B. SPECIFICATION FOR CIVIL WORKS

B1. STANDARD CONSTRUCTION MATERIALS

1. WATER

Water for construction work shall not be salty or blackish and shall be clean drinking water, reasonably clear and free from objectionable quantities of silt and traces of oils, acid and injurious alkali, salts, organic matter and other deleterious material which will weaken the concrete. Water shall be obtained from the sources approved by the Engineer. Sources of water shall be maintained at such a depth and the water shall be withdrawn in such a manner as to exclude silt, mud, grass or other foreign materials. Containers for transport, storage and handling of water shall be clean.

2. CEMENT

Cement shall conform to I.S. 269-1976 / I.S. 8112-1989. The type of the cement as to whether it shall be ordinary Rapid Hardening or Low Heat shall be specified. When no type is specified, Ordinary Portland Cement shall be used.

The weight of Ordinary Portland Cement shall be taken as 1440 kg per cum and Rapid Hardening Portland Cement as 1210 kg per cum. The measurement of proportion of cement should normally be on the basis of weight and whole bags each undisturbed and sealed 50 kg. When part bag is required, cement shall be taken to see that each bag contain full quantity of cement.

Tests: when tests are considered necessary, they shall be carried out as indicated in I.S. 269-1958/I.S. 8112-1989. The contractor should ensure that the cement is of sound and required quality before using it.

Storage: cement required for use shall be as fresh as possible and stored on planks raised 15 to 20 cms above the storey and stacked 30 cms away from the walls in suitable closed weatherproof buildings at the work site or at the selected approved site in such a manner as to prevent deterioration by dampness or moist atmosphere or intrusion of foreign matter. Cement shall be stored in such a way as to allow the removal and use of cement in chronological order of receipt, i.e. first received being first used. Not more than 15 bags shall be stacked vertically in one pile and maximum width of the piles should not be more than 3 meters. Any cement which has deteriorated cracked or which has been damaged shall not be used. Cement concerning which there is doubt shall not be used pending testing and satisfactory results. Cement that is condemned shall be immediately removed from the work site. When temporarily stored in the open for use within 48 hours, it shall be kept on a platform of planks about 15 to 20 cm above ground and covered with a tarpaulin. Ordinary cement stored for more than 2 months from the date of receipt from the factory shall be subjected to test and used only if found satisfactory. The cost of test shall be borne by the Agency responsible for the storage after two months from receipt. Different kinds or brands of cement or cement of the same brand from different factory (mills) shall be stored in separate groups and shall not be mixed during use except when directed in writing by the Engineer. Cement shall be kept in a store under double locking arrangement so that it can be taken out or fresh stock admitted with the knowledge of supervising staff of the Works. A board indicating stock and daily transactions of cement shall be kept in each room of the cement store. The cement shall not be stored unduly long periods. It shall not be handled in such a way as to impair its strength or useful characteristics.

3. SAND

Sand shall consist of siliceous material having hard, strong, durable, uncoated particles, free from undesirable amounts of dust, lumbs, soft, or flaky particles or other deleterious substances. The amount of different undesirable substances shall not exceed the percentage limits by weight as specified in relevant I.S. Codes but in no case, the total amount of all undesirable substances shall exceed five percent by weight.

All fine aggregate (sand) shall conform to I.S. 383-1970.

Sand for use in concrete shall be natural sand. Sand shall be clean, well graded, hard, strong, durable and gritty particles free from injurious amounts of dust, clay, soft or flaky particles, shale, salts, organic matter, loam, mica or other deleterious substances and shall be approved by the

Engineer. When the quality of fine aggregate is doubtful, it shall be tested for clay, organic impurities and other deleterious substances as laid down in I.S. 383-1970.

The fine aggregate shall be of the sizes as specified below.

a. Cement concrete topping of thickness 40 mm and above - fineness modules between 2 and 3.

b. Cement concrete topping of thickness 10mm and above - fineness modules between 4 and 6.

4. REINFORCING BARS

Reinforcing steel shall be clean and free from loose millscales, dust, loose rust and coats of paints, oil, grease or other coating, which may impair or reduce bond. It shall conform to the following I.S. specifications.

1. Mild steel, Tor steel and medium tensile steel bars and hard-drawn steel wire conforming to IS:432, IS:456, latest revision.
2. Deformed bars conforming to IS:1139 latest revision.
3. Cold twisted steel bars ribbed Tor steel conforming to IS:1786 - latest revision.
4. Hard-drawn steel wire fabric conforming to IS:1566 - latest revision.
5. Structural steel section conforming to IS:226 - latest revision.

All steel reinforcement above 6mm diameter shall necessarily be of tested quality.

5. BRICKS

Bricks: Unless otherwise specified, burnt clay bricks shall conform to the requirement of I.S. 1077-1957. Specification for Common Burnt Clay Building Bricks and shall be first class quality. The bricks have been referred as local chimney made bricks and machine made brick for fair face. Bricks shall be of uniform deep red, thoroughly burnt, regular in shape and size and shall have sharp and square edges and parallel faces to ensure uniformity in the thickness of the courses of brick work.

Bricks shall be free from cracks, chips, flaws, stones or lumps of any kind. They shall be free from salt which effect the mortar of the masonry. Bricks shall not show any sign of efflorescence either dry or subsequent to soaking in water. Bricks shall be sound, hard, homogeneous texture and emit a clear ringing sound on being struck and water absorption shall be minimum. All bricks shall have to be approved by the Engineer/Resident Engineer. Any bricks not up to the specification must be removed from the site immediately at Contractor's own cost. Representative samples of bricks to be used shall be submitted to the Engineer and his approval taken before bulk purchase. The samples shall be kept with the Engineer for future reference and comparison. All bricks supplied shall conform to these approved samples in all respects.

Bricks shall not be dumped at site. They shall be stacked in regular layers even as they are unloaded. The supply of bricks shall be arranged that at least two weeks requirement of bricks are available at site at any time.

Bricks selected for different situation for use in the work shall be stacked separately.

6. COARSE AGGREGATE

Coarse aggregate shall consists of crushed or broken stone and be hard, strong, dense, durable, clean and of proper gradation and free from skin and coating likely to prevent proper adhesion of mortar. The aggregate shall generally be cubical in shape and as far as possible flaky, elongated pieces shall be avoided. It shall generally with the provision of I.S. 383-1970 and I.S. 515-1959. Unless special stones

from particular quarries are mentioned in the special provision, aggregates shall be broken from the best granite/quartzite/gneiss stones in that order available in the region and approved by the Engineer. Stone shall have no deleterious reaction with cement.

The coarse aggregate shall be of the following sizes:

a. Normal cement concrete of 100mm and above thickness - graded 20mm and below
b. Cement concrete topping thickness 40mm and above - graded from 12mm and below
c. Mass cement concrete of 500mm and above - graded 38mm and below

Aggregate other than crushed stone conforming to the provisions of this Specification may be used under special conditions, if permitted by the Engineer.

Grading tests shall be taken in the beginning and at change of source or material. Where required, by the Engineer, tests indicated in I.S. 383- 1970 and I.S. 456-2000 shall be carried out in an approved laboratory at the Contractor's cost to show the acceptability of the material.

Coarse aggregate of a porous nature where absorption of water after 24 hours immersion in water, is more than 5 percent by weight, shall not be used.

Limits of deleterious substances shall not exceed those prescribed in 2.3.1.1 and 2.3.1.2 of I.S. 515-1959.

The aggregates of different sizes shall be stored separately and handled in such a manner as to prevent intermixing of different sizes of aggregate required separately for grading purposes. No foreign matter shall be allowed to be mixed up with aggregates. If covered with dust etc. they shall be washed clean before use.

Sample of coarse aggregates required for the work shall be approved by the Engineer both regarding the quality and grading and shall be kept in the site office. The coarse aggregates to be used shall conform to these samples.

For controlled concrete, the aggregate shall be supplied in separate batches, consisting at least of coarse, medium and fine gradings. These will then be combined in proportions given by standard grading curves specified in relevant I.S. Codes. An average mix composition of 20mm (3/4") and 38mm (1.5") aggregates that will be obtained from the average standard aggregates grading curves is shown in Table - A.

Table - A

Type of Aggregate	Aggregate Size	Proportion Remarks of Total Mix. by Weight	Remarks
3/4" aggregate (20mm)	3/4" to 3/8" 3/8" to 1/4" Sand	61.5% 38.5% 35.0%	Passing 3/4" must 100%
1½" aggregate (38 mm)	1½" to 3/4" 3/4" to 3/8" 3/8" to 3/16" Sand	37.0% 16.0% 100.0% 34.0%	Passing 1 1/2" seive must be

Note: The above will NOT give a perfect grading. It can be expected, however, that the above grading will normally give good results.

Stone shall be hard, sound, far from decay, durable, tough, free from cracks and decaying. Stones with process matter or with boulder skin shall be rejected. It should be gravels / quartzite / gneiss stone in that order a preferably of similar quality and strength. It should in no case shall have any deleterious reaction with cement.

7. TIMBER

Quality: Timber to be used for the work shall be from the heart of a sound tree of mature growth, the sapwood being entirely removed. It shall be uniform in substance straight in fibre, free from large, loose,

dead or cluster knots, flaws, shakes, warp, cup, spring, twist bends or defects of any kind. It should be free from spongy, brittle flaky or brushy condition.

All timber shall be seasoned and be free from decay, rot, harmful fungi and insect attacks and from any other damage or harmful nature which will effect the strength durability, appearance or its usefulness for the purpose for which it is required.

Colour: The colour shall be uniform as far as possible, the darkness of colour amongst coloured species of timber being generally a sign of strength and durability.

Kind: The timber shall be of best from the locally available quality timber as specified in the item. The samples of the approved timber to be used shall be deposited in the office of the Engineer.

Moisture Content: The maximum permissible moisture content for timber shall be 12 percent of dry weight of timber.

Timber for the work shall not be brought until seen and approved by the Engineer, who may reject defective timber which shall be immediately removed from the site of work. Any effort like plugging painting, using, any adhesives or resinous materials to hide defects shall render the pieces, rejectable by the Engineer. Timber prepared for inspection shall be clean and free from dust and paint or other material which may conceal the defects.

Sawing: All scantlings shall be sawn in straight lines and plains and of uniform thickness and of full measurement from end to end and shall be sawn in the direction of the grain. They shall be sawn with such sufficient margin as to secure specified dimensions, lines and planes after being wrought.

Maximum slope of grain shall range between 1 in 10 and 1 in 20.

Any timber rejected shall at once be removed from site of work.

8. GLASS

All glass shall be of the best quality, free from specks, bubbles, smokes, veins, air holes, blisters and other defects. The kind of glass supplied by the contractor shall be as mentioned in the item or in the special provision or as shown on the detailed drawings.

When plate glass is specified, it shall be "polished patent plate glass" of the best quality. It shall have both the surfaces ground flat and parallel and polished to obtain clear undistorted vision and reflection. The plate shall be of the thickness mentioned in the item, shown in the detailed drawings or specified in the special provisions. In the absence of any specified thickness the thickness of the plate glass to be supplied shall be 5.5 mm. A tolerance of $\pm$ 0.5 mm shall be admissible on the nominal thickness of polished plate glass.

9. WOOD/VENEER

Ply wood/veneer shall be of 3 or 5 or 7 ply. All such ply wood shall be pressed properly to the required degree and to the required uniformity. They shall be of approved pattern and shall conform to I.S. 1328-1959.

Defective ply wood/veneer either the damaged corner or edge or by defective pressing shall not be used at all.

Storage of such boards shall be done in uniform layer above storey level in a dry platform. No edge shall be contacted with wall while storing.

10. STEEL SECTIONS

Structural steel section shall be as per IS specification and steel tubes used in the truss shall be hot finished tubes confirming to the requirements of specified in IS 1161 - 1968 and IS 807 - 1968. Tubes shall be of grade heavy or medium unless instructed.

11. STONES

The stone shall be of approved quality, sound, hard, dense and durable, free from segregation, seams, cracks, weathered portion and other structural defects as imperfections tend to affect their soundness and strength. The stone shall be compact grained and uniform in texture and color. The stones shall be free from rounded, wash or weathered surface or skin or coating which prevents the adherence of mortar. The stone shall be free from decay, flaws, veins and holes. The stone shall have a crushing strength of at least 100 kg/sq.cm.

The stone shall stand weathering well and when immersed in water for 24 hours shall not absorb more than 5 % of its dry weight.

The surface of freshly broken stone shall be bright, clean, sharp and shall have uniformity of texture without loose grains and be free from any dull chalky or earthy appearance. Stones showing molted color shall not be used for face work.

The stones shall be kept free from dust, dirt, oil and other injurious materials which may attack the stone or mortar and prevent adhesion of mortar.

Stones shall be properly seasoned by exposure to air before they are put into the structure, as stones increase in durability after quarrying especially limestones, sand stones and laterites. Stones newly quarried contain quarry sap and can more easily be worked in this condition.

Stones to be used as headers, pin headers quoin, copings etc. shall comply with the size and shape stipulated under the relevant item.

Different categories of stones such as face stones, headers, quoins etc. shall be collected in advance to suffice at least a month's requirements and shall be stacked separately category wise.

12. PAVING MATERIALS

12.1 Terrazzo Tiles

The terrazzo precast tiles of 300 mm x 300 mm size shall be from the standard manufacturers such as Siddico, Kathmandu Mosaic Tile or superior either prefinished or unfinished as per the requirements. The shape and size shall be true and perfect. The color shall be uniform and homogeneous.

13. PAINTING MATERIALS

Varnish, synthetic enamel paint, acrylic emulsion paint, waterproof cement paint, primers, distemper etc. shall be from new tins of reputed manufacturer like Asian Paints, Jenson and Nicholson, British Paints (India) Ltd., Snowcem, Berger, ICI Paints or equivalent as approved by the engineer.

B2. CONSTRUCTION WORKS

EARTH WORK

1. SCOPE

This specification covers the earth work in excavation for all types of foundation wet or dry.

2. CLEARING SITE

The site on which the structure is to be built as shown on the plan and the area required for setting out and other operations should be cleared and all obstructions, loose stones, materials and rubbish of all kinds, stumps, brush wood and trees removed as directed, roots being entirely grubbed up. The materials obtained will be the property of the Government and materials pronounced useful by the consultant will be conveyed and properly stacked as directed within the specified lead. Useless materials shall be burnt or otherwise disposed off as directed by the Engineers.

3. SETTING OUT

After clearing the site, the centre lines shall be given by the Engineers and it will be the responsibility of the Contractor to install substantial reference marks, bench marks etc. and maintain them as long as required true to line, curve, slopes and level. The contractor shall assume full responsibility for alignment, elevation and dimension of each and all parts of the work. Labour, material etc. required for setting out and establishing Bench Marks and other reference marks shall be arranged by the Contractor at his own cost.

4. EXCAVATION

Foundation excavation shall include removal of all materials of whatever nature and whether wet or dry, necessary for the construction of foundation and substructure exactly in accordance with the lines, levels, grades and curves as shown on the plans or as directed by the Engineers. It shall be taken to the exact width of the lowest step of the footing and the sides shall be left plumb where the nature of soil admits it. Unless there is a specific extra provision in the contract for shoring or for cutting side slopes, contractor shall at his own cost do the necessary shoring or cutting of slopes to a safe angle or both as approved by the Engineers, when the strata need such treatment. The contractor shall notify the Engineers before starting excavation to enable him to take cross sectional level for purposes of measurements before the ground is disturbed.

5. PREPARATION OF FOUNDATION FOR FOOTING

The bottom of foundation shall be leveled both longitudinally and transversely or stepped as directed by the Engineers. Before footing is laid final surface shall be slightly watered and rammed. If any soft patches come to light on inspection or ramming, these shall be dug out and dealt with a directed by the Engineers. No filling shall be allowed to bring the foundation to level. If by contractor's mistake, excavation is made deeper than shown on the plans or ordered by the Consultant, the extra depth shall be made up with concrete or masonry of the foundation grade as directed by the Engineers, and at the cost of the contractor. All rock or other hard foundation shall be cleaned of all soft and loose material and out to a firm surface, either level, stepped or serrated as directed by the Engineers. The elevation of the bottom of foundation shown on the plan shall be considered as approximate only and the Consultant may order such changes in the dimensions and elevations of the foundation as may be deemed necessary to secure satisfactory foundation.

After each excavation is completed, the contractor shall notify the Engineers to that effect and no footing shall be allowed to be laid until the Engineers has approved the depth and dimensions of excavation and nature of the foundation material and the levels and measurements are recorded.

6. SHORING

Unless separately provided for in the contract, excavation of slopes to prevent falling in of sides or providing, fixing, maintaining and removing shoring, bracing etc. shall not be paid for. The Contractor shall be responsible for the design of shoring of sufficient strength to resist side pressure and ensure safety from steps and blows and to prevent damage to work and property and injury to persons. It shall be removed as directed after all the items for which it is required are completed.

7. PROTECTION

Near towns and all frequented places foundation pits, well pits and similar excavation shall be strongly fenced and marked with red lights at night placed in charge of watchman to avoid accidents. Adequate protective measures shall be taken to see that the foundation excavation does not affect or damage adjoining structures. All measures required for the safety of the excavation, the people working in and near the foundation trenches, property and the people in the vicinity shall be taken by the Contractor at his own cost, he being entirely responsible for any injury to life and damage to property caused by his negligence or accident due to his constructional operations.

8. DISPOSAL OF EXCAVATED MATERIALS

No materials excavated from the foundation trenches of whatever kind they may be, are to be placed even temporarily nearer than 1.5 meters or greater distance as directed by the Engineers from the outer edge of excavation. All materials excavated will remain the property of the Owner. Rate for excavation includes sorting out of useful materials and stacking them separately as directed within the specified lead. Materials suitable and useful for back filling or other use shall be stacked in convenient places but not in such a way as to obstruct free movements of men, animals and vehicles or encroach on the area required for constructional purposes. It shall be used to the extent required to completely backfill the structure to original ground level or the elevation shown on the drawings or as directed by the Engineer. For backfilling, the materials shall be placed in 15 to 20 cm layers, moistened and well compacted. Materials not useful in any way shall be thrown as directed by the Engineers. If useful excavated rubble is required by the Contractor for the use in other items, it shall be paid for at the rate fixed in the tender and if not so provided, at the rate at which both parties mutually agree. The site shall be left clean of all debris on completion.

9. DEWATERING

Unless specially provided for as a separate item in the Contract, the excavation rate shall include pumping out all water which may accumulate in the excavation during the progress of the work either from seepage, springs, rain or any other cause and diverting surface flow if any, by bonds or other means. The bonds shall be removed after their purpose is served.

Pumping water from any foundation enclosure or trenches shall be generally in such a manner as to preclude the possibility of any damage to the foundation trenches, concrete or masonry or any adjacent structures. The excavation shall be kept free form water (i) during inspection and measurement, (ii) when concrete and / or masonry are in progress and till they come above the natural water level and (iii) till the consultant considers that the mortar is sufficiently set.

10. SLIPS AND BLOWS

If there are any slips or blows in the excavation, they shall be removed by the Contractor without any extra cost so as to provide correct dimensions required for the foundation.

11. BACK FILLING

All timber work and form work shall be removed after their necessity ceases and trash of any sort shall be cleaned out from the excavation. All space between foundation masonry or concrete and the sides of excavation must be refilled to the original surface with approved materials, in layers of 15 to 20 cm in thickness, watered and rammed to compact.

The filling shall be done after concrete or masonry is fully set and done in such a way as not to cause undue thrust on any part of the structure. Where suitable excavated material is to be used for refilling, it shall be brought from the place where it was temporarily deposited and used in refilling.

12. TYPES OF EXCAVATION

12.1 Ordinary Soil

Soils of all sort, sand, loose gravel, soft clay, black soil and other similar soft or loose materials etc. shall include all materials of earthy or sandy nature which can be easily ploughed or small shingle or gravel which can be easily removed.

12.2 Conglomerate

Gravel mixed soil / hard soil which is to be excavated by the help of pick, Jumper and lifted or removed by the help of shovel.

12.3 Rock / Hard Rock

Large boulder / stone or pebbles formally jointed / cemented which need chisel to brake / excavate.

13. RATE

The rate for the item of excavation shall include the following:

a) Cleaning site.
b) Setting out works, profiles etc. according to the sanctioned plan or as ordered by the Engineers and setting up Bench Marks and other reference marks.
c) Providing and subsequently removing shoring and shuttering or cutting slopes except when separately provided for in the Contract.
d) Bailing and pumping out water when separate provision does not exist for in the contract.
e) Excavation and removal of all materials of whatever nature dry or wet and necessary for the construction of foundation including materials like explosives, removal of blows and slip sand use of tools, plant and equipment necessary for satisfactory completion of the items and preparing bed for foundation.
f) Sorting out of useful excavated materials, conveying them up to the specified lead clear beyond the structure and stacking them neatly for backfilling or reuse and disposing useless materials as directed by the Engineers.
g) Backfilling the trenches alongside masonry or concrete with approved material up to the natural ground level.
h) Necessary protection including labour, materials and equipment to ensure safety and protection against risk or accident.
i) Supply of facilities for inspection and measurement at any time by the Engineers.
j) Compensation for injury of life and damage to property if any caused by the Contractor's operation connected with this item.
k) Small drill holes to explore the nature of substratum if necessary.

14. MEASUREMENT AND PAYMENT

The payment for respective class of excavation shall be made at the Contract rate per cubic meters (cubic foot) for the quantity acceptably excavated, limited to the dimension shown in the sanctioned

plan or as directed by the Engineer. The excavation to dimension in excess of the above shall not be measured nor paid for and if so ordered by the Engineers the Contractor shall have to fill up the excess depth with cement concrete or masonry of foundation grade without extra payment.

Driving of sounding bars or inserting small drill holes to explore the nature of substratum up to a total length of 1 meter distributed in 2 or 3 places in each foundation if necessary shall be considered incidental work and shall not be paid for separately.

Removal of slips and blows in the foundation trenches shall not be measured nor paid for. If it is necessary in the opinion of the Engineer to carry foundation below the levels shown on the plans, the excavation for the first 1.5 meters of the additional depth shall be included in the quantity for the particular classification at the tendered rate. The excavation below this additional depth of 1.5 meters shall be paid for as extra work at rate to be decided under general conditions of Contract unless the contractor is willing to accept payment at tendered rates. For all depths less than the designed depth plus 1.5 meters the excavation shall be paid for at tendered rates.

Dimension shall be measured nearest to one centimeter and individual quantity shall be calculated correct to two places of decimals of a cubic meter.

CEMENT CONCRETE WORK FOR GENERAL USE

1. SCOPE

This specification deals with the cement concrete, plain or reinforced for general use of specified proportion and flooring (I.S. Code of Practice IS:456 latest revision to be complied with unless permitted otherwise hereinafter).

2. MATERIALS

All required materials shall be as specified in "STANDARD CONSTRUCTION MATERIALS"

Admixtures: The use of admixtures in concrete for promoting workability improving strength, entraining air or for any other purpose may be used only with the prior approval of the Engineer.

3. GRADES OF CONCRETE

a. General:

Structural concrete shall be either ordinary or controlled and in three grades designated as M15, M20 and M25, as specified in IS:456 - latest provision.

Ordinary Concrete:

Ordinary concrete is recommended only when accurate control is impracticable and not necessary. However, if ordinary concrete is allowed by the Engineer, it shall be used only in the concrete of Grades M15, M20 and M25. Ordinary concrete does not require preparation of trial mixes.

Concrete mix proportions for ordinary concrete shall be as per IS:456 - latest revision - and as follows:

Mix Proportions (By Weight) Expected to Give Different Degrees of

Workability with Different Water Cement Ratios and A

Specified Strength

(For Guidance)

Workability	Water Cement Ratio	Compressive Strength in 28 days kg/cm²	Ratio by Weight of Cement to Gravel Aggregate		Ratio by Weight of Cement to Crushed Stone Aggregate	
			20 mm size	38 mm size	20 mm size	38 mm size
Very low	0.4	360	1:4.8	1:5.3	1:4.5	1:5.0
Slump	0.5	290	1:7.2	1:7.7	1:6.5	1:7.4
0-25 mm	0.6	220	1:8.5	1:8.6	1:7.8	1:8.4
	0.7	160	1:9.0	1:9.0	1:8.7	1:8.9
Low	0.4	360	1:3.9	1:4.5	1:3.5	1:4.0
Slump	0.5	290	1:5.5	1:6.7	1:5.0	1:5.5
25-50 mm	0.7	160	1:8.0	1:8.5	1:7.4	1:8.0
Medium	0.4	360	1:3.5	1:3.8	1:3.1	1:3.6
Slump	0.5	290	1:4.8	1:5.7	1:4.2	1:5.0
50-100 mm	0.7	160	1:6.8	1:7.9	1:6.2	1:7.0
High	0.4	360	1:3.2	1:3.5	1:2.9	1:3.3
Slump	0.5	290	1:4.4	1:5.2	1:3.9	1:4.6
100-175 mm	0.6	220	1:5.4	1:6.7	1:4.7	1:5.7
	0.7	160	1:6.2	1:7.4	1:5.5	1:6.5

Notwithstanding anything mentioned hereinbefore, the maximum total quantity of aggregates by weight per 50 kg of cement shall not exceed 450 kg except where otherwise specifically permitted by the

Engineer.

The minimum cement content for each grade of concrete shall be as follows:

Grade of Concrete	Minimum Cement Content per Cum of Finished Concrete
M 15	325 kg.
M 20	360 kg.
M 25	420 kg.

At least four trial batches are to be made and six test cylinders/cubes taken for each batch noting the slump on each mix. These cylinders/cubes shall be tested in a testing laboratory approved by the Engineer at 7 days and others at 28 days for obtaining the ultimate compressive strength. The test reports shall be submitted to the Engineer. The cost of the mix design and testing shall be borne by the Contractor.

On the basis of the above test reports, proportion of mix by weight and water-cement ratio will be approved by the Engineer, the proportions so decided for different grades of concrete shall be adhered to during all concreting operations. If, however, at any time, the Engineer feels that the quality of the materials being used, has been changed from those used for preliminary mix design, the Contractor shall have to run similar trial mixes design, the Contractor shall ascertain the mix proportions and water-cement ratio for obtaining the desired strength and consistency. It will be within the competency of the Engineer to reduce the number of trial batches and the number of test specimens mentioned above.

The mixes once approved must not be varied without prior approval of the Engineer.

In designing the mix proportions of concrete, the quantity of both cement and aggregate shall be determined by weight. The Engineer may allow the quantity of aggregates to be determined by equivalent volume basis after the relationship between the weight and volume is well established by trial and the same shall be verified frequently. Water shall be either measured by volume in calibrated tanks or weighted.

All measuring equipments shall be maintained in a clean and serviceable condition and their accuracy periodically checked.

To keep the water-cement ratio to the designed value, allowance shall be made for the moisture content in both fine and coarse aggregates and determination of the same shall be made as frequently as directed by the Engineer. The determination of moisture contents shall be according to IS: 2386 (Part III) - (latest revision).

4. STRENGTH REQUIREMENTS

Where ordinary portland cement conforming to IS: 269 - latest revision or Portland cement-Furhance Slag cement conforming to IS: 455 - (latest revision) is used, the compressive strength requirements for various grades of concrete shall be as shown in Table - IV and shall apply to both controlled concrete and ordinary concrete.

The acceptance of strength of concrete shall be as per clause 5.4 "Sample size and Acceptance Criteria" of IS: 456 - latest revision subject to the stipulations and/or modifications stated elsewhere in this specification.

Concrete work found unsuitable shall have to be dismantled and replacement to be done as per specification by the Contractor. No payment for the dismantled concrete, the relevant formwork and reinforcement embedded fixtures, etc shall be made. In course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good free of charge by the Contractor to the satisfaction of the Engineer.

Compressive strengths for different grades of concrete as specified in Table - IV shall always refer to the cylinder/cubes strength based on test conducted on 15 cm diameter and 30 cm height.

Other requirements of concrete strength as may be desired by the Engineer shall be in accordance with IS:456 - (latest revision).

In exceptional circumstances, the Engineer may accept a concrete of lower strength than specified and which is otherwise unacceptable according to the "Acceptance Criteria" of IS:456 - (latest revision), provided the strength is never less than 80% of the specified strength. All concrete having a strength less than 80% of that specified shall always be rejected. Payment for concrete of lower strength than specified but accepted by the Engineer shall always be made at a reduced rate on prorata basis to the strength obtained.

Strength Requirement of Concrete

Grade of Concrete	Compressive strength of 15 cm. diameter and 30 cm. high cylinder or 15 cm cube at 28 days after mixing, conducting in accordance with IS: 456 - latest revision	
	Preliminary tests N/mm^2	Work test N/mm^2
M 15	20	15
M 20	26	20
M 25	32	25

With permission of the Engineer, for any of these above mentioned grades of concrete shall also be increased proportionately to keep the ratio of water to cement same as adopted in trial mix design for each grade of concrete. No extra payment for the additional cement will be made.

5. WORKABILITY

The workability of the concrete shall be checked at frequent intervals by slump test. Where facilities exist and if required by the Engineer, alternatively, the compacting factor test in accordance with IS: 1199 - (latest revisions), shall be carried out. The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formworks and around on the type and nature of structure and shall be based on experience and tests within the preferred limits of consistency as specified in Table below for various types of structures.

Limits of Consistency

Degree of Workability	Slump in mm		Use of which concrete is suitable
	Min	Max.	
Low	20	40	Mass concrete foundations without vibrations, simple reinforced section with vibration.
Medium	50	100	Normal reinforced beams, columns, slabs without heavily reinforced section with vibration.
High	100	150	Section with congested reinforcement not normally suitable for vibration.

Note: However, the slump to be obtained for work in progress shall be as per direction of the Engineer.

6. WORKMANSHIP

a. General: All workmanship shall be according to the latest and best possible standards.

Concrete:

i Mixing of Concrete:

The proportion of fine and coarse aggregate, cement and water shall be as determined by the preliminary tests or according to fixed proportions in case of ordinary concrete and shall always be approved by the Engineer. The quantities of fine and coarse aggregates shall be determined by weight. The water shall be measured accurately after giving proper allowance for surface water present in the aggregates for which regular check shall be made by the Contractor. Due allowance shall be made for bulking in case of volume batching in accordance with I.S. 2386 (Part III) - (latest revision).

Concrete shall be always mixed in a mechanical mixer unless specifically approved by the Engineer for concrete to be used in unimportant structure. The water shall not be poured into the drum of the mixer until all the cement and aggregates constituting the batch are already in the drum and mixed for at least

one minute. Mixing of each batch shall be continued until there is a uniform in colour and consistency, but in no case shall mixing be done for less than two minutes and at least forty revolutions after all the materials and water are in the drum. When absorbent aggregates are used or when the mix is very dry, the mixing time shall be extended as may be directed by the Engineer. Mixer shall not be loaded above their rated capacity as this prevents thorough mixing.

The entire contents of the drum shall be discharged before the ingredient for the next batch are fed into the drum. No partly set or remixed or excessively wet concrete shall be used and it shall be immediately removed from site.

Each time the work stops, the mixer shall be thoroughly cleaned and when the next mixing commences, the first mix shall have 10% additional cement at no extra cost to the Employer to allow for loss in the drum.

When hand mixing is permitted by the Engineer for concrete to be used in unimportant structures, it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. In case of hand mixing, extra cement @ 10% shall be added to each batch with no extra cost to the owner.

ii Conveying Concrete:

Concrete shall be handled and conveyed from the place of mixing to the place of final deposit as rapidly as practicable by approved means before the initial setting of the cement starts. Concrete should be conveyed in such a way as will prevent segregation or loss of any of the ingredients. If segregation does occur during transport, the concrete shall be remixed. During the very hot or cold weather, if directed by the Engineer concrete shall be transported in deep containers which will reduce the rate of loss of water by evaporation and loss of heat. Conveying equipment for concrete shall be well maintained and thoroughly cleaned before commencement of concrete mixing. Such equipment shall be kept free from set concrete.

iii Placing Concrete:

Form work and reinforcement shall be approved in writing by the Engineer prior to placing of concrete. Concrete shall be placed in its final position without segregation. The forms shall be well wetted and all shavings, dirt and water that may have collected at the bottom shall be removed before concrete is placed. The interval between adding the water to the dry materials in the mixer and the completion of the final placing inclusive of compaction of the concrete shall be not more than initial setting time of the cement, normally 30 minutes for ordinary portland cement. The concrete shall be well placed in the form work by means approved by the Engineer and shall not be dropped from a height or handled in a manner which may cause segregation. Any drop above 180 cm shall have to be approved by the Engineer. Once the concrete is placed in its final position, it shall not be disturbed. After the concrete has been placed, it shall be spread and thoroughly compacted by approved mechanical vibration to a maximum subsidence without segregation and thoroughly worked around reinforcement or other embedded fixtures into the correct form and shape. Vibration shall not be used for pushing and shoveling concrete. Vibrator must be operated by experienced men and over vibration shall not be permitted. Hand tamping in some cases may be allowed subject to the approval of the Engineer.

No concrete shall be placed in open, while it rains. If there has been any sign of separation of cement and sand by washing, the concrete shall be entirely removed immediately. Suitable precautions shall be taken in advance to guard against rains before leaving the fresh concrete at site. No accumulation of water shall be permitted on freshly laid concrete. Slabs, beams and similar members shall be poured in one operation normally. Bleeding of under layer, if any shall be effectively removed. Moulding, throating, drip coarse, etc. shall be poured as shown on the drawing or as directed by the Engineer. Holes shall be provided and bolts sleeves, anchors fastenings or other fixtures shall be embedded in concrete as shown on the approved drawings or as directed by the Engineer. Any deviation there from the drawing shall be set right by the Contractor at his own expense as instructed by the Engineer.

iv Construction Joints:

When the work is to be interrupted, the concrete shall be rebated at the joint to such shape and size as may be required by the Engineer or as shown on the drawing. All vertical construction joints shall be

made with step boards, which are rigidly fixed and slotted to allow for the passage of the reinforcing steel. If desired by the Engineer keys and/or dowel bars shall be provided at the construction joints. In the case of water retaining structure water stops of approved material shall be provided if so specified in the drawings or desired by the Engineer. Construction joints shall be provided in positions as described, the joints shall be in accordance with the followings:

In a column, the joint shall be formed about 75mm below the lowest soffit of the beams framing into it.

Concrete in a beam shall be placed throughout without a joint, but if the provision of a joint is unavoidable, the joint shall be vertical and at the middle of the span. A joint in a suspended floor slab shall be vertical at the middle of the span at right angle to the principal reinforcement. The locations of construction joint shall be planned by the contractor well in advance of pouring and will have to be approved by the Engineer.

Before fresh concrete is placed, the cement skin of the partially hardened concrete shall be thoroughly removed and surface made rough by hacking, sand blasting, water jetting, air jetting or any other method as directed by the Engineer. The rough surface shall be thoroughly wetted for about two hours and shall be dried and coated with 1:1 freshly mixed cement sand slurry before placing the new concrete. The new concrete shall be worked against the prepared surface before the slurry sets. Special care must always be taken to see that the first layer of concrete placed after a construction joint is cold. Joints during pour shall be treated with 1:1 freshly made cement sand slurry only after removing all loose materials.

v Protection and Curing of Concrete:

Newly placed concrete shall be protected by approved means from rain, sun and wind. As soon as the concrete has hardened sufficiently for the surface to be marked, it shall be covered either with sand, hessian, canvas or similar materials and kept continuously wet for at least fourteen days after final setting. This period may be extended at the discretion of the Engineer.

vi Control Tests on Concrete:

Six test cylinders/cubes for each type of work shall be taken by the Contractor for each 8 hours or less of concreting. If the value of concrete poured is less than 20 M3 on any day per mixing plant, the Engineer may exempt or reduce the number of test cylinders. The samples of concrete, shall be tested in an approved laboratory in presence of the Engineer and the test results shall be submitted in triplicate to the Engineer. The Contractor shall carry out the sampling and testing according to the provisions of this Specification at his own cost. No payment shall be made for the concrete used in specimens.

To control the consistency of concrete from every mixing plant, slump tests shall be carried out by the Contractor free of charge every two hours or as directed by the Engineer. The amount of mixing water shall not be changed without prior approval of the Engineer. Slumps corresponding to the test cylinders shall be recorded for reference. The Engineer if he so desires may order special tests to be carried out on cement, sand or coarse aggregates, water reinforcing steel, or traverse tests in accordance with I.S.I. recommendations. If the material tested is found to be suitable for the intended use, the cost of these special tests shall be borne by the Owner. If the material is found to be not suitable for the intended use, the cost of these special tests shall be borne by the Contractor. Further, during the progress of the work if the Engineer has doubt about the quality of any material in use he can instruct suspension of its use till the material is proved acceptable by test. Any consequent loss arising out of the suspension shall be borne by the Contractor.

b. Exposed Surface

Interior: - Imperfect surface, where strength is not required shall be patched and rubbed smooth with carborundum stone. Immediately the formwork is stripped off, fins and projections shall be removed and the concrete surface affected thereby shall be rubbed smooth to the satisfaction of the Engineer.

c. Anchor Bolts, Anchors, Openings, Sleeves, Insert and Other Built-in Fixtures

The Contractor shall leave all openings, grooves, chases etc. in concrete work as shown on the drawings or as specified by the Engineer. He shall build into concrete work all the materials noted below and shall embed and secure the same as and when required. The material is required to be supplied

by the Contractor, shall be of best quality available of approved manufacture and shall be up to the satisfaction of the Engineer.

Materials to be embedded:

I Inserts, hangers, anchors, opening frames, manholes, covers, floor clips, sleeves and conduits.
ii Anchor bolts and plates for machinery, equipment and for structural steel work.
iii Dowels bars, etc. for concrete work falling under scope of future works.
iv Lugs or plugs for door and window frames occurring in concrete work.
v Flashing and jointing in concrete work.
vi Any other built-in-fixtures as may be required.

Correct location, exact alignment, etc. of all these shall be entirely the responsibility of the Contractor.

d. Joints etc.

i. Expansion and Isolation Joints:

Expansion joints in concrete structures shall be provided at specified places as indicated on the drawings. The materials and types of joints shall be as specified below. In case of liquid retaining structures, additional precaution shall be taken to prevent leakage of liquids as may be specified on the drawings or as directed by the Engineer. The Engineer may demand test certificates for the materials and/or gt them tested.

ii. Bitumen Boards:

Bitumen impregnated fiber or approved manufacture as per IS: 1838 - latest revision shall be used as fillers for expansion joints. It must be durable and water proof. At the exposed end, the joint shall be sealed with approved sealing compound to a depth of 25mm after application of an approved primer. The sealing compound and the primer shall be applied as specified by the manufacturer.

iii. Bitumen Compound:

The gap for expansion joints shall be thoroughly cleaned and the bitumen compound laid as per manufacture specifications. The compound to be used shall be of approved manufacture and shall conform to the requirements of IS: 1834 - latest revision.

iv. Separation Joint:

Strong and tough alkathene sheet or equivalent of about 1mm in thickness as approved by the Engineer shall be used. It shall be stucked by an approved sticker to the cleaned surface of the already set concrete to cover it fully. Fresh concrete shall be laid against the sheet, care being taken not to damage the sheet in any way.

v. Rubber Pad:

Hard foundation quality rubber pads of required thickness and shape are to be put below machine or other foundations where required as shown on the drawings or as directed by the Engineer. The rubber shall be of best quality of approved manufactures, durable, capable of observing vibration and must be chemically insert in contact with moist or dry earth under normal conditions.

7. WATERPROOFING JOINTS

The materials shall conform to the respective I.S. Code - latest revision, where applicable. The Engineer's approval to the materials shall be obtained by the Contractor before procurements. If desired by the Engineer, test certificates for the materials shall be submitted by the Contractor. The materials shall be of best quality available indigenously, fresh and thoroughly clean.

a. Water Proofing Admixtures

i. In Concrete:

The admixture shall be of right variety and procured freshly. The admixture shall be approved by the Engineer. The method of application and other details shall exactly conform to the manufacturers specification. The concrete shall have the services of the manufacturers supervision at no extra expense to the Employer to supervise the work if desired by the Engineer.

ii. In Plaster:

The concrete surface to be plastered, to be hacked to the Engineer's satisfaction. The plaster shall be made of cement and sand as approved by the Engineer. If desired by the Engineer, the Contractor shall have the work supervised by the manufacturers supervisor at no extra cost to the Owner.

b. Other Admixtures in Concrete:

The Engineer may in his direction instruct the Contractor to use any admixture in the concrete.

Payment shall be made extra over the price on concrete on the actual quantity of admixture used at the landed cost of admixture plus 15% to cover extra labour, tools, plant, profit, etc.

8. RATES

The rates for items shall include cost of all materials consumed in the work at all levels, hire charges of materials, tools and plant, cost of labour, insurance, all transport, services, accommodation, supervision, storage, protection etc. complete.

9. MEASUREMENT AND PAYMENT

The payment for respective class of concrete shall be made at the Contract rate per cubic meters for the quantity acceptably executed limited to the dimension shown in the sanctioned plan or as directed by the Engineer. The concrete to dimension in excess of the above shall not be measured nor paid for. The dimensions for measurement shall be the concrete excluding any finishes. The size shall be measured correct up to 12 mm and content worked out in cubic meter. Deductions for reinforcement and conduits shall not be made.

NON STRUCTURAL CONCRETE (LEAN CONCRETE)

1. SCOPE

This specification deals with the plain cement concrete for lean concrete works for general use of specified proportion.

2. MATERIALS

All required materials shall be as specified in “STANDARD CONSTRUCTION MATERIALS”

3. WORKMANSHIP

All workmanship shall be according to the latest and best possible standards.

Non-structural concrete will be designated by their volume ratio 1:3:6. These concrete act only as platform and as such are assumed to have no structural strength. Concrete of this class are proportioned according to its volumetric ratios and may be hand mixed. The maximum size of aggregates for this type of concrete shall be 20 mm. Non-structural concrete shall be batched and mixed in the following manner:

Cement and aggregates shall be batched by volume and mixed together to a uniform consistency until the cement color can no longer be distinguished. Water shall be added by approved means while undergoing further mixing and within two minutes, the mix shall be worked up to a homogeneous mass to a workability approved by the Engineer.

Boxes for volume batching of non-structural concrete shall be filled without tamping, ramming, or consolidation of any kind (other than occurring naturally during filling process), and shall be screeded off level with their topmost edges.

Mix shall be prepared and used in quantities that no more than 30 minutes shall elapse between the first wetting and complete use. Under no circumstances shall any of the stiffened concrete be used. Fresh concrete shall not be mixed with those prepared earlier and all batches shall be used separately.

Non-structural concrete shall be placed and then compacted by gentle ramming with a metallic rammer so that work can commence on it within 24 hours. If work cannot commence as stipulated, it shall be cured as per provisions of structural concrete.

4. RATES

The rates for items shall include cost of all materials consumed in the work at all level, hire charges of materials, tools and plants, cost of labour, cost of side forms, insurance, all transport, services, etc, complete.

5. MEASUREMENT

Measurement of works will be made in cubic meter or as specified in bill of quantities.

CENTERING AND SHUTTERING FOR RCC WORK

1. SCOPE

This specification covers centering and shuttering works for RCC works of any size, shape etc. at only level including strutting, propping and removal thereof.

2. MATERIAL

Form work shall be composed of steel or shuttering plywood. Timber shall be free from knots and shall be of medium grain as far as possible. Hard woods shall be used as caps and wedges under or over posts. Plywood or equivalent shall be used where specified to obtain smooth surface for exposed concrete work. Struts shall generally be mild steel tubes and strong sal ballahs 150mm in diameter or above. Bamboos, small diameter ballahs, etc. shall never be used unless specially approved by the Engineer in specified cases.

3. SHOP DRAWING

The Contractor shall prepare, design and drawings for formwork and centering before commencement of actual work and get them approved by the Engineer. The form work and centering shall conform to the shape, lines and dimensions as shown on the drawings.

4. CONSTRUCTION

The centering shall be true and rigid and thoroughly braced both horizontally and diagonally. The forms shall be sufficiently strong to carry without undue deformation, the dead weight of the concrete as a liquid and working load. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration without appreciable deflection, bulging distortion or shall be sufficiently tight to prevent any leakage of mortar. The formwork shall be such as to ensure the concrete a smooth uniform surface free from honeycombs, air bubbles, fines and other blemishes.

Any blemishes or defect found on the surface of the concrete must be brought to the notice of the Engineer and immediately rectified free of charge as directed or approved by the Engineer. Where there are chances of fixtures being embedded, only mild steel or concrete of adequate strength shall be used.

For exposed interior and exterior concrete surface of beams, columns and walls, plywood or other approved forms, thoroughly created and tied together with approved corrosion-resident divides shall be used. Rigid care shall be exercised in ensuring that all columns are plumb and true and thoroughly cross braced to keep them so. All floor and beam centering shall be crowned not less than 8mm in all directions for every 5 meter span. Unless described in the drawing or elsewhere to the contrary, beveled strips 25mm by 25mm shall be provided without any extra charge, to form angles and in corners of column and beam boxes for chamfering of corners. Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base of vertical forms and at other places, where they are necessary and as may be directed by the Engineer. The temporary openings shall be so formed that they can be conveniently concerted.

5. CLEANING AND TREATMENT OF FORMS

All rubbish, loose concrete chippings, shavings, saw dust etc. shall be scrupulously removed from the interior of the forms before the concrete is poured. Wire brushes, brooms, etc. compressed air jet and/or water jet shall be kept handy for the cleaning if directed by the Engineer.

The form surface in contact with concrete shall be treated with approved non-staining composites, such as approved brand form oil. It shall not come in contact with reinforcing steel or existing concrete surface. They shall not be allowed to accumulate at the bottom of the shuttering.

The formwork shall be so designed and erected that the forms for slabs and the sides of the beams,

columns and walls may be removed first, leaving the shuttering to the soffits of beams and their support in position. If formwork for column is erected for the full height of the columns, one side shall be left open and built up in sections, as placing of concrete proceeds. Wedges, spacer bolts, clamps, or other suitable means shall be provided to allow accurate adjustment of the formwork and to allow it to be removed gradually without jarring the concrete.

6. REMOVAL OF FORMS

The Contractor shall record on the drawing or in some approved manner, the date on which the concrete is placed in each part of the work and the date on which the formwork is removed therefrom and have this record checked and countersigned by the Engineer. The Contractor shall be responsible for the safe removal of the formwork, but the Engineer may delay the time of removal, if he considers it necessary. Any work showing signs of damage through premature removal of formwork or loading shall be entirely reconstructed without any extra cost of the owner.

Forms for various types of structural component shall not be removed before the minimum periods specified below, which shall also be subjected to the approval of the Engineer.

Ordinary Portland Cement Concrete (Temp °C)				Rapid Hardening Portland Cement Concrete(Temp °C)	
Part of Structure	40 – 20 Days	20 – 5 Days		40 – 20 Days	20 – 5 Days
a. Columns & Walls	1	2	Do not remove forms unit	1/2	2
b. Beam Sides	2	4	Site cured test cylinders develop 50% of	1	3
c. Slabs 125 mm	7	14	28 days strength	4	7
d. Slab below 125 mm	14	21		8	14
e. Soffit of main beams	21	28		10	16

Where exposed surface of concrete can be effectively sealed to prevent loss of water, the periods specified for temperature above 40° C can be reduced to those for the temperature range of 20° C to 40° C subject to the approval of the Engineer. Before removing any form work the Contractor must notify the Engineer well in advance to enable him to inspect the concrete if he so desires.

7. TOLERANCE

The formwork shall be so made as to produce a finished concrete true to shape, lines, levels, plumb and dimensions as shown on the drawings subject to the following tolerance unless otherwise specified elsewhere in this specification or drawings or directed by the Engineer.

For:

a.	Sectional dimension	-	5 mm
b.	Plumb	-	1 in 1000 of height
c.	Levels	-	3 mm before any deflection has taken place.

8. RE-USE OF FORMS

Before re-use, all forms shall be thoroughly scraped, cleaned, joints etc. examined and when necessary repaired and inside surface treated as specified hereinbefore. Formwork shall not be used / re-used, if declared unfit or unserviceable by the Engineer.

9. CLASSIFICATION

Ordinary exterior grade plywood of good quality shall be used for formwork. Where a specially good

finish is required and shall be made mostly of approved brand of heavy quality plywood to produce a perfectly level, uniform and smooth surface. Re-use only may be permitted after special inspection and approval by the Engineer. He may also permit utilization of used plywood for the "ordinary" class.

Ornament - These shall be used where ornamental and curved surface are required and shall made of selected best quality well seasoned timber which can be shaped as required. Generally, the "ordinary" class formwork shall be used unless otherwise directed by the Engineer.

10. RATE

Rate shall include for all necessary material and labour to execute the formwork.

11. MEASUREMENT AND PAYMENT

The payment for respective type of formwork shall be made at the Contract rate per square meters for the quantity acceptably executed limited to the dimension shown in the sanctioned plan or as directed by the Engineer. The concrete to dimension in excess of the above shall not be measured nor paid for. The dimensions for measurement shall be the area contacting to concrete. The size shall be measured correct up to 2 decimal places and content worked out in square meter.

REINFORCING FOR RCC WORKS

1. SCOPE

This specification covers providing and fixing High Strength Steel and Mild steel reinforcement of various sizes in all type of R.C.C. works.

2. MATERIAL

The reinforcement shall be as specified in the STANDARD CONSTRUCTION MATERIAL and test certificate shall be submitted to the Engineer for approval. Each reinforcing bars shall be tested and any bar showing cracks or flows or scales shall not be used.

3. SHOP DRAWINGS: BAR BENDING SCHEDULES

The Contractor shall furnish to the Engineer bar bending schedules for all R.C.C. work in triplicate within one month of the receipt of the Letter of Intent or of the receipt of each design drawings whichever later. Upon receipt of the Engineer's final corrections as corrected, contractor shall submit six prints of the approved drawings/schedules. Approval of schedule/drawing by the Engineer shall not relieve the Contractor from responsibility for errors nor relieve him of any part of his obligation to meet all the requirement of the Contractor or of the responsibility for the correctness of his drawings.

4. CLEANING

All steel for reinforcement shall be free from loose rust, oil grease, paint or other harmful matters.

5. BENDING

Unless otherwise specified, reinforcing steel shall be bent in accordance with procedure specified in IS:2502 - (latest revision) or as approved by the Engineer. Bends and shapes shall comply strictly with the dimensions in the approved Bar Bending Schedule. Contractor shall be entirely responsible for its correctness. Bars correctly bent shall only be used. No reinforcement shall be bent when in position in the work without approval of the Engineer, whether or not is partially embedded in concrete. Bars shall not be straightened in a manner that will injure the materials. Re-bending can be done only if approved by the Engineer. Reinforcement bars shall be bent by machine or other approved means producing a gradual and even motion. All the bars shall be cold bent unless otherwise approved.

6. PLACING IN POSITION

All reinforcement shall be accurately placed in position as shown on the drawings. Bars intended to be in contact, at crossing points, shall be securely bound together at all such points by No. 20 BG annealed soft iron wire or by tack welding as may be directed by the Engineer .

Binders and the like shall be tightly embraced the bars with which they are intended to be in contact and shall be securely held. The vertical distance between successive layers of bars shall be placed by provision of mild steel spacer bars. They should be so spaced that the main bars do not sag perceptibly between adjacent spaces.

Welding by gas or electricity may be permitted by the Engineer under suitable conditions and with suitable safe guards in accordance with relevant I.S. But welding between ends of a bar in line whereby stress is transferred across the section may be allowed for mild steel bars only.

The placing of reinforcement bars shall be completed well in advance of concrete pouring. The reinforcement shall be checked by the Engineer for accuracy of placement and cleanliness and necessary corrections prior to pouring the cement. Concrete blocks shall be used for ensuring the cover and positioning of reinforcement, they shall be made of mortar of mix one part cement to two parts sand by volume and cured for at least seven days. The sizes and locations of concrete blocks shall be as

approved by the Engineer. Laps and anchorage lengths of reinforcing bars shall be in accordance with IS:456 - latest revision- unless otherwise specified. If the bars in a lap are of the different diameter the smaller will guide the lap length. The laps shall be staggered as far as practicable and as directed by the Engineer.

7. EXPOSED REINFORCEMENT

Reinforcement projecting from work being concreted or already concreted shall not bent out of its correct position for any reason unless they are protected from deformation or other damage. Reinforcement left projecting for bending with future extension shall be thoroughly coated with cement grout wash, encased in concrete or otherwise protected from corrosion as approved by the Engineer.

8. COVER TO THE REINFORCEMENT

Unless otherwise specifically stated anywhere in the contract, the following clear cover to the main reinforcement shall be strictly adhere to:

Column	- 40mm or size of the main bar whichever is greater
Beam	- 25mm or ,, ,, ,,
Slab	- 15mm or ,, ,, ,,

9. MEASUREMENT

The net reinforcement work shall be work out in term of weight as per the bar bending schedule approved by the Engineer, taking theoretical unit weight for various size of the bars. Lapping, chair, spacer bars shall be measured.

10. RATE

Rate shall include all material, labour and other incidental items for complete work.

BRICK MASONRY WORK

1. SCOPE

This specification covers the construction of brick work in general and the erection of half brick, full brick and above thick walls in foundation and superstructure.

2. MATERIALS

All required materials shall be as specified in the "STANDARD CONSTRUCTION MATERIALS".

3. MORTAR

Mortar shall be as specified in the drawing, Bills of quantities or schedule of items for the particular work which may differ from case to case and as per the size, shape and thickness of the wall.

a. Mix:

Cement and sand (or any binding and supporting materials) shall be mixed dry thoroughly on clean approved platform or in a mechanical mixer and water shall then be added to obtain a mortar of the consistency of a stiff paste. Care being taken to add just sufficient water for the purpose.

b. Use of Mortar:

Mortar shall be used as soon as possible, after mixing and within 1/2 hours after cement is mixed wet. Mortar unused for more than 1/2 hours shall be rejected and removed (mixes of lime putty and sand can be kept for a period of 72 hours, provided it is kept damp and not allowed to dry).

c. Transportation of Mortar:

The well mixed mortar shall be transported from the mixing platform to the site of work in such a manner as to prevent formation of laitance or segregation.

4. BOND

"English Bond" shall be used in the construction of full brick and thicker walls unless otherwise specified in the drawing. For half brick thick wall, "stretcher bond" shall be used throughout the length of the wall.

Quoin bricks shall be laid header and stretcher in alternative courses, bond being obtained by placing a closer next to the quoin header. The arrangement of quoin in a course shall generally be symmetrical. Holes for required size shall be left in the brick work during laying only, for fixing pipes, service lines, passage of water etc. After they are fixed, the extra hollow left in the holes shall be filled with 1:3 cement mortar or 1:3:6 cement concrete and the face neatly made up with bricks in cement mortar. When iron fixtures etc. are to be laid in the brick work, shall be entirely covered with not less than 10mm of 1:3 cement mortar.

5. THICKNESS OF JOINTS

The thickness of the joints in the brickwork shall be 8mm unless otherwise specified and uniform throughout the work.

6. SOAKING OF BRICKS

Bricks shall be soaked in water before use for a period that is sufficient for the water just to penetrate the whole depth of the bricks. Any dirt, sand and dust shall be removed from the surface of the bricks. Bricks shall not be too wet at the time of use, as they are likely to slip in the mortar bed and there will be difficulty in ensuring plumpness of the wall. When bricks are soaked, they shall be removed from the tank sufficiently early so that at the time of laying they are skin dry. Such soaked bricks shall be stocked on a clean place, where they are not again spoil by dirt, earth etc.

7. LAYING OF BRICKS FOR MASONRY

Bricks shall be laid on a full bed of mortar evenly applied on the wetted surface of the old brick work. If any dirt or earth is on the wall they shall be cleaned by wire brush and washed down with water jet. When laying, the bricks shall be slightly pressed so that the mortar can get into all the pores of the brick surface to ensure proper adhesion. Cross joints and wall joints shall be properly flushed and packed with mortar so that no hollow spaces are left. All brick work shall be in plumb, square and true to dimensions as shown in drawings. All brickwork shall be built tightly against columns floor slabs or other structural parts around window and door frames with proper distance to permit concealed joints.

8. RAKING OUT JOINTS

Joints of brick work shall be raked out to a depth of 6mm at the time of laying. The face of the brick work shall be kept clear of all mortar, the very day the brick work is laid.

9. REINFORCING AND ANCHORAGE

For external walls, the anchors in the form of flats or rods from beams and columns and any other anchoring and reinforcement as shown on drawing shall be adequately embedded in the masonry.

10. OTHER BRICK WORK

a. Half brick thick wall:

Two bars of 6mm (1/4") diameter shall be used longitudinally at every 5th course of brick work. The first reinforcement shall be placed on the top of the bottommost course. The bars shall be fully embedded in the mortar and the ends shall be properly bonded in the vertical joints of brick work or to the main wall as directed by the Engineer Laps for the reinforcement shall be provided of minimum length of 45 times the diameter of bar.

11. WORKMANSHIP

a. All loose materials, dirts, and set lump of mortars may be laying over the surface over which the brick work is to be freshly started, shall be removed with a wire brush.
b. All the bricks shall be thoroughly soaked in clean water before use.
c. The surface over which the brick work is to be started shall be slightly wetted.
d. The first course itself shall be made horizontal by providing enough mortar in the bed joint to fill up any undulations in the bed course.
e. Required quantity of water is mixed in the mixing platform itself and not over the courses.
f. The joint should be of uniform thickness as specified.
g. There shall be no thorough joints and the lap shall not be less than half the width of the brick, and all the vertical joints are properly filled with mortar.
h. The verticality and horizontality of the courses shall be checked very often with plumb bob and spirit level respectively.
i. The courses of brick work shall be aligned and care shall be taken to keep the perpends.
j. The brick work shall be built in uniform layers, corners and other advanced works shall be racked back. No part of the wall during its construction shall rise more than 1 metre above the general construction level, to avoid unequal settlement, and also improper jointing. Where the masonry of one part has to be delayed the work shall be racked back suitably at an angle not exceeding 45 degrees according to bond and not toothed.

12. ARCHITECTURAL FEATURES

All projecting architectural features, such as string courses, cornices etc. shall be effectively bonded by tailing into the brick work to ensure stability. Such architectural features shall be set straight and true as shown in the drawing with finished joints (as far as possible).

13. CURING AND PROTECTION

a. The brick work shall be kept wet for 7 days commencing from 24 hours after the course is laid.
b. at the end of the day's work the masonry construction shall be protected from harmful effects of rain, sun, and frost by suitable coverings such as tarpaulin or any other suitable coverings.
c. Care shall be taken during construction that edges of jambs, sills, heads etc. are not damaged.

14. SCAFFOLDING

Double scaffolding having two sets of vertical supports shall be provided as directed by the Engineer. The supports shall be sound and strong and of steel tubular construction unless otherwise by other approved means. The vertical posts shall be tied together with horizontal pieces over which the scaffolding planks be fixed. The three sides of the scaffolding should be covered with 1.0 m wide ply boards to protect the materials from dropping off while working.

15. RATES

Rates for item shall include necessary materials, labour and equipment for proper execution of work and that all auxiliary work is included. Rates shall include work at all the levels, double scaffolding, (special) conveyance of materials etc. Rates shall also include for curing.

16. MEASUREMENT AND PAYMENT

The payment for respective type of brickwork shall be made at the Contract rate per cubic meters for the quantity acceptably executed limited to the dimension shown in the sanctioned plan or as directed by the Engineer. The lift of brickwork in superstructure shall be upto 12 m above ground level. Deductions of all openings in the brickwork shall be done to arrive the net quantity. However nothing extra shall be paid for making such openings and scaffoldings. No deductions shall be made for holdfast. The size shall be measured correct up to 2 decimal places and content worked out in cubic meter.

WOODEN DOORS AND WINDOWS

1. SCOPE

This specification covers the preparation, supply and fixing of door and window frames and shutters glazed, flywiremesh, fixed or openable with or without ventilator of best quality specified timber as mentioned in the item. The door or windows sizes shown in the drawings shall be the clear unrebated openings of the frame. The frames and shutters shall be finished as specified in the item.

2. MATERIALS

All required materials shall be as specified in the "STANDARD CONSTRUCTION MATERIALS".

3. FIXTURES AND FASTENINGS

All fixtures and fastenings shall be of brass or oxidized brass or stedler aluminum (as specified in the item) and shall be new sound and strong. They shall be sectional and of the best quality and workmanship. The size, shape, design and finish shall be as shown on drawings or as directed by the Engineer and deposited in his office for reference.

All fixtures shall be fixed to the joining in a secure and efficient manner. Any of the fixtures damaged during fixing shall be removed and new ones fixed in their place and the surface of joinery made good where affected at the Contractor's expense. When the type of fixing is not mentioned on the drawing or the item it shall be hung or swung as directed by the Engineer. In case the ventilator is hung, 2 brass or steel butt hinges shall be fixed with brass screws unless otherwise mentioned in the drawing. A pair of 22.5 cms brass hooks and eyes shall be fixed to the ventilator frame and the shutter as directed. If the detailed drawings specify different type of fixtures the work shall be carried out according to the drawing.

If the ventilator is of the swung type, then hooks and eyes can be dispensed with. The ventilator shall swing about a central horizontal axis of a pair of brass pivots in sockets. One pair of such centres, chat hooks, one brass ring with screws attachment as per detailed drawings or directed by the Engineer (R.E.) and a good quality window hemp cord of adequate length for convenient operation of the ventilator shall be provided. A two pronged brass hook shall be embedded in the wall at the said height above floor level for tying the cord. All the fixtures shall be fixed as shown on the drawings or as directed by the Engineer.

4. CHAUKOT OR FRAME

The quality of the timber shall be as specified in the drawing or first class salwood / locally available wood if not specified. The timber shall be of best quality from the heart of matured trees, with permissible gradient of in grain. The timber shall be either seasoned in a seasoning plant or naturally sun dried in a shed for a period of two (2) years.

The work shall be as per drawings. The timber shall be properly planed wrought and dressed in a workman like manner. Joints shall be true to fit properly and of the kind directed by the Engineer.

When a ventilator is provided above a door, full length of frame shall be provided. Joints in the frame vertical style or horizontal rail shall not be allowed. The unrebated edges of the frame in the opening shall be rounded or beaded uniformly. Rebates and plaster key grooves shall be provided as shown in the drawings. Six (6) number 250mm long by 30mm wide by 6mm thick hold fasts shall be provided at each frame unless otherwise specified in the drawings.

5. PANELLED SHUTTER

Planned shutter shall be made in number of ways and can be of different varieties as enumerated in the specification for "paneling". The shutter may be paneled single, double, triple or so on. The design of panels and the number of panels to be used shall be as per the drawings and directed by the Engineer. The styles shall be continuous from the top to bottom.

Design of panels and the number of panels to be used shall be as per the drawings and directed by the Engineer. The styles shall be continuous from the top to bottom.

The rails and, muttons or mullions shall be jointed to the styles and the muttons or mullions shall be joined to the rails. The thickness of the frame for the shutters shall vary from 32mm to 50mm (1 1/4" to 2?) or as per the drawing, depending upon the size of the door, the situation, the thickness of the panels etc. The thickness of the panels shall be 12mm or as specified in the drawing. Grooves shall be made on all the inside faces of the frame to receive panels.

6. FULLY GLAZED OR PARTLY GLAZED SHUTTERS

These shall be as described in No. 6 but instead of panels glasses of various thickness as per drawings or item shall be as per "Glazing Work" specification.

7. IRON MONGER FOR SHUTTERS

Unless and otherwise specifically mentioned in the drawing or in the item, following iron monger shall be provided in each shutter.

a. Hinges

For window shutter up to 0.2 sqm area - 2 nos.50mm size.

For window shutter up to 0.3 sqm area - 2 nos. 65mm size.

For window shutter up to 0.7 sqm area - 2 nos. 90mm size.

For window shutter up to 0.5 sqm area - 2 nos. 75mm size.

For high shutters 3 nos. of respective size shall be provided.

For door shutters up to 1 sqm - 2 nos. 75mm size.

For door shutters up to 2 sqm - 3 nos. 100mm size.

For door shutters up to 3 sqm - 3 nos. 150mm size.

For door shutters of area more than 3 sqm.

Special provisions shall be made.

b. Tower Bolts:

in each window shutter or a pair of window shutter following tower bolts shall be provided.

For ventilator	:	Top hung type: 2 nos. 50mm size at bottom.
Bottom hung type	:	2 nos. 50mm size eye bolt at top.
Central pivot type	:	2 nos. 50mm size at bottom.
Window	:	Bottom 150mm size for all.

Top 230mm long for up to 178mm lintel height.

Top 300 mm for above.

c. Eye hooks : 75mm size for all window shutters.

150mm to 230mm (as approved) for top hung

ventilator for bottom hung ventilator.

d. Stoppers and Cleats

In doors, where the shutters dashes the wall or another door, a wall type door stopper shall be provided in each door shutter, so that the door shutter remains untouched in the surface of the wall.

Unless combined stop and holder is not provided to the doors a standard type of door holder or cleat shall be provided to each door shutter so that the door can be kept completely open when required.

e. Door Spring

Each door shutter shall consist of a 230 to 300 long door spring or approved type/make.

f. Locks

A knob type or mortice type door lock with latch and dead bolt or 7 lever pad lock with 9" to 12" aldrop (aluminum) shall be provided in each door shutter as per item. But for internal room doors such locks shall be replaced by tower bolts.

g. Handle

All window shutter shall be included with one 100mm size handle of approved make and type. In case of door wherever handled, knob type door lock is not provided handle/push plate of approved type and make shall be provided.

8. RATE

The unit rate shall include:

a) The cost of timber, required number of holdfast with concrete block, wood preservatives to the surface contacting to the masonry surface, all required laborers and materials to complete the work for door and window frame.

b) The cost of timber, infill panels, hinges, towerbolts, handles, eye-hooks etc. all required materials to complete the shutter works.

9. MEASUREMENT AND PAYMENT

Measurement for payment of timber doors and windows frame shall be made in cubic meter. The shutter of timber shall be measured net including the beading in square meter. Nothing extra shall be admissible for putty etc. The metal window, collapsible gate, rolling shutter etc. shall be measured in square meter for the opening provided inclusive of frame out to out.

ALIMINUM DOORS AND WINDOWS

1. SCOPE

This specification covers the preparation, supply, and installation of door and window frames and shutters glazed, fly-wiremesh, fixed or operable with or without ventilator of best quality specified aluminum as mentioned in the item. The door or windows sizes shown in the drawings shall be the clear unrebated openings of the frame. The frames and shutters shall be finished as specified in the item.

Aluminum windows and doors shall be obtained from a specialist manufacturer approved by the Engineer. They shall be of the appropriate sizes and thickness best suited for the types of the opening and/or sizes conforming to the details shown on the Drawings and shall comply with the following requirements.

This specification covers furnishing of all labor, materials, all required hardware, services and equipment necessary for aluminum doors, windows and ventilators in any level,

2. MATERIALS

2.1 General Requirement

Aluminum doors, windows etc. shall be of sizes, sections and details as shown in the drawings. The details shown in the drawings may be varied slightly to suit the standards adopted by the manufacturers of the aluminum work, with the approval of Engineer. Before proceeding with any fabrication work, the contractor shall prepare and submit, complete fabrication and installation drawings for each type of doors, windows, ventilators and partition etc. for the approval of Engineer and nothing extra shall be paid on this account.

Windows shall be made up of aluminum frame sections as required for heavy intermediate units where operating sash are indicated. For fixed units, use standard intermediate weight.

Materials and building components which the Contractor has to supply and build in, i.e. they go into the permanent works, must be new and unused. They must comply with standards and dimensions.

No products or suppliers are indicated in this Specification. The Contractor shall propose suitable materials and systems which comply with the intent and performance criteria stated, whilst remaining fully responsible for the detailed design / co-ordination of the works including all fixings and associated works to provide a safe and warranted installation.

2.2 Products

- **Anchors:** Lead-shield or toothed-steel, drill-in expansion bolt anchors shall be stainless steel.

- **Weather stripping:** Continuous wool, silicone treated, or type recommended by the manufacturer. It shall not be liable to shrink, expand, warp or lose adhesion to the frames to which it is attached and shall provide an effective seal against draughts without impairing the performance of the windows or doors in any way.

  The weather stripping shall be capable of being renewed without disturbing the glazing system and without removal of outer frames from the structure.

- **Glazing Gasket:** The EPDM Gaskets shall be of size and profile as shown in drawings and as called for, to render the glazing, doors, windows, ventilators etc. air and water tight. Samples of gaskets shall be submitted for approval and the EPDM gasket approved by Engineer shall only be used. The contractor shall submit documentary proof of using the above material in the work to the entire satisfaction of Engineer.

  The EPDM gasket shall meet the requirements as given in Table below:

S.No.	Description	Standard	Specification
1	Tensile strength Kg.f/cm^2	ASTM-D 412	70 Min.
2	Elongation at break %	ASTM-D 412	250 Min.
3	Modulus 100% kgf/cm^2	ASTM-D 412	22 Min.
4	Compression set % at 0º C 22 Hrs	ASTM-D 395	50 Max.
5	Ozone resistance	ASTM-D 1149	No visible cracks

- **Sealant:** The sealants of approved grade and color shall only be used. The silicone for perimeter joints (between Aluminum and RCC/Masonry) shall be of make approved by the Engineer.

- **Aluminum Profile:** Aluminum sections used for fixed/operable windows, ventilators, & doors etc. shall be suitable for use to meet architectural designs to relevant works and shall be subject to approval of the Engineer for technical, structural, functional and visual considerations. Alloy used for extrusion shall be 6063-T5 confirming to ASTM B 221. The aluminum profile shall be PVDF or powder coated and the thickness and profile sizes shall be as shown in the drawings or as mentioned in the description of items. It is mandatory that all aluminum members shall be wrapped with self adhesive non-staining PVC tape.

  In general the aluminum profiles sizes shall be as follows:

  Genuine Chinese/Thai profiles from Thailand, supplied in alloy number Temper 505-T5 (compatible with AA 6063-T5). The finishing is Pure Polyester Powder Coated, corro-coat (PE-F), 60-80 microns thickness.

Description of aluminum profiles	Size & Thickness
1. Fix Partition	76.2mm x 38.1mm x 1.8mm
2. Door	
2.1 Vertical shutter	36.5mm x 41.3mm x 1.5mm
2.2 Top shutter	34.5mm x 65.0mm x 1.5mm
2.3 Transom	34.5mm x 65.0mm x 1.5mm
2.4 Bottom shutter	34.2mm x 97.0mm x 1.5mm
3. Sliding Window	
3.1 Sliding frame with fly screen	81.5mm x 17.8mm x 1.5mm
3.2 -do- without fly screen	71.5mm x 17.8mm x 1.5mm
3.3 Sliding frame side track	71.5mm x 19.9mm x 1.5mm
3.4 Sliding frame top track	71.5mm x 26.8mm x 1.5mm
3.5 Sliding bottom sash	24.4mm x 60.0mm x 1.5mm
3.6 Sliding top sash	26.8mm x 35.0mm x 1.5mm
3.7 Sliding handle sash	26.0mm x 51.2mm x 1.5mm
3.8 Sliding interlock sash	32.1mm x 34.4mm x 1.5mm
4. Casement Window	
4.1 Casement frame section	36.6mm x 38.8mm x 1.5mm
4.2 Casement sash section	36.6mm x 40.2mm x 1.5mm
4.3 Casement mullion/transom	36.6mm x 35.4mm x 1.5mm
4.3 Bead	24.3mm x 22.7mm x 1.5mm
5. Fly screen section	12.60mm x 42.70mm x 1.5mm

  Accessories shall be the followings or superior:

  - Thai CENZA friction stays
  - Thai quality gaskets.
  - Thai Rollers
  - Thai weather piles.
  - Japanese “Reliance” hook locks.

- Bangkok "Polymate Co. Ltd." fibre net fly screen.
- Bangkok “CENZA” cam handle locks.
- Thai 'ADB 104' Silicone..
- Silicone backing foam seal.

- **Aluminum Sheet:** Aluminum Sheets for use as panels shall be 1.5 mm thick aluminum alloy sheet conforming to ASTM B 209. Aluminum alloy sheet for use in general paneling work shall be of types and thickness as specified and conforming to the requirement of ASTM B 209. Aluminum sheets shall be of approved make and manufacturer, Aluminum panel may be prefabricated units manufacture on modular or non-modular dimension.

- **Glass:** unless otherwise stated, the glass shall be clear float glass and should be approved by the Engineer. All glass shall be of the best quality, free from specks, bubbles, smokes, veins, air holes, blisters and other defects. The kind of glass supplied by the contractor shall be as mentioned in the item or in the special provision or as shown on the drawings. The float glass shall conform to the IS 14900.

  When plate glass is specified, it shall be "polished patent plate glass" of the best quality. It shall have both the surfaces ground flat and parallel and polished to obtain clear undistorted vision and reflection. The plate shall be of the thickness mentioned in the item, shown in the detailed drawings or specified in the special provisions. In the absence of any specified thickness the thickness of the plate glass to be supplied shall be 5.5 mm. A tolerance of 0.55 to 0.80mm shall be admissible on the nominal thickness of polished plate glass.

  When Annealed clear/tinted/coated float glass is specified shall meet the requirements of ASTM C 1036, Type 1, Class 1, Quality q3; with pyrolytic coating meeting the requirements of ASTM C 1376 "Specification for Pyrolytic and Vacuum Deposition Coatings on Glass".

- **Toughened Glass:** The toughened glass shall be highly elastic and safe against bending failure. Temperature variations shall not affect the stability; in case of breakage, glass shall not splinter.

  Glass shall be fixed by neoprene strip, and glazing beads of rectangular aluminium section screwed to the frame.
  Thickness of panes shall be as shown in Drawings or as specified in Bill of Quantities.

- **Safety and Narrow Lite Glass (Gergian Glass):** Wired plate glass, as well as wired float glass, wired ornamental glass, wired "difulite" glass, and corrugated wire glass shall be adequately resistant to fire. In the event of breakage of glass panes, the wire netting shall hold the splinters.

  If sectional wired building glass is cracked, its wire netting shall retain the glass fragments to the largest possible extent.

  Single-sheet safety glass, being pre-stressed, shall be highly elastic, safe against bending failure and resistant to temperature variations. In the event of breakage, the glass shall not splinter.

  The thickness of glass shall not be less than 6mm

- **Particle Board:** Synthetic resin bonded flat pressed three layers, multilayer and graded particle board defined in IS 3087 having superfine surface shall be used for production of prelaminated particle board. For ECO Marks the particle board shall also conform to the requirements of ECO Mark specified in IS 3087.

- **Fittings:** Handles, hinges, striking plates, crescent lock, friction ring centres, spring catches, stays etc. shall match the colour of the windows and / or doors, Bolts, nuts fixing screws and large pins shall be of stainless steel.

2.3 Delivery, Storage and Handling

Inspect materials delivered to the site for damage. Unload and store with minimum handling. Provide storage space in dry location with adequate ventilation, free from dust or water, and easily accessible for inspection and handling. Stack materials on nonabsorptive strips or wood platforms. Do not cover doors and frames with tarps, polyethylene film, or similar coverings. Protect finished surfaces during shipping and handling using manufacturer's standard method, except that no coatings or lacquers shall be applied to surfaces to which calking and glazing compounds must adhere.

All materials shall be delivered in manufacturer's original, unopened, undamaged packages or containers with manufacturer's label intact.

All materials shall be carefully stored in an area that is protected from deleterious elements in a manner recommended by the product manufacturer. Storage shall be in a manner that will prevent damage to the material or marring of its finish.

3. QUALITY ASSURANCE

Manufacturer: Provide products of manufacturer with no less than 10 years experience in manufacturing the aluminum profile and accessories for the required work. Manufacturers that cannot provide the performance test data specified herein will not be considered for the project.

Provide a complete aluminum profile and required accessories from single manufacturer specializing in the production of this type of work. For the purpose of designating type and quality for the work under this section, drawings and specifications are based on the Genuine Thai Powder Coated Section.

Fabricator/Installer: All fabrication and installation works shall be carried out with the fabricator/installer experienced to perform work of this section who has specialized in the fabrication and installation of work similar to that required for this project.

4. EXECUTION

4.1 General

Prior to the start of the work, all the shop drawings for each type of doors/windows/ventilators etc. shall be prepared by using suitable sections based on architectural drawings, adequate to meet the requirement/specifications and by taking into consideration varying profiles of aluminum sections being extruded by approved manufacturers. The shop drawings shall also show the details of fittings and joints. Before start of the work, all the shop drawings shall be got approved from the Engineer.

Actual measurement of openings left at site for different type of door/window etc. shall be taken. The fabrication of the individual door/windows/ventilators etc. shall be done as per the actual sizes of the opening left at site. The frames shall be truly rectangular and flat with regular shape corners fabricated to true right angles. The frames shall be fabricated out of section which have been cut to length, mitered and jointed mechanically using appropriate machines. Mitered joints shall be corner crimped or fixed with self tapping stainless steel screws using stainless steel cleats of required length and profile. All aluminum work shall provide for replacing damaged/ broken glass panes without having to remove or damage any member of exterior finishing material.

4.2 Fabrication

The windows and doors shall be constructed from clean extruded sections and shall be free from distortions and imperfections.

The outer frames of the windows shall have long or short flanges to suit the internal and external finishes detailed on the Drawings.

All frames shall be mechanically jointed and sealed at corners, the window frames being mitered, the door frames being butted. The joints shall be designed to withstand a wind load of 150 kg/m2. All

members shall be accurately machined and fitted to form hairline joints prior to assembly. The joints and accessories such as cleats, brackets, anchors, screws, etc. shall be of such material as not to cause any bimetallic action. The design of the joints and accessories shall be such that the accessories are fully concealed. The fabrication of doors, windows, etc. shall be done in suitable sections to facilitate easy transportation, handling and installation. Adequate provision shall be made in the doors and windows members for anchoring to support and fixing of hardware and other fixtures as approved by the Engineer.

All screws used for window or door assembly or fitted and for fixing shall be non-ferrous, countersunk stainless steel Phillips screws and if exposed shall match the finish of the surrounding metal.

After accurate fittings at the works, associated doors, windows and ventilators units shall be packed separately and clearly marked to indicate the manner in which they are to be assembled on site.

The Contractor shall be responsible for ensuring that manufacturers are fully informed of structural opening sizes to ensure that windows and doors will fit correctly with the necessary tolerances for composite assembly and building in.

4.3 Installation

All windows and doors shall be installed accurately, true to line and with all necessary tolerances as detailed.

Installation of the aluminum glazing shall conform to IS - 1081 – codes of practice for fixing and glazing of metal (sheet and aluminum) Doors, Windows and Ventilators. It shall be duty of the manufacture to make arrangements for proper fixing of the glazing which shall have to withstand a wind velocity of 157-km/hr. at height of 15 meter elevation as pressure in Kg/M^2 of 150.

Aluminum frames set in timber sub-frames or other rebated surrounds shall be bedded externally in a suitable non-setting mastic compound. The compound shall be such as will not react with adjacent materials and shall form a long lasting and flexible weather-tight seal under the local climatic conditions.

All windows and doors shall be protected from damage during the work of subsequent trades.

Window and door openings into which aluminum windows and doors have been fixed shall not be used for the passage of materials or men, except where unavoidable, and in these cases the frames shall be cased in plywood.

Extreme care shall be taken at the time of assembly and installation of aluminum works with a view to see that no damage is done to the work of other agencies. In case of any damage the same has to be made good to the satisfaction of the Engineer at no extra cost.

4.4 Doors, Windows and Ventilator Shutters

Material, fabrication and dimensions of aluminum doors, windows and ventilators manufactured from extruded aluminum alloy sections of standard sizes and designs complete with fittings, ready for being fixed into the building be as per IS 1948.

All in fill panels and shutters shall be as shown in the drawings or mentioned in Bill of Quantities.

4.5 Provision for Glazing

Windows and doors shall be fitted with approved clip-on glazing beads or solid glazing beads with countersunk screws, the beads sized and positioned to suit the particular types and thickness of glass required.

Clip on glazing beads shall not be used in exposed locations.

All beads shall be fixed internally.

4.6 Provision for Fixing

Window and door frames shall be supplied complete with all fixing components including lugs, cramps, straps, shims, woodscrews etc. and the Contractor shall be responsible for ensuring that full details of fixing requirements and spacing are supplied to site in time to allow for plugs, sockets, grounds and other fixing points to be located and built in where required.

Fixing components shall either be of non-ferrous metal or shall be suitably protected to prevent the risk

of electrolytic corrosion of the aluminum.

4.7 Infill Panels/Shutter (panelling Materials)

Infill panels or shutters in doors, windows and ventilator shall be as shown in the drawings or as mentioned in Bill of Quantities.

4.8 Weathering Stripping

Provide on stiles and rails of exterior doors. Fit into slots which are integral with doors or frames. Weatherstripping shall be replaceable without special tools, and adjustable at meeting rails of pairs of doors. Installation shall allow doors to swing freely and close positively. Air leakage of a single leaf weatherstripped door shall not exceed 1.25 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E 283.

4.9 Anchorage

On the backs of subframes, provide anchors of the sizes and shapes indicated for securing subframes to adjacent construction. Anchor transom bars at ends and mullions at head and sill. Reinforce and anchor freestanding door frames to floor construction as indicated on approved shop drawings and in accordance with manufacturer's recommendation. Place anchors near top and bottom of each jamb and at intermediate points not more than 635 mm apart.

4.10 Condensation Drainage

At the bottom of all external window and door frames provision shall be made for the collection of condensation, with drain holes or weepiness to lead it to the outside.

4.11 Protection from Dissimilar Materials

a. Dissimilar Metals: Where aluminum surfaces come in contact with metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact to dissimilar metals.

1. **Protection:** Provide one of the following systems to protect surfaces in contact with dissimilar metals:
   i. Paint the dissimilar metal with one coat of heavy-bodied bituminous paint.
   ii. Apply a good quality elastomeric sealant between the aluminum and the dissimilar metal.
   iii. Paint the dissimilar metal with one coat of primer and one coat of aluminum paint.
   iv. Use a nonabsorptive tape or gasket in permanently dry locations.

b. Drainage from Dissimilar Metals: In locations where drainage from dissimilar metals has direct contact with aluminum, provide protective paint to prevent aluminum discoloration.

c. Masonry and Concrete: Provide aluminum surfaces in contact with mortar, concrete, or other masonry materials with one coat of heavy-bodied bituminous paint.

d. Wood or Other Absorptive Materials: Provide aluminum surfaces in contact with absorptive materials subject to frequent moisture, and aluminum surfaces in contact with treated wood, with two coats of aluminum paint or one coat of heavy-bodied bituminous paint. In lieu of painting the aluminum, the Contractor shall have the option of painting the wood or other absorptive surface with two coats of aluminum paint and sealing the joints with elastomeric sealant.

5. RATE

The rate shall include the cost of materials, accessories, labour and other required accessories for all the operations described above. The rate shall also include the cost of respective types of shutter, frames, provision of all required fixing accessories handles, tower bolts, hinges, door locks, door closer, etc., all complete.

6. MEASUREMENT AND PAYMENT

Measurement for payments shall be made in square meter for the completed work as indicated in the Bill of Quantities. Dimensions shall be measured correct to the nearest 0.01 m i.e. 1 cm. Areas shall be calculated to the nearest 0.01 sq. m. The elevation, height and width shall be measured out to out of the frame.

The completed aluminium door and window shall be paid at their respective contract unit rate which shall be the full and the final compensation to the Contractor to complete the work as per these Specifications.

ROLLING SHUTTER

1. SCOPE

This specification covers the providing and fixing of Mild Steel Rolling Shutter inclusive of all required fittings.

2. MATERIALS

All finished steel shall be well and cleanly rolled to the dimensions and weight specified by ISI subject to the permissible tolerances as per IS:1852-1973. The finished materials shall be reasonably free from defects. Steel sections shall be free from excessive rust, scaling and pitting and shall be well protected.

3. ROLLING SHUTTER CONSTRUCTION

General: Rolling shutters shall be obtained from a firm amongst the manufacturer approved by the Employer. These shall include necessary locking arrangement and handles etc. These shall be suitable for fixing in position as specified i.e. outside or inside or below lintel or between jambs of the opening. The door shall be either push and pull type or operated with chain and crank device supplied by the firm. Shutter upto 10 square meter shall be pushed and pull type and shutter with an area of over 10 square meter shall generally be provided with reduction gear operated by mechanical device with chain or handle.

Shutter: Shutter shall consist of M.S. laths 1.25 mm thick and 80 mm wide laths or as specified. The laths shall be machine rolled and straightened with an effective of 16 mm shall be interlocked together throughout their entire length and joined together at the end with end locks. These shall be mounted on specially designed shaft. Each laths shall be a continuous single strip piece without any joint.

The springs shall be , preferably of coiled type. The spring shall be manufactured from high tensile spring steel wire or strip os adequate strength to balance the shutter in all positions. The spring pipe shaft etc, shall be supported on strong mild steel brackets.

Guide Channels: The guide channels shall e of mild steel deep channel section and rolled, pressed or built-up (fabricated) construction. The thickness of the sheet used shall not be less than 3.15 mm.

The minimum depth for guide channels shall be as follows:

Clear width of shutter	Depth of Guide Channel
Upto 3.5 m	60 mm
3.5 m and above	75 mm

The gap between the two leg of guide channel shall be sufficient to allow the free movement of the curtain and at the same time close enough to prevent the rattling of the curtain due to wind.

Each guide channel shall be provided with a minimum of three fixing cleats or supported for attachment to the wall or column by means of bolts or screws. The spacing of cleats shall not exceed 750 mm. Alternatively, the guide channels may also be provided with suitable dowels, hooks or pins for embedding in the walls.

The guide channels shall be attached to the jambs, plumb and true, either in overlapping fashion, projecting fashion or embedded in grooves, depending on the method of fixing.

The top cover of shaft/spring etc, shall be of same material as that of lath.

4. FIXING

Brackets shall be fixed on the lintel or under lintel or beam or under beam as specified with rawl-plugs, and screw bolts etc. The shaft along with the spring shall then be fixed on the brackets.

The lath portion (shutter) shall be laid on ground and the side guide channels shall be bound with it with ropes etc. The shutter then be placed in position and top fixed with pipe shaft with bolts and nuts. The

side guide channels and the cover frame shall then be fixed to walls through the plate welded to the guides. These plates and brackets shall be fixed by means of steel screw bolts, and rawl-plugs drilled in the wall. The plates and screw bolts shall be concealed in plaster to make their location invisible. Fixing shall be done accurately in a workmen like manner that the operation of the shutter is easy and smooth.

5. RATE

The rate shall include all labour, materials and equipment necessary for all operations described above including the cost of top cover and spring etc to complete the works.

6. MEASUREMENT AND PAYMENT

Clear width and clear height of the opening for rolling shutter shall be measured correct to two decimal places. The area shall be calculated in square meter correct to two place of decimal and paid applying unit rate quoted n the item of work in bill of quantities.

GLAZIER'S WORK

1. SCOPE

This specification shall cover the glazier's work including the types of glasses, putty, methods of fixing the glass in wooden or steel frames, partitions etc.

2. MATERIALS

Glass: All glass shall be of the best quality, free from specks, bubbles, smokes, veins, air holes, blister and other defects. The kind of glass supplied by the Contractor shall be as mentioned in the item or in the special provisions or as shown on the detailed drawings. The thickness of glass panes shall be uniform. The specifications for different kinds of glasses shall be as under.

a. Putty. The putty to be used for fixing the glass in wood frames shall conform to IS. 419-1953.

   The putty may be coloured to suit the colour of door or window etc. For glazing in metal sashes, putty to be used shall conform to IS 420-1953.

b. Mastic. For glazing in metal sashes, patent mastic shall be used instead of putty when so specified in the special provisions or directed by the Engineer. Glass bricks shall be laid in mastic specified by the manufacturers of glass blocks or in 1:3 cement mortar if so specified in the special provisions.

3. FIXING

In wooden frames and sashes. The glass panes shall be properly cut to fit the rebates of the frames and sashes truly with a slight minus margin of about 1.5mm (about 1/16") on all sides. The rebates should not be less than 8mm (about 1/3") in the frames and sashes. Before glazing, the frames shall be primed and prepared for painting so that the wood may not draw oil out of the putty and the putty may adhere properly. The rebate shall be puttied first and glass pane is then pressed in to position and secured with glazier's springs and firmly back putied. The rebates shall be chamfered. The putty may be given a coat of oil paint or oil to match the side surfaces and also seal the edges of the putty to the glass. The putty shall be left for a week so before painting to ensure its setting.

When so specified, for better class of work and larger panes of glass, the glass shall be bedded in putty and fitted to the frames with wooden beads or mouldings and secured with brass countersunk or round headed screws or with brass screws and cups. For fixing plate glass or large sheets of glass, the glass shall be embedded in putty externally, but internally, wash leather, valvet, felt, rubber or some similar material approved by the Engineer shall be used before fixing the beads.

4. RATE

The rate shall include:

a. Providing the specified type of glass panes of the required dimensions and fixing material.
b. Fixing the glass in the frame as specified, including cutting and waste.
c. Cleaning the glazed work.
d. Repairing of any work damaged during glazing.
e. All labour, material, scaffolding and equipment to carry out the item.

5. MEASUREMENT AND PAYMENT

The glazed shutter shall be measured net including the beading in square meter. Nothing extra shall be admissible for putty etc.

FLYWIREMESH SHUTTER

1. SCOPE

This specification covers supply, fabrication and fitting of Flywire mesh shutter with timber frame / MS folded plate on door and window frames.

2. MATERIALS

Timber: All timber used for the work shall be seasoned and free from decay, free from any harmful fungies and insects attacks and from any other damage of harmful nature which will affect the strength, durability, appearance and usefulness for the purpose for which it is required.

Mild Steel Plate: Mild Steel Plate used for the work shall conform to the relevant IS specification and of size and section provided as per the drawing.

Fixers and fastening: Providing and fixing in position fixers and fastening per every leaf as per instruction of Engineer.

Wire gauge: Wire gauge shall be of woven wire webbing. It shall be of 14 to 16 mesh to liner 25 mm with 28 to 30 gauge GI wire or as approved by Engineer.

3. FABRICATION

The stiles, rails etc. shall be rebated 12 mm (½") along the side to receive the wire gauge. The galvanized iron fly proof webbing of 14 to 16 mesh to 25 mm linear length shall be used unless otherwise specified. The webbing shall be bent at 90° at 12 mm (½") along both side to rebate and fixed securely to stiles, rails and mountings by 12 mm (½") galvanized Iron staples at about 15 cm (6") intervals, staggered spacing. Fillet shall be of salwood or shishaum wood or specified timber of size 10 mm x 10 mm (3/8" x 3/8") which shall be securely and neatly fixed with small screws spaced at 75 mm (3") centres round the rebate for each hand of webbing after the filets are pressed well into the rebate to hold the wire mesh. The wire mesh shall be tightly stretched during fixing. The space between filet and the rebate where the webbing is bent shall be neatly finished with putty so that the cut ends of the webbing may not be visible. Each shutter shall be fitted with necessary fittings of approved quality as shown on the drawing.

4. RATE

The rate shall be inclusive of labour and all materials required.

5. MEASUREMENT AND PAYMENT

The flywire mesh shutter shall be measured net including the beading in square meter. Nothing extra shall be admissible for putty etc.

CEMENT FLOOR FINISH

(Ordinary or Colour Crete)

1. SCOPE

This specification covers cement concrete floor neatly finished in general and ordinary or colour create floor finish with or without cement concrete wearing coat and dado and skirting without concrete wearing coat in particular.

2. MATERIALS

Cement, sand, aggregates, water etc. as specified in plain cement concrete work.

Colour pigment: Colour pigment shall be of superior quality, confirming to BS or IS standards as approved by the Engineer.

3. MIXING

Cement concrete and cement sand shall be mixed as specified in plain cement concrete work and plastering work. Colour pigment with cement shall be mixed in an approved manner and the proportion shall be as directed by the Engineer but it should be between 1:3 to 1:12 (pigment and cement).

4. PREPARING BASE

The base where such flooring is to be laid shall be cleaned, brushed and watered properly. In structural slab or concrete surfaces the screw shall be removed by chisel and wire brush and cleaned properly. Such surfaces shall be wire brushed and watered for 3 to 4 hours.

5. LAYING OF CONCRETE

Form Work: Form work for concreting work shall be made in square or rectangular of suitable size but not exceeding 1.2m x 1.2m in any case. The ready finished form work shall then be coated with one coat of oiling before placing concrete. One layer of cement slurry shall be provided before placing concrete panels, alternatively. The alternate panels can be laid only after the final setting of the previous concrete work. Such concrete work shall be thoroughly tamped, struck off level and surface floated with a wooden float. The surface shall then be tested with a straight edge and mason's spirit level to detect any inequalities and undulations in surface which, if any, shall be made good immediately. The thickness of the concrete shall be 40mm unless otherwise specified. In case of integrated concrete work, the mix shall be as specified in bill of quantity, using light weight aggregate. The method of laying shall be as described above.

Joint: In the joints between concrete panels, coal tar shall be filled up to the half depth and rest shall be filled with cement sand mortar of weak proportion.

6. FINISHING COAT

Neat cement finish: One layer of cement sand plaster of specified proportion shall be used, which shall be cut in pattern, the joints shall be just above the joints of the concrete. Such plaster shall be followed by a thin coat of cement punning of specified mix which shall be in the approved pattern, trowelled and finished neatly. However, the thickness of such film shall not be less than 3mm. Curing of the finished work shall be done by covering the whole surface with damp jute bags and kept wet for one week or as directed by the Engineer. Wherever colour crete is specified, such work shall be applied only in the neat finish coat and finished similarly.

7. FINISHING

After laying final coat and final curing is over, the surface shall be grinded with various grades of carborandum stones to the smooth and plain surface. Steel and iron fleats shall not be used in coloured floors. The polishing and finishing shall be as mentioned hereunder.

When the finished surface is 3 to 4 days old, it shall be surfaced by hand or with a surface grinding machine, to remove laitance or loose materials and to produce smooth finish. The first grinding shall be done with a course carborundum **stone**, using water freely. All pores and holes are filled with cement mortar of the same as of floor surface. Second grinding shall be carried out after 5 days of first grinding with fixed grinding carborandum stone and patches if any shall similarly be filled and the 3rd grinding carried out. The floor is washed thoroughly after each grinding and in the final grinding washing should be done with hot water and pure soft soap. Final grinding is generally done after 10 days.

In the case of machine grinding, the first cut should not be made till coloured surface layer is 14 days old. After the final grinding oxalic acid is dusted over the surface (2/3 lbs per 100 sft) which must be sprinkled with water and rubbed hand with numdah blocks.

The following day the floor is wiped with a moist rag and dried with a soft cloth. A hot mixture of turpentine and beeswax (4:1 or 3:1) is then applied to the surface and thoroughly rubbed in with hand and later again with clean cotton waste for four hours. The rubbing must be continued until the floor/skirting ceases to be sticky. Best result is obtained with minimum of beeswax and a maximum of rubbing.

8. SLOPES

Unless shown in the drawing, all slopes of the floor shall be towards the outlet at the rate of 0.75 to 1.0%.

9. SKIRTING

Skirting shall be finished as finishing coat of the floor unless otherwise specified. The skirting work shall include racking and cleaning of base, watering, applying plaster work and neat finish. The level, line and corners shall be done carefully to get even, plumb and uniform surface through uniformity. The skirting work shall be done simultaneously with floor work or as directed by the Engineer. The top edge of the skirting shall be chamfered to prevent dust collection.

10. FLOOR HARDENER

Concrete floor hardener shall be of the quality approved by the engineer which shall be used as per manufacturer's instructions and specifications.

11. RATE

The rate shall include:

a) Laying wearing course after preparing base.

b) Providing ordinary or colour crete floor as per the item or drawings.

c) Cost of formwork for dividing such floors into the panels.

d) Curing and protections of the work.

e) Finishing of the laid surface including dividing into panels and polishing as required.

12. MEASUREMENT AND PAYMENT

Measurement of cement concrete floor finish shall be done in square meter as in item. Measurement shall be done nearest to 12 mm. Nothing extra shall be paid for the strip provided to lay the concrete in alternate panels.

FLOORING OTHER THAN CEMENT FLOOR

1. SCOPE

This specification covers floor finishes of terrazzo floor cast in site ordinary or colored, precast terrazzo floor ordinary or colored, ceramic tile glazed or non glazed, clay flooring tiles, dividing strips etc.

2. MATERIALS

i) Cement, sand, stone aggregate, lime, water etc. shall be a specified in concrete works.

ii) Terrazzo aggregates: The aggregates used in terrazzo topping shall be marble aggregate of the sizes as per finish requirement. The aggregates shall be mixed in proportion as specified of require colored and sizes.

iii) Colour cement: The colour cement shall be 'Colorcrete' of Snowcem India Ltd. Bombay or any other reputed company.

iv) Terrazo tiles shall generally conform to IS 1237-Edition 2.3. Unless otherwise specified, the tiles shall be supplied with initial grinding and grouting of wearing layer.

v) Ceramic tiles: The ceramic tiles shall be glazed or non-glazed or non-glazed of specified sizes, pattern and color from any reputed company. The sample of tiles is to be approved by the Consultant for color, pattern and size, which are to be kept for future reference.

vi) Clay flooring tiles: The Clay flooring tiles shall be wire cut machine made brick tiles from "MD Prajapat or superior. These shall be well burnt and of uniform color. Sample of tiles is to be approved by the Consultant, which are to be kept for future reference.

vii) Dividing strips: The dividing strips shall be glass or as specified 4 mm lesser than the depth of floor finish.

viii) Parquet flooring: This shall be of seasoned wood of specified size and thickness and of pattern as specified in the drawingsCement, sand, aggregates, water etc. as specified in plain cement concrete work.

3. SURFACE PREPARTION

Sub-grade concrete or RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. Specified mortar bedding shall then be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set.

4. WORKMANSHIP

4.1 Terrazzo Floor Finish Cast-in-Situ

4.1.1 Under Layer

Cement concrete of specified mix shall be used and the specifications given under cement screed (Cement Floor Finish) shall apply. The panels shall be of uniform size, not exceeding 2 sqm in area or 2 m in length for inside situations. In exposed situations, the length of any side of the panel shall not be more than 1.25 metre. Cement slurry @ 2.00 kg per sqm shall be applied before laying of under layer over the base cement concrete/RCC base.

4.1.2 Fixing of Strips

4 mm thick glass strips or 2 mm thick PVC strips/aluminium strips/brass strips / stainless steel strips/copper strips unless otherwise specified shall be fixed with their top at proper level to required slope. Strips of stone or marble or of any other material of specified thickness can also be used if specifically required. Use of glass and metallic strips shall be avoided in areas exposed

to sun. 4 mm thick glass strips or 2 mm PVC strips or 2 mm aluminium or brass strips shall be fixed with their tops at proper level, giving required slopes.

4.1.3 Top Layer

4.1.3.1 Mortar : The mix for terrazo shall consist of cement with or without pigment, marble powder, marble aggregate (marble chips) and water. The cement and marble powder shall be mixed in the proportion of three parts of cement to one part marble powder by weight. For every part of cement marble powder mix, the proportion of aggregate by volume shall be as shown in Table below.

The marble chips shall be white or pink Makrana, black Bhainslana, Chittoor black, Jaisalmer Yellow, Baroda green, Dehradun white, Chittoor pink, yellow Patam cherala (Madras), grey Gadu (Surat), Chittoor green and yellow and Alwar black or as specified. It shall be hard, sound, dense and homogenous in texture with crystaline and coarse grains. It shall be uniform in colour and free from stains, cracks, decay and weathering. The maximum thickness of the top layer for various sizes of marble aggregates (marble chips) shall be as shown in Table below:

Thickness of top layer by chips size

Grade No.	*Size of Aggregates in (mm)*	*Proportion of Aggregates to Binder Mix*	*Minimum Thickness of Top Layer (mm)*
00	1 - 2	1.75 : 1	6
0	2 - 4	1.75 : 1	6
1	4 - 7	1.75 : 1	9
2	7 - 10	1.50 : 1	12

Where aggregate of size larger than 10 mm are used, the minimum thickness of topping shall not be less than one and one third times the maximum size of the chips. Where large size chips such as 20 mm or 25 mm are used, they shall be used only with a flat shape and bedded on the flat face so as to keep the minimum thickness of wearing layer.

Before starting the work, the contractor shall get the sample of marble chips approved from the Engineer. This shall be done in advance by mixing different colour marble chips and panel samples of minimum 1 m x 1 m size shall be prepared and got approved from the Engineer before laying of flooring. The cement to be used shall be ordinary grey cement, white cement, cement with admixture of colouring matter of approved quality in the ratio specified in the description of the item in the ratio to get the required shade as ordered by the Engineer. Colouring materials where specified shall be mixed dry thoroughly with the cement and marble powder and then marble chips added and mixed as specified above. The full quantity of dry mixture of mortar required for a room shall be prepared in a lot in order to ensure a uniform colour. This mixture shall be stored in a dry place and well covered and protected from moisture. The dry mortar shall be mixed with water in the usual way as and when required. The mixed mortar shall be homogenous and stiff and contain just sufficient water to make it workable.

The terrazo topping shall be laid while the under layer is still plastic, but has hardened sufficiently to prevent cement from rising to the surface. This is normally achieved between 18 to 24 hours after the under layer has been laid. A cement slurry preferably of the same colour as the topping shall be brushed on the surface immediately before laying is commenced. It shall be laid to a uniform thickness slightly more than that specified in order to get the specified finished thickness after rubbing. The surface of the top layer shall be trowelled over, pressed and brought true to required level by a straight edge and steel floats in such a manner that the maximum amount of marble chips come up and are spread uniformly over the surface.

4.1.3.2 Curing, Polishing and Finishing: The surface shall be left dry for air-curing for a duration of 12 to 18 hours depending on atmospheric temperature conditions. It shall then be cured by allowing water to stand in pools over it for a period of not less than 4 days.

The grinding and polishing may be commenced not before 2 days from the time of completion of laying for manual grinding and not before 7 days for maching grinding. For polishing by machines, the surface shall be watered and ground evenly with machine fitted with special rapid cutting grit blocks (carborundum stone) of coarse grade (No. 60) till the marble chips are evenly exposed and the floor is smooth. After the first grinding, the surface shall be thoroughly washed to remove all grinding mud and covered with a grout of cement and colouring matter in same mix and proportion as the topping in order to fill any pin holes that appear. The surface shall be allowed to dry for 24 hours and wet cured for 4 days and then rubbed with machine fitted with fine grit blocks (No. 120). Curing shall be done by ponding of water between panels formed with fine sand. The surface is cleaned and repaired as before and allowed to cure again for 3 to 5 days. Finally the third grinding shall be done with machine fitted with mere fine grade grit blocks (No. 320) to get even and smooth surface without pin holes. The finished surface should show the marble chips evenly exposed.

Where use of machine for polishing is not feasible or possible, rubbing and polishing shall be done by hand, in the same manner as specified for machine polishing except that carborundum stone of coarse grade (No. 60) shall be used for the 1st rubbing, stone of medium grade (No. 80) for second rubbing and stone of fine grade (No. 120) for final rubbing polishing.

After the final polish either by machine or by hand, oxalic acid shall be dusted over the surface @ 33 gm per square metre sprinkled with water and rubbed hard with Pad of Woolen rags. The following day, the floor shall be wiped with a moist rag and dried with a soft cloth and finished clean.

4.1.3.3 Wax Polishing: Wax polish shall be of approved brand and manufacture and in sealed containers. It shall be applied in uniform layer to the dry surface of the floor/skirting.

When the layer of the wax is stiffened and surface of floor is saturated with the polish, polishing shall be resorted with machine fitted with bobs (pad of rags) and shall be done until shades of all chips have appeared and glossy surface is obtained.

The fresh polished floor surface shall be protected using appropriate protective materials until the surplus wax has been absorbed and the floor shall be opened only after proper drying of wax polish.

4.2 Pre-Cast Terrazzo Floor Finish:

4.2.1 Terrazzo Floor Tiles

Terrazzo tiles shall generally conform to IS 1237-Edition 2.3. Unless otherwise specified, the tiles shall be supplied with initial grinding and grouting of wearing layer.

The size of tiles shall be as given in Table below or as shown in the drawings or as required by the Engineer. Half tiles for use with the full tiles shall be such as to make two half tiles when joined together, match with the dimensions of one full tile.

Length Nominal (mm)	*Breadth Nominal (mk)*	*Thickness not less than (mm)*
200	*200*	*20*
250	*250*	*22*
300	*300*	*25*

4.2.1.1 Tolerance: Tolerances on length and breadth shall be plus or minus one millimetre, and tolerance on thickness shall be plus 5 mm. The variation of dimensions in any one delivery of tiles shall not exceed 1 mm on length and breadth and 3 mm on thickness.

4.2.1.2 Tile Manufacturing: The tiles shall be manufactured in a factory under pressure process subjected to hydraulic pressure of not less than 140 kg per square centimeter and shall be given the initial grinding with machine and grouting of the wearing layer before delivery to site.

The wearing layer shall be free from projections, depressions, cracks, holes, cavities and other blemishes. The edges of wearing layer may be rounded.

The proportion of cement to aggregate in the backing of tiles shall be not leaner than 1:3 by weight. Where colouring material is used in the wearing layer, it shall not exceed 10 per cent by weight of cement used in the mix.

The finished thickness of the upper layer shall not be less than 5 mm for size of marble chips ranging from the smallest upto 6 mm and also, not less than 5 mm for size of marble chips ranging from the smallest upto 12 mm, and not less than 6 mm for size of marble chips varying from the smallest upto 20 mm.

4.2.2 Laying

Base concrete or RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tiles shall be with cement mortar of specified proportion and in conformity with provisions in relevant sections of the specifications.

Cement mortar 1:4 (1 Cement : 4 coarse sand) bedding shall be used. Average thickness of the bedding mortar shall be 20 mm and the thickness at any place shall not be less than 10 mm.

Cement mortar bedding shall be spread, tamped and corrected to proper levels and allowed to harden for a day before the tiles are set. If cement mortar is laid in bedding the terrazzo tiles, these shall be set immediately after laying the mortar. Over this bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 4.4 kg of cement per square metre over such an area as would accommodate about twenty tiles. Tiles shall be washed clean and shall be fixed in this grout one after another, each tile being gently tapped with a wooden mallet till it is properly bedded, and in level with the adjoining tiles. The joints shall be kept as thin as possible not exceeding 1 mm and in straight lines or to suit the required pattern. The joints shall be properly cleaned before filling with cement grout of matching colour.

The surface of the flooring during laying shall be frequently checked with a straight edge of length at least 2 metre, so as to obtain a true surface with the required slope.

Where full tiles or half tiles can not be fixed, tiles shall be cut (sawn) from full tiles to the required size and their edges rubbed smooth to ensure a straight and true joint.

Tiles which are fixed in the floor adjoining the wall shall enter not less than 12 mm under the plaster, skirting or dado. The junction between wall plaster and tile work shall be finished neatly and without waviness.

After the tiles have been laid, surplus cement grout that may have come out of the joints shall be cleared off.

4.2.3 Curing, Polishing and Finishing

The day after the tiles are laid all joints shall be cleaned of the grey cement grout with a wire brush or trowel to a depth of 5 mm and all dust and loose mortar removed and cleaned. Joints shall then be grouted with grey or white cement mixed with or without pigment to match the shape of the topping of the wearing layer of the tiles. The same cement slurry shall be applied to the entire surface of the tiles in a thin coat with a view to protect the surface from abrasive damage and fill the pin holes that may exist on the surface.

The floor shall then be kept wet for a minimum period of 7 days. The surface shall thereafter be grounded evenly with machine fitted with coarse grade grit block (No. 60). Water shall be used profusely during grinding. After grinding the surface shall be thoroughly washed to remove all grinding mud, cleaned and mopped. It shall then be covered with a thin coat of grey or white cement, mixed with or without pigment to match the colour of the topping of the wearing surface in order to fill any pin hole that appear. The surface shall be again cured. The second grinding shall then be carried out with machine fitted with fine grade grit block (No. 120).

The final grinding with machine fitted with the finest grade grit blocks (No. 320) shall be carried out the day after the second grinding described in the preceding para or before handing over the

floor, as ordered by the Engineer.

For small areas or where circumstances so require, hand grinding/polishing with hand grinder may be permitted in lieu of machine polishing after laying. For hand polishing the following carborundum stones, shall be used:

1st grinding — coarse grade stone (No. 60)

Second grinding — medium grade (No. 80)

Final grinding — fine grade (No. 120)

In all other respects, the process shall be similar as for machine polishing.

After the final polish, oxalic acid shall be dusted over the surface at the rate of 33 gm per square metre sprinkled with water and rubbed hard with a pad of woolen rags. The following day the floor shall be wiped with a moist rag and dried with a soft cloth and finished clean.

If any tile is disturbed or damaged, it shall be refitted or replaced, properly jointed and polished and the finished floor shall not sound hollow when tapped with wooden mallet.

4.2.4 ***Wax Polishing:*** Wax polish shall be of approved brand and manufacture and in sealed containers. It shall be applied in uniform layer to the dry surface of the floor/skirting.

When the layer of the wax is stiffened and surface of floor is saturated with the polish, polishing shall be resorted with machine fitted with bobs (pad of rags) and shall be done until shades of all chips have appeared and glossy surface is obtained.

The fresh polished floor surface shall be protected using appropriate protective materials until the surplus wax has been absorbed and the floor shall be opened only after proper drying of wax polish.

4.3 Ceramic Tiles

Cement slurry of paste like consistency shall be spread over the bedding at the rate of 3/4 cu.ft. of cement/100 sq. ft. over an area, which would accommodate about 25 tiles and the tiles, shall be washed clean before laying.

Tiles shall be fixed in the above cement grout one after another, each tile being gently tapped with a wooden mallet till it is properly bedded and in level the adjoining tiles. The joints between different tiles shall be kept as thin as possible and in perfect straight line and to suit the required pattern as shown in the drawings. The surface of the flooring as laid shall be true to levels and slopes. Tiles, which are fixed in the floor adjoining the wall, shall enter not less than 1/2" under the plaster, skirting or dado.

All joints shall be cleaned of the gray cement grout with a wire brush to a depth not exceeding 3/16" on the following day of laying the tiles and all the dust and loose mortar removed and cleaned. The joints shall then be flush pointed with non shrinkable grout to match the shades of the tiles and there after the floor shall be kept wet for a minimum period of 7 days.

The entire surface of the floor, after curing, shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden mallet.

4.4 Clay Floor Tiles

The clay floor tiles shall be laid over lime Surkhi green mortar of specified mixed and joints maintained properly shall be grouted with lime Surkhi. Broken or cracked tiles shall be rejected.

4.5 Parquet Timber Flooring

The parquet flooring of specified pattern and color shall be laid on smooth finished damp proofed dry surface. The tiles with wire cloth base shall be laid using parquet adhesive in approval pattern.

After completion of laying the tiles the top surface shall be smoothly finished which shall be stained and polished as approved.

4.6 Dividing Strips

The dividing strips shall usually be of glass. Each strip shall be of full length as that of a single panel. There shall be no joint of the strip except of junction only. The top edges of the strip shall be smoothly finished without projections. The strips in required pattern shall be laid to plane, slope, and level held in position by cement mortar. These shall be checked prior to laying of concrete in panels. Proper care shall also be exercised during laying of concrete to avoid any dislocation, breakage of the strips.

4.7 Marble Floor

The marble slabs shall be of as specified in the description of the item. The contractor shall get the samples approved by the Engineer before starting the work. The size of the Marble slabs shall be as specified or as shown in the drawings or as ordered by the Engineer. The thickness shall be 20-25 mm as specified in the description of the item. The slabs shall be hand or machine cut (as specified) to the required shape and dimensions. They shall be fine chisels dressed on all sides to the full depth so that a straight edge laid along the side of the stone shall be fully in contact with it. The top surface of each slab shall also be fine chisel dressed to remove all wariness. All sides and top surface of the slabs shall be machine rubbed or table rubbed with coarse sand before paving. All angles and edges of slabs shall be true, square and free from shipping and the top surface shall be perfectly true and plain.

The bedding for the slabs shall be with cement mortar 1:2 cement 2 sand) or as specified in the description of the item. The average thickness of bedding mortar shall be 12-18 mm the thickness at any place under the slabs shall not be less than 12 mm.

Cement slurry of paste like consistency shall be spread over the above bedding at the rate of 1cu.ft. of cement/100 sq. ft. of area. The edges of the slabs already paved shall be buttered with match the shade of the marble slab. The slab to be paved shall then be lowered gently back in position and tapped with wooden mallet till it is properly bedded in level with and closer to the adjoining slab with as fine a joint as possible. Subsequent slabs shall be laid in the same manner. After each slab has been laid, surplus cement on the surface of the slabs shall be cleaned off. The surface of the flooring as laid shall be true to levels and slopes and the flooring shall be cured for a minimum period of 7 days. Slabs, which are fixed in the floor adjoining the wall, shall enter not less than 12 mm under the plaster, skirting or dado.

If there is any unevenness at the meeting edges of slabs, the same shall be removed by fine chiseling in a slant. The surface shall then be polished and finished flushed except that cement slurry with or without pigments shall not be applied on the surface before each polishing.

4.8 Polished Machine Cut Stone Flooring

The stone flooring shall be of slabs of machine cut, machine polished and stone of specified thickness of approved quality free from cracks and flakes, of uniform color and shall have an even surface. The edges shall be straight. The stone shall be 30 cm. x 30 cm. and properly dressed square and laid as directed with fine joints not exceeding 1.0 mm. They shall be firmly bedded flush in cement mortar 25 mm. thick, cement floated with no hollows between. The floor shall be well washed and pointed with cement and sand (1 to 1) flush with the surface of the stone. After laying, the flooring shall be polished and all unevenness removed.

The surface of the base slab shall be struck off reasonably true at a level not less than 60 mm. (2 3/4") below the required finished level. The mortar base for the tiles shall be 20 to 30 mm. thick with cement float. Keeping required jointing thickness the slabs/ tiles shall laid to proper level and line work. The joints to be filled in by neat cement/color cement slurry, and allowed to set. The

stone for flooring shall be machine cut and machine polished. The Contractor shall submit samples for all the tiles for approval before using the same. The work must be protected from any kind of damage till handing over the building.

4.9 Granite Flooring

The granite slabs shall be of as specified in the description of the item. The contractor shall get the samples approved by the Engineer before starting the work.

The size of the marble slabs shall be as specified or as shown in the drawings or as ordered by the Engineer. The thickness shall be 20-25 mm as specified in the description of the item. The slabs shall be hand or machine cut (as specified) to the required shape and dimensions. They shall be fine chisels dressed on all sides to the full depth so that a straight edge laid along the side of the stone shall be fully in contact with it. The top surface of each slab shall also be fine chisel dressed to remove all wariness.

All sides and top surface of the slabs shall be machine rubbed or table rubbed with coarse sand before paving. All angles and edges of slabs shall be true, square and free from shipping and the top surface shall be perfectly true and plain.

The bedding for the slabs shall be with cement mortar 1:2 cement 2 sand) or as specified in the description of the item. The average thickness of bedding mortar shall be 12-18 mm the thickness at any place under the slabs shall not be less than 12 mm

Cement slurry of paste like consistency shall be spread over the above bedding at the rate of 1cu.ft. of cement/100 sq. ft. of area. The edges of the slabs already paved shall be buttered with match the shade of the granite slab. The slab to be paved shall then be lowered gently back in position and tapped with wooden mallet till it is properly bedded in level with and closer to the adjoining slab with as fine a joint as possible. Subsequent slabs shall be laid in the same manner.

After each slab has been laid, surplus cement on the surface of the slabs shall be cleaned off. The surface of the flooring as laid shall be true to levels and slopes and the flooring shall be cured for a minimum period of 7 days. Slabs, which are fixed in the floor adjoining the wall, shall enter not less than 12 mm under the plaster, skirting or dado. If there is any unevenness at the meeting edges of slabs, the same shall be removed by fine chiseling in a slant. The surface shall then be polished and finished flushed except that cement slurry with or without pigments shall not be applied on the surface before each polishing.

5. RATE

The rate shall include the cost of all materials, plant and labour involved in all the operations described above

6. MEASUREMENT AND PAYMENT

The work shall be measured in sq. metres. Length and breadth shall be measured between the finished faces of skirting, dado, or wall plaster correct to 0.01m. No deduction shall be made nor extras paid for any opening in the floor up to 0.01 Sq. m. Steps and treads of stairs paved with granite/marble stone slabs shall also be measured under the respective item.

The flooring works shall be paid at their respective contract unit rate which shall be the full and the final compensation to the Contractor to complete the work as per these Specifications.

SLOPED CEMENT SCREED

1. SCOPE

This specification covers furnishing of all labor, materials, services and equipment necessary for the grading of roof to drain the rain water efficiently.

2. MATERIALS

Cement, Sand and aggregate shall confirm to “STANDARD CONSTRUCTION MATERIALS”.

The grading of coarse aggregate when determined by testing shall be within the limits as given for 10mm single sized coarse aggregate

3. WORKMANSHIP

Laying: Before laying cement concrete for grading, the level markings to the required slope/gradient shall be made only with the cement concrete on the surface of the slab at suitable spacing with the help of string and steel tape so that the mason can lay the concrete to the required thickness, slope/gradient easily in between the two level markings.

On getting the level marking approved by the Engineer, the surface should be sprinkled with thick cement slurry and the concrete should be laid carefully, without throwing from height, in predetermined strips.

The concrete should be consolidated by specially made wooden tamping. After the tamping is done, the surface should be finished to the required slope/gradient with wooden trowels without leaving any spots of loose aggregates etc.

The mixed cement concrete must be laid in position, within half an hour of its mixing. In case any quantity of concrete remains unused for more than half an hour the same should be rejected and removed from the site.

Finishing: The slope of the finished terrace shall be as shown in the drawings unless directed by the Engineer.

The minimum thickness of the concrete at its junction with parapets shall be 25 mm. The concrete shall be rounded at the junction of roof slab and parapet.

The finished concrete surface shall present a smooth surface with correct slope and uniform rounding. The concrete shall be free from cracks. Excess trowelling shall be avoided.

Curing: Curing shall be done either by spreading Hessian cloth over the graded surface, keeping the same wet for full 10 days or flooding the graded area with water by making beads with weak cement mortar for 10 days. Occasional curing by simply spraying water now and then shall not be permitted under any circumstances.

4. RATES

The rates for items shall include cost of all materials consumed in the work at all level, hire charges of materials, tools and plants, cost of labour, insurance, all transport, services, etc, complete.

5. MEASUREMENT

It shall be measured in square meter/cubic meter as specified in bill of quantities as per exact

dimensions shown in the drawing inclusive all materials, manpower, curing, etc, all complete.

PRESSED CLAY TILE PAVING

1. SCOPE

This specification covers supplying and laying of pressed fully fired clay tiles over sloped cement screed in roof deck and other areas as shown in the drawings and finishing schedule including furnishing of all labor, materials, services and equipment necessary to complete the works.

2. MATERIALS

Cement, Sand and aggregate shall confirm to “STANDARD CONSTRUCTION MATERIALS”.

Paving tiles shall be fully pressed and fully fired red clay tiles manufactured by M.D. Prajapath , India or superior. Unless otherwise specified the size of tile shall be 200 mm x 200 mm x 10 mm. All paving tiles shall be in regular size without variations in dimensions and shall be free from the cracks, pinholes, cavities, bowed surface, etc

3. WORKMANSHIP

Pressed clay tile should be laid on a solid base of concrete using thick bed method. A bed of semi-dry cement and sand of mix 1:4 (1 cement : 4 coarse sand) shall be spread over the concrete or screed base and packed to a thickness of 20 mm. The bed then shall be covered with a grout (wet mix) of cement and sand 1:1 (1 cement : 1 sand) into which the tiles shall be bedded, levelled and the joints grouted or filled with a mortar of 1:2 (1 cement : 2 sand) with 2% integral waterproofing compound.

The joints between the tiles shall be wide enough to allow the variation in the size of tiles. Joint width shall be 3 mm minimum and should not exceed 10 mm. The joint shall be filled with a mortar of cement and fine sand with integral waterproofing compound.

To take-up the possible expansion of tiles, an expansion joints shall be formed around the perimeter of tiled floor. For the large area of tiled floor, additional expansion joints should be formed both along and across the floor at interval not exceeding 6 meter. The expansion joint shall be filled with an elastic UV stabilized sealing compound.

The finished surface shall be cleaned in after completion of the works. Tiled surface shall be protected until completion of project by taking appropriate protection measures.

4. RATES

The rate shall include the cost of materials and labour required in all the operations described above. The rate shall also includes the cost of making and sealing expansion joints.

Roof grading works shall be paid at their respective contract unit rate which shall be the full and the final compensation to the Contractor to complete the work as per these Specifications.

5. MEASUREMENT AND PAYMENT

Length and breadth shall be measured correct to a cm. Area shall be worked out to nearest 0.01 sq.m.

No deduction shall be made for either opening or recessed for chimney stacks, roof lights etc,. Nothing extra shall be paid either for any extra materials or labours involved in forming such opening or recess or in rounding the concrete function of roof with parapet walls, chimney stack or hunch etc.

Pressed Clay Tile Paving works shall be paid at their respective contract unit rate which shall be the full and the final compensation to the Contractor to complete the work as per these Specifications.

PLASTER WORK

1. SCOPE

This specification covers cement plaster finishes to walls, columns ceilings and similar surfaces on background normally wet with, such as brick, or concrete (plain or reinforced).

2. MATERIALS

All required materials shall be as specified in "STANDARD CONSTRUCTION MATERIALS".

3. CARE OF TOOLS AND ACCESSORIES

All tools shall be cleaned by scraping and working at the end of each day's work, or after use with different materials. Metal tools shall be cleaned and greased after each operation. All tools shall be examined and thoroughly cleaned before plastering begun.

4. SCAFFOLDING

Wooden ballies, planks, trestles, G.I. pipes, ply board and other scaffolding material shall be sound and erected in accordance with the specification given under Brick Work or as directed by the Construction Manager.

5. MORTARS

a. ***Cement Mortar:*** The mortar for cement plaster of specified proportion shall be mixed as specified in the specification for Brick Work.

b. ***Lime Mortar***: The mortar shall consist of such proportions of slaked lime and sand as may be specified in the item measured by volume. If moist sand is used, necessary, allowance shall be made for bulking. The lime mortar shall be prepared by wet process, in the power driven mill. The slaked lime is to be first placed in the mill in an even layer and ground for 180 revolutions with a sufficiency of water. Water shall be added as required during grinding, care being taken not to add more water than will bring the mixed material to a consistency of stiff paste. Thoroughly wetted sand in specified proportion and finely chopped jute fibre at the rate of one pound of jute fibre for every 0.1 cubic meter of lime sand mixture are then to be added evenly and the mixture ground for another 180 revolutions for each stone shall be 90 for each part of the grinding. The mortar shall be stirred continuously during the grinding process.

The hydraulic lime shall be ground second time. The mortar shall always be kept damp and protected from sun and rain till used up. All mortars shall be used as soon as after grinding and shall be used within the day on which it is prepared. In no case the mortar prepared earlier than 36 hours be permitted or remain at the site of work.

The mortar more than 36 hours old or damaged mortar or mortar which has once set or caked shall be condemned and removed from the site by the Contractor at his own expense. No retampering or rejected mortar shall be permitted.

c. ***Pure fat lime paste for finishing:*** Lime shall be slaked and mixed with sufficient water to form a thick paste. It shall be reduced to a fine paste by grinding. It shall then be passed through a fine sieve (3mm mesh) to remove all unslaked particles and foreign matters and allowed to mellow under water for at least 10 days in large slaking tanks. The surplus water on the top shall be allowed to run-off. The slaked lime paste thus formed shall be used for finishing.

6. PRELIMINARY WORK

a. All materials for plastering shall be kept readily available at the site.

b. Plastering operation shall not be started until and necessary fixings such as doors, windows,

and fittings of light and services etc. are completed and all pipe and conduits to be embedded in the wall or plaster are installed.

c. A preliminary inspection shall be made to ensure that the surfaces are in a suitable condition for plastering, particularly as regards their planeness and dryness. If dubbing out is necessary, it should be done in advance, so that an adequate time interval may be permitted before the application of the first under coat.

7. SEQUENCE OF OPERATIONS

a. For external plaster, the plastering operation shall be started from the top storey and carried downwards. For internal plaster, the plastering operation shall be started wherever the building frame and placing work are ready and the temporary supports of the ceiling resting on the wall or the storey have been removed.

b. The surfaces to be plastered shall first be prepared as follows:

i. Cleanliness:

The loose layer of dust on masonry shall be brushed away before the plaster is applied. A stiff bristle brush or wire brush may be used or to be more effective brushing may be combined with blowing of compressed air. A freshly cast concrete surface is often covered by laitance and this shall be removed. A concrete surface may also often be contaminated by the soap which is formed by the reaction of resins with calcium hydrate or is derived from mouls oils. The contaminated layer shall be removed by brush. Special care shall be taken in repairing for re- rendering an old plaster coat. Old layers of the plaster coats shall be completely removed and made good. Crumbled and frost- damaged parts shall be cut out and patched. Any trace of algae or moss formation shall be removed. If the background contains soluble salts, particularly sulphates, the application of plaster shall be done only after the efflorescence of the salt is complete, and efflorescence is thoroughly removed from the surface.

ii. Roughness:

The roughness of the background may generally improve the bond of the plaster. A smooth surface may be roughened by wire brushing, if it is not hard, or by hacking or bush-hammering if it is hard. Alternatively to obtain a rough surface, a mortar may be forcibly dashed on to the surface (spatterdash treatment) by suitable means or to a hard surface like concrete; on a soft smooth surface, a thin coat of cement slurry 1:1 (cement and fine sand) may be applied for the purpose. After roughening the surface, care shall be taken to moisten the surface sufficiently before plastering, as otherwise the freshly exposed surface may tend to absorb considerable amount of water from the plaster. In addition to general roughness in the masonry, the joints shall also be raked to a depth of about 3mm for providing key to plaster.

iii. The wall shall not be soaked but only damped before applying the plaster. If the surface becomes dry in the spot, such areas shall be moistened again to restore uniform suction. A fog-spray shall be used for this purpose.

iv. Evenness:

The background shall be even in order to avoid variations in the thickness of the plaster. Any unevenness must be leveled before the plaster is applied. Local projections in brick wood are serious from the point of view of plastering. For coat thick plaster work, the local projection shall not exceed 12mm of the general surface as determined by the periphery of the surface concerned and local depression shall not exceed 19mm. For two coats of plaster, a local projection shall not exceed 12mm and

local depression 12mm.

8. APPLICATION OF UNDERCOAT

a. The undercoat shall be approximately 12mm thick and carried to the full length of the wall or to the natural breaking points like doors, or windows. Before the undercoat hardens, it shall be deeply worked to provide mechanical key for the finishing coat.

Masonry walls on which plaster is to be applied directly, shall be clean and dry with the joints raked to a depth of at least 10mm. Before applying the undercoat, the surface shall be damped evenly to control suction. The undercoat shall be trowel had and tight, forcing it into surface depressions to obtain a permanent bond.

On monolithic walls, the undercoat shall be dashed on unless the surface is sufficiently rough to ensure adequate bond for it when applied with a trowel. Rough surfaces that permit successful application with the trowel are produced by mechanical roughening.

The dashing of the undercoat shall be done using a strong whipping motion at right angles to the face of the wall, or it may be applied with a plaster machine or cement gum.

The undercoat shall be kept damp for at least two days immediately following its application. It shall then be allowed to become thoroughly dry.

On metal reinforcements, the plaster shall completed, embed the metal. This is easily accomplished with the large mesh type of reinforcement, the openings of which are large enough to permit plaster readily to pass through them.

9. APPLICATION OF THE FINISHING COAT

a. Before starting to apply the finishing coat, the second coat shall be damped evenly. Whenever possible, textures shall be applied from top to bottom in one operation to eliminate joining marks. The finishing coat shall be applied with a trowel to a thickness or approximately 12mm and roughly leveled off.

b. When the surface has begun to harden, it shall be leveled off with a straight grained wood float. At a later period during drying out, when the face is quite stiff and there is no moisture on the surface, the float shall be worked with a circular movement bringing the sand in the plaster to the face and producing a uniform texture.

Alternatively the facing shall be tapped gently with a wood float after the setting has commenced but before the plaster is dry and care shall be taken that the tapping is even, uniform and is not overdue. As a final operation, to remove any float marks which may be left on the surface, a damp rubber sponge shall be applied with a circular motion on the face.

10. LIME PLASTERING

a. In all plaster work the mortar shall be firmly applied with somewhat more than required thickness and well pressed into the joints and on the surface and rubbed and leveled with a flat wooden rule to give required thickness. Long straight edges shall be freely used to ensure a perfectly plane and even surface. All corners shall be finished to their true angles or rounded as shown on the drawings. The surface shall be finished to plane or covered surfaces as shown on the drawings and shall present a neat appearance.

The mortar shall adhere to the masonry surface intimately when set and there should be no hollow sound when struck. The plastering shall be done in squares or strips as directed by the Construction Manager Plastering shall be done from top to downwards.

b. Finishing: In any continuous face of a wall, finishing treatment of any type shall be carried out continuously and dry to dry breaks made to coincide with architectural break in order to avoid unsightly junction.

The thick paste of lime prepared as specified above shall be applied to the prepared and partially set out somewhat plastic surface with steel trowel to a thickness slightly exceeding 5mm - 2mm and rubbed

down to 1.5mm thickness and polished to a perfectly smooth and even finish, working from top to bottom. While trowelling is going on, soap stone powder contained in thin muslin bags shall be dusted over the surface and worked in. Moistening shall be commenced as soon as the plaster has hardened sufficiently and is not susceptible to injury. Soaking of wall shall be avoided and only as much water as can be readily absorbed shall be used.

c. Moulding: All moulding shall be worked true to template and drawn neat, clean and level. All exposed angles and junctions with door frames etc. shall be carefully finished.

11. CEMENT PLASTER WITH NEAT CEMENT FINISH IN DADO

Whenever it is required, there shall be 3mm thick film of neat cement finish of 1:1 mix or specified proportion. The neat cement finish, if required, shall be mixed with 3-12% of colour create of specified colour and brand or as directed by the Construction Manager. The neat cement finish shall be applied after completely setting the final layer of cement plaster. The neat finishing layer or film shall be trowelled smooth.

12. DECORATIVE PLASTER WORK

The decorative plaster of specified proportion shall be applied as specified above, the design and workmanship quality should be same as that of existing finished decorative surface.

13. SAMPLE TO BE APPROVED

Samples of about 1 square meter of plaster of all types of plaster work shall be prepared for the approval of the Construction Manager prior to further execution.

When only one coat of plaster is specified, the base shall be prepared as specified for undercoat and directly apply one coat of plaster as finish coat.

14. CURING

Each coat shall be kept damp continuously for at least two days. Moistening shall commence as soon as the plaster has hardened sufficiently and is not susceptible to injury. The water shall be applied by using a fine fog-spray. Soaking of wall shall be avoided and only as much water as can be readily absorbed shall be used. Excessive evaporation on the sunny or windward sides of the building in hot dry weather, shall be prevented by hanging mattings or gunny bags on the plaster and keeping them wet.

After the completion of the finishing coat, the plaster shall be kept wet for seven days and shall be protected during that period as mentioned above.

If the work perish through the neglect of watering or any other default and if the work is not done as specified, the work shall be removed and redone at the Contractor's expense.

Curing of the plaster shall be so done as to avoid or minimize overflow or seepage to the existing surface below.

15. RATE

The rate include all labour, materials, erection and removal of scaffolding, preparation of background, finishing, curing etc.

16. MEASUREMENT AND PAYMENT

Measurement and payment shall be done in square meter as in item. Measurement shall be done nearest to two decimal places separately for various mixes and various thickness of the work for the net quantity executed. All openings shall be deducted and any jambs, soffits etc. measurements shall be allowed.

CEMENT POINTING

1. SCOPE

This specification covers supplying materials and executing the pointing works on stone work.

2. PREPARATION

The joints of the stone work shall be raked out to a depth of 3/4" and the wall surface washed and cleaned and kept wet for two days before pointing

3. SCAFFOLDING

See plaster work.

4. MATERIALS

The materials for mortar-cement and sand as specified shall be of standard specifications as mentioned in the beginning, (see concrete works). The materials shall be first mixed by measuring with boxes to give the required proportion as specified (1:2 or 1:3); and then mixed by adding water slowly and gradually to give a working consistency.

5. OPERATIONS

The mortar shall be pressed into the raked, cleaned and wet joints and a groove of shape and size of 5 to 6 mm deep shall be formed running a forming tool of steel along the centre line of the joint. The vertical joints also shall be finished in a similar way at right angles to the horizontal lines. The finished work shall give a neat and clean appearance with straight edges.

6. CURING

The finished work surface shall be cured for seven days and shall be protected by hanging mattings or gunny bags on the pointing keeping them wet.

Curing shall be done in a way to avoid or minimize overflow or seepage to the existing surface below.

7. RATE

The rate includes all labour, materials, erection and removal of scaffolding, preparation of background, finishing etc.

8. MEASUREMENT AND PAYMENT

Measurement and payment shall be done in square meter as in item. Measurement shall be done nearest to two decimal places separately for various mixes of the work for the net quantity executed. All openings shall be deducted and any jambs, soffits etc. measurements shall be allowed.

CEMENT SAND PUNNING

1. SCOPE

This specification deals with the Cement Sand punning in floor or vertical surface.

2. MATERIALS

Cement and Sand shall confirm to “STANDARD CONSTRUCTION MATERIALS”

3. WORKMANSHIP

All workmanship shall be according to the latest and best possible standards.

Cement sand punning l used shall be in the ratio of 1:1 over and including 20 mm base screed 1:4, it shall placed on floor, skirting, dado etc. The entire surface, in advance, shall be thoroughly cleaned of any loose materials, mortar and other foreign materials. Surface shall be thoroughly wetted with water. Laying & rubbing shall be carried out with steel trowel to a hard, smooth & shining surface. Curing shall be carried out for at least seven days

Before applying cement sand punning, the surface shall be cleaned of any dust or loose particles. The average thickness of punning shall not be less than 3mm .The pattern of the surface should be as per instruction of the Engineer. The surface shall be finished by rubbing with a steel trowel & any depression shall be filled in & rubbed to a shining surface. All corners & edges shall be rounded. The contractor shall prepare a 3 square feet of the punning as per instruction of the Engineer, after which all punning executed shall confirm with the respective approved sample. All punning shall be finished smooth, even & truly level. It shall be kept wet for 7 days.

4. RATES

The rates for items shall include cost of all materials consumed in the work at all level, hire charges of materials, tools and plants, cost of labour, insurance, all transport, services, etc, complete.

5. MEASUREMENT

It shall be measured in square meter or as specified in bill of quantities as per exact dimensions shown in the drawing inclusive all materials, manpower, curing , etc, all complete.

PAINTING WORKS

1. SCOPE

This specification covers different type of paintings in different surface in general and application of cement paint, enamel paint. Dry or oiled distemper, plastic emulsion paint etc. in wall/ceiling surface in particular with a petroleum base/water base paint in roof.

2. MATERIALS

All required materials shall be as specified in the "STANDARD CONSTRUCTION MATERIALS".

3. SCAFFOLDING

The scaffolding shall be double or single according to requirements and shall be provided by the contractor at his own expense. The scaffolding shall be erected with steel section or pipes, or bamboos of adequate strength to safe for all operation. The Contractor shall test all measures to ensure the safety of the work and working people. Any instruction of the Engineer in this respect shall also be compiled with. The Contractor shall be entirely responsible for any damage to property, or injury to persons resulting from ill erected scaffolding, defective ladders and materials or otherwise arising out of his default in this respect. Proper scaffolding shall be provided to allow easy approach to every part of the work. Overhead work shall not be allowed.

4. PREPARATORY WORK

The surface to be painted shall be prepared as specified by the manufacturer of the paint. The surface shall be thoroughly sand papered and cleaned from dirt, dust etc. by brushing and washing down with clean water. Any grease, oil paint or any other foreign material shall be removed by approved method.

Rough coat and pebble dash surface shall be thoroughly sand papered brushed and washed to remove dirt and dust.

5. CEMENT PAINT

5.1 Mixing

The dry cement paint shall be thoroughly mixed with clean fresh water so as to produce paint of required consistency which for normal work shall be that of ordinary paint. In mixing and application, the Contractor shall follow the manufacture instructions. Paint for application by brush shall be stained through paint strainer. The paint shall be kept stirred and used within the specified time of the manufacture. Hardened or damaged paint shall not be used.

5.2 Application of Cement Paint

The paint shall be applied by means of brushes and in the manner specified by the manufacturer. The number of coats shall be as mentioned in the item. The subsequent coats shall be applied after the preceding coat is properly cured and has thoroughly hardened, inspected and approved and as per manufacturer's specification.

Absorbent surface shall be evenly damped so as to give even suction. In dry weather, freshly painted surfaces shall be kept damp for at least two days and protected from direct sun. The minimum consumption rate of materials or coverage area per unit quantity shall be as specified by the manufacturer.

6. ACRYLIC EMULSION PAINT

6.1 Paint and Primer

The acrylic emulsion paint shall be of British paints India Ltd., Jenson and Nicolson, India or any other superior brand in sealed tins as approved by the Construction Manager.

6.2 Preparation of Surface

The surface where paint is to be applied shall be cleaned and smoothly sand papered, all dust being removed. If the paint is to be applied on a wooden surface a suitable filler materials shall be applied and sanded off to achieve a clean and smooth surface. When painting a metal surface, all loose scales, rust, etc. shall be removed by the use of suitable sand paper.

6.3 Primer

Two coats of cement primer, wood primer or metal primer as required shall be applied. Each coat shall be approximately 20-30 microns when applied by brush. The primed surface shall be neatly and smoothly sand papered and cleaned.

6.4 Application of Paint

The paint of approved shade shall be applied as per manufacturer's printed instruction by suitable brush. A minimum of two (2) coats shall be applied to achieve a uniform painted surface. The minimum consumption rate of materials or coverage area per unit quantity shall be as specified by the manufacturer.

7. SYNTHETIC ENAMEL PAINT

7.1 Paint

The paint shall be of British Paints India Ltd., Jenson and Nicolson India or any other superior brand approved by Construction Manager. It shall be in sealed tins and its type and use for exterior and interior surface shall be as per the manufacturer's printed instructions.

7.2 Preparation of surface shall be as for Acrylic paints (clause 6.2).

7.3 Primer

When synthetic enamel paint is to be applied onto a cement plastered surface or concrete surface, two coats of suitable cement primer shall be applied to the clean prepared surface. When the paint is to be applied to a wooden surface two coats of wood primer shall be applied to the cleaned prepared surface.

7.4 Application of the Paint

Following the preparation of the surface and the application of the primer a top coat shall be applied. A second coat shall be applied after the first coat has dried. Care should be taken that dust or other foreign materials do not settle or otherwise disfigure the various coats. The minimum consumption rate of materials or coverage area per unit quantity shall be as specified by the manufacturer.

The same brand and same batch of materials shall be used for all coats. The paint shall be used and applied as per manufactures' printed instruction. The paint shall be applied with bristle brushes. Once

the paints shall be applied in the thinnest possible layers with parallel drawings, no flow down shall be allowed.

8. OIL BOUND AND DRY DISTEMPER

8.1 Paint

The distemper shall be of British paints India Ltd., Jenson and Nicolson, India or any other superior brand approved by the Engineer. It shall be in sealed tins. Generally synthetic washable distemper is available in paste form and dry distemper in powder form.

8.2 Preparation of Surface

The preparation of surface shall be as specified for Acrylic paints (clause 6.2). Oil bound distemper is not to be applied to freshly plastered surface.

8.3 Mixing

The paste of synthetic washable distemper shall be thinned by adding 700 ml of cold water to every kg of distemper paste. Water should be added gradually to mix them properly to get uniform consistency.

The dry distemper powder shall be mixed with 300-400 ml of clear warm water to a kg. of distemper to obtain a creamy paste. The paste shall be kept aside for sometime. Then after 700-1000 ml of water shall be added to obtain a proper brushing consistency.

8.4 Application

As described for synthetic enamel paint (clause 7.4).

9. SAMPLE TO BE APPROVED

Sample of approximately 1 sqm of painting work of all types of paint work shall be prepared, to be approved by the Engineer before further execution.

10. MEASUREMENT

Measurement shall be done in square meter. The measurements shall be as follows:

	Description of Work	How Measured	Multiplying Factor
a.	Paneled or Framed	Measured flat (not girthed) end of frame to frame	1.50 for each side
b.	Flush doors	- do -	1 for each side
c.	Fully glazed or wire gauged	- do -	0.50 for each side
d.	Part paneled and par glazed or gauged	- do -	1 for each side
e.	Fully ventianed or		

louvered	- do -	1.50 for each side

Nothing extra shall be paid for short width and surface of any shape, size. This shall include for two or more coats inclusive of materials, scaffolding and labour complete.

11. RATE

The rate shall include all labour, materials and use of tools to carry out the operation described as above.

MILD STEEL GRILL

1. SCOPE

This specification deals with the Mild Steel Grill for windows.

2. MATERIALS

The Mild Steel grills shall be fabricated from Mild Steel flats, angles and channel confirming to BS 15 or equivalent. The welding shall be fillet-welding confirming to the requirements of BS-449 or equivalent. For fixing grill frame to structure the grips shall be of plastic or metal. The screws shall be steel screws.

3. WORKMANSHIP

All workmanship shall be according to the latest and best possible standards.

The mild steel grill shall be made according to pattern given in the drawings. Welded joints shall be neatly made, filled, smooth and left clean. The site in-charge shall be informed when the welded work is ready for inspection and such work must left unprimed until the site in-charge gives his approval. The contractor shall furnish at his own expense all necessary tools and all materials, which he may require for the safe erection of the work and remove the same when the work is completed. The contractor shall be solely responsible for any damage due to structure during erection.

The grill work shall be finished with two coats of metal primer followed by three coats of enamel paint and fixed to the opening.

4. RATES

The rates for items shall include cost of all materials consumed in the work at all level, hire charges of materials, tools and plants, cost of labour, insurance, all transport, services, etc, complete.

5. MEASUREMENT

Measurement of works will be made in square meter or as specified in bill of quantities.

RAILING WORKS

1. SCOPE

This specification covers supply, fabrication, and installation of railing works in stairs as well as verandah portion of different building complexes.

2. MATERIALS

Mild steel pipes, stainless steel pipes and fittings as specified shall comply with relevant IS code specification.

3. FABRICATION AND INSTALLATION

Mild Steel pipe railings are fixed with overall fittings as bends, Tees etc. which are welded as per drawing and instruction of Engineer. Welded joints shall be neatly made, filed smooth and left cleaned; and adequate means shall be employed for temporarily fastening the parts to be welded together until the joints are leveled.

4. PAINT

The railing shall be finished with one coat of red lead followed by one coat of aluminum paint and fixed in position as per instruction of Engineer.

5. RATE

The rate for the item shall include all labour, materials, use of tools and machinery inclusive.

6. MEASUREMENT AND PAYMENT

Measurement and payment shall be done in square meter or linear unit as in item. Measurement shall be done nearest to two decimal places separately for various types of the work for the net quantity executed.

C. SPECIFICATIONS FOR ELECTRICAL WORKS

General Specifications

Scope

The scope of works covered shall include supply of all materials, labor, equipment and services in connection with the Electrical works, consulting drawings, bill of quantities and specifications of followings:

a. Transformer, 11 KV HT substation works, Terminal boards etc.

b. Generator sets including the ATS panels works and earthings

c. Control Panel, Block Distribution Boards, Distribution Boards.

d. Earthing works of electrical installation and general lightening protection.

e. Outdoor Lighting and arrangements.

f. Internal wiring and electrification though UPVC based hard conduit, Cable tray, Cable trench/laid under ground, riser mains etc and provide light points, fan points, socket outlets etc including supplying, installation testing and commissioning of the light fixture.

g. The conduits are to be laid in straight line with necessary elbo, T's and 4 way circular ensuring that the line of lay is straight.

h. Testing and commissioning of complete electrical installed system.

i. Prepare shop drawing prior to installation works for approval; prepare "As Built" drawing after testing and commissioning of complete electrical system.

The Contractor shall consult drawings, bill of quantities, and specifications all together, which gives the total scope of the work.

Rates

a. The rates given in the electrical installation scheme are all inclusive of labour and materials required for breaking brick work, concrete work, earth work in excavation etc., as and where required for carrying out the implementation of the complete electrical installation scheme.

b. The rates given in the electrical installation scheme are all inclusive of any labour and materials required for reinstating general civil works with all finishes and trench filling in the exterior inclusive of levelling to approved level and distribution or removal of surplus soil, or according to specifications.

c. The rates are also inclusive of painting work of all exposed parts of the installation consisting of one or two coats of anti-corrosive paints on any metal part plus 2 or more coats of approved finishing / paint in colours to be instructed by the Consultants.

d. The rate quoted in the tender shall include all charges for scaffoldings, centring materials, water and electricity charges, tools and equipment, sheds for material, transferring all materials from place of availability to the site of work, etc. The tender rates shall also include Contractor's temporary establishment and services he may require for the successful completion of the work. The rates shall be inclusive of sales tax / value added tax, or any other fees or duty levied by any government or public bodies.

Quantities

The calculations made by the Bidder should be based upon probable quantities of the several items of work which are furnished for the Bidder's convenience in schedule of probable quantities, but it must be clearly understood that the schedule of quantities is liable to alteration by omission, deletion or addition at the discretion of the Consultants without vitiating the contract and the contract is not a lump sum contract, and neither the probable any way assure the Bidder or guarantee that the said probable quantities are correct or that the quantity of work would correspond thereto.

Drawings

a. It is the intent of the specifications, along with bill of quantities and accompanying drawings to provide a complete workable facility. The drawings, specifications and bill of quantities are complimentary and what is called for by one shall be as bidding as if called for by all. Items shown on the drawings or bill of quantities are not necessarily included in the specification.

b. The drawings provided are design drawings and generally are diagrammatic. They do not show offsets, bends, elbows, or junction boxes which may be required for the installation in the space provided. The Contractor shall follow the drawings as closely as is practicable to do so and shall install bends, offsets, junction boxes, pull boxes, etc. where required, by local conditions from measurements taken at the building, subject to approval and without additional cost.

c. The contract drawings shall serve as working drawings for the general layout of lighting, outlets, cables, and various items of equipment. The Contractor shall prepare and submit for approval [up to 5 sets or as required] detailed shop drawings of all installations not detailed on the drawings provided. Any change or amendment made during installation or erection shall be noted in the working drawing. The preparation and submission of detailed as built in drawings after completion of the works, shall be the responsibility of the Contractor. The submission of the final as built in drawing is obligatory prior to the issuance of the Completion Certificate.

Shop drawings shall include, but are not limited to :-

- Control system,
- Conduit layouts with location of junction boxes and number of wires
- External and internal cables pipes, anchors, supports, loops, building entrances
- Electrical distribution boards, wire or cable ways, etc.,

- Lighting fixture catalogue sheets for all fixtures to be installed, with fixture type indicated for each item.

d. Submit for approval, manufacturer's detailed shop drawings, specifications and data sheets for all equipment.

Cutting, Patching and Repairing

Cutting, patching and repairing required for the proper installation and completion of the work including plastering, masonry work, concrete work, carpentry work and painting shall be performed by skilled craftsmen in their respective trades. Holes which are cut over size shall be filled, so that the equipment fit tightly.

Equipment Protection

Keep all cables and conduit opening closed by means of plugs or cover to prevent entrance of foreign matters. Protect all cables, conduits, raceways, fixtures, equipment or apparatus. Any such item damaged prior to final acceptance of the work shall be restored to its original condition or replaced at no extra cost to the client.

Inserts and Sleeves

Layout inserts and sleeves necessary to complete the work in advance of pouring of slabs or construction of walls. Cost of cutting or patching made necessary as a result of this operation shall be at no extra cost.

Cleaning

a. Electrical switch boards, receptacles, equipment shall be vacuum cleaned of dust and debris.
b. Painted surface which have been scratched or marred shall be cleaned of rust or other foreign matters and painted with matching colour of industrial enamel.

Operation

The Contractor shall instruct thoroughly the Owner or his representative in the efficient operation and maintenance of the entire system.

Guarantee

The Contractor shall make good the following guarantee requirements within six months following date of final acceptance without additional cost to the Owner:-

a. All work and apparatus shall be so built and installed as to deliver its full rated capacity at the efficiency for which it was designed.
b. All work and apparatus shall be free from defects of material or workmanship. Any defective material due to defective manufacture, or bad workmanship, or wrong installation shall be replaced free of cost during this period.

c. The entire electrical and mechanical apparatus shall operate at full ratings without objectionable noise or vibration.

Equipment Connections

Provide electrical connections as required to all equipment like light fixtures, fans, outlets etc., include all incidental wiring, materials, devices, and labour necessary for a finished working installation.

Safety and Disconnect Switches

Provide safety and disconnect switches as per IS / BS specifications of quick-make, quick break type, suitably rated and having electrical characteristics as required for the load served. Provide cover, interlock for switches and install required disconnect switches as per the code, whether or not specifically shown.

Codes, Rules, and Regulations

Unless otherwise specified, electrical equipment, materials and workmanship shall conform to the applicable current standard rules, and BS specifications. All products shall bear the mark of Indian / British Standards Institutions and acceptable to Regional Fire Insurance Council. The following Indian Standard specification will apply to the equipment to be used under this contract.

1)	Transformer	-	IS 2026, 1962
2)	Distribution boards	-	IS 2675, 1966
3)	Low Voltage Moulded Case Circuit Breaker	-	IS 2516, 1977
4)	Miniature Circuit Breakers for AC circuits	-	IS 8828 : 1978
5)	Degrees of Protection provided by enclosures for low voltage switchgear	-	IS 2147 : 1962
6)	Installation and maintenance of switchgear not exceeding 1000 volts	-	IS 10118 : 1982
7)	General requirements for switchgear and Control gear for voltages not exceeding 1000 volts	-	IS 4237 : 1982
8)	Marking of Switchgear busbar	-	IS 11353 : 1985
9)	Degree of Protection of Enclosures for low voltage switchgear.	-	IS 2147: 1962
10)	Electrical relays for power system protection	-	IS 231: 1986
11)	Code of Practice for selection, installation And Maintenance of switchgear & control gear	-	IS10118: 982

12)	Low voltage switchgear & control gear assemblies	-	IS 623 : 1993
13)	Current Transformer	-	IS 2705 (part -I, II and III)
14)	Potential transformer	-	IS 3156 (Part-I,II and III)
15)	Earthing	-	IS 3043, 1966
16)	Earth Resistivity	-	IS 3043.
17)	Protection against lightning.	-	IS: 2309 - 1989
18)	Wiring installation	-	IS 732, 1963
19)	PVC conduits for electrical wiring.	-	IS9537 : Part III 1980
20)	Switch socket outlets	-	IS4615 : 1990\
21)	Plugs and socket outlets of rated voltage upto and including 250 volts and rated current upto and including 16 amperes.	-	IS: 1293- 1988
22)	Switches for domestic and similar purposes	-	IS : 3854 : 1997
23)	PVC Cable	-	IS : 554, 1964
24)	Flexible steel conduits for electrical wiring	-	IS: 3480 : 1990
25)	Boxes for the enclosure of electrical accessories-		IS : 5133:Parts I&II 1969
26)	660/1100 V grade PVC insulated wires.	-	IS : 694 : 1990
27)	Rigid steel conduits for electrical wiring. -	-	IS : 9537 : Part I 1980 IS : 9537 : Part II 1981
28)	Accessories for rigid steel conduits 1990	-	IS 3837 :
29)	personal hazard fire safety of buildings 1998	-	IS 1644:
30)	electrical installation fire safety of buildings 1997	-	IS 1646 :
31)	electrical wiring installations	-	IS 732 : 1989
32)	Conduits for electrical installations:	-	IS: 9537 (Part - 1) - 1980
33)	PVC insulated heavy duty cables	-	IS 1554 - 1988
34)	Cross link polyethylene insulated PVC (sheathed XLPE cables)	-	IS 7098 - 1985
35)	Code of practice for installation and maintenance of power cables	-	IS 1255 - 1983
36)	Conductors for insulated electrical cables	-	IS 8130 – 1984
37)	Drums for electrical cable	-	IS 0418 - 1982
38)	Methods of test for cables	-	IS 0810 - 1988
39)	Recommended current rating	-	IS 3961 - 1987
40)	Recommended short circuit rating of high voltage PVC cables	-	IS 5891 - 1970
41)	Short circuiting Rating of cable	-	IS 1554 Part-I.
42)	Bus Bars and Bus Chamber	-	IS 375, 1963
43)	FTL for general lighting service:	-	IS: 2418 (Part-1) – 1977
44)	HP mercury vapour lamps:	-	IS: 9900 (Part-1) – 1981
45)	HP sodium vapour lamps:	-	IS: 9974 (Part-1)-1981
46)	Interior illumination: Principles for good lighting and aspects of design.	-	IS: 3646 (Part-1) 1966
47)	Hospital lighting	-	IS: 4347- 1967
48)	Library lighting.	-	IS: 2672 – 1966
49)	Luminaries: General requirements.	-	IS: 10322 (Part-1) - 1982
50)	Luminaries: Constructional requirements.	-	IS: 10322 (Part-2) - 1982

51)	Luminaries: Particular requirements: Recessed luminaries. 1987	-	IS:10322(Part-5/Sec-1)
52)	Flame-proof electric lighting fittings: Well glass and bulkhead types.	-	IS: 2206 (Part-1)1984
53)	Luminaries for hospitals	-	IS:8030- 1976
54)	Emergency lighting units.-	-	IS: 9583- 1981
55)	Electric call bells and buzzers for indoor use	-	IS: 2268- 1988
56)	Electric ceiling type fans and regulators	-	IS: 374 - 1979.
57)	Exhaust & Ventilating fans.	-	IS: 2312 – 1967

Samples

- The Contractor shall supply samples of the materials, which may require Consultant's approval prior to the use. These samples shall be supplied at the Contractor's own expenses and without delay.

- Whenever required by the Consultant in consultation with the Employer, the Contactor, at his own expense shall provide all facilities to have the stores or materials tested at any time during the works electrification or prior to the expiry of maintenance period, that the stores or materials provided by the Contractor are sound or of a satisfactory quality or meeting the specified standard, or in accordance to the Contract. In the event that the test results are otherwise, the Contractor shall remove such unsatisfactory stores and materials within 24 hours upon the written instructions of the Consultant. Such decision of the Consultant shall be final, binding and conclusive even though such stores or materials may have been inadvertently passed, certified and paid for.

Technical Specifications

Power Distribution Panels

Scope

The scope of this section covers manufacture, supply, installation, testing and commissioning of Power Distribution Panels including MCCB panels and Capacitor Panels rated up to 1000 volts.

Electrical Characteristics of Factory Built Assemblies

The electrical characteristics of component parts of factory built assemblies shall be as indicated and shall apply when the components are mounted in their enclosures, appropriate derating factors having been allowed for effect of enclosures, other components and interconnections.

Enclosures of Factory Built Assemblies

a. Unless otherwise indicated enclosures shall provide a minimum degree of protection of IP 42 when located within buildings.

b. Door shall have adequate fastenings with provision for locking in the closed position. Covers requiring tools for their removal are excluded from this requirement.

c. Fixing holes for equipment inside buildings may be inside or outside the enclosure.

d. Earthing terminals shall be fitted to each enclosure, suitable for internal and external connection, to enable the exposed conductive parts of the protective conductor. Where the enclosure has a painted finish, provision shall be made for earthing terminal to be electrically connected to the enclosure without need to remove any paint from ferrous metal.

e. Cable terminals shall be suitable for the number, size and type of cables as indicated. Adequate spacing shall be allowed for spreading of cable tails to avoid stress on the insulation or terminals; if necessary, extension boxes shall be fitted to standard enclosures. Terminals for neutral conductors for three phase and neutral circuits shall be the same size as for phase conductor, except where reduced section neutral cable cores are indicated.

f. Gland plates shall be provided for all multi-core cables of 35 Sq. mm and larger. For all sizes of single-core cable non ferrous gland plates shall be provided and there shall be a clearance of not less than 25 mm between cable glands and ferrous metal.

g. Metallic enclosures for location within buildings shall have a stove dried painted finish of the manufacturer's standard colour, unless otherwise indicated. Ferrous parts shall be degreased and adequately rust protected immediately prior to painting.

Construction

a. All electrical panels shall be fabricated from 2 mm and 1.6 mm MS sheets properly supported with angles and channels.

b. The cubicle shall be floor/wall surface/wall flushed type unless specified otherwise.

c. The door shall be provided with internal hinges and panel locks of superior quality. The hinges shall be union joint type to facilitate easy removal of the doors when necessary.

d. The doors shall be provided in a similar fashion as generally provided for the outdoor cabinet, where water cannot enter in the cabinet from the door.

e. The door shall be provided with strengthening arrangement to avoid wobbling and distortion.

f. Wherever the doors are opened on horizontal hinges, an arrangement shall be provided to latch the doors in an open condition for inspection of the wiring.

g. Generally push buttons, signal lamps and control components shall be provided on hinged door, hinged at the top, with suitable latching arrangement to hold the door in open position. These components i.e. push buttons, lamps etc. will be at approximately 1400 mm height.

h. The cabinet shall be welded construction and not of jointing construction.

i. The channel frame of 300 mm height fabricated from minimum section of channel 75mm x 6 mm x 40mm will be provided at the bottom of each cabinet. This is required to make the cabinet stable and space for cable bends. The foundation holes with grouting bolts will be provided in the channel frame.

j. Sectionalized cable entry plates of 16 SWG MS sheets at the bottom complete with cable glands and cable lugs for both the end terminations of each cable should also be supplied in sizes as specified in the panel details.

k. The circuit components will be mounted on sectionalized 16 SWG MS sheet with suitable threading in the sheets to facilitate easy maintenance, future addition etc.

l. The circuit components will be mounted on sectionalized 16 S.W.G. M S sheet with suitable threading in the sheets to facilitate easy maintenance, future addition etc.

Lockout/Tag Out Features

a. Lockout or tagout of energy isolating devices shall be used to ensure that the machines or Equipment are isolated from all potentially hazardous energy, and are locked out or tagged out before employees perform any servicing or maintenance activities where the unexpected energization, start-up or release of stored energy could cause injury.

b. Servicing and/or maintenance which takes place during normal operations is covered only if an employee is required to:
   - remove or bypass a guard or other safety device;
     Or
   - place any part of the body into an area on a machine or piece of equipment where work is actually performed upon the material being processed (point of operation) or where an associated danger zone exists during a machine operating cycle.

c. **Capable of Being Locked Out** - An energy isolating device will be considered to be capable of being locked out either if it is designed with other attachment or integral part to which, or through which, a lock can be affixed, or if it has a locking mechanism built into it. Other energy isolating devices will also be considered to be capable of being locked out, if lockout can be achieved without the need to dismantle, rebuild, or replace the energy isolating device or permanently alter its energy control capability.

d. **Energy Isolating Device** - a mechanical device that physically prevents the transmission or release of energy including but not limited to the following: A manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors and, in addition, no pole can be operated independently; a slide gate; a slip blind; a line valve; a block; and any similar device used to block or isolate energy. The term does not include a push button, selector switches, and other control circuit type devices.

e. **Lockout** - the placement of a lockout device on an energy isolating device, in accordance with an Established procedure, ensures that the energy isolating device and equipment being controlled cannot be operated until the lockout device is removed.

f. **Tagout Device** - a prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy isolating device in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

Dimensions

The height of the panel shall be as per the drawing but not be more than 2200 mm. Depth of the panel shall not be more than 400 mm and width of the panel shall be given in the particulars of panel specifications. Width of the door shall be restricted to 600 mm. Shop drawings shall have to be approved by the consultant before fabrication is taken up by hand.

Adaptor Chambers for all cable entries

Wherever necessary, sheet metal adaptor chambers with angle frame and minimum depth of 300 mm shall be supplied with panel. All the covers of adaptor box shall be removable type. The box can be mounted horizontally or vertically. The pattern of cable entry, wherever not specified shall have to be confirmed by the manufacturer in writing after placement of order.

Powder Coating Treatment

The cubicle shall undergo the process of Powder Coating treatment to the satisfaction of the consultant.

Bus-bars

The Bus-bars shall be tinned and made of copper designed to have a current density of 1.25 amps per sq. mm. The Bus-bars will be covered with PVC color sleeves and properly supported. The Bus-bar supports will be designed to withstand short circuit current equivalent to 25 MVA at 415 volts. The Bus-bars will be adequately insulated and protected to prevent accidental contact during operation and maintenance.

Insulation

The insulation between phases and between phases and ground of the power conductors will be made of synthetic resin board/molding, resistant to dust and dampness. All insulating material shall be non-hygroscopic, fungus-proof and treated with suitable synthetic varnishes.

Terminals

Up to 35 sq. mm cables, the terminal will be provided of clip-on type generally manufactured by M/s Elmex or M/s Technoplast and above 35 sq. mm, cable end terminals will provide of brass stud type designed of rugged construction.

Wire Ways

PVC extruded wire ways of required size shall be provided for wiring in the control panel.

Ferruling and Colour Code

Cabling for power circuit should be red, yellow and blue or otherwise proper coloured sleeving will be provided at both ends of cables. For control cables every conductor will be provided with the identification ferrule matching with the one in the drawing.

Cable Termination

Every cable, either for control or power duty shall be provided with crimped type of lugs of suitable size as specified.

Cables (Internal Wiring)

All the cables shall be PVC insulated of NS approved and reputed make. The cables shall be copper conductor only and shall be stranded and minimum number of strands shall be three. The ratings shall confirm to IEE regulations. PVC flexible conductor, if used, shall have minimum size of 2.5.sqmm.

Earthing

The earth Bus-bars should be of tinned copper as specified, G.I. bolts and nuts. Bolts to be of cadium plated with washer earth Bus-bars will be provided all around the cubicle at the bottom and it will be of the same size as neutral Bus-bar but the maximum size will be 75 x 6 mm with duplex external earth connection arrangement.

Cable Glands and Lugs

The cable glands will be of brass cone grip type. These glands will be provided for all the outgoing connections at both the ends for power as well as control circuits provided in the panel and also for the incoming cable or cables. Lugs will be crimped for termination of outgoing cable at both ends (i.e. load end and panel end) with each outgoing feeder.

Feeder Units

a. The feeder units shall be of compartmental design comprising of cubicles assembled together and shall incorporate cubicle MCCB and MCB having rupturing capacity of 25/35 KA and 10 KA at 440 volts respectively.

b. The MCCB shall be quick break, double break system and trip free type with magnetic thermal release and under voltage release protection against overload and short circuit and under voltage. The MCCB should be able to provide distant fault indication in event or short circuit / over load.

c. Individual MCCB should have rotary type external handle for with the clear indications of ON & OFF position. The connections to MCCBs from the Bus-bars and cables should be terminated in pressure bolted joints inside the switch contacts.

d. The MCCB shall have ratings: 100A, 200 A, 250A, 400A, 50 A, 40 A, 32 A, 20 A with 25/35 KA (minimum) rupturing capacity. ACB SHALL BE OF 50 KA.

e. Bus bar should have sufficient mechanical strength to withstand the effects of short circuit until it can be cleared by appropriate protecting device. All Bus-bars should be clearly marked with appropriate colour code to enable immediate identification of the phase and neutral & MCCB/MCB should have adopter terminals for proper termination.

f. Bus bar bushing shall be placed at a interval of 200 mm fixed with brass nuts and bolts and connections should be well managed in reference to the available space of cable allay.

g. Arrangements should be provided to receive PVC cables either from the topside or from the bottom (as specified). End plates should be mounted inside the Bus-bar at unit level for cables from above or below.

h. All sheet-steel parts used in the construction of a cubicle board should have undergone rigorous rust proofing process which must comprise of alkaline degreasing descoaling in dilute sulphuric acid and a recognized phosphate process. The steel work shall be finished with powder coating paint.

i. The equipment when assembled shall form a neat and compact unit and shall be complete with supporting framework, mounting channels, and foundation bolts etc. and shall be designed so as to ensure complete interchangeability of components.

j. All major components like ACB & MCCB should to have total discrimination & Manufacturer should provide a back up printed document along with curves in support of that. Following features shall also be incorporated in ACB & MCCB's.

- All MCCB/ACBs should have Rating Plug, Zone Selective Interlock, Ready to Close Indication & communication capable release.
- All ACBs & MCCBs should have provision for release replacement for system up gradation in future.

- All MCCBs should have positive isolation as well as Class II Front Face for operator's safety.
- All MCCBs should have line load reversibility & should be able to mount in any orientation.
- In event of any change in ratings / models on account of ensuring discrimination, the same will be in account of the bidder only.

Capacitor Bank and Panel (Provisional)

1) This specification covers requirements of Medium Voltage Capacitors and Control Panel to be used for power factor improvement of the electrical system and shall be connected to Main L.T. Panels. Automatic Power Factor Correction Panel shall function to improve power factor of the system in which it is connected. It shall improve power factor upto 0.95 from initial power factor of 0.70.

2) The design, manufacture and performance of power capacitors and accessories shall comply with all currently applicable statutes, regulations and safety codes for power installation as prescribed in relevant IS codes and to requirement of Local Electricity Supply Authority to which the equipment shall be installed.

3) Unless otherwise specified the capacitor and control panel shall conform to following:

   - IS : 2834 - Shunt capacitors for power systems.
   - IS : 2147 - Degree of protection provided by enclosures for low voltage switchgear and control gear.
   - IS : 4237 - General requirements for switchgear and control gear for voltages not exceeding 1000V.
   - IS : 8623 - Specification for factory built assemblies of switchgear and control gear (Upto 1000 volts).
   - IS : 2208 - HRC cartridge fuse links upto 650 volts.
   - IS : 4064 - Specification for Fuse Switch and Switch Fuse switchgear and control gear.
   - IS : 2959 - AC contactors for voltage not exceeding 1000 volts.

4) Capacitor bank shall be suitable for operation on 415 volts 3 phase, 4 wire, 50 c/s, solidly earthed AC supply system. The capacitor shall be connected to the 415 V Switchgear bus and shall be manually as well as automatically switched in and out in steps so as to correct the power factor to be required value depending on the actual KVAR requirement of bus.

5) The capacitor bank shall be complete with the required capacitor units with the supporting post insulators, sheet steel cubicles, bus-bars, connecting strips, foundation channels, fuses, corrosion proof rating plate etc.

6) Each basic unit is to be built up with a number of elements. These elements should be wounded with high-grade metalized polypropylene film. These metalized film capacitors should be self healing, having very low loss factor. Capacitor element to be completely sealed with epoxy resins to provide maximum humidity protection and highest insulation. The capacitor elements are to be given adequate outside insulation and should be put in all welded surface treated MS containers. These capacitors shall be impregnated with special grade of capacitor oil under high vacuum. The metal case shall be equipped with porcelain bushings to permit connection between power lines and active capacitors.

7) Externally each capacitor unit shall have two separate earthing points, name plate conforming to the requirements of IS: 2834 (amended up to date), discharge resistance etc.

8) The capacitor bank may comprise suitable number of single phase self cooled hermetically sealed units in series parallel combination to achieve required KVAR rating. However, failure of one unit shall not create an over voltage on other units connected in parallel to avoid failure of parallel units.

9) Each capacitor unit/bank shall be provided with directly connected continuously rated, low loss discharge device built into the unit to reduce the residual voltage to a safe value within the specified time as recommended in the relevant standard after the capacitor has been disconnected from the supply.

10) All capacitors shall be suitably protected against over current by means of suitable over current protection (other than fuses) which are adjusted to interrupt the circuit when the current exceeds the safe permissible limit.

11) Capacitor units shall also be protected against internal faults and the effected units/banks shall be automatically and immediately isolated in the event of such fault.

12) Each capacitor unit shall continuously operate at the following overload conditions separately.

- Over voltage up to 10% of the rated RMS voltage.
- Over current upto 15% of the rated current.
- Maximum reactive output upto 30% over the rated reactive output.

13) Each capacitor unit shall be individually protected by HRC fuses with visual indication for operation.

14) The control panel shall be indoor, cubicle type, floor mounted, dust and vermin proof conforming to degree of protection IP54 excepting the enclosure enclosing capacitor bank which shall be of protection class IP-41.

15) Cubicle shall comprise rigid structural frame enclosed by 3mm thick cold rolled sheet steel, doors and covers shall be from 2mm thick cold rolled sheet steel. Structural frame-work with foundation bolts etc. shall be provided at the bottom to mount control panel directly on concrete/floor/steel channel base.

16) All doors, removable covers shall be gasketed all around preferably with neoprene gaskets.

17) The capacitors control panel shall, in general, comprise of the following and shall be housed in well-ventilated panels. Capacitors and their control elements may be installed in different compartments of the same panel to minimize space requirement.

- Power factor correction relay.
- Step controller with reversing motor.
- Time delay and No-volt relays.
- Protection fuses.
- Contactors for individual capacitors banks.

- Change-over switch for either automatic operation or manual operation with push button control.
- Visual indication for capacitor IN-OUT.
- Incoming fuse switch unit.
- 4 pole auxiliary switch for power supply to APFC relay.
- Ammeter with selector switch & CT's.
- Voltmeter with selector switch, protection fuse, indicating lamps.

18) Switches shall be triple pole, air break AC-23 duty. The switch shall have a quick make, quick break mechanism operated by a suitable external handle complete with position indicator.

19) The compartment door shall be interlocked mechanically with the switch so that the door cannot be opened unless the switch is in OFF position. Means shall be provided for releasing this interlock at any time.

20) Fuses shall be HRC, preferably link type, with a minimum interrupting capacity equal to the listed short circuit current. Fuses shall be complete with fuse base and fitting of such design as to permit easy and safe replacement of fuse element. Visible indication shall be provided on blowing of the fuse.

21) The Contactors shall be three pole, air break type designed for duty class III category AC3 with non bouncing silver/silver alloy contacts. Each Contactor shall be provided with 2 NC and 2 Nos. auxiliary lamps contacts rated at 10 amp. Indicating lamps shall be low watt filament type with series register. Lamp and lens shall be replaceable form front.

22) The main buses and connection shall be of high conductivity aluminium/aluminium alloy, sized for specified current rating shall be limited to $105^{O}C$ and $100^{O}C$ for silver plated copper joints and aluminium joints respectively.

23) Bus-bars and connections shall be fully insulated for working voltage with adequate phase/ground clearance. Insulating sleeves for bus-bars and shrouds for joints shall be provided. Shrouds for Bus-bar joints and tapping points shall be of two part epoxy resin cast/fibre glass moulded. Minimum clearance of 25mm is required between phases and between phase and earth irrespective of sleeve/shrouds provided for Bus-bar. Insulating shrouds shall be of moulded type.

24) All buses and connections shall be supported and braced to withstand the stresses due to maximum short-circuit current and also to take care of any thermal expansion.

25) Bus bars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear, when viewed from the front to panel assembly.

26) The horizontal Bus-bar chamber shall be separate and totally enclosed.

27) Gland plate shall be minimum 3mm thick & shall be removable.

28) Screws of corrosion resistant material shall be furnished on all ventilating louvers to prevent the entry of insects.

29) All internal wiring inside the cubicle shall be carried out with 650 V grade, PVC insulated copper wires duly ferruled at either end. The power wiring above 100A shall be carried out with PVC insulated aluminium links.

30) Separate labels shall be provided for relay, instruments, switch, indicating lamp etc. Approval for the type of label shall be taken from the consultant.

31) Painting shall include emulsion cleaning, pickling with dilute acid, washing and rinsing by water, phosphating and oven drying. One (1) coat of stoving type zinc chromate primer and two (2) coats of synthetics enamel.

32) Automatic control relay with necessary taps shall be provided.

MCB Distribution Board

Miniature Circuit Breaker Type Sub- Distribution Boards

1) Miniature circuit breaker boards shall comply with relevant Indian standards. They shall have a fault withstand classification of class 1 unless otherwise indicated. Miniature circuit breakers shall comply with all required standards.

2) These distribution boards shall be used for control of all lighting/power circuits and shall consist of single pole/double pole/triple/four pole miniature circuit breakers mounted in double cover design, dust tight, heavy gauge sheet steel enclosures preferably zinc coated with powder coating finish. Distribution Boards shall be flush or surface pattern according to the requirements of their location and shall incorporate isolators and circuit switches as specified in bill of quantities. All MCBs shall be connected to the electrolytic copper Bus-bars with direct bolted connections. Earthing line and neutral bars shall be provided having sufficient ways to enable each cable to be connected to a separate terminal. Neutral connections shall be corresponding in position to phase connections. Distribution boards shall have phase barriers and PVC ducts for all interior wiring. All distribution boards shall have removable end plates at top and bottom and handles with provision for locking.

3) Phase barriers shall be provided in the 3 phase distribution Boards.

4) In TP&N distribution boards, neutral bus-bars shall have one outgoing terminal for each outgoing circuit.

5) Size of SDB shall be selected to cater to extra space on the bus for mounting ELCBs in addition to outgoing No. of specified MCBs.

6) A multi-terminal bar for the circuit protective conductors shall be provided for both insulated and metal cased boards, with one terminal for each outgoing circuit. It shall be directly connected to the earthing terminal without dependence on the exposed conductive parts of the enclosure.

7) Identification of each MCB way shall be by numbering. Identification in the neutral Bus-bar and protective conductor bar shall clearly relate each terminal to its respective MCB way.

8) Spare MCB ways shall be provided as indicated. Where specific ratings are indicated, MCB shall be incorporated otherwise, the ways shall be left blank but suitable for future additions.

9) A separate Junction box of min. height of 150 mm shall be provided for extra lengths of outgoing circuit wires on Top/Bottom (as required) to avoid jumbling of wires within the main section of SDB.

10) Each distribution board shall be fitted with an isolating switch/MCB.

11) Miniature circuit breakers shall be designed and tested strictly in accordance with the relevant parts of Indian standard shall consist of spring accelerated quick-make and quick break action mechanism fitted in moulded cases of high di-electric strength plastic or urea. Fixed and moving contacts shall have silver tungsten contacts. The breakers shall incorporate hydraulic devices for over current tripping and magnetic devices for short circuit tripping calibrated and sealed during manufacture and arc extinction shall be fitted with coupled tripping mechanisms to ensure disconnections of all poles and hydraulic magnetic tripping for each phase of the supply.

12) The MCBs shall be tested as per relevant standards. Copies of Tests to be furnished before supply.

13) Miniature circuit breakers shall have a rupturing capacity of 10 KA at 415 V.

The electrical power system shall be of AC three phase / single phase with 400/231 volt, 50 hertz system. Three phase system shall be 3-phase, 4-wire with neutral solidly earthed.

Un-Interrupted Power Supply System

Scope

The scope of this section covers manufacture, supply, installation, testing and commissioning of Un-interrupted Power Supply (UPS) System.

Technology

- The offered UPS system should be based on True On–line; Double conversion technology with IGBT modules (Line interactive and Delta Conversion technology is not accepted).
- UPS should have inbuilt isolation transformer for total isolation between input and output.
- Offered UPS should have a built in battery charger as a standard design to accommodate higher capacity batteries for longer back-up.
- All wiring and electronics should be accessible from the front for ease of maintenance and repair.
- UPS status monitoring should be provided through user friendly, LCD display for input/output voltage, frequency, battery level etc.
- UPS power/status monitoring software should be available for all operating systems.
- Offered UPS system should be able to work on low/high input voltage preferably from 295 volts AC 3 Phase to 520 Volts AC 3 phase situations without an input voltage stabilizer.

- The offered UPS system should have an isolated bypass with inbuilt Automatic Voltage Regulator (AVR) as standard design.
- UPS offered should have good overload handling capabilities.
- UPS should have a good crest factor to handle heavy inrush currents (minimum 3:1).
- Auto re-transfer if the UPS system trips to bypass due to an over load situation; it should automatically sense and transfer the load from by pass to UPS when the overload is cleared.
- The offered UPS system should be compact and light so that to ensure that minimum space is occupied

Power Distribution Cables

Scope

The scope of this section covers the supply, laying, testing and commissioning of underground/surface mounted/ LT cables as specified in Bill of Quantities.

LV Cables

a. Cables shall be PVC insulated and shall be of 600/1000 volts grade or as specified and shall have been manufactured confirming to BS 6346, NS and Indian Standard Specifications IS-694 and IS-1554 as applicable. These shall be of approved types accepted by the Fire Insurance Association of India for use in industrial risks and to the following specifications. The contractor shall submit the Manufacturer's catalogues giving electrical characteristics of the cables.

b. The fire retardant (LHHO) cables shall be 650/1100V grade multicore having annealed tinned copper wires, insulated with special polymeric material suitable to withstand 150 degree for 30 minutes, cores laid up melinex taped, special low halogen and low smoke elastometric material inner sheathed black, armoured with G.I. Wires/cast steel strips, melinex taped outer sheathed with special low halogen and low smoke elastomeric material.

Mutli-core Cables

These shall be as specified and small comprise of plain, circular, solid or stranded copper conductors. PVC insulated and having an inner sheath of PVC compound armoring and PVC sheath overall and shall comply with IS:.1554-1961.

Flexible Cables

Twin flexible cables used for pendants and connections to other lighting fixtures shall have cross-section area or should be of 0.001sq. Inch (equivalent to 23/0.0076) or larger and be insulated in accordance with relevant IS specifications. The metric equivalent size for 23/0.0076 wherever mentioned may be noted as 23/0.20mm.

Jointing and Terminating Cables

a. Joints and terminations shall comply as appropriate to the type of cable. The consultant shall be informed where it is proposed to install joints that are not indicated.

b. The consultant shall be given evidence that the joint or termination manufacturer has stated the materials to be employed are suitable for the type of cable to be jointed or terminated.

c. Cable shall not be cut until the jointing or terminating commences and the work shall precede continuity until it is completed. All necessary precautions shall be taken to prevent damage and ingress of moisture and impurities; cable ends shall be free from moisture before jointing commences. Where circumstances prevent, completion the cable ends shall sealed. In the case of lead sheathed cables this shall be by plumbing and for aluminum sheathed cables by hermetically sealing.

d. The Contractor shall employ for this work, staff who is fully qualified and competent for the types of joints and terminations to be made.

e. Core identification shall be matched at each joint without twisting or crossing of the cores. Where numbered cores are jointed to coloured all cable runs and on sites with existing installations consistent with the system already in use.

f. For joints in armoured cables, a bonding conductor shall be connected across the armouring. A spilt ferrule shall be placed under the armouring to prevent deformation of the cable by the clamp.

g. At terminations, armouring and metal sheaths shall be connected directly to the external earthing terminal of the equipment by a bonding conductor. For LV cables the bonding conductor shall have a cross sectional area in accordance with IEE wiring Regulations. Metal sheaths of single core cables shall be bonded and earthed at one point only, as indicated; insulated glands shall be used at the open- circuit end or ends.

h. At terminations, cable tails shall be formed by separating and bringing out the cores. Each tail shall be long enough to connect to the terminals of the equipment.

i. At the terminations of single core cables, gland plates shall comply with for three phase circuits the phase conductors shall be arranged, if possible, in trefoil formation where they pass through the enclosure of equipment.

j. Core identification at terminations shall be by coloured or numbered plastic stretch or shrink ferrules.

k. Continuity of spare cores shall be maintained at joints and at terminations, the cores shall be connected to spare terminals.

l. Solder shall be used only for connecting or terminating paper-insulated cables. All other connections and terminations shall be by means of compression fittings or mechanical clamps.

m. Compression connectors and associated dies for compression tools shall be of correct type and size. Tools shall be so designed that the correct compression must be applied before it can be released.

Cable Indentification

a. For multi core cables, PVC ferrule type indicators or tags shall be provided at both ends for core identification. For phase identification of 2/3/3.5 core cables, coloured PVC tapes shall be used at both ends.

b. All cables shall be provided with aluminium tags of approved design, spaced not less than 7.5 meters. Apart and these shall contain the following:

- Feeder No.
- Size
- No. of Cores

Sleeves, Tapes and Sealing Compound

a. Sleeves shall be of the shrink type applied cold by mechanical device or by the use of heat, they shall provide a sufficient thickness of insulation to suit the particular application.

b. Insulating tapes used in joints and terminations shall be compatible with and have a temperature rating and insulating property not less than the cable insulation. They shall be complying with BS 3925.

c. Impregnated cotton tapes shall be double selvedge.

d. All tapes shall be stored in sealed containers until required.

e. Resin filling should be, as far as is reasonably practicable, safe and without risk to health. Each pack shall include warnings as to any hazards in its use, e.g. dermatic or toxic properties with details of precautions, which the user must take to minimize these.

f. Hot pouring sealing compound shall be hard setting and comply with BS 1858:1973(1986). Selection of the compound shall take account of the ambient temperature of installation as well as characteristics of the joint.

g. Care shall be taken to prevent voids occurring in consequence of too rapid cooling.

h. Resin filling shall be used with PVC/ XLPE type cables and hot poured compound shall be used with paper insulated lead covered cables.

Cable Support

a. Unless otherwise indicated the type of cable supports used shall be selected by the Contractor to suit the circumstances of the installation, but they shall comply with given standard.

b. Unless otherwise indicated all ferrous metal for cable tray, cable racks, and cable ladder, cable hangers and their fixings and suspensions shall have a galvanized finish.

c. For general use inside buildings the galvanized finish shall be a coating equivalent to and not less than type G275 to BS 2989, but manufacturer's standard finishes will be accepted for slotted angles. All metal exposed during fabrication shall be given a coat of zinc-rich paint, brushed on or finished to match the manufacturer's finish.

d. Metal cable tray shall be used unless otherwise indicated and it shall comply with IS code where cables are laid in the cable tray they shall be secured by ties, each tie securing the cables of only one circuit. The ties shall be of a proprietary type not requiring screws or bolts for fixing the use of wire or similar material will not be permitted. Ties shall be spaced at not greater than 600 mm along each cable and within 100 mm of each bend or set.

e. Where cable tray is installed in the veritable plane, cables shall be supported by cable cleats.

f. Cable tray shall be fixed at regular intervals not exceeding 1200 mm and at 225 mm from bends and intersections. A minimum clear space of 20 mm shall be left behind all cable trays.

g. Sub-mains cable shall be drawn into surface or recessed type PPR pipes of 10 Kg pressure made out of pure virgin PPR resin having the melting point of 120 degree.

Cable Saddles

a. Cable saddles shall be made from materials, which are resistant to corrosion without the need for treatment of special finish.

b. Cable saddles shall be of a size such that they can be tightened down to grip the cables without exerting undue pressure or strain on them. For vertical cable two bolt cable cleats shall be used which shall grip the cables firmly enough to prevent them slipping.

c. The spacing of cable saddle shall be complying with the IEE/IS Wiring Regulations. At bends in the cable, cleats shall be located immediately on each side.

Cable Tray

a. Ladder Type Cable Tray

Ladder type cable tray shall be fabricated out of double bended channel section longitudinal members with single bended channel section runs of cross members welded to the base of the longitudinal members at a centre to centre spacing of 250 mm. The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. These shall be galvanized to the desired lengths.

Alternatively, this shall be fabricated from 2 nos. of 50mm L-section ms channel (3mm thick) separated at 12" wide with 3 mm ms flat as spacer (at least 8" difference) welded with L-section ms channels. The channel and the flat shall be thoroughly cleaned by the sand paper before applying two coats of red oxide primer and then two final cost of enamel of Grey color shall be painted. Every pieces of cable tray shall be connected to the protective earthing with proper screws and 4 sq mm copper cable with cable shoe. A single length of L-section channel shall not be less than 3 or 4 m without joints. The cable tray shall be clamped by down rod at an interval of 1m in horizontal as well as in vertical run.

The down rod shall be fixed to concrete ceiling or wall with the help of expansion bolts. No right angle turning shall be made in cable tray. At such turning, mild curvature shall be provided so that the cable can be turned without damage.

b. Perforated Type Cable Tray

The cable tray shall be fabricated out of perforated galvanized Sheet as channel section single or double bended. The channel section shall be supplied in convenient length and assembled at site to the desired lengths. These shall be of galvanized steel as per design.

The jointing between the sections shall be made with coupler plates of the same material and thickness as the cable tray section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. Earth continuity shall be maintain properly on the contact surface between the coupler plates and cable tray.

Cable Hangers

Cable hangers shall be used only where indicated. They shall be made from mild steel flat bar.

Suspensions and Fixings

a. It is preferred that proprietary suspension systems comprising channel sections with return lips and compatible fixing accessories or slotted angles should be used, Where necessary fixing may be fabricated from mild steel flat bar. Metal arc welding shall comply with BS 5135.

b. Unless otherwise indicated fixing to the building fabric shall comply with table below:

TABLE-FIXING FOR CABLE SUPPORTS

Building fabrics	Type Fixing
Structural Steel work	Purpose made clamps (Type to be approved by consultant)
Non-structural steel work	Bolts, Washers and nuts.
Expanding anchors	Concrete brick or building Blocks
Timber	Coach bolts

Note: Where cable cleats are fixed direct to concrete, brick or building block, fiber plugs and screws may be used as appropriate.

c. No shot firing shall be used and no drilling or welding of structural steel shall be done without approval of the consultant.

d. Suspensions and fixings shall be comply with BS wiring regulations.

e. Bolts, nuts, washers and screws shall be cadmium or zinc Electroplated or passivated.

Bonding

Supplementary bonding shall be installed between component parts of cable trays, racks or ladders where the method of mechanical connection does not provide permanent and reliable metal to metal joints of negligible impedance.

Cable Installation

a. Unless the routes of cables are indicated on drawings, they shall be determined by the contractor and approved by the consultant before work is started.

b. Cable installation on the surface shall be parallel with the lines of building construction and properly aligned.

c. A minimum clearance of 150mm shall be allowed from any equipment, pipe work or duct work. The distance shall be measured from external surface of any lagging.

d. In the event of difficulty in achieving these requirements, consultant shall be informed and decision will be made as per site condition.

e. Spacing between cables shall comply with relevant table, but where indicated account must be taken of any grouping necessary to maintain the current carrying capacities of cables.

f. Space shall be allowed along cables routes for future additions where indicated and cable supports shall be of adequate size for the ultimate load.

g. Adequate space shall be left between cable runs, the building fabrics and other services to allow for future removal or installation of cables.

h. Cables shall be adequately supported by one of the methods specified in the drawing throughout cable ducts or are buried direct in the ground. Fixing direct to building fabric by cable cleats may be adopted for single runs subject to the approval of consultant where indicated.

i. Cables shall be supported within 30mm of their termination at equipment; the weight of the cable shall not be carried by the terminal box gland.

j. where cables cross expansion and settlement joints in the building structure, they shall be fixed 300 mm each side of the joint and sufficient slack left between to allow for movement. Where the cables are buried in the building fabric suitable provision shall be made to allow for movement of the structure. The contractor shall submit his proposals for approval of consultant.

Handling of Cables

Cables shall be handled with care and every effort made to avoid damage to the cables, to other services and to building fabric. Recommendations or instructions available from the cable manufacturers concerning the installation of cables shall be taken into account. In particular co-axial cable shall not be bent in radius less than six times the overall diameter. Any damage shall be immediately replaced as per consultant's instructions.

Marking of Cables

a. Cables located in switch rooms, ducts and spaces designated solely for electrical services or have orange over sheaths, they shall be identified by adhesive bands coloured orange, complying with BS 1711. The bands shall not be less than 100 mm long, located at least once within each separate compartment through which the cables pass at intervals not exceeding 12 m.

b. Except where cables are buried or enclosed in conduit, trunking or ducting, they shall be permanently identified by discs. Discs shall be of laminated plastic materials with black characters on white: characters shall be not less than 3 mm high. The inscription shall indicate nominal voltage, designation of load, number and cross sectional area of cores and rated voltage of cable.

c. Cable identification discs shall be attached to the cables with ties. Discs shall be located within 500 mm of terminations and joints, at least once within each separate compartment through which cables pass and at intervals not exceeding 24 m, they shall coincide with the colour bands.

Luminaires, Lamps, Light Fixtures, Fan and Switch/Socket Outlets

Scope

a. The scope of this section comprises the supply, erection, testing and commissioning of lighting fixtures for internal lighting of service areas wherever required of the specified models.

b. Without restricting to the generality of the foregoing, this section shall include luminaires, lamps and accessories necessary and required for the installation.

c. Whether specifically mentioned or not, the luminaires and lamps shall be provided with all fixing devices, terminal blocks, holders etc. as required.

General Requirements

a. All the luminaires and lamps shall be of best quality and as per approved makes. Wherever alternative makes are specified the choice of selection shall remain with the Engineer-in - charge .

b. The luminaires and lamps shall be fixed in a neat workman like manner, true to level and in accordance with manufacturer's instructions.

c. The luminaire and lamps shall be provided with such accessories as are required to complete the item in working condition whether specifically mentioned in the specifications, drawings or not.

Luminaires

a. Luminaries shall comply with relevant Indian Standards.

b. Unless otherwise indicated, enclosure of luminaires shall provide a minimum degree of protection of IP44 when located within buildings and IP 65 when located outside buildings, but luminaires mounted externally; and less than 2 M above finished ground or paved level shall be IP 65.

c. Unless otherwise indicated, luminaires, both with and without built-in ballast or transformers shall be suitable for direct mounting on normally flammable surface.

d. Where specific requirements related to flame propagation and flammability of translucent covers are indicated, certificates of tests shall be submitted to the consultant .The tests shall comply with relevant Indian Standards.

e. Terminal blocks for connection of the supply cables shall be of adequate size for the size of conductors forming the loop in wiring. Unless separate tails are required as in clause 18.3.5. Where indicated, terminal blocks shall incorporate a fuse of suitable type and rating.

f. Ballasts for tubular fluorescent lamps shall have a maximum value of harmonics complying with the colour headed “without H Marking" in Table VII of BS 28116. Power factor correction shall be provided and this shall be not less than 0.85 lagging unless otherwise indicated.

g. Translucent covers and reflective surfaces shall be clean at the completion of the works.

Lamps

a. Lamps shall be of the type and ratings as indicated.

b. All lamps shall be installed by the contractor.

c. Lamp caps shall be suitable for the lamp holders listed socket by means of a locking ring.

Support and Fixing

a. Where fluorescent luminaires 1200 mm or more in length are supported directly by the conduit system, they shall be fixed to two circular conduit boxes both of which shall form an integral part of the conduit system.

b. Where the weight of a luminaire is supported by a conduit box or cable trunking, the fixing of the conduit box or trunking shall be adequate for the purpose and approved by Engineer-in - charge .

c. Luminaires fitted with tungsten filament lamps and having metal back plates shall not be fixed directly to conduit box in which thermoplastic material is the principal load bearing member.

d. Support of luminaires from cable trunking shall be by means of proprietary clamps or brackets.

e. Where luminaires are supported from the structure other than by the conduit system, the supports shall comply with clause 18.12.1.

f. Luminaires mounted on or recessed into suspended ceilings shall not support luminaires unless specifically shown and approved.

g. For wall mounted luminaires, the mounting height shall be 1900 MM above finished floor level, measured to the centre of the conduit box, unless otherwise indicated.

Wiring Connections

a. Where luminaires, other than those are fixed direct to circular conduit boxes or are supported by pedants or chains, the final circuit wiring shall terminate at a terminal block in the conduit box.

b. Where luminaires having flourescent tubes are fixed direct to circular conduit boxes, the final circuit wiring may be terminated within the luminaire unless otherwise indicated. The wiring shall enter each luminaire at the conduit entry nearest to the terminal block and where a loop

in wiring system is used, leave by the same entry; wiring shall not pass through a luminaire unless the approval of the consultant.

c. Where luminaires are mounted on or recessed into a suspended ceiling, connection shall be by flexible cord from a plug-in ceiling rose unless otherwise indicated. The plug-in ceiling rose shall be located not more than 500 mm from the access in the ceiling and shall be firmly supported, unless otherwise approved by the consultant.

d. Cables and flexible cords for final connections to luminaries shall be suitable for the operating temperature of the luminaire.

e. The size of final connection cables or flexible cords shall be as indicated.

f. Cables and cords passing close to a ballast within a luminaire shall be suitable for the operating temperature of the ballast.

g. A protective conductor shall connect the earthing terminal or earthing contact of each luminaire to an earthing terminal incorporated in the adjacent conduit box. Where the final connection is by flexible cord, the protective conductor shall form part of the cord.

h. The scope of this section covers the supply, installation, inter connection, testing, commissioning and putting into operation of specified types and rating light fixtures/luminaries as mentioned in BOQ. All types of light fixtures are subjected to the prior approval of the consultant. The contractor shall submit the actual sample of the fixtures with manufacturers catalogues. The light fixtures must be delivering at site in a factory pack complete with all accessories, lamps and fixing and connecting materials.

Light Fixtures

a. **2x36 and 2x18 watt CFL Paralite:** These luminaries shall be made of CRCA powder coated housing integrated with parabolic shaped pre-anodized purity aluminum reflector and Paralit P5 louver system with spring loaded plastic toggles to fix the louver, pre-wire up to the terminal with electronic ballast. The fixtures shall be suitable for both surface and recessed mounting type as per site conditions. The anticipated physical dimension of 2x36 watt is 595x595 mm with the recessed depth of 55 mm and for 2x18 watt is 300x300 mm with recessed depth of 55 mm.

b. **2x 9 watts CFL down Light:** This type of light fixtures shall be made out of CRCA powder coated rim and housing integrated with super high purity textured aluminum reflector and double parabolic cross louver. The fixture shall be connected with electronic ballast and lamps shall be in horizontal configuration. The anticipated cut out of the ceiling is 168 mm Dia and recessed height is 108 mm.

c. **1x40 Box type fluorescent light:** This light fixture is made out of high quality polyester pre-coated galvanized steel sheet consisting twist lock lamp holders interconnected with electronic ballast.

d. **1x 15 watts CFL down Projected wall light:** Having cast housing, fitted with 250 mm dia milky white glass diffuser and 3 Nos stainless steel screws. The fixture shall be of 200 mm width, 270 mm height and 270 mm extension. Color as approved.

e. **External Bulkhead: (HL-1160):** The fixture shall have cast aluminium housing, stainless steel screw fitted sand blasted glass diffuser integrated with rubber gasket. The entire external part of the fixture shall have corrosion resistant coating of black color.

f. **5 watt Recessed LED Light:** The single shaped recessed LED down light shall be made of CRCA white powder coated rim and housing with super high purity aluminium reflector housing efficient heat sink system. The fixture shall have enclosed driver and wires with the heat proof wire up the terminal.

g. **Notice Board/display board light: (Decon Trim Tube)** The light fixture is Trim Tube made out of MS Sheet protected against corrosion by white color powder coating suitable for 1x36 W true tube with electronic ballast. The length shall be 1260, height 85 and projection 195 mm.

h. **Picture light:** 600 mm long rectangular base to mount the 200 mm projected light bar suitable for 1x14 Watt T5 lamp with electronic ballast. The light bar in adjustable independently without any strain in the connecting cable.

i. **15 W CFL Ceiling Dome light having Spun:** Steel housing with corrosion resistant coating integrated with lockable sand blasted galas diffuser. The diameter of the diffuser shall be 315 mm with the extension of 5 mm.

j. **Exist Light:** Low energy consumption wall mounted or ceiling suspended Exit light as a acrylic signage on green background color. The alluminated edge lit shall be 10 mm thick. The overall size of building Exit Light shall be 340x290 mm including battery box. The battery shall be of 12V 1.2 AH self maintained type.

k. **Toilet Mirror Light:** Shall be 4' ling T5 lamp fixture enclosed in a acrylic enclosure complete with electronic ballast and fixing and connecting materials.

Sweep Ceiling Fan

The sweep ceiling fan shall be of 1400 mm dia in 4 blades and 1200 mm dia for 3 blades with the center distance of 4 and 2.5 meter respectively. The external finish shall be white elegant look enameled finish. The fan shall function with double ball bearing and soundless motor fixed with aerodynamically balanced blades. The speed shall be 275 rpm for 1400 mm and 310 for 1200 mm with the air displacement of 305 & 240 CMM. The fan hanging rod could be shorten and extended as per site conditions. The ceiling mounting details are given in the drawing.

The speed regulator shall be stepped type electronic type integrated in modular plate of light control switches. The speed regulator will be active after ON of a switch designated for single fan only.

Switches and Socket Outlets

All switches/dimmers and socket outlets are to be I modular formation and flush type. All types of switches and sockets (3- pin round pin/ flat pin/ computer/ TV/Telephone) stall be made of corrosion resistant, heat resistant and impact resistant polycarbonate. The data socket with patented integrated shutter. Electrical socket with reinforced nylon protective shutter. All switches are electric are encapsulated are tested 80000 times. Sockets tested to 150;00 cycles and complying IEC or IS. The flushing GI Box shall be of 1.6 mm thick fully rust proof.

Four Components Floor Recessed Box

Rectangular shaped floor recessed box suitable for data, telephone and 2 No 13 A 3-pin flat switch sockets made our of rust proof steel sheet with stainless steel open able cover at finish floor level. Separate cable entry for power communication with sufficient cable space radius. The recommended size of the box is 140 mm deep 400 mm long and 250 mm wide with IP 32 rated.

Metal Clad Plug & Socket

The plug and socket shall be made out of non-corroding die cast aluminum alloy having high strength and anti tracking properties. The design must avoid accidental contact while inserting /removing the plug. The cable grip to the plug shall be made very strong by providing compression gland and by protecting it at the point of entry by strong rubber guard. The socket box shall be integrated with 20 A DP MCB for local protection. The rating of the plug and socket shall be 20 A single phase 220 volt AC supply.

Emergency Exit Light

Low watt, hybrid IC controlled self contained emergency exit light with fluorescent lamp. The IC controlled shall have high efficiency current feed push – pull sine wave inverter for the full utilized the battery power and to prevent the frequent blackening the tube. The general specification shall be as follows:

TECHNICAL CHAPRACTERISTICS

INPUT VOLTAGE	**:** 230Vac 50/60Hz±10% or 115Vac 50/60Hz±10%or others
BATTERY	: 2.4V 2AH/4AH High temp rated Nickel Cadmium cells or others
LAMP USED	: Fluorescent tube 1x8 W daylight 30 cm
RATED PERIOD	: > 1 hr, 2 hrs, 3 hrs or others
MODE	: Maintained
OPERATION TEMPERATURE	: to 40^{o}C

POWER CONSUPTION	: < 12 VA
CHARGE MONITOR	: Super bright red LED 5mm Ø
RECHARGE PERIOD	: 16- 24 hrs
EMERGENCY LUMINANCE	: >8 cd/m^2
ELECTROMAGNETIC FIELD	: 6 m gause @ 0.1 m
CHARGER	: Hybrid controlled charger
PROTECTION	: Low volt cut off to percent battery over discharge
	Incoming AC fuse and Battery DC fuse
	Tropical climate protection coating on hybrid control circuit
CONSTRUCTION	: Electrode galvanized sheet steel with epoxy powder coating
	20 mm Ø K/0 hole, Fire Retardant Acrylic Opal diffuser
DIMENSION	: 468 mm(L) x 74 mm (W) x 266 mm (H)
WEIGHT	: 2.70 kg(Net)
COMPLIANCE	: CP 19, ss263 : part 2, IEC 598-2-33, AS 2293
INGRESS PROTECTION	: IP 30

Wiring

Scope

The scope of this section covers the supply, erection, testing and commissioning of conduits & wiring for lighting; power, telephones, and P.A. system. Wiring shall be carried out in accordance with relevant I.S. rules and regulations.

System of Wiring

a. All lights and power wiring shall be carried out in surface conduits/PVC pipes/on cable trays as specified.

b. NS/IS/I.E.E. regulations shall be applicable for all material and workmanship.

c. The wiring to be carried out on such that specified 'Power' wiring shall be in ring mains system and kept separate and distinct from 'Lighting' wiring. The wiring shall be done on the distribution system with main and branch distribution boards at convenient physical and electrical centers as shown in drawings. All conductors shall be run as far as possible along the walls and ceiling and above false ceiling so as to be easily accessible and capable of being thoroughly inspected. In all types of wiring, due consideration shall be given for neatness and good appearance.

d. The balancing of circuits in three wire or poly phases installations shall be arranged before hand to the satisfaction of consultant. Circuits on opposite side of a three wire system or on different phase of poly phase system shall be kept apart at a minimum distance of 2m (5.5.ft) unless they are enclosed in earthed metal casing suitably marked to indicate the risk of dangerous shock due to voltage between the conductors contained in them. In large or important areas, light and socket outlet points shall be distributed over more than one circuit as directed.

e. Medium pressure wiring and associated apparatus shall comply in all respects with the requirements of IEE rules.

Joints & Looping Back

a. The wiring shall be done in a 'looping System'. Phase or live conductors shall be looped at the switch box and neutral conductor can be looped either from the light, fan outlet.

b. No bare or twist joints shall be made at intermediate points in the through run of cables, unless the length of final sub circuit or sub-main or main is more than the length of the standard coil given by the manufacturer of the cable.

Cables

a. The type and size of cables shall be as specified in BOQ those which will be used most commonly.

b. PVC insulated non-sheathed cables shall comply with BS 6005. They shall have copper conductors unless otherwise indicated.

c. Rubber insulated non-sheathed cables shall comply with relevant Indian Standards.

d. Core identification colours shall extend throughout the length of PVC insulated cables. Core identification for sound distribution or public address systems shall be in grey colour. For other Category 2 systems, the colours shall be as indicated.

e. Cables shall be protected throughout their length by trunking, ducting, conduit and equipment enclosures. Framework or partitions may be used, but only where indicated or with the approval of Engineer-in –charge.

PVC Pipes/Conduit Accessories

a. Unless otherwise indicated, HDP pipes shall be NS marked whereas MS conduits and accessories shall be ISI marked.

b. Unless otherwise indicated, protection against corrosion of conduits and conduit fittings for general use inside buildings shall be Class 2.

c. Adaptable conduit Pull boxes with their covers shall provide a minimum degree of protection of IP42 when used inside building and IP54 when used outside buildings or at other locations as indicated.

d. When conduit/Pipe boxes are installed flush with the building fabric, overlapping covers shall be fitted.

e. Flexible steel conduit for general use inside buildings shall be type A with protection against corrosion equivalent to Class 2. Adaptors shall be of solid type.

Routes and Segregation

a. In case the routes of conduit and ducting are not shown on the drawings, they shall be determined by the Contractor and approved by Engineer-in -charge before work is started. This requirement shall apply where the conduit or duct is concealed within the building fabric as well as where they are on the surface.

b. Conduit and ducting shall be parallel with lines of building construction and properly aligned except where conduit is permitted in floor screeds. Conduit buried in wall finishes shall run vertically only, unless Engineer-in -charge gives approval to deviate from this requirement.

c. Conduit and ducting shall be parallel with lines of building construction and properly aligned except where conduit is permitted in floor screeds. Conduit buried in wall finishes shall run vertically only, unless Engineer-in -charge gives approval to deviate from this requirement.

Accessories

a. Unless otherwise indicated, accessory boxes used with steel conduit shall be made of metal.

b. Accessory boxes shall be suitable for flush or surface mounting, as indicated. Unless otherwise indicated, metal boxes for general use inside buildings shall be of steel of medium category against corrosion.

c. Accessory boxes shall be of adequate depth to accommodate the accessories without causing compression of the cables. Generally boxes shall be 35 mm deep, but for lighting switches installed flush in plaster finish with multi-cored sheathed cables, 16 mm depth boxes may be used.

d. Earthing terminals shall be fixed inside each accessory box and on the grids of grid switches. The earthing terminal of each grid shall be connected by a separate protective conductors to the earthing terminal of the box.

e. Front plates of accessories shall be of material and finish as indicated, but generally finish of various types of accessories in the same area shall match. For flush mounting, plates shall overlap the boxes. For surface mounting, plate shall match the profile of box, without overlap.

f. Where pilot lamps are required, they shall comprise a neon lamp with resistor and a red coloured lens, unless otherwise indicated.

g. Accessories with their boxes and front plates shall provide a minimum degree of protection of IP42 when used inside buildings and IP54 when used outside buildings or at other locations where indicated.

h. Accessory boxes shall be fixed to the fabric of building, independent of connecting cables or conduits. Where the accessories have a minimum degree of protection of IP44, the fixings shall not reduce that protection.

Switches

a. Switches shall be single pole unless otherwise indicated. Their current ratings shall be as indicated, allowance being made for any inductive or capacitive load.

b. Wall mounted switches and socket outlets located inside buildings shall be modular type actuating members unless otherwise indicated. Where mounted adjacent to one another, they shall be grouped in a multi gang box with a common front plate.

c. Pull cord operated switches shall be fixed to white moulded plastic mounting blocks, which in turn shall be fixed to a circular conduit box. Where the conduit boxes are flush with the finish, mounting block shall overlap them. Pull cords shall be white or natural colour and the lower end shall terminate in a moulding of rubber or plastic material.

Socket Outlets

a. Socket outlets shall be of type and rating as indicated. Pilot contacts shall be provided where indicated.

b. Modular formation Socket outlets shall be switched where indicated. On socket outlets rated at 16A and located inside buildings, the switches shall be single pole and have rocker type actuating members unless otherwise indicated.

c. Socket outlets for wet locations shall be provided with covers which shall be screwed on. Any cover required to achieve total enclosure and to ensure the required degree of protection against moisture shall be securely fixed to socket outlet.

Plugs

a. Plugs shall be provided as indicated. Plug bodies shall be of metal, plastic or other material as indicated.

b. Plugs rated at 16A shall be of a non resilient material unless otherwise indicated.

c. Fuse plugs shall be fitted with fuses rated as indicated.

Terminal Blocks

a. Conductors shall be clamped between metal surface and no screws shall make direct contact with conductors.

b. The design shall be such as to maintain sufficient contact pressure to ensure connections on negligible impedance at all times.

c. Metal in contact with conductors shall be 85% copper alloy and any screws shall be of metal that is electrolytically compatible with the copper alloy. The moulded housing shall be an insulating material suitable for the maximum operating temperature of the conductor.

Mounting Heights

a. Mounting heights shall be as follows unless otherwise indicated by the Architects/ Interior Designer, where decision shall be obtained by contractor before start of work.

MOUNTING HEIGHTS (for accessories and equipment)

Accessories or Equipment	Height (mm)
Lighting Switch	1350
Socket outlet	
Location:General	200
above worktops	1100
Telephone outlet	1100

NOTES:

1. Heights are from finished floor level to the center of the accessory or equipment, except in the case of worktops when the measurement shall be from the worktop surface.
2. If the specified height of an accessory coincides with the top of tiling, the accessory shall be mounted above the tiling, leaving a clear gap of 50 mm.
3. Where apparatus is located underneath a worktop, the accessory shall be mounted 100 mm below the underside of the worktop.

b. Where difficulty in locating accessories or equipment occurs the Engineer-in -charge shall be informed.

Supports and Fixing

a. Support shall be positioned with in 300 mm of each bend and conduit box. Conduit boxes shall be fixed to fabric of building independent of the conduit. Where the conduit boxes have a minimum degree of protection of IP44, the fixing shall not reduce that protection.

b. Conduits shall be fixed in accordance with under mentioned Table. No shot firing shall be used and no drilling or welding of structural steel work shall be done without the approval of Engineer-in -charge.

TABLE CONDUIT FIXINGS

1. Fixing of Conduit

Location	Type of fixing
Floor screeds	Saddles
Buried in plasteror render	Crampets or saddles
Above false ceilings	Spacer bar saddles
Surface	Distance Saddles

2. Fixing of Saddles, Conduit Boxes

Building Fabric	Type of fixing
Structural steelwork	Purpose made clamps (type to be approved by SO)
Non-Structural steelwork	Sets screws and nuts.
Concrete, brick or Blocks	Fiber plugs & screws
Hollow blocks & pot Floors	Butterfly spring toggle bolts or gravity bolts.
Timber	Wood screws

c. Screws and nuts shall be cadmium or zinc electroplated or passivated.

Installation

a. If the protective finish of any material has been damaged, those materials shall either not be used or any remedial work shall be approved by the Engineer-in -charge before use. Conduits shall be clean and free from oil.

b. Steel Conduits shall be connected by means of a coupler and an externally screwed bush. Bushes shall be tightened by spanners. Pliers and toothed wrenches shall not be used.

c. Where a terminal block is to be accommodated in a circular conduit box, an extension ring shall be fitted to the box, of sufficient depth to ensure adequate space for the terminal block and cables.

d. The length of thread on the ends of steel conduits shall match that in the conduit fittings or equipment and exposed threads will not be permitted. Running couplings with backnuts may be used with conduit having Class 2 protection, but where the protection is Class 4 only, manufactured running joints will be accepted. Exposed thread on running couplings shall be given a coat of zinc-paint.

e. Conduit shall be cold bent on site with a suitable bending tool and sand filling, without deforming its cross section.

Draw in conduit boxes shall be incorporated at intervals not exceeding the following:

Straight run	l0m;
Run with one or two bends	l0m;
Run with three bends	5m;
Run with four bends	5m;

f. Unless otherwise indicated, conduit buried in concrete shall have at least 30mm depth of cover; it shall be securely fixed to prevent movement during pouring and vibrating of the concrete. Conduit in plaster shall have at least 5 mm depth of cover.

g. Where conduits or ducting cross expansion and settlement joints occur in the building structure, suitable provision shall be made to allow for movement of the structure. The Contractor shall submit his proposals for the approval of Engineer-in –charge.

h. Where conduit passes through an external wall, a conduit box shall be fitted on the inside of the wall and after wiring, filled with an inert permanently plastic compound having a high insulation value.

i. Conduit and ducting shall be installed in screeds only where indicated or after receipt of the Engineer-in -charge approval. Conduit boxes in floors, other than for agreed outlets will not be permitted.

j. Under floor ducting / conduit shall be straight and level and adjusted in height to relate to the finished floor level, as indicated.

k. Open ends of conduit and ducts shall be temporarily plugged immediately after installation to prevent ingress of water and solid materials. The boxes of under floor ducting shall be fitted with temporary lids immediately after they are installed and they shall be maintained as effective protection against ingress of water and solid material until the permanent lids are fitted after screeding is complete.

l. Method to be used for forming fire barriers at fire resistant structural elements such as floors and walls shall be submitted for the Engineer-in -charge approval.

m. Installed conduits and ducts shall be cleaned internally with a swab before cables are drawn-in.

n. If the protective finish of conduit or ducting is damaged after fixing, the damage shall be made good in a manner approved by Engineer-in –charge.

Protective Conductor

a. Protective conductor shall be drawn through ducting and non-screwed metallic conduit.

b. Where live conductors terminate at or loop into terminals adjacent to an appliance or accessory, the protective conductor shall be similarly terminated.

c. A protective conductor shall be installed within each length of flexible steel conduit and connected to an earthing terminal at each end of the flexible conduit.

Wiring

a. No wiring shall be carried out until the appropriate tests required in Section “Inspection and Testing" have been done and the Engineer-in -charge has given his clearance for wiring to commence.

b. A loop in form of wiring shall be used as far as practicable or unless otherwise indicated. Joints in conductors shall not be permitted.

c. At expansion joints, adequate slack shall be left in the cables.

d. Where conduits are installed for wiring by others, a draw wire shall be provided between each draw-in position.

e. Cables forming part of communication circuits shall have identification sleeves at their terminations. Identification shall be consistent with the relevant wiring diagrams.

Cables

a. Cables shall comply with BS 6004; for LV circuits in accordance with Table 5 or ELV circuits in accordance with Table-5. Cables shall have copper conductors, unless otherwise indicated, and the size shall be as indicated.

b. The colour identification of cores shall comply with the IEE wiring regulations for all categories of circuits and for live conductors. The identification shall extend throughout the length of the cable. The additional identification requirements of clause shall also be met.

c. Joint boxes shall comply with BS 4662 or BS 5733 and where they are of insulating material the material shall have the ignitability characteristic 'P' as specified in BS 475. Where terminals are not integral, insulated terminal blocks complying with the requirements of clause 15.15.9 shall be used.

d. Boxes for accessories shall comply with the requirements of clause 15.15.

e. Unless the routes of cables are indicated on the drawings, they shall be determined by the Contractor and approved by the Engineer-in -charge before work is started. Cables shall be concealed within the fabric of the buildings or fixed to the surface of walls and ceilings as indicated.

f. Cables shall be parallel with the lines of the building construction and properly aligned. Cables passing through joints shall be as nearly as practicable at right angles to them and at a distance not greater than 450 mm from a load bearing wall, beam or similar support. Cables buried in wall finishes shall run vertically only, unless the Engineer-in -charge has given approval to deviate from this requirement.

g. A minimum clearance of 150 mm shall be allowed from any equipment, pipe work or ductwork. The distance shall be measured from the external surface of any lagging. In the event of difficulty in achieving these requirements, the Engineer-in -charge shall be informed

h. Cables shall be fixed by saddles of nylon or other suitable plastic material.

i. Cables buried in wall finishes shall be protected throughout the length that is buried by rigid PVC conduit. Normally the conduit shall be non circular but where appropriate, tubular form type A may be used.

j. Cables passing through walls or buried in concrete including floor screeds, shall be protected throughout the length that is buried by rigid PVC conduit tubular form type A.

k. Unless otherwise indicated, conduits buried in concrete all have at least 30 mm depth of·cover. Conduits buried in plaster shall have at least 5 mm depth of cover.

l. Where conduits cross expansion and settlement joints in the building structure, suitable provision shall be made to allow for movement of the structure. The Contractor shall submit his proposals for the approval of the consultant .

m. Conduits entering voids shall terminate not less than 22 mm clear of the building fabric. Open ends of conduit shall be temporarily plugged immediately after they are installed to prevent ingress of water and solid materials.

n. Where cables pass through joints, the number and size of holes shall allow for easy withdrawal and replacement of cables. The diameter of holes shall not exceed 1/6th the depth of the joints. They shall be approximately on the centre line and shall be not less than 75 mm between centres. Joints shall not be notched.

o. The method to be used for forming fire barriers at fire resistant structural elements such as floors and walls shall be submitted for the Engineer-in -charge approval.

p. Where cables enter a metal enclosure, they shall be protected by grommets or secured by cable clamps.

q. Cables shall be looped between outlet points and as far as practicable, intermediate joints shall not be used.

r. Cables fixed to the surface, except in ducts, shall be protected up to a height of 1500 mm by high impact PVC channel.

s. Cables shall have identification sleeves at their terminations.

t. Identification shall be consistent with the relevant wiring diagrams.

Earthing

Scope

a. The scope of this section covers supply installation and testing of earthing system for all non-current carrying metal parts of electrical installation.
b. The type and number of earth electrodes shall be as indicated and shall comply with clauses as appropriate.
c. Dedicated earthing shall be provided for the Server Room equipments, EPABX, UPS System etc.

Earthing System and Equipment Bonding

a. Unless otherwise indicated, earth plates shall be 600 mm x 600 mm minimum, of solid or lattice copper not less than 3 mm thick.
b. Earthing system shall comprise of earth electrode near sub-station. Test link boxes shall be provided at each electrode for periodical resistance measurement. All such earth electrodes shall be interconnected forming a main loop (MEL).
c. Where the earth electrodes are formed with tape, the tape shall be to BS 1432, of the size, length, depth below ground level and layout as indicated.

Conductors

a. Earthing conductors, main earthing bars and main equi-potential bonding conductors shall be of the type, size and conductor material as indicated and shall comply with clauses 19.03.2 to 19.03.5.

b. Tapes shall comply with relevant Indian Standards. Where used to interconnect copper electrodes the tape may be bare, but for interconnecting pipe electrodes and for all other purposes the tap shall have an extruded PVC sheath.

c. Main earthing bars shall comply with relevant Indian Standards.

d. Shall comply with relevant Indian Standards, without sheath, unless otherwise indicated.

Joints and Connections

a. Joints in conductors shall be kept to a minimum.

b. All contact surfaces shall be thoroughly cleaned and coated with an anti-corrosive electrical jointing compound suitable for the conductor materials. For bi-mettallic joints, a separate abrasive shall be used to clean each metal.

c. Connections shall be made as follows:
   - to main earthing bars by phosphor bronze set screws and nuts;
   - to earth rods by bronze, gunmetal or copper clamps with phosphor bronze. Edges of clamps shall be rounded;
   - to earth pipes by phosphor bronze bolts and nuts, direct to the flange of the pipe;
   - to earth plates by bolting, rivetting or welding.

d. Termination of cables shall be by connectors jointed to the cable conductor by the thermit welding process or by compression joints complying with relevant Indian Standards.

e. Joints which are indicated as test points shall be bolted or clamped. Joints in tape, other than at test points shall be made by the reveting and sweating. Overlap of conductors shall be not less than 100 mm.

f. Joints and connections shall be protected by a coating which will form a seal and exclude moisture in all weather conditions. At connections to earth electrodes, the coating shall cover all exposed conductors and in the case of earth pipes, to top surface of the flanges. Protective coatings shall be of a waterproof, inert, tenacious material and of one of the following forms:
   - solvent cutback thixotropic corrosion preventative forming a film of resilient matt petroleum wax;
   - a fast drying durable rubberised sprayed coating;
   - a heat shrink clear sheathing

g. Screws, nuts, washers and rivets for copper conductors shall be of phosphor bronze, naval brass or copper silicon; for aluminium conductors, they shall be of stainless steel. The minimum provision shall be as follows:
   - for flat strip--- two M8 bolts or four 5 mm diameter rivets;
   - for sheet metal--two M8 bolts; where the sheet metal is less than 2 mm thick, it shall be backed for an area of at least 1000 mm2.

Inspection Pits

a. Unless otherwise indicated, connection between an earth conductor and its associated earth electrode system shall be in an enclosure.

b. The enclosure shall have a removable top cover which shall be flush with finished ground level. The enclosure shall be a purpose made concrete inspection pit, a galvanised steel inspection pit embedded in concrete, an earthenware pipe or similar, as indicated. The earth electrode connection shall be just below the lid of the inspection pit with adequate access for testing purposes.

Supports and Fixing

a. Cables shall be supported and fixed in accordance with the standard.

b. Tapes and bars shall be fixed by spacer bar saddles which shall be of non-metallic material or corrosion resistant alloy compatible with the conductors. The maximum spacing off fixings shall not exceed 600 mm unless otherwise indicated.

c. Main earthing bars shall be supported on insulators; they shall be not less then 25 mm clear of the building fabric.

d. For general areas inside buildings, screws and nuts shall be of cadmium electroplated steel or stainless steel; outside buildings, in plant rooms or other locations as indicated, they shall be of stainless steel.

e. No shot firing shall be used and no drilling or welding structural steelwork shall be done without the approval of the consultant.

Installation

a. Electrodes shall be installed in undisturbed ground. The distance between any two electrodes shall be not less than 1.25 times the depth of the longer electrode.

b. Excavations shall be carried out in accordance with relevant Indian Standard and shall comply with the construction IS Regulations, 1961. Excavations shall be kept free of water and protected against damage or collapse. The safety of persons and the protection of structures, buildings, roads, sewers and services from damage shall be ensured; all necessary sheeting, timbering, struting and shoring shall be supplied, erected and subsequently removed.

c. Trenches shall be backfilled in layers and each layer shall be rammed. The first two layers shall be 100 mm deep and rammed by hand the remaining layers shall be not more than 200 mm deep and power ramming may be used. Warning tapes and covers shall be included as specified. Where applicable, top soil and turf shall be replaced and the final level shall be level with or not more than 25 mm above the adjacent ground level.

Lighting Protection System

a. Scope of Works

The work to be done under this section comprises the supply & installation necessary for complete installation of lightning protection system.

The lightning protection system should comply in accordance with IS standards and all installations shall be based on it.

b. Air Terminals

Air termination shall be of tas per given drawings and must have:

- Mechanical Supports
- Down – conductors
- Performance Recording Equipment
- A low impedance Grounding system.

c. Down Conductor

Down conductor shall be as specified in BOQ and shall be copper strip. Main copper conductor shall be connected directly to air termination.

Down conductor must be kept in constant physical contact with structure.

Lightning and Surge Voltage Protection

a. Scope of Works

Work required under this section shall include all material, labour and auxiliaries required to furnish and install complete surge protection devices at main LT Panel incoming feeders (Stage I /Class B) & Distribution Boards (Stage II / Class C) for protection of Building electrical and Electronic system from effect of Lightning discharges. Line induced transient surge voltage or switching surges as per details mentioned in the BOQ.

b. Codes and Standards

Unless and otherwise mentioned somewhere else, the following standards & publications as referred in various parts of these specifications shall apply.

- IEC – 61643-11, IEC – 61643-12
- IEC – 60 364 – 5 - 5. 53
- IEC – 62 305 – 4

c. Surge Protector at Stage I/Class B (LT Panel Protector)

The surge protection Device (SPD) manufacture shall offer a complete line of Surge protection devices to support requirement for main LT panel incoming feeder. Surge protector at this stage shall be provided to protect the down stream electrical and electronics against any lightning discharge surges that may enter into the system through main panel.

Unit status indicator shall be provided to indicate the status of complete protection unit.

Protection shall be manufactured for specific type and voltage of electrical services and shall provide clamping for both normal (L-N) and common (N-G) mode operation.

Protection shall be manufactured to withstand a maximum continuous operating voltage of not less than 115% of normal RMS line voltage of 240 V.

Protection shall be provided with safety MCB's to be connected in series between Line/s to neutral & neutral to earth as per TNS configuration of wiring. It shall be testable on line for routine maintenance, module failure and in order to prevent catastrophic failure modes.

Protection shall be a fail –safe type device that shall have a follow through current quenching capacity upto 25 KA r.m.s, shall have repeated surge capability state, shall be self restoring and be fully automatic in all modes of operation.

Protections shall comply with IEC 61643 and shall be approved for location in which they are listed.

Protection shall have an operating temperature range from -20°C to 60°C.

d. Protection Criteria

- Maximum continuous operating voltage (Rated Voltage) for SPD devices connected to phase – neutral shall not be less than values shown in table.

Nominal voltage rating per phase	Maximum continuous operating voltage
(Vrms)	(Vrms)
240	320

- Surge protective device and associated hardware must comply with IEC 61643 – 11.
- Protection voltage of complete rail ,mount surge protective service shall be type tested to figure as indicated in table below, which must not exceed the values shown.

Service voltage / per phase	Protection voltage @In (Nominal discharge current) / Protection Level
240	<2.5 k V (between line to neutral) 1.5 k V (between Neutral to Earth)

- Surge protective device application at low voltage AC main LT Panel incoming feeder surge impulse current withstanding capacity as shown in table below.

Application Panel Location	Max. Single Withstand surge Current (of 10/350µs Impulse)
Service Entrance (Main LT Panel)	25 k V, 10/350µs (between line to neutral) 100 k V,10/350µs (between Neutral to Earth)

- Compliance to these specifications must be provided in form of a certificate from an independent testing laboratory.

e. Response time of stage – I class – B arrester should not be <100ns

Inspection and Testing

General

a. Inspection and testing shall be done in accordance with the Indian or IEE Wiring Regulations, the requirements of this Section and as indicated.
b. Inspection shall include a physical check that all equipment has been securely fixed and that all electrical connections are mechanically sound.
c. In addition to the test at the completion of each installation, certain tests shall be done during the progress of the Works as required.

Information

For equipment supplied under the contract, the Contractor shall obtain from manufacturers the time/current characteristics of all protective devices for automatic disconnection of supply and provide copies to the Engineer- in -Charge and to the person or persons carrying out the inspection and testing, in addition to meeting the requirements of clause.

Testing Methods

a. The consultant shall be notified of the method to be used for each type of test and the notification shall be given not less than 28 days before the final tests are to be made. The tests shall be carried out in accordance with the methods set out in the IEE Wiring Regulations.
b. For testing, continuity of protective conductors and equi-potential bonding AC source shall be used unless the consultant's agrees otherwise.
c. The method used to verify the effectiveness of the protection afforded by a residual current-operated device shall give the operating time and the current used shall not exceed 100% of the nominal setting of the device. For a fault voltage operated device, the test voltage between the exposed conductive part and earth shall not exceed 50 volts. In addition to the tests simulating an appropriate fault condition, any test facility incorporated in the device shall be operated to test its effectiveness.
d. High Voltage tests on LV cables and factor assemblies shall comply with the requirements for site testing in the appropriate Indian Standards.
e. Alternative methods to those set out in the IEE Wiring Regulations may be proposed for the approval of the Consultant, but they shall be not less effective than those in the Regulations.
f. Where necessary to prevent damage to components of equipment, the equipment shall be disconnected for the duration of the relevant tests.

Power cables

a. Tests shall be made immediately on completion of the installation of power cables to demonstrate that the phase sequence is correct at all end connections.
b. Where indicated, LV cables shall be tested at high voltage in accordance with suitable methods and instruments as soon as their installation is complete.
c. LV cables not required to be high voltage tested, shall be tested for insulation resistance as soon as their installation is complete. The test voltage shall be 500V DC for installations rated up to 500V and 1000V Dc for installations rated up to 1000V. Tests shall cover all permutations between each conductor, screen, metallic sheath, armour and earth.
d. The over sheaths of cables laid under ground shall be given a voltage withstand test after backfilling of the trenches is complete but before termination.

Control and Communication Cables

a. Cables shall be tested as soon as their installation is complete to ensure that the cores are continuous and they have not been crossed and the insulation resistance is satisfactory. Insulation tests shall cover all permutations between each conductor, screen, metallic sheath, armour and earth.
b. For polyethylene and dry paper-insulated communications cables, the insulation resistance for each conductor shall be not less than 1500 L mega ohms, where L is the cable length in Kilometres. The measured resistance of each conductor shall not exceed the calculated resistance by more than 5%; the calculated value will be made available by the Engineer - in - Charge.

Conduits/Pipes and Trunking

a. Where conduit is cast in situ in reinforced concrete, it shall be checked for freedom from blockage and steel conduit shall be tested for electrical continuity as soon as the shuttering has been removed.

b. Steel conduit and bus duct systems shall be inspected and tested before any wiring is installed; under floor ducting shall be inspected and tested before screeding.

Earth Electrodes

The resistance of each earth electrode, whether for earthing of protective conductors, lightning protection or an electrical system, shall be checked immediately after installation of the electrodes and the results submitted to the consultant.

Records and Certificates

a. Inspection and test results shall be recorded on the forms provided by the Authority. Two copies shall be submitted to the Engineer within 7 days of each test.

b. When all inspections and tests results are satisfactory, a Completion Certificate and an Inspection certificate shall be given to the not later than the date of completion of the works. The certificates shall be given in the form laid down in the IS standards/IEE Wiring Regulations for electrical installations and BS 5266 for emergency lightning systems.

c. The values of prospective short-circuit current and earth fault loop impendence at the origin of the installation shall be recorded on the Inspection certificates.

Safety and Miscellaneous Requirements

Scope

This section covers the requirements of items to be provided in the substation for compliance with statutory regulations safety and operational needs.

Requirements

Safety provision shall be generally in conformity with appendices (A) and (C) of Indian CPWD General Specifications for Electrical Works (part 1 Internal) 1972. In particular the following items shall be provided.

Safety Equipment

a. Insulation Mats

Insulation mats confirming to IS: 5424-1969 shall be provided in front of main switch boards and other control equipment as specified.

b. First Aid Charts and First Aid Box

A SHOCK TREATMENT CHART of size 900mm x 600mm high (one in English, one in Hindi, one in Regional language), duly framed on 3mm thick hard board and covered with transparent polythene sheet shall be provided.

The chart displaying methods of giving artificial respiration to a recipient of electrical shock shall be prominently provided at appropriate places.

Standard First Aid Boxes containing materials as prescribed by St. John Ambulance brigade or Indian Red Cross should be provided in each sub-station.

c. Danger Plares

Danger plates shall be provided on HV and MV equipment. MV danger notice plate shall be 200 mm x 150 mm made of mild steel at least 2 mm thick vitreous enamelled white on both sides and with inscriptions in signal red colour on front side as required.

Size of the HV Danger Notice plate shall be 250 mm x 200 mm and 2 mm thick.

d. Fire Extinguisher

Portable CO2 conforming to IS :2878-1976 dry chemical (conforming to IS : 2171-1976) extinguishers shall be installed in the sub-station at suitable places as specified.

e. Fire Buckets

Fire buckets conforming to IS : 2546-1974 shall be installed with the suitable stand for storage of water and sand.

f. Tool Box

A standard tool box containing necessary tools required for operation and maintenance shall be provided in sub-station.

g. Caution Board

Four number of 16 gauge M.S sheet caution boards (of size 300 mm x 150 mm) with the language such as "Man on Line", "Don't switch on" etc. shall be available in the sub-station.

The boards shall be printed in RED on white back ground on both sides and provided with wire hook at the top for hanging.

h. Key Board

A key board of required size shall be provided at a proper place containing castle keys, and all other keys of sub-station and allied areas.

Steel Tubular Poles

Poles for Walkway lighting

The pole shall be of galvanised / painted steel of appropriate diameter and length as specified in the drawing or bill of quantities. It should also have holes for cable entry and exit. The poles shall be planted to specified depth in accordance with the height of the pole and the pole bottom shall be concreted by plain cement concrete of ratio 1:2:4 of section 30 cm square, 100 cm height and the upper 30 cm of the concrete remain above ground , or as per the dimensions detailed in the bill of quantity. Alternatively, the pole foundation concrete could be in the form of cylinder with

diameter of 35 cm. And height 100 cm. With upper 30 cm protruding above ground level.

Poles for Area lighting

The poles to be used shall be GI or mild steel tubular poles of appropriate diameter and length as stated in the BQ. The pole shall be planted to specified depth after concreting the bottom by plain cement concrete of ratio 1:2:4 of section 30 cm square, or 35 cm diameter and of specified height as detailed in the bill of quantity. The upper 30 cm of concrete shall protrude above ground level.

Poles for LT Overhead lines

The poles to be used shall be 9 mt. long (complete) consisting of three section of different sized MS pipes welded together with at least 20 cm of overlap at the joints. The dimensions of each section of the pole shall be as follows:

Pole Section	**Outside dia.**	**Length**	**Thickness**
Top section	89 mm	220 cm	3.25 mm
Middle section	114 mm	220 cm	4.50 mm
Bottom section	140 mm	500 cm	4.85 mm

The pole shall be planted to a depth of 1.5 mt. below ground level. The lower portion of the pole shall be cast by plain cement concrete of ratio 1:2:4 forming a cylinder of cross-section of 35 cm in diameter and 100 cm height with 30 cm of lenght above ground level. The remaining 70 cm shall remain buried under ground. The pole including cross arms shall be painted by two coats of red oxide paint.

Poles for HT Overhead lines

The poles to be used shall be 10.6 mt long (complete) consisting of three section of different sized MS pipes welded together with at least 20 cm of overlap at the joints. The dimensions of each section of the pole shall be as follows:

Pole Section	**Outside dia.**	**Length**	**Thickness**
Top section	114 mm	300 cm	3.75 mm
Middle section	139 mm	200 cm	4.50 mm
Bottom section	160 mm	600 cm	6.00 mm

The pole shall be planted to a depth of 1.5 mt. below ground level. The lower portion of the pole shall be cast by plain cement concrete of ratio 1:2:4 forming a cylinder of cross-section of 36 cm in diameter and 100 cm height with 30 cm above ground level. The remaining 70 cm shall remain

buried under ground. The pole including cross arms shall be painted by two coats of red oxide paint.

Pole Stay

The dead end poles and angle poles shall be guyed by means of stay set of appropriate capacity as detailed in the bill of quantities in a manner to counter the un-balanced pull on the pole.

House Service Clamp

The service clamp containing shackle insulators of required numbers, as detailed in the drawing and the bill of quantities shall be grouted on the building wall at a convenient place for house service line. The service cable after tapping the overhead distribution line shall be hooked to the service clamp before entering the house for connecting to main switch board.

Distribution Transformer

Requirement

Copper wound 11,000/400/231 volts distribution transformers suitable for solidly earthed neutral system. The size and number of transformers shall be as detailed in the bill of quantity.

General Specification

The transformer shall comply with IS 1180 [1964] except for the following deviation:

a.	Voltage ratio	:-	11000/400/231 volts
b.	Location	:-	to be used at an average attitude of 2500 mt. above sea level.
c.	Tapping	:-	+2.5% to - 7.5% in steps of 2.5% at no load.
d.	Ambient temperature	:-	Maximum ambient temperature is 40^{o} C and maximum daily average ambient temperature is 30^{o} C.

Connection

Vector group Dy-11 with secondary neutral solidly earthed for which a neutral bushing shall be brought out separately for earthing.

Installation

Indoor or outdoor installation including the details of cable box sizes shall be as detailed in the addenda or the bill of quantities.

Losses and Impedance

These shall be within the tolerance as specified in BS 171 and the bidder shall supply the following information along with the bid.

a. No load and full load losses.
b. Impedance volts
c. Name of the manufacturer
d. Approx. dimension of the tank
e. Approx. total weight

Accessories

The transformer shall be equipped with, but not limited to the following accessories:

a. Off load tap changer with locking arrangement.
b. Silica gel breather
c. Oil conservator with oil level indicator
d. Lifting lugs.
e. Steel rollers
f. Tank grounding terminals
g. Drain valve with plug on the bottom of the tank.

List of approved Manufacturers for Electrical Materials

1.	HT Panel	Alsthom **Crompton** **Schneider** **Siemens**
2.	HT Cable	Gloster Polycab Skytone
3.	Transformers	Volt-amp Kirlosker Crompton Alsthom
4.	Protection Relays	
	a. Numeric Type	Areva

		Siemens Larsen & Toubro
	b. Electromagnetic type	Areva L&T Siemens
5.	static Power Meter & Logger (Trivector Meters)	Conzerv /secure
6.	Electronic Digital Meter (A/V/PF/HZ/KWH) with led display	Conzerv /secure
7.	HRC Fuse and Fuse Fitting	Siemens GE Larsen & Toubro
8.	Bus Ducts and Rising mains	a) Advance Power Control System Adelec Control and Switchgear Ambit Switchgear Tricolite b) Enerlac SPC Electrotech Vidhyut Control and Switch Gear Enerlac Neptune
9.	MV Panel	a) Advance Power Control System Adelec Ambit Switchgear Tricolite b) Enerlac SPC Electrotech Vidhyut Control and Switch Gear Enerlac Neptune
10.	MCB Boards/MCBs/ELCBs	Legrand-MDS Siemens Schneider (Merlin Gerin)
11.	ACBs	L&T Siemens Schneider Electric
12.	MCCBs	L&T Schneider(Merlin Gerin) Siemens
13.	Residual Current Circuit Breakers	Legrand

	Schneider Electric(MG) Siemens
14. Contactors	L&T Merlin Gerin Siemens
15. Meters	L&T Enercon Neptune
16. Indicating Lamps	L&T Siemens
17. CTs and PTs	AE Siemens
18. Selector Switches	L&T(Slazer) Kaycee
19. Capacitors	L&T Siemens Asian Schneider
20. APFC Relay	Epcoss L&T Ducati
21. Bus-bar Support	Nomex Powermex
22. Change Over Switch	HH-Elcon L&T
23. Dimmer Panel	Lutron Schneider iLight (cooper controls)
24. LT Power Cables	Janata Skytone Trishakti Nicco Polycab
25. Cable Glands	Comet Siemens
26. Thimbles	Dowells
27. Cable Joints	Reychem Mahindra

28. Terminal Strip	Connect Well Elmex
29. Wires	Finolex Skyline Rajnigandha Lapp R R Kable
30. MS Conduits	Steel Craft(ISI) BEC(ISI)
31. FRLS PVC Conducts	Polypack BEC Precision
32. Switches/Sockets/outlets	Clipsal(Zencelo –IS) Legrand(Rteor)
33. Telephone Tag Block	Krone
34. Luminaires and Lamps	Wipro, Philips, Decon, Homedec
35. UPS	APD, Power Ware Libert
36. Cable Trays	Pilco Sun Light MEM
37. Industrial Power Socket	
a. Splash Proof	Clipsal MDS Legrand Neptune Balls
b. Metal Clad	Clipsal Legrand
38. Ceiling Fan	Crompton Graves Orient Usha
39. Lighting Fixure: (Service Areas)	
a. Fluorescent	Fiam. Decon Philips Wipro
a) Incandescent/Halogen/PL /Metal Halide	Artlite GE Linolite, Concord, Luminance) Keslec

	Philips Wipro
c) External lighting Fixture	Homedec. Wipro Philips
d) Aviation Obstruction Light (LED Type)	Actos Bajaj Binay
40. Electronic Ballast for Fluorescent	Wipro Philips
41. Lighting Control Equipment/ Dimmers	ABB Dynalite Helvar Lutron Wipro Schneider Electric
42. 50 W Halogen Light Transformer (Encapsulated transformer)	Gemini Global Philips Reiz Opal
43. Shaver Soket	Clipsal(Zencelo –IS) Legrand(Rteor)
44. Timer	Larsen & Toubro MDS lagrand Schneider Electric Siemens
45. Sealed Maintenance Free Batteries	Exide Global Hitachi Shinkobe
46. Battery Charger	Caldyne Chhabi Electricals Joshi Electricals Volstat
47. Lighting pples (HEX / Angular Pole/MS Tubular (Decorative)	Bombay Tubes and Poles Bajaj electricals HOMDEC Lighting Keselec K-Light
48. Fire Sealant & Fire Retardant Paint	BTHM engineering Birla 3 M HILTI Promat

49. Lighting Protection System (early Steamer Emission Type)	Erico LPI Indelec
50. Lighting & Surge Voltage Protection	Hager (marketed By L&T) Obeo betterman Schneider Electric
51. 230/12 V Step Down transformer With BUILTIN Isolation Transformer	Talema Volstat
52 Energy Saving Units	FMS In link Systems Schneider

D. SPECIFICATIONS FOR SANITARY, PLUMBING & WATER SUPPLY WORKS

1.1 SCOPE

This Specification covers the construction of internal and external water supply, soil, waste, vent and rain water system, installation of toilet fixtures, installation of fire fighting system.

1.2 REFERENCE DOCUMENT

The work specified in this section shall be in accordance with the following standards, or approved equal, except as they are modified and supplemented herein:

Code	Subject
IS:1171 - 1963	Basic requirement of water supply, drainage and sanitation.
IS:1239 - 1968	Specification for M. S. or G. I. Pipes and fittings.
IS:1703 - 1962	Specification for cast iron manhole covers and frames intended for use in drainage work.
IS:1742 - 1960	Code of practice for building drainage.
IS:2065 - 1963	Code of practice for water supply in building.
IS:771 - 1958	Specification for vitreous china sanitary ware.
IS:4985	Specification for UPVC pipe
IS:5382	Specification for rubber seal ring.
ASTM : D 2846	Specification for CPVC pipes
NBC 208:2003	Nepal National Building Code
	Sanitation and Plumbing Design Requirements

1.3 RELATED WORK

The Contractor shall become familiar with other Divisions of the specifications affecting work of this trade.

1.4 GENERAL REQUIREMENT

The scope of work covered by this Chapter shall be deemed to comprise the furnishing and installation of all cold and hot water supply pipe work, soil, waste, rain and vent pipe work, vitreous china sanitaryware, CP fixtures etc as shown on plans and as specified. It shall also include the supply of the appertaining materials and parts, scaffolding, off loading on site and all operations in connection with civil works, unless otherwise specified in the Bills of Quantities.

Materials and parts, which the Contractor shall supply and install, shall be new and unused. They shall comply with the regulations regarding quality and dimensions. Materials and parts that are not standardised shall be used only with the approval of the Engineer.

The materials shall be protected from rain and inclement weather all to the satisfaction of the Engineer. The cost of covering materials shall be deemed to be included in the unit prices for the brickwork and masonry.

1.5 SAMPLES/SUBMITTALS

Representative samples to be used shall be submitted to the Engineer and his approval taken before bulk purchase. The samples shall be kept with the Engineer for future reference and comparison. All materials supplied shall conform to these approved samples in all respects.

1.6 BASIC MATERIALS AND METHOD

All materials provided for the contract will be in strict accordance with the latest version of the applicable Indian Standards. All manufacturer's data, specifications and relative information together with samples will be submitted to the Engineer or Site In-charge for approval prior to being purchased, otherwise at the contractor's own risk.

1.7 MATERIALS TRADE NAMES VARIATIONS

Tenders shall be based upon complete installations. Products required which are not shown or mentioned, or not specified herein as to manufacturer; quality, etc. shall be furnished of the highest quality. Materials shall be new and free from all defects. All materials, apparatus or equipment called for on the plans or in the specifications by trade names, or the name of a particular manufacturer, or by catalogue reference are the materials, apparatus, or equipment which should be allowed for in the Tender, or qualification submitted at the time of Tender submission.

1.8 REGULATIONS

The work shall be carried out in accordance with all rules, regulations, by-laws and requirements of all authorities having jurisdiction. All changes and alterations required by an authorized inspector of any authority having jurisdiction should be carried out at no cost to the Owner.

1.9 DRAWINGS AND SPECIFICATIONS

These specifications shall be considered as an integral part of the drawings, which accompany them. Neither the plans nor the specifications shall be used alone. Any item or subject omitted from one, but which is mentioned or reasonably implied in the other shall be considered as properly and sufficiently specified and therefore must be supplied by the contractor. Misinterpretation of any requirements of either the drawings or specifications shall not relieve the contractor of his responsibility for properly completing his work. The contractor shall apply to the Engineer or Site In-charge for any explanation, which he may require in regard to the meaning and intent of any clause in the specification and contract. He shall be held responsible for any errors or losses consequent upon failure to obtain such explanation. The contractor shall consult with the Engineer or Site In-charge to obtain detail drawings or instructions for exact location of equipment as work progresses, before installing fitting or equipment and will be responsible for coordination with all other work trades including finishes. Drawings show general location and routes to be followed by pipes, ducts, etc. where not shown, or shown diagrammatically, the contractor shall install them in accordance with best trade practices.

1.10 SHOP DRAWINGS

The contractor shall submit to the Engineer or Site In-charge all shop and setting out drawings or diagrams necessary in order to make clear the work intended or to show its relation to adjacent work of other trades. The contractor shall make any changes in such drawings or diagrams, which the Engineer or Site In-charge may require, consistent with the contract. Details of shop drawings submitted for approval shall show clearly the relations of the various parts to the main members and lines of the structure, and where correct fabrication of the work depends upon field measurements, such measurements shall be made by the contractor and noted on the drawings before being submitted for approval.

1.11 AS BUILT RECORD

The contractor shall request a complete set of mechanical drawings (white) from the Engineer or Site In-charge and use these for "As Built" records. "As Built" records shall be retained in the site office and kept up to date daily in regard to changes in actual installation from the plans and specifications. Alterations to duct work, piping services, etc. shall be noted and the revised arrangement drawn in accurately, complete with dimensions from column lines. Every precaution shall be taken to protect the drawings from damage and loss. The "As Built" records shall be made available to the Engineer or Site In-charge upon request and made available at each site meeting. After no further alteration can be expected and the contract is nearing completion, the records shall be submitted for final approval. The contractor shall include on "As Built" records the dimensions location of all buried piping and valves, and during construction plainly mark location of exterior services and valves to prevent damage to these until the project is completed.

1.12 CUTTING AND PATCHING

Openings not indicated on the Engineering or Structural drawings, which are required for bringing equipment into the building or for other temporary or permanent service, shall be approved by the Engineer or Site In-charge. The contractor will provide maintain and restore these openings and shall pay for their provision and restoration. Ample notice shall be given of size and location of such openings. The contractor shall ensure that he does not undertake any cutting that may impair the

strength of the building. No holes, except expansion bolts and small screws may be drilled into the structure without obtaining prior approval. Persons, skilled in the trades, shall do all cutting and patching work in a neat and workman like manner.

1.13 PAINTING

All equipment supplied under this specification shall be delivered to the site with a factory applied prime coat of paint unless noted otherwise. All supports and hangers shall receive a prime coat of paint. Painting where required for pipe, duct services, equipment identification, including stenciling shall be carried out by a paint tradesman under this division in accordance with the workmanship and material specification. All factory prime-coated or finish coated equipment shall be touched up or repainted if equipment is marred during shipment or installation.

1.14 EXPANSION AND CONTRACTION

Unless shown otherwise, the contractor shall be responsible for measures to control the thermal movement of piping and apparatus. Piping shall be erected in such manners that strain and weight does not come directly upon connections, joints or apparatus. Where possible, the effect shall be obtained by providing changes in direction and loops in pipe runs, supplemented by the necessary guides, anchors and limit stops.

1.15 PIPE SLEEVES

An adequate number of sleeves (pipe inserts) of mild steel shall be provided where pipes pass through concrete, masonry and similar work. The pipe inserts shall have a flange welded in the center around its circumference, in order to provide water tight and secure fixing into the structure. The sizes of the pipe sleeves (pipe inserts) shall be as per the drawings supplied and / or as given below.

1.15.1 Sleeves through Exterior Walls below Grade

i. Sleeves in exterior foundation walls below grade shall project 25 mm beyond the outside surface of the wall and be flush with the inside surface.

ii. The annular space between the sleeve and the pipe shall be caulked with un-tarred oakum and sealed with approved caulking compound. The sealing shall be 25 mm deep from each side. The pipe and sleeve surfaces shall be cleaned to enable good bonding. Allow 24 hours for setting of the compound. The contractor shall adhere strictly to the manufacturer's recommendation.

1.15.2 Sleeves through Interior Wall, Floor and Ceilings

i. Sleeves through interior masonry walls and partitions shall be set flush with finished wall surfaces.

ii. Sleeves through floors in finished areas shall terminate 25 mm above the finished floor.

iii. Sleeves through floors in service area (e.g., mechanical rooms) shall terminate 50 mm above the finished floor.

iv. The annular space between sleeves and pipes shall be packed with Silicon Rubber. In Machine Room, the packing shall be finished at both ends of the sleeve with 6 mm deep caulking compound. In other areas the finishing may be on the room side only.

v. Pipe insulation shall be carried full thickness through pipe sleeves.

Unless otherwise specified elsewhere, the sleeves size shall be as follows:

Out Side (OD) Diameter of Pipe (If Insulated, OD of Insulation)	Sleeve Size (Nominal Bore of the Pipe for Sleeve)
OD 20 mm to OD 32 mm	NB 2" (50 mm)
OD 33 mm to OD 75 mm	NB 4" (100 mm)
OD 76 mm to OD 125 mm	NB 6" (150 mm)
OD 126 mm to 160 mm	NB 8" (200 mm)
OD 161 mm to OD 200 mm	NB 10" (250 mm)

1.16 CLEAN UP

The contractor shall clean all exposed metal surfaces from grease, dirt or other foreign materials. Chrome plated and polished work shall be left bright and clean. All openings in pipes and fixtures shall be properly capped and plugged during construction. Fixtures and equipment shall be properly protected from damage during the construction period and shall be cleaned in accordance with the manufacturer's instructions.

1.17 SANITARY FIXTURES, RUNS, PIPES

(i) The recommended positions of the sanitary fixtures, runs of all piping etc. as shown in the layout drawing will be adhered to as far as possible or as far as practicable.

(ii) Should there be any discrepancy or incomplete description, ambiguity or omission in the drawings and other documents, whether original or supplementary forming the Agreement, completion or maintenance of the installation, the Contractor shall immediately on discovering the same, draw the attention of the Engineer to this.

(iii) Prior to the installation of all fittings, pumps, traps, etc. The finial position shall be ascertained from the Engineer.

1.18 PROPRIETARY OF MATERIALS

Where proprietary of materials are specified hereafter, the Contractor may propose the use of similar materials of other manufacture but of equal quality for approval by the Engineer. Should the price of alternate materials proposed be lower in price, the Contractor shall a revise schedule of price for the particular item along with his proposal for the use of alternate material in lieu of the one specified.

All materials and goods, where specified to be obtained from a particular manufacturer or supplier, are to be used or fixed strictly in accordance with their instructions.

1.19 PACKAGING

The Contractor is to provide special packaging according to standard practices to project materials or parts of materials from damage, and his rates will be deemed to include for all such protection.

1.20 SPECIFIED MATERIALS

The sources of materials stated in the Specifications are those from which materials are generally

available. However, materials not conforming Specifications shall be rejected even if they come from the stated sources. The Contractor should satisfy himself that sufficient quantity of material of acceptable Specification is available from the stated or other sources.

1.21 STANDARDS

All materials, Workmanship and components shall where applicable and unless otherwise stated in the Agreement or comply with Indian standard or code of practice in use. The Indian Standards referred to here are:

Indian Standards (I.S.), Published by Bureau of Indian Standard, India.

Should there be any discrepancy or incomplete description, ambiguity or omission in the drawings and other documents; whether original or supplementary forming the Agreement, completion or maintenance of the installation, the Contractor shall immediately on discovering the same draw the attention of the Engineer to this. The Works shall be carried out according to this Specification whether specifically mentioned elsewhere or not. No extra in any form will be paid unless it is definitely stated as it is in the Bill of Quantities. Whenever the Specifications are not given or when the Specification is ambiguous, the relevant Indian standards or British Standards and further amendments will be considered as final and binding.

1.22 QUANTITIES

The Works shall be related to the drawings which the Agreement is presumed to have studied. Nothing extra will be paid for any items because of its shape, locations or other difficult circumstances, even if the schedule makes no distinction, as long as the item is shown in the drawings. The quantities given in this schedule are provisional. The Contractor will be paid for the actual quantity of Works executed as measured at Site and priced at the rates in the schedule. The Engineer reserves the right to increase or decrease any of the quantities or to totally omit any item or Works. Any claim by the Contractor on these accounts will not be entertained.

1.23 EXCAVATION FOR PIPE LINES

In excavating trenches for pipe lines, slight rails shall be erected, before excavation is commenced, at every 100 meters and at all change of direction or gradient. The sight rail shall consist of a board, not less than 10 centimeters deep, with the top edge planed true and straight. This shall be supported by a stout wooden post at each end, and its top edge accurately fixed to a definite and, as far as practicable, uniform height above the level of the pipe to be laid. The centre line of the pipe shall be denoted on each rail thereon, and the rail on one side of the centre line painted rail, and on the other side white. The depth of the excavation and the level of the pipe invert shall be checked by means of boning rods of appropriate length. The boning rods used are to be accurately made to the various lengths required, the lower and being provided with a shoe of sufficient projection to rest on the centre of the invert of the last pipe laid.

The excavation shall be carried out to the lines and levels shown on the plans or as ordered by the Engineer, and shall be deep enough to permit a minimum cover as specified hereunder.

	hum Cover in mm
	ıal Ground
anized Iron C / PVC	

The Contractor shall be responsible for and shall at his own cost, make up all subsidence or slips whether arising from its nature of the materials in embankments, from the nature of the ground or from any cause whatsoever. The Contractor shall, his own expense keep the whole of the Working Site dry and from water and construct such temporary water courses and drain as may be surface of the Works. The Contractor shall include in his rates the cost of providing all tools, machinery and all temporary Works such as staging, struts, shoring, planks and poling boards and their removal on the completion of the Works and the cost of pumping and trenches. Whenever pumping is necessary, the whole Works shall be executed as quickly as possible, due care being taken to avoid excessive pumping, which may cause settlement of surrounding land and property.

Any trench or excavation which may have been taken to a great depth than necessary shall be filled into the required level with suitable material approved by the Engineer and rammed solid with watering at the Contractor's expense.

Special care shall be taken provide a solid even bed for the barrel of the pipe, and the floor of the trench shall be properly shaped to received the socket it and the barrels of the pipes. Where lock is met within the trenches, the excavation shall be taken to a depth of 15 cm of selected filling (approved by the Project Engineer) placed on the rock and consolidated to form a firm even bed for the pipe where required, socket holes shall be cut in the rock. In narrow trenches, socket holes shall be cut in the rock. In narrow trenches, the width of the excavation shall be increased. The sides of trenches shall be allowed a slope not exceeding 1 to 12, the width at the bottom being at least 30 cm wider than the socket of the pipe, so as to allow room for ramming the refilled materials under and at the sides of the pipe.

1.24 RE-FILLING

No refilling shall be carried out until the construction Works has been tested and approved. The re-filling on the top and around the sewers shall be done with great care and in such a manner as will obtain the greatest amount of compactness and solidity possible. For that purpose, the earth shall be laid and rammed in regular layers not more than 230mm (9") thick up to the surface and also watered and rammed at each layer. The top soil shall be carefully replaced to match the existing.

1.25 DISPOSAL OF SURPLUS SOIL

The contractor shall, at his own costs and charges, provide places for disposal of all surplus materials not required to be used on the works. As each trench is refilled the surplus soil shall be immediately removed, the surface properly restored and roadways and sides left clear.

1.26 TESTING OF PIPES LINES

CPVC Water Supply Pipes

After each section of the pipeline has been laid and jointed and anchorage's built in for the bends, the pipeline shall be tested in lengths of 2 kilometers or less as directed by the Project Engineer, by and at the expense of the Contractor. Before testing, the trench shall be partially backfield except at the joints. The accessories nodded viz. Test pump, pressure gauge, end pieces including connecting valves and piping etc., for carrying cut the hydraulic tests shall be provided by the Contractor's. The Contractor shall provide the supply of necessary labour and water for testing at his expense, the cost of this shall be included in the unit rate for lying and jointing of pipes. The pipes and joints found to be defective during the test shall be replaced and or reduce by the Contractor and the related labour cost be met by the Contractor.

The two tests that shall be carried out are -

(i) Pressure test: a pressure of at least double the maximum Working pressure, pipes and joints shall be absolutely watertight under the test.

(ii) Leakage test (to be conducted after the satisfactory completion of the pressure test) at a pressure to be specified by the Engineer for a duration of two hours. Unless otherwise specified the leakage test pressure shall be the lower or ½ times the maximum static pressure that will be experienced by the pressure after installation.

Where any section of the main is provided with concrete thrust blocks or anchorages, the pressure test shall not be made until at least five days have elapsed after the concrete was caste.

The procedures to be followed are as follows:

(i) Pressure Test:

- Each valved section of the pipe shall be slowly filled with water and all air shall be expelled from the pipe through hydrants and blow-offs. If these are not available are not available at high places, necessary tapping may be made at points or highest elevation before the test is made and plugs inserted after the tests have been completed.
- If the trench has been partially back-filled the specified pressure based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the poi in a manner satisfactory to the Engineer. The duration of the test shall not be less than 24 cm.
- All exposed pipes, fittings, valves and joints should be carefully examined. Any cracked or defective pipe, fitting and value discovered in consequence of this pressure test shall be removed and replaced by sound material and the test shall to repeat. All joints showing visible leaks shall also be recalled or redone until tight.

(ii) Leakage Test:

- Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure.

The pipe installation will not be accepted until the leakage is less than the number of cm3/h as determined by the formula-

$$q1 = \frac{N\ D\ P}{3.3}$$

Where,

q1 = the allowable leakage in cm^3/h.

N = number of joints in the length of the pipeline.

D = diameter in mm, and

P = the average test pressure during the leakage

1.27 SANITARY AND SEWER PIPES

1.27.1 Sewer Drainage and Site Drainage

The work covered under this section comprises of the supply and installation of the following:

a. Night Soil and Waste Water drainage system complete

Pipes for these works shall be as follows:

a. Pipes up to OD 110 mm size should be of PVC Pipe having working pressure of 4.0 kgf per sq cm and carried out as described herein.

1.27.2 Manholes and Grease Trap Collection Chambers

Manholes and Chambers shall be constructed as shown in Detail Drawings, and where shown on Site Services layout. Materials shall be of not less than 225 mm Brickwork, cast-in-place concrete, or pre cast concrete. Concrete shall be M: 20 strength. All brickwork shall be plastered in cement, sand (1:2). Gratings, lids and castings in general shall be in Cast Iron in accordance with IS 5961 and built in or fixed as detailed.

All manholes designated to be constructed shall be as specified in the Schedule of Quantities.

All manholes shall be supported on a base of cement concrete of such thickness and mix as given in the Schedule of Quantities or shown on the drawings.

Where not specified, manholes shall be constructed as follows:

Maximum Depth in mm	Internal Dimensions of Manhole Chamber
Up to 450 mm	450 mm x 450 mm
Over 450 mm and Up to 600 mm	600 mm x 600 mm
Over 600 mm and Up to 1200 mm	Dia 900 mm or 900 mm x 900 mm

All manholes shall be provided with cement concrete benching in 1:2:4 mix. The benching shall have a slope of 100 mm towards the channel. The depth of the channel shall be the full diameter of the pipe. Benching shall be finished with a floating coat of neat cement.

The manhole chamber covers and frames shall comply with the following ratings:

Manhole Cover	Outside Size of Frame	Inside Size of Frame	Weight in Kg
Light	27" x 27"	24 " x 24" or Ø 500 mm	78.5 kg
Heavy	27" x 27"	24 " x 24" or Ø 600 mm	216 kg

All manholes shall be plastered with 12 mm thick cement mortar 1:3 (1 cement & 3 coarse sand) and finished inside with a floating coat of neat cement. Manholes shall be plastered outside as above cut with rough plaster.

All manholes shall be provided with cast iron covers and frames and embedded in reinforced cement concrete slab weight of cover and frame thickness of slab shall be as specified in the Bill of Quantities or given above.

1.27.3 Making Connections

Contractor shall connect the new sewer line to the existing manhole by cutting the walls, benching and restoring them to the original condition. A new channel shall be cut in the benching of the existing manhole for the new connections; contractor shall remove all sewage and water if encountered in making the connection without additional cost.

1.28 SOIL, WASTE, VENT AND RAIN WATER PIPING

1.28.1 Soil, Waste and Vent Pipes

1.28.1.1 Polyvinyl Chloride (PVC) Pipes and Fittings:

All soil, waste, vent and rain water pipes shall be Un-Plasticized Rigid Polyvinyl Chloride (UPVC) pipes unless specified otherwise. All pipes shall be straight and smooth and inside free from irregular bore and other manufacturing defects.

Fittings shall be of the required degree with or without access door. All access doors shall be made up with rubber gasket, while screw cover to make the fitting air and water tight.

The recommended joints of uPVC pipes shall be solvent cement joints or with rubber ring socket joints.

1.28.1.2 Storage and Handling

UPVC Pipes: The pipes should be given adequate support at all time. Pipes should be stored in a reasonably flat surface free from stones and sharp projections so that the pipe is supported throughout its length. In storage, pipes racks should provide continuous support and sharp corners of metal racks should be avoided. Socket and spigot pipes should be stacked in layers with socket end placed at alternate ends of the stacks to avoid top sided stacks. It is recommended not to store pipe inside another pipe.

On no account pipes shall be stored in a stressed or bent condition or near the source of the heat. Pipes should not be stacked more than 1.5 meters high and pipes of different sizes and classes should be stacked separately.

The ends of pipes should be protected from abrasion and particularly those specially prepared for jointing either by spigot or socket solvent cement joints.

If due to unsatisfactory storage of handling a pipe becomes 'kinked' the damaged portion should be cut out completely. 'Kinking' is likely to occur in very thin walled pipes.

1.28.1.3 Jointing of UPVC Pipes

Methods of Jointing:

i) Solvent Cement Joints

The technique is used with spigot and socket type joint, in which the socket is made specially to form a close fit on the pipe end and with injection molded fittings.

Solvent Cement of the pipe manufacturer (the approved brand used) make shall be used as per the recommendations of the manufactures.

The dust, oil, water grease etc. should be wiped out with dry cloth from the surface to be coated with solvent cement. The coating of solvent cement shall be applied evenly on the inside of the fittings for full length of insertion and then on the outside of the pipe end up to the marked line and the pipe twisted to a quarter of a turn to spread the cement evenly at the same time ensuring the pipe, pushed home fully into the socket. The pipe should be pushed into the rifting socket and held for one to two minutes as otherwise the pipes comes out of the fitting due to slippery quality of cement and the tapering inside bore of the fitting. The surplus cement on the pipe surfaces shall be wiped out. In most of the cases the pipe inserted should be up to the marked line and in no case shall be less than 2/5 of the diameter of the pipe and up to marked line.

When the joint is made, the remaining cement on the pipe surfaces shall be wiped off immediately without fail as the continued action of solvent cement will weaken the wall on the pipe and cause failure under pressure. For warm place in summer month joints shall be made preferably early in the morning or in the evening, when it is cooler and for cold place in winter joints shall be made preferably during the day (sunny) when it is warm.

Since solvent cements are inflammable they should not be used near the naked flames. In certain cases fumes given off from solvent cement may be a source of danger if not carried in a ventilated area.

When not in use, containers of solvent cement should be kept closed tightly to avoid loss of solvent or entry of dirt. Cement, which has gelled or hardened, should be discarded.

ii) Rubber Ring Joints or 'O' Ring Shrink Joints (Shaft Piping)

UPVC pipe and UPVC pipe fittings may be jointed with approved rubber ring to provide the watertight seal. The ring may be housed in groove formed in the socket housing. The rubber is compressed and makes a seal between the pipe and the housing. It is advisable to use uPVC Lubricant for proper sliding of the pipe end to the rubber socket piece.

1.28.1.4 Fixing to Supports

The pipes and specials (fittings) before being laid of fixed shall be examined to see that there are no cracks or defects. The pipes and fittings shall be thoroughly cleaned of all dust and dirt. After laying or fixing the pipes in position they shall be arranged in such a way that centre line of pipes coincide with the centre line of the alignment. Fittings, cleanout and floor drains shall also be laid in their position as stated above uPVC Pipes shall be fixed vertically in shaft by means of uPVC clips anchored to walls using uPVC washers, Galvanized Screws and Plastic dowels. In case of pipes laid horizontally, pipe shall be supported on M.S. Brackets / Hangers of approved design clamped with uPVC Clips.

All pipes laid shall have its open ends securely closed with appropriate plugs during progress of work. Pipes and fittings shall be fixed by using proper approved holder bat clams and special hangers. The pipes shall be fixed perfectly vertical or in a line as directed or as shown in the drawings. The pipes, lay vertically or horizontally shall have the

supporting clamps, hangers, Brackets, etc., as per the specification or as directed by the Engineer. UPVC bat clamps holders shall be used to fix all vertical uPVC pipes in truly vertical position. Branch pipes shall be connected to the stack at the same angle as that of the fittings. Each stack shall be terminated at top for vent. Horizontal pipes running below the ceiling shall be fixed on structural with adjustable clamps. Horizontal pipes shall be laid to uniform slope as mentioned in the drawings and the clamps adjusted to the proper levels so that the pipes fully rest on them. As per the site condition, if required or directed by the Engineer, pre-fabricated semicircular (half the diameter of the said pipe) made out of Plain GI Sheet of proper thickness shall be provided below the horizontal running pips along with above-mentioned adjustable clamps.

1.28.1.5 Testing

All uPVC Soil, Waste, Vent, Rain Water (SWR) pipes and uPVC pipe fittings shall be tested by smoke test and left in working order after completion. The smoke test shall be carried out as stated below:

Smoke shall be pumped into the SWR pipes at the lowest level from a smoke machine, which consists of a blower and a burner.

The materials usually brunt are greasy cotton waste which form clear pungent smoke which is easily detectable by sight as well as by smell if leaking at any point of the drain. During testing if any joint is found leaking the same shall be rectified by the Contractor at no extra cost & to the satisfaction of the Engineer-in-charge.

1.28.2 Nahani or Floor Traps

Nahani or floor traps shall be uPVC, deep seal with an effective seal of 50 mm. As per drawing, Waste pipes may be discharged over the trap. The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate) and extended 35 mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 300 mm x 300 mm and of the required depth.

1.28.3 Cutting and Making Good

Pipes shall be fixed and tested as building work proceeds. Contractor shall provide all necessary sleeves, holes and chases in structural members as building work proceeds. Wherever holes are cut or left originally they shall be made good with cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate) and the surface restored as in original condition. No additional payment shall be made for cutting and making good of holes.

1.29 WASTE PIPES FROM APPLIANCES

1.29.1 Waste Pipes from Appliances

Waste pipe from appliances e.g. wash-basins, shower, bath tub, sinks, drinking fountain, urinals, water closets, etc. shall be of uPVC as given in the Schedule of Quantities or drawings. "Galvanized or Black Wrought Iron Pipes or Pipe Fittings should not be used for Soil Pipes, Waste Pipes, Rain Water Pipes, Anti-Siphon Pipes, Vent Pipes or Drain Pipes from any appliances."

All pipes shall be fixed in gradient towards the out fall drain. Pipes inside a toilet room shall be chased unless otherwise shown on the drawings. Where required pipes may be run at ceiling level in suitable gradient as mentioned in the drawing or directed by the Engineer and supported on structural clamps.

1.29.2 Clean Outs

Clean-outs shall be full pipe size up to 110 mm and a minimum of 110 mm on larger pipe. A clean out shall be installed at, or as close as possible to, the base of every vertical waste, soil and drain stack. A clean out shall be installed at the up-slope of each pipe at which a building drain or branch changes direction by more than 45°.

Clean-outs in horizontal drainage piping shall be at intervals not greater than:

- 15 m where the piping is of dia 100 mm and smaller.
- 30 m where the piping is of large than dia 100 mm.
- 6 m where waste pipes are horizontally connected to sinks.

Nickel Bronze or Stainless Steel Floor Plates with Frames shall be installed on finished floors for access to clean-outs. Clean-outs on horizontal lines in finished areas shall be as per IS specifications.

1.30 WATER SUPPLY

1.30.1 Pipe Line

All Water Supply Pipe Line shall be as mentioned in the drawings and Bill of quantities. The Pipes may be:

1.30.1.1 Chlorinated Polyvinyl Chloride (CPVC) Pipe & Fittings

Chlorinated Polyvinyl Chloride (CPVC) Tubes / Pipes of Class 11 in Copper Tube Size (CTS) dimensions conforming to ASTM: D 2846 of approved brand. Pipe Fittings shall be of Chlorinated Polyvinyl Chloride (CPVC) of Class 11 in Copper Tube Size (CTS) dimensions conforming to ASTM: D 2846 of approved brand. The Pipe Fittings are Couplings, Elbows, Bends, Tees, Transition Coupling, Transition Bushings, etc. Manufacturer's Trademark should be stamped on the CPVC Pipe Fittings. The pipe should have Flowguard labeled and certified.

CPVC Pipe and CPVC Pipe Fittings shall have cold weld joints by CPVC Solvent cement confirming to ASTM: 493. After cutting the pipe, care shall be taken to remove burr from the end of the pipe with appropriate tools. Only with TEFLON tape, threaded Fixtures shall be fitted with CPVC Threaded Adopters.

1.30.2 Laying

All Pipes and fittings shall be of class specified in BOQ manufactured under respective Standards.

All main supply pipes and other pipes to be laid under the ground shall be laid over a minimum of 600 mm sand bedding or selected granular material compacted as described herein this specification.

The water main shall be laid and maintained to the required lines and grades with fittings,

valves, and connections at the required locations and all valves and stems plumb.

Proper implements, tools and facilities shall be provided and used by the Contractor for the safe and convenient performance for the work.

All pipes, valves and fittings shall be carefully lowered into the trench piece by piece by hand ropes or other suitable tools or equipment in such a manner as to prevent damage to water main materials and protective coatings and linings.

Under no circumstances shall water main materials be dropped or dumped into the trench.

Valves, valve covers, meters, tapping sleeves and other accessories shall be installed as per the manufacturer's recommendations and in conjunctions and compliance with the requirements of the Local Government or Public Service Authority specifications.

It will be the responsibility of the Contractor to furnish and install all proper size pipe bends for both horizontal and vertical deflections that are required to construct the water main to the line and grade as shown and specified.

1.30.3 Jointing

The jointing shall be made in accordance with the instructions of the pipe and fitting manufactures. The pressure pipe shall be tested to a minimum of 10 kg / sq. cm. pressure. The setting and arrangement of pipes shall be as per the working drawings. Pipes are cut to size and ends are squared.

The pipes and fittings shall be inspected at the site before use. Where the pipes have to be cut, the end shall be carefully plugged so that no obstruction to bore is effected.

The pipe shall be cleaned and cleared of all foreign matters before being laid. For joining, the out side of pipe (thread for GI pipe line) and the inside of the socket shall be cleaned. Care should be taken that all pipes and fittings are properly joined so as to make the joints completely watertight.

After lying, the open ends of the pipe shall be temporarily plugged to prevent access of water, soil or any other foreign materials. Jointing of pipes shall be made according to the different kind of pipes by thread screwing, cold welding, flanges, or flexible joints etc. Joints between dissimilar materials, e.g. copper shall be by means of copper-alloy unions or union ferrules, etc.

Care shall be taken to ensure that all piping and fittings are clean internally and free from particles of sand, soil, metal, plastic, filings and chips, etc.

1.30.4 Clamps

All pipes laid shall have its open ends securely closed with appropriate plugs during progress of work. Pipes and pipe fittings shall be fixed by using proper approved holder bat clams and special hangers. The pipes shall be fixed perfectly vertical or in a line as directed or as shown in the drawings. The pipes laid vertically shall have supporting, the clamps at 1.5 meters centre to centre and the pipes laid horizontally, the clamps at every 1.2 meters centre to centre as shown in the Drawing or as directed by the Engineer. MS bat clamps holders shall be used to fix all vertical pipes in truly vertical position. Horizontal pipes running below the ceiling shall be fixed on structural with adjustable clamps. Horizontal pipes shall be laid to uniform slope as mentioned in the drawings and the clamps

adjusted to the proper levels so that the pipes fully rest on them. As per the site condition, if required or directed by the Engineer, pre-fabricated semi circular (half the diameter of the said pipe) made out of Plain GI Sheet of proper thickness shall be provided below the horizontal running pips along with above-mentioned adjustable clamps. No Iron hooks shall anchor pipes in wall chases.

1.30.5 Testing Water Service Lines

The water service lines shall be hydrostatically tested. Test pressure shall be 10 kg / sq. cm. and the pipes shall be tested for the specified pressure for 24 hours. Defective pipes, pipe fittings and pipe joints shall be replaced or repaired immediately and retested.

1.30.6 Unions

Adequate number of unions shall be provided on all pipelines to enable to dismantle later. Unions shall be provided near each valve, stopcock, and check valve and in case of GI Pipe - at an interval of 6 m (20 ft.) on straight runs.

1.30.7 Shut-Off Valve

Gate Valves shall be heavy gunmetal full way type conforming to IS: 778 (Class: II). Valves shall be tested at manufacturer's works to 21 kg / sq. meter and shall have manufacturer's name stamped on it.

1.30.8 Check (Non Return) Valves

Check Valves / Non Return Valves shall be heavy gunmetal Swing Type conforming to IS: 778 (Class: II). Valves shall be tested at manufacturer's works to 21 kg / sq. meter and shall have manufacturer's name stamped on it.

The Engineer or Site In-charge shall approve all valves before installation work. up to 65 mm and small shall be gunmetal

1.30.9 Isolating Valves

Isolating valves shall be provided on all branch lines to enable isolation of groups of fixtures and sections of building and as shown on drawings.

1.30.10 Drain Points

Drain valves shall be installed in all liquid carrying systems at the low points to facilitate complete drainage of the system.

1.30.11 Hose Bibs

Hose bibs in the building shall be cast brasses with a leather disc, screwed pipe end, 20 mm pipe hose tread. Hose bibs in finished areas shall be chromium plated.

1.31 EXTERNAL WATER SUPPLY

1.31.1 Pipes

All pipes lay outside of the building and generally underground shall be considered as External Water Supply. The types of Pipe and Pipe Fittings shall be as per drawings and / or as mentioned in the Bill of Quantities. The installation of pipe line shall be properly carried out and should be completely watertight. All fixtures and fittings shall be properly

installed and checked against leaks at designated pressure. Necessary Pipe Sleeves in the wall, floor, etc should be provided as per the specification.

1.31.2 Excavation

Generally, external water mains pipe shall be laid a minimum of 600 mm below ground level. Excavation for trenches shall be done as specified elsewhere, but the depth of the trenches shall be as follow

Size of Pipe	Width of Trench	Depth of Trench
For dia 15 mm to 50 mm	300 mm	750 mm
For dia 65 mm to 100 mm	450 mm	1000 mm

1.31.3 Backfilling

Backfilling of trenches shall not commence until the pipes therein have been tested and approved by the Engineer. Under non-paved areas selected excavated materials free from large stones refuse, or organic material as approved by the Engineer or Site In-charge shall do the backfill.

1.32 INTERNAL WATER SUPPLY

1.32.1 Pipes

All pipes inside the building from Over Head Tank to the Toilets and Kitchen and where specified, shall be considered as Internal Water Supply Pipe Line. The types of Pipe and Pipe Fittings shall be as per drawings and / or as mentioned in the Bill of Quantities. The installation of pipe line shall be properly carried out and should be completely watertight. All fixtures and fittings shall be properly installed and checked against leaks at designated pressure. Expansion of hot water pipes shall be compensated for by flexible piping layouts and / or by utilizing bends in pipe line. Necessary Pipe Sleeves in the wall, floor, etc as well as pipe supports, clamps, brackets, etc should be provided as per the specification and instruction of the Engineer.

1.32.2 Pipe Supports and Hangers

The pipes and pipefitting before being laid to fixed shall be examined to see that there are no cracks or defects. The pipes and fittings shall be thoroughly cleaned of all dust and dirt. After laying or fixing the pipes in position they shall be arranged in such a way that centre line of pipes coincide with the centre line of the alignment. Fittings, Valves, etc., shall also be laid in their position as stated above. CPVC or PVC Pipes shall be fixed by push fit before any solvent cement is applied and when cleared by the Engineer then only permanent joints to be made. All the horizontal and vertical run pipes should be supported to walls with the help of PVC Pipe Clamps that should be anchored by Galvanized Screws and Plastic dowels. In case of pipes laid horizontally under ceiling, pipe shall be supported on M.S. Brackets / Hangers of approved design.

SPACING FOR SUPPORTS & HANGERS OF FIXING FOR INTERNAL PIPING

of Pipe	ze of Pipe Line	erval for Pipe Supports for Horizontal Run Pipe Line	nterval for Pipe Supports for Vertical Run Pipe Line

I Pipe Line for water Supply	NB ½"	2.00 m	2.50 m
	NB ¾"	2.50 m	3.00 m
	NB 1"	2.50 m	3.00 m
	NB 1¼"	3.00 m	3.50 m
	NB 1½"	3.00 m	3.50 m
	NB 2"	3.50 m	4.50 m
	NB 2½"	3.50 m	4.50 m
	NB 3"	3.50 m	5.00 m
C / PVC / PP-R Pipe Line for Water Supply	15 mm / ½ "	1.25 m	1.25 m
	20 mm / ¾"	1.50 m	1.50 m
	25 mm / 1"	1.50 m	1.50 m
	32 mm / 1¼"	1.75 m	1.75 m
	40 mm / 1½"	1.75 m	1.75 m
	50 mm / 2"	2.00 m	2.00 m
C Pipe Line for Soil, Waste & Rain Water	0 mm	1.50 m	2.00 m
	OD 75 mm	2.00 m	2.50 m
	OD 110 mm	2.00 m	3.00 m
	OD 160 mm	2.50 m	3.00 m

1.33 METHOD OF MEASUREMENT

GI, CPVC, PVC Pipe Line above ground or under ground shall be measured per running feet and the rate shall be inclusive of all fittings including unions, Hangers, Brackets, Clamps, Pipe Sleeves, cutting chases etc on wall, ceiling, floor and making good the same and testing of pipes and fittings, making good.

GI pipes below ground shall be measured per running feet and the rate shall be inclusive of all fittings and testing of pipes and fittings except the excavation for trenches, refilling and disposal of surplus earth.

Other Fixtures such as Gunmetal valves, non return valves, ball cocks, foot valves, stop cocks, bib cocks, etc., shall be measured by number.

1.34 BATHROOM FIXTURES AND FITTINGS

1.34.1 Bathroom Fixtures

All bathroom fixtures, Ceramic and CP fittings shall be supplied free of cost by the Owners at site Store, Contractor shall make his own arrangement at his cost to check, take delivery, store, install in position including transportation to site of work. No allowances shall be made for theft, breakage and defective materials after taking delivery of the materials.

1.34.2 Installation of Fixtures

The fixtures and fittings shall be provided with all such accessories as are required to complete the item in satisfactory working conditions, whether specifically mentioned or not in the Schedule of Quantities, Specifications and Drawings.

The Bathroom fixtures and fittings shall be installed at the correct assigned position as shown on the drawings and as directed by the Engineer in-charge/Engineer or Site In-charge/Owners, and shall fully meet with the esthetic and symmetrical requirements as demanded by the Engineer In-charge / Engineer or Site In-charge / Owner.

All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per Engineer-in-charger's requirements. Wherever necessary, the fittings shall be centered to dimensions and pattern as called for.

Skilled workman shall install fixtures with appropriate tools according to the best trade practice. Manufacturer's instructions 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.

1.34.3 Mock Up and Trail Assembly

The installation of the bathroom fixtures and fittings shall be as per the shop drawings approved by the Engineer-in charge.

The contractor shall assemble on trial basis at least one set of each type of bathroom fixture and fittings in order to determine precisely the required supply and disposal connection. Relevant instructions from manufacturers shall be followed as applicable. This trial assembly shall be developed to facilitate determining the location of punctures, holes, holding devices etc. that will be required for final installation in position of all bathroom fixtures and fittings. The above assembly shall be subject to final approval by the Engineer-in charge / Engineer or Site In-charge / Owner.

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

1.34.4 Supporting and Fixing Devices

The contractor at his own cost shall where required, provide all fixtures and fittings securely in position. The fixing devices shall be rigidly anchored into the building structure. The devices shall be rust resistant and shall be so fixed that they do not present an unsightly look in the final assembly. These shall be installed complete with appropriate washers and

gaskets, jointing Materials and Screws etc. as per manufacture manuals.

1.34.5 Final Installation

The contractor at his own cost shall install all bathroom fixtures and fittings in their final position in accordance with approved trail assemblies and as shown on drawings. The installation shall be complete with all supply and waste connections. The connection between built-in piping system and the bathroom fixtures shall be through proper couplings, unions and flanges to facilitate removal / replacement of bathroom fixtures without disturbing the built in piping system. All couplings, unions and flanges shall match in appearance with other exposed fittings.

Fixtures shall be mounted rigid, plumb and true to alignment. The outlets of water closet bowls and similar appliances shall be examined to ensure that outlet ends are butting on the receiving pipes before making the joints. It shall be ensured that the receiving pipes are clear of obstruction. When fixtures are being mounted attention shall be paid to the possibility of movement and settlement by other causes. Overflows shall be arranged as to give visible warning and discharge. A check shall be made to ensure that necessary anchoring devices have been provided for supporting Water Closets, Wash Basins, Sinks and other appliances.

1.34.6 Protection against Damage and Theft

The contractor shall take every precaution to protect all bathroom fixtures and fittings issued to them against damage, misuse, crazing, staining, breakage and pilferage by providing proper wrapping and locking arrangement till the completion and handing over of the installation. At the time of handing over, the contractor shall clean, disinfect and polish all fixtures and fittings. Any fixtures and fittings found damaged, cracked, chipped, stained or scratched shall be removed and new fixtures and fittings free from defects shall be installed at his own cost to complete the work.

1.34.7 Testing

All fixtures and fittings shall be tested for their proper performance by the Contractor thoroughly to satisfy himself that they are in order, before applying for virtual completion.

1.35 MISCELLANEOUS WORK

1.35.1 Disinfecting the Piping System

Before commissioning the water supply system the contractor shall arrange to disinfect the entire system as described in the succeeding paragraph.

The water pipes shall first be filled with water and thoroughly flushed out. The storage tanks shall then be filled with water again and disinfecting chemical containing chlorine added gradually while tanks are being filled to ensure through mixing. Sufficient chemical shall be used to give the water a dose of 50 parts of chlorine to one million parts of water. If ordinary bleaching powder is used, the proportions will be 150 gms of powder to 1000 litres of water. The powder shall be mixed with water in the storage tank. If a proprietary brand of chemical is used the proportions shall be as specified by the makers. When the storage tank is full, the supply shall be stopped and all the taps on the distributing pipes opened successively

working progressively away from storage tank. Each tap shall be closed when the water discharge begins to smell of chlorine. The storage tank shall then be filled up with water from supply pipe and added with more disinfecting chemical in the recommended proportions. The storage tank and pipe shall then remain charged at least for three hours. Finally the tank and pipes shall be thoroughly flushed out before any water is used for domestic purposes.

1.36 SAFETY CODE

- First aid appliance shall be maintained in a readily accessible place including adequate supply of sterilized dressings and cotton wool.
- An injured person shall be taken on a public hospital without loss of time, in cases where the injury necessitates hospitalization.
- Suitable and strong scaffolds should be provided for all works that cannot safely be done from ground.
- No portable single ladder shall be over 8 meters in length. The width between the side rails shall not be less than 30 cm (clear) and the distance between two adjacent runs shall not be more than 30 cms. When a ladder is used an extra labor shall be engaged for holding the ladder.
- The excavated materials shall not be placed within 1.5 meters of the edge of the trench or half of the depth of trenches whichever is more. All trenches and excavations shall be provided with necessary fencing and lighting.
- Every opening in the floor of a building or in working platform be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be one meter.
- No floor, roof or other part of the structure shall be over loaded with debris or materials as to render it unsafe.
- Workers employed on mixing and handling materials such asphalt, cement mortar or concrete and lime mortar shall be provided with protective foot wear and rubber hand gloves.
- Those engaged in welding works shall be provided with welder's protective eye-shields and gloves.
- No paint containing lead or lead products shall be used.
- Suitable facemasks should be provided to the workers when the paint is applied in the form of spray or surface having lead paint dry rubbed and scraped.
- The Contractor to the painter shall supply overalls and adequate facilities shall be provided to enable the working painters to wash during the periods of cessation of work.
- Hoisting machines and tackle used in the works, including their attachments, anchorage and supports shall be in perfect condition.
- The ropes use in hoisting or lowering material or as means of suspension shall be of durable quality and adequate strength and free from defects.

1.37 SANITARY FIXTURES AND ACCESSORIES

All sanitary wares and fittings shall be first class quality white glazed vitreous china ceramic and approved by the Engineer.

1.37.1 Water Closet (W.C.)

(a) European pattern W.C. commode and flushing cistern.

These shall be of white glazed vitreous china first class quality, double or single trap syphonic water closet suite as specified in the Bill of Quantities, P or S Trap flushing cistern as specified conforming to Indian standard Specification. The commode and flushing cistern shall be free from cracks, blisters and shall have smooth surface.

Fixing :- W.C. commode shall be fixed to floor or wall with CP brass screws or by means of 75mm long 6.5mm dia counter sunk bolts and nuts imbedded in floor concrete or as per the instruction of the Project Engineer. The base of pedestal of the commode shall be filled with white cement mixed with pigment to match the shade of floor or as directed by the Engineer. Following measure shall be adopted for fixing the W.C. commode

1. The central axis of the commode shall be perpendicular to the finished face of wall.
2. The outlet of the commode shall be centrally placed in the rubber gasket of the PVC pipe pipe as per drawing or as directed by the Engineer and shall have not leakage.
3. The distance between centre line of outlet of W.C. commode and finished wall face shall be so adjusted as to rest squarely against the finished wall face.
4. Seat and lid shall be of ISI marked solid of heavy duty quality and fitted exactly on the rim of the W.C. Commode with C.P. brass hinges, rubber buffers and C.P. brass nuts.

Method of Measurement

Measurement for the European Water Closet will be made per unit set of complete installation.

1.37.2 Wash Basins

These shall be white glazed vitreous china of first class quality with single tap hole as specified in the Bill of Quantities. These shall be free from cracks, crazes, blister and shall have smooth surface.

Fixing: The basin shall be supported on brackets as per manufacturer's instructions. The basin shall be under-counter or wall hung type. There shall not be any gap between top edge of the basin and finished face of wall.

C.P. Pillar cock: This shall be 15 mm size of C.P. brass central hole Pillar Cock.

Method of Measurement

Measurement for the Hand Wash basin will be made per unit set of complete installation.

1.37.3 Urinals

These shall be white glazed vitreous china of first class quality flat back type with CP push cock. The urinals shall be free from cracks, blisters and shall have smooth surface.

Fixing : Urinals shall be fixed on the wall with the help of C.P. brass screws as per the manufacturer's and/or directed by the Engineer. There shall not be any gap between the back edge of the urinal and finished face of the wall.

Method of Measurement

Measurement for the Urinal will be made per unit set of complete installation.

1.37.4 Water Tanks

Water tank shall be of HDPE as shown on the drawing and specified in the Bill of Quantities. Tank shall be supplied with manhole covers and locking arrangement as per drawing or as directed by the Engineer.

Water tank shall provide inlets, outlets, scour and overflow pipes, sockets for float level switches and inter connections if required. Overflow pipes shall be provided with a mosquito proof brass grating. Scour pipe of size as specified by the Engineer shall be provided with a bend and pipe piece and plug terminating outside the tank wall.

Ball cocks used for tanks shall be high or low pressure ball cocks with brass lever rods and polythene ball floats. The ball floats shall conform to Indian standard which shall be hammer tested.

Water tank shall be fixed in position as shown on drawing or as directed by the Engineer.

Method of Measurement

Measurement for the Water tank will be made per unit set of complete installation.

1.37.5 Toilet paper holder

Toilet paper box shall be of white glazed vitreous china of the same colour and shade as that of the main sanitary fixture. It shall be fixed in wall in a neat Workmanlike manner. Recess in walls, where required, shall be provided. It shall be fix with C.P. brass screws, where required.

Method of Measurement

Measurement for the Toilet Paper Holder will be made per unit set of complete installation.

1.37.6 Soap tray or soap dish

Soap tray or soap dish shall be of white glazed vitreous China of the same colour and shade as that of the main fixtures. Soap tray shall be fixed in wall in a neat Workmanlike manner. Recess in walls, where required, shall be provided. It shall be fixed with C.P. brass screws, where required.

Method of Measurement

Measurement for the Soap Dish will be made per unit set of complete installation.

1.37.7 Towel Rod

Towel rod shall be heavy type of C.P. brass with two brackets. The size of the rod shall be s specified on the drawing or Bill of Quantities. The brackets shall be firmly fastened by means of C.P. brass screws to wooden plugs or fawl plugs firmly embedded in the wall.

Method of Measurement

Measurement for the Towel Rod will be made per unit set of complete installation.

1.37.8 Mirror

Mirrors shall be of approved make 5mm thick. All edged shall be rounded off. Mirrors shall be fixed to wall with brass chromium plated screws and washers. Mirrors shall be of beveled edge of sizes as specified in the Bill of Quantities.

Method of Measurement

Measurement for the Mirror will be made per unit set of complete installation as per size.

1.37.9 C.P. Grating

Floor and urinal traps shall be provided with chromium plated grating, with rim of approved design and shape. Minimum thickness shall be 3mm.

Method of Measurement

Measurement for the CP Grating will be made per unit set of complete installation.

1.37.10 C.P. Fittings

All C.P. fittings, additional bib cocks, shall be of the best quality heavy pattern of approved make. All C.P. fittings shall be fixed in a Works man like manner and shall not carry tool marks and scratches.

Method of Measurement

No Measurement will be made for CP fittings except for the additional items in BOQ. All CP fittings are presumed to be installed with sanitaryware requirement. Measurement will be made for Additional CP fittings as per BOQ item per unit of installation.

1.38MAKE OF EQUIPMENT AND APPROVED MANUFACTURES

1. Sanitary Ware: Hindware or Parryware or equiivalent
2. C. P. Fitting: Jaquar, Nova, Blue Satr or equvalent
3. Glass: Modiguard or equvalent
4. CPVC Pipes: Astral, Ashirbad or equvalent
5. PVC Pipes and fittings: Panchakanya, Nepatop or equivalent
6. Gate Valves: Leader, GG or equivalent
7. C.P. Push Cock: Jaquar, Jal, Viking or equivalent
8. Stainless Steel: Grade 304