j) Measurement

Reinforcement including authorized spacer bars, chairs and lap pages shall be measured in length of different diameters, as actually (not more than as specified in the drawings) used in the work nearest to a centimeter and their weight calculated on the basis of standard weight given in Table below. Wastage and unauthorized overlaps shall not be paid for. Annealed steel wire required for binding or tack welding shall not be measured, its cost being included in the rate of reinforcement.

Chairs separators etc. shall be provided as directed by the Engineer-in-charge and measured separately and paid for.

TABLE

Cross Section Area and Mass of Steel Bar

Nominal Size Mm	Cross Sectional Area Sq.mm	Mass per meter Run Kg.
6	28.3	0.222
7	38.5	0.302
8	50.3	0.395
10	78.6	0.617
12	113.1	0.888
16	201.2	1.58
18	254.6	2.00
20	314.3	2.47
22	380.3	2.98
25	491.1	3.85
28	616.0	4.83
32	804.6	6.31
36	1018.3	7.99
40	1257.2	9.85
45	1591.1	12.50
50	1964.3	15.42

k) Rate

The rate for reinforcement shall include the cost of labour and materials required for all operations described above such as cleaning of reinforcement bars, straightening, cutting, hooking, bending, binding, placing in position etc. as required or directed including tack welding on crossing of bars in lieu of binding with wires.

2.3.6 Testing of Materials:

(a) (I) Manufacturer's Tests

For each batch of materials supplied Manufacturer's Test Certificate as per IS :1786 shall be submitted for approval.

(ii) Field Tests – Following type of lab test shall be carried out.

1) Tensile Tests
This shall be done as per IS 1608

2) Bend Test
This shall be done as per IS 1599

3) Re-test
This shall be done as per IS 1786

4) Rebend Test
This shall be done as per IS 1786

5) Chemical composition Test
This shall be done as per IS 228

6) Unit weight Test

This shall be done as per IS 1786

Should any one of the test pieces first selected fail to pass any of the tests specified above, two further samples shall be selected for testing in respect of each failure. Should the test pieces from both these additional samples pass, the materials represented by the test samples shall be deemed to comply with the requirement of the particular test. Should the test piece from either of these additional samples fail, the material represented by the test samples shall be considered as not having complied with standard.

(b) Acceptance Criteria

Based on the results of tests carried out as mentioned above, the Engineer-in-charge will decide the acceptance of the batch under test for use in RCC structures, and his decision shall be final and binding on the Contractor.

The charges for all the tests shall be borne by the Contractor and are deemed to have been included in the price quoted for the relevant BOQ item. It shall be clearly understood by the Contractor that the confirmatory test stipulated above is mandatory and the time required for such testing shall be catered for in the delivery schedule for materials.

All reinforcement shall be clean, free from pitting, oil, grease, paint, loose mill scales, rust, dirt, dust, or any other substance that will destroy or reduce bond.

2.4 Concrete
All structural concrete shall be Mix designed & weight batched.

2.4.1 Design Mix

Design mix concrete is that in which design of mix i.e. the proportion by weight of cement, aggregates and water is arrived as to have mean target strength with required workability in wet condition and the desired durability in hardened state.

2.4.2 Grade of Concrete

The compressive strength of various grades of designed concrete shall be as per Table below (Table IV)

TABLE IV

GRADE OF CONCRETE

Sr. No.	Type of Concrete	Min. Cement Content in Kg/Cum of Concrete	Compression Strength	
			7 day N/mm^2	28 days N/mm^2
1.	M 15 (PCC)	315	10.0	15
2.	M 20 (RCC)	405	13.5	20
3.	M 25 (RCC)	410	17.0	25

Compressive Strength indicated above pertains to pressure test on works test cubes 15 cm x 15 cm x 15 cm after normal curing for 14 days as per IS: 516.

The minimum cement content stipulated above should be adopted irrespective of whether the Contractor achieves the desired strength with less quantity of cement. The Contractor's quoted rates for concrete shall provide for the above eventuality and

nothing extra shall become payable to the Contractor in this account. Even in the case where the quantity of cement required is higher than that specified above to achieve desired strength based on an approved mix design, nothing extra shall become payable to the Contractor.

The Contractor shall not commence concreting in the Permanent Works until details of trial mixes and test results for each class of concrete have been submitted to and approved by the Engineer-in-charge.

The Contractor shall not alter the approved mix proportions nor the approved source of supply of any of the ingredients without having previously obtained the approval of the Engineer-in-charge.

During production, the Engineer-in-charge may require trial mixes to be made before a substantial change is made in the materials or in the proportions of the materials to be used.

It shall be the Contractor's sole responsibility to carry out the mix designs at his own cost from a reputed institute as approved by Engineer-in-charge-in-charge. He shall furnish to the Engineer-in-charge at least 30 days before concreting operations, a statement of proportions proposed to be used for the various concrete mixes and the strength results obtained.

A range of slumps, which shall generally be used for various types of construction unless otherwise instructed by the Engineer-in-charge, is given below:

Structure/Member	**Slump in millimeters**	
	Maximum	**Minimum**
Reinforced foundation walls and footings	75	40
Plain footings, caissons and substructure walls	75	40
Slabs, Beams and reinforced walls	100	40
Pump & miscellaneous Equipment Foundations	75	40
Building columns	100	40
Pavements	50	40
Heavy mass construction	75	25

Note: All concreting done for water retaining structures shall have a minimum slump value of 60 mm and maximum of 100 mm

2.4.3 Design Procedure for Concrete Mix (refer IS 10262)

2.4.3.1 Data to be stipulated / specified

1. Characteristics compressive strength of concrete at 28 days
2. Degree of workability
3. Limitations on Water Cement ratio
4. Standard Deviation
5. Minimum Cement Content as per IS: 456
6. Standard Deviation (Table V)
7. Degree of Control (Table VI)

2.4.3.2 Target Strength

As per IS 456 and IS 1343 target average Compressive strength at 28 days is fck + 1.65s
Where fck = characteristics compressive strength at 28 days
S = standard deviation.

2.4.3.3 Batching

In proportioning concrete, the quantity of cement and aggregates shall be determined by mass. Water shall be measured by volume in calibrated tanks. Uniform quality of graded aggregates and water cement ratio shall be maintained.
Admixtures if required shall be mixed as per the relevant IS: 9103/456.

2.4.3.4 Mixing

Concrete shall be mixed in a mechanical mixer. The mixer should comply with IS 1791. It shall be fitted with hopper. The mixing shall be continuous until there is uniform distribution of the material and the mass is uniform in colour and consistency. If there is segregation after unloading from the mixer, the concrete should be remixed. The mixing time shall not be less than 2 minutes.

Each time the work stops, the mixer shall be cleaned out, and while recommencing; the first batch shall have 10% additional cement to allow for sticking in the drum.

2.4.5 Transporting, Placing and Compacting

2.4.5.1 Transportation

Concrete shall be transported from the mixer to the place of laying as rapidly as possible by methods, which will prevent the segregation or loss of any of the ingredients, and maintaining the required workability.

2.4.5.2 Placing

The concrete shall be deposited as nearly as practicable in its final position to avoid rehandling. It shall be laid gently (not thrown) and shall be thoroughly vibrated and compacted before setting commences and should not be subsequently disturbed. Method of placing shall be such as to preclude segregation. Care shall be taken to avoid displacement of reinforcement or movement of form work and damage due to rains. Concrete shall not be dropped from a height of more than 1 m.

While placing concrete the Contractor shall proceed as specified below and also ensure the following:

(a) Continuously between construction joints and pre- determined abutments.

(b) Without disturbance to forms or reinforcement.

(c) Without disturbance to pipes, ducts, fixings and the like to be cast in; ensure that such items are securely fixed. Ensure that concrete cannot enter open ends of pipes and conduits etc.

(d) Without dropping in a manner that could cause segregation or shock.

(e) In deep pours only when the concrete and formwork designed for this purpose and by using suitable chutes or pipes.

(f) Do not place if the workability is such that full compaction cannot be achieved.

(g) Without disturbing the unsupported sides of excavations; prevent contamination of concrete with earth. Provide sheeting if necessary. In supported excavations, withdraw the linings progressively as concrete is placed.

(h) If placed directly onto hardcore or any other porous material, dampen the surface to reduce loss of water from the concrete.

(i) Ensure that there is no damage or displacement to sheet membranes.

(j) Record the time and location of placing structural concrete.

(k) Maintain separate pour card for each pour as per the format approved by Engineer-in-charge-in-charge.

2.4.5.3 Compaction

Concrete shall be thoroughly compacted and fully worked around embedded fixtures and into corners of the form work. Mechanical vibrator of appropriate type shall do compaction till a dense concrete is obtained. The mechanical vibrators shall conform to IS 2505,IS 2506,IS 2514,IS 4656 specifications for concrete vibrators (immersion type). To prevent segregation,

over vibration shall be avoided. The use of mechanical vibrator may be relaxed by the Engineer-in-charge at his discretion for certain items and permit hand compaction.

Hand compaction shall be done with the help of tamping rods. Compaction shall be completed before the initial setting starts. For the items where mechanical vibrators are not to be used, the contractor shall take permission of the Engineer-in-charge in writing before the start of the work. After compaction the top surface shall be finished even and smooth with wooden trowel before the concrete begins to set.

2.4.5.4 Construction Joints

Concreting shall be carried out continuously upto construction joints. The position and arrangement of construction joints shall be as shown in the structural drawings or as directed by the Engineer-in-charge. Number of such joints shall be kept minimum. Joints shall be kept as straight as possible.

Dowels for concrete work, not likely to be taken up in the near future, shall be coated with cement slurry and encased in lean concrete as indicated on the drawings or as approved by the Engineer-in-charge.

As soon as the exposed concrete has sufficiently hardened, the surface of the joint shall be water jetted or brushed with a stiff brush to expose the larger aggregate without being disturbed. Alternatively, if the preparation is not satisfactory, or proper joint preparation is not possible due to inclement weather, the Contractor shall thoroughly remove the laitance of hardened concrete by mechanical chipping after seven days of concrete work at his own cost. Before placing fresh concrete against a construction joint all loose material shall be removed and the surface sluiced with water until it is perfectly clean, thereafter all pounded water should be removed.

When concreting is to be resumed on a surface, which has not fully hardened, all laitance shall be removed by wire brushing, the surface wetted, free water removed and a coat of cement slurry applied. On this, a layer of concrete not exceeding 150 mm thickness shall be placed and well rammed against the old work. Thereafter work shall proceed in the normal way.

2.4.5.5 Standard of Acceptance

(a) The average strength of group of cubes for each grade cast for each day shall not be less than the specified work cube strength. 20 per cent of cubes cast for each day may have values less than the specified strength provided that the lowest value is not less than 85% of the specified strength.

(b) Concrete strength less than specified may as a special case be accepted in a member with the approval of Engineer-in-charge-in-charge provided that the maximum stress in the member under the maximum design live load does not exceed the permissible safe stress appropriate to the lower strength of the concrete.

(c) Concrete which does not meet the strength requirements as specified but has a strength greater than that of the lowest value of 85% may, at the discretion of the designer, be accepted as being structurally adequate without further testing. However in such cases pro-rata reduction in the rate of concrete shall be incorporated for payment.

(d) Concrete of each grade shall be assessed separately.

(e) Concrete shall be assessed daily for compliance.

2.4.5.6 Criteria for acceptance of work

Part or element of concrete work shall be deemed to be acceptable, provided the three cubes tested for 28 days strength conform to the following:

a) Average of the three cubes strengths shall not be less than the specified strength.

b) No individual cube strength shall be less than 90% of the specified strength.

c) If any individual cube strength exhibits more than 133% of the specified strength, such cube shall be classified as freak and the criteria in (a) and (b) above, shall be applied for the remaining two cubes only and the acceptability determined.

d) Quantum of cubes and testing

A set of 6 cubes shall be cast per every sample of concrete. The minimum frequency of sampling of concrete of each grade shall be as under:

Quantity of Concrete (in m3)	No. of samples
1 – 5	1
6 – 15	2
16 – 30	3
31 – 50	4
51 and above	4+1 additional sample for each additional 50 m3 or part there of.

At least one sample shall be taken from each shift and a set of 6

Cubes on every important element as decided by the Engineer-in-charge-in-charge.

The decision of The Engineer-in-charge in this regard shall be final and binding.

TABLE 5

Grade of concrete	Standard Deviation for different degree of control in N / mm^2		
	Very Good	Good	Fair
M15	2.5	3.5	4.5
M20	3.6	4.6	5.6
M25	4.3	5.3	6.3
M30	5.0	6.0	7.0
M35	5.3	6.3	7.3

(e) Degree of quality control expected under different site conditions is described in table 6.

TABLE 6

Degree of Control	Condition of production of concrete
Very Good	Fresh cement from single source and regular tests, weigh batching of all materials, aggregates supplied in single size, control of aggregates grading and moisture content, control of water added, frequent supervision, regular workability and strength tests and field laboratory facilities.

Good	Carefully stored cement and periodic test, weigh batching of all materials, controlled water, graded aggregate supplied, occasional grading and moisture tests, periodic check of workability & strength, intermittent supervision and experienced workers.
Fair	Proper storage of cement, volume batching of all of the aggregates, allowing for bulking of sand, weigh batching of cement, water content controlled by inspection of mix & occasional supervision and tests.

2.4.5.7 Finish to concrete surfaces

Finish to concrete surfaces at various situations shall be as per directions of The Engineer-in-charge. Where form finish is specified, the final surface shall be smooth and even and no undulations, ridges, spots etc. shall be permitted. They shall also be laid to pattern as directed. In case surfaces intended and directed for form finish, exhibit any of the defects above mentioned, the surfaces shall be rubbed with carborundum or plastered and finished as directed at the risk and cost of the contractor. The decision as to the acceptability or otherwise of a surface will be notified by The Engineer-in-charge and the contractor will implement the instructions accordingly.

2.4.5.8 Concrete cover for reinforcement

Where not specifically indicated in the drawings, concrete cover for reinforcement shall be as per the latest IS 456 or as per directions at site from time to time. Proper concrete cover blocks to suit various covers as required shall be provided in adequate numbers sufficiently ahead of the work.

2.4.5.8a) Specification for self levelling floor topping

- Surface Preparation

The substrate must be cleaned thoroughly by wire brush to make it free from loose particles, laitaince, oil, grease etc. substrate must be from any moisture

- Priming with Sikafloor 80 Primer

On the prepared surface, application of a solvent free epoxy resin based primer of density approximate 1 Kg/litre (A+B) at 30ºC. Mixing ratio of primer should be comp. A : Comp. B = 1:2.5 by weight.

- Application of normal setting epoxy modified cementitious self-levelling floor topping Sikafloor 81 Epocem.

On the primed surface application of 2mm thick, self leveling floor topping floor topping Sikafloor 81 Epocem @ 4.4 Kg/M^2.

- Application of Sikafloor 80 Primer

On the top of Sikafloor 81 Epocem further application of Sikafloor 80 primer

Finally application of Epoxy based self-smoothening floor topping Sikafloor 261 S of 1mm thickness.

2.4.5.9 Curing

It is very important that all cement concrete work shall be cured properly. All concrete work shall be covered with a layer of sacking, canvas, Hessian or similar absorbent material and kept wet continuously for not less than a fortnight or as directed. Water used for curing shall also be free from any deleterious substances and shall generally be fit for drinking. The work shall be adequately protected from premature drying, winds, directed sun rays, rapid cooling during the first few days after placing, vibration and impact which may disrupt the concrete and interfere with its bond to the reinforcement. Membrane curing shall be allowed with prior permission of Engineer-in-charge-in-charge without any extra payment.

2.4.5.10a) Openings and inserts

All openings and inserts which are designated in due time or as required for services, will be exactly provided by the contractor including supply of materials. The Contractor should also fix the anchors or such items, which may be supplied by the Engineer-in-charge in exact position and in perfect lines and levels. Inserts apply to such items as timber, dowels bolts, loop, brackets, suspension irons, hooks, screw plates, pipe of various types and diameter etc. etc. Openings in concrete or masonry must be provided in slightly bigger, if directed so, as shown in drawings or as instructed. It must be clearly understood that the provisions of inserts and openings as contemplated in this contract are to be carried out with "utmost precision" and any deviation of the same from that as shown in drawing or instructed, have to be rectified by the contractor at his own cost and risk.

b) Liquid Retaining Structures

The Contractor shall take special care for concrete for liquid retaining structures, underground structures and those others specifically called for to guarantee the finish and water tightness. All such concrete shall be mixed with water proofing compound and placed with least number of joints.

All such structures shall be hydro-tested.

The Contractor shall make all arrangements for hydro-testing of structure, all arrangements for testing such as temporary bulk heads, pressure gauges, pumps, pipe lines etc.

Any temporary arrangements that may have to be made to ensure stability of the structures shall also be considered to have been taken into account while quoting the rates.

Any leakage that may occur during the hydro-test or subsequently during the defects liability period or the period for which the structure is guaranteed shall be effectively stopped either by cement/epoxy pressure grouting, guniting or such other methods as may be approved by the Engineer-in-charge. All such rectification shall be done by the Contractor to the entire satisfaction of the Engineer-in-charge at no extra cost to the HAL.

c) Testing Concrete Structures for Leakage

Hydro-static test for water tightness shall be done at full storage level or soffit of cover slab, as may be directed by the Engineer-in-charge, as described below:

In case of structures whose external faces are exposed, such as elevated tanks, the requirements of the test shall be deemed to be satisfied if the external faces show no sign of leakage or sweating and remain completely dry during the period of observation of seven days after allowing a seven day period for absorption after filling with water.

In the case of structures whose external faces are buried and are not accessible for inspection, such as underground tanks, the structures shall be filled with water and after the expiry of seven days after the filling, the level of the surface of the water shall be recorded. The level of water shall be recorded again at subsequent intervals of 24 hrs. Over a period of seven days. Backfilling shall be withheld till the tanks are tested. The total drop in surface level over a period for seven days shall be taken as an indication of the water tightness of the structure. The Engineer-in-charge shall decide on the actual permissible nature of this drop in the surface level, taking into account whether the structures are open or closed and the corresponding effect it has on evaporation losses. Unless specified otherwise, a structure whose top is covered shall be deemed to be water tight if the total drop in the surface level over a period of seven days does not exceed 40 mm.

Each compartment/segment of the structure shall be tested individually.

For structures such as pipes, tunnels etc. the hydrostatic test shall be carried out by filling with water, after curing as specified, and subjecting to the specified test pressure for specified period. If during this period the loss of water does not exceed the equivalent of the specified rate, the structure shall be considered to have successfully passed the test.

2.4.5.11 Repair and Replacement of Unsatisfactory Concrete

Immediately after the shuttering is removed, all the defective areas such as honey-combed surfaces, rough patches, holes left by form bolts etc. shall be inspected by the Engineer-in-charge who may permit patching of the defective areas or reject the concrete work.

All through holes for shuttering shall be filled for full depth and neatly plugged flush with surface.

Rejected concrete shall be removed and replaced by the Contractor at no additional cost to the client.

For patching of defective areas all loose materials shall be removed and the surface shall be prepared as approved by the Engineer-in-charge.

Bonding between hardened and fresh concrete shall be done either by placing cement mortar with approved bonding agent or by applying epoxy. The decision of the Engineer-in-charge as to the method of repairs to be adopted shall be final and binding on the Contractor. The surface shall be saturated with water for 24 hours before patching is done with 1:4 cement sand mortar. The use of epoxy for bonding fresh concrete shall be carried out as approved by the Engineer-in-charge.

All the form bolt repairs and delayed repairs shall be carried out using a proportion of white cement in repair mix to the approval of the Engineer-in-charge, so as to match the colour of the surrounding area.

Tolerances for R.C. Buildings

a) Variation from the Plumb

(I) In the lines and surfaces of columns, piers, and walls and in arrises 5 mm per 2.5 m or 25 mm, whichever is less?

(ii) For exposed corner columns and other conspicuous lines

In any bay or 5 m maximum	-	5 mm
In 10 m or more	-	10 mm

b) Variation from the level or from the grades indicated on the drawings

(I) In slab soffits, ceilings, beam soffits, and in arrises

In 2.5 m	-	5 mm
In any bay or 5 m maximum	-	10 mm
In 10 m or more	-	15 mm

(ii) For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines:

In any bay or 5 m maximum	-	5 mm
In 10 m or more	-	10 mm

c) Variation of the linear building lines from established position in plan and related position of columns, wall and partitions:

In any bay or 5 m maximum	-	10 mm
In 10 m or more	-	20 mm

d) Variation in the sizes and locations of sleeves, openings in walls and floors – 5 mm except in the case of and for anchor bolts.

e) Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls

Minus	-	5 mm
Plus	-	10 mm

f) Footings

(I) Variation in dimension in plan
Minus - 5 mm
Plus - 50 mm

(ii) Misplacement or eccentricity
2% of footing width in the direction of misplacement but not more than 50 mm

(iii) Reduction in thickness
Minus - 5% of specified thickness subject to a maximum of 50 mm

g) Variation in Steps

(I) In a flight of stairs
Rise - 3 mm
Tread - 5 mm

(ii) In consecutive steps
Rise - 1.5 mm
Tread - 3.0 mm

2.4.5.12 Measurement

Dimensions shall be measured nearest to a cm except for the thickness of slab, which shall be measured correct to 0.5 cm. The areas shall be worked out nearest to 0.01 sq.mt. The cubical contents shall be worked out to nearest 0.01 cubic meters.

Reinforced cement concrete whether cast-in-situ or precast shall be classified and measured separately as per Bill of Quantity.

No deduction shall be made for the following: -

a) Opening upto 0.1 sq.m

Note: In calculating area of openings upto 0.1 sqm the size of opening shall include the thickness of any separate lintels or sills. No extra labour for forming such openings or voids shall be paid for.

b) The volume occupied by reinforcement.

c) The volume occupied by water pipes conduits etc. not exceeding 25 sq cm each in cross sectional area. Nothing extra shall be paid for leaving and finishing such cavities and holes.

The measurement of RCC work of various units shall be regulated as below;

a) Slabs shall be taken as running continuously.

b) Beams shall be measured from face to face of columns and shall include haunches, if any, between columns and beam. The depth of the beam shall be from the bottom of slab to the bottom of beam.

c) The columns measurement shall be taken upto the underside of slab.

d) Chajjas along with the bearing on wall shall be measured in cubic meter nearest to two places of decimal. When chajjas is combined with lintel, slab or beam, the projecting portion shall be measured as chajjas, built in bearing shall be measured as per item of lintel, slab or beam in which chajja bears.

e) Where the band and lintels are of the same height and the band serves as llintel, the length of the band to be measured as lintel shall be for clear length of opening plus twice the over all depth of band.

2.4.5.13 Rate

The rate includes the cost of materials and labour involved in all the operations described above including cost of centering and shuttering work.

2.5 Nominal Mix Concrete

2.5.1 Mix Design & Testing

Mix design and preliminary tests are not necessary for Nominal Mix Concrete. However works tests shall be carried out as per IS:456. Proportions for Nominal Mix Concrete may be adopted as per Table 9 of IS:456. However it will be the Contractor's sole responsibility to adopt appropriate nominal mix proportions to yield the specified strength.

2.5.2 Batching & Mixing of Concrete

Based on the adopted nominal mixes, aggregates shall be measured by volume. However cement shall be by weight only, using whole bags of cement.

2.6 Optional Tests

If the Engineer-in-charge is not satisfied with the results of the tests or otherwise considers that the materials i.e. cement, sand, coarse aggregates, reinforcement and water are not in accordance with the Specifications or if specified concrete strengths are not obtained, he may order tests to be carried out on these materials in laboratory, to be approved by the Engineer-in-charge, as per relevant IS Codes. Contractor shall have to pay for these tests.

In the event of any work being suspected of faulty material or workmanship requiring its removal or if the works cubes do not give the stipulated strengths, the Engineer-in-charge reserves the right to order the Contractor to take out cores and conduct tests on them or do ultrasonic testing or load testing of structure as referred to in IS 456, etc. The Engineer-in-charge also reserves the right to ask the Contractor to dismantle and re-do such unacceptable work, at no cost to the HAL.

If the structure is certified as failed by Engineer-in-charge, the cost of the test and subsequent dismantling/reconstruction shall be borne by the Contractor.

The quoted unit rates/prices of concrete shall be deemed to provide for all tests mentioned above.

2.7 Grouting

a) Standard Grout

Grout shall be provided as specified on the drawings. The proportion of Standard Grout shall be such as to produce a flowable mixture consistent with minimum water content and shrinkage. Surfaces to be grouted shall be thoroughly roughened and cleaned. All Structural steel elements to be grouted shall be cleaned of oil, grease, dirt etc. The use of hot, strong caustic solution for this purpose will be permitted. Prior to grouting, the hardened concrete shall be saturated with water and just before grouting water in all pockets shall be removed. Grouting once started shall be done quickly and continuously. Variation in grout mixes and procedures shall be permitted if approved by Engineer-in-charge. The grout proportions shall be limited as follows:

Use	Grout Thickness	Mix Proportions	W/C Ratio (max)
a) Fluid mix	Under 25mm	One part Portland Cement to one part sand	0.44
b) General mix	25mm and over but less than 50mm	One part Portland Cement to 2 parts of sand	0.53
c) Stiff mix	50mm and over	One part Portland Cement to 3 parts of sand	0.53

b) Non-Shrink Grout

Non – shrink grout where required shall be provided in strict accordance with the manufacturer's instructions / specifications on the drawings.

2.8 Form Work (Centering and Shuttering)

2.8.1 Form Work

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

2.8.2 Design and Tolerance in Construction

Form work shall be designed and constructed to the shapes, lines and dimensions shown on the drawings with the tolerances given below :

a) Deviation from specified dimensions of cross section
Of columns and beams + 12 mm
- 6 mm

b) Deviation from dimensions of footings

i) Eccentricity in plan 0.02 times the width of the footings in the direction of deviation but not more than 50 mm.

ii) Thickness

+ 0.05 times the specified thickness.

(**Note** – Tolerance apply to concrete dimensions only, and not to positioning of vertical steel or dowels).

2.8.3 General Requirement

It shall be strong enough to withstand the dead and live loads and forces caused by ramming and vibrations of concrete and other incidental loads, imposed upon it during and after casting of concrete. It shall be made sufficiently rigid by using adequate number of ties and braces, Screw jacks or hard board wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete.

Forms shall be so constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections. Care shall be taken to see that no piece is keyed into the concrete.

2.8.3.1 Material for Form Work

a) Propping and centering

All propping and centering should be either of steel tubes with extension pieces or built up sections of rolled steel.

2.8.3.2 a) Centering / Staging

Contractor shall design the staging as per design for slabs / beams etc. and as per levels as shown in drawings. All the staging to be either Tubular steel structure with adequate bracings as approved or made of built-up structural sections made from rolled structural steel sections.

b) In case of structures with two or more floors, the weight of concrete, centering and shuttering of any upper floor being cast shall be suitably supported on one floor below the top most floor already cast.

c) Form work and concreting of upper floor shall not be done until concrete of lower floor has set atleast for 14 days.

2.8.3.3 Shuttering

Shuttering used shall be of sufficient stiffness to avoid excessive deflection and joints shall be tightly butted to avoid leakage of slurry. New waterproof ply / steel shuttering only shall be used.

If steel shuttering is used for concreting it should be sufficiently stiffened. The steel shuttering should also be properly repaired before use and properly cleaned to avoid stains, honey combing, seepage of slurry through joints etc.

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

2.8.3.5 Camber

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

2.8.3.6 Removal of Form Work (Stripping time)

In normal circumstances and where ordinary Portland cement is used, forms may generally be removed after the expiry of the following periods or as specified by engineer-in-charge:

a) Walls, columns and vertical Faces of all structural members	16 to 24 hours as may be decided by the Engineer-in-charge
b) Slabs	
i) Spanning upto 4.50 M	7 days
ii) Spanning over 4.50 M	14 days
c) Beams and arches	
i) Spanning upto 6 M	14 days
ii) Spanning over 6 M & upto 9 m	21 days
iii) Spanning over 9 M	28 days

2.8.4 Surface Treatment

2.8.4.1 Oiling the Surface

Shuttering gives much longer service life if the surfaces are coated with suitable mould oil, which acts both as a parting agent and also gives surface protections.

A typical mould oil is heavy mineral oil or purified cylinder oil containing not less than 5% pentachlorophenol conforming to IS 716 well mixed to a viscosity of 70-80 centipoise.

After 3-4 uses and also in cases when shuttering has been stored for a long time, it should be recoated with mould oil before the next use.

2.8.5 Inspection of Form Work

The completed form work shall be inspected and approved by the Engineer-in-charge before the reinforcement bars are placed in position.

Proper form work should be adopted for concreting so as to avoid honey combing, blow holes, grout loss, stains or discolouration of concrete etc. Proper and accurate alignment and profile of finished concrete surface will be ensured by proper designing and erection of form work which will be approved by Engineer-in-charge.

Shuttering surface before concreting should be free from any defect / deposits and fully cleaned so as to give perfectly straight smooth concrete surface. Shuttering surface should be therefore checked for any damage to its surface and excessive roughness

before use. Inserts and reinforcement shall be correctly positioned and securely held; and, necessary openings, pockets, etc. provided.

2.8.5.1 General

The form work shall include the following;

i) Splayed edges, notching, and allowance for overlaps and passing at angles, sheathing battens, strutting, bolting, nailing, wedging, easing, striking and removal.

ii) All supports, struts, braces, wedges as well as mud sills, piles or other suitable arrangements to support the form work.

iii) Bolts, wire ties, clamps, spreaders, nails or any other items to hold the sheathing together.

iv) Working scaffolds, ladders, gangways and similar items.

v) Filleting to form stop chamfered edges of splayed external angles not exceeding 20 mm wide to beams, columns and the like.

vi) Where required, the temporary openings provided in the forms for pouring concrete, inserting vibrators, and cleaning holes for removing rubbish from the interior of the sheathing before pouring concrete.

vii) Dressing with oil to prevent adhesion and

viii) Raking or circular cutting.

2.8.5.2 Classification of Measurements

Where it is stipulated that the form work shall be paid for separately, measurements shall be taken of the area of shuttering in contact with the concrete surface. Dimensions of the form work shall be measured correct to a cm. The measurements shall be taken separately as per items in Bill of Quantity.

2.9 Damp Proof Course

2.9.1 Cement Concrete Layer

This shall consist of cement concrete of specified proportions and thickness. The surface of brick or stone masonry work shall be leveled and prepared before laying the cement concrete. Edge of damp proof course shall be straight, even and vertical. Side shuttering shall consist of steel forms and shall be strong and properly fixed so that it does not get disturbed during compaction and the mortar does not leak through. The concrete mix shall be of workable consistency and hall be tamped thoroughly to make a dense mass. When the sides are removed, the surface should come out smooth without honeycombing. Continuity shall be maintained while laying the cement concrete layer and laying shall be terminated only at the predetermined location where damp proof course is to be discontinued. There shall be no construction joint in the Damp Proof Course.

2.9.2 Curing

Damp proof course shall be cured for at least seven days, after which it shall be allowed to dry.

2.9.3 Application of Hot Bitumen

Where so directed, hot bitumen in specified quantity shall be applied over the dried up surface of cement concrete, properly cleaned with brushes and finally with a piece of cloth soaked in kerosene oil. Bitumen of penetration A 90 or equivalent where used shall be heated to a temperature of 160° ± 5°C. The hot bitumen shall be applied uniformally all over, so that no blank spaces are left anywhere. It will be paid for separately.

2.9.4 Water Proofing Materials

Where so specified or as directed by Engineer-in-charge, water proofing material of approved quality shall be added to the concrete mixture in accordance with the manufacture's specifications stating the quantity of water proofing material in litres per 50 kg of cement, waterproofing material will be paid for separately.

2.9.5 Measurements

The length and breadth shall be measured correct to a cm and its area shall be calculated in square meters correct to two places of decimal. The depth shall not be less than the specified thickness at any section.

2.9.6 Rate

The rate is inclusive of the cost of materials and labour involved in all the operations described above except for the application of a coat of hot bitumen and addition of water proofing materials, which shall be paid for separately, unless otherwise specified.

2.10 Preformed Fillers and Joint Sealing Compound

2.10.1 Materials

Preformed filler for expansion/isolation joints shall be non-extruding and resilient type of bitumen impregnated fibers conforming to IS: 1838 (Part I).

Bitumen coat to concrete/masonry surfaces for fixing the preformed bitumen filler strip shall conform to IS: 702. Bitumen primer shall conform to IS: 3384.

Sealants shall be:

Sealant Polysulphide

Sealant shall be a cold pouring compound complying with BS 4254/IS 12118, suitable for sealing movement and construction joints in concrete and other areas. It shall be water tight & non-sagging. It shall be tough, abrasion-resistant and shall not decompose in strong sunlight.

Hardness (Shore A) : 15-20
Transverse Movement Accommodation : □12.5%

2.10.2 Workmanship

The thickness of the preformed filler shall be 25mm for expansion joints and 50mm for isolation joints around foundation supporting rotatory equipments. Contractor shall procure the strips of the desired thickness and width in lengths as manufactured. Assembly of small pieces/thicknesses of strips to make up the specified size shall not be permitted.

The concrete/masonry surface shall be cleaned free from dust and any loose particles. When the surface is dry, one coat of industrial blown type bitumen of grade 85/25 conforming to IS:702 shall be applied hot by brushing at the rate of 1.20 kg/sq.m. When the bitumen is still hot the preformed bitumen filler shall be pressed and held in position till it completely adheres. The surface of the filler against which further concreting/masonry work is to be done shall similarly be applied with one coat of hot bitumen at the rate of 1.20 kg/sq.m.

Sealing compound shall be heated to a pouring consistency for enabling it to run molten in a uniform manner into the joint. Before pouring the sealing compound, the vertical faces of the concrete joint shall be applied hot with a coat of bitumen primer conforming to IS:3384 in order to improve the adhesive quality of the sealing compound.

The Contractor shall construct recesses at all joints and on both faces of the concrete work except on the underside of ground slabs. The recesses shall be accurately formed to the lines and dimensions shown on the Drawings or as agreed with the Engineer-in-charge.

The Contractor shall prepare the surfaces of the recess and shall supply a joint sealer and fill or caulk the recess completely with it.

Joint sealing shall not be commenced without the approval of the Engineer-in-charge.

All joint sealers shall be from an approved manufacturer. The Contractor shall supply the manufacturer's test certificates for each consignment of each type of joint sealant delivered to the Site and shall if requested supply to the Engineer-in-charge sufficient samples of each type and consignment for confirmatory tests to be carried out in accordance with the appropriate test procedure.

Sealants shall be installed in strict accordance with the manufacturer's instructions. De-bonding strip shall be used in conjunction with the sealers as indicated on the Drawings. The de-bonding strip shall be compatible with the joint sealer and shall be resistant to attach from the primer used to bond the sealer to the concrete.

Polysulphide sealants shall not abut bitumen sealers. Surfaces to receive Polysulphide sealants shall be kept free from bituminous paints. All sealants shall be appropriate for the prevailing climatic conditions. Bituminous sealants shall comply with the BS 2499 and Polysulphide sealants shall comply with IS 12118/BS 4254.

2.10.3 Measurement

Measurement for the preformed joint filler shall be in sq.m correct to two places of decimal for the specified thickness as per items of work. Measurement for applying the bitumen coat to concrete/masonry surfaces shall be in sq.m correct to two places of

decimal. Measurement for the joint sealing compound shall be in running meters correct to two places of decimal for the specified width and thickness as per the items of work.

2.11 Concreting Records

A written record of the concrete works shall be made each day by the Contractor and kept available for inspection by the Engineer-in-charge. The diary shall contain notes and records of :

The names of the Contractor's Engineer-in-charge who are responsible for the different phases of the concrete work and also the names of their assistants.

The temperatures of air, water, cement, aggregates, together with the air humidity and type of weather.

Deliveries to the Site of concrete materials (quantity, brand of concrete, etc).

Inspections carried out, tests performed, etc. and their results.

Times of commencement and completion of different parts of the concrete works and times of erection and striking of forms.

Quantity of cement, fine and coarse aggregate and admixture used for each section of work and the number and kind of test samples taken on these ingredients and water.

2.12 Admixtures

Accelerating, retarding, water-reducing and air entraining admixtures shall conform to IS:9103 and integral water proofing admixtures to IS:2645.

Admixtures may be used in concrete as per manufacturer's instructions only with the approval of the Engineer-in-charge. Trial mixes shall verify an admixture's suitability and effectiveness with the other materials used in the works. If two or more admixtures are to be used simultaneously in the same concrete mix, their interaction shall be checked and trial mixes done to ensure their compatibility. There should also be no increase in risk of corrosion of the reinforcement or other embedment.

Calcium chloride shall not be used for accelerating set of the cement for any concrete containing reinforcement or embedded steel parts. When calcium chloride is permitted such as in mass concrete works, it shall be dissolved in water and added to the mixing water by an amount not exceeding 1.5 percent of the weight of the cement in each batch of concrete. The designed concrete mix shall be corrected accordingly.

3.0 GENERAL BUILDING WORKS

MASONRY, PLASTERING AND PAINTING

3.1 Applicable Codes and Specifications

The following Indian Standard Codes, unless otherwise specified herein, shall be applicable. In all cases, the latest editions including all applicable official amendments and revisions shall be referred to.

IS: 110	-	Ready mixed paint, brushing, grey filler, for enamels for use over primers
IS: 269	-	Specification for 33 grade ordinary Portland cement
IS: 280	-	Specification for mild steel wire for general Engineering purposes
IS: 287	-	Recommendations for maximum permissible moisture content of timber used for different purposes
IS: 304	-	High Tensile Brass Ingots and Castings.
IS: 337	-	Varnish, finishing interior
IS: 348	-	French polish
IS: 383	-	Specification for coarse and fine aggregates from natural sources for concrete
IS: 412	-	Expanded metal steel sheets for general purposes
IS: 419	-	Specification for putty for use on window frames
IS: 428	-	Distemper, oil emulsion, colour as required
IS: 459	-	Specification for unreinforced corrugated and semi-corrugated asbestos cement sheets
IS: 702	-	Specification for industrial bitumen
IS: 710	-	Specification for marine plywood
IS: 712	-	Specification for building limes
IS: 730	-	Specification for hook bolts for corrugated sheet roofing
IS: 733	-	Wrought aluminum and aluminum alloys, bars, rods and sections for general Engineering purposes
IS: 777	-	Specification for glazed earthenware tiles
IS: 1003	-	Specification for timber panelled and glazed shutters (Parts 1 & 2)
IS: 1038	-	Specification for steel doors, windows and ventilators
IS: 1077	-	Specification for common burnt clay building bricks
IS: 1081	-	Code of practice for fixing and glazing of metal (steel & aluminum) doors, windows and ventilators
IS: 1124	-	Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones
IS: 1237	-	Specification for cement concrete flooring tiles
IS: 1322	-	Bitumen felts for water proofing and damp proofing
IS: 1346	-	Code of practice for water proofing of roofs with bitumen felts
IS: 1361	-	Specification for steel windows for industrial buildings
IS: 1397	-	Specification for kraft paper
IS: 1443	-	Code of practice for laying and finishing of cement concrete flooring tiles
IS: 1477	-	Code of practice for painting of ferrous metals in buildings (Parts 1 & 2)
IS: 1542	-	Specification for sand for plaster
IS: 1580	-	Specification for bituminous compounds for water-proofing and caulking purposes
IS: 1597	-	Code of practice for construction of stone masonry: Part 1 Rubble stone masonry
IS: 1659	-	Specification for block boards
IS: 1661	-	Code of practice for application of cement and cement-lime plaster finishes
IS: 1834	-	Specification for hot applied sealing compound for joint in concrete

IS: 1838	-	Specification for preformed fillers for expansion joint in concrete pavements and structures (non extruding and resilient type): Part 1 Bitumen impregnated fiber
IS: 1948	-	Specification for aluminum doors, windows and ventilators
IS: 1949	-	Specification for aluminum windows for industrial buildings
IS: 2074	-	Ready mixed paint, air-drying, red oxide- zinc chrome, and priming
IS: 2098	-	Asbestos cement building boards
IS: 2114	-	Code of practice for laying in-situ terrazzo floor finish
IS: 2116	-	Specification for sand for masonry mortars
IS: 2185	-	Specification for concrete masonry units (Parts 1,2 & 3)
IS: 2202	-	Specification for wooden flush door shutters (Solid core type): Parts 1 & 2
IS: 2212	-	Code of practice for brickwork
IS: 2250	-	Code of practice for preparation and use of masonry mortars
IS: 2338	-	Code of practice for finishing of wood and wood based materials (Parts 1 & 2)
IS: 2339	-	Aluminum paint for general purposes, in dual container
IS: 2395	-	Code of practice for painting concrete, masonry and plaster surfaces (Parts 1 & 2)
IS: 2402	-	Code of practice for external rendered finishes
IS: 2571	-	Code of practice for laying in-situ cement concrete flooring
IS: 2572	-	Code of practice for construction of hollow concrete block masonry
IS: 2645	-	Specification of integral cement waterproofing compounds
IS: 2690	-	Specification for burnt clay flat terracing tiles: Part 1 Machine made
IS: 2691	-	Specification for burnt clay-facing bricks
IS: 2750	-	Specification for steel scaffoldings
IS: 2835	-	Flat transparent sheet glass
IS: 2932	-	Specification for enamel, synthetic, exterior type (a) undercoating, (b) finishing
IS: 3007	-	Code of practice for lying of asbestos cement sheets - corrugated and (Part 1 & 2) semi-corrugated sheets
IS: 3036	-	Code of practice for laying lime concrete for a waterproofed roof finish
IS: 3067	-	Code of practice of general design details and preparatory work for damp-proofing and water- proofing of buildings
IS: 3068	-	Specification for broken brick (burnt clay) coarse aggregates for use in lime concrete
IS: 3384	-	Specification for bitumen primer for use in waterproofing and damp proofing
IS: 3461	-	Specification for PVC-asbestos floor tiles
IS: 3462	-	Specification for unbacked flexible PVC flooring
IS: 3495	-	Method of test for burnt clay building bricks: Part 1 to 4
IS: 3536	-	Specification for ready mixed paint, brushing, wood primer, pink
IS: 3564	-	Specification for door closers (hydraulically regulated)
IS: 3696	-	Safety code of scaffolds and ladders (Parts 1 & 2)
IS: 4020	-	Methods of test for wooden flush door: Type test
IS: 4021	-	Specification for timber door, window and ventilator frames
IS: 4351	-	Specification for steel doorframes
IS: 4443	-	Code of practice for use of resin type chemical resistant mortars
IS: 4457	-	Specification for ceramic unglazed vitreous acid resisting tile
IS: 4631	-	Code of practice for laying epoxy resin floor toppings
IS: 4832	-	Specification for chemical resistant mortars (Part II)
IS: 4860	-	Specification for acid resistant bricks
IS: 4948	-	Specification for welded steel wire fabric for general use
IS: 5318	-	Code of practice for laying of flexible PVC sheet and tile flooring
IS: 5410	-	Cement paint, colour as required
IS: 5411	-	Specification for plastic emulsion paint (Parts 1 & 2)
IS: 5437	-	Wired and figured glass
IS: 5491	-	Code of practice for laying of in-situ granolithic concrete floor topping
IS: 6041	-	Code of practice construction of autoclaved cellular concrete block masonry

IS: 6042	-	Code of practice for construction of light weight concrete block masonry
IS: 6248	-	Specification for metal rolling shutters and rolling grilles
IS: 7193	-	Specification for glass fiber base coal tar pitch and bitumen felts
IS: 7452	-	Specification for hot rolled steel sections for doors, windows and ventilators
IS: 8042	-	Specification for white Portland cement
IS: 8543	-	Methods of testing plastics
IS: 8869	-	Specification for washers for corrugated sheet roofing
IS: 9197	-	Specification for epoxy resin, hardeners and epoxy resin composites for floor topping
IS: 9862	-	Specification for ready mixed paint, brushing, bituminous, black, lead-free, acid, alkali, water and chlorine resisting
IS: 12200	-	Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams
BS: 476 (Part – 20)	-	Methods for determination of the fire resistance of elements of construction (General Principles)
BS: 476 (Part – 21)	-	Methods for determination of the fire resistance of load bearing elements of construction
BS: 476 (Part – 22)	-	Methods for determination of the fire resistance of non-load bearing elements of construction
Part – IV Fire Protection	-	National Building code of India

3.2 Brick Masonry

3.2.1 Materials

Bricks used in the works shall conform to the requirements laid down in IS: 1077. The class of the bricks shall be as specifically indicated in the respective items of work.

The nominal size of the modular brick shall be 200mmx100mmx100mm with the permissible tolerances over the actual size of 190mmx90mmx90mm as per IS: 1077. The nominal thickness of one brick and half brick walls using modular bricks shall be considered as 200 mm and 100 mm respectively. In the event of use of traditional bricks of nominal size 230 mmx115mmx75mm with tolerance up to □3 mm in each dimension, one brick and half brick walls shall be considered as 230 mm and 115 mm respectively.

Bricks shall be sound, hard, homogenous in texture, well burnt in kiln without being vitrified, hand/machine molded, deep red, cherry or copper coloured, of regular shape and size & shall have sharp and square edges with smooth rectangular faces. The bricks shall be free from pores, cracks, flaws and nodules of free lime. Hand molded bricks shall be molded with a frog and those made by extrusion process may not be provided with a frog. Bricks shall give a clear ringing sound when struck and shall have a minimum crushing strength of 35N/sq.mm unless otherwise specified in the items of work.

The average water absorption shall not be more than 20 percent by weight up to class 12.5 and 15 percent by weight for higher classes. Bricks, which do not conform to this requirement, shall be rejected. Over or under burnt bricks are not acceptable for use in the works.

Sample bricks shall be submitted to the Engineer-in-charge for approval and bricks supplied shall conform to approve samples. If demanded by Engineer-in-charge, brick

samples shall be got tested as per IS: 3495 by Contractor. Bricks rejected by Engineer-in-charge shall be removed from the site of works within 24 hours.

3.2.2 Mortar

Mortar for brick masonry shall consist of cement and sand and shall be prepared as per IS: 2250. Mix shall be in the proportion of 1:6 for brickwork of thickness one brick or above and 1:4 for brickwork of thickness half brick or below, unless otherwise specified in the respective items of work. Sand for masonry mortar shall conform to IS: 2116. The sand shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by Engineer-in-charge. If so directed by the Engineer-in-charge, sand shall be screened and washed till it satisfies the limits of deleterious materials.

For preparing cement mortar, the ingredients shall first be mixed thoroughly in dry condition. Water shall then be added and mixing continued to give a uniform mix of required consistency. Mixing shall be done thoroughly in a mechanical mixer, unless hand mixing is specifically permitted by the Engineer-in-charge. The mortar thus mixed shall be used as soon as possible preferably within 30 minutes from the time water is added to cement. Incase, the mortar has stiffened due to evaporation of water, this may be re-tempered by adding water as required to restore consistency, but this will be permitted only up to 30 minutes from the time of initial mixing of water to cement. Any mortar, which is partially set, shall be rejected and shall be removed forthwith from the site. Droppings of mortar shall not be re-used under any circumstances.

The Contractor shall arrange for test on mortar samples if so directed by the Engineer-in-charge.

3.2.3 Soaking of Bricks

Bricks shall be soaked in water before use for a period for the water to just penetrate the whole depth of the bricks. Alternatively, bricks may be adequately soaked in stacks by profusely spraying with clean water at regular intervals for a period not less than six hours. The bricks required for masonry work using mud mortar shall not be soaked. When the bricks are soaked they shall be removed from the tank sufficiently early so that at the time of laying they are skin-dry. Such soaked bricks shall be stacked on a clean place where they are not again spoiled by dirt earth etc.

Note I

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

Note II

If the bricks are soaked for the required time in water that is frequently changed the soluble salt in the bricks will be leached out, and subsequently efflorescence will be reduced.

3.2.4 Laying

Bricks shall be laid in English Bond unless otherwise specified. For brick work in half brick wall, bricks shall be laid in stretcher bond. Half or cut bricks shall not be used except as closer where necessary to complete the bond. Closers in such cases, shall be cut to the required size and used near the ends of the wall. Header bond shall be used preferably in all courses in curved plan for ensuring better alignment.

Note

Header bond shall also be used in foundation footings unless thickness of walls (width of footing) makes the use of headers impracticable. Where thickness of footing is uniform for a number of courses, the top course of footing shall be header.

All loose materials, dirt and set lumps of mortar which may be lying over the surface on which brick work is to be freshly started, shall be removed with a wire brush and surface wetted. Bricks shall be laid on a full bed of mortar, when laying, each brick shall, be properly bedded and set in position by gently pressing with the handle of trowel. Its inside face shall be buttered with mortar before the next brick is laid and pressed against it. Joints shall be fully filled and packed with mortar such that no hollow spaces are left inside the joints.

The walls shall be taken up truly in plumb or true to the required batter where specified. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. Vertical joints in the alternate course shall come directly one over the other. Quoin, Jambs and other angles shall be properly plumbed as the work proceeds. Care shall be taken to keep the perpends properly aligned within following maximum permissible tolerances:

a) Deviation from vertical within a storey shall not exceed 6 mm per 3 m height.

b) Deviation in vertically in total height of any wall of building more than one storey in height shall not exceed 12.5 mm.

c) Deviation from position shown on plan of any brick work shall not exceed 12.5 mm.

d) Relative displacement between loads bearing wall in adjacent storeys intended to be vertical alignments shall not exceed 6 mm.

e) A set of tools comprising of wooden straight edge, Masonic spirit levels, square, 1-meter rule line and plumb shall be kept on the site of work for every 3 masons for proper check during the progress of work.

All quoins shall be accurately constructed and the height of brick courses shall be kept uniform. This will be checked using graduated wooden straight edge or storey rod indicating height of each course including thickness of joints. The position of damp proof course, windowsills, bottom of lintels, top of the wall etc. along the height of the wall shall be marked on the graduated straight edge or storey rod. Acute and obtuse quoins shall be bonded, where practicable in the same way as square quoins. Obtuse quoins shall be formed with squint showing three quarters brick on one face and quarter brick on the other.

The brickwork shall be built in uniform layers.

No part of the wall during its construction shall rise more than one metre above the general construction level. Parts of wall left at different levels shall be raked back at an angle of 45 degrees or less with the horizontal. Toothing shall not be permitted as an alternative to raking back. For half brick partition to be keyed into main walls, indents shall be left in the main walls.

All pipe fittings and specials, spouts, hold fasts and other fixtures which are required to be built into the walls shall be embedded, as specified, in their correct position as the work proceeds unless otherwise directed by the Engineer-in-charge.

Top courses of all plinths, parapets, steps and top of walls below floor and roof slabs shall be laid with brick on edge, unless specified otherwise. Brick on edge laid in the top courses at corner of walls shall be properly radiated and keyed into position to form cut (maru) corners. Where bricks cannot be cut to the required shape to form cut (maru) corners, cement concrete 1:2:4 (1 cement; 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) equal to thickness of course shall be provided in lieu of cut bricks.

Bricks shall be laid with frog (where provided) up. However, when top course is exposed, bricks shall be laid with frog down. For the bricks to be laid with frog down, the frog shall be filled with mortar before placing the brick in position.

In case of walls one brick thick and under, one face shall be kept even and in proper plane, while the other face may be slightly rough. In case of walls more than one brick thick, both the faces shall be kept even and in proper plane.

To facilitate taking service lines later without excessive cutting of completed work, sleeves (to be paid separately) shall be provided, where specified, while raising the brickwork. Such sleeves in external walls shall be sloped down outward so as to avoid passage of water inside.

Top of the brickwork in coping and sills in external walls shall be slightly tilted. Where brick coping and sills are projecting beyond the face of the wall, drip course / throating shall be provided where indicated.

Care shall be taken during construction that edges of jambs, sills and projections are not damaged in case of rain. New built work shall be covered with gunny bags or tarpaulin so as to prevent the mortar from being washed away. Damage, if any, shall be made good to the satisfaction of the Engineer-in-charge.

Vertical reinforcement in the form of bars (MS or high strength deformed bar), considered necessary at the corners and junction of walls and jamb opening doors, windows etc. shall be encased with cement mortar not leaner than 1:4 (1 cement: 4 coarse sand), or cement concrete mix as specified. The reinforcement shall be suitably tied, properly embedded in the foundation and at roof level. The diameter of bars shall not be less than 8 mm and concrete grade shall be minimum 1:3:6 (1 cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size).

In retaining walls and the like, where water is likely to accumulate, weep holes, 50 to 75 mm square shall be provided at 2 m vertically and horizontally unless otherwise specified. The lowest weep hole shall be at about 30 cm above the ground level. All weep holes shall be surrounded by loose stones and shall have sufficient fall to drain out the water quickly.

Work of cutting chases, wherever required to be made in the walls for housing G.I pipe, CI pipe or any other fixtures shall be carried out in various locations as per guidelines given below:

a) Cutting of chases in one brick thick and above load bearing walls.

   i) As far as possible services should be planned with the help of vertical chases. Horizontal chases should be avoided.

   ii) The depths of vertical chases and horizontal chases shall not exceed one third and one-sixth of the thickness of the masonry respectively.

   iii) When narrow stretches of masonry (or short length of walls) such as between doors and windows, cannot be avoided they should not be pierced with openings for soil pipes or waste pipes or timber joints, etc. where there is a possibility of load concentration such narrow lengths of walls shall be checked for stresses and high strength bricks in mortar or concrete walls provided, if required.

   iv) Horizontal chases when unavoidable should be located in the upper or lower one-third of height of storey and not more than three chases should be permitted in any stretch of a wall. No continuous horizontal chase shall exceed one metre in length. Where unavoidable, stresses in the affected area should be checked and kept within the permissible limits.

   v) Vertical chases should not be closer than 2 m in any stretch of a wall. These shall be kept away from bearings of beams and lintels. If unavoidable, stresses in the affected area should be checked and kept within permissible limits.

   vi) Masonry directly above a recess, if wider than 30 cm horizontal dimension) should be supported on lintel. Holes in masonry may be provided up to 30 cm width and 30 cm height without any lintel. In the case of circular holes in the masonry, no lintel need be provided for holes up to 40 cm in diameter.

b) Cutting of chases in half brick load bearing walls.

   No chase shall be permitted in half brick load bearing walls and as such no recessed conduits and concealed pipes shall be provided with half brick thick load bearing, walls.

c) Cutting of chases in half brick non-load bearing wall:

   Services should be planned with the help of vertical chases. Horizontal chase should be provided only when unavoidable.

3.2.5 Joints

The thickness of all types of joints including brick wall joints and cross joints shall be such that four course and three joints taken consecutively shall measure as follows:

i) In case of modular bricks conforming to IS: 1077 specification for common burnt clay buildings bricks, equal to 39 cm.

ii) In case of non-modular bricks, it shall be equal to 31 cm.

Note

Specified thickness of joints shall be of 1 cm deviation from the specified thickness of all joints shall not exceed one-fifth of specified thickness.

Finishing of Joints

The face of brick work may be finished flush or by pointing. In flush finishing either the face joints of the mortar shall be worked out while still green to give a finished surface flush with the face of the brick work or the joints shall be squarely raked out to a depth of 1 cm while the mortar is still green for subsequently plastering. The faces of brick work shall be cleaned with wire brush so as to remove any splashes of mortar during the course of rising the brick work. In pointing, the joints shall be squarely raked out to a depth of 1.5 cm while the mortar is still green and raked joints shall be brushed to remove dust and loose particles and well wetted, and shall be later refilled with mortar to give ruled finish. Some such finishes are 'flush', 'weathered', ruled, etc.

3.2.6 Curing

The brickwork shall be constantly kept moist on all faces for a minimum period of seven days. Brickwork done during the day shall be suitably marked indicating the date on which the work is done so as to keep a watch on the curing period.

3.2.7 Scaffolding

Scaffolding shall be strong to withstand all dead, live and impact loads, which are likely to come on them. Scaffolding shall be provided to allow easy approach to every part of the work.

3.2.8 Double Scaffolding

For all brick masonry work double scaffolding having two independent supports, clear of the work, shall be provided.

3.2.9 Measurements

Brickwork shall be measured in cubic metres unless otherwise specified. Any extra work over the specified dimensions shall be ignored. Dimensions shall be measured correct to the nearest 0.01 m i.e. 1 cm. Areas shall be calculated to the nearest 0.01 sq mtrs and the cubic contents shall be worked out to the nearest 0.01 cubic metres.

No deductions or additions shall be done and no extra payment made for the following:

Note

Where minimum area is defined for deduction of an opening, void or both, such areas shall refer only to opening or void within the space measured.

a) Ends of dissimilar materials (that is, joists, beams, lintels, posts, girders, rafters, purlins, trusses, corbels, steps, etc); up to 0.1 m^2 in section;

b) Opening up to 0.1 m^2 in area

c) Wall plates, bed plates, and bearing of slabs, chajjas and the like, where thickness does not exceed 10 cm and bearing does not extend over the full thickness of wall;

d) Cement concrete blocks as for hold fasts and holding down bolts;

e) Iron fixtures, such as wall ties, pipes up to 300 mm diameter and hold fasts for doors and windows; and

f) Chases of section not exceeding 50 cm in girth.

g) Bearing portion of drip course, bearing of molding and cornice.

Note

In calculating area of an opening, any separate lintel or sills shall be included with the size of the opening but end portions of lintel shall be excluded. Extra width of rebated reveals, if any, shall also be excluded.

Walls half brick thick and less shall each be measured separately in square metres stating thickness.

String courses, projecting pilasters, aprons, sills and other projections shall be fully described and shall not be measured separately.

Circular pillars shall be measured separately in cubic metres as per actual dimensions.

Brick work curved on plan shall be measured like the brick work in straight walls and shall include all cutting and wastage of bricks, tapered vertical joints and use of extra mortar, if any. Brickwork curved on plan to a mean radius not exceeding six metres shall be measured separately and extra shall be payable over the rates for brick work in straight walls. Nothing extra shall be payable if the mean radius of the brickwork curved in plan exceeds six metres.

Tapered walls shall be measured net as walls and no extra payment shall be allowed for making tapered surface for brickwork in walls.

3.2.10 Rate

The rate shall include the cost of materials and labour required for all the operations described above except the vertical reinforcement and its encasement in cement mortar or cement concrete. The rate shall also include the following:

a) Raking out joints or finishing joints flush as the work proceeds;

b) Preparing tops of existing walls and the like for raising further new brickwork.

c) Rough cutting and waste for forming gables, splays at eaves and the like.

d) Leaving holes for pipes up to 150 mm diameters And encasing hold fasts etc.

e) Rough cutting and waste for brick work curved in plan and for backing to stone or other types of facing.

f) Embedding in ends of beams, joists, slabs, lintels, sills, trusses, etc.

g) Bedding wall plates, lintels, sills, roof tiles, corrugated sheets, etc. in or on walls if not covered in respective items and

h) Leaving chases of section not exceeding 50 cm in girth or 750 sq. cm in cross-section.

i) Brick on edge courses, cut brick corners, splays reveals, cavity walls, brick works

3.3 Random Rubble Masonry
Squared Rubble Masonry (cut-size).

3.3.1 Stone

The stone shall be of the type specified in BOQ or as directed by Engineer-in-charge-in-charge such as granite, trap, limestone, sand stone, quartzite, etc. and shall be obtained from the quarries, approved by the Engineer-in-charge. Stone shall be hard, sound, durable and free from weathering decay and defects like cavities, cracks, flaws, 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, quality or texture. Generally stone shall not contain crypts crystalline silica or chart, mica and other deleterious materials like iron-oxide organic impurities etc.

Stones with round surface shall not be used.

The compressive strength of common types of stones shall be as per Table 1 and the percentage of water absorption shall generally not exceed 5% for stones other than specified in Table 1. For literate this percentage is 12%.

TABLE 1

Type of stone	Maximum water Absorption percentage by weight	Minimum compressive strength kg/sq.cm.
Granite	0.5	1000
Basalt	0.5	400
Lime stone (Slab & Tiles)	0.15	200
Sand stone (Slab & Tiles)	2.5	300
Marble	0.40	500
Quartzite	0.40	800
Literate (Block)	12	35

Note 1: Test for compressive strength shall be carried out as laid down in IS: 1121 (Part I)

Note 2: Test for water absorption shall be carried out as laid down in IS: 1124.

3.3.2 Size of Stones

Normally stones used should be small enough to be lifted and placed by hand. Unless otherwise indicated, the length of stones for stone masonry shall not exceed three times the height and the breadth or base shall not be greater than three-fourth the thickness of wall, or not less than 15 cm. The height of stone may be up to 30 cm.

3.3.3 (i) Random Rubble Masonry shall be uncoursed or brought to courses as specified. Uncoursed random rubble masonry shall be constructed with stones of sizes as referred to in para 4.2.2 and shapes picked up random from the stones brought from the approved quarry. Stones having sharp corners or round surfaces shall however, not be used.

(ii) Random rubble masonry brought to the course is similar to uncoursed random rubble masonry except that the courses are roughly leveled at intervals varying from 30 cm to 90 cm in height according to the size of stones used.

3.3.4 (a) Uncoursed: In this type, the stones shall be roughly squared as risers or jumpers and stretchers with varying heights and shall be laid uncoursed.

(b) Brought to course: The stones shall be similar to those used for uncoursed rubble but the work is leveled to coursed of varying depth from 30 cm to 60 cm in height.

(c) Coursed: Coursed walling shall be built in coursed which may vary in height from 10 to 30 cm but the stones in any one course are roughly squared to the same height.

3.3.5 Dressing

(i) Random Rubble Masonry
Each stone shall be hammer dressed on the face, the sides and the bed. Hammer dressing shall enable the stones to be laid close to neighboring stones such that the building in the face shall not project more than 40 mm on the exposed face and 10 mm on the face to be plastered.

(ii) Size Stone Masonry
Face stone should be hammer dressed on all beds & joints so as to give them approximately rectangular shape. The bushes on the face shall not be more than 20 mm. The bed joint shall be chisel drafted for at least 8 cm back from the face and for the side joints at least 4 cm. No portion of chisel dressed surface shall show a depression of more than 6 mm from a straight edge placed on it. The remaining portion of the stone shall not project beyond the surface of Bed and side joints.

3.3.6 Mortar

The mortar used for joining shall be as specified.

3.3.7 Laying

All stones shall be wetted before use. Each stone shall be placed close to the stones already laid so that the thickness of the mortar joints at the face is not more than 20 mm. Face stones shall be arranged suitably to stagger the vertical joints and long vertical joints shall be avoided. Stones for hearting or interior filling shall be hammered down with wooden mallet into the position firmly bedded in mortar. Chips or sprawls of stones may be used for filling of interstices between the adjacent stones in heartening and these shall not exceed 20% of the quantity of stone masonry for Random Rubble & 10% for squared rubble masonry. To form a bond between successive courses plum stones projecting vertically by about 15 to 20 cm shall be firmly embedded in the heartening at the interval of about one metre in every course. No hollow space shall be left any where in the masonry.

The masonry work in wall shall be carried up true to plumb or to specified batter.

Also for squared coursed Rubble Masonry the face stone, quoin and jamb stones and bond stones shall be roughly squared to the same height in any one course. The height of courses shall be 10 to 30 cm.No course shall be of greater height than the course below and all bond stone shall be provided at 1.4 to 1.8 meters apart in every course.

Random rubble masonry shall be brought to the level courses at plinth, windowsills, lintel and roof levels. Leveling shall be done with concrete comprising of one part of the mortar as used for masonry and two parts of graded stone aggregate of 20 mm nominal size.

The masonry in structure shall be carried uniformly. Where the masonry of one part is to be delayed, the work shall be raked back at an angle not steeper than 45°.

3.3.8 Bond Stones

Bond or through stones running right through the thickness of walls, shall be provided in walls up to 60cm thick and in case of walls above 60cm thickness, a set of two or more bond stones overlapping each other by at least 15 cm shall be provided in a line from face of the wall to the back.

For all thick nesses of such walls, a set of two or more bond stones overlapping each other by at least 15 cm shall be provided. Length of each such bond stone shall not be less than two-third of the thickness of the wall.

Where bond stones of suitable lengths are not available precast cement concrete block of 1:2:4 mix (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) of cross section not less than 225 square centimeters and length equal to the thickness of wall shall be used in lieu of bond stones. (This shall be applicable only in masonry below ground level and where masonry above ground level is finally required to be plastered).

At least one bond stone or a set of bond stones shall be provided for every 0.5 sq.m of the area of wall surface. All bond stones shall be marked suitably with paint as directed by the Engineer-in-charge.

3.3.9 Quoin and Jamb Stones

The quoin and jamb stones shall be of selected stones neatly dressed with hammer or chisel to form the required angle. Quoin stones shall not be less than 0.01 cum in volume. Height of quoins and jamb stones shall not be less than 15 cm. Quoins shall be header and stretcher alternatively.

3.3.10 Joints

Stones shall be so laid that all joints are fully packed with mortar and chips. Face joints shall not be more than 20 mm thick.

The joints shall be struck flush and finished at the time of laying when plastering or pointing is not to be done. For the surfaces to be plastered or pointed, the joints shall be raked to a minimum depth of 20 mm when the mortar is still green.

3.3.11 Scaffolding

Single scaffolding having one set of vertical support shall be allowed. The supports shall be sound and strong, tied together by horizontal pieces, over which the scaffolding planks shall be fixed. The inner end of the horizontal scaffolding member may rest in a hole provided in the masonry. Such holes, however, shall not be allowed in pillars less than one meter in width or near the skew back of arches. The holes left in masonry work for supporting scaffolding shall be filled and made good with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size).

3.3.12 Curing

Masonry work in cement or composite mortar shall be kept constantly moist on all faces for a minimum period of seven days. In case of masonry with fat lime mortar curing shall, commence two days after laying of masonry and shall continue for at least seven days thereafter.

3.3.13 Protection

Green work shall be protected from rain by suitably covering. The work shall also be suitably protected from damage, mortar dropping and rain during construction.

3.3.13.1 Measurements

The length, height and thickness shall be measured correct to a cm. The thickness of wall shall be measured at joints excluding the bushing. Only specified dimensions shall be allowed; anything extra shall be ignored. The quantity shall be calculated in cubic metre nearest to two places of decimal.

3.3.13.2 No deduction shall be made nor extra payment made for the following:

i) Ends of dissimilar materials (that is joists, beams, lintels, posts, girders, rafters purlins, trusses, corbels, steps, etc.) up to 0.1 sqm in section.

ii) Openings each up to 0.1 sqm in area. In calculating the area of openings, any separation lintels or sills shall be included along with the size of opening but the end portions of the lintels shall be excluded and the extra width of rebated reveals, if any, shall also be excluded.

iii) Wall plates and bedplates, and bearing of chajjas and the like, where the thickness does not exceed 10 cm and the bearing does not extend over the full thickness of the wall.

Note: The bearing of floor and roof shall be deducted from wall masonry.

iv) Drain holes and recesses for cement concrete blocks to embed hold fasts for doors, windows, etc.

v) Building in masonry, iron fixture, pipes up to 300 mm diameter, hold fasts of doors and windows, etc.

vi) Forming chases in masonry each up to section of 350 sq.cm.

3.3.14 Square or Rectangular Pillars

These shall be measured as walls, but extra payment shall be allowed for stonework in square or rectangular pillars over the rate for stone work in walls. Rectangular pillar shall mean a detached masonry support rectangular in section, such that its breadth does not exceed two and a half times the thickness.

3.3.15 Circular Pillars (Columns)

These shall be measured as per actual dimensions, but extra payment shall be allowed for stone work in circular pillars over the rate for stone work in walls. The diameter as well as length shall be measured correct to a cm.

3.3.16 Tapered walls shall be measured net, as per actual dimensions and paid for as other walls.

3.3.17 Curved Masonry

Stone masonry curved on plan to a mean radius exceeding 6 metres shall be measured and included with general stonework. Stonework circular on plan to a mean radius not exceeding 6 metres shall be measured separately and shall include all cuttings and waste and templates. It shall be measured as the mean length of the wall.

3.3.18 Rate

The rate shall include the cost of materials and labour required for all the operations described above and shall include the following :

(a) Raking out joints for plastering or pointing done as a separate item, or finishing flush as the work proceeds.

(b) Preparing tops and sides of existing walls for raising and extending.

(c) Rough cutting and waste for forming gables cores, skew backs of spandrels or arches, splays at eaves and all rough cutting in the body of walling unless otherwise specified.

(d) Bond stones or cement concrete bond blocks.

(e) Leading and making holes for pipes etc.

(f) Bedding and pointing wall plates, lintels, sills etc. in or on walls, bedding roof tiles and corrugated sheets in or on walls.

(g) Building in ends of joists, beams, lintels, etc.

3.4 Cement Plastering Work

3.4.1 Materials

The proportions of the cement mortar for plastering shall be 1:4 (one part of cement to four parts of sand) or as specified in respective items. Cement and sand shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water and cement shall be as per relevant IS standards. The quality and grading of sand for plastering shall conform to IS:1542. The mixing shall be done thoroughly in a mechanical mixer unless hand mixing is specifically permitted by the Engineer-in-charge. If so desired by the Engineer-in-charge sand shall be screened and washed to meet the Specifications. The mortar thus mixed shall be used as soon as possible preferably within 30 minutes from the time water is added to cement. In case the mortar has stiffened due to evaporation of water this may be re- tempered by adding water as required to restore consistency but this will be permitted only up to 30 minutes from the time of initial mixing of water to cement. Any mortar, which is partially set, shall be rejected and removed forthwith from the site. Droppings of plaster shall not be re-used under any circumstances.

3.4.2 Workmanship

Preparation of surfaces and application of plaster finishes shall generally conform to the requirements specified in IS: 1661 and IS: 2402.

Plastering operations shall not be commenced until installation of all fittings and fixtures such as door/window panels, pipes, conduits etc. are completed.

All joints in masonry shall be raked as the work proceeds to a depth of 10mm/20mm for brick/stone masonry respectively with a tool made for the purpose when the mortar is still green. The masonry surface to be rendered shall be washed with clean water to remove all dirt, loose materials, etc., Concrete surfaces to be rendered shall be roughened suitably by hacking or bush hammering for proper adhesion of plaster and the surface shall be evenly wetted to provide the correct suction. The masonry surfaces should not be too wet but only damp at the time of plastering. The dampness shall be uniform to get uniform bond between the plaster and the masonry surface.

Interior plain faced plaster - This plaster shall be laid in a single coat of 15mm thickness. The mortar shall be dashed against the prepared surface with a trowel. The dashing of the coat shall be done using a strong whipping motion at right angles to the face of the wall or it may be applied with a plaster machine. The coat shall be trowelled hard and tight forcing it to surface depressions to obtain a permanent bond and finished to smooth

surface. Interior plaster shall be carried out on jambs, lintel and sill faces, etc. as shown in the drawing and as directed by the Engineer-in-charge.

Plain Faced Ceiling plaster - This plaster shall be applied in a single coat of 10 mm thickness. Application of mortar shall be as stipulated in above paragraph.

Exterior plain faced plaster - This plaster shall be applied in 2 coats. The first coat or the rendering coat shall be approximately 14mm thick. The rendering coat shall be applied as stipulated above except finishing it to a true and even surface and then lightly roughened by cross scratch lines to provide bond for the finishing coat. The rendering coat shall be cured for at least two days and then allowed to dry. The second coat or finishing coat shall be 6 mm thick. Before application of the second coat, the rendering coat shall be evenly damped. The second coat shall be applied from top to bottom in one operation without joints and shall be finished leaving an even and uniform surface. The mortar proportions for the coats shall be as specified in the respective item of work. The finished plastering work shall be cured for at least 7 days.

Exterior Sand Faced Plaster for Stone Masonry, Roof gutters etc. - This plaster shall be applied in 2 coats. The first coat shall be approximately 14mm thick and the second coat shall be 6mm thick. These coats shall be applied as stipulated above. However, only approved quality sand shall be used for the second coat and for the finishing work. Sand for the finishing work shall be coarse and shall be of even size and shall be dashed against the surface and sponged. The mortar proportions for the first and second coats shall be as specified in the respective items of work.

Wherever more than 20mm thick plaster has been specified, which is intended for purposes of providing beading, bands, etc. this work shall be carried out in two or three coats as directed by the Engineer-in-charge duly satisfying the requirements of curing each coat (rendering/floating) for a minimum period of 2 days and curing the finished work for at least 7 days.

In the case of pebble faced finish plaster, pebbles of approved size and quality shall be dashed against the final coat while it is still green to obtain as far as possible a uniform pattern all as directed by the Engineer-in-charge.

Where specified in the drawings, rectangular grooves of the dimensions indicated shall be provided in external plaster by means of timber battens when the plaster is still in green condition. Battens shall be carefully removed after the initial set of plaster and the broken edges and corners made good. All grooves shall be uniform in width and depth and shall be true to the lines and levels as per the drawings.

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

For waterproofing plaster, the Contractor shall provide the water-proofing admixture as specified in manufacturers instruction while preparing the cement mortar.

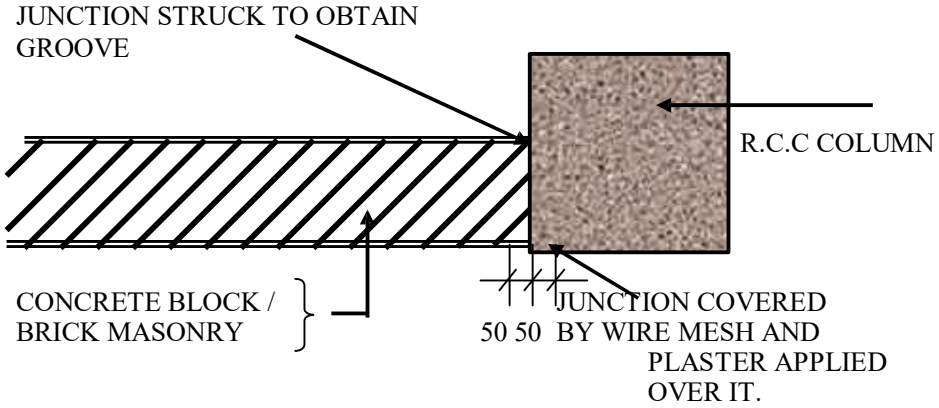
For external plaster, the plastering operations shall be commenced from the top floor and carried downwards. For internal plaster, the plastering operations for the walls shall commence at the top and carried downwards. Plastering shall be carried out to the full length of the wall or to natural breaking points like doors/windows etc. Ceiling plaster shall be completed first before commencing wall plastering.

The finished plaster surface shall not show any deviation more than 4mm when checked with a straight edge of 2m lengths placed against the surface.

To overcome the possibility of development of cracks in the plastering work following measures shall be adopted.

a) Plastering work shall be deferred as much as possible so that fairly complete drying shrinkage in concrete and masonry works takes place.

b) Where plastering is to be done over junction of two different materials e.g. concrete and masonry, a chicken mesh of 100 mm width shall cover the junction with margins on either side and then the plaster shall be applied. Where only one of the materials is plastered over, the plaster at junction shall be struck to obtain a groove as shown below:



Ceiling plaster shall be done, with a trowel cut at its junction with wall plaster. Similarly trowel cut shall be adopted between adjacent surfaces where discontinuity of the background exists.

3.4.3 Measurements

Measurement for plastering work shall be in sq.m correct to two places of decimal. Unless a separate item is provided for grooves, moldings, etc., these works are deemed to be included in the unit rates quoted for plastering work. The quantity of work to be paid for under these items shall be calculated by taking the projected surface of the areas plastered after making necessary deductions for openings for doors, windows, fan openings etc. The actual plasterwork carried out on jambs/sills of windows, openings, etc. shall be measured for payment.

3.4.3.1 The rate includes for following:

(a) Preparation of surfaces
(b) Thickness of plasters Key in joints.
(c) Arrisers, chamfers of any width, internal rounded angles up to 80 mm in Width on girth except in case of mud plaster and leaping when angle etc. Of any girth are included.
(d) All labors & equipment necessary for incorporating admixtures in the manner specified by the manufacturer and in proportions indicated. The admixture (liquid water proofing compound) supplied shall be paid for Separately under relevant item of work, if not included in relevant item.
(e) Scoring surface of plastering for key, when the surface is not required to be finished fair.

(f) Providing Chicken mesh at the joints of dissimilar materials.
(g) Curing of plaster surface.
(h) Cleaning stains & dripping mortar from floors & walls etc.

3.5 Cement Pointing

3.5.1 Materials

The cement mortar for pointing shall be in the proportion of 1:3 (one part of cement to three parts of fine sand). Sand shall conform to IS: 1542 and shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by Engineer-in-charge and if so directed it shall be washed/screened to meet specification requirements.

3.5.2 Workmanship

Where pointing of joints in masonry work is specified, the joints shall be raked at least 15mm/20mm deep in brick/stone masonry respectively as the work proceeds when the mortar is still green.

Any dust/dirt in the raked joints shall be brushed out clean and the joints shall be washed with water. The joints shall be damp at the time of pointing. Mortar shall be filled into joints and well pressed with special steel trowels. The joints shall not be disturbed after it has once begun to set. The joints of the pointed work shall be neat. The lines shall be regular and uniform in breadth and the joints shall be raised, flat, sunk or 'V' as may be specified in the respective items of work. No false joints shall be allowed.

The work shall be kept moist for at least 7 days after the pointing is completed. Whenever coloured pointing has to be done, the colouring pigment of the colour required shall be added to cement in such proportions as recommended by the manufacturer and as approved by the Engineer-in-charge.

3.5.3 Measurement

The quantity of work to be paid for under this item shall be measured in sq.m. Correct to two places of decimal by taking the projected surface of the area pointed after making necessary deductions for openings, etc.

3.6 Metal Lath and Wire Fabric

3.6.1 Materials

Welded steel wire fabric shall conform to IS: 4948.
Expanded metal shall conform to IS: 412.
Galvanized wire mesh shall be of approved quality.

3.6.2 Workmanship

The type and details of the steel material to be used for metal lath plastering work and at the junctions of masonry/concrete before wall plastering shall be as specified in the respective items of work.

For metal lath plastering work, the weight of steel material shall be not less than 1.6 kg/sq.m.

Steel material for use at the junction of masonry/concrete shall have the mesh dimensions not greater than 50 mm.

Steel material shall be obtained in maximum lengths as manufactured to restrict joints to the minimum. Overlap at the joints shall be minimum 25 mm which shall be securely tied with wires of diameter not less than 1.25 mm at spacing not more than 100 mm for lath plastering work. Nailing to wall shall be at spacing not exceeding 200 mm. The material shall be straightened, cut and bent to shape if required for fixing as per the details indicated in the drawings.

3.6.3 Measurement

Measurement shall be in sq.m correct to two places of decimal for the type as specified in the respective items of work.

3.7 Water-Proofing Admixtures

For use in cement works: Waterproofing admixture shall be liquid conforming to the requirements of relevant IS and shall be of approved manufacturer as approved by Engineer-in-charge-in-charge. The admixture shall not contain calcium chloride. The quantity of the admixture to be used for the works and method of mixing etc. shall be as per manufacturer's instructions and as directed by the Engineer-in-charge.

3.8 Painting of Concrete, Masonry & Plastered Surfaces

3.8.1 Materials

Oil bound distemper shall conform to IS: 428. The primer shall be alkali resistant primer of the same manufacture as that of the distemper.

Cement paint shall conform to IS: 5410. The primer shall be a thinned coat of cement paint.

Lead free acid, alkali and chlorine resisting paint shall conform to IS: 9862.

White wash shall be made from good quality fat lime conforming to IS: 712. It shall be slaked at site and mixed with water in the proportion of 5 liters of water to 1 kg of un-slaked lime stirred well to make a thin cream. This shall be allowed to stand for a minimum period of one day and strained through a clean coarse cloth. Four kg of adhesive dissolved in hot water shall be added to each cu.m of cream. 1.30 kg of sodium chloride dissolved in hot water shall then be added per 10 kg of lime used for the white wash to be ready for application.

Colour wash shall be made by addition of a suitable quantity of mineral pigment, not affected by lime, to the prepared white wash to obtain the shade/tint as approved by the Engineer-in-charge.

All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the Engineer-in-charge for the brand of manufacture and the colour/shade. All materials shall be brought to the site of works in sealed containers.

3.8.2 Workmanship

Contractor shall obtain the approval of the Engineer-in-charge regarding the readiness of the surfaces to receive the specified finish, before commencing the work on painting.

Painting of new surfaces shall be deferred as much as possible to allow for thorough drying of the sub- strata.

The surfaces to be treated shall be prepared by thoroughly brushing them free from dirt, mortar droppings and any loose foreign materials. Surfaces shall be free from oil, grease and efflorescence. Efflorescence shall be removed only by dry brushing of the growth. Cracks shall be filled with Gypsum. Workmanship of painting shall generally conform to IS: 2395.

Surfaces of doors, windows etc. shall be protected suitably to prevent paint finishes from splashing on them.

3.8.3 White Wash

The prepared surfaces shall be wetted and the finish applied by brushing. The operation for each coat shall consist of a stroke of the brush first given horizontally from the right and the other from the left and similarly, the subsequent stroke from bottom upwards and the other from top downwards, before the first coat dries. Each coat shall be allowed to dry before the next coat is applied. Minimum of 2 coats shall be applied unless otherwise specified. The dry surface shall present a uniform finish without any brush marks.

3.8.4 Colour Wash

Colour wash shall be applied in the same way as for white wash. A minimum of 2 coats shall be applied unless otherwise specified. The surface shall present a smooth and uniform finish without any streaks. The finished dry surface shall not show any signs of peeling/powdery and come off readily on the hand when rubbed.

3.8.5 Cement Paint

The prepared surfaces shall be wetted to control surface suction and to provide moisture to aid in proper curing of the paint. Cement paint shall be applied with a brush with stiff bristles. The primer coat shall be a thinned coat (50% consistency) of cement paint. The quantity of thinner shall be as per manufacturer's instructions. The coats shall be vigorously scrubbed to work the paint into any voids for providing a continuous paint film free from pinholes for effective water proofing in addition to decoration. Cement paint shall be brushed in uniform thickness and the covering capacity for two coats on plastered surfaces shall be 3 to 4 kg/sq.m. A minimum of 2 coats of the same colour shall be applied. At least 24 hours shall be left after the first coat to become sufficiently hard before the second coat is applied. The painted surfaces shall be thoroughly cured by sprinkling with water using a fog spray at least 2 to 3 times a day. Curing shall commence after about 12 hours when the paint hardens. Curing shall be continued for at least 2 days after the application of final coat. The operations for brushing each coat shall be as detailed above.

3.8.6 Oil Bound Distemper

The prepared surfaces shall be dry and provided with one coat of alkali resistant primer by brushing. The surface shall be finished uniformly without leaving any brush marks and allowed to dry for at least 48 hours. A minimum of two coats of oil bound distemper shall be applied, unless otherwise specified. The first coat shall be of a lighter tint. At least 24 hours shall be left after the first coat to become completely dry before the application of the second coat. Broad, stiff, double bristled distemper brushes shall be used for the work. The operations for brushing each coat shall be as detailed above.

3.8.7 Plastic Emulsion Paint

Paint shall be as per IS 5411. The prepared surface shall be dry and provided with one coat of primer, which shall be a thinned coat of emulsion paint. The quantity of thinner

shall be as per manufacturer's instructions. The paint shall be laid on evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in a direction at right angles. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off constitutes one coat. The next coat shall be applied only after the first coat has dried and sufficiently become hard which normally takes about 2 to 3 hours. A minimum of 2 finishing coats of the same colour shall be applied unless otherwise specified. Paint may also be applied using rollers. The surface on finishing shall present a flat velvety smooth finish and uniform in shade without any patches.

3.8.8 Painting Priming coat on Wood, Iron or Plastered Surfaces:

Primer

1. The primer for woodwork, ironwork or plastered surface shall be as specified in the description of the item.

2. Primer for wood work / Iron & Steel / Plastered / Aluminum surfaces shall be as specified below:

	Surfaces	**Primer to be used**
a.	Wood work (hard and soft wood)	Pink conforming to IS 3536 – 1966
b.	Resinous wood and ply wood	Aluminum Primer
c.	Iron & Steel, aluminum and galvanized steel work:	Zinc chromate primer conforming to IS 104-1962
d.	Plastered surfaces, cement brick work, Asbestos surfaces for oil bound distemper and paint	Cement primer

3. The primer shall be ready mixed primer of approved band and manufacture.

Preparation of Surface:

Wood work:

The wood work to be painted shall be dry and free from moisture

The surface shall be thoroughly cleaned. All unevenness shall be rubbed down smooth with sand paper and shall be well dusted. Knots, if any, shall be covered with preparation of red lead made by grinding red lead in water and mixing with strong glue sized and used hot. Appropriate filler material with same shade as paint shall be used where so desired by the Engineer-in-charge.

The surface treated for knotting shall be dry before painting is applied. After the priming coat is applied, the holes and indentation on the surface shall be stopped with glaziers putty or wood putty (for specifications for glaziers putty and wood putty – refer as mentioned herein before). Stopping shall not

be done before the priming coat is applied as the wood will absorb the oil in the stopping and the latter is therefore liable to crack.

3.8.8.1 Application**:**

The primer/paint shall be applied with brushes, worked well into the surface and spread even and smooth. Crossing and laying off as described herein before shall do the painting.

3.8.9 Measurement

Measurement for all painting work shall be in sq.m correct to two places of decimal. Measurement shall be for the areas as executed duly deducting for any openings etc. as specified in MES mode of measurement Rate quoted shall also take into account the provision of necessary enabling works such as scaffolding, painter's cradle, tools & plants and cleaning of paint / primer spillage etc.

3.9 Flashing

3.9.1 Materials

Anodized Aluminum sheets shall be 1.00mm thick with anodic film thickness of 0.025 mm.

Galvanized mild steel sheets shall be 1.00mm thick with zinc coating of 800 gms/sq.m.

Bitumen felt shall be either Hessian base self finished bitumen felt Type-3 Grade I conforming to IS: 1322 or glass fiber base self finished felt Type-2 Grade 1 conforming to IS: 7193.

3.9.2 Workmanship

The type of the flashing and method of fixing shall be as specified.

Flashing shall be of the correct shape and size as indicated in the construction drawings and they shall be properly fixed to ensure their effectiveness.

Flashing shall be of long lengths so as to provide minimum number of joints. The minimum overlap at joints shall be 100mm.

Fixing of the flashing shall be either by bolting with bitumen washers or by tucking into the groove 75 mm wide x 65 mm deep in masonry/concrete along with cement mortar 1:4 filletting as indicated in the Drawings. Curing of the mortar shall be carried out for a minimum period of 4 days.

Bitumen felt flashing of the type as specified shall be provided with 2 coats of bituminous paint at the rate of 0.10 liter/sq.m after the installation.

3.9.3 Measurement

Measurement shall be in sq.m correct to two places of decimal. Measurement shall be for the actual area of the flashing material provided and the rate shall include for all the incidental works of bending to shape and fixing details as per the construction drawings.

FLOORING, TILING AND DADO

3.10 Terrazzo and Plain Cement Tiling Work

3.10.1 Materials

Terrazzo tiles and cement tiles shall generally conform in all respects to standards stipulated in IS: 1237. Tiles shall be of the best quality manufactured adopting hydraulic pressure of not less than 14N/mm^2.

The type, quality, size, thickness colour etc, of the tiles for flooring/dado/skirting shall be as specified.
The aggregates for terrazzo topping shall consist of marble chips, which are hard, sound and dense. Cement to be used shall be either ordinary Portland cement or white cement with or without colouring pigment or ordinary Portland cement mixed with white cement. The binder mix shall be with 3 parts of cement to 1 part of marble powder by weight. The proportion of cement shall be inclusive of any pigments. For every one part of cement-marble powder binder mix, the proportion of aggregates shall be 1.75 parts by volume, if the chips are between 1mm to 6mm and 1.50 parts by volume if the chips are between 6mm to 25mm.

The minimum thickness of wearing layer of terrazzo tiles shall be 5mm for tiles with chips of size varying from 1mm up to 6mm or from 1mm up to 12mm. This shall be 6mm for tiles with chips varying from 1mm up to 25mm. The minimum thickness of wearing layer of cement/coloured cement tiles shall be 5mm. This shall be 6mm for heavy-duty tiles. Pigment used in the wearing layer shall not exceed 10 percent of the weight of cement used in the mix.

3.10.2 Workmanship

Laying and finishing of tiles shall conform to the requirements of workmanship stipulated in IS: 1443.

Tiling work shall be commenced only after the door and window frames are fixed and plastering of the walls/ ceiling is completed. Wall plastering shall not be carried out up to about 50mm above the level of proposed skirting/dado.

The base concrete shall be finished to a reasonably plane surface about 40 to 45mm below the level of finished floor. Before the tiling work is taken up, the base concrete or structural slab shall be cleaned of all loose materials, mortar droppings, dirt, laitance etc. using steel wire brush and well wetted without allowing any water pools on the surface.

A layer of 25mm average thickness of cement mortar consisting of one part of cement to 6 parts of sand shall be provided as bedding for the tiles over the base concrete. The thickness of bedding mortar shall not be less than 10mm at any place. The quantity of water to be added for the mortar shall be just adequate to obtain the workability for laying. Sand for the mortar shall conform to IS: 2116 and shall have minimum fineness modulus of 1.5. The surface shall be left rough to provide a good bond for the tiles. The bedding shall be allowed to harden for a day before laying of the tiles.

Neat cement slurry using 4.4 kg of cement per sq.m of floor area shall be spread over the hardened mortar bedding over such an area at a time as would accommodate about 20 tiles. Tiles shall be fixed in this slurry one after the other, 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 in straight lines and shall normally be 1.5mm wide. On completion of

laying of the tiles in a room, all the joints shall be cleaned and washed fairly deep with a stiff broom/wire brush to a minimum depth of 5mm. The day after the tiles have been laid, the joints shall be filled with cement grout of the same shade as the colour of the matrix of the tile. For this purpose white cement or grey cement with or without pigments or mixed cement as specified shall be used. The flooring should be kept moist and left undisturbed for 7 days for the bedding/joints to set properly. Heavy traffic shall not be allowed on the floor for at least 14 days after fixing of the tiles.
About a week after laying the tiles, each and every tile shall be lightly tapped with a small wooden mallet to find out if it gives a hollow sound; if it does, such tiles along with any other cracked or broken tiles shall be removed and replaced with new tiles to proper line and level. The same procedure shall be followed again after grinding the tiles and all damaged tiles replaced, properly jointed and finished to match. For the purpose of ensuring that such replaced tiles match with those laid earlier, it is necessary that the Contractor shall procure sufficient quantity of extra tiles to meet this contingency.

Wherever a full tile cannot be provided, tiles shall be cut to size and fixed. Floor tiles adjoining the wall shall go about 10mm under the plaster, skirting or dado.

Tile skirting and dado work shall be executed only after laying tiles on the floor. For dado and skirting work, the vertical wall surface shall be thoroughly cleaned and wetted. Thereafter it shall be evenly and uniformly covered with 10mm thick backing of 1:4 cement sand mortar. For this work the tiles as obtained from the factory shall be of the size required and practically full polished. The back of each tile to be fixed shall be covered with a thin layer of neat cement paste and the tile shall then be gently tapped against the wall with a wooden mallet. Fixing shall be done from the bottom of the wall upwards. The joints shall be in straight lines and shall normally be 1.5mm wide. Any difference in the thickness of the tiles shall be evened out in the backing mortar or cement paste so that the tile faces are in conformity & truly plumb. Tiles for use at the corners shall be suitably cut with bevelled edges to obtain a neat and true joint. After the work has set, hand polishing with carborundum stones shall be done so that the surface matches with the floor finish.

Wall plastering of the strip left out above the level of skirting/dado shall be taken up after the tiles are fixed.

Chequered terrazzo tiles for flooring and for stair treads shall be delivered to site after the first machine grinding.

Machine grinding and polishing shall be commenced only after a lapse of 14 days of laying. The sequence and three numbers of machine grinding operations, usage of the type of carborundum stones, filling up of pin holes, watering etc. shall be carried out all as specified in IS: 1443.

Tiles shall be laid to the levels specified. Where large areas are to be tiled the level of the central portion shall be kept 10mm higher than that at the walls to overcome optical illusion of a depression in the central portion. Localized deviation of ±3mm in any 3m lengths is acceptable in a nominally flat floor.

3.11 Shahabad / Tandur/ Kota Stone Slab work

3.11.1 Materials

The slabs shall be of approved selected quality, hard, sound, dense and homogenous in texture, free from cracks, decay, weathering and flaws. The percentage of water absorption shall not exceed 5 percent as per test conducted in accordance with IS: 1124.

The slabs shall be hand or machine cut to the required thickness.

Slabs shall be supplied to the specified size with machine cut edges or fine chisel dressed to the full depth. All angles and edges of the slabs shall be true and square, free from any chipping giving a plane surface. Slabs shall have the top surface machine polished (first grinding) before being brought to site. The slabs shall be washed clean before laying.

3.11.2 Workmanship

The type, size, thickness and colour/shade etc. of the slabs for flooring/dado/skirting shall be as specified in the respective items of work.

Preparation of the concrete base, laying and curing shall be as per clause 3.10.2.

Dado / skirting work shall be as per clause 3.10.2. The thickness of the slabs for dado/skirting work shall not be more than 25mm. Slabs shall be so placed that the back surface is at a distance of 12mm. If necessary, slabs shall be held in position temporarily by suitable method. After checking for verticality, the gap shall be filled and packed with cement sand mortar (with or without pigment) of proportion 1:3. After the mortar has acquired sufficient strength, the temporary arrangement holding the slab shall be removed.

Grinding and polishing shall be as per preceeding clause 3.10.2.

3.12 Glazed Tile Flooring

Providing and laying white glazed tiles 148.5 mm X 148.5 mm in size and 8 mm 19.5 mm thick for flooring in required positions, laid on a bed of 1: 4 cement mortar including neat cement float, all specials required like round edge tiles, corner cups, etc. filling joints with neat white cement slurry, curing and cleaning complete. Tiles shall conform to IS: 13753-1993

3.12.1 Mortar bedding: -

The amount of water added while preparing mortar shall be the minimum necessary to give sufficient plasticity for laying. Care shall be taken in the preparation of the mortar to ensure that there are no hard lumps that would interfere with even bedding of the tiles. Before spreading the mortar bed, the base shall be cleaned of all dirt, scum or laitance and loose materials and then well wetted without forming any pools by the use of screed battens to proper level or scope. The thickness of the bedding shall not be less than 12 mm or more than 20 mm any one place. The tiles shall be laid on the bedding mortar when it is still plastic but has become sufficiently stiff to offer a fairly cushion for the tiles.

3.12.2 Fixing tiles: -

The tiles before laying shall be soaked in water for at least 2 hours. Tiles, which are fixed in the floor adjoining the wall, shall be so arranged that the surface of the round edge tiles shall correspond to the skirting or dado. Neat cement grout of honey like consistency shall be spread over the bedding mortar just to cover so much area as can be tiled within half an hour. The edges of the tiles shall be smeared with neat white cement slurry and fixed in this grout one after the other, each tile being well pressed and gently tapped with a wooden mallet till it is properly bedded and in level with adjoining tiles.

There shall be no hollows in bed or joints. The joints shall be kept as close as possible and in straight lines. The joints between the tiles shall not exceed 1.5 mm wide. The joints shall be grouted with a slurry of white cement . After fixing the tiles finally in an even plane, the flooring shall be covered with wet saw dust and allowed to mature undisturbed for 14 days.

3.12.3 Cleaning: -

After the tiles have been laid in a room or the day's fixing work is completed, the surplus cement grout that may have come out of the joints shall be cleaned off before it sets. Once the floor has set, the floor shall be carefully washed clean and dried. When dry, the floor shall be covered with oil free dry saw dust which shall be removed only after completion of the construction work and just before the floor is occupied

3.12.4 Item to include: -

The rate shall include all labour, materials, tools and tools and equipment required for the following operations to carry out the item as specified above

(1) Providing and laying the bedding mortar and leveling
(2) Providing and fixing the tiles including round edges, corner cups, etc. in neat cement float over the bedding.
(3) Grouting the joints of the tiles with white cement slurry.
(4) Curing
(5) Cleaning the floor

3.12.5 Mode measurement and payment: -

The contract rate shall be per square metre of the finished floor area covered by the flooring of the specified type. All work shall be measured net. The length and width of the flooring shall be measured net between the faces of skirting or dados or plastered faces of walls. Paving under the dado, skirting or plaster shall not be measured.

No deduction shall be made nor extra paid for voids not exceeding 0.20 square metres. Deduction for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metres.

3.13 Glazed tiles in Dado and Skirting

Providing and fixing white glazed tiles 148.5 mm X 148.5 mm in size an 6.5 mm thick for dado and skirting in required positions, on plaster of cement mortar 1:4 including all specials required like round tiles, angles, corner cups, etc. and filling joints with white cement slurry, curing and cleaning complete.

3.13.1 Materials: -

White glazed tiles including specials shall be of the approved make and quality and shall conform to I.S: 13755-1993 in all aspects. The Engineer, who will keep them in his office for verification as to whether the materials brought for use confirm to the approved samples except that the thickness of tiles shall be 6.5 mm, shall be approved samples of tiles.

3.13.2 Plastering: -

Cement plaster of about 12 mm (about ½") for brick walls and 20 mm for stone masonry walls shall be applied to the part of the wall where dado or skirting is to be fixed as per specification No. B.11. The proportion of mortar shall be as mentioned in the item.

3.13.3 Fixing tiles: -

Dado or skirting work shall be done by only after fixing tiles on the floor. The white glazed tiles shall be soaked in water for at least 2 hours before being used for skirting or dodo work. Tiles shall be fixed when the cushioning mortar is still plastic and before it gets very stiff. The back of tiles shall be covered with a thin layer of neat cement plastic

and the tile shall then be pressed in the mortar and gently tapped against the wall with a wooden mallet. The fixing shall be done from the bottom of wall upwards without any hollows in the bed or joints. Each tile shall be fixed as close as possible to the one adjoining. The tiles shall be joined with white cement slurry. Any difference in the thickness of tiles shall be evened out in cushioning mortar to that all tile faces are in one vertical plane. The joints between the tiles shall not exceed 1.5 mm in width and they shall be uniform. While fixing tiles in dado work care shall be taken to break joints vertically. After fixing the dado, skirting etc., they shall be kept continuously wet for 14 days.

If doors, windows or other opening are located within the dado area, the skills, jambs, angles etc., shall be approved with white glazed tiles and appropriate specials according to the foregoing specification and such tiled area shall be measured not along with the dado.

3.13.4 Cleaning: -

After the files have been fixed the surplus cement grout that may have come out of the joints shall be cleaned off before it sets. After the complete curing, the dado of skirting work shall be washed thoroughly clean.

3.13.5 Item to include: -

The rate shall include all labour, materials, tools and equipment required for the following operations to carry out the item as specified above.

(1) Plastering
(2) Fixing the tiles including all angles, etc. after applying neat cement paste.
(3) Joining the tiles with white cement slurry
(4) Curing
(5) Cleaning the dado and skirting

3.13.6 Mode of measurement and payment: -

The contract rate shall be per square metre of the net area actually covered by the dado or skirting tiles including special tiles on walls, jambs, sills etc. if necessary. All work shall be measured net. The length of the dado face shall be measured net between its face edges at the ends excluding overlap. The width of the face shall be measured between the top of dado or skirting and the top of flooring. The dimensions shall be measured correct up to two places of decimals of a metre and the area worked out correct up to two places of decimals of a square metre. Teak wood cover moldings if provided shall be paid separately. No deduction shall be made nor extra paid for voids not exceeding 0.20 square metres.Deduction for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metres not exceeding 0.10 square metres.

3.13.(a)PVC Flooring: -

Providing and laying 2 mm thick Antistatic unbacked flexible P.V.C. flooring / skirting using vinyl sheets of approved colour and shade with or without and confirming to IS 3642-1986 and IS 4-1986 for general properties confirming to BS 2050-1978 for antistatic and conducting properties. The sheets shall be aid over existing / newly laid cement concrete / terrazzo flooring / skirting to the required sixe and patter as directed accordingly to the size of the room / hall using approved quality rubber based ashesive of approved brand or as per manufacturers specifications. The adjusting / newly laid floor shall be cleaned thoroughly to make it free from floor shall be made good suitably before laying vinyl flooring. All joints of the PVC flooring shall be welded using antistatic and conductive PVC electrode so as to get uniform seamless and water proofing surface proper strips (15 mm X 1 mm) shall be fixed to the underside of the antistatic flooring and laid all along the edge of the antistatic flooring and laid all along

the edges of the room / all and or as recommended by the manufacturer with necessary MS push button as required and directed to create and effective route for electrostatic discharge. The finished vinyl flooring shall be free from air bubbles and undulations and it shall be thoroughly cleaned and polished, with all lead and lifts as directed Engineer in charge (Note: Sample material shall be furnished to the Engineer in charge and got approved before commencement of laying.

3.13 (a).1. Mode of Measurement : -
As stated under Clause 3.13.6 & 3.12.5

3.14 Vitrified tile Flooring, Dado / Skirting / Facia:

3.14.1 Materials : -
The tiles shall be of approved make and shall generally conform to ISO: 13006 They shall be flat and true to shape, free from cracks, crazing spots, chipped edges and corners. The glazing shall be of uniform shade.

The tiles shall be as specified in the schedule of quantity or drawings. The length of all four sides shall be measured correct to 0.1 mm and average length breadth shall not vary more than □0.8 mm from specified dimensions. The variation of individual dimensions from average value of length / breadth shall not exceed □ 0.5 mm. Tolerance in thickness shall be (□) 0.4 mm.

The thickness of the tiles shall not be less than 6.5 mm or as specified in the items and shall conform to ISO: 13006 in all respects. The Engineer-in-charge before use on the work shall be approved samples of tiles.

3.14.2 Preparation of Surface and laying:
Sub grade concrete or RCC slab or side brick wall / or plastered surfaces on which tiles are to be laid shall be thoroughly hacked, cleaned of all mortar scales, concrete lumps etc. brushed, washed with water to remove mud, dirt etc. from the surface, wetted and mopped.

12 mm thick plaster of CM 1.3 shall be applied and allowed to harden. The plaster shall be roughened with wire brushes or by scratching diagonal lines 1.5 mm deep at 7.5 mm center both ways.

The back of tiles shall be buttered with a cost of grey cement slurry paste and edges with white cement slurry and set in the bedding mortar. The tiles shall be tapped and corrected to proper planes and lines. The tile shall be butt jointed in pattern and joints shall be as fine as possible. The top of skirting / dado shall be truly horizontal and joints truly vertical.

After a period of curing of 7 days minimum, the tiles shall be cleaned and shall not sound hollow when tapped.

The surface during laying shall be checked with a straight edge 2m. Long.

Tiles shall enter not less than 10mm under side skirting.

After the tiles have been laid, surplus cement grout shall be cleaned off.

3.14.3 Mortar and Bedding:
Cement mortar for bedding shall be of proportion specified in items schedule and shall conform to the specification for materials, preparation etc. as specified under cement mortar. The amount of water added while preparing mortar shall be the minimum necessary to give sufficient plasticity for laying. Care shall be taken in preparation of the mortar to ensure that there are no hard lumps that would interfere with even bedding of the tiles. Before spreading the mortar bed the base shall be cleaned of all dirt, scum or laitance and loose materials and well wetted without forming any pools of water on the surface. The mortar of specified proportion and thickness shall then be even and smoothly spread over the base by use of screed battens to proper level or slope.

Cement mortar of thickness and proportion as specified in the schedule for dado shall be applied to the wall after preparing the wall surface as specified under cement plaster 20 mm thick and brought to correct line and plumb and the surface left rough to receive the tiles.

3.14.4 Fixing of tiles for flooring: -
The tiles before laying shall be soaked in water for at least 2 hours. The tiles shall be laid on the bedding mortar when it is still plastic but has become sufficiently stiff to offer a fairly firm cushion for the tiles. Tiles, which are fixed on the flooring adjoining the wall, shall be so arranged that the surface on the round edge tiles shall correspond to the skirting or dado. Neat cement mortar grout 1:2, using fine sand (table III, zone IV and as per IS 383) of honey like consistency shall be spread over the bedding mortar just to cover as much area as can be tiled within half an hour. The edges of the tiles shall be smeared with neat white cement slurry and fixed in this grout one after the other, each tile being well pressed and gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. There shall be no hollows in bed or joints. The joints, shall be kept as close as possible and in straight line. The joints between tiles shall not exceed 1.00 mm, in width. The joint shall be grouted with white cement slurry. After fixing the tiles, finally in an even plane or slope, the flooring shall be covered with wet sand and allowed undisturbed for 14 days.

3.14.5 Fixing tiles for Dado and Skirting / Facia: -
The dado work, shall be done only after fixing the tiles / slabs on the floor. The approved glazed tiles before laying shall be soaked in water for at least 2 hours. Tiles shall be fixed when the cushioning mortar is still plastic and before it gets very stiff.

The back of the tile shall be covered with this layer of cement mortar 1:3 using fine sand (table III, zone IV, IS383-1963), and the edge of the tile smeared with neat white cement slurry. The tile shall then be pressed in the mortar and gently tapped against the wall with a wooden mallet. The fixing shall be done from bottom of wall upwards without any hollows in the bed of joints. Each tile shall be as close as possible to one adjoining. The tiles shall be jointed with white cement slurry. Any thickness difference in the thickness of the tiles shall be arranged out in cushioning mortar so that all tiles faces are in one vertical plane. The joints between the tiles shall not exceed 1.00 mm in width and they shall be uniform.

While fixing tiles in dado work, care shall be taken to break the joints vertically. The top of the dado shall be touched up neatly with the rest of the plaster above.

After fixing the dado / skirting etc. they shall be kept continuously wet for 7 days.

If doors, windows or other openings are located within the dado area, the corners, sills, jambs etc. shall be provided with true right angles without any specials. The contractor will not be entitled to any extra claims on this account for cutting of tiles if required.

3.14.6 Cleaning: -

After the tiles have been laid in a room or the day fixing work is completed, the surplus cement grout that may have come out of the joints shall be cleaned off before it sets. After the complete curing, the dado or skirting over shall be washed thoroughly clean. In the case of flooring, once the floor has set, the floor shall be carefully washed clean and dried. When dry, the floor shall be covered with oil free dry sawdust. It shall be removed only after completion of the construction work and just before the floor is used.

3.14.7 Pointing and Finishing: -

The joints shall be cleaned off with wire brush to a depth of 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement and floor kept wet for 7 days and then cleaned. Finished floor shall not sound hollow when tapped with a wooden mallet.

3.14.8 Mode of measurement: -

As stated under Clause 3.13.6 & 3.12.5

3.14.9 The rate for all works mentioned above in preceding Clause heads 3.10, 3.11, 3.12, 3.13 & 3.14 shall include all the cost of labour and materials involved, nothing extra shall be paid for the use of cut (swan) tiles in work.

3.15 Indian Patent Stone

3.15.1 Granolithic Flooring (Indian Patient Stone)

Granolithic flooring shall consist of cement, sand and aggregates. The proportion and thickness shall be as specified in drawings & BOQ. Fine aggregates shall be 4.75 mm downwards and coarse aggregates 10 mm down. All aggregates specified above should consist of 10 mm screenings and 3 mm screenings with sufficient sand and minimum water added to make a workable mix. All aggregates should be properly sifted to be free from all dust of fine materials.

Hacking and Saturated shall roughen the sub base concrete with water for 8 hours. Immediately before laying the granolithic mix all excess water shall be removed and the surface cleaned of all dust and dirt. The base concrete surface is covered with a thin layer of neat cement grout well brushed in to ensure adequate keying. The granolithic mix is then well tamped into place screeded and lightly floated to the required level and slopes. As soon as the initial set takes place, the surface shall be trowelled and broom finished as per approved pattern. Dry cement or mixture of dry cement and sand shall not be sprinkled on the surface with the object of absorbing moisture or stiffening the mix. Final trowelling and broom finishing shall not be started

until pressure with the fingers ceases to make any dents. The panels shall have to be cured properly by creating a pond of water. While laying panel adjacent to one another care shall be taken to provide a groove of size 0.5 cm. wide and 2.5cm deep.

After allowing a time lag of three weeks (two for curing and setting and one for evaporation of moisture, clean the groove by means of jet of compressed air or any other suitable means to remove all the dust, oily substances, moisture, etc.

Fill the groove up to two-third depth with hot (heated to a temperature of 185 deg C) fluid bitumen (Mexphalte 85/25 or equivalent). At no stage of the work should the temperature of bitumen exceed 200 deg C. since it is liable to lose its ductility otherwise. Care should be taken by placing a smooth, greased metal template to prevent staining of floor outside the groove.

Allow the bitumen to cool down to room temperature and then clean the groove once as above, the remove all the dust particles that may have deposited in the meantime.

Fill up the groove completely with a homogeneous mixture of hot bitumen (as above) mixed with 15-20% (by weight) medium length Asbestos fiber. This filling may be allowed to project slightly above the top of the groove to allow for contraction.

After filling has cooled down to room temperature, cut the superfluous material by means of a heated sharp-edged trowel.

Note: For proper adhesion of bitumen to the floor, the groove should be completely free from moisture and greasy/oily substances throughout the operation.

3.15.2 I.P.S. for the Water Tanks, ducts etc. shall be 2.5cm. thick and shall be laid without panels as specified above. In case of large areas however, the construction joints shall be rendered waterproof with bitumen joint filling as mentioned earlier.

DOORS AND WINDOWS

3.16 Timber Doors& Windows

3.16.1 Wood work

The work consists of supply of materials, fabrication, joinery, carpentry, delivery and erection at site of wooden doors & window frames, wooden flush doors/ paneled doors, and partition etc.

3.16.2 Materials

All timber shall be of best quality or hard wood well seasoned, uniform in texture, free from large, loose dead or cluster knots, waves injurious open shakes, discoloration, soft or spongy spots. It shall have uniform colour, reasonably straight grains and shall be free from all defects and conforming to the relevant IS code.

Woodwork abutting against or embedded in masonry or concrete shall be painted with bitumen coat before being placed in position. All timberwork shall be treated with an approved anti-termite treatment.

3.16.3 Fixing/erection in position of door frames

Before the frames are fixed in position these shall be inspected and passed by the Engineer-in-charge. The frames shall be placed in proper-position and fixed to the walls with suitable holdfasts as shown in drawing. The frames shall have dovetailed joints. The posts shall be through jamb tenoned into the mortise of the transoms. Thickness of the tenons shall be more than 25 mm. Tenons shall closely fit into the mortise without any gap.

In case the doorframes are without sills the vertical members shall be buried in floor 50mm. deep. Sills shall be provided where so directed. The doorframes without sills while being placed in position shall be provided with temporary wooden bracings well wedged between the styles at the sill level. The sills shall be retained to keep the frames from warping during construction. These frames shall also be protected from damages during construction.

3.16.4 Flush door Shutters (Block Board)

Flush door shutter shall be solid core type with block board core, as indicated, And shall conform to IS: 2202, Specification for wooden flush door shutter (soild core type) Part – I plywood face panels; except with regard to the size of shutters which shall be as indicated. Flush door shutters shall be non-decorative (commercial)type; or decorative type when indicated.

3.16.5 Tolerance

Tolerance on width and height shall be ± 2mm Tolerance on thickness shall be ± 1.2mm. The thickness of shutter shall be uniform throughout with a variation not exceeding 0.8mm when measured at any two points.

3.16.6 Adhesives

Only Synthetic resin adhesives conforming to I.S.S. No. IS-851 shall be used for bonding core members to one another including core frame and other exposed parts. The adhesive used for bonding cross band to core and face veneers to cross band shall conform to IS: 848 (Phenolic and Amino plastic), or equivalent IS standards.

3.16.7 Fittings

Fitting as indicated in drawings shall be approved by Engineer-in-charge and provided as specified .The fittings shall be measured & paid for separately.

All fittings shall be of approved make.

Details of Fittings:

Sr.	Description	Location

No.		
1.	Iron Oxidized But Hinges (125 x 85 x 5.5 mm) (Heavy type)	Flush shutters
2.	Aluminum Butt Hinges (125 x 85 x 5.5 mm) (Heavy type)	Aluminum Doors
3.	Aluminum Sliding door bolt 300 x 16 mm	Flush Shutters / Alu. Shutters
4.	Tower Bolts – Iron Oxidized (250 x 10 mm)	Flush Shutters / Alu. Shutters
5.	Casement stays – (300 mm – wt 200 gm)	M.S. Windows
6.	Handles – Aluminum 125 mm long	Flush shutters / Alu. Shutter
7.	Pull Bolt Lock (85 x 42 mm) M.S. Bright polished nickel plated	Toilet Doors
8.	Brass Mortice Lock – 100 mm – 6 lever	Alu. Shutters in VIP Cabins
9.	Brass hydraulic door closers (Sleek design)	Alu. Shutters in VIP Cabins
10.	Aluminum bolt lock (anodized 15 micron)	Aluminum Windows
11.	Double action hydraulic floor springs	Aluminum Doors
12.	Floor Door Stopper – MS Oxidized	Flush shutters
13.	Floor Door Stopper – Aluminum	Alu. Shutters

3.16.8 Measurements

Measurements shall be in sq mtr on the basis of out to out width & height of the Shutter. Nothing extra shall be measured for rebated and or splayed meeting stiles of door & windows.

Glass or wire cloth/mesh etc. shall be measured separately.

3.16.9 Rate

The rate shall be inclusive of materials, labour and construction as per description above for single/Double including sand papering to an even & smooth texture, fitting of shutters to frames all complete.

3.17 M.S. Door Frames, Rolling Shutters, Steel Sliding Doors, M.S. Grating and Cat Ladders

3.17.1 M.S. Door Frames

The M.S. Door framing shall be fabricated out of 14g. M.S. Sheets and fabricated with necessary stiffeners, hinges, holdfasts, etc. as per the drawings/sketches attached with the tender. The contractor shall quote the rate taking into account all the

above requisites, including the width of frame and erecting at site in line, level, plumb, etc. and with one coat of shop paint of Zinc Chromate Primer.

The work shall have to be done in co-ordination with other agencies working at site.

The mode of measurement for payment shall be per number of door or running meter of frames as specified in the Bill of Quantities.

3.17.2 Rolling Shutters

Rolling shutters shall be of an approved manufacture, conforming to the requirements specified in IS: 6248.

The type of rolling shutter shall be self-coiling type (manual) for clear areas up to 12 sq.m; gear operated type (mechanical) for clear areas up to 35 sq.m and electrically operated type for areas up to 50 sq.m. Mechanical type of rolling shutters shall be suitable for operation from both inside and outside with the crank handle or chain gear-operating mechanism duly considering the size of wall/column. Electrical type of rolling shutter shall also be provided with a facility for emergency mechanical operation.

Rolling shutters shall be supplied duly considering the type, specified clear width/height of the opening and the location of fixing as indicated in the drawings.

Shutters shall be built up of interlocking laths 75 mm width between rolling centers formed from cold rolled steel strips. The thickness of the steel strip shall not be less than 0.90 mm for shutters up to 3.50m widths and not less than 1.20 mm for shutters above 3.50 m width. Each lath section shall be continuous single piece without any welded joint.

The guide channels out of mild steel sheets of thickness not less than 3.15 mm shall be of either rolled, pressed or built up construction. The channel shall be of size as stipulated in IS: 6248 for various clear widths of the shutters.

Hood covers shall be of mild steel sheets not less than 1.0 mm thick and of approved shape.

Rolling shutters shall be provided with a central hasp and staple safety device in addition to one pair of lever locks and sliding locks at the ends.

All component parts of the steel-rolling shutter (excepting springs and insides of guide channels) shall be provided with one coat of zinc chrome primer conformity to IS: 2074 at the shop before supply. These surfaces shall be given an additional coat of primer after erection at the site along with the number of coats and type of finish paint as specified in the respective items of works prepared by the Contractor.

In case of galvanized rolling shutter, the lath sections, guides, lock plate, bracket plates, suspension shaft and the hood cover shall be hot dip galvanized with a zinc coating containing not less than 97.5 percent pure zinc. The weight of the zinc coating shall be at least 610gms/sq.m.

Guide channels shall be installed truly plumb at the specified location. Bracket plate shall be rigidly fixed with necessary bolts and holdfasts. Workmanship of erection shall ensure strength and rigidity of rolling shutter for trouble free and smooth operation.

3.17.3 Steel Sliding / Hinged Doors

The shutters shall be of M.S. Box type and shall be single/double shutter sliding or hinged type and fabricated as specified in drawing. Necessary guide rails locking arrangement shall also be provided along with one coat of zinc chromate primer

3.17.4 Measurement for Rolling shutter and Steel doors.

The measurement for payment shall be equal to area of the opening in the wall.

3.17.5 Rate

The rate quoted shall be inclusive all necessary fittings i.e. hinges/sliding arrangement, locking arrangement and one coat of zinc oxide primer.

3.18 M.S.Windows

3.18.1 All window shutters shall be fabricated to correct shape and size as per drawings approved by The Engineer-in-charge However, before fabricating any item the contractor has to check the opening dimensions at site. Any discrepancy therein shall be brought to The Engineer-in-charge's notice in writing mentioning the particular windows.

3.18.2 All sections for windows shall be extruded sections of approved quality. All extruded sections shall be of approved size as per IS 1038 & IS 1361.

3.18.3 Glass for windows shall be indicated in drawing. These shall be of best quality approved by The Engineer-in-charge. HPG or equivalent, clear/ ground.

3.18.4 The contractor shall have to make all necessary holes in concrete, masonry for fixing of windows. The contractor shall also fix and grout the windows in line, level and plumb.

3.18.5 The steel members shall be given a coat of approved anti-rust paint.

3.18.6 Channel shaped Aluminum beading to be provided around periphery of glass pane. Glass panes to be secured to shutter frames by 10 mm x 10 mm aluminum extruded beading and rubber, PVC gasket around the glass panel.

3.18.7 Hardware: Pegstay arms, handles, hinges etc. shall be heavy duty of approved quality.

3.18.8 Fixed or open able panels of the windows shall be as shown in the drawing.

3.18.9 Rates

The rates quoted by the Contractor under each item in Bill of Quantities shall be for a complete finished item or work. Supplying and fixing of all the fittings and iron monglery shall be deemed to have been included in Contractor's rates. The rates quoted by the Contractor shall also be inclusive of painting and/or as indicated in the Bill of Quantities.

The formwork and scaffolding shall be deemed to have been included in the rates quoted by the contractor.

3.19 Aluminum Doors & Windows

3.19.1 Aluminum Sections

All the aluminum windows, doors and ventilators shall be fabricated as per specified section as directed by the Engineer-in-charge. The Aluminum sections for Side hung, Top hung, Center hung, sliding and fixed windows and ventilators shall have an adequate thickness so that they can withstand flash-butt welding. In case of sliding windows, the bottom member of the frame shall have drainage provision.

Aluminum alloy used in the manufacture of extruded sections for the fabrication of doors, windows, and ventilators shall conform to designation 63400 of IS: 737.

Transparent sheet glass shall conform to the requirements of IS: 2835. Wired and figured glass shall be as per IS: 5437.

3.19.2 Corner Joints

All aluminum window frames and shutters for Side-hung, Top hung and Fixed will be flush-butt welded to obtain uniformly strong joints which are necessary for proper functioning without sagging or warp age over the years.

Corners of sliding window shutters and frames swing doors and fixed side shutters will be mechanically joined with properly designed cleats and fixtures.

3.19.3 Accessories

Side Hung Windows

a. All side-hung windows shall be provided with heavy gauge aluminum anodized handles and aluminum peg-stay, which have been so, designed to give trouble-free performance over the years.

b. All side hung windows shall be provided with sturdy aluminum butt-hinges with special alloy pins, which would ensure smooth movement of the shutters in addition to preventing any sagging due to the weight of the glass or continuous usage.

3.19.4 Top Hung Ventilators

All top hung ventilators shall be provided with sturdy butt type aluminum hinges and are provided with heavy gauge 300 mm long aluminum pegstays.

3.19.5 Center Hung Ventilators

a. Specifically extruded neoprene lining

b. All windows shall be made weather-tight by means of special rayon weather lining fitted in the grooves around the periphery of the shutters.

c. Specially designed nylon rollers, with brass axles shall be provided (two numbers per shutter).

d. Locking arrangement.

e. Aesthetically appealing and sturdy handles, one per shutter.

3.19.6 Entrance Doors and Fixed Panels

a. Aluminum swing doors shall be provided with double action heavy duty. Everite floor springs with necessary locks and aluminum handles as per design.

b. Fixed sidelights shall be fabricated as per design with relevant hardware.

3.19.7 Finish

Anodized in light dull sliver grey finish/or as specified. All the aluminum sections shall be mechanically polished and buffed for the removal of extrusion defects.

Thoroughly cleaned aluminum sections shall be anodized. The anodizing process results in aluminum oxide film of 15 microns shall be provided.

All the aluminum sections shall be coated with lanolin paper wrapping which will prevent the sections from getting damaged due to handling or due to vagaries of construction work at site. This coating will be removed after the completion of erection.

3.19.8 Erection

The erection of aluminum windows/doors in position would involve the following work: -

a. All the items shall be fixed in level, line and plumb.

b. The joints between aluminum and masonry shall be adequately caulked with approved sealant to prevent any seepage of water.

c. The frame shall be fixed to the masonry with the help of suitable screws/holdfasts.

d. In case of aluminum windows erected in rough ground, contractor shall ensure that the joint between the aluminum windows and the rough ground is made completely water-tight with approved sealant.

3.19.9 Rates

The quoted price is inclusive of all materials, labour, fabrication and carryout the construction as described above.

3.19.10 Shop Drawing

Before commencing the fabrication work at the factory contractor shall submit detailed shop drawing, which gives the exact details of the products, and get approved from the Engineer-in-charge.

3.19.11 Sample

The Contractor shall present one sample of any type of window for approval and comments by the Engineer-in-charge.

WATER PROOFING

3.20 General

Various methods of waterproofing are in practice. The recommended specifications are described hereinafter. The contractor shall satisfy himself about adequacy, effectiveness and effective service life of these methods. In most cases specialized agencies may have their own 'proprietary' methods and chemicals. The contractor shall give a specific bond

on Rs.100/- stamp paper for water tightness of the structure or building for a period of 5 years reckoned from date of handing over the building.

3.20.1 Brickbat Coba & Top stop Method Cement based Water-proofing for WCs, Sanitary Blocks, Kitchen, washing places etc.

Before waterproofing work is started, all cutting or chasing in the floor and/or walls and all the plumbing work shall be completed and the normal plaster to the ceiling and upper part of walls shall be provided.

The water proofing treatment to vertical and horizontal surfaces of depressed portions of W.C kitchen and the like shall consist of:

1) 1st course of applying cement slurry @ 4.4 kg/sqm mixed with water proofing compound conforming to IS: 2645 in recommended proportions.

2) 2nd course of 20 mm cement plaster 1:3 (1 cement: 3 coarse sand) mixed with water proofing compound in recommended proportion.

3) 3rd course of applying blown or / residual bitumen applied hot at 1.7 kg per sq.m of area.

4) 4th course of 400 micron thick PVC sheet (Overlaps at joints of PVC sheet should be 100 mm wide and pasted to each other with bitumen @ 1.7 kg/sq.m)

3.20.2 Brickbat Coba & Top stop Method Cement based Water-proofing for Terraces, chajjas, Canopies, Staircases, Gutters, etc.

This method is recommended for terraces and gutters. Water proofing treatment shall start directly over the RCC slab setting brickbats on a grout consisting of chemical and cement mortar to provide necessary gradient of 1 in 120 (1 inch in 10 feet) for the easy flow away of rainwater. The treatment shall consist of laying integral cement based water proofing treatment including preparation of surface as required for treatment of roofs, balconies, terraces, etc. consisting of following operations.

a) Applying and grouting a slurry coat of neat cement using 2.75 kg/sq.m of cement admixed with proprietary liquid water proofing compound conforming to IS 2645 over the RCC slab including cleaning the surface before treatment.

b) Laying cement concrete using broken bricks / brick bats 25 mm to 100 mm size with 50% of cement mortar 1:5 (1 cement: 5 coarse sand) admixed with proprietary liquid water proofing compound conforming to IS: 2645 over 20 mm thick layer of cement mortar of mix 1:5 (1 cement: 5 coarse sand) admixed with proprietary liquid water proofing compound conforming to IS: 2645 to required slope and treating similarly the adjoining walls with plaster up to 300 mm height including rounding of junctions of walls and slabs.

c) After two days of proper curing applying a second coat of cement slurry admixed with proprietary water proofing compound conforming to IS: 2645.

d) Finishing the surface with 20 mm thick joint less cement mortar of mix 1:4 (1 cement: 4 coarse sand) admixed with proprietary water proofing compound conforming to IS: 2645 and finally finishing the surface with trowel with neat cement slurry and making of 300 x 300 mm square.

e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. All above operations to be done in order and as directed and specified by the Engineer-in-charge.

The average thickness of the above treatment shall be 120 mm and minimum thickness at water outlet shall be 65 mm.

Notes:

1. If it is desired to cover the treatment with decorative tiles, marble, china mosaic, etc. the surface shall be finished rough to receive the same.

2. Due to the location of rainwater pipes being far apart and/or due to the span being wider than 6 meters and if the water is required to travel on one side only, then the thickness of the treatment shall increase proportionately to maintain the minimum gradient for the easy flow away of rainwater. The average thickness of coba shall be 150 mm.

3.20.3 Chemical Based Waterproofing

This method is recommended on inclined terraces. The surface on which the waterproofing is to be provided shall be cleaned thoroughly from any loose material, after removing any abrupt/sharp undulation. The surface shall be made bone dry before applying any chemical.

The adhesive coat or the primer, as the case may be, shall be applied to the surface in desired layers/ coats, as specified by the manufacturers. Consideration for pot life of the material for effective bond shall be the main criteria.

For elastic membrane coat, the number of coats shall depend upon the mode of application viz. brush or roller application, liquid spray application. The membrane thickness shall be minimum 0.2mm though higher thickness shall be preferred for structural reasons. It is understood that, the membrane shall be joint less and continuous. In the event of any intermediate joints the minimum lap length shall be 50 cm. The joints shall be hot sealed, if feasible. Care should be taken to avoid any wrinkles in the membrane layer as well as to relieve the trapped air below the membrane.

The protective coat shall be minimum 2mm. thick and shall be able to resist abrasive load due to human traffic. Moreover, if the chemical components adopted in the construction are vulnerable to ultra violet rays, the protective coat shall be resistive to such rays and also against normal vagaries of weather.

Before using the material, the material has to be got approved by the Engineer-in-charge.

3.20.4 Testing

The contractor shall test the work carried out for a period for minimum 72 hours and diligently rectify if leakages are detected: -

Terraces

Impound 10 – 15 cm of water for 72 hours and check underside.

Under ground water tanks

No back filling is to be done outside perimeter. Tank to be completely filled with water and check water levels and physical inspection on the exterior side.

Water Storage Tanks

Inside surface area of tank, Bottom and sides up to underside of top slab.

Internal walls and top slab shall not be measured and paid for.

Terraces, Chajjas and RCC roof gutters

Surface area of terrace, surface area of parapet for a height 300 mm measured from top of RCC roof slab.Surface area of canopies and chajjas. Surface area of sidewalls abutting the chajja for a height of 300 mm measured from RCC top of chajja / canopy / gutter. Covings to be done at the junction of slabs and wall is deemed to be included in above and shall not be separately measured.

3.20.5 Rate

The rates shall be inclusive of work to be carried out as above and including all materials, labour, testing rectification, etc

STRUCTURAL STEEL WORKS

4.1 Applicable Codes and Specifications

1) The supply, fabrication, erection and painting of structural steel works shall comply with the following specifications, standards and codes unless otherwise specified herein. All standards, specifications and codes of practices referred to herein shall be the latest editions including all applicable official amendments and revisions.

IS: 808	Dimensions for Hot Rolled Steel sections
IS : 814	Covered Electrodes for Manual Metal Arc Welding of Carbon and Carbon Manganese Steel
IS : 817	Code of practice for training and testing of metal arc welders
IS : 800	Code of Practice for General Construction in Steel
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 : 7205	Safety Code for Erection of Structural Steel Work
IS : 7215	Tolerances for Fabrication of Steel Structures
IS : 4000	High Strength Bolts in Steel Structure – Code of Practice
AISC	Specifications for Design, Fabrication and Erection of Buildings
IS : 1161	Steel Tubes for structural purposes
IS:102	Ready Mixed paint, Brushing, Red Lead, Non-setting, Priming.
IS:110	Ready Mixed paint, brushing, grey filler for enamels for use over primers.
IS:117	Ready Mixed paint, Brushing, Finishing, Exterior Semi gloss for general purposes, to Indian Standard colors.
IS:158	Ready Mixed paint, Brushing, Bituminous, and Black; Lead free, Acid, Alkali and heat resisting.
IS:159	Ready Mixed paint, Brushing, Acid resisting for protection against acid fumes, colour as required.
IS:341	Black Japan, Types A, B and C
IS:2339	Aluminum paint for general purposes, in Dual container
IS:2932	Specification for enamel, synthetic, exterior, type 1, (a) undercoating, (b) finishing
IS:2933	Specification for enamel, exterior, type 2, (a) undercoating, (b) finishing
IS:3613	Acceptable tests for wire flux combination for submerged arc welding
IS:5905	Sprayed Aluminum and Zinc coatings on Iron and Steel.
IS:6005	Code of practice for phosphating of Iron and Steel.
IS:9862	Specification for ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water & chlorine resisting.
IS:13183	Aluminum paint, Heat resistant.
IS : 1239	Mild steel tubes, tubular and other Wrought steel fittings Part 1 – Mild steel tubes Part 2 – Mild steel tubular and other wrought steel pipe fittings
IS : 1363 (Parts 1to3)	Hexagon Head Bolts, Screws and Nuts of product Grade C (Size range M5 to M64)
IS : 1367 (All parts)	Technical Supply Conditions for Threaded Fasteners
IS : 1852	Rolling and Cutting Tolerances for Hot Rolled Steel Products
IS : 1977	Structural Steel (Ordinary Quality)
IS : 2062	Steel for General Structural Purposes
IS : 2074	Ready Mixed Paint, Air drying, Red Oxide Zinc Chrome and Priming
IS : 3502	Steel Chequered Plate
IS : 3757	High Strength Structural Bolts
IS : 5369	General Requirements for Plain Washers and Lock Washers
IS : 5372	Taper Washers for Channels
IS : 5374	Taper Washer for 1 Beams

IS : 6610	Heavy Washers for Steel Structures
IS : 7318	Approval tests for welders when welding procedure approval is not required (Part 1 and 2)
IS : 8500	Structural Steel-micro alloyed (medium and high strength qualities)
IS : 803	Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded storage tanks
IS : 816	Code of Practice for use of Metal Arc Welding for General construction in Mild Steel
IS : 822	Code of Procedure for Inspection of Welds
IS : 1182	Recommended Practice for Radiographic examination of Fusion – Welded Butt Joints in Steel Plates
IS : 1200	Method of Measurement in Building Civil Works
IS : 1477	Code of Practice for Painting of (Parts 1&2) Ferrous Metals in Buildings
IS : 2595	Code of Practice for Radiographic Testing
IS : 3658	Code of Practice for Liquid Penetrate Flaw Detection
IS : 5334	Code of Practice for Magnetic Particle Flaw Detection of Welds
IS : 9595	Recommendations for Metal Arc Welding of Carbon and Carbon Manganese Steel

4.2 Steel Materials

Steel materials shall comply with the Codes and Standards referred to herein under.

All materials used shall be new, unused and free from defects.

Steel conforming to IS codes mentioned below shall be only be used for the following:

Fe310-0(St 32-0)	IS:1977	**FOR GENERAL PURPOSES SUCH AS DOOR/WINDOW FRAMES, WINDOW BARS, GRILLS, STEEL GATES, HANDRAILS, FENCE POSTS, TEE BARS AND OTHER NON-STRUCTURAL USE.**
Fe410 W A	IS:2062	For all structural purposes in welded, bolted and nutted structures.
Fe410 W B	IS:2062	For all structural purposes in welded, bolted and nutted structures subjected to severe fluctuation of stresses.
	IS: 3502	For steel Chequered Plates.

4.3 Fabrication: -

Fabrication shall conform to IS: 800

All fabrication shall be done on a, well lit, laid up platform, big enough to accumulate men & material for the fabrication at the rate as specified by the work schedule. The Contractor shall ensure sufficient arrangement with back up arrangement for the continuous supply of welding power in order to adhere the work schedule.

All members shall be punch marked for identification before transportation from fabrication yard to erection yard.

4.3.1 General

All materials shall be straight and if necessary before being worked shall be straightened and or flattened by pressure, unless required being of curvilinear form and shall be free from twists. workmanship and finish shall be of the best quality and shall conform to the best approved method of fabrication. All materials shall be finished straight and shall be machined/ground smooth true and square where so specified. All holes and edges shall be free of burrs. Shearing and chipping shall be neatly and accurately done and all portions of work exposed to view shall be neatly finished. Unless otherwise approved by the Engineer-in-charge, reference may be made too relevant IS codes for providing standard fabrication tolerance. Material at the shops shall be kept clean and protected from weather.

The work shall be done as per approved fabrication drawings.

4.3.2 Connections

Shop/field connections shall be as per approved fabrication drawings.

Bolts and nuts shall be of grade 'Black' (B) conforming to the requirement given in the following IS specifications.

(a) IS: 1363 – Specification for Black Hexagonal bolts, nuts & locknuts (dia 6 to 39 mm) and Black Hexagonal screws (dia 6 to 24 mm).
(b) IS: 1367 – Technical Supply condition for threaded fasteners.
(c) IS: 6639 – Specifications for Hexagonal bolts for steel structures.

The electrode for manual metal arc welding shall conform to the requirement of IS: 814.The electrodes for Gas shielded welding procedure shall conform to IS: 6419 and the shielding gapes shall conform to as provided for in IS: 9595.

In case of bolted connections, taper washers or flat washers or spring washers shall be used with bolts as necessary. The length of the bolt shall be such that at least one thread of the bolt projects beyond the nut.

In all cases where bearing is critical, the unthreaded portion of bolt shall bear on the members assembled. A washer of adequate thickness may be provided to exclude the threads from the bearing thickness, if a longer grip bolt has to be used for this purpose.

All connections and splices shall be designed for full strength of members or loads. Column splices shall be designed for the full tensile strength of the minimum cross section at the splice.

Splicing shall be avoided at critical locations and be done only after the approval of Engineer-in-charge as per the splice drawing submitted by Contractor and approved by Engineer-in-charge.

All members likely to collect rain water shall have drain holes provided.

4.3.3 Straightening

All materials shall be straight and, if necessary, before being worked shall be straightened and/or flattened by pressure and shall be free from twists. Heating or forging shall not be resorted to without the prior approval of the Engineer-in-charge in writing.

4.3.4 Welding

Only welding Generators and rectifiers shall be used for welding, transformers shall not be used for structural welding.

Welding procedure shall be submitted to the Engineer-in-charge for approval. Welding shall be entrusted to qualified and experienced welders who shall be tested periodically and graded Reference shall be made to IS 817, IS: 7310 (Part 1) and IS: 7318 (Part 1), as the case shall be.

Electrodes for use shall be approved by HAL before use. The mechanical properties of the weld deposit shall be such as to satisfy all the requirements such as tensile strength, elongation strength & impact strength of parent metal.

Approval of the welding procedure by the Engineer-in-charge shall not relieve the Contractor of his responsibility for correct and sound welding without undue distortion in the finished structure.

No welding shall be done when the surface of the members is wet nor without adequate protection during periods of high wind.

Base metal shall be preheated to the temperature as per relevant IS codes.

Electrodes other than low-hydrogen electrodes shall not be permitted for thick nesses of 20 mm and above.

Deep penetration electrodes shall be used as specified.

All welds shall be inspected for flaws by any of the methods described under Sub-clause 6.5.3. The method adopted shall be agreed with the Engineer-in-charge.

The correction of defective welds shall be carried out without damaging the parent metal in a manner approved by the Engineer-in-charge. When a crack in the weld is removed, magnetic particle inspection or any other equally positive means approved by the Engineer-in-charge shall be used to ensure that the whole of the crack and material upto 25 mm beyond each end of the crack has been removed. The cost of all such tests and operations incidental to correction shall be borne by the Contractor.

4.4 Tolerances

The dimensional and weight tolerance for rolled shapes shall be in accordance with IS: 1852 for indigenous steel and equivalent applicable codes for imported steel. The tolerance for fabrication of structural steel shall be as per IS: 7215.

Cutting, punching, drilling, welding and fabrication tolerances shall be generally as per relevant IS codes.

4.5 End Milling

Where compression joints are specified to be designed for bearing, the bearing surfaces shall be milled true and square to ensure proper bearing and alignment.

4.6 Inspection

4.6.2 General

The Contractor shall give due notice to the Engineer-in-charge in advance of the works being made ready for inspection. All rejected material shall be promptly removed from the shop and replaced with new material for the Engineer-in-charge's inspection. The fact that certain material has been accepted at the Contractor's shop shall not invalidate final rejection at site by the Engineer-in-charge if it fails to conform to the requirements of these specifications, fails to be in proper condition or has fabrication inaccuracies which prevent proper assembly nor shall it invalidate any claim which the Employer may make because of defective or unsatisfactory materials and/or workmanship.

No materials shall be painted or dispatched to site without inspection and approval by the Engineer-in-charge unless such inspection is waived in writing by the Engineer-in-charge.

The Contractor shall provide all the testing and inspection services and facilities for shop work except where otherwise specified.

For fabrication work carried out in the field the same standard of supervision and quality control shall be maintained as in shop fabricated work. Inspection and testing shall be conducted in a manner satisfactory to the Engineer-in-charge.

Inspection and tests on structural steel members shall be as set forth below.

4.6.3 Material Testing

If mill test reports are not available for any steel materials the same shall be tested by the Contractor to the Engineer-in-charge satisfaction to demonstrate conformity with the relevant specification, before consumption in the work.

4.6.4 Tests on Welds

a) Liquid Penetrate Inspection

In the case of welds examined by Liquid Penetrate Inspection, such tests shall be carried out in accordance with relevant IS Code. All defects shown shall be repaired and rechecked.

b) Radiographic Inspection

Generally full Strength butt weld shall be tested with Ultrasound as per IS provision of IS. Raw material plates shall also be tested to check for laminar tearing, if any.
All full strength butt welds for important connection shall be radio graphed as specified in accordance with the recommended practice for radiographic testing as per relevant IS code.

4.6.5 Dimensions, Workmanship & Cleanliness

Members shall be inspected at all stages of fabrication and assembly to verify that dimensions, tolerances, alignment, surface finish and painting are in accordance with the requirements shown in the Contractor's approved fabrication drawings.

4.6.6 Test Failure

In the event of failure of any member to satisfy inspection or test requirement, the Contractor shall notify the Engineer-in-charge. The Contractor must obtain permission from the Engineer-in-charge

before any repair `is undertaken. The quality control procedures to be followed to ensure satisfactory repair shall be subject to approval by the Engineer-in-charge.

The Engineer-in-charge has the right to specify additional testing as he deems necessary, and the additional cost of such testing shall be borne by the Employer, only in case of successful testing.

The Contractor shall maintain records of all inspection, testing & retesting which shall be made available to the Engineer-in-charge.

4.7 Drilling Holes for other Works

As a part of this Contract, holes in members required for installing equipment or steel furnished by other manufacturers or the Contractor at no extra cost of the Employer shall drill other contractors. The information for such extra holes will be supplied by the Employer/Engineer-in-charge.

4.8 Marking of Members

After checking and inspection, all members shall be marked for identification during erection. This mark shall correspond to distinguishing marks on approved erection drawings and shall be legibly painted and stamped on it.

4.9 Errors

Any error in shop fabrication which prevents proper assembling and fitting up of parts in the field by moderate use of drift pins or moderate amount of reaming will be classified by the Engineer-in-charge as defective workmanship. Where the Engineer-in-charge rejects such material for defective workmanship, materials and workmanship conforming to these HAL's Requirements by the Contractor, at no cost to the HAL, shall replace the same.

4.9.2 Site Operations

The Contractor shall complete all preliminary works at site well before the arrival of structural steel, such as establishment of a well equipped and adequately staffed site office, stores, unloading gantry, unloading and pre-assembly yard, labour quarters if any, electrical and water connections, electrical winches, derricks, cranes, compressors, all tools and tackles, rivet guns, welding sets, torque wrenches, spud wrenches, staging, etc., as well as experienced erection and supervisory personnel as part of this contract and any other work that may be necessary so as to start erection immediately after the arrival of the first batch of steel on site.

The Contractor shall furnish at his own expense, the necessary non-inflammable staging and hoisting materials or equipment required for the erection work and shall remove and take them away after completion of the job. The Contractor shall also provide necessary passageways, fences, safety belts, helmets, lights and other fittings to the satisfaction of the Engineer-in-charge and to meet the rules of local authorities and for protection to his men and materials. A licensed electrician shall be kept on the job for the entire duration of the work to maintain the Contractor's electrical equipment and connections.

The Contractor shall protect all existing plant, structures, piping, conduits, equipment and facilities against damage during erection. Any damage caused by Contractor shall be rectified entirely at his cost, to the satisfaction of the Engineer-in-charge. If work has to be carried out adjacent to existing switch yards or electrical installations which are live, the Contractor must ensure suitable safety precautions in consultation with Engineer-in-charge.

If a portion of the work of the project area cannot be made available to the Contractor for his activities due to operations being carried out by other agencies, he shall suitably modify his sequence of operations so as to continue work without interruption. The Contractor shall work in co-ordination with other agencies working on the project site and plan his work suitably so as not to hinder the progress of construction at site.

4.10 Acceptance of Steel, its Handling and Storage

The Contractor shall carefully check the steel to be erected at the time of acceptance. Any fabrication defects observed should be brought to the notice of the Engineer-in-charge.

No dragging of steel shall be permitted. All steel shall be stored 300mm above ground on suitable packing to avoid damage. It shall be stored in the order required for erection, with erection marks visible. All storage areas shall be prepared and maintained by the Contractor. Steel shall not be stored in the vicinity of areas where excavation or grading will be done and, if so stored temporarily, the Contractor well before such excavation shall remove this and/or grading commences to a safe distance to avoid burial under debris.

Scratched or abraded steel shall be given a coat of primer in accordance with these HAL's Requirements for protection after unloading and handling prior to erection. All milled and machined surfaces shall be properly protected from rust/corrosion by suitable coating and also from damage.

Proper record of movement of shop-tested steel from Fabrication yard to erection yard shall be maintained.

4.11 Anchor Bolts & Foundations

The Contractor shall carefully check the location and layout of anchor bolts embedded in foundations constructed, to ensure that the structures can be properly erected as shown on the drawings. Any discrepancy in the anchor bolts/foundation shall be reported to the Engineer-in-charge.
Leveling of column bases to the required elevation may be done either by providing shims or three nuts on the upper threaded portion of the anchor bolt. All shim stock required for keeping the specified thickness of grout and in connection with erection of structures on foundations, crane brackets or at any other locations shall be of good M.S. plates and shall be supplied by the Contractor at his cost.

A certain amount of cleaning of foundations and preparing the area is considered normal and shall be carried out by the Contractor at no extra cost.

Where beams bear in pockets or on walls, bearing plates shall be set and leveled as part of the work. The Contractor as specified by the Engineer-in-charge will carry out all grouting under column base plates or beam bearing plates.

4.12 Assembly & Connections

Field connections may be effected by riveting, bolting, welding or by use of high strength friction grip bolts as shown on the design and erection drawings.

The Contractor shall carry all field connection work as per the shop drawings prepared. All bolts, nuts, washers, rivets, electrodes required for the Contractor shall supply field connections.

All assembling shall be carried on a level platform.

Drifts shall be used only for drawing the work to proper position and must not be used to such an extent as to damage the holes. Size of drifts larger than the normal diameter of hole shall not be used. Any damaged holes or burrs must be rectified to the satisfaction of the Engineer-in-charge.

Corrections of minor misfits and reasonable amount of reaming and cutting of excess stock from rivets shall be considered as a part of erection. Any error in the shop, which prevents proper fit on a moderate amount of reaming and slight chipping or cutting, shall be immediately reported to the Engineer-in-charge.

4.13 Erection

All structural steel shall be erected as shown on the drawings. Proper size steel cable slings, etc., shall be used for hoisting. Guys shall not be anchored to existing structures, foundations, etc.,

unless so permitted by the Engineer-in-charge in writing. Care shall be taken to see that ropes in use are always in good condition.

Reference shall be made to IS: 7205 for safety precautions during the erection of steel.
Structural steel frames shall be erected plumb and true. Frames shall be lifted at points such that they are not liable to buckle and deform. Trusses shall be lifted only at node points. In the case of trusses, roof girders, all of the purlins and wind bracing shall be placed simultaneously and the columns shall be erected truly plumb on screed bars over the pedestals. All steel columns and beams shall be checked for plumb and level individually before and after connections are made. Temporary bracings shall be introduced wherever necessary to take care of all loads to which the structure may be subjected, including erection equipment and the operation thereof. Such bracings shall be left in place as long as may be required for safety and stability.

Chequered plates shall be fixed to supporting members by tack welding or by countersunk bolts as shown/specified in relevant drawings and/or as approved by the Engineer-in-charge. The edges shall be made smooth and no burrs or jagged ends shall be left. While splicing, care should be taken so that there is continuity in pattern between the two portions. Care should also be taken to avoid distortion of the plate while welding. The erection of chequered plates shall include:

(a) Welding of stiffening angles/vertical stiffening ribs
(b) Cutting to size and making holes to required shape wherever necessary to allow service piping and/or cables to pass through
(c) Splicing as shown in relevant drawings
(d) Smoothening of edges
(e) Fixing of chequered plates by tack welding or by countersunk bolts
(f) Providing lifting hooks for ease of lifting.

As erection progresses, the work shall be securely bolted or tied to take care of all dead load, wind, seismic and erection stresses.

No riveting or welding or final bolting shall be done until the structure has been properly aligned and approved by the Engineer-in-charge. No cutting, heating or enlarging of the holes shall be carried out without the prior written approval of the Engineer-in-charge.

The erection scheme shall be got approved from Engineer-in-charge before start of erection work.

The Contractor shall furnish test certificates.

4.14 Inspection

The Engineer-in-charge shall have free access to all parts of the job during erection and all erection shall be subjected to his approval. In case of faulty erection, all dismantling and re-erection required will be at the Contractor's cost. No paint shall be applied to rivet heads or field welds or bolts until these have been approved by the Engineer-in-charge.

4.15 Tolerances

Tolerances mentioned in the relevant MES/IS codes of practice shall be achieved after the entire structure or part thereof is in line, level and plumb.

4.16 Painting

4.16.2 Surface Treatment

All the surfaces of steel work to be painted shall be thoroughly cleaned of all loose mill scale, rust, grease, dirt and other foreign matter. The workmanship shall generally conform to the requirements of IS 1477- Part I.

Oil and grease removal shall be carried out either by solvent cleaning or by using alkali type degreasing agents.

The procedure for cleaning shall be as per manufacturer's instructions.

Loose mill scale, loose rust and loose paint shall be removed by wire brushing, scrapping, chipping, rubbing with abrasive paper or steel wool. This method shall not be employed when the surface has firmly adhering mill scale. After hand tool cleaning, the surface shall be rubbed with sand paper so as to ensure that no loose material exists and the surfaces shall be dusted off.

4.16.3 Materials: -

a) Primer Coat

Anti-corrosive primers shall be either lead based or lead free types.Zinc chrome primer shall conform to IS 2074.

All the materials shall be of the best quality from an approved manufacturer. The Contractor shall obtain prior approval of the Engineer-in-charge for the brand of manufacture and the color/shade prior to procurement for usage in the works.

Primer and finish paints shall be compatible with each other to avoid cracking and wrinkling. And shall be from the same manufacturer for each painting system.

b) Workmanship

The type and the number of coats of the primer paint and finish paint shall be as specified.

Painting shall be carried out only on thoroughly dry surfaces.

No painting shall be done in frosty/foggy weather or when the humidity is high enough to cause condensation on the surface to be painted. Paint shall not be applied when the temperature of the surface to be painted is at 5deg.C or lower.

Primers shall adhere to the surface firmly and offer a key to the subsequent coats.

Workmanship shall generally conform to requirements specified in IS: 1477-Part II.
It is essential to ensure that immediately after preparation of the surfaces, the first coat of primer paint shall be applied by brushing and working it well to ensure a continuous film. After the first coat becomes hard dry a second coat of primer shall be applied by brushing.

The dry film thickness of each coat of primer shall be not less than 25 microns. This shall be checked with the help of electrometer before delivery of material from fabrication yard to erection yard.

Application of finishing paints shall be carried out within the shortest possible time interval after primer since the primer coats are too thin to give adequate corrosion protection of the steel surface over a long duration.

Painting shall be carried out either by brushing or by spraying. The Contractor shall procure the appropriate quality of paint for this purpose as recommended by the manufacturer.

After the second coat of primer is hard dry, the entire surface shall be wet rubbed cutting down to a smooth uniform surface. When the surface becomes dry, the undercoat of paint of optimum thickness shall be applied by brushing/spraying with minimum of brush marks. The coat shall be allowed to hard dry. The under coat shall then be wet rubbed cutting down to a smooth finish, taking adequate care to ensure that at no place the undercoat is completely removed. The surface shall then be allowed to dry.

The first finishing coat of paint shall be applied at the fabrication yard by brushing or by spraying and allowed to hard dry. The gloss from the entire surface shall then be gently removed and the surface dusted off. The second finishing coat shall then be applied by brushing or by spraying at work site after erection.

At least 24 hours shall elapse between the applications of successive coats. Each coat shall vary slightly in shade and shall be approved by the Engineer-in-charge, prior to applying the next coat.

Minimum dry film thickness of each coat of finish paint of synthetic enamel shall be 25 microns. Minimum dry film thickness of other finish paints shall be as specified in the respective item of work.

The final finished surface shall look smooth and even. The contractor shall ensure this by providing additional coat, if and when required. Nothing extra shall be paid for this.

4.17 Rate for steel: -

Rate is inclusive of all items indicated above including men, material and equipments. However Enamel painting shall be paid separately.

4.17.2 Measurement for steel: -

The structural steel shall be measured as built. No deduction for holes less than 0.02 sq.m shall be made. Steel as erected and specified shall be paid.

4.18 Rate for Painting: -

Rate for painting shall include all item indicated above inclusive of men, material and equipments.

4.18.2 Measurement for Painting: -

Measurement for painting shall be as of Metric tones of Structural steel erected and completed.

4.19 Galvanising of Structural Steel

4.19.2 Galvanising Plant

Prior approval shall be obtained from Employer / Engineer-in-charge if galvanizing is proposed to be carried out outside Contractor's plant.

4.19.3 Workmanship

After all shop work is complete, all structural materials shall be punched with the erection mark and be hot-dip galvanized. Before galvanizing, the steel shall be thoroughly cleaned of any paint, grease, rust, acid or alkali or such other foreign matters as are likely to interfere with the galvanizing process or with the quality and durability of the zinc coating. Pickling shall be very carefully done and shall be proper.

The weight of the zinc coating shall be at least 0.610 kg/sq.m unless specified otherwise. Stub members and members for grillage type footing shall have heavier zinc coating not less than 0.80 kg/sq.m.

The galvanized surface shall consist of a continuous and uniformly thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth, and shall be free from defects like discolored patches, bare spots, unevenness of coating, spelter that is loosely attached to the steel, globules, spikes, etc. The finish shall be as per IS: 2633 unless specified otherwise.

All galvanized members shall be treated with Sodium dichromate solution or an approved equivalent after galvanizing; so as to prevent white storage stains.

Galvanizing of each member shall be carried out in one complete immersion. Double dipping shall not be permitted. However, in case of members over 7.5 m long, the Contractor shall take prior approval of Engineer-in-charge for double dipping. When the steel section is removed from the galvanizing kettle, excess spelter shall be removed by 'bumping'.

Wherever galvanized bolts, nuts locknuts, washers, accessories etc. are specified, they shall be hot-dip galvanized. Spring washers shall be electro-galvanized. Excess spelter from bolts, nuts, etc. shall be removed by centrifugal spinning. Rechasing of bolt threads after galvanizing shall not be permitted. Nuts, however, may be tapped, but not to cause appreciable rocking of the nuts on the bolts. Readily available GI nuts, bolts and washers conforming to galvanizing requirements may also be used.

Defects in certain members indicating presence of impurities in the galvanizing bath in quantities larger than that permitted by the specifications, or lack of quality control in any manner in the galvanizing plant, shall render the entire production in the relevant shift liable to rejection.

Contractor shall ensure that galvanizing is not damaged in transit. In the event of occurrence of any damages Contractor shall at his own cost adopt scraping and regularizing the member to satisfy the specific requirements.

4.20 False Ceiling with Gypboard & G I framework:

4.20.2 Scope of work

The work envisaged under these specifications refer to supplying and fixing in position false ceiling at any floor, any location and at any height.

a) Providing and fixing suspended G.I frame work

b) Providing and fixing one layer of 12.5 mm gypboard over this frame work

c) Jointing the board flush, applying two coats of primer suitable for gypboard and two coats of acrylic emulation matt finish paint of approved shade and make.

d) Making necessary cut outs for light fitting, A.C grills diffusers and other necessities. The work shall include horizontal, vertical and inclined surfaces depending upon the various requirements

4.20.3 Material:

4.20.4 G.I Frame work: -

The system consists of G.I framework suspended from the soffit of the RCC ceiling. The following G.I components shall be used for grid work:

a) Ceiling section of 80 x 26 x 0.5 mm

b) Perimeter channel of 20 x 27 x 30 x 0.5mm

c) Intermediate channels of 15 x 45 x 0.9 mm

d) Ceiling angle of 25 x 10 x 0.55 mm

e) Connecting clips of 2.64 mm dia.

f) Soffit cleat 22 x 37 mm

g) Anchor fasteners 6 mm

All the G I components shall be of M/s. India Gypsum Limited make and bear the embossing of "GYPSTEEL' in each length.

The G.I grid work system shall be suspended from the soffit of RCC ceiling using anchor fasteners of 6 mm of approved type and make and connected to soffit cleats and ceiling angle by means of necessary nuts, bolts and washers etc.

4.20.5 GYP BOARD: -

Gyp. Board of plain series 12.5 mm manufactured by India gypsum shall be used. The Gyp board shall conform to be 2095. The longitudinal edge of the Gyp board shall be of tapered / square edges, so as to have flush joints while fixing.

Handling and transporting of Gyp board shall be done carefully and as recommended by the manufactures. The board should always be kept in a dry and covered place sheltered from rain and to avoid dampness from flow, they should be supported on wooden battens which should not be more than 45 cm apart on a flat surface. The material shall be stacked in piles of smaller heights and should not be stacked on edges. Gyp board, which have deformed due to poor stacking should not be used.

Cutting of board should be made in faced side of the board by means of retractable knife or by using a normal saw and the edges of the boards shall be planned using proper files.

4.20.6 FINISHING MATERIALS: -

All jointing compounds, paper tapes, primer and paints shall be with materials manufactured / recommended by India Gypsum.

4.20.7 INSTALLATION: -

Perimeter channels are leveled at the required position of the finished ceiling line and fixed to the wall at 610 mm center with the screws and nylon plugs. The remaining G.I gird component is installed to form a regular grid suspended from the soffit of RCC slab using soffit cleats ceiling angle and anchor fasteners as specified. Extra frame for various cutouts of different shapes, light fittings, AC grills, diffusers, smoke detectors and other necessities have to be provided wherever required is included in the scope of the work at no extra cost. This frame work has to be made with perimeter channel of specified size and shall be suitably supported. The line and level of the grid work has to be checked for perfection and prior clearance of the grid work has to be obtained from the Engineer-in-Charge before the placement of Gyp board.

The Gyp board is fixed with bound edges at right angles to ceiling section with all joints staggered. All joints of Gyp board have to be fixed on ceiling section. The Gyp boards are screwed to the ceiling section and perimeter channels with Gyp board dry wall screws with joints staggered. Spotting of screws and jointing are then carried out according to India Gypsum recommendations to give a flush and smooth joint.

Necessary door openings of hinged type of suitable sizes has to be provided with a suitable framework for control valves and for access above false ceiling / AC duct boxing at no extra cost.

Joints at horizontal, vertical and inclined surfaces shall be suitably strengthened with additional G.I framework as required.

Finally the boards are jointed and finished so as to have a flush look which includes filling and finishing the tapered and square edges of the board with a jointing compound, paper tape and two coats of primer suitable for gyp board (all as per recommended practices of Indian Gypsum). Then, the finished Gyp board has to be painted with 2 coats of acrylic emulsion matt finish paint of approved color and make.

The rate shall includes providing all material, erecting, suspending, G.I grid work, jointing the boards, providing required cutouts and open able doors and painting including providing necessary fittings and fixtures etc. complete as per the specifications and all other activities related to the completion of the above job.

Details of A.C grills, diffusers, recessed type electrical fittings to be erected in false ceiling will be as per specifications and as shown in drawings.

The quantities indicated are approximate and is likely to vary depending upon the site conditions.

Samples of light fittings are available with Engineer.

The scope of works includes fixing with screws, fixtures etc. the recessed electrical light fittings in the grid work of false ceiling / boxing. Marine plywood (6 mm thick) / special G.I sections, if required, shall also be provided at no extra cost. The rate quoted shall include all the above-mentioned activities related to the completion of the above job.

4.20.8 MODE OF MEASUREMENT: -

Measurements will be made on flat plan area basis in Sq.M calculated to 3 places of decimal. Length and breadth shall be measured corrected to a cm. No deduction shall be made for cutouts made for a. C grills, diffusers, electrical fittings, smoke detectors etc.

4.20.9 ROOFING, WALL CLADDING SYSTEM USING PRE-COATED GI SHEETS OF TRAPEZOIDAL PROFILE

4.20.10 MATERIAL: -

APPLICATION: ROOFING
BASE METAL:0.55 mm Thick for roofing (BMT) 550 MPa – G550
PROFILE: Single Skin -TRAPEZOIDAL
SUBSTRATE: Zinc –Aluminum alloy Coating AZ150
PAINT SYSTEM: Super – Polyester XRW
FASTENER: Hex-head, Self-Drilling, Tapping Screw;
(Class 3 screws as per AS3566)

4.20.11 General: -

Supply, fabrication, errection and fixing of colour coated Single Skin Trapezoidal profiled sheeting 720 -1020mm cover width 28-32 mm crests depth at 186-250 c/c (Above 195 mm c/c crest distance there will be minimum 2 ribs at the centre for stiffning). The feed material is manufactured out of 0.45 mm BMT (Base Metal thickness) Hi-Tensile steel with min. 550Mpa yield strength coated with hot dip metallic zinc-aluminium alloy coating Zincalume AZ-150 or equivalent (as per AS1397) as 150 gms/sq.mt total on both sides of Zinc (45 %) & Aluminium (55%), with super polyester Colorbond XRW quality paint coat or equivalent as per AS/NZS-2728 (category 3) of approved color. The color shall have a total coating thickness of 35 microns of an super polyester XRW quality paint system or equivalent as per AS/NZS-2728 (category 3), comprising of 20 microns exterior coat on top surface and 5 micron reverse coat on back surface over 5 micron primer coat on both surfaces. The Steel manufacturers test certificate for the chemical and mechanical properties of steel must be submitted for approval by the concerned authority prior to installation. The sheet shall have brand marking of the manufacturer on the back of the sheet at every 1 mt c/c which should have the brand name, product specification and the coil number for confirming genuinity of the material.The profile and length of the sheet shall be commensurate with the site requirements and pre-coated with approved color. The contractor shall prepare the shop drawings based on the drawings supplied by the Engineer – in charge or the concern authority. These shall be submitted in five sets sufficiently in advance to the concern authority for approval.

4.20.12 Steel Sheet Material: -

The Steel base material of sheet shall have minimum 550 MPa Yield Strength made out of cold rolled steel and shall be coated with anti-corrosive layer of zinc-aluminum alloy coating as Zincalume AZ-150 coating or equivalent as per AS-1397 with min. 150 gms/sq.mt zinc-alluminium alloy coating mass (total on both side).

4.20.13 Profile:-

Single skin Trapezoidal profiled sheeting 720 -1020mm cover width 28-32 mm crests depth at 186-250 c/c (Above 195 mm c/c crest distance there will be minimum 2 ribs at the centre for stiffning).

4.20.14 Coating:-

The sheet shall is prepainted with super-polyester Colorbond XRW coat or equivalent as per AS/NZS-2728: 1997 (Category 3) of approved color on Zincalume zinc-alluminium alloy substrate or equivalent (as per AS 1397: 1993). The color shall have a total coating thickness of 35 microns of super polyester Color bond XRW quality paint system or equivalent as per AS/NZS-2728: 1997 (category 3), comprising of 20 microns exterior coat on top surface and 5 micron reverse coat on back surface over 5 micron primer coat on both surfaces

All specials and accessories should also be factory fabricated. All the flashing and ridge cap or any other covering should be made out of the same material as that of roofing.

4.20.15 Erection and Fixing:-

- The product will be fastened using Class 3 screws as per AS3566 (as per design) galvanized hex headed, self drilling fasteners of approved make (Buildex or equivalent) and quality including EPDM / Neoprene washer on each crest (or as per design) of the sheet connecting with purlin.
- The standard practice as specified by the manufacturer and as approved by the concern authority. All sheets and accessories must be stored and finally erected without any damage, dent, scratches, etc.
- The contractor will be required to submit design calculation in support of the proposed profile of the sheet and over all the fixing system for the structural properties, standard loading etc. to the satisfaction of the design consultant and the client. The contractor shall also submit methodology for fixing and also a maintenance manual for routine maintenance.
- Flashing, capping and trims shall be formed out of same color coated substrate and thickness as that of the roofing sheet and shall be supplied in a minimum length of 2.5 mt. in the required shape and girths and fixed with fixtures compatible with the system. Silicon sealant non-hardening, neutral cure type of approved make and grade shall be applied at all end laps.
- The contractor shall ensure that panel erector is familiarized with the erection procedure and all the supporting members are straight, level, plump and true (according to AISC) before starting panel erection. Panels shall be erected according to approved shop drawings.

4.20.16 Measurement: -

The payment will be done on the actual finish / covered surface area of the sheet.

No separate payment will be made for the lap of sheet and accessories, bolts, nuts, washers, adjustable bolts and supports for gutters and other fixtures. These are assumed to be included in the quoted rates.

LIST OF APPROVED MAKES/AGENCIES

FOR WORKS COVERED UNDER THIS CONTRACT

1) All materials and products used in the work shall conform to the relevant standards/ specifications and shall be of approved make and design. Lists of approved manufacturers/ vendors for Civil works, Plumbing works, Fire fighting & Fire Alarm works, Electrical works etc. is given herein below. The approval of a manufacturer/ vendor shall be given only after review of the sample/specimen by the Engineer-in-charge. The complete system and installation shall also be in conformity with the "Applicable Codes Standards and Publications".

2) List of Approved makes for Products, Materials and specialist agencies is given below. Other equivalent manufacturers may be considered with prior approval; however the decision of the Engineer-in-charge shall be final.

CIVIL WORKS

SL. NO.	ITEM	MAKE
1	GREY CEMENT	J.P., ACC, LARSEN & TOUBRO, GUJARAT AMBUJA, VIKRAM, BINANI J.K, BIRLA, SHREE OR ANY OTHER BRAND WITH APPROVAL OF ENGINEER INCHARGE.
2	WHITE CEMENT	JK, BIRLA OR EQUIVALENT
3	REINFORCEMENT/STRUCTURAL STEEL	SAIL, TISCO, RINL, VIZAG
4	ANTI-TERMITE TREATMENT	PEST CONTROL INDIA LTD, PEST CON INDIA, PEST CONTROL INCORPORATED, OR ANY OTHER AGENCY TO BE APPROVED BY THE ENGINEER IN CHARGE
5	CONCRETE ADDITIVE	FOSROC, STP, CICO-TL, SIKA, PIDILITE
6	FLUSH DOORS	GREEN, DURO, CENTURY, MAYUR, JAYNA, ARCHID PLY, ALPRO
7	FIRE CHECK DOORS	GLOBAL FIRE PROTECTION COMPANY, RADIENT SAFE FIRE DOORS, GODREJ
8	PLYWOOD / BLOCK BOARD / SOFT BOARD	ANCHOR, DURO, MAYUR, GREEN LAM, CENTURY, ARCHID PLY, ALPRO
9	PRELAMINATED PARTICLE BOARD	ACTION TESA, NOVAPAN, ANCHOR, MERINO, GREEN LAM, CENTRURY, ARCHID PLY
10	LAMINATES	CENTURY, ROYAL CHALLENGE, MERINO,GREEN LAMP, ARCHID LAM
11	ADHESIVE FOR WOOD WORK	DUNLOP, FEVICOL, VAMICOL, PIDILITE
12 a)	POLYRETHANE SEALANT	MBT, CHOKSEY,PIDILITE
b)	SILICON SEALANT	DOWN CORNING, ALSTONE OR EQUIVALENT
13	POLYETHELENE BOARD	SUPREME OR EQUIVALENT
14 a.	ALUMINIUM EXTRUSIONS	JINDAL, HINDALCO, NARMADA, BHARUKA, INDAL, MAHAVIR OR EQUIVALENT
b.	STAINLESS STEEL	SALEM, JINDAL OR EQUIVALENT
c.	EXPANSION, FASTENERS	FISCHER, HILTI, ANCHORS, AXEL

SL. NO.	ITEM	MAKE
15	FLOAT GLASS	MODI GUARD, SAINT GOBAIN, ASAHI, ATUL
16	CERAMIC TILES	NITCO, KAJARIA, SOMANY, JOHNSON, SUNHEART, VARMORA
17	VITRIFIED PORCELINE TILES	NAVEEN DIAMOND TILES, NITCO, JOHNSON, MARBITO BRAND, RAK, KAJARIA, VARMORA, CT TILES
18	INTERLOCK TILES/GRASS PAVER BLOCKS/ KERB STONE	DALAL TILES, UNISTONE, MODERN OR EQUIVALENT
19	TERRAZZO TILES	NITCO, MODERN, A-1, NTC, DALAL TILES OR EQUIVALENT AS PER ISI SPECIFICATION
20 a)	CEMENT CONCRETE TILES	UNISTONE, ULTRA, DALAL TILES OR EQUIVALENT
b)	HANDMADE CERAMIC TILES	RAJA, ARIHANT, JAIN
21	ROOF WATER PROOFING	NINA CONCRETE SYSTEM PVT. LTD, C R S ASSOCIATES AND ENGINEERS PVT.LTD, CREATIONS,PIDILITE
22	PAINT	NEROLAC, JOHNSON & NICHOLSON, BERGER, ASIAN PAINTS, SHALIMAR
23	TEXTURED COATING	UNITILE, SPECTRUM, HERITAGE OR EQUIVALENT
24	DOOR FITTINGS	GODREJ, DOORSET, OZONE, INDOBRASS
25	LOCKS AND HANDLES	EVERITE, GODREJ, HARRISON, INDOBRASS
26	NON METALLIC HARDENER COMPOUND	FOSROC, S TP, PIDILITE, CICO
27	ROLLING SHUTTER	RAMA, PRAKASH, SANJEEV OR EQUIVALENT AS PER CPWD SPECIFICATIONS.
28	DOOR CLOSER	DOORSET, EVERITE, GARNISH, INDOBRASS
29	FLOOR DOOR SPRING	D-LINE,OZONE,DOORSET,EVERITE,INDOBRASS
30	HDF LAMINATED BOARD	ARMSTRONG, BVG, EGO FLOORS, SQUARE FOOT, ACTION TESA
31	EXPANSION FASTENERS	HILTI, FIHSER, GKW, AXEL
32	FASTENERS	HILTI, FIHSER, GKW, AXEL
33	GYPSUM CEILING	INDIA GYPSUM, LAFARGE
34	CALCIUM SILICATE BOARD FALSE CEILING	AEROLITE, HYLUX
35	PATCH FITTING	DORMA, GEZE, OZONE OR AS APPROVED
36	WORK STATION AND MODULAR FURNITURE	GODREJ, BP ERGO, FEATHERLIGHT, WIPRO
37	BLINDS	VISTA, MAX, ARMSTRONG
38	ADHESIVE	FEVICOL, VEMICOL OR EQUIVALENT
39	FURNITURE HARDWARE	UNIQUE, HATTICH INDIA, EBCO, EARL BEHARI.
40	LACQUERED GLASS	SAINT GOBIN, ASAHI, ATUL
41	MELAMINE POLISH	ASIAN PAINT, BERGER, SHALIMAR

	ELECTRICAL WORKS LIST OF APPROVED MAKES	
1	Switch Fuse Unit (HRC Type)	Schnider/GE/L&T/Siemens/C&S/Havells/MDS
2	MCB's, MCCBs, RCCBs, ELCB's & MCB DBs	Legrand / ABB / L&T /Siemens / Havells / C&S / Schneider / GE / Hagger / Anchor / Standard / Action
3	LT XLPE Aluminium Armoured cables upto 1100v	Plaza/Skytone/ National/Ralison/PYTEX/Paragon/ KEI
4	HT XLPE Aluminium Armoured cables upto 11000V	Skytone/ National/INCAB/ Nicco
5	Air Circuit Breakers	Schneider/ GE /L & T/Siemens
6	Terminals	Elmex /Technoplast
7	Lugs	Dowells/ Ismal
8	Glands	Gripwell/ Comet
9	Indicating lamps	L &T/ Siemens/Technique
10	Power factor correction relay	Syntron/ Avomec/Sigma
11	Indicating Instruments	Automatic Electric/ Rishab
12	KWH Meters	L&T/HPL SOCOMEC
13	Current Transformers	Automatic Electric/ Kappa
14	Selector Switches	Salzer-L&T/ Kaycee
15	Change over switches	HH Elecon/HPL
16	11 KV VCB/RMU Panel	Crompton/ABB/Siemens/Areva
17	Power Transformers	Crompton/ Kirloskar/ABB/Siemens
18	HT Jointing Kits	Raychem/ Mahindra/Denson/Cabseal
19	DG Sets- Engine.	Kirloskar/Cummins/Caterpillar/Mitsubishi
20	Alternator	Kirloskar /Stamford./Crompton/Mitsubishi
21	LT Panels, Fidder Pillars etc.	Ambit, Trikolite/KEPL/Madhu elect./SPC/ Amptech/ USHA Power/Precision System Control
22	Power Capacitors	Crompton/Siemens Apcos/Khatou
23	HRC Fuse Base & HRC Fuses	L&T/GE/Schneider/HPL
24	Sound Proof Acoustic Enclosures	DG suppliers
25	Lighting Fittings & Luminaries	Crompton/Philips/Wipro/BAJAJ/Havell's
26	PVC insulated 1.1KV grade copper wires	Plaza/Pytex/National/Ralison/RKG/Finolex/Polycb / Batra-Henlay/Havells
27	Piano/Modular Type Sockets & Switches	Roma(Anchor)/Legrand/MK/Crabtree/ Philips/ Clipsal/North West
28	Steel/PVC Conduit	BEC/AKG/ATUL/STEEL KRAFT/RKG
29	Ceiling/Wall/Exhaust fans	Crompton /Almonard /Bajaj/Usha/Orient
30	External lights	Bajaj/ Philips/ Decon/K-Lite/Metal Coat

Sr No.	Description	Approved Brands
1	U-Pvc water Pipes	Supreme, Jain Pipes, Captain Pipes, Jindal, Ori-Plast or as approved by Engineer-in-Charge
2	HDPE Pipes	Apollo, Supreme, Jain or as approved by E-I-C
3	Electro Fusion Fittings	Apollo, Supreme, Kimplas, or as approved by E-I-C
4	Sluice Valve	Indian valves or as Approved by EIC
5	G.I water supply pipes	Tata, Jindal or as Approved by EIC
6	RCC Pipes	Hindustan Hume pipe or as Approved by EIC
7	Ball Valves	Audco or as Approved by EIC
8	Butterfly/ NRV valves	Audco or as Approved by EIC
9	Water meters	ACTARIS Multymag Turbine type residential water meter or as Approved by EIC
10	Ball cocks	Audco or as Approved by EIC
11	C.I. Manholes Cover and frames	Necco or as Approved by EIC
12	P.V.C. Tanks	Sintex or as Approved by EIC
13	Soil, Waste & Rain water pipe & fittings Sandcast iron pipes (IS: 1729)	Audco or as Approved by EIC
14	Air Valve	Indian Valve, or as Approved by EIC
15	PVC water stopper	Supreme, or as approved by EIC
16	Aluminium Extruded section	Hindal co./Jindal or as approved by EIC
17	Aluminium composite panels	Alucobond / Rweynobond /Alucomat or as approved by EIC
18	Stainless steel door fittings	Godrej/Dorset or as approved by EIC
19	Door closer	Godrej/Dorset or as approved by EIC
20	Hard ware	Godrej/Dorset or as approved by EIC
21	Patch fittings	Godrej/Dorset or as approved by EIC
22	Water proofing compound	Dr.fixit/ Fosroc or as approved by EIC

QAP for Civil Works, Check Lists & Formats

Pre- Concrete Check List

Structure No. — Date & Time of Concrete
Location — Grade of Concrete
Source of Concrete — Brand of Cement

Sr. No	Description	Approved		Observations & Remarks
		Yes	No	
1	**ALIGNMENT / LEVEL CHECK**			
2	**GENERAL CLEANLINESS**			
3	**FORM WORK**			
	a) Shutters- Smooth & Cleaned Surface			
	b) Application of Mould Oil			
	c) The roads, Supports / Props provided			
4	**REINFORCEMENT CHECKING**			
	a) Size (as per drawing)			
	b) Spacing (As per drawing)			
	c) Starter Bar			
	d) Lapping of bars			
5	**CEMENT**			
	a) Weight of cement per cum			
	b) Theoretical cement consumption			
	c) Actual cement consumption			
6	**REINFORCEMENT COVER**			
7	**WEEP HOLES PROVIDED**			
	a) Not Required			
	b) Not Provided			
8	**CONSTRUCTION JOINT REQUIRED**			
9	**EQUIPMENT VERIFICATION**			
	a) No of needle vibrators deployed			
10	**CONCRETE PLACEMENT ARRANGEMENT**			
	A) Using Pump			
	a) Joint / Fixing Checked			
	B) Direct			
	a) Platform placed			
	b) clean chute provided			
	c) proper gradient provided			
11	**CONCRETE VOLUME REQUIRED**			
12	**NO. OF CUBES CASTED**			
13	**RFI SUBMITTED TO QA/ QC**			
14	**PROPER ACCESS ROAD PROVIDED**			
15	**LIGHTING ARRANGEMENT FOR NIGHT WORKING**			
	a) No of spot lights provided			
16	**CURING ARRANGEMENT**			
17	**SAFETY REQUIREMENTS**			
	a) Proper Barricading done			

	b) Cautionary sign boards provided			
	c) Lights & Genset Arrangement for night works			
	d) First Aid Box			
18	**MISC**			
	a) Supervisors			
	b) Labours			

Contractor Representative

Consultant Representative

NAME OF PROJECT _____

CONTRACTOR		**CHECK LIST FOR CONCRETING**			
		REF DRAWING NO _____			
CONTRACT NO.		LOCATION BLOCK _____ FLOOR ____ AREA____			
LAYOUT	☐ Alignment Checked	☐ Level of base Checked	☐ Dimensional Check (edges & diagonals)	☐ Starters	☐ Location of cu-outs & services
STAGING/ SCAFFOLDING	☐ Adequacy & rigidity of Props stays.bracings. Conformity to scheme drawings	☐	☐		
FORMWORK	☐ Qty of forms and support ☐ Props adequate	☐ Vertical form surface in alignment & plumb	☐ Even surface ☐ Oil sprayed	☐ Gaps between shuttering are ☐ Properly closed.	☐ No space for sagging of ☐ Form work
REINFORCEMENT	☐ Cutting & bending as per Bar bending schedule (schedules attached)	☐ Adequate laps ☐ Welds	☐ Chair/cover blocks ☐ Placed as per scheme	☐ Binding wire not ☐ Touching shuttering	☐ Fixtures, inserts ☐ Conduits in position
	☐ Dowels & positioning ☐ Provided as per drg.	☐ Walkway for ☐ Labour provided			
PRE-CONCRETING	☐ Concreting Arrangements	☐ Approval of Construction joint	☐ Mixer/vibrator ☐ Condition & mixing	☐ Top level of ☐ Concerete marked	☐ Transporting & Placeing arrangement
POST-CONCRETING	☐ Compaction ☐ Checked	☐ Removal of laitance	☐ Post concreting ☐ Level/dimensions.	☐ Nos of cubes cast	
DESHUTTERING & CLEARING	☐ Curing days------ ☐ Water/compound	☐ Surface finish ☐ OK	☐ Concrete Test ☐ Results OK		

W.O. Item	UNIT	QTY.

SIGNATURE:							
CONTRACTOR	DATE	SITE ENGR	DATE	SITE INCHARGE	DATE	CONSULTANT	DATE

NAME OF PROJECT_____

CONTRACTOR CONTRACT NO.	CHECK LIST FOR MASONRY WORK REF DRAWING _____ LOCATIONBLOCK_____FLOOR_____AREA_____	

LAYOUT	☐ Alignment & wall Thickness checked	☐ Brick on edge (top course)		
SCAFFOLDING	☐ Adequacy of props. Stays, platform	☐ Rigidity of base	☐ Movement space	☐ Approach to height
PRE-LAYING	☐ Working arrangements & service provisions checked	☐ Bricks as per specification	☐ Mortar grade & mix As specified	☐ Bricks moistened
LAYING	☐ Joint thickness & course Ht. As specified	☐ Joint alignment Checked	☐ Vertical joints Properly mortar filled from top	
	☐ Raking of joints Done (if applicable)	☐ Bearing plaster for Concrete		
CURING AND CLEARING	☐ Proper curing of const. Joint	☐ Scaffolding removed (if required)		

W.O. Item	UNIT	QTY.

SIGNATURE:							
CONTRACTOR	DATE	SITE ENGR	DATE	SITE INCHARGE	DATE	CONSULTANT	DATE

NAME OF PROJECT_____

CONTRACTOR CONTRACT NO.	CHECK LIST FOR PLASTERING WORK LOCATION BLOCK _____ FLOOR _____AREA _____	

SCAFFOLDING	☐ Platform	☐ Stability	☐ Movement space	☐ Approach to Height	
SERVICE	☐ All chasing work Complete	☐ Fixing in position Using clamps etc.	☐ Patching Work complete	☐ All door/window frames Fixed in position	☐ Skirting to floors marked
				CLEARANCE FROM AE (E)	
SURFACE PREPARATION	☐ Cleaning & raking of Surface	☐ Roughening Hacking done	☐ Fixing metal/lathe Chicken mesh	☐ Mortar level Guides made	☐ Surface moistened/ Cement slurry
PLASTERING	☐ Mix & w/p compound Checked as per specification	☐ Coating/thickness As specified	☐ Groove at joints Provided	☐ Corners & edges sharp & at right Angles lines & levels maintained	☐ Surface leveled with At straight edge
FINISHING	☐ Texture	☐ Curing Days———	☐ Site cleared	☐	☐

W.O. Item	UNIT	QTY.

SIGNATURE:							
CONTRACTOR	DATE	SITE ENGR	DATE	SITE INCHARGE	DATE	CONSULTANT	DATE

NAME OF PROJECT_____

CONTRACTOR CONTRACT NO.	CHECK LIST FOR LAYING OF EXTERNA SEWER REF DRAWING NO _____ LOCATION	

Excavation	☐ Layout	☐ Slope/cutting as per Specifications	☐ Level
Laying /RCC pipes	☐ Bed concrete as per Specifications	☐ RCC pipes as per Requirement	☐ Jointing of pipes
	☐ Boxing	☐ Strata bore Dewatering (wherever required)	
Manholes	☐ Bricks as per specifications	☐ Mortarasper specifications	☐ Plastering
	☐ End of pipes plugged		
Back fillings	☐ In layers		

W.O. Item	UNIT	QTY.

SIGNATURE:							
CONTRACTOR	DATE	SITE ENGR	DATE	SITE INCHARGE	DATE	CONSULTANT	DATE

NAME OF PROJECT_____

CONTRACTOR CONTRACT NO.	CHECK LIST FOR SUB GRADE LOCATION FLOOR NO._____	

LAYOUT	☐ Alignment of center line as drawings	☐ Marking of carriage way edges as per drawing		
SUB GRADE PREPARATION	☐ Initial cross sectional levels recordod	☐ Cleaning & grubbing of vegetation and top soil as specified	☐ Watering & rolling as specified	☐ Cross section levels recorded after rolling
FORMATION LEVEL (FILLING)	☐ Depth of filling upto formation Level _____mtr.	☐ Nosof layers upto formation level _____	☐ Fill material	☐ Spreading, watering & rolling of layers on layer no.
	☐ % compajotion of soil (Proctor test)	☐ Camber/slope Provided as drawing	☐ Formationcrosssectional levels recorded	

W.O. Item	UNIT	QTY.

SIGNATURE:							
CONTRACTOR	DATE	SITE ENGR	DATE	SITE INCHARGE	DATE	CONSULTANT	DATE

LIST OF MANDATORY TESTS					
S. No.	**Description of Material**	**Test**	**Reference of IS Code / Specification for testing**	**Field / Laboratory test**	**Frequency of testing**
1	**Cement**	Physical & chemical properties	IS : 4031	Lab	Initial Test-01 test for each brand of cement. Subsequently, 01 test for 200 MT or part thereof for each brand. Cement should be of approved brand and each lot should be accompanied by manufacturer's test certificates
2	**Reinforcement steel**	Physical & chemical properties	IS :1786	Lab	Initial Test-01 test for each brand and each dia of reinforcement steel , Subsequently - One test for every 35 MT or part thereof. Reinforcement Steel should be of approved brand and each lot should be accompanied by manufacturer's test certificates
3	**Water**	PH value, chlorides, sulphates, alkalinity test, acidity test, suspended matter, organic matter and inorganic matter	IS:3025	Lab	Initial Test- Source approval at commencement of work and Subsequently- every six months or change of source.
4	**Coarse Aggregate - Building works**	Gradation	IS 2386 – I	Field / Lab	Minimum one test for every 50 cum or part thereof.
		Deleterious material	IS 2386 - II	Field / Lab	
		Specific Gravity	IS 2386 - III	Field / Lab	
		Crushing value	IS 2386 - IV	Field / Lab	
		impact value	IS 2386 - IV	Field / Lab	
		10% fine value	IS 2386 - IV	Field / Lab	
5	**Fine Aggregate- Building works**	Organic impurities	Appendix 'A 'of chapter 3 ,CPWD Specifications	Field	Minimum one test for every 50 cum or part thereof.
		Silt content	Appendix ' C 'of chapter 3 ,CPWD Specifications	Field	
		Bulking of Sand	Appendix 'D 'of chapter 3 ,CPWD Specifications	Field	
		Gradation	Appendix 'B 'of chapter 3 ,CPWD Specifications	Field / Lab	

6	**Coarse Aggregate - Road , Pavement works**	Gradation	IS 2386 – I	Field / Lab	One test for everyday's work.
		Flakiness and Elongation Index	IS 2386 – I	Field / Lab	Once for each source of supply and subsequently on monthly basis.
		Deleterious material	IS 2386 - II	Lab	One test for everyday's work.
		Water Absorption	IS 2386 - III	Lab	Regularly as required subject to a minimum one test a day. This data shall be used for correcting the water demand of mix on a daily basis
		Los Angeles Abrasion Value/Aggregate Impact value	IS 2386 - IV	Lab	Once for each source of supply and subsequently on monthly basis
		Soundness	IS 2386 - V	Lab	Before approving the aggregates and every month subsequently.
		Alkali aggregate reactivity	IS 2386 - VII, IS:456	Lab	Before approving the aggregates and every month subsequently.
7	**Fine Aggregate - Road ,Pavement works**	Gradation	IS 2386 – I	Field / Lab	One test for everyday's work.
		Deleterious material	IS 2386 - II	Lab	One test for everyday's work.
		Water Absorption	IS 2386 - III	Lab	Regularly as required subject to minimum two test per day. This data shall be used for correcting the water demand of mix on a daily basis.
		Silt Content	Appendix 'C' of chapter 3 ,CPWD Specifications	Field	Minimum one test for everyday's work.
8	**Slump Test - Building Works**		Appendix 'D' of Chapter 4, CPWD Specifications	Field	Minimum one test for every 20 cum of concrete or part thereof
9	**Slump Test - Pavement Works**		IS 1199	Field	One test per each dumper load at both Batching plant site and paving site initially when work starts. Subsequently, sampling may be done from alternate dumper.
10	**Cube Test**				
(i)	**Reinforced Cement Concrete - Building works**	7 days and 28 days Compressive strength	IS 516	Lab	One sample of six cubes for every 50 cum or part thereof
(ii)	**Dry Lean Concrete (DLC) - Pavement Work**	7 days compressive strength	IS 516	Lab	One sample of five cubes for every 150 cum or part thereof
(iii)	**Pavement Quality Concrete (PQC) - Pavement Work**	Compressive strength, flexure strength	IS 516	Lab	2 cube set samples and 2 beam set samples per 150 cum or part thereof for each day production.
11	**Earthwork**				
		Gradation/clay & sand content	IS 2720 -IV	Lab	2 tests per 3000 cum or part thereof for each source.
		Atterberg's limit	IS: 2720-V	Lab	
		California Bearing Ratio	IS 2720-XVI	Lab	

		Maximum dry density / OMC	IS 2720-VIII	Lab	
		Deleterious content	IS: 2720-XXVII	Lab	
		Free swelling Index	IS: 2720-XXXX	Lab	As and when required by Engineer
		Field density	IS: 2720-XXVIII	Field	(a) One set of 10 measurements for each layer per 3000 sqm of compacted area for embankment (b) One set of 10 measurements for each layer per 2000 sqm of compacted area of shoulder and sub-grade.
		Moisture content	IS: 2720-II	Field	2 tests per 1000 cum
12	**Granular Sub base**				
		Gradation	IS 2386- I	Field / Lab	Minimum 01 test per source and additional test after every 1000 cum
		Water absorption	IS 2386- III	Lab	Minimum 01 test per source and additional test as required by Engineer
		Wet Aggregate Impact Value test (if WA >2.0%)	IS 5640	Lab	As required by Engineer
		Aggregate Impact Value	IS 2386- IV	Lab	Minimum 01 test per source and additional test after every 2000 cum
		Atterberg's limit	IS 2720-V	Lab	Minimum 01 test per source and additional test after every 1000 cum
		Maximum dry density /OMC	IS 2720-VIII	Lab	Minimum 01 test per source and additional test as required by Engineer
		Moisture content prior to compaction	IS 2720-II	Field	Minimum 01 test every 400 cum
		Field Density	IS 2720-XXVIII	Field	one test per 2000 Sqm or part thereof
		Deleterious material	IS: 2720-XXVII	Lab	Minimum 01 test per source and additional test as required by Engineer
		CBR	IS 2720-XVI	Lab	Minimum 01 test per source and additional test as required by Engineer
13	**Water Bound Macadam**				
		Gradation	IS 2386- I	Field / Lab	Minimum 01 test per source and additional test after every 500 cum
		Aggregate Impact Value	IS 2386- IV or IS5640	Lab	Minimum 01 test per source and additional test after every 500 cum
		Combined Flakiness and Elongation Indices	IS 2386- I	Lab	Minimum 01 test per source and additional test after every 500 cum
		Atterberg's Limit (Screening, Binding Material)	IS 2720-V	Lab	Minimum 01 test per source and additional test after every 500 cum or part thereof
		Water absorption	IS 2386-III	Lab	Minimum 01 test per source and additional test as required by Engineer
		Sulphur Content, Water Absorption, Chemical Stability, Density for Crushed Slag (if used)	To comply with requirements of Appendix of BS : 1047	Lab	As required by Engineer
		Soundness test (if WA >2.0%)	IS 2386-V	Lab	As required by Engineer
14	**Wet Mix Macadam**	Gradation	IS 2386 – I	Field / Lab	Minimum 01 test per source and additional test after every 500 cum

		Water Absorption	IS 2386-III	Lab	Minimum 01 test per source and additional test as required by Engineer
		Soundness (if WA > 2.0%)	IS 2386-V	Lab	As required by Engineer
		Atterberg's limit of portion of aggregate passing 425 micron sieve	IS 2720 - V	Lab	Minimum 01 test per source and additional test after every 500 cum or part thereof
		Aggregate Impact value	IS 2386- IV or IS 5640	Lab	Minimum 01 test per source and additional test after every 500 cum
		Maximum Dry Density / OMC	IS 2720 - VIII	Lab	Minimum 01 test per source and additional test as required by Engineer
		Combined Flakiness and Elongation Indices	IS 2386 – I	Lab	Minimum 01 test per source and additional test after every 500 cum
		Moisture content	IS 2720-II	Field	Minimum 03 tests per day
		Field Density	IS 2720 – XXVIII	Field	One set of three test per 2000 sqm or part thereof
15	**Prime /Tack Coat**				
		Quality of Binder	IS 73, IS 217, IS 8887	Lab	No. of samples per lot and tests as per IS 73, IS 217, IS 8887as applicable
		Binder Temperature for Application	As per MORTH specifications	Field	At regular close interval
		Rate of Spread of Binder	As per MORTH specifications	Field	Minimum 03 tests per day
16	**Dense Bituminous Macadam / Bituminous Concrete**				
		Mix grading	IS 2386- I	Lab	One set for individual constituent and mixed aggregates from dryer for each 400 tonnes of mix subject to a minimum of two tests per day per plant
		Plasticity Index	IS 2720-V	Lab	One test for each source and whenever there is change in the quality of aggregate.
		water absorption	IS 2386-III	Lab	One test for each source and whenever there is change in the quality of aggregate.
		Soundness (if WA>2%)	IS 2386-V	Lab	One test for each source and whenever there is change in the quality of aggregate
		Impact value / Abrasion value	IS 2386-IV	Lab	One test per 350 cum of aggregates for each source and whenever there is change in the quality of aggregates
		Combined flakiness and elongation Indices	IS 2386- I	Lab	One test per 350 cum of aggregates for each source and whenever there is change in the quality of aggregates
		Stripping value	IS 6241	Lab	Initially one set of 3 aggregate representative specimen and then for each change in quality of aggregate
		Stability and Void Analysis of Mix	ASTM: D-1559	Lab	Three tests for stability, flow value, density and void contents for each 400 tonnes of mix subject to minimum of two tests per day per plant

		Retained Tensile test (if retained Coating <95%) / Moisture Susceptibility Mix	AASHTO T283	Lab	one test for each mix type whenever there is change in quality or source of coarse or fine aggregate
		Binder Content	IRC: SP 11 Appendix 5	Field	Minimum 2 tests per day
		Field Density	IRC: SP 11 Appendix 5	Field	One test per 700 sqm
		Quality of Binder	IS 1201 to IS 1220	Lab	number of samples per lot (as in IS 73) and tests as per IS 73
		Temp Control at the time of laying and compaction		Field	At regular interval
17	**Brick work / brick tiles / sewer brick/Burnt clay perforated building Bricks**				
		Dimension	Appendix A, B, C & D of Chapter 6 of CPWD Specifications	Lab	Minimum one test for every 50000 bricks or part thereof
		Compressive strength		Lab	
		Water Absorption		Lab	
		Efflorescence		Lab	
18	**Stone work**				
		Water absorption	IS 1124	Lab	Minimum one test for every 200 sqm / 100 cum or part thereof
		Transverse Strength	IS 1121 - II		
		Resistance to wear	IS 1706		
		Durability	IS 1126		
19	**Marble**				
		Moisture absorption	IS 1124	Lab	Minimum one test for every 100 sqm or part thereof
		Hardness test	Mho's Scale		
		Specific Gravity	IS 1122		
20	**Granite**				
		Moisture	IS 1124	Lab	Minimum one test for every 100 sqm or part thereof
		Specific Gravity	IS 1122		
21	**Structural Steel (other than PEB)**				
		Tensile strength	IS 1599	Lab	Minimum one test for every 20 tonnes or part thereof per source and also manufacturer's test certificates for each consignment should be accompanied.
		Bend Test			
22	**Steel Tubular pipes**				
		Tensile test	IS 1608	Lab	Minimum one test for every 8 tonne or

		Bend Test	IS 2329		part thereof per source and also manufacturer's test certificates for each consignment should be accompanied.
		Flattening Test	IS 2328		
23	**M 50 Grade Cement Concrete Paver Blocks**				
(i)	**M-50 Grade Pre-Cast Concrete Paving Blocks**	Compressive Strength	As per Technical Specifications	Field / Lab	a) 16 paving blocks for everyday production. If, however, the average strength of the first 04 blocks tested is not less than 54 N/sqm, the sample shall be deemed to comply and the remaining 12 blocks from the sample need not be tested.
					b) If blocks are procured from outside and not manufactured at project site 01(one) test of 16 blocks per 10,000 nos. paving blocks or part thereof
		Dimensions	As per Technical Specifications	Field / Lab	a)16 paving blocks for everyday production b) If blocks are procured from outside and not manufactured at project site 01(one) test of 16 paving blocks per 10,000 nos. paving blocks or part thereof
(ii)	**Sand for Bedding Layer**				
		Percentage of Deleterious material	IS 2386	Lab	Minimum one test for every 50 cum or part thereof
		Particle Size Distribution	As per Technical specification	Field / Lab	
		Silt Content	As per Appendix 'C' of Chapter 3 of CPWD Specifications	Field	
		Moisture Content	IS 2720	Field	
(iii)	**Sand for Joint Filling**	Particle Size Distribution	As per Technical specification	Field / Lab	Minimum one test for every 50 cum or part thereof
Note:-	**For items not covered above may be dealt with as per the technical specifications in the contract.**				

1. Site Order Book				
Date	**Instructions issued on the Inspection of work with Signature and designation**	**Contractor / contractor's representative acknowledgement with Signature, Name & Date**	**Compliance report by contractor / contractor's representative with Signature, Name & date**	**Final remark Engineer with S designation**
2	**3**	**4**	**5**	**6**

2. Hindrance Register

Sl. No.	Nature of Hindrance	Date of Occurrence	Date of clearance	Period	Over lapping period if any	Weight age of hindrance	Net effective days of hindrance	Remarks and references	Sign. of Site Engineer with date	Contractor / contractor's representative Signature with Name & date
1	2	3	4	5	6	7	8	9	10	11

3. Drawing Register

Sl. No	Drg. No. and revision no. if any	Date of receipt	Details of DRG	Date of Issue to Contractor	Acknowledgement of contractor	Signature of Site Engineer with date
1	2	3	4	5	6	7

4 Cement Register

Sl. No.	Date of Receipt	Source of Receipt	Bill/ Challan no.	Manufacture Test Certificate reference	Quantity Received (bags)	Progressive Total of Receipts (Bags)	Date of Issue	Qty. Issued (Bags)	Qty. Returned at the end of the Day (Bags)	Net Qty issued (Bags	Progressive Total of issue (Bags)

5 Steel Register

Sl. No	Date of Receipt	Source of Receipt & Ch. No. /Bill No.	Qty Received (MT)	Cum Qty Received (MT)	Date of Issue	Qty issued (MT)	Cumulative qty issued (MT)	Balance at the end of the Day (MT)	Item of work in which consumed	Sign. Of Site Engineer with date	Sig con r w dat

6. Sieve Analysis of Stone Aggregate Nominal Size

Sl. No.	Date	Weight of sample in gms	Size of Sieves	Weight retained on each Sieve	%age of weight retained	Cumulative %age of weight Retained	%Age of weight passing	Specified %age of weight Passing	Sign. Of contractor with date	Sign. Of Site Engineer with date	Remarks/action taken
1	2	3	4	5	6	7	8	9	10	11	12

Note: Size of Sieve should be as per CPWD manual/BIS specification

7. Silt Contents of Fine Sand/Coarse Sand

Sl. No.	Date	Source of material	Height of Silt after Setting (V-1)	Height of sand after setting (V-2)	%age Silt Content V1/V2x100	Acceptability as per specification	Sign. Of Site Engineer with date	Sign. Of contractor with date	Location where sand used	Remarks/action taken
1	2	3	4	5	6	7	8	9	10	11

8. Slump Test

Sl. No.	Date of Testing	Item of work and location	Vibrators used Yes / No	Quantity of water added per bag of cement (Liters)	Height of specimen after removal of mould in (mm)	Slump (mm)	Acceptability of result or action taken	Sign. Of Site Engineer with date	Sign. of contractor with date	Remarks
1	2	3	4	5	6	7	8	9	10	11

9. Cube Test

Sl. No.	Date of Collection	Grade of Mix	Mark of Specimen	7 days Test Result				28 days Test Result				Required specified strength	Approx. qty represented by Specimen	Item of work from where the sample is collected	Sign. Of Site Engineer with date	Contractor / contractor's representative Signature with Name & date
				Date of Testing	Load in KN	Compressive strength (KN / mm2)	Average compressive strength (KN / mm2)	Date of Testing	Load in KN	Compressive strength(KN / mm2)	Average compressive strength (KN / mm2)					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

10. Density Test by Core Cutter Method

MDD as per lab test W5……..

Sl. No	Location (C.H.) / Area Represented by the Test	Core Cutter Nos.	Weight of Core Cutter + Weight of Soil (in gram) (W1)	Weight of Empty Core cutter (in gram) (W2)	Weight of Wet Soil (in gram) W= W1-W2	Volume of Core Cutter (in CC) V	Bulk Density (gram/cc) W3= W/V	Moisture Content of compaction layers (M)	Dry Density gram/cc W4 = W3/ (1+M)	Degree of compaction W4/W5	Acceptability limit	Sign. of Site Engineer with date	Contractor / contractor's representative Signature with Name & date
1	2	3	4	5	6	7	8	9	10	11	12	13	14

11. Test for Thickness and Density of the Compacted Layer (By Sand Replacement Method)
for Asphalt Concrete / Bitumen Macadam / CC Pavement
Lab Test Density in gms/CC ……..

Sl. No	Date of Test	Qty. represented by the test	Location of holes	Thickness of Layer		Weight of materials removed from the carpet Hole	Initial weight of sand taken in Cylinder	Weight of sand filling in cone of cylinder	Weight of sand remaining in cylinder	Predetermined bulk density of sand	Density = $\frac{A.d.}{(W1+W2)}$ W-	Remarks / Acceptability	Sign. Of Site Engineer	Contractor / contractor's representative Signature with Name & date	Action Taken
				Individual (mm)	Average (mm)	A gm	W gm	WI gm	W2 gm	d gm/CC	gm/CC				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

12. Density Test Register for Soil ---- By Sand Replacement Method
Unit Wt. of Standard Sand in grams/CC (W6) = …….
Lab Test MDD in gms/CC (W10) = …….

Sl. No	Date of Test	Qty. represented by the test	Location of holes	Thickness of Layer (mm)		Wt. of Material from the hole	Moisture Content %age	Initial weight of sand taken in the Cylinder before filling in hole in gms	Wt. of sand after filling in hole in gms	Wt. of sand in hole & cone in gms	Wt. of sand in cone in gms	Wt. of sand in hole in gms	Volume of hole in CC	Bulk Density in gms/CC	Dry Density in gms/CC	Degree of compaction	Remarks / Acceptability	Sign. Of Site Engineer with date	Contractor / contractor's representative Signature with Name & date	Action Taken
				Individual	Average	(W) gms	(Y)	(W1)	(W2)	(W3)= W1-W2	(W4)	W5 = (W3-W4)	(W7)= W5/W6	(W8)=W/W7	(W9)= W8/Y	W9/W10 x100	W9/W10 x100			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

13. Test of the Brick / Brick Tiles for Compressive Strength

Sl. No	Date of collection of sample	Date of testing	Wt. (in Kg)	No. of Specimen	Size in cm/Area in cm2	Compressive Strength obtained for individual bricks in Kg. per Cm2	Average Strength in Kg/Cm2	Specified Compressive Strength in Kg/Cm2	Acceptability	Sign. Of Site Engineer with date	Contractor / contractor's representative Signature with Name & date	Action Taken / Remark
1	2	3	4	5	6	7	8	9	10	11	12	13

14 Inspection Register

Sl. No	Date and time	Officer's Name and designation	Items inspected and specific defects noticed & action to be taken	Signature	Defects taken to Site Order Book/letter written			Final action / result
					Site Order Book Page no. / letter no.	Date	Sign. of Site Engineer / PMC	

Bill Performa

Name of work :

LOI No.

Name of Contractor :

Date of Start :

Date of Preparation of Bill :

S N	Item No.	Description of Items	Unit	Qty as per Agt.	Rate as per Agt.	Qty as per Pre. Bill	Qty as per this Bill	Cumulative Qty.	Amt. as per Previous Bill	Amt. as per this Bill	Cumulative Amount
1											
2											
3											
4											
5											
						Total of Schedule A					
						Add Enhancement or Rebate @					
						Grand Total of Schedule A					

FORMATS

SCHEDULE – 1

ELIGIBILITY CRITERIA DOCUMENT

1.	Name of Company/Firm	
	Registered Address	
	Website & Email Address	
	Telephone Number	
	Fax Number	
2.	Description of the company giving detail of activities	
3.	Number of years of experience as a General Contractor	
4.	Number of years of experience as a Sub-Contractor	
5.	Names of members of Board of Directors	
6.	Names of principals who sign documents on behalf of the company	
7.	Attach a Company organization chart	
8.	Previous names of the company with the dates of changes (if any)	
9.	Previous partners with dates of changes(if any)	
10.	State if a member of any contractor's association/organization.	
11.	In which field of SITC/Engineering do you claim specialization & Interest.	

Encl.:

1) Attach attested copies of original documents:
a) Applicant's legal status.
b) Principal place of business.
c) The place of Incorporation (for applicants who are Corporation), the place of registration and nationality of the owners (for applicants who a rein partnerships or individually owned firms).
2) Power of attorney or authority to sign duly attested by Magistrate 1st Class.
3) Latest brochures and technical literatures.

Authorized Signatory with official seal

SCHEDULE – 2
ELIGIBILITY CRITERIA DOCUMENT

FINACIAL CAPABILITY

a) Summary of assets and liabilities on basis of the audited financial statements of the last three financial years.

ITEM	DESCRIPTION	2017-2018	2018-2019	2019-2020
1.	Total Assets			
2.	Current Assets			
3.	Total Liabilities			
4.	Current liabilities			
5.	Net worth (1-3)			
6.	Working Capital (2-4)			
7.	Annual Turn over			
8.	Services related turn over			
9.	Profit before taxes			
10.	Profit after Taxes			

Note:

a) Attach attested copies of the audited financial statements of the last three financial years.
b) Details of services related turnover

Name and Address of the Bank providing Credit line

c) Specify proposed sources of financing to meet the cash flow demands of the project, net of current commitments:

SOURCE OF FINANCING	AMOUNT
1.	
2.	
3.	

4.	

Firms owned by individuals, partnerships, may submit their balance sheets certified by the registered Chartered Accountant, and supported by copies of tax returns, if audits are not required by the laws of their countries of origin.

NOTE: (The following information is mandatory)

i) The average annual financial turnover during the last 3 years ending 31st March of previous financial year should clearly be indicated.

ii) The applicant should have positive net worth. This will be judged from audited balance sheet of the last financial year ending on a date not prior to 24 months from the due date of submission of this document.

Authorized Signatory with official seal

SCHEDULE - 3
ELIGIBILITY CRITERIA DOCUMENT

Assessed Available Bid capacity

The applicant must fulfil the criteria of...

Working Bid Capacity> Total estimated **cost of work(s) at the time of bidding**. Contractors should calculate the bid capacity as per given formula.

WBC = 2AN – B

A=	Average Annual Turnover of the bidder for last three financial years from similar nature of projects
B=	Value of the existing commitments and ongoing works of the bidder (lead member of the Consortium) to be completed during next 6 months (period of completion of works as per bid)
N=	No. of years prescribed for completion of works for which bids are invited i.e. 0.5 in this case.

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SECHUDLE – 4
ELIGIBILITY CRITERIA DOCUMENT

WORK EXPERIENCE

LIST OF RELEVANT PROJECTS OF VALUE OF PACKAGE (FOR WHICH PREQUALIFICATION IS SOUGHT), COMPLETED/STILL CONTINUING, DURING THE LAST TEN YEARS

Name of Employer / Client	Name, Location, Nature & Description of Work	Contract Price in Indian Rs.	% of Participation of the Company	Contractual Date of Commencement	Contractual Date of completion of Work	Actual Date of Start of Work	Actual Date of Completion of work	Reasons for Delay in Completion, if any	Value of work completed till the last date of submission of bid supported with certificate from employer/ client

Note :-
1. Certificates from the employers are to be attached in respect of the information furnished.
2. Attach photographs of completed Projects.
3. Attach additional photo copied pages, if required.
4. Works to be listed separately as per the similarity.
5. Attach performance certificates as per the value of work as defined in this document. There should not be an unsatisfactory performance of the applicant.

Authorized Signatory with official seal

SCHEDULE – 5
ELIGIBILITY CRITERIA DOCUMENT

LIST OF CURRENT PROJECTS

PROJECT TITLE	WORKS INVOLVED	HAFED	CONTRACT VALUE	DATE OF COMMENCEMENT OF WORKS	DUE DATE OF COMPLETION	%AGEWISE COMPLETION	EXPECTEDDATE OF COMPLETION

Note :- Works to be listed separately as per the similarity.

Authorized Signatory with official seal

SCHEDULE – 6

ELIGIBILITY CRITERIA DOCUMENT

INFORMATION REGARDING CURRENT LITIGATION OR ABANDONMENT OF WORK BY APPLICANT

i)	a) Is the applicant currently involved in any arbitration/litigation to the contract works.	**Yes / No**
	b) If yes, give details	
ii)	a) Has the applicant or any of its constituent partners been debarred/expelled by any agency in India during the last 5 years due to any reason	**Yes / No**
	b) If yes, give details	
iii)	a) Has the applicant or any of its constituent partners failed to complete any contract work in India during the last 5 years due to any reason.	**Yes / No**
	b) If yes, give details	
iv)	Applicant shall submit an affidavit with an undertaking that the applicant / associates have not been blacklisted by any Govt. Agency / State Government/ Central Government offices if any of the State in India.	

Note:- If any information in this schedule is found to be incorrect or concealed, participation of applicant will be summarily rejected at any time. The applicant is supposed to fill-up the correct details of arbitration/litigation during last five years with their outcome.

Details of dispute	Year	Award for or against applicant	Name of HAFED, cause of litigation and matter of dispute	Current value of disputed amount	Actual awarded amount

Signature with Seal of the Company
(Name of the Authorized Signatory)
Title / Designation

SCHEDULE – 7
ELIGIBILITY CRITERIA DOCUMENT
AFFIDAVIT

1. I, the undersigned duly authorized on behalf of company/firm/do hereby certify that all the statements made in the required attachments are true and correct to the best of my knowledge.

2. The undersigned hereby authorize(s) and request(s) any bank, person, firm or Corporation to furnish pertinent information deemed necessary and requested by the HAFED to verify this statement or regarding my(our)competence and general reputation.

3. The undersigned understands and agrees that further qualifying information may be requested and agrees to furnish any such information at the request of the HAFED.

(Signed by an Authorized Officer of the Firm)

Name and Title of Officer

Name of the Firm

Date
Encl.: Requisite Power of Attorney duly attested by Magistrate – 1st Class.

SCHEDULE – 8
ELIGIBILITY CRITERIA DOCUMENT

ADDITIONAL INFORMATION

Following additional information supported with attested copies, may be supplied along with your application:

1. Registration of company, partnership deed, Article of Association, Registration under Labour Law, Registration under GST etc

2. EPF No., PAN No. etc.

3. Details of available site testing equipments.

4. Details of possession of Electrical License from Chief Electrical Inspector of the State for execution of High Tension line network.

Please add any further information, which you consider to be relevant to the evaluation of your application. If you wish to attach other documents please list below, otherwise state “not applicable”.

Authorized Signatory with official seal

Technical Data Sheet (To be filled by Bidders and submitted in technical Bid)

Parameters	2500 MT Silo System (1 No Silo-1500 MT, 1 No Silo-1000 MT)		
	Technical Specifications		
Basic Details	**Reference**	**Included**	**Brief Details (To be filled by Vendor) (To include capacity, MOC/ input/ output parameters & makes of equipments with reference to the applicable IS standards)**
Number of Silos	2		
Capacity/ Silos (MT)	1500+1000		
Product Density (kg/ cum)	750		
Structure Data			
No of rings	Please Specify		
Guage thickness (mm)	Please Specify		
Sheet per rind	Please Specify		
Eve Height (mtr)	Please Specify		
Diameter (Approx.) (in mtrs)	Please Specify		
Galvanization (gsm)	Please Specify		
Wind Velocity (kmph)	Please Specify		
Seismic resilience	Please Specify		
Corrugation pitch (inches)	Please Specify		
Corrugation depth (inches)	Please Specify		
No of stiffners	Please Specify		
Inside ladder	Please Specify		
Outside ladder with cage	Please Specify		
Roof Ladders with hand rail	Please Specify		
Steel Grade for Wall sheet & Stiffeners	Please Specify		
Accessories			
Aeration System with fans	Electromechanical Operational Mechanism		
Sweep Auger	Please Specify		
High Level Sensor for auto cut-off during loading	Tuning Fork type / Equivalent- Please Specify		
Temp Monitoring system	Please Specify		
Roof exhaust fan	Please Specify		
Discharge Gate	Please Specify		
Receiving hopper	Please Specify		
Bucket Elevator	Please Specify		

Conveyor	Please Specify		
In feed speed (TPH)	Please Specify		
Output feed (TPH)	Please Specify		
Drum Sieve with capacity	Please Specify		
Pre cleaner capacity (TPH)	Please Specify		
Bin Silo for further truck loading	Please Specify		
Bagging Silo and Weighing System	Please Specify		
Chutes & Ducting	Please Specify		
Catwalk with guiding rails	Please Specify		
Electrical panels, wiring with PLC	Please Specify		
It is mandatory that this sheet has to be submitted in the technical bid with all details, otherwise the HAFED may reject their technical offer without any justification. The Bidder can propose any other details/ accessories with technical specifications and justification.			

Format of Bank Guarantee for Bid Security
(BANK GUARANTEE ON NON-JUDICIAL STAMP PAPER OF Rs.100)

BID SECURITY (BANK GUARANTEE)

WHEREAS, _____ *[name of Bidder]* (hereinafter called "the Bidder") has submitted his Bid dated _____ *[date]* for the (**insert the name of the works)** (hereinafter called "the Bid").

KNOW ALL PEOPLE by these presents that We _____ *[name of bank]* of having our registered office at _____ (hereinafter called "the Bank") are bound unto _____(hereinafter called "the Employer") in the sum of Rs._____[1](Rupees _____ _____ ____ _____) for which payment well and truly to be made to the said Employer the Bank binds itself, his successors and assigns by these presents.

SEALED with the Common Seal of the said Bank this _____ day of _____ 2018.
THE CONDITIONS of this obligation are:

(1) If after Bid opening the Bidder withdraws his bid during the period of Bid validity specified in the Form of Bid;
or
(2) If the Bidder having been notified of the acceptance of his bid by the Employer during the period of Bid validity:

(a) fails or refuses to execute the Form of Agreement in accordance with the Instructions to Bidders, if required; or

(b) fails or refuses to furnish the Performance Security, in accordance with the Instruction to Bidders; or

(c) does not accept the correction of the Bid Price pursuant;

we undertake to pay to the Employer up to the above amount upon receipt of his first written demand, without any protest or demur or any objection, whatsoever on our part and without any first claim or reference to the Contractor, without the Employer having to substantiate his demand, provided that in his demand the Employer will note that the amount claimed by him is due to him owing to the occurrence of one or any of the three conditions, specifying the occurred condition or conditions.

This Guarantee will remain in force up to and including the date _____ days after the deadline for submission of Bids as such deadline is stated in the Instructions to Bidders or as it may be extended by the Employer, notice of which extension(s) to the Bank is hereby waived. Any demand in respect of this guarantee should reach the Bank not later than the above date.

DATE _____ SIGNATURE OF THE BANK _____

WITNESS _____ SEAL _____

_____
[signature, name, and address]

The Bidder should insert the amount of the guarantee in words and figures denominated in Indian Rupees. This figure should be the same as shown in Section 1 (II).

Instruction for furnishing Bank Guarantee

 The Bank Guarantee by Bidders will be given on non-judicial stamp paper as per stamp duty applicable at the place where the tender has emanated. The non-judicial stamp paper should be in name of the issuing bank.

 This bank guarantee/ all further communication relating to the bank guarantee should be forwarded to HAFED Office, Panchkula only.

 The full address along with the Telex/Fax No. and email address of the issuing bank to be mentioned.

PERFORMANCE BANK GUARANTEE

To

_____ [name of Employer]
_____ [address of Employer]

WHEREAS _____ [name and address of Contractor] (hereafter called "the contractor") has undertaken, in pursuance of Contract No. _____ dated _____ to execute _____ [name of Contract and brief description of Works] (hereinafter called "the Contract").

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with his obligation in accordance with the Contract;

AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee:

NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you on behalf of the Contractor, up to a total of _____ [amount of guarantee]* _____ (in words), such sum being payable in the types and proportions of currencies in which the Contract Price is Payable, and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of _____[amount of guarantee] as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the contractor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed there under or of any of the Contract documents which may be made between you and the Contractor shall in any way release us from any liability under this guarantee, and we waive notice of any such change, addition or modification.
The Bank guarantee for performance security shall remain in force as given in the Bid Document shall be valid up to 3 months beyond the expiry of the Defects Liability Period.

Signature and Seal of the guarantor_____
Name of Bank_____
Address _____
Date_____

* An amount shall be inserted by the Guarantor, representing the percentage of the Contract Price specified in the Contract including additional security for unbalanced Bids, if any and denominated in Indian Rupees.

BANK GUARANTEE FOR ADVANCE PAYMENT

To

_____ [name of Employer]
_____ [address of Employer]
_____ [name of Contractor]
_____ [name of Contract]

Gentlemen:

In accordance with the provisions of the Conditions of Contract, sub-clause 51.1 ("Advance Payment") of the above mentioned Contract,_____

[Name and address of Contractor] (Hereinafter called" the Contractor") shall deposit with _____ [name of Employer]a bank guarantee to guarantee his proper and faithful performance under the said Clause of the Contract in an amount of _____[amount of Guarantee]*_____[in words].

We, the _____[bank of financial institution], as instructed by the Contractor, agree unconditionally and irrevocably to guarantee as primary obligator and not as Surety merely, the payment to _____[name of Employer] on his first demand without whatsoever right of obligation on our part and without his first claim to the Contractor, in the amount not exceeding_____[amount of guarantee]*_____[in words].

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed there under or of any of the Contract documents which may be made between_____ [name of Employer]and the contractor, shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

The guarantee shall remain valid and in full effect from the date of the advance payment under the Contract until_____ [name of Employer] receives full repayment of the same amount from the Contractor.

Yours truly,

Signature and Seal: _____
Name of Bank/Financial Institution:_____
Address: _____
Date: _____

---

* An amount shall be inserted by the Bank of Financial Institution the amount of the Advance Payment, and denominated in Indian Rupees.

INDENTURE FOR SECURED ADVANCES
FORM 31

(for use in cases in which the contract is for finished work and the contractor has entered into an agreement for the execution of a certain specified quantity of work in a given time)

This indenture made the _____ day of _____, 20____ BETWEEN _____ (hereinafter called the contractor which expression shall where the context so admits or implies be deemed to include his executors, administrators and assigns) or the one part and the Employer of the other part.

Whereas by an agreement dated _____ (hereinafter called the said agreement) the contractor has agreed.

AND WHEREAS the contractor has applied to the Employer that he may be allowed advanced on the security of materials absolutely belonging to him and brought by him to the site of the works the subject of the said agreement for use in the construction of such of the works as he has undertaken to executive at rates fixed for the finished work (inclusive of the cost of materials and labour and other charges.)

AND WHEREAS the Employer has agreed to advance to the Contractor the sum of Rupees _____ on the security of materials the quantities and other particulars of which are detailed in Accounts of Secured Advances attached to the Running Account bill for the said works signed by the Contractor on _____ and the Employer has reserved to himself the option of making any further advance or advances on the security of other materials brought by the Contractor to the site of the said works.

Now THIS INDENTURE WITNESSETH that in pursuance of the said agreement and in consideration of the sum of Rupees _____ on or before the execution of these presents paid to the Contractor by the Employer (the receipt where of the Contractor doth hereby acknowledge) and of such further advances (if any) as may be made to him as a for said the Contractor doth hereby covenant and agree with the President and declare as follows:

(1) That the said sum of Rupees _____ - so advanced by the Employer to the Contractor as aforesaid and all or any further sum of sums advanced as aforesaid shall be employed by the Contractor in or towards expending the execution of the said works and for no other purpose whatsoever.

(2) That the materials details in the said Account of Secured Advances which have been offered to and accepted by the Employer as security are absolutely the Contractor's own propriety and free from encumbrances of any kind and the contractor will not make any application for or receive a further advance on the security of materials which are not absolutely his own property and free from encumbrances of any kind and the Contractor indemnified the Employer against all claims to any materials in respect of which an advance has be made to him as aforesaid.

(3) That the materials detailed in the said account of Secured Advances and all other materials on the security of which any further advance or advances may hereafter be made as aforesaid (Hereafter called the said materials) shall be used by the Contractor solely in the execution of the said works in accordance with the directions of the Engineer.

(4) That the Contractor shall make at his own cost all necessary and adequate arrangements for the proper watch, safe custody and protection against all risks of the said materials and that until used in construction as aforesaid the said materials shall remain at the site of the said works in the Contractor's custody and on his own officer authorized by him. In the event of the said materials or any part thereof being stolen, being stolen, destroyed of damaged of becoming deteriorated in a greater degree than is due to reasonable use and wear thereof the Contractor will forthwith replace the same with other materials of like quality of repair and make good the same required by the Engineer.

(5) That the said materials shall not be any account be removed from the site of the said works except with the written permission of the Engineer of an officer authorized by him on that behalf.

(6) That the advances shall be repayable in full when of before the Contractor receives payment from the Employer of the price payable to him for the said works under the terms and provisions of the said agreement. Provided that if any intermediate payments are made to the Contractor on account of work done than on the occasion of each such payment the Employer will be at liberty to make a recovery from the contractor's bill for such payment by deducting there form the value of the said materials than actually used in the construction and in respect of which recovery has not been made previously, the value of this purpose being determined in respect of each description of materials at the rates at which the amounts if the advances made under these presents were calculated.

(7) That if the Contractor shall at any time make any default in the performance or observance in any respect of any of the terms and provisions of the said agreement or of these presents the total amount of the advance or advances that may still be owing of the Employer shall immediately on the happening of such default be repayable by the Contractor to be the Employer together with interest thereon at twelve percent per annum from the date or repayment and with all costs, charges, damages and expenses incurred by the **Employer** in or for the recovery thereof or the enforcement of this security or otherwise by reason of the default of the Contractor and the Contractor hereby covenants and agrees with the **Employer** to reply and pay the same respectively to him accordingly.

(8) That the Contractor hereby charges all the said materials with the repayment to the Employer of the said sum of Rupees _____ and any further sum of sums advanced as aforesaid and all costs, charges, damages and payable under these presents

PROVIDED ALWAYS and it is hereby agreed and declared that notwithstanding anything in the said agreement and without prejudice to the power contained therein if and whenever the covenant and the money owing shall not be paid in accordance there with the **Employer** may at any time thereafter adopt all of any of the following courses as he may deem best:

(a) Seize and utilize the said materials or any thereof in the completion of the said works on behalf of the contractor in accordance with the provisions in that behalf contained in the said agreement and the amount due to the contractor with the value of work done as if he had carried it out in accordance with the said agreement and at the rates thereby provided. If the balance is against the contractor, he is to pay same to the **Employer** on demand.

(b) Remove and sell by public auction the sized materials or any part thereof and our of the moneys arising from the sale retain all the sums aforesaid repayable or payable to the **Employer** under these presents and pay over the surplus (if any) to the Contractor.

(9) That except in the event of such default on the part of the contractor as aforesaid interest on the said advance shall not be payable.

(10) That in the event of any conflict between the provisions of these presents and the said agreement the provisions of these presents shall prevail and in the event of any dispute of difference arising over the construction of effect of these presents the settlement of which has not been here-in-before expressly provided for the same shall be referred to the Employer whose decision shall be final and the provision of the Indian Arbitration Act for the time being in force shall apply to any such reference.

FORMAT FOR POWER OF ATTORNEY FOR LEAD MEMBER OF CONSORTIUM POWER OF ATTORNEY

(Only applicable for JV/ Consortium)

Whereas the Awarder of India (AWARDER) has invited applications from interested parties for Whereas, the member of the Consortium are interested in bidding for the Project and implementing the Project in accordance with the terms and conditions of the tender document (DNIT) and other connected documents in respect of the Project.

Whereas, it is necessary under the DNIT Document for the members of the Consortium to designate one of them as the Lead Member with all necessary power and authority to do for and on behalf of the Consortium, all acts, deeds and things as may be necessary in connection with the Consortium's bid for the Project.

NOW THIS POWER OF ATTORNEY WITNESSE THAT:

We, M/s. , M/s. and M/s. (the respective names and addresses of the registered office) do hereby designate M/s.(name and address of the registered office) being one of the members of the Consortium, as the Lead Member of the Consortium (name and address of the registered office) being one of the members of the Consortium, to do on behalf of the Consortium, all or any of the acts, deed or things necessary or incidental to the Consortium's bid for the Project, including submission of application / Proposal, participating in conference, responding to queries, submission of information / documents and generally to represent the Consortium in all its dealings with AWARDER, any other Government Agency or any person, in connection with Project until culmination of the process of bidding and thereafter till the Concession Agreement is entered into with AWARDER.

We hereby agree to ratify all acts, deeds and things lawfully done by Lead Member our said attorney pursuant to this Power of Attorney and that all acts, deeds and things done by our aforesaid attorney shall and shall always be deemed to have been done by us.

Dated this the day of[year] (Executants)

(To be executed by all the members of the Consortium) Notes:

• The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executants (s) and when it is so required the same should be under common seal affixed in accordance with the required procedure.

• Also, wherever required, the executants (s) should submit for verification the extract of the charter documents and documents such as a resolution / power of attorney in favor of the Person executing this Power of Attorney for the delegation of power hereunder on behalf of the executants (s)

FORMAT FOR POWER OF ATTORNEY FOR SIGNING OF APPLICATION
(Applicable for all bidders including JV)

(On Stamp paper of relevant value)

POWER OF ATTORNEY Know all men by these presents, we(name and address of the registered office) do hereby constitute, appoint and authorize Mr. / Ms. (name and address of residence) who is presently employed with us and holding the position of as our attorney, to do in our name and on our behalf, all such acts, deeds and things necessary in connection with or incidental to our bid for the project envisaging Bid for _____.at HAFED Mega Food Park, Rohtak including signing and submission of all documents and providing information / responses to HAFED, representing us in all matters before HAFED, and generally dealing with HAFED in all matters in connection with our bid for the said Project.

We hereby agree to ratify all acts, deeds and things lawfully done by our said attorney pursuant to this Power of Attorney and that all acts, deeds and things done by our aforesaid attorney shall and shall always be deemed to have been done by us.

Dated this the Day of ....., …… For _____

(Signature)
(Name, Title and Address)
Signing on behalf of the Bidder/ Lead Member in case of Consortium

Accepted …… (Signature)
(Name, Title and Address of the Attorney)

Agreement Form

Agreement

This agreement, made the _____ day of _____ between _____ (name and address of Employer) [hereinafter called "the Employer"] and _____ (name and address of Contractor) hereinafter called "the Contractor" of the other part.

Whereas the Employer is desirous that the Contractor execute

_____

(name and identification number of Contract) (Hereinafter called "the Works") and the Employer has accepted the Bid by the Contractor for the execution and completion of such Works and the remedying of any defects therein, at a cost of Rs.

_____

NOW THIS AGREEMENT WITNESSTH as follows:

1. In this Agreement, words and expression shall have the same meanings as are respectively assigned to tem in the conditions of contract hereinafter referred to and they shall be deemed to form and be read and construed as part of this Agreement.
2. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy any defects therein conformity in all aspects with the provisions of the contract.
3. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying the defects wherein Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.
4. The following documents shall be deemed to form and be ready and construed as part of this Agreement viz.
   - i) Letter of Acceptance
   - ii) Notice to proceed with the works;
   - iii) Contractor's Bid
   - iv) Condition of Contract : General and Special
   - v) Contract Data
   - vi) Additional condition
   - vii) Drawings
   - viii) Bill of Quantities and
   - ix) Any other documents listed in the Contract Data as forming part of the Contract.

In witnessed whereof the parties there to have caused this Agreement to be executed the day and year first before written.

The Common Seal of _____ was hereunto affixed in the presence of:

Signed, Sealed and Delivered by the said _____
_____

in the presence of :

Binding Signature of Employer _____

Binding Signature of Contractor _____

Witnesses of Employer	Witnesses of Contractor
1	1
2	2

Section-7

BILL OF QUANTITIES/DNIT

Sr. No.	Description	Unit	Estimated Lump-sum Cost (Rs. in Crores)
1	Planning, Design, fabrication, supply and labour job for installation, testing commissioning & trial run of 3 months of grain storage silos system of CAPACITY 2500 MT (1 No SILO-1500 MT, 1 No SILO-1000 MT)complete with cleaning system, collection system and bagging unit with all associated accessories, including Civil MEP Works means all complete on turnkey basis at HAFED Mega Food Park, ROHTAK District, Haryana State	**JOB**	**Rs. 4. 70 Crores**
2	Charges for Annual Maintenance of Three years after expiration of Defect Liability period of electrical and mechanical installations of the entire plant.	**LS**	

Note:

1. The item wise price of goods to be supplied shall be on F.O.R. site basis inclusive of GST, applicable taxes, duties, freight etc. The item wise price shall also include the charges for packing and forwarding, transportation, transit insurance and all other local costs incidental to delivery of the goods to their final destination, storage insurance and safe custody at site.

2. The bidder should submit the bill of quantities/ individual price break-up of each item, clearly mentioning the item description, makes, model nos., quantities, rate, amount, GST and all applicable Tax if any and total price in numbers as well as in words. Failing to submit the individual price break-up in the asked format shall not be taken into account for evaluation and shall not be considered for award.

3. Bidders must quote their prices for all the three parts. In case the bidder omits any part(s), their bid will be considered as incomplete and treated as non-responsive.

4. Individual price break-up of each item shall be finalized by Competent Authority of HAFED for billing purpose.

5. The item wise price of goods to be supplied shall be on FOR site basis inclusive of applicable taxes & duties. The item wise price shall also include the charges for packing and forwarding, transportation, transit insurance and all other local costs incidental to delivery of the goods to their final destination, storage insurance and safe custody at site.
6. In case of discrepancy between unit price and total price, unit price shall prevail.

7. The item wise quoted price should inclusive of service cover/incidental services during defect liability period of 2 years.

FORM FOR PRICE BID

I/We hereby tender for the execution of the works for the Haryana State Cooperative Supply and Marketing Federation Limited (here in after referred to as HAFED) specified in the underwritten memorandum within the time specified in such memorandum.

Single percentage rates are to be quoted in the box specified below in figures as well as in words above/below applicable on Lump cost mentioned as Estimated cost in Tender documents.

We quote our rates _____ (in figures) above/below which will be applicable on the LS Amount provided in DNIT	We quote our rates _____ (in words) above/below which will be applicable on the LS Amount provided in DNIT

And in accordance, in all respects, with the specifications drawings and instructions in writing referred to in Section 1 to 7 of this document and with such materials as are provided by the Implementing Agency in all other respect in accordance with such conditions so far as applicable. The contract shall be divided in two parts (1-SITC Supply Installation Testing and Commissioning, Civil MEP and all Execution works, 2-AMC for three years).

Enter both the rates in figures as well as in words, only in the space provided above. In the event of variation of rate in figures and words, the lower value only shall be considered. Only single percentage on all items of DNIT/BOQ is to be entered. In case more than one percentage is entered, the tender will liable to be rejected.

MEMORANDUM

(a)	General Description	Planning, Design, fabrication, supply and labour job for installation, testing commissioning & trial run of 3 months of grain storage silos system of CAPACITY 2500 MT (1 No SILO-1500 MT, 1 No SILO-1000 MT)complete with cleaning system, collection system and bagging unit with all associated accessories, including Civil MEP Works means all complete on turnkey basis and Annual Maintenance for three years post defect liability period at HAFED Mega Food Park, ROHTAK District, Haryana State
(b)	Estimated Cost	Rs. 470 Lakhs
(c)	Earnest Money	Rs. 4.70 Lakhs
(d)	Security to be deducted	5% of all bills (including earnest money)
(e)	Time allowed for completion of capital work	06 (Six) Months

Signature of Contractor

If, this tender is accepted, I/We hereby agree to abide by and fulfill all the terms and provisions of the said conditions of contract annexed hereto so far as applicable or in default thereof forfeit to and pay to the Federation or its successors in office the sums of money mentioned in the said conditions.

The Bank Guarantee of Rs. _____ lakhs is being submitted as EMD for this Bid, the full value of which is to be absolutely forfeited by the Federation or its successors in office without prejudice to any other rights or remedies of the said Federation or its successors in office, if I/We fail to commence the works specified in the above memorandum or otherwise the Bank Guarantee of Rs. _____ Lakhs shall be retained by the Federation on account of the security deposit. Should I/We withdraw or modify the tender within the period of bid validity, my/our earnest money will stand forfeited to the said Federation.

(Signature of the Contractor)

Price Schedule

(To be filled by the bidder and uploaded along with Price Bid)

Planning, Design, fabrication, supply and labour job for installation, testing commissioning & trial run of 3 months of grain storage silos system of CAPACITY 2500 MT (1 No SILO-1500 MT, 1 No SILO-1000 MT)complete with cleaning system, collection system and bagging unit with all associated accessories, including Civil MEP Works means all complete on turnkey basis and Annual Maintenance for three years post defect liability period at HAFED Mega Food Park, ROHTAK District, Haryana State

Part –I: SITC (Supply Installation, Testing & Commissioning) of Silos Systems and Civil, MEP, Freighting works

S. NO.	ITEM DESCRIPTION	MAKE	MODEL NO.	QUANTITY	RATE	AMOUNT	PACKING FORWARDING	INSURANCE	GST	FREIGHT	TOTAL

Part II: Annual Maintenance of three years after completion of Defect Liability Period

S. NO.	Per Month Cost for 36 months	

Authorized Signatory with official seal

SECTION – 8

Deviation Statement Forms Technical Deviation Statement

(TO BE SUBMITTED AND ATTACHED IN TECHNICAL BID)

Format A: Technical Deviation Statement

(1) The following are the particulars of deviations from the requirements of the tender specifications:

CLAUSE REFERENCE	DEVIATION	JUSTIFICATION	REMARKS

The technical specifications furnished in the bidding document shall prevail over those of any other document forming a part of our bid, except only to the extent of deviations furnished in this statement.

Dated:

Signature and seal ofthe Manufacturer / Bidder

NOTE:

- Where there is no deviation, the statement should be returned duly signed with an endorsement indication **"NO DEVIATIONS"**

FORMAT-B: Bidding Terms Deviation Statement Form

(2) The following are the particulars of deviations from the requirements of the bidding conditions / terms:

CLAUSE REFERENCE	DEVIATION	JUSTIFICATION	REMARKS

Dated:

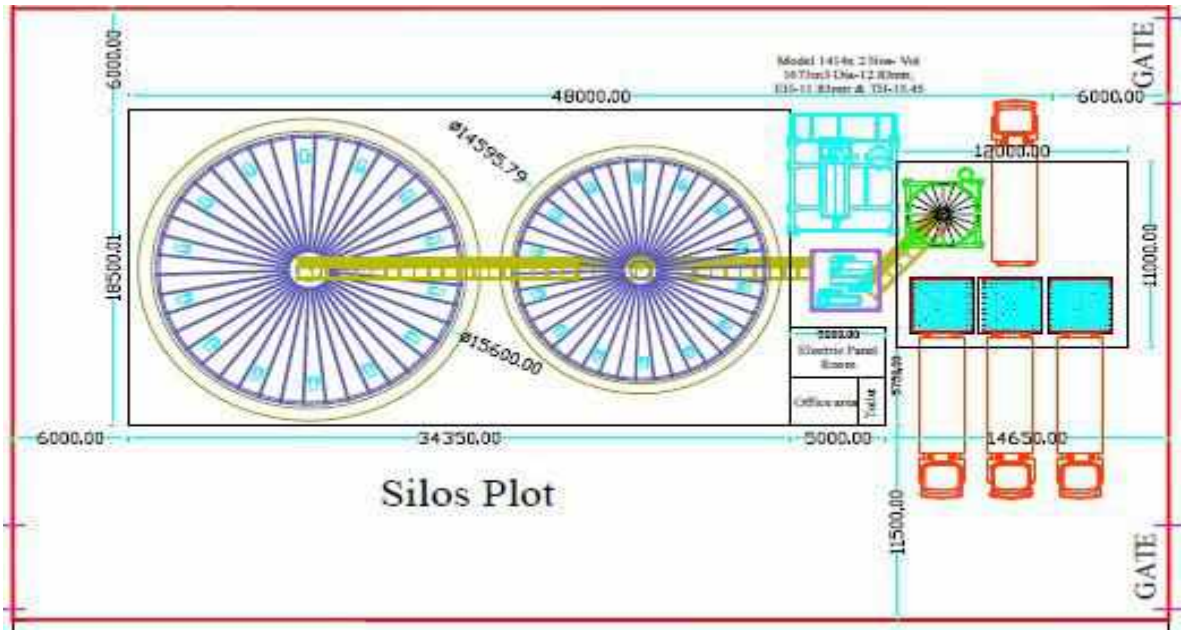
Signature and seal of the

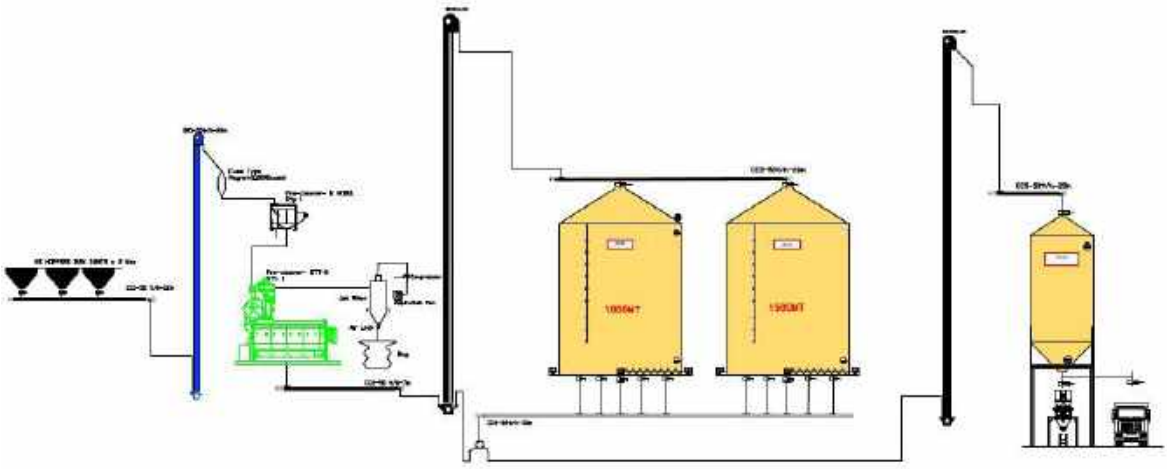
Manufacturer / Bidder

NOTE:

(1) Where there is no deviation, the statement should be returned duly signed with an endorsement indication **"NO DEVIATIONS"**

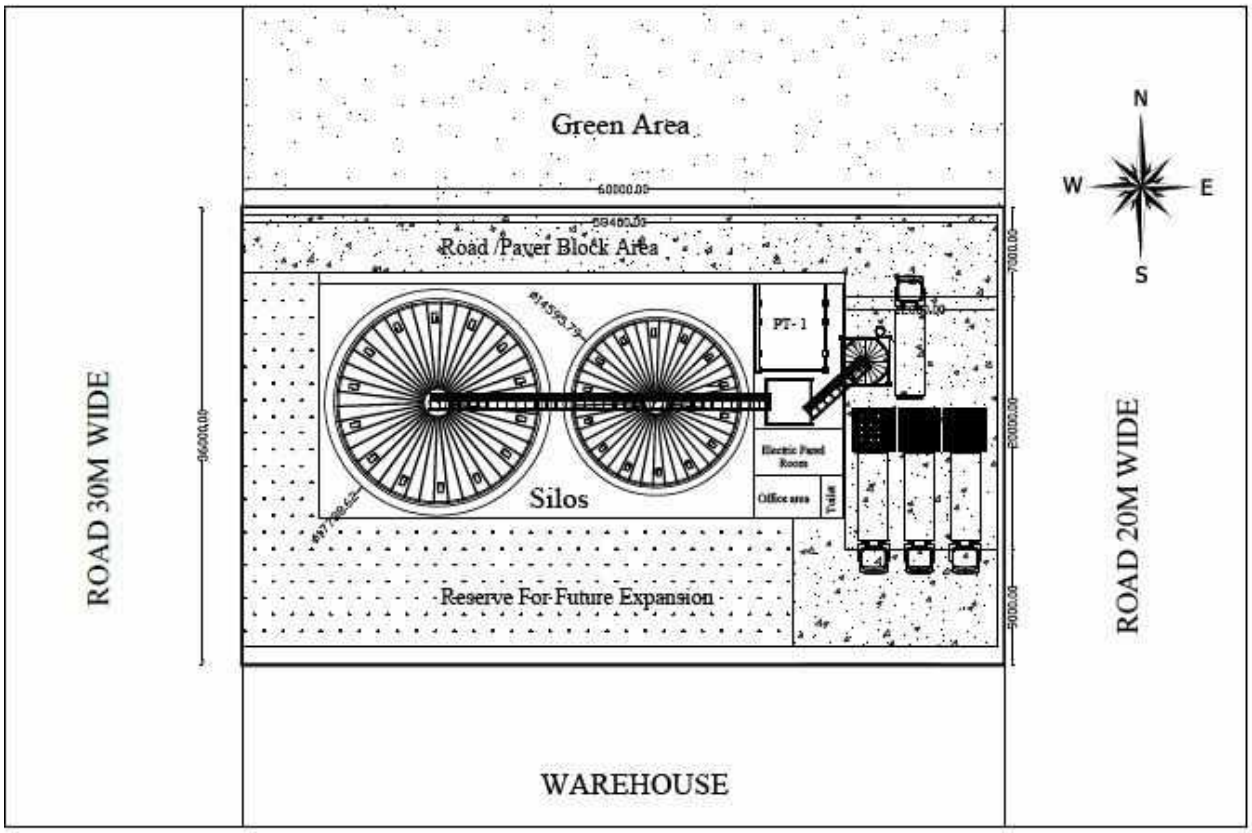
SECTION- 9 (Layout of Plot)





*****Setback is be provided as per industrial norms**

***Drawing file (Autocad) may be obtained through email i.e. hafed@hry.nic.in on request.


Green Area
60000.00
Road /Paver Block Area
PT- 1
Silos
Electric Panel Room
Office area
Toilet
Reserve For Future Expansion
ROAD 30M WIDE
ROAD 20M WIDE
WAREHOUSE
N
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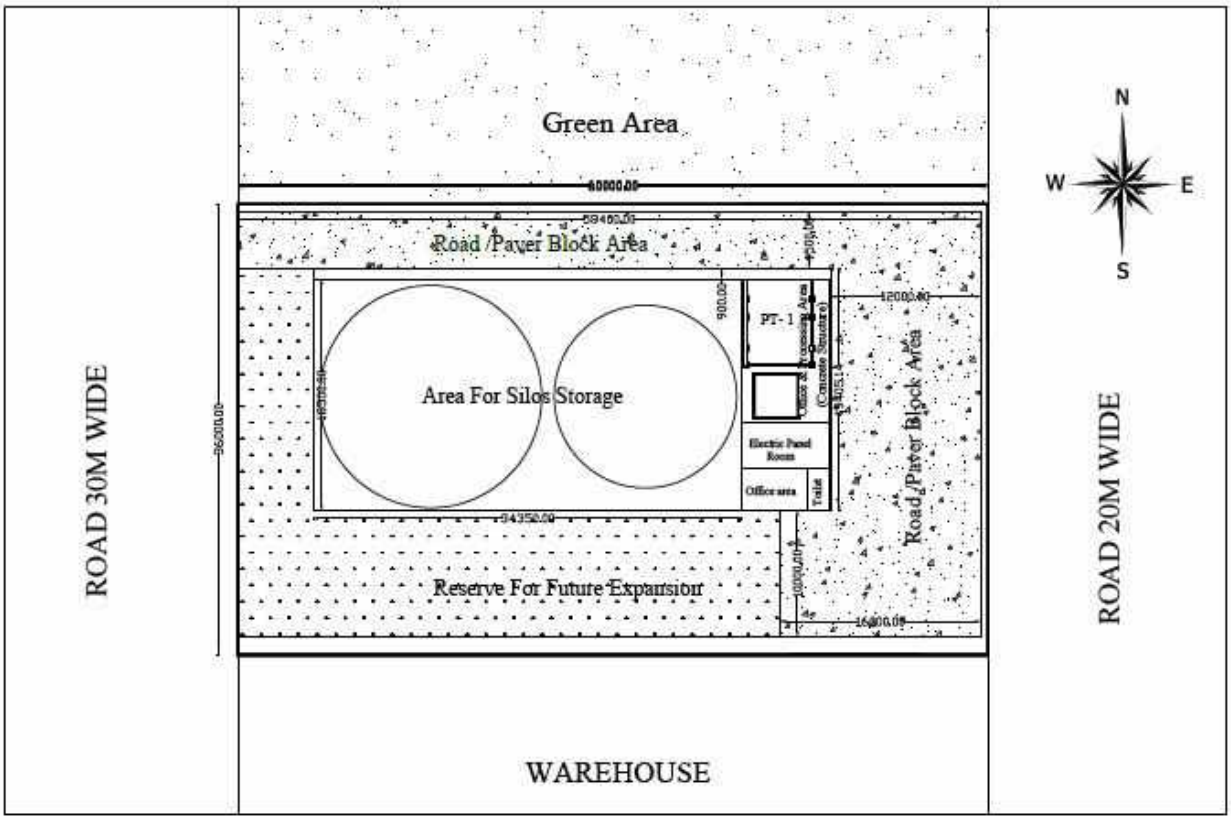
Green Area
Road Paver Block Area
Area For Silos Storage
PT- 1
Electric Panel Room
Office area
Toilet
Road Paver Block Area
Reserve For Future Expansion
ROAD 30M WIDE
ROAD 20M WIDE
WAREHOUSE
N
W
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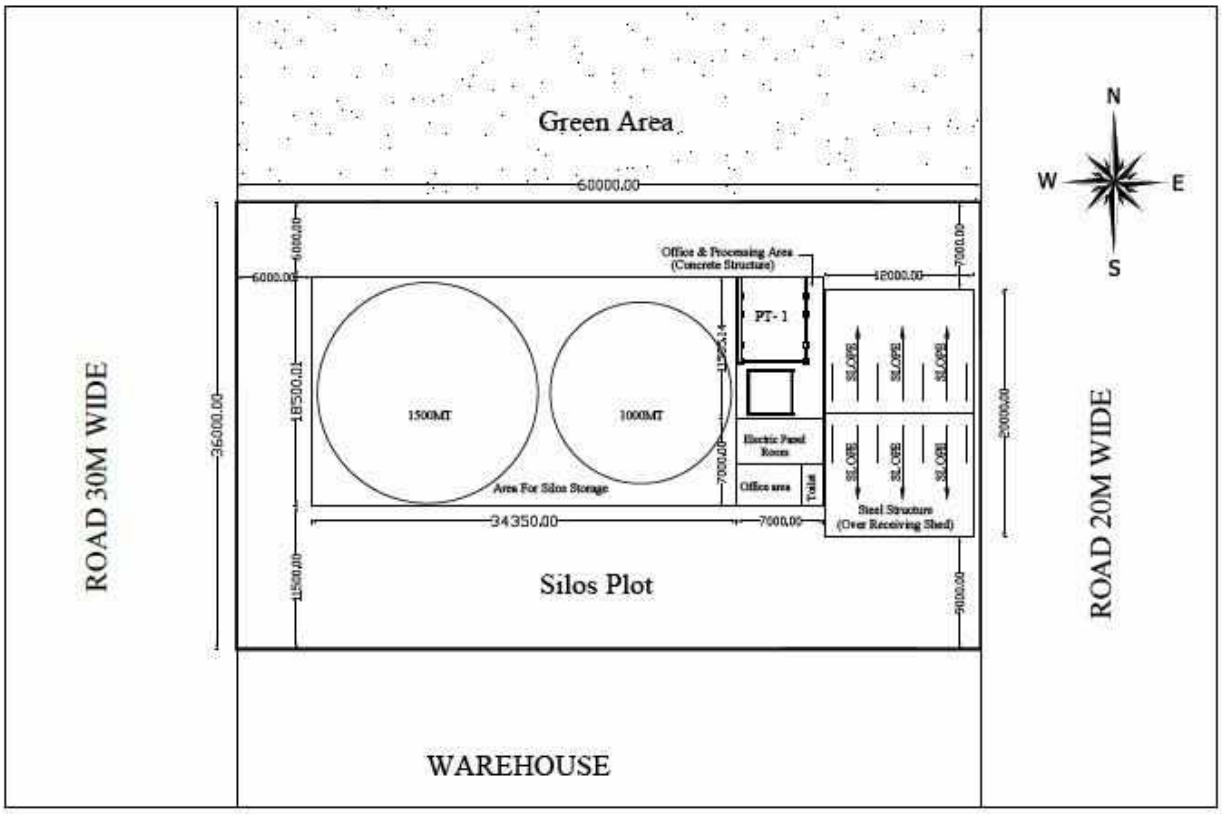
S


Green Area
60000.00
N
W
E
S
ROAD 30M WIDE
ROAD 20M WIDE
Office & Processing Area
(Concrete Structure)
12000.00
7000.00
6000.00
6000.00
PT- 1
35000.00
18500.01
1500MT
1000MT
Area For Silos Storage
Electric Panel Room
Office area
Toilet
34350.00
7000.00
Steel Structure
(Over Receiving Shed)
23000.00
Silos Plot
WAREHOUSE