjoining ground level so as to exclude the surface water from entering the gully trap.
- 12.6** Measurements: The work shall be enumerated. Excavation shall be measured separately under relevant item of earth work.

- 12.7** Rate: The rate shall include the cost of materials and labor involved in all the operations described above, except earth work which shall be paid for separately.

13 INSPECTION CHAMBER

- 13.1** At every change of alignment, gradient or diameter of drain, there shall be an inspection chamber. Bends and junctions in the drain shall be grouped together in inspection chamber as far as possible. The maximum distance between chambers shall be 30m.
- 13.2** Inspection chambers of different types and sizes as specified shall be constructed in the drainage line at such places and to such levels and dimensions as shown in the drawings or as directed by the Engineer-in Charge. The size specified shall indicate the inside dimensions between brick faces of the inspection chamber.
- 13.3** Where the diameter of the drain is increased, the crown of the pipe shall be fixed at the same level and necessary slope given in the invert of the inspection chamber. In exceptional cases and where unavoidable, the crown of the branch drainage may be fixed at lower level but in such cases the peak flow level of the two drainages shall be kept the same.
- 13.4** Drainage of unequal sectional area shall not be joined at the same invert in an inspection chamber. The invert of the smaller drainage at its junction with main shall be at least $\frac{2}{3}$ the diameter of the main above the invert of the main. The branch drainage shall deliver drainage in the inspection chamber in the direction of main flow and the junction must be made with care so that flow in main is not impeded.
- 13.5** Inspection chamber of 455 × 610 mm and 45 cm deep for single pipe line, 500 × 700 mm and 45 cm deep for one or two inlets and 600 × 850 mm and 45 cm deep for three or more inlets are generally constructed for drainage line.
- 13.6** **Excavation** The excavation for inspection chamber shall be true to dimensions and levels shown on the plans or as directed by the Engineer-in-Charge.
- 13.7** **Bed Concrete** The inspection chambers shall be built on a bed of cement concrete 1:5:10 (1 cement: 5 coarse sand: 10 graded stone aggregate 40 mm nominal size) unless required by local authorities. The thickness of the bed concrete shall be 15 cm unless otherwise specified or directed by the Engineer-in-Charge and 40 mm thick cement concrete 1:2:4 (1 cement: 4 coarse sand: 4 grade stone aggregate 40 mm nominal size).

- 13.8 Brick Work** The brick work shall be with class 75 bricks in one brick thickness in cement mortar 1:4 (1 cement: 4 coarse sand). The external joints of the brick masonry shall be
- 13.9 Plaster and Pointing** The walls of the inspection chambers shall be plastered inside including bed with 12 mm thick cement plaster 1:3 (1 cement: 3 coarse sand) finished smooth. For earth work excavation, bed concrete, brick work, plaster and pointing, R.C.C. work and refilling of earth, respective specifications shall be followed.
- 13.10 Inspection Chamber Covers and Frames** The frame of inspection chambers shall be firmly embedded to correct alignment and levels in R.C.C. slab or plain concrete as the case may be on the top of the masonry. After completion of the work, inspection chambers covers shall be sealed by means of thick grease.
- 13.11 Measurements** Inspection chambers shall be enumerated under relevant items. The depth of the inspection chambers shall be reckoned from the top level of C.I. cover to the invert level. The depth shall be measured correct to a cm. The extra depth shall be measured and paid as extra over the specified depth.
- 13.12 Rate** The rate shall include the cost of materials and labour involved in all the operations described above but excludes the cost of excavation, 12 mm thick cement plaster with water proofing material applied at the external surface of the inspection chambers if required, 40 mm thick cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 grade stone aggregate 40 mm nominal size). These items shall be paid for separately under relevant items of work. Payment for extra depths of inspection chambers shall be made separately under relevant items of work.

14 Overhead Tank

- 14.1** Three layer insulated polyethylene water storage tanks made from high quality material, durable polyethylene with IS specification IS 10701/96 the tank is meant for outdoor (or) indoor use complete with removable hinged top locking arrangement and to make provision to fix water supply pipe lines and including all PVC specials pugs, screws nails to fix the tank etc., complete. The rate shall be inclusive of all materials, labour conveyance hoisting and fixing charges etc. The Water storage tanks shall be located minimum 1.0 metre above the terrace level of toilet block and shall be suitably designed for the same.

W.10 Water Dispenser

- W.10.1.** Supplying, fixing and commissioning of approved make & suitable model for Water Dispenser with purified normal hot and cold water outlets including all fittings and accessories complete.,

Make / Brand	Specification
Power Supply	230 Volts
Display	LCD
Water Dispenser Options	Normal , Hot & Cold
Storage Tank Capacity (Normal)	07 Ltrs
Storage Tank Capacity (Hot)	2.5 Ltrs
Storage Tank Capacity (Cold)	07 Ltrs
Normal water Storage Tank MOC	LLDPE - Food Grade
Hot & Cold water Storage Tank MOC	SS 304 With PUF
Purification Method	RO & UV
No Of Stages	4 Stages Filtration 1. Micron 2. Carbon 3. RO Membranes 4. UV
In Built RO Capacity	10 Ltrs
No Of Memberanes	1 No
No Of Pumps	1 No
RO Wattage	65 Watts
UV Bulb Power	11 Watts
UV Bulb Make	Philips
UV Chamber Dimension	50 x 300 mm
Heater Wattage	1000 Watts
Compressor Model	THK 1340 YCF
Compressor Make	Tecumseh
No.of Faucets	2 No's - ABS
Machine Dimension (L x W x H)	309 X 302 X 1027
Outer Body MOC	Stainless Steel -304
No..of Power Cords (With Proper Earth Connection)	3 Pin 15 Amps - 1 No

W.11 Hydro pneumatic System for Multiple Overhead tank filling

The scope shall cover the supply, installation, testing, commissioning of the Variable Speed Hydro pneumatic system (Individual VFD for Each Pump). Booster should minimum consist of the components as per the below specifications. Complete system shall be tested at the manufacturer's factory, in accordance to the provisions of the appropriate standard before delivery. Manufacturer should have facility of witness test with proper test bed.

System Descriptions

The variable speed booster system shall be supplied and installed as designed.

The system shall comprise of number of pumps as mentioned in BOQ, in parallel and it shall be a package system manufactured by the manufacturer of the pumps at their factory. System assembled by the dealers locally will not be accepted. System should come with CED coated base frame & Manifolds to reduce the rust formation. The system shall consist of:

Vertical In Line Multistage Centrifugal pumps with IE5 efficiency class Motor as per IEC 60034-30-2 standard. Pump should come with integrated VFD & Control panel with each pump.

The quantity shall be as per BOQ.

Integrated Frequency Drives with each pump (IP 55 Protected) Quantity shall be as per BOQ.

Low Carbon steel Pre-pressurized bladder or diaphragm type pressure vessel complete with pre-charged nitrogen gas/Air to the design pressure settings.

Each pump shall have individual PI controller & integrated VFD and with IE5 efficiency class motor as per IEC standard.

Pipe work and valves, pressure transmitter, pressure gauge, check valve, gate valve and all necessary fittings etc to the satisfactory operation of the system and to make system as complete. Only supply & delivery line will be connected to start the system.

Components of Variable Speed Booster - Pumps and Motors

The pump shall be of approved make of vertical-in-line multistage centrifugal type pump with IE5 efficiency class motor, integrated VFD & controller with each pump with IP 55 protection.

The suction and discharge port shall be in line with each other. The maximum operating liquid temperature for the pump shall be up to 120 deg C.

The motors shall be vertically stool mounted on top of the pump casing and the pump casing shall be designed to take the dynamic load of the motor. The motor shall be provided with thrust bearing to cater for the downward thrust of the pump.

The manufacturer of the pump should have a local factory with at least 20 years of experience and able to provide after sales service. The factory must have a pump testing facilities with approved test bed to carry out pump as well as complete booster performance witness testing.

Pump Selection

Each pump shall have the stable characteristics and the operating point shall fall within the acceptable range on the pump curve. Duty point should not be selected at extreme right or left side of the curve.

The pump performance curve shall be complying with the tolerance according to ISO 9906:2012, 3B.

Per Pump Flow Rate -10 m³/hr (1W+1S), Head-20m

Pump Head and Base

Pump head and base should be made of CED (Cathodic Electro deposit) coated Cast Iron, SS-316 or better -Shaft, SS-304 Impeller, Mechanical Seal (SiC vs SiC face combination).

The motor terminal housing shall be of a completely watertight design with tight cable glands to prevent ingress of water. For bigger motor, the housing shall have provision for the lubrication of the motor bearing to enable the pump to run effectively with only periodic withdrawal for maintenance and lubrications, if required.

Shaft, Impeller and Guide Vanes

All the inter stage components (impeller, intermediate chambers, diffusers) as well as sleeves and guide vanes shall be made of stainless steel 304 material, Shaft-SS 316 or Better.

Mechanical Seal

The mechanical shaft seal shall be of cartridges type with seal faces of Silicon Carbide/silicon carbide material or C vs SiC.

It should be possible to change mechanical seal without opening the pump to reduce downtime.

Motor

The electric motor shall be of total enclosed fan cooled (TEFC) squirrel cage induction type suitable for operation on a 380-500V / 3 ph/ 50 Hz voltage supply. The motor shall be designed based on 50 deg C ambient temperature with IE5 Efficiency Class and integrated VFD & Controller (IP 55 Protection). The motor shall be of class F insulation and a minimum of IP 55 enclosure with a maximum surface temperature of 120 deg C.

The motor shall comply with the Efficiency Class IE5 requirement as per IEC standard.

All motors shall be sized for pump operation based on non-overloading conditions for the full QH curve. The motor shall also be suitable for at least 40 start/stop per hour.

All motor should be of IE5 efficiency class.

Variable Frequency Drives

Integrated AC variable (IP 55 Protection) drive with in-built Harmonics IEC/EN 61000-3-12. Up to

7.5 kW (5.5 kW low speed): Category C1 according to EN 61800-3, corresponding to CISPR11,

class B (residential area) Above 7.5 kW (5.5 kW low speed): Category C3 according to EN 61800-3,

corresponding to CISPR 11, class.

Pump Controller

Each Pump shall be having PI controller with HMI Graphical display. Controller should of the same make, as of pump i.e. Pump manufacturer should provide dedicated PI integrated controller with each pump for this application. General purpose PLC programmed for boosting application will not be accepted.

The controller should have the following features

as minimum: Built-in PI-controller.

External input signal both digital and

analog. Alarm output.

Soft pressure buildup.

Color Graphical Display.

Suitable for Modbus (RS 485).

Eternal BUS communication port.

Automatic pump changeover.

Upgradeable software program.

Back light for specific button to be light up only when applicable. Adjustable contrast for display.

Selectable service language.

Selectable units between SI and

US. Manual entry of pumps data.

Primary sensors.

Clock Program.

The controller should be able to perform the following functions as minimum: Selectable auto/manual mode for both system and individual pump from Controller.

Set point influence.

Friction loss compensation at lower flows.

Adjustable number of start/stops

Adjustable system time and error correction value

Adjustable ON/OFF band (stop function)

Pump test function

Security setting with password for operation and setting

External fault input

Selectable dry running protection for either digital or analog signal

Selectable auto/manual reset for dry running protection.

Selectable open/close loop operation

The controller should be able to display the following alarms, whenever it occurs:

Alarm log up to 24 event

Pump Selector Mode

Selection should be provided to enable any pump to be the lead pump, first duty pump, second duty pump and standby pump as desired. There shall be alternating mode selection too, where all pumps are operated cyclically upon each call for pumping.

Liquid Level Control

To prevent dry running, electrode liquid level or float level control shall be provided in the suction tank to shut down the system in the event of low water level.

Pump Isolation

It shall be possible to isolate any pump for maintenance without affecting the performance of the system in the automatic mode.

Alarm

Alarm should be displayed in case of any problem. Alarms should be as per details given in Panel section.

All panels/controllers shall be tested at the factory according to the procedures stipulated before dispatch. The manufacturer shall carry all spare-parts for the controllers. All spares of the controllers shall be readily available for a minimum period of 10 years after the production of the particular model of controller has been discontinued.

Hydro Pneumatic Pressure Tank

The hydro-pneumatic tank shall be of butyl bladder diaphragm type with pre-pressurized air/nitrogen. It shall be capable of handling the designed effective system protection (ESP) Volume to protect pump and operating controls by ensuring that the actual pump operation conform to the manufacturer's specified minimum running time and maintaining the designed pressure range.

The shell shall be constructed with deep-drawn low carbon steel.

The diaphragm/membrane shall be of heavy-duty type. This diaphragm/membrane should be the only component in contact with the liquid.

The tank should have an air valve for the introduction of compressed air.

The tank shall have a maximum operating pressure of 10 bars/16 Bar depending on the pump shutoff head and shall be able to handle a maximum liquid temperature of 90 DegC/70 DegC respectively.

Pressure Transmitter

Pressure transmitters shall be field mounted and shall transmit an isolated 4-20mA signal indicative of process variable to the pump logic controller via standard two wire 24 DC system. Unit shall have stainless steel wetted parts and it should be installed at the discharge header. It should have watertight, electrical enclosure capable of withstanding minimum 10/16 bar static pressure.

Headers, Skid & Accessories

The suction and discharge manifolds & skid shall be fabricated steel with Cathodic Electrode Deposit Coated. Both manifolds shall be designed to attach to the system piping at either end of the manifold (Completely Factory Assembled set, locally manufactured/assembled set is not acceptable). Delivery manifold shall include a pressure gauge along with 2 Nos of pressure transmitter. The discharge manifold shall include a socket to install a pressure transducer with a 4-20mA output. The pressure transducer shall be factory installed and wired.

Isolation valves shall be installed on the suction and discharge of each pump. A check valve shall be installed on the discharge of each pump (optional on the suction side for suction lift applications). Base frame should also be made of galvanized sheet.

Hydro pneumatic System Working

The system shall be under the control of PI based pump logic controller with graphical color display. 2 Nos. of pressure transmitter shall be incorporated into the system to detect the pressure at the discharge manifold and feedback to the Microprocessor based controller.

The system shall always maintain a constant pressure regardless of the system demand. The activation of the next duty pump in a high demand situation shall not be based on a different set point. However, the microprocessor-based controller should have a flow test function to determine the numbers of pumps in operation and a stop function into the controller to stop all pumps from operation, whenever there is no demand, which prevents and reduces wear and tear of the system as well as reduces energy consumption. The controller shall also ensure alternation of all pumps for even running hours.

The lead pump shall operate when the system pressure reduces to the preset point. If demand escalates, the lag pumps shall commence operation as required. During next operation lead pump to become lag and lag pump to become lead pump automatically. The system shall vary the frequency of each pump (in case of multi VFD system) and it will be equalized to ensure smooth operation to meet the specific demand. Under decreasing hydraulic demand, the reverse to the above description shall apply.

Operations

The control circuit shall enable automatic and manual operations of the system.

Automatic Operation

Everything will be controlled by controller in this case.

III TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

A TECHNICAL SPECIFICATIONS FOR ELECTRIFICATION WORK

A.1. TECHNICAL SPECIFICATION FOR LT SWITCH BOARDS

1.1 SCOPE

This specification covers the technical requirements for Design, Engineering, Manufacture, testing at manufacture works of 433 V LV Panel complete with all accessories for efficient and trouble-free operation.

1.2 STANDARDS

The equipment covered by this specification shall, unless otherwise stated, be designed, constructed and tested in accordance with the latest revisions of relevant Indian Standards and shall conform to the regulations of Local Statutory Authorities.

IS:722	A.C. electricity meters
IS:732	Code of practice for Electrical wiring installation.
IS:375	Marking and arrangement for switchgear busbar main connections and auxiliary wiring.
IS:1248	Direct acting electrical indicating instruments.
IS:13947	LV Switchgear and Control Gear.
IS:2705	Current Transformers.
IS:2824	Method for determining the comparative tracking index of solid insulating materials under moist 'conditions.
IS:3156	Voltage transformers
IS:3231	Electrical relays for power system protection.
IS:3618	Phosphate treatment of iron and steel for protection against corrosion
IS:5082	Material data for aluminum bus bars.
IS:5578	Guide for marking of insulated conductor.
IS:6005	Code of practice of Phosphating of iron and steel.
IS:8623	Specification for factory Built assemblies for Voltages upto1000V A.C. and 1200V D.C.
IS:4237	General requirements of switch gear and control gear for voltage not exceeding 1000V.
IS:2959	AC Contactors for voltage not exceeding 1000V.
BS:162	Specification for Electric Power Switchgear and Associated apparatus.

- IS:2834 Capacitors
- IS:1353 Guide for uniform system marking and identification of conductors and apparatus terminals.
- IS: 13703 Low voltage fuses.
- IS: 13947 LV Switchgear and control gear

1.3 CONSTRUCTION

1.3.1 General

The panel shall be factory-built assembly, metal-enclosed, free standing, compartmentalized, modular type Main panel (form 4B) and Sub Panels (Form 4A) suitable for indoor installation. The panel shall be dust and vermin proof and the enclosure shall provide a degree of protection of not less than IP-42/44. The panel shall be of uniform height not exceeding 2200mm. The fabrication shall be rigid, robust, flaw less and shall have a smooth finish.

The board shall be fabricated out of sheet steel of not less than 2.0mm thickness. The internal partition shall be of 1.6mm thick.

The panel shall be extendable on either side by the addition of a module. It shall be possible to extend the switch board irrespective of the type of end panel. The busbars shall be suitably drilled for future extension.

Incomers and outgoing feeders shall be provided with their own separate modules having separate doors, isolating switch of each unit shall be mechanically interlocked with its respective doors. Knob type screws shall be provided for securing the doors.

All feeder terminals shall be segregated fully and efficiently, using SMC / DMC / FRP Shrouds such that it shall be possible to work on one set of terminals when the other feeders are live.

Due consideration shall be given to the following during design of the Switchgear Panel and locating the various components viz. Circuit Breakers, Instruments & Relays, Busbar and secondary wiring.

- a. Facility for inspection, maintenance & repair
- b. Minimum vibration and Noise
- c. Risk of accidental short circuit, open circuit and damage to personnel due to accidental contact with live parts.
- d. Inter changeability of Components
- e. Secure and vibration proof connection for power and control circuit

f. Shrouding of all live parts in feeder component and cable chamber.
All retaining catches, screws and bolts for doors and covers shall be zinc passivated. Screws and bolts shall be captive. All covers, doors and joints shall be gasketed. Equipment to be mounted outside cubicles shall be flush mounted on cubicle door. No externally mounted equipment shall be mounted above 1.9m or below 0.4m from floor level. The panel shall be fabricated in suitable transport sections and assembled on rolled steel channel box frames, to form a continuous flush fronted switchboard. All components like MCCB/MCB Contactor shall be of same make & shall be suitably rated to achieve type - 2 co-ordination.

1.4 BUS BARS

The busbars shall be air insulated and made up of high conductivity, electrolytic Aluminium.

All busbars shall be fully screened by means of PVC sleeves in their own compartment running throughout the length of the panel both vertical as well as horizontal and also suitable allowance shall be made for bus expansion. Suitable segregation shall be provided in between busbar chamber and adjoining compartments.

The busbars shall be 0.8 Amps per Sq mm. of TPN with Neutral Bus being half the size of phase busbar.

The busbar shall be PVC sleeved with color strips of red, yellow, blue and black and the same shall be arranged in accordance with IS-375.

The busbar shall be properly segregated, suitably braced with insulated supports (SMC) placed at appropriate intervals to withstand the electromagnetic stresses during short circuit.

Minimum electrical clearances shall be maintained between phase, neutral and body as per standards.

The insulation used shall be non - hygroscopic and shall be treated for preventing fungus growth. The main incoming busbars shall be brought up to the top rear busduct flange and shall be provided with necessary drilled holes for fixing the fish plates for connection to the bus bars of the bus duct.

1.5 INTERCONNECTION

The interconnections of all the phases between the busbars and the incoming side of the switch control shall be inaccessible when the doors of the controls are opened.

For each and every tapplings from the bus bars, separate connections shall be made.

No direct tappings from the bus bar shall be made for any feeder without control and protection. All interconnections shall be by rigid busbars only.

Wherever lugs are used for terminations of rigid busbars, it shall be soldered and not crimped.

1.6 MOULDED CASE CIRCUIT BREAKER /MCB

The MCCB shall confirm to IS:13947 / IEC947 in all respects. The MCCB shall comprise of switching mechanism, contact system, arc extinguishing device, all mounted in a moulded case, made of high strength heat resistant and flame-retardant thermosetting insulating material.

MCCB shall employ quick make and quick break switching mechanism independent of the speed of operation of the operating handle. The operating mechanism shall be trip free. The operating handle shall indicate the position of the MCCB in ON / OFF / TRIPPED. The operating handle shall have provision for door interlock and padlocking. The MCCB shall be provided with micro-Processor based relay suitable for short circuit and overload and earth fault protection.

The over load protection shall be field settable. MCCB shall be suitable for horizontal and vertical mounting and with line load reversibility. All MCCB shall be of current limiting type.

MCCB shall be provided with RS 485 ports for Communication.

MCCB in Main Panel shall be CAT B Type and Sub Panels shall be CAT A Type.

1.7 Routine Tests

The Vendor shall offer the panel for inspection and the following routine test shall be conducted during the inspection.

1. Mechanical operation test
2. Dielectric tests
3. Physical check & dimension check megger test

1.8 DRAWINGS AND DOCUMENTS

The following drawings and documents shall be furnished.

- a. General Arrangement drawing of the panel showing.
 - i. Overall Dimensions (GA Drawing)
 - ii Terminal locations
 - iii. Total weight
 - iv Foundation details

- v. Sectional view
- vi. Bill of materials
 - b. Single line diagram and wiring diagram.
- c. Technical details for Switchgear, lamps, meters etc.
- d. Manufacturing schedule and test schedule.
- e. Calculation for sizing of busbars.

A.2.LT CABLES - CROSS LINKED POLYETHYLENE POWER CABLES

2.1 SCOPE

The section covers the supply, installation, storing, laying, fixing, jointing/termination, testing and commissioning of low voltage XLPE insulated armored sheathed aluminium conductor cables laid in built up trenches, directly buried underground, on cable trays, clamped directly to wall or structures etc., as called for in the drawing. The contractor shall provide all materials, labour, equipment, scaffolding etc., as required for the completion of LV cables, as called for.

2.2 STANDARDS

The cables covered by the specification shall, unless otherwise stated, be designed, manufactured and tested in accordance with the latest revision of relevant India standard.

IS 3975	: Mild Steel Wires, strips and tapes for armouring of cables.
IS: 8130	: Conductor for insulated electric cables and flexible cords.
IS 5831-84	: PVC Insulation and Sheath of Electric Cables
IS 7098	: Cross Linked Polythyethylene Insulated PVC sheathed
IS 1554-88	: PVC insulated (heavy duty) electric cables Part I for working voltages upto and including 1100V.
IS 3961-67	: Recommended current ratings for cables: (Part 2): PVC insulated and PVC sheathed heavy duty cables.

2.3 CONDUCTOR

The conductor shall be Aluminium / Copper as specified.

The conductor shall be smooth, uniform in quality and free from scale and other defects.

The Aluminium conductor for 10sq.mm and above (upto 6sq.mm copper cable or otherwise specified) shall be stranded and shall be clear and reasonably uniform in size and shape. The conductor shall be circular or Sector Shaped.

The stranded conductor shall be compacted to reduce dimension and to give smoother profile.

2.4 INSULATION SCREEN

The semi conducting insulation shield shall be preferably be strippable and shall be triple extruded thermoset type.

2.5 CORE SCREENING

The low voltage 1.1K above cable, shall be provided with copper tape screen over cores to achieve full coverage. The number and thickness of tape shall be suitable for the short circuit rating of the cables.

2.6 INNER SHEATH

The inner sheath shall be extruded PVC Polypropylene filler shall be provided.

2.7 ARMOUR

Galvanized steel wire / strips armour shall be provided over the inner sheath for protection against mechanical damage.

The armour coverage shall be more than 95% to achieve better mechanical protection and low armour resistance.

2.8 OUTER SHEATH

The outer sheath shall be extruded PVC and shall be resistant to termite and rodent attack. Progressive sequential marking, size marking, voltage grade name of manufacture at every one meter shall be made on the outer sheath.

2.9.1 TERMINATION OF CABLES

Cable termination shall be done in terminal box or cable end box or distribution boards, or apparatus/ equipments. Terminations are to be made with mechanical and glands be tinned/nickel plated, anti-corrosive, three piece improved pattern which is to grip inner and outer PVC sheaths as well as the armour of the cable. The cable ends or the core conductor are to be connected by solder less lugs or sockets using crimping tool of approved make for all cables.

All terminations of cable conductors and base conductors shall be mechanically and electrically sound and shall comply with the requirements of IEE regulations.

The connectors or connecting sockets are to have such dimensions so as to limit temperature rise.

When required the water tightness of the terminal boxes may be obtained by filling with a compound preferably plastic flame-retarding and non-dripping type within the normal range of temperatures.

When the cable is cut during the course of installation the open ends are to be sealed immediately by means of self-adhesive non-hygroscopic tape over a wax water seal to make an air and watertight joint.

2.9.2 INSTALLATION OF CABLES

Cable shall be laid in a manner as indicated on the drawings. Generally, cables are laid in the following manner.

- i. In the underground masonry trench.
- ii. On the cable tray/or on cable ladders.
- iii. Buried underground.
- iv. Through pipe sleeves.

Various installation methods are discussed in the following paragraphs. Cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cable. The cable drums shall be placed on jacks before unwinding the cable. The cable drums shall be rotated in the direction as indicated by the manufacturer. Care shall be exercised in laying cables to avoid forming kinks. The drums shall be unrolled and cables run over wooden rollers, placed at intervals not exceeding two (2) meters.

2.9.3 ROUTINE TESTS (To be performed on each drum length)

These shall include, among others normally performed by the manufacturer, the following:

- a. Conductor D.C. resistance test
- b. Capacitance
- c. Partial discharge level measurement at Power frequency
- d. High voltage test

A.3. LIGHT FITTINGS AND ACCESSORIES:

3.1 SCOPE

Scope of work under this section shall include inspection at supplier's/manufacturer's premises, appropriate, receiving at site, safe storage, transportation from point of storage to point of erection and erection of light fittings, fixtures and accessories including all necessary supports, brackets, down rods and painting as required. The contractor shall supply all materials and accessories (other than those supplied by the

owner), labor, tools, transportation, scaffolding etc., required for the completion of above work in all respects.

STANDARDS APPLICABLE:

The lighting and their associated accessories such as lamps, reflectors, housings, ballasts etc., shall comply with the latest applicable standards, more specifically the following:

Electric light fittings General and safety requirements	- IS - 1913.
Industrial lighting fittings with metal reflectors	- IS - 1777
Decorative lighting outposts	- IS - 5077
Flood Lights	- IS - 1947
Luminaries for street lighting	- IS - 2149
Bayonet lamp holders	- IS - 1258
Bi-pin lamp holders for tubular fluorescent lamps	- IS - 3323
Ballast for use in fluorescent light fittings	- IS - 1534
Starters for fluorescent lamp	- IS - 2215

3.2 Light Fittings - General Requirements:

Fittings shall be designed for continuous trouble-free operation under atmospheric conditions, reduction in lamp life or without deterioration of materials and internal wiring. Outdoor fittings shall be weather - proof and rain proof.

- a. Fittings shall be so designed as to facilitate easy maintenance including cleaning, replacement of lamps/starters etc.
- b. Outdoor type fittings shall be provided with weather proof boxes.
- c. Each fitting shall have a terminal block suitable for loop-out connection by 1100 V PVC insulated copper conductor wires up to 4 Sq.mm. the internal wiring should be completed by the manufacturer by means of standard copper wire and terminated on the terminal block.
- d. All hardware used in the fitting shall be suitably plated or anodized and passivated for use in industrial plants.
- e. Earthing each light fitting shall be provided with an earthing terminal. All metal or metal enclosed parts of the housing shall be bonded and connected to the earth terminal so as to ensure satisfactory earthing continuity throughout the fixture.
- f. Painting/Finish All surfaces of the fittings shall be thoroughly cleaned and degreased and the fittings shall be free from scale, rust, sharp-edges, and burrs.

- g. The housing shall be stove-enameled or anodized as required. The surface shall be scratch resistant and shall show no sign of cracking or flaking when bent through 90 deg. over 12 mm dia mandrel.

3.3. LED Batten – 20W/10W surface mounted

a) High Efficiency LED Batten with CRCA housing and high efficiency polycarbonate diffuser. The system lumens shall not be less than 2000 lumens with (6500K) 'CCT and wattage shall not be less than 20W. The CRI shall be > 80 . A specially designed heat management system to ensure luminous efficacy $\geq 105 \text{ lm/W}$. The luminaire shall be designed to meet its specifications on performance & life time at a design ambient temperature of 45 deg C and ensure lumen depreciation upto 30% over 40k burning hours as per L70. The luminaire shall be able operate from 140V - 270V AC, 50Hz with PF > 0.95 & THD $\leq 10\%$. The luminaire shall be compatible for short circuit and over voltage cut off protection. Luminaire shall be supply with suitable mounting accessories.

b) High Efficiency LED Batten with CRCA housing and high efficiency polycarbonate diffuser. The system lumens shall not be less than 1000 lumens with (6500K) 'CCT and wattage shall not be less than 10W. The CRI shall be > 80 . A specially designed heat management system to ensure luminous efficacy $\geq 105 \text{ lm/W}$. The luminaire shall be designed to meet its specifications on performance & life time at a design ambient temperature of 45 deg C and ensure lumen depreciation upto 30% over 40k burning hours as per L70. The luminaire shall be able operate from 140V - 270V AC, 50Hz with PF > 0.95 & THD $\leq 10\%$. The luminaire shall be compatible for short circuit and over voltage cut off protection. Luminaire shall be supply with suitable mounting accessories.

3.4. SURFACE/RECESS MOUNTED SQUARE/ROUND TYPE LED DOWN LIGHT

a) 13W LED 9S-4000K fitting

Surface/Recess mounted LED luminaire with efficient optics, System lumen efficacy $> 100 \text{ Lumen/Watt}$, System Luminous flux of 1300 lumens and System Wattage shall not be less than 13W with system burning hours of 50,000 hours as per L70. Color rendering index > 80 with SDCM of < 5 and Color temperature 6500K. CRCA housing with high efficiency opal diffuser. Luminaire with completely isolated LED compartment and integral construction. Zero maintenance, Zero mercury. Luminaire with surge protection of upto 3kV. Electronic In-Built PF > 0.9 , THD $< 10\%$, IEC Compliant for Safety, Performance & EMI. The luminaire shall be able operate from 140V - 270V AC.

b) 6W LED 6S-4000K fitting

Surface/Recess mounted LED luminaire with efficient optics, System lumen efficacy > 100Lumen/Watt, System Luminous flux of 6000 lumens and System Wattage shall not be less than 6W with system burning hours of 40,000 hours as per L70. Color rendering index > 80 with SDCM of <5 and Color temperature 6500K. CRCA housing with high efficiency opal diffuser. Luminaire with completely isolated LED compartment and integral construction. Zero maintenance, Zero mercury. Luminaire with surge protection of upto 3kV. Electronic In-Built PF > 0.9 , THD < 10% , IEC Compliant for Safety , Performance & EMI. The luminaire shall be able operate from 140V - 270V AC.

c) 12W LED Wall Mounted fitting

Wall mounted Incandescent type LED luminaire with efficient optics lamp, System lumen efficacy > 90 Lumen/Watt, System Luminous flux of minimum 1100 lumens and System Wattage shall not be less than 12W with system burning hours of 40,000 hours.

d) 5W Wall Mounted Foot Light fitting

Wall mounted type Foot lamp LED luminaire with efficient optics, System lumen efficacy > 70Lumen/Watt, System Luminous flux of 3500 lumens and System Wattage shall not be less than 5W with system burning hours of 40,000 hours as per L70. Color rendering index > 80 with SDCM of <5 and Color temperature 6500K. CRCA housing with high efficiency opal diffuser. Luminaire with completely isolated LED compartment and integral construction. Zero maintenance, Zero mercury. Luminaire with surge protection of upto 3kV. Electronic In-Built PF > 0.9, THD < 10%, IEC Compliant for Safety, Performance & EMI. The luminaire shall be able operate from 140V - 270V AC.

3.5. Bulk Head and High Bay type LED fitting**a) 9W LED Bulk Head fitting**

Supply of LED Bulkhead with a nominal system lumen output of 600 lumens and a minimum system efficacy of 60 lm/W. The luminaire shall have a rated system lifetime of 50,000 burning hours at L70. The luminaire should have a color temperature of 6500K and CRI > 70. The luminaire shall meet IP66 rating and IK 09 rating with THD < 20% and PF > 0.9. The luminaire housing should made of High pressure die cast Aluminium with polycarbonate front diffuser. The total power consumption should not exceed 9W (including driver).

b) 32W LED Wall Mounted Periphery lighting light fitting

The wall mount shall be installed with clamp bolt nets. Along with LED light with die cast aluminium housing, inbuilt driver, system wattage maximum of 32 Watts, lumen output of lamp greater than 3000 lumens, power factor > 0.9, rated life of L70 @ 50,000 hours. system efficacy greater than 100lumen/watts, IP 66 compliant including all necessary accessories as required complete, IK08 compatible. Luminaire with IEC compliance of IEC10322, IEC 60598. The operating voltage of the luminaire shall be 140V - 270V, power factor of PF>0.9. The luminaire shall be supplied along with the decorative 5m to 7m pole. Luminaire shall have Manufacturer warranty of minimum 3 years.

A.4. DISTRIBUTION BOARD, MCBs, ELCB and RCBOs**4.1 SCOPE**

This specification covers the safety-first selection of SPN DBs, TPN Selector switch DBs, testing at works as per IS 8623 and IEC 61439-3. Complete with all accessories for efficient and trouble-free operation.

4.2 CONSTRUCTION

The TPN - Phase Selector vertical type distribution boards shall be totally enclosed with inbuilt 3 no's of 63/40 A Phase selector switches, the DBs as per IEC 61439-3, IP 43, dust and vermin proof, dead front, door-reverse, key lock convertible, door and shield independent, DPX type suitable for flush mounting and surface mounting.

The provision for FP MCB/Isolator/RCCB/RCBO as incomer and SP MCB's as outgoing

Each board shall have gasketed doors with cam lock arrangement. Removable conduit/cable entry plates shall be provided at top and bottom of the board to facilitate drilling the conduit holes at site to suit individual requirements or knockout shall be provided.

Protective insulated cover plate shall be provided inside the board to shroud all the live parts. Only the operating handle of the switch and the operating knobs of the miniature circuit breakers shall be projecting outside the inner cover plate. The unused outgoing gap of board shall be suitably blanked with PVC plate at no extra cost. The

incoming switch terminals shall be suitably shrouded to avoid accidental contact. Circuit identification cables shall be provided on the cover.

All boards shall be phase segregated and shall be provided with Double Door arrangements.

All components in the Distribution boards shall be of as per approved make.

4.3 BUS BARS

The busbars shall be fully insulated and made of high conductivity high strength copper busbars liberally sized with high safety factor for the required rating (both short circuit and continuous currents). The neutral busbar shall have adequate number of terminals for all outgoing single-phase circuits. The Earth bar and Cable ties for Cable management. Fully insulated busbar & shrouded Neutral bars.

4.4 MINIATURE CIRCUIT BREAKERS

The Miniature Circuit Breakers (MCBs) shall be heat resistant, moulded type, designed, manufactured and tested as per IS 8828. The MCBs shall have inverse-time tripping characteristic against over loads and instantaneous trip against short circuits. The MCBs shall be of fault current limiting type also. The MCBs shall be slip on type to the busbar. The ON and OFF positions of the switch handle shall be clearly marked. The incoming and outgoing of the MCBs shall be accessible only after opening the front door of the DB. The MCBs shall be suitable for 433V, 3 phase, 4 wire, 50 Hz system with the fault level of 9-10 KA RMS symmetrical. The terminals of MCBs shall be suitable for use with eye lugs. The 4 pole, 3 pole and 2 pole MCB knobs shall be trunked with tandem pin of adequate strength.

Watt loss per pole shall not exceed 2W for 6A & 16A, 2.5W for 20A, 4W for 32 A and 6W for 63A.

4.5 EARTH LEAKAGE CIRCUIT BREAKER

Earth leakage miniature circuit breakers current operated with a sensitivity of 30 mA or 100mA wherever mentioned. The ELCB shall have Trip free mechanism and shall operate even on neutral failure.

The ELCB shall be provided with a Test Push Button to stimulate leakage and test the ELCB. The ELCB shall operate and switch off the circuit within 300 milli seconds in case of a fault.

The enclosures of the ELCB shall be moulded from High quality insulating materials, which shall be fire retardant, anti-tracking, non-hygroscopic, impact resistant and shall withstand high temperatures.

4.6 GROUNDING

The board shall be provided with two brass earthing stud terminals with suitable nuts, washers for connection to earth bus outside the boards.

4.7 TESTS

All necessary routine tests shall be performed on the equipment to demonstrate satisfactory performance at works without any extra cost. Equipment shall not be dispatched without obtaining approval of test certificates for type, routine and acceptance tests. The test certificated shall be provided by vendor along with the delivery of the material.

4.8 DRAWING & INSTRUCTION MANUALS

Along with the offer, the Contractor shall submit the following documents, in Triplicate.

- a. General arrangement of board size.
- b. Technical leaflets on board, MCB, isolator etc.
- c. Type test reports as per IS 8828
- d. Tripping characteristic curves for MCB.

After award of the order, the contractor shall submit the following documents for approval, in six copies.

- a. General arrangement drawing showing the constructional features, dimensions, installation details etc.
- b. Complete technical particulars of Distribution boards, miniature circuit breakers, isolators etc.
- c. Tripping characteristic curves for MCB.

Before taking up manufacturing of the equipment the Contractor shall have to take the approval of, for design and drawing. Any manufacturing done prior to approval shall be rectified by the bidder at his own cost and the equipment shall also be supplied within the stipulated period.

A.5. TECHNICAL SPECIFICATION FOR EARTHING

5.1 SCOPE

This specification covers the supply, installation testing and commissioning of earthing system.

STANDARDS

IS 3043 : 2018 Code of Practice for earthing

5.2 EARTH ELECTRODE

Earth Electrode shall be used AS MES and IS 3043: 2018 Code of practice.

The Electrode shall be enclosed in a concrete earth pit with suitable RCC covers and Lifting Hooks. Each earth electrode shall have provision for individually testing the electrode.

Earth electrodes shall be erected 1.5 Mts. away from the building edge and minimum spacing between the electrodes shall be maintained as per IS: 3043

All the earth pits shall be identified with name plates.

5.3 EARTHING LAYOUT

Earthing conductors in outdoor areas shall be buried atleast 300mm below finished grade level unless stated otherwise.

Wherever earthing conductors cross cable trenches, underground service ducts, pipes, tunnels, etc. it shall be laid minimum 300 mm below and shall be re-routed in case it fouls with equipment structure foundations.

Tap-connections from the earthing grid to the equipment/structure to be earthed shall be terminated on earthing terminals of the equipment/structure, if the equipment is available at the time of laying the grid, otherwise, "earth riser" shall be provided near the equipment foundation/ pedestal for future connections to the equipment earthing terminals.

Earthing conductors along their run on cable trench ladder columns, beams, walls, etc. shall be supported by suitable cleating at intervals of 750 mm. Earthing conductors along cable trenches shall be cleated to the wall nearer to the equipment. Cable trays and supports shall be connected to the earth mat at every 30 meters' interval. Wherever it passes through walls, floors, etc. GI sleeves shall be provided for the passage of the conductor.

Earthing conductor around the building shall be buried in earth at a minimum distance of 1500 mm from the outer boundary of the building.

5.4 EQUIPMENT EARTHING

All electrical power items shall be earthed by two separate and distinct earth connections from main earth bus.

Metallic conduits shall not be used as earth continuity conductor.

Wherever earthing conductor crosses or runs along metallic structures such as gas, water, steam, conduits, pipes etc. and steel reinforcement in concrete, it shall be bonded to the same. Cable end boxes, glands, etc. shall be connected to the earthing conductor running along with the supply cable which, in turn, shall be connected to earthing grid conductor at minimum two points.

The metallic screens of the single core cable, shall be connected to earth at one end only.

5.5 JOINTING

Earthing connections ground rods with equipment earthing pads shall be by cad welded moulding type. Contact surface shall be free from scale, paint enamel, grease, rust or dirt. Two bolts shall be provided for making each connections Bolted connections, after being checked and tested shall be taped with PVC tape.

Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor. The earth strip jointing, painting with bitumen paint.

5.6 GENERAL

Excavation and refilling of earth necessary for laying of underground earth bus and earth pipes shall be the responsibility of the Contractor.

All earth electrodes shall be tested for earth resistance by means of standard earth resistance tester.

Earthing resistance of the main bus shall be measured after connecting all the electrodes to the bus and the resistance shall not exceed one (1) ohm.

The exact location of Earth Bus/conductor, earth electrodes and earthing points on the equipment shall be determined at site in consultation with EIC. Any change of methods, routing, size of conductor shall be subject to approval by Contractor.

A.6 WIRING SYSTEM

SCOPE

The scope of work under this section generally covers internal wiring for lights, fans, exhaust fans, call bells, fan coil units, geysers, power sockets etc., The contractor shall provide all materials, labour, equipment, scaffoldings, etc., as required for the completion of wiring installation called for. The wiring shall generally be done using PVC insulated copper conductor wires in PVC/G. I conduit as called for including providing switches, sockets, plug tops, fan regulators, outlet boxes etc.,

6.1 STANDARDS APPLICABLE

6.1.1 The applicable standards for above work shall be as listed below:

- IS: 732 Code of practice for electrical wiring installation (System voltage not exceeding 650V).
- IS: 1646 Code of practice for fire safety of buildings (General Electrical installation).
- IS: 2667 Fittings for rigid steel conduits for electrical wiring.
- IS: 3480 Flexible steel conduits for Electrical wiring.
- IS: 3837 Accessories for rigid steel conduit for electrical wiring.
- IS: 694 PVC insulated cables.
- IS: 2509 Rigid - non-metallic conduits for electrical wiring.
- IS: 6946 Flexible (Pliable) non-metallic conduits for electrical installation.
- IS: 1293 3 Pin plugs and sockets.
- IS: 8130 Specifications for conduits for electrical installation.
- IS: 3854 Switches for domestic purpose.
- IS: 3415 Fittings for rigid non-metallic conduits.
- IS: 4648 Guide for electrical layout in residential building.
- IS: 9537 Conduits for electrical installation.
- IS: 302 General and safety requirements for household and similar electrical appliances.
- IS: 3043 Code of practice for earthing.
- IS: 5216 Guide for safety procedures and practices in electrical work.

Indian Electricity Act and Rules.

Regulations for the electrical equipment in buildings issued by the Bombay Regional Council of Insurance association of India.

All standards and codes mean the latest.

6.2 POINT WIRING FOR LIGHTS, FANS, EXHAUST FANS & 5A CONVENIENCE SOCKETS

- 6.2.1** A point wiring shall consist of the branch wiring from the distribution board together with a switch/fan regulator as required, including providing conduit and accessories, the ceiling rose or pendant holder or a swan holder, or ceiling fan hook box or socket etc., with suitable termination. Point wiring shall include, in addition, the earth continuity conductor/wire from the distribution board to the earth pin/stud of the outlet/switch box and to the outlet points.

The point wiring shall be carried out in the under mentioned manner:

- b) Supply, installation, fixing of PVC conduits and GI pull wire with necessary accessories, junction/pull/inspection/switch boxes and outlet boxes/Fan hook box etc.
- c) Supplying and drawing of wires of required size including earth continuity PVC insulated wire.
- d) Supply, installation and connection of Modular type switches, sockets, cover plates, switch plates, and fixing fan regulator, lamp holder, ceiling rose etc.,
- e) The point shall be complete with the branch wiring from the distribution board to the outlet point, through switch board, conduit with accessories, junction, pull, inspection boxes, control switch, socket, outlets boxes, ceiling roses, lamp holder, connector, extension cord wire, flexible conduits etc.,

6.2.2 POINT RATE

For purposes of measurements and payments the rate for point wiring for lights/fans etc., is divided into two parts.

- a) Circuit Main
- b) Point Wiring.

a) Circuit Main for Light/Fan Point

The circuit main for lights/fan/6A sockets (where 6A sockets connected to light circuit) shall include the wiring from the MCB distribution boards to switch box. This is measured in linear meter. The scope of work under this section shall include

- i) Supply and wiring in concealed/surface conduit from DB's to first Switch / light / fan point.
- ii) Providing and installing PVC insulated copper conductor earth wire.
- iii) Providing and installing GI fish wire (pull wire) in the conduit.

- iv) Termination of wires in DB's and switches using proper tinned copper lugs of Crimping type.
- v) Providing and installing necessary pull/junction boxes where necessary.

b) Point Wiring

The rate for point shall include supply, installation, and connection, testing and commissioning of point wiring in conduit. The points shall be measured in No/sets for the set/group of lights controlled as mentioned in SOQ.

The exact scope of work included in the point wiring for the purposes of measurement is numerated as stated below

- i) Wiring starting from the first switch/light/fan point, where the circuit main is terminated to the various lights/fans/sockets (where 6A sockets connected to light circuit loop), and then looping between the switches/lights/fans/6A sockets etc.,
- ii) Providing and installing all necessary switches, switch plates, sockets, pull/junction/fan hook boxes etc. as called for. Providing and installing insulated earth continuity wire in each conduit along with the wiring system.
- iii) Providing and installing G.I. fish wire (pull wire) in the conduits.
- iv) Providing and installing ceiling roses, lamp holders where necessary.
- v) Providing and installing PVC insulated, PVC sheathed flexible three cores 1.5 Sq.mm extension cords including flexible conduits from light/fan outlet points mounted at ceiling point to the light/fan outlet.

Wiring for 6A Sockets, 16A Power Sockets for Equipment Wiring

Except where 6A sockets connected to the lighting loop which are measured in Number of points, the measurement for wiring of 6A/16A sockets and wiring for power outlets is done as follows:

- i) Length of circuit wire including conduit, accessories and earth wire for power wiring is measured together in linear meter.
- ii) The socket outlet with outlet box is measured in Numbers.

6.3 MATERIALS:**6.3.1 CONDUITS**

Type of Conduit

Generally concealed electrical wiring installation shall be in PVC conduits and surface wiring in G.I conduits.

a) **PVC CONDUITS:**

Non-metallic conduits and accessories shall conform to IS 9537 (part 3) - 1983, IS 2509 & IS 3419 and each conduit shall bear the ISI Mark. PVC conduits shall be of the black, round, heavy gauge polyvinyl chloride (PVC). The conduit shall be plain end type as specified in IS 2509-1973/IS 2537-1983. The conduit internal surface shall be smooth. Only approved quality factory made bends/accessories shall be used. Minimum size of conduits shall be 20mm diameter. PVC conduits shall be rigid unplasticised, heavy gauge having minimum wall thickness of 2.0mm upto 25mm diameter conduit and 2.5mm wall thickness for all sizes above 25mm diameter.

6.3.2 CONDUIT ACCESSORIES

PVC CONDUIT BENDS & COLLARS

The PVC conduit bends & collars shall be of heavy duty and preferably of the same make as of conduit. This shall conform to IS 9537/1983 Part III with ISI Mark where necessary bends or diversion may be achieved by means of using bends and or circular inspection boxes with adequate and suitable inlet and outlet termination. In case of recessed installation system. The bends shall be properly secured & flush with the finished wall surface. Elbows shall not be used. No bends shall have radius less than 2 1/2 times the outside diameter of the conduit.

PVC/INSPECTION/JUNCTION/PULL BOXES

The Inspection/pull box/junction box, where used, with relevant PVC conduit installation shall be of heavy gauge PVC and conform to IS specification and shall match with the conduit sizes. The box shall be round/square rectangular with conduit stub projection for termination of conduit. The box shall be of minimum 50mm deep and the size of box shall be suitable to pull/make necessary joints of wires inside the boxes. Extra deep boxes are preferred. The boxes shall have flush type cover. The color of plate shall match the color of paint of the surface where installed. The boxes shall have concealed screwed socket for fixing the ceiling rose.

6.3.3 SWITCH OUTLET & SOCKET OUTLET BOXES CONCEALED TYPE OUTLET BOXES

The concealed outlet boxes for switches, sockets, power outlets, telephone outlet, fan regulator etc., shall be of standard factory made and to match the exact requirement of combination of outlets. The boxes shall be fabricated out of heavy gauge CRCA cold rolled carbon alloy sheet steel with zinc plating (G.I). The size of boxes shall match the type of outlet/switch plate to be mounted on the box. Adequate No. and size of knockout holes shall be provided to terminate the conduits in the box. These boxes shall be of standard factory-made product and of same make as of switch plates and sockets. Separate screwed earth terminal shall be provided in the box for earthing. The outlet box shall be of minimum depth of 50mm. Boxes shall be suitable for grid mounting type of accessories. Long screw shall be provided to take care of the extra plaster thickness to mount the switch plates. Provision shall be made in the box and switch plate to have the minor adjustment of alignment of switch plate to plumb level.

SWITCHES

Switches shall conform to IS: 3854, and IS: 4615. Switches shall be single pole, single or two ways as shown on the drawings. They shall be of the molded type rated for 250V, 5/15A. They shall be provided with insulated dollies and covers.

The switches shall be rocker operated with a quiet operating mechanism with bounce-free, snap acting mechanism in an arc resistant chamber. The switches shall have pure silver and silver cadmium contacts. The switches shall be of approved make as indicated in the 'List of Approved Makes'. Switches installed outdoors shall be industrial, metal clad type, and shall be provided in weather-proof enclosure, complete with weather proof gasketed covers.

COVER PLATES FOR SWITCHES & OUTLETS

Switches/sockets/wiring devices plates shall be of the same make as of switches/sockets/wiring devices. These shall be of best quality. Moulded plastic grid mounting type device plates/frames shall be used and these shall match with the type of switches/sockets and boxes.

COVER PLATES FOR INSPECTION/JUNCTION/PULL BOXES

The cover plate for PVC boxes shall be with minimum 3mm thick Perspex / Formica sheet cover and for the G.I boxes shall be of G.I plates. The shape of the plate shall match with that of the box.

CONDUCTORS:

All PVC insulated copper conductor wires shall conform in all respects to standards as listed under sub-head 'Regulations and Standards' and shall be of 650/1100V Grade.

PVC INSULATED WIRES (FOR LIGHT & SMALL POWER WIRING)

The PVC cables shall conform to IS: 696/1977. For all internal wiring PVC insulated cables of 650/1100V grade, single core shall be used. The wires shall have the approval of Tariff Advisory Committee.

The cores of all cables shall be identified by colors in accordance with the following sequence.

- Single phase - Red
- Three phase - Red, Yellow, Blue
- Neutral - Black
- Earth - Green or Green/Yellow.

A means of identifying the manufacturer shall be provided throughout the length of cable.

Unless otherwise specified in the drawings, the sizes of the cables/wires used for internal wiring shall be as follows:

In case of circuit wiring for lights, exhaust fans, ceiling fans, bells, convenience socket outlet points: -

1.5 Sq.mm - For 5A socket wiring from nearest switch box to outlet points

2.5 Sq.mm - For Lights/fans/5A socket wiring from DB's upto the outlet points including Control wiring where the circuit length from the DB's to 1st outlet is less than 40 m.

4.0 Sq.mm - From DB's to 16 A sockets.

The earth continuity conductor size as indicated in the drawing/SOQ shall be drawn through conduit along with other circuit cables/wires. The size of the earth continuity conductor shall be as follows: -

UNLESS OTHERWISE SPECIFIED MINIMUM SIZE OF EARTH CONTINUITY CONDUCTOR WIRES NOT FORMING PART OF THE SAME CABLE AS THE ASSOCIATED CIRCUIT CONDUCTOR.

Nominal cross-sectional area of	Nominal cross-sectional area of earth
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largest associated copper circuit conductor in Sq.mm	continuity conductor in Sq.mm (PVC insulated green color wire)
1.5	2.5
2.5	2.5
4.0	2.5
6.0	4.0
10.0	6.0

Separate circuits shall run for each water heater, pantry/kitchen equipment, window air conditioner, and similar outlets at locations as shown on drawings.

A.7. TECHNICAL SPECIFICATION FOR INSTALLATION

7.1 STANDARDS

The equipment erected shall be in accordance with the latest revision of relevant Indian Standards.

IS:10118	:	Code of Practice for Selection, Installation and Maintenance of Switchgear and Control Gear
IS:12063	:	Degree of Protection provided by enclosures
IS:8623:		Specification for Factory Built Assemblies for Voltages upto 1000V AC & 1200V DC
IS:732	:	Code of Practice for Electrical Wiring Installation.
IS:1646:		Code of Practice for Fire Safety of Buildings (General) Electrical Installation
IS:3043:		Code of Practice for Earthing

7.2 DRAWINGS

Before start of execution work from the Contractor shall prepare all necessary installation drawing based on the drawings supplied by the consultants.

All design calculation, installation drawing prepared by the Contractor shall be submitted to the BEML / Consultant for Approval.

The Contractor shall be responsible for preparing necessary drawings for submission and obtain approval from statutory authority including but not limited to CEIG and EB.

All drawings need to be approved by BEML / Consultant prior to start of Erection or Installation.

7.3 EQUIPEMENT AND MATERIALS

All equipment and materials supplied by the Contractor shall be suitable in all respects, for the type of environment specified.

All equipment and materials supplied shall be to the approval of the BEML regarding Quality, Conformity to the specification and standards and suitability for the specified site conditions.

7.4 STORAGE AND CARE PRIOR TO ERECTION

The Contractor shall be fully responsible for the safe storage and care of equipment and materials. The Contractor shall be responsible for care and maintenance of all the Electrical equipment's, whether supplied /erected by him or by BEML, after the installation is completed and until the final certificate of acceptance of Electrical Installation is signed.

7.5 LV PANELS / METERING PANEL

All busbar joints shall be tightened using torque wrench and all shipping sections shall be properly bolted together.

After completion of cable terminations, all unused cable entry holes are to be covered to make the panel vermin proof.

The contractor can do basic tests as physical check, ration test, insulation resistance etc.

7.6 DISTRIBUTION BOARDS

Distribution boards shall be erected on wall / structure using GI Anchor Rail (2.5mm Thick) with spring loaded Nuts.

Necessary clearance shall be maintained in front of the Distribution Boards for operation and maintenance.

The contractor can do basic tests as physical check, ration test, insulation resistance etc.

7.7 LIGHTING

The installation shall include all fittings, support brackets, clamps, cleats, down rods, ball & socket, earthing, cabling, wiring & conduits, in accordance with the requirements of this specification.

Wiring shall be done using Single Core PVC insulated multi stranded copper conductors, laid in GI Conduits unless otherwise mentioned separately. Suitable nonmetallic junction boxes shall be provided wherever required.

The contractor can do basic tests as physical check, insulation resistance etc.

7.8 CABLING

No cable shall be laid alongside a water main. Spacing equal to the diameter of the cable shall be maintained between adjacent power cables.

Selection of cable drums for each run shall be so planned as to minimize straight through joints. In each cable run, extra length shall be kept at a suitable point to enable one straight through joint to be made, should the cable develop a fault at a later date.

Whenever straight through joints are made, a “S” loop of sufficient length shall be kept at both ends for future of use.

All due care shall be taken during unreeling, laying and termination of cable, to avoid damage due to twist, kink and sharp bends, etc. Cable drum jacks shall be used wherever cables are to be unreeled and cables shall not be unreeled when the drums are lying on their sides. Wherever cables pass through floor or through wall openings, it shall be taken through pipe sleeves. The open ends of the sleeves shall be sealed by cold setting compound after cables are pulled through them to prevent entry of vermin and ingress of water.

The Contractor shall replace at his cost any cable pulled off from drums lying on its side.

While laying cable, cable rollers shall be used. The cables shall be pushed over the rollers by a gang of people positioned between rollers. The cable shall not be pulled from the end without intermediate pushing arrangement. The bending radius shall not be less than that specified by the manufacturer.

Each cable shall be provided with punched aluminium identification tags at every 50M intervals and at both ends.

The tag shall be of aluminium, with the number punched on it and securely attached to the cable by stainless steel straps. All multi core cables shall be secured to the cable tray by UV rated PVC ties at every 600mm intervals. The contractor can do basic tests as physical check, ration test, insulation resistance etc.

7.9 Cable Termination

LT Cable Termination

Termination of LT armored cables shall be by means of compression method using compression type cable glands and compression type lugs.

Whenever aluminium cables are to be terminated on copper busbar or vice versa, necessary bimetallic washers shall be provided.

All control cables shall be terminated using pin type lugs.

Cable tails shall be sufficiently long to run all cores to the farther most terminal and then back to the appropriate point of connection.

All cable glands shall be properly earthed using suitable earthing clips and connected to main earth bus. Wherever required, extension boxes shall be provided.

The Contractor shall submit samples of all cable gland, lugs & Bi - Metallic washers. The contractor can do basic tests as physical check, ration test, insulation resistance etc.

7.10 EARTHING

The Earth Electrodes will be located in the Substation Area and will be connected to an Earthing Terminal Board. The main Earth Bus in all the L.V. Panels will be connected to the Earth Terminal Board using suitably sized PVC insulated copper cables. The contractor can do basic tests as physical check, ration test, insulation resistance etc.

7.11 INSPECTION

After completion of erection/installation, each piece of equipment shall be thoroughly inspected in the presence of Engineer in Charge / Consultant for correctness and completion of erection and operation.

7.12 MISCELLANEOUS ITEMS

The Contractor shall supply and install the safety devices as required by the statutory authorities but not limited to the following.

- Danger boards for LT Panels & Transformers.
- Rubber mats for switchgear panels, power distribution boards etc.
- Rubber gloves, first aid charts, first aid box etc.
- Fire extinguishers and Fire Buckets.
- Earth Rod.
- The contractor can do basic tests as physical check, ration test, insulation resistance etc.

7.13 STATUTORY REQUIREMENTS / APPROVAL FROM STATUTORY AUTHORITIES.

Electrical Contractor - Work for electrical installation shall be carried out in accordance with this specification and complying with the relevant statutory requirements and national standards. It shall be the responsibility of Contractor to obtain approvals of competent Central or State Government authorities and satisfy them regarding the compliance with relevant regulations for this scope of work.

The Contractor should possess a valid ESA /EA grade license issued by the Electrical Licensing Board. **The entire electrical work should be carried out only under the**

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supervision of A grade licensed supervisors. The licenses possessed by the Contractor's supervisor shall be made available to the Client for scrutiny before commencement.

Test certificate for installation shall be prepared in the form required by Chief Electrical Inspector/Electricity Board. Any rework on account of remarks by Electrical Inspector shall have to be carried out by the Contractor at no extra cost.