Annexure-I

(Part: 1 of 2)

TECHNICAL SPECIFICATIONS

CIVIL & INTERIOR WORKS

Name of the work: Renovation work of BNPM Staff Canteen, BNPM premises, Mysore

E Tender No. BNPM/NCB/ CR/1010/2020-21 dated 20.01.2021

SUBMITTALS TO BE MADE BY THE CONTRACTOR

DURING THE EXECUTION OF WORK

1. Daily progress report stating number of men employed under each trade, equipment at site, etc.
2. Weekly/ fortnightly progress report showing progress against programme.
3. Programme of work for the forthcoming week.
4. Labour and equipment deployed at site - requirement plan v/s actual deployed - weekly.
5. Updated approved monthly PERT CHART along with monthly progress chart - weekly.
6. Construction materials by contractor: status and mobilization programme - fortnightly.
7. Progress digital photographs - fortnightly.
8. Value of work anticipated to be done in the forth-coming month including the value of any materials and equipment of large value - monthly.
9. Material test report.
10. Workmanship Check list.

EXC EARTH WORK AND EXCAVATION

1. SCOPE

The work under this section covers all operations listed below in connection with building construction and external work.

a. Clearing, grubbing and removing all vegetation from the site.

b. Excavation including setting out.

c. Filling and back filling.

d. Compacting.

e. Removal and disposal of surplus material.

f. Hard stone soling to floors and paving.

The Contractor shall provide all materials, labour, equipment, operations and incidentals necessary and required for the completion of all aspects of work listed above as called for in the drawings and specifications.

2. GENERAL

2.1 The extent of the works shall include but not be limited to the following:

a. The excavation of the Site as per the drawings released for construction.

b. The design and installation of temporary works to provide lateral support for exposed sides of excavation.

c. The execution of all associated works shown on the drawings.

d. The Contractor shall visit the site, inspect the bore holes and decide for himself the nature of the ground and the subsoil to be excavated. No claim of extra will be entertained in consequence of any misunderstanding of incorrect information or ignorance of existing conditions.

2.2 The works shall be carried out generally in accordance with the recommendations contained in the following standards, codes of practice, reports and statutory regulations.

a. SS CP/ 8 - Earthworks

b. IS: 3764-1992, Safety Code for Excavation work

c. IS: 1498-1970, Classification and identification of soils for general engineering purposes

d. IS: 6313 (Part II)-2001, Pre-constructional Chemical Treatment measures against termites

e. IS: 1892-1979, Subsurface investigation for foundations

f. SP: 27, Handbook of method of measurement of building works

g. Local building regulations and statutory regulations

h. Soil Test Report made available to contractor if required

2.3 The Contractor shall comply with all requirements of the regarding the notification, inspection and approval of all excavations and formation levels. The Contractor shall keep dated records of the inspections and any instructions which result in the defined limits of the excavation being exceeded.

2.4 The Contractor shall give the not less than 36 hours notices of the time each formation level will be exposed so that the Architect/ may inspect the formation.

2.5 If at any time the is not satisfied that a formation was prepared in accordance with the specification before covering, he may direct that it to be exposed for inspection.

3. DEFINITIONS

3.1 **Clear**: The removal of trees, shrub and artificial obstructions including fences, concrete slabs, kerb and channel, remains of old buildings and the like.

3.2 **Grub**: The removal of tree stumps and roots.

3.3 **Cut**: A general term for 'in place' material removed by digging from the ground. The term 'excavation' or derivatives thereof may be used interchangeably.

3.4 **Fill**: A general term for material spread and compacted over the ground to make up finished levels or levels to sub-grade. The term embankment or derivatives thereof may be used interchangeably.

3.5 **Sub-Grade**: The finished, trimmed and prepared surface of the earthworks. After completion of all cut and fill operations, the term 'formation level' or derivatives thereof may be used interchangeably.

3.6 **Sub-Base**: A selected filling layer spread and compacted over the sub-grade to make up levels to the underside of the base.

3.7 **Base**: A selected filling layer spread and compacted to finished levels to form an acceptable working surface for either a building or road.

4. SETTING OUT

4.1 The Contractor shall erect sufficient permanent benchmarks in suitable locations for all the buildings before starting work from which all important levels shall be laid out. Exact levels of all floors shall be set. An experienced surveyor shall be engaged by the Contractor to locate utility lines, all buildings, paths, roads, etc. The Contractor shall provide all pegs, flags, pillars and labour required for setting out. The contractor shall be responsible for the accuracy of all setting out and for establishing all levels accurately. Any error in setting out and any consequential loss to owner/ employer shall be made good at Contractor's expense to the satisfaction of the PMC .

4.2 The Contractor shall protect and maintain all bench marks. If any bench mark be displaced or lost it must be replaced by the surveyor at the Contractor's expense.

4.3 The Contractor shall be responsible for the checking and verification of all information shown on the survey drawings.

5. EXCAVATION

5.1 Classification of Soils (applicable IS Code:1498)

The earth work shall be classified under the following categories and measured separately for each category:

a. All kinds of Soils: Generally any strata, such as sand, gravel, loam, clay, mud, black cotton, morum, shingle, river or Nallah bed boulders, soling of roads, paths, etc. and hard core, macadam surface of any description (water bound, grouted tarmac, etc.), lime concrete, mud concrete and their mixtures which for excavation yields to the application of picks, shovels, jumper, scarifies, ripper and other manual digging implements.

b. Ordinary Rock: Generally any rock which can be excavated by splitting with crow bars, picks and does not require blasting, wedging or similar means for excavation such as lime stone, sand stone, hard laterite, hard conglomerate and un-reinforced cement concrete below ground level. If required light blasting may be resorted to, for loosening the materials but this will not in any way entitle the material to be classified as 'Hard rock'.

c. Hard Rock: Generally any rock or boulder for the excavation of which blasting is required such as quartzite granite, basalt, reinforced cement concrete (reinforcement to be cut through but not separated from concrete) below ground level and the like.

d. Hard Rock (blasting prohibited): Hard rock requiring blasting as described under 'c' but where the blasting is prohibited for any reason and excavation has to be carried out by chiseling, wedging or any other agreed method.

5.2 Recording of Ground Level

The Ground level shall be taken at 5 to 15 meters intervals (or as directed by the PMC or Engineer In charge) in uniformly sloping ground and at closer intervals where local mounds, pits or undulations are met with. After approval the actual earthwork is started. The labor required for taking levels shall be supplied by the contractor at his own cost.

6. EXCAVATION GENERAL

6.1 Clearing and Grubbing

The contractor shall clear and grub as defined in areas of the site on which excavation is to be carried out and on which filling is to be placed.

All stumps and roots greater than 75mm diameter within the area of earthworks shall be removed to a depth of not less than 0.5m below sub grade. Holes left by clearing and grubbing shall be filled and compacted with suitable material.

All trees, scrub, stumps, roots, cleared and fallen timber and combustible rubbish of every description resulting from these operations shall be burnt in accordance with the requirements of the local fire authority or removed from the site. Obtain any permits required and notify neighbors of the intention to bum. Carry out burning in such a way as to avoid damage to standing timber or other property. No tree, log, or other destructible rubbish shall be placed in any embankment, scour or other hollow place.

6.2 Setting Out

Prior to commencement of the earthworks, the contractor shall set such line and level pegs as are necessary for the adequate control of construction.

6.3 Removal of Topsoil

Prior to the commencement of the earthworks, areas which are to be excavated or covered by fill material are to have the topsoil removed and stockpiled on the site.

6.4 Proof Rolling under Fill Embankments

After removal of topsoil, the existing ground under fill embankments shall be scarified to a depth of not less than 150mm and compacted according to the standard cited elsewhere in this specification.

6.5 Earthworks - General

The whole of the excavated material unless otherwise specified shall remain the property of the owner and shall be used in the formation work. Any surplus or unsuitable material remaining thereafter shall be stockpiled as spoil in accordance with this specification.

6.6 Excavation in All Kinds of Soils

a. All excavation shall be carried out in accordance with the requirements. All excavation shall be carried out in a workman like manner to lines, levels and grades indicated on the drawings and to the Specified standards.

b. The sequence of excavation and strutting and or cutting of slopes shall be to the approval of the PMC. Under no circumstance shall the Contractor be allowed to over excavate at any stage of the works except with the approval of the PMC

c. The excavation for the works shall be measured as shown on the drawings in concurrence with IS: 1200.

d. Should the Contractor excavate beyond the formation level as shown on the Drawings, then the will require the whole of the void be filled with approved mass concrete of not inferior than Grade 10 at the Contractor's expense.

Any excavation below the required formation levels as shown on the Drawings, except where specifically instructed in order to reach a firm bearing stratum, shall be brought up to the correct level with granular fill material in accordance with standards and this Specification, or with materials specified in accordance with the 's Instruction, at the Contractor's expense.

e. The sequence of excavation and methods adopted shall be to the approval of the PMC

f. The Contractor shall be responsible for upkeep all temporary works, slopes, roads, ramps, paths, etc. during the execution of the works.

g. Excavation for basements, foundations, footings, trenches, paving, walks, etc. as called for on the drawings shall be generally made to as specified in the drawings. "Battering" or "Benching" to the sides of excavation shall have prior approval of the PMC Extra excavation (i.e., excavation beyond the limits required by the drawings) carried out without the prior approval of the PMC will not be measured and such unauthorized excavations shall be filled up to the proper level with concrete of the same type and mix as for foundations or as ordered by the PMC at the Contractor's own expense.

h. All soft spots and loose pockets shall be dug out and filled with cement concrete 1:4:8 well rammed and consolidated. Clear out all sludge and slush before laying foundation.

i. All excavations shall be done true to levels, slope, shape and patterns called for. The sides shall be trimmed, bottom dressed, rammed and consolidated to correct levels.

6.7 Excavation in Rock

All rock excavation shall be carried out by crowbars, chiseling or burning. Blasting shall not be carried out without written permission from . Shattering or removing rock beyond authorized lines and grades shall be avoided. Unless otherwise specified rock shall be classified as soft rock/ hard rock as laid down earlier and as decided by the .

Where solid rock is encountered in the floor of cuttings on which paving is to be constructed, the rock shall be removed to a depth not less than 150mm below formation level and replaced with material suitable for embankment construction. Scrabble the rock face to give even plane bearing surfaces. The top of the rock after removal shall be close to level or stepped, but also free draining without pockets to pond water.

Where boulders are encountered in the floor of cuttings, the boulders shall be removed and the resultant void filled with material suitable for embankment construction.

7. FORMATIONS

a. Formation shall mean the surface of the ground after completion of any excavation or filling operation.

b. To avoid damage to excavation formations, excavation surface shall be left at least 150mm above formation level until immediately before being inspected. The Contractor shall not allow any formation to be left exposed for more than 4hours after approval.

If any areas of formation are damaged by the weather or any other cause the shall be immediately notified.

c. All formations shall be trimmed, leveled and cleared of loose material prior to inspection. Loose rock shall be removed to the nearest sound jointing layer and brushed clean.

d. A layer of specified thickness lean binding concrete shall be placed on every foundation formation as soon as possible and not more than 24hours after inspection and approval.

e. The permissible deviations of the formation levels from the positions shown on the drawings and with reference to the nearest temporary bench mark hall be as follows:

Beneath mass concrete foundations	+0, -100mm
Beneath reinforced concrete foundations	+0, -50mm

(Including pile caps and base slabs)

Embankment and cutting slopes +0, -100mm

Beneath reinforced concrete foundations, the mean value of at least 40 levels on the formation at the intersection points of a square grid shall be within +0, -25mm of the level shown on the Drawings.

7.1 Stacking of Spoil

Excavated materials shall not be placed within 1.5meter of the edges of trenches/ pits or half the depth of the trench, whichever is more. Spoil heaps for earthworks materials including topsoil shall be constructed with a minimum crest width of 3.0m, maximum side slope of 1 on 1, maximum height of 3.0m and shall be left neat and free draining.

7.2 Drainage of Excavation

The Contractor shall maintain the excavation free from water from whatever sources it may originate, at all times. No accumulation of water shall be permitted at any time. The Contractor shall provide sufficient pumps together with all necessary standby units to ensure removal of water at all times.

The Contractor is to allow for temporary surface water channels, sumps for pumping and all other measures to drain off water from the site and prevent erosion and other damage. Care shall be taken to ensure that the water is discharged only to points where it will not stagnate.

All temporarily drainage proposals are to be submitted to the PMC for their approval prior to commencement of work but such approval will not reduce the Contractor's responsibility under the contract.

In the case of material brought from outside the site, the contractor shall gather samples of the material he proposes to use, suitably bagged and labeled, for examination, testing and approval. Each sample supplied shall be not less than 50kg by weight.

No material shall be brought or placed until the contractor is satisfied that the material is acceptable and meets the specification of PMC

7.3 The following materials shall not be used in embankment construction:

a. vegetable matter
b. organic clays and silts
c. ashes, coal or the like
d. dispersible clays
e. material which becomes unstable when wet
f. material containing stones, rock or broken concrete exceeding the following maximum sizes:

- 200mm maximum dimension and
- in the upper 300mm portion of embankments and 100mm maximum dimension at other portions.

The above materials shall be removed as spoil unless otherwise approved by .

Where the ground surface on which the embankment is to be constructed has a transverse slope steeper than 1 on 8, a horizontal step not less than 300mm high shall be cut into the ground surface at the toe of the embankment on the low side. Where the ground surface has a transverse slope steeper than 1 on 3, a series of horizontal steps not less than 300mm high shall be cut into the ground surface to

be covered by the embankment. These steps shall be continuous longitudinally and contiguous transversely.

7.4 Protection

The Contractor shall protect the excavation from the effect of inclement weather or other damage or make good such damages to the satisfaction of the .

7.5 Dressing

Pit and trench bottoms shall be smoothened and tightly rammed to a uniform surface.

8. FILLING

8.1 Fill Material

Materials used for filling by the sides of foundations, etc., shall be granular materials within the limits specified below:

Sieve Size %	Passing (by mass)
5mm	100
7.5mm	85 - 100
0mm	45 - 90
mm	25 - 75
00Micron	8 - 45
5Micron	0 - 10

Excavated material from the site, meeting above requirements may be used for filling. Fill material shall be hard, free from shrubs, construction debris, vegetation, grass, etc. and shall be subject to the approval of the . Fill under floors, terraces and concrete beds shall be free of saltpeter, white ants, etc.

8.2 Fill Compaction

The fill shall be spread in layers not exceeding 300mm thick and each layer shall be watered and thoroughly consolidated with vibratory compactors and heavy rammers till the required level is reached. Vibratory Rollers shall be employed for compaction where it can be conveniently used. The fill shall then be flooded with water for at least 24hours, allowed to dry and then rammed and consolidated again. The finished surfaces shall be formed to connect lines, levels, slopes, shapes, etc. as required. Fills at building structures, walks, paths, etc. shall not be executed until all foundations, footings, etc. have been inspected and approved by the . Return and fill around foundations, walls, etc. as described above and bring grades up to either original ground levels or as required by the drawings when different from original.

The above work shall be placed in uniform horizontal layers not exceeding 150mm loose thickness spread and well compacted at or near optimum moisture content by means of vibrating, tamping or pneumatic tyred rollers or other compaction equipment as required to achieve the standard of compaction specified. At least one roller shall be operated continuously for each 100cum of material or part thereof placed per hour. This is estimated as the minimum necessary to attain the required compaction. When several embankments, each of small area are so isolated that one roller cannot compact them satisfactorily, additional rollers shall be provided. In inaccessible places or against structures, use hand tamping or small vibratory compaction equipment. Take care during compaction that no planes are formed between adjacent layers.

Where the PMC is of the opinion that a specific area within a work area is not suitable for compaction to the specified density he may accept a lesser density, or he may order alternative improvement works.

8.3 Compaction Requirements

A: Fill material not classified as rock fill shall be compacted at or near optimum moisture content to a density of not less than 97% standard maximum dry density.

Tests shall be conducted at the following minimum frequency:

Not less than one test per 150cum of fill volume or one test per layer per 1000m^2 of filled area, whichever requires the greater number of tests. Testing shall be distributed evenly throughout the fill volume and layer area. Test locations shall be to the satisfaction of the PMC and copies of all tests submitted to him whether successful or not.

In the event that test results do not answer the minimum compaction requirements, the whole of the area for which the test is representative shall be reworked and retested, unless otherwise directed by the PMC.

The contractor shall be paid for successful tests only. The cost of failing tests shall be borne by the contractor.

The following tests shall be conducted to confirm compliance:

ımpling:	**ɔ IS: 2720 (Part 1)**
eld Dry Density:	**ɔ IS: 2720 (Part 28) "Determination of dry density of soil on site - Sand replacement test"**
andard Maximum Dry Density:	**ɔ IS: 2720 (Part 8)**
oisture Content:	**ɔ IS: 2720 (Part 2)**

The fill materials shall not contain more than 0.5% by dry weight of sulphate determined in accordance with IS: 2720 (Part 27).

The material passing the 425micron IS sieve, when tested in accordance with IS: 2720 (Part 5) shall have a plasticity index of less than 6. The amount of material retained on the sieve shall be reported for each test.

At least 21 days before any backfilling is started, the Contractor shall submit full details of the sources and types of his proposed filling materials together with 25kg representative samples of each type. At the same time, the Contractor shall deliver sufficient representative samples of each material to an approved independent laboratory for testing.

Before the Works commence, the Contractor shall submit the name of the independent testing laboratory he proposed to employ for testing the proposed fill material for approval by the PMC.

Each layer of fill shall be compacted by approved compaction plants as specified below:

Plant	Variable	Value	Maximum Thickness of compacted Layer, mm	Minimum Number of Passes
Vibratory Roller	**Static load in tones per meter**	**0.3 - 0.6** **0.7 - 1.1**	**75** **125**	**16** **12**

Plant	Variable	Value	Maximum Thickness of compacted Layer, mm	Minimum Number of Passes
	width of vibratory roller			
Vibratory Plate Compactor	Static pressure under base plate in kgf/ cm sq.	.1 - 0.12 .13 - 0.14 lore than 75	75 75 125	10 6 6
Vibro Tamper	Weight in kgf	50 - 75 lore than 75	100 150	3 3
Power Rammer	Weight in kgf	100	150	6

B: For fill material classified as rock fill, the Contractor shall carry out a test compaction program at the beginning of earthwork operations to the satisfaction of the PMC to confirm the number of passes of his roller to be made to achieve a satisfactory density. Notwithstanding the results of the test program, the may direct that additional passes be made with the roller during the construction to achieve the required densities.

8.4 Finish Grading

Finish grading shall be done to fertile top soil as directed by. Depth of top soil shall be as specified. Top soil shall be approved by the before placement.

8.5 Removal

Removal of excavated material includes the separation of the useful from the useless portion (what is useful and what is useless is the sole discretion of the) and depositing the former in regular heaps and removal of the latter. Surplus earth, if any and useless spoil shall be carted away from the 'site' and disposed as directed.

8.6 Planking, Strutting and Shoring

The Contractor shall be responsible to adopt such measures as may be needed uphold the sides of excavation and shall include use of waste timber or steelwork as planking and strutting including Wales, struts and open or close poling boards as directed by the pmc The type of planking and strutting, open or close shall be determined by the. Shoring and strutting shall be designed as per the guide lines in IS: 3764-1966.

9. STONE SOLING

Stone soling under floors and other locations where called for shall be of approved hard broken stones as specified. The stones shall be hand packed in position; the surface thoroughly compacted with rollers and vibratory compactor with frequent watering. The surface shall be then bonded with murrum, watered thoroughly rammed, rolled and consolidated again to required grade. Earth shall on no account be used for making good binding purposes. Where rolling as described above is not

possible, the consolidation shall be carried out using heavy band rammers and band rollers. The consolidated thickness shall be as specified.

10. MEASUREMENT OF EARTH WORK APPLICABLE CODE IS: 1200 (PART-I)

The length and breadth of excavation or filling shall be measured with a steel tape correct to the nearest centimeter. The depth of cutting or height of filling shall be measured, correct to 0.01m, by recording levels before the start of the work and after the completion of the work, the cubical contents shall be worked out to the nearest two places of decimal in cubic meter.

Rates: Rates for earthwork shall include the following:

a. Site clearance.
b. Setting out and making profile.
c. Excavation and depositing excavated material away from the edges.
d. Handling and depositing at specific locations, the antiquities and useful materials.
e. Protection of sides of excavation.(Shoring etc.,)
f. Bailing out or pumping of water from all sources other than sub soil water.
g. Removing slush collected excavated areas.
h. Unless otherwise mentioned Only PCC area will considered for Earth Excavation Measurement.

ATT <u>ANTI-TERMITE TREATMENT</u>

1. SCOPE

All the buildings shall be adequately protected against attack by subterranean termites by suitable chemical treatment measures. The work shall be carried out by a specialist pest control agency approved by the PMC

2. CODES AND STANDARDS

The treatment shall be carried out generally in accordance with the stipulations laid down by IS: 6313 (Part-II) - 2001 (Code of practice for Anti Termite Measures in Buildings - Part II Pre-constructional Chemical Treatment Measures) subject to the minimum requirements given in this specification.

3. GENERAL

The pest control agency to be selected by the PMC The work to be carried out by the specialist firm shall carry a guarantee for the satisfactory performance of the treatment for a minimum period of ten (10) years.

Generally chemical soil treatment shall be applied to soil in contact with the following:

a. Soil in contact with the sub-structure of the building
b. Sides of pile caps
c. Base and sides of all beams and trenches
d. Base of lower slab (under the slab)

e. Vertical areas

f. Sloping areas where building covers

g. Any voids where building may cover exposed soil

h. Lift pits, walls, etc.,

i. Perimeter one meter surrounding the building.

4. MINIMUM SPECIFICATIONS

The earth filling immediately under the stone soling (under floors), bottom and side fills of all foundations and soil along external perimeter of all buildings shall be chemically treated against termites. The chemicals to be used for the treatment shall be conforming to the requirements and concentration laid down in IS: 6313 (Part-II)-2001 and permitted for usage by the authorities.

5. APPLICATION

The chemical solution shall be prepared by mixing the chemical with the appropriate quantity of water to obtain a chemical emulsion of the correct concentration as stipulated. The prepared emulsion shall be applied as described below:

5.1 Column Pits, Wall Trenches, etc.:

The bottom surface and sides of the excavations made for column foundations, wall foundations, etc., shall be treated with the chemical emulsion at the rate of 5 liters per sqm of surface area.

5.2 Treatment to Back-fill:

After the column foundations, wall foundation, etc., come up, the back fill in immediate contact with the foundation structure shall be treated at the rate of 7.5liters per sqm of the surface of the substructure for each side. If water is used for ramming the earth fill, the chemical treatment shall be done after ramming operation is completed by rodding earth at 15cm centers close to the wall face and spraying the chemical with the above dose. If the earth is to be returned in layers, then the treatment shall also be carried out in similar stages. The chemical emulsion shall be directed towards the masonry wall surfaces so that the earth in contact with these surfaces is well treated with chemical.

In case of RCC walls and columns, the treatment shall start at the depth of 50cm below natural ground level. From this depth the back fill around the RCC columns, walls, etc., shall be treated at the rate of 7.5 liters per sqm of the surface.

5.3 Top Surface of Plinth Filling:

The top surface of the plinth fill (just below the stone soling) shall be treated with chemical emulsion at the rate of 5 liters per sqm of the surface before the stone soling is laid. If the filled earth has been well consolidated and does not permit the emulsion to seep through, holes up to 50 to 75mm deep at 150mm centers both ways may be made with crowbars to facilitate saturation of the soil with the chemical emulsion.

5.4 Junction of Wall and Floor:

A channel of size 3cm x 3cm shall be made at all junctions of walls and columns with the floor (before laying the soling) and rod holes made in the channel up to the ground level at 15cm centers. The solution is poured into the channel at the rate of 7.5 liters per sqm of the vertical surface and allowed to soak through the holes fully so that the soil in contact with the column/ wall is fully soaked with the

chemical. The soil shall be tamped back into the channel and consolidated to original condition.

5.5 External Perimeter of Building:

After the building is complete, holes shall be made along the external perimeter of the building at intervals of 15cm and depths of 30cm and the emulsion shall be allowed to soak through these holes fully at the rate of 5 liters per running meter of the perimeter wall.

5.6 Soil Surrounding Pipes:

Wherever any service pipes enter the soil inside the area of the foundation of any building, the soil surrounding the point of entry of each pipe at the foundation, floor, etc., shall be fully soaked with the chemical solution for a distance of at least one meter from the point of such entry.

5.7 Treatment under Aprons:

The soil below the concrete or stone aprons to be provided around the perimeter walls of all buildings shall also be treated with the chemical solution at the rate of 5 liters per sqm.

6. MODE OF MEASUREMENT

For excavations: Surface area of bottom and two sides.

For floors: The surface area of the floor.

For substructure: The vertical area of the substructure. (Only plinth area)

Above measurements to be in Square meters

7. SPRAYING EQUIPMENT

To facilitate proper penetration of chemical into the soil, a pressure pump of adequate capacity and sprayers shall be employed to apply the solution.

1. SCOPE

It is the intent of these specifications to ensure that all concrete placed at various locations on the job should be durable and strong. It should wear well and be practically impervious to water. It should be free from such defects as shrinkage, cracking, honeycombing and pealing of the surface. All plain and reinforced concrete shall conform to pertinent Indian Standards cited below.

The contractor shall provide all materials (other than those supplied by the owner) labour, operations, equipments, incidentals and everything necessary and required for the completion of all concrete works called for.

2. CODES AND STANDARDS

The following specifications, standards and codes are made a part of these specifications. All standards, tentative specifications, codes of practice referred to herein shall be the latest edition including all applicable official amendments revisions and additional publications.

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

2.1 Materials

IS: 299	Specification for ordinary, rapid hardening and low heat Portland cement.
IS: 455 - 1989	Specification for Portland blast furnace slag cement.
IS: 1489 - 1991	Specification for Portland pozzolona cement.
IS: 4031-1988	Method of physical tests for hydraulic cement.
IS: 650 - 1991	Specification for standard sand for testing of cement.
IS: 383-1991	Specification for coarse and fine aggregate for use in mass concrete.
IS: 515	Specification for natural and manufactured aggregate for use in mass concrete.
IS: 2386	Method of test for aggregates for concrete.
IS: 516 - 1959	Methods of tests for strength of concrete.

IS: 11991959	Methods of sampling and analysis of concrete.
IS: 3025	Methods of sampling and test (physical and chemical) for water used in industry.
IS: 432 - 1982	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.
IS: 1139	Specification for hot rolled mild steel and medium tensile steel deformed bars for concrete reinforcement.

IS: 1566 - 1982	Specification for plain hard drawn steel wire fabric for concrete reinforcement.
IS: 1785 - 1983	Specification for plain hard drawn steel wire for pre-stressed concrete.
IS: 1786 - 1985	Specification cold twisted steel bars concrete reinforcement.
IS: 2080 - 1983	Specification for high tensile steel bars used in pre-stressed concrete.
IS: 303 - 1989	Plywood for general purposes.
IS: 4990 - 1993	Specification for plywood for concrete shuttering work.
IS: 1629	Rules for grading of cut size of timber.
IS: 2645 - 1975	Specification for integral cement water-proofing compounds.

2.2 Equipment

IS: 1791	Specification for batch type concrete mixers.
IS: 2438	Specification for roller pan mixer.
IS: 2505 - 1992	Specification for concrete vibrations, immersion type.
IS: 2506 - 1985	Specification for screed board concrete vibrator.
IS: 2514	Specification for concrete vibrating tables.
IS: 3366	Specification for pan vibrators.
IS: 4656	Specification for form vibrators.
IS: 2722	Specification for portable swing weigh-batchers for concrete (single and double bucket type).
IS: 2750	Specification for steel scaffoldings.

2.3 Codes for Practice:

IS: 456 - 2000	Code of practice for plain and reinforced concrete.
IS: 1343 - 1980	Code of practice for pre-stressed concrete.
IS: 457 – 1957	Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.
IS: 3370 - 1965	Code of practice for concrete (Part-I to IV) structures for storage of liquids.
IS: 3935 - 1966	Code of practice for composite construction.
IS: 3201 - 1988	Criteria for design and construction of pre cast concrete trusses.
IS: 2204 - 1962	Code of practice for construction of reinforced concrete shell roof.

IS: 2210 - 1988	Criteria for the design of RC shell structures and folded plates.
IS: 2751	Code of practice for welding of mild steel structures or folded plates.
IS: 2502	Code of practice for bending and fixing of bars for concrete reinforcement.
IS: 3558	Code of practice for use of immersion vibrators for consolidating concrete.
IS: 3414 - 1968	Code of practice for design and installation of joints in buildings.
IS: 4014 - 1967	Code of practice for steel tubular, scaffolding.
IS: 2571 - 1970	Code of practice for laying in-situ cement concrete flooring.

3. CAST IN-SITU CONCRETE

3.1 Related Work

a. Concrete Formwork

b. Concrete Reinforcement

c. Concrete Finishing

d. Sealants

3.2 Definitions

a. Water/ Cement Ratio:

The ratio by weight of water to cement in a mix expressed as a decimal fraction.

b. Hot Weather:

Shade air temperature of 37°C and higher.

3.3 Quality Assurance

a. Supervising staff shall have qualifications and experience specified in the contract.

b. The following tests shall be carried out by the approved agency:

- Testing preliminary test cubes
- Testing work test cubes
- Testing in-situ concrete at site by hammer test, ultrasonic tests and core tests.

c. Standards:

Comply with the following codes, specifications and standards and as shown on the drawings.

IS: 456 - 2000 Specifications for plain and reinforced concrete.

IS: 269 – 1976 Specifications for ordinary and low heat Portland cement.

3.4 Materials

Materials covered under this section of specification are:

a. Cement

b. Aggregates (Coarse and Fine)

c. Water

d. Admixture

e. Miscellaneous

a. Cement

- Contractor will have to make his own arrangements for the storage of adequate quantity of cement. Cement in bulk may be stored in bins or silos, which will provide complete protection from dampness, contamination and minimize caking and false set. Cement shall be stacked well away from the outer walls and insulated from the floor to avoid contact with moisture from ground and so arranged as to provide ready access. Damaged or reclaimed or partly set cement will not be permitted to be used and shall be removed from the site. The storage bins and storage arrangements shall be such that there is no dead storage. No more than 12 bags per row and shall be stored as received and shall be consumed in the order of their delivery.
- Cement held in storage for a period of ninety (90) days or longer shall not be used. Should at any time the have reasons to consider that any cement is defective, then, irrespective of its origin and or manufacturer's test certificate, such cement shall be tested immediately at a National Test Laboratory/ approved laboratory. Until the results of such tests are found satisfactory, it shall not be used in any works.
- Cement used in the works shall conform to only the following:

  Ordinary Portland cement of:

  Grade 43 conforming to IS: 8112

  Grade 53 conforming to IS: 12269

  Portland pozzolana cement (fly ash based) 43 grade conforming to IS:1489 (Part-I)
- Setting time of cement of any type or any grade specified in these specifications, when tested by the vicat apparatus method described in IS:4031 shall conform to the following limits:

  Initial setting time: not less than 30 minutes

  Final setting time: not more than 600 minutes.
- Cement to be used for the manufacture of concrete of different grades and for different purposes shall be as specified by the user/ purchaser of such concrete and as approved

b. Aggregates:

- Coarse Aggregate:

❖ Coarse aggregate for the manufacture of concrete shall conforming to IS:383 and IS:2386.

❖ Coarse aggregate shall consist of naturally occurring stones and gravels. They shall be hard, strong, dense, durable, clear and be free from veins and adherent coatings. These should be free from injurious amounts of disintegrated pieces, alkali, vegetable matter and other deleterious substances. Flaky and elongated pieces should be avoided as far as practicable and shall not exceed the permissible limits specified in the IS specifications.

❖ Single sized coarse aggregates or graded coarse aggregate for manufacture of concrete shall have grading as given in table SA-I and SA-II respectively.

Table SA-I

IS Sieve	% passing through for single sized coarse aggregates of nominal sizes				
	40mm	20mm	16mm	12.5mm	10mm

63mm	100	-	-	-	-
40mm	85 to 100	100	-	-	-
20mm	0 to 25	85 to 100	100	-	-
16mm	-	-	85 to 100	100	-
12.50mm	-	-	-	85 to 100	100
10mm	0 to 5	0 to 20	0 to 20	0 to 20	85 to 100
4.75 mm	-	0 to 5	0 to 5	0 to 5	0 to 20
2.36 mm	-	-	-	-	0 to 5

Table SA-II

IS Sieve	**% passing through for single sized coarse aggregates of nominal sizes**			
	40mm	**20mm**	**16mm**	**12.5mm**
63mm	100	-	-	-
40mm	95 to 100	100	-	-
20mm	30 to 70	95 to 100	100	-
16mm	-	-	95 to 100	100
12.50 mm	-	-	-	95 to 100
10mm	10 to 35	22 to 55	30 to 70	40 to 85
4.75 mm	0 to 5	0 to 10	0 to 10	0 to 10

- Strength and other tests for coarse aggregates shall be done in accordance with IS: 2386 as per instructions of and all such test reports shall be furnished to him for his approval before any aggregate is used in manufacture of concrete for the works.
- Maximum nominal size of coarse aggregate to be used for the manufacture of concrete of different grades and different purposes shall be as specified by the user/ purchaser of such concrete and as approved by the .
- Coarse aggregate should be free from soft, thin, porous, laminated or flaky pieces, dust and foreign matter.
- It shall be chemically inert when mixed with cement.
- It shall have a minimum specific gravity of 2.6 (standard surface dry basis)

- Fine Aggregate:

- ❖ Shall be washed dry sand and shall conform to IS: 383.
- ❖ Shall pass through IS sieve 4.75mm test sieve leaving a residue not more than 5%.
- ❖ Shall not contain any traces of silt.
- ❖ Shall comprise of either naturally occurring sand or crushed and milled stone and gravels or a combination thereof. These shall be free from injurious amounts of alkali, vegetable matter and other deleterious substances.
- ❖ Strength and other tests for coarse aggregates shall be done in accordance with IS: 2386 as per instructions of and all such test reports shall be furnished to them for their approval before any of the fine aggregate is used in manufacture of concrete for the works.

c. Water:

- Water for mixing shall be from potable supply system or from bore well supply IS: 456-2000 gives permissible limits for solids in water.
- Water for curing shall be from potable supply or from bore well supply.
- Water which may erode or dis colour concrete or which has got more than 1000ppm of chloride content shall not be used.
- Water proposed to be used for manufacture of concrete and curing of concrete shall be tested as per recommendations of IS: 3025. All such test reports shall be furnished to the PMC
- The PH value of water to be used for manufacture of concrete shall not be less than 6.
- Prior to testing of water sample, it shall not have any pre-treatment. Sample shall be stored in a clean container previously rinsed out with the same water.

d. Admixtures

1. General:

   Admixtures may be used in concrete only with the approval of / Engineer-in-charge based upon evidence that with the passage of time, neither the compressive strength nor its durability get reduced. Calcium chloride shall not be used for accelerating set of the cement for any concrete containing reinforcement, or embodied steel parts. When calcium chloride is permitted to be used, such as in mass concrete works, it shall be dissolved in water and added to percent of the weight of the cement in each batch of concrete. When admixtures are used, the designed concrete mix shall be corrected accordingly. Admixture shall be used as per manufacturer's instructions and in the manner and with the control specified by / Engineer-in-charge.

2. Air Entraining Agents:

   Where specified and approved by / Engineer-in-charge, neutralized vinsol resin or any other approved air entraining agent may be used to produce the specified amount of air in the concrete mix and these agents shall conform to the requirements of ASTM standard 6-260, air entraining admixtures for concrete. The recommended total air content of the concrete is 4% plus or minus 1%. The method of measuring air content shall be as per IS:1199.

3. Retarding Admixtures:

   Where specified and approved by / Engineer-in-charge retarding agents shall be added to the concrete mix in quantities specified by / Engineer-in-charge.

4. Water Reducing Admixtures:

   Where specified and approved by / Engineer-in-charge water reducing lingo sulfonate mixture shall be added in quantities specified by / Engineer-in-charge. The admixtures shall be added in the form of a solution.

5. Waterproofing Agent:

   Where specified and approved by / Engineer-in-charge, chloride and sulphide free water proofing agent shall be added in quantities specified by / Engineer-in-charge.

6. Other Admixtures:

   The / Engineer-in-charge/ Structural consultants may at his discretion instruct the contractor to use any other admixtures in the concrete.

7. If the Contractor so wishes to use admixtures, then the following should be adhered to (subject or / Engineer-in-charge/ Structural consultants approval).

- No reduction will be allowed to target mean strength when compared to admixture free concrete of the same class.
- Dosage of admixture shall be strictly in accordance with the manufacturer's instruction.

8. The following information about the admixture shall be submitted to the / Engineer-in-charge/ Structural consultant for record and approval.

- Certificate confirming that the use of a particular brand of mixture shall not be harmful to concrete in any way.
- Certificate confirming the exact dosage of admixture of a particular brand.
- Certificate stating the specific purpose for which the admixture is to be used.
- Special precautionary measures to be taken in the manufacture of concrete when using the particular of admixture.
- Certificate confirming that the admixture conforms to specifications of IS:9103 or to ASTM – C 141, ASTM – C 595 or to ASTM – C 618.
- Effect of admixture of concrete permeability:

  Long and short term effects of the admixture in the concrete and effects of over and under dosage.

  The Contractor when requested shall provide the services of a full time field technician of the admixture manufacturer at his own cost, to advise the proper addition of the admixture to the concrete or adjustment of concrete mix proportions to meet changing conditions.

  The Contractor shall furnish a statement of responsibility from the admixture manufacturer for their products.

e. Miscellaneous

- Chemical curing compound of approved make to form a membrane or surface which will disintegrate and flake from that surface over a period of days commencing at least 7 days after application.
- Vapour barrier and separation layer to underside of concrete slab, with grade 10 mil (0.25mm) thick polyethylene sheets with laps 100mm on sides and ends.

11. MATERIALS HANDLING AND STORAGE

a. Cement shall be delivered in original sealed and branded bags and shall be stored and neatly stacked above the ground by at least 200mm, stacking each batch separately and using in order of delivery.

b. Cement deteriorated or clotted shall not be used.

c. Cement register showing receipts and consumption shall be maintained.

d. Effective precautionary measures shall be taken to eliminate dust-nuisance during loading or transferring cement.

e. Sand shall be stacked carefully on a clear, hard, dry surface and shall not get mixed with deteriorated foreign materials.

f. Moisture variation in fine aggregates shall be restricted to 0.5% per hour. To ensure stable moisture content in fine aggregate before loading in batch plant bin, moisture meter shall be used.

g. Admixtures, being manufactured ingredients for use in concrete, shall be handled as packed by manufacturers, damaged packing shall not be acceptable and contents of such packages shall not be used in the works.

12. MIX DESIGN AND PROPORTIONING

a. Mix proportions shall be designed to ensure that all the workability of fresh concrete is suitable for conditions of handling and placing, so that after compaction it surrounds all reinforcements and completely fills the formwork. When concrete is hardened, it shall have the stipulated strength, durability, and impermeability.

b. Determination of the proportions by weight of cement, aggregates and water shall be based on design of the mix.

c. As a trial the manufacturer of concrete may prepare a preliminary mix according to provisions of SP: 23-1982. Reference may also be made to ACI 211.1-77 for guidance.

d. Mix design shall be tried and the mix proportions checked on the basis of tests conducted at a recognized laboratory approved by .

e. All concrete proportions for various grades of concretes shall be designed separately and the mix proportions established keeping in view the workability for various structural elements, methods or placing and compacting. Irrespective of the variables, each grade of concrete being produced for works shall meet the characteristic strength requirements as given in table given below when tested in accordance with IS: 516.

Concrete grade	Specified characteristic cube compressive strength at 28 days
M – 20	20 N/mm2
M – 25	25 N/mm2
M – 30	30 N/mm2
M – 35	35 N/mm2
M – 40	40 N/mm2

Strength values given in above table shall alone be the criterion for acceptance or rejection of the concrete.

f. In order to get a relatively quicker idea of the strengths gained by concrete, tests shall be conducted in accordance with IS: 516 as per requirement and instructions of , for tests to determine modulus of rupture and compressive strengths. For such test results, with ordinary portland cement, the guideline values shall be as given in table below:

Concrete grade	Compressive strength of cubes at 7 days (N/mm2)	Modulus of rupture by beam test	
		(N/mm2) at 72 +/-2 hrs	7 days
M – 20	13.5	1.7	2.4
M – 25	17.0	1.9	2.7

M – 30	20.0	2.1	3.0
M – 35	23.5	2.3	3.2
M – 40	27.0	2.5	3.4

g. Concrete compressive strength tests for preliminary works including trial mix design conducted in accordance with IS: 516 under controlled laboratory conditions shall meet the requirements of values stipulated in the table given below:

Concrete grade	**Compressive strength of cubes (N/mm2)**	
Designation days	**at 7 days**	**at 28 days**
M – 20	17.5	26
M – 25	22.0	33
M – 30	26.0	39
M – 35	31.0	46
M – 40	35.0	52

h. The minimum quantity of cement to be used for different grade of concrete are as follows:

	43 GRADE	**53 GRADE**
M 15	280 Kg/cum	280 Kg/cum
M 20	318 Kg/cum	290 Kg/cum
M 25	350 Kg/cum	300 Kg/cum
M 30	388 Kg/cum	335 Kg/cum
M 35	423.5 Kg/cum	375 Kg/cum
M 40	459 Kg/cum	410 Kg/cum

NOTE: These are minimum quantity of cement to be used irrespective of the design mix.

Standard Deviation:

a. Assumed Standard Deviation:

Where sufficient test results for a particular grade of concrete are not available, the value of standard deviation given in table below may be assumed.

Grade of Concrete	**Assumed Standard**
(As per IS: 456-2000, Page: 23, Table-8)	
M 10	(3.5)
M 15	(3.5)
M 20	(4.0)
M 25	(4.0)
M 30	(5.0)
M 35	(5.0)
M 40	(5.0)

However, when adequate past records for a similar grade exists and justifies to the designer a value of standard deviation different from the shown in table above, it shall be permissible to use that value.

b. Standard deviation based on test results:

- Number of test results: Total number of test results required to constitute an acceptable record for calculation of standard deviation shall be not less than 30. Attempts should be made to obtain the 30 test results, as early as possible, when a mix is used for the first time.
- The calculation of the standard deviation shall be brought up to date after every change of mix design and at least once a month.

c. Determination of standard deviation:

- Concrete of each grade shall be analyzed separately to determine its standard deviation.
- The standard deviation of concrete to a given grade shall be calculated using the following formula from the results of individual tests of concrete of that grade obtained as specified for test strength of sample.
- Estimated standard deviation S=Square root of (sum of squared deviations of the individual strength of n samples divided by n-1) where n= number of sample test results.
- When significant changes are made in the production of concrete batches (for example changes in the materials used. mix design, equipment of technical control), the standard deviation value shall be separately calculated for such batches of concrete.

Proportioning, Batching and Mixing of Concrete:

a. Proportioning:

- Aggregate:

The proportions, which shall be decided by conducting preliminary tests, shall be by weight. These proportions of cement, fine and coarse aggregates shall be maintained during subsequent concrete batching by means of weigh batchers conforming to IS: 2722 capable of controlling the weights within one percent of the desired value. Except where it can be shown to the satisfaction of the / employer that supply of properly graded aggregate of uniform quality can be maintained over the period of work, the grading of aggregate shall be controlled by obtaining the coarse aggregate in different sizes and blending training the coarse aggregate in different sizes and blending them in the right proportions. The different sizes shall be stocked in separate stockpiles. The grading of coarse and fine aggregate shall be checked as frequently as possible, as determined by **PMC** to ensure maintaining of grading in accordance with the samples used in preliminary mix designs. The material shall be stockpiles well in advance of use.

- Cement:

The cement shall be considered by weight, for design mix.

- Water:

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

- Definition of Water/ Cement Ratio:

The water cement (W/C) ratio is defined as the weight of water in the mix (including the surface moisture of the aggregates) divided by the weight of cement in the mix.

The actual water cement ratio to be adopted shall be determined in each instance by contractor and approved by the **PMC**

- Proportioning by Water/ Cement Ratio:

The W/C ratio specified for use by shall be maintained. Contractor shall determine the water content of the aggregates as frequently as desired by the PMC as the work progresses and as specified in IS: 2386 (Part-III) and the amount of mixing water added at the mixer shall be adjusted as directed by the so as to maintain the specified W/C ratio. To allow for the variation in their moisture content, suitable adjustments in the weights of aggregates shall also be made.

b. Batching and mixing of concrete:

- The proportions of the materials for the concrete mix as established by the preliminary test for mix design shall be followed for all the concrete in the works and shall not be changed except when specifically permitted by the .
- If approved by the PMC concrete may be produced by volume batching the ingredients except the cement. Fine and coarse aggregate shall be proportioned volumetrically by subsequent conversion of the weights of volumes knowing their bulk densities as stipulated in paragraph 9.2.2 or IS:456-2000. All concrete shall be mixed in mechanically operated batch mixers complying with IS: 1791 of approved make with suitable provisions of correctly controlling water delivered to the drum. The quality of water actually entering the drum shall be checked with reading of gauge or valve setting before starting the job. The test shall be made while mixer is running. The volume of the mix material shall not exceed the manufacturer's rated mixer capacity. The batch shall be charged into the mixer so that some water will enter the drum in advance of cement and aggregates. All water shall be in the drum by the end of 15 seconds of the specified mixing time. Each batch shall be mixed until the concrete is uniform in colour for the minimum period of 2 minutes after all the materials and water are in the drum. The entire contents of the drum shall be adjusted in one operation before the raw materials for succeeding batches are fed into the drum. The entire contents of the drum shall be adjusted in one operation before the raw materials for succeeding batches are fed into the drum. The weighing gauge of mix shall be periodically checked or as directed by the .PMC The contractor should carry out rectifications immediately if found necessary.
- Mixer and the weight batcher shall be maintained in clean and serviceable condition. The accuracy of the weight batcher shall be periodically checked. Both mixer and the weight batcher shall be set up level on firm base and the hopper shall be loaded evenly. The needle shall be adjusted to zero when the hopper is empty fine and coarse aggregates shall be weighed separately.
- Each time the work stops, the mixer shall be cleaned out and in the next mixing, the first batch shall have 10% additional cement to allow for sticking in the drum.

Batching aggregate by volume in the site:

a. Obtain approval before using this method.

b. Batch cement by weight and water by either weight or volume.

c. Measure aggregate in metal container whose depth is not less than their greater width and the size of which is such as to enable the whole to be easily checked.

d. Concrete shall be mixed in concrete mixers until a uniform distribution of the material and a uniform colour and consistency is obtained.

e. Concrete mixing shall in no case be less than two minutes.

f. Each batch shall be so charged into the mixer that approximately 10% of the water enters the drum before the cement and aggregate. Water shall be added gradually while the drum is in motion, so that all the water is in the drum until the first quarter of the minimum time.

g. The amount of concrete mixed in drum shall not exceed the rated capacity of the mixer and the whole of the material shall be removed before a fresh batch enters the drum.

h. Do not modify the mixed concrete either by addition of water or cement or other means.

i. Admixture dosage, point of application, the desired results should be clearly understood.

j. Accelerators, retarders, plasticizers, integral waterproofing compound are the additives commonly used.

k. Expiry date of the chemical should be checked before use.

Cleanliness:

a. Clean mixer and handling plant by washing with clean water at the end of the work and at intervals of 30 minutes during mixing.

b. If old concrete mix remains in the mixer drum, rotate the drum with clean aggregate and water before mixing the cement.

13. ORDINARY CONCRETE

a. Ordinary cement concrete where specified shall be used.

b. Proportions 1:3:6, 1:2:4, 1:1.5:3, etc., in the specification refers to the quantity of cement by volume, dry coarse sand by volume, quantity of coarse aggregate by volume.

c. Cement shall be weighed based on 1cum of cement weighs 1440kg or 1 full bag of cement 50kg corresponding to 35litres by volume.

d. Correction factors to be applied for bulking of sand when the sand is either wet or moist.

e. Water cement ratio used shall be just sufficient for the workability of concrete.

f. Minimum strength of concrete shall be obtained as below:

Sl. #	Proportion of concrete	Preliminary tests	Work tests
1	1:3:6	135 kg/Sqcm	100 kg/Sqcm
2	1:2:4	200 kg/Sqcm	150 kg/Sqcm
3	1:1.5:3	265 kg/sq.cm	200 kg/sq.cm

Compressive strength of concrete shall be obtained by testing 15cm cubes at 28 days curing.

g. Testing: 6 cubes shall be taken from any mix, 3 of them to be tested at 7 days, 3 at 28 days.

h. Strength of concrete at 7 days shall be 2/3rds of the strength of concrete at 28 days.

i. Strength of concrete at 28 days shall be as mentioned in a table and the criterion for accepting concrete is only the strength of concrete at 28 days.

14. READY MIX CONCRETE

Reference – IS: 4926-1976

a. Material:

- Cement: The cement used shall be ordinary portland cement or low heat portland pozzolana cement conforming to IS: 1489-1976 or rapid hardening portland cement conforming to IS: 8041-1976 as may be specified by consultant at the time of placing the order. If the type is not specified, ordinary portland cement shall be used.
- Fly ash when used for partial replacement of cement, shall conform to the requirements of IS: 3812 (Part-I)-1966.
- Water used for concrete shall conform to the requirement of IS: 456-2000.
- Admixtures shall only be used when so agreed to between the purchases and the manufacturer. The admixtures shall conform to the requirements of IS: 456-2000 and their nature, quantities and methods of use shall also be specified. Fly ash when used as an admixture for concrete shall conform to IS: 3812 (Part-II)-1966.
- Measurement and Storage of Materials: Measurement and storage of materials shall be done in accordance with the requirements of IS: 456-2000.

b. Basis of supply:

- The ready mixed concrete shall be manufactured and supplied on the following basis:

  Specified strength based on 28-day compressive strength of 15cm cubes tested in accordance with IS: 456-2000.

  When the concrete is manufactured and supplied on the basis of specified strength, the responsibility for the design of mix shall be that of the manufacturer and the concrete shall conform to the requirements specified.

c. Measurement of Ready Mixed Concrete:

- The basis of purchase shall be the cubic meter of plastic concrete as delivered to the purchaser.
- The volume of plastic concrete in a given batch shall be determined from the total mass of the batch divided by the actual mass per cum of concrete. The total mass of the batch shall be calculated either as the sum of the masses of all materials, including water, entering the batch or as the net mass of concrete in the batch as delivered. If the purchaser wishes to verify the total mass of the batch, this shall be obtained from the gross and tare masses of the vehicle on a stamped weigh bridge. The mass per cum shall be determined in accordance with the method given in IS: 1199-1959.

d. General Requirement:

- In addition to the requirements specified in this standard and subject to such modifications as may be agreed to between the purchaser and the manufacturer at the time of placing order, the ready-mixed concrete shall generally comply with the requirements of IS: 456-2000.
- The minimum quantity of cement and the details regarding proportioning and works control shall be as per tender clause.
- When a truck mixer or agitator is used for mixing a transportation of concrete, no water from the truck-water system or from elsewhere shall be added after the initial introduction of the mixing water for the batch, except when on arrival at the site of the work, the slump of the concrete is less than that specified; such additional water to bring the slump within required limits shall be injected into the mixer under such pressure and direction of flow that the requirements for uniformity are met.
- Unless otherwise agreed, when a truck mixer of agitator is used for transporting concrete, the concrete shall be delivered to the site of the work and discharge shall be complete within 1.5 hours (when the prevailing atmospheric temperature is

above 20°C) and within 2 hours (when the prevailing atmospheric temperature is at or below 20°C) of adding the mixing water to the dry mix of cement and aggregate or of adding the cement to the aggregate, whichever is earlier.

- Temperature: The temperature of the concrete at the place and time of delivery shall be not less than 5°C. Unless otherwise required by the purchaser, no concrete shall be delivered, when the site temperature is less than 2.5°C and the thermometer reading is falling.
- The temperature of the concrete shall not exceed 5°C above the prevailing shade temperature, when the shade temperature is over 20°C. The temperature of concrete mass on delivery shall not exceed 40°C.
- Sampling and testing: Adequate facilities shall be provided by the manufacturer for the purchaser to inspect the materials used, the process of manufacture and the methods of delivering the concrete. He shall also provide adequate facilities for the purchaser to take samples of the materials used.

  Unless otherwise agreed to between the purchaser and the supplier, the sampling and testing of concrete shall be done in accordance with relevant requirements of IS: 456-2000, IS: 1199-1959 and IS: 516-1959.
- Consistency or workability: The tests for consistency or workability shall be carried out in accordance with requirements of IS: 1199-1959 or by such other method as may be agreed to between the purchaser and the manufacturer.
- Strength Test: The compressive strength and flexural strength tests shall be carried out in accordance with the requirements of IS: 516-1959 and the acceptance criteria for concrete whether supplied on the basis of specified strength or on the basis of mix proportion, shall conform to the requirements of IS: 456-2000.

15. VACUUM DE-WATERING CONCRETING

a. Preparation:

- The surface to receive flooring shall be clean, free from dirt, oil and free from foreign material.
- Any undulations or mortar remaining on the floor shall be trimmed.
- Base course shall be trimmed.
- The base shall be cleaned and watered before laying the floor.
- Work includes at all depths and heights.
- The finished surface shall be kept wet for a minimum period of one week.

b. Concreting:

- General:

❖ Concreting shall have a concrete base of specified strength and thickness.

❖ Flooring shall have hard top on the concrete base.

❖ Flooring shall be laid in strips, the size of which is mentioned on the drawings.

- Materials:

	Cement	-	Portland
Sand	- River sand		
	Aggregate	-	Maximum size 10 to 20mm
	Water	-	Potable
	Hardner (Optional)	-	@3kg/Sqm

- Execution:

❖ Mix cement, sand and aggregates in required proportion thoroughly with water to get an appropriate consistency.

❖ Prepared concrete shall be laid immediately after mixing.

❖ The base shall be free from water and other foreign materials, dust and dirt.

❖ A coat of cement slurry of the consistency of thick cream shall be brushed on the surface of the base course.

❖ The concrete shall then be spread over this base evenly and leveled carefully to the required thickness.

❖ Low areas shall be filled with concrete and humps removed. De-vacuumisation shall be done for removing the voids.

❖ The whole concrete surface shall be leveled, compacted by ramming and troweling.

❖ Prepared surface shall be allowed to set.

❖ Hardener screed:

Hard top to be prepared as per the specifications with specified hardner.

The hard top shall be provided over concrete base immediately after it is set, compacted and leveled with a steel trowel.

The surface shall be troweled to bring the hardener coat to a leveled surface.

Excessive toweling shall be avoided.

After the initial set further compaction shall be done by steel toweling.

Final brushing shall be made before the topping becomes too hard.

c. Curing:

Curing shall commence as soon as the surface is hard enough to receive the water.

The surface shall be covered with sacks or sand and shall be kept continuously wet for a period of at least one week.

16. PLANNING OF CONCRETE

a. shall be informed 24 hours in advance before the pour of each concrete to allow for inspection of reinforcement, sizes and levels of the members to be concreted, concrete cover, cleanliness, filling of gaps and wides and supporting props.

b. Ensure that the spaces to receive concrete are clear and free from debris and free from water.

c. Transportation: Use approved method to identify that the grade of concrete to be placed in proposed location.

d. Use suitable stools, walkways, barrow runs, for movement over reinforcement or freshly placed concrete.

e. Clean the transportation equipment immediately after use or whenever cement and aggregate is used by using clean water.

17. PLACING OF CONCRETE

a. Record time and date of all concrete pours.

b. Avoid double handling.

c. Do not discharge concrete through reinforcement or other obstruction in the way, which may cause uneven dispersal, segregation or loss of ingredients.

d. Do not move concrete into position with rakes or vibrators.

e. Use suitable chutes or trucking to place concrete where reinforcement is congested.

f. Sufficient placing capacity shall be arranged for so that concrete can be kept plastic and free of cold joints while placing.

g. Concrete shall be laid in layers not exceeding 300mm thick. Inclined layers and cold joints shall be avoided. For monolithic construction, each layer shall be placed while the underlying layer is still responsive to vibrations and compactions. Shallow layers permit knitting the layers together by proper vibration.

h. On sloping surfaces, concrete shall be placed on the lower end of the slope first and progressing upwards, thereby increasing natural compaction.

i. High velocity discharge/ dumping of concrete segregation shall not be permitted.

j. Finished surfaces of placed concrete shall be protected by planned walkways and the surface kept covered till these are strong enough to resist damage from traffic to which these may be exposed.

k. Use suitable chutes to pour concrete if the depth of pour is more than 1.5m.

18. COMPACTION

a. Compact to full depth of fresh concrete to ensure full compaction and amalgamation with previous batches. Do not damage adjacent partly hardened concrete.

b. Compact until air bubbles cease to appear.

c. Vibrators shall not be used for moving concrete laterally and shall be inserted into concrete vertically at close intervals.

d. Immersion vibrators shall be inserted vertically at points not more than 50mm apart and withdrawn when air bubbles cease to come to the surface. Immersion vibrators shall be withdrawn slowly, in no case shall immersion vibrators be used to push concrete inside the forms. Particular attention shall be paid to vibration at the top of a lift eg. in a column or wall.

e. Concrete shall be thoroughly poured around the reinforcement and embedded fixtures, spread against corners of the form work by pushing, roding or by any other approved means and the member compacted by mechanical vibrator approved by the PMC

f. Vibrators shall be of immersion type with frequency of 100Hz. minimum when operating in concrete, or the exterior with a frequency of 50Hz. minimum. The number and size shall be as such to ensure vibration throughout the volume of the concrete.

g. Apply suitable size vibrators systematically at such intervals that zones of influence overlap.

h. Apply vibrators at any one point only until proper compaction is achieved and no segregation occurs.

i. In case of any honeycombs in the concrete occurs, then the contractor at his own expenses has to repair the honey combs using approved chemicals.

j. Adequate number of stand by vibrators shall be kept ready while placement and compaction of concrete is in progress.

19. CASTING METHODS

a. Slabs cast on ground in strips and not in alternate bays.

b. Casting walls:

Cast in successive pours working away in both directions from the center with no shrinkage gaps except for a final closure.

c. Casting kickers:

Casting kickers shall be the same as far the main member and shall be vibrated or rammed into place and prepared as for other joints.

d. Casting kickers for walls monolithic with foundation concrete.

e. Casting kickers for columns after foundation/ slabs or cast.

20. JOINTS

a. Construction Joints:

- Keep the number of construction joints to a minimum consistent with reasonable precautions against shrinkage.
- Locate to take due account of shear and bending stresses.
- Arrange joint line to coincide with feature of finished work.
- Form at right angles to main reinforcement.
- Reinforcement shall continue through joints.
- Provide with a key in walls, slabs as shown in drawings.
- All cold joints should be treated with bonding agent before laying the next concrete.

b. Expansion Joints:

- Joint filler shall be of specified material.
- Sliding type rigid bearing pad of structural grade shall be used.

c. Horizontal Joints in Walls:

Form horizontal joints in walls designed to be continuous with floor slabs at the top of an integrally cast kicker of minimum specified height. No other horizontal joints will be allowed.

d. Form Horizontal Joints in Walls other than in (c) above:

- At the top of footing
- At the top of slabs
- At a minimum 20mm above the soffit of beam or girders connecting into columns.
- 15mm above soffit of suspended floors.

e. Construction Joints of Slabs cast on ground:

- To comply with IS codes.
- To align with column or grid lines where practicable.

f. Isolation Joints:

- Form diamond shaped or circular separations around columns.
- Ensure all edges of slabs are isolated from adjoining construction.

g. Control Joints:

- Space at 4 to 7 meter in width for one panel.

- Form by either:

❖ Sawing a continuous straight line in the top of the slab.

❖ Grooving fresh concrete with hand grooves.

Placing strips of wood, metal or pre-moulded joint material at joint locations.

Top edges of strips shall be flush with concrete.

Control joints shall be extended 1/5 to 1/4 times slab thickness into the slab.

h. Construction Joints in Suspension Slabs:

- Locate near the middle of slabs, beams or girders, unless a beam intersects a girder at the middle location, in which case offset joints in girders a distance equal to twice the width of the beam.
- Make provision for transfer of shear and other forces through construction joints.

i. Vertical Joints in Walls:

Space not exceeding 5m centers and also locate where abrupt changes in thickness or height occur, at least 2m from corner.

21. CURING AND PROTECTION

a. Protect freshly placed concrete from premature drying and excessive cold or heat.

b. Maintain concrete without drying, at a relatively constant temperature, for the time necessary for hydration of the cement and proper hardening.

c. Initial curing to commence as soon as free moisture disappears from concrete surface after placing and finishing.

d. Keep concrete continuously moist for at least 72 hours.

e. Final curing commences immediately following initial setting and before concrete has dried.

f. Moist curing shall be done either by pounding (overcharge horizontal areas) or by spraying of water at intervals so that the surface is never dry.

g. For vertical faces and soffits of slabs and beams, moist curing shall be done either by spraying or sprinkling water at intervals directly on the surfaces to keep them wet continuously, or by covering the surface with suitable absorbent membrane (hessian cloth) completely hugging the surfaces and keeping the membrane wet and covering the membrane with polyethylene sheet to keep the membrane wet.

h. Final curing to continue for at least 7 days in accordance with IS standard.

Curing Methods:

a. Moist Curing:

Covering the surface with water and keeping continuously wet by ponding.

Continuously spraying with water on the surface.

b. Liquid Membrane Curing:

Apply a membrane forming curing compound in accordance with the manufacturer's recommendations immediately within two hours of striking formwork on formed surfaces.

22. SITE QUALITY CONTROL

a. Inspection methodology for Quality Assurance:

1. Personnel:

❖ Ensure all personnel are wearing gumboots and rubber gloves.

❖ Ensure personnel are wearing safety belts during concreting at heights or on periphery of structures.

2. Before Concreting:

❖ Ensure base plate have been cleaned and sealed with sealing tape so as there is no leakage of slurry.

❖ All reinforcements are in place especially chairs.

❖ All cover blocks damaged during reinforcement layout are replaced.

❖ All sunken areas (sunken beams, toilets and cutout areas) have been properly cleaned of dust and oily substances using high pressure water cleaners.

3. During Concreting:

❖ Ensure proper grade of concrete as recommended by the consultant is employed.

❖ Ensure proper expansion joints as per working drawings and protected.

❖ Check slab and beam for parallelity using spirit levels before and after concreting.

❖ Check the top surface of fresh concrete for evenness of top surface.

❖ Ensure sufficient compaction using correct needle size of vibrator.

4. After Concreting:

❖ Curing carried as per guidelines.

❖ Columns are covered with a damp hessain/ jute cloth for 7 days.

❖ Slabs - water level is maintained during ponding.

❖ If honeycombing seen after de-shuttering, immediate touch up without delay.

❖ Ensure the cube test results are available at the end of the term indicated.

5. Tools to be used for quality inspection:

❖ Dumpy levels to check finished slab level

❖ Spirit levels 1-3m

❖ Measuring tape

❖ Plumb bob

❖ All related “Good for Construction” drawings

b. Slump Tests:

- Test fresh concrete in accordance with IS standard periodically during the day and when directed.
- Increase the frequency of slump test when washed sand is used.
- Keep on site a 'moisture content' table to enable doses of water and sand in a mix to be provided at site.

The following slumps shall be adopted for different kinds of work.

Sl. #	Description	With Vibrator	Without Vibrator
1	Mass concrete in RCC foundation footings and reinforcing walls	10-25mm	80mm

2	Beams, Slabs and Columns	25-40mm	100-125mm
3	Thin RCC section with heavy steel	40-50mm	25-150mm

c. Strength Tests:

- Preliminary test cubes made with concrete taken from test mixes, in accordance with IS standard.
- Work test cubes made in accordance with IS standard.

d. Test Cubes:

- Size: 150mm x 150mm x 150mm cube.
- To be legibly marked with the location, date of concreting.
- Where the concrete in the works is to be vibrated or not vibrated, the cubes must be cast according to the IS standards.
- Where the concrete in the works is uncompacted, pour the concrete into the mould in three layers and compact each layer with a 16mm diameter tamping rod.

e. Trial Mix:

- Within 7 days of signing the contract and before commencing work on site, prepare trial mixes for each type of concrete and submit 6 preliminary test cubes from each mix to the testing authority.
- The testing authority shall test three test cubes at 7 days and three at 28 days for each type of mix where the difference between the higher and the lowest test results from any one trial mix at 7 days exceeds 15% of the average and any cube weaker than the minimum requirement, make a further trial mix, increasing the proportion of cement if necessary to obtain the required strength.
- If any test results from any one trial mix fail to exceed the minimum strength at 28 days:

  Remove from site materials from which the trial mix was prepared.

  Provide new materials and prepare and test further trial mixes until specified requirements are achieved.

f. Work Test Cube:

- Take test cube as specified from fresh mixed concrete which is being used in the works and which has been prepared in the normal way.
- Take at least 6 cubes for each sampling and test 3 at 7 days and 3 at 28 days.
- Strength of cubes shall not be less than the minimum strength requirements for each type of concrete.
- If works test cubes fail at 7 days, at your option, defective concrete may be removed and replaced without awaiting the 28 day test results.
- If works test cubes fail at 28 days:

❖ Suspend concreting operations and do not proceed further without approval.

❖ Take test cores in accordance with IS standard or conduct in-situ load tests in accordance with IS standard on suspect work, in the presence of the / Engineer-in-charge.

❖ Replace all defective work.

❖ Re-testing shall be executed for the / Engineer-in-charge approval.

g. Frequency:

- Structural Concrete:

  At least once for each individual part of the structure or

  At least once per 100 cubic meters of concrete; whichever occurs more frequently.

h. Schedule of Tolerances:

- The concrete work shall be constructed to an accuracy, which shall permit the proper assembly of components and installations and shall compatible with the finish. The accuracy of the work shall be within the tolerances stated on the drawings or specified elsewhere and in the absence of any other requirements, shall comply with the following:

All laying out dimensions	± 5mm
Sections of concrete members	± 5mm
Surface of foundations against ground	- 5 + 10mm
Top surface of foundations, bases and piers.	+ 5 - 20mm
Surface level of floor slabs (5m straight edge)	± 5mm
Surface level of floor slabs to datum	± 10mm
Plumb of columns and walls in storey height	± 5mm
Plumb of columns and walls in full building height	± 20mm
Inside faces of lift shafts in storey height	± 5mm
Inside faces of lift shafts in full building height	± 10mm

FMW FORMWORK

1. SCOPE

This section covers the requirements for System form works providing, fabricating and erecting of formwork including propping, bracing, shoring, strutting, tying, bolting, wedging and all other temporary supports to the concrete during the process of setting and subsequent striking and removal of forms.

2. CODES AND STANDARDS

The codes and standards generally applicable to the work of this section are:

IS: 303	Specification for plywood for general purposes
IS: 456	Code of practice of plain and reinforcement concrete
IS: 883	Code of practice for design of structural timber in building
IS: 1629	Rules for grading of cut size of timber
IS: 2750	Steel scaffoldings
IS: 3337	Ballies for general purposes
IS: 4014	(Part-I & II) Code of practice for steel tubular scaffolding
IS: 4990	Plywood for concrete shuttering work

IS: 6461 Glossary of terms relating to cement concrete, Part-5 Formwork for concrete

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

2.1 Design of form:

Submission of formwork design calculations if asked for shall be produced for Structural Engineer's approval.

After Structural Engineer/ approval, forms can be fabricated. However, the approval of the formwork design in no way will relieve the contractor of his responsibility for adequately constructing and maintaining the forms so that they will function properly as required. The design shall take into account all the loads vertical as well as lateral that the forms will be carrying including live and vibration loadings. Slab centering shall be of telescopic spans or similar support held up by telescopic jacks. Casurinas/ wooden poles will not be allowed for staging or centering work.

3. MATERIALS

3.1 Formwork shall be of fabricated wood, plywood, plastic, steel and aluminum, capable of retaining the size and profile and resisting damage to the contact faces under all conditions of erecting forms, fixing steel reinforcement and placing concrete. The selection of materials suitable for formwork shall be made by the contractor subject to approval of the , based on the adequacy of quality, consistent with the specified finishes and safety. The essential requirement shall be that the formwork shall retain its dimensions and shape without bulging, buckling or sagging and produce and finish to concrete surface as envisaged by the and within the limits specified in Indian Standards.

3.2 Plywood: New Plywood used for formwork shall be 12mm thick or more, where required shuttering quality plywood complying with standards and of make approved by PMC.

3.3 Steel: Steel formwork shall be made of minimum 1.5mm thick MS sheets or as required and adequately stiffened with structural steel members.

4. FORMWORK REQUIREMENT

4.1 Plywood shall be used for Exposed Concrete surfaces where called for. Sawn and wrought timber may be used for unexposed surfaces. Inside faces of forms for concrete surfaces,"áhich are to be rubbed finished, shall be planed to remove irregularities or unevenness in the face. Formwork with linings will be permitted.

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

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

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

4.5 Excessive construction camber to compensate for shrinkage, settlement, etc. that may impair the structural strength of members and will not be permitted.

4.6 Forms for substructure concrete may be omitted when, in the opinion of the open excavation is firm enough to act as the form. Such excavation shall be slightly larger than required by the drawings to compensate for irregularities in excavation and to ensure the design requirements.

4.7 Forms shall be so designed and constructed that their removal will not damage the concrete. Face of formwork shall provide true vertical and horizontal joints, conform to the features of the structures as to location of joints and will be as directed by .

4.8 Where exposed smooth of rubbed concrete finish are required the forms shall be constructed with special care so that the resulting concrete surface will require a minimum finish.

4.9 The material specified for formwork of various structural elements shall be as follows in decreasing order of preference:

Footings	Aluminium/ Marine Plywood/ Steel sheets
Walls/ Columns	Aluminium/ Marine Plywood/ Steel/ Plastic
Beams	Aluminium/ Marine Plywood / Steel/ Plastic
Slabs	Aluminium/ Marine Plywood/ Steel / Plastic
Domes	Aluminum/ Marine Plywood/ Steel

5. BRACING, STRUTS AND PROPS

Shuttering shall be braced, strutted, propped and so supported that it shall not deform under weight and pressure of the concrete and also due to the movement of men and other materials.

Casurina poles shall not be used as props or cross braces.

The shuttering for beams and slabs shall be so erected that the shuttering on the sides of the beams and under the soffit of slab can be removed without disturbing the beam bottoms. Re-propping of beams shall not be done except when props have to be reinstated to take care of construction loads anticipated to be in excess of the design load. Vertical props may be supported on wedges so that the props can be gently lowered vertically while striking the shuttering.

6. TYPE OF FORMWORK

Prior to start of delivery of materials for formwork, the contractor shall prepare sample of different types of formwork for slabs, columns, etc. as instructed by the and obtain approval before procuring and proceeding with further fabrication work.

7. TIE BOLTS AND SPACER BLOCKS

The contractor shall use spacer blocks and removable ties for walls as far as possible. In case the contractor proposes to use tie bolts running through the concrete, the location and size of such tie bolts shall be submitted to the for their approval.

8. TIMBER

Timber used for formwork shall be easily workable with nails without splitting. It shall be stable and not liable to warp when exposed to sun and rain or wetted during concreting. Timber for exposed work shall be seasoned hardwood.

8.1 Centering/ False work:

Formwork supports or centering or false work shall be of multi-legged prefabricated steel tubular frames, in modular sizes suitably designed for easy assembly and quick dismantling.

Formwork supports, centering and scaffolding shall be only in steel and not in timber/ bally or other materials. Wherever may be the system, it shall consist of adjustable steel props and scaffolds with special arrangement for drop heads, specially designed bases, heads, clamps and accessories and shall be adequately strong and safe in respect of the loads coming on it and the height of the centering and shall ensure fast erection and dismantling.

Prefabricated modular steel tubular centering and scaffolding system shall conform to relevant Indian standards IS:2750 and IS:4014 (Part-I and II) and shall be specially designed and manufactured by any approved specialist firms engaged in design and manufacture of formwork and scaffold systems.

The contractor shall keep the posted of the contractors proposal and programme for centering/ scaffolding for important concrete elements such as transfer girders, double height (and more) floor slabs, bridge support columns, etc. In view of the large area of the ground floor slab and the repetitive nature of the slab, the contractor shall devise suitable system for ensuring quick easy erection and dismantling of the formwork. Similar designs shall be worked out for the upper floor slabs also to achieve an expeditious pouring cycle.

9. FORM OILS

Use of form oil shall not be permitted on the surfaces which require painting. If the contractor desires to use form oil on the inside of formwork for other concrete areas, a non-staining mineral oil or other approved oil/s may be used provided (Ardex Endura Make oil) it is applied before placing reinforcing steel and embedded parts. All excess oil on the form surfaces and any oil on metal or other parts to be embedded in the concrete shall be carefully removed.

Before treatment with oil, form shall be thoroughly cleaned of dried concrete from placement of previous lift.

9.1 Cleaning and Oiling of Forms:

The surface of the forms that come in contact with the concrete shall be free from incrustations of mortar, grout or other foreign material. Temporary opening shall be left at the bottom of formwork to enable sawdust. Shavings, wire cutting and other foreign material to be removed from the interior of the forms before the concrete is placed. Compressed air shall be used to clean the completed formwork and remove all traces of dust and debris before pouring concrete. The formwork shall be wetted thoroughly to prevent absorption of water in concrete. The formwork of timber shall be kept wet during concreting and for the whole time that it is left in place.
The surface of the forms to be in contact with the concrete shall be coated with an approved coating that will effectively prevent adherence of concrete and will not stain the concrete surfaces. After each use the surfaces of forms in contact with concrete shall be cleaned of mortar, etc, well wetted and treated with form oil approved by the . Lubricating (machine) oil shall not be used. Mould release agents approved by shall be used for applying on the form faces. They shall be used only strictly as recommended by the manufacturers.

10. REMOVAL OF FORMWORK

Formwork shall be removed carefully so as to prevent damage to the concrete. Wooden wedges only shall be used between the concrete surface and the form where force is necessary to separate the form from the concrete. Metal wedges, bars or tools shall not be used for this purpose. Any concrete damaged in the process of removing the forms shall be repaired in accordance with instructions.

All non-supporting forms shall be loosened and removed during regular working hours, whenever the concrete has hardened sufficiently. All false work and forms supporting concrete beams and slabs, or other members subject to direct bending stress, shall not be removed or released until the concrete has attained sufficient strength to ensure structural stability and to carry both the dead and live loads including any construction loads which may be placed upon it.

Unless otherwise permitted in writing by the forms shall not be stripped in less than the minimum periods specified in IS:456. However, they may insist on retaining the formwork for longer periods, necessary for structural stability for particular locations.

No construction loads exceeding the combination of superimposed dead load plus specified live load shall be imposed on any un-shored portion of the structure under construction, unless analysis indicates adequate strength to support such additional loads.

Formwork shall be removed in such a manner as not be impair safety and serviceability of the structure. It shall be removed gradually and in sequence where called for to prevent sudden application of loads to the concrete. The mode of removal of formwork for important structural elements shall be discussed and got approved by the before removal.

The responsibility for the safe removal of any part of the false work shall rest with the contractor.

11. REUSE OF FORMS

Immediately after the forms are removed, they shall be cleaned with jet of water and a soft brush before they are reused.

The contractor shall not be permitted to reuse any forms which in the opinion of the has worn out and has become unfit for reuse. The may in his absolute discretion order rejection of any forms he considers unfit for use in the works and order their removal from the site.

12. WORKMANSHIP AND CONSTRUCTION

12.1 Construction and Preparation of Formwork

12.1.1 General

Before construction of the formwork begins, the contractor shall decide details of the systems of formwork to be used for all main structural members for approval by the PMC

12.1.2 Formwork Design

The Contractor shall be solely responsible for the design and construction of formwork, taking due account of the surface finish required. The formwork should be sufficiently rigid and tight to prevent loss of grout or mortar from the concrete at all stages and for the appropriate method of placing and compacting.

Formwork (including supports) should be sufficiently rigid to maintain the forms in their correct positions and to correct shape and profile so that the final concrete structure is within the limits of the dimensional tolerances specified. The supports should be designed to withstand the worst combination of self weight, formwork

weight, formwork forces, reinforcement weight, wet concrete weight and construction and wind loads, together with all incidental dynamic effects caused by movement of pipe carrying pumped concrete, placing, vibrating and compacting the concrete.

The formwork should be so arranged and assembled as to be readily dismantled and removable from the cast concrete without shock, disturbance or damage. Formwork to exposed concrete surfaces shall produce a consistent and uniform texture in the exposed surface upon its removal.

12.1.3 Holes, Inserts and Fixings

Approval for the size, type and position of any holes, insert or fixing required by the contractor or any sub-contractor shall be obtained before work proceeds.

Unless otherwise specified or approved, all holes shall be formed and all inserts cast in at the time of pouring. No part of the concrete works shall be drilled or cut away without approval.

The contractor shall cast into the concrete those inserts and fixings (such as anchors, columns corner guards, sleeves, bolts, plates, etc.) shown on the drawings. They shall be securely fixed to ensure their correct location in the finished concrete.

12.1.4 Release Agents

Release agents for formwork should be carefully chosen for the particular conditions they are required to fulfill.

Release agents shall be materials marketed as such and shall be of one of the following types:

a. cream emulsion

b. neat oil with surfactant added

c. chemical release agent

Release agents should be applied so as to provide a thin uniform coating to the formwork without contaminating the reinforcement and previously placed concrete at a construction joint against which fresh concrete will be placed. Where a concrete surface is to be permanently exposed, only one agent should be used throughout the entire area and the agent shall be colourless, non-staining and have no deleterious effect upon the concrete surfaces. Where the surface is to receive an applied finish, care should be taken by the contractor to ensure that the bonding of subsequent paint or finishing materials are not adversely affected.

Release agents shall be stored and used strictly in accordance with the manufacturer's instructions.

12.1.5 Cambers

Unless otherwise directed all formwork to suspended beams and slabs shall be constructed so that the following upward cambers exist immediately before striking:

a. Spanning between supports 0.25% of span at centre

b. Cantilevers 0.4% of span at free end

c. In unusual cases such as deep transfer girders of large spans, the contractor shall get support system and formwork design approved by structural engineer.

12.1.6 Stiffness of Panels

Formwork panels shall be stiff enough to prevent damage to the concrete surface caused by excessive movements of the panel during vibration of the concrete.

12.1.7 Repair of Formwork

Damaged formwork shall not be reused if in the opinion of the the making good would impair the surface appearance of the concrete.

12.1.8 Sealers on Timber Surfaces

Where their use has been specified or approved, sealers shall be applied to surfaces which are dry and free from dirt, greases or other impurities. Before a surface is sealed, it shall be sanded to remove any protrusions or to smooth any rough areas. Any holes or indentations shall be stopped with waterproof filler. The manufacturer's instructions regarding the method of applying the sealer shall be followed exactly and the work shall be done by a skilled painter.

12.2 False work

12.2.1 Formwork Props

If formwork props are to be left in place when soffit forms are removed, they shall not be disturbed during the removal process without approval. Formwork props shall be positioned between permanent supports so that all structural members are supported at no more than 3.0m centre in both directions.

12.2.2 Propping Details

Not less than two weeks before the start of any pour requiring props the contractor shall get approval for the props he proposes to use with the likely loads.

12.2.3 Propping of floor slabs

The propping shall be arranged so that the load from the wet concrete is carried by structures which have attained their specified 28-day concrete cube compressive strength. When props are carried through from one floor to another, the props shall be aligned vertically one above the other.

12.2.4 Propping of Structural Walls

Concrete structural walls shall be propped until the wall concrete has gained the 28-day concrete cube compressive strength and all the permanent structures which contribute to the stability of the wall have been completed.

13 ERECTION OF FORMWORK

13.1 Forms shall have sufficient strength to withstand the pressures resulting from placement and vibration of concrete and shall be maintained rigidly in position. Formwork shall be supported by centering/ false work with adequate number and size of struts, braces, ties and props to ensure complete rigidity of forms during concreting. Where props rest on natural or filled up ground to avoid any settlement, the soil shall be thoroughly compacted and wooden/ steel bases provided to distribute the load. Bases of props shall be of sufficient size so as to restrict the bearing pressure on the ground to 5 ton/ Sqm.

13.2 Forms shall be tight enough to prevent loss of slurry from the concrete and to produce dense, homogeneous and uniformly coloured concrete completely free from honey-combing or surface roughness. Joints in formworks shall be designed to prevent leakage, not only between individual elements forming the panels but also from the horizontal and vertical junction between the panels themselves.

13.3 If the formwork is held together by bolts or other steel members these shall be so fixed that no steel shall be exposed on surface against which concrete is to be laid. / Engineer-in-charge may at his discretion allow the contractor to use tie bolts running through the concrete. Holes left in the concrete by these tie-bolts shall be refilled at the contractor's expenses.

13.4 Formwork shall be constructed so as to facilitate loosening and permit removal without jarring the concrete. Wedges, clamps and bolts shall be used wherever

practicable instead of nails. All frameworks shall be erected true to line and levels and shall have approval from the Engineer-in-charge before concreting is started.

13.5 Chamfer strips shall be placed in the corners of forms for exposed exterior corners, if indicated in drawings so as to produce beveled edges except where otherwise shown in the drawings. Interior corners and edges at formed joints shall not be beveled unless shown on the drawings.

14 REMOVAL OF FORMS

14.1 Contractor shall record on the drawing or a special register the date upon which the concrete is placed in each part of the work and the date on which the shuttering is removed there from.

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

14.3 In normal circumstances where temperature is above 20oC, forms may be struck after expiry of the following periods as specified in IS:456.

Sl. #	Description	Minimum period before striking formwork
A	Walls, columns, vertical sides directed by the sides of beams	16 to 24 hours
B	Slabs (props to be refixed immediately after removal of formwork)	3 days
C	Beam soffits (props to be refixed immediately after removal of formwork)	7 days
D	Removal of props under slabs Spanning up to 4.5m Spanning over 4.5m	 7 days 14 days
E	Removal of props under beams & arches: Spanning up to 6.0m Spanning over 6.0m	 14 days 21 days

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

14.5 Reinforced temporary openings shall be provided, as directed by , to facilitate removal of formwork which otherwise may be inaccessible.

14.6 Tie rods, clamps, form bolts, etc., which must be entirely removed from walls or similar structures shall be loosened not sooner than 24 hours nor later than 40 hours after the concrete has been deposited. Ties except those required to hold forms in place may be removed at the same time. Ties withdrawn from walls and grade beams shall be pulled towards the inside face. Cutting ties back from the face of walls and grade beam will not be permitted.

15 REUSE OF FORMS

Before reuse, all forms shall be thoroughly scraped, cleaned nails removed, holes that may leak suitably plugged and joints examined and when necessary, repaired

and the inside retreated to prevent adhesion, to the satisfaction of / Engineer-in-charge. Warped lumber shall be resized. Contractor shall equip himself with enough shuttering material to complete the job in the stipulated time. They may in his absolute discretion order rejection of any forms he considers unfit for use in the works and order their removal from the site.

16 FORMWORK FOR VARIOUS SURFACES

16.1 Formwork for sloped surfaces:

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

Requirements laid down in Indian Standards shall be followed in this regard.

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

16.2 Formwork for Curved surfaces:

The contractor shall interpolate intermediate sections as necessary and shall construct the forms so that the curvature is continuous between sections. Where necessary to meet requirements for curvature, the formwork shall be built up of laminated plywood strips cut to make tight, smooth form surfaces. Fabricated steel moulds for circular elliptical columns may be used, if approved by the .

After the forms have been constructed, all surface irregularities at matching faces of form material shall be dressed to the specified.

16.3 Formwork for exposed concrete surfaces:

a. Where it is desired, directed, or shown on the drawing to have original fair face finish of concrete surface without any rendering or plastering or any finish, formwork shall be carried out by using hard wood planks, shuttering plywood or steel plates as approved and as per direction of the / Engineer-in-charge. Joints in the case of planks shall be tongue and grooved.
b. he contractor shall use one type of material for all exposed concrete surfaces and the forms shall be constructed so as to produce a uniform and consistent texture on the face of the concrete. Patches or forms for these surfaces will not be permitted. The formwork shall be placed so that all horizontal formworks are continuous across the entire surface. If forms are constructed of lumber and are not paneled the formwork shall be staggered.
c. To achieve a finish which shall be free of board marks, the formwork shall be faced with plywood or equivalent material in large sheets. The sheets shall be arranged in an approved pattern. Wherever possible joints between sheets shall be arranged to coincide with architectural features, sills, window heads, or change in direction of the surface. All joints between panels shall be vertical or horizontal unless otherwise directed. Suitable joints shall be provided between sheets. The joints be arranged and fitted so that no blemish or mark is imparted to the finished surfaces.
d. Formwork boards, unless otherwise stated, shall be average 150mm wide, securely jointed with tongued and grooved joints, if so required, to prevent grout loss with the rod positions and direction of boards carefully controlled. Sawn boards shall be set horizontally, vertically or at inclination shown in the drawings. All bolt holes shall be accurately aligned horizontally and vertically and shall be filled with matching mortar recessed 5mm back from the surrounding concrete face.
e. The wood, planks, plywood and steel plates used in formwork for obtaining exposed surfaces shall not be used for more than 4 times in case of wood planks, 6 times for plywood and 10 times for steel plates respectively. However no forms will be allowed for reuse, if in the opinion of the / Engineer-in-charge it is doubtful to produce desired texture of exposed concrete.

17 TOLERANCES

Sl. #	Item	Tolerance
1.	Variation from plumb in the lines of surface of columns, piers, walls and arises	
	a) In any 3.05m height	± 6mm
	b) Maximum for total building height of approx. 50m	± 36mm
2.	Variation in plumb for exposed corner columns, control joint grooves and other conspicuous lines	
	a) In any 6.10 m height	± 6mm
	b) Maximum for total building height of approx. 50m	± 19mm
3.	Variation in level of slab, soffit, ceiling, beam soffit and in arises, measured before removal of supporting shores.	
	a) In any 3.05m length	± 6mm
	b) In any bag or in any 6.10m length	± 10mm
	c) Maximum for total length of the structure	± 19mm
4.	Variation in level of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines.	
	a) In any bay or in any 6.10m length	± 6m
	b) Maximum for the total length of the structure	± 13mm
5.	Variation in level of elevation control points for slabs on grade	
	a) In any bay for 6.10mlength	± 10mm
	b) Maximum for the total length of the structure	± 19mm
6.	Variation in linear building lines from the basic dimension in plan and related position of columns, walls, beams and partitions	
	a) In any bay	± 13mm
	b) In any 6.10m	± 13mm
	c) Maximum for the structure	± 25mm
7.	Variation in size of sleeves, floor openings and wall opening	± 6mm
8.	Variation in location of centre lines of sleeves, floor opening, and wall opening.	± 13m
9.	Variation in cross sectional dimensions of columns, beams, walls and slab thickness	
	a) Up to 305mm	
	b) More than 305mm	+ve +13mm & -ve -10mm
10.	Variation in horizontal dimension of footings with formed	+ve +51mm & -ve -13mm excavation

Sl. #	Item	Tolerance
11.	Variation in horizontal dimension of footing with unformed	+ve +76mm & -ve Nil excavation
12.	Variation in misplacement or eccentricity of footing	± 51mm or 2% of footing dimension in the direction of misplacement
13.	Variation in cross sectional thickness of footing Positive no limit	-5%
14.	Variation in alignment of footing to receive masonry construction;	
	a) In 3.05m length	± 6mm
	b) Maximum for 15.24m length	± 13mm
15.	Variation in level of footing to receive masonry construction	
	a) In 3.05m length	± 6mm
	b) Maximum for 15.24m length	± 13mm
16.	Variation in dimension of an individual step of a stairway	
	a) Riser	± 3mm
	b) Tread	± 6mm
17.	Variation in dimension of an extra flight of a stairway	
	a) Rise	± 3mm
	b) Run	± 6mm
18.	Variation in finished slab surface determined as depressions in floors between high spots using 3.05m long aluminium straight edge over five consecutive measurements per bay.	8mm
19.	Variation from specified gradient in longitudinal direction of pavements as measured with a 3.05m long aluminium straight edge.	8mm
20.	Variation from specified gradient in turnover direction of pavements as measured with a 3.05m long aluminium straight edge.	6mm
21.	Variation from specified gradient of ramps and intersection as measured with a 3.05m long aluminium straight edge	6mm
22.	Variation from specified location of dowels	± 25mm
23.	Variation in alignment of 450mm long dowels	± 6mm
24.	Variation in cross sectional dimensions of pre-cast non-pre-stressed elements	
	a) Sections up to and including 152mm	± 3mm

Sl. #	Item	Tolerance
	b) Sections between 153mm and 456mm	± 5mm
	c) Sections between 457mm and 913mm	± 6mm
	d) Sections above and including 914mm	± 10mm
25.	Variation from straight line of pre-cast non pre-stressed elements	
	a) In any 3.05m of length	± 3mm
	b) Maximum for entire Length±19 mm	
26.	Variation from specified camber of pre-cast non-pre-stressed elements	
	a) Per 3.05m of span	± 3mm
	b) Maximum for entire width	± 13mm
27.	Differential in camber between adjacent units in erected position of pre-cast, non-Pre-stressed elements	
	a) Per 3.05m of span	± 3mm
	b) Maximum for entire length	± 13mm
28.	Tolerance in measurement of quantity of materials for batching concrete	
29.	Variation from specified values of slump of concrete	± 25mm
30.	Variation from specified clearance of embedded material in concrete relative to reinforcement steel.	± 25mm
31.	Variation from specified location of embedded material in concrete.	± 6mm

STL REINFORCEMENT STEEL

1. SCOPE

This section covers the requirements for providing, fabricating, delivering and placing in positions and securing at location by binding or welding, of reinforcements for in-situ and precast non-prestressed reinforced concrete work.

2. CODES AND STANDARDS

Reinforcements for concrete may be from any of the "Grades" of steel indicated below; conforming to the latest relevant IS mentioned against each.

Grade	Description Conforming to	
Fe 250	Mild Steel	IS:432 (Part I)
Fe 490	Hard drawn steel wire	IS:432 (Part II)
Fe 415	High strength Deformed/Ribbed steel	IS:1786
Fe 500	High strength Deformed/Ribbed steel	IS:1786
Fe 550	High strength Deformed/Ribbed steel IS:1786	

2.1 Reinforcing steel may be any of the following types:

Type - I : Plain Round Bars (PR)

Type - II : Welded wire Fabrics (WWF)

Type - III : Cold Twisted Deformed Bars (CTD)

Type - IV : Thermo Mechanically Treated Ribbed Bars (TMT)

Type - V : Thermo Mechanically Treated Ribbed Corrosion Resistant bars

(Copper Bearing TMT-CR)

Type - VI : Corrosion resistant CTD bars (CTD-CR)

2.2 Unless specifically shown in drawings or instructions issued in writing by the Structural Consultant/ , steel of any grade or type other than those specified in codes and standards shall not be used for the purpose of concrete reinforcements.

2.3 Type and grade of steel to be used in a work shall be verified from and relevant drawings/ contract documents before procuring such steel.

2.4 All steel shall be procured only from original manufacturers. Re-rolled steel shall not be procured for the purpose of using them as reinforcement in concrete work.

2.5 Every consignment of steel brought to the site of works for use in reinforced concrete work, shall be accompanied by a certificate from the manufacturer giving details like process of manufacture, grade and type of steel, chemical composition of steel and results of tests giving yield strength, ultimate strength, tensile strength, elongation percentage, bond strength values, corrosion test results and fatigue test results. All such certificates shall be deposited with the for his record and reference.

2.6 Some tests to reconfirm the mechanical properties of steel be conducted on every consignment of steel received at site. Frequency of such tests shall be as under:

For every consignment of steel up to be tested or part there of:

ests to be conducted	umber of tests
Tensile strength test	1 No. for each size with a minimum of 3 tests
Bend test for: Bars smaller than and including 20mm diameter	1 No. for each size with a minimum of 3 tests
Bars larger than 20mm diameter	1 No. for each size with a min. of 3 tests
Elongation test one number from any two different sizes if applicable	Minimum of 3 No. choosing
Mass tolerance test number from different sizes if applicable	Minimum 3 test with one

All such tests shall be conducted in an approved laboratory.

2.7 Steel brought to site shall be free from mill scales, rust, grease, oil, paint or any other coatings which have deleterious effects on the performance. Bars and wires shall be cleanly rolled and shall be free from all surface defects detrimental to its use.

2.8 However, rust, seams, mill scales, or minor surface irregularities shall not be the cause for rejection. Such bars shall be properly cleaned and placed as directed by the . Tests shall be conducted in accordance with relevant IS specifications.

2.9 For acceptability of steel, test results shall comply with the values given below.

Sl.#	Steel Grade	Fe250	Fe490	Fe415	Fe500	Fe550
1	Yield strength/ 0.2% proof stress (min)	250	490	415	500	552
2	Ultimate tensile strength (min)	410	580	485	550	585
3	Elongation on gauge length 5 diameter (min)	23%	10%	14.5%	14%	12%
4	Mandrel diameter for bend test (max)					
a	For bars up to and including 20mm	2Dia	2Dia	3Dia	4Dia	5Dia
b	For bars above 20mm	3Dia	2Dia	4Dia	5Dia	6Dia
5	Mandrel diameter for re-					

	bend test (max)					
a	For bars up to and including 20mm	NA	NA	5Dia	5Dia	7Dia
b	For bars above 20mm	NA	NA	7Dia	7Dia	8Dia
6	Tolerance on nominal mass of 7.85gm/ cc	+/- 2%	+/- 2%	+/- 2%	+/- 2%	+/- 2%

2.10 Steels of all grades and all types shall have minimum carbon content of less than 0.25% by mass for guaranteed weldability.

2.11 Steel Type-V shall have a minimum copper content of 0.30% by mass.

2.12 Steel if Type-II shall be manufactured in conformity with provisions of IS:1566 and shall be certified by the manufacturer as such.

3. BINDING WIRES

3.1 Binding wire for steels of all grades and types shall normally be black annealed steel wire conforming to IS:280.

3.2 When reinforcing bars are galvanized for corrosion protection, the binding wires to be used in conjunction with such steel shall also be galvanized as per relevant specifications given elsewhere.

3.3 Binding wires to be used in conjunction with fusion bonded epoxy-coated reinforcing bars shall be plastic coated as per specifications given elsewhere.

3.4 Nominal size of binding wires shall be as under:

For bars of size less than and including 20mm : 20 Gauge

For bars of size over 20mm : 18 Gauge

4. STORAGE OF STEEL

Reinforcing steel shall be handled and stored in a manner such that bending and distortion of the bars is avoided.

All reinforcing steel shall be stored horizontally above ground level on platforms of other approved supports. Contact with soil shall be avoided. Reinforcement shall be coated with cement wash before stacking to prevent scale and rust. Fabricated reinforcement shall be carefully stored to prevent damage, distortion, corrosion and deterioration.

Reinforcing steel different varieties and sizes shall be stored separately in such a manner as will permit easy identifications of different size and type.

Reinforcing bars treated with a corrosion resistant protective coating of any kind shall be handled and stored with utmost care so as not be cause any damage to the protective coating. Such bars shall be stored separately from others.

Every stack of reinforcement stored shall be provided with a distinctively displayed identification board carrying the following information:

Grade of steel

Type of steel

Nominal size of steel

Type of corrosion treatment to steel - if provided

Delivery batch number and date.

5. QUALITY

5.1 All steel shall be of good quality. No re-rolled material will be accepted. If demanded by the , contractor shall submit the manufacturer's test certificate for steel. , as per relevant Indian Standards, may perform random tests on steel supplied by contractor. All costs incidental to such tests shall be at "contractor's expense". Steel not conforming to specifications shaF, be rejected.

5.2 All reinforcement shall be clean, free from grease, oil paint, dirt, loose mill scale, loose rust, dust, bituminous material, or any other substances that will destroy or reduce the bond. All rods shall be thoroughly cleaned before being fabricated. Pitted and defective rods shall not be used. All bars shall be rigidly held in position before concreting. No welding of rods to obtain continuity shall be allowed unless approved by the PMC If welding is approved, the work shall be carried out as per IS standards according to best modern practices and as directed by the PMC. In all cases of important joints, special precautions as specified by the PMC shall be taken in the welding of cold worked reinforcing bars and bars other than mild steel.

6. CUTTING AND BENDING

All bars shall be accurately bent according to the sizes and shapes shown on the detailed working drawings/ bar bending schedules. They shall be bent gradually by machine or other approved means. Reinforcing bars shall not be straightened and re-bend in a manner that will injure the material, bars containing cracks or splits shall be rejected. Flames cutting and hot bending are absolutely forbidden. Re-bending of bars shall be carried out only after the approval. The rating of bending shall be as follows:

a. for plain steel bars - not less than 4d

b. for high strength bars - not less than 6d

Bars incorrectly bent shall be used only if the means used for straightening and re-bending is such as shall not in the opinion of the injure the material. No reinforcement shall be bent when in position in the work without approval, whether or not it is partially embedded in hardened concrete. Bars having kinks or bends other than those required by design shall not be used. All bars shall be properly tagged for easy identification.

7. FABRICATION

7.1 Contractor shall prepare bar bending schedules for all reinforcement steel based on drawings issued for construction. Such schedules shall be approved by PMC Fabrication of reinforcements shall be commenced only on receiving approval on bar bending schedule from the PMC

7.2 Reinforcement steel shall be carefully cut-bent and formed to the dimensions and configurations shown on drawings and bar bending schedules.

7.3 All cutting, bending, fixing, binding, etc., shall be done generally in accordance with IS unless otherwise specified herein.

7.4 Bending dimension tolerances shall be as specified in IS. However, cutting tolerance for all sizes of bars and for lengths shall be limited +/- 10mm.

7.5 All bars shall be bent cold using appropriate mandrel sizes. Dimensions of bends and hooks shall be as indicated in schedules.

7.6 It shall be ensured that bars are not bent or straightened in any manner that will injure the material. Any incorrectly bent bar shall be used only when the bends are set right, provided that during straightening and re-bending the bars is not damaged in any way including formation of twisted necks.

7.7 No bars shall be bent or straightened when in position on the works without approval of the PMC whether or not such bar is partially embedded in hardened concrete.

7.8 Reinforcing steel having a reduced section, visible cracks, peels or any other defects shall not be used for the purpose of reinforcing of concrete.

8. WELDING

8.1 Wherever specified on drawings or instructed by , welded laps shall be provided.

8.2 Welding of reinforcements shall be done in accordance with:

IS: for Mild steel bars of grade Fe250

IS: for Type III (CTD bars) steel conforming to grades Fe415, Fe500 and Fe550.

For types IV and V (TMT-CR bars) of grades Fe415, Fe500 and Fe550, welding procedures shall be confirmed from manufacturer of such steel and shall be strictly followed as recommended by manufacturer.

8.3 Welding, if approved, may be used for:

Lapping reinforcement in position

Fixing reinforcement to other steel members.

8.4 The length of run deposited in a single pass shall not exceed 5xbar diameter. If a longer welded length is required, divide into sections with the space between runs not less than 5xbar diameter.

8.5 Welded joints:

Shall not be made at bends in reinforcement.

Stagger joints in parallel bars of principal reinforcement unless otherwise approved.

The distance between staggered joints shall not be less than the end anchorage length joints.

9. SPLICING

9.1 As far as practicable, bars of maximum available lengths shall be used. All bars shall preferably be in single lengths. Where such arrangements are not possible, bars shall be spliced together.

9.2 Splices may be lapped splices or welded splices, unless specifically shown on drawings or conveyed in writing by the , welded splice shall not be provided.

9.3 Where welded splices are indicated on drawings or instructed by the PMC such welding shall be provided as specified.

Where details and specific locations of splicing are not shown on drawings, lap splices shall be so provided that:

At any section not more than 50% of total numbers of bars are spliced together at any face of the member.

From the end of one splice to the beginning of the next splice in two contiguous bars, there is a clear distance of 300mm or 12 times the bar diameter whichever is greater.

9.4 Lengths of such lap splices shall be as given in table below:

Steel Grade	Steel Type	Splice lengths for grades of concrete in multiples of nominal bar diameter					
		M-20	M-25	M-30	M-35	M-40	
Fe250	I	45	40	36	32	30	
Fe490	II	89	76	71	63	56	
Fe415	III/ IV/ V		47	40	38	33	30
Fe500	III/ IV/ V		57	50	45	40	36
Fe550	III/ IV/ V		62	53	50	44	40

9.5 Splice lengths given in table are for steels which do not have any coating on the surface affecting its bond strength.

9.6 Irrespective of values obtained from the table minimum splice length shall be 300mm.

9.7 When bars of two different diameters are spliced, the splice length shall be based on the smaller of the two diameters, unless otherwise shown in drawings.

10. ANCHORING

Anchoring of bars and stirrups shall be provided exactly as detailed in the structural drawings or as directed by / Engineer-in-charge.

In case of reinforcement steel in tension, deformed bars may be used without end anchorage provided the development length requirement is satisfied. Hooks shall normally be provided for plain bars in tension. Development length of the bars shall be determined as per relevant clauses of IS.

The anchorage length of straight bar in compression shall be equal to the Development length of the bars in compression as specified in relevant clause of IS.

11. LAPPING OF BARS

Laps shall be strictly as per the structural drawing or as directed by the . For general guidance the following principles shall be followed as given in IS:456 - 2000.

11.1 As far as possible bars of the maximum length available shall be used.

11.2 Laps shown on drawings or otherwise specified by the structural consultant will be based on the contractor using bars of maximum length.

11.3 In case contractor wishes to use bars of shorter length, laps shall be provided at the contractor's expense in the manner and the locations approved by the PMC

11.4 Splices shall be provided as far as possible away from the sections of maximum stress and be staggered.

11.5 Not more than half of the bars shall be spliced at a section.

11.6 If more than half of the bars shall be spliced at a section, special case shall be ensured such as increasing length of lap or closer spacing of stirrups around the length of splice.

11.7 Lap splice shall not be used for bars having diameter larger than 36mm. For larger diameters bars it may be welded. Lap length including anchorage value of hooks in flexural tension shall be La (as defined in Article 25.2.1 of IS: 456-2000) or 30 times the diameter of the bar whichever is greater and for direct tension 2La or 30 times the diameter of the bar whichever is greater. The straight length of lap shall not be greater than 15D or 200mm, whereas D is the diameter of the bar.

11.8 Lap length in compression shall be equal to the development length in compression calculated as described in relevant clause of IS:456 - 2000 or as specified in the structural drawing but not less than 24 times the diameter of the bar.

11.9 Overlapping bars shall not touch each other and these shall be kept apart with concrete between them by 25mm or 1.25 times the maximum size of the coarse aggregate, whichever is greater.

11.10 When above is not possible, the overlapping bars shall be bound together at intervals not exceeding twice the diameter of such bars with two strands of annealed binding wire of 0.90mm to 1.6mm diameter twisted together tightly.

11.11 As and when necessary welded laps shall be proved as specified by the structural consultant.

12. SPACERS CHAIRS AND OTHER SUPPORTS

12.1 Provide necessary supports to maintain reinforcement in its correct position.

12.2 Provide spacer bars of same diameter as longitudinal bars but not less than 25mm diameter between two layers at 1.5mm centers except where bundled bars are detailed.

13. ADJUSTMENT AND CLEANING

13.1 Check reinforcement prior to and during placing concrete with particular attention to the top reinforcement in cantilever sections.

13.2 Ensure that reinforcement is clean and free from corrosive pitting, loose rust, loose mill scale, oil and other substances, which may adversely affect reinforcement concrete or the bond between the two.

13.3 Protect the projecting reinforcement from weather where the rust staining of exposed concrete surfaces may occur.

STS STRUCTURAL STEEL WORKS

1. SCOPE

The scope of this section covers the requirements for providing, fabrication, erection and placing of structural steel work for building construction including temporary supports and all other work as required for structural steel construction.

2. CODES AND STANDARDS

The codes and standards generally applicable to the work of this section are listed hereunder:

IS: 210 Grey iron castings

IS: 226 Structural steel (standard quality)

IS: 451 Technical supply condition for wood screws

IS: 800 Code of practice for use of structural steel in general building construction

IS: 801 Code of practice for use of Cold Formed Light gauge steel structural members in general building construction.

IS: 806 Code of practice for use of steel tubes in general building construction

IS: 811 Specifications for cold formed light gauge structural steel sections.

IS: 813 Scheme of symbols for welding

IS: 814 Covered electrodes for metal arc welding of (Part-I & II) structural steel

IS: 816 Code of practice for use of metal arc welding for general construction in mild steel

IS: 822 Code of practice for inspection of welds

IS: 961 Structural steel (high tensile)

IS: 1024 Code of practice for use of welding in bridges and structures subject to dynamic loading

IS: 1030 Carbon steel casting for general engineering purpose

IS: 1120 Coach screws

IS: 1161 Steel tubes for structural purposes

IS: 1182 Recommended practice for radiographic examination of fusion welded butt joints in steel plates

IS: 1363 Black hexagon bolts, nuts and lock nuts and black hexagon screws

IS: 1365 Slotted countersunk screws

IS: 1367 Technical supply conditions for threaded fasteners

IS: 2016 Plain washers

IS: 2062 Structural steel (fusion welding quality)

IS: 3063 Single coil rectangular section spring washers for bolts, nuts and screws

IS: 3443 Corner rail sections

IS: 3600 Code of practice for testing of fusion welded (Part-I) joints and weld metal in steel

IS: 3757	Specifications for High Tensile Friction Grip Bolts
IS: 4923	Hollow steel sections for structural use
IS: 5624	Specifications for Foundation Bolts
IS: 6227	Code of practice for use of metal and welding in tubular structure
IS: 7205	Code of practice for erection of steel work

3. MATERIALS

3.1 Structural Steel

Structural steel used in the works (other than steel in reinforced concrete), shall be either of the following types:

Mild steel conforming to IS:226 “Structural steel (standard quality)” or IS:2062 “Structural steel (fusion welding quality)” whichever is approved.

Whenever high tensile steel is specified, it shall be conforming to IS:961 “Structural steel (high tensile)”.

All steel tubes shall be hot finished seamless steel tubes (HFS) of the specified strength and as approved by the and shall conform to IS:1161. Tubes made by other processes and which have been subjected to cold working, shall be regarded as hot finished if they have subsequently been heat treated and are supplied in the normalized condition.

3.2 Threaded Fasteners

All bolts and nuts shall comply with IS:1367. Black bolts, nuts and screws shall be in accordance with IS:1363.

Wherever counter sunk screws are specified, they shall be precision grade, slotted, counter sunk head, machine screws conforming to IS:1365.

Wherever high tensile special quality bolts and nuts are specified, they shall comply with provision of IS:3757.

Coach screws shall be in accordance with IS:1120 and wood screws shall conform to IS:451.

All plain washers shall conform to requirements of IS:2016. Wherever spring washers for bolts, nuts and screws are specified, they shall be in accordance with the provisions of IS:3063. Avoid paint abrasions and other damage. Steel work shall be transported in such a way so as not to overstress the fabricated sections. All pieces bent or otherwise damaged shall be rejected and shall be replaced by the contractor at his own cost.

Checking and inspection of fabricated structural steel work by the will be done at various stages of completion of fabrication work. The contractor is required to ensure that fabricated steel work is properly stacked such that all joints of all members are either visible or accessible for inspection at all stages of inspection work. Care should also be taken to ensure that fabricated members are not subjected to stresses due to defective stacking.

4. FABRICATION DRAWINGS

Fabrication drawings of structural steel work with all details such as dimensions and tolerances must be got approved by structural engineer/ before being taken up for fabrication. Any alterations/ additions indicated by structural engineer/ PMC must be incorporated in the drawing and approval taken for fabrication.

5. FABRICATION WORK

5.1 Templates

All fabrication shall be in accordance with IS:800. Extensive use of templates shall be made. The templates shall be clean and should have true surfaces for every successive use.

In case actual members are used as templates for similar pieces, it will be at the discretion of the PMC to decide whether such pieces are fit to be incorporated in the finished structure.

5.2 Straightening

All material shall be straight and free from twist and bends unless required to be curvilinear in form. If necessary, the materials shall be straightened and or flattened by pressure. Heating of rolled sections and plates for purpose of straightening will not be permitted. Limited straightening can be done only on receiving approval from .

Mild steel rolled sections and plates shall be cut by machining and then grinding the surfaces to true shape. Gas cutting of mild steel may be permitted by the provided that every cut faces and edges are smoothened by grinding operation. Prior approval of must be obtained for using gas cutting techniques either by mechanized gas cutters or manually operated gas cutters. While using gas cutting methods, proper allowance must be made for grinding to bring the cut piece to exact required dimensions.

Gas cutting technique shall not be used for High Tensile steel. All such steel shall be machine cut and then finished smooth by grinding.

Small plate pieces like gussets may be sheared or cropped to size. Sawing, shearing and cropping shall be clean and free from any distortion. If necessary the edges shall be ground afterwards.

For tubular construction cutting of the pipe and preparation of joint surface shall be done in a neat manner for a good fit up. The ends of the tubes may be flattened or otherwise formed for connections provided that the methods adopted for such flattening do not injure the material. The charge of section shall be gradual and should be done with the concurrence of the .

5.3 Making Holes

All holes shall be made at right angles to the surface of the member. Holes shall be clean cut without any torn or ragged edges.

Holes for bolts shall be drilled. All holes, except as stated hereunder, shall be drilled to the required size or sub-punched 3mm less in diameter and reamed thereafter to the required size. Thickness of the material for sub-punching shall not be greater than 16mm. All matching holes for bolts shall register with each other so that a gauge of 0.8mm less in diameter than the diameter of the hole can pass freely through the members assembled for bolting in the direction at right angle to such members. All holes for turned and fitted bolts shall be drilled undersize by 1mm and after assembly, reamed to a tolerance of +0.13mm/ -0.00mm unless otherwise specified.

Alternatively, holes may be punched, provided that the punched hole is of the same standard as drilled holes.

All punching and sub-punching shall be clean and accurate and all drilling shall be free from burns.

No holes shall be made or enlarged by flame cutting processes.

6. EXECUTION

6.1 Erect structural steel in accordance with IS specifications vide IS:7205.

6.2 Make provision for erection loads and for sufficient temporary bracing to maintain the structure in proper plumb and in true alignment until completion of erection and installation of permanent bracing.

6.3 Do not field cut or alter structural members without approval of PMC.

6.4 After erection, prime welds, abrasions and surfaces not shop primed, except surfaces to be in contact with concrete.

6.5 Members shall be cut mechanically by saw or shear or by oxy acetylene flame and not by electric metal arc.

6.6 Cut edges shall be ground as per IS:823.

6.7 Cutting tolerances shall be

6.7.1 Members connected at bolt ends: ±1mm.

6.7.2 Other members: ±3mm.

6.8 All bolt holes shall be drilled and to the sizes specified in drawings.

6.8.1 Tolerance for spacing between two holes: ±1mm.

6.8.2 Tolerance between two perpendiculars of any oval hole: ±1mm.

6.8.3 Bolt holes for field joints shall be drilled in the shop to the required diameters and tested.

6.9 Drilling holes for standard sizes if varies can be reamed to next higher sizes. The tolerance for hole reaming shall not exceed 15% of the total number of holes for one joint.

7. WELDING

Welding shall be done in accordance with IS:816.

Welding shall be performed only by experienced welders specifically trained and experienced for the type of job to execute the welding work to the complete satisfaction of the .

Welding symbols to be adopted shall be as indicated on drawings.

Structural welding shall not commence until joint elements are bolted or tacked in intimate contact and adjusted to dimensions shown with allowance for any weld shrinkage that is expected. Welding sequence shall be planned and controlled to minimize undue stress increase or undue stress distortions in restrained members. Heavy sections and those having a high degree of restraint shall be welded with low hydrogen type electrodes.

If copper wire spacers are used between two surfaces to be welded to reduce transverse stresses in the weld, care shall be taken that it does not mix with the weld metal.

Concave bead shapes shall be avoided. Ratio of weld width to weld depth shall preferably vary from a minimum of 1 to a maximum of 1.4 to 1.

Field welding shall not be permitted unless shown on the drawings.

Subsequent to fabrication, the overlapping or contracting surfaces or other closed sections (such as tubular, box section) which are inaccessible to painting shall be seal welded. When the end of the tube is not automatically sealed by virtue of its connection by welding to another member the end shall be properly and completely sealed. Before sealing, the inside of the tube shall be made dry and free from loose scale.

Order of assembly of the tubular sections shall consist of welding the tensile member to the main member first. Compression member shall be cut back to overlap the tensile member and then welded to both of these members.

All welded connections shall be inspected as per IS:822. In addition to visual inspection of welds, radiographic testing shall be carried out by the contractor at his own cost on the discretion of the /structural consultant. Any type of crack or

zone of incomplete fusion or penetrations revealed by such test shall not be acceptable.

Defective welds shall be repaired or replaced as decided by the / structural consultant. The repaired or replaced welds shall be tested. Additionally when defective welds are found, the cause of the defective welding shall be determined and the contractor shall institute immediate corrective action.

8. SHOP PAINTING

All structural steel work shall be thoroughly cleaned of rust, loose mill scales, dirt and other foreign material. Greasy and oily surfaces shall be cleaned with solvent and dry rags. Unless otherwise specified the contractor shall not sand blast, flame clear or pickle the steel work prior to painting. The cleaned surface shall be got inspected and approved by the / structural consultant.

Within 4 hours of the cleaning the surface, a coat of approved priming paint shall be applied, preferably by brushing. Within one week a second coat of approved priming paint shall be applied by brushing or spraying, each coat shall be allowed to dry thoroughly before the subsequent coat is applied.

The following shall be thoroughly cleaned but shall not be painted or oiled:

Members to be encased in concrete.

Contact surfaces of welded connections.

Contact surfaces of high strength bolted (friction type) connections.

Milled surfaces

Top surfaces of steel beam flanges to receive shear connectors, but not supporting metal deck.

Members to receive any other special treatment.

Sandblasting: It is a general term used to describe the propelling of very fine particles at high velocity to clean the surface of dirt, dust and bubbles of the previous surface before painting. It is done by forcing fine sand through a nozzle by compressed air. Sandblasting as a method has been widely used for over a hundred years.

ERECTION

9.1 General

The erection of structural steelwork shall be carried out in accordance with the IS:7205 - 1974, in conformity with the drawings and specifications and in an expeditious manner.

The suitability and capacity of all plant, equipment, etc., used for erection shall be to the satisfaction of the .

9.2 Scope of Erection Work

The Contractor shall provide all construction material and equipment, transport facilities, tools, tackles, consumables, labour and supervision for erection, including carrying out the following:

Receiving, unloading, checking and moving into the storage facility at site, as outlined under General Conditions of Contract inclusive of attending to all Insurance matters in respect of materials arriving at site.

Transporting from site, storage, handling, rigging, assembling, riveting, bolting, welding and installation of all fabricated materials in proper location according to drawings or as directed by the .

Checking centre lines, levels of all foundations blocks including checking line and level, position and plumb of all bolts and pockets. Any defect observed in the foundation shall be brought to the notice of the . The Contractor shall satisfy himself regarding the correctness of the foundations before installing the fabricated structures on the foundation blocks.

Aligning, leveling, riveting, bolting, welding, fixing in position fabricated materials in accordance with drawings, or as directed by the

Supply of all required consumables, construction and erection materials, including but not limited to gauges, welding and brazing rods, electrodes and wires, oxygen, acetylene, fuel, bolts, nuts, rivets, shims and temporary supports etc., as required for the incidental works and for the completion of erection.

Erection shall also include all minor modification such as:

Removal of small bends, kinks, twists, etc., of parts damaged during transport and handling.

The following shall be considered as a legitimate part of erection work:

Re-making work to replace parts damaged beyond repair during transport and handling or in respect of those that are incorrectly fabricated. Replacements shall be made in the original workshop.

Fabrication of parts omitted during fabrication due to an error, or subsequently found to be essential. Omitted parts shall be made in the original workshop.

Drilling of holes that were not done during the original fabrication.

9.3 Storing and Handling of Fabricated Material

The fabricated materials shall be carefully unloaded at site, checked for any damage that may have occurred during transportation, sorted out for each building and stacked carefully above ground level so as to be kept clean and properly drained. The handling and storing of the component parts of a structure shall involve the use of methods, tools and appliances not likely to produce any damage to the fabricated material including applied finishes. No member slightly bent or twisted shall be put in place until the defects are corrected.

9.4 Setting Out

The Contractor shall be responsible for checking the alignment and levels of foundations, correctness of foundation-bolt centres, their projected height above the foundation tops, length of threading provided, the provision and fitment of nuts for the foundation bolts. These shall be checked well in advance of starting the erection work and the contractor shall be responsible for any consequences resulting from not doing this.

One set of reference axes and one bench mark level will be available on the drawings. He shall use these for the setting out operation.

The Contractor shall assume full responsibility for the correct setting out of all steelwork and erecting it correctly as per the alignment, levels and verticality called for on the drawings.

9.5 Assembly and Erection

During the erection of a structure, the steelwork shall be securely bolted, or clamped and if necessary temporarily braced, so as to make adequate provision for all erection stresses and conditions, including those due to erection equipment and its operation. Any temporary bracing shall be maintained in position until the erection work has reached a stage where the bracing provided is no longer required.

Connections for temporary bracing and additional holes, members or cleats used to facilitate handling or erection, shall be provided in a manner that does not weaken the steelwork already erected.

The alignment of each portion of the structure shall be carried out progressively, soon after that portion is erected. However, permanent connections shall not be made until the correct alignment of all portions has been achieved. This will entail a sufficiently large portion of the structure being erected and temporarily connected so that all the members thus connected are not overstressed or displaced during the progressive alignment of the remainder of the structure.

9.6 Tolerances

Erection tolerances shall be provided strictly in accordance with the requirements of IS:12843 - 1989. The contractor shall control the erection of steel structures in such a way that in level no components are more than 10mm out of their correct position nor shall the lines of the structure depart from straightness of plumb by more than at 3mm in 3m. The error shall be measured from the designed position or level given by the dimensions and coordinates on the drawings.

In structures where movements due to temperature change are considerable the deviations listed above will apply at the mean position of the member being checked.

9.7 Grouting under Base plates

Grouting under base plates shall be done after erection of the structural steel, unless otherwise approved by the PMC . All bearing plates, bearing assemblies and masonry plates shall be set level and to the elevations shown on plans. These shall be shimmed with approved means and grouted to assure full bearing on the supporting substrata regardless of the tolerances otherwise permitted.

The grout to be used in superstructure stanchion bases shall be shrink resistant grouting compound and shall have a 28 days compressive strength of at least 300kg/sqm. The surfaces, which are to receive the grout, shall be thoroughly cleaned immediately prior to the grouting operation. The grout shall be carefully worked under the base plates and shall completely fill the space under the base plates.

After the grout has had its initial set the grout shall be cut back flush with the base plate and the surplus grouting material removed. The surplus material thus removed shall not be reused.

MAS MASONRY

1. SCOPE

The contractor shall furnish all materials, labour, operations, equipment and incidentals, necessary and required for providing masonry walls as called for in the drawings.

2. STONE MASONRY

The following IS Codes are applicable to this section:

IS Code No.	Description
1121(Part-I) - 1974	Methods of test for determination of strength properties of natural building stones: Part-I Compressive strength (First revision).
1124 - 1974	Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones (First revision).
1597 - 1992	Code of practice for construction of stone masonry.

1706 - 1972 Method for determination of resistance to wear by abrasion of natural building stones (First revision).

2.1 The stone shall be of the type specified such as granite, trap, other igneous rock, limestone, sand stone, quartzite, etc. and shall be obtained from the approved quarries.

2.2 Stone shall be hard, sound, durable and free from weathering, decay and defects like cavities, crack, flaw, sand holes, injurious veins, patches of loose or soft materials and other similar defects that may adversely affect its strength and appearance. As far as possible, stones shall be of uniform colour and texture.

2.3 The compressive strength and water absorption of common types of stones are given in the table below:

Type of stone	**Water absorption % by weight max.**	**Compressive strength Kg/Sqcm min.**
Granite	0.50	1000
Basalt	0.50	400
Marble	0.40	500

Notes:

1. Test for compressive strength shall be carried out as laid down in IS:1121 (Part-1) - 1974, Method of test for determination of strength properties of natural building stones, Part 1-Compressive Strength.
2. Test for water absorption shall be carried out as laid down in IS:1124 - 1974, Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones.

2.4 Dimension of Stones

Unless otherwise indicated, the length of stone for stone masonry shall not exceed three times the height and the breadth on base and shall not be greater than three/fourth the thickness of wall. Height of stone may be up to 300mm. Minimum dimensions of stones (except slate stone) for various types of masonry shall be as given below:

a. Stone for random rubble masonry may be of any size and shape but shall be not less than 150mm in any direction.

b. Stones for squared rubble masonry shall be not less than 150mm in length and width.

c. Stones for block-in-course masonry shall be not less than 200mm in breadth or height and length not less than twice the height.

d. Stones for ashlars masonry shall be not less than 300mm in breadth and height and length not less than twice the height.

e. Stones for sills shall be of full thickness (depth) and width. Length of stones shall be as large as available but normally not less than 900mm.

f. Stones for lintels shall be of full thickness (depth) and length. Where stone lintel of full width is not available, two stones may be used to make the width.

g. Stones for copings shall be of full thickness and width. Length of stones shall be as large as available but not less than 300mm.

h. Stones for kerb stone shall be of size as indicated. The length shall not be less than the height.

i. Stones for arches, domes and circular moulded works, the dimension shall depend on the particulars of the curve.

2.5 Boulders

Boulders shall be rounded or sub-angular stones with sufficient base area and to be stable. They shall be sound, hard, durable, and free from laminations, seams, soft spots, cracks and other defects. Specific gravity shall be not less than 2.5. They shall be obtained from the approved sources.

Boulders shall be of reasonably uniform size. The minimum dimensions at any section shall be not less than half the average dimension of stones along the longest axis. Generally, large size boulders with minimum dia not less than 150mm shall be used in all boulder work except in hearting for bunds and thick walling where small boulders between 70 to 150mm minimum dia may be used to the extent of 50 percent of hearting.

Note: The minimum diameter shall mean the least diameter of the boulder across its mid-section.

2.6 Types of Stone Masonry

a. Random Rubble Masonry

Uncoursed: This type of masonry is constructed of stones as they come from the quarry. The mason selects stones of all shapes and sizes, more or less at random and places them in position to obtain a good bond, while restricting cutting of the stones to the removal of in convenient corners with a scabbing or spalling hammer.

Brought to Courses: This walling is similar to uncoursed random rubble except that the work is roughly levelled up to courses at intervals varying from 300mm to 600mm in height according to the locality and the type of stone used.

b. Polygonal Rubble Masonry

Stone with no pronounced stratification is roughly hammer dressed or pitched into irregular polygonal shapes and bedded to show the face-joints running irregularly in all direction.

c. Squared Rubble Masonry

Uncoursed: In this type, the stones are roughly squared as risers or jumpers and stretchers with varying heights and are laid uncoursed.

Brought to Courses: The stones are similar to those used for uncoursed rubble but the work is leveled to courses of varying depth from 30mm to 600mm according to the locality and the type of stone used.

Coursed: Coursed waning is built in courses which may vary in height from 100mm to 300mm but the stones in anyone course are roughly squared to the same height.

d. Ashlar Plain Ashlar Masonry

Stone blocks of the same height in each course are used and every stone is rough tooled on all beds and joints, full and true and faces dressed as indicated.

2.7 General Requirements for Stone Masonry Construction

a. All stone masonry shall be set out and built to the respective type dimensions, thickness and heights as indicated.

b. All work on stone shall be executed when it is freshly quarried.

c. Stones shall be sufficiently wetted before laying to prevent absorption of water from mortar.

d. The natural bed of the stratified stone shall be so laid that the pressure is always perpendicular to the strata. Stone in walling, steps, copings, sills, etc. shall be placed with the grain or natural bed, horizontal. In arches the grains shall be parallel to the bed or voussoirs. In projecting cornices and corbels the natural bed shall be vertical and at right angle to the face of wall.

e. The courses shall be built perpendicular to the pressure which the masonry will bear. In case of battered walls, the beds of stones and the plane of courses shall be at right angle to the batter.

f. Vertical joints shall be staggered as far as possible. In the case of squared rubble coursed masonry block-in-course masonry and ashlars masonry, stones shall break joints, on the face for at least half the height of the course and the bond shall be carefully maintained throughout.

g. Bell shaped bond stones or headers shall not be used.

h. All necessary chases for joggles, dowels and clamps shall be formed in the stones beforehand.

i. Stones shall be laid on a full bed of mortar. All joints shall be properly flushed and packed.

j. The walls and pillars shall be carried up truly plumb or to the specified batter.

No part of the wall during its construction shall rise more than 1 meter above the general construction level to avoid unequal settlement. Where there is a break in masonry work, the masonry shall be raked back in sufficiently long steps for facilitating joining of old and new work. The stepping of the raking shall not be more than 30 degree with the horizontal.

At all angular junctions, the stones in each alternatives course shall be well bonded into the respective courses of the adjacent wall.

In alteration work, the stones shall gauge with existing courses, unless otherwise directed.

2.8 Protection

Care shall be taken during construction those edges of jambs, sills, heads, etc. are not damaged. In inclement weather newly built work shall be suitably protected by covering with gunny bags or tarpaulin.

2.9 Curing

Masonry work shall be kept constantly moist on all the faces for a minimum period of seven days. Watering shall be done carefully so as not to disturb or wash out green mortar.

2.10 Bond Stones

Dressing of bond stones shall be done as for other stones. In coursed masonry full surface of the bed shall be dressed. In random rubble masonry, bond stones shall be hammer dressed on the face, beds and joints and made into a squared block.

For pillars with a cross sectional area 0.25Sqm and below, the bond stone shall be a single full bond stone. For pillars exceeding 0.25Sqm either it shall be single bond stone or it shall be made up of four stones provided in two courses crossing the joint at right angles as directed by the Project Manager. The full bond stones shall be provided one at the bottom, one at the top and remaining in-between them at courses not exceeding one metre apart centre to centre.

2.11 Scaffolding

Unless otherwise instructed by the / Engineer-in-charge, double scaffolding having two sets of vertical metal supports shall be provided for all building work. The supports shall be sound, strong and tied together with horizontal pieces over which scaffolding planks shall be fixed.

OR

This may be double or single as warranted by the working conditions. Scaffolding shall be tubular steel sections. All scaffolding shall be built of adequate strength to support all conceivable loads likely to come on them. Put log holes shall be made good by brick to match the face work and holes behind shall be made good by filling solidly with 1:4:8 cement concrete.

The Contractor shall be responsible for providing and maintain sufficiently strong metal scaffolding so as to withstand all loads likely to come upon it. Wooden scaffolding shall not be permitted.

2.12 Dressing

a. Random Rubble Masonry, Uncoursed: Stones shall be hammer-dressed on the face, the sides and the beds to enable to come in proximity with the neighboring stones. The bushes on the face i.e. maximum depression from a straight edge held against the dressed surface shall not be more than 40mm on an exposed face and 20mm on faces to be rendered.

b. Square Rubble Masonry, Uncoursed: Face stones shall be hammer dressed on all beds and joints so as to give them approximately rectangular shape. The bushes on the face shall not be more than 20mm. The bed joints shall be chisel drafted for at least 80mm back from the face and for the side joints at least 40mm. No portion of the chisel dressed surface shall show a depression of more than 6mm from a straight edge placed on it. The remaining portion of the stone shall not project beyond the surface of bed and side joints.

2.13 Laying

a. Random Rubble Masonry, Uncoursed: Every stone shall be carefully fitted to the adjacent stone so as to form neat and close joint. Face stone shall extend and bond well in the back. These shall be arranged to break joints as much as possible and to avoid long vertical lines of joints. Thickness of joints shall not exceed 25mm. Walls shall be leveled up at top of plinths, sill and lintel levels of openings, floor and roof levels and at top with minimum amount of chips and spalls.

b. Square Rubble Masonry, Uncoursed: All bed joints shall be laid truly horizontal and all side joints shall be truly vertical. The quoin stones shall be laid stretchers and headers alternately. Thickness of joints shall not exceed 15mm. Walls shall be leveled at top of plinth, sill and lintel levels of openings, roof and floor level and top with minimum amount of chips.

2.14 Stone Kerb

Kerb stones shall be not less than 600mm in length except when required as closer or on curve and shall be of sectional dimensions as indicated. Not more than half the depth of each stone shall be buried in ground. Kerb stones shall be hammer dressed so that the maximum depression from a straight edge held against the dressed surface shall not exceed 20mm. Where indicated, the top and exposed surfaces of sides shall be dressed so that the maximum depression from a straight edge held against the surface shall not exceed 6mm and top edge shall be chamfered not exceeding 100mm in girth. Kerb stones shall be jointed in cement mortar 1:6 and struck flush.

3. CONCRETE BLOCK MASONRY

3.1 Indian Standards

The following IS shall apply to this section.

IS Code No.	Description
2185 - 1979	Specification for concrete blocks.

1905 -1987	Code of practice for structural use of unreinforced masonry (Third revision).
2116 - 1980	Specification for sand for masonry mortars (First revision).
2386 - 1963	Methods of test for aggregates for concrete.

3.2 Block work

Concrete blocks (hollow or solid or autoclaved blocks) shall generally conform to IS:2185. Blocks shall be regular in size and shape and shall be of specified strength. Blocks shall be properly cured before they are brought to site. Half or three quarter size blocks are to be used wherever required to make up length of wall and broken blocks shall not be used. The texture of the blocks shall be such that plaster will adhere to it. They shall be sound, free from cracks, honeycombing, broken edges and other flaws. They shall have plane rectangular faces with parallel sides and sharp straight angled edges. They shall a fine, compact, uniform texture and thoroughly dried. The contractor shall supply samples for approval. Blocks supplied shall conform to approved samples. In cases the owner supplies the Blocks, it is the responsibility of the contractor to load, unload, transport to the required work spot and properly store it.

3.3 Dimensions

The size of hollow and solid blocks shall be as specified in the item of work. The maximum variation in dimensions shall not be more than +/-1.5mm in height and breadth and +/-3mm in length. The blocks shall be 400x200x190mm, 400x190x140mm or 400x190x90mm as called for.

3.4 Handling and Storage

The contractor is responsible for transporting concrete blocks in such a manner that the units are adequately protected during transportation. The units shall be handled in a manner, which will prevent soiling, chipping or damage of any kind. Broken, chipped or otherwise damaged units will be rejected and shall not be used in the work. The blocks shall be stored in next piles free from contact with ground, which shall be located to avoid being disturbed or damage by construction activities.

3.5 Sampling and Testing

A sample of 20 blocks shall be taken from every consignment of 5000 blocks of the same size, batch, and manufacturer for conducting tests.

All 20 blocks shall be checked for dimension and inspected for visual defects. Out of the 20 blocks, 3 blocks shall be subjected to test for block density, 8 blocks for compressive strength, 3 blocks for test of water absorption, 3 blocks for drying shrinkage and rest for moisture movement. Block shall be approved if requirement of conditions mentioned in IS: 2185 (Part-1) are satisfied.

All Block work to be painted or plastered or to remain exposed in the finish shall be equal to the approved samples.

If solid concrete blocks are used in foundation, plinth or basement wall, the hollows must be filled up with cement concrete 1:3:6. In damp soils, the foundation and basement masonry shall be laid in richer mortar as directed by the engineer-in-charge. In addition, a damp proof course consisting of a 25mm layer of cement mortar 1:2 as an approved type of bituminous course shall be provided.

3.6 Mortar

The mortar for 200mm thick hollow block masonry shall be cement mortar consisting of one part of cement and 6 parts of sand or as specified. For 100mm thick masonry, mortar shall be one part of cement and 4 parts sand or as specified.

The unit measurement shall be standard bag of cement 50kg. Assumed to be 35liters (0.035Cum). Sand shall be measured in boxes of suitable size. In case of damp sand, the quantity may be corrected for bulkage.

Cement mortar used for jointing and layi ng of blocks for hollow block masonry shall be as specified in the item of work or as directed by the / Engineer-in-charge.

3.7 Preparatory Work

Wetting of blocks: The blocks need not be wetted before or during laying in the walls. In case the climatic conditions so require, the top and the sides of the blocks may only be slightly moistened so as to prevent absorption of water from the mortar and ensure the development of the required bond with the mortar

3.8 Workmanship

a. 100mm thick block work:

- 100mm thick block walls shall be constructed wherever shown in the drawing. These shall be all of stretchers only and half blocks shall not be used. The mortar to be used shall be cement sand mortar 1:4 and as per specification mentioned elsewhere in this document.
- To increase the stability of 100mm thick block work, 2No. of reinforcement bars of specified diameter shall be provided after every 5th course. These reinforcement bars shall be well anchored at the ends and fully embedded in mortar.
- Whenever the height of the walls is more 2.0m an RCC band shall be provided if so instructed by the Project Manager, at the rate of one band for every 1.6m height/ 4th course as per specifications.
- Care shall be taken to see that the wall is not disturbed till it is fully set. All scaffolding, shuttering and formwork for RCC work connected to the newly built wall shall be constructed with utmost care. So that the stability of the wall is fully secured. While making the shuttering for the RCC band, nailing planks to the wall shall not be permitted. While curing, the water is to be sprinkled by a hose to the wall and not by throwing and splashing across the wall.

b. Only skilled and experienced masons shall be employed in laying block masonry.

c. All blocks shall be thoroughly wetted before use.

d. No broken blocks shall be used. Brickbats may be used for closures.

e. The blocks shall be laid in cement mortar to lines, levels, etc., as shown in the drawings slightly pressed and thoroughly bedded in the mortar and all joints properly flushed and thoroughly packed with mortar so that no hollows are left. Blocks shall not come over the other, each joint being in the centre of the block below.

f. Both faces of the wall shall be flush and the verticality and horizontality of the courses shall be checked frequently by means of plumb-bobs and spirit level respectively.

g. Joints shall not exceed 10mm thickness and struck flush with the face when placing.

3.9 Concrete Blocks (Solid & Hollow 200mm, 150mm & 100mm)

Concrete blocks shall conform to requirements stipulated in IS:2185 (Part-I) - 1979. Cement aggregates sand & water shall conform to requirements laid down under concrete work. The size of the blocks shall be 400x200x200mm, 400x200x150mm and 400x200x100mm.

The blocks shall be of the exact dimensions called for, with clean, shape edges and sides. Blocks shall full match the specimens to be got approved by the architect. The blocks shall be free from broken edges, cracks and other defects. They shall be stock piled in an approved manner to protect from any damage. The blocks shall be

handled with care. Damaged blocks shall be removed from the site and replaced by good ones.

3.10 Laying

The blocks shall be laid as stipulated in IS:2572 - 1963. Before commencing laying, ascertain from other trades that all pipes, conduits, drains, receive and other inserts/ pockets have been catered for. The blocks need not be wetted before use. Mark the courses on columns and adjust the first course so as to avoid any gap at beam bottom. The first course shall be laid with the greatest care to ensure that it is properly aligned, leveled and plumbed. Subsequent courses shall be laid over this course true to line and levels. Each block and each course shall be carefully checked for alignment, level and plumb so that the wall is truly straight and vertical. To assure satisfactory bond, mortar shall not be spread too far ahead of actual laying of block. The mortar joints shall be struck off flush with wall surface and when the mortar has started stiffening, it shall be compressed with a rounded or 'U' shaped tool to obtain a water tight joint. The joints both horizontal and vertical shall not be more than 10mm thick. They shall be uniform and straight and truly horizontal and vertical, staggered vertically. The jambs at openings for doors, windows, etc. shall be built truly vertical and to correct dimensions. The top course at sills, roof levels, etc. shall be made truly horizontal and to correct heights and dimensions. All walls wherever they meet or intersect shall be bonded or tied securely in approved manner. Where two walls meet or intersect, the courses in the two walls shall be, as far as possible, laid up at the same time with a hue masonry bond between at least 50percent of the units at the intersection. Where the two walls cannot be laid simultaneously, toothing or pockets with 200mm maximum vertical spacing shall be left in the first wall laid. The corresponding course of the second wall shall be built into these toothing or pockets as the case may be. The intersection of hollow block wall and brick wall shall also be bonded as described above. Use templates for forming Door and Window openings where not built in. Proper half-length closers shall be cast and not cut from full-length blocks.

3.11 Joints

The joints shall be full of mortar. The face joints shall be raked to a minimum depth of 8mm by a raking tool during the progress of the work when the mortar still green so as to provide key for the plaster to be done. The face of the wall shall be cleaned daily and mortar droppings removed.

3.12 Curing

All brick work when laid shall be initially protected against hot sun and drying winds, if necessary by covering with wet sacking or similar other absorbent material. The brickwork shall be kept wet for a period of at least 14days after laying. At no time shall the mortar be allowed to dry. A check list for daily curing of the required areas shall be maintained.

3.13 Scaffolding

Unless otherwise instructed by the / Engineer-in-charge, double scaffolding having two sets of vertical metal supports shall be provided for all building having two sets of vertical metal supports shall be provided for all building work. The supports shall be sound, strong and tied together with horizontal pieces over which scaffolding planks shall be fixed.

OR

This may be double or single as warranted by the working conditions. Scaffolding shall be tubular steel sections. All scaffolding shall be built of adequate strength to support all conceivable loads likely to come on them. Log holes shall be closed neatly by brick to match the face work and holes behind shall be closed neatly by filling solidly with 1:4:8 cement concrete.

The Contractor shall be responsible for providing and maintain sufficiently strong metal scaffolding so as to withstand all loads likely to come upon it. Wooden scaffolding shall not be permitted.

3.14 Tolerance

The maximum permissible tolerance in masonry shall be as follows:

a. Variation from specified thickness of head and bed joints ± 3mm

b. Variation in vertical joint alignment

- In any 3.05m of height ± 6mm
- Maximum for entire height ± 13mm

c. Variation in level of bed joint

- In any 3.05m of height ± 6mm
- Maximum for entire length ± 13mm

d. Variation from specified thickness of walls ± 6mm

e. Variation in vertical alignment of walls

- In any 3.05m of height ± 6mm
- Maximum per floor ± 13mm
- Maximum for total height ± 25mm

f. Variation in horizontal alignment of walls

- In any 3.05m of length ± 6mm
- Maximum for entire length ± 13mm

3.15 Protection

Maintain protection against entry of moisture into block work when stored and whenever work is interrupted. Exposed ledges are to be protected. External corners must be protected which may be damaged by construction activities.

3.16 Cleaning and Pointing

Smooth finished block work to be cleaned by means of scrapes or stoning. Acids should not be used for cleaning. Any loose or open joints are to be pointed as required. Replace finishes and materials that cannot be satisfactorily cleaned.

Weber Blokset for constrcuction of cement block Masonry works

PRODUCT DESCRIPTION;

Weber blokset is a ready to mix , self curing cementatious mortar for mounting and bonding aerated autoclaved concrete , hollow blocks and bricks . **Weber blokset** is made from cement , graded sand and polymeric additives which helps in providing mechanical bond as well as excellent adhesion between the blocks .

KEY FEATURES;

1) Ready to use -- Just add water.

2) Provides Excellent Adhesion betwen blocks - blocks & Block to other porous cementatious surface.

3) Reduces the time required for mounting the blocks.

4) Larger quantity of material can be mixed at a time due to its longer pot life.

5) It is a self curing hence no post curing is required for mounting the blocks.

RECOMMENDATION;

1) It is recommended for fixing all type of Autoclave Aerated Concrete (AAC) blocks & Reinforced concrete hollow blocks & bricks .

TECHNICAL PARAMETERS;

Appearance	Grey power
Bulk Density	1.45 - 1.55 g/cc
Pot Life	10 -15 minutes
Tensile Adhesion strength @ 28 days	Initial > 0.5 Mpa , After immersion > 0.5Mpa
Compressive strength @ 28 days	>12Mpa

DIRECTION FOR USE;

SURFACE PREPARATION .

1) Pre wet the blocks to be used for mixing .

2) The surfaces for mounting must be thoroughly cleaned of all laitance , loose materials , oil greases etc.

3) Ensure that surface is flat , structurally sound & free from any other contamination which would reduce the bond strength.

4) The surface should be free from voids , holes and cracks.

MIXING .

1) Gradually add 3 parts of power to 1 part of water (by volume) and mix it to smooth , workable paste .

2) Do not attempt to extend the pot life by adding more water to mix.

3) After mixing allow the paste to stand for 2 - 3 minutes for it to mature..

APPLICATION METHODOLOGY .

1) Apply **weber blokset** uniformly .

2) After first unit is placed apply **weber blokset** on both side of the surface with uniform thickness and continue the mounting by checking line and level.

3) Firmly press the block into weber blokset to ensure good initial bonding.

4) Clean the excess materials if any .

4. BRICK WORK

1.1 General

a. This section covers the requirements for brick work in walls and partitions.

b. IS: 2212 "Code of Practice for Brickwork" shall apply in so far as it is applicable. The provisions of the following Indian Standard Specifications shall form a part of this

specification to the extent they have been referred to or applicable with this specification.

IS: 8041 & 12600	Specification for ordinary, rapid hardening low heat portland cement.
IS: 1077	Specification for common burnt clay Building Bricks.
IS: 3466	Specification for masonry cement.
IS: 2250	Code of practice for preparation and use of Masonry Mortars.

1.2 Bricks

Bricks shall be first class semi wire cut bricks with a crushing strength of not less than 35kg/sqcm (unless otherwise specified) uniform in color and size and shall generally conform to IS:1077. Bricks shall be free from cracks, chips, flaws, stones or lumps of any kind. They shall be sound, hard and homogenous in texture. They shall be of uniform shape and color and shall give a ringing sound when struck with a mallet. When soaked in water for 24 hours, the bricks shall not absorb water more than 20% of its weight when dry. Bricks shall be soaked in water for at least 6 hours before use. Broken bricks shall not be used except in closures. The nominal size of the brick shall be 230x115x70mm (nominal) unless otherwise specified.

1.3 Testing

Samples of Bricks taken at random from stacks/ trucks by the Project Manager shall be got tested for strength, water absorption, etc. at contractor's expense.

1.4 Samples

Samples of each type of brick taken at random from the load shall be deposited with the / Engineer-in-charge for his approval before being used in the work. All subsequent deliveries shall be up to the standard of sample approved.

1.5 Soaking of Bricks

All bricks shall be thoroughly soaked in clean water immediately before use. They shall be placed in specially prepared vats, tubs or tanks for not less than one hour. The Superintendent may amend this time after trials at site. After they have been soaked, the bricks shall be kept on wooden planks or brick platforms to avoid earth being smeared on them.

Note 1: The period of soaking may be easily found at site by a field test in which the bricks are soaked in water for different periods and then broken to find the extent of water penetration. The least period that corresponds to complete soaking will be the one to be allowed for in the construction work.

Note 2: If the bricks are soaked for the required time in water that is frequently changed, the soluble salts in the bricks will be leached out and subsequent efflorescence will be reduced.

1.6 Mortar Mixing

Mortar shall be of the mix as indicated. The mixes specified are by volume mix proportions of cement mortar specified are in the proportions of cement to dry sand. Mixing of mortar shall be done in a mechanical mixer. Hand mixing shall be resorted to only when specifically permitted by the / Engineer-in-charge. Hand mixing should be carried out over a GI sheet. Cement and sand shall be mixed dry thoroughly and then water shall be added gradually. Wet mixing shall be continued till mortar of the consistency of a stiff paste and uniform color is obtained. Only the quantity of mortar which can be used within thirty minutes of its mixing shall be prepared at a time.

Mortar shall be used as soon as possible after mixing and before it has begun to set and in any case within thirty minutes after the water is added to the dry mixture. Mortar left unused for more than thirty minutes after mixing shall be rejected and removed from the site of work immediately.

1.7 Laying

If bricks/ blocks are of size such that the width of the header course does not come equal to the width of the stretcher course, the difference shall be made up during construction of brick work itself by the same mortar as used for construction of masonry to provide a plane vertical surface. The surface should also be scarified to receive plaster.

All junctions of walls and cross walls shall be carefully bonded into the main walls. The rate of laying masonry will be up to a height of 100cm per day if cement mortar is used. Greater heights may be built only if permitted by the architects.

While using old size bricks (FPS conventional bricks) top courses of all plinths, parapets, steps and top of walls below roof slab or floor slab shall be laid with bricks on edge, applicable in case of traditional bricks unless directed otherwise. Care shall be taken that the bricks forming top courses and ends of wall are properly keyed into position.

Bricks shall be laid with frog up. However, when the top course is exposed, bricks shall be laid with frog down; care shall be taken to fill the frogs with mortar before embedding the bricks in position.

All quoins shall be accurately constructed and the height of courses checked with storey rods as the work proceeds. Acute and obtuse quoins shall be bonded, where practicable, in the same way as square quoins; obtuse quoins shall be formed with squint showing a three quarter brick on one face and quarter brick on the other.

During rains, the work shall be carefully covered to prevent mortar from being washed away, should any mortar or cement be washed away, the work shall be removed and rebuilt at the contractor's expense.

1.8 Bond

All brickwork shall be built in English Bond, unless otherwise indicated. Half brick walls shall be built in stretcher bond. Header bond shall be used for walls curved on plan for better alignment. Header bond shall also be used in foundation footings, stretchers may be used when the thickness of wall renders use of headers impracticable. Where the thickness of footings is uniform for a number of courses, the top course of the footings shall be of headers.

Half or cut bricks shall not be used except where necessary to complete the bond.

Overlap in stretcher bond is usually half brick and is obtained by commencing each alternate course with a half brick. The overlap in header bond which is usually half the width of the brick is obtained by introducing a three quarter brick in each alternate course at quoins. In general, the cross joints in any course of brickwork shall not be nearer than a quarter of brick length from those in the course below or above it.

1.9 Joints

Joints shall not exceed 10mm in thickness. All joints shall be struck flush with the face when facing, for all the walls requiring plastered finish. Joints of brickwork shown to be exposed in the drawings shall be raked out not less than 10mm deep when the mortar is green to receive subsequent pointing treatment.

1.10 Half Brick Walls

a. Half brick walls shall be constructed wherever shown in the drawing. These shall be all of stretchers only and half bricks shall not be used. The mortar to be used

shall be cement sand mortar 1:6 and as per specification mentioned elsewhere. The work shall be carried out as per as IS: 2212.

b. Reinforcement consisting of 2 bars of specified diameter shall be provided after every fourth course, the MS bars shall be well anchored at the ends of the partition. These bars shall be fully embedded in mortar and overlaps if any shall be minimum 300mm and shall conform to specifications mentioned under `Steel Reinforcement'.

c. Whenever the height of the walls is more than 2.0m and RCC band shall be provided if so instructed by the , at the rate of one band for every 1.5m height. Care shall be taken to see that the wall is not disturbed till it is fully set. All scaffolding, shuttering and formwork for RCC work connected to the newly built wall shall be constructed with utmost care. So that the stability of the wall is fully secured. While making the shuttering for the RCC band, nailing planks to the wall shall not be permitted. While curing, the water is to be sprinkled by a hose to the wall and not by throwing and splashing across the wall.

PLW PLASTERING AND OTHER WALL FINISHES

1. SCOPE

The contractor shall furnish all materials, labour, scaffolding equipments, tools, plant and incidentals necessary and required for the completion of all plaster and wall finishes, subject to approval by .

2. CODES AND STANDARDS

IS: 8112, 12269	Specification for cement
IS: 383	Specification for coarse and fine aggregates
IS: 412	Specification for expanded metal sheet for general purposes
IS: 1542	Specification for sand for plaster
IS: 1661	Code of practice for application of cement plaster finishes
IS: 2645	Specifications for integral cement waterproofing compounds

3. GENERAL

Plaster as herein specified shall be applied to all internal and external surfaces where called for. and schedule of finishes. Areas called for on drawings shall be considered to apply to appropriate adjoining areas whether shown on same drawings or not and whether indicated or not.

All plaster work and other wall finishes shall be executed by skilled workmen in a workman like manner and shall be of best workmanship and in strict accordance with the dimensions on drawings subject to the approval of the .

4. PLASTER WORK

The primary requirement of plaster work shall be to provide absolutely water tight enclosure, dense, smooth and hard and devoid of any cracks on the interior and/ or exterior. All that is necessary steps to be taken to ensure that this objective is achieved. All plastering shall be finished to true plane, without any imperfections and shall be square with adjoining work and form proper foundation for finishing materials such as paint, etc.

Masonry and concrete surfaces which call for applications of plaster shall be clean, free from efflorescence, damp and sufficiently rough and keyed to ensure proper bond, subject to the approval of the .

Wherever directed by the , all joints between concrete frames and masonry in filling shall be expressed by a groove cut in the plaster. The said groove shall coincide with the joints beneath as directed. Where grooves are not called for, the joints between concrete members and masonry in filling shall be covered by specified gauge galvanised chicken mesh strips as called for on drawings/ written instructions which shall be in position before plastering.

5. CHASING AND BREAKAGE

All chasing, installations of conduits, inserts boxes, etc., shall be completed before any plastering or other wall finish is commenced on a surface. No chasing or cutting of plaster or other finish on a surface shall be permitted. Broken corners shall be cut back not less than 150mm on both sides and patched with cement mortar plaster or plaster of paris as directed by .

6. SAMPLES

Samples of each type of plaster and other wall finish shall be prepared well in advance of undertaking the work for approval by the .

7. PREPARATION OF SURFACES

The materials used for plastering shall be proportioned by volume by means of gauge boxes. The joints in all walls, both existing and freshly built shall be raked to a depth of 15mm, brush cleaned with wire brushes, dusted and thoroughly wetted before starting plastering work. Concrete surfaces to receive plaster shall be roughened by hacking over the entire surface so that the skin of the concrete is completely removed as approved by the , to ensure proper key for the plaster.

8. PLASTER TO WALLS

Plaster to internal faces of walls shall be as specified comprising of one part cement and six parts of clean fine sand. The external surfaces of external wall shall have plaster of minimum 10mm thickness comprising of one part of cement and 4 parts of clean fine sand.

9. MORTAR MIXING

Mortars shall be of the mix as indicated. The mixes specified are by volume mix proportions of cement mortars specified are in the proportions of cement to dry sand. Mixing of mortar shall be done in a mechanical mixer. Hand mixing shall be resorted to only when specifically permitted by the / Engineer-in-charge. Hand mixing should be carried out in metal trays. Cement and sand shall be mixed dry thoroughly and then water shall be added gradually. Wet mixing shall be continued till mortar of the consistency of a stiff paste and uniform colour is obtained. Only the quantity of mortar which can be used within thirty minutes of its mixing shall be prepared at a time. Mortar shall be used before it has begun to set and in any case within thirty minutes after the water is added to the dry mixture. Mortar left unused for more than thirty minutes after mixing shall be rejected and removed from the site of work immediately.

Cement mortar shall be of proportion specified for each type of work .Proportions are specified as 1:2, 1:3, 1:4, 1:5, etc, the first figure being volume of cement and second the volume of sand respectively.

10. APPLICATIONS

Plaster application shall be commenced only after the preparatory work is approved by the / Engineer-in-charge. Correct thickness of plaster shall be obtained by laying plaster screeds (gauges) at intervals of 1.5m as directed.

Mortar shall be firmly applied, well pressed into the joints, rubbed and finished as approved by the to give a smooth and even surface.

11. CURING

Each coat shall be kept damp continuously for at least two days. Moistening shall commence as soon as the plaster has hardened sufficiently. The water shall be applied preferably 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 sites of buildings in hot dry weather shall be prevented by hanging mats or gunny bags on the outside of the plaster and keeping them wet.

After the completion of finishing coat, the plaster shall be kept wet for at least ten to fourteen days and shall be protected during that period from extremes of temperature and weather.

12. WORKMANSHIP

Mortar mixing shall be done by mechanical means. Each mortar batch shall be within half an hour. Surfaces to be plastered must be clean and free from dust, loose material, oil grease, mortar droppings, sticking of foreign matter, traces of algae, etc. It is very important to ensure that there should not be any chance of plaster getting de-bonded due to material harmful to bonding.

Raking out joints should be carried out along with masonry but it should be checked thoroughly so as to receive good key.

Walls (concrete, brick or stone) should be sufficiently damp prior to plastering. Water from plastering mortar must not be absorbed by masonry under any condition.

Any unavoidable projection in masonry and concrete surfaces shall be chiseled back. Care shall be taken that surrounding surfaces are not damaged and reinforcements not exposed.

All angles and arises must be finished straight, fine and sharp. Thickness of one coat should not be more than 15mm or less than 8mm for single coat of finished plaster.

Method of application is important and it is recommended to dash the mix on the surface rather than stick with a trowel. This enhances the adhesion.

The plaster shall be finished smooth with this layer. The plaster surface shall be combed with wire brushes.

Scaffolding should be rigid allowing free and safe movement on the platform and it should be at sufficient distance or height from the working areas.

As a safety measure scaffolding with railing gives protection and more confidence to workers and increases quality of work.

Plastering of entire or unobstructed areas shall be done at one stretch. On occasions when as a result of the extent of the area being too large, or any other reason, the

work is to be left over for completion on the next morning, the work to be carried out in such a manner as to have no marks left on the finished work and joints are to be rubbed with carborundum stone to give an even surface without any impression.

Plastered surface shall be cured for 14 days by wet curing. During this period, plaster shall be protected from exposure to extreme temperature and weather.

Plaster shall be lined and leveled with aluminum hollow sections, 2 - 3m long. There shall not be more than 2mm difference in level when checked with a 3m straight edge. Finishing of plaster may be carried out with wooden or metal floats. Thickness shall be as specified in BOQ and Specifications.

All works shall be executed as per Method Statement approved by the .

The items relating to plastering in the Bill of Quantities apply to all positions, locations and all the different kinds of surfaces of which the work is to be executed on all floors and heights. The Contractor is to include for small or scattered work, difficult portions and the need for double scaffolding for executing the work up to any height.

13. CEILING PLASTER

Plaster to ceilings, soffits or flight slabs of stairs and at similar locations, where called for, shall be 12mm thick and comprise of one part cement and four parts of clean fine sand.

14. CHICKEN MESH/ EXPANDED METAL MESH TO WALLS

Galvanized chicken mesh or expanded metal (24 gauge, 12mm size) shall be provided at junctions of brick/ block masonry and concrete members. Such areas to be plastered and at other locations, mesh to be 150mm on either sides of the junction in double fold or as called for, properly stretched and nailed, ensuring equal thickness of plaster on both sides of the mesh.

15. GYPROC ONE COAT PLASTER FOR CEILING (N1)

General

Gyproc One Coat is a vermiculite based gypsum plaster Vermiculite is natural mineral which expands with the application of heat. It is formed by hydration of certain basaltic minerals.

Properties

1) Compact Dry Bulk Density -- Max 770 kg/m^3.

2) Wet Bulk Density -- 1.60--1.70 gm/cm^3.

3) Initial Setting Time -- 15 to 20 Minutes , Hence **wastages** are **less**.

4) Final Setting Time -- 20 to 25 Minutes.

5) It gives a better **coverage , Approx Coverage -- 68 Sq.Mtr /MT.**

6) Workability -- Easy.

7) **Compressive strength** -- **6.5** N/mm^2 to **7.5** N/mm^2.

8) It gives a **hard & dense surface impact resistance** .

9) **Finish** -- Attractive Smooth surface with off white Color.

10) It gives an off white coloured Finish Surface.

GYPROC ONE COAT ELITE PLASTER FOR WALLS.

General

Gyproc One Coat Elite is a gypsum plaster containing higher lightweight aggregates dosages. Those aggregates are naturally occurring, volcanic glass . It contains around 2 to 5 percent of water which makes it expand , when heated to a temperature sufficient to soften it.

Properties

1) Compact Dry Bulk Density -- Max 600 -- 670 kg/m^3.

2) Wet Bulk Density -- 1.40--1.60 gm/cm^3.

3) Initial Setting Time -- 20 to 25 Minutes , Hence **wastages** are **less**.

4) Final Setting Time -- 25 to 30 Minutes.

5) It gives a **larger coverage than Vermiculite based Gypsun Plaster , Approx Coverage -- 89 -- 92 Sq.Mtr /MT.**

6) Workability -- Very easy due to softness of aggregates used .

7) **Compressive strength** -- **4.5** N/mm2 to **5.5** N/mm2.

8) It gives a high **early hard & dense surface impact resistance** .

9) **Finish** -- Attractive Marble like Smooth surface.

10) It gives you an absolute white coloured Finish Surface. Whiteness more than Supreme.

16. SAND FACED PLASTER (SPONGE PLASTER EXTERNAL)

16.1 Base Coat

The base coat shall be of cement mortar as specified and shall have a minimum thickness as specified.

16.2 Final Coat

The finishing coat shall be of cement mortar 1:4 and 6mm thick. The mortar shall contain sand with slightly larger proportion of coarse material and shall be approved by the Employer/ . After application, the surface shall be finished with wooden float to the correct plane. Then it shall be treated with wetted sponge rubber by which sand particles stand out and give an even finish as approved by the . A sample over a considerable area shall be first made in consultation with the Employer/ and shall be got approved before starting the work. Curing shall be perfect and to be continued for at least 14 days.

17. ROUGH CAST PLASTER

17.1 General

The specification for sand faced plaster shall also apply to roughcast plaster, subject to the following:

17.2 Base Coat

The first coat of plaster shall be of cement mortar 1:4 mixed and applied according to the relevant provisions of IS: 1661. The finished thickness shall be 12mm for brick masonry. The plaster shall be laid by throwing the mortar by using a strong whipping action and pressing to form a good bond. The surface shall be roughened.

17.3 Second Coat

The second coat shall be the rough cast mixture consisting of aggregate, which may vary in size from 5mm to 8mm and may consist of specially graded mixture mixed with fine sand and cement. The proportion of cement to sand to aggregate shall be

1:1:3. It shall be flung upon the first coat with large trowels to form a protective over coat. The second coat must be applied while the first coat is still soft and plastic. The work shall generally conform to requirements IS: 1661. The thickness of the coat shall be about 12mm.

Mortar should be machine mixed at a centralized location for supply to various plastering locations.

A Typical chart with Water/ Cement (W/ C) ratios for various mortar mixes is given below:

Nominal Mix Cement/ FA	W/ C ratio (by weight) for minimum consistency
1:1	0.25
1:1.5	0.28
1:2	0.30
1:25	0.35
1:3	0.40
1:4	0.53

17.4 Rough Plaster for Dado

Rough Plaster for dado work is done exactly as per the first coat of rough cast plaster specification cited above. Instead of second coat, dado tiles are fixed over rough plaster first coat.

18. WATER PROOFING PLASTER

Integral water proofing compound shall be mixed with cement in the proportion as specified by the manufacturer. Care shall be taken to ensure water proofing material gets well and integrally mixed with cement and does not run out separately when water is added.

19. REPAIRS TO PLASTERED SURFACES

19.1 Cutting

The mortar of the patch where the existing plaster has cracked, crumbled or sounds hollow when gently tapped on the surface, shall be removed. The patch shall be cut out, to a square or rectangular shape at the position marked on the wall. The edges shall be under-cut slightly to provide a dovetailed key for the patch plaster.

19.2 Preparation of Surface

The masonry joints that become exposed after removal of the old plaster shall be raked out to a minimum depth of 12mm in the case of brick work and 15mm in the case of stone work. The raking shall be carried out uniformly with a raking tool and loose mortar dusted off. The surface shall then be thoroughly washed with water and kept wet before plastering is commenced.

Concrete surfaces shall be thoroughly scrubbed with wire brushes after the plaster had been cut out. The concrete surface shall be pock marked with a pointed tool, at spacing of about 50mm, the pocks made being not less than 3mm deep to ensure a proper key for the plaster. The mortar shall be washed off and the surface cleaned of all oil, grease, etc., and well wetted before the plaster is applied.

19.3 Application of Plaster

The mortar of the specified mix shall be used. The method of application shall be the same as described for single coat plaster work. The surface shall be finished

even and flush with the old surrounding plaster. All rounding necessary at junctions of walls ceilings, etc., shall be carried out carefully and neatly.

19.4 Protective Measures

Doors, windows, floors, railings, grills, etc., and such other parts of the building shall be properly protected from being splashed upon. Splashing and drops if any shall be scraped, removed and the surface cleaned immediately.

Shall keep other exposed surfaces covered to avoid deposition of loose mortar when the work is progressing.

FLR FLOORING, SKIRTING, DADO AND CLADDING WORKS

1. SCOPE AND GENERAL INFORMATION

1.1General

The contractor shall furnish all materials, labor operations including fixing devices, equipments and incidentals and everything necessary and required for the completion of all flooring and paving works. The contractor shall pave the areas indicated on the plans and schedule of finishes, the materials therein called for. All flooring shall be laid to the best practice known to the trade. The flooring shall be laid to the levels called for except where slopes are required and slopes shall be uniform and arranged to drain into the indicated outlets. Particular care shall be exercised to ensure that all flooring, skirting and dados shall be perfectly matched for colour and finish.

1.2The following BIS Codes shall apply to this section:

code No.	Description
77 - 1988	Specification for glazed earthenware wall tiles
508 -1984	Specification for low density polythene films
3711 - 1993	Ceramic tiles - sampling and basis for acceptance
3712 - 1993	Ceramic tiles - Definitions, classifications, characteristics and marking
571 - 1970	Code of practice for laying in situ cement concrete flooring
531 - 1986	Code of practice for laying of epoxy resin floor toppings
491 - 1969	Code of practice for laying of in situ granolithic concrete floor topping
13630 - 1993 all parts	Methods of test for ceramic tiles
8112 and 12269	43 grade and 53 grade Ordinary Portland Cement
456-2000	Plain and reinforced concrete code of practice
383-1970	Coarse and fine aggregate from natural sources for concrete

1.3Samples

After approval by , samples of materials and each type of floor finish and dado finish with size, type, etc, work shall start and conform to samples approved.

1.4Specialist Workers

Work on vitrified tiles, ceramic tiles, marble, granite and other finishes shall be carried out by specialist workmen or specialist firms approved by the .

1.5 Laying to Pattern

All flooring shall be laid to the pattern called for in the drawings and as instructed by the . The pattern could be in the form of differently arranged shapes of same colour slab or tile, slabs\ tiles of different colours to particular pattern, tiles/ slabs of one material with band of different material and so on. All items will be measured under the respective relevant items in the schedule.

1.6 Fixing with Adhesive for Dadoing

Where called for vitrified tiles, marble and granite slabs shall be fixed with appropriate tile adhesive manufactured by approved manufacturer. The joints shall be sealed, pointed and finished neat with joint fillers or other approved equivalent.

1.7 Cement Mortar Mixing

Bedding mortar or screed shall consist of cement and sand in the proportion of 1:4 (1 cement and 4 screened sand) to a thickness of about 20 to 30mm to match the required level and to make up the overall thickness as called for.

Mortars shall be of the mix as indicated. The mixes specified are by volume mix proportions of cement mortars specified are in the proportions of cement to dry sand. Mixing of mortar shall be done in a mechanical mixer. Hand mixing shall be resorted to only when specifically permitted by the / Engineer-in-charge. Hand mixing should be carried out over a GI sheet. Cement and sand shall be mixed dry thoroughly and then water shall be added gradually. Wet mixing shall be continued till mortar of the consistency of a stiff paste and uniform colour is obtained. Only the quantity of mortar which can be used within thirty minutes of its mixing shall be prepared at a time.

Mortar shall be used as soon as possible after mixing and before it has begun to set and in any case within thirty minutes after the water is added to the dry mixture. Mortar left unused for more than thirty minutes after mixing shall be rejected and removed from the site of work immediately.

1.8 Laying Bed Mortar

a. The surface to receive flooring shall be clean, free from dirt and free from foreign material.
b. Any undulations or mortar remaining on the floor shall be trimmed.
c. Base course shall be trimmed.
d. The base shall be cleaned and watered before laying the floor.
e. Provide a layer of mortar to the specified preparations in the case of slabs, tiles to correct levels and slopes as required.
f. Provide a layer of chemical adhesive for fixing ceramic tiles on to the floor slab or walls as per specifications to correct height and levels.
g. Work includes at all depths and heights.
h. The finished surface shall be kept wet for a maximum period of one week.

2. GRANOLITHIC FLOORING

2.1 General

This specification relates to the furnishing of the component materials that are to form the granolithic topping, preparation of the concrete from these materials and laying the same in the finish or topping over an already laid base concrete.

2.2 Materials

As the floor topping referred to in this specification is in the form of cement concrete, the materials and preparation of the floor finish shall be as laid down under specification for concrete for plain and reinforced works. The mix shall be as specified in the schedule.

2.3 Construction details

Before the operation of laying the topping is started, the surface of base concrete shall be thoroughly cleaned of all dirt, loose particles, rake mortar droppings and laitance if any, by scrubbing with coir or steel wire brush. Where the concrete has hardened so much that roughening of surface by wire brush is not possible, the surface shall be roughened by chipping or hacking at close intervals. Before laying the topping, the surface shall be soaked with water at least for twelve hours and surplus water shall be removed by mopping immediately before the topping is laid in position.

The operation of laying the topping shall commence with fixing of screed strips over the base concrete dividing into suitable panels so as to reduce the risk of cracking. Size of panel is governed by the thickness of the floor finish, the type of construction (monolithic or bonded construction), local conditions of temperatures, humidity and the season in which the floor is laid. For floor finish laid in exposed situations or in hot and dry climate, the size of the panels shall be smaller as compared to the floor finish laid in less exposed situations or in cold humid climates. Generally, no dimension shall exceed 2m in the case where the floor in finish is laid separately on a hardened base, the length of the panel shall not exceed 1.5 times its breadth. The thickness shall not be less than 40mm. Side Formwork for panels shall be only structural steel sections.

The limits with regard to the dimension of panels (normally 7.5sqm) shall also apply to borders and skirting laid around the floor. The joints in the floor finish shall extend through the borders and skirting. If the skirting is laid monolithic with the floorings a border of about 300mm width must be provided all around the floor. The width of border provided around the floor when the skirting is not monolithic with floor finish shall not exceed 450mm. Rows of panels shall be staggered to an extent of about 300mm to avoid the corners of the adjacent panels meetings at one point.

The screed strips shall be so arranged that the joints, if any, in the base concrete shall coincide with the joints in the topping. Before placing the concrete mix for topping, neat cement slurry shall be thoroughly applied on to the prepared surface of the base concrete.

The topping shall be laid in alternate panels, the intermediate panels being filled in after two to three days depending upon the temperature and atmospheric conditions. Longer intervals shall always be preferred to allow the concrete topping in the panels laid first to complete its initial shrinkage and to attain sufficient strength to allow tamping to the topping in the new panels without damaging the edges of panels laid earlier.

The screed strips shall be removed a few hours after the concrete has been deposited in the panels and the edges of panels shall be examined for any honeycombing or undulations, which if found, shall be repaired straight and smooth by cement mortar. The screed strips shall then be cleaned and put back against the edges of panel's deposit. When the topping is to be deposited in the alternate panels the screed strips shall be removed and the edges of panels laid earlier shall be covered with paper strips and alike, laid vertically and folded over the surface of

panels already laid, to prevent the new topping from spoiling the edges. When the topping is being concreted in new panels, care shall be taken to avoid damages to the panels already laid.

The topping laid as indicated above shall be thoroughly tamped, struck off level and the surface floated with a wooden float. The surface shall be tested with a straight edge and mason's spirit level or any other equipment approved as equivalent by the to detect any inequalities in the surface, which, if any, shall be made good immediately.

After topping is thoroughly tamped, vibro floated and struck off level, etc., as indicated above it shall be trowel finish. Finishing operations shall start shortly after the compaction of the topping and shall be spread over the period of one to six hours depending upon the temperature and atmospheric condition. The surface shall be finished three times with trowel at intervals so as to produce a uniform and hard surface.

The satisfactory resistance of floor to wear depend largely upon the care with which finishing with trowel is carried out. The object of trowel finish is to produce as hard and close knit a surface as possible. The time interval allowed between successive trowel finishes is very important. Immediately after laying, only just sufficient use of trowel shall be done to give a surface. Excessive use of trowel in the earlier stages shall be avoided, as this tends to work a layer rich in cement to the surface. Some time after the first close any pores in the surface, and to bring to surface and scrap off any excess water in concrete or laitance (it shall not be trowel back into the topping). The final trowel finish on the surface shall be done such a time after the first trowel finished surface is re-trowelled to close any pores in the surface and to bring to surface and scrap off any excess water in concrete of laitance (it shall not be trowelled back into the topping). The final trowel finish shall be done well before the concrete has become too hard but at such time that considerable pressure is required to make any impression on the surface. Trowel finish of rich mix of dry cement and fine aggregate onto the surface shall not be permitted. Ramps shall be given serrated finish.

2.4 Curing

Immediately after the flooring surface is finished, it shall be protected from rapid drying by erecting barriers against wind, drought or strong sunlight. As soon as the surface has hardened curing shall be started and continued for at least ten days by means of wet gunny bags, 50mm thick layer of damp sand spread over the surface, or pooling water on the surface. During this period the flooring shall not be exposed to any traffic/ movement. Premature exposure to traffic/ movement will lead to damage to surface, which cannot be satisfactorily repaired.

2.5 Skirting

Granolithic skirting to walls, recessed or flush with the finished wall surface as called for on the drawings, shall be 20mm thick, consisting of one part cement and four parts screened sand, applied to wall faces, compacted and trowel finished smooth with a floating coat of neat cement to a finish approved by the to match with the granolithic floor. The junction of the skirting with the floor to be neatly rounded to a smooth curve. The surface shall be kept constantly wet for 10 days. Skirting shall be of the same topping concrete of flooring for a height as specified shall perfectly match with the flooring.

2.6 Providing and laying Power floated and finished controlled concrete flooring

Providing and laying power floated and finished with specified grade controlled concrete flooring of specified thickness with necessary shuttering, consolidation curing, etc., as detailed below:

a. Providing and laying specified grade and thickness of concrete over the prepared surface.

b. Supplying and mixing high strength super plasticizer in concrete as per the manufacturer's specification.

c. Providing and running surface vibrator on pre-laid concrete and leveling the concrete between the form work of angles or MS channels and finished smoothly using power trowels only.

d. The floor has to be laid in panels of specified size by the alternative bay method. During the laying of concrete the construction joints have to be de-marketed for the next operation of shrinkage joint treatment.

e. The finished surface shall be within the allowable tolerance of +/ - 2mm only with an area of 9Sqm.

f. In case variation in levels exceeding the allowable tolerance of 2mm, the same shall be made up by using approved chemical manufactured by approved manufacturer at the contractors cost.

g. The floor has to be laid in panels of maximum size 3x3m panels by the alternative bay method. The construction joint shall be cut using diamond bit wheel for a width of 3 to 4mm and a depth of 30mm within 20 to 30 hours of concreting. No delay shall be acceptable.

h. On curing and drying of the concrete, the construction joints have to be filled with approved non-shrink material manufactured by approved manufacturer or approved equivalent.

2.7 Providing and laying power floated and finished with standard hard top floor hardener with the approved water cement ratio:

a. Providing and laying specified thickness specified grade controlled concrete over the prepared surface brought casting with standard hard top floor hardener.

b. Supplying and mixing high strength super plasticizer as per the manufacturer's specification.

c. Providing and running surface vibrator on pre-laid concrete and leveling the concrete between the form work of angles or MS channels and finished smoothly using power trowels only.

d. The finished surface shall be within the allowable tolerance of +/ - 2mm only with an area of 9Sqm.

e. The floor has to be laid in panels of maximum size 3x3m panels by the alternative bay method. The construction joint shall be cut using diamond bit wheel for a width of 3 to 4mm and a depth of 30mm within 20 to 30 hours of concreting. No delay shall be acceptable.

f. On curing and drying of the concrete, the construction joints have to be filled with approved non-shrink material. The rate shall include for all materials, labour, form work moulds and machineries, etc., complete. If the plasticizer is cancelled during construction which will be deducted at the rate quoted in the appropriate item.

2.8 Providing and laying specified grade controlled concrete vacuum dewatered flooring with an approved water cement ratio:

a. Providing and laying controlled concrete over the prepared surface.

b. Supplying and mixing high strength super plasticizer in concrete as per the manufactures specification.

c. Providing and running surface vibrator on pre laid concrete and leveling the concrete between the form work of angles or MS channels and finished smoothly using power trowels only.

d. Providing and laying suction mats and tops spread and dewatered the concreting with help of vacuum pump.

e. Power floating the dewatered concrete with skim floater till a desired top smooth finish obtained.

f. Immediately after dewatering, the surface should be broad cast by using hard top standard by approved manufacturer or any other approved equivalent at the contractors cost. The concrete hardener should be used at 3kgs/ Sqm or as per manufacturer's instructions depending upon abrasion resistant required over the trimix vacuum dewatered floor.

g. The finished surface shall be within the allowable tolerance of +/ - 2mm only with an area of 9Sqm.

h. In case variation in levels exceeding the allowable tolerance of 2mm, the same shall be made up by using approved chemical leveler or any other approved equivalent at the contractors cost.

i. The floor has to be laid in panels of maximum size 3x3m panels by the alternative bay method. The construction joint shall be cut using diamond bit wheel for a width of 3 to 4mm and a depth of 30mm within 20 to 30 hours of concreting. No delay shall be acceptable.

j. On curing and drying of the concrete, the construction joints have to be filled with approved non-shrink material, or approved equivalent.

k. The rate shall include for all materials, labour, form work moulds and machineries, etc. complete. If the plasticizer is cancelled during construction which will be deducted at the rate quoted in the appropriate item.

2.9 Providing and laying, power floated and finished controlled concrete flooring of specified thickness for grade slab with an approved water cement ratio:

a. Providing and laying specified thickness and grade of concrete over the prepared surface.

b. Supplying and mixing high strength super plasticizer in concrete as per the manufacturer's specification.

c. Providing and running surface vibrator on pre-laid concrete and leveling the concrete between the form work of angles or MS channels and finished smoothly using power trowels only.

d. The finished surface shall be within the allowable tolerance of +/ - 2mm only with an area of 9Sqm.

e. Incase variation in levels exceeding the allowable tolerance of 2mm, the same shall be made up by using chemical leveler at contractor's cost.

f. The floor has to be laid in panels of maximum size 3x3m panels by the alternative bay method. The construction joint shall be cut using diamond bit wheel for a width of 3 to 4mm and a depth of 30mm within 20 to 30 hours of concreting. No delay shall be acceptable.

g. On curing and drying of the concrete, the construction joints have to be filled with approved non-shrink material approved equivalent.

h. The rate shall include for all materials, labour, form work moulds and machineries, etc. complete. If the plasticizer is cancelled during construction which will be deducted at the rate quoted in the appropriate item.

i. Curing: As soon as the surface is hard enough, it shall be covered with sacking or sand and kept continuously wet for a period of at least one week.

3. TERRAZO/ MOSAIC TILE FLOORING

The tiles shall conform to IS: 1237 having the colour and chips approved by the . The mosaic topping of lighter shade tiles shall be made of white cement with an approved shade pigment and natural shade tiles shall be of grey cement with an approved shade pigment. The type of tiles shall be as specified in respective items.

A bed of cement mortar consisting of one part of cement and 6 parts of sand shall be laid and properly leveled to an average thickness of 20mm and the surface shall be kept slightly rough to form a satisfactory key for tiles. Neat cement paste of honey like consistency shall be spread over mortar bed, over such area at a time as would accommodate about 20 tiles. Tiles shall be soaked in water for at least 15 minutes and allowed to dry for the same duration. Tiles shall then be fixed with a thin coat of cement paste on back of each tile and then each tile gently tapped with a wooden mallet till it is properly bedded and in level with adjoining tiles. Joints shall be fine and as imperceptible as possible (not more than 1.5mm wide).

After tiles have been laid in a room or a day's fixing work is completed, surplus cement grout that may have come out of the joints may be wiped off gently and joints cleaned. Thick slurry of coloured cement matching the colour of tiles shall be spread over it and rubbed so as to seal even the thinnest joint between the tiles and make it impervious and the flooring cured for 14 days. The floor shall be polished and finished according to IS: 1443.

4. FLOORING USING NATURALLY OCCURRING MATERIALS LIKE CUDAPPAH (OTHER THAN MARBLE)

The slabs shall be of selected quality, hard sound, dense, homogenous in texture, free from cracks, decay, weathering and flaws and of thickness as specified. The top exposed faces should have been roughly polished before bringing it to site. Unless otherwise specified the slabs should be cut to the required shape and size, by hand using fine chisel or machine cut as specified. All pieces should be of uniform size.

A bed of cement mortar 1:6 shall be laid and properly leveled to an average thickness of 20mm and the surface should be kept slightly rough to form a satisfactory key for the tiles. Neat cement paste of honey like consistency shall be spread over mortar bed over such an area so that the paste will not harden before laying tiles. Slabs shall be soaked in water for 15 minutes and allowed to dry. The slabs shall then be fixed as per approved pattern with thin coat of cement paste on back of each slab. They will be tapped with a wooden mallet till it is properly bedded in level with adjoining slabs. Joints shall not be more than 1.5mm wide. The surplus cement grout that may have come out of the joints has to be wiped off gently and joints cleaned. The joints shall be filled up with grey or white cement with an admixture of pigments to match the shade of the slab. The flooring shall be cured for 14 days. Then it shall be polished according to IS: 1443, except that 1) first polishing with course grade carborundum shall not be done. 2) Cement slurry with or without pigment shall not be applied before polishing.

5. MARBLE OR GRANITE SLAB WORKS

All supplied granite should be cut mechanically before laying. All work should be protected from scratches and chippings by appropriate means.

5.1 Granite and Marble Slab Flooring

The Contractor shall provide pre-polished Granite or Marble slab flooring to areas as called for in the drawings and schedule of Finishes. The size of the slabs shall be as called for in the drawings and shall be normally 20mm thick. They shall be of colour as approved by the and shall be hard, sound, dense, homogeneous in texture, free from cracks, decay, weathering and other defects. Pave areas where called for (toilet floors, etc) with pre-polished granite/ marble slab of size and thickness as called in the drawings. The cut slab shall be truly rectangular, true to size and free

of any defects. It shall be ensured that the slabs are of same uniform colour. Allowable tolerances shall be +1mm for length and breadth.

Screed base, laying, fixing with adhesive, grouting and pointing. Final cleaning, protection of completed surface, etc., shall be as laid down earlier. Add water proofing compound to screed base as per manufacturer's specifications.

5.2 Sample

Samples of all flooring materials shall be submitted to the for approval and all slabs procured shall fully match the samples.

5.3 Machine Polished Faces

Every stone shall have the top surface machine polished before being brought to the site. All stones shall be machine cut to the required sizes and all edges ground smooth and even to the full depth. A straight edge laid along the side of the slab shall be in full contact with it. All angles and edges of the slabs shall be true and square and free from chipping.

5.4 Tolerances

Allowance tolerances in length and breadth shall be +3mm and in thickness +1.5mm.

5.5 Laying

Requirements for laying of slabs, adhesive or cement mortar etc. shall be the same as laid down under earlier excepting that the slabs shall be laid abutting each other to obtain as fine joints as possible. Edges of slabs shall also be buttered with adhesive and placed in position closely in contact with the adjacent slab to correct levels with fine joints. Slabs adjoining walls shall enter under the skirting or dado as called for on the drawings. Any slight unevenness at the meeting of the slabs shall be removed by fine chiseling and grinding to original finish.

6. NATURAL STONE BANDS

Where called for, specified natural stone shall be laid in bands and borders of required widths as called for on the drawings. Such borders and bands will be having its length uniform width as called in the drawings shall merge with the level of the flooring/ cladding.

Slabs for treads and risers shall be of single lengths to cover the full width of steps. Treads shall project slightly beyond the face of the riser as called in the drawings, round off edge/ provide bull nosing as shown and provide 3mm deep grooves for grip, over full length of tread.

Risers will rest on the treads and slightly slant outwards from vertical. Treads and risers shall be fixed to cement mortar (1:4) base screed with tile adhesive as described earlier. Cement mortar shall be 20mm thick, mixed and laid as described earlier. Stone sills in toilets, etc. shall be 20mm thick with all visible faces and edges polished. Finished work shall be true to line and levels. Cleaning, washing, protecting, etc., shall be as described earlier.

7. STONE SKIRTING

The skirting is laid truly vertical, with the face slightly projecting from the plaster face above. Top of skirting shall be chamfered as shown in the drawings and polished finished skirting height shall be minimum 100mm clear.

8. NATURAL STONE SLAB CLADDING FOR INTERNAL AREAS

The slabs shall be of approved colour/ shade, of approved variety, etc. all as selected by the PMC They shall be of size as called in the drawings with clear sharp, correct corners. They shall be truly rectangular to enable joints to be uniform and straight. Slabs shall be free from cracks, chipped edges and corners, spots, etc. and shall be hard and dense.

8.1 Laying

The slabs shall be laid with waterproof tile adhesive over dry, clean, hardened plaster backing or rough plaster backing. All requirements as laid down for ceramic tiles in regard to adhesive, laying to pattern to true plane, etc., and cleaning, joints, etc. shall be applicable.

8.2 Cleaning and Protection

The Contractor shall protect completed work in the manner already described.

8.3 Final Polish

At the appropriate time when all other trades have completed their work, the marble and granite stone slab surfaces shall be worked clean with dilute oxalic acid solution and dried. Non-slip work polish shall then be applied with soft linen on the clean and dry surfaces and a polishing machine fitted with felt shall be run over the surface to achieve desired glossy finish as approved by the . Care shall be exercised to ensure that the floor is not rendered slippery. Spread clean sawdust and protect surface until practical completion.

9. NATURAL STONE SLAB CLADDING FOR EXTERNAL AREAS

The slabs shall be of approved colour/ shade of approved variety, etc. all as selected by the PMC They shall be of size as called in the drawings with clear sharp, correct corners. They shall be truly rectangular to enable joints to be uniform and straight. Slabs shall be free from cracks, chipped edges and corners, spots, etc. and shall be hard and dense.

9.1 Laying

The slabs shall be laid with tile adhesive (water proof) over dry, clean, hardened plaster backing or rough plaster backing. The granite shall be fixed to the wall using GI clamps. As all requirements as laid down for ceramic tiles in regard to adhesive, laying to pattern to true plane, etc. and cleaning, etc. shall be applicable. The edges shall be chamfered to the required angles at joints as called in the drawings. The open joints shall be sealed with non bleeding silicone sealant of any approved make by the

9.2 Dry Fixing

The finished size of saw cut stones to be of specified size. The stone shall be hard, sound, durable and tough, free from cracks, decay, weathering and defects like cavities, cracks, flaws, sand holes, veins, patches of soft or loose material, etc. The stones shall be cut into required thickness along the planes parallel to the natural bed of stone. The stones shall be secured to the plastered wall by means of stainless steel clamps, which shall be able to resist the corrosion under conditions of dampness and against the chemical action of mortar/ concrete in which the clamps are embedded.

The thickness of the clamps shall be as per the design of the supplier/ builder. The clamps to be fixed to the concrete/ block masonry work with the help of stainless steel 304 grade dash fasteners of approved make. The center to center spacing of the clamps should not be greater than 600mm in horizontal direction. Six numbers of clamps shall be used for each stone of size 1200x600mm. The clamps to be designed as per IS: 4101 (Part-I) - 1967 (Code of practice for external facings and veneers Part-I, Stone facing Reaffirmed 1990) for holding the units in position and to transfer the weight of the slab to the backing. The stone cladding work to be

carried out to true plumb. All courses to be laid in perfect horizontal and vertical joints. The slabs shall have a break in the joints and all the stones to be of the same height. A 50mm air gap is to be provided in between the plastered surface and the stone cladding. 10mm deep groove is to be provided at every horizontal joint of the cladding.

9.3 Cleaning and protection

The Contractor shall protect completed work in the manner already described.

9.4 Final polish

At the appropriate time when all other trades have completed their work, the marble and granite stone slab surfaces shall be worked clean with dilute oxalic acid solution and dried. Non-slip work polish shall then be applied with soft linen on the clean and dry surfaces and a polishing machine fitted with felt shall be run over the surface to achieve desired glossy finish as approved by the .

10. GRANITE COUNTER TOPS

Counter tops toilets, kitchen, pantry and other areas shall be of granite slabs, pre-polished on the top and visible edges (including 30mm under top where under counter basin is fixed). The slabs shall be in single length for toilet counters and in appropriate long lengths as called for in kitchens. They shall be clear 600mm wide unless otherwise called for on the drawings.

Provide neatly cut holes, oval or circular as required to accommodate under slung wash basins in toilets. Edges of formed holes shall be ground neat and smooth and polished. The openings provided shall be precise to size and shape. Provide cutouts as required for stainless steel sinks in kitchen, toilets and pantry. Provide neatly cut holes for pillar cocks wherever called for. Round off or bull nose edges and polish neatly.

Supports: Counters shall be supported by galvanized steel brackets as called for on the drawings. Supports shall be anchored into wall properly with the other end screwed to granite slab bottom through stainless steel plates and screws as shown in details.

11. NATURAL STONE SLAB TREADS, RISERS, ETC.

Treads of steps and risers of steps of staircases shall be of pre-polished stone slabs of sizes as called for on the drawings. They shall be of specified uniform thickness and of single piece. The tread shall be provided with three lines anti skid grooves and the nosing shall be of specified thickness. Bull nose which is prepared by sticking two 20mm thick half nosed slab by metal paste or as called in the drawing. Riser shall be of single piece stone slab and placed truly vertical as called in the drawings.

12. TILES (MANUFACTURED)

12.1 Ceramics tiles/ Glazed tiles flooring, dado & skirting

Glazed tiles from an approved manufacturer conforming to IS: 777 shall be of specified size and thickness and colour. All specials viz. coves, internal and external angles, corners, beads, etc. shall be used wherever directed. Under layer of 12mm average thickness of cement mortar 1:3 proportion shall be laid. Tiles shall be well soaked in water washed clean and set in cement grout and 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 and in straight lines or to suit the required pattern. After the tiles have been laid, surplus cement grout shall be cleaned off. The joints shall be cleaned off the grey cement grout with a

wire brush or trowel to a depth of 5mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement if necessary mixed with colour to match the colour of the tile. The floor/ dado shall then be kept wet for 14 days. After curing, the surface shall be washed with mild hydrochloric acid and clean water. The finished floor/ dado shall not sound hollow when tapped with a wooden mallet. The rate will include the cost of under layer of cement mortar.

12.2 Vitrified tiles

Vitrified tile flooring areas called for shall be of polished tiles of approved manufacture and of size 300x300mm and of approved colour and shade with chamfered edges. The tiles shall be of uniform colour true of size shape, free from crazing and other defects. Tiles with chipped edges or other defects shall be rejected and removed from site. All tiles shall conform to approved samples. Tiles shall conform to standards in all respects. Tiles shall be ordered directly on the manufacturer and proof of ordering, delivery details, etc. submitted to the .

Tiles on delivery at site shall be inspected for their correctness to size, colour, etc. and stacked in a safe place in appropriate manner.

12.3 Laying

Ensure that the screed surface in dry, to plane and level, clean and free from loose dirt, etc. The tiles shall be soaked in water for one hour before laying and wiped clean before laying in position.

12.4 Tile adhesive

Tile adhesive for fixing tiles to screed and wall shall be approved water proof adhesive. The tiles shall be laid to the pattern called for in the starting from the 'start' point. The lay out shall be first marked with guide lines on the screed surface and the tiles shall be first laid as a trial to the required pattern in combination with granite stone bonds without adhesive, with uniform straight joints. Only full tiles shall be used as far as possible where tiles have to be cut, proper cutting tools shall be used to obtain precise sizes with neat straight edges. Tiles with jagged edges damaged edges, etc. shall not be accepted.

The adhesive shall then be applied to the screed face and to the back of the tiles using a notched trowel. The quantity of adhesive shall be as recommended by the manufacturer. It shall be prepared and kept ready as recommended by the manufacturer when set sufficiently for laying, the tiles shall be placed in position one end onwards slowly so that no air pockets are left between the tiles and screed. The tile and proper adhesion over the whole of the tile back. Place adjacent tiles 3mm away ensuring uniform straight joints 3mm wire in both directions. Check for pattern formed, line and level and correct where required. Provide for 12.5mm level drop at mat locations.

Remove all excess adhesive and smears from the surface as the work proceeds.

Grouting: Joints shall be grouted and pointed with approved joint filler to uniform texture and depth as approved. Remove all excess adhesive from the surface as the work proceeds.

Any hardened grout film shall be removed using appropriate solution recommended by the manufacturer.

The finished surface shall fully conform to the pattern called for shall be true to line and levels.

12.5 Cleaning and Protection

All precautions shall be taken to protect finished work from damages by other trades and where the floor is likely to be subject to damage by ensuing construction operations or traffic. It shall be protected in suitable manner by a larger of plaster of paris or other means at the contractor's expenses. Any tiling damaged shall be removed and replaced satisfactorily at contractor's expenses. Remove protective

layers at appropriate time, clean the surface thoroughly, wash with mild acid solution compatible with tile and grout and leave the surface clean and tidy.

13. VITRIFIED TILE SKIRTING

Vitrified tile skirting shall be with vitrified tiles of specified size cut from full tiles where required. The cutting shall be precise, to correct required size with straight edges. Tiles shall fully match the floor tiles in every aspect. The flooring tile shall enter under the skirting tile as shown.
Base plaster shall be 15mm thick in cement mortar 1:4 laid and finished true to line and level. Vitrified tiles to required size shall be fixed to mortar base with tile adhesive with 3mm wide joints.

Joint grouting, finishing, cleaning, etc. shall be as described earlier for flooring.

The finished surface shall be true to line and slightly project from the plaster face above as called for in the drawing.

14. WALL CLADDINGS

Cladding to walls in toilets, kitchen, pantry and other areas shall be with ceramic tiles, marble tiles, etc. as called for in drawings/ schedule of finishes. Tiles to be procured shall fully match the samples approved by the PMC Sufficient specimens shall be furnished to the PMC to enable him to select the tiles. The tiles shall be procured from the same single source to ensure uniformity in colour, size, finish, etc.

14.1 Ceramic tiles

Ceramic tiles shall be tiles manufactured by standard manufacturers approved by . The tiles shall be free from cracks, spots, crazing, chipped edges and corners and other defects. The tiles shall conform to above and other requirements laid down IS: 13712-1993.

Ceramic tiles will be selected by the .

14.2 Laying

Tiles are to be laid with cement mortar or approved waterproof tile adhesive over the dry, hardened backing plaster already laid. Ensure that the surface is dry, clean, true to plane and level, free from contamination, loose particles, etc. Set out tiles to the pattern shown on detail drawings to keep cut tiles to the minimum. Where they do occur, they shall be as large as possible. Joints are to be laid in straight unbroken lines. Horizontal joints in adjacent walls shall align. Neatly cut and fit tiles around obstructions.

After the setting out is finalized, art laying from top of skirting as shown. Apply cement mortar or tile adhesive to back of tile and also on plastered surface, set on assigned place firmly, tamp to correct plane and level. The backing plaster shall be true to plane and level so that the tiles are also truly laid.

The joints shall be tight, straight and uniform and shall be as fine as possible. The joints shall be truly vertical and horizontal on laying and form the pattern called for.

Clean the surface of all smears after grouting the joints with joint filler and finishing neat. Wash the surface with mild acid solution and polish the surface upon completion.

15. INTERLOCKING PAVERS

15.1 Material

Interlocking pavers block shall be of approved make/ colour/ shape as approved by PMC and it shall be homogenous in texture and must be free from cracks. It shall have the thickness as specified in the drawing and must be from approved manufacturer conforming to IS, having minimum compressive strength of 350kg/Sqcm.

15.2 Laying

Over the existing compacted and leveled surface/ soling, a layer of clean/ sharp/ course sand with a minimum thickness of 50mm shall be spread and consolidated using vibratory rammer. Over the laid sand, pavers are placed as per the pattern and design and joints are filled with sand. Top laid surface shall once again be consolidated using vibratory rammer. Vibratory rammer shall be of adequate capacity. The entire surface shall be cleaned and sloped as per requirement. Edge protection shall be provided wherever required as approved by PMC Pavers shall be cut, using machine only.

16. FLOORING AND DADOOING ADHESIVES & EPOXY GROUTS.

WEBER.SER PLUS WHITE .

DIRECTIONS FOR USE :

SURFACE PREPARATION :

1) Clean the substrate of oil strains and bond inhibiting compounds . Also remove dirt , dust and laitance , if any , using high pressure water jet or any other suitable method.

2) Ensure that the substrate is flat , stable, well adhered and has a normal absorption.

3) Concrete screeds, renders and block work should be cured sufficiently to avoid the shrinkage cracks.

4) Correct the local undulation/ damage on the substrate at least 48hours before the application of **weber.set plus- white**.

5) Saturate the surface well and remove excess water before application of the tile adhesive.

MIXING

1) Gradually add 2.5 parts of powder to 1 part of water (by volume) and mix it to a smooth , workable paste using a suitable stirrer or a low speed drill mix .

2) Do not attempt to extend the pot life by adding more water to the mix.

3) After mixing allow the mixture to stand for 2 minutes for it to mature.

TILE FIXING

1) Apply **weber.set plus-white** over the surface using the straight edge of the notched trowel and then comb the applied adhesive using the notched side of the trowel to achieve the desired thickness . If the adhesive is buttered to the tile , then ensure proper coverage of the tile surface to avoid voids .

2) Firmly press the tile into the adhesive to ensure good initial bonding.

WEBER .SET FIRM

DIRECTIONS FOR USE :

SURFACE PREPARATION :

1) Clean the substrate of oil strains and bond inhibiting compounds . Also remove dirt , dust and laitance , if any , using high pressure water jet or any other suitable method.

2) Ensure that the substrate is flat , stable, well adhered and has a normal absorption.

3) Concrete screeds, plastered surfaces , block works and renders should be cured sufficiently to avoid the shrinkage cracks.

4) Correct the local undulation/ damage on the substrate at least 48hours before the application of **weber.set firm**.

5) Saturate the surface well and remove excess water before application of the tile adhesive.

MIXING

1) Gradually add 2.5 parts of powder to 1 part of water (by volume) and mix it to a smooth , workable paste using a suitable stirrer or a low speed drill mix .

2) Do not attempt to extend the pot life by adding more water to the mix.

3) After mixing allow the mixture to stand for 2 minutes for it to mature.

TILE FIXING

1) Apply **weber.set firm** over the surface using the straight edge of the notched trowel and then comb the applied adhesive using the notched side of the trowel to achieve the desired thickness . If the adhesive is buttered to the tile , then ensure proper coverage of the tile surface to avoid voids .

2) Firmly press the tile into the adhesive to ensure good initial bonding.

WEBER. SET FLEX

DIRECTIONS FOR USE :

SURFACE PREPARATION :

1) Clean the substrate of oil strains and bond inhibiting compounds . Also remove dirt , dust and laitance , if any , using high pressure water jet or any other suitable method.

2) Ensure that the substrate is flat , stable, well adhered and has a normal absorption.

3) Concrete screeds, plastered surfaces , block works and renders should be cured sufficiently to avoid the shrinkage cracks.

4) Correct the local undulation/ damage on the substrate at least 48hours before the application of **weber.set flex**.

5) Saturate the surface well and remove excess water before application of the tile adhesive.

MIXING

1) Gradually add 3 parts of powder to 1 part of water (by volume) and mix it to a smooth , workable paste using a suitable stirrer or a low speed drill mix .

2) Do not attempt to extend the pot life by adding more water to the mix.

3) After mixing allow the paste to stand for 2 minutes for it to mature.

TILE FIXING

1) Apply **weber.set flex** over the surface using the straight edge of the notched trowel and then comb the applied adhesive using the notched side of the trowel to achieve the desired thickness . If the adhesive is buttered to the tile , then ensure proper coverage of the tile surface to avoid voids .

2) Firmly press the tile into the adhesive to ensure good adhesion.

WEBER .SET NOVA – WHITE

DIRECTIONS FOR USE :

SURFACE PREPARATION :

1) Clean the substrate of oil strains and bond inhibiting compounds . Also remove dirt , dust and laitance , if any , using high pressure water jet or any other suitable method.

2) Ensure that the substrate is flat , stable, well adhered and has a normal absorption.

3) Concrete screeds, plastered surfaces , block works and renders should be cured sufficiently to avoid the shrinkage cracks.

4) Correct the local undulation/ damage on the substrate at least 48hours before the application of **weber.set nova white**.

5) Saturate the surface well and remove excess water before application of the tile adhesive.

MIXING

1) Gradually add 2.5 parts of powder to 1 part of water (by volume) and mix it to a smooth , workable paste using a suitable stirrer or a low speed drill mix .

2) Do not attempt to extend the pot life by adding more water to the mix.

3) After mixing allow the paste to stand for 2 minutes for it to mature.

TILE FIXING

1) Apply **weber.set nova white** over the surface using the straight edge of the notched trowel and then comb the applied adhesive using the notched side of the trowel to achieve the desired thickness . If the adhesive is buttered to the tile , then ensure proper coverage of the tile surface to avoid voids .

2) Firmly press the tile into the adhesive to ensure good adhesion.

WEBER EPOXY SYSTEMS

DIRECTIONS FOR USE :

SURFACE PREPARATION :

1) Clean and remove any loose particles , laitance and dust from the tile joints before grouting .

APPLICATION

1) Take 2 parts resin , 1 part harderner & 8 parts filler by weight.

2) Mix the resin & hardener for a minute . Add 80% of the filler and mix it for 2 minutes . Then add balance 20% of filler and mix all the components for another 2 minutes to get a homogeneous paste .

3) Before application wear rubber gloves and start filling the tile joints with a rubber trowel or any other appropriate tool.

4) Remove the excess material by placing the rubber trowel or any appropriate tool ,perpendicular to the tiled surface.

5) As the epoxy grout start gelling after 30-45 minutes (depending upon the site temperature) start the initial cleaning with a scrubber and soap water solution.

6) Finally clean the tiled surface with a dry cloth.

JNR **JOINERY WORK**

1. SCOPE

This item of specification relates to the requirement of supplying, fabricating and erecting in position wood works like doors, windows and ventilators. The type, quality, materials, sizes and shapes of members, etc., shall be as per detailed drawings and specifications.

2. REFERENCE TO STANDARD SPECIFICATIONS

The provisions of the following Indian Standard specifications shall with the amendments form a part of these specifications:

IS: 303 Plywood for general purpose.
IS: 1003 Timber panelled and glazed shutters (Parts I & II).
IS: 1141 Seasoning of timber.
IS: 1328 Veneered decorative plywood.
IS: 2202 Wooden flush door shutters (Solid core type).
IS: 2338 Finishing of wood and wood based materials.
IS: 2380 Methods and tests for wood particle boards and boards from other lignocellulosic materials.
IS: 3097 Veneered particle boards.
IS: 4021 Timber door, window and ventilator frames.
IS: 4913 Code of practice for selection, installation and maintenance of timber doors and windows.

3. TIMBER GENERALLY

Timber shall be the best of its kind, well seasoned, sawn die square, free from large or unsound knots, spongy or brittle heart and any other defects.

3.1 Hardwood for joinery work:

All hardwood for joinery work shall be selected so that timber in adjacent pieces is matching or uniform or symmetrical in colour and grain and left clean to receive staining or clear finish.

3.2 Teak, Nandi and Sal wood:

Shall have uniform colour reasonably straight grains and shall be free from large loose dead knots, cracks, shakes, warp, twists, bends, bore holes, sap wood, etc.

3.3 Plywood:

Plywood is of weather and boil proof standard with grade A veneers which is Smooth and paintable, neatly made repairs permissible and used for natural finish in less demanding applications.

3.4 Laminated plastic:

Laminated plastic sheet shall be standard grade fixed with suitable contact adhesive. After fixing, exposed edges of sheets shall be planed and left with a smooth beveled edge.

3.5 Non-combustible boards:

Non-combustible boards should be approved from specified manufacturer.

4. ADHESIVES

Adhesives shall be compatible with the preservative treatment used for the timber.

5. WORKMANSHIP

All joinery shall be such that all planes are moulded. Mouldings for glazed panels shall have rounded edges.

All joinery shall be carried out by skilled workmen using proper tools. All works should be properly mortised, tenoned, shouldered, housed, dovetailed, mitred, glued, pinned, nailed as appropriate. All joints shall be fine and neatly done.

Curved work shall be built from an appropriate number of pieces cut to the required shapes. Where visible, nails should be punched in and stopped. Screw heads shall be countersunk 2mm below the finished surface.

All paneled shutters shall be fabricated to precise sizes, with rails and styles to correct sizes and joined together with fine joints. Provide grooves to receive glass as called for.

6. INSTALLATION

Install all frame work in prepared openings to true plumb and square. Frames to be securely fixed to masonry/ other supports through expansion bolts passing through the teakwood ‘rough ground’ already installed.

Install all shutters to fit snugly into frames, operating smoothly.

7. HARDWARE

Fix all hardware with matching screws. Ensure smooth functioning of all hardware. Remove all hardware except hinges before decoration and subsequently refix, oil and adjust. Nails shall comply with standards and where used for fixing joinery, shall have an external exposed face and interior exposed face galvanized if used in damp conditions. Bolts should be mild steel with nuts and washers as per standards. Bolts to be galvanized for exterior work and in damp interior locations shall include nuts and washers.

Bolts connecting timbers loaded parallel to the grain shall be spaced a minimum of eight times the diameter of the bolt from the end of the timber. Bolts connecting timbers loaded perpendicular to the grain shall be spaced a minimum of four times the diameter of the bolt from the load edge. No bolt should be closer than twice the diameter of the bolt from any edge of timber.

Wood screws shall comply with standards and be of sufficient size adequate for the purpose for which they are required. Unless otherwise specified, brass screws shall be used for interior locations and galvanized screws shall be used for exterior locations.

8. SIZES

The dimensions of timber specified are nominal unless described as finished.

Sawn timber shall be left with a sawn face to hold the full nominal dimensions specified. Re-sawn timber shall be within 2mm of the nominal size. Finished timber shall be within a tolerance of 2.5mm of each finished face from the nominal size.

9. PLUGGING

Plugging shall be by shot fired fixings, where approved or by casting in or drilling and inserting fibrous or other approved fixing materials at 450mm centers (minimum) and fixing with nails or screws to brick, block or concrete surfaces through any plaster, tile or other surface finishing. Where walls are of hollow block partitions, concrete fixing blocks shall be built in for such fixings.

10. FLUSH DOORS

Timber flush doors shall be of specified thickness constructed of hardwood cores and plywood facing of specified thickness to both sides. The core shall consist of top rail and stiles, middle and bottom rails, intermediate rails and with lipping, tongued on to all four edges and will be of specified dimensions. Rebated lippings to stiles shall be of specified dimensions.

11. PAINTING AND POLISHING

All panes, shutters, etc., shall be polished and painted as called for

PAINTING WORKS.

General

All paints, varnishes, distemper or other surface coating materials shall be of approved quality conforming to the appropriate Indian Standard, wherever such standard IS available, and be obtained from a manufacturer of repute. If there are more than one quality for one particular product, only first quality shall be used unless otherwise stated in the Schedule of Items.

Sampling & Testing.

The Project Consultants may at his discretion, require samples of paint to be tested. In such cases testing will be according to IS: 101 (Part 1-8) – 1964-1993

Storage.

Paints, primers, distempers and varnishes shall be delivered in sealed containers. They shall be stored in cool dry condition to the satisfaction of the Project Consultants.

Paints for priming.

Ready mixed paints for priming coats of steel and ironwork shall either comply with IS:2074-1992 “Ready Mixed Paint”, “Red Oxide Zinc Chrome Priming” or Red Oxide metal primer as specified. For wood work it shall be pink / white wood primer as specified by the manufacture of the synthetic enamel paints, conforming to IS: 3535-1966.

Royale Shyne is a high-sheen variant of Royale that offers enhanced radiance on ceilings walls, for those who want to make their walls a point of attraction.

1**Green Assure**

The promise of Green Assure from Asian Paints, implies that this product conforms to strict international environmental and safety standards. Low VOC standards and the absence of any harmful chemical results in very low odor

2**Teflon Surface Protector**

Teflon Surface Protector, fortifies your walls against tough stains, increases durability and reinforces the strength of the paint film. It has enhanced stain resistance that protects your walls for all kind of stains. The toughest household stains like turmeric and ink are reduced to a large extent, while water based stain like tea, coffee etc are completely removed.

3**Hi-Sheen Finish**

Smooth hi-sheen finish offers an enhanced radiance on the walls making your home more attractive

4**Anti- Bacterial and Anti- Fungal Shield**

Royale Shyne is designed to prevent fungal growth on walls. It also offers a unique anti- bacterial shield that kills = 99% of microorganisms as per Japanese Industrial Standard Z - 2801.

Asian Paints Royale Shyne Luxury Emulsion Generic: Apply 2-3 coats of Asian Paints Royale Shyne or equivalent luxury water based emulsion, with high sheen, low VOC, anti fungal properties and high wash ability, with 40-45% dilution with water, over two coats of Asian Paints DCP Primer or equivalent primer after dilution with water or turpentine (depending on the primer used) and two coats of Asian Paints Acrylic Wall Putty or equivalent as per the recommended application procedure.

Apply 2-3 coats of Asian Paints Royale Shyne or equivalent luxury water based emulsion with Teflon TM additives, high sheen (11-17 at 60 deg GH), low VOC (56.31 gms/lit, for White shade) as per ASTM D 6886 as tested at Shriram Institute for Industrial Research (for Non Flat Coating type) conforming to LEED, GS 11 and IS 15489 Type 1 standards with anti fungal properties, high wash ability and coverage of 150-175 sq.ft/ltr for 2 coats, with 40-45% dilution (with water). This has to be applied over two coats of Asian Paints DCP Primer or equivalent primer after dilution with water or turpentine (depending on the primer used) and two coats of Asian Paints Acrylic Wall Putty or equivalent as per the recommended application procedure.

Asian Paints Apex -- Weatherproof Emulsion is a smooth water-based, modified acrylic, exterior

wall finish with silicon additives.

1) **Excellent Anti-algal Performance** Resists algae and fungi growth on walls preventing appearance of black spots on walls.

2) **Weather Guard**

It withstands extreme tropical conditions of high rainfall, humidity and heat.

3) **Alkali and UV degradation**

It protects against alkali and UV degradation ensuring shades do not fade.

Under coats :

Exterior Wall Primer

TECHNICAL DETAILS

a. Drying time Surface dry time 30 min

b. Sheen levels: 5 - 7 at 60 deg GH

c. Flash point IS101/1987 Part 1, Sec 6:NA

d. Stability of thinned paint: To be used within 24 hours

PRODUCT FEATURES

Color Available.

Shelf life: 3 years from date of manufacture in original tightly closed containers away from direct sunlight and excessive heat.

Asian Paints Apex

Generic: Apply 2 coats of Asian Paints Apex or equivalent premium water based, modified acrylicexterior emulsion with silicon additives and soft sheen with anti algal properties over one coat of Asian Paints Exterior Wall Primer or equivalent and Asian Paints Wall Putty or equivalent as per the recommended application procedure.

Product Specific:

Apply 2 coats of Asian Paints Apex or equivalent premium water based, modified acrylic exterior emulsion with silicon additives conforming to I S 15489 standards with low VOC of 32.34 gms / lit (for Classic White shade) as per ASTM D 6886 as tested at Shriram Institute for Industrial Research (for Non Flat Coating type), 3 - 3.5 at 60 deg GH sheen levels and coverage of 55 - 60 sq ft/ltr over one coat of Asian Paints Exterior Wall Primer or equivalent and Asian Paints Wall Putty or equivalent as per the recommended application procedure.

uPVC DOORS, WINDOWS, VENTILATORS

General
WINTECH PRODUCES PROFILES FOR CASEMENT & SLIDING SYSTEMS IN 60MM & 75MM SERIES. THE PROFILES ARE DESIGNED TO SUIT INDIAN CLIMATIC CONDITIONS AND FOLLOW BS-EN 12608:2003 STANDARDS. THE WINTECH PROFILES ARE MULTI CHAMBERED AND PROVIDE OPTIMAL SOUND AND THERMAL INSULATION. THE CO-EXTRUDED BEADS GIVE BETTER FINISHES AND ARE EASY TO INSTALL. PROFILE COMES WITH 10 YEARS WARRENTY.

uPVC wall thickness will be 2.2 mm.
Profile testing is done in CIPET.
Gaskets used in this system are TPV gaskets which come along with the profile and coextruded in case of glazing beads. Gaskets come with 10 years warrenty.

Installation

uPVC windows comes fully fabricated from factory and installed at site with the help of anchor fasteners and silicon sealant. No fabrication work is done at site.

Sections

2.5 track sliding window frame (41201-01500) will be of 94mm x 45mm and window shutter (41201-03100) will be of 39mm x 58mm. 3 track sliding door frame (41201-01000) will be of 108mm x 45mm and door shutter (41201-03000) will be of 39mm x 75mm. Casement window frame (41101-11000) will be of 60mm x 55mm and casement shutter (41101-13000) of size 60mm x 75mm.

Hardwares

Touch lock will be used for sliding windows and multipoint locking mechanism for sliding doors and openable doors. All hardwares are tested and come with 1 year warrenty.

Reinforcement

Galvanized iron reinforcement will be used inside the uPVC frame and shutter of thickness between 1mm to 2.5mm based on the window size.

Glass:

Glass used will be DGU glass of total thickness 20mm (5mm clear + 10mm airgap + 5mm clear) from Saint Gobain with noise reduction up to 40 decibels.

Following standards are adhered during the profile extrusion.

- **BS EN 12608:2003,**
- **EN 477, EN 478, EN 513**
- **ISO 306 Method B,**
- **ISO 178, ISO 179, ISO 527, EN 479, UL-94,**
- **ASTM D 257**
  ASTM D792

CEMENT:

a. Recommended tests:

i. Fineness

ii. Soundness

iii. Consistency

iv. Setting time

v. Compressive strength and

vi. Chemical analysis

b. Sampling and frequency of sampling:

As per guidelines of IS: 3535-1986 Method of sampling hydraulic cements.

c. Acceptance criteria:

As per guidelines of

IS: 8112-1989, Specification for 43 grade ordinary portland cement.

IS: 12269-1987, Specification for 53 grade ordinary portland cement.

IS: 12330-1988, Specification for sulfate resisting portland cement.

d. Relevant references:

IS: 4031-1988, Method of physical tests for hydraulic cements.

Part-2: Determination of fineness by specific surface by Blaine air permeability method.

Part-3: Determination of soundness.

Part-4: Determination of consistency of standard cement paste.

Part-5: Determination of initial and final setting time.

Part-6: Determination of compressive strength of hydraulic cement (other than masonry cement).

Part-6: Determination of compressive strength of masonry cement.

IS: 4032-1985, Chemical analysis of hydraulic cement.

IS: 3535-1986, Method of sampling hydraulic cements.

IS: 8112-1989, Specification for 43 grade ordinary portland cement.

IS: 12269-1987, Specification for 53 grade ordinary portland cement.

IS: 12330-1988, Specification for sulphate resisting portland cement.

Concrete workers guide-1992 by Research and Consultancy directorate, ACC Ltd., Mumbai.

FINE AGGREGATE:

a. Recommended tests:

i. Particle size and shape.

ii. Estimation of deleterious materials and organic impurities.

iii. Specific gravity and density.

b. Sampling and frequency of sampling:

As per guidelines of IS: 2430-1986, Methods of sampling of aggregates for concrete.

c. Acceptance criteria:

As per guidelines of IS: 383-1990 Specification for coarse and fine aggregate from natural sources for concrete.

d. Relevant references:

IS: 383-1990, Specification for coarse and fine aggregate from natural sources for concrete.

IS: 2430-1986, Methods of sampling of aggregates for concrete.

IS: 2386-1990, Methods of tests for aggregates for concrete.

Part-1: Particle size and shape.

Part-2: Estimate of deleterious materials and organic impurities.

Part-3: Specific gravity, density, voids, absorption and bulking.

Part-6: Measuring mortar making properties of fine aggregate.

Concrete workers guide-1992 by Research and Consultancy directorate, ACC Ltd., Mumbai.

Best quality of Manufactured sand can be used instead for Sand, Approval to be taken from PMC before procurement.

Manufactured Sand (Zone II – IS:383 -1970)

COARSE AGGREGATE:

a. Recommended tests:

i. Sieve analysis

ii. Flakiness index

iii. Specific gravity and density

iv. Soundness

v. Alkali aggregate reaction

vi. Mechanical properties

vii. Petrographic examination

b. Sampling and frequency of sampling:

As per guidelines of IS: 2430-1986, Methods of sampling of aggregates for concrete.

c. Acceptance criteria:

As per guidelines of IS: 383-1990, Specification for coarse and fine aggregates from natural sources for concrete.

d. Relevant references:

IS: 383-1990, Specification for coarse and fine aggregates from natural sources for concrete.

IS: 2430-1986, Methods of sampling of aggregates for concrete.

IS: 2386-1990, Methods of tests for aggregates for concrete.

Part-1: Particle size and shape

Part-3: Specific gravity, density, voids, absorption, and bulking

Part-4: Mechanical properties

Part-5: Soundness

Part-7: Alkali aggregate reactivity

Part-8: Petrographic examination

Concrete workers guide-1992 by Research and Consultancy directorate, ACC Ltd., Mumbai.

WATER:

a. Recommended tests:

i. P-Alkalinity

ii. M-Alkalinity

iii. Inorganic solids

iv. Sulphates

v. Chlorides

vi. Suspended solids

vii. Organic solids

viii. pH value

b. Sampling and frequency of sampling:

As per guidelines of IS: 3025-1986, Methods of sampling and tests (physical and chemical) for water and wastewater.

c. Acceptance criteria:

As per guidelines of IS: 456-1978, Code of practice for plain and reinforced concrete.

d. Relevant references:

IS: 456-1978 Code of practice for plain and reinforced concrete

IS: 3025-1986 Methods of sampling and tests (physical and chemical) for water and wastewater.

Part-1 (1986): Sampling

Part-2 (1983): pH value

Part-15 (1989): Total residue (total solids dissolved and suspended

Part-16 (1989): Total dissolved solids

Part-17 (1989): Total suspended solids

Part-23 (1986): Alkalinity

Part-24 (1986): Sulfates

Part-32 (1988): Chlorides

ADMIXTURES:

(Accelerating, retarding, water reducing/ workability improvement and air entraining admixtures)

a. Recommended tests:

i. Water content of concrete with and without admixture.

ii. Setting time of concrete with and without admixture.

iii. Compressive strength of concrete with and without admixture.

iv. Change in length of concrete with and without admixture.

v. Bleeding of concrete with and without admixture.

vi. Workability of concrete with and without admixture.

vii. Air content of concrete with and without admixture.

viii. Heat of hydration of concrete with and without admixture.

ix. Chloride content.

x. Uniformity tests (pH value, dry material content, relative density).

xi. Compatability of admixture with cement.

b. Sampling and frequency of sampling:

As per guidelines of IS: 9103-1979, Concrete admixtures – Specification.

c. Acceptance criteria:

As per guidelines of IS: 9103-1979, Concrete admixtures – Specification.

d. Relevant references:

IS: 9103-1979	Concrete Admixtures – Specification.
IS: 516-1991	Methods of tests for strength of concrete
IS: 6925-1987	Methods of test for determination of water soluble chlorides in concrete admixtures.

FRESH CONCRETE:

a. Recommended tests:

i. Slump/ compaction factor/ Vee Bee test

ii. Setting time of concrete by penetration method

iii. Air content

iv. Analysis for constituents

b. Sampling and frequency of sampling:

As per guidelines of IS: 456-1978, Code of practice for plain and reinforced concrete.

c. Acceptance criteria:

As per guidelines of

IS: 456-1978	Code of practice for plain and reinforced concrete.
IS: 1199-1991	Methods of sampling and analysis of concrete.

d. Relevant references:

IS: 1199-1991	Methods of sampling and analysis of concrete.
IS: 8142-1987	Setting time of concrete by penetration resistance.

HARDENED CONCRETE:

a. Recommended tests:

i. Compressive strength

- Accelerated curing
- Normal curing

ii. Permeability test

b. Sampling and frequency of sampling:

As per guidelines in relevant Indian Standards.

c. Acceptance criteria:

As per guidelines of

IS: 456-1978 Code of practice for plain and reinforced concrete.

IS: 1199-1991 Methods of sampling and analysis of concrete

d. Relevant references:

IS: 456-1978 Code of practice for plain and reinforced concrete.

IS: 516-1991 Methods of tests for strength of concrete.

IS: 9013-1987 Method of testing of accelerated cured concrete.

IS: 3085-1990 Method of test for permeability of cement mortar and concrete.

REINFORCING STEEL:

a. Recommended tests:

i. Tensile test on bars welded or otherwise

ii. Bend and rebend test

iii. Bond test

iv. Chemical analysis

b. Sampling and frequency of sampling:

As per guidelines of IS: 1786-1990, Specification of high strength deformed steel bars for concrete reinforcement.

c. Acceptance criteria:

As per guidelines of IS: 1786-1990, Specification of high strength deformed steel bars for concrete reinforcement.

d. Relevant references:

IS: 1786-1990 Specification of high strength deformed steel bars for concrete reinforcement.

IS: 1608-1991 Methods of tensile testing of steel products.

IS: 228-1987 Methods of chemical analysis of steel.

Part-1: Determination of carbon by volumetric method.

Part-3: Determination of phosphorous by alkali metric method.

Part-9: Determination of sulphur.

SOLID CONCRETE BLOCKS:

a. Recommended tests:

i. Dimensional tolerances

ii. Block density and compressive strength

iii. Water absorption

iv. Drying shrinkage

v. Moisture movement

b. Sampling and frequency of sampling:

As per guidelines of IS: 2185-1987, Specification for concrete masonry units Part-1 (1987) solid concrete blocks.

c. Acceptance criteria:

As per guidelines of IS: 2185-1987, Specification for concrete masonry units Part-1 (1987) solid concrete blocks.

d. Relevant references:

IS: 2185-1987, Specification for concrete masonry units Part-1 (1987) solid concrete blocks.

AUTOCLAVED CELLULAR CONCRETE BLOCKS:

a. Recommended tests:

i. Dimensional tolerances

ii. Block density and compressive strength

iii. Water absorption

iv. Drying shrinkage

v. Moisture movement

b. Sampling and frequency of sampling:

As per guidelines of

IS: 2185-1987 Specification for concrete masonry units.

Part-3 (1990) Autoclaved cellular (aerated) concrete blocks.

c. Acceptance criteria:

As per guidelines of

IS: 2185-1987 Specification for concrete masonry units

Part-3 (1990) Autoclaved cellular (aerated) concrete blocks

d. Relevant References:

IS: 6072-1990 Specification for autoclaved reinforced cellular concrete wall slabs.

IS: 6441-1987 Methods of tests for autoclaved cellular concrete products

Part-1: Determination of unit wt. And moisture content

Part-2: Determination of drying shrinkage.

Part-4: Corrosion protection of steel reinforcement.

Part-5: Determination of compressive strength.

IS: 2185-1987 Specification for concrete masonry units

Part-3 (1990): Autoclaved cellular (aerated) concrete blocks.

DOOR SHUTTERS:

a. Recommended tests:

i. Dimensions and defects of squareness test

ii. General flatness test

iii. Local planeness test

iv. Impact indentation test

v. Edge loading test

vi. Shock resistance test

vii. Buckling test

viii. Misuse test

ix. Slamming test

x. Screw holding power test

Additional tests on wood particleboard:

i. Determination of water absorption

ii. Determination of swelling in water

b. Sampling and frequency of sampling:

As per guidelines in relevant Indian Standards

c. Acceptance criteria:

As per guidelines in relevant Indian Standards

d. Relevant references:

IS: 4020-1994	Door shutters method of test
Part-1:	General
Part-2:	Measurement of dimensions and defects of squareness
Part-3:	Measurement of defects of general flatness
Part-4:	Local planeness test
Part-5:	Impact indentation test
Part-7:	Edge loading test
Part-8:	Shock resistance test
Part-9:	Buckling test
Part-10:	Misuse test
Part-11:	Slamming test
Part-12:	Screw holding power test
IS: 2380-1977	Method of test for wood particle boards
Part-16:	Determination of water absorption
Part-17:	Determination of swelling in water

ALUMINIUM:

a. Recommended tests:

i. Thickness measurement of member

ii. Coating thickness

b. Sampling and frequency of sampling:

As per guidelines in relevant Indian Standards

c. Acceptance criteria:

As per guidelines in relevant Indian Standards

d. Relevant references:

IS: 5523-1991 Method of testing anodic coating on Aluminium.

TILES (CONCRETE):

a. Recommended tests:

i. Dimensional tolerance

ii. Flatness

iii. Perpendicularity

iv. Straightness

v. Water absorption

vi. Wet transverse strength

vi. Resistance to wear

b. Sampling and frequency of sampling:

As per guidelines of IS: 1237-1990, Specification for cement concrete flooring tiles.

c. Acceptance criteria:

As per guidelines of IS: 1237-1990, Specification for cement concrete flooring tiles.

d. Relevant references:

IS: 1237-1990 Specification for cement concrete flooring tiles.

GLAZED EARTHENWARE TILES:

a. Recommended tests:

i. Dimensional tolerance

ii. Warpage

iii. Water absorption

iv. Impact strength

v. Cracking test

b. Sampling and frequency of sampling:

As per guidelines in relevant Indian Standards

c. Acceptance criteria:

As per guidelines in relevant Indian Standards

d. Relevant references:

IS: 777-1986 Specification for glazed earthenware wall tiles

MARBLE:

a. Recommended tests:

i. Moisture absorption

ii. Hardness

b. Sampling and frequency of sampling:

As per guidelines in relevant Indian Standards

c. Acceptance criteria:

As per guidelines in relevant Indian Standards

d. Relevant references:

IS: 1237-1990 Specification for cement concrete flooring tiles

IS: 1124-1990 Methods of tests for determination of water absorption, apparent specific gravity and porosity of natural building stone.

NON-DESTRUCTIVE TESTING OF CONCRETE:

a. Recommended tests:

i. Ultrasonic pulse Velocity test

ii. Rebound hammer test

b. Frequency of test:

About 5% of randomly selected reinforced concrete structural components (in-situ of precast).

c. Acceptance criteria:

As per guidelines of

IS: 13311-1997 Non-destructive testing of concrete

Part-1: Method of test for Ultrasonic pulse velocity

Part-2: Method of test for Rebound hammer

d. Relevant references:

IS: 13311-1997 Non-destructive testing of concrete

Part-1: Method of test for Ultrasonic pulse velocity

Part-2: Method of test for Rebound hammer

The testing of concrete in structures by J.H. Bungey, Surrey University Press, 1982.

CORE TEST ON CONCRETE:

a. Recommended tests:

i. Texture of concrete

ii. Compressive strength test

b. Frequency of test:

Core to be taken from walls, slabs and footings whenever in doubt.

c. Acceptance criteria:

As per guidelines of

IS: 516-1991 Method of tests for strength of concrete.

IS: 456-1978 Code of practice for plain and reinforced concrete.

d. Relevant references:

IS: 516-1991 Method of tests for strength of concrete.

IS: 456-1978 Code of practice for plain and reinforced concrete.

LOAD TEST:

a. Recommended test:

Load testing of selected in-situ panels/ pre-cast components (service load test).

b. Frequency of test:

On representative in-situ panels in each type of housing whenever in doubt about 0.5% of the total pre-cast floor roof components.

c. Acceptance criteria:

As per guidelines of

IS: 456-1978	Code of practice for plain and reinforced concrete
IS: 6441(Part-7 and 8)	Method of test for autoclaved cellular concrete products subject to load test.

d. Relevant references:

IS: 456-1978:	Code of practice for plain and reinforced concrete.
IS: 6441(Part-7 and 8):	Method of test for autoclaved cellular concrete products subject to load test.

EARTH-FILLING IN BUILDING:

a. Recommended tests:

i. Grain size distribution for material selection

ii. Proctor compaction test

iii. Field density by core extraction or Sand replacement method

b. Frequency of test:

i. One sample from each borrow pit

ii. Three cores for every 1000Sqm in compacted thickness of 30cm.

c. Acceptance criteria:

As per guidelines in relevant Indian Standards

d. Relevant references:

IS: 2720-1987	Method of test for soil
Part: 2-1987	Determination of water content
Part: 4-1990	Grain size analysis
Part: 5-1990	Determination of liquid and plastic limit
Part: 7-1987	Determination of water content-dry density relation using light compaction.
Part: 28-1988	Determination of dry density of soils in place by sand replacement method.
Part: 29-1988	Determination of dry density of soils in place by core cutter method.

MIX DESIGN:

a. Recommended method:

Any one of the Methods outlined in SP 23-1982, Hand book on concrete mixes.

b. Frequency of design:

On every source or type of the following:

i. Aggregates

ii. Cement

iii. Admixtures and for different grades of workability.

Or

Once a year

c. Acceptance criteria of Mix:

As per guidelines of

SP: 23-1982 Handbook on concrete mixes

SP: 10262-1982 Recommended guidelines for concrete mix design

SP: 456-2000 Code of practice for plain and reinforced concrete

d. Relevant references:

SP: 23-1982 Handbook on concrete mixes

SP: 10262-1982 recommended guidelines for concrete mix design

SP: 456-2000 Code of practice for plain and reinforced concrete

GENERAL REFERENCES

1 Properties of concrete by A.M. Neville, ELBS Publication 1981

2 a. Elements of concrete making, 1991

b. Concrete workers guide, 1992

c. Control tests for quality user, 1992

d. Notes for the cement user, 1992 by Research and Consultancy directorate, A.C.C. Ltd., Mumbai.

3 SP: 24-1983: Explanatory handbook on Indian Standard Code of practice for plain and reinforced concrete.

4 Workshop on testing of fresh and hardened concrete Indian Concrete Institute, 1986

5 SP: 21-1983: Summaries of Indian Standard for building materials

6 National building code, 1983

7 Non-destructive testing by Barry Hall, Macmillan Education,

1988

SAFETY REQUIREMENTS

The contractor and sub-contractors shall comply with ALL the safety precautions, protective measures, house keeping requirements, etc.

The contractor should display all the personal protective equipment used at the site at the entrance of the site. A qualified safety engineer should be deployed at site. The Employer/ Construction Project Management Consultant () with due intimation shall have the right to stop the work at site or penalize, if in his opinion proceeding with the work will lead to an unsafe and dangerous condition. Contractor shall get the unsafe condition removed or provide protective equipment. Contractor shall ensure that all workmen are aware about the nature of risk involved in their work and have adequate knowledge for carrying out their work safely.

The contractor shall be held responsible for non-compliance if any of the safety measures and delays, implications, injuries, fatalities and compensation arising out of such situations or incidents. The contractor should follow the following safety requirements.

In respect of all labour, directly or indirectly employed on the works for the performance and execution of the contractor's work under the contract, the contractor shall at his own expense arrange for all the safety provisions as listed in (i) safety norms forming part of the contract documents (ii) Indian Standards (iii) The electricity act (iv) The mines act and (v) Regulations, rules and orders made there under and such other acts as applicable.

Precautions as stated in the safety clause are the minimum necessary and shall not preclude the contractor taking additional safety precautions as may be warranted for the particular type of work or situations. Also mere observance of these precautions shall not absolve the contractor of his liability in case of loss or damage to property or injury to any person including the contractor's labour, the owner, , architect's and engineer-in-charge's representatives or any member of the public or resulting in the death of any of these.

Protective gear such as safety helmets, boots, belts and nets, etc. shall be provided by the contractor at his own cost to all his manpower at site. The contractor shall impose such requirements on all sub-contractors also. It shall be the responsibility of the contractor to ensure that such protective gear is worn at all times by all personnel working at site. The / Engineer-in-charge shall have the right to stop or impose fine to any person not wearing such protective gear from working on the site. Adhering to environment protection norms shall be implied.

First aid room with necessary medical facilities to be provided as per BOCW (Building and Other Construction Workers act.

A covered smoking zone shall be provided at least at four different locations and other areas duly marked as non-smoking areas.

In case the contractor fails to make arrangements and provide necessary facilities as aforesaid, the owner shall be entitled to do so and recover the costs thereof from the contractor. The decision of the / Engineer-in-charge in this regard shall be final and binding on the contractor.

GENERAL EHS REQUIREMENTS

- No one should be allowed inside the site without safety orientation/ site induction training.
- All persons should wear ID cards, approved helmet and safety shoes before entering the site.
- Child labour (below 18 years) at site is strictly prohibited.
- Smoking is prohibited at work place, except in smoking zones.
- Gambling, alcohol, drugs and unruly behavior strictly prohibited.
- No musical instruments are allowed inside the site.
- Permission should be taken before taking photographs and video filming on site.
- Follow all safety sign (in Hindi, English and local languages), site traffic rules and obey all instructions given by authorized persons.
- All hazards should be properly isolated/ indicated by signs and barricaded.
- The boundary of the site to be barricaded with GI sheets to a height of 5m and suitable methods are adopted at site to see that nothing falls on the outside of the boundary causing major/ minor accidents.

- All equipments/ machineries entering the site should have proper documents and should be operated only by qualified and approved operators. Copy of the documents to be furnished to the .
- All vehicles entering/ working at the premises should have valid documents, helper and reverse horn.
- Perform all works in accordance with permits and procedures.
- Approved safe work method statement should be followed strictly.
- Follow lockout and tag out procedure for every electrical and mechanical operation involving more than two persons and distance.
- Always maintain the work area and labour camp clean and tidy and maintain good housekeeping.
- All incidents and accidents should be reported to immediately.
- The site should be lit up during late hours to the extent that any part of the site should have a minimum of 100-lux intensity.
- Emergency evacuation procedure, escape route, emergency number and responsible flow chart to be displayed at the entrance or as directed by the / Owner.
- EHS statistic board to be displayed and updated periodically.
- The contractor shall arrange appropriate location for assembly point with signages.
- The contractor shall provide adequate drinking water points and hygienic toilet facilities at site premises for all labours.

1. TRAFFIC

1.1 The contractor shall organize operations by taking approval to use the existing roads, if any, from employer.

1.2 The contractor shall exercise full care to ensure that no damage is caused by him or workmen, during the operation, to the existing water supply, sewerage, power or telecommunication lines or any other services or works. The contractor shall provide and erect before construction, substantial barricades, guardrails and warning signs. He shall furnish, place and maintain adequate warning lights, signals, etc., as required by client.

2. SAFE MEANS OF ACCESS

2.1 Adequate and safe means of access and exit shall be provided for all work places, at all elevations shall be avoided.

2.2 Suitable scaffolds shall be provided for workmen for all works that cannot safely be done from the ground, or from solid construction except such short duration work as can be done safely from ladders. Ladder shall be of rigid construction having sufficient strength for the intended loads and made of metal and all ladders shall be maintained well for safe working condition. Suitable footholds and handholds shall be provided on the ladder. The ladder shall be given an inclination not steeper than 1 in 4 (1 horizontal and 4 vertical).

2.3 Scaffolding or staging more than 1.2m above the ground or floor, swung or suspended from an overhead support or erected with stationary support shall have a standard guard-rail properly attached, bolted, braced or otherwise secured at least 1m high above the floor or platform of such scaffolding or staging. The guardrail shall extend along the entire exposed length of the scaffolding with only such opening as may be necessary for the delivery of materials. Standard railing shall have posts not more than 2m apart and an intermediate rail half way between the floor and platform of the scaffolding and the top rail. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure. Scaffolding and ladder shall conform to relevant IS specification (IS: 3696-1966). Timber/ bamboo scaffolding shall not be used.

2.4 Working platforms of scaffolds shall have toe boards at least 15cm in height, to prevent materials from falling down.

2.5 A sketch of the scaffolding proposed to be used shall be prepared prior to start of erection of scaffolding. Safety engineer shall examine all scaffolds before using.

2.6 Working platform, gangways and stairways shall be so constructed that they shall not sag unduly or unequally and if the height of the platform or gangway or stairway is more than 3.5m above ground level or floor level, they shall be closely boarded, shall have adequate width for easy movement of persons and materials and shall be suitably guarded.

2.7 The planks used for working platform shall not project beyond the end supports to a distance exceeding four times the thickness of the planks used. The planks shall be rigidly tied at both ends to prevent sliding and slippage. The thickness of the planks shall be adequate to take load of men and materials and shall not collapse.

2.8 Every opening in the floor of a building or in a working platform shall be provided with suitable means to prevent fall of persons or materials by providing suitable fencing or railing, the minimum height of which shall be 1m, along with 15cm high sheet obstruction at floor level along the railing.

2.9 Safe means of access shall be provided to all working platforms and other elevated working places. Every ladder shall be securely fixed. No single portable ladder shall be over 9m in length. For ladders up to 3m in length, the width between side rails in the ladders shall in no case be less than 300mm. For longer ladders this width shall be increased by at least 20mm for each additional meter of length. Step spacing shall be uniform and shall not exceed 300mm.

2.10 Adequate precautions shall be taken to prevent danger from electrical lines and equipment. No scaffolding, ladder, working platform, gangway runs, etc. shall exist within 3m of any un-insulated electric wire. Whenever electric power and lighting cables are required to run through (pass on) the scaffolding or electrical equipment are used, such scaffolding structures shall have minimum two earth connections with earth continuity conforming to IS code of practice.

3. EXCAVATION, TRENCHING AND EARTH REMOVAL

3.1 All underground cables/ water line/ sewage line, etc to be checked before commencement of excavation and work permit should be obtained and displayed.

3.2 All trenches 2m or more in depth shall at all times be supplied with at least one ladder for each spacing of 30m in length or fraction thereof. Ladder shall be extended from bottom of the trench to at least 1m above the surface of the ground.

3.3 The sides of the trench which are 2m or more in depth shall be stepped back to give suitable slope (angle of repose) or securely held by timber bracing, so as to avoid the danger of sides from collapsing. The excavated material shall not be placed within 1.5m of the edges of the trench or half of the depth of the trench, whichever is more. Cutting shall be done from top to bottom. Under no circumstances mining or undercutting shall be done.

3.4 The contractor shall ensure the stability and safety of the excavation, adjacent structures, services and the works.

3.5 Open excavations shall be fenced off by MS railing and warning signals installed at night at well lit places so as to prevent persons slipping or falling into the excavations.

3.6 All blasting operations shall be carried out on the basis of procedures approved by inspector of explosives. All works in this connection shall be carried out as per IS code of practice. Barricades, warning signs, etc., shall be placed on the roads/ open area.

3.7 a) As far as practical, earth shall be removed mechanically.

b) Wherever manual removal of earth is involved, earth shall be removed from the top by maintaining the proper slope equal to the angle of re-pose of the earth.

c) The contractor to ensure that no under-cutting is done and shall constantly supervise such work.

4. DEMOLITION

Before any demolition work is commenced and also during the progress of the work:

4.1 All roads and open area adjacent to the work site shall either be closed or suitably protected. Appropriate warning signs shall be displayed for cautioning approaching persons and security should be posted at entries/ exit.

4.2 Before demolition operations begin, the contractor shall ensure that the power on all electric service lines is shut off and the lines cut or disconnected at or outside the demolition site. If it is necessary to maintain electric power during demolition operation, the required service lines shall be adequately protected against damage. Persons handling heavy materials/ equipment shall wear safety shoes.

4.3 No floor, roof or other part of the building shall be overloaded with debris or materials as to render it unsafe.

4.4 Entries to the demolition area shall be restricted to authorised persons only.

4.5 During night red lights should be placed on and around all barricades.

5. PERSONAL PROTECTIVE EQUIPMENT

All necessary personal protective equipment shall be kept available for the use of the persons employed on the site and maintained in a condition suitable for immediate use. Also the contractor shall take adequate steps to ensure proper use of equipment by those concerned.

Manufacturers' specification of all PPE's to be submitted to confirm IS standard and to be procured only from authorized dealers.

The personal protective equipments to be provided by the contractor are:

a) All persons employed at the construction site shall use safety helmets (if not used, a fine of Rs.100/ person/ day would be recovered from the contractor).

b) Workers employed on mixing aspaltic materials, cements and lime mortars should use protective goggles, protective foot wears, nose mask and hand gloves. Provide safety foot wear and cotton hand gloves to bar benders and carpenters.

c) Persons engaged in welding and gas-cutting works shall use suitable welding face shields, leather hand gloves and apron. Use of LPG is prohibited. The persons who assist the welders shall use suitable goggles. Protective goggles and nose mask shall be worn while chipping and grinding.

d) Stonebreakers shall use protective goggles, ear plug/ muff and hand gloves. They shall be seated at sufficiently safe intervals of distance.

e) Persons engaged in or assisting in shot blasting operations and cleaning the blasting chamber shall use suitable gauntlets, overalls, dust-proof goggles, boots and protective hood supplied with fresh air at the minimum rate of 9m/hr.

f) All persons working at heights. More than 2m above ground or floor and exposed to risk of falling down shall use of full body harness, unless otherwise protected by cages, guard railings, etc.

g) Protective nets shall be provided at places where men are working at heights to safe guard against falling object/ debris.

h) When workers are employed in sewers and inside manholes that are in use, the contractor shall ensure that the manholes are opened and are adequately ventilated at least for an hour. After it has been well ventilated, the atmosphere inside the space shall be checked for the presence of any toxic gas or oxygen deficiency and recorded in the register before the workers are allowed to get into the manholes. The manholes opened shall be cordoned off with suitable railing and provided with warning signals or caution boards to prevent accidents. There shall be proper illumination in the night and to be carried out under strict vigilance and supervision.

i) Wherever suggested by the / Engineer-in-charge, ear plugs, dust masks, gum boots, safety shoes and hand gloves should be used.

6. PAINTING

6.1 The contractor shall not employ women on the work of painting with products containing lead in any form. Only men above the age of 18 years shall be employed on the work with lead paint. The following precautions shall be taken during the work:

a) Supply air respirators for use by the workers when paint is applied in the form of spray, or a surface having lead paint is dry rubber or scraped.

b) The workmen shall use overall and adequate facilities shall be provided to enable the painters to wash at the cessation of work.

c) All painting jobs, especially those in which lead paints are used shall be kept under industrial hygiene surveillance.

6.2 Smoking, open flames or sources of ignition shall not be allowed in places where paints and other flammable substances are stored, mixed or used. A caution board, with the instructions written in national/ regional language, "SMOKING - STRICTLY PROHIBITED" shall be displayed in the vicinity where painting is in progress or where paints are stored. Symbols shall also be used for caution boards.

Suitable fire extinguishers/ sand buckets shall be kept available at places where flammable paints are stored, handled or used.

When painting work is done in a closed room or in a confined space, adequate ventilation shall be provided. If adequate ventilation cannot be provided, workers shall wear suitable respirators.

6.3 Epoxy resins and their formulations used for painting shall not be allowed to come in contact with the skin. The workers shall use plastic gloves and or suitable barrier creams.

Adequate ventilation shall be provided especially when working with hot resin mixes.

Increased personal hygiene shall be practiced to control inadvertent contact with the resin and eliminate its effects.

Workers shall thoroughly wash hands and feet before leaving the work. Work clothes shall be changed and laundered frequently.

6.4 During external painting fall arrestor to be attached to full body harness and separate poly propylene rope to be tied to secure fall arrestor. If hanging platform is used that platform is rigidly fixed using twin poly propylene ropes and work to be carried out under strict supervision.

7. LIFTING MACHINES AND TACKLES

7.1 Use of lifting machines and tackles including their attachments, anchorage and supports shall conform to the following standards or conditions:

a) Lifting machines and tackles shall be of good mechanical construction, sound material and adequate strength and free from any defects and shall be kept in good repair and in good working order.

Every rope used in hoisting or lowering materials or as a means of suspension shall be of good quality and adequate strength and free from any defect.

b) Every crane operator or lifting appliance operator shall be qualified person. No person under the age of 21 years will be permitted to operate or shall be made in charge of any hoisting machine or give signal to operator of such machine. Experienced signalmen to be deputed to give signal to operator of such machine and free fall arrestor to be used while climbing up and down.

c) In case of every lifting machine (and of every chain, ring, hook, shackle, swivel and pulley block used in hoisting or as means of suspension) the safe working load shall be ascertained and clearly marked. In case of a lifting machine having a variable safe working load, each safe working load and the conditions under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing. The safety engineer shall approve this.

d) The safety engineer shall note the safe working load. Regarding other machines, the contractor shall notify the safe working load of the machine to the safety engineer, whenever he brings any machinery to site of work and gets it verified by the safety engineer.

e) Thorough inspection and load testing of lifting machines and tackles shall be done by a competent person at least once every 2 months and records of such inspection and testing shall be maintained.

7.2 Motors, gearing transmission, couplings, belts, chain drives and other moving parts of hoisting appliances shall be provided with adequate safeguards. Hoisting appliances shall be provided with such means as will reduce to the minimum the risk of any part of a suspended load becoming accidentally displaced or lowered.

8. WELDING AND GAS CUTTING

Use of LPG cylinder and oil cooled welding machine is strictly prohibited.

8.1 Welding and gas cutting operations shall be done by qualified and authorised persons and as per IS specifications and code of practice.

8.2 Welding and gas cutting shall not be carried out in places where flammable or combustible materials are kept and where there is danger of explosion due to presence of gaseous mixtures.

8.3 Welding and gas cutting equipment including hoses and cables shall be maintained in good condition and approved by the concerned authority.

8.4 Barriers shall be erected to protect other persons from harmful rays from the work. When welding or gas cutting is done in elevated positions, precautions shall be taken to prevent sparks or hot metal falling on persons or flammable materials.

8.5 Suitable type of protective clothing consisting of fire resistant gauntlet gloves, leggings, boots and aprons shall be provided to workers as protection from heat and hot metal splashes. Welding shields with filter glasses of appropriate shade shall be worn as face protection.

8.6 Adequate ventilation shall be provided while welding in confined space or while brazing, cutting or welding zinc, brass, bronze, galvanized or lead coated materials.

8.7 Welding and gas cutting shall not be done on drums, barrels, tanks or other containers unless they have been emptied cleaned thoroughly and it is made certain that no flammable material is present.

8.8 Appropriate fire extinguisher shall be available near the location of welding operations. Fire safety permit shall be obtained for working at vulnerable areas and operating areas before flame cutting/ welding is taken up.

While shifting the cylinders, trolley should be used and to be kept vertically always. Separate storage of empty and full cylinder of oxygen and acetylene respectively with proper fire point.

8.9 For electric (Arc) welding the following additional safety precautions shall be taken:

a) When electrical welding is undertaken near pipelines carrying flammables, such pipelines shall not be used as part of earth conductor but a separate earth conductor shall be connected to the machine directly from the job.

b) Personnel contact with the electrode or other live parts of electric welding equipment shall be avoided.

c) Extreme caution shall be exercised to prevent accidental contact of electrodes with ground.

d) The welding cable shall not be allowed to get entangled with power cables. It shall be ensured that movement of materials does not damage the cables.

9. GRINDING

9.1 All portable grinders shall be used only with their wheel guards in position to reduce the danger from flying fragments when the wheel breaks during the use. Metallic body potable equipment not allowed to use in the site.

9.2 Grinding wheels of specified diameter only shall be used on a grinder - portable or pedestal - in order not to exceed the prescribed peripheral speed.

9.3 Goggles, nose mask and hand gloves shall be used during grinding operation.

10. HOUSE KEEPING

10.1 The contractor shall at all time keep his work spot, site office and surroundings clean and tidy from rubbish, scrap, surplus materials and unwanted tools and equipment.

10.2 Welding and other electrical cables shall be so routed as to allow safe traffic by all concerned.

10.3 No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public.

10.4 At the completion of the work, the contractor shall ensure removal from the work premises all scaffoldings, surplus materials, rubbish and all huts and sanitary arrangements used/ installed for workmen on the site.

10.5 The wheels of the lorries should be cleaned before it leaves the site by means of wheel wash pits or pressure washing such that the mud stuck on the tyres should be washed inside the site itself.

10.6 The portion of the public road adjacent to the site should be kept clean by sweeping, scrapping of mud adhered to road.

10.7 The site should be periodically cleaned (at least once in two days), cart out the debris, unwanted materials and sweep the areas and floors. One day of every month should be dedicated to only for housekeeping.

10.8 Employees/ workers of the contractors should not be allowed to take bath inside the premises.

10.9 Motorable roads, pathways and stairways should be free from materials/ debris.

11. FIRE SAFETY

All necessary precautions shall be taken to prevent outbreak of fires at the construction site. Adequate provisions shall be made to extinguish fires, should they still break out.

11.1 Quantities of combustible materials like timber, bamboo, coal, paints, etc. shall be the minimum required in order to avoid unnecessary accumulation of combustibles at site.

11.2 Containers of paints, thinners and allied materials shall be stored in a separate room with MSDS (Material Safety Data Sheet), which shall be well ventilated and free from excessive heat, sparks, flame or direct rays of the sun. The containers of paint shall be kept covered or properly fitted with lid and shall not be kept open except while using.

11.3 Appropriate fire extinguishers shall be located at the construction site at appropriate/ required places. All fire extinguishers to be serviced by authorized agency and records to be maintained.

11.4 Adequate number of workmen shall be given education and training in fire fighting and extinguishing methods.

12. WORK IN RADIATION AREA

The contractor shall follow the stipulated procedure regarding work in the radiation area and other works related with radiography.

13. WORK IN AND AROUND WATER BODIES

When the work is done near any places where there is risk of drowning, all necessary rescue equipment such a life buoys and life jackets shall be provided and kept ready for use and

all necessary steps taken for prompt rescue of any person in danger and adequate provision shall be made for prompt first-aid treatment of all injuries likely to be sustained during the course of the work. Persons who do not know swimming shall not be engaged alone for any work where risk of drowning exists. Sufficient number of life buoys or life jackets shall be provided.

Abandoned bore wells should be plugged permanently.

14. MEDICAL FACILITIES

14.1 The contractor shall arrange for medical aid and treatment for his staff and workers engaged on the work site including the first-aid facilities if they are not available at the project site. Maintain a record book.

14.2 First-aid box to be provided with necessary medicines as per BOCW (Building and Other Construction Workers) act, appliance including sterilized dressing, cotton wool and antiseptic cream shall be made available at readily accessible places at every work site. These shall be maintained in good order under the charge of a responsible person and sufficient number of stretchers to be readily available at construction site in case of emergency. The contractor should tie-up with nearest hospitals for immediate treatment.

14.3 At large work places where hospital facilities are not available within easy reach of the work; first-aid posts shall be established. Ambulance availability shall be identified during the entire period of work for attending to injury cases.

14.4 The contractor should have authorized documents for disposal of bio-medical waste and the copy of the same to be submitted to whenever asked for.

14.5 Periodically anti-tetanus injection to be given for all the labours engaged and record to be maintained.

15. SAFETY CO-ORDINATOR

The contractor shall have a safety officer and a supervisor to be designated as safety coordinators in order to specifically look into the implementation of different safety requirements of the site work. The person thus designated will in general co-ordinate on matters of safety and in particular ensure that the safety manual is complied with. His name shall be displayed on the notice board at a prominent place at the work site.

16. REPORTING OF ACCIDENT

16.1 All accident leading to property damage and or personnel injuries shall be reported to the concerned authorities immediately, viz. insurance company, police, head office, regional office, , owner, etc.

16.2 Contractor shall also submit a monthly statement of accidents to the by 4th of every month showing details of accident, nature of injury including disability, days lost, treatment provided, etc., and the extent of property damage.

17. PUBLIC PROTECTION

The contractor shall make all necessary provisions to protect the public. He shall be held responsible for defense of every action of other proceedings at law that may be brought by any person for injury sustained owing to neglect of any precaution required to taken to protect the public.

18. OTHER STATUTORY PROVISIONS

All operations involving the transport, handling, storage and use of explosive shall be as per the standing instructions and conform with the latest Indian Explosives Act and the Explosives Rules. Handling, transport, storage and use of compressed gas cylinders and pressure vessels shall conform to the latest Gas Cylinder Rules and Static and Mobile Pressure Vessels (unfired) Rules.

In addition, the Indian Electricity Act and Indian Electricity Rules - latest, the Atomic Energy Act, the Radiation Protection Rules - latest, Radiation Protection Manual of Nuclear Facilities and the Atomic Energy (Factories) Rules - latest, and various latest Rules and Act related to mining shall also be strictly complied with.

19. GUIDELINES AND GENERAL PROCEDURES FOR SUPPLY AND USE OF ELECTRICITY AT SITE

19.1 Following safety requirements shall be complied with before the contractor uses the power supply:

a) The contractor shall submit a list of licensed electrical staff to be posted at site.

b) It shall be the responsibility of the contractor to provide and maintain complete installation on the load side of the supply point with regard to the safety requirements at site. All cabling and installation shall comply with the appropriate latest statutory requirements given below and shall be subject to approval of the client at site:

i. Indian Electricity Act.

ii. Electricity (Supply) Act.

iii. Indian Electricity Rules.

vi. National Electricity Code.

v. Other relevant rules of Local Bodies and Electricity Boards.

The power supply shall be regulated as per the terms and conditions of the supply of the respective electricity boards.

c) Where distribution boards are located at different places, the contractor shall submit schematic drawing indicating all details like size of wires, over head and cable feeders, earthing, etc. The position and location of all equipment and switches shall be given.

d) The contractor shall make his own arrangement for main earth electrode and tapings thereof. The existing earth points available at site can be used at the discretion of client with prior permission. Method of earthing, installation and earth testing results shall conform to relevant IS specifications (IS-3043).

e) All three phases' equipment shall be provided with double earthing. All light fixtures and portable equipment shall be effectively earthen to main earthing.

f) All earth terminals shall be visible. No gas pipes and water pipes shall be used for earth connection. Neutral conductor shall not be treated as earth wire.

g) The contractor shall not connect any additional load without prior permission of client.

h) Joints in earthing conductors shall be avoided. Loop earthing of equipment shall not be allowed. However, tapping from an earth bus may be done.

i) The entire installation shall be subjected to the following tests before energizing the installation including portable equipment:

i. Insulation resistance test.

ii. Polarity test of switches.

iii. Earth continuity test.

vi. Earth electrode resistance.

The test procedures and their results shall conform to relevant standards.

19.2 Guidelines are provided for general observations:

a) Installation:

i. Only persons having valid wireman's license/ competency certificate shall be employed for carrying out electrical work and repair of electrical equipment, installation and maintenance at site. A qualified licensed supervisor shall supervise the job.

ii. Electrical equipment and installations shall be installed and maintained as to prevent danger from contact with live conductors and to prevent fires originating from electrical causes like short circuits; overheating etc. Installation shall not cause any hindrance to movement of men and materials.

iii. Materials for all electrical equipment shall be selected with regard to working voltage, load and working environment. Such equipment shall conform to the relevant standards.

vi. The minimum clearance to be maintained for all overhead lines along roads and across roads shall be as per the statutory requirements.

v. Grounding conductor of wiring system shall be of copper or other corrosion-resistant material. An extra grounding connection shall be made in appliances/ equipment where chances of electric shock are high.

vi. Electric fuses and or circuit breakers installed in equipment circuits for short circuit protection shall be of proper rating. It is also recommended that high rupturing capacity (HRC) fuses are used in all circuits. For load of 5kW or more earth leakage circuit breaker shall be provided in the circuits.

vii. Wherever cables or wires are laid on poles, a guard wire of adequate size shall be run along the cables/ wires and earthen effectively. Metallic poles as a general rule, shall be avoided and if used shall be earthen individually. Anti-climbing guards and danger notices shall be provided on poles. Every equipment shall have individual isolating switch.

viii Wires and cables shall be properly supported and an approved method of fixing shall be adopted. Loose hanging of wires and cables shall be avoided. Lighting and power circuits shall be kept distinct and separate.

xi. Reinforcement rods or any metallic part of structure shall not be used for supporting wires and cables, fixtures, equipment, earthing, etc.

x. All cables and wires shall be adequately protected mechanically against damages. In case the cable is required to be laid under ground, covering the same with bricks, plain cement concrete (PCC) tile or any other approved means, shall adequately protect it.

xi. Using suitable cable glands shall properly terminate all armoured cables. Using cable lugs/ sockets shall connect multi-stranded conductor cables. Cable lugs shall preferably be crimped. They shall be of proper size and shall correspond to the current rating and size of the cable. Twisted connections will not be allowed.

xii. All cable glands, armouring and sheathing of electric cable, metal circuits and their fittings, metallic fittings and other non-current carrying parts of electrical equipment and apparatus shall be effectively grounded.

xiii. All the distribution boards, switch fuse units, bus bar chambers, ducts, cubicles, etc. shall have MS enclosures and shall be dust, vermin and waterproof. The distribution boards, switches, etc. shall be so fixed that they shall be easily accessible. Changes shall be done only after the approval of the clients.

xvi. The contractor shall provide proper enclosures/ covers for protection of the entire switchboard, equipment, etc. against rain. Exposed live parts of all electrical circuits and equipment shall be enclosed permanently. Crane trolley wires and other conductor that cannot be completely insulated shall be placed such that they are inaccessible under normal working conditions.

xv. Ironclad industrial type plug outlets are preferred for additional safety.

xvi. Open type distribution boards shall be placed only in dry and ventilated rooms; they shall not be placed in the vicinity of storage batteries or otherwise exposed to chemical fumes.

xvii. Isolating switches shall be provided close to equipment for easy disconnection of electrical equipment or conductors from the source of supply when repair or maintenance work has to be done on them.

xviii. In front of distribution boards a clear space of 90cm shall be maintained in order to have easy access during an emergency.

xix. Adequate working space shall be provided around electrical equipment, which requires adjustment or examination during operation.

xx. As far as possible electrical switches shall be excluded from a place where there is danger of explosion. All electrical equipment such as motors, switches and lighting fittings installed in workroom where there is possibility of explosion hazard shall be explosion proof.

xxi. All connections to lighting fixtures, starters or other power supplies shall be provided with PVC insulate, PVC sheathed twin/ three/ four core wires to have better mechanical protection for preventing possible damage to equipment or injury to personnel. Taped joints shall not be allowed and the connections may be made in looping system. Electric starter of motors, switches shall not be mounted on wooden boards. Only sheet steel mounting or iron framework shall be used.

xxii. All the lighting fixtures and lap holders shall be of good quality and in good condition. Badly repaired or broken holders, etc. shall not be used.

xxiii. Only PVC insulated and PVC sheathed wires or armoured PVC insulated and sheathed cables shall be used for external power supply connections of temporary nature. Weatherproof rubber wires shall not be used for any temporary power supply connections. Taped joints in the wires shall not be used.

xxiv. The bulbs/ lamps used for illumination and testing purpose shall have cover or guard to protect them from accidental breakage. Only 24V supply system shall be used for hand lamps, etc. while working inside metallic tanks or conducting vessels.

b) Operation and Maintenance:

i. All persons, who work with electrical installation/ equipment, shall be aware of the electrical hazards, use to protective devices and safe operational procedures. They shall be given training in fire fighting, first aid and artificial resuscitation techniques.

ii. The contractor shall instruct the workers in the proper procedure, specify and enforce the use of necessary protective equipment such as adequately insulated pliers, screw drivers, fuse pulleys, testing lamps and similar hand tools. Only wooden ladders shall be used to reach the heights in electrical work.

iii. No material or earthwork shall be allowed to be dumped below or in the vicinity of the bare overhead line conductors.

vi. Before any maintenance work is commenced on electrical installations/ equipment, the circuits shall be de-energized and ascertained to be dead by positive test with an approved voltage-testing device. Switches shall be tagged or the fuse holders withdrawn before starting the work. Adequate precautions shall be taken in two important aspects viz.

- That there shall be no danger from any adjacent live parts and
- That there shall be no chances of re-energization of the equipment on which the persons are working.

v. While working on or near a circuit, whenever possible the use of one hand may be practiced even though the circuit is supposed to be dead. The other hand may preferably be kept in pocket.

vi When it is necessary to touch electrical equipment (for example when checking for overload of motors) back of the hand may be used. Thus, if accidental shock were to cause muscular contractions, one would not ‘freeze’ to the conductor.

vii. Operations of electrical equipment shall be avoided which standing on wet floor or when hands are wet.

viii. Before blown fuses are replaces, the circuit shall be locked out and an investigation shall be made for the cause of the short circuit or overload.

ix. When two persons are working within reach of each other, they shall never work on difference phases of the supply.

x. When structural repairs, modification or painting work are to be undertaken, appropriate measures shall be taken for the protection of persons whose work may bring them into the priority of live equipment/ circuit.

xi. It shall be ensured that the insulation and wire size of extension cords are adequate for the voltage and current to be carried.

xii. While tapping electricity from the socket, plug top must be used. It shall be ensured that no extension boards are over loaded while tapping. Only standard three pin plugs shall be used for tapping electricity. Broken sockets/ plugs shall be replaced immediately with good ones. Only joints free cables shall be used for connecting equipment/ apparatus.

xiii. Floors shall be kept free from tailing electrical cables to avoid tripping hazard.

xiv. Power supply to the entire machines and lighting fixture shall be switched off when not in use.

xv. Temporary electrical connections shall be removed as soon as the stipulated work is over. After completion of the works, the contractor shall dismantle the distribution boards and the other facilities erected at site.

xvi. Unauthorized tapping of power by others from distribution boards under the control of the NCC shall be prohibited at all circumstances.

xvii. No flammable materials shall be stored in any working area near the switch boards.

xviii. "MEN ON LINE" "DO NOT SWITCH ON" "DANGER" OR "CAUTION" boards as applicable shall be used during maintenance works on the electrical equipment.

19.3 Portable electrical equipment:

a) Portable electrical equipment shall be regularly examined, tested and maintained to ensure that the equipment and its leads are in good order. Register shall be maintained for inspection, recording the testing dates and results of the equipment discord metallic body electrical equipments.

b) All portable appliances shall be provided with three core cable and three-pin plug. The third pin of the plug shall invariably be earthen. It shall be ensured that the metal part of the equipment shall be effectively earthen.

c) All connections to portable equipment or machines from the panel/ distribution board/ extension board shall be taken using 3 core double insulated PVC flexible copper wire cable in one length. No joints shall be allowed in this flexible cable wire. In case single length of wire is not sufficient for a particular location then the supply can be tapped by providing another extension board comprising of switch and socket.

d) Flexible cables for portable lamps, tools and apparatus shall be regularly examined, tested periodically and maintained to ensure safety.

20. SAFETY CODES IN CONSTRUCTION INDUSTRY

20.1 Excavation (IS: 3764):

Location and protection of underground utility via. water main, cables.

a) Barricade - openings.

b) Lamp at night - warning signs.

c) Excavated material - 5 feet away

d) Shoring for sides - avoid sides from collapsing.

e) Avoid vertical cuts.

f) Water controlled.

g) Equipment/ vehicles at safe distance.

h) Ensure stability of other structures nearby.

i) Do not take gas cylinders inside trenches.

Trenches greater that 4 feet, depth should be provided with shoring - ladder for every 30m excavated portion.

20.2 Blasting (IS: 4081):

Accidents are caused during blasting due to the following main reasons:

a) Wrong placement of charge in the blast hole.

b) Inadequate size of blast hole.

c) Excess quantity of charge.

d) Misfires during actual blasting.

e) Wrong handling of explosives.

The following points should be observed during blasting operation (prior permission to be taken from concerned statuary authority before commencement of the activity)

a) **Do not carry out blasting near any structure, foundation, column, crane, installation, etc.**

b) **Explosives should be of low sensitive to external influence (shock, friction, heat, sparks, etc.).**

c) **The radius to depth ration of the blast should be kept as low as possible so that the flight range of the fragments will be reduced.**

d) **The charge should be placed in such a way that the angle of throw of fragments would be between 85^0 to 90^0 with the horizontal.**

e) **Transportation, handling, storage of explosives as per Indian explosive act.**

f) **Supervision by experienced person.**

g) **Prior warning - evacuation to 400 meter away.**

h) **If charge fails - wait ½ hour/exam.**

i) **Store explosives in standard magazines.**

j) **No smoking signs.**

k) **Proper accounting of explosives.**

l) **Cases opened with wooden tools only.**

m) **Post flagmen - cordon off area.**

n) **Advise near by residents of danger.**

o) **Use non-sparking tools/ shoes.**

p) **Do not carry matches/ open lights.**

q) **Use flameproof fittings/ lights.**

r) **Children/ unauthorized persons are not allowed in this area.**

s) **For electrical blasting, voltage shall not exceed 220V.**

t) **Do not carry on blasting under over-head power line/ utility communication/ utility lines.**

u) Used loud siren to mark beginning and completion of blasting.

v) Only authorised persons allowed to go to misfired holes.

w) Misfired explosives to be disposed in accordance with explosives act.

x) Leaky explosives to be washed with de-sensitizing agents.

y) The charge should be placed in the boreholes only when the blasting operation is carried out - not earlier.

z) The blasting area to be covered completely using sand bags and steel plates (controlled blasting).

20.3 Cement works:

Cement dermatitis, burns-use gumboots, gloves, and respirators.

20.4 Scaffolding (IS: 4014 - PART-II):

a) Clear the area of unwanted materials.
b) Erection under proper supervision.
c) Ensure ropes and cables are in good condition.
d) Ensure that all structural members and all connections adequate.
e) Supports strong - adequate cross bracing.
f) Ensure ground is compacted and leveled safe and provide proper foot hold.
g) Keep ladder/ working area free of grease/ oil.
h) Passerby's are protected.
i) Provide guardrails and toe board.
j) Wear safety harness, helmet while working on scaffolding.
k) Do not use the scaffolding for more than 15 days without rechecking.
l) Frequent inspection.
m) Excavation is not permitted near base of scaffolding.

20.5 Ladders (IS: 3696 - PART-II):

a) Proper inspection - rungs/ steps are not spliced.
b) Properly secured - top and bottom.
c) Side rails on fixed ladders to extend above top landing.
d) Build up ladders of sound material.
e) Rungs not to exceed 12 inches.
f) Step ladders fully open during use.
g) Metal ladders - prohibited near electrical lines.
h) Proper maintenance and storage after use.

20.6 Barricades:

a) Floor and lift openings covered/ barricaded properly.
b) Road ways/ side walks protected.
c) Traffic controlled.

20.7 Concrete construction:

a) Forms properly installed and braced.
b) Adequate shoring, plumbing and cross bracing.
c) Shoring remains in place till strength attained.
d) Proper curing period and procedure.
e) Mixing and transporting equipment properly supported/ routed.
f) Adequate runways.
g) Protection from cement dust.
h) Hard hats - safety shoes, skin covering.
i) Nails to be removed from shuttering material.

20.8 Masonry:

a) Proper scaffolding.

b) Dust protection.

c) Safe hoisting equipment.

20.9 Hoists, cranes, derricks:

a) Inspect - cables, slings, chains, hooks, eyes

b) Equipment stability/ supports.

c) Out riggers used if required.

d) Power lines removed/ inactivated (cranes).

e) Signals understood and observed.

f) Experienced operators.

g) All equipment properly lubricated/ maintained.

h) Protective head gears.

i) If person climbs on derrick installed for lifting material, special precautions should be taken.

j) Gas cylinders are kept in properly designed cages.

k) Periodical test/ inspection of hoists cranes.

l) Mark “safe working loads” on hoists/ cranes.

m) Cranes to be operated by certified operator.

n) Ensure that slings are vertical.

o) Do not drag chains, slings, hooks and load over the floor.

p) Know the load before lifting.

20.10 Conveyors:

a) Proper inspection and maintenance.

b) Screens and other protection.

c) Adequate inspection and maintenance, ladders, light.

20.11 Heavy equipment and trucks:

a) Qualified operators with license.

b) Vehicle laws and regulations to be observed.

c) Check - breaks, lights, warning devices and wheels.

d) Weight limits - load sizes controlled.

e) Haul loads well maintained - properly laid.

f) Personnel not carried in unsafe manner.

g) Protection when equipment not used.

h) Planned inspection - maintenance.

i) Adequate equipment records.

j) Proper oil, fuel, lubricants used.

20.12 House keeping and sanitation:

a) General neatness in working area.

b) Regular disposal of waste/ trash.

c) Pathways and walkways clear.

d) Adequate lighting.

e) Sanitary facilities - clean.

f) Adequate drinking water.

20.13 Emergency procedure:

a) First aid station - properly manned.

b) First aid boxes - with items and inspected weekly.

c) Injuries reported promptly.

d) Safety net and safety harness used for heights.

e) Adequate escape facilities.

f) Proper storage of tools when not being used.

g) Emergency phone numbers - fire department, police department, hospital, ambulance, etc. to be displayed at site office by the main contractor.

h) Fire extinguishers to be placed by all vendors - readily and easily available.

i) Emergency vehicle must be readily available.

j) First aid person readily available.

k) Free passages, ladders and stair ways.

l) Public addressing systems to be available.

20.14 Welding and cutting:

a) Qualified operators.

b) Proper screen, shield, goggles, gloves, clothing, equipment.

c) Electrical equipment - grounded - inspected.

d) Power cables protected and in good condition.

e) Fire extinguishers - available.

f) Inspection of fire hazards.

g) Flammable materials - protected (40 feet away).

h) Gas cylinders - upright and chained.

i) Gas line, torch in good condition.

j) Trolleys for moving cylinders.

k) Proper covering of mezzanine holes or barricades for cut portion.

l) Barricades/ notices below mezzanine being cut - work permit (special).

m) Helper also to use goggles.

20.15 Flammable gases – liquids:

a) “No smoking” signboard.

b) Containers clearly identified/ marked.

c) Proper storage practices.

d) Proper storage temperature - protection.

e) Fire hazards to be checked.

f) Proper and adequate fire extinguishers.

g) Neat storage area - clear passages.

h) Material firmly stacked - not too high.

i) Entry restricted.

j) Store in separate enclosed area.

20.16 Handling and storage:

a) Proper number for operation.

b) Person picking up leads correctly.

c) Materials protected from heat/ moisture.

d) Protection from falling into hoppers/ bins.

e) Dust protection observed.

f) Extinguishers/ fire protection available.

g) Traffic routing and control.

20.17 Power tools:

a) Metal bodies tools are not allowed, only fiber body tools to be used.

b) Good house keeping where used.

c) Tools - cords - earthing - in good condition.

d) Proper instructions for use.

e) Proper mechanical safe guards.

f) Tools nearly stored when not in use.

g) Right tool for job.

h) Proper wiring.

i) Proper training to operator.

j) Proper supervision.

k) Use of safety appliances - goggles - face shield.

l) Flying hazards checked up.

21. DUST CONTROL

a) Frequently water shall be sprinkled for drive ways and path ways by using mobile sprinkler tankers.

b) Carting away of surplus earth/ debris shall be controlled by covering the tippers with polythene sheets. There shall be no spillage of earth/ debris on the road while carting away.

22. GARBAGE DISPOSAL

a) Garbage bins shall be provided around the site for collection and disposal of garbage/ debris on and from the site. Contractor shall obtain necessary permissions from on methods for disposal of hazardous waste such as waste oil from generators, thermocoal, HDPE bags, etc.

23. DIESEL GENERATOR (DG)

a) DG set should be acoustic to reduce noise level.

b) The contractor shall obtain clearance from the State pollution control board (KSPCB) for all DG.

c) Used oil of DG to be stored in a scientific manner and disposed to authorized representatives of KSPCB and copy of the same to be submitted.

d) Proper earthing to be given as per IS norms.

e) Secondary container to be provided underneath DG and fuel tank to avoid spillage.

f) Height of the exhaust pipe to be as per PCB norms.

g) Appropriate fire extinguisher to be placed at entrance of the DG room.

h) Barricading to be provided around the DG area with proper sign.

24. FUEL STORAGE

Fuel should be stored at well ventilated and isolated area with appropriate fire extinguishers as per explosive act. Secondary container to be provided underneath barrel to avoid spillage on earth.

25. WORK PERMIT

Work permits required for the following:

Work at height, excavation, hot work, confined space entry, night work, work on electrical equipment, shaft works, tippers/ JCB/ Tractor/ cranes and other equipments. LIST OF APPROVED MAKES

S.No	Description	Approved Make
1	**CONCRETE AND ALL WORKS.**	
	Cement Grade – 53 or Grade 43	Birla Super, ACC, Bharathi
	Ready Mix Concrete	RMC India, Ultratech,Coramondal, ACC.
	Steel for Reinforcement	SAIL, JSW, TATA -- TMT BARS .
	Steel Sections	SAIL, TATA, JSW ..
	Admixture as Retarder	Cico, Sika and Fosroc.Krishna conchem.
2	**MASONRY WORKS**	
	Solid cement Blocks	As per SR rate
	Cement bockset	Weber Blockset (Saint Gobian)
	Gyp sum board	Saint Gobain
	Adhesives	Weber.sets (Saint Gobian)
	Manufactured Sand	BESTO / ROBO SAND
3	**JOINERY WORKS**	
	Mild steel Rolling shutter	Gandhi / Padma Engg. / Technocrats / Indo Germa Products Ltd. or Equivalent.
	Sliding Gate	L Mark / Gandhi / Indo Germa Products Ltd. or Equivalent
	Water Proof Ply	National / Greenply Green ply,Sharon Ply

S.No	Description	Approved Make
	Laminate	Greenlam / Timex / Uro
4	**FLOOR & FINISHES**	
	Ceramic Tiles	Johnson / NITCO / KAJARIA / NAVEEN.
	Vitrified Tiles	Johnson / NITCO / KAJARIA / NAVEEN.
	Cement based Tiles	Ultra / Basant betons / Eurocon
	Vinyl flooring (Sports grade)	Armstrong / LG
	Glazed mosaic tiles	Bissaza Approved by Client.
	Granite / Marble / Imported Marble	Krishmal / Marble centre / HMG.
	Paints & Polish material.	Asian Paints / Berger / Sherwin williams /Delux.
	Spl.Finish material on floor & Dado	Dural / Arpitha or Equivalent.
	Tile Adhesive.	Weber.set ---- Firm / Nova white / Flex / plus white.
	Melamine / French Polish/ PU polish	Asian / Berger / ICI
	Texture paint	Asian Paints / Sherwin williams /Delux
5	**WATER PROOFING CHEMICALS**	
	Water proofing chemicals	BASF, CICO, FOSROC.
6	**RAILINGS**	
	Stair case Railing / Balcony Railing	SS Railing As per SR Rate – Grade 304
	All types of Glass	Saint Gobain / Modi /Glaverbel
	Glass Wool	Twiga or Lloyd Insulation. or Equivalent
7	**EXTERNAL CLADDING**	
	SLATE	Astone / Nustar.
	SADARALLI GRANITE	KRISHMAL GRANITE OR AS PER SR RATE
8	**FALSE CEILING**	
	Bison Board panel	Saint Gobain / NCL - Industries or Equivalent

S.No	Description	Approved Make
	E' Board panel	Eternity Everest or Equivalent
	Prelaminated External Grade Board	Funder Max / Green Lam.

ANNEXURE - a

LIST OF BIS CODES

IS 383-1970 Specification for coarse & fine aggregates from natural Source for concrete

IS 2386 (Part 1 to 8) Method of test for aggregates for concrete

IS 712-1984 Specification for building limes.

IS 3182 – 1986 Specification for broken brick (burnt clay) fine aggregate for use in lime mortar.

IS 269-1989 Specification for 33 grade ordinary Portland Cement

IS 455 – 1989 Code of practice for Portland Slag Cement.

IS 1489-1991 Specification for Portland Pozzolana Cement

IS 8041 –1990 Specification for rapid hardening Portland Cement

IS 8112 –1989 Specification for 43 grade ordinary Portland Cement.

IS 12269 –1987 Specification for 53 grade ordinary Portland Cement

IS 8043- 1991 Specification for Hydrophobic Portland Cement.

IS 12330-1988 Specification for Sulphate resisting Portland Cement

IS 6452-1989 Specification for high alumina cement for structural use.

IS 8042-1989 Specification for White Portland Cement.

IS 3535-1986 Methods of sampling Hydraulic Cement

IS 4031 (Part 1to 15-

Methods test for Hydraulic Cement.

IS 4032-1985 Method of Chemical Analysis of Hydraulic Cement

IS 2645-1975 Specification for Integral Cement Waterproofing Compounds

IS 1599-1985 Method of Bend Test

IS 1608-1972 Method of Tensile Testing of Steel Products

IS 6925-1973 Method of test for determination of water Soluble Chlorides in concrete admixtures

IS 432-1982 Specification for mild steel and medium tensile steel bars and hard drawn steel wire.

IS 1786-1985 Specification for high strength deformed steel bars and wires for concrete reinforcement.

IS 1566-1982 Specification for hard drawn steel wire fabric for Concrete reinforcement

IS 280-1978 Mild steel wire for general engineering purposes

IS 2062-1992 Structural Steel (Standard Quality)

IS 1161-1979 Steel Tubes for structural purposes

IS 5624-1970 Foundation bolts
IS1363-(Part 1 to 3)-1992 Hexagon Head bolts, serews, nuts
IS 2016-1967 Plain washers
IS 3063-1972 Single coil rectangular section spring washers
IS 1239(Part 1&2)-1990 Mild steel tubes and other wrought steel pipe fittings
IS 1367-1980 Technical supply conditions for threaded steel fasteners
IS 1030-1989 Carbon steel castings
IS 3480-1966 Flexible steel conduit for electrical wiring
IS 2667-1988 Fittings for rigid steel conduits for electrical wiring
IS 9537-(Part 3)-1983 Conduit for electrical installations-Rigid plain conduits of insulating material
IS 6946-1973 Flexible non-metallic conduits for electrical installations
IS 3419-1989 fittings for rigid non-metallic conduits
IS 5913-1989 Methods of tests for Asbestos cement products
IS 2098-1964 Specification for asbestos cement building boards
IS 2096-1992 Specification for asbestos cement flat sheets
IS 9537 (Part 2)-1981 Conduit for electrical installations-Rigid steel conduits
IS 1592-1989 Specification for asbestos cement pressure pipes
IS 9627-1980 Specification for asbestos cement pressure pipe (light duty)
IS 6908-1991 Specification for asbestos cement pipes and fittings for sewage and drainage
IS 1626(Part 1to 3)-1980-1991 Specification for asbestos cement building pipes fittings and roofing fittings

IS 459-1992 Specification for unreinforced corrugated and semi corrugated asbestos cement sheets
IS 1077-1992 Specification for common burnt clay building bricks
IS 3495(Part 1 to 4)-1992 Method of test for burnt clay building bricks.
IS 3620-1979 Specification for late rite stone block for masonry.
IS 1121-1974 Method of test for determination of strength properties of natural building stone.
IS 1124-1974 Method of test for determination of water absorption
Sp.Gr. etc. of building stones.
IS 1125-1974 Method of test for determination of durability of building.
IS 1127-1970 Recommendation for dimensions and workmanship of
natural building stones for masonry work.
IS 2185-(Part-1)-1979 Specification for concrete masonry unit-Hollow and solid concrete blocks.
IS 2116-1980 Specification for sand for masonry mortar.
IS 1542-1992 Specification for sand for plaster.
IS 2185(Part-2)-1983 Specification for concrete masonry unit-Hollow and solid light weight concrete blocks.

IS 2185 (Part-3)-1984 Specification for concrete masonry unit-Autoclaved
Cellular Aerated concrete blocks..
IS 6041-1985 Code of practice for construction of Autoclaved cellular concrete block masonry.
IS 6441 (Part 1 to 9)-1972 &73 Method of test for Autoclaved concrete products.
IS 3068-1986 Specification for broken brick (burnt clay) coarse.
IS 2114-1984 Code of practice for laying in-situ terrazzo floor finish.
IS 460 (Part1 to3)-1985 Specification for Test Sieves.
IS 1237-1980 Specification for cement concrete flooring tiles.
IS 777-1988 Specification for glazed earthenware wall tiles.IS 1129-1972 Recommendation for dressing of natural building stone.
IS 1130-1969 Specification for Marble (Blocks, slabs and tiles).
IS 809-1992 Specification for rubber flooring materials for general purposes.
IS 3462-1986 Specification for unbacked flexible PVC flooring.
IS 3461-1980 Specification for PVC asbestos floor tiles Indian Hessians
IS 2818-1990 linoleum sheets and tiles
IS 653-1992 Code of practice for laying hard wood parquet and wood block flooring. IS 5389-1969
IS 210-1978 Grey iron casting
IS 2114-1984 Code of practice for laying in-situ terrazzo finish
IS 1198-1982 Code of practice for laying of linoleum flooring
IS 1003 (Part-2)-1983 Specification for timber panelled & glazed shutters,
Windows and ventilator shutters
IS 1141-1973 Code of practice for seasoning of timber
IS 1003 (Part-1)-1983 & 1991 Specification for timber panelled & glazed shutters-Door shutters.

IS 287-1973 Recommendation for maximum permissible moisture content of timber used for different purposes
IS 2202(Pat-1)-1983&1991 Specification for wooden flush door shutters (cellular and hollow.
IS 2192 (Part-1&2)-1983 Specification for wooden flush door shutters (cellular & hallow core type.
IS 3087-1985 Specification for wood particle boards.(medium density) for general purpose.
IS 3478-1966 Specification for high density wood particle boards.
IS 3097-1980 Specification for veneered particle boards.
IS 303-1989 Specification for plywood for general purpose.
IS 1328-1982 Specification for veneered decorative plywood
IS 205-1992 Specification for non-ferrous metal butt hinges
IS 1341-1992 Specification for steel butt hinges
IS 362-1991 Specification for parliament hinges
IS 453-1973 Specification for double acting spring hinges.
IS 3818-1992 Specification for continuous (Piano) hinges
IS 206-1992 Specification for Tee and Strap hinges
IS 281-1991 Specification for mild steel sliding door bolts for use with padlocks
IS 1019-1974 Specification for rim latches
IS 2681-1979 Specification for non ferrous metal sliding door bolts for use with padlocks
IS 204 (Part 1&2)-1991& 92 Specification for tower bolts-ferrous and non-ferrous metals
IS 208-1987 Specification for door handles
IS 2209-1976 Specification for mortice locks (Vertical type)
IS 6607-1972 Specification for rebated mortice locks (Vertical type)
IS 1823-1980 Specification for floor door stoppers
IS 1837-1966 Specification for fan light pivots
IS 207-1964 Gate and shutter hooks and eyes
IS 6343-1982 Specification for door closers(pneumatically regulated) for light door weighing upto 40kg
IS 8756-1978 Specification for ball catches for use in wooden Almirah
IS 6315-1992 Specification for floor springs (hydraulically regulated) for heavy doors
IS 7197-1974 Specifications for Double act on floor spring (without oil check) for heavy doors.
IS 364-1993 Specification for fan light catch.
IS 3828-1966 Specification for ventilator chains.
IS 363-1976 Specification for hasp and staples.
IS 9899-1981 Specification for hot coat and wardrobe hooks
IS 729-1979 Specification for drawer locks, cupboard locks and box locks.
IS 3564-1986 Specification for door closers (Hydraulically regulated).
IS 4351-1976 Specification for steel door frames
IS 419-1967 Putty for use on window frames
IS 5187-1972 Specification for flush bolts.
IS 3847-1992 Specification for mort ice night latches.
IS 4621-1975 Specification for indicating bolts.
IS 1038-1983 Specification for steel doors, windows and ventilators
IS 1977-1975 Specification for structural steel.
IS 1361-1978 Specification for steel windows for industrial buildings
IS 7452-1990 Hot rolled steel sections for doors, windows and ventilators.
IS 1948-1961 Specification for aluminium windows and ventilators.
IS 1148-1982 Specification for hot rolled rivet bars for structural purposes.
IS 1949-1961 Specification for aluminium windows for industrial buildings
IS 204 (Part-1)-1992 Specification for tower bolts –non-ferrous metal
IS 733-1983 Wrought aluminium and aluminium alloy bars, rods and sections(for general engineering purposes)
IS 6248-1979 Specification for metal rolling shutters and rolling grills.
IS 1081-1960 Code of practice for fixing and glazing of metal doors, windows and ventilators.
IS 2339-1963 Specification for Aluminium Paint for general purpose in dual containers.
IS 2835-1987 Flat transparent sheet glass.
IS 5437-1969 Wired and figured glass.
IS 101 (Part 1-8)-1964-1993Method of sampling and test for paints, varnishes and related products.
IS 2074-1992 Ready mixed paint, air drying, red oxide, zinc chrome, priming.
IS 5410-1992 Cement paint, colour as required.
IS 427-1965 Distemper, dry, colour as required.

IS 428-1969 Distemper, oil emulsion, colour as required
IS 348-1968 French polish
IS 5411 (Part 1 & 2)-1972-74 Plastic emulsion paint.
IS 702-1988 Industrial Bitumen
IS 73-1992 Paving Bitumen.
IS 217-1988 Cut back Bitumen
IS 454-1961 Specification for digboi type cutback bitumen
IS 5467-1986 Specification for shellac wax.
IS 3384-1986 Specification for Bitumen primer for use in water proofing and damp proofing.
IS 290-1961 Specification for Coal tar black paint
IS 341- 1973 Specification for Black Japan, type A, B & C
IS 1322-1982 Specification for bitumen felts for water proofing and damp proofing
IS 218-1983 Specification for creosote oil for use as wood preservative
IS 3037-1986 Specification for bitumen mastic for use in water proofing of roofs.
IS 1580-1991 Specification for Bituminous compound for water proofing and caulking purposes.
IS 8542-1977 Specification for polish for wooden furniture paste.
IS 9862-1981 Ready mixed paint, brushing etc.,
IS 782-1978 Specification for caulking lead
IS 405 (Part 1& 2)-1992 Lead sheet and strips
IS 5134-1977 Bitumen impregnated paper.
IS 2849-1983 Specification for non load bearing gypsum partition blocks
IS 8591-1977 Specification for floor polish paste.
IS 2095-1982 Specification for gypsum plaster boards.
IS 77-1976 Specification for linseed oil, boiled for paints.
IS 533-1973 Gum spirit of turpentine (oil of Turpentine)
IS 1504-1974 Bees wax
IS 3536-1966 Ready mixed paint, brushing, wood primer pink
IS 8273-1984 Specification for gypsum plaster for use in the manufacture of fibrous plaster board.
IS 5871-1987 Specification for bitumen mastic for tanking and damp proofing.
IS 651-1992 Specification for salt glazed stoneware pipe and fittings.
IS 1729-1979 Sand cast iron spigot and socket soil pipe.
IS 771 (Part1 to 7)-1979-1985 Specification for glazed fire clay appliances
IS 1230-1979 Cast iron rain water pipes and fittings.
IS 774-1984 Flushing cisterns for water closets and urinals.
IS 2548 (Part 1 & 2)-1983 Specification for plastic seats and cover for water closet.
IS 1726-1991 Specification for cast iron manhole cover and frames.
IS 1239 (Part1 & 2)-1990-1992 Mild steel tubes and fittings.
IS 4984-1987 Specification for high density polyethylene pipes for potable water supplies: sewage and industrial effluents.
IS 2556 (Part 1-15)-1972-1985 Specification for vitreous sanitary appliances (Vitreous China)
IS 7328-1992 High density polyethylene materials.
IS 4985-1988 Specification for unplasticised PVC pipes for portable water supplies.
IS 3076-1985 Specification for low density polyethylene pipe for portable water supplies.
IS 9762-1981 Specification for polyethylene materials floats for ball valve.
IS 3395-1984 Code of practice for fire safety of industrial buildings
IS 7834 (Part 1 to 8)-1987 Specification for injection moulded PVC fittings for potable water.
IS 8008-(Part 1 to 7)-1976 Specification for injection moulded HOPE fittings for potable water.
IS 8360 (Part 1 to 3)-1977 Specification for fabricated high density polyethylene fittings for potable water.
IS 784-1978 Specification for prestressed concrete pipe.
IS 1703-1989 Specification for copper alloy float valves (horizontal plunger type) for water supply fittings.
IS 12234-1988 Specification for plastic equilibrium float valve for cold water services
IS 778-1984 Specification for copper alloy gate, globe and check valves for water purposes.
IS 1536-1989 Centrifugally cast (spun) iron pressure pipes
IS 1537-1976 Vertically cast iron pressure pipes for water, gas and sewage.
IS 1538 (Part 1 to 23)-1976 Sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS 3589-1991 Specification for cast copper alloy screw down bib taps and stop valves for water services
IS 1239 (Part 1 & 2)-1990-1992 Mild steel tubes and fittings.
IS 779-1978 Specification for water meters
IS 1795-1982 Specification for pillar taps for water supply purposes.
IS 1363 (Part 1 to 3)-1992 Dimensions for screw thread runpouts and undercuts

IS 2016-1967 Plain washers.
IS 638-1979 Sheet rubber jointing and rubber insertion jointing.
IS 4127-1983 Code of practice for laying of glazed stoneware pipes.
IS 458-1988 Specification for precast concrete pipes.
IS 6313-1981 Code of practice for anti termite measures in building
IS 1054-1962 Diealdrin emulsifiable concentrates
IS 1308-1984 Aldrin dusting powders
IS 1791-1985 Specification for batch type concrete mixers.
IS 10262-1982 Recommended guidelines for concrete mix design.
IS 7861 (Part 1)-1975 Code of practice for extreme weather concreting-recommended practice for hot weather concreting
IS 1199-1959 Methods of sampling and analysis for concrete
IS 516-1959 Methods of test for strength of concrete.
IS 7861 (Part 2)-1981 Code of practice for extreme weather concreting recommended practice for cold weather concreting
IS 2502-1963 Code of practice for bending and fixing of bars for concrete reinforcement.
IS 2751-1979 Recommended practice for welding of mild steel plain and deformed bars for reinforced construction
IS 800-1984 Code of practice for general construction in steel and deformed bars.
IS 816-1969 Code of practice for use of metal in welding
IS 814-1991 Covered electrodes for manual metal are welding.
IS 3370 (Part 1 & 2)-1965 Code of practice for concrete structures for the storage of liquids.
IS 2911 (Part 1 to 4)-1979-1985 Code of practice for design and construction of pile foundations.
IS 1343-1980 Code of practice for prestressed concrete?
IS 1785 (Part 1 & 2)-1983 Specification for plain hard drawn steel wires for prestressed concrete.
IS 2250-1981 Code of practice for preparation and use of masonry mortars.
IS 1635-1992 Code of practice for field slaking of building lime.
IS 2212-1991 Code of practice for brick work.
IS 1597-(Part 1 & 2)-1992 Code of practice for construction of stone masonry.
IS 4101 (Part 1 to 3)-1967-1985 Code of practice for external facing and veneer.
IS 737-1986 Wrought aluminum and aluminum alloys, sheet and strips (for general engineering purposes)
IS 2572-1963 Code of practice for construction of hollow concrete block masonry.
IS 1661-1972 Code of practice for application of cement finishes
IS 5766-1970 Code of practice for laying burnt clay brick flooring.

IS 5491-1969 Code of practice for laying of in-situ granolithic concrete flooring topping.
IS 3316-1974 Specification for structural granite
IS 1196-1978 Code of practice for laying bitumen mastic flooring
IS 1195-1978 Specification for bitumen mastic for flooring
IS 3462-1986 Specification for unbacked flexible PVC flooring.
IS 1198-1982 Code of practice for laying fixing and maintenance of linoleum floor.
IS 848-1974 Specification for synthetic resin adhesive for plywood.
IS 4457-1982 Specification for ceramic unglazed vitreous acid resisting tiles.
IS 851-1978 Specification for synthetic resin adhesive for construction work (non-structural) for wood
IS 2202(Part 1 & 2)-1981-1991 Specification for wooden flush door shutters
IS 102-1962 Ready mixed paint.
IS 1081-1960 Code of practice for fixing and glazing of metal doors
IS 6248-1979 Specification for metal rolling shutters and rolling grills
IS 1868-1982 Anodic coating on aluminum and its alloys
IS 2065-1983 Code of practice for water supply in buildings.
IS 2064-1993 Code of practice for selection, installation and maintenance of sanitary appliances
IS 7634-(Part 1 to 3)-1975 Code of practice for plastic pipes.
IS 1742-1983 Code of practice for building drainage
IS 5330-1984 Criteria for design of anchor blocks for penstocks with expansion joints.
IS 311-1985 Code of practice for laying of cast iron pipes.
IS 783-1985 Code of practice for laying of Concrete pipes.
IS 6509-1985 Code of practice for installation of joints in concrete pavement
IS 1838 (Part 1)-1983 Specification for preformed filler for expansion joint in concrete pavements and structures.

IS 3036-1992	Code of practice for laying lime concrete for water proofing.
IS 1346-1991	Code of practice for water proofing of roofs with bitumen felts.
IS 1609-1991	Code of practice for laying damp proofing treatment using bitumen felt
IS 4365-1967	Code of practice for application of bitumen mastic for water proofing of roofs.
IS 9103-1979	Specification for admixtures for concrete.
IS 2645-1975	Specification for integral cement water proofing compounds.
IS 1834-1984	Specification for hot allied sealing compound for joint in concrete.
IS 278-1978	Specification for galvanized barbed wire for fencing.
IS 2721-1979	Specification for galvanized steel chain link fabric.
IS 280-1978	Specification for mild steel wire.
IS 4826-1979	Specification for hot dipped galvanized coating on round steel wires.
IS 1200 (Part 1 to 28)-1971-1993	Method of measurement of building and civil engineering works safety.
IS 4081-1986	Code of blasting.
IS 5916-1970	Specification for cast iron gratings for drainage purposes.
IS 4130-1991	Safety code for demolition of building
IS 3764-1992	Safety code for excavation work
IS 5121-1969	Safety code for piling
IS 4014 (Part 2)-1967	Code of practice for steel tubular scaffolding.
IS 3696 (Part 1 & 2)-1987-1991	Safety code of scaffolds and ladders.
IS 6922-1973	Criteria for safety and design of structures subject to underground blast.
IS 5499-1969	Code of practice for construction of underground raid shelter
IS 4138-1977	Safety code for working in compressed air
IS 7293-1974	Safety code for working with construction machinery.
IS 8989-1978	Safety code for erection of concrete framed structures
IS 4756-1978	Safety code for tunneling work
IS 7205-1974	Safety code for erection of structural steel works

GENERAL NOTES COVERING THE BOQ

i These general notes are applicable for all work in this contract.

ii This work is to be read in conjunction with the Drawings, Specifications, Preambles to Work Sections and General Condition and Preliminaries in BOQ which shall be construed as being complementary to one another. Any discrepancy discovered should be reported to the Engineer before commencing work. The words 'as specified' wherever used in this work shall mean as specified in the above stated documents.

iii This work is wholly PROVISIONAL and is subject to final remeasurement on completion of the Works.

iv Unless otherwise specified, method of measurement shall be in accordance with IS 1200.

v The description provided are brief. The Contractor shall inspect the site, STUDY THE DRAWINGS AND DETAILS and fully determine for himself the full scope of each item and price the same accordingly. No claim shall be permissible for lack of knowledge on Contractor's part in pricing of these items.

vii The work shall be carried out as per drawings, specifications, the description of the items in the schedule and / or architects instructions.

viii Items of work provided in this schedule but not covered in the specifications shall be executed strictly as per instructions of the project manager/architect.

ix Rates quoted must have full compliance with the following including the cost of grey cement, Cement mortar and white cement.

x The owner reserves the right to supply or issue price basis for any material item.

xi The owner reserves the right to 'lend' his name for all imported items in order to avail any possible duty exemptions and the said benefit shall go to the owner.

xii The items which are supplied free of cost need to be reconciled at the end of the project based on material constraints.

xiii Special attention to be paid to Technical specifications.

ix Basic rate shall material to include (Material cost, transportation, delivery and handling charges (delivered at site).

x Upon receipt of majority of good for construction (GFC) Drawings, the contractor has to do a re-qualification of all the items in this bill of quantities and shall get approved by project manager. All rate only items and items which exceed this BOQ needs to be addressed and submitted to the project manager for approval.

xi Only items which are present and quantified in this BOQ Shall be considered for payment. The Contractor shall prepare and submit to project manager a variation order for items excluding this BOQ, operation of rate only items and non tendered items in order to be considered for payment.

xii The Quantities furnished in the Bill of Quantities are tentative / Indicative and the probable quantities is liable to altrerations, omissions or additions and it may vary on the higher or lower side at the sole discretion of the Project Manager / Owner.

xiv All concrete works to be to be design mix and the contractor shall quote the rate as per minimum cement requirement specified in the respective mix in the Bill of Quantities.If any variation of cement contents in the execution will be considered only for reconciliation but not for payment.

GENERAL NOTES COVERING THE BOQ

xv	Any cliams, disputs in the quoted rates and extra items at later stages will not be entertained outside the scope of above.
xvi	No asbestos - containing material in construction materials to be used by vendors / contractors.
Notes :	The contractor is to note and allow the following preambles in his scope of work.
A	TYPICAL NOTES - CIVIL WORKS / FLOORING / DADO WORKS / COUNTER WORKS
1	The thickness of stone like marble or Granite has been clearly mentioned in the specifications but if the vendor has proposal for any other thickness then the same should be specified.
	Granite slabs should be free of all defects and all grains / patterns shall be properly matched from the same lot. Any colour / lot variation shall be rejected.
2	Please refer all detailed drawings for flooring and cladding works of stone to understand the variation in size of the stone slab at the periphery or anywhere as per design and site condition.
3	All Granite to be locally sourced and supplied unless and until specified in the drawings.
4	The vendor to consider undulance tolerance code as per IS Code for all civil works
5	For all 'hard flooring areas',(areas with Granite / marble/ceramic-vitrified tiles/etc,) only the 'laid area' (visible after complete laying, etc.) shall be paid for. No 'extra' shall be paid for cutting / wastage / etc.
6	All 'inlays' in the flooring shall be paid for as per relevant item(s) in RMT. If, as per design, any 'module' of the relevant inlay, (width / length) has to be executed at site and the same is not conforming to / with the specification(s), the rate shall be derived on a prorata basis from the quoted rates.
7	All stones mentioned in the tender shall be brought to site only from the lots pre-approved /selected by the architects.
8	Rates quoted for items of counter,etc. shall be inclusive of making necessary cutouts for sinks, basins and inclusive of polishing the cut edge to the profile as indicated on the drawings, to the entire satisfaction of the supervising architects.
9	All masonry and plastering works shall be sufficiently cured, to the entire satisfaction of the supervising architects, before taking up finishing works on the same.
10	Rates quoted for the treads of the staircases shall be deemed to be inclusive of making all necessary cutouts, for railing balustrades, etc., in 'workmanlike manner, and, to the entire satisfaction of the supervising architects
	All Samples of tiles, fittings etc.shall be presented after ensuring that the necessary quantities of the relevant item(s) for which

11 the same are invited are available, (ex-stock, or otherwise) and shall be approved by the architect before placing of mass orders.

12 Vitrified tile / ceramic tiles shall be flat and true to shape and free from cracks, crazing spots, chipped edges, even color and corners.The tiles shall be of nominal sizes such as 600mm x 600mm size (or as size specified) and of colour and shade as approved/specified. They shall be of one consignment/lot.

13 The acid resistant tiles shall be as per the manufacturer's specifications.

GENERAL NOTES COVERING THE BOQ

All the Dado and/ Flooring shall include rates of the 6mm thk spacers with colour matching grouts and Edge Guards

14 of matching color of the dado wherever the walls are in right angles, as per instructions / related specifications

towards the same, as provided by the consulting architects

All appointed agencies are required to ensure that their scope of works are undertaken in an absolutely professional

and workmanlike manner and, furthermore, to ensure that 'housekeeping' activities are undertaken , at the site /

15 premises in question in such a manner that no debris/rejected materials/etc. are retained at site in a disorderly

manner, failing which, the Clients/Architects shall be at liberty to take remedial action at the sole cost(s) and

consequences of the appointed contracting agency

Daily housekeeping of work areas which includes segregation of debris like cement based,

16 plastic, glass, wood and collecting in containers provided to/by you, at an acceptable location inside the site premises.

17 All floor surfaces receiving the appropriate flooring material(s) need to be thoroughly cleaned prior to installation of the desired flooring.

No allowances shall be made to undertake rectification works if the same are so desired to

18 be undertaken for improper adherence to recommended application procedures / standards.

19 All joints, wherever necessary, shall be undertaken after prior approval of the same from the Architects.

All finished flooring surfaces shall be free from bubbles/scratches/stains/etc. prior to final hand- over of the activity at the

20 desired locations.All finished flooring shall be covered with plaster of Paris of 6mm thick over a plastic film without any extra

cost till handing over to the Owner.

All materials utilised shall be as per tender recommendations and shall be applied

21 according to manufacturer's specifications.

Plastering rates to include Expanded metal mesh (24 gauge) of approved make which shall be provided at the

22 Junctions of masonry and concrete surfaces of 150mm wide on either side of the junction in double fold stretched

and nailed properly prior to plastering.

Receiving all materials supplied by the Owners / your vendors, unloading, storing at location specified by the project

23 manager. No additional payment will be paid for any increase lead from this location conveying to work site & fixing in

position.

24 The minimum quality benchmark will be decided by the Owner / Project manager / Architect based on mock up samples before commencing the work.

25 Unless otherwise specified the rates quoted shall include only the the following ~ Cost of material,transport and labour. Overheads and profit shall be indicated separately as per bid summary sheet.

26 The basic rate of granite/marble/vitrified/ ceramic / etc., includes supply and delivery to site of approximately 8' x 4' (granite / marble) random slabs (or larger) delivered and unloaded to the point of cutting the same. All granite material shall be "gang saw water cut".

27 If there is a reduction is the basic rate the cost for the same shall be adjusted pro rata in the quoted rates. No increase in basic rates shall be allowed without written approval from the Architect.

28 Base sub-grade/sub-floor to be prepared by cleaning all dust/loose particles, caked mortar droppings, etc by scrubbing with steel wire brushes. Surface to be roughened if so required and surface cleaned with water and kept wet for minimum 12 hours.

29 Bedding layer of mortar to be provided as directed in the case of 19mm + slabs to correct level, step as instructed.

30	Finished work to be inclusive of cutting and polishing where specified/applicable.
31	Contractor to be responsible for hiring/operating of all machines/equipment. Approval to be obtained from Project Manager before operating.
32	Finished floor must be cured by keeping wet for atleast 1 week after installation.
33	Flooring to be cleaned, waxed or acid washed where applicable and as directed.
34	Pointing to be done using matching coloured grout as specified/directed
35	All granite / marble flooring slabs to be polished using tin oxide only.
36	Slurry for marble flooring to be of white cement only.
37	In the instance of granite/marble floors, the contractor has to obtain prior approval on dry laying. Wet laying to be carried out only on approval. Not extra cost shall be paid for dry laying.
B	General Notes-Interior
1	The rates for all tiles, slabs of marble, granite, Kota or any other stone should be inclusive of all materials, transport, loading unloading, Octroi and all taxes thereon. The rate mentioned is the maximum and in no way should exceed, the one mentioned.
2	The door size mentioned is the overall opening size.
3	The contractor should refer to the detailed drawings for details. All the rates so quoted should be inclusive of all hardware. In case of discrepancy between drawing and Bill of Quantity the drawing supersedes, unless specifically mentioned in the BOQ , before executing the works should be highlighted to the architect for approval.
4	Rates for all exposed wooden members and lipping shall include cost of melamine finish.
5	The rate of all units to be inclusive of approved locks for individual work space every drawer and shutter to be provided with locks of approved make.
6	Details of the items under this schedule shall be read in conjunction with the corresponding specifications, drawings and other Tender Documents.
7	The work shall be carried out as per drawings, specifications, the description of the items in the schedule and / or architects instructions.
8	Items of work provided in this schedule but not covered in the specifications shall be executed strictly as per instructions of the project manager/architect.
9	Unless specifically mentioned otherwise in the contract, the tenderer shall quote for the finished items and shall provide for the complete cost towards labour, materials, plant and machinery, operational costs, levies, taxes, transport, repairs,

rectification, maintenance till handing over, revenue expenses, contingencies, overheads, profits and all incidental items not

specifically mentioned but reasonably implied and necessary to complete the works according to the contract.

GENERAL NOTES COVERING THE BOQ

The quantities of the various items mentioned in the schedule in the schedule of items are approximate and may vary up to
any extent or be deleted altogether. he quoted rates of each item shall remain firm for both the variation and extra items. The
10 contractor, in his own interest, should get an indication of the probable extent of the work to be executed under any particular
item in this schedule, before undertaking any preliminary and enabling work or purchasing bought out components related to
the work.

Project managers / architects decision shall be final and binding on the contractor
11 regarding clarifications of items in this schedule with respect to the other sections of the Contract.

It may be noted that the total work or any part / parts of the same may be awarded as
12 mentioned in this schedule of items.

The rates quoted shall be inclusive of all mock-ups, associated samples prior to any mass production or procurement as per
13 complete satisfaction of the Client and Architect. Inclusive of dismantling, demolishing and carting the material and making
good of the surface.

All services works, any interface works with other vendors have to be completed before finishing of partition
14 paneling, other wall finishes and false Ceiling works. Signoff shall be taken from the Engineer incharge before
proceeding with the final finishing works.

15 Application area indicated in BOQ is for reference purpose only. The particular item may be operated elsewhere in any area /
floor, as& if required and as directed by EIC

C TYPICAL NOTES - PARTITIONS

All cross sections of timber mentioned in the specifications for the frame works of the partition shall be of desired type, free
1 from knots/variations/indentations/etc., and, shall be with moisture content, if so, upto acceptable limits, free from warpage
and bends, upto desired lengths, and, shall be finished sizes, and, from lots, or as ,(pre) approved by the architects.

In case of two levels of false ceiling abutting the partitions on either side, the height of
2 the partition shall be measured upto the higher false ceilings.

In case of stepped ceilings abutting the partitions on the same side, then the higher of the two shall be measured for the
3 height of the partition if the taller portion of the partition is more than 1/2 the length of the partition. If not then the two portions
of the partition shall be measured separately.

Rate quoted for the partitions shall be inclusive of pre-approved anti termite treatment for the frames in case of timber frames;

4 application of the same,(mode of application/number of coats/etc.) shall be as per and conform with the related manufacturer's specifications.

Rates quoted for full height partitions shall be inclusive of insulation of glass wool/ rock wool / thermocole(of pre-approved

5 grains/massing, as specially required/recommended by consultants, for acoustic purposes) as specified unless mentioned otherwise.

Rates quoted for the partitions shall be inclusive of making cutouts for Electrical and

6 Data outlets and for making provisions for passing conduits through the framework.

Rates quoted for partitions shall be inclusive of additional vertical or horizontal frame members as required for skirting, fixing

7 soft board, white board, projection screens etc fixing of elec. Boxes etc. apart from the regular framework members @ 600mm c/c bothways.

Any/all inserts/grooving and laying patterns shall be as per architects specifications and

8 shall form part of the relevant paneling detail(s) and shall not be paid for extra, unless otherwise specified/mentioned

9	Vendor to be provided extra GI Noggin channel & ply support whereever the LCD TV is coming as per the detail drawings/architect's & PM's Instructions.
10	Vendor to provide extra additional GI Members / aluminium sections / salwood sections for where the height of partition is coming above 3m.
11	Vendor to provide necessary fire sealent filling whereever required in the walls/partitions as per the PM's / architects instructions.
12	Contractor to make provisions of all necessary scaffoldings to facilitate high level installations.
13	Contractor to form openings on partition for services and to seal gaps using silicon sealant.
14	For partition frame work : 16/8 no. sheet metal screw 16mm in length.
15	For partition anchoring on floor & true ceiling : 75/10 no. sheet metal screw 75mm in length.
16	Quoted rates shall include transport, customs clearing, lead, lift, installation, rectification of defects or replacement of defective material.
17	Storing, safe guarding of the supplied material shall be the scope of the vendor till handing over.
18	All glass to be of best quality of approved manufacture, and be free from bubbles, smoke wanes, air holes and other defects. It is to accord with the indications given on the Material Selection Schedule.
19	Tempered glass shall have structural integrity and shall not contain any harmful scratches, pinholes, unevenness, sharp angled or field edge.
20	On completion, all glass shall be cleaned both sides and any broken, cracked or defective panes shall be replaced at Contractor’s own expense.
21	Glazing to be delivered to site in cut sizes, in packages bearing the manufacturer’s name and/or trade mark. The type, quality, thickness or weight of the glazing is to be clearly marked on the package.
22	In cutting glass, proper allowance shall be made for expansion. Each square of glazing to be as large as possible. Glazing is to comply with requirements of BS Code of Practice 152. All glass edges to be properly machine ground and polished.
23	On completion, clean all glazing, replace all cracked, scratched or broken sections and leave in good condition to the satisfaction of the Designer.
24	Gaskets for glazing shall be preformed rubber gaskets to BS4255 Part 1 on approved neoprene gaskets, to be used strictly in accordance with the manufacturer’s printed instructions.
25	The Tender shall be read in conjunction with the General Conditions & Preliminaries, Bill of Quantities / Specification of Materials & Workmanship, Drawings and all other documents part of the Tender which shall be construed as being

complementary to one another.

26 If the Vendor should find any discrepancy in the Drawings or between the Drawings and the Bill of Quantities / Specification of Materials and Workmanship or any other Documents forming part of the Tender, she/he shall immediately refer the same at the time of pre-bid meeting to the Architect and same shall be clarified on, if not the Vendor shall not be liable for any further additional claim.

GENERAL NOTES COVERING THE BOQ

27 It will be the vendors responsibility to hand-over the installed Glass to clients/owner free of defects.

28 Lamination of glass shall be done using DuPont make acoustic PVB laminate only.

29 Cappings & gaskets shall be of EPDM.

30 All TEE joints of the glass to be welded with UV glue.

31 Payments shall be on Actual Installed quantities, Face elevation area is considered for measurements.

D TYPICAL NOTES - PANELINGS

1 All cross sections of timber mentioned in the specifications for the frame works of the paneling shall be of desired type, free from knots/variations/indentations/etc., and, shall be with moisture content, if so, upto acceptable limits, free from warpage and bends, upto desired lengths, and, shall be finished sizes, and, from lots or as (pre) approved by the architects..

2 All Paneling shall be measured and paid for only upto the false ceiling / as per the approved size given in the drawing.

3 Rates quoted shall be inclusive for any and all cutouts to be made in the paneling for electrical and other outlets.

4 For all running meters band items wherein the width of the bands are mentioned, if widths other than those mentioned herein are used as per site conditions, the rates for the same shall be extrapolated prorata from the rates quoted.

5 All job works to be undertaken in workman like manner and to the entire satisfaction of the supervising Architects.

6 All Vertical (Walls / partitions) / Horizontal (Ceiling) panel surface shoulb be free from water moisture reistant.Test certificates and warrenty certificates to be provided for Acoustic panels / Water moisture resistant panels.Before installing the paneling vendor has to check the site condition and install the same.Care has to be taken for after installation.After execution any defects happen vendor has to replace the material / appropriate solution to be given.The rework cost will not payable.

7 For 6mm thick ply panelling 19/6 no. sheet metal flat head screw, 12mm thick ply panelling 25/8 no. sheet metal flat head screw, for 19mm thick ply panelling 32/8 no. sheet metal screw.

8 The Fabric paneling / other paneling should be free from odour.care has to be undertaken for the same.After execution any defects happens, vendor has to provide the appropriate solutions for the same.The rewok cost will not payable.

E TYPICAL NOTES DOORS

1 For all Flush Doors mentioned in the specifications, approved brand Flush doors only shall be used.

2 The door frame sizes mentioned in the specifications shall be finished sizes of Timber.

3 All door frames fixed to partitions shall be embedded into the floor, in workman like manner, by atleast 38mm for rigidity. The rates quoted for the door frames shall be inclusive of this extra length required.

4 All Door frames to be fixed to masonry in proper plumb and in workman like manner, and shall be inclusive of desired number of hold fasts, per door, as specified, and all other hardware's as required to fix the same, and upto the entire satisfaction of the Architects.

GENERAL NOTES COVERING THE BOQ

5	The thickness of the flush door mentioned in the specifications shall be bare thickness of the flush door exclusive of finishing
6	Rates quoted for the doors shall be inclusive of all hardware as specified in the specifications. Individual rates of the hardware as asked for, shall be operated and the difference in the cost payable to the contractor in case of alternate hardware being chosen by the architect/client during execution.
7	All doors shall be of standard 32 mm to 38mm thickness unless otherwise specified. In case of concealed door closures mentioned in the specifications the doors shall be min.42mm thk (even if not specified). Rates to be quoted accordingly.
8	Rates quoted for hardware shall be assumed to be quoted for based on the thickness of the door specially in case of cylindrical locks. No extra shall be paid for in case longer cylinders need to be used in case of thicker doors.
9	In case of variation in door and door frame sizes from those mentioned in the specifications, the rates shall be arrived at on a prorata basis on the sizes.
10	All job works to be undertaken according to design / details, in workman like manner and to the entire satisfaction of the supervising Architects.
11	All door locks to have a master key

F	TYPICAL NOTES - BUILT IN FURNITURES
1	All tables shall have provision for Wire management as per design and detail.
2	If required and instructed by the architect, the wire management system of the table shall be separately bought out and fitted on to the table as per design and detail.
3	All tables to be finished in workman like manner upto desired and approved finishing standards, failing which, the same shall be undertaken and achieved by the Architects at the sole risk and responsibility of the concerned Contractors.
4	All tables to be factory finished
5	All storages unless otherwise mentioned in the item specifications shall be 450mm depth to 600mm depth.
6	All internal surfaces of cabinets, etc in conventional carpentry works shall be finished with 0.8mm thick matt finished laminate of approved shade
7	All under surfaces of furniture (tables, counters, etc) to be finished with 0.8mm thick matt finished laminate of approved shade
8	

All exposed horizontal laminated surfaces shall be finished with 1mm thick laminate of approved make shade unless otherwise specified.

9 All exposed vertical laminated surfaces shall be finished with 1.0mm thick laminate of approved make shade unless otherwise specified.

10 Storages shall be inclusive of approved hardware, brushed steel handles, tower bolts, ball catches, SS hinges of approved make even if not explicitly mentioned in the specifications unless specifically mentioned otherwise.

11	If so specified by the architect during the progress of works at site, the storages shall be fabricated outside the site and brought to the site and placed at instructed locations. No extra shall be payable for the transportation of the same.
12	All exposed edges of ply / board etc. shall be finished with lipping Patti of TW of required size & All margins to be finished with colour polish to match Laminate / Veneer. This shall apply for the carcass, shutters of the storages and shelves if any.
10	All storages should be factory finished.
11	All locks of storage units to have a master key
12	All internal woodwork shall be treated with anti termite and fire retardant paint where
13	All exposed veneer shall be group matched natural cut plain veneer of approved make and shade.
14	All exposed veneered, wood surfaces shall be finished with matt melamine polish to approved shade
15	All exposed edges of plywood, blockboard etc shall be finished with 3mm thick lipping beading of specified wood
16	All plywood, blockboard for office areas shall be water resistant, termite/borer proof commercial grade of specified make.
17	All plywood, blockboard for wet areas (toilets/pantry) shall be termite/borer proof and waterproof marine grade of specified make.
18	Timber used shall be kiln seasoned and should be free from shrinkage, warpage even after fabrication of furniture.
19	Provision to be made for additional supports and reinforcement that may be required for stability and evenness at where curved partition is constructed
20	Where the use of spring loaded auto closing hinges is specified, the same shall be installed strictly as per manufacturers guidelines and relevant tools required for the same.
21	All items to have sample approved prior to commencement of mass production
22	All screws seen out side should be star SS.
23	Contractor to use the following screws unless otherwise specified.
24	For fixing door hinges : 30/8 no. Philip head SS screw.
25	For fixing drawer channel : For bottom channel - 19/6 no., For side - 9.5/6 no. sheet metal screw.
26	For fixing metabox drawer channel : 9.5/6 no. sheet metal screw
27	For fixing auto closing hinge : 16/6 round philip head screw.

G TYPICAL NOTES- PAINTING

1 All painting job works to be undertaken utilising relevant materials of pre-approved manufacturers and according to manufacturer's specifications only after undertaking the necessary preparatory steps for the same.

GENERAL NOTES COVERING THE BOQ

2	Care to be undertaken to ensure appropriate dryness of the desired surface prior to undertaking an activity of this nature; no allowances shall be entertained later if the same activity shall be required to be undertaken additionally to achieve the desired results.
3	Relevant agency to ensure proper housekeeping / maintenance during the course of the(se) job works; absence of the same shall fully empower the Clients to undertake these activities at the sole risk/costs of the concerned agency
4	All job works need to be undertaken as per design / details supplied and to the entire satisfaction of the supervising Architects.
5	Contractor to make provisions of all necessary scaffoldings to facilitate high level installations.
H	TYPICAL NOTES - INTERIOR FLOORING
1	All floor surfaces receiving the appropriate flooring material(s) need to be thoroughly cleaned prior to installation of the desired flooring.
2	No allowances shall be made to undertake rectification works if the same are so desired to be undertaken for improper adherence to recommended application procedures / standards.
3	All joints, wherever necessary, shall be undertaken after prior approval of the same from the Architects.
4	All finished flooring surfaces shall be free from bubbles/scratches/stains/etc. prior to final hand- over of the activity at the desired locations
5	All material utilised shall be as per tender recommendations and shall be applied according to manufacturer's specifications.
I	TYPICAL NOTES-BLINDS
1	The colour of the Fabric to be as selected by the Architect
2	The samples of the fabric in both 5% & 3% perforation/openness factor to be submitted with this tender.
3	Inspection: A. Installer shall be responsible for inspection of jobsite, approval of mounting surfaces, verification of field measurements and installation conditions. Installation shall commence when satisfactory conditions are met.
4	Installation: Install blinds in accordance with manufacturer’s instructions including recommended support brackets and fasteners.
5	Install shades with adequate clearance to permit smooth operation of the blinds. Demonstrate blinds to be in smooth, uniform working order.
6	Installed blinds shall be free from defects & smooth to operate.
7	It will be the vendors responsibility to hand-over the installed blinds to clients/owner free of defects.

8	Quoted rates shall include transport, customs clearing, lead, lift, installation, rectification of defects or replacement of defective material.
9	Storing, safe guarding of the supplied material shall be the scope of the vendor till handing over.
10	Availability of material & timelines shall be discussed & agreed at the time of pre-bid meeting, Architect's shall not be liable for any delay or deviation from there on.

GENERAL NOTES COVERING THE BOQ

11 Vendor shall submit the samples of the Blinds & the same shall be approved by architect.

J FALSE CEILING WORKS

1 Scope of Work shall include furnishing of all materials, equipment and labour to install the complete ceiling system.

2 It is the contractors/suppliers responsibilty to ensure that materails delivered to the installation site as safeguard from the time of His purchase until he hands over the finished ceiling. It is desirable to store materials in a flat, clean and dry surface.

3 It is the contractor's responsibility to store the material as per manufacturer's installation guidelines to avoid any kind of damage to the men, material, building.

4 Controlled ventilation should be used to disperse moisture laiden air.

5 Ceiling system shall be installed by a sub contractor throughly experienced with this type of installation and approved by the manufacturer. The contractor to inspect premises prior to commencement of work and verify that the building is ready for installation.

6 Dust and loose particles should be removed by brushing or with a vacuum cleaner. Any pencil marks etc can be removed using ordinary pencil eraser. All damaged tiles to be replaced.

7 Spot lights and other luminaries should not be supported by or on the ceiling tiles.

8 Suspension wire / rod must be Galvanised of diameter not be less than 3mm to 4mm.

9 The rod shall always be mechanically pre- straightened.

10 Finished area shall be measured in length & breadth for payment. The quoted rate shall be inclusive of wastages.

11 Quoted rate shall include making cutout for light fixture, diffuser or any other service cutouts.

12 Vendor to the submit samples,shop drawings and get the approval from the

K Arhcitect/Designer before the production.

1 MODULAR FURNITURE WORKS

2 Vendor shall mark the workstation footprints at site before starting the production.

3

4	Any variation in site dimensions shall be brought to the notice of Architect's before starting the production. Approval on the finished product shall be taken by installing the finished mock-up before starting the production.
5	Waste generated from shall be disposed by the Vendor as per LEED norms, disposed out side the Premises in dump yard allocated by the Authorities. should also adhere to LEED certification norms and requirement.
6	Any material found to be defective shall be replaced free of cost.
7	Quoted rate shall include supply, transport, lead, lift, installation, safe guarding & handing-over the finished product to the Vendor shall rectify all snags before handing over.

GENERAL NOTES COVERING THE BOQ

8 Documents pertaining to LEED criteria points, test certificates, LEED approvals, LEED affiliations shall be submitted along with the bids.

9 Shop drawings of all furniture's that is quoted for shall be submitted at the time of technical bid meeting.

10 Vendor shall Coordinate and provide all documents / documentation required to the clients/owner to get LEED certification.

11

12 Vendor shall address HSSE issues in all the furniture supplied. All fabric / upholstery used shall be fire rated.

13 Provision shall be made for fixing data & electrical out lets above the table top. Vendor to read the BOQ in conjunction with the drawings .

14 CHAIRS

L Lead, lift & placing in location as specified in the drawing.

1 Quoted rate shall include for a mock-up for each type of chairs at location indicated by Project Manager. Approval shall be taken on the mock-ups before starting the mass production.

2 Availability of material & timelines shall be discussed & agreed at the time of pre-bid meeting, Architect's shall not be liable for any deviation from there on.

3 Storing, safe guarding of the supplied material shall be the scope of the vendor till handing over. Warranty certificates shall be provided for the period of minimum 5 years.

4 Warranty Period shall start from date of handing over / Client's occupancy.

5 Vendor shall address HSSE (Health Safety Security Environment) issues in all the furniture supplied.

6 The Chairs shall conform to EN 1335 and ANSI/BIFMA standards with ergonomic seal of approval from authorized

7 Vendor shall Coordinate and provide all documents / documentation required to the clients/owner to get LEED certification.

8

9 Castors shall be provided as per the flooring (Carpet/Hard floor)

10 Clearing of debris & disposing the same as per Project Manager's instructions.

11 SIGNAGES

12

M Quoted rate shall include supply, transport, lead, lift, installation, Storing, safeguarding, rectification of defects or replacement of defective material & handing-over the finished product to the Client/Owner.

1 The Contractor shall submit a Sample of each signage for Architect's approval.

2 Before installing the signages the vendor shall inspect the premises & make sure that the site is ready to receive the signages.

GENERAL NOTES COVERING THE BOQ

4	Signages shall be installed by the authorized installers and shall be installed in proper condition.
5	Installed signages should be free of defects.
6	Vendor shall rectify all snags before handing over.
7	Waste generated from shall be disposed by the Vendor as per norms.
8	The Tender shall be read in conjunction with the General Conditions & Preliminaries, Bill of Quantities / Specification of Materials & Workmanship, Drawings and all other documents part of the Tender which shall be construed as being complementary to one another.
9	If the Vendor should find any discrepancy in the Drawings or between the Drawings and the Bill of Quantities / Specification of Materials and Workmanship or any other Documents forming part of the Tender, she/he shall immediately refer the same at the time of pre-bid meeting to the Architect.
N	GRAPHICS & FROST FILM WORKS
1	Quoted rate shall include supply, transport, lead, lift, installation, Storing, safeguarding, rectification of defects or replacement of defective material & handing-over the finished product to the Client/Owner.
2	The quote shall include providing of design, composing & implementing for graphics.
3	The Contractor shall submit a Sample of Graphics for Architect's approval.
4	Before installing the Graphics the vendor shall inspect the premises & make sure that the base surface is ready to receive the graphics to be installed.
5	Surface to take Graphics shall be thoroughly cleaned for loose particles, cement/POP/concrete lumps, paint etc., for proper adhesion of the Graphics to the surface.
6	Graphics shall be installed by the authorized installers and shall be installed to proper line & level.
7	Installed Graphics to be free of bubbles and other defects.
8	Vendor shall rectify all snags before handing over.
9	Waste generated from shall be disposed by the Vendor as per norms.
10	The Tender shall be read in conjunction with the General Conditions & Preliminaries, Bill of Quantities / Specification of Materials & Workmanship, Drawings and all other documents part of the Tender which shall be construed as being complementary to one another.

If the Vendor should find any discrepancy in the Drawings or between the Drawings and the Bill of Quantities / Specification of

11 Materials and Workmanship or any other Documents forming part of the Tender, she/he shall immediately refer the same at

the time of pre-bid meeting to the Architect.

Annexure-I

(Part: 2 of 2)

TECHNICAL SPECIFICATIONS

PLUMBING, ELECTRICAL, HVAC, FIREFIGHTING WORKS

Name of the work: Renovation work of BNPM Staff Canteen, BNPM premises, Mysore

E Tender No. BNPM/NCB/ CR/1010/2020-21 dated 20.01.2021

TECHNICAL SPECIFICATIONS
PLUMBING WORKS

1. MATERIALS

1.0 GENERAL:

All materials shall be of the best-approved quality obtainable and unless otherwise specified they shall conform to the respective Bureau of Indian Standard specifications.

Samples of all materials shall be got approved before placing order and the approved samples shall be deposited with the Employer.

In case of non – availability of materials in metric size, the nearest size in FPS units shall be provided with prior approval of the Employer / Consultants for which neither extra will be paid nor any rebate shall be recovered.

If directed / found necessary, materials shall be tested in any testing laboratory selected by the Employer and the Contractor shall produce the test results to the Consultant for his scrutiny and approval. The entire charges for original as well as repeated tests shall be borne by the Contractor. If required, the Contractor shall arrange to test portion of work at his own cost in order to prove the soundness of the same, to the Employer / Consultant or their representatives. The work or portion of work if found to be not satisfactory in the opinion of the Employer / Consultant or their representatives, Contractor shall pull down and re – do the same at his own cost. All defective materials shall be removed from the site immediately as ordered.

It shall be obligatory for the contractor to furnish certificates, if so demanded by the Employer
/ Consultant from manufacturer or the material supplier, that the work has been carried out by using their material and installed / fixed as per their recommendations.

1.1 GENERAL:

Equipment offered for supply and installation shall include the following:

All minor items and incidental work, equipment accessories and materials may not be specifically mentioned but are required for the proper completion of the installatios in accordance with the true intent and meaning of this specification.

All necessary safety devices for the protection of personnel against injury and the protection of plant and equipment against damage including relief valves, belt guards, fan

inlet and / or discharge guards, safety railing effective earthing of electrical components, electrical interlocks, warning lights and alarms.

Readily accessible, dust-proof including facilities on all moving parts and equipment including provision for cleaning all lubricating lines and bearings and charging same with the correct lubricants after installation but prior to testing and commissioning.

Clearly visible and robust manufacturer's name-plates permanently fitted each and every item of equipment and showing the manufacturer's name, type and/or model number, serial number, and all essential operating data such as speed, capacity, voltage, current draw, etc.

The contractor also shall allow provision for the inspection of all plant and equipment by the manufacturer or his licensed representative, at least twice during the course of the installation.

A.1.0 WATER SUPPLY:

All pipe used for toilet internals, kitchen internals and external piping, ring main pipe (for cold water application only) shall be of chlorinated polyvinyl chloride (CPVC), made as per ASTM–D 2846 from 15 mm dia to 50mm dia. All CPVC pipes shall be of Flow Guard make. They shall be sound with good surface finish, mechanical strength and capacity. They shall be of the diameter (nominal bore) as specified in the items specification / as directed by the consultants, nominal bore, of the pipes for which they are intended.

DIMENSIONS: Flow Guard CPVC shall confirm to the following thickness and weight for various dimensions.

Nominal Pipe Size (Inch)	Mean Outside Diameter Inch	mm	Minimum Wall Thickness Inch	mm	Nominal Weight Kg / m
½	0.840	21.34	0.147	3.73	0.337
¾	1.050	26.67	0.154	3.91	0.457
1	1.315	33.40	0.179	4.55	0.671
1- ¼	1.660	42.16	0.191	4.85	0.928
1- ½	1.900	48.26	0.200	5.08	1.13
2	2.375	60.33	0.218	5.54	1.56

A.1.1 PIPE FITTINGS:

The fittings shall be of CPVC and brass with female screwed ends as called for in the specification complying with all the appropriate requirements given in para A.1.1 or as specified. The fitting shall be designated by the respective nominal bores of the pipes for which they are intended.

The fittings where the taps, stop cock, mixer fitting, are intended to be fixed, shall be of brass body and shall have screw threads at the ends / female threads or fittings shall be parallel and male threads (except on running nipples and collars of unions) shall be tapered. Unions shall be provided at regular intervals in the pipelines for easy Maintenance / Repair / Replacement of pipes.

A.1.2 CUTTING:

CPVC pipes shall be cut with a wheel – Type plastic tubing cutter, a hacksaw or other fine-toothed hand or power saws. Use of ratchet cutters shall be permitted provided blades are sharpened regularly. A miter box should be used to ensure a square cut when using a saw. CPVC pipes shall be cut as squarely as possible to provide optimal bonding area within the joint. If any indication of damage or cracking is evident at the tubing end, the pipe shall be cut off at least 2 inches (5cm) beyond any visible crack.

A.1.3 The pipes shall be cleaned of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over with white lead and a few turns of locklite wrapped round the screwed in the socket, tee etc., with the pipe wrench. Care should be taken that all pipes and fittings are properly jointed so as to take the joints completely watertight and pipes are kept at all time free from dust and dirtduring the fixing. Burr from the joint shall be removed after screwing. After laying, the open ends of the pipes shall be temporally plugged to prevent access of water, soil or any other foreign matter.

Any threads exposed after jointing shall be painted or in the case of underground piping thickly coated with approved anticorrosive paint to prevent corrosion / wrapped with 4 mm thick pipe kote pipe running below ground level shall be laid at a minimum depth 600mm.

A1.4 DEBURRING / BEVELING:

Burrs and filings can prevent proper contact between tube and fitting during assembly, and should be removed from the outside and inside of the tubing. A chamfering tool is preferred but a pocketknife or files are suitable for this purpose. A slight bevel on the end of the tubing will ease entry of the tubing into the fitting socket and minimize the chances of pushing solvent cement to the bottom of the joint.

A.1.4 PRIMER / CLEANER APPLICATION:

Primer or cleaner shall be applied for preparing the bonding area for the addition of cement and subsequent assembly. A proper applicator shall only be used. A dauber or natural bristle paint brush approximately ½ the size of the tubing diameter shall be appropriate. Apply primer to both the outside of the tubing end and in the fitting socket. Primer should not be allowed to puddle in the fitting.

A.1.5 SOLVENT CEMENT APPLICATION:

FOR MAKING JOINT ONLY CPVC CEMENT OR AN ALL – PURPOSE CEMENT CONFIRMING TO ASTM F- 493 SHALL ONLY BE USED. When the primed pipe and fitting surfaces are dry, apply a thin coat inside the fitting socket.

A.1.6 LAYING AND JOINTING:

The pipes and fittings shall be inspected at site before use, to ascertain that they confirm to the specification given in parA1.1.The defective pipe shall be rejected. Where the pipes have to be cut or jointed the ends shall be carefully filed, so that no obstruction to bore is offered. The jointing to be dry fit checked. A thick coat of solvent cement shall be applied to the outer surface of the socket by mean of a brush. Solvent cement shall be of approved and of good quality ASTM – F493. The pipe shall be then inserted is to the fitting and turned 90 degree to ensure even distribution of solvent cement with in the joint. Excess solvent cement shall be wiped off. Properly align the fitting. Hold the assembly for approximately 10 seconds, allowing the joint to set – up. An even bead of cement should evident around the joint. If this bead is not continuous around the socket edge, it may indicate that insufficient cement was applied. In this case, remake the joint to avoid potential leaks. Wipe excess cement from the tubing and surfaces for an attractive professional appearance. Clamps / pipe hooks a required size shall be used for clamping the pipe to the walls.

A.1.7 SET AND CURE TIMES:

Solvent cement set and cure times are a function of pipe size, temperature, and relative humidity. Curing time is shorter for drier environments, smaller size, and higher temperatures. Refer to the following table for minimum cure time after the last joint has been made of before pressure testing can begin.

A.1.8 MINIMUM CURE PRIOR TO PRESSURE TESTING AT 150 PSI (10 BAR)

AMBIENT TEMPERATURE DURING CURE PERIOD	PIPE SIZES ½" – 1"	PIPE SIZES 1 ¼" – 2"
Above 15^0 C	1 Hour	2 Hours
4-15^0 C	2 Hours	4 Hours
Below 4^0 C	4 Hours	8 Hours

Special care should be exercised when assembling Flow Guard systems in extremely low temperature (below 4^0 C) or extremely high temperature (above 38^0 C). In extremely hot temperatures, care should be taken to ensure both surfaces to be jointed are still wet with cement when putting them together.

A.1.9 TESTING:

Once an installation is completed and cured per these recommendations, the systems should be hydrostatically pressure tested. 10bar (150 PSI) for one hour is recommended. When pressure testing, the system should be filled with water and all air bled from the highest and farthest points in the run. If a leak is found, the joint must be cut out and discarded. A new section should be installed using couplings. During sub – freezing temperatures, water should be blown out of the lines after testing to eliminate potential damage from freezing.

A.1.10 HANDLING AND STORAGE:

Flow Guard CPVC is a tough, corrosion resistant material, but it does not have the mechanical strength of metal. Reasonable care should be exercised in handling CPVC pipes and fittings. They should not be dropped, stepped on, or have objects thrown on them. If improper handling or heavy impact results in cracks, splits, or gouges, the damaged section shall be discarded. Flow Guard tubing should be covered with a non-transparent material when stored outdoors for long periods of time.

A.1.11 HANGERS AND SUPPORTS:

For vertical runs supports shall be provided a at each floor level, plus a mid – story guide. For horizontal runs, supports shall be provided at three-foot (90-cm) intervals for diameters of one inch and below and at four-foot (1.2 m) intervals for larger sizes. Piping should not be anchored tightly to supports, but rather secured with smooth straps or hangers that allow for movement caused by expansion and contraction. Most hangers designed for metal pipe are suitable for Flow Guard. Hangers shall not have rough or sharp edges which come in contact with the tubing.

A.1.12 HORIZONTIAL AND VERTICAL SUPPORT:

A typical Cold water distribution system operating at 26^0-30^0 C supports shall be provided for horizontal lines at every 3'(90cm) for sizes ½" – 1", and every 4' (120 cm) on sizes larger than 1". However, the following spacing shall be used at water temperatures indicated.

SPACING								
Nominal Pipe size (In)	21^0 C (70^0 F)		49^0 C (120^0 F)		71^0 C (160^0 F)		82^0 C (180^0 F)	
	FT	M	FT	M	FT	M	FT	M
½	5.5	1.7	4.5	1.4	3.0	0.9	2.5	0.8
¾	5.5	1.7	5.0	1.5	3.0	0.9	2.5	0.8
1	6.0	1.8	5.5	1.7	3.5	1.1	3.0	0.9
1- ¼	6.5	2.0	6.0	1.8	3.5	1.1	3.0	0.9
1 – ½	7.0	2.1	6.0	2.0	3.5	1.1	3.5	1.1
2	7.0	2.1	6.5	2.0	4.0	1.2	3.5	1.1

A.1.5 Internal Work:

Generally the galvanized iron pipes and fittings shall run in the wall chase inside the toilets and kitchen but on the surface in the service ducts. For exposed pipes, the clamps fixing shall be done by means of steel / GI angle brackets and clamps, keeping the pipes about 2.5cm to 5.0cm clear of the wall. When it is concealed, the pipe chasing may be adopted with groove cutting machine. For pipes fixed in the ducts or recesses etc., provide sufficient space to work on the pipes with the usual tools. The pipe shall not ordinarily be buried for short distances provided adequate protection is given against damage and shall be fixed at a place a pipe is passing through a wall or floor to allow freedom for expansion and contraction and other movements. In the case, the pipes is embedded in floors it should be painted with anti – corrosive bitumastic of approved quality and pipe shall be wrapped in burlap or hessain based bitumen pipe coat of 4mm thickness with overlap of minimum 25mm. The wrapping shall be made to fit tightly over the pipe and where wrapping with a new overlap the old pipe and where wrapping one joint it shall be tied with MS wire or nylon thread. Where pipes are encased with in chases made in the wall, they shall be fixed to the wall with MS clamps MS hooks at every 2 m c/c as to prevent movement before filling in grouting and making good the chase.

A.1.6 External Works:

The galvanized iron pipes and fittings in external work shall be laid in neatly excavated trenches. The widths and depths of the trenches for different diameters of the pipes shall be as given in the table below, and shall be deep enough to have a clear cover of atleast 600mm above the top of pipes.

Dia. Of pipe	Width of trench	Depth of trench
15mm to 50mm	30cm	60cm
65mm to 100mm	45cm	75cm

At joints the trench, width shall be widened wherever it is necessary. The work of excavation and refilling shall be done true to line and gradient by watering and consolidating the excavated soil in layers.

The pipes shall be painted with two coats of anticorrosive bitumastic paint of approved quality followed by wrapping with burlap or hessain based bitumen pipe kote of 4mm thickness with overlap of minimum 25mm. The pipes shall be laid on a layer of 7.5cm sand and filled with excavated earth. The supplies earth shall be disposed off as directed. The filling shall be done after testing & rectifying leakages and after final passing of work by the plumbing management Consultant.

When the excavation is done in rock the bottom shall be cut deep enough to permit the pipes to be laid on a sand cushion of minimum 7.5cm. in case of bigger diameter pipes where the pressure is very high thrust blocks of cement concrete 1:2:4 (1 cement :2 coarse sand: 4 graded stone aggregate of 20 nominal size) shall be constructed on all bends to transmit the hydraulic thrust without impairing the ground and spreading it over a sufficient area, as directed by the plumbing management Consultant.

A.1.7 Testing the joints:

After laying and jointing, the pipes and fittings shall be inspected under working conditions of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra cost to Owner. The pipes and fittings after they are laid shall be tested to hydraulic pressure of 10kg / sq.cm. (100 meter or double the designed working pressures whichever is more). The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw off takes and stopcocks shall be then closed and specified hydraulic pressure shall be applied gradually. Pressure gauge observations shall be made for atleast 24 hrs. The pipes and fittings should be tested in section as the work of laying proceeds, keeping the joints exposed for inspection during the testing.

A.1.8 Measurements:

The lengths shall be measured in running meter correct to a cm for the finished work, which shall include GI pipes and sockets, GI fittings such as bends, tees, elbows, reducers, crosses, plugs, sockets, nipples and nuts, but exclude brass or gunmetal taps (cocks), valves, lead connection pipes and shower rose. The length shall be taken along the central line of the pipefitting. All pipes and fittings shall be classified according to their diameter of the internal bore. The pipe shall be described as including all cuttings and wastage. In case of fittings of unequal bore, the largest bore shall be measured.

Digging and refilling of trenches shall be measured separately or clubbed with main item as called for in the item specification/tender bill of quantities.

A.1.9 Internal work:

The rate of internal work shall include the cost of labour and material involved in all the operations described above except in para A.1.7. The rate shall include the cost of chasing, cutting holes in walls and floors making good the same including clearing of the debris. Insulation of pipes for hot water supply will be paid separately as extra item.

Size of pipe	Width of chasing	Depth of chasing
15mm dia	20mm	15 mm
20 mm dia	25mm	20 mm
25mm dia	32mm	25 mm
32 mm dia	38mm	32 mm

The grove cutting shall be covered with GI mesh of "ARPITHA" make before grouting

A.1.11 External work:

The rate of external work shall include the cost of labour and materials involved in all the operations described above except in para A.1.5. The rate shall exclude excavation of trenches, rates include painting of pipe and wrapping with 4mm thick pipe kote and refilling all round the pipes.

A.1.10 Water supply and waste Fittings: (General)

The brass or gunmetal fitting shall be heavy quality and approved manufacture and pattern with screwed or flanged ends as specified. The fittings shall in all respects comply with the Indian standard specifications No. I.S. 778 – 1984 (Fourth revision) and I.S. 781 – 1984 (Second revision). The standard size of brass or gunmetal fittings shall be designated by the nominal bore of the pipe outlet to which the fittings are attached. A sample of each kind of fittings shall be got approved from the Consultants / Employer and all supplies should be made according to the approved samples.

All cast fittings shall be sound and free from laps, blowholes and filings. Both internal and external surfaces shall be clean, smooth and free from sand etc. Burning, plugging, stopping or patching of the casting shall not be permissible. The bodies, bonnets, spindles and other parts shall be truly machined so that when assembled the parts shall axial, parallel and cylindrical with surfaces smoothly finished. The area of the water – way of the fittings shall be less than the area of the nominal bore.

The fittings shall be fully examined and cleared of all foreign matters before being fixed. The fittings shall be fitted in the line in a workman – like manner. The joints and fittings shall be leak – proof when tested to a pressure of 10kg / sq.cm. as described in para above and the defective fittings and joints shall be replaced or redone, without any extra cost.

A.1.10 Regulations and Standards:

All equipment supply erection testing and commissioning shall comply with the requirements of Indian standards and code of practices given below as amended up to 30 may 2002. All equipment and material being supplied by the contractor shall meet the requirements of IS. Tariff advisory committee's regulation (fire insurance) electrical inspectorate and Indian Electricity rule other Codes / publications as given below:

A.1.11 PRESSURE REDUCING VALVE SET:

Each pressure-reducing valve set shall be complete with pressure reducing or pressure regulating valve, isolating valve, pressure relief valve on outlet and filter on inlet.

Each pressure reducing valve shall contain loading neoprene diaphragm and a full floating, self aligning, ignition resistant seat and shall be of the single stage, pressure reduction type with provision for manually adjusting the delivery pressure. The valve shall fail safe to the low pressure.

Valve shall be capable of operating at the maintaining automatically the respective delivery pressure and flow rates as indicated and shall not be liable to creep. Valve shall also be capable of maintaining the pre – set down stream pressure under static condition.

The filter on each inlet to a pressure-reducing valve shall be of replaceable porous sintered metal type.

A.1.12 PRESSURE RELIEF VALVES:

Each pressure relief valve shall be of the fully enclosed type and fitted with hand easing gear.

Each pressure relief valve in a pressure reducing station shall have a flow capacity equal to that of the pressure-reducing valve.

Pressure relief valves in locations other than reducing stations shall have flow capacities equal to that of the associated equipment.

A.1.13 PRESSURE GAUGE:

The pressure gauge shall be constructed of die cast aluminum and enameled. It shall be weather proof with an IP 55 enclosure. It shall be a stainless bourden tube type pressure gauge with a scale range from 0 to 16 kg / cm square and shall be constructed as per IS: 3524. Each Pressure gauge shall have a siphon tube connection. The shut off arrangement shall be by ball valve.

A.1.14 DRAWINGS:

a.	Contract drawings duly signed by Architect / Consultant are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the architectural and other services drawings and with the prior approval of Architect.
b.	Architectural drawings shall take precedence over services drawings in regard to all Dimensions.
c.	Contractor shall verify all dimensions at site and bring to the notices of Engineer-in- charge / Consultant discrepancies if any Engineer-in-charge‘s decision in this respect shall be final.
d.	Large size details and manufactures’ dimensions for materials to be incorporated shall take precedence over small-scale drawings.

A.1.15 WORK TO BE CARRIED OUT BY LICENCED PERSONS / FIRMS:

All service installations namely water supply plumbing drainage and sewerage electrical fire detection and fire protection works shall be carried out by technically competent persons holding valid license to carry out their respective trade at the site and having a minimum experience of five years in their relevant trades.

A.1.16 DRILLING, CUTTING, ETC.:

All cutting and drilling of walls or other elements of the building for the proper entry / installation of pipes, and other equipment shall be carried out using electrically operated tools, only. Manual drilling, cutting, chiseling, etc shall be cut or chased with the written permission of the project engineer.

A.1.17 Water supply Fittings:

All water supply fittings (including mixer fittings accessories) shall be brass / copper, heavy chromium plated, of the make and design specified. The fittings shall be cast fittings of screw type, machined and threaded properly for fixing to the supply pipes.

The plating shall conform to Indian standard specification IS 4827 –1968 electroplated coating of nickel and chromium on copper alloys.

The fittings shall be supplied complete with chromium plated matching flanges, nuts and extension pieces of required lengths. Metallic washers where required shall also be of chromium plated brass. All bib cocks and stop cocks shall conform to Indian standard specifications IS: 781 – 1984 (second revision) bib taps and stop valves for water services, sand cast brass screw – down (revised) pillar cocks to IS: 8934 – 1978 – pillar taps, mixing fitting to IS: 1701 – 1960 mixing valves for ablutionary and domestic purpose. Both filler, shower arm, rose spout and other fittings shall match the supply fittings in construction, performance and appearance.

All fixing accessories and screws shall be similar to fittings with all exposed parts chromium plated. All washers shall conform to Indian standard specification IS: 4326 – 1967 washers for water taps for cold water services.

A.1.18 Waste Fittings:

All waste fittings (waste, chain, pop-up, over-flow) shall be brass / copper, heavy chromium plated of the make and design specified and match the supply fittings. They shall confirm to Indian Standard specification IS: 2963 – 1964 waste fittings for wash basins and sinks, non- ferrous.

A.1.19 Bottle Traps:

Bottle traps (for wash basins, sinks, urinals, etc.,) shall be deep seal (minimum 6cm. seal) cast brass bottle traps, heavy chromium plated. All bottle traps shall be provided with suitable cleaning eye, extension piece, flare nuts – all chromium plated. Bottle traps shall be of approved make and design. Waste coupling for washbasins shall be 32mm, for sinks 40mm, for urinal.

A.1.20 Wall Flange:

Wall flange / caps shall be provided on all walls, floors, columns, etc., wherever supply and disposal of pipes pierce through them. These wall caps shall be chromium-plated brass snugly fitting. The receiving pipes shall be large enough to cover the punctures properly.

A.1.21 Floor Traps:

Floor traps shall be of PVC of the size required, of approved design incorporating a deep seal (6cm. minimum) and venting device unless otherwise indicated. All PVC floor traps in general
/unless otherwise specified, shall be of moulded type only. However, floor traps of sizes as mentioned in the BOQ and that are not available in moulded type, shall be of fabricated type. Samples of these fabricated floor traps including other PVC fabricated fittings to be got plumbing management Consultant. The traps shall be supplied with cast iron / PVC cap with collar capable of receiving a grating.

A.1.22 Lawn Hydrants:

Lawn hydrants shall be 20mm, unless otherwise indicated. All hydrants shall provide with lever-operated ball valves that is screwed faucet to receive hosepipes. Lawn hydrants shall be of approved make and design. Where called for lawn hydrants shall be located in brick masonry chambers of appropriate size as per specification given herein after.

A.2.0 VALVES AND APPURTENANCES:

A.2.1 Ball Float Valves:

The ball valve shall be of high-pressure type and shall be of sizes as specified. The normal size of a ball valve shall be that corresponding to the size of the pipe to which it is fixed. The ball valve shall be of brass or gun metal as specified and the float of copper sheet. The minimum thickness of copper sheet used for making the float shall be 0.45mm for float exceeding 115mm dia. The body of the high pressure ball valve when assembled in working conditions with the float immersed to not more than half of its volume shall remain closed against a test pressure of 3.5kg / sq.cm.

The ball valve shall generally conform to IS specification No.1703: 1977 (Second revision). The weight of ball cock and the size of the ball cock shall be as per IS specification.

A.2.2 Brass full way Valve:

Full way valve is a valve with suitable means of connection for insertion in a pipeline for controlling or stopping the flow. The valve shall be of brass fitted with a cast iron wheel and shall be of gunmetal gate valve type opening full way of the size as specified. The valve shall be of best quality approved by the Consultants \ Architects.

A.2.3 Gun-metal full way valve with wheel:

These shall be of the gunmetal fitting with wheel and shall be of gate valve type opening full way and of the size as per specification. These shall generally conform to I.S. 780-1984 (Sixth Revision).

A.2.4 Butterfly/Ball Valves:

Valves up to 40 mm dia and below shall be Nickel plated brass body heavy stainless steel ball, lever operated, tested to 20Kg/sq.cm with female screwed ends. All ball valves shall be of full-bore type.

Valves from 50mm up to 150mm dia shall be of cast of iron body butterfly valves lever operated with flange ends. Valves shall carry IS certification mark.

All valves shall be approved by consultants before they are used on work.

All globe and check valves shall have working parts suitable for hot and cold water, as required. Valves shall be tagged with permanent label under hand wheel indicating type or duty.

A.2.5 Foot Valves:

Provide cast iron body with brass disc and strainer of approved quality, wherever shown.

A.2.6. "Y" STRAINERS:

"Y" strainers up to 50mm shall be of gunmetal and above 50mm shall be of cast iron body. Strainers shall incorporate a removable bronze screen with mm (1/8") perforations and a permanent magnet. Strainers shall be provided with flanges at both inlet and outlet. They shall be designed to enable blowing out of accumulated dirt and facilitate dirt and facilitate removal and replacement of the screen without disconnection of the main pipe.

A.2.7 Pressure Reducing Valves:

Pressure reducing valves shall be of " Hawk " make bronze pivot operated spring-loaded valves for reducing pressure as required suitable for specified dia of pipe.

A.2.8 Sluice Valves:

The sluice valves are used in a pipeline for controlling or stopping flow of water. They shall be of specified size and class and shall be of inside non – raising screw type spindle with either double flange or double sockets ends and cap or hand – wheel.

These shall in all respects comply with the Indian Standard specification IS. 780 – 1984 for Valves up to and including 300mm, size and No. BDC (429) p2 for valves above 300mm, size. Calls – I sluice valves are used for maximum working pressure of 10kg / cm2, (100 meter head) and class – II sluice valves for 15kg / cm2 (150 meter head).

The body, domes, covers, wedge gate and stuffing box shall be of good quality cast iron, the spindle of bronze the nut and valves seats of leaded tin bronze. The bodies, spindles and other parts shall be truly machined with surfaces smoothly finished. The area of the waterway of the fitting shall be not less than the area equal to the nominal bore of the pipe. The valve

wheel shall be marked with an arrow to show the direction of turn for closing the valves.

The valve shall be fully examined and cleared of all foreign matter before being fixed. The fixing of the valve shall be done by means of bolts, nuts, and 3mm rubber insertions or chemically treated compressed fiber board of 1.5mm thick minimum thickness and of weight not less than 0.183gm per sq.cm with the flanges of spigot and the socketed tail pieces drilled, to the same specification in the case of S & S pipe and with flanges in case of flanged pipes. The tailpieces shall conform to IS. 1938 – 1960. These shall be jointed to the pipes line by means of lead caulked joints.

A.2.9 Valve Schedules:

Service	Type	Size	Rating	Ends	Materials
Water	Gate	65	300psi /	Screwed	Bronze
Water	Gate	75&over	20kg / cm2	Flanged	CI.body bronze trim
Water	Globe	65 & under	20kg / cm2	Screwed	Bronze
Water	Globe & Angle	65 & under	20kg / cm2	Screwed	Bronze
Water	Globe & Angle	65 & over	20kg / cm2	Flanged	Iron body bronze trim
Water	Horizontal vertical check	65 & under	20kg / cm2	Screwed	Bronze
Water	Horizontal vertical check	65 & under	20kg / cm2	Flanged	Iron body bronze trim

A.2.10 Appurtenances:

The other appurtenances of pipeline are mentioned below:

a) Air Valves:

These are placed at every summit in the pipeline to permit the escape of air when the main is filled and afterwards, if any air carried out in to the mains. These are also placed on long stretches of nearly level main.

b) Scour Valves:

These are placed at the bottom of all depressions for emptying the main of letting out the sediment.

c) Reflux /Non-return Valves:

These are fixed so as to open in the direction of flow but automatically close if the water flows back. They are used to diminish the damage done by the escape of water due to a burst or prevent damage to impellers of pumps.

A.2.11 Fixing water meter and stopcock in GI pipeline:

Materials – pipe fittings as described in material

section. Cutting GI pipeline:

The GI line shall be cut to the required length at the position where the meter and stopcock are required to be fixed. The ends of the pipe shall then be threaded unions shall be provided in the pipe assembly for fixing water meter.

Fixing meter and stopcock:

The meter and stopcock shall be fixed in position by means of connecting pipes, GI jam nut

and socket etc., The stopcock shall be fixed near the inlet of the water. The paper disc inserted in the ripples of the meter shall be removed and meter installed exactly horizontal or vertical in the flow line in the direction shown on by the arrow cast on the body of the meter.

Care shall be taken that the factory seal of the meter is not disturbed. Wherever the meter shall be fixed to a newly fitted pipeline, the pipeline shall have to be completely washed before fitting the meter. For this purpose a piece of pipe equal to the length of the meter shall be fitted in the proposed position of the meter in the new pipeline. The water shall be allowed to flow completely to wash the pipeline and then the meter installed as described above by replacing the connecting piece.

A.3.0 Masonry Chambers:

A.3.1 General:

All masonry chambers for stopcocks, sluice valves, etc., shall be built as per supplied drawings.

A.3.2 Excavation:

The excavation for chambers shall be done true to dimension and levels as indicated on plans or as directed by the Consultants / Architects.

A.3.3 Bed Concrete:

This shall be cement concrete 1:4:8 (1cement: 3 fine sand: 6 graded stone aggregate 40mm nominal size).

A.3.4 Brick Work:

This shall be in Class B brick (Table Moulded) with crushing strength not less than 35kg / sq.cm, in cement mortar 1:6 (1 cement: 6 fine sand). Conforming to Relevant IS. codes.

A.3.5 Plastering:

Plastering not less than 12mm thick shall be done in cement mortar 1:3 (1 cement:3 coarse sand) finished with a floating coat of neat cement.

A.3.6 Surface Box:

This shall be of cast iron, well made and free from casting and other defects. All sharp edges shall be removed and finished smooth. The shape and dimensions for surface boxes for stopcocks, sluice valves etc., shall be as per approved samples.

A.3.7 Measurements:

Masonry chambers shall be enumerated under the relevant items.

A.3.8 Rate:

The rate shall include the cost of materials and labour involvement in all the operations described above, except the excavation in soft or decomposed and hard rock. The difference in cost, between ordinary soil and soft or decomposed or hard rock as the case may be, shall be paid for separately if the rock is met with and duly certified by the soil consultant.

A.3.9 BALL FLOAT VALVE:

The ball valve shall be of high-pressure class and shall be sizes as specified and directed.

The nominal size of ball valve shall be that corresponding to the size of the pipe to which it is fixed. The valve shall be of gunmetal as specified with standard polyurethane float. The float should be special in shape. The jointing of float shall be efficiently finished, lapped and soldered seam or brazing. Polyurethane floats shall be used as specified.

The ball valve shall generally confirm to IS. Specifications No.1703. The weight of ball cock and size of ball shall as per table given below:

Both high pressure and low-pressure ball valves are designed for use on mains having pressure of 17.kg/sq.cm.and above.

Dia. In mm	Total weight high pressure	Total weight Low pressure
15	524 gms	481 gms
20	986 gms	867 gms
25	1549 gms	1411 gms
32	2120 gms	1873 gms
40	2646 gms	2303 gms
50	4454 gms	3959 gms

A.3.10 THRUST BLOCKS AND ANCHORAGE:

At all changes of directions or gradients, thrust blocks made of cement concrete M150 duly designed should be provided around the bends of the pipes made of GI or PVC or CI withstand dynamic and static forces likely to be developed due to water running the pipes. The thrust blocks shall be made after the joints are tested and found OK.

B. DRAINAGE (EXTERNAL WORKS)

B.1.0 Salt Glazed Stoneware Pipes:

All pipes with spigot and socket ends shall conform to IS 651 – 1992 (fourth revision) and shall be of grade `A' as specified. These shall be sound, free from visible defects such as fire cracks or hair cracks. The glaze of the pipes shall be free from crazing. The pipes shall give a sharp clear note / sound when struck with a light hammer. There shall be no broken blisters or chipping on the spigot or socket. The approximate thickness of 60cm long pipes shall be given in the table below:

Internal Diameter of The pipe	Thickness of the barrel & of socket	Weight of each pipe per m.
mm	mm	Kg
100	12	14
150	16	22
200	17	33
230	19	44
250	20	52
300	25	79

The length of pipes shall be 60cm exclusive of the internal depth of the socket. The pipes shall be handled with sufficient care to avoid damage to them.

B.1.1 Trenches for SW stoneware pipes drain.

Unless otherwise mentioned the widths of trenches for various dia of stoneware pipes shall be as given in the table given below for depth upto 2.0m.

Size of pipes	Width of trench
150	0.75m
230	0.90m
300	1.00m

Wherever depth exceeds 2.0m, the width will be increased by 1.1m.

B.1.2 Laying of stoneware pipes:

All pipes shall be laid on a bed of 15cm cement concrete of 1:4:8 using ¾" graded granite aggregates projecting on each side of the pipe to the width of the trench specified. The pipes with their crown level at 1.20m, depth and less from ground shall be covered with 15cm thick concrete above the Crown of the pipe ends sloped off to meet the outer edges of the concrete to give a minimum thickness of 15cm, all round the pipe. Pipes laid at a depth greater than 1.20m. at crown shall be concerted at the sides upto the level of the center of the pipe and sloped off from the edge to meet the pipe tangentially.

The pipes shall be carefully laid to the alignments, levels and gradients shown on the plans and sections. Great care shall be taken to prevent sand etc., from entering the pipes. pipes between two manholes shall be laid truly in a straight line without vertical or horizontal undulation the pipes shall be laid with socket up the gradient.

If the excavation has been carried too low, the desired levels shall be made up with concrete 1:5:10 (1cement: 5 fine sand: 10 graded stone aggregate 40mm nominal size) for which no extra payment shall be made.

If the floor of the trench consists of rock or very hard ground that cannot easily be excavated to a smooth surface the pipe shall be laid on a leveling course of concrete as desired.

B.1.3. JOINTING:

Tarred gasket of hemp yard soaked in thick cement slurry shall first be placed round the spigot of each pipe and the spigot shall then be slipped home well into the socket of the previously laid. The pipe shall then be adjusted and fixed in the correct position and the gasket caulked tightly home so as to fill not more than ¼th of the total depth of the socket.

The remainder of the socket shall be filled with stiff mixture of cement mortar in the proportion of 1:1 (1cement: 1 fine sand). When the socket is filled, a trowel fillet shall be formed round the joint with a trowel forming an angle of 45 degree with the barrel of the pipe. The joints shall be tested hydraulically as per para B.1.4 and no. Concreting for encasement shall be done. Unless pipes are jointed and tested after a day's work any extraneous material shall be removed from the inside of the pipe. The newly made joints shall be cured.

B.1.4. TESTING OF JOINTS: - IS 4127 - 1983

Hydraulic test: Stoneware pipe used for sewers shall be subjected to a test pressure of 3:0m or required head of water at the highest point of the section plugging the low end of the drain and the ends of the connection, if any and filling the system with top and a sufficient length of vertical pipe jointed to it so as to join with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitably for observation.

During the test the required head is maintained for 30 minutes by adding water from a measuring vessel at 10 minutes interval and the average quantity added shall not exceed 1 litter per hour per 100m. Length per 10m dia of pipe

Where leakage will be visible the defective part of the work shall be removed and made good, at no extra cost.

B.1.5 Refilling of Trenches:

As described under water supply section. In case where pipes are not bedded on concrete, special care shall be taken in refilling trenches to cement the displacement and subsequent settlement at the surface resulting in uneven surfaces and dangers to foundations etc. The back filling materials shall be packed by hand under and around the pipe and rammed with a shovel and light tamper. This method of filling will be continued up to the top of pipe. The refilling shall rise evenly on both sides of the pipe continued up to 60m above the top of pipe so as not to disturb the pipe. No tapping/ramming should be done within 15cm, of the top of pipe. The remainder of the backfill sewers and 14 days for concrete sewers, unless local conditions or materials are suitable tapping / ramming shall become progressively heavier as the depth of the backfill increases.

B.1.6 Measurements:

The length of pipes shall be measured in running meter nearest to a centimeter as laid or fixed from inside of one manhole to the inside of the other manhole. The length shall be taken along the centerline of the pipes overall fittings such as bends, junctions etc., which shall not be measured separately. Excavation, shoring, timbering, backfilling in trenchers and cement concreting wherever required and is clubbed with the item. Excavation in hard rock will be paid separately on stack measurement basis after deducting voids.

B.1.7 Rates:

The rate shall include the cost of material and labour involved in all the operations described above.

B.1.8 Stoneware Gully Trap:

Gully traps shall conform to IS: 651 – 1980 (Fourth revision) these shall be sound, free from visible defects such as fire cracks or hair cracks. The glaze of the traps shall be free from crazing. They shall give a sharp clear note when struck with a light hammer. There shall be no broken blisters.

The size of the gully trap shall be as specified and all dimensions will be as per drawing. Each gully trap shall have one CI grating of square size corresponding to the dimensions of inlet of gully trap. It will also have a water tight CI cover with frame inside dimensions 300 x 300mm the frame and cover weight not less then 7kg and of sound and good casting and shall have truly square machined seating faces.

B.1.9 Excavation:

The excavation for gully traps shall be done true to dimensions and levels as indicated on plans or as directed by the Consultants / Architects.

B.1.20 Fixing:

The gully trap shall be fixed on cement concrete foundation 600 x 600cm square and not less then 10cm Thick. The mix for the concrete will be 1:5:10 (1cement: 5 fine sand: 10 graded stone aggregate 40m nominal size). The jointing of gully outlet to the branch drain shall be done similar to jointing of SW pipe.

B.1.21 Brick Masonry Chamber:

After fixing and testing gully and branch drain, a brick masonry chamber 300 x 300 (inside) in class B bricks in cement motor 1:5 (1 cement: 5 fine sand) shall be built with a 4.5" thick brick work round the gully trap from the top of the bed concert up to ground level. The space between the chamber walls and the trap shall be filled in with cement concrete 1: 5: 10 (1cement: 5 fine sand: 10 graded stones aggregate 40mm nominal size). The upper portion of

the chamber i.e. above the top level of the trap shall be plastered inside with water proof cement motor 1:3 (1 cement: 3 coarse sand) finished with a float in coat of neat cement. The corners and bottom of the chamber shall be rounded off as to slope towards the grating and form a hopper. CI cover with framed 300 x 300mm (inside) shall then be fixed on the top of the bricks masonry with cement concrete 1:2:4 (1 cement: 2 coarse sand: & 4 graded stone aggregated 20mm nominal size) and rendered smooth. The finished top of cover shall be left above the adjoining ` level so as to exclude the surface water from entering the gully trap

B.1.22 Cement Concrete pipes:

The pipes shall be with or without reinforcement as required and of the class as specified. These shall confirm to IS: 458 – 1971 (Second Revision) the reinforced cement concrete pipes shall be manufactured by centrifugal (Or spun process. All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate, mixing or molding. The pipes shall be RCC light duty, NP type.

Concrete used for the manufacture of reinforced concrete pipes and collars shall not be leaner than 1:2:4 (1cement: 2coarse sand: 4 graded stone aggregate). The maximum size of aggregate should not exceed one third of the thickness of the pipe or 20m whichever is smaller. The reinforcement in the reinforced concrete pipe shall extend throughout the length of the pipe. The circumferential and longitudinal reinforcement shall be adequate to withstand the specified hydrostatic pressure and further bending stresses due to the weight of water when running full across the span equal to the length of pipe plus three times it's own weight.

B.1.23 Laying of pipes:

Loading, transporting and unloading of concrete pipes shall be done with care. Handing shall be such as to avoid impact. Gradual unloading by inclined plane or by chain block is recommended. All pipe sections and connections shall be inspected carefully before being laid. Broken or defective pipes or connections shall not be used. Pipes shall be lowered in to the trenches carefully. Mechanical appliances may not be used. Pipes shall be laid true to line and grade as specified. Laying of pipe shall proceed up grade of a slope. If the pipes have spigot and socket end shall face upstream. In the case of pipe with joints to be made with loose collars, the collars shall be slipped on before the next pipe is laid. Adequate and proper expansion joints shall be provided where directed. In case where the foundation conditions are unusual such as in the proximity or trees or holes, under exiting or proposed manholes etc, the pipe shall be encased all round in 15cm, thick cement concrete 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 40mm nominal size) or compacted sand or gravel.

In cases where the natural foundation is inadequate the pipes shall be laid either in concrete cradle supported on proper foundation or on any other suitably designed structure as specified. If a concrete cradle bedding is used the depth of concrete below the bottom of the pipe shall be at least ¼ ^{the} of the internal dia and shall extend up to the sides of the pipe at least to a distance of ¼ th of the outside diameter. For pipes 300mm, and over in dia. The pipe shall be laid in this concrete bedding before the concrete has set. Pipes laid in trenches in earth shall be bedded evenly and firmly and as far up the haunches of the pipes as to stately transmit the load expected from back fill through the pipe to the bed. This shall be done either by excavating the bottom of the trench to fit the

curve of the pipe to form an even bed. Necessary provision shall be made for joints wherever required.

When the pipe is laid in a trench in rock, hard clay, or other hard materials the space below the pipe shall be excavated and replaced with an equalizing bed of concrete, sand or compact earth. In no place shall pipe Be laid directly on such hard material. When the pipes are laid completely above the ground the foundations shall be made even and sufficiently compacted to support the pipeline shall be supported on PCC sandal blocks. Similar arrangement shall be made to retain the pipeline in the proper alignment. Such as by shaping the top of the supports to fit the lower part of the pipe. The distance between the supports shall in no case exceed the length of the pipe. The pipe shall be supported as far as possible close to the joints. In no case shall the joint come in center of the span. Care shall be taken to see that superimposed loads greater than the total load equivalent to the weight of the pipe when running full shall not be permitted.

B.1.24 Jointing of Pipes:

Joints are generally of rigid type. When specified flexible type joints may also be provided.

i) Spigot and socket joint (rigid)

The spigot of each pipe shall be slipped home well into the socket of the pipe previously laid and adjusted in the correct position. The opening of the joint shall be filled with stiff mixture of cement motor in the proportion of 1:2 (1cement: 2 fine sand), which shall be rammed with caulking tool.

After a day's work any extraneous materials shall be removed from the inside of the pipe and the newly made joint shall be cured.

ii) Collar joint (rigid):

The adjoining pipes shall be butted against each other and adjusted in correct position. The collar shall then be slipped over the joint, covering equally both the pipes. The annular space shall be filled with stiff mixture of cement mortar 1:2 (1cement: 2 find sand)

Which shall be reamed with caulking tool.

After a day's work any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured.

B.1.25 The testing of joints, refilling of trenches:

The testing of joints, refilling of trenches for concrete pipe shall be similar to specification for stone ware pipes.

B.2.0 Manholes, Inspection Chambers, Gullies etc:

B.2.1 Inspection Chambers:

Where depth of sewer is less than 1.5m, below outside rectangular made up/ finished level of paving, square inspection chambers shall be used having size as specified. Usual size are 600 x 600 x 900. These shall be constructed in the sewer line at such places and levels and dimensions as indicated on the drawing. Sizes specified shall be clear internal dimensions of the chamber.

B.2.2 Manholes:

Where depth of sewer exceeds 1.5m, with respect to outside made up ground / finished level of paving, circular/ conical manholes shall be provided. Various types and sizes of manholes are specified for different depths. Typical drawing of various types of manholes shall be supplied to the contractors. In the absence of such drawings the Manhole details as per IS4111 (part – 1) to be followed.

Manholes and inspection chambers, which are provided on road or where heavy vehicular traffic is expected, are to be provided with 'heavy duty' C.I. airtight frame & cover. With double seal as per IS 1726 for those built on footpaths, carriage drives and cycle tracks, medium duty covers shall be provided. For locations within domestic premises or areas not subjected to wheel traffic loads they shall be provided with light duty covers.

B.2.3. Construction of manholes, Inspection chambers and gullies.

i) Excavation:

This shall be done to dimensions and levels on the drawing.

ii) Bed Concrete:

Base of the manhole shall be constructed in P.C.C. 1:4:8. Using ¾" graded stones Thickness shall be 200mm upto 4.25m and 300mm for depths more than 4.25m or as specified by the consultants.

iii) Brickwork:

Brickwork shall be in C.M. 1:4 constructed with class B wire cut bricks. Brick masonry in arches and arching over the pipe shall be in C.M. 1:3. Walls shall be generally built in 230mm thickness for inspection chambers and manhole upto a depth of 2.1m and 350mm for depth over 2:2.

iv) Plastering:

Walls of manholes shall be plastered inside with 15mm thick cement plaster 1:3 using Water proof compound and finished smooth. Where ground water table is high, external surfaces of manholes shall also be plastered in C.M. 1:3.

v) Filleting:

75mm fillet shall be made with C.M. 1:3 all round the external joint between the bed concrete and brick masonry wall of manhole.

vi) Benching:

Channels and benching inside the manhole or inspection chamber shall be done in C.C. 1:3:6 and rendered smooth with cement. Depth of channel and benching shall be as per the table given below:

Size of drain in mm	Top of channel at center In cm. Above bed concrete	Depth of benching at side walls in cm above bed conc.
100	15	29
150	20	30
200	25	35
250	30	40
300	35	45

vii) P.C.C. cap:

PCCM. 150 cap of 1:2:4 150mm thickness shall be provided on top of manholes for fixing the manhole frame.

viii) Footrest:

Footrests shall be C.I. runs weighing 5.41 kg and conforming to IS 2064- 1962 made up of 20mm square or round bars. These shall be embedded 20cm deep in 20x20x10cm blocks of pcc 1:2:4. The blocks with C.I. foot rest placed on its center shall be cast in- situ along with masonry. Footrest shall be placed 300mm apart vertically and 375mm horizontally in staggered fashion. First footrest shall be painted with coal tar or bituminous paint and the portion embedded shall be painted with thick cement slurry before fixing.

ix) Manhole frames and covers:

Approximate weights for various dimensions of frames and covers of various duties shall be as follows: (All M.H. type and light duty single seal type).

Size	Heavy duty kg	Medium duty kg	Light duty kg
Rect. 600x600	210	115	60

Rect.600x900	300	175	75
Circular 560 dia	250	128	-

The covers and frames shall be cleanly cast and shall be free from air and sand holes and from cold shuts. They shall be neatly dressed and carefully Trimmed. All castings shall be free from voids either due to shrinkage gas inclusion or other causes.

Covers shall have raised chequer design on the top surface to provide adequate non-slip grip. The cover shall be capable of easy opening and closing and it shall be fitted in the frame in a workman – like manner. Covers shall be gas and watertight. Size of the cover shall be the clear internal dimensions of frame. 2-1/2% variation in weights shall be permissible.

Covers and frames shall be coated with a black anticorrosive paint of bituminous composition. The coating shall be smooth and tenacious. It shall not flow at 63degree c. and shall not drip off at 0 degree c. the covers shall be so fixed as to be flushed with ground surface. After completion the manhole covers shall be sealed by mean of grease.

B.2.4 Testing:

Manhole, after it is raised above highest expected sub- soil water level in monsoon, shall be tested for water tightness. The mouths of all pipes entering the manhole shall be suitably plugged with brick masonry or wooden or any other type of plug. Manhole under test shall then be filled with water upto general subsoil water level and the level observed for one hour. If the level does not drop to more than 50mm in one hour, it shall be deemed as water tight. During testing the pit around shall be kept free of water and contractor shall observe the places where leakage takes places and takes steps to correct the same. Filling earth around manholes shall be done after testing.

B.2.5 Drop connection:

In cases where branch pipes sewer enters the manhole of main pipe sewer at level higher than the main sewer by more than 600mm a drop connection should be provided as per typical drawing for drop connection. For 150 and 250mm main line, the difference in level between the water line (peak-flow-level) and the invert level of branch line is less than 60cm a drop connection may be provided within the manhole by giving ramp. If the difference in level is more than 60cm the drop should be provided externally.

1) Excavation:

The excavation shall be done for the drop connections at the place where the branch line meets the manhole. The excavation shall be carried upto the bed concrete of the manhole and to the full width of the branch line.

2) Laying:

At the end of branch sewer line stoneware shall be fixed to the line which shall be extended through the wall of the manhole by a horizontal place of Stoneware pipe to form an inspection or cleaning eye. The stoneware drop shall be connected to the tee at the top and the stoneware bend at the bottom. The end shall be extended through the wall of the manhole by a piece of C.I. pipe, which shall discharge into the channel. Necessary channel

shall be made with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm. Nominal size) and finished smooth to connect the main channel. The joint between stoneware pipe and tee and stoneware branch line shall be made with cement mortar 1:1(1 cement: 1fine sand) as per para 2.1.3 for S.W. pipes. The exposed portion of the drop connection shall be encased all round with a single brickwork in C.M. 1:4 and pointed. The holes made in the walls of the manholes shall be made good with brickwork in cement mortar 1:4 (1cement: 4 fine sand) and plastered with cement mortar 1:3 (1wall. The excavated earth shall be backfield in the trench in level with the original ground level.

B.3.0 DRAINAGE (INTERNAL AND EXTERNAL WORKS)

B.3.1 Soil, waste, vent pipes and fittings

Materials:

a) All soil, waste and vent pipes and fittings used within the toilets, shafts vertical run, basement ceiling – suspended run, shall be PVC pipes of SWR quality (4kg / sq. cm pressure rated) as per IS 13592 (latest revision). Pipe of higher Dia i.e. 160mm Dia. and above shall of agricultural series (6kg / sq. cm pressure rated) made as per IS 4985.They shall be made of polyvinyl chloride (PVC) and shall be sound with good surface finish, mechanical strength and capacity. During manufacture only those additives may be added to produce the above characteristics. No additives shall be added separately or together in quantities sufficient to constitute a toxic hazard, or impair its physical or welding properties of the pipe or impair its physical or chemical properties. All pipes shall be spigot and socket type (bell end type) OR rubber ring socket type.

c) Tolerances:

Tolerance on diameter and wall thickness shall be as per I.S 13592 and 4985.

d) Fittings:

All fitting shall be injection moulded socket fittings with or without inspection doors as specified and shall be in accordance with requirement of the relevant I.S 7834.

Pressure ratings and tolerances shall be as per I.S 13592 and 4985.

e) Laying and jointing:

Pipes shall be cut to length required including the portion to be inserted in the socket with a hacksaw. The pipe shall be cut square. Pipes and sockets shall be clean and dry and burrs removed both inside and outside with a file. The surface to surfaces to be in contacted shall be roughened with emery paper, and dry fit checked.

A thick coat of solvent cement shall be applied to the outer surface of the pipe and a thin coat on the inside surface of the pipe and a thin coat on the inside surface of the socket by means of a brush. Solvent cement shall be of approved make and quality. The pipe shall then be inserted in the socket and turned for 90 degree to ensure even distribution of solvent cement. Excess solvent cement shall be wiped off. Leak proof adhesives like FRP

paste / M – seal to be applied. GI clamps of required size shall be used for clamping the pipes to the walls etc., pipe shall be clamped at least two inch / 50mm away from the wall surface using GI clamps screwed to the PVC rawl plugs, not more than 1 meter apart.

f) Clean Outs:

At every bends, branches and where necessary suitable cleanouts shall be provided in to the piping system.

B.3.2 Connecting PVC pipes to CI pipes:

PVC collar ring shall be welded to the spigot end of the PVC pipe by means solvent cement. The spigot end of the pipe to be jointed shall then be inserted in to the socket and aligned. Tarred spun yarn shall be caulked in to the angular space between the spigot and socket up to height of 20mm.

The remaining space shall be filled with C.M. 1:2 and well caulked using wooden caulking tool and finished off neatly. Joint shall be kept for 24

Hours. Alternatively, if so directed by Architect, the following method may be adopted.

The spigot end of the PVC pipe should be jointed to a PVC collar using solvent cement as detailed in 7.3.1.

The other end of the collar is then jointed to the socket of the CI pipe using solvent cement.

a) Connecting CI pipe to PVC pipes:

A connector socket shall be used for such connections, a rubber ring is to be placed over the spigot, which is then inserted in to the socket connector. Gentle, even heat is applied to the connector socket by means of a blowlamp. The connector socket will shrink making a watertight airtight joint.

b) Connecting PVC to GI pipes:

Standard threaded couplers shall be used for this purpose.

B.3.3 Miscellaneous Items:

Supports, pedestals and base for inspection chambers, gully traps and pipes shall be of GI or MS provided with water bar flange.

B.3.4 Pipes sleeves and inserts, etc., through RCC walls either external or internal shall be of GI or MS provided with water tight flange.

B.3.5 During installation open ends of pipes shall be plugged with wood out in to required shape or gunny bags and to be maintained free from dirt.

B.3.6 PVC waste pipes and fittings shall be of agricultural series of supreme / Prince make (4kg / sq. cm pressure rated) or equivalent with PVC unions, tailpiece reducers and connections to be provided between joints to either lead or CI pipes.

B.3.7 The sizes of branch waste pipes for different fittings shall be generally as follows:

Wash Basin	40mm dia PVC (15kg / sq. cm pr. Rated)
Urinal	50mm dia PVC (15kg / sq. cm pr. Rated)
Sink	50mm dia PVC (15kg / sq. cm pr. Rated)
Nahani Trap	75mm dia PVC (4kg / sq. cm pr. Rated)
Special Floor Trap	75mm dia or 110mm dia. As required

B.5.8 W.C pan connectors shall be to suit the requirements as per drawing, with 75mm dia. Vent provision for connection to the anitisiphonage pipe with pan connector.

B.5.9 The pipe Connection to the sewage or storm water collection chambers shall perfectly water tight.

B.5.10 The floor traps for toilet blocks shall be PVC with CP brass grating, bolted down design. The traps shall be provided with minimum water seals of 40mm to 50mm.

B.5.11 Where toilet slabs are sunk, the floor trap shall be of 110 x 75 heavy type PVC `P' trap, with CP brass grating, with rim type design.

B.5.12 Bathroom CP grating shall be of rim type design made out of heavy cast brass with the chromium plating of the best approved standard.

B.6.1 RAIN WATER PIPES AND FITTING:

a) All rain water and vent pipes and fittings used within the plumbing shafts vertical run, basement ceiling suspended run, shall be PVC pipes of SWR quality of pressure rating 4kg / sq. cm. They shall be made of polyvinyl chloride (PVC) and shall be sound with good surface finish, mechanical strength and capacity. During manufacture only those additives may be added to produce the above characteristics. No additives shall be added separately or together in quantities sufficient to constitute a toxic hazard, or impair the fabrication or welding properties of the pipe or impair its physical or chemical properties. All pipes shall be spigot and socket type (bell and type)

c) Tolerances:

Tolerances on diameters and wall thickness shall be as per IS 4985.

d) Fittings:

All fitting shall be injection moulded socket fittings with or without inspection doors as specified and shall be in accordance with the requirements of the relevant IS 7834. Pressure ratings and Tolerances shall be as per IS 4985.

b) Tolerances:

Tolerances on diameters and wall thickness shall be as per IS 4985.

c) Fitting:

All fitting shall be injection moulded socket fittings with or without inspection as specified and shall be in accordance with the requirements of the relevant IS 7834. Pressure ratings and tolerance shall be as per IS 13592 and 4985.

d) Laying and jointing:

Pipes shall be cut to length required including the portion to be inserted in the socket with a hacksaw. The pipe shall be cut square. Pipes and sockets shall be clean and dry and burrs removed both inside and outside with a file. The surface to surfaces to be in contacted shall be roughened with emery paper, and dry fir checked.
A thick coat of solvent cement shall be applied to the outer surface of the pipe and a thin coat on the inside surface of the socket by means of a brush. Solvent cement shall be of approved make and quality. The pipe shall then be inserted in the socket and turned for 90^0 to ensure even distribution of cement. Excess cement shall be wiped off. GI clamps of required size shall be used for clamping the pipes to the walls etc., pipe shall be clamped atleast two inch away from the wall surface using GI clamps screwed to the wooden plugs, not more than 1 meter apart.

e) Clean outs:

At every bend, branches and where necessary suitable cleanouts shall be provided in to the piping system.

f) Connecting PVC pipes to CI pipes:

PVC collar ring shall be welded to the spigot end of the PVC pipe by means solvent cement. The spigot end of the pipe to be jointed shall then be inserted in to the socket and aligned. Tarred spun yarn shall be caulked in to the angular space between the spigot and socket up to a height of 20mm.

The remaining space shall be filled with CM 1:2 and well caulked using wooden caulking tool and finished off neatly. Joint shall be kept for 24 hours. Alternatively, if so directed by Architect, the following method may be adopted.

The spigot end of the PVC pipe should be jointed to a PVC collar using solvent cement as detailed in 7.3.1. The other end of the collar is then jointed to the socket of the CI pipe using solvent cement.

g) Connecting CI pipe to PVC pipes:

A connector socket shall be used for such connections. A rubber ring is to be placed over the spigot, which is then inserted in to the socket connector. Gentle, even heat is applied to the connector socket by shrink making a watertight airtight joint.

h) Connecting PVC to GI pipes:

Standard threaded couplers shall be used for this purpose.

i) Rain water collection gratings:

i) The rain water collection grating at the terrace level shall be of PVC grating with PVC frame embedded on to the water proof surface. Waterproofing shall be done around the pipe, frame and grating to ensure the water tightness around the collection point. Adequate slope on the terrace level shall be provided for collecting all rainwater at the collection gratings.

ii) The rain water collection detail at the balconies shall be done using PVC pipe bend installed concealed in the concrete slab and connected to the vertical main PVC rain water stack, at the collection point heavy brass CP frame with CP grating shall be provided. The CP frame shall be laid in the slab above the pipe with water seal joint all round the frame.

k) Rain water / storm water, gullies / Chambers:

Storm water gullies shall be constructed for admitting storm water from the courtyard area. It is constructed of specified size and is provided with precast RCC or CI grating on top for admitting storm water run off into it. A typical drawing shall be provided giving all details of construction. For other details of construction refer specification for manholes and inspection chambers.

C. SANITARY FIXTURES AND FITTINGS:

C.1.0 Installation of fixtures and fittings:

All Plumbing and Sanitary Fixtures and Fittings should be first 1st(standard) quality and shall be stored in covered stores and handled carefully to prevent damage. The sanitary fittings shall be installed at the correct assigned positions as shown on the drawings and as directed by the Consultants / Architects and shall fully meet with the aesthetic and symmetrical requirements as demanded by the Consultant. Fixtures shall be installed by skilled workman with appropriate tools according to the trade. Manufacturer's instructions shall be followed for the installation of the fixtures.

Fixtures in all toilets shall be standard height mounted rigid, plumb and true to alignment. The outlet of water closet pans and similar appliances shall be examined to ensure that outlet ends are abutting properly 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, atonement shall be other causes. A check shall be made to ensure that necessary anchoring devices have been provided for supporting water closets, lavatory has in sinks, flushing cisterns and other appliances. Where the built in types of brackets are used, they shall be securely fixed to the walls and slabs by approved means. It shall be ensured that while fixing the fixtures and fittings, no tool marks or scratches are developed. All MS / Steel brackets and supports shall be painted.

C.1.1 Cutting, Patching repairing and making good:

Cutting, patching and repairing required for the installation and completion of the work specified in each division, including chasing, plastering masonry work, concrete work, etc. and making good shall be carried out by the contractor wherever required. Holes, which are over size, shall be refilled, so that a tight fit is obtained around the pipe or other passing through.

Any damages to water proofed locations should not be patched up, without rectification by water proofing agency to ensure his guarantee.

C.1.2 Protection of Fixtures / Equipment:

Care shall be taken at all times, particularly after fixing to protect fixtures from damage. All offsets shall be temporarily plugged during progress of work to prevent obstruction. Fixtures shall be finally cleaned to the satisfaction of the consultants. Keep all pipes and conduit openings closed by means of plugs or caps to prevent the entrance of foreign mater.

Protect all piping, conduit, fixtures, equipment or apparatus. Any such items damaged prior to final completion of work shall be restored to its original conditions or replaced at no expense to the Owner.

C.1.3 Accessibility:

The installation of valves, thermometers, cleanout fittings and other indicating equipment or specialties requiring frequent reading, adjustment, inspection, and accessibly located with reference to the finished buildings. Thermometers and gauges shall be installed so

as to be easily read from the floor clean out minimum distance of 600mm shall be available from any wall.

C.1.4 Equipment, material and workmanship:

a) Determine that each piece of equipment meets that detailed requirements of the contract documents and that it is suitable for the installation shown. Notify the Architect of any shortcomings found during the tendering period. Each piece of equipment furnished shall meet all detailed requirements will not be acceptable, even though specified by name along with other manufacturers.

b) Where two or more units of same class of equipment are furnished use products of the same manufacture, component parts of entire system need not product of the same manufacturer, but confirm to I.S.I standard. Furnished all materials and equipment, new and free from defects and of size, make type and quality here in specified or approved by the Employer / Architects. All shall be installed in a neat and workmanlike manner.

C.1.5 Sanitary fixtures and CP fittings (Owner's supply):

Unless otherwise specified the sanitary fixtures shall be of the following specifications:

SANITARY FIXTURES AND FITTINGS:

C.2.1. SCOPE:

a)	Sanitary appliances and fixtures for toilets.
b)	Chromium plated brass fittings.
c)	Stainless steel sinks.
d)	Accessories e.g. towel rods, toilet paper holders, soap dish, liquid soap dispensers, towel rails, coat hooks etc.
e)	Hand driers, drinking water fountains etc.

Whether specifically mentioned or not the contractor shall provide for all appliances and fixtures all fixing devices, nuts, bolts, screws, hangers as required.

All exposed pipes within toilets and near appliances / fixtures shall be of chromium plated brass or copper unless otherwise specified.

C.2.2 GENERAL REQUIREMENT:

All appliances, fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the schedule of quantities, Specifications, drawings. Accessories shall include proper fixing arrangements, brackets, nuts, bolts, washers, screws and required connection pieces.

The sanitary fixtures and fittings shall be installed at the correct assigned position as shown on the drawings and as directed by the architect / Owner's site representative and shall fully meet with the aesthetic and symmetrical requirements as demanded by the architect / interior designer

All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per architect requirements. Wherever necessary, the fittings shall be centered to dimensions and pattern as called for.

Fixing screws shall be half round head chromium plated (CP) brass screws, with CP brass washers unless otherwise specified.

Fixtures shall be installed by skilled workman with appropriate tools according to the best trade practice.

All appliances, fittings and fixtures shall be fixed in a neat workman like manner true to level and to heights shown on the drawings and in accordance with the manufacturers recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling, plaster, paint, insulations or terrace shall be made good by the contractor at his own cost. Fixtures shall be mounted rigid, plumb and true to alignment.

All materials shall be rust proofed: materials in direct contact shall be compatible to prevent electrolytic or chemical (bimetallic) corrosion.

Wall flanges shall be provided on all walls, floors, columns etc., wherever supply and disposal pipes pierce through them. These wall caps shall be or chromium plated brass fittings and the receiving pipes and shall be large enough to cover the punctures properly.

Sanitary appliances, subject to the type of appliance and specific requirements, shall be fixed in accordance with the relevant standards and the following:

1)	Contractor shall during the entire period of installation and afterwards protect the appliances by providing suitable cover or any other protection so as absolutely prevent any damages to the appliances until handing over (the original protective wrapping shall be left in position for as long as possible).
2)	The appliances shall be placed in correct position or marked out in order that pipe work can be fixed or partially fixed first.
3)	The appliances shall be fixed in a manner such that it will facilitate subsequent removal if necessary.
4)	The appliance shall be securely fixed. Manufacturer's brackets and fixing methods shall be used wherever possible. Compatible rust – proofed fixings shall be used. Fixing shall be done in a manner that minimize noise transmission.
5)	Appliances shall not be bedded (e.g. WC pans, pedestal units) in thick strong mortar that could crack the unit e.g. ceramic unit).
6)	Pipe connections shall be made with demountable unions. Pipe work shall not be fixed in a manner that it supports or partially supports and appliance.
7)	Appliances shall be fixed true to level firmly fixed to anchor or supports provided by the manufacture and additional anchors or supports where necessary.

Size of sanitary fixtures given in the specification or in the schedule of quantities are for identification with reference to the catalogues of make considered. Dimensions of similar models of other makes may very with in +/- 10% and the same shall be provided and no claim for extra payment shall be entertained no shall payment be deducted on this account.

The contractor shall fix all plumbing fittings such as water faucets, shower fittings, mixing valves etc in accordance with manufacturer's instructions and connect to piping system. The contractor shall supply all fixing materials such as screws rawl plugs, unions, collars and shade to match that of the appliances / fixture and the floor / wall to the extent possible.

C.2.3 SUPPORTING AND FIXING DEVICES:

The contractor shall provide all the necessary supporting and fixing devices to install the

sanitary 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 appearance in the final assembly. Where the location demands, the architect may instruct the contractor to provide chromium plater or other similarly finished fixing devices. In such circumstances the contractor shall arrange to supply the fixing devices and shall be installed complete with appropriate vibration isolating pads, washers and gaskets.

C.2.4 FINAL INSTALLATION:

The contractor shall install all sanitary fixtures and fittings in their final position in accordance with approved trial assemblies and as shown on drawings. The installation shall be complete with all supply and waste connections. The connection between building and piping system and the sanitary fixtures shall be through proper unions and flanges to facilitate removal/replacement of sanitary fixtures without disturbing the built in piping system. All unions and flanges shall match in appearance with other exposed fittings.

Fixtures shall be mounted rigid. Plumb and to alignment. The outlets of water closet pans 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 made to ensure that necessary anchoring devices have been provided for supporting water closets, washbasins, sinks and other appliances.

C.2.5 PROTECTION AGAINST DAMAGE:

The contractor shall take every precaution to protect all sanitary fixtures against damage, misuse, cracking, staining, breakage and pilferage by providing proper wrapping and locking arrangement till the completion of the installation. All the time of handing over, the contractor shall clean, disinfect and polish all the 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.

C.2.6 MEASUREMENT:

Rate for fixing only of sanitary fixtures accessories, CP fittings shall etc. include all items, and operations stated in the respective specifications and bill of quantities and nothing extra is payable.

Rates for all items under specifications para above shall be inclusive of cutting holes and chases and making good the same CP screws, nuts, bolts and any fixing arrangements required and recommended by manufacturers, testing and commissioning and making good to the satisfaction of the owner's site representative.

C.2.7 TESTING:

All appliances, fixtures and fittings shall be tested before and after installation. Water seals of all appliances shall be tested. The contractor shall block the ends of waste and ventilation pipes and shall conduct an air test.

C.2.8 WATER CLOSET:

Water closet shall be wash or siphonic wash down type floor or wall mounted set, as shown in the drawings, designed for low volume flushing from 3-6 liters of water, flushed by means of a porcelain flushing cistern or an exposed or concealed type (as detailed in the drawings or as directed by the owner's site representative) 32 mm size CP brass flush valve with regulator valve. Flush pipe / bend shall be connected to the WC by means of a suitable rubber adaptor. Wall hung WC shall be supported by CI floor mounted chair, which shall be fixed in a manner as approved by the owner's site representative.

Each WC set shall be provided with approved quality of seat, rubber buffers and chromium plated hinges, seat shall be so fixed that it remains absolutely stationary in vertical position with out falling down on the WC.

Each WC shall be provided with 110 mm dia (OD) PVC pan connector connecting the ceramic outlet of WC to CI pipe.

Squatting type water closet – Orissa Pattern:

Squatting type water closed (WC) pan shall be of Orissa pattern of size as specified in schedule of quantities. Each WC pan shall be provided with a 100 mm dia cast iron or porcelain P or S traps with or without vent horn as directed by owner's site representative.

WC shall be flushed by means of concealed type or exposed type (as detailed in the drawings or as directed by the owner's site representative) 32 mm size CP brass flush valve with regulator valve.

C.2.9 URINALS:

Urinals shall be lipped type shall with glazed vitreous china of size as called for in the bill of quantities.

Half shall urinals shall be provided with 15 mm dia CP spreader 32 mm dia CP domical waste and CP cast brass bottle trap with pipe and wall flange and shall be fixed to wall by CI brackets, CI wall clips and CP brass screws as recommended by manufacturer complete as directed by the owner's site representative.

Flushing for urinals shall be by means of no hand operation, infrared electric flush valve with complete kit of plumbing, electrical and electronic items, infrared photo cells, solenoid valve transformer and electrical connection. The automatic flush sensor plate shall be flush and press fitted and be of height quality mirror polish finish. Each urinal shall be provided with one flush valve unit.

Flush pipes shall be GI pipes concealed in wall chase but with chromium-plated bends at inlet and outlet.

Urinal Partitions:

Urinals partitions shall be white glazed vitreous china of size specified in the schedule of quantities.

Porcelain partitions shall be fixed at proper height with CP brass bolts, anchor fasteners and MS clips as recommended by the manufacturer and directed by the owner's site representative.

C.2.10 CISTERNS / FLUSH VALVE:

Low-level fishing cistern (exposed or concealed) shall be provided for WC in specified toilets. Contractor shall install cistern in accordance to the manufacturer's specification to the satisfaction of the owner site representative. Provision of flush valve shall be made for public / staff toilets.

C.2.11 WASH BASIN:

Washbasins shall be white glazed vitreous china of size. Shape and type specified in the schedule of Quantities.

Each basin shall be provided with painted MS angle or CI brackets and clips and the basin securely fixed to wall / counter slab. Placing of basins over the brackets without secure fixing shall not be accepted. The MS angle shall be provided with tow coats of red oxide primer and

two coats of synthetic enamel paint of make brand and cooler as approved by the owner's site representative. The cost of fixing the basin shall be inclusive of supply and installation of bracelets as described above.

Each basin shall be provided with 32mm dia CP waste with overflow pop-up waste or rubber plug and CP brass chain as specified in the schedule of Quantities.

Each basin shall be provided with hot and water mixing fitting or as specified in the schedule of Quantities.

C.2.12 SINKS:

Sinks shall be stainless shall or any other material as specified in the schedule of Quantities.

Each sink shall be provided with painted MS or CI brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable painted angle iron brackets or clips as recommended by the manufacturer. Each sink shall be provided with 40mm dia CP waste and rubber plug with CP brass chain as given in the schedule of Quantities. The MS angle shall be provided two coats of red oxide primer and two coats of synthetic enamel paint of make. Brand and colour as approved by the owner's site representative.

Sanitary fit tings for sinks shall be deck mounted or wall mounted CP swivel faucets with or without hot and cold water mixing fittings as specified in the schedule of Quantities. Installation of fittings shall be measured and paid for separately.

C.2.13 TOWEL RAIL:

Tower rail shall be chromium plated brass or of stainless steel or powder coated brass of size, shape and type specified in the schedule of Quantities.

Tower rail shall be fixed with screws/capping having finish similar to the towel rail; in wall with rawl plugs or nylon sleeves and shall include cutting and making good as required or directed by the owner's site representative.

C.2.14 LIQUID SOAP DISPENSER:

Liquid soap dispenser shall be wall/counter mounted suitable for dispensing liquid soaps. Lotions. Detergents. The cover shall lock to body with concealed locking arrangement, opened only be key provided.

Liquid soap dispenser body and shank shall be of high impact resistance material. The piston and spout shall be stainless steel with I litre capacity polyethylene container.

The valve shall operate with less than 2.27 Kg (5 ibs) of force.

C.3.0 Mode of measurement:

C.3.1 All drainpipes shall be measured in linear lengths along the centerline of drainage line laid. Deductions shall be made for chambers and fitting lengths, etc. The rate shall include all works as specified in the respective items.

C.3.2 Stoneware or cast iron gully, traps, bends and junctions, sewer traps etc. shall be measured in numbers as in above.

C.3.3 All GI pipes for water supply shall be measured in linear lengths along the center line completed including the fittings like collars, elbows, tees, hex nipples etc. the rate shall include cutting, threading, jointing, pressure testing etc. complete as specified in the respective items.

C.3.4 Same rate shall be applicable for pipes of same size and materials laid in building at any level or floor.

C.3.5 The rock cutting shall be measured in cu. m of the stacks of excavated rock. The deductions for voids being 50%of the stack measurement. Only the rock which is removed by chiseling or blasting etc., shall be measured for this item of work. Boulders shall not be considered as a rock. The excavated rock will be the owner's property.

C.3.6 All PVC pipes such as soil, waste, vent and rainwater shall be measured in linear lengths along the centerline, to nearest centimeter as completed including length over fittings. The rates shall include all joints and clamps etc. as specified in the respective items.

C.3.7 Plain cement concrete for supports and for encasement or bedding etc. shall be measured as specified in the respective items in the schedule of quantities.

C.3.8 All sanitary fittings and CP fixtures including CP extension pipe with brass screws shall be measured in numbers and the rates shall include all the work specified and described under item in the schedule of quantities.

C.3.9 All gate valves, ball valves, non- return valves, sluice valves, pressure reducing valves etc. shall be measured in numbers, after excluding them from linear measurement.

C.3.10 The diameters of pipes and fittings mentioned in the specifications are the inside nominal diameters in all cases except PVC pipes or unless otherwise specified.

D.0 MISCELLANEOUS WORKS:

D.1.0 HANGERS & SUPPORTS:

D.1.1 General:

Provide proper solid angle iron / channel section, supports for all pipe runs in the vertical ducts and run horizontally suspended from the slab, complete with clamps. Wherever insulation comes, to provide wooden guide to support pipe on the angle iron hangers / supports. For attachment in concrete, use `Dash' fasteners or Anchor plug type inserts or equivalent. Provide hangers within 900mm of all changes in direction of mains. A minimum of three hangers per expansion bends wherever shown in drawing. Provide all additional structural steel angles, channels or other members not specifically shown but are required for proper support.

Where necessary additional hangers to be provided to arrest water hammers of hydraulic resonance with proper rubber padding.

Space hangers as noted below, except on all soil pipes which shall have a hanger of multiple fittings. Sufficient hangers shall be provided to maintain proper slope without sagging. In case of angle suspended line, the following is suggested.

a)

Pipe Sizes	Hanger Rod Dia.
20 through 50mm	10mm
65 through 125mm	12mm
150 and over	15mm

b)

Pipe Sizes	Spacing of Supports
12 to 20mm	1.5m apart
25 to 40mm	2 m apart
50 above	2 m apart or as per IS.

Provide floor stands, brackets or masonry piers etc. for all lines running under the floor or near walls for those lines can be properly supported or suspended from the walls or floors. Pipelines near concrete or masonry walls shall be supported by hangers carried from wall brackets. Hanging of any pipe from another is prohibited.

D.2.0 Cutting, Patching, Repairing & Making good:

Cutting, patching and repairing required for the proper installation and completion of the work specified in each division, including chasing, plastering, masonry work, concrete work, etc. and making good shall be carried out by the contractor wherever required. Holes which are cut oversize shall be refilled, so that a tight fit is obtained around the pipe or passing through. Any damages to water proofed location should not be patched up, without rectification by the water proofing agency (specialist contractor) to ensure his guarantee. Repair of waterproofing shall be born by the sanitary contractor if the damage is done by sanitary contractor.

D.2.1 Equipment Protection:

Keep all pipe and conduit openings closed by means of plugs or caps to prevent the entrance of foreign matter. Protect all piping, conduit, fixtures, equipment or apparatus. Any such work shall be restored to its original condition or replaced at no expense to the owner.

D.2.2 Accessibility:

The installation of valves, thermometers, cleanout fittings and other indicating equipment or specialties requiring frequent reading, adjustment, shall be conveniently and accessibly located with reference to the finished buildings.

Thermometers and gauges shall be installed so as to be easily read from the floor. For floor cleanouts minimum distance of 600mm shall be available from any wall.

E.0 Cleaning, operation & Tests:

Plumbing equipment fixtures, piping etc. shall be free of stampings, making (except those required by codes) iron cutting and other foreign materials.

E.1.1 Hot, cold and drinking water systems shall be cleaned thoroughly, filled and flushed with water.

E.1.2 The entire mechanical apparatus shall operate at full capacity without objectional noise or vibrations.

E.1.3 Test all plumbing systems in the presence of the site engineer / supervisor and the Architect as herein specified. Provided all equipment, materials and labour necessary for inspection and tests. After repairs are made, repeat test until units / a system is found satisfactory, to the above authorities. Carry out tests prior to concealing, insulating or back filling over any piping. No exceptions will be made.

E.1.4 Test entire system of soil, wast and vent piping by water test after sealing all traps.

E.1.5 Water Test:

Test entire system or sections of system by closing all openings except the highest opening and filling system with water to the point of overflow. If the system is tested in sections, plug each opening except the highest opening of the section filled with water. Keep the water in system or in portion under test for atleast 45 minutes before inspection starts with test pressure / head of 10 kg / sq. cm lasting for two hours. The system must be tight at all joints.

E.1.6 Final Test:

After fixtures are set, test the system with smoke test as follows:

E.1.7 Smoke Test:

Fill traps with water, then introduce in to system a pungent thick smoke produced by one or more smoke machines. When smoke appears at stacks on the roof, plug stacks and allow pressure of 1 – inch water column to build up in systems. The system shall be tight at all joints.

E.1.8 Test all down spouts or rain headers and their branches within the building by water as described for the above soil, waste and vent system.

E.1.9 All Water Piping:

Hydro – static test 10 kg / cm 2 or twice the working pressure which ever is higher. Without drop in pressure as for a duration of minimum two hours.

E.1.10 All tests on below ground lines shall be continued to backfill on such a line is completed to disclose any damages caused by back filling.

E.1.11 All system shall be tested in section as required to expedite the work of other trades and meet construction schedules and final test on completion.

E.1.12 On completion of the works, the following tests shall be performed to the satisfaction of the consultants / clients representative before issue of virtual completion certificate, if so required.

a) Smoke Test
b) Hydraulic Test
c) Performance Test for fixtures
d) Tests for anti syphonage system
e) Pump rating and output
f) Inspection of all units and fixtures.

E.1.13 The contractor shall arrange for similar tests during the progress of works to ensure that there are no defects in materials / workmanship in portions of work to be concealed or embeded under the floor or walls in ceiling and get this approved by the consultants. The under floor pipe works shall not be closed without the approval of consultant.

F. Disinfections of piping System and Storage Tanks:

Before commissioning the water supply system, the contractor shall arrange to disinfect the entire system as described below. The filtered water storage tanks and pipe shall first be filled with water and thoroughly flushed out. The storage tanks shall be then filled with water again and disinfecting chemical containing chlorine added gradually, while tanks are being filled to ensure thorough mixing. Sufficient chemical shall be used to give the water. One part of chlorine to one million parts of water. If ordinary bleaching powder is mixed to 1000 liter of water, the powder shall be mixed with water to a creamy consistency before being added to the water in the storage tank. If a proprietary brand of chemical is used, the proportion shall be as specified by the manufacturer. When the storage tank is full, the supply shall be stopped and all the taps on the distributing pipes opened successively, working progressively from storage tank. Each tape 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 recommend proportion. The storage tank and pipe shall then remain charged atleast for three hours. Finally, the tank and pipes shall be thoroughly flushed out before any water is used for domestic purpose.

G.1.0 GREASE TRAP:

G.1.1 Size of grease trap:

The size given in bill of quantities and drawings shall be internal size of chamber. The work shall be done strictly as per standard and following specifications.

G.1.2 Bed Concrete:

Shall be in 1:4:8 cement concrete 150 mm thick.

G.1.3 Brick work:

Brickwork shall be with best quality bricks in 1:5 CEMENT MORTAR.

Baffle walls be of RCC and of size as mentioned in bill of quantities. Brick partition constructed of best quality table molded bricks in cement mortar 1:5 shall be provided for the entire height of chamber.

G.1.4 Plaster:

The walls of chamber shall be plastered from inside with 12 mm thick cement plaster 1:3 and finished smooth with a floating coat of neat cement & rough plaster on outside in cement mortar 1:3.

G.1.5 Chamber covers:

Covers shall be of size and duty as mentioned in bill of quantities, covers shall be of cast iron as per the details given in the drawing and shall be fixed on frame embedded in concrete.

CI steps shall be provided at two corners of the chamber.

All cast iron and MS items shall be painted with two coats of bitumastic paint.

G.1.6 Cast iron manhole cover and frame:

The cast iron manhole cover and frame shall conform to IS: 1726 and the grade and types have been specified in the bill of quantities. The cover and frames shall be cleanly cast and they shall be free from air and sand holes and from cold shuts.

They shall be neatly dressed and carefully trimmed. All castings shall be free from voids whether due to shrinkage, gas inclusion or other causes. Covers shall have a raised checked design on the top surface to provide an adequate non – slip grip.

The sizes of covers specified shall be taken as the clear internal dimensions of the frame.

The covers and frames shall be coated with a black bituminous composition. The coating shall be smooth and tenacious. It shall not flow when exposed to a temperature of 63^0 C and shall not brittle as to chip off at a temperature of 0^0 C.

G.1.7 TESTING:

All rights of the sewer and drain shall be carefully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole to manhole. All pipes shall be subject to a test pressure of 1.5, meter head of water. The test pressure will however, not exceed 6 meters head at any point. The pipes shall be plugged preferably with standard design plugs or with rubber plugs on both sides, the upper end shall, however, be connected to a pipe for filling with water and getting the required head poured at one time

Sewer lines shall be tested for straightness by:

a)	Inserting a smooth ball 12 mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball shall roll down the invert of the pipe and emerge at the lower end.
b)	Means of a mirror at one end a lamp at the other end. If the pipe is straight the full circle of light will be seen otherwise obstructions or deviations will be apparent.
c)	The contractor shall give a smoke test to the drain and sewer at his own expense and charges, if directed by the owner's site representative.
d)	A test register shall be maintained which shall be signed and dated by contractor and owner's site representative.

H.1.0 COMMISSIONING AND GUARANTEE

H.1.1 SCOPE OF WORK:

Work under this section shall be executed with out any additional cost. The rates quoted in this tender shall be inclusive of the works given in this section.

Contractor shall provide all tools, equipment, metering and testing devices required for the purpose.

On award of work, contractor shall submit a detailed proposal giving methods of testing and gauging the performance of the equipment to be supplied and installed under this contract.
All tests shall be made in the presence of the architect or his representative or any inspecting authority. At least five working days notice in writing shall be given to the inspecting parties before performing any test.

Water flow rates of all equipment and in pipe lines through valves shall be adjusted to design conditions. Complete results of adjustments shall be recorded and submitted.

Contractor shall ensure proper balancing of the hydraulic system and for the pipes / valves installed in his scope of work by regulating the flow rates in the pipeline by valve operation. The contractor shall also provide permanent tee connection (with plug) in water supply lines for ease of installing pressure gauge, temperature gauge and rotameters. Contractor shall also supply all required pressure gauge, temperature gauge and rotmeters for system commissioning and balancing. The balancing shall be to the satisfaction of consultant / Project Manager .

Three copies of all test result shall be submitted to the engineer in A4 size sheet paper with in two weeks after completion of the tests.

H.1.2 PRECOMMISSIONING:

On completion of the installation of all pumps, piping, valves, pipe connections, installation etc., the contractor shall proceed as follows:

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a)	Prior to start – up and hydraulic testing, the contractor shall clean the entire installation including all fitments and pipe work and the like after installation and keep them in a new condition. All pumping systems shall be flushed and drained at least once through to get rid of contaminating materials. All pipes shall be rodded to ensure clearance of debris, cleaning and flushing shall be carried out in sections as the installation becomes completed.
b)	All strainers shall be inspected and cleaned out or replaced.
c)	When the entire systems are reasonably clean, a pre – treatment chemical shall be introduced and circulated for at least 8 hours. Warning signs shall be provided at all outlets during pre – treatment. The pre – treatment chemical shall:
	Remove oil, grease and foreign residue from the pipe work and fittings.
	Pre – condition the metal surfaces to resist reaction with water or air.
	Establish an initial protective film.

	After pre – treatment, the system shall be drained and refilled with fresh water and left until the system is put in to operation.
	Details and procedures of the pre – treatment shall be submitted to the architect for approval.
d)	Check all clamps, supports and hangers provided for the pipes.
e)	Check all the equipment, piping and valves coming under hot water system and operate each and every valve on the system to see if the valves are functioning properly. There after conduct and hydro test of the system as for (b) above.
f)	Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specification. If any leakage is found, rectify the same and retest the pipes.

H.1.3 STATUTORY AUTHORITIES TESTS AND INSPECTIONS:

As and when notified in writing or instructed by the architect, the contractor shall submit shop drawing and attend all tests and inspections carried out by local fire authorities, water authority and other statutory authorities, and shall forth with execute free of charge any rectification work ordered by the architect as a result of such tests and inspections where these indicate non – compliance with statutory regulations. Some of these tests may take place after the issue of practical completion of the main contract and the contractor shall make all allowances in this respect.

The contractor shall be responsible for the submission of all necessary forms and shop drawings to the statutory authorities, which shall conform in layout to the latest architectural plans submitted to and kept by these authorities.

Fixing screws shall be half round head chromium plated (CP) brass screws, with CP brass washers unless otherwise specified.

Fixtures shall be installed by skilled workman with appropriate tools according to the best trade practice.

All appliances, fittings and fixtures shall be fixed in a neat workman like manner true to level and to heights shown on the drawings and in accordance with the manufactures recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling, plaster, paint, insulation or terrace shall be made good by the contractor at his own cost. Fixtures shall be mounted rigid, plumb and true to alignment.

All materials shall be rustproof materials in direct or indirect contact shall be compatible to prevent electrolytic or chemical (bimetallic) corrosion.

Wall flanges shall be provided on all walls, floors, columns etc. wherever supply and disposal pipes pierce through them. These wall caps shall be or chromium plated brass fittings and the receiving pipes and shall be large enough to cover the punctures properly.

Sanitary appliances, subject to the type of appliance and specific requirements, shall be fixed in accordance with the relevant standards and the following:

a)	Contractor shall, during the entire period of installation and afterwards protect the appliances by providing suitable cover or any other protection so as to absolutely prevent any damage to the appliances until handing over (the original protective wrapping shall be left in position for as along as possible).
b)	The appliances shall be placed in correct position or marked out in order that pipe work can be fixed or partially fixed first.
c)	The appliance shall be fixed in a manner such that it will facilitate subsequent removal if necessary.
d)	The appliance shall be securely fixed. Manufacturer's brackets and fixing methods shall be used wherever possible. Compatible rust – proofed fixings shall be used. Fixing shall be done in a manner that minimize noise transmission.
e)	Appliances shall not be bedded (e.g. WC pans, pedestal units) in thick strong mortar that could crack the unit (e.g. ceramic unit)
f)	Pipe connections shall be made with demountable unions. Pipe work shall not be fixed in a manner that it supports or partially supports and appliance.

The submission shall comply with the requirements set forth in the current codes of practice and circular letters of the statutory authorities. The shop drawings to be submitted shall be forwarded to the architect for checking before submission.
The contractor shall allow for at least two submissions of complete sets of shop drawings to the authorities, one to be made within three months after the award of the contract but not less than six weeks before the inspection. The architect may at his discretion instruct the contractor for additional submissions to the local authorities wherever necessary.

The contractor shall notify the architect at least seven days in advance of his application for local authority tests and inspections. On receipt of a confirmed date for test and inspection the contractor shall inform the architect without delay.

H.1.4 FINAL ACCEPTANCE TETS:

Following commissioning and inspection of the entire installation, and prior to issue of the completion certificate, the contractor shall carry out final acceptance test in accordance with a programme to be agreed with the architect.

Should the results of the acceptance tests show that plant, systems and / or equipment fail to perform ti the efficiencies or other performance figures as given in this specification, the contractor shall adjust, modify and if necessary replace the equipment without further payment in order that the required performance is obtained.

Where acceptance tests are required by the relevant authorities having jurisdiction, these tests shall be carried out by the contractor prior to the issue of completion certificate to the acceptance of the authorities.

H.1.5 REJECTION OF INSTALLATION / PLANT:

Any items of plant or system or component which fails to comply with the requirements of this specification in any respect whatsoever at any stage of manufacture, test, erection or on completion at site may be rejected by the architect either in whole or in part as he considers necessary / appropriate.

Adjustment and / or modification work as required by the architect so as to comply with the authority's requirements and the intent of the specification shall be carried out by the contractor at his own expense and to the satisfaction of the authority / architect.

After works have been accepted, the contractor may be required to carry out assist in carrying out additional performance tests as reasonably required by the architect / employer.

H.1.6 WARRANTY AND HANDOVER:

The contractor shall warrant that all plant, materials and equipment supplied and all workmanship performed by him to be free from defects of whatsoever nature before handover to the owner.

H.1.7 HANDING OVER OF DOCUMENTS:

All testing and commissioning shall be done by the contractor to the entire satisfaction of the owner's site representative and all testing and commissioning documents shall be handed over to the owner's site representative.

The contractor shall also hand over all maintenance and operation manuals, all certificates and all other documentation as per the terms of the contract to the owner's site representative.

.1.8 PIPE COLOUR CODE:

Sl. No.	Pipe Lines	Ground / Base colour	First colour brand	Second colour brand
01.	Cooling water	Sea Green	French blue	
02.	Boiler feed	Sea Green	Gulf red	
03.	Condensate	Sea Green	Light Brown	
04.	Drinking water (all cold water lines after filter)	Sea Green	French blue	Single red
05.	Treated water (soft water)	Sea Green	Light Orange	
06.	Domestic hot water	Sea Green	Light grey	
07.	Compressed air up to 15 / kg / sq.m	Sky blue		
08.	Steam	Silver Grey		
09.	Drainage	Block		
10.	Gas	Canary Yellow		
11.	Oils:			
	Diesel (indicated by letter HSD / as applicable)	Light Brown		
12.	Medical Gases:			
	Air	Sky blue	White / black	
	Oxygen	Canary yellow	White	
	Nitrous Oxide	Canary yellow	White	
	Vaccum	Canary yellow Sky blue	French blue Black	

Colour code to confirm to IS: 2379:1990.

TECHNICAL SPECIFICATIONS
ELECTRICAL WORKS

SPECIFICATION FOR WIRING SYSTEM

1.0 SCOPE:

This Specification covers wiring System applicable to 3phase, 4wire 415Volts, 50Hz AC and single phase, 2 wire 230 Volts, 50 Hz AC system.

2.0 CONDUITS & ACCESSORIES

2.1 Supplying heavy gauge PVC conduit pipe …….. dia …… mm thick confirming to IS 2509 with suitable size bends, junction boxes, adhesive paste etc. and fixing using inverted wood plugs in case of RCC ceiling and RCC wall / stone structure or rawl plugs in case of brick walls and cement plastering the damaged portion using heavy gauge saddles at an interval of 700 mm using NF screws. The minimum wall thickness of conduits shall be as follows;-

Rigid PVC Conduits - 2mm.

2.2 Conduit Accessories co: Conduit accessories such as bends, inspection bends, inspection tees, elbows, reducers, draw boxes, junction boxes, etc. shall be of approved makes. Boxes shall have internally tapped spouts, junction boxes/inspection boxes shall be provided wherever required at no extra cost.

2.3 All the conduits shall be adequately protected while stored on site prior to erection and no damage conduit shall be used.

2.4 All conduit accessories shall be made out of 2 mm thick PVC enclosures.

2.5 The inside surface and ends of conduits and threads and fittings used shall be clean, smooth, cut square and free from burrs and other defects. Powdered soap stone, talc or prepared compounds shall be used as lubricants to facilitate the smooth pulling in of conductors.

3.0 INSTALLATION OF RECESSED CONDUIT SYSTEM

3.1 Supplying heavy gauge PVC conduit pipe …….. mm dia …….. mm thick confirming to IS 2509 with suitable size bends, metal/PVC junction boxes, adhesive paste etc. and running before concreting the slab. The conduit should be tied to the reinforcement rods by using binding wires and unused ways of junction boxes and pipe ends should be covered using PVC end enclosures, run with 18 SWG GI fish wire wherever necessary.

3.2 The conduit shall be properly and tightly screwed between the various lengths and to the boxes to which it runs and terminates. No part of the conduit shall be under mechanical stress and the whole conduit system shall be electrically and mechanically continuous throughout.

3.3 The conduit shall be installed in such a manner that drawing of wires can be carried out from the outlet box, junction box, pull box and switch boxes only.

3.4 Conduits recessed in walls shall be secured in walls shall be secured rigidly by means of steel hooks/staples at 0.8 mtrs. Intervals. Before conduit is concealed in the walls, all chases, grooves shall be neatly made out proper dimensions to accommodate the required number of conduits.

The outlet boxes, point control boxes inspection and draw boxes shall be securely fixed by means of counter sunk steel screws and rawl plugs. They shall be firmly grouted in position prior to plastering fixed as and when conduit is being laid. The recessing of conduits in walls shall be arranged as to allow at least 12 mm plaster cover on the same. All grooves, chases, etc. shall be refilled with the cement mortar and finished up to the wall surface before plastering of walls is taken up by the general contractor. The top edge of the conduit shall be at least 25 mm below the finished surface of wall. Wherever conduits terminate into point control boxes, boards, etc. with check nuts on either side of the entry to ensure electrical continuity.

3.4 After conduits, junction boxes, outlet boxes, etc. fixed in position their outlets shall be properly plugged with PVC

stoppers or with any other suitable materials so that water, mortar, vermin or any other foreign material do not enter into the conduit system

4.0 INSTALLATION OF SURFACE CONDUIT SYSTEM

4.1 Conduits shall run in straight lines. Before the conduits are installed, the exact routes shall be marked at site and approval of the consultant shall be obtained. Conduit shall be fixed by heavy gauge GI base plates, saddles, secured to suitable raw plugs, at an interval of not more than 1 Mtr. conduits shall be joined by means of screwed couplers and screwed only. In long distance straight runs of conduits, inspection type couplers or running type couplers or pull boxes shall be provided. Straight runs of conduits, inspection type couplers or running type couplers or pull boxes shall be provided.

4.2 Bends in conduit runs shall be done by bending conduits by bending conduits by pipe bending machine. Bends which cannot be negotiated by pipe bends, shall be accompanied by introducing inspection boxes or inspection bends, not more than three equivalent 90 c bends shall be used in a conduit run from outlet to outlet.

5.0 INSTALLATION OF CONDUITS ABOVE FALSE CEILING

5.1 In the false ceiling area, the conduits shall be run above the false ceiling frame work supported by means of PVC. Straps secured and fixed to both conduits and structural ceiling keeping the outlet box as near as possible to the fittings/fans for connections. The conduits boxes for fittings/fans are independently supported by means of separate fixing arrangements to the box and structural ceiling so that the box is held rigidly.

6.0 DRAW BOXES, PULL BOXES, ENCLOSURES ETC

6.1 Enclosure for electrical accessories shall have wall thickness of PVC. Not less than 2 mm. The enclosure boxes shall be provided with a minimum of four fixing lugs located at the corners for fixing the covers. All fixing lugs shall have holes to take machined brass screws.

6.2 Sufficient number of knockouts shall be provided for conduit entries. The enclosures shall be adequately protected against rust or corrosion both inside and outside. Generally switch box enclosure will be of standard size to /pores sheet to be used as cover for mounting switches and sockets.

7.0 WIRING CONDUCTORS

7.1 All wiring conductors shall be PVC insulated, copper conductors of 1100V grade, and shall conform to IS:694 Part II (Latest Edition).

7.2 Wiring conductors shall be supplied in Red, Yellow, Black and Green colours for easy identification of wires. The wires shall be supplied in seated in sealed coils 0 100 Mtrs. Length and shall bear manufacturer's trade mark, name Voltage grade etc.

8.0 INSTALLATION OF WIRING CONDUCTORS\CABLES

8.1The wiring conductors shall not be drawn into the conduits until all the works of any nature that may cause damage to the wires are completed. The installation and termination of wires shall be carried out with due regard to the followings:

a) While drawing the wiring conductors, care shall be taken to avoid scratches and kinks which cause breakage of conductors. There shall be no sharp bends in the conduit system.

b) Strands of the wires shall not be cut for connecting to the terminals or lugs. The Terminals shall have adequate cross section to take all the strands.

8.2 Wiring for power and lighting circuits shall be carried out in separate and distinct wiring systems.

8.3 The wiring system envisaged is generally shown on the layout drawings and line diagrams. However, a brief account of the general wiring system is given below:

a) Submains wiring-wiring from Meter boards/switch boards to the individual distribution boards, and shall consist of wires, conduits, and all conduit and fixing accessories as required and specified. The sizes of conduits and number of wires shall be as specified in Schedule of Quantities Wires shall be drawn in conduits as required without being damaged, with necessary draw boxes if required. The wire lengths must be adequate for terminating at either end and identifying ferrules shall be provided at

termination. The wiring shall be colour coded. The rate shall include all materials, connections, labour etc. as specified above.

b) Circuit wiring-Wiring from DBs to the first point control boxes for lighting, fans, 5A sockets, call bells, etc. The scope of work shall be same as in sub-main wiring.

c) Power wiring: The wiring from DBs to heating supplies. 16 A 3 pin socket outlets, etc

.The scope of work shall be same as in the sub-main wiring.

8.4 Each sub-main/ power wiring circuit shall also have its own earth continuity wire as specified.

8.5 All the wiring shall be carried out in loop-in-loop system only and phase or line conductors shall be looped at switch box and neutral conductor can be looped from light, fan or sockets.

Phases- Red, Yellow and Blue.

Neutral- Black.

Earth-Green or Bare wire as specified.

9.0 SWITCHES, SOCKETS AND ACCESSORIES

9.1 GENERAL REQUIREMENTS: General control switches shall be of a 6/16 A rating and shall be of approved make/type suitable for flush mounting. Switches shall be of modular polycarbonate type to be fixed on metal concealed or PVC box .

9.2 All sockets, 6A and 16A ratings shall be of flush mounting type with combined control switches of the same rating as that of the sockets. All sockets outlet shall be of 3 pin type.

9.3 The switch, plug socket or regulator boxes for the concealed application shall be made of GI/sheet steel of minimum 16SWG on all except in the front. Depth of boxes shall not be less than 75 mm and suitably increased where fan regulators are mounted in flush pattern.

9.4 Supplying of Industrial metal clad plug and sockets for providing power supply to the canteen electrical appliances.

10.0 INSTALLATION OF SWITCHES, SOCKETS AND ACCESSORIES

All the switches shall be wired on phases. Connections shall be made only after testing the wires for continuity cross, phase etc. with the help of meguro. Regulators shall also be polycarbonate type fixed on PVC box with necessary supporting back plate with required nos. of machine screws, bolts, nuts etc. complete on the existing metal / PVC box. The arrangement of switches and sockets shall be neat and systematic. For wall plug sockets, the conductors may be terminated directly into the switches and sockets. The outlets point control boxes etc.

Installation of Industrial metal clad plug sockets wherever required for canteen electrical appliances.

11.0 POINT WIRING

11.1 Point wiring shall commence from the first point control box/local control box for the points connected to the same circuit. Point wiring for lights, ceiling and exhaust fans, 6 A sockets, call bells etc. shall be carried out with 1100 V grade PVC insulated wires. The point wiring shall be inclusive of conduits of not less than 19 mm size, switches, wiring along with conduit accessories such as bends, inspections bends, reducers, pull boxes, junction boxes, switch boxes, fans boxes, covers etc. together with wiring up to 1 mtr. long at outlet end connectors point control boxes (enclosure for electrical accessories) switches, etc. point wiring shall be provided with earth continuity wires as specified for earthing 3rd pin of sockets, luminaries and fan fixtures. Light control shall be either single, twin or multiple points controlled by a switch, as specified.

SPECIFICATION FOR POWER AND LIGHTING DISTRIBUTION

GENERAL BOARDS

This specification is applicable to 415 Volts, 3 Phase 4 wire A C supply and shall conform to the following Indian Standards [IS] (Latest Version)

1.0 TYPE AND CONSTRUCTION

Manufacture and supply of Medium Voltage, ___ Way SPN / TPN / VTPN/ & segment distribution boards with RCCB/ ELCB of suitable rating Single/ Double door with IP42 and above rating. The DB should be Phase Segregated and Separated between incomer and outgoings , suitable for surface mounting.
The distribution boards conforming to the specification and features given below.

The main switch and out goings shall have rating as specified in the drawings and schedule. The board shall be designed to have adequate cabling space for either top or bottom of both incoming and outgoing cables Earthing sockets should be fitted to the casing of D.B.

2.0 MINIATURE CIRCUIT BREAKERS

Miniature circuit breakers shall have a minimum breaking capacity of 9 KA. Circuit breakers shall be equipped with individual insulated, braced and protected connectors. The front face of all the breakers shall be flush with each other. The breakers shall have “quick break trip free” mechanism with current limiting an overload and short circuit tripping characteristics. The mechanism shall be such that the circuit cannot be held closed when a fault occurs or persists.

The contacts shall be silver tungsten or other suitable material to give long contact life. Multiple units shall have an interrupting mechanism thereby ensuring complete isolation in the circuit in the event of an overload anyone of the phases. The connectors shall be suitably shrouded.

Supplying, fixing and wiring Residual Current Circuit Breaker (RCCB) 240/450V up to 300 mA sensitivity on existing wood/panel board.

SPECIFICATION FOR LOW TENSION CABLES

1.0 SCOPE

This specification covers the technical requirements of supply, laying testing and commissioning of Heavy duty medium voltage cables up to 1100 Volts for power control and lighting application for efficient and trouble free operation.

The cable shall be properly packed for transportation, supply and delivery at site.

2.0 CODE AND STANDARDS

The materials covered by this specification shall unless otherwise stated as designed Constructed, manufactured and tested in accordance with latest revisions of the relevant Indian Standards.

3.0 RATING

The cable shall be rated for a voltage rating of 1100 Volts.

4.0 SELECTION OF CABLES

Cables should be selected considering the conditions of maximum connected load, ambient temperature, grouping factor, and allowance for voltage drops. However it is the responsibility of the contractor to recheck the sizes before cables are procured. He should submit the cable departing, voltage drop and length calculation to Architects for approval before procuring cables.

5.0 INSULATION

The conductor is insulated with suitably compounded PVC applied to the conductor by the extrusion.

The PVC compound used for insulation shall have reduced flame propagation properly. This shall also have reuses emission of hydrogen-chloride gas fumes etc., when severely overheated.

6.0 CORE IDENTIFICATION

The cores of the cables shall be provided with the colour scheme of PVC insulation as per IS for any easy identification.

7.0 ARMOURING

The armouring of multicore cable consists of either GI round steel wires or GI flat strips and in case of single core cable armouring shall be of non-magnetic material such as hard drawn aluminium or aluminium alloy wires or strips.

8.0 OUTER SHEATH

The PVC compound used for outer sheath shall be resistant to termites, fungus and rodent attacks and shall also have reduced flame propagation properly as specified above.

9.0 LAYING

Cables shall be laid in outdoor trenches wherever called for. The depth of the trenches shall not be less than 75 cms. From the Formed Ground level (FGL) which has to be ascertained from the Architects. The width of the trenches shall be allowed between the cables. The trenches shall not be less than 45 CMS.A spacing of not less than 15 cms shall be allowed between the cables. The trenches shall be cut square with vertical side walls and uniform depth. Suitable shoring and propping may be done to avoid caving in of trench walls. The floor of the trench shall be rammed level. Cable unreeling from drums shall be done only with the help of cable drum rolling supports. The cables shall be laid in trenches over the rollers places inside in trench. The cable drum shall be rolled in the direction of the arrow for rolling. Wherever cables are bent, the minimum bending radius shall not less than 12 times the diameter of the cable. After the cable is laid and straightened, it shall be covered with 8 CMS. Thick layer of sand. Cable shall be taken lifted and placed over this and cushion. The cable shall then be covered with an 8 CMS. cushions, where cable is laid in rocky situation.

10.0 JOINTING AND END TERMINATION

Cable jointing shall be done as per the recommendations of the cable manufacturer jointing shall be done by qualified cable jointer under strict supervision. Sample crimping of different size cables shall be subjected to contact resistance and heating tests in the presence of the Architects.

Each termination shall be carried out using Electroplated Brass single compression glands and copper cable sockets and approved jointing materials are to be used Hydraulic crimping tool shall be used for making the end terminations. Cable gland shall be bonded to the earth by using suitable copper/GI wire. The cable armouring is to be earthed properly so that the earth continuity as maintained.

11.0 TESTING

a. Cables shall be tested at factory as per the regulations of IS:1554 Part-1. The tests shall incorporate routine tests, type tests and acceptance tests. Copy of such test certificates shall be furnished to the Owner.

b. Cables shall be tested at site after installation and results shall be submitted to Consultants/Engineers.

c. Insulation resistance between conductors and neutral and conductors and earth.

SPECIFICATION FOR LIGHTING FIXTURES

Supplying and Installation of LED batten, LED downlighter as per the BOQ with 2 year standard warranty against any manufacturing defect working under standard electrical condition.

SPECIFICATION FOR CABLE TRAYS

1.0 SCOPE:

This specification covers the design, supply, fabrication fixing, aligning, and painting of cable trays and other steel frame works at site as required.

The cable trays shall be designed and fabricated out of various sections such as M.S angles, flats, and channels etc. and got approved by Consultants.

Before fabrication the MS sections shall be properly straightened, aligned, cleaned properly to remove rust if any.

All materials used for fabrication of cable of cable trays shall conform to IS 226 and fabrication shall be as per IS:800.

After fabrication the cable trays, and accessories shall be free from sharp edges, corners, burrs and unevenness, and a coat of cold phosphating chemical shall be applied followed by a coat of red oxide primer.

The cable trays shall be welded to the mounting supports which in turn are either welded to plate inserts or grouted to structural members.

Plate inserts for cable tray mounting supports shall be provided by Civil Contractor.

Cable trays shall be either run in cable trenches or run overhead and supported from available structure.

Minimum clearance between the top most tray tier and structural member shall be 300mm.

The type and size of tray to be used shall be as required.

Each continuous length of cable tray shall be earthed at minimum two places.

The cable trays, accessories, covers etc. shall be painted with two coats of red oxide primer followed by two finishing synthetic enamel paint of approved shade. Where any cuts or holes are made or welding is done on finished steel work, the same shall be sealed against oxidation by red oxide primer followed by finished paint.

SPECIFICATION FOR NETWORKING SYSTEM

Supplying and drawing UTP-CAT 6E LAN cable for Data, Telephone and CCTV.
Supplying and drawing PVC insulated gas injected physical foam jelly flooded co-axial TV cable.

PREAMBLE TO SCHEDULE OF QUANTITIES

1 All items of work mentioned in the Schedule of Quantities shall be read and executed strictly in accordance with the description in the Schedule of quantities, equipment schedule/Data Sheet, drawings and standard specification read in conjunction with the appropriate IS and Conditions of Contract.

All materials, fixing materials, accessories, hardware, operations, tools, equipment, consumables, civil works wherever involved and incidentals required in preparations for the full and entire execution and completion of the work called for in the item and as per specifications and drawings completely & include the cost of:

a) Wastage on materials and labour.

b) All taxes, duties, octroi, including works contract tax, VAT, Service Tax, transit

insurance, packing and forwarding charges, loading, transportation, unloading, handling hoisting, to all levels, setting and fixing in position, disposal of debris and all other labour necessary in accordance with contract documents, good practice and recognized principles.

c) Liabilities, obligations and risks arising out of conditions of contract.

d) Liaison service charges.

3. All requirements of system whether such of them are mentioned in the item or not the specifications and drawings are to be read as complimentary to and part of the schedule of quantities and any work called for in one shall be taken as required for all.

4. In the event of conflict between the bill of quantities and other documents the most stringent shall apply and

interpretation of the Architect shall be final and binding.

5. The installation price of switchboards, metering panels, DB's or any other items shall include supply and fixing or supporting steel structures/MS channels grouting of the same civil works etc., as required.

6. No change in unit rate shall be allowed for any change in quantity or for any other reason whatsoever.

7. Supply of materials shall mean supply of materials at site. The rate for supply shall include all taxes, octroi, and insurance, packing and forwarding charges, transportation, unloading at site.

8. The successful contractors shall submit the Schematic diagrams, fabrication drawings with details of all equipment's wiring before commencement of such works. The approval of these drawings will be general and will not absolve to contractor of the responsibility of the correctness of these drawings.

9. The tenders must see the site conditions such as type of soil, locations etc., and take all factors into considerations while quoting the rates as no extra cost will be allowed on any ground arising out of or relating to the site conditions.

10. Any error in description or in quantity or omission of items from the contract shall not vitiate this contract but shall be corrected and deemed to be a variation required by the Architects/Owners.

TECHNICAL SPECIATION FOR FIRE FIGHTING SYSTEM

1. MATERIALS

1.0 GENERAL:

All materials shall be of the best-approved quality obtainable and unless otherwise specified they shall confirm to the respective Bureau of Indian Standard specifications.

Samples of all materials shall be got approved before placing order and the approved samples shall be deposited with the Employer.

In case of non – availability of materials in metric size, the nearest size in FPS units shall be provided with prior approval of the Employer / Consultants for which neither extra will be paid nor any rebate shall be recovered.

If directed / found necessary, materials shall be tested in any testing laboratory selected by the Employer and the Contractor shall produce the test results to the Consultant for his scrutiny and approval. The entire charges for original as well as repeated tests shall be borne by the Contractor. If required, the Contractor shall arrange to test portion of work at his own cost in order to prove the soundness of the same, to the Employer/Consultant or their representatives. The work or portion of work if found to be not satisfactory in the opinion of the Employer / Consultant or their representatives. Contractor shall pull down and re – do the same at his own cost. All defective materials shall be removed from the site immediately as ordered.

It shall be obligatory for the contractor to furnish certificates, if so demanded by the Employer / Consultant from manufacturer or the material supplier, that the work has been carried out by using their material and installed / fixed as per their recommendations.

A.1.0 FIRE HYDRANT PIPES:

All fire hydrant pipes, sprinkler etc., shall be of GI pipe (`C' class).

A.1.1 GI Pipes shall be galvanised mild steel hot finished seamless or ERW pipes screwed and socketed tubes confirming to the requirement of I.S 1239 – 1982 for medium grade. They shall be of the diameter (Nominal bore) as specified in the item specification / as directed by the Consultant nominal bores of the pipes for which they are intended. The GI pipes shall be of MAKE as per the list of approved makes only.

The pipes and sockets shall be clearly finished, well galvanised in and out and free from cracks, surface flaws, laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut clean and square with the axis of the tube.

All screwed tubes and sockets pipe to up to and including 40mm dia shall have pipe threads confirming to the requirements of IS-543 – 1955(or revised) screwed tubes shall have threads while the sockets shall have parallel threads.

Pipe 50mm dia and above shall have welded / flanged joints. All welding shall be done by qualified welder and shall shortly confirm to India standard code of procedure for manual metal are welding of mild steel.

The weights of GI pipes for various classes and diameters shall be as reproduced below: Weights in kg per

meter of common GI pipe of various diameters (plain ends)

Dia in mm	(Light) `A' Class	(Medium) `B' Class	(Heavy) ` C' Class
15	0.952	1.22	1.45
20	1.410	1.58	1.90

25	2.010	2.44	2.97
32	2.580	3.14	3.84
40	3.250	3.61	4.43
50	4.110	5.10	6.17
65	5.800	6.51	7.90

A.1.2 Pipe fittings:

The fittings shall be of malleable cast iron or galvanised mild steel tubes as called for complying with all the appropriate requirements given in para A.1.1 or as specified. The fitting shall be designated by the respective nominal bores of the pipes for which they are intended.

The fittings shall have screw threads at the ends and confirming to the requirement of IS-544 – 1955 (or revised). Female threads or fittings shall be parallel and male threads (except on running nipples and collars of unions) shall be tapered.

A.1.3 Cutting, Laying and Jointing:

The pipes and fitting shall be inspected at site before use to ascertain that they confirm to the specifications given in para A.1.1 above. The defective pipes shall be rejected. Where the pipes have to be cut or rethread, the ends shall be carefully filed out so that no obstruction to born is offered. The ends of the pipes shall then be threaded confirming to the requirements of IS: 544 – 1955 with pipe dies and taps carefully in such a manner as will not result in slackness of joints when two pipes are screwed together. The taps and dies shall be used only for the straightening screw threads which have become bent or damaged and shall not be used for turning of the threads so as to make them slack, as the later procedure may not result in a water tight joint. The screw threads of pipes and fittings shall be protected from damage until they are fitted.

A.1.4 The pipes shall be cleaned of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over with white lead and a few turns of cotton thread spun yarn wrapped round the screwed in the socket, tee etc., with the pipe wrench. Care should be taken that all pipes and fittings are properly jointed so as to take the joints completely watertight and pipes are kept at all time free from dust and dirt during the fixing, the joint shall be removed after screwing. After lying, the open ends of the pipes shall be temporally plugged to prevent access of water, soil or any other foreign matter.

Any threads exposed after jointing shall be painted or in the case of underground piping thickly coated with approved anticorrosive paint to prevent corrosion.

A.1.5 External Works:

The galvanized iron mild steel pipes and fittings in external work for fire hydrant / yard hydrant piping shall be laid in neatly excavated trenches. The widths and depths of the trenches for different diameters of the pipes shall be as given in the table below, and shall be deep enough to have a clear cover of atleast 400mm above the top of pipes.

Dia. Of pipe	Width of trench	Depth of trench
80mm to 100mm	450cm	60cm
150mm to 100mm	600cm	75cm

At joints the trench, width shall be widened wherever it is necessary. The work of excavation and refilling shall be done true to line and gradient.

The pipes shall be painted with two coats of anticorrosive bitumastic paint of approved

quality followed by wrapping with burlap or hessain based bitumen pipe kote of 4mm thickness with overlap of minimum 25mm. The pipes shall be laid on a layer of 7.5cm sand and filled with excavated earth. The supplies earth shall be disposed off as directed. The filling shall be done after testing & rectifying leakages and after final passing of work by the Consultant.

When the excavation is done in rock the bottom shall be cut deep enough to permit the pipes to be laid on a sand cushion of minimum 7.5cm. in case of bigger diameter pipes where the pressure is very high thrust blocks of cement concrete 1:2:4 (1 cement :2 coarse sand: 4graded stone aggregate of 20 nominal size) shall be constructed on all bends to transmit the hydraulic thrust without impairing the ground and spreading it over a sufficient area, as directed by the engineer – in – charge / Consultants.

A.1.6 Testing the joints:

After laying and jointing, the pipes and fittings shall be inspected under working conditions of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra cost to Owner. The pipes and fittings after they are laid shall be tested to hydraulic pressure of 15kg/ sq.cm. (100 meter or double the designed working pressures whichever is more). The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw off takes and stop cooks shall be then closed and specified hydraulic pressure shall be applied gradually. Pressure gauge observations shall be made for atleast 2hrs. The pipes and fittings should be tested in section as the work of laying proceeds, keeping the joints exposed for inspection during thetesting.

A.1.7 Measurements:

The lengths shall be measured in running mater correct to a cm for the finished work, which shall include GI pipes and sockets, GI fittings such as bends, tees, elbows, reducers, crosses, plugs, sockets, nipples and nuts, but exclude brass or gunmetal taps (cocks), valves, lead connection pipes and shower rose. The length shall be taken along the central line of the pipefitting. All pipes and fittings shall be classified according to their diameter of the internal bore. The pipe shall be described as including all cuttings and wastage. In case of fittings of unequal bore, the largest bore shall be measured. Digging and refilling of trenches shall be measured separately or clubbed with main item as called for in the item specification/tender bill of quantities.

A.1.8 Internal work:

The rate of internal fire hydrant piping shall include the cost of labour and material involved in all the operations described above except in para A.1.7. The rate shall include the cost of cutting holes in walls and floors making good the same including clearing of the debris. Insulation of pipes for hot water supply will be paid separately as extra item.

A.1.9 External work:

The rate of external fire hydrant work shall include the cost of labour and materials involved in all the operations described above except in Para A.1.5. This shall exclude excavation of trenches, painting of pipes and refilling all round the pipes.

A.1.10 Gun metal Fittings: (General)

The brass or gunmetal fitting shall be heavy quality and approved manufacture and pattern with screwed or flanged ends as specified. The fittings shall in all respects comply with the Indian standard specifications No. I.S. 778 – 1984 (Fourth revision) and I.S. 781 – 1984 (Second revision). The standard size of brass or gunmetal fittings shall be designated by the nominal bore of the pipe outlet to which the fittings are attached. A sample of each kind of fittings shall be got approved from the Consultants / Employer and all supplies should be made according to the approved samples.

All cast fittings shall be sound and free from laps, blowholes and filings. Both internal and external surfaces shall be clean, smooth and free from sand etc. Burning, plugging, stopping or patching of the casting shall not be permissible. The bodies, bonnets, spindles and other parts shall be truly machined so that when assembled the parts shall axial, parallel and cylindrical with surfaces smoothly finished. The area of the water – way of the fittings shall be less than the area of the nominal bore.

The fittings shall be fully examined and cleared of all foreign matters before being fixed. The fittings shall be fitted in the line in a workman – like manner. The joints and fittings shall be leak – proof when tested to a pressure of 6kg / sq. cm as described in Para above and the defective fittings and joints shall be replaced or redone, without any extra cost.

A.2.0.1 Gun-metal full way valve with wheel:

These shall be of the gunmetal fitting with wheel and shall be of gate valve type opening full way and of the size as per specification. These shall generally confirm to I.S. 780-1984 (Sixth Revision).

A.2.0.2 Butterfly / Ball Valves:

Valves up to 40 mm dia and below shall be Nickel plated brass body heavy stainless steel ball, lever operated, tested to 20Kg/sq.cm with female screwed ends. All ball valves shall be of full-bore type and of RB make.

Valves from 50mm up to 150mm dia shall be of cast of iron body butterfly valves lever operated with flange ends. Valves shall carry IS certification mark. The valves shall be of INTERVALVE make.

All valves shall be approved by consultants before they are used on work.

All globe and check valves shall have working parts suitable for hot and cold water, as required. Valves shall be tagged with permanent label under hand wheel indicating type or duty.

A.2.0.3 Sluice Valves:

The sluice valves are used in a pipeline for controlling or stopping flow of water. They shall be of specified size and class and shall be of inside non – raising screw type spindle with either double flange or double sockets ends and cap or hand – wheel.

These shall in all respects comply with the Indian Standard specification IS. 778– 1984 for Valves up to and including 300mm, size and No. BDC (429) p2 for valves above 300mm, size. Calls – I sluice valves are used for maximum working pressure of 10kg / cm2, (100 meter head) and class – II sluice valves for 15kg / cm2 (150 meter head).

The body, domes, covers, wedge gate and stuffing box shall be of good quality cast iron, the spindle of bronze the nut and valves seats of leaded tin bronze. The bodies, spindles and other parts shall be truly machined with surfaces smoothly finished. The area of the waterway of the fitting shall be not less than the area equal to the nominal bore of the pipe. The valve wheel shall be marked with an arrow to show the direction of turn for closing the valves.

The valve shall be fully examined and cleared of all foreign matter before being fixed. The fixing of the valve shall be done by means of bolts, nuts, and 3mm rubber insertions or chemically treated compressed fibre board of 1.5mm thick minimum thickness and of weight not less than 0.183gm per sq.cm with the flanges of spigot and the socketed tail pieces drilled, to the same specification in the case of S & S pipe and with flanges in case of flanged pipes. The tail pieces shall conform to IS. 1938 – 1960. These shall be jointed to the pipes line by means of lead caulked joints.

A.2.0.4 Appurtenances:

The other appurtenances of pipeline are mentioned below:

a) Air Release Valves:

These are placed at every summit in the pipeline to permit the escape of air when the main is filled and afterwards, if any air carried out in to the mains. These are also placed on long stretches of nearly level main.

b) Scour Valves:

These are placed at the bottom of all depressions for emptying the main of letting out the sediment.

c) Reflux /Non-return Valves:

These are fixed so as to open in the direction of flow but automatically close if the water flows back. They are used to diminish the damage done by the escape of water due to a burst or prevent damage to impellers of pumps.

A.3.0 Masonry Valve Chambers:

A.3.1 General:

All masonry valve chambers for sluice valves, etc., shall be built as per supplied drawings / shall be of size 1200 x 1200 x 1500mm depth with 600x600 mm cast iron manhole cover.

A.3.2 Excavation:

The excavation for valve chambers shall be done true to dimension and levels as indicated on plans or as directed by the Consultants / Site Engineering.

A.3.3 Bed Concrete:

This shall be cement concrete 1:3:6 (1 cement: 3 fine sand: 6 graded stone aggregate 40mm nominal size).

A.3.4 Brick Work:

This shall be in Class B brick (Table Moulded) with crushing strength not less than 35kg / sq.cm, in cement mortar 1:6 (1 cement: 6 fine sand). Confirming to Relevant IS.codes.

A.3.5 Plastering:

Plastering not less than 12mm thick shall be done in cement mortar 1:3 (1 cement: 3 coarse sand) finished with a floating coat of neat cement.

A.3.6 Surface Box:

This shall be of cast iron, well made and free from casting and other defects. All sharp edges shall be removed and finished smooth. The shape and dimensions for surface boxes for stopcocks, sluice valves etc., shall be as per approved samples.

A.3.7 Measurements:

Masonry chambers shall be enumerated under the relevant items.

A.3.8 Rating:

The rate shall include the cost of materials and labour involvement in all the operations described above, except the excavation in soft or decomposed and hard rock. The difference in cost, between ordinary soil and soft or decomposed or hard rock as the case may be, shall be paid for separately if the rock is met with.

A.4.0 Thrust Blocks and Anchorage:

At all changes of directions or gradients, thrust blocks made of cement concrete M150 duly

designed should be provided around the bends of the pipes made of GI withstand dynamic and static forces likely to be developed due to water running the pipes. The thrust blocks shall be made after the joints are tested and found OK.

A.4.1 `Y' Strainers:

Strainers shall be of approved make, equal `Y' type of pot strainers, with cast / MS fabricated bodies. Strainers shall have bronze screen with 3mm perforations. Screen shall be removable and replaceable without disconnection of the main pipes. All strainers shall be provided with equal size isolation valves, so that the strainer may be cleaned without draining the system. All `Y' type strainers wherever specified shall be MS fabricated type only.

All pipe supports shall be mild steel, thoroughly cleaned and given on primary coat of red oxide paint before being installed.

A.4.2 Water Flow Switch:

Vane type water flow detectors shall be installed on the sprinkler system piping as designated on the drawings and / or as specified herein. Detectors shall be designed for mounting on either vertical or horizontal piping, but shall not be mounted in a fitting or within 300 mm (12 inches) of any fitting that changes the direction of water flow, and shall have a sensitivity setting to signal any flow of water that equals or exceeds the discharge from one sprinkler head. Detector switch mechanisms shall incorporate an instantly recycling pneumatic retard element with an adjustable range of 0 to 70 seconds. Switches shall have a minimum rated capacity of 7 amp 220 volt AC 0.25 amp 24 volt DC and shall be actuated by a polystyrene vane extending into the water way of the piping. Detector a 15-mm (1/2inch) conduit entrances and shall be finished in red baked enamel.

A.4.3 Tamper Switch:

If specified and listed in BOQ, valve supervisory switches shall be on all control valves throughout. Switches shall be mounted so to interfere with the normal operation of the valve and shall be adjusted to operate within two revolutions of the valve control or when the stem has moved no more than one fifth of the distance from its normal position. The switch shall provide a tapped conduit entrance and incorporate the necessary facilities for attachment baked enamel. The switch mechanism shall have a minimum rated capacity of 7 amp. 220 volt, 0.25 amp 24 volt DC. The entire installed assembly shall be temper proof and arranged to cause a switch operation if the housing cover is removed or if the unit is removed from its mounting.

A.5.0 External Stand Post Type Hydrant Assembly:

Stand Post

MS stand post with MS heavy grade pipe for seating the yard hydrant valve 80mm dia x 1800mm long.

A.5.1 Single Headed Hydrant Valve:

Gun metal oblique type hydrant valve of single outlet with necessary hose coupling adapter of 63 mm size, instantaneous spring lock arrangement and blank cap conforming to IS 5290.

A.5.2 Hose with coupling:

Controlled percolation / RRI, hose confirming to IS 8423 of 63mm dia. x 15 RMT long shall be provided with suitable fire hose delivery coupling of instantaneous spring lock arrangement comprising of male and female half and rubber cap washer as per IS 903.

A.5.3 Gun Metal Branch Pipe with Nozzle:

Gun metal short branch pipe shall be of shall be of 63 mm dia. female instantaneous inlet, male threaded outlet complete with hexagonal nozzle of 19 mm dia heavy quality as per IS 903 shall be provided.

A.5.4 Hose cabinet:

MS hose cabinet to accommodate two nos. of hosepipes with coupling and 1no branch pipe shall be provided for each yard hydrant valve. This cabinet shall be glass fronted with hinged door and lock. The cabinet shall be powder coated to scarlet red colour.

A.5.5 Fire Brigade Inlet Connection:

Fire brigade connection shall be provided to the reservoir comprising of four instantaneous pattern 63 mm dia inlets with four nos. built – in non- return valve including cap with chair and 150 mm dia sluice valve. The manifold shall be mounted in a MS cabinet with glass fronted door.

A.6.0 Internal Hydrant Assembly:

A.6.1 Single Headed Hydrant Valve:

Gun metal oblique type hydrant valve of single outlet with necessary hose coupling adapter of 63 mm size instantaneous spring lock arrangement and blank cap confirming to IS 5290.

A.6.2 Hose with Coupling:

Controlled percolation / RRL hose confirming to IS 8423 of 63 mm dia x 15 RMT long shall be provided with suitable fire hose delivery coupling of instantaneous spring lock arrangement comprising of male and female half and rubber cup washer as per IS 903.

A.6.3 Gun metal Branch Pipe with Nozzle:

Gunmetal short branch pipe shall be of 63 mm dia. Female instantaneous inlet, male threaded outlet complete with hexagonal nozzle of 19 mm dia. Heavy quality as per IS 903 shall be provided.

A.6.4 Hose Reel:

Hose reel of swing type with 19 mm dia and 36 RMT long hose and hand-controlled nozzle of 6.35 mm dia shall be provided on a drum with suitable bracket for fixing on the wall.

A.6.5 Hose Reel Cabinet:

MS hose cabinet of size to suit the location of fire duct shown in drawing for the fire escape hydrant and the hose reel assembly and shall be flush with the wall. These cabinets shall be glass fronted with hinged door and lock. The cabinet shall be powder coated to scarlet red colour.

A.6.6 Hose and Extinguisher Cabinet:

Where indicated on the plan installs the auxiliary hose stations within a fire hose cabinet.

Recessed Style – box shall be 18 gauge steel with 20 gauge hollow metal door and 16 gauge steel trim – door shall be due panel type with finish interior with trim – door shall be due panel type with finish interior with factory prime exterior set finished specified Croakers standard 5000 series.

A.7.0 Piping Installation:

Tender drawings indicate schematically the size and location of pipes. The Contractor on the award of the work. Shall prepare detailed working drawings, showing the cross section, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports. He must view the specific openings in buildings and other structures through which pipes are designed to pass.

A.7.1 Above Ground Piping:

All pipes inside and outside the building, laid above the ground shall be properly supported on, or suspended from, stands, clamps and hangers as specified and as required. The contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers, and be responsible for their section and usage. Approved type of anchor fastener shall be used along with standard pipe supports, like HITEC supports.

the pipes shall be duly painted with one coat red oxide primer and two coats of synthetic enamel paint of fire red colour as per shade No 536per IS 5. The pipes shall be supported a minimum interval of 3.5 Mts. between adjacent supports.

A.7.2 Vertical risers shall be parallel to walls and column lines and shall be straight and plump. Risers passing from floor to floor shall be supported at each floor by clamps or collars attached to pipe and with a 15 mm thick rubber pad or any resilient material. Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent waterleakage.

A.7.3 Pipe sleeves 50mm larger diameter than pipes shall be provided wherever pipes through walls and slabs and annular space filled with fibreglass and finished with retainer rings.

A.7.4 All pipe work shall be carried out in a workman like manner causing minimum disturbance to the existing services, buildings roads and structure. The entire piping work shall be organized in consolation with other agencies work so that laying of pipe supports pipe and pressure testing for each area shall be carried out in one stretch.

A.7.5 Cut outs in the floor slab for installing the various pipes are indicated in the drawings. Modification of these cut-outs / additional cut-outs if required shall be included in theoffer.

A.7.6 The contractor shall make sure that the clamps, brackets, clamps saddles and hangers provided for pipe supports are adequate. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.

A.7.7 All pipes shall be accuraction cut to the required sizes in accordance with relevant ISI codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reducers shall be used for the piping to drain freely. In other location, concentric reducers may be used.

A.7.8 All welding of pipes shall be carried out by certified welding only. A welding procedure shall be prepared and qualified before any welding is done. The welding standard shall be as per AWSD 10.9, level AR- 3. All pipe works of 40 mm NB and below shall be of screwed constructions.

A.7.9 Under Ground Piping:

All buried piping shall be duly painted with one coat of bituminous primer and above this one layer of tar felt of 4 mm thickness shall be wrapped. Above this a finished wrapping with PipeKote shall be provided. The UG piping is to be laid in such a way that TOP level is minimum 1mtr from ground level PCC 1:4:8 anchor supports shall be provided for bends and tees wherever change in flow direction occurs.

A.7.10 Excavation and Back Filling:

Excavation for UG pipeline shall be done in all type of soil conditions to a minimum of 1mtr below the ground level i.e. to the top of pipe elevation.

A.7.11 Testing & Balancing:

All piping shall be tested to hydrostatic test pressure of atleast One and Half time the maximum operating pressure but not less than 10kg per sq.cm gage for a period of not less than 2 hours. All leaks and defects in joints revealed during the testing shall be rectified and got approved at site.

A.7.12 Piping repaired subsequent to the above pressure test shall be re- tested in the same manner till no leaks and pressure drops are found.

A.7.13 System may be tested in sections and such sections shall be securely capped then retested for entire system.

A.7.14 The contractor shall give sufficient notice to all other agencies at site of his intention to test a section or sections of piping and all testing shall be witnessed and recorded by owner's site representative.

A.7.15 Measurements for piping:

Unless otherwise specified measurements for piping for the project shall be on the basis of centreline measurements described herewith.

A.7.16 Piping:

Shall be measured in units of length along the center line of installed pipes including all pip fittings, flanges (with gaskets and nuts and bolts for jointing) unions, bends, elbows, tees, concentric and / or eccentric reducers, inspection pieces, expansion loops etc., the above accessories shall be measured as a part of piping length along the center line of installed pipes and no special rates for these accessories shall be permitted.

The quoted unit rates for centre line linear measurements piping shall include all wastage allowance, pipe supports including hangers, MS channel, wooden haunches, nuts and check nuts, vibration isolator suspension where specified or required and any other item required to complete the piping installation as per the specification. None of these items will be separately measure NOR paid for.

However, all valves (gate / globe / check / balancing / butterfly / ball etc.,) strainers, orifice plates, thermometers, pressure gages shall be separately measured and paid as per their individual unit rates.

B.1.0 Equipment, material and workmanship:

a) Determine that each piece of equipment meets that detailed requirements of the contract documents and that it is suitable for the installation shown. Notify the Architect of any shortcomings found during the tendering period. Each piece of equipment furnished shall meet all detailed requirements will not be acceptable, even though specified by name along with other manufacturers.

b) Where two or more units of same class of equipment are furnished use products of the same manufacture, component parts of entire system need not product of the same manufacturer, but confirm to I.S.I standard. Furnished all materials and equipment, new and free from defects and of size, make type and quality here in specified or approved by the Employer /

Architects. All shall be installed in a neat and workmanlike manner.

B.2.1 Mode of measurement:

B.2.2 All drainpipes shall be measured in linear lengths along the centreline of drainage line laid. Deductions shall be made for chambers and fitting lengths, etc. The rate shall include all works as specified in the respective items.

B.2.3 Stoneware or cast iron gully, traps, bends and junctions, sewer traps etc. shall be measured in numbers as in above.

B.2.4 All GI pipes for fire hydrant shall be measured in linear lengths along the centre line completed including the fittings like collars, elbows, tees, hex nipples etc. the rate shall include cutting, threading, jointing, pressure testing etc. complete as specified in the respective items.

B.2.5 Same rate shall be applicable for pipes of same size and materials laid in building at any level or floor.

B.2.6 The rock cutting shall be measured in cu. m of the stacks of excavated rock. The deductions for voids being 50%of the stack measurement. Only the rock which is removed by chiselling or blasting etc., shall be measured for this item of work. Boulders shall not be considered as a rock. The excavated rock will be the owner's property.

C.0 MISCELLANEOUS WORKS:

C.1.0 HANGERS & SUPPORTS:

C.1.1 General:

Provide proper solid angle iron / channel section, supports for all pipe runs in the vertical ducts and run horizontally suspended from the slab, complete with clamps. Wherever insulation comes, to provide wooden guide to support pipe on the angle iron hangers / supports. For attachment in concrete, use `Dash' fasteners or Anchor plug type inserts or equivalent. Provide hangers within 900mm of all changes in direction of mains. A minimum of three hangers per expansion bends wherever shown in drawing. Provide all additional structural steel angles, channels or other members not specifically shown but are required for proper support.

Where necessary additional hangers to be provided to arrest water hammers of hydraulic resonance with proper rubber padding.

Space hangers as noted below, except on all soil pipes, which shall have a hanger of multiple fittings. Sufficient hangers shall be provided to maintain proper slope without sagging. In case of angle suspended line, the following is suggested.

a)

Pipe Sizes	Hanger Rod Dia.
20 through 50mm	10mm
65 through 125mm	12mm
150 and over	15mm

b)

Pipe Sizes	Spacing of Supports
12 to 20mm	1.5m apart
25 to 40mm	2 m apart
50 above	2 m apart or as per IS.

Provide floor stands, brackets or masonry piers etc. for all lines running under the floor or near walls for those lines can be properly supported or suspended from the walls or floors. Pipelines near concrete or masonry walls shall be supported by hangers carried from wall brackets. Hanging of any pipe from another is prohibited.

C.2.0 Cutting, Patching, Repairing & Making good:

C.2.1 Cutting, patching and repairing required for the proper installation and completion of the work specified in each division, including chasing, plastering, masonry work, concrete work, etc. and making good shall be carried out by the contractor wherever required. Holes which are cut oversize shall be refilled, so that a tight fit is obtained around the pipe or passing through. Any damages to water proofed location should not be patched up, without rectification by the water proofing agency (specialist contractor) to ensure his guarantee. Repair of waterproofing shall be born by the sanitary contractor if the damage is done by sanitary contractor.

C.3.0 Equipment Protection:

C.3.1 Keep all pipe and conduit openings closed by means of plugs or caps to prevent the entrance of foreign matter. Protect all piping, conduit, fixtures, equipment or apparatus. Any such work shall be restored to its original condition or replaced at no expense to the owner.

C.3.2 Accessibility:

The installation of valves, thermometers, cleanout fittings and other indicating equipment or specialties requiring frequent reading, adjustment, shall be conveniently and accessibly located with reference to the finished buildings. Thermometers and gauges shall be installed so as to be easily read from the floor. For floor cleanouts minimum distance of 600mm shall be available from any wall.

D.1.0 Cleaning, operation & Tests:

D.1.1 Fire hydrant equipment piping etc. shall be free of stampings, making (except those required by codes) iron cutting and other foreign materials.

D.1.2 Fire hydrant and sprinkler piping shall be cleaned thoroughly, filled and flushed with water.

D.1.3 The entire mechanical apparatus shall operate at full capacity without objectionable noise or vibrations.

D.1.4 Test all fire hydrant systems in the presence of the site engineer / supervisor and the Consultant as herein specified. Provided all equipment, materials and labour necessary for inspection and tests. After repairs are made, repeat test until units / a system is found satisfactory, to the above authorities. Carry out tests prior to concealing, insulating or back filling over any piping. No exceptions will be made.

D.2.1 Water Test:

Test entire system or sections of system by closing all openings except the highest opening and filling system with water to the point of overflow. If the system is tested in sections, plug each opening except the highest opening of the section filled with water. Keep the water in system or in portion under test for atleast 2 hours before inspection starts with test pressure
/ head lasting for two hours. The system must be tight at all joints.

D.3.0 All hydrant Piping:

Hydro – static test 15 kg / cm 2 or twice the working pressure which ever is higher. With

drop in pressure as required.

All tests on below ground lines shall be continued to backfill on such a line are completed to disclose any damages caused by back filling. All system shall bee tested in section as required to expedite the work of other trades and meet construction schedules and final test on completion.

D.3.1 On completion of the works, the following tests shall be performed to the satisfaction of the consultants / client representative before issue of virtual completion certificate, if sorequired.

a) Hydraulic Test

b) Pump rating and output

The contractor shall arrange for similar tests during the progress of works to ensure that there are no defects in materials / workmanship in portions of work to be concealed or embedded under the floor or walls in ceiling and get this approved by the consultants. The under floor pipe works shall not be closed without the approval of consultant.

FIRE HYDRANT PUMPS

E.0 Automatic Fire pumps & Controllers:

a) Complete Fire pump System, including pump motor auxiliary components, controllers and interconnecting power and control wiring.

b) For rating model No. Total dynamic head and electrical characteristics of pumps refer to schedule in drawings and BOQ.

c) Motor: shall be of suitable rating as specified and shall be TEFC squirrel cage induction type with class B insulation.

d) The pump shall also deliver not less than 150% of rated capacity at a pressure less than 65% rated head. The shut – off pressure should not exceed 120% of the rated pressure.

e) The following accessories shall be included with the pump unit: Eccentric Suction

Reducer

Discharge Tee

Test header with valves and caps Casing Relief Valve

Overflow Cone

Suction and discharge gauges Coupling guard

Vibration Isolator

f) Pump and driver shall be mounted on a common base plate of either cast lorn or fabricated steel and direct connected through a flexible coupling. The pump shall have Bronze impellers mounted on to SS shafts.

g) Provide name and capacity plate with pump.

h) Prior to shipment, the pump and motor for this project shall be thoroughly shop tested as a complete unit by the pump manufacturer. This shall include a hydrostatic test to twice the working pressure, but in no case too less than 1724 KPA (250 psig). A certified characteristic curve showing the pump performance based upon the results of the shop test shall be furnished to the purchaser. The test data shall include a plot of motor speed Vs pump capacity over the entire range from shut – off to beyond 150% of design capacity.

E.1.0 JOCKEY PUMP:

a) Pumps shall be horizontal centrifugal end section top discharge type having bronze impellers, which are pinned for positive driving to stainless steel impeller shafts.

b) For pump rating total dynamic head and electrical characteristics refer to schedule on drawings

c) Pump shall contain close grained cast iron diffusers and equipped with and equipped with bronze casing rings. Sleeve – type base bearings shall be bronze.

d) Pump base and motor adapter shall be cast iron with complete mechanical shift seals and standard TEFC / SPDP proof motors drip canopies.

E.1.1 DIESEL ENGINE DRIVEN PUMPSET:

As stand – by for the main electric motor driven pump set a diesel engine pump set shall be provided. The pump construction and duty conditions shall be similar to the electric motor driven pump sets.

The engine shall be multi cylinder radiator water-cooled diesel engine directly coupled to the pump. The capacity of the engine shall be atleast 20% greater than HP required to drive the pump at its duty point. The engine shall be complete with following accessories.

a) Fly Wheel.

b) Direct coupling for pump and coupling guard, radiator with fan, water pumps drive arrangement and guard.

c) Air Cleaner

d) Corrosion resistor

e) Fuel service tank (8hour) level gauge, supports, fuel oil filter with GI pipe work and valves from tank to engine.

f) Lube oil pump and filter

g) Electrical staring battery 2 x 12V

h) Residential Exhaust silencer with insulated exhaust piping.

i) Instrumentation panel complete with Lube oil pressure, temperature gauges, water temperature, pressure gauges, tachometer, hour meter and starter switch with key for manual operation.

j) Safety controls consisting of low lube oil pressure, high cooling water and lube oil temperature and over speed.

k) Anti-vibration mounting

l) Battery charger with float and booster charger.

E.1.2 Control Panels:

A combined control for automatic/manual operation of fire pump sets shall be provided. The functional requirement of control panel shall be as follows:

a. When the water pressure in the system fall 0.35Kg/sq.cm below normal system pressure, the jockey pump shall start automatically when set to auto status and shut down when the system pressure reaches set value.

b. When the water pressure in the system falls 0.35 kg / sq.cm below the normal system pressure (due to opening of hydrant / test valves etc.,) the main electric pump shall start automatically when set to auto status and shut down when system pressure reaches set value. The pressure setting shall be adjustable.

c. If within a preset period the electric pump has not started pumping water or electric fire pump fails during operation the electric pump shall be locked out and start up of diesel pump shall be initiated. An audiovisual alarm shall be given indicating failure of main pump operation.

d. If with in a preset period the stand by pump also to start pumping water the stand by pump shall be given a control panel.

e. The control panel shall have been manual / auto operation selector switches. During manual operation individual pumps shall be manually operated through relevant push buttons.

f. Returning the locked out pumps to normal operation shall be feasible by manual rest of locked out units by operation of appropriate push buttons.

g. When main fire pump is in operation an audible tone shall be provided to indicate healthiness of the system. This tone will be shut down along with main fire pump shut down.

h. Alarm for failure / lock out of the pump shall be distinct from the healthy alarm. Failure alarm shall be loud and can be silenced on acceptance.

i) The control panel shall have visual announciator for running of jockey & fire pumps, power failure and mains on.

j) The control system shall be designed for 24 VDC supply and shall be complete with battery charger unit with boost / flot charge facility with voltmeter capable of charging 2 sets of batteries at a time.

E.1.3 POWER PANEL:

Incomer	:	250 A TP&N Fuse Switch Units with HRC Fuses.
Bus bar	:	250 A TP&N Aluminium bus bar
Outgoing	:	a) 200 A TP&N fuse switch unit with HRC fuses and star & Delta starter suitable for main pump motor. b) 63 A TP&N fuse switch units with HRC fuse and star & delta starter suitable for jockey pump motor. c) 16 A TP&N fuse switch units with HRC fuses for battery charger and control panel. d) Indication Lamps and Ammeter with CTs for Fire pump motors.

The panel shall be totally enclosed free standing floor mounted cubicle type fabricated out of sheet of 2 mm / 1.6 mm. The construction shall be compartmentalized sectionalised suitable for front operation with all connections accessible from the front. Removable gland plates shall be provided at top / bottom as required. The bus bars shall be electrolytic grade aluminium (grade E91E of IS: 5082) with current density not exceeding 130 Amps / sq.cm. The bus bars shall be covered with PVC sleeves and supported by non hygroscope insulated supported such as DMC and shall be capable of withstanding 50 KARMS symmetrical current for 1sec. GI earth bus of 25 mm x 5 mm shall be run along entire be run along entire length of board with 2 earth terminals. The entire panel shall be given a primer coat of red lead after degreasing and phosphating and 2 coats of final paint of approved shade. Suitable engraved panels shall be fixed at the panel for all switches, instruments, push button, indicating lamps etc.,

E.1.4 SUBMITTALS:

1. Pump factory test data.

2. Shop drawings for the sprinkler system showing the location of the sprinkler pipe layout location of landing valves and hose reel assemblies, etc., shall be submitted and approval sought for from the consultants before start of work. Care should be taken to co- ordinate with other services like lighting etc., so that there shall be no mutual hindrances.

3. Upon completion of the installation as – built drawings for the entire system shall be prepared and submitted along with 4 sets of operating manuals for the systems.

E.1.5 PARTICULAR SPECIFICATION:

Fire Pumps:

ITEM	MAIN PUMP	DIESEL PUMP	JOCKEY PUMP
Water flow rate	2280	2280	180 LPM

LPM			
Total Head in mtr	70	70	70
Pump speed RPM	2900	1500 / 1800	2900
Pump type	Centrifugal End suction top discharge.	Centrifugal End suction top discharge.	Centrifugal End suction top discharge.
Pump Drive	Electric motor	Diesel engine	Electric motor
Type of Coupling	Direct	Direct	Direct
Pump casing material	Cast Iron	Cast Iron	Cast Iron
Impeller	Bronze	Bronze	Bronze
Shaft	Stainless Steel	Stainless Steel	Stainless Steel
Shaft Seal	Mechanical	Mechanical	Mechanical
Type of Starting	Star Delta	Battery start	DOL
Location	Basement Floor	Basement Floor	Basement Floor

FIRE EXTINGUISHERS

HAND APPLIANCES (FIRE EXTINGUISHERS).

Fully charged and tested ISI marked fire extinguishers of various types as required shall be installed in readily accessible locations with brackets fixed to wall by suitable anchor fasteners.

Each appliance shall be provided with an inspection card indicating the date of inspection, testing, change of charge and other relevant data.

All appliances shall be fixed in a true workman like manner, truly vertical and at correct locations.

Fire extinguishers shall be installed as per Indian standard 'code of practice for selection, installation and maintenance of portable first aid appliances' IS-2190-1962.

FIRE ALARM SYSTEM

- The fire alarm system shall conform to relevant Indian Standards in respect to design and Installation and give audio /visual alarm signals triggered by Manual PB stations located suitably in an area to be monitored for fire. The system shall give pin point location of fire with warning system Zone wise as well as warning for any fault within the system.
- The operating voltage system shall be 230 V AC/ 24 V DC with sealed lead acid battery backup and battery charger/ DC distribution board operating on 230 V AC+/- 10%.
- The system shall be capable to supervise all conditions with distinctive audio tones operated for system fault warning and fire alert conditions. All Audio alarms shall have except push button for cancellation of audible alarm reset future to ensure that no alarm warning is switched off inadvertently.

Following features shall be incorporated system fault warning Fire Alert and Annunciation. System Fault warning /Fire Alert

- Open Circuit in detector wiring
- Short circuit in detector wiring
- Normal conditions
- Fire Conditions
- AC Main Failure
- DC Supply Failure
- Battery low Alarm

ANNUNCIATION

- 'Flash ' on Fault
- ' Steady' On Accept
- 'OFF' on reset after fault clearance
- 'Flash', If reset with fault persisting
- 'Steady After accept even if fault cleared in the interim
- 'flash' Even if Fault disappears before accepting

Lamp test Push button shall be provided for testing the healthiness of all lamps.

The System shall be capable to switch – Off air conditioning or P & V System operating in the affected area in case of Fire.

HOOTERS

- Dual tone hooters shall be electronic type and shall give discontinuous / intermittent audible alarm automatically.
- The sound level shall be 90 dB and above

MANUAL PUSH POINTS.

- Minimum one manual push point shall be installed for each Zone in the manned area forming integral part of the Fire Detection System.
- Manual push point shall be wall mounting break glass type units, completely encase in whether proof 16 SWG housing with hinged front cover with glass front window and housing push button.
- The Front glass shall have words in bold letters " INCASE OF FIRE BREAK GLASS" a hammer with chain attached to the main housing shall be provided.
- The push button housed inside shall be Red Mushroom head, normal in pressed condition and actuating when released by breaking glass in front of housing.
- It shall have two sets of "NO" or "NC" potential free contacts suitable for 30 V DC, 3 Amps. The contact shall be wired up to terminal strip inside.
- The housing shall accommodate minimum two cables and suitable glanding / Conduit coupling arrangement shall be provided.
- The metal housing shall be treated with one coat Iron Oxide before applying two coats of Fire Red enamel paint.

MAIN CONTROL PANEL

- Main control panel shall conform to provisions of IS 2189. The panel shall be totally enclosed in dust and vermin proof type. Conforming to IP: 54 and of 16 SWG dust inhibited sheet with oven baked finish. The panel shall be completely solid state design. Microprocessor based panel also to be offered.
- Main control panel shall be designed and installed so as to prevent ingress of sut and moisture and in inaccessible to un authorized persons. The main control shall be clearly labeled to indicate mode of operation and their function.
- The panel shall have solid state circuits with restricted use of relays and shall have the following facilities.
- A pair of red LED to indicate origin of faults and milk white jeweled lamp with Floor Numbers **/ Building /Area on it.**
- Distinct audible sounds for Fire and Fault Alarms.

- Audible signal Acknowledge/ silence button and LED lamp to indicate its operation.
- Voltmeter shall be provided
- 'System on' 'Standby on' test Key operation indication shall be provided.
- 'System off Switch, Its indication and floor isolation switches shall be provided. When the isolation switch it's operated, fault signal must come on the respective floor indicators.
- Failure of any indicator circuit shall not prevent the Fire Alarm from Sounding nor should acknowledgement / Silencing of Alarm from one floor prevent another alarm system from other Zone on the same floor, or any other floor.
- Test Facility to check Fire Alarm Circuit, Indicators shall be provided.

Fault warning in the Following events

- Failure or disconnection of normal supply
- Failure or disconnection of standby supply
- Failure or Disconnection of Battery Charging equipment
- Earth Faults
- Any Fault on floor
- Any Fault on floor as detailed earlier for system failure warning
- The main Control shall work on 230 V normal supply. A standby power shall be immediately available in the event of failure of normal supply and shall be automatically connected as to maintain the Equipment in condition such that Fire Alarm originating from the operation of Fire Detector in separate Zone can be Subsequently given. The standby battery of storage type shall be of such type that when charged by associated battery charging equipment for a period of 24 hours shall have enough power supply to cope up with the additional load regulating in a an alarm originating from two separate Zone for one hour. If Utilized send Emergency evacuation Alarm, It shall supply power for at least ten minutes. The batteries shall be lead acid sealed type with required all rating.
- Suitable arrangements shall be incorporated to prevent batteries from discharging through the battery equipment in the event of its breakdown or a failure in the supply.

CONDUITS

- These shall be 16 SWG M.S welded conduit and perfectly circular tubing and capable of being cleaned and with tight fitting joints.

- All conduits shall be laid either on surface or in recess as required and as approved by consultants/ Purchaser and shall be protected from rust by one coat iron oxide and two coats of enamel paint.

ELECTRIC CABLES

- The wiring for the fire detection and alarm system shall be Fire retardant & HR PVC insulated copper conductor having minimum 1.5 Sqm cross sectional area. Conductor size for DC power shall not be less than 2.5 Sqmm copper.
- The wiring for power supply to panel and between panels shall be PVC, HR aluminum conductor power cables of 1100 volts grade conforming to IS 1553.
- All the Cables and wire shall be tagged for proper identification
- The multi-core cables should not be shared for other low voltage or High voltage circuits.
- All clamping of cables, detectors or any fixing of equipment shall be done with the use of anchor fasteners. Chipping of ceiling, floors, columns etc., shall not be permitted.

GUARANTEE AND MAINTENANCE:

A warranty for all equipments, materials and accessories supplied shall be submitted against manufacturing defects or under capacity fraction for a period of 12 months from handing over. During this guarantee period any defective items shall be repaired / replaced without any additional cost and with out any considerable delay.

TECHNICAL SPECIFICATIONS OF ACMV SERVICES

CONTENTS

SCOPE OF WORK

The ACMV services for the project will comprise of the following:

- Air-conditioning System for dining
- Mechanical ventilation, exhaust system for kitchen
- Exhaust system for toilets & garbage room

BASIS OF DESIGN

In the design of the system the following standards have been adopted.

Codes and Standards

ASHRAE STANDARDS
ISHRAE Outdoor design data

Design Data

Location – Mysuru
Altitude – 767 M Latitude - 12.2 Deg N
Peak Summer Month - April

Outside design conditions

Summer	Monsoon	Winter
38.0 ^{0}C DBT 25.6 ^{0}C WBT	29.4 ^{0}C DBT 25.0 ^{0}C WBT	18.9 ^{0}C DBT 15.6 ^{0}C WBT

Air Conditioning

The design conditions considered for air conditioning are as follows –

SL. No.	Description	Values	Unit
1	Dining	23 +/- 1	Deg C
2	Relative Humidity	Not to exceed 60	%
3	Lighting	0.6	W / Sqft
4	Fresh Air – Dining	As per ASHRAE Standards (7.5 cfm / person + 0.18 cfm / sq ft)	Cfm
5	Type of Glass	DGU	-
6	U Value of Glass	0.61	BTU/Hr.sft.F
7	Shading Coefficient of Glass	0.56	-

The cooling load for air conditioning is as follows –

Basis of Design	EXECUTIVE DINING	INDOOR DINING	TOTAL
FLOOR	**GF**	**GF**	
ZONE	**1**	**2**	
Air conditioned area - Sft	216	2297	**2514**
True ceiling Height - ft	12	12	
Ambient Conditions			
Dry Bulb – Deg F/C	100 / 37.7	100 / 37.7	
Wet Bulb – Deg F/C	78 / 25.5	78 / 25.5	
Inside conditions			
Temperature - Deg F/C	73 / 23	73 / 23	
Humidity - % RH	Not to exceed 60%		
Internal Loads			
Number of occupants	12	102	**114**
Fresh air quantity - cfm	73	1179	**1251**
Lights - watts	173	1838	**2011**
Number of computers	6		**6**
Other Equipment Loads (Kw)	0.25	2.00	**2**
TR	**1.61**	**15.03**	**16.64**
De-humidified Cfm	**620**	**4403**	**5024**

The total cooling demand for the dining works out to 16.64 TR / 5024 cfm. This demand shall be met by 4-way chilled water based cassette units as suggested by the clients (BNPM). The chilled water pipes from utility block adjacent to the canteen shall be routed to these cassette units. It is assumed that the inlet chilled water will be at 7 to 8 Deg.C.

Point has to be noted that these cassette units are not provided with fresh air as these units have a negligible capacity to handle fresh air load.

Mechanical Ventilation & Exhaust

The ventilation and exhaust system has been designed based on the data shared by kitchen vendor.

We have selected floor mounted type exhaust fan & fresh air fan located either sides of the canteen. The fresh air is ducted into the canteen & the exhaust air from kitchen hoods & other areas shall be ducted to the exhaust fan via dry scrubber to burn out the oil particles.

Toilet exhaust system has been designed for 15ACH as per NBC 2016. Propeller fan has been selected for garbage room exhaust

EQUIPMENT SPECIFICATION

CASSETTE UNITS

1.0 TYPE

The cassette unit shall be of the factory assembled, tested and complete with Centrifugal Fan, chilled water cooling coil, Filter in GI housing suitable for Horizontal or Vertical Installation as specified in Drawing / Equipment schedule.

2.0 CABINETS

The housing shall be fabricated out of 20 gauge G.S.Sheet. The Unit shall be fabricated from high quality Galvanized sheet with a neat finish. The unit shall be of light construction and easy to access all interior component such as Fan, Coil and filter. The housing, if needed, shall be doubled skin in case of special application and the same shall be specified in the BOQ.

3.0 COILS

Coil shall be constructed of Aluminium fins mechanically bonded to copper tubes. The minimum fin thickness shall be 0.008" and tubes dia shall be not less than 12 mm O.D. and the minimum wall thickness shall be 25G. Provide air vent and drain plug in the coil. Coil shall be tested at 17 bar while submerged in water.

The Coil fixing arrangement shall be designed such a way that water connection end can be easily interchanged from Left to Right Hand or vice versa at site.

The coil Header should be fitted with air-vent valve with grab screw having its outlet properly extended to the drain pan by means of flexible hose.

4.0 DRAIN PAN

Drain Pan shall be provided under the cooling coil, supply and return lines, and control valves. The pan shall be of sufficient size to catch all drippage of condensation from any part of the unit. The drain pan shall be fabricated by 1.25mm thick stainless steel sheet and shall be insulated with not less than 12 mm thick polyurethane sheet / closed cell Nitrile rubber effectively to prevent condensation from the pan.

5.0 MOTORS AND FAN

The Fans shall be of light construction Aluminium bladed forward curved having drum type rotors to minimize the noise level. The entire Fan assembly with its direct driven motor shall be statically and dynamically balanced to eliminate the vibration. The Motor shall be of the split capacitor type and shall have sufficient torque to start on low speed. The motor shall be PSC type motor and have built-in thermal over load protection. Motor shall be suitable for 240V/1Ph/50Hz Power supply. The fan assembly shall be fitted with the unit in such a way that single service personnel can easily remove the same from installed position.

6.0 VALVES / FLEXIBLE PIPES / SWITCH & THERMOSTAT

The coil shall be complete with 1 ball valve with strainer, 1 ball valve without strainer and 2-way motorised valve with dynamic balancing Valve or as specified in BOQ. The control valve shall be actuated by unit Thermostat shall be complete with digital thermostat with temperature display, 3-speed Fan switch with on/off including GI mounting junction box.

The valve package shall be connected with Pipes and unit by means of Flexible connector with brass flare fittings for quick and easy dismantling.

The entire valve package shall be located over the extended unit drain pan.

7.0 FAN SPEED CONTROL / ROOM THERMOSTAT ASSEMBLY

The unit shall be complete with fan speed control switch (either high – medium – low - off). The digital type room thermostat / 3speed switch will be mounted on a concealed standard 80 x 80 mm G.I. terminal box.

The Switch & Control assembly shall be either stand alone or communicable type as mentioned under BOQ / BMS specification.

The location of the thermostat in each room shall be as shown in the drawing and duly approved by the site Engineer.

8.0 TEMPERATURE CONTROLLER / MODULATING VALVE

The unit may have temperature controller by way of a 2 way modulating valve operated by a temperature controller communicable with BMS or as specified in BOQ.

9.0 FILTER SECTION

The units shall be fitted with washable Pre-filters (80% efficiency down to 15 microns), 12mm thick having all Aluminium construction.

10.0 NOISE LEVEL

The Noise Level of the Fan Coil Unit must be within 40db at 1.5mt. Special care should be taken to reduce the Fan noise level to minimum by acoustically treating the supply air duct.

FANS FOR VENTILATION

1.0 AXIAL FLOW FANS (DIRECT DRIVE)

Fans shall be licensed to bear the AMCA air and sound certified ratings seal. the test standard used shall be ANSI/AMCA 210-85, ANSI/ASHRAE standard 51-1985 "laboratory method of testing fans for rating and AMCA 300 "reverberant room method for sound testing of fans.

Fans shall be oven-baked with polyester coating for minimum thickness of 60 microns or hot-dipped galvanized. To achieve the minimum and equal clearance between the blade tips and casing, tube casing shall maintain its roundness by means of using one piece of sheet metal with 90 edge flanging up.

Fan motor base support shall be properly secured (locked and sealed) to the fan housing and be of adjustable type to have precise control of motor shaft central position as well as running clearance between blade tips and casing. Motor (KW/HP) shall be able to be changed or upgraded at site without changing fan housing or ducting construction.

Fans supplied shall be complete with factory fabricated mounting bracket (ceiling or foot mounted) and suction/discharge matching flanges as accessories.

All hubs shall be cast Aluminum alloy (Grade LM2) unless for Smoke Extractor Fans where high temperature (250C/2Hrs) air is expected then Aluminum alloy or steel fan impeller blades are required. Otherwise impeller blade material with Polypropylene (PP), Glass-reinforced Polypropylene (PPG) and Glass-reinforced Polyamid (PAG), to provide self-balancing, anti-static, anti-sparking characteristic is preferable.

Running clearance between blade tips and casing shall not exceed 1% of the impeller diameter, and 2% for smoke spill high temperature fan where mechanical expansion coefficient is different from normal ambient temperature. Fan manufacturer shall provide the fan assembled with the dame clearance between blade tips and casing of the tested prototype. Note that the air performance and pressure loss are greatly affected by this clearance.

Impellers shall be secured to the drive shaft by a key and keyway. Axial location shall be provided by a collar or shoulder on the drive shaft together with a retaining washer and screw fitted into a tapped hole at the end of the shaft and locked in position. Blades shall be secured in place to the angle setting by setscrews, locking nuts or setting pins.

Fan motor shall be totally enclosed and external terminal box of at least IP55 shall be provided. Motor Efficiency shall be minimum confirming specification as described in ECBC -2007

Fans shall not exceed 1500 RPM.

All fans after assembly shall be dynamically trim-balanced to ISO1940 and AMCA 204/3 - G2.5 quality grade. A computer printout with vibration spectrum analysis shall be attached to the fans.

2.0 SMOKE EXTRACTION FAN

Smoke and heat exhaust fans are required to be in compliance with the requirements of Class B performance, as defined in clause 9 of BS 7346:Part 2:1990. This requires the fan to be subjected to a rated temperature of 250C for a rated duration of 120 minutes

The fan is required to satisfy the performance criteria specified in BS 7346: Part 2:1990 relating to structural performance, electrical performance and aerodynamic performance throughout the rated duration

The testing certificate or test report shall be issued by authorized test labs duly approved by statutory body of the country of origin or common body like ASHRAE / ARI /AMCA.

For two-stage counter-rotating Smoke Spill Fan for high-pressure application, each impeller shall be driven by a separate motor within a separate casing.

3.0 BELT DRIVEN FANS

Fan impellers shall be driven by V-belts with the pulley keyed to the shaft and retained by taper-bushes.

Motor mounting plate shall be supported using four threaded rods for belt tensioning. Belt tunnel shall be sealed from the air stream and belt guards with proper ventilation should be provided.

4.0 CENTRIFUGAL FANS

Fans, Aerofoil, forward or backward curved, SISW or DIDW, shall be licensed to bear the AMCA Air and Sound Certified Ratings Seal. The test standard used shall be ANSI/AMCA 210-85, ANSI/ASHRAE Standard 51-1985 "Laboratory Method of Testing Fans for Rating" and AMCA 300 "Reverberant Room Method for Sound Testing of fans".

All fans shall be dynamically trim-balanced to ISO1940 and AMCA 204/3 - G2.5 quality grade after assembly. A computer printout with vibration spectrum analysis shall be attached to the fans.

Fans shall be oven-baked with polyester coating for minimum thickness of 60 microns, unless the housing scroll and side frame is constructed from galvanized steel sheet (G.I.), Stainless Steel, Aluminum and etc.

Fans housing shall be of an appropriate thickness to prevent vibration and drumming and in no case the housing shall be constructed less than 14-gauge sheet steel and all parts shall be bonderized and then coated with primer finish of approved colour. The fan scroll shall be attached to the side plate by means of continuous lock seam or welded seam. 18 gauge galvanised wire mesh inlet screens of 5 cm with sleeves shall be provided on both inlets. Housing shall be provided with standard cleanout & door with quick locking tension handless and neoprene gasket. Rotation arrow shall be clearly marked on the housing. The wheel and inlet cone shall be aerodynamically designed and constructed to provide maximum performance and efficiency as published by the manufacturer.

Fans must be physically capable of operating safely at every point of rating at or below the "minimum performance" limit for that class as defined in AMCA standard 99-2408- 69 "Performance Class of Operating Limits for Centrifugal Fans".

Shafts sizes shall be carefully calculated and designed such that the maximum operating speed (RPM) shall not exceed 75% of the first critical speed. For any application that is not a standard product from catalogue of the fan manufacturer detailed calculation of critical speed characteristic shall be submitted for approval.

Shafts shall be made of carbon steel (C45) machined and polished to tolerance of standard ISO 286-2 - grade g6. Protective coat of anti-rusting shall be applied to all bare surfaces of the shafts at the factory.

Bearings shall be of self-alignment (concentric) type with adaptor sleeve bearing. Bearings of eccentric locking collar with grub screw type are not acceptable. Bearing shall be maintenance free with permanently lubricated sealed ball bearing type. Bearing life shall be at least 75,000 hours based on basic rating life, L10 of ISO 281 standard.
Calculation sheet of Bearing Life shall be submitted for approval.

Motor installed shall be of a minimum 130% of the fan power absorbed (Brake horsepower) and shall have sufficient torque available for starting and continuous operation. Motor Efficiency shall be minimum confirming specification as described in ECBC -2007

Belts and pulleys shall be sized for a minimum 150% of the installed motor horsepower. The belt speed shall not exceed 30m/s. The pulley shall be of Taper Lock SPZ, SPA, SPB or SPC type. Conventional type of pulley is not acceptable. Both fan and motor pulley shall be balanced to the quality grade G.2.5.

Fan outlet velocity shall not exceed 9 meters per second and maximum fan speed shall be 900 RPM.

A computer printout on fan performance rating corresponding to the AMCA licensed data, with corrected rating for altitude and temperature, fan operating speed, bearing life, etc. shall be submitted for approval.

5.0 INLET GUIDE VANES

A. Inlet vane control for modulation of fan where specified for VAV System shall be supplied by the fans manufacturer.

B. Fans capacity shall be as per catalogue performance with the inlet vane fully open and capacity shall be able to be reduced to 25% with maximum closed inlet vane.

C. Fan shall be backward curved and will not surge for the whole operating range of the desired volume / system resistance. An inspection door is required.

6.0 CABINET FANS

Cabinet type ventilation units shall be of double skinned type and the specification remains same as described under.

Double Skin wall panels shall be provided by 48 mm thick sandwich panels made of GSS, pressure injected with polyurethane foam (CFC free) insulation of density 40 kg/cum and K factor not exceeding 0.02 W / M deg C. Double skin wall panels shall be fixed to 3 mm thick, hollow extruded aluminium profile joined by 3-D Extruded aluminium chamfered corners, forming the structural frame work to house all internal components. Inner sheet of the panels shall be made of 0.63 mm thick plain GSS and outer sheet shall be of 0.8 mm thick GSS with pre plasticised finish.

The entire framework shall be mounted on a 100mm (minimum) GI channel base. The panels shall be sealed to the framework by heavy-duty "O" ring neoprene gaskets held captive in the framed extrusion. All panels shall be detachable or hinged. Hinges shall be made of die cast aluminium with stainless steel pivots. Handles shall be made of hard nylon and be operational from both inside and outside of the unit. Units supplied with various sections shall be suitable for on-site assembly match drilled, with bolts, nuts and continuous neoprene rubber gaskets. All fixing and gaskets shall be concealed.

Unit shall have hinged quick-opening insulated access door on fan and filter sections. Access doors shall be double skin type and shall be of same construction as the wall panels.

Four (4) lifting lugs shall be bolted to each base section for lifting or placing the unit in place.

All connecting fasteners and related hardware and its accessories shall be in stainless steel.

Casing shall be of air-tight construction and sufficiently rigid to exclude vibrations, throughout the working capacity range of the unit.

The corner pieces shall be heavy duty extruded PVC / aluminium. The unit must be fitted with a suitable oppose bladed damper of all aluminium construction at the outlet of the unit

Centrifugal Fan shall follow the Fan construction as described under centrifugal fan section described. For Technical data sheet submittal formats, these equipment should take the relvant portion of fan data from AHU Technical sheet.

FILTER SECTION (Only for fresh air Unit) should be as per air filter section as described in the later part of specification.

7.0 DIRECT DRIVE TYPE

Fans shall be of DIDW Forward Curved centrifugal type with fan scroll within a cabinet. Fan speed

shall not exceed 1450 RPM.

Motor shall be for power supply 220~240V/415V / 50Hz/Single Phase or 3-phase. Motor Efficiency shall be minimum confirming specification as described in ECBC -2007

8.0 IN-LINE CENTRIFUGAL DUCT FAN

Fan shall be of SISW, forward or backward curved centrifugal, direct driven type.

Casing shall be of Galvanized steel with Oven-baked epoxy coating. Impeller material shall be either Galvanized Steel or Glass Reinforced Polypropylene.

Motor shall be external rotor / standard type for power supply 20~240V/415V/50Hz/Single Phase or 3-phase. Motor Efficiency shall be minimum confirming specification as described in ECBC -2007 / ASHRAE 90.1-2011.

9.0 PROPELLER FAN

Fans shall be of the ring-mounted type and the blades constructed from heavy gauge metal. An aerodynamically designed bell mouth constructed from heavy gauge metal shall be provided.

Propeller fans shall be direct driven type, the motor either a single-phase capacitor start-run or a three-phase squirrel cage induction type. The motor shall have inbuilt inherent protection against overloading. Motor with shaded pole or centrifugal switch type is not acceptable.

Bearings shall be maintenance free permanently lubricated type. Fans shall be complete with wire guards. External grilles, fan chambers and volume control damper shall be provided where indicated in the specification drawings.

Motor shall be standard (easily replaceable) permanent split capacitor or shaded pole for small sizes, totally enclosed with pre lubricated sleeve or ball bearings, designed for quiet operation with a maximum speed of 1000 rpm for fans 60 cm dia or larger and 1440 rpm for fans 45 cm dia and smaller. Motors for larger fans shall be suitable for 415±6%
volts, 50 cycles 3 phase power supply, and for smaller fans shall be suitable for 220 ± 6% volts, 50 cycles single phase power supply. Motors shall be suitable for either horizontal or vertical service as indicated on Drawings and in Schedule of Quantities.

Accessories : The following accessories shall be provided with propeller fans : a.Wire guard on inlet side and birdscreen at the outlet.

b. Fixed or gravity louvers built into a steel frame at the outlet.

c. Regulator for controlling fan speed for single phase fan motor.

Motor Efficiency shall be minimum confirming specification as described in ECBC -2007.

10.0 VIBRATION ISOLATION

Base shall be provided for each fan. Base for both fan and motor shall be built as an integral part and shall be mounted on a concrete foundation through vibration isolators of Dunlop make / Metalstik cushy foot mountings.

11.0 KITCHEN EXHAUST UNIT

The Kitchen exhaust shall be same as described under Smoke Extract fan. Suitable drain plug shall be provided at the bottom of Fan for easy drain out. The Fan scroll must be provided with a suitable hatch with proper gasket (high temperature) for impeller cleaning. In case the exhaust system is fitted with Dry or wet scrubber unit at the up-stream of the Fan, the construction of the unit can be DIDW cabinet fan as described above.

AIR DISTRIBUTION SYSTEM

1.0 GENERAL

Supply, fabrication, installation and testing of all galvanized steel/aluminum ducts & supply, installation, testing and balancing of all grilles, registers and diffusers, in accordance with these specifications and the general arrangement shown on the drawings.

Duct work shall mean all ducts, casings, dampers, access doors, joints, vanes, stiffeners, hangers, splitters and supports etc.

2.0 DUCT MATERIALS

The ducts shall be fabricated from galvanized steel sheets class VIII - Light coating of Zinc conforming to ISS: 277-1962 (REVISED) with accompanying Mill test Certificates. Galvanizing shall be of 120gms/sq.m. (total coating on both sides). In addition, if deemed necessary, samples of raw material, selected at random by owner's site representative shall be subject to approval and tested for thickness and zinc coating at contractor's expense.

In case of factory fabricated duct the G.I. raw material should be used in coil-form (instead of sheets) so as to limit the longitudinal joints at the edges only irrespective of cross-section dimensions

2.1 SPECIFICATIONS FOR FACTORY FABRICATED DUCTING

Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA-1995 standards ("HVAC Duct Construction Standards-Metal and Flexible-Second Edition-1995" SMACNA)

DUCT CONNECTORS AND ACCESSORIES

All transverse duct connectors (flanges / cleats) and accessories/related hardware are such as support system shall be zinc-coated (galvanized).

2.2 FABRICATION STANDARDS

All ductwork including straight sections, tapers, elbows, branches, show pieces, collars, terminal boxes and other transformation pieces must be factory-fabricated. Equivalency will require fabrication by utilizing the following machines and processes to provide the requisite quality of ducts and speed of supply. Coil lines to ensure location of longitudinal seams at comes / folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any face side of the duct. All ducts, transformation pieces and fittings to be made on CNC profile cutlers for required accuracy of dimensions, location and dimensions of notches at the folding lines. All edges to be machine treated using lock formers, flanges and roller for fuming up edges. Sealant dispensing equipment for applying built-in sealant in Pittsburgh lock where sealing of longitudinal joints are specified will be used.

2.3 SELECTION OF G.I. GAUGE AND TRANSVERSE CONNECTORS

Duct Construction shall be in compliance with 2" (500Pa) w.g. static norms as per SMACNA. All transverse connectors shall be as per OEM 4-bolt slip-on flange system or equivalent of similar 4-bolt systems with built-in sealant if any to avoid any leakage additional sealant to be used. The specific class of transverse connector and duct gauge for a given duct dimensions will be 1" (250 Pa) pressure class. Non-toxic, AC -applications grade P.E. or PVC Casketing is required between all mating flanged joints. Gasket sizes should conform to flange manufacturer's specification.

2.4 DUCT CONSTRUCTION

2.4.1 The fabricated duct dimensions should be as per approved drawings and all connecting sections are dimensionally matched to avoid any gaps.

2.4.2 Dimensional Tolerances: All fabricated dimensions will be within 1.0 mm of specified dimension. To obtain required perpendicularity, permissible diagonal tolerances shall be **1.0 mm per meter**

2.4.3 Each and every duct pieces should be identified by color coded sticker which shows specific part numbers, job name, drawing number, duct sizes and gauge.

2.4.4 Ducts shall be straight and smooth on the inside Longitudinal seams shall be airtight and at comers only, which shall be either Pittsburgh or Snap Button Punch as per SMACNA practice, to ensure air tightness.

2.4.5 Changes in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7). Turning vanes or air splitters shall be installed in all bends and duct collars designed to permit the air to make the tum without appreciable turbulence.

2.5 FACTORY FABRICATED RECTANGULAR GSS DUCTING.

All ducts shall be fabricated from galvanized steel / aluminum of the following thickness, as indicated as below:

RECTANGULAR DUCT (LOW PRESSURE)

SMACNA Standard

Dimensions of Ducts	Gauge G.I	Joints
Up to 600	26 (0.48mm)	C & SS
601 to 900	26 (0.48mm)	TDF
901 to 1200	24 (0.63mm)	TDF
1201 to 1800	22 (0.80mm)	TDF
1801 to 2250	20 (1.0mm)	TDF
2251 and above	18 (1.25mm)	TDF

IS Standard

Dimensions of Ducts	Gauge G.I	Aluminium
Up to 750	24 (0.63mm)	22 (0.80mm)
751 to 1500	22 (0.80mm)	20 (1.0mm)
1501 to 2250	20 (1.0mm)	16 (1.61mm)
2251 and above	18 (1.25mm)	14 (1.99mm)

Rectangular Ducts G. S.	External Pressure 500 Pa		
	Duct Section Length 1.2 m (4 ft)		
Maximum Duct Size	Gauge	Joint Type	Bracing Spacing
1–600 mm	24	C & SS	As per duct manufacturer
601-750 mm	24	4 Bolt Transverse Duct , Connector-E (TDC) with built in sealant	
751-1000 mm	22	4 Bolt TDC-E	
1001-1200 mm	22	4 Bolt TDC-H	
1201-1300 mm	22	4 Bolt TDC-J	
1301-1500 mm	22	4 Bolt TDC-J	
1501-1800 mm	20	4 Bolt TDC-J	
1801-2100 mm	20	4 Bolt TDC-J	
2101-2250 mm	20	4 Bolt TDC-J	
2251-2400 mm	18	4 Bolt TDC-J	
2401-2700 mm	18	4 Bolt TDC-J	

'C'-cleat; 'S'-S cleat; 'SS'-Standing S cleat; 'AI' -Angle Iron in mm
***Distance of reinforcement/bracing from each joint. Bracing material to be same as of material used for joining of duct sections.**

NOTE:

a) DUCT USING LOCK FORMER MACHINE AT SITE SHALL NOT BE ACCEPTED.
b) MS FLANGES SHALL BE USED FOR DUCTS FOR THE AHU HAVING HEPA FILTERS.

HANGERS FOR DUCT

Duct Size (mm)	Spacing (M)	Size of Slotted / MS angle (mm x mm)	Size of rod dia (mm)
Up to 750	2.4	1.6 mm thick slotted rail	8
751 to 1500	2.4	40 x 3	10
1501 to 2250	2.0	50 x 3	12
2251 to above	2.0	50 x 3	12

Ducts above 750 mm wide to be provided with MS angle supports.
Additional hangers shall be provided in ducts near smoke/fire damper connections.

All ducts shall be fabricated and installed in workman like manner, conforming to relevant SMACNA codes. Ducts so identified on the Drawings shall be insulated from outside as described in the section "Insulation" and as indicated in schedule of Quantities. Duct dimensions shown on drawings, are overall sheet metal dimensions inclusive of the acoustic lining where required and indicated in Schedule of quantities. The fabricated duct dimensions should be as per approved drawings and care should be taken to ensure that all connecting sections are dimensionally matched to avoid any gaps. All ducts up to 75cms width within conditioned spaces shall have slip and drive (C & S/SS) joints. The internal ends of slip joints shall be in the direction of airflow. Care should be taken to ensure that S/SS Cleats are mounted on the longer side of the duct and Cleats on the shorter side. Ducts and accessories within ceiling spaces, visible from air-conditioned areas shall be provided with two coats of mat black finish paint. Ducts shall be fabricated as per details shown on Drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees, or angles, of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing. All sheet metal connection, partitions and plenums, required to confine the flow of air to and through the filters and fans, shall be constructed of 18 gauge GSS / 16gauge aluminum, thoroughly stiffened with 25mm x 25mm x 3mm galvanized steel angle braces and fitted with all necessary inspection doors as required, to give access to all parts of the apparatus. Access doors shall be not less than 45cm x 45cm in size. Plenums shall be shop/factory fabricated panel type and assembled at site. Fixing of galvanized angle flanges on duct pieces shall be with rivets heads inside i.e. towards GS sheet and riveting shall be done from outside. Self adhesive Neoprene rubber / UV resistant PVC foam lining 5mm nominal thickness instead of felt shall be used between duct flanges and between duct supports in all ducting installation.

2.6 INSTALLATION

2.6.1 During the construction, the contractor shall temporarily close duct openings with sheet metal covers to prevent debris entering ducts and to maintain opening straight and square, as per direction of Engineer-In-Charge.

2.6.2 Great care shall be taken to ensure that the duct work does not extend outside and beyond height limits as noted on the drawings.

2.6.3 All duct work shall be of high quality approved galvanized sheet steel guaranteed not to crack or peel on bending or fabrication of ducts. All joints shall be air tight and shall be made in the direction of air flow.

2.6.4 The ducts shall be re-in forced with structured members where necessary, and must be secured in place so as to avoid vibration of the duct on its support.

2.6.5 All air turns of 45 degrees or more shall include curved metal blades or vanes arranged so as to permit the air to make the abrupt turns without an appreciable turbulence. Turning vanes shall be securely fastened to prevent noise or vibration.

2.6.6 The duct work shall be varied in shape and position to fit actual conditions at building site. All changes shall be subjected to the approval of the Engineer -In-Charge. The contractor shall verify all measurements at site and shall notify the Engineer-In-Charge of any

difficulty in carrying out his work before fabrication.

2.6.7 Sponge rubber or approved equal gaskets of 6 MM maximum thickness shall be installed between duct flanges as well as between all connections of sheet metal ducts to walls, floor columns, heater casings and filter casings. Sheet metal connections shall be made to walls and floors by means of wooden member anchored to the building structure with anchor bolts and with the sheet screwed to them.

2.6.8 Flanges bracings and supports are to be sourced from the duct manufacturer. Accessories such as damper blades and access panels are to be of materials of appropriate thickness and the finish similar to the adjacent ducting, as specified.

2.6.9 Joints, seams, sleeves, splitters, branches, takeoffs and supports are to be as per duct details as specified, or as decided by Engineer-In-Charge.

2.6.10 Joints requiring bolting or riveting may be fixed by Hexagon nuts and bolts, stove bolts or buck bolts, rivets or closed centre top rivets or spot welding. Self tapping screws must not be used. All jointing material must have a finish such as cadmium plating or Galvanized as appropriate.

2.6.11 Fire retarding flexible joints is to be fitted to the suction and delivery of all fans. The material is to be normally double heavy canvass or as directed by Engineer-In-Charge. On all circular spigots the flexible materials are to be screwed or clip band with adjustable screws or toggle fitting. For rectangular ducts the material is to be flanged and bolted with a backing flat or bolted to mating flange with backing flat.

2.6.12 The flexible joints are to be not less than 75 MM and not more than 250 MM between faces. The duct work should be carried out in a manner and at such time as not to hinder or delay the work of the other agencies especially the boxing or false ceiling contractors.

2.6.13 Duct passing through brick or masonry, wooden frame work shall be provided within the opening. Crossing duct shall have heavy flanges, collars on each side of wooden frame to make the duct leak proof.

2.6.14 The work shall meet with the approval of Consultant/customer in charge in all its parts and details. All necessary allowances and provisions shall be made by the Contractor for beams, pipes, or other obstructions in the building, whether or not the same are shown on the drawings. Where necessary to avoid beams or other structural work, plumbing or other pipes, and conduits, the ducts shall be transformed, divided or curved to one side (the required cross sectional area being maintained) all as per the site requirement. If a duct cannot be run as shown on the drawings, the contractor shall install the duct between the required points by any path available in accordance with other services and as per approval of consultant/customer in charge.

All ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with trapeze hangers formed of galvanized steel rods and galvanized steel angle / channel or a pair of brackets, connected by galvanized steel rod under ducts. The spacing between supports should be not greater than 2.0 meter. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates left in slab at the time of slab casting. Galvanized steel cleat with a hole for passing the hanger rods shall

be welded to the plates. Trapeze hanger formed of galvanized steel rods shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash/anchor fastener driven into the concrete slab by electrically operated gun. Hanger rods shall then hang through the cleats or fully threaded galvanized rods can be screwed into the anchor fasteners. Ducting over furred ceiling shall be supported from the slab above or from beams after obtaining approval of Consultant / customer in charge. In no case shall any duct be supported from false ceiling hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other contractor's work in the building. All ducts shall be totally free from vibration under all conditions of operation. Whenever ductwork is connected to fans, air handling units or blower coil units that may cause vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge. Flexible connections shall be constructed of fire retarding flexible heavy canvas sleeve at least 10cm long securely bonded and bolted on both sides. Sleeve shall be made smooth and the connecting ductwork rigidly held by independent supports on both sides of the flexible connection. The flexible connection shall be suitable for pressure at the point of installation. Duct shall not rest on false ceiling and shall be in level from bottom. Taper pieces shall taper from top.

2.7 DOCUMENTATION TO MEASUREMENTS

For each drawing, all supply of ductwork must be accompanied by computer-generated detailed bill of material indicating all relevant duct sizes, dimensions and quantities. In addition, summary sheets are also to be provided showing duct areas by gauge and duct size range as applicable.

Measurement sheet covering each fabricated duct piece showing dimensions and external surface area along with summary of external surface area of duct gauge-wise.

All duct pieces to have a part number, which should correspond to the serial number, assigned to it in the measurement sheet. The above system will ensure speedy and proper site measurement, verification and approvals.

2.8 TESTING

After duct installation, a part of duct section (approximately 20% of total ductwork) may be selected at random and tested for leakage. The procedure for leak testing should be followed as per SMACNA-"HVAC Air Duct Leakage Test Manual: (First Edition).

The entire air distribution system shall be balanced to supply the air quantity as required in various areas and the final balance of air quantity through each outlet shall be submitted to the engineer-in-charge for approval. Measured air quantities at fan discharge and at various outlets shall be identical to or less than 5% in excess of those specified and quoted. Branch duct adjustments shall be permanently marked after air balancing is completed so that these can be restored to their correct position if disturbed at any time.

3.0 DAMPERS

Dampers shall be opposed blade type of robust construction and tight fitting. They shall be made of G.S. steel minimum 16 g thick and shall have brass bushes. The design, method of handling and control shall be suitable for the location and service required.

Dampers shall be provided with suitable links, levers and quadrants as required for their proper operation control or setting. Devices shall be made robust, easily operable and accessible. Every damper shall have an indicating device clearly showing the damper position at all times. Handles will be provided with extended arms to account for insulation thickness.

Dampers shall be placed in ducts and at every branch supply or return air duct connection, whether or not indicated on the drawings, for the proper volume control and balancing of the system. Cost of dampers & vanes shall be included in the cost of ducts.

4.0 FLEXIBLE DUCT CONNECTION

The Flexible Connection should be made of TF quality fire retardant double canvas or imported fabric of fiberglass weave having silicone rubber coating, as mentioned in the schedule of quantities. Flexible connections shall be air tight & water proof and withstand high temperature application, non flammable type and does not support combustion. There shall be extruded Angle aluminum frame at both ends for connection.

5.0 MOTORIZED COMBINATION SMOKE & FIRE DAMPER

All supply/return air duct or path at Package unit room wall or slab crossing shall be provided motorized combined smoke and fire damper. The fire rating shall be of 120 minutes at 250^{O}C. Fire damper blades and outer frame shall be formed of 1.6mm galvanized sheet steel. The damper blade shall be pivoted spindles in self lubricated bronze bushes, stop seals shall be provided on top and bottom of the damper housing made of 16G galvanized sheet steel. Side seal shall be provided to prevent fine leakages. Smoke damper shall be kept open during normal mode with the help of 230 V operated electric actuators to provide maximum air passage without creating any noise or through UL stamped electro-thermal link with limit switch for fan cut-off. The actuator shall be energized with the help of a signal from space smoke detector installed in air conditioned space/ RA duct. The fire damper has to be provided with a sleeve of at least 450 mm length such that the spindle mounted in the sleeve will house the actuator and the actuator should be accessible from inside the AHU room. The fire damper shall also close due to temperature rise in SA ducts through the electric temp sensor factory set at 165 deg F, limit switches with bakelite base will be provided to stop fan motor & give open & close signal at remote panel in case of motorised damper. Fire dampers in sensitive installations shall operate through duct mounted Heat sensors operating at 94 deg C. In case of power failure, the damper shall close with spring and automatically open when power is switched`ON'. Each damper shall be provided with its individual control panel along with interlocking through AHU control panel. Fan shall remain off when damper is in closed position. Damper shall remain shut off after smoke/fire unless switched on manually.

6.0 SUPPLY AND RETURN AIR GRILLES

Supply and return air grilles shall be anodized extruded aluminum construction with individually adjustable/fixed bars as shown on drawings and indicated in schedule of quantities. Supply air grilles shall generally be double deflection type, with removable key operated volume control dampers. Return air grilles shall generally be double deflection type similar to supply air grilles but without dampers. All supply and return air grilles behind wooden grilles shall be single deflection type with one way bars only, the supply air grilles being provided with removable key operated volume control dampers. Aluminum supply and return grilles shall be powder coated with color of client's choice or shall be extruded aluminum as per schedule of quantities.

7.0 SUPPLY AND RETURN AIR DIFFUSERS

Supply and return air diffusers shall be as shown on the drawings and indicated in schedule of quantities. The supply air diffuser shall be provided with removable key operative volume control dampers if specified. Aluminum supply and return air diffusers shall be powder coated with color of client's choice, or shall be anodized aluminum.

I. ROUND OR RECTANGULAR DIFFUSERS

Supply/return air linear diffuser shall be extruded aluminum construction, square, rectangular, or round diffusers with flush fixed pattern or adjustable flow pattern. Anodized aluminum diffusers shall be square or rectangular in shape. Diffusers for different spaces shall be selected in consultation with the Architect/Consultants. Supply air diffusers may be equipped with fixed air-distribution grids, removable key-operated volume control dampers, and anti smudge rings as indicated in schedule of quantities.

II. LINEAR SUPPLY AIR/ RETURN AIR GRILLES

These shall be extruded aluminum construction with fixed horizontal bars at 15 deg inclination and flanges on both sides. The thickness of fixed bar louvers shall be at least 5.5mm & angle shall be 20mm/30mm inside. The grilles shall be suitable for concealed fixing. Volume control damper of aluminum construction with black anodised finish shall be provided in SA duct collars.

8.0 LINEAR DIFFUSER

Liner diffuser shall be extruded aluminum construction multi slot type with air pattern control provided in each slot. Supply air diffuser shall be provided with hit & miss damper in each slot of the supply air diffuser. Plenum shall be provided for each supply air diffuser.

The Material of Grilles shall be as follows:

i. All grilles shall be selected in consultation with the Client/Architect/Consultant. Different spaces shall require horizontal or vertical face bars, and different width of margin frames.

ii. All grilles shall have a soft, continuous neoprene gasket between the periphery of the registers and the surface on which it has to be mounted. The effective area of the registers shall not be less than 85 percent.

iii. Grilles shall be of adjustable pattern as each grille bar shall be pivotable to provide pattern with 0 to 90 deg horizontal arc and up to 30 deg deflection up or down. Bars shall hold deflection settings under all conditions of velocity and pressure. Extruded aluminum grilles shall have fixed bars.

iv. Bars longer than 45cm shall be reinforced by set-back vertical members of approved thickness.

The material thickness of grills, diffuser, and damper shall be as follows:

	DIFFUSER	ALUMINUM
a)	Frame	18 gauges
b)	Louvers	18 gauge

GRILLS

a)	Frame	18 gauges
b)	Louvers	24 gauge

V.C. DAMPER

a)	Frame	18 gauges
b)	Louver	24 gauge

V. FRESH AIR INTAKE AND EXTRACT LOUVERS

All the louvers shall be rain protection type and shall be fabricated from extruded aluminum/G.I section. The bottom louver shall be provided with extended lip to prevent rain water seepage inside duct/room. The louvers shall additionally be provided with heavy duty expanded metal (aluminum -alloy) bird screen from within.

9.0 TESTING & BALANCING

After the installation of the entire air distribution system is completed in all respects, all ducts shall be tested for air leaks before painting the interiors of conditioned spaces air distribution system shall be allowed to run continuously for 2 hours for driving away any dust & foreign material logged within ducts during installation.

10.0 MISCELLANEOUS

Sponge rubber gaskets also to be provided behind the flange of all grills. Each shoot from the duct, leading to a grille, shall be provided with an air deflector to divert the air into the grille through the shoot. Inspection doors measuring at least 450 mm x 450 mm are to be provided in each system at an appropriate location, as directed by Engineer-in-Charge.

Diverting vanes must be provided at the bends exceeding 600 mm and at branches connected into the main duct without a neck. Proper hangers and supports should be provided to hold the duct rigidly, to keep them straight and to avoid vibrations. Additional supports are to be provided where required for rigidity or as directed by Engineer-in-Charge. All duct work joints are to be true right angle and with all sharp edges removed.

All the air distribution terminals like diffusers, grilles etc has to be suspended from the true ceiling using adjustable suspension system and the same should not rest on the false ceiling.

AIR FILTER

1.0 GENERAL

This specification covers the manufacture, construction feature, erection, testing and commissioning of Air filter at site.

2.0 SCOPE

The scope of work will include supplying, installing, testing and commissioning of following type of filters.

3.0 SYNTHETIC FIBRE FILTERS (FOR AHU'S AND FRESH AIR INTAKE)

The filter media shall be constructed of suitable fibrous material (ie. coir extruded of (HDPE). Packaged into frame of Aluminium sheet 18 gauge thickness. Filter element shall be supported by galvanized steel wire mesh of 10 mm square on either side. Filter frame shall be provided with suitable handle.

This filter shall be capable of being cleaned off the accumulated dust by ordinary tap water flushing.

Initial pressure drop through the filter shall not exceed 3.5 mm WC. Final

pressure drop shall not exceed 7.5 mm WC at rated flow.

4.0 METALLIC FILTERS

Filter shall consist of V-fold galvanized wire mesh interspaced with a flat layer of galvanized wire mesh. The density of the filter medium shall increase in the direction of air flow. Wire mesh edges shall be suitably hemmed to eliminate the danger of abrasion during handling. Filter media shall be supported on either side by galvanized expanded metal casing. Filter frame shall be fabricated from aluminum alloy of minimum 16 gauge thickness. The filter shall be either dry or oil wetted type.

Filter must be capable of being completely cleaned off their accumulated dust by flushing with tap water.

The efficiency of the filter shall be as per ASHRAE 52-76/ BS-6540 initial pressure drop shall not exceed 5.0 mm WC & Final pressure drop shall not exceed up to 7.5 mm WC at rated flow filter frame shall be provided with suitable handle.

PIPING, VALVES & ACCESSORIES

1.0 SCOPE

The scope of this section comprises the supply and laying of pipes, pipe fittings and valves, testing and balancing of all water piping required for the complete installation as shown on the drawings. All piping inclusive of fittings and valves shall follow the applicable Indian Standards.

2.0 CHILLED AND CONDENSER WATER PIPING

2.1 All chilled water and condenser water pipes and fittings shall be of , MS class `C' (heavy class) conforming to BIS 1239 for pipe size up to 150mm dia and for pipe size 200mm dia and above shall be as per BIS 3589 having minimum 6mm thickness. All jointing in the pipe system shall generally be by welding, unless mentioned otherwise, or directed at site. All welding shall be done by qualified welders and shall strictly conform to Indian Standards code of procedure for manual metallic welding of Mild steel as per BIS 823. Condenser & Chilled water line must have quick filling connection arrangement at plant room 40mm size with full way valve & a drain line too of the same size.

2.2 All pipes and their steel supports shall be thoroughly cleaned and given one primary coat of red oxide paint before being installed. All chilled water piping will rest on PUF blocks 48 Kg/cum density neatly moulded or teak wooden block of 2 1/2" thickness with groove to the radius of pipes and seated on MS angles / channel. All welded piping shall be subjected to the approval at site.

2.3 Fittings shall be malleable casting of pressure rating suit-able for the piping system. Fittings used on welded piping shall be of the weldable type.

2.4 Tee-off connections shall be through equal or reducing tees, otherwise ferrules welded to the main pipe shall be used. Drilling and tapping of the walls of the main pipe shall not be resorted to.

2.5 Ball valve, Butterfly valves, globe valve, conforming to the following specifications, shall be provided as shown on drawings:

Size	Construction	Ends
15 to 40 mm	Gun metal	Screwed
50 mm and above	Body cast iron spindle and valve seat of Bronze or Gun metal or Nitrile rubber. (in case of butterfly valve)	Flanged

2.6 All valves shall be heavy duty conforming to BIS 5155, BIS 5152, BIS 780. Valves shall have non-rising spindles unless specified otherwise and shall be suitable for not less than 16 Kg. per sq.cm. gauge working pressure.

Butterfly valve shall perform the function of isolating valves, Butterfly valves shall have cast iron body with black nitrile seat. All Butterfly valves shall be provided with locking devices. Valves 300 mm dia & above shall be gear driven.

All AHU's & water chilling machines shall be provided with balancing / control valves with built in pressure drop measuring facility. The water flow shall be measured by online Hydronic Balancing System with data display on monitor screen.

2.7 Flanges shall be of slip on raised face type. The supply of flanges shall also include supply of bolts and nuts and suitable asbestos/fibre rubber insertion gaskets (minimum 3mm thick).

2.8 Non-return (check) valves shall be provided as shown on the drawings, conforming to BIS 778 and IS 5312 (Part I) and in accordance with the following specifications.

Size	Construction	Ends
10 to 40 mm	Gun Metal	Screwed
50 mm and 150	Cast Iron/Gun Metal	Flanged plate
200mm to 450 mm	Body casting iron, plate	Flanged carbon steel with 13%chrome overlay

The spring and hinge/stop pin shall be SS 304 and bearing fire material. Valves shall be suitable for not less than 16 Kg per Sq cm gauge working pressure.

Non-return valves shall be swing check valves, normally used in all water services. Lift type valves may be used in horizontal runs. Valves shall be suitable for not less than 16 Kg per sq.cm. gauge working pressure.

2.9 Strainers shall be of `Y' type or pot strainers as shown on the drawings, with cast bodies designed for the test pressure specified for the butterfly valves. Strainers shall have bronze screen with 3mm perforations. Screen shall be removable and replaceable without disturbing of the main pipes. All strainers shall be provided with isolating valves so that the strainer may be cleaned without draining the system. Strainers shall be provided on the inlet side (at suction) of each pump, and where shown on the drawings.

2.9 Pot strainers shall be fabricated out of MS sheet with bronze/SS 304 basket of sizes as under:

Pipe Size (mm)	Pot Dia (mm	Pot H.T (mm	Basket dia (mm)	Basket HT	Thickness of Basket
50	300	400	200	240	24 Gauge
80	350	450	250	250	
100	450	500	300	280	
125	500	600	330	340	22 Gauge
150	540	700	360	390	
200	610	815	400	470	
250	800	955	550	510	
300	1000	1105	750	580	
350	1190	1300	895	678	20 Gauge
400	1350	1500	1020	785	
450	1518	1700	1060	890	
500	1690	1800	1100	900	

Pot strainer shall be fabricated out of MS plate upto 100mm dia pipes shall be fabricated of 6mm thick MS sheet, 125 to 300 mm dia pipes of 8mm thick and higher sizes above of 12mm thick. All strainers shall be sized to provide minimum resistance through perforated vessel & shall be sized as per given table.

2.11 Pipe bends shall be prefabricated type up to 150mm dia. Pipe bends fabricated at site shall be provided with segments of bend not exceeding 15^{o}angle. A 90^{o} bend shall thus be provided with 6 Nos. welding joints. Pipes shall be cut with Power saw/Hacksaw only, followed by hand grinding to provide V-groove.

2.12 All chilled water piping and fitting shall be pressure tested, then insulated as described under the section "Insulation".

2.13 After all chilled/condenser water piping has been installed; the pressure testing shall be run for at least three days of eight hours each. The piping, fittings & supports shall be painted with one coat of red oxide paint & two finish coats of 3 mils each of approved color of synthetic enamel paint conforming to IS 2379 (Incase the chilled water piping, the paint shall be done after insulation of the pipes). The direction of flow of fluid in the pipes shall be visibly marked with identifying arrows.

2.14 Auto Air vent & GM drain valve of suitable size shall be provided in the chilled & condenser water piping at highest point and at lowest points in the risers respectively. Air Vent shall be provided with 15 mm dia pipe connection, drain pipe connection & in built isolation for ease of servicing.

3.0 CONDENSATE AND DRAIN PIPING

3.1 All pipes to be used for cold water (makeup), drain, and condensate drain shall be approved make and fittings as per BIS 4736 or galvanized steel class B (medium class) conforming to relevant BIS codes.

3.2 All jointing in the pipe system shall be by screwed fittings using non-hardening lubricant as sealing material and/or by screwed flanges using 3mm 3 ply rubber gaskets. Pipe threads and flanges shall be as per BS 534 and BS 4504.

3.3 All pipe supports shall be mild steel, thoroughly cleaned and given on primary coat of red oxide paint before being installed.

3.4 Fittings shall be galvanized steel `Medium Class' malleable casting of pressure rating suitable for the piping system. Flanges shall be of approved make. Supply of flanges shall include bolts, washers and gaskets as required. Sufficient number of flanges and unions shall be provided for future cleaning and servicing of piping. Tee-off connections shall be through equal or reducing tees. All equipment and valve connections or connections to any other mating pipe shall be through unions/screwed flanges up to 50 mm dia and through screwed flanges for larger diameters, or as required for the mating connections.

3.5 All condensate drain piping shall be insulated as per the section `Insulation'. Cold water piping within the building may also be insulated.

3.6 After the piping has been installed, tested and run for atleast three days of eight hours each, all piping and pipe supports shall be painted with one coat of red oxide paint & two finish coats of 3 mils each of approved color of synthetic enamel paint conforming to IS 2379.

3.7 The direction of flow of fluid in the pipes shall be visibly marked with identifying arrow.

4.0 PIPING INSTALLATION

4.1 Tender drawings indicate schematically the size and location of pipes. The contractor, on the award of the work, shall prepare detailed working drawings, showing the cross-section, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air auto vent valves, and all pipe supports. He must keep in view the specific openings in buildings and other structures through which pipes are designed to pass.

4.2 Piping shall be properly supported on, or suspended from, stands, clamps, hangers as specified and as required. The contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers, and be responsible for their structural sufficiency.

4.3 Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finish coated black. Where pipe and clamps are of dissimilar materials, a gasket shall be provided in between spacing of pipe supports shall not exceed the following:

Pipe Size	**ROD Diameter (mm)**	**Base Support**
Up to 125mm	10	clamp support
150 mm to 200 mm	15	ISMC 75
250 mm	20	ISMC 100 *
300 mm	22	ISMC 150 *
350, 400 mm	25	ISMC 150 *
450, 500 mm	32	ISMC 150 *
600 mm	32	ISMC 200 *

*** Floor mounted support shall be preferred.**

PIPE SIZE	SPACING BETWEEN SUPPORTS
Up to 40 mm	**1.5 meter**
50 to 150 mm	**2.0 meter**
Over 150mm	**2.5 meter**

4.4 Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars attached to pipe and with a 15mm thick rubber pad or any resilient material. Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent water leakage. Risers shall have a suitable clean out at the lowest point and air vent at the highest point.

4.5 Pipe sleeves, 50mm larger diameter than pipes, shall be provided wherever pipes pass through walls and slabs, and annular space filled with fiber glass and finished with retainer rings.

4.6 Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. 14 gauge metal sheets shall be provided between the insulation and the clamp, saddle or roller, extending atleast 15cm on both sides of the clamp, saddles or roller.

4.7 All pipe work shall be carried out in a workman like manner, causing minimum disturbance to the existing services, buildings, rods and structure. The entire piping work shall be organized, in consultation with other agencies work, so that laying of pipe supports, pipe and pressure testing for each area shall be carried out in one stretch.

4.8 Cut-outs in the floor slab for installing the various pipes are indicated in the drawings. Contractor shall carefully examine the cut-outs provided and clearly point out where ever the cut- outs shown in the drawings, do not meet with the requirements.

4.9 The contractor shall make sure that the clamps, brackets, clamps saddles and hangers provided for pipe supports are adequate. Piping layout shall take due care for expansion and contraction in pipes, and include expansion Loop where required.

4.10 All pipes shall be accurately cut to the required sizes in accordance with IS 554 and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reducers shall be used for the piping to drain freely. In vertical pipes, concentric reducers shall be used.

4.11 Flanged inspection pieces 1.5 meters long, with bolted flanges on both ends, shall be provided no more than 30 meters centre's wherever shown in approved for construction to facilitate future cleaning of all welded pipes.

4.12 All buried pipes shall be laid over 100 mm concrete bed and the pipes have to be insulated as per insulation section of the technical specification.

4.13 The buried piping has to be sand filled by 300 mm from top of the pipe and then refilling of stone free soil has to take place and the same has to be compacted in order to strengthen the area.

4.14 The valves for buried piping have to be provided with masonry valve chamber for proper maintenance.

4.15 Auto/ Manual air vent valves shall be provided at all specified points in the piping system for air venting. All valves shall be of 20mm/15mm pipe size, provided with drain connection & non return valve for ease of maintenance. Discharge from the air valves shall be piped through an equal sized mild steel or galvanized steel pipe to the nearest drain or sump. All pipes shall be pitched towards drain points.

4.16 Pressure gauges with gun metal gate valves as specified under section "Automatic Controls and Instruments", shall be provided at the suction and discharge of chilled water/condenser water pumps supply and return at air handling units, at chillers and at condensers, as shown on the drawings and included in schedule of quantities. Care shall be taken to protect pressure gages during pressure testing.

4.17 Temperature gauge as specified under section "Automatic Controls and Instruments" shall be provided at each Air handling units Supply & Return Chilled water line, at chillers, and condensers, as shown on drawings and included in schedule of quantities.

5.0 TESTING & BALANCING

5.1 All piping shall be tested to hydrostatic test pressure of at least two and half times the maximum operating pressure, but not less than 8 Kg per sq.cm. Gauge for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified and gotten approved at site.

5.2 Piping repaired subsequent to the above pressure test shall be re-tested in the same manner.

5.3 System may be tested in sections and such sections shall be securely capped, then retested for entire system.

5.4 The contractor shall give sufficient notice to all other agencies at site, of his intention to test a section or sections of piping and all testing shall be witnessed and recorded by Owner's site representative.

5.5 The Contractor shall make sure that proper noiseless circulation of fluid is achieved through all coils and other heat exchange equipment in the system concerned. In case of improper circulations, the contractor shall rectify the defective connections. He shall bear all expenses for carrying out the above rectifications. He shall bear all expenses for carrying out the above rectifications, including the tearing up and re-finishing of floors and walls as required.

5.6 The contractor shall provide all materials, tools, equipment, instruments, services and labour required to perform the test and to remove water resulting from cleaning and after testing.

5.7 After completion of the installation, all water system shall be adjusted and balanced to deliver the water quantities as specified, quoted or as directed, to individual air handling units and fan coil units cooling coil.

5.8 Water circuit shall be adjusted by balancing cocks provided for balancing; these shall be permanently marked after balancing is completed so that they can be restored to their correct positions, if disturbed.

5.9 Complete certified balancing report shall be submitted for evaluation and approval. Upon approval, four copies of the balancing report shall be submitted with complete drawings and documents.

5.10 Exposed Pipes & insulation surface/cladding shall be provided the approved colour along with name & arrows marked distinctly in service areas.

INSULATION

1.0 GENERAL

Scope of this specification comprises of supplying, installing, testing and commissioning of insulation on duct, chilled water piping, AHU room and duct acoustic lining.

2.0 THERMAL DUCT INSULATION

2.1 Duct Insulation (Closed Cell)

The material should be high quality closed cell nitrile rubber insulation. The thermal conductivity of insulation shall not exceed 0.038 W/M deg K (0.022 BTU/hr. ft. deg F) at 20oC (68 deg F) mean temperature and density shall not be less than 60 Kg/m3.Temperature range shall be – 50^{O}C to + 116^{O} C and should be class 'O' self extinguishing type. All the adhesives employed should be VOC / SVOC free.

2.2 THICKNESS OF INSULATION

The thickness of the nitrile rubber shall be as shown on drawing or identified in the schedule of quantity. Following installation procedure should be adopted:

2.3 APPLICATION – UNEXPOSED DUCT

- Duct surfaces shall be cleaned to remove all grease, oil, dirt, etc. prior to carrying out insulation work.
- Measurement of surface dimensions shall be taken properly to cut closed cell elastomeric rubbers sheets to size with sufficient allowance in dimension.
- Material shall be fitted under compression and no stretching of material should be allowed.
- A thin film of adhesive shall be applied on the back of the insulating material sheet and then on to the metal surface.
- When adhesive is tack dry, insulating material sheet shall be placed in position and pressed firmly to achieve a good bond.
- All longitudinal and transverse joints shall be sealed as per manufacturer recommendations.
- The adhesive shall be strictly as recommended by the manufacturer.

2.4 APPLICATION – EXPOSED DUCT

- Duct surfaces shall be cleaned to remove all grease, oil, dirt, etc. prior to carrying out insulation work.
- Measurement of surface dimensions shall be taken properly to cut closed cell elastomeric rubbers sheets to size with sufficient allowance in dimension.
- Material shall be fitted under compression and no stretching of material should be allowed.
- A thin film of adhesive shall be applied on the back of the insulating material sheet and then on to the metal surface.
- When adhesive is tack dry, insulating material sheet shall be placed in position and pressed firmly to achieve a good bond.
- All longitudinal and transverse joints shall be sealed as per manufacturer recommendations.
- The adhesive shall be strictly as recommended by the manufacturer.
- Apply 1st coat of UV resistant paint on the nitrile rubber insulation.
- Then wrap 7 mm thick fiber glass cloth.
- Apply 2nd coat of UV resistant paint over the fiber glass cloth.

3.0 ACCOUSTIC DUCT INSULATION

3.1 Duct Insulation (Open Cell)

The material should be high quality open cell nitrile rubber insulation. The thermal conductivity of insulation shall not exceed 0.043 W/M deg K (0.0248 BTU/hr. ft. deg F) at 20oC (68 deg F) mean temperature and density shall not be less than 180 Kg/m3.Temperature range shall be – 20^{O}C to + 105^{O} C and should be class '1' acoustic type. All the adhesives employed should be VOC / SVOC free.

3.2 APPLICATION

The inside surface for the ducts shall be covered with adhesive recommended by the manufacturer. Cut Foamed sheets into required sizes apply adhesive on the foam and stick it to the duct surface

3.3 ACOUSTIC LINING OF AHU ROOM

For acoustic lining of AHU room the material shall be resin bonded glass wool of density 48 kg/m^{3}. The extent of insulation will be as shown in the drawing.

3.4 THICKNESS OF INSULATION

The thickness of the insulation shall be 50 mm. Following installation procedure should be adopted:

3.5 APPLICATION

- Masonry surface to be lined shall be dry and clean.
- Fix 600 x 600 x 50 mm/100 mm thick 22 G GI Channel frameworks to masonry with rowl plugs.
- Insulating material of specified thickness shall be fixed in GI frame of 600mm x 600mm dimension, covered with R.P. Tissue.
- Cover the material with 22 gauge perforated GI sheet with perforation center to center with self tapping screws.
- Perforated GI Sheet shall be sealed with 20 mm GI beading (25 mm x 3 mm) over all vertical channel frame work. GI screws with washer shall be fixed to horizontal channels. Perforated sheet shall be stretched tight over frame work.

4.0 CHILLED WATER PIPES INSULATIONS

4.1 INSULATION USING TF QUALITY EPS

The insulation for chilled water piping shall be carried out from pre-moulded pipe section of rigid expanded polystyrene 'TF quality' having K valve of 0.027 Kcal/Hr. Sqmt/deg C at mean temperature of 10 deg C and a density shall not be less than 18 kg/cubic M. Premoulded pipe section shall be used for pipes up to and including 250 mm dia.

4.2 THICKNESS

The Chilled water piping shall be insulated to the following thickness.

Pipe Size in mm		**Thickness of Insulation in mm**
15 to 20	**:**	**25**
25 to 40	**:**	**40**
50 to 125	**:**	**50**
150 and above	**:**	**75**
300 and above	**:**	**100**

1) Chilled Water Pipes

4.3 APPLICATION – FOR INTERIOR, EXPOSED & TRENCH PIPING

All chilled water pipes shall be insulated after pressure tested as follows:

- Brush and clean all piping and fittings to remove all dust, rust, dirt, mortar and oil. Then provide 2 coats of zinc chromate primer of ASIAN Paints or approved equal.
- Apply 2 coats of cold setting CPRX adhesive.
- Apply pre-moulded pipe sections over the pipe before the adhesive dries up and seal all longitudinal and transverse joints with hot bitumen. Wrap 500g polythene sheet over the surface with 50 mm overlap in longitudinal and transverse joints. All joints shall be sealed with 50 mm wide PVC/aluminum faced adhesive tape, to provide proper vapour barrier.
- Final finish shall be made by cladding the Chilled Water pipe with 24 gauge aluminum sheet. The insulation shall be continuous over the entire run of piping fittings and valves.
- Insulation pipes shall be marked with arrow to indicate the direction of flow.

4.4 INSULATION USING NITRILE RUBBER SHEETS / ROLL

The material should be high quality closed cell nitrile rubber insulation. The thermal conductivity of insulation shall not exceed 0.036 W/M^{O}K (0.20 Btu. In/hr. ft.^{2} F^{O}) at 0^{O}C (32^{O} F) mean temperature and density shall not be less than 60 Kg/m^{3}. Temperature range shall be – 50^{O}C to + 116^{O}C and should be class 'O' self extinguishing type. All the adhesives employed should be VOC / SVOC free. An air gap of 100 mm shall be present between adjacent insulated surfaces carrying chilled water and also between the insulated surface and the wall to allow natural ventilation without affecting its external surface coefficient of heat transfer.

4.5 THICKNESS OF INSULATION

The thickness of the nitrile rubber shall be as shown on drawing or identified in the schedule of quantity. Following installation procedure should be adopted

4.6 APPLICATION – FOR INTERIOR PIPING

All chilled water pipes shall be insulated after pressure tested as follows:

- Brush and clean all piping and fittings to remove all dust, rust, dirt, mortar and oil.
- Only Tubular Insulation (For 1st layer in case of multi-layered Insulation) shall be used up to 80NB. Sheets may be used above 80NB in Single / Multiple layers to build insulation thickness to recommended levels.
- On existing piping, slit opened tube of the insulating material (slit with a very sharp knife in a straight line) shall be placed over the pipe and adhesive shall be applied as suggested by the manufacturer.
- Adhesive must be allowed to tack dry and then press surface firmly together starting from butt ends and working towards centre.
- Wherever flat sheets shall be used it shall be cut out in correct dimension. All longitudinal and transverse joints shall be sealed as per manufacturer recommendations.
- Final finish shall be made by cladding the Chilled Water pipe with 24 gauge aluminum sheet. The insulation shall be continuous over the entire run of piping fittings and valves.
- All valves, fittings, joints, strainers, etc. in chilled water piping shall be insulated to the same thickness as specified for the main run of piping and application shall be same as above. Valves bonnet, yokes and spindles shall be insulated in such a manner as not to cause damage to insulation when the valve is used or serviced

STARTER PANEL

1.0 GENERAL

The switchboard shall be metal clad, totally enclosed, rigid, compartmentalized design, floor mounting, air insulated, extensible cubicle type for use on medium voltage power, 3 phase 4 wire 50 cycles system.

The equipment shall be designed for operation in high ambient temperature and high humidity tropical atmospheric conditions. Means shall be provided to facilitate ease of inspection, cleaning and repairs for use in installations where continuity of operation is of prime importance.

One of the panels which are to be used for the project shall be CPRI tested. The selection of panel shall be decided during the negotiation.

2.0 TYPE AND CONSTRUCTION

The switchboard shall be of

a. Sheet steel enclosed, indoor, floor mounted, free standing cubicle type.
b. Made up of the requisite vertical sections modular type which when coupled together shall form continuous dead front switchboards.
c. Dust, vermin and damp proof and enclosure protection of not less than IP 54.
d. Each feeder/instrument compartment shall be provided with a hinged door interlocked with MCCB inside the compartment such that door can only be opened when MCCB in off position.
e. Readily extendable as required by the addition of vertical sections after removal of the end covers.
f. Switchboards shall have access to the feeders, bus bars, cable termination, cable alley, etc. as required.
g. Main Breakers need to be lockable.
h. Each panel shall be complete with all necessary accessories.

EACH VERTICAL SECTION SHALL COMPRISE

a. A front framed structure of rolled/folded CRCA sheet steel angle section of minimum 3 mm thickness rigidly bolted together. This structure shall house the components contributing to the major weight of the equipment such as circuit breaker cassettes, main horizontal bus bars, vertical risers and other front mounted accessories.

b. The structure shall be mounted on a rigid base frame of folded CRCA sheet steel of minimum 6 mm thickness and 75 mm height. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.

c. A cable chamber housing the cable end connections and power or control cable terminations. The design shall ensure generous availability of space for ease of installation and maintenance of cabling and adequate safety for working in one vertical or horizontal section without coming into accidental contact with live parts of the adjacent section.

d. A cover plate at the top of the vertical section, provided with a ventilating hood where necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1mm diameter perforations to prevent entry of vermin.

e. Front and rear doors fitted with dust excluding neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors generous overlap shall be ensured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

The height of the panel shall not be more than 2200 mm unless otherwise specified and maximum height of switch operating handle shall not be more than 1800mm from FFL. The total depth of the panel shall be adequate to cater for proper cabling space.

Doors shall be of minimum 14 gauge sheet steel and covers and partitions of 160 sheet steel. All sheet steel work forming the exterior of switchboards shall be smoothly finished, levelled and free from flaws. The corners shall be rounded.

The Components in the switchboards shall be so arranged as to facilitate ease of operation and maintenance and at the same time to ensure necessary degree of safety.

Components forming part of the switchboards shall have the following minimum clearances:

a.	Between phases	25 mm
b.	Between phases and neutral	25 mm
c.	Between phases and earth	25 mm
d.	Between neutral and earth	19 mm

When, for any reason, the above clearances are not available, suitable insulation barrier/shielding shall be provided. Clearances shall be maintained during normal service conditions.

Creepage distances shall comply to those specified in relevant standards.
All insulating material used in the construction of the equipment shall be of non- hygroscopic material treated to withstand the effects of high humidity, high temperature and tropical ambient service conditions.

Functional units such as circuit breakers, MCCBs, etc. shall be arranged in multi- tier formation except that not more than two air circuit breakers shall be housed in a single vertical section.

Metallic and/or insulated shrouding shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with:

a. Main bus-bars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.

b. Cable terminations of one functional unit, when working on those of adjacent units.

All covers providing access to live power equipment or circuits shall be provided with tool operated fasteners to prevent unauthorized access. Provision shall be made for permanently earthing the frames and other metal parts of the switch gear by two independent distinct connections.

Only CRCA steel sheets shall be used for fabricating the cubicle.

Thickness tolerance for sheets shall be as applicable in relevant IS.

3.0 METAL TREATMENT AND FINISH

Generally the treatment and finish of the metal surface shall be as per detailed specifications in Clause 8.4 Metal Treatment and Finish.

4.0 BUS BARS

The bus bars shall be made of high conductivity high strength E91E aluminium alloy suitable for 440 volts 3phase 4 wires 50 Hz 20KA unless otherwise specified.

The bus bars shall be suitably supported with non-hygroscopic supports to provide a fault withstand capacity as specified.

High tensile bolts and spring washers shall be provided at all bus bar joints. Fish

plates of equal type and size shall be used at all joints.

The bus bars shall have uniform cross section throughout and shall be capable of carrying the rated current at 433V continuously. The bus bars shall be designed to withstand a temperature rise of 45 Deg C above the ambient. A current density of
1.00 Amp/Sqmm shall not be exceeded for copper bus bars.

The neutral bus bars shall have a continuous rating of at least 100% of the phase bus bars, unless mentioned otherwise.

Bus bars shall be fully sleeved using heat shrunk PVC sleeves appropriately colour coded to identify different phases and neutral bar.

An earth bus of size not less than 40 x 6 mm aluminium shall run throughout the length of switchboard at top or bottom as required.

5.0 MPCB – MOTOR PROTECTION CIRCUIT BREAKER

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

The MPCB shall be provided with Thermal Magnetic relay suitable for short circuit and overload protection and the over load protection shall be field settable. MPCB shall employ quick make and quick break switching mechanism independent of the speed of operation of the operating handle. The operating mechanism shall be trip free. The operating handle shall indicate the position of the MPCB in ON / OFF /

TRIPPED. The operating handle shall have provision for door interlock and padlocking.

6.0 STARTERS

The drive motor shall be provided with starters conforming to IS: 1822, IEC 60470:2000. The starters shall be totally enclosed metal clad and dust proof constructions. The motors of 5 hp and below shall be provided with DOL starters while those above 5 hp shall be provided with automatic star-delta starters and the starter shall have thermal overloads on all the phases, under voltage and single phasing protection. Suitable number of extra contacts for interlocking, indicating lamps, and ammeter with CTS shall be provided for starters of motors.

Every AHU room will have wall mounting panel for accommodating the starter/MPCB of the AHU and the cabling between the AHU to Condensing unit will have to be carried out by the vendor. The condensing unit shall have their panel with microprocessor for sequencing and operation with energy saving.

The modules shall be non draw out type. Each motor feeder shall be provided with combination starter comprising MCCB/MPCB, magnetic contactor and thermal overload relay and other accessories such as auxiliary relays, indicating lamps, push buttons, and control switches within the module. The front drive kit provided on the door for the MPCB / MCCB shall have padlocking facility with door interlocking feature, which shall, however, have defeat facility.

7.0 CURRENT TRANSFORMERS (CT)

Current transformers shall comply with the requirements of IS 2705. They shall have ratios, outputs and accuracy as specified/required. All CT's shall be of resin cast type unless otherwise specifically called for.

All CTs shall be of bar type primary or suitable for the cable given type and size.

For all the CTs suitable type and size clamps are to be supplied for mounting in the switchboards.

Polarities and terminal markings of primary and secondary shall be clearly marked on all CTs.

SPECIFICATIONS FOR CTS

a) Current Ratios:
   1. Primary: As per feeder ratings
   2. Secondary: 5A

b) Type: Resin Cast

c) Class: PS-Differential Protection
   5P10-O/C,E/F, RPR
   Class 1 for metering

d) System Voltage
   LT:415V, 3Ph, 50Hz

8.0 POTENTIAL TRANSFORMERS

All the Potential Transformers shall comply with the requirements of IS 3156 latest edition. All PT's shall be resin cast type and shall have Voltage ratios, output and accuracy class as Specified in Data Sheet.

All PT's shall be single phase, dry type suitable for mounting inside the panel or cubicles. Clamps, brackets and supports required for the mounting shall be supplied along with PT.

Polarities and Terminal markings shall be clearly marked in all PT's. Name plate indicating, voltage ratio, burden, accuracy class, type, serial number, make and model plus other related data, shall be provided.

A common earth terminal for earthing of core, bolts, clamps (non current carrying metal parts) etc., shall be provided.

For 415V system, Specification of the PT's shall be as follows:

a) Voltage ratio : 415V/110V
b) Type : Resin cast
c) Burden : 100VA
d) Class (Metering/Protection) : 0.5/3P

9.0 INSTRUMENTS AND METERS

Measuring instrument shall be of digital type. They shall be capable of carrying the normal full load current (via CTs) and shall not be damaged by effects of rated fault current. The instruments shall have an accuracy class of 1.0 as per IS – 1248 & shall have RS 485 MODBUS RTU Half duplex interface for IBMS integration.

All instruments and meters shall be enclosed in dust proof, moisture resistant black finished cases and shall be suitable for tropical use. They shall be calibrated to read directly the primary quantities. They shall be accurately adjusted and calibrated at Works and shall have means of calibration, check and adjustment at site.

The Ammeter and Wattmeter current coils shall withstand 200% of rated current continuously and 10 times the rated current for 0.5 seconds without loss of accuracy. Voltmeter and Wattmeter potential coils shall withstand 120% of rated voltage continuously and twice the rated voltage for 0.5 sec. without loss of accuracy.

10.0 VOLTMETER

Voltmeter shall be suitable for operating directly on LT supply voltage 433V. 50Hz AC. with a scale indicating directly as for LT metering. 0-500V Voltmeter shall be used.

All Voltmeters are 96mm x 96mm, suitable for mounting on the panel.

Type, Serial Number, accuracy class and borders of the Voltmeter shall be indicated on the dial.

11.0 AMMETER

All the ammeters shall be CT operated (5A) with a dial marked for line currents. Type, Serial Number, Accuracy class, Operating Current, Burden etc., shall be indicated on the dial.
All Ammeter shall be digital, panel mounting type and shall be provided with zero adjustment.
All ammeters shall b 96mm x 96mm, suitable for mounting on the panel.

12.0 ENERGY METERS

WATT HOUR AND VAR HOUR METERS shall be of the three phase two element type suitable for measurement of unbalanced loads in three phase four wire circuits. They shall be of draw out type and suitable for flush mounting with back connecting terminals. The meter shall have glass covers removable from the front of the panel, without dismantling the meter from the panel. All permanent magnets shall of the non-ageing type. The meter shall be fitted with a separate test block for testing of the reverse direction. They shall be provided with a separate test block for testing of the meters without disturbing the CT and PT secondary connections. They shall have cyclometer type of register. At least two sealing studs for sealing purposes shall be provided. The Energy Meter shall be connected to the secondary of potential transformers and current transformers rated for 110 3 Volts and 5 Amp. respectively. These meters shall conform to IS : 13010 and have an accuracy of class 1.0 or better for KWH meter and 3.0 or better for LVARH meters.

Meters shall be compensated for temperature errors and factory calibrated to directly read the primary quantities without the use of additional multiplying factor. Multiplying factor, if unavoidable shall be a multiple of 10. Number of digits provided shall be adequate to cover at least 1000hrs. of operations.

The current coil of the meters shall have a continuous overload capacity of 200% for both accuracy and thermal limits. Also the current coils shall withstand at least 10 times the rated current for 0.5 seconds without loss of accuracy.

13.0 PUSH BUTTONS

Push buttons shall be of momentary contact type with rear terminal connection. These shall be suitably shrouded to prevent inadvertent operation. Integral inscription plates engraved with their functions shall be provided. All push buttons shall have two Normally Closed and two Normally.

Open contacts comprising rivets of pure silver. The contacts shall be able to make and carry 5 A and break up one amp inductive loads at 250V DC.

PUSH BUTTON COLOR SHALL BE AS FOLLOWS:

Stop/open/emergency-Red
Start/close-Green
Reset/test- Yellow/black/white

14.0 INDICATING INSTRUMENTS

Indicating instruments shall be flush mounted with digital displays. The indicating instruments shall conform to IS:1248 and shall have on an accuracy class of 1.5 or better.
Indicating lamps shall be LED type (Cluster Type).

15.0 CABLE TERMINATIONS

Cable entries and terminals shall be provided in the switchboard to suit the number, type and size of copper conductor power cables and copper conductor control cable specified in the detailed specifications.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided with the position of cable gland and terminals such that cables can be easily and safely terminated.

Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

Cable sockets shall be of tinned copper and of the crimping type.

16.0 CONTROL WIRING

All control wiring shall be carried out with 660/1100V grade single core PVC cable having stranded copper conductors with minimum cross section of 1.5Sqmm for potential circuits and 2.5Sqmm for current transformer circuits.

Wiring shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance.

Wires shall be identified by numbered ferrules at each end. The ferrules shall be of ring type and of non-deteriorating material. They shall be firmly located on each termination so as to prevent free movement.

All control circuit fuses shall be mounted for easy accessibility.

17.0 TERMINAL BLOCKS

Terminal blocks shall be of 500 Volts grade and of stud/screw less type.

Terminal blocks shall have a minimum current rating of 10 Amps and shall be shrouded. Provisions shall be made for label inscriptions. At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.
Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. Also current transformer secondary leads shall be provided with short circuiting and earthing facilities.

There shall be a minimum clearance of 250mm between the first row of terminal blocks and the associated cable @land plate. Also, the clearance between two rows of terminal blocks shall be a minimum of 150mm.

18.0 RELAYS

All Relays shall conform to the requirement of IS : 3231/IS 8686 or other applicable approved standards Relays

All AC Relays shall be suitable for operation at 50Hz. AC Voltage operated relays shall be suitable for 110v 3 Volts PT secondary and Current operated relays for 5Amp CT secondary, as specified in this specification. Voltage operated relays shall have adequate thermal capacity for continuous operation.

Auxiliary Relays and Timers, shall have pairs of contacts as required to complete the scheme. Contacts shall be silver faced with spring action.

All Protective Relays, Auxiliary Relays and Timers except the lockout relays and Interlocking relays specified, shall be provided with self reset type contacts. All Trip relays and Timers shall be provided with externally hand reset positive action provided with inscription subject to Consultant/Client approval. Timers shall be of the electromagnetic or solid state type.

Wherever solid state relays are used the following requirement shall be met:

(a). All Relays shall be designed for operating under an ambient temperature 55 Deg; C and 100% relative humidity.

(b) All accessories required for correct operation of each relay shall be supported by the Contractor without any extra cost.

(c) The solid state relays shall be stable and suitably protected against transient or induced over voltages. The Bidder shall state clearly in his list special requirements, if any, for DC input arrangement or cabling considered necessary for satisfactory operation of solid state relays quoted by him.

19.0 LABELLING

19.1 General

Every switchboard, switchboard control contactor, time switch, relay, indicator lamp, meter. motor starter, link and any control or protection equipment within or on a switchboard shall be clearly and accurately labelled.

Labels shall be engraved laminated plastic or photo anodised rigid aluminium and shall comply with the following requirements.

Except where otherwise required, labels shall be fixed adjacent to, but not on any item of equipment.

Engraved lettering shall be black on a white background, except that the label for a main switch shall have red lettering on a white background, and warning and caution labels shall have white lettering on a red background.

The minimum height of lettering shall be 3mm and of sufficient definition to allow easy reading.

19.2 FIXING OF LABELS

Labels shall be securely fixed by:

(a) Screws and adhesive, or
(b) Fixed in an extruded aluminium section which shall be countersunk screw fixed or countersunk riveted to the panel.

Screws shall be tightened with nuts or into tapped holes in the switchboard. Mechanically expanded plastic rivets of minimum 6mm head diameter are acceptable instead of screws. Aluminium rivets may be used to fix aluminium labels only. Self-tapping screws, thread-cutting screws or other fixings are not acceptable.

19.3 LABELS ON EXTERIOR OF SWITCHBOARDS AND SCHEDULES

All switchboards shall be labelled with the manufacturer's name.

A switchboard designation label shall be provided. For other than main switchboards, the designation label shall also state the source of electrical supply. Separate sections of enclosures shall be identified. The label for any section or enclosure containing Supply Authority equipment shall be to the satisfaction of the Consultant / Client and the Supply Authority.

Every switchboard control shall be labelled and shall include:

(a) Circuit designation for all main switches, main controls and sub-main controls.
(b) Details of the consumer's mains and all sub-mains.
(c) Incoming busbar or cable rating to the first tee-off.

The minimum height of lettering shall be 6 mm.

For identification of final sub circuits, a typed schedule, cross-referenced to the lighting and power layout plans shall be provided. The schedule shall be protected by a plastic sheet and fixed in a suitable frame mounted on the inside of the relevant switchboard door or, if the switchboard has no door, on the wall immediately adjacent to the switchboard.

19.4 LABELS ON INTERIORS OF SWITCHBOARDS

Labels identifying equipment within a switchboard shall be located such that the item referred to is obvious and the lettering is not substantially obscured by the temporary or permanent position of any equipment or wiring.

For plug-in equipment where items are physically but not functionally interchangeable, the label wording shall be expanded to clearly identify the removable section (e.g. to identify the contact configuration or timing range). Where this is not possible, a second identifying label shall be glue fixed to the removable section.

The function and coding shown on the circuit diagram shall be used.

The Main link shall be labelled, or stamped and in-filled, `MAIN LINK' on the link.

19.5 WARNING LABELS

Where copolymer membrane coating is used anywhere on live conductors without further insulation, a warning label shall be provided on the front cover near the main switch or local main switch and in a prominent position within each section of the switchboard. The label shall have the following wording in 6mm high lettering:

WARNING

PAINTED COATING ON BUSBARS OR TERMINATIONS IS NOT INSULATION.

If a stand-by power supply is installed, an appropriate warning label shall be fixed at the main switch or local main switch. An example of a typical label is:

WARNING

IN THE EVENT OF LOSS OF NORMAL SUPPLY GENERATOR SET WILL AUTOMATICALLY START AND BE CONNECTED TO THIS SWITCHBOARD

When anti-condensation heaters are fitted, a label shall be provided at each heater reading

WARNING

THERMOSTATICALLY CONTROLLED ANTI-CONDENSATION HEATER-DO NOT SWITCH OFF

20.0 Tests

20.1 General

The routine tests shall be conducted as per IS standards on each Power Control Center and shall comprise:

Inspection of the Switchboards including inspection of wiring and electrical operational and functional tests where necessary.

Checking of protective measures and electrical continuity of the protective circuits.

20.2 DIELECTRIC TESTS

Insulation resistance of the power circuit between each pole and the earth and that between the poles shall be measured.

Insulation resistance of all secondary wiring between phase and earth shall be measured. Insulation test shall be carried out both before and after high voltage test.

20.3 HIGH VOLTAGE TEST

A high voltage test with 2.5 kV for power circuit and 1.5kV for Control Circuit, Duration one minute shall be applied between each pole and earth and between poles. Test certificate shall be submitted along with panel.

21.0 STORING, ERECTION AND COMMISSIONING

21.1 Storing

The panels shall be stored in a well ventilated dry place.

Suitable polythene covers shall be pro-aided for necessary protection against moisture, dust, and vermin.

21.2 ERECTION

Switchboards shall be installed over trench/floor as required. Suitable grouping holes shall be provided in the flooring. Suitable MS base channel shall be embedded in the flooring on which the panel can directly be installed The switchboards shall be properly aligned and bolted to the flooring by at least four bolts. Cables shall be terminated on the bottom plate or top plate as the case may be, by using brass compression glands. The individual cables as shall then be led through the panel to the required feeder compartments for necessary terminations. The cables shall be clamped to the supporting arrangement. Either side, the switchboard earth bus shall be connected to the local earth grid.

The base channel used for erection of panels shall form part of the cost of the panel and shall not be measured or paid separately.

21.3 PRE-COMMISSIONING TESTS

The panels shall be commissioned only after successful completion of the following tests. The tests shall be carried out in the presence of the Consultant / Client.

(a) All main and auxiliary bus bar connections shall be checked and tightened.

(b) All wiring terminations and bus bar joints shall be checked and tightened.

(c) Wiring shall be checked to ensure that it is according to the approved drawing.

(d) All wiring shall be tested for insulation resistance by a 500 volt megger

(e) Phase rotation tests shall be conducted.

(f) Suitable injection tests shall be applied to all the measuring instruments to establish the correctness and accuracy of calibration and working order if required by the Client.

(g) All relays and protective devices shall be tested for correctness of settings and operation by introducing a current generator and an ammeter in the circuit or

shall produce calibration or test certificate as required by the inspectorate or Consultant / Client.

(h) Functional tests on all feeders.

(i) Make, type and ratings of all components shall be checked and verified as per the approved drawings.

21.4 METAL TREATMENT AND FINISH

All steel work used in this Contract shall in general, undergo the following process of treatment and finish.

(a) Degreasing: by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.

(b) Phosphating: by a recognized phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rust in the event of the paint film being mechanically damaged. This again shall be followed by hot water rinsing to remove traces of phosphate solution.

(c) Drying in dust-free atmosphere.

(d) Primer: Primer coating with a coat of corrosion resistant primer applied on wet surface.

(e) Finish coat: Two finishing coats of stoving synthetic enamel paint to the specified shade of IS 5. Both the finish coats shall be only spray painted.

(f) For outdoor units the finishing coat shall be of weather resistant stoving epoxy paint of specified shade of IS5.

21.5 WARRANTY AND MAINTENANCE

The installation shall be guaranteed against faulty workmanship for minimum of one year from the date of practical completion. All faulty workmanship shall be replaced and restored to full operation at no cost to the Client within the guarantee period.

Manufacturer's guarantees and warranties shall be obtained in accordance with Clause 9.11 of the Preliminaries. The warranty period shall be for eighteen months commencing from the date of installation or twelve months from the date of practical completion, whichever is the first to occur.

AUTOMATIC CONTROL SYSTEM EQUIPMENT

1.0 SCOPE

The scope of this section comprises the supply, erection, testing and commissioning of automatic controls and instruments conforming to these specifications and in accordance with the requirements of Drawings and Schedule of Quantities. It is the Scope of the HVAC Contractor to provide sockets & nozzles for building automation system as required.

2.0 TYPE

Controls shall be as described in specifications & of listed makes.

3.0 AUTOMATIC CONTROLS

Automatic controls required for various types of machines have been described in the various sections of these Specifications. The individual safety controls and various automatic controls shall be installed within the machines by the manufacturers before shipment. However, the following automatic controls, if not already installed on the machines, may be installed at site by the Contractor, as per the Schedule of Quantities.

4.0 AIR HANDLING UNIT

Each air handling unit shall be provided with temperature sensor, 2 way valve and air flow sensors by BMS vendor. 2 way valve shall be installed by HVAC vendor.

5.0 FAN COIL UNITS

The thermostat shall be pulse duration modulated valve with thermal actuators line voltage type contemporary design mounted on a plate, suitable for heating and cooling, off/3-speed fan control, automatic and manual thermostat, a 2 way motorised valve in water line.

6.0 FLOW SWITCHES

Sockets or necessary arrangements to be made by HVAC Contractor for bellow type flow switches shall be provided in condensing water outlet and chilled water outlet at the water chilling machines, and at the water cooled condensing units for refrigeration load. The flow switch shall prevent the compressor from starting unless the water flow is established in condensing water lines, and chilled water flow is established chilled water lines.

7.0 THERMOSTATS

7.1 Shall be electric snap-acting fixed differential type as specified herein, with sensing element located in the return air stream. The profile, mounting arrangement and exact location of the thermostats shall be as included in Schedule of Quantities and as approved by the Project Manager. All thermostats shall supply with the standard mounting boxes, as recommended by the manufacturer.

7.2 Instruments required for different types of machines have been described in the various sections of these specifications and shown on the Drawings. Following instruments shall be provided as per the Schedule of Quantities.

8.0 TEMPERATURE GAUGE

Shall be dial type with centigrade & Fahrenheit scales Temperature gauge shall be of the separable socket type and shall have extended brass stem, where required, for insulated pipes. Temperature gauge shall be installed at water supply and return at air handling units, chillers & condensers as shown on the Drawings. Range of scales shall be 30-120 deg.F (0- 50 deg. C) for air conditioning applications.

9.0 PRESSURE GAUGES

Shall be installed on suction and discharge of pumps, supply & return at air handling units, inlet and outlet at chillers, and condensers and cooling towers and included in Schedules of Quantities. Suction side gauges at pumps shall be compound gauges with 100 mm dia of the range 0-75cm. (0-30 inches) mercury vacuum and 0 - 4 Kg. per Sq.cm (0-60 psi) pressure. Discharge side gauges at pumps and at all other locations shall be 100 mm dia of the range
0.5 Kg. per sq.cm (0-60 psi) pressure. Gauges shall be connected to the pipes by U-tube with gun metal gate valve, required for gauge protection during testing.

10.0 ROOM THERMOMETERS

The thermometer shall be mercury in glass type or electronic indicators, wall hung temperature indicators, of appropriate range, for A/C Space in accordance with the requirements of Drawings and as included in Schedule of Quantities.

11.0 CALIBRATION AND TESTING

All automatic controls and instruments shall be factory calibrated and provided with necessary instructions for site calibration and testing. Various items of the same type shall be completely interchangeable and their accuracy shall be guaranteed by the manufacturer. All automatic controls and instruments shall be tested at site for accuracy and reliability before commissioning the installation.

MODE OF MEASUREMENTS

Mode of Measurement for payment of items of ducting and piping & their insulation shall be as follows:

1.0 DUCTING

Payment for ducting shall be on the basis of the external surface area of the ducting including all material and labor for installed duct.

The rate per Sq.meter of the external surface shall include all wastage, flanges, gaskets for joints, bolts and nuts, duct supports and hanger vibration isolation pads or suspenders, flexible connections, inspection doors, dampers, turning vanes, straight vanes and any item which will be required to complete the external insulation and acoustic lining.

The external area shall be calculated by measuring the over all width and depth (including the corner joints) in the center of the duct section from flange face to flange face in case of ducts length with uniform cross section. Total area will be arrived at by adding up the area of all duct sections.

In case of taper pieces average width and depth will be worked out as follows: W 1

= Width of small cross section
W 2 = Width of large cross section
D 1 = Depth of small cross section
D 2 = Depth of large cross section

$$\text{Average Width} = \frac{W1 + W2}{2}$$

$$\text{Average Depth} = \frac{D1 + D2}{2}$$

Width and depth in the case of taper pieces shall be measured at the edge of the collar of the flange for duct sections flatted with angle iron flanges, otherwise at the bottom of the flange where the flanges are of duct sheet.

For circular pieces the diameter of the section midway between large and small diameters shall be measured and adopted as the mean diameter for calculating the surface area of the taper piece. Duct measurements for calculation of area shall be taken before applications of insulation.

For the special pieces like bends, branches and tees etc, same principles of areas measurements as for liner and outer periphery along the curvature angle of the piece shall apply.

2.0 PIPING

Shall be measured in units of length along the center line of installed pipes including all pipe fittings, flanges (with gaskets and nuts and bolts for jointing), unions, bends, elbows, tees, concentric and eccentric reducers, inspection pieces, expansion loops, ceiling/floor mounted supports etc. The above accessories shall be measured as part of piping length along the center line of installed pipes and no special rates for these accessories shall be permitted.

The quoted unit rates for center line linear measurements of piping shall include all wastage allowances, pipe supports includes hangers, MS channel, wooden haunches, nuts and check nuts, vibration isolator suspension where specified or required, and cost of excavation, bedding, back filling and finishing as required to complete the piping installation as per the specification. None of these items will be separately measured nor paid for. However, all valves (gate/globe/butterfly/check/balancing/purge/drain etc.), strainers, orifice plates, temperature gauge, pressure gauges shall be separately measured and paid as per their individual unit rates, which shall also include their insulation as per specifications, piping measurements shall be taken before application of the insulation.

3.0 PIPING INSULATION

Shall be measured in units of length along the center line of the installed pipe, strictly on the same basis as the piping measurements described above.

The linear measurements shall be taken before the application of the insulation, it may be noted that for piping measurements, all valves, orifice plates and strainers are separately measurable and their quoted unit rates shall include the insulation cost in the valve required and as specified.

4.0 DUCT INSULATION/ACOUSTIC LINING

This item is provided separately for various thickness and shall be paid for an area basis of uninsulated duct. The area of the duct to be insulated shall be measured before application of insulation

5.0 GRIILS & DIFFUSERS

Grills and dampers shall be measured on cross sectional area basis excluding flanges.

6.0 CABLES

Payment of LT armoured cables shall be on the basis of linear measurements measured from gland to gland. The rate shall include extra cables left in the panel. Measurement will be taken as straight runs along the route. No claims for balance cable remaining after the completion of work will be entertained. No joints in straight runs will be permitted. The contractor has to take the actual measurements based on approved route before procuring the cables.

The rates quoted for the cables laid in underground trenches shall include excavation, sand cushioning, standard burnt brick protection, refilling consolidating, etc. as per specifications.

7.0 CABLE TERMINATION

The rate quoted for the termination shall include copper/ Al. lugs as applicable, brass compressed glands, copper earth clamps for glands, taping, crimping etc.

TECHNICAL DATA TO BE FURNISHED WITH THE TENDER

VENTILATION & EXHAUST AIR FAN

Sl.no	Description	FAN 1	FAN 2	FAN 3	FAN 4	FAN 5
1	Manufacturer					
2	Model No					
3	Single / Double skin					
4	Size of the Unit					
5	Length					
6	Width					
7	Height					
8	Casing thickness					
9	Material of Insulation					
10	Thickness of outer skin					
11	Thickness of inner skin					
12	Sections offered					
	Fan					
1	Make of Fan					
2	Model no					
3	Type of fan					
4	Total static - mm wg					
5	External static - mm wg					
6	Efficiency					
7	Noise level					
8	Operating speed					
9	Critical speed					
10	BKW of fan					
11	Drive arrangement					
12	Motor efficiency					
13	Motor rating offered					
14	Degree of protection					
15	Operating voltage frequency and range					
	Filter					
1	Make of filter					
2	Thickness of filter					
3	Number of filters					
4	Pressure drop when clean – mm wg					
5	Pressure drop when dirty – mm wg					
6	Efficiency of filter					

CASSETTE UNITS

Sl.no	Description	CU 1	CU 2	CU 3	CU 4	CU 5
1	Manufacturer					
2	Model No					
3	Size of the Unit					
4	Length					
5	Width					
6	Height					
7	Sections offered					
	Fan					
1	Make of Fan					
2	Model no					
3	Type of fan					
4	Total static - mm wg					

Sl.no	Description	CU 1	CU 2	CU 3	CU 4	CU 5
5	External static - mm wg					
6	Efficiency					
7	Noise level					
8	Operating speed					
9	Critical speed					
10	BKW of fan					
11	Drive arrangement					
12	Motor efficiency					
13	Motor rating offered					
14	Degree of protection					
15	Operating voltage frequency and range					
	Cooling coil					
1	Make					
2	Size					
3	Coil face velocity					
4	Number of sections					
5	Number of rows					
6	Diameter of tube					
7	Fin density					
8	Coil capacity – TR					
9	Entering Water temperature – deg C					
10	Bypass factor of coil					
11	Leaving water temperature – deg C					
12	Pressure Drop – ft of wg					
	Filter					
1	Make of filter					
2	Thickness of filter					
3	Pressure drop when clean – mm wg					
4	Pressure drop when dirty – mm wg					
5	Efficiency of filter					

READINGS TO BE FURNISHED DURING PERFORMANCE TESTING

AMBIENT CONDITIONS

a) Dry Bulb Temp – Deg C
b) Wet Bulb Temp – Deg C
c) Relative Humidity - %

CASSETTE UNITS

a) Total Air Quantity Across Filter – Cfm
b) Air Entering DB Temperature – Deg C
c) Air Entering WB Temperature – Deg C
d) Air Leaving DB Temperature – Deg C
e) Air Leaving WB Temperature – Deg C
f) Water Entering Temperature – Deg C
g) Water Leaving Temperature – Deg C
h) Water Discharge Pressure – Kg / Sq cm

a) Water Suction Pressure – Kg / Sq cm

i) Water Flow Rate - GPM
j) Fan Motor Current – Amps
k) Fan Motor Voltage – Volts
l) Fan Motor – RPM

FRESH AIR INTAKES

a) Face Area of Louvers – Sq m
b) Air Quantity – CFM

VENTILATION AIR UNITS

a) Total Air Quantity Across Filter – Cfm
b) Fan Motor Current – Amps
c) Fan Motor Voltage – Volts
d) Fan Motor – RPM

EXHAUST AIR UNITS

a) Total Air Quantity Across Opng – Cfm
b) Fan Motor Current – Amps
c) Fan Motor Voltage – Volts
d) Fan Motor – RPM

AIR BALANCING REPORT

a) Floor
b) Office Area Name
c) Diffuser / Grill Number :

(The numbers should be marked on the drawings too)

d) Velocity across diffuser / Grill - FPM
e) Neck Size of diffuser / Grill – M
f) Attained air flow qty – CFM

g) Designed air flow qty – CFM
h) Difference in air flow qty – % CFM

CONDITIONED SPACE (for each zone)

a) Average temperature in the conditioned space (Readings should be taken at various points in the Conditioned space and marked on the drawing).

CONTROLS

a) Function of each control shall be tested and report furnished.

GENERAL LIST OF APPROVED MAKE OF MATERIALS

Sl No	Description of Item	Recommended Make / Manufacturer
	CIVIL AND INTERIOR WORKS	
1	Ordinary Portland Cement	
	Grey Cement	Acc / Bharthi/ Ultratech / Grasim Industries / Coromandel
	White Cement	Birla White / Jk
2	Integrated Water Proofing Compound	Fosroc / Sika / Hycrete Elite / Evercrete Dps / Myk Acqafin Admix
3	Construction Chemicals	Fosroc / Roffe / Mc Bauchamie / Krishna Conchem / Fairmate
4	Expansion Joint Filler	Sil Flex Of Supreme Industries Ltd
5	Steel	
	Hysd Bars	Tisco / Rinl / Jsw / Sail
	Structural Steel	Tata / Sail /Jsw
	Stainless Steel	Salem Steel / Indalco / Jindal /Sail
6	Aluminium Extrusion	Hindalco / Indal / Jindal / Bhorukha / Sapa
7	Cement Concrete Blocks	Apco / Prayosa / Conwood / Automatic
8	Aotoclaved Aerated Concrete / Light Weight Blocks	Shirke / Aerocon / Biltech
9	Fire Retardant Paint	Akzonobel / Promat
10	High Tensile Bolts	Unbrako / Gkw / Fischer / Hilti
11	Mechanical Splicing Couplers	Jianmao Bldg / Technology Pvt Ltd / G-Tech / Sha Martin
12	Synthetic Enamel Paints & Primer	Ici (Akzonobel) / Asian Paints / Goodlass Nerolac / Berger
13	Crystalline Water Proofing Compound	Krystol T1 & T2 / Krystalline / Peneseal Cwp / / Aquafin Ic / Vandrex / Basf / Zuba
14	Epoxy Paint	Ici (Akzonobel) / Asian Paints / Goodlass Nerolac / Jotun / Berger
15	Acrylic Weather Shield Paint	Ici (Akzonobel) / Asian Paints / Berger
16	Plastic Emulsion & Acrylic Distemper	Ici (Akzonobel) / Asian Paints / Goodlass Nerolac / Jotun / Berger
17	Synthetic Textured Paint	Spectrum / Asian Paints / Berger
18	Premium Textured Exterior Paint	Terraco India Ltd / Spectrum / Asian Paints / Berger
19	Interior Textured Paints	Oikas / Caprol / Spectrum / Asian,Berger / Ici
	Wall Putty	Birla White,Jk White
	Red Oxide & Pink Primers	Ici,Asian,Berger,Nerolac
	Melamine Polish	Ici Dulux, Timberstone Melamine Coating,
	Pu Polish /Paint	Asian / Ici Dulux , Nerolac , Mrf (Aqua Fresh)
20	Floor Hardeners - Dry Shake/Liquid Nonmetallic	Fosroc / Roffe / Fairmate / Stp Ltd / Mc Bauchemie
21	Membrane Water Proofing System	Elastodek P4 / Myk Aquafin-2Km / Multiplas / / Iwl / Stp Ltd / Basf
22	Concrete Paver Tiles	Basant Beton / Conwood / Automatic
23	Cobble Stone	Basantbeton / Somani
24	Rolling Shutter	Swastik / Standard / Shubdwer
25	Chemical / Mechanical Anchor Fastners	Hilti / Fischer / Mkt (Germany)
26	Metalic Fire Doors	Steelage / Shakti Met-Dor
27	Pvdf Coating, Polyester Powder Coating	Akzonobel / Jotun
28	Vitrified Tiles	Johnson,Nitco,Kajaria,Orient,Somany, L Thai,Cotto Italia
29	Tile Grouts, Joint Filler	Laticrete, Bal Endura, Ge Bayer Silicon

30	Ceramic Tiles	Johnson / Somany / Kajaria / Nitco
31	Glass Mosaic	Bizazza / Pixel Mosaic India Ltd / Italia / Palladio
32	Mirror	Modi Glass / Ashai / Saint Gobain
33	Tile Adhesive	Bal Adhesive / Laticrete / Pidilite
34	False Flooring	Kingspan
35	Gypsum Board False Ceiling & Gypsum Partitions	Saint Gobain India Gypsum Ltd / Lafarge / Ramco Industries / Usg
36	Metal Ceiling	Hunter Douglas / Armstrong
37	Mineral Fibre Board Ceiling	Saint Gobain India Gypsum Ltd / Armstrong
38	Calcium Cilicate Board	Ramco Industries
39	Glass Wool	Lloyds / Twiga
40	Plywood (Bwp Marine Grade)	Century / Anchor / Greenply / Kitply / Archidply / Mayur / Kenwood
41	Marine Grade Block Board	Century / Anchor / Greenply / Kitply / Kenwood
42	Laminated Sheet	Greenply / Formica / Decolam / Royal Touche / Signature / Merino
43	Flush Doors	Anchor / Kutty / Century / Greenply
44	Mdf Boards	Bajaj Eco-Tech / Anchor / Nuwud / Duro, Century Ply, Green Ply
45	Veneers	Century / Greenply / Durian / Anchor / Timex / Archidply
46	Mortice Lock, Multipurpose Lock, Handle, Tower Bolt, Hinges & Cp Fittings For Doors/ Windows	Godrej, Dorset, Dorma, Hettich, Geze.
47	Furniture Hardware	Hettich, Dorset, Ebco,
48	All Others Hardware	Hettich , Doorset , Godrej ,Dorma, Ipsa, Geze
49	Stainless Steel Hinges	Hettich , Doorset , Godrej ,Dorma, Geze
50	Pre Laminated Particle Board	Century, Merino , Archidply
51	Adhesive	Fevicol Sh, Vamicol, Araldite Of Hindustan, Laticrete
52	Wooden Fire Rated Doors	Promat / Doors & Doors
53	Galvalume Roof Sheeting	Tata Blue Scope Steel / Jsw Steel / Ispat Industries / Bhushan Power & Steel
54	Anti Termite / Pest Control	Pest Control India Ltd / Bigico
55	Toughened Glass Laminated Glass Safety Glass Annealed Glass (Glass (Relevant Code Bs 952) Heat Strengthened Glass)	Saint Gobain, Asahi India, Modi Glass
	Glass Film	3M, Llumar
56	Aluminium Extrusions	Hindalco / Indal / Jindal / Bhorukha
57	Stainless Steel	Salem Steel / Indalco / Jindal
58	Neoprene	Amee / Bohra Rubbers
59	Aluminium Composite Panels	Alucobond, Alstrong , Alstone
60	Expansion Anchors	Hilti / Fischer / Mkt (Germany)
61	Chemical Anchors	Hilti / Fischer / Mkt (Germany)
62	Bolts / Screws (Ss 316)	Hilti / Fischer
63	Structural Sealant	Dow Corning / Ge
64	Weather Sealant	Dow Corning / Ge
65	Polysulphide Sealant	Fosroc, Choksey, Pidilite
66	Silicone Sealant	Ge Bayer Silicone, Dow Corning, Wacker.
67	Double Sided Tape	Norton / 3M
68	Patch Fittings	Dorma / D-Line
69	Fixtures For Structural Glazing	Dorma /Giesse / Cottswold
70	Insulation	Twiga / Lloyds / Rockwool
71	Structural Steel	Tisco / Rinl / Jsw / Sail / Apl Apollo Only For Shs)
72	Pvdf Coating	Akzonobel / Jotun
73	Architectural Coating Applicators	Sp Architectural Coatings / Radiant Coatings

74	Outdoor Furniture (Sitting Bench, Dustbin)	Approved Make
75	Modular Furniture	Godrej, Hni, Featherlite,
76	Furniture-Chairs And Sofas, Table Bench Pouf Etc	Godrej, Hni, Featherlite,
77	Acoustical Panelling	Absound Overseas, Anutone, Armstrong, Bose
78	Acoustical False Ceiling	Absound Overseas, Anutone, Armstrong
79	Decking Sheet	Tata Bluescope Corus
80	Aac Block	J.K Lakshmi Cement, Shree Cement, Ash Tech India Pvt. Ltd, Instablock
81	Pop	Sriram
82	Wallpaper,Wall Covering	Asian,Happy Walls,Kayra Décor,Tbc,Elitis
83	Fabrics	Bandhini Home ,Freedom Tree,Anhad,,Maharam
84	Tile Grouts, Joint Filler	Laticrete, Bal Endura, Ge Bayer Silicon
85	Carpet/Rugs	Maharaja Carpet,Rks,Royal Thai
86	Laminated Wooden Flooring	Armstrong, Rosselle, Floor Master
	Plumbing Works	
	Pipeline Works:	
87	Pvc Pipes And Fittings	Supreme / Finolex / Prince / Oriplast / Or Approved Equivalent
88	Hdpe Pipes And Fittings	Manikya / Pioneer Polyfeb / Hasti / Or Approved Equivalent
89	Ci Pipes And Fittings	Lanco Kalahasti / Kejriwal / Neco / Or Approved Equivalent
90	Stoneware Pipes And Specials	Mysore Potteries / Tsl / Or Approved Equivalent
91	Sluice Valve	Kirloskar / Ivc / Ivi / Or Approved Equivalent
	Vitreous China Items	
92	Orissa Pan 580Mm X 440Mm	Hindware / Cera / Parryware / Or Approved Equivalent
93	Wall Hung European Water Closet With Chair Brackets	Hindware / Cera / Parryware / Or Approved Equivalent
94	Wash Basin Oval - Counter Top 510Mm X 380Mm	Hindware / Cera / Parryware / Or Approved Equivalent
95	Wash Basin - Rectangular 550Mm X 400Mm	Hindware / Cera / Parryware / Or Approved Equivalent
96	Large Flat Back Urinals	Hindware / Cera / Parryware / Or Approved Equivalent
97	Urinal Partition	Hindware / Cera / Parryware / Or Approved Equivalent
98	Recessed Soap Tray 216Mm X 108Mm	Hindware / Cera / Parryware / Or Approved Equivalent
99	Toilet Paper Holder	Hindware / Cera / Parryware / Or Approved Equivalent
	Chromium Plated (Cp) Fittings	
100	Cp Pillar Tap With Long Neck - 15Mm Dia.	Jaquar / Nova / Or Approved Equivalent
101	Cp Long Body Bib Cock - 15 Mm Dia.	Jaquar / Nova / Or Approved Equivalent
102	Cp Angle Cock – 15 Mm Dia.	Jaquar / Nova / Or Approved Equivalent
103	Cp Concealed Stop Cock - 20 Mm Dia	Jaquar / Nova / Or Approved Equivalent
104	Cp Sink Cock	Jaquar / Nova / Or Approved Equivalent
105	Cp Shower Rose - 15 Mm Dia	Jaquar / Nova / Or Approved Equivalent
106	Cp Shower Arm	Jaquar / Nova / Or Approved Equivalent
107	Cp Bottle Trap - 32 Mm Dia	Jaquar / Nova / Or Approved Equivalent
108	Cp Waste Coupling - 32 Mm Dia	Jaquar / Nova / Or Approved Equivalent
109	Toilet Seat And Cover	Commander Pelican / Prince / Or Approved Equivalent

110	32 Mm Dia Pc Flush Valve	Jaquar / Nova / Or Approved Equivalent
111	32 Mm Dia Fp Flush Pipe	Jaquar / Nova / Or Approved Equivalent
112	Pvc Flushing Cistern	Prince / Commander / Or Approved Equivalent
113	Cp Wall Flange	Jaquar / Nova / Or Approved Equivalent
114	Mirror	Commander / Tulip / Nandi / Atul / Pilco / Or Approved Equivalent
115	Cp Tower Rod	Ess-Ess / Or Approved Equivalent
116	Cp Towel Ring	Ess-Ess / Or Approved Equivalent
117	Cp Double Horn Coat Hook	Ess-Ess / Or Approved Equivalent
118	Cp Liquid Soap Dispenser	Sona Or Approved Equivalent
119	Cp Connection Tube	Aryan / Or Approved Equivalent
120	Pvc Connection Tube	Kohinoor / Or Approved Equivalent
121	Water Heater	Racold / Venus / Usha / Or Approved Equivalent
122	Stainless Steel Sink	Diamond / Nirali / Amc / Jayna / Or Approved Equivalent
123	Toilet Seat Cover	Commander / Prince / Or Approved Equivalent
	Pipes & Fittings	
124	Ci Pipes And Fittings	Neco-Centri / Or Approved Equivalent
125	Ci Manhole Cover And Frame	Neco-Centri / Bic / Or Approved Equivalent
126	Gi Pipes	Tata / Apollo / Zenith / Or Approvoed Equivalent
127	Gi Fittings	R Brand / Unik / New / Or Approved Equivalent
128	Gm Gate Valves / Flat Valves / Non Return Valves	Leader / Neta / Zolotto / Or Approved Equivalent
129	Butterfly Valves	Intervalve / Or Approved Equivalent
130	A) Cpvc Pipes B) Pvc Pipes (Blue Threaded Pipes)	Astral / Ashirwad Or Approved Equivalent Oriplast / Supreme Or Approved Equivalent
131	Stoneware Pipes And Fittings	Mysore Stoneware & Potteries / Tsl Or Approved Equivalent
132	Ci Rungs	Neco-Centri / Bic Or Approved Equivalent
133	Ci Manhole Cover And Frame	Neco-Centri/Bic Or Approved Equivalent
134	Elastomeric Rings / Gaskets	Prabhat Elastomers / Madras Industrial Products/ Approved Equivalent
	Pumps & Accessories	
135	Monoblock Pumps	Grundfos / Kirloskar /Beacon / Darling Or Approved Equivalent
136	Water Meter	Dasmesh / Anand Asahi Or Approved Equivalent
	Electrical Works	
	Ht Side:	
137	11Kv Ht Xlpe Cables	Polycab /Kei/Havells
138	Ht Cable Termination Kit	Raychem / Birla-3M
139	Oil Filled Transformer	Volt Amp/ Kirloskar/Esennar
140	Current Transformer	Kappa / Kalpa/ Pragathi
141	Voltage Transformer	Kappa / Kalpa / Pragathi
142	11Kv Ht Vcb	Abb / Schneider/ Siemens
143	Ht Panel	Pragathi Controls /Power Control Equipments / Lotus
	Lt Side:	
144	Bus Duct (Air Insulated Type)	Pragathi Controls /Power Control Equipments / Lotus Powergear
145	Bus Duct (Sandwitched Construction)	C&S / Schneider
146	Acb / Mccb	Abb / Schneider/Indoasea
147	Lt Panels / Amf /Apfc Panels	Pragathi Controls /Power Control Equipments / Lotus Powergear
148	Dg Sets	Cummins / Caterpillar /Mtu

149	Batteries	Amaron /Exide / Amco
150	Ups	Delta / Liebert / Emerson
151	1.1Kv Lt Cables	Avocab / Polycab / Havell'S / Kei
152	Cable Glands	Sunil / Smi / Cosmos
153	Cable Lugs	Dowell/3D
154	Lt Cable Termination Kit	Raychem / Safe Kit
155	Mcb / Rcbo /Elcb Mcb - Dbs For Lighting / Power / Emergency / Ups	Abb / Schneider /Havells / L&T
156	Mccb	Schneider / Abb /L&T
157	Apfcr (Numeric Type)	Beluk (Germany) / Enercon Sys. Pvt.Ltd / Alstom
158	Cable Trays	Profab / Indiana / Rico Steel
159	Race Ways / Cable Management System	Schneider / Mk / L&T
160	Telephone Cable (Indoor)	Dooravani / Delton / Finolex
161	Telephone Cable Outdoor (Jelly Filled)	Finolex / Karnataka Telecables / Vindhya
162	Television Cable	Rr Kabels/Finolex
163	Advanced Lightning	Abb / Erico / Indelec
	Meters / Switches / Relays:	
164	Timers	Abb / Legrand / Telemechanic
165	Capacitors	Universal / Meher / Epcos
166	Selector Switches	Siemens / L&T / Kaycee
167	Indicating Meters	Conzerv
168	Energy Meter	Conzerv / Ae / Meco
169	Push Buttons	Siemens / L&T / Teknic
170	Indicating Lamps	Siemens / Alstom / Vaishno / Binay
171	Protective Relays	C&S / Abb / Siemens / Alstom / Easun
172	Industrial Sockets	Legrand / Abb / C&S
173	Inverter Batteries	Exide / Luminous /Amaron
174	Cat 6 Cable For Data	Amp
175	Cat 6 Cable For Voice	Amp
176	Cat 6 Angled /Straight Jack Panel Data	Amp
177	Cat 6 Angled /Straight Jack Panel Voice	Amp
178	Cat 6 Information Outlet	Amp
179	Face Plate (Simplex ,Duplex, Quad)	Amp
180	9 U,12 U , 15 U And 45U Closed Rack	Netrack
181	Closed Circuit Tv System	Honeywell / Pelco / Bosch / Tyco
182	Camera / Dvr	Honeywell / Bosch / Ge / Pelco
	Light Fixtures / Conduits	
183	Light Fixtures	Philips / Ge / Bajaj / Lvds (Induction Lamps Only)
184	Led / Cfl Light Fixtures	Havells / Philips / Wipro / Crompton
185	Street Light Poles	Shubham / Pipe Corporation / Keselec
186	Ceiling / Exhaust Fans	Havells/ Cg Almonard / Khaithan / Crompton Greaves / Bajaj / Usha
187	Frls Pvc Conduits	Vip / Precision / Universal / Nelco / Avon Plus
188	Metal Conduits	Tata / Bharath / Gb
189	Frls Wires-1100V Grade	Rr Kabels / Anchor / Finolex / Power Flex / Kei / Havells / Great White
190	Light Switches	Anchor Roma / Tresa / Mds Mosaic / Mk India / Schneider / Havells / Abb
191	Db	Legrand / Abb
	Fire Fighting And Fire Protection	
192	Gi Pipes	Tata "C" Class
193	Gi Fittings	"R" Brands
194	Hydrants	Newage

195	Portable Extinguishers	Excellent
196	Pumps (Electrical & Diesel)	Kirloskar/Mather & Platt
197	Detection System	Notifier/Gent/Hochiki
198	Public Address System	Ahuja
199	Valves	Kirloskar