TECHNICAL SPECIFICATION FOR THE STRUCTURAL WORKS
TECHNICAL SPECIFICATIONS

STRUCTURAL

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Note: All references to the term ‘the owner’ or ‘client’ shall mean “Pashmina”
SECTION 2.1 - EXCAVATION

2.1.0 Site Work

2.1.1 Subsurface Investigation

2.1.1.1 General

Contractor shall be deemed to have visited the site prior to submitting his bid and made all necessary inspection and investigations and to have decided for himself the means of access and working space, the nature of the ground and subsoil, if any, level of water table, extent of rock demolitions, alterations, support of neighboring properties, etc. Soil report is attached for the reference only.

2.1.1.2 Related work

a. Clearing, grubbing and removing all vegetation from the site.
b. Excavation including getting out, and necessary dressing to make surface ready to receive blinding.
c. Filling and back filling and compaction of fills
d. Removal and disposal of surplus material.
e. Stone soling to roads and paving.

The Contractor shall provide all labor, equipment, materials and any incidentals necessary to complete all aspects of work included in the drawings and specifications.

2.1.1.3 Applicable Standards:

The following standards shall be followed:

e. SP27 Handbook of method of measurement of building works.
f. Local Building Regulations and Statutory Regulations.

2.1.1.4 Definitions

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

Grub: The removal of tree stumps and roots.

Topsoil: Topsoil is all surface soils, which have sufficient humus to support plant growth without resort to artificial fertilization.

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

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

Sub-Grade: The finished, trimmed and prepared surface of the earth works after completion of all cut and fills operations. The term 'formation level' or derivatives thereof may be used interchangeably.
Sub-Base: A selected filling layer spread and compacted over the sub-grade to make up levels to the underside of the base course or floor slab.

Base course: A selected filling layer spread and compacted to levels immediately below road wearing course.

Spoil: Excess cut material remaining at the end of filling operations.

Bulk Earthwork: Earthworks to create, by excavation and/or filling and compacting, building platforms, road formations, parking areas, reservoir, embankments, drainage canals or any other formation where the unimpeded use of large earthmoving equipment is possible. This is distinct from backfill of trenches, foundations or other earthworks immediately adjacent to completed or partially completed structures.

2.1.2 Site Preparation

2.1.2.1 Site Inspection - Preamble

Any Site details or site information included in the contract documents or Drawings are provided for the Contractor’s guidance only. The information provided may not be a complete or accurate description of conditions existing below the surface of the ground. The correctness of the information is not guaranteed and the Contractor shall be responsible to make its own interpretation of sub-surface conditions.

The Contractor shall visit the site, examine the boreholes, and decide for himself the nature of the ground and the subsoil to be excavated. No claim for extra payment will be entertained because of any misunderstanding, incorrect information, assumptions, or ignorance of existing conditions.

2.1.2.2 Site Quality Control

The Contractor shall provide in his quality assurance program information to show that a system will be used to ensure that all works carried out under this section (including any done by Sub-Contractor) will comply with all the requirements of this section.

2.1.3 Antiquities

Any ancient carvings, relics, coins or other curiosities discovered during the excavation or other work shall remain the property of the owner and shall be handed over to the owner as required under the General Conditions of Contract.

2.1.4 Setting Out and Clearing of the Site - Scope to Include.

The Contractor shall set out the centre line of the building or other involved works after clearing the site and get the same approved from Project Manager / Professional Team. It shall be the responsibility of the Contractor to install substantial reference marks, bench marks etc and maintain them as long as required by the Project Manager / Professional Team. The Contractor shall assume full responsibility for proper setting out, alignment, elevation and dimension of each and all parts of the work.

2.1.5 Benchmarks and Setting Out

The Contractor shall engage a qualified surveyor to establish permanent benchmarks in suitable locations around the site. These benchmarks shall enable the Contractor to set out the location of all buildings, paths, roads, utility lines, storm water drains and all other portions of the Contract work.
If an error in setting out causes some portion of the work to be constructed in the wrong location, or to the wrong dimensions, the Contractor shall make good the incorrect work at his own expense to the satisfaction of the Project Manager / Professional Team. The Contractor shall be liable for any consequential loss experienced by the Client.

2.1.6 Excavation Classification

a. Excavate foundation from existing ground level to the formation levels shown in drawing.
b. Excavation to pit working level.
c. Earthworks outside property line.
d. Excavation, compaction and backfill to plinth and service trenches.

2.1.6.1 Related Works

a. Site clearance, layout and reparation
b. Dewatering, shoring and strutting.
c. Cast-in-Situ Concrete

2.1.6.2 Blasting /Excavation in Hard Rock

1. When blasting operations are considered necessary, the Contractors shall intimate about the same and shall obtain license from District/Public authorities for carrying out blasting work as well as for obtaining, transporting and storing explosives as per 'Explosive Rules 1940' or as amended. The Contractor shall responsible for safe custody and accounting of explosives.

2. Blasting operations shall be carried out under the supervision of a responsible Licensed operator of the Contractor during certain specified hours preferably during Lunch break on approval in writing.’ The operator shall be conversant with the rules of blasting. The operator should have the valid blasting license.

3. All proper precautions for safety shall be taken. All persons shall be moved to a distance not less than 200 Mts away. All entries to the blasting zone shall be sealed and red flags displayed at prominent places.

4. The Contractor shall be responsible for any accident / death to these working on the site, to the public or to the property due to blasting operations, and that the Contractor shall keep the Client fully indemnified against such accidents / death.

5. The Project Manager / Professional Team shall be informed about all misfires, their causes and the remedial steps taken.

6. The Contractor shall obtain license from District Authorities for undertaking blasting work and explosive storing as per Explosives Rules. 1940, and as updated Explosives shall only be procured from an authorized dealer. He shall be responsible for the safe custody and proper accounting of explosives. The Project Manager / Professional Team shall have access to the store.

2.1.6.3 Classification of Soil / Rocks:

Soils: Material such as sand, gravel, loam, clay, mud, black cotton, moorum, shingle, river or nallah bed boulders, disintegrated rock, soling of roads, paths, hardcore, macadam surface of any description (water bound, routed
tarmac etc.) lime concrete mud concrete or any combination of these. This class of material will yield to the application of picks, shovels, or any other manual digging implements.

Ordinary Rock: Material such as limestone, sandstone, laterite, hard conglomerate. This is any material that will not yield to manual implements, but is capable of being excavated by conventional earthmoving plant applicable to the site and the distances that material has to be moved. The use of a pusher unit or small crawler tractor with ripper to facilitate excavation shall be considered as part of conventional plant.

The Contractor may with the written permission of the Project Manager / Professional Team resort to a small amount of blasting to loosen any of this material but this action will not in any way entitle the material to be classified as ‘Hard Rock’.

Hard Rock: Any rock or boulder the excavation of which requires blasting. Such materials include quartzite, granite, basalt, reinforced cement concrete (reinforcement to be cut through but not separated from concrete) located below ground level.

Hard Rock (blasting prohibited):
Hard rock as described at c) above but where the blasting is prohibited for any reason and excavation has to be carried out by chiseling. Wedging or any other method agreed to by the Project Manager / Professional Team.

2.1.6.4 Classification of Soils - Scope to Include:

Excavation in all types of soil comprising any of the following:

- Vegetable or organic soil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose moorum.
- Any mixture of soils in above.
- Mud concrete below ground level.
- Generally any material that yields to the ordinary application of excavation equipment.
- Stiff heavy clay, hard shale, or compacted moorum requiring close application of excavation equipment.
- Soft rock
- Gravel and cobblestone usually rounded, having maximum dimension in one direction of 300mm.

2.1.7 Method of Excavation - Scope to Include:

If the excavation is carried out to a greater depth than specified, extra depth shall be made up by filling with lean concrete in a ratio of 1:4:8 (1 cement: 4 coarse sand: 8 stone graded aggregate of 40 mm size) as directed by the Project Manager / Professional Team. The cost of such extra excavation and of the filling therein as specified shall be borne by the Contractor. No extra claims whatsoever will be entertained in this regard. The bottom of excavation shall be trimmed, leveled, rammed and sides dressed and trimmed in accordance with the drawings/directions of the Project Manager / Professional Team. The Contractor shall ensure that excavation is to be carried out as indicated on the drawings with sufficient working space to permit erection of forms, shoring, inspection of foundations and any other activity likely to be carried out below ground level. All ramps for excavation except one will be cleared before completion (unless specifically noted otherwise) and made good before final completion. No concrete shall be placed in foundation until the Contractor has achieved Project...
Manager / Professional Team’s approval that a secure foundation has been prepared.

The Contractor shall ensure proper methods are adopted to control the creation of Dust. Method adopted shall be approved by the Project Manager / Professional Team.

2.1.8 Excavation and Preparation for Concreting:

Excavation shall include removal of all materials of whatever nature at all depths and whether wet or dry necessary for the construction foundation and substructure (including mass excavation for underground reservoir where applicable) exactly in accordance with lines, levels grades and curves shown in the drawing or as directed by the Project Manager / Professional Team. The bottom of excavation shall be leveled both longitudinally and transversely or sloped as directed by the Project Manager / Professional Team.

Should the Contractor excavate to a greater depth or width than shown on the drawings or as directed by the Project Manager / Professional Team he shall at his own expense fill the extra depth or width in cement concrete in proportion as directed by the Project Manager / Professional Team but in no case with concrete of mix leaner than 1:4:8 cement concrete.

The Contractor shall report to the Project Manager / Professional Team when the excavations are ready to receive concrete. No concrete shall be placed in foundations until the Contractor has obtained Project Manager / Professional Team approval in case, the excavation is done through different strata of soil and if the same is payable as per provision in the Schedule of Quantities the Contractor shall get the dimensions of the strata decided by the Project Manager / Professional Team for payment. If no specific provisions are made in the Schedule of Quantities it will be presumed that excavation shall be in all types of soil and other material and the Contractor’s rate shall cover for the same.

After the excavation is passed by the Project Manager / Professional Team and before laying the concrete, the Contractor shall get the depth and dimensions of excavation and levels (and nature of strata as applicable as per Schedule of Quantities like hard rock, soft rock etc) and measurements recorded from the Project Manager / Professional Team. Excavated pit should have adequate clearance from the face of concrete at all faces to have adequate working space.

2.1.9 Stacking of Excavated Materials:

All materials excavated will remain the property of the Project Manager / Professional Team and rate for excavation including sorting out of useful materials and stacking them on site as directed but with a safe distance from the edge of excavation to avoid collapse/shielding of excavated area. Materials suitable and useful for back filling, plinth filling or leveling of the plot or other use shall be stacked in convenient place but not in such a way as to obstruct free movement of men, animals and vehicles or encroach on the area required for constructional purposes.

2.1.10 Disposal / Carting of Surplus Earth - Scope to Include:

Top layer of hard soil free from vegetation, spoils, rocks, boulders for a quantity of approximately 15% of the total excavated earth quantity shall be stocked at locations as directed by the Project Manager / Professional Team for re-use up to a distance of 300m from the periphery of the buildings. The remaining excavated earth, except for the hard rock excavated, shall be disposed off including lifting out, transportation to locations approved by local bodies, Government agencies or as directed by the Project Manager / Professional Team, as the case may be.
The Contractor is responsible for finding suitable dumping yard and for the removal of all sub grade obstructions, whether indicated or not, wherever it is likely to interfere with execution and completion of the Project is deemed to be included in its Scope.

All surplus and unusable earth shall be carted out and disposed off outside the Site but at a location approved by local authority and confirming to their specifications. The Contractor shall quote its rate for disposing off or carting away the item considering requirements and standards of the local authority with whose permission surplus and unusable earth shall have to be disposed off.

2.1.11 Dewatering:

Rate for excavation shall include bailing or pumping out which may accumulate in the excavation during the progress of work either from seepage, rain water or any other cause and for diverting surface flow, if any by bunds or other means. Pumping out water shall be done in such approved manner as to preclude the possibility of any damage to the foundation trench, concrete or masonry or any adjacent structure inside or outside the wall front. When water is met in foundation trenches or in tank excavation, pumping out water shall be from auxiliary pit of adequate size dug slightly outside the building excavations. The depth of auxiliary pit shall be more than the working foundation trenches / levels. The auxiliary pit shall be refilled with approved excavated materials after the dewatering is over.

The Contractor shall adopt an appropriate method of dewatering work and shall submit its proposal for carrying out the dewatering work for the approval of the Project Manager / Professional Team. The water shall be pumped continuously to keep the water level at a minimum of two 2’ (feet) below the lowest point of excavation level. The operation shall be continued until the entire excavation has been completed so as to ensure the excavation is always dry.

Adequate number of pumps shall be deployed to ensure a continuous dewatering process.

Power / Fuel required for the operation of pumps etc shall be provided and paid for by the Contractor.

Softening of the bottom of excavation will not be allowed. If softening occurs due to weather or any other source, the Contractor shall remove the affected area and replace as specified and directed by the Project Manager / Professional Team at no extra cost.

Necessary grading, trenching and temporary sumps shall be made around excavations as required to prevent water runoff into excavation and to ensure proper protection to slopes from erosion.

The excavation shall be kept free from water:-

a) During inspection

b) From start to completion of concreting till they come above existing ground.

c) Till the Project Manager/Professional Team considers that the concrete is sufficiently set.

d) Till the underground reservoir is tested for water tightness.

2.1.12 Shoring and Strutting - Scope to Include:

The Contractor shall uphold the faces of excavation work to retain the earth, if required, at
locations where considered necessary. Shoring and strutting shall be erected depending on
Nature of soil and the work. The arrangement of shoring and strutting including sizes and
spacing of member used shall be approved by the Project Manager /Structural
consultants/ Professional Team. All such necessary work, including but not limited to making
/ preserving / maintaining adequate slopes, necessary precautions, etc for ensuring safety
of workmen below natural ground level shall be the responsibility of the Contractor. No
extra charges shall be admissible on this account. Similarly the Contractor shall be responsible
to protect the bottom of excavation from weather.

2.1.13 Protection - Scope to include:

The excavated area shall be surrounded by strong barricaded safety barriers made of
wooden posts three to four (3 to 4) inches in diameter and cross planks/ runners shall be
erected to a height of 1.2m all around the excavation with reflective tapes and necessary
lighting at night all as shown on drawings. The Contractor shall take all necessary measures for
the safety of the excavation, persons working, tools and plants working in and near the
excavation pits, property and people in the vicinity.

Protection and maintenance of all bench marks axis points and other similar reference points
if disturbed and/ or damaged, to be replaced by the Contractor at no extra cost
to the Developer.

Location of existing utility lines; if shown on the drawings, is only approximate and only for
interpretation. The Contractor shall be responsible of their protection during the duration
of the contract without causing any damage, dislocation, injury and/ or interruption to
these utility services. If so, to be replaced/ restored to their original status at the
Contractor's own cost.

All the temporary roads, constructions etc shall be made and maintained according to
the provisions of this contract and as per the instructions of the Project Manager /
Professional Team upon the completion of this contract, the Contractor shall remove
after getting the approval from the Project Manager / Professional Team all such
temporary roads, structures, etc. and restore the area in its original condition without any
extra cost.

2.1.14 Earthwork - Fills

2.1.14.1 General filling:

1. Deposit in horizontal layers not exceeding 300 mm thick before compaction.
2. Where material is dry, wet each layer to its optimum moisture content for
compaction purposes.
3. Where material is wet, delay compaction and placement of additional fill until
optimum moisture content is attained.

2.1.14.2 Structural filling:

1. Deposit in horizontal layers not exceeding 200 mm thick before compaction.
2. Each layer shall be uniformly moist and at the optimum moisture content for
compaction purposes.

2.1.14.3 Crushed stone:

1. Deposit in horizontal layers not exceeding 200 mm thick.
2. Deposit material so that it is free from lenses, pockets, streaks and other
imperfections.
3. Consolidate using hand tamping, vibratory tampers or other approved
2.1.14.4 Testing of fill materials:

i. Tests shall be executed by an independent testing agency. ii. In executing tests comply with the following IS Standards:

   a. Sampling  
   b. Sample preparation  
   c. Sieve analysis  
   d. Liquid limits  
   e. Plastic limit and plasticity index  
   f. Moisture content  
   g. Moisture density relationship  
   h. Sand equivalent  
   i. Specific gravity  
   j. Sand core density  
   k. Rubber balloon density  
   l. Classification

iii. Carry out moisture density tests on representative samples prior to placing. iv. Carry out gradation of materials prior to placing as the work proceeds.  
v. Carry out site density tests of materials as the work proceeds and as follows:

2.1.14.5 Frequency of Tests

**Structural Fill:**

a. One test whenever there is a change of gradation or placement conditions.  
b. One test for every 150mm thick compacted layer at every 505qm area

**General Fill:**

a. One test for each 3000 Cum. placed.  
b. One test whenever there is a change of gradation or placement conditions.  
c. Execute site density tests for compaction at a minimum depth of 100 mm below compacted surface.  
d. Execute a full compaction test or a one-point compaction test in conjunction with each site density determination.  
e. Execute a gradation test with each site density test and whenever there is an apparent change in material being placed.  
f. Execute the following site density tests and laboratory moisture density tests to evaluate compaction achieved:
   (i.) One test for every 200-400 cum. of backfill in trenches or surrounding structures.  
   (ii.) One test for every full shift of compaction operations on mass earthwork.

2.1.14.6 General and Structural Fill:

- To conform to gradation of well graded soil.  
- To be free from plastic fines and weakly elemented lumps of sand.  
- To be homogeneous and at the optimum moisture content for compaction purposes when placed.
2.1.14.7 Crushed stone:

To consist of either:
- Durable crushed rock comprising angular fragments obtained by breaking and crushing solid or shattered natural rock, -OR-
  Durable crushed gravel stone obtained by artificial crushing of gravel, boulders, or fieldstone.
- Rubble soling 20 cm in height consisting of random granite stone/ available laterite stone including filling in voids with durable crushed rock comprising angular fragments and consolidating with mechanical ramming.

2.1.14.8 Water

Water used for compacting fill or for washing crushed stone shall be clean and free from oil, grease, organic matter, suspended sediments and other deleterious substances.

2.1.14.9 Adjacent excavations:

Where an excavation encroaches below a line drawn at an angle of 60 Deg. from the horizontal from the nearest formation level of another higher excavation, the lower excavation, all work within it and backfilling thereto shall be completed before the higher excavation is done.

2.1.14.10 Excavated formations:

a. In made up ground excavate foundations down to a natural bearing formation of undisturbed subsoil, unless otherwise instructed.
b. Obtain instructions if a natural bearing formation of undisturbed subsoil:
   - Is obtained at a lesser depth than shown on the Drawings.
   - Is not obtained at the depth shown on the drawings.
c. If, after inspection, formation becomes unsuitable for any reason, excavate further and backfill with approved material all at the Contractor's expense.

2.1.14.11 Treatment of formations generally:

a. Trim excavations to required profiles and levels.
b. Remove all loose material.

2.1.14.12 Excess excavation:

a. Backfill any excavations taken wider or deeper than required with mass concrete.
b. Where such excess excavation is carried out without approval, necessary extra backfilling shall be at the Contractor's expense.

2.1.14.13 Proof Rolling under Fill Embankments

After removal of topsoil, the existing natural ground that will be under fill embankments shall be scarified to a depth of not less than 150 mm and compacted so that the criteria called for on the specification are met.

2.1.14.14 Compaction Requirement

The required compaction of fills which are deemed to be part of bulk earthworks shall be achieved by a minimum number of passes of compaction plant. This plant shall unless the Project Manager / Professional Team specifically allows in writing, include type:
a. For primary compaction, and may include either or both types.
b. Of the following listed types for the final compaction of the surface.

1. Vibratory roller of either double or single vibrating drum of not more than 3.2 tonne mass per meter of roll width having a vibration frequency of not less than 37 Hz. Vibrating roller not exceeding the above weight limit but of frequency less than 37 Hz. are approved providing the nominal amplitude does not exceed that shown relative to the weight in tones per meter roll width in figure 1 any other vibrating roller specifically approved by the Project manager. Vibrating rollers of less than 1 tonne per meter of roll width shall not be used to compact any layer of fill of more than 175mm of un-compacted thickness.

2. Three-wheel steel- tired rollers having rear rolls each at least 0.50m wide and having not less than 4.5 tonne per meter of roll width.

3. Pneumatic tyred roller having a minimum weight when operating of not less than seven tonne, spread over at least seven pneumatic tyred wheels.

![Figure 1](image)

For filling in inaccessible places or against structures, hand tamping or small vibratory compaction equipment may be used with the approval of the Project Manager / Professional Team.

Care must be taken during compaction to ensure that no gaps are formed between adjacent layers.

Fill material shall be compacted to attain the densities as called for in the specifications.

As filling proceeds, test to verify the compaction being achieved shall be conducted. Tests shall be done at a minimum frequency no less than one test per 150 cum. of fill volume. Testing locations shall be distributed evenly throughout the fill volume and each layer area. The locations shall be to the satisfaction of the Project Manager / Professional Team and copies of the results of all tests shall be submitted to them whether successful or not.

In the event that tests do not verify the minimum compaction requirements, the whole of the area for which the test is representative shall be reworked and retested, unless otherwise directed by the Project Manager / Professional Team.
Where the Project Manager / Professional Team are of the opinion that a specific area within an embankment cannot compact to the specified density, he shall order alternative improvement works.

The following references shall be used to confirm compliance:

Sampling: BS 5930 (or as updated), IS 2720
Field Dry Density: BS 1377: 1975 Clause 4.4 Test 15 (or as updated)
"Determination of the dry density of soil on the site - Sand replacement test"
Standard Maximum: BS 1377: 1975 Clause 4.1 Test 12 (or as updated)
Dry Density: "Determination of dry density / moisture content relationship" using 2. Kg rammer
Moisture Content: BS 1377: 1975 Clause 2.1 Test 1 (or as updated)
"Determination of the moisture content - Standard"

1. Remove all suitable and excess material from areas to be filled.
2. Surface of ground with a gradient exceeding 1 in 5, which is to receive filling must have horizontal benches cut to match the depths of compacted layers of filling.
3. Do not place fill until the formation has been inspected by the Project Manager / Professional Team. Give the Project Manager / Professional Team at least 24 hour's notice of when formations will be ready for inspection.

Compact filling after grading and leveling surfaces. Compact filling in layers, adding any necessary extra fill and water, to attain the minimum dry densities as tabulated in the table appended at the end of this Section.

Backfilling and compaction shall be undertaken under full-time presence of the Contractor's Supervisor, and each layer shall be got checked by the Project Manager / Professional Team. Further layers are not to be placed without the approval of the Project Manager / Professional Team.

Compact filling using vibratory plate, roller or other approved (mechanical) equipment, making the required number of passes with the equipment to obtain specified densities. Each trip of equipment shall overlap the previous trip by 500mm.

If selected earth kept aside as per the provisions of the Clause 2.110 is not sufficient for the back filling, the Contractor, with its own cost, shall bring in good quality earth, moorum etc. from borrow pits, either approved at the site and/or elsewhere by the Project Manager / Professional Team. The cost of developing and reinstating the same after use as per the directions of the Project Manager / Professional Team and/or local laws prevailing for such borrow pits, loading, transporting and re-handling of earth/moorum etc. deemed to have been included in its Scope by the Contractor.

The Contractor at its own cost shall rectify and/or restore the damage(s) occurred due to improper backfill and compaction done by it.

If any settlement occurs due to improper backfill and compaction and/or cracks developing in the sub-structure/super structure works due to the same, the Contractor shall make good its damages/defects at no extra cost to the Developer.

The Contractor at its own cost protect by bracing the basement walls till the proper back filling and compaction are completed with the satisfaction of the Project Manager / Professional Team and complying with the conditions of the Contract and Technical Specifications. The Contractor shall also undertake and execute the patching of the basement wall after removal of such bracing at no extra cost.
All the back filling and compaction works shall be of acceptable standard to both the Project Manager / Professional Team.

The Contractor shall include in its Scope the cost of removal of debris/rubbish etc. from the bottom of the basement wall prior to back filling.

Schedule:
Curve No. 1: To be referred.
Table for compaction requirements

<table>
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<th>Fill Materials</th>
<th>Min. Passes</th>
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<th>Min. Compaction</th>
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<td>Open spaces</td>
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<td>4450 Kg</td>
<td>95%</td>
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<tr>
<td>Crushed stone:</td>
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<tr>
<td>Confined spaces</td>
<td>4</td>
<td>1150 Kg</td>
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<tr>
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<tr>
<td>Catch</td>
<td>3</td>
<td>4450 Kg</td>
<td>95%</td>
</tr>
</tbody>
</table>

Notes:

1. Forces applied for compaction shall be dynamic or impact loads.
2. Specified percentages of compaction shall be related to the maximum dry density at the optimum moisture content as established by and verified on site by.
3. Correct field density to account for stone material larger than 19 mm in accordance with suggested methods.

2.1.15 Excavation items - Scope to include:

Apart from other factors mentioned elsewhere in this contract, Scope for the item of excavation shall also include for the following:

i) Clearing site.

ii) Setting out works as required.

iii) Providing shoring and shuttering to avoid sliding of soil and to protect adjacent structures and subsequently by removing the same.

iv) Collection of excavated spoil and sorting out useful excavated materials and conveying beyond the structure and stacking them neatly on the site for back filling or re-use as directed.

v) Bailing and pumping out water as required and directed.

vi) Excavation at all depth (unless otherwise specified in the Schedule of Quantities) and removal of all materials of whatever nature wet or dry and necessary for the construction of foundation underground reservoir etc and preparing bed for laying concrete.

vii) Necessary protection including labor, materials, and equipment to ensure safety and protection against risk or accident.

viii) Drilling of small holes as directed to explore the nature of substratum if necessary.

2.1.16 Backfilling item - Scope to include
Apart from other factors mentioned elsewhere in this contract, Scope for the item of backfilling item of work shall also include for the following:

i) Backfilling the trenches alongside masonry or concrete with approved excavated materials up to the natural ground level in layers as specified including watering and ramming.

ii) Earth filling in plinth: If there is approved surplus earth after backfilling the sides of excavations, the same will be used for plinth filling if required. Any additional approved earth if required for plinth filling the same shall be brought on the site, by the Contractor from outside. No borrow pits shall be opened on the site; Filling in plinth shall be done in layers of 15cm thick; each layer being consolidated by ramming and watering. The payment of back filling item shall be made on measurement of finished consolidated quantity.

2.1.17 Soling used as sub-base

2.1.17.1 Location

Soling shall be constructed under floors and other areas where shown n the drawings.

2.1.17.2 Soling Materials

The size of stones to used soling shall not be more than 120mm, nor less than 50 mm when measured in any direction, and their height shall be equal to the proposed soling course depth of 75mm +/-25mm.

2.1.17.3 Preparation of the Sub-grade before laying soling

The top level of the sub-grade shall be lower than the level of the underside of the floor or other structure, to be built over it, by a distance equal to the combine depth of soling and metalling (due allowance being made for consolidation). The depth of the soling shall be 75mm but to achieve this finished depth, an initial loose layer of approximately 100mm will be necessary.

2.1.17.4 Laying and packing the soling stones

A layer of sand or small size gravel 50mm thick shall be spread and consolidated on the sub-grade surface prepared

The stones for soling shall be of a height equal to the required thickness of soling. Their length or breadth shall not be greater than twice the soling thickness. This means that the stones would pass through a ring 180mm in diameter but not a ring 100mm in diameter.

Soling stone shall be hand packed as close as possible with their broadest side downward and greatest length across the road. Gauge pegs shall be driven at close intervals to indicate the required thickness of the soling. The joints between stones shall be placed at the edges of the area to be covered. All interstices between stones shall be wedged in with smaller stones, well driven into achieve tight packing and complete filling of the interstices.

2.1.17.5 Consolidation of the soling

The soling shall be thoroughly consolidated with mechanical rollers of 8 to 10 tonne weight starting at the edges and working towards the center. If the soling is to have a cross fall the rolling shall commence at the lowest edge and work over and up to the upper edge. Rollers shall pass over the same surface at least 8 times to ensure that the soling is well consolidated. The top surface shall be checked frequently to make sure that it conforms to
the design grade and level.

Vibratory compactors may be used, if approved by the Project Manager / Professional Team instead of mechanical rollers. For areas where access is difficult or restricted heavy hand rammers and hand rollers may be used if approval for this has been obtained from the Project Manager / Professional Team.
SECTION 2.2 - CAST IN-SITU CONCRETE

2.2.1 Related Work

a. Concrete Formwork
b. Concrete
Reinforcement c. Concrete Finishing
d. Sealants

2.2.1.a Applicable Standards

<table>
<thead>
<tr>
<th>IS</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS - 299</td>
<td>Specification for Ordinary, rapid hardening and low heat Portland Cement</td>
</tr>
<tr>
<td>IS - 455</td>
<td>Specification for Portland blast furnace slag Cement</td>
</tr>
<tr>
<td>IS - 1489</td>
<td>Specification for Portland pozzolona Cement</td>
</tr>
<tr>
<td>IS - 4031</td>
<td>Method of physical tests for hydraulic Cement</td>
</tr>
<tr>
<td>IS - 650</td>
<td>Specification for Standard sand for testing of Cement</td>
</tr>
<tr>
<td>IS - 383</td>
<td>Specification for Coarse and Fine aggregate for use in mass concrete</td>
</tr>
<tr>
<td>IS - 515</td>
<td>Specification for natural and manufactured aggregate for use in mass concrete</td>
</tr>
<tr>
<td>IS - 2387</td>
<td>Method of test for aggregates for concrete.</td>
</tr>
<tr>
<td>IS - 516</td>
<td>Methods of test for strength of concrete</td>
</tr>
<tr>
<td>IS - 1199</td>
<td>Methods of sampling and analysis of concrete</td>
</tr>
<tr>
<td>IS - 3025</td>
<td>Methods of sampling and test (physical and chemical) for water used in industry</td>
</tr>
<tr>
<td>IS - 2645</td>
<td>Specification for integral cement water proofing compounds</td>
</tr>
<tr>
<td>IS - 1791</td>
<td>Specification for batch type concrete mixers</td>
</tr>
<tr>
<td>IS - 2438</td>
<td>Specification for roller pan mixer</td>
</tr>
<tr>
<td>IS - 2505</td>
<td>Specification for concrete vibrators, immersion type</td>
</tr>
<tr>
<td>IS - 2506</td>
<td>Specification for screed board concrete vibrator</td>
</tr>
<tr>
<td>IS - 2514</td>
<td>Specification for concrete vibrating tables</td>
</tr>
<tr>
<td>IS - 3344</td>
<td>Specification for pan vibrators</td>
</tr>
<tr>
<td>IS - 4656</td>
<td>Specification for form vibrators</td>
</tr>
<tr>
<td>IS - 2722</td>
<td>Specification for portable swing weigh batchers for concrete (single &amp; double bucket type)</td>
</tr>
<tr>
<td>IS - 456</td>
<td>Code of practice for plain and reinforced concrete</td>
</tr>
<tr>
<td>IS - 1343</td>
<td>Code of practice for pre-stressed concrete</td>
</tr>
<tr>
<td>IS - 457</td>
<td>Code of practice for general construction of plain and reinforced concrete for</td>
</tr>
<tr>
<td>IS - 3370</td>
<td>Code of practice for concrete (Part I to IV structures for storage of liquids</td>
</tr>
<tr>
<td>IS - 3935</td>
<td>Code of practice for composite construction</td>
</tr>
<tr>
<td>IS - 3201</td>
<td>Criteria for design and construction of pre-cast concrete trusses.</td>
</tr>
<tr>
<td>IS - 2210</td>
<td>Criteria for the design of R.C. shell structures and folded plates.</td>
</tr>
<tr>
<td>IS - 3558</td>
<td>Code of practice for use of immersion vibrators for consolidating concrete</td>
</tr>
<tr>
<td>IS - 3414</td>
<td>Code of practice for design and installation of joints in buildings</td>
</tr>
<tr>
<td>IS - 2571</td>
<td>Code of practice for laying in-situ cement concrete flooring</td>
</tr>
<tr>
<td>IS - 12269</td>
<td>Code of practice for 53 grade cement</td>
</tr>
</tbody>
</table>

2.2.2 Definitions

a. Water / Cement Ratio:

The ratio by weight of water to cement in a mix expressed as a decimal fraction. Water being that which is free to combine with cement, including free water in aggregate, but excluding that for arriving at the ratio.
b. **Hot Weather:**

Shade air temperature of 37°C and higher.

2.2.3 Quality Assurance

a. Supervising staff shall have qualifications and experience specified in the contract.
b. The following tests shall be carried out by the approved agency:
   i. Testing preliminary test cubes;
   ii. Testing work test cubes;
   iii. Testing in situ concrete at site by hammer test, ultrasonic tests and core tests.
c. Standards:

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

i. IS 456: 2000 - Specifications for plain and reinforced concrete.
ii. IS 269:1976 or latest amendment - Specifications for ordinary and low heat Portland cement.

2.2.4 Submittals

**Samples:**
Slide bearings

2.2.5 Materials

2.2.5.1 Quality

All materials used in the works shall be of best quality of their respective kind as specified herein, obtained from suppliers and sources approved by the Structural and shall comply strictly to tests instructed by the Project Manager / Professional Team, and where tests are not laid out, with the requirements of the latest issue of the relevant Indian Standard.

2.2.5.2 Test Certificate

All manufacturer's test certificates, proof sheets, etc showing that the materials have been tested in accordance with the requirements of the specification and of the approved Indian Standard(s) are to be supplied free of charge on request to the Project Manager / Professional Team.

2.2.5.3 Cement

Cement shall be of Portland type and shall comply of IS: 269 and IS - 12269. The cement used shall be of approved manufacture and the sources of supply shall not be changed without approval of the Project Manager / Professional Team.

It shall be received in bags of 50 kg each confirming to IS 2580-1982 IS 11652-1986 or IS-11633-1986 or IS-12174-1987. The bags shall be marked with the manufacturer's name or its registered trademark, if any, type of cement and grade legibly and each batch shall be accompanied by a Test Certificate from the factory.

Samples shall be taken immediately on receipt of cement at about one sample per 1000 bags. Tests shall be carried out on fineness, initial and final setting time and compressive strength as per IS: 4031 and result verified by the Project Manager / Professional Team before use in the permanent works. Samples shall be taken immediately on receipt of cement at site. Sampling shall be as per IS 3535.
Stacking and Storage of Cement

Cement shall be stored in such location so as to prevent deterioration due to moisture. A dry and waterproof shed designated, as “cement go down” shall be best suited for this. Bags shall be stacked on rigid waterproof platforms about 15 to 20 cm clear above the floor. Flooring of the shed shall consist of the two layers of dry bricks laid on a well-consolidated earth to avoid contact of cement bags with the floor. It shall also be 35 to 45 cm clear from the surrounding walls. A maximum high stack of Ten (10) bags is permitted. The bags shall be arranged in header and stretcher fashion. Stacks shall be so arranged that the first batches are used first, and so that they permit easy access for inspection and handling.

The size and dimensions of the cement go down shall got to be approved, before its construction, from the Project Manager / Professional Team.

For extra safety during monsoon, or when cement is expected to be stored for an unusually long period, each stack shall be completely enclosed by a waterproofing membrane, such as polyethylene which shall cover the top of the stack. Care shall be taken to see that the stored cement is not damaged at any time during the use.

Storage of the cement at the Site shall be at the Contractor’s expense and risk. Any damage occurring to cement due to faulty storage in the cement go down or on account of negligence on its part, shall be the liability of the Contractor.

2.2.5.4 Aggregate

a. To be crushed naturally occurring materials conforming to IS: 383-1970. All physical properties and grading parameters must conform to this code.
b. Aggregate, 95% of which shall be retained on 4.75 mm test sieve.
c. Aggregate shall be from crush granite, quartzite, trap, and basalt quarries.
d. Free from soft friable thin porous laminated or flaky pieces.
e. Free and clean from dust and foreign matters, namely injurious amounts of disintegrated pieces, alkali, vegetable matters and other deleterious substances.
f. Shall be chemically inert when mixed with cement.
g. The aggregate shall not contain any material that will attack the reinforcement. The maximum quantities of deleterious materials in coarse aggregates shall not exceed the limits laid down as per IS: 2386 (Part I & II)
h. Shall be angular in shape
i. Maximum size of the aggregate shall be 20 mm.
j. Shall have a minimum Specific gravity of 2.6 (Standard surface dry basis)
k. When stone aggregate or gravel is brought to the site single sized (un graded), it shall be mixed with single sized aggregates of different sizes in the proportion to be determined by the field tests to obtain graded aggregate or specified nominal size. The Contractor is deemed to have included the cost for above in its Scope.

Coarse aggregates shall be measured in stacks and adjustment shall be made by deducting seven and half (7.5) per cent of gross measurements of stacks in respect of aggregate of nominal size 40 mm and above. No deduction from the gross measurements of the stacks is to be made in respect of aggregates of nominal size below 40 mm.

Coarse aggregates brought to site shall be washed clean if required and as directed by the Project Manager / Professional Team.
2.2.5.5 Fine Aggregate

a. Shall be washed dry sand and shall confirm to IS: 383-1970 between Grading Zone I and II for structural concrete.
b. Shall pass through IS sieve 4.75mm test sieve leaving a residue not more than 5%
c. Shall not contain any traces of silt, and the sand shall be thoroughly washed with water so as to bring the percentage of silt content within the prescribed limit. Nothing extra is payable to Contractor on this account.
d. Fine aggregates shall be so stacked as to prevent dust and foreign matter getting mixed up with it as far as practically possible.
e. Since fine aggregates bulk to a substantial extent when partially wet, measurements shall be taken when the stacks are dry or an appropriate allowance has been made for bulking.

2.2.5.6 Water

a. Water for mixing shall be from potable supply system or from bore well supply.
b. Water for curing shall be from potable supply or from bore well supply.
d. The pH value of water shall not be less than 6 and more than 9.
e. Water which may erode or discolor concrete or which has got more than 1000 ppm of chloride content shall not be used.
f. The Contractor shall make its own arrangements for storing of water if necessary in drums, tanks or cisterns to the satisfaction of Project Manager / Professional Team. Care shall be taken to ensure that water is not contaminated anyway.

2.2.5.7 Expansion and Contraction Joints

a. Joint filler shall be Bitumen impregnated shalite board 25mm or Supreme board of 25mm thick (CAPCELL HD 100) for expansion joint.
b. Poly sulphide/ polyurethane/ silicon based joint sealants shall be provided in expansion joint.
c. Sliding type neoprene bearing pad of structural grade for expansion joints.

2.2.5.8 Miscellaneous

Chemical curing compound of approved make to form a membrane or surface which will disintegrate and flake from that surface over a period of days commencing at least 7 days after application.
Vapour barrier and separation layer to underside of concrete slab, as and when necessary, and grade 10 mil (.25 mm) thick polyethylene sheets with laps 100mm on sides and ends.

2.2.6 Proportioning, Batching & Mixing of Concrete

2.2.6.1 Proportioning

a. Aggregate

The proportions, which shall be decided by conducting preliminary tests, shall be by weight. These proportions of cement, fine and coarse aggregates shall be maintained during subsequent concrete batching by means of weight batchers conforming to I.S. 2722 capable of controlling the weights within one percent of the desired value. Except where it can be shown to the satisfaction of the Project Manager / Professional Team that supply of properly graded aggregate of uniform quality can be maintained over the period of work, the grading of aggregate shall be controlled by obtaining the coarse aggregate in different sizes and blending training the coarse aggregate in different sizes and blending them
in the right proportions.

The different sizes shall be stocked in separate stockpiles. The grading of coarse and fine aggregate shall be checked as frequently as possible, as determined by Project Manager / Professional Team to ensure maintaining of grading in accordance with the samples used in preliminary mix designs. The material shall be stockpiles well in advance of use.

b. **Cement**

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

c. **Water**

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

d. **Definition of Water/Cement Ratio**

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

e. **Water/Cement Ratio**

The actual water cement ratio to be adopted shall be determined in each instance by Contractor and approved by the Project Manager / Professional Team. Maximum water cement ratio shall be restricted to 0.53

f. **Proportioning by Water/Cement Ratio**

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

2.2.6.2 **Batching and mixing of concrete**

a. The proportions of the materials for the concrete mix as established by the preliminary test for mix design shall be followed for all the concrete in the works and shall not be changed except when specifically permitted by the Project Manager / Professional Team.

b. If approved by the Project Manager / Professional Team concrete may be produced by volume batching the ingredients except the cement. Fine and coarse aggregate shall be proportioned volumetrically by subsequent conversion of the weights of volumes knowing their bulk densities as stipulated in Para 9.2.2 or I.S. 456-2000. All concrete shall be mixed in mechanically operated batch mixers complying with I.S. 1791 of approved make with suitable provisions of correctly controlling water delivered to the drum. The quality of water actually entering the drum shall be checked with reading of gauge or valve setting before starting the job. The test shall be made while mixer is running. The volume of the mix material shall not exceed
the manufacturer's rated mixer capacity. The batch shall be charged into the mixer so that some water will enter the drum in advance of cement and aggregates. All water shall be in the drum by the drum. The entire contents of the drum shall be adjusted in one operation before the raw materials for succeeding batches are fed into the drum. The weighing gauge of mix shall be periodically checked or as directed by the Project Manager / Professional Team. The Contractor should carry out rectifications immediately if found necessary.

Mixer and the weight batcher shall be maintained in clean and serviceable condition. The accuracy of the weight batcher shall be periodically checked. Both mixer and the weight batcher shall be set up level on firm base and the hopper shall be loaded evenly. The needle shall be adjusted to zero when the hopper is empty. Fine and coarse aggregates shall be weighed separately.

Each time the work stops, the mixer shall be cleaned out and on next commencing the mixing, the first batch shall have 10% additional cement to allow for striking in the drum.

2.2.6.3 Batching Aggregate by Volume

a. Obtain approval before using this method.
b. Batch cement by weight and water by either weight or volume.
c. Measure aggregate in metal container whose depth is not less than their greater width and the size of which is such as to enable the whole to be easily checked.
d. Concrete shall be mixed in concrete mixers until a uniform distribution of the material, and a uniform colour and consistency is obtained.
e. Concrete mixing shall in no case be less than two minutes.
f. Each batch shall be so charged into the mixer that approximately 10% of the water enters the drum before the cement and aggregate. Water shall be added gradually while the drum is in motion, so that all the water is in the drum until the first quarter of the minimum time.
g. The amount of concrete mixed in drum shall not exceed the rated capacity of the mixer and the whole of the material shall be removed before a fresh batch enters the drum.
h. Do not modify the mixed concrete either by addition of water or cement or other means.

2.2.6.4 Cleanliness

a. Clean mixer and handling plant by washing with clean water at the end of the work and at intervals of 30 minutes during mixing.
b. If old concrete mix remains in the mixer drum, rotate the drum with clean aggregate and water before mixing the cement.

2.2.6.5 Planning of Concrete

a. Project Manager / Professional Team shall be informed 24 hrs in advance before the pour of each concrete to allow for inspection of reinforcement, sizes and levels of the members to be concreted, concrete cover, cleanliness, filling of gaps and wide and supporting props.
b. Ensure that the spaces to revive concrete are clear free from debris and free from water.
c. Transportation: Use approved method to identify that the grade of concrete to be placed in proposed location.
d. Use suitable stools, walkways, barrow runs, for traffic over reinforcement or freshly placed concrete.
e. Clean the transportation equipment immediately after use or whenever cement and aggregate is used by using clean water.
Following issues are to be noted while planning of concrete pours:

- Slabs: to be cast in strips and not in alternate bays.
- Walls: to be cast in successive pours working away in both directions from the center with not shrinkage gaps except for final closure.
- Starters: shall be the same as for the main member and shall be vibrated / rammed into place and prepared as for other joints. Starters to be cast for walls monolithically with foundation. In case of columns, they can be cast after concreting of foundation / slab.

2.2.6.6 Ordinary Concrete

a. Ordinary cement concrete where specified shall be used
b. Proportions 1:3:6, 1:2:4, 1:1.5:3, etc., in the specification refers to the quantity of cement by volume, dry coarse sand by volume, quantity of coarse aggregate by volume.

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

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

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

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

<table>
<thead>
<tr>
<th>S No</th>
<th>Proportion of concrete</th>
<th>Preliminary tests</th>
<th>Work tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1:3:6</td>
<td>135 kg/sq.cm.</td>
<td>100 kg/sq.cm.</td>
</tr>
<tr>
<td>2.</td>
<td>1:2:4</td>
<td>200 kg/sq.cm.</td>
<td>150 kg/sq.cm.</td>
</tr>
<tr>
<td>3.</td>
<td>1:1.5:3</td>
<td>265 kg/sq.cm.</td>
<td>200 kg/sq.cm.</td>
</tr>
</tbody>
</table>

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

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

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

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

2.2.7 Reinforced Cement Concrete

RCC comprises of formwork, reinforcement and concrete. Payment of Reinforced Cement Concrete shall be item wise as specified in the Conditions of Contract. Concrete shall be classified by its compressive strength at the 28th day. The concrete grade shall be as designated in Table 2 of IS: 456-2000.

Drawings and Specifications shall specify various types of concrete aimed to be used in the Project. It shall be the Contractor’s responsibility to carry out Design mixes and approval of the same from the Developers Representative well in advance of the actual pouring of concrete at the Site in the permanent works.

The basic aim of Mix Design shall be to find the most economic proportion of cement, aggregate and water which will give the desired target mean strength of concrete, workability and durability for specified grade of concrete. Also it is important that the Mix should be easily worked with the help of equipment available at the Site. The operations involved are
measurement of materials, their mixing, placing, compacting, finishing required and curing. The design shall be carried out strictly to IS Specifications and IS Codes of Practice, namely IS: 456-2000 and SP -23-1982.

In order to ensure that not more than the specified proportion of test results are likely to fall below the characteristic strength, the concrete mix has to be designed for higher average compressive strength for a specified grade of concrete is defined a target mean strength.

2.2.7.1 Design Mix and Trial Mixes

Design Mix and weigh batching will be done as approved by the Project Manager / Professional Team. The Contractor shall submit to the Project Manager / Professional Team the tentative Mix Design it proposes to use at the site.

On receipt of the above, the Project Manager / Professional Team may immediately order to carry out work or site test before the final approval. This shall be done with the mixer, weigh batches, etc. and materials actually used in the Project.

This shall give the Contractor additional chance to check for itself actual workability and make sure that the mix proposed by it will be satisfactory with regards to slump, water-cement ratio and workability.

Test cubes shall be of size 150mm x 150mm x 150mm. These are to be legibly marked with location and date of concreting. Where concrete (in works) is to be vibrated or not vibrated, the cubes are to be casted as per IS Standards.

Where the concrete in the works is un-compacted, pour the concrete into the mould in three layers and compact each layer with a 16mm dia tamping rod.

Six (6) cubes shall be taken from each of the three batches to test the mix. Cubes shall be cast, stored, cured, transported and tested as per IS:516-1959. The test may be carried out at the Site or at laboratory as approved by the Project Manager / Professional Team.

Trial mix

a. Within 7 days of signing the contract and before commencing work on site, prepare trial mixes for each type of concrete and submit 6 preliminary test cubes from each mix to the testing authority.

b. The testing authority shall test three test cubes at 7 days and three at 28 days for each type of mix where the difference between the higher and the lowest test results from any one trial mix at 7 days exceeds 15% of the average and any cube weaker than the minimum requirement, make a further trial mix, increasing the proportion of cement if necessary to obtain the required strength.

c. If any test results from any one-trial mix fail to exceed the minimum strength at 28 days:
   i. Remove from site materials from which the trial mix was prepared.
   ii. Provide new materials and prepare and test further trial mixes until specified requirements are achieved.

The Design Mix shall hold good so long as the materials continue to be of the same quality and from the same source. Minor adjustments are to be done daily based on the tests of materials used.
Compression strength on 150mm. Cubes

<table>
<thead>
<tr>
<th>Grade of concrete at 28 days</th>
<th>Preliminary test minimum kg/sq.cm</th>
<th>Work test minimum kg/sq.cm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>M10</td>
<td>135</td>
<td>100</td>
</tr>
<tr>
<td>M15</td>
<td>200</td>
<td>150</td>
</tr>
<tr>
<td>M20</td>
<td>260</td>
<td>200</td>
</tr>
<tr>
<td>M25</td>
<td>320</td>
<td>250</td>
</tr>
<tr>
<td>M30</td>
<td>380</td>
<td>300</td>
</tr>
<tr>
<td>M35</td>
<td>440</td>
<td>350</td>
</tr>
<tr>
<td>M40</td>
<td>500</td>
<td>400</td>
</tr>
</tbody>
</table>

Control concrete shall be proportioned to obtain the required strength by conducting lab tests using the coarse aggregate, sand and cement based on the design mix.

Control concrete shall have suitable workability for proper consolidation.

At places having heavy reinforcement when compacting concrete is a problem, the control concrete shall be designed with special care to the required strength and workability at no extra cost.

Testing facilities to access the moisture content of aggregate at frequent intervals, testing of concrete cubes and testing of aggregate shall be done at the site by establishing testing laboratories.

Concrete shall be weighed batched. The dials of weigh-batching units shall be checked with standard weights periodically.

Under special circumstances the conversion of weights to volumes will be allowed by the Project Manager / Professional Team.

The minimum cement content to be used for the job is as follows:

<table>
<thead>
<tr>
<th></th>
<th>43 GRADE</th>
<th>53 GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 25</td>
<td>330</td>
<td>300 Kg/cum</td>
</tr>
<tr>
<td>M 30</td>
<td>388</td>
<td>335 Kg/cum</td>
</tr>
<tr>
<td>M 35</td>
<td>423.5</td>
<td>375 Kg/cum</td>
</tr>
<tr>
<td>M 40 Not recommended</td>
<td>410</td>
<td>450 Kg/cum</td>
</tr>
<tr>
<td>M 45 Not recommended</td>
<td>450</td>
<td>450 Kg/cum</td>
</tr>
<tr>
<td>M 50 and above Not recommended</td>
<td>Design mix with micro silica and high performance super plasticizers (Glenium or equivalent) as per the manufacturer’s specification approved by consultants.</td>
<td></td>
</tr>
</tbody>
</table>

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

Further the Contractor has to provide and maintain all the equipment and stock at the Site throughout to carry out the following tests in a small Site laboratory or get these tests done from approved laboratories without extra cost to the Contract.
• Grading of aggregate
• Silt content of sand
• Moisture content of aggregate
• Slump test of concrete mix
• Concrete cube test

The Contractor shall maintain full records for all above tests in a register. The format of the records shall be prepared in consultation with the Project Manager / Professional Team. It shall have full access to the Contractor’s site laboratory. The Contractor shall include charges for these in its Scope and no extra whatsoever shall be payable on this account of designing, testing, maintaining laboratory, etc.

2.2.7.2 Assumed Standard Deviation

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

<table>
<thead>
<tr>
<th>Grade of Concrete</th>
<th>Assumed Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 10</td>
<td>2.3</td>
</tr>
<tr>
<td>M 15</td>
<td>3.5</td>
</tr>
<tr>
<td>M 20</td>
<td>4.6</td>
</tr>
<tr>
<td>M 25</td>
<td>5.3</td>
</tr>
<tr>
<td>M 30</td>
<td>6.0</td>
</tr>
<tr>
<td>M 35</td>
<td>6.3</td>
</tr>
<tr>
<td>M 40</td>
<td>6.6</td>
</tr>
</tbody>
</table>

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

2.2.7.3 Standard Deviation Based on Test Results

i. Number of test results - Total number of test results required to constitute an acceptable record for calculation of standard deviation shall be not less than 30. Attempts should be made to obtain the 30 test results, as early as possible, when a mix is used for the first time.

ii. Standard deviation to be brought up to date - The calculation of the standard deviation shall be brought up to date after every change of mix design and at least once a month.

2.2.7.4 Determination of Standard Deviation

i. Concrete of each grade shall be analysed separately to determine its standard deviation.

ii. The standard deviation of concrete to a given grade shall be calculated using the following formula from the results of individual tests of concrete of that grade obtained as specified for test strength of sample.

iii. Estimated standard deviation \( S = \sqrt{\frac{\text{sum of squared deviations of the individual strength of n samples divided by n-1}}{n}} \) where \( n \) = number of sample test results.

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iv. When significant changes are made in the production of concrete batches (for example changes in the materials used, mix design, equipment of technical control), the standard deviation value shall be separately calculated for such batches of concrete.

2.2.7.5 Mixing of Concrete

Weigh Batching shall be followed if mixed at the site for all structural concrete works. The Contractor shall provide Concrete Batch Mixers, Vibrators, Weigh Batchers conforming to relevant IS Specifications and from approved and recognized manufacturers. The capacity and number of mixers and vibrators required at the Site from time to time shall be to the approval of Project Manager / Professional Team. No equipment from the site shall be removed without the prior written approval of the Project Manager / Professional Team. The Contractor shall maintain a platform weighing scale of capacity 300 kg with fraction of 100 gm at the site.

The machine will have to be got calibrated by the Contractor once in every two weeks or after 200 cum of concrete whichever is earlier, and records of these calibrations shall be maintained. The dials of the weigh batchers shall be checked with standard weights periodically.

2.2.7.6 Consistency

The concrete which will flow freely into the forms and around the reinforcement without any segregation of coarse aggregates shall be used. The consistency shall depend upon the type of vibrator etc. to be used. The controlling factor for the same is the Slump Test.

When considered necessary by the Project Manager / Professional Team, the workability of the concrete shall be ascertained by compacting factor test and VEE BEE consistometer method as per IS:1199-1959. The computing of values of workability of concrete by above two methods IS: 456-2000 has to be referred to.

2.2.7.7 Temperature of Concrete

The placing temperature of concrete shall not be more than 38 degrees Celsius. If it is more, the Project Manager / Professional Team may order addition of ice or chilled water to the concrete. Also the Contractor shall take following precautions:

- Mixer and Weigh Batcher shall be painted white color.
- Aggregate storing bin shall not be exposed to the sun.
- Water shall be sprinkled on aggregate well before concreting to keep the temperature low.

Similarly, during the cold weather, concreting shall not be done when the temperature falls below 4.5 Degrees Celsius. The concrete placed shall be protected against by suitable covering. The concrete damaged by frost shall be removed and work redone with no extra cost.

2.2.7.8 Shrinkage Cracks
Concreting shall be avoided in very warm weather. Under such circumstances, the placed concrete shall be covered with damp Hessian cloth within two hours of placing of concrete.

To achieve good result the concrete shall be immediately covered with a plastic sheet and not allowed to any direct wind contact to eliminate shrinkage cracks.

2.2.7.9 Workmanship

All works shall be true to level, plumb and square and all corners and edges in all cases shall be unbroken and neat.

Any work not to the satisfaction of the Project Manager / Professional Team or the Design will be rejected and the same should be rectified or removed and replaced with work of the required standard of workmanship at no extra cost.

2.2.7.10 Transportation

Concrete shall be transported with the help of pumps of sufficient capacity to achieve necessary heights wherever required 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. The pumps can be either compressor type or boom type. All the pumping equipments have to be maintained and kept operational by the Contractor.

2.2.7.11 Placing of Concrete

Placing of concrete shall be done using pumps only at all levels. The pumps shall be of sufficient capacity to achieve necessary heights wherever required.

The slump of concrete placed with the help of pumps shall not be more than 90mm unless otherwise instructed by the Project Manager / Professional Team. Concreting shall commence only after formwork is approved reinforcement is recorded and permission to proceed with concreting has been approved in writing from the Project Manager / Professional Team.

Formwork should be clean, free from dust, pieces of wood or any other foreign material. It should be treated by form releasing agent prior to the laying of reinforcement and concrete, based on sample approved by the Project Manager / Professional Team prior to start of construction at Site. Concrete shall be as gently deposited as is practically possible, in its final position to avoid rehandling and shall be so deposited that segregation of aggregates does not occur. In case of deep trenches and footings, it may be done with the help of chutes. Concrete from wheelbarrows shall not be dumped away from the face of concrete already been placed. It shall be dumped into the face of concrete already in place. Concrete shall be laid during normal working hours. Concreting at night or on holidays shall be permitted only on the written approval of the Project Manager / Professional Team. No concreting shall be done within half an hour of the closing time of the day, unless permitted by the Project Manager / Professional Team.

For concreting of slabs and beams wooden plant or catwalks of chequered MS plates or bamboo mats or any other suitable materials supported directly on the centering by means of wooden blocks or lugs shall be provided to convey the concrete to the place of final deposition without disturbing the reinforcement in any way. In no case labour or any other persons are allowed to walk over the reinforcement.
In case of columns and walls, it is desirable to place concrete without any construction joints. The progress of concreting in the vertical direction shall be restricted to one meter per hour.

2.2.7.12 Compaction of Concrete

Concrete shall be thoroughly compacted into a dense mass, as depositing shall proceed by means of suitable vibrators. The vibrator shall maintain the entire concrete under treatment in an adequate state of agitation and shall continue during whole period occupied by placing of concrete. Care should be taken not to over-vibrate the concrete. While vibrating no holes should be visible in concreting. Compaction should be completed before the initial setting time. Compaction shall be done till air bubbles cease to appear. Concrete already set shall not be disturbed by successive vibration.

Hand tamping shall not be permitted. But only in exceptional cases, depending on the thickness of the members and feasibility of vibrating the same, the Project Manager / Professional Team may permit hand tamping. Hand tamping or compaction shall be done with the help of tamping rods so that concrete is thoroughly compacted and completely worked around the reinforcement embedded fixtures, and into the corners of the form look.

The layers of concrete shall be so placed that the bottom layer does not finally set before the top layers are placed. The vibrators are so applied so that the centre of mass being compacted at the time of placing of concrete.

Vibrator shall be of immersion type with frequency of 100 Hz minimum when operating in concrete, or the exterior with a frequency of 50 Hz minimum.

Care shall be taken to ensure that at no time the vibrators and /or vibration action is used to push the concrete ahead. Vibrators shall be applied systematically to overlap zones of influence.

It shall be ensured that the needle vibrators are not applied directly on the reinforcement on the formwork, which may destroy the bond between concrete and reinforcement.

When electric vibrators are in use the standby petrol, diesel or kerosene vibrator should always be available at the concreting point.

2.2.7.13 Construction Joints

Construction joint shall be avoided as far as possible. If provided, concreting shall be carried out continuously up to the construction joints as directed by the Project Manager / Professional Team and/or at the location and arrangement shown in the structural drawings. However, the number of such joints shall be kept to a minimum and they shall be as straight as possible.

Proposed location of construction joints shall be submitted by the Contractor well in advance for approval of Structural consultants / Project Manager / Professional Team. The joints shall be at places where shear force is nil or at a minimum (normally at 1/3rd to 1/4th point of a span) and these shall be straight and at right angles to the direction of the main reinforcement. Stop ends provided shall be with necessary slots for reinforcement bars to pass freely without bending or other obstructions. They should be supported firmly so that the concrete can be properly vibrated and
compacted at these points.

Before commencement of concreting after a break, adjacent concrete stopper and surfaces shall be cleaned, chipped free of any loose mortar and roughened to expose the aggregate and than brushed and cleaned. Preformed plastic adhesive water stop or swelling water stop (Synko flex / Master flex or equivalents) shall be placed before casting of next concrete. The concrete surface shall be sprayed with water for 24 hours before casting and kept wet until casting. Nitobond application shall be done between new and old surface after cleaning one hour before concreting.

Horizontal joints in walls

(A) Form horizontal joints in walls designed to be continuous with floor slabs at the top of an integrally cast kickers minimum 25mm high. No other horizontal joints will be allowed.

Form horizontal joints in walls other than in (A) above

a. At the top of footings
b. At the top of slabs
c. At a minimum 20mm above the soffit of beam or girders connecting into columns.
d. 15mm above soffit of suspended floors.

Construction joints in ground slabs

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

Isolation joints

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

Control joints

a. Space at 4 - 7 meter in width for one panel.
b. Form by either:
   i. Sawing a continuous straight line in the top of the slab
   ii. Grooving fresh concrete with hand grooves
   iii. Placing strips of wood, metal or pre-moulded joint material at joint locations. Top edges of strips shall be flush with concrete.
   iv. Control joints shall be extended 1/5 to 1/4 times slab thickness into the slab.

Construction joints in suspended slabs

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

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

2.2.7.14 Expansion Joint

As indicated in the drawing, or as directed by the Structural consultants / Project Manager / Professional Team. Sealing the joints shall be done with Polyurethane / Polysulphide sealants as specified by Consultants / Architects.

2.2.7.15 Curing

Curing of concrete is most important. There shall be no compromise on this activity as it is for the Contractor to arrange for everything necessary to make sure that the concrete is cured to the complete satisfaction of the Project Manager / Professional Team. As said above after concrete has begun to harden, i.e. about 1 to 2 hours after laying, it shall be protected from quick drying with moist or damp Hessian cloth or any other material approved by the Project Manager / Professional Team. After 24 hours of laying of concrete, the surface shall be cured by flooding with water or covering with moist hessian cloth for period of 7 days to keep it moist. For the next seven days surface shall be kept wet all the time by sprinkling water continuously.

In order to properly monitor the curing activity, the Contractor shall write legibly with paint, the date of casting the concrete of each member of the structure which shall remain clearly visible at least till the completion of curing.

2.2.7.16 Finishing

Concrete surface shall be finished keeping in mind the next operation to be carried out over the surface.

For guidance the following points shall be noted:

- Roof shall be trowelled even and smooth with a wooden float, before the concrete begins to set.
- Surface that will receive plaster shall be roughened immediately.
- Surfaces that will be in contact with masonry shall be roughened immediately.
- Surfaces that will receive floor finishes, tiling, etc. shall be roughened while it is still green.
- Every care shall be taken not to disturb the freshly laid concrete.
- For Ramps and Basements concrete shall be broom-finished.

On finishing standards and quality / workmanship, the decision of the Project Manager / Professional Team shall be final and binding on all parties.

2.2.7.16 Inspection and Corrective Measures

Immediately on removal of formwork, the RCC surface shall be examined by the Project Manager / Professional Team. Till such time, no remedial measures shall be carried out by the Contractor. All remedial actions including breaking, if any, shall be
on the instructions of the Project Manager / Professional Team. In case of any violation of this rule, the concrete poured stands rejected. The decision of the Project Manager / Professional Team in this regard shall be final and binding to all parties.

Sagged, bulged, patched, honeycombed work to an extent detrimental to structural safety or architectural concept shall stand to be rejected and Contractor shall rectify by breaking or redoing, if required, as directed by the Project Manager / Professional Team and all expenses incurred due to this shall be to the Contractor’s account.

a. Surface defects minor in nature may be accepted as a special case by the Project Manager/ Professional Team/ whose decision in this matter is final and binding on the Contractor. Once accepted, the defects shall be rectified as follows and all expenses incurred due to the rectification process, shall be to the Contractor’s account.

b. Surface defects which require repair when forms are removed, usually consist of bulges due to the movement of forms, ridges at form joint, honey combed areas, damage, resulting from the stripping of forms and bolt holes, bulges and ridges are removed by careful chipping or tooling and the surface is then rubbed with a grinding stone. Honey combed and other defective areas must be clipped out, the edges being cut as straight as possible and perpendicularly to the surface, or preferably slightly undercut to provide a key at the edge of the patch.

c. If permitted in writing by the Project Manager / Professional Team shallow patches are first to be treated with a coat of thin grout composed of one part of cement and one part of fine sand added with polymer modified cementitious material as per manufacturer’s specification, and then filled with mortar (mixed with non-shrink additives) similar to that used in concrete. The mortar is placed in layers not more than 10 mm thick and each layer is given scratch finish to secure a bond with the succeeding layer. The laid layer is finished to match with the surrounding concrete by floating, rubbing or tooling on formed surfaces by pressing the form material against the patch while the mortar is still plastic.

d. Or as an alternative to Para (b) above, as directed by the Project Manager / Professional Team the patch-work shall be treated with epoxy based proprietary items like non-shrinking grouts etc. available in the market. In such cases, the methodology as indicated by the manufacturer of the item shall be followed - if permitted in writing by the Project Manager / Professional Team.

e. Large and deep patches require filling up with concrete held in place with try forms. Such patches are reinforced and carefully drawled to the hardened concrete.

f. Or as an alternative to Para (d) above, epoxy based proprietary items like grouts as directed by the Project Manager / Professional Team shall be used. The methodology as specified by the manufacturers of the proprietary item shall be strictly adhered to.

Holes left by bolts are to be filled with non-shrink grouts, as specified and directed by the Project Manager / Professional Team carefully packed in to places in small amounts. The mortar is mixed as dry as possible to allow enough water to go into it, so that it will be tightly compacted when forced into the place.

Tiered holes extending right through the concrete may be filled with mortar or non-shrink grout, as the case may be, a pressure gun similar to the gun used for greasing motorcars.
Normally, patches appear darker than the surrounding concrete. When uniform surface colour is important, this defect shall be remedied by adding 10 to 20 percent of while Portland cement to the patching mortar, the actual quantity being determined by trial.

The same amount of care shall be taken to avoid the material in the patches as with the whole structure. Curing shall be started immediately after packing is done to prevent early drying. A membrane curing compound is these cases will be most convenient.

2.2.7.17 Cracks

Cracks observed shall be examined. It shall be kept under observation and a record shall be maintained for a period of 45 days. It shall be shown to the Project Manager / Professional Team and the following procedure shall be followed:

Cracks not propagating/developing further and according to the Project Manager / Professional Team not detrimental to the strength of the construction shall be grouted with non-shrinking epoxy based cement slurry or as directed by the Project Manager / Professional Team.

Cracks developing further and felt detrimental to the strength of construction shall be tested as per the relevant Indian Standards.

Based on results, the Project Manager / Professional Team shall order remedial measures or order the Contractor to dismantle construction, cart away the debris, replace the construction and carry out all the consequent works thereto as directed/specified.

Cost of above shall be borne by the Contractor if the failure is on its part unless it is due to a design fault, decided at the discretion of the Project Manager / Professional Team.

2.2.7.18 Quantum of Cube Testing

The minimum frequency of cube testing shall be as follows. Each set of sample shall consist of 6 cubes.

Concrete Quantity Number of Sample sets

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 5 cum a day</td>
<td>1</td>
</tr>
<tr>
<td>5 cum to 15 cum a day</td>
<td>2</td>
</tr>
<tr>
<td>15 cum to 30 cum a day</td>
<td>3</td>
</tr>
<tr>
<td>30 cum to 50 cum a day</td>
<td>4</td>
</tr>
<tr>
<td>More than 50 cum per day</td>
<td>4 + one additional for each 50 cum or part thereof.</td>
</tr>
</tbody>
</table>

Three cubes shall be tested on the 7th day and three cubes on the 28th day.

2.2.7.19 Acceptance of Work

It shall be in accordance with in is: 456-2000, SP-23 and SP-24. The guidance brief is elaborated below. Part or element of work shall be deemed to be accepted, provided the results of the 28th day cube testing confirm to the criteria stated as under:

The average of the three consecutive cubes strength shall not be less than specified strength.

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

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If the individual cube strength exhibit more than 133% of the specified strength such a cube shall be specified as freak and the criteria in above two points shall be applied to remaining two cubes and their acceptability determined.
If cubes fail at 7 days, defective concrete can be dismantled, removed and replaced without awaiting 28 day test results.
If the concrete tests fail to meet the acceptance strength required for respective grades of concrete, the Project Manager / Professional Team may take one of the following actions:
Instruct Contractor to carry out such additional tests (e.g. Core tests, load tests, ultrasound, etc.) and/or remedial measures to ensure the soundness of the structure at the Contractor’s expense.
The work will be rejected and any consequential action as needed shall be taken at the Contractor's expense, including cutting out and replacing a part or whole of work.

2.2.8 Concreting under Special Conditions

During hot or cold weather concreting should be done as per the procedure set out in IS:7861
Part I or IS:7861 Part II or as directed by the .

Fixtures

Any fixture, steel angles, holdfasts etc shall be embedded according to the drawing or as instructed by the Project Manager / Professional Team.

2.2.9 Precast Concrete

Refer Clause 2.9.4

2.2.10 Ready Mix Concrete

Reference - IS 4926-1976

2.2.10.1 Terminology

2.2.10.1.1 Ready Mix concrete - Concrete delivered at site or into the purchaser's vehicle in a plastic condition and requiring no further treatment before being placed in the position in which it is to set and harden. All provisions for good workmanship, quality control and treatment, as stated in previous clauses shall be applicable.

2.2.10.1.2 Agitation - The process of continuing the mixing of concrete at a reduced speed during transportation to prevent segregation.

2.2.10.1.3 Agitator - Truck mounted equipment designed to agitate concrete during transportation to the site of delivery.

2.2.10.1.4 Truck mixer - A mixer generally mounted on a self-propelled chassis capable of mixing the ingredients of concrete and of agitating the mixed concrete during transportation.

2.2.10.2 Types

Concrete-mix - Concrete shall be produced by completely mixing cement, aggregates, admixtures, if any and water at a stationary central mixing plant and delivered in containers fitted with agitating devices.
2.2.10.3 Materials

Cement - The cement used shall be ordinary Portland cement or low heat Portland cement conforming to IS-269-1976* or Portland slag cement conforming to IS 455-1976* or Portland-pozzolana cement conforming to IS: 1489-1976+ or rapid hardening Portland cement conforming to IS 8041E-1976 as may be specified by at the time of placing the order. If the type is not specified ordinary Portland cement shall be used.

2.2.10.4 Fly ash when used for partial replacement of cement, shall conform to the requirements of IS:

3812 (part I)-1966.

2.2.10.5 Water used for concrete shall conform to the requirement of IS: 456-1964.

2.2.10.6 Admixtures shall only be used when so agreed to between the purchaser and the manufacturer.

The admixtures shall conform to the requirements of IS 456-1964 and their nature, quantities and methods of use shall also be specified. Fly ash when used as an admixture for concrete shall conform to IS: 3812 (Part II)-1966.

2.2.10.7 Measurement and Storage of Materials - Measurement and storage of materials shall be done in accordance with the requirements of IS: 456-2000.

2.2.10.8 Basis of Supply

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

a) Specified strength based on 28-day compressive strength of 15-cm cubes tested in accordance with IS: 456-1964.

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

2.2.10.9 General Requirement

2.2.10.9.1 In addition to the requirements specified in this standard and subject to such modifications as may be agreed to between the purchaser and the manufacturer at the time of placing order, the ready-mixed concrete shall generally comply with the requirements of IS: 456-2000.

2.2.10.9.2 The minimum quantity of cement and the details regarding proportioning and works control shall be as per Clause 2.2.7.1.

2.2.10.9.3 When a truck mixer or agitator is used for mixing a transportation of concrete, no water from the truck-water system or from elsewhere shall be added after the initial introduction of the mixing water for the batch, except when on arrival at the site of the work, the slump of the concrete is less than that specified; such additional water to bring the slump within required limits shall be injected into the mixer under such pressure and direction of floor that the requirements for uniformity specified in Appendix A are met.

2.2.10.9.4 Unless otherwise agreed to between the purchaser and the supplier, when a truck
mixture of agitator is used for transporting concrete, the concrete shall be delivered to 
the site of the work and discharge shall be complete within 1.5 hours (when the 
prevailing atmospheric temperature is above 20°C) and within 2 hours (when the 
prevailing atmospheric temperature is at or below 20°C) of adding the mixing water to 
the dry mix of cement and aggregate or of adding the cement to the aggregate, 
whichever is earlier.

2.2.10.9.5 Temperature - The temperature of the concrete at the place and time of delivery shall 
be not less than 5°C. Unless otherwise required by the purchaser, no concrete shall 
be delivered, when the site temperature is less than 2.5°C and the thermometer 
reading is falling.

2.2.10.9.6 The temperature of the concrete shall not exceed 5°C above the prevailing shade 
temperature, when the shade temperature is over 20°C. The temperature of concrete 
mass on delivery shall not exceed 40°C.

2.2.10.9.7 Sampling and testing: Adequate facilities shall be provided by the manufacturer for 
the purchaser to inspect the materials used, the process of manufacture and the 
methods of delivery of concrete. He shall also provide adequate facilities for the 
purchaser to take samples of the materials used.

2.2.10.9.8 Sampling and testing - Unless otherwise agreed to between the purchaser and the supplier, 
the sampling and testing of concrete shall be done in accordance with relevant 
requirements of IS: 456-1964, IS: 1199-1959 and IS: 516- 
1959.

2.2.10.9.9 Consistency or workability - The tests for consistency or workability shall be carried out 
in accordance with requirements of IS: 1199-1959 or by such other method as may be 
agreed to between the purchaser and the manufacturer.

2.2.10.9.10 Strength Test - The compressive strength and flexural strength tests shall be carried 
our in accordance with the requirements of IS: 516-1959 and the acceptance criteria 
for concrete whether supplied on the basis of specified strength or on the basis of mix 
proportion, shall conform to the requirements of Table 5 and other related 
requirements of IS: 456-1964.

2.2.10.9.11 Cost of Testing - Unless otherwise agreed to between the purchaser and the 
manufacturer, the cost of the tests carried our in accordance with the requirements 
of this specification shall be borne as follows:

a) By the manufacturer if the results show that the concrete does not comply 
   with the requirements of this standard.

b) By the purchaser if the results show that the concrete complies with the 
   requirements of this standard.

2.2.10.9.12 Manufacturer's Records and Certificates - The manufacturer shall keep batch records of 
the quantities by mass of all the solid materials, of the total amount of water used in 
mixing and of the results of all tests. If required by the purchaser, the 
manufacturer shall furnish certificates, at agreed intervals, giving this information.

The concrete quality shall meet all requirements and Specifications of concrete as 
stated hereof. Contractor shall be allowed to use own Batching Plant or procure 
concrete, but Quality Tests will be the responsibility of the Contractor and off-site 
Batching Plants shall be open for inspection to the Project Manager / Professional Team 
throughout the Project.

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2.2.11 Admixtures

2.2.11.1 General

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

2.2.11.2 Air Entraining Agent

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

2.2.11.3 Retarding Admixtures

Where specified and approved by Project Manager / Professional Team retarding agents shall be added to the concrete mix in quantities specified by Project Manager / Professional Team.

2.2.11.4 Water Reducing Admixtures

Where specified and approved by Project Manager / Professional Team water reducing lingo sulphonate mixture shall be added in quantities specified. The admixtures shall be added in the form of a solution.

2.2.11.5 Water Proofing Agent

Where specified and approved by Project Manager / Professional Team, chloride and sulphide free waterproofing agent shall be added in quantities specified.

2.2.11.6 Other Admixtures

- a. The Project Manager / Professional Team may at his discretion instruct the Contractor to use any other admixtures in the concrete.
- b. If the Contractor so wishes to use admixtures, then the following should be adhered to (subject or Project Manager / Professional Team’s approval).
- c. No reduction will be allowed to target mean strength when compared to admixture free concrete of the same class.
- d. Dosage of admixture shall be strictly in accordance with the manufacturer’s instruction.
- e. The following information about the admixture shall be submitted to the Project Manager / Professional Team for record and approval.
- Long and short term effects of the admixture in the concrete.
- Effect of admixture of concrete permeability.
- Effects of over and under dosage.
- Shortage life and special storage requirements.

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

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

h. If the use of admixture is approved by the Project Manager / Professional Team, it shall be construed as constructing part of the concrete without any extra payment.

2.2.12 Measurement

Formwork and reinforcement shall be paid separately. Volume of concrete measured shall include that occupied by:

Reinforcement of other metal sections
Cast in components more than 0.01 m³
in Rebates or internal each less than 0.005 m³ is 0005 sectioned area
Pockets and holes not exceeding 0.01 m³ in volume

All works shall be measured in the Decimal system.

Dimensions shall be measured to the nearest 0.01 meter except for thickness of slabs that shall be measured to the 0.005 meter.

Areas shall be worked out to the nearest 0.01 Sqm. Cubic contents shall be worked out to the nearest 0.01 cum. Formwork and reinforcement shall be paid for separately.

The price of concrete shall include all labour, material, equipment, mixing, pumping, gangways, tools, transporting, hoisting to any height and lowering to any depth, pouring or laying, consolidating, leaving pockets, holes, disconnecting them till the next operation or completion of work, hacking the surface, to provide key for providing further work including cleaning wetting surfaces, etc preparing construction joints as described, and all other activities required as per good construction practice.

Unit Scope shall allow for chamfers, grooves, lines etc. in reinforced concrete members as well as necessary slope, drops, drip models etc.

No deductions shall be made for:

- Ends of dissimilar materials (for example beams, posts, girders, corbels, purlins and steps) up to 500 sq cm. in section.
- Opening up to 0.1 sq m.
- Volume occupied by drainage, water, pipes, conduits, etc. not exceeding 100 sq cm. each in cross-section.
- Small voids not exceeding 40 sq cm. in cross-section.
Small moulds, drip moulds, chamfers, splays, rounded or covered angles, beads, grooves, rebates up to 10 cm in depth and width.

Minimum cement content per cubic meter of cement concrete has been specified in each item of cement concrete work, refer Clause 2.2.4. However, if cement is required to be used so as to obtain the minimum strength specified for the grade of cement concrete, the Contractor will not be paid for extra cement used.

2.2.13 Scope of Works

The following items are not intended to exclude any other items of works required by the Design, or that which may be required by local code or good construction practice. The following work shall be included by the Contractor in its Tender and Contract Sum as they may not have been detailed specifically on the architectural and engineering drawings and specifications but are required in order that a complete job in every respect can be delivered.

1) The supply, maintenance and removal of all temporary rungs, and ramping as necessary on the site

2) Placing of concrete will be by pumps only or as approved by the Project Manager / Professional Team.

3) All finishes to the concrete work as shown or specified.

4) Allow for the removal of constructions encountered.

5) The excavation and concrete construction of all sump pits, manholes, drains under slabs, etc as described in the specifications and shown on the drawings.

6) Formwork, reinforcement, embedded items and layout for concrete tank cradles.

7) All roof mechanical and other building services equipment pads and kerbs at the HVAC And Electrical openings, concrete including dowels, formwork and roughing of concrete

8) All fine grading and removal of standing water before the placing of concrete.

9) Include for all below slab, surface water and drainage, including brick fill, within The Tender.

10) Points and in steel below slabs lightning protection systems as detailed.

11) The Contractor, in the preparation of his Tender, is to allow for watertight construction.

12) Allow for keeping the works clear and tidy at all times and for the removal of debris arising from the works, and to be disposed off at locations designated by the Project Manager / Professional Team, and frequently removed from the site. Any surplus concrete deposited at the work front on the site (concrete droppings) must be removed by the Contractor at its own expense.
13) Provisions, hoisting, distribution and fixing of all embedded items required.

14) Leaving all necessary holes and pockets for steel work beams for lifts and for making good after installation by other Contractors. Casting in all slots and inserts for fixings to guides and runners to lift shafts.

15) All trench drain box-cut with necessary recesses and casting in all anchor bolts and providing and installing trench drains and other embedded items as shown on the drawings.

16) Include design mix weight and storage box for samples and test cylinders.

17) Levelling of the floors to proper elevations as shown on the drawings to the tolerances and cambers and slopes specified including all changes of slab elevation.

18) All means of transportation of concrete.

19) Providing and casting into concrete slots to receive masonry or block work ties to support all such walls as shown on the drawings or as directed by the Project Manager / Professional Team.

20) Forming holes to riser ducts.

21) Forming necessary cut-outs at pipe locations to accommodate electrical, plumbing, sprinkler and electrical services.

22) Forming in the concrete members, chases for any asphalt "track-in" and/or flashing and the like.

23) Provide grout for lift saddle and floor closures prior to setting (setting by others).

24) Grout pumps and other mechanical equipment as required.

25) Provide temporary shoring and strutting as required due to the operations of the Contractor.

26) Provide and maintain ladders until stairs are usable.

27) Provide adequate lighting at all areas

28) Erect sufficient safety signs, posters and maintain high level of safety during the entire construction period.

END OF SECTION
Annexure 1
Course Aggregate Grading IS: 383 Table 2

<table>
<thead>
<tr>
<th>IS Sieve Sizes</th>
<th>Percentage passing for single size Aggregate</th>
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<tr>
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<tr>
<td>4.75mm</td>
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<td>2.36mm</td>
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<th>Percentage passing for Graded Aggregate Nominal Size</th>
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<td>10 to 35</td>
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Annexure 2
Grading of Fine Aggregates
IS: 383 Table 4

<table>
<thead>
<tr>
<th>IS Sieve Designated</th>
<th>Grading Zone I</th>
<th>Grading Zone II</th>
<th>Grading Zone III</th>
<th>Grading Zone IV</th>
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<td>90 to 100</td>
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<td>600 microns</td>
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<td>15 to 50</td>
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<tr>
<td>150 microns</td>
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<td>0 to 10</td>
<td>0 to 10</td>
<td>0 to 15</td>
</tr>
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SECTION 2.3 - REINFORCEMENT

2.3.1 Related Works

A. Concrete Formwork
B. Cast in-situ Concrete

2.3.1. a Applicable Standards

<table>
<thead>
<tr>
<th>IS</th>
<th>Description</th>
<th>Conforming to</th>
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</thead>
<tbody>
<tr>
<td>432</td>
<td>Specification for Mild steel and medium tensile bars and hard drawn steel wire.</td>
<td>IS 432 (Part I)</td>
</tr>
<tr>
<td>1139</td>
<td>Specification for hot rolled mild steel, medium tensile steel and high yield steel deformed bars for concrete reinforcement.</td>
<td>IS 1139</td>
</tr>
<tr>
<td>1566</td>
<td>Specification for plain hard drawn steel wire fabric for concrete reinforcement</td>
<td>IS 1566</td>
</tr>
<tr>
<td>1785</td>
<td>Specification for plain hard drawn steel wire for pre stressed concrete.</td>
<td>IS 1785</td>
</tr>
<tr>
<td>1786</td>
<td>Specification for cold twisted high strength deformed bars for concrete reinforcement.</td>
<td>IS 1786</td>
</tr>
<tr>
<td>2080</td>
<td>Specification for high tensile steel bars used in pre stressed concrete</td>
<td>IS 2080</td>
</tr>
<tr>
<td>2751</td>
<td>Code of practice for welding of mild steel structures are folded plates</td>
<td>IS 2751</td>
</tr>
<tr>
<td>2502</td>
<td>Code of practice for bending and fixing of bars for concrete reinforcement</td>
<td>IS 2502</td>
</tr>
</tbody>
</table>

2.3.2 Steel Grades

Reinforcements for concrete may be from any of the “grades” of steel indicated below, conforming to the relevant Indian Standards and their latest amendments mentioned against each:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Conforming to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fe 250</td>
<td>Mild Steel</td>
<td>IS 432 (Part I)</td>
</tr>
<tr>
<td>Fe 490</td>
<td>Hard drawn steel wire</td>
<td>IS 432 (Part II)</td>
</tr>
<tr>
<td>Fe 415</td>
<td>High strength deformed/ribbed steel</td>
<td>IS 1786</td>
</tr>
<tr>
<td>Fe 500</td>
<td>High strength deformed/ribbed steel</td>
<td>IS 1786</td>
</tr>
<tr>
<td>Fe 550</td>
<td>High strength deformed/ribbed steel</td>
<td>IS 1786</td>
</tr>
</tbody>
</table>

Reinforcing steel may be any of the following types:

- Type I Plain round bars (PR)
- Type II Welded wire Fabrics (WWF)
- Type III Cold Twisted Deformed Bars / Corrosion resistant bars. (CTD-CR)
- Type IV Thermo-Mechanically Treated Ribbed bars (TMT)
- Type V Thermo-Mechanically Treated Ribbed Corrosion Resistant bars (Copper) Bearing (TMT-CR)

2.3.3 BIS Certification

Material received at the site shall have BIS Certification mark. Such bundle or coil containing the bars shall be suitably marked with BIS Certification mark. Bars shall also be marked to identify categories. This shall be done as per IS: 1387.

In case bars are without BIS Certification mark, the manufacturer shall give a certificate stating the process of manufacture, chemical composition and mechanical properties. Each certificate shall indicate the number or identification mark of the cart to which it applies, corresponding to the number or identification mark to be found on the material.
All reinforcements shall be free from loose mill scale, excessive rust, loose rust, pitting, oil, grease, paint, mud or any other foreign deleterious material present on the surface. Cleaning should be done to the satisfaction of the Project Manager / Professional Team.

Each batch of steel brought to the Site shall be tested prior to use. Cost of all tests shall be borne by the Contractor. Material acceptable as per IS Specifications will be allowed into the Project. All rejected material shall be removed from the Site by the Contractor within 30 days of its rejection. If the same is not done, the Project Manager / Professional Team can get work done by third party at the Contractor’s risk and cost shall impose a penalty of Rs 500 (Rupees Five Hundred only) per metric ton per day. This will be without any appeal and shall not be subjected to arbitration.

2.3.4 Storage

Reinforcement bars received at the Site shall be stored on hard, concreted platform and clear of the ground to a minimum of 200 mm with the use of timber sleepers or any other means. Reinforcements shall be kept covered by tarpaulins or plastic to avoid excessive corrosion or any other contamination. It is advised to follow storage methods as described in IS: 4082.

Reinforcement steel shall be stored in such a manner as to avoid distortion and to prevent deterioration and corrosion. Prior to assembly of reinforcement on no account any oily substance shall be used for removing the rust.

2.3.5 Quality Assurance

a. Supervisory staff shall have qualification and experience in the above field.
b. Welders qualified and having approved certificates for welding shall be employed.

2.3.6 Handling

a. Bend test requirements shall conform to the following and shall be based on 1800 bends of full size bars around pins.

<table>
<thead>
<tr>
<th>Bar diameter (mm)</th>
<th>Pin diameter for test bend</th>
</tr>
</thead>
<tbody>
<tr>
<td>10, 12,16</td>
<td>3.5 x bar dia</td>
</tr>
<tr>
<td>20, 22, 25</td>
<td>5.0 x bar dia</td>
</tr>
<tr>
<td>28, 30, 32</td>
<td>7.0 x bar dia</td>
</tr>
</tbody>
</table>

b. Spacers shall be of any of the following:
   i. Wire
   ii. Pre cast concrete
   iii. Moulded plastic

Spacer material shall be of durable quality and shall not lead to corrosion of reinforcement or spilling of concrete.

Precast concrete spacers shall be of the same mix as that of surrounding concrete.

c. Tying wire shall be of 18 G black annealed mild steel wire or other approved type double fold to tie the reinforcements.

d. Cover blocks shall be non-corrosive material such as plastic, but not wooden or broken bricks or stone. Specially made concrete blocks shall be used. Such cover blocks shall be cast from concrete and not from cement mortar; strength of these blocks shall be equal to the concrete in use.
e. Tying wire shall be of 18G black annealed mild steel wire or other approved type
double fold to tie the reinforcements. It shall be face from rust, oil, paint,
grease, loose mill seals or any other deleterious material undesirable for
concrete or reinforcement or which may prevent adhesion of concrete to
reinforcement.

2.3.7 Unit Weights:

Unit weights payable per meter shall be as follows:

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
<th>Weight (kg/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>0.22</td>
</tr>
<tr>
<td>8</td>
<td>0.39</td>
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<tr>
<td>10</td>
<td>0.62</td>
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<tr>
<td>12</td>
<td>0.89</td>
</tr>
<tr>
<td>16</td>
<td>1.58</td>
</tr>
<tr>
<td>20</td>
<td>2.47</td>
</tr>
<tr>
<td>25</td>
<td>3.85</td>
</tr>
<tr>
<td>28</td>
<td>4.83</td>
</tr>
<tr>
<td>32</td>
<td>6.31</td>
</tr>
</tbody>
</table>

2.3.8 Execution

2.3.8.1 Cutting and Bending

a. Flame cut and hot bending is absolutely forbidden.
b. Cut and bend reinforcement to approved shop drawings and details shall be used.
c. Bars to be cold-bend, either mechanically or by hand, but to correct radius using
   proper tools, machine and platform and confirming to IS 2502-1963.
d. Do not rebend without approval. In case of re bending, care shall be taken that the
   rating of bend is not less than 4 x bar dia at construction joints for plain steel
   bars and 6 x bar dia for high strength bars.
e. Reinforcement projecting from concrete shall not be bent without approval.
   Bar bending schedule to be submitted to the Project Manager / Professional Team
   for approval prior to commencement of any cutting, bending and binding of
   steel at site.
f. Cracked end of bars shall not be used on this Project.
g. Bars should be inspected for visible defects such as cracks, brittleness, excessive
   rust, loose mills scale, etc.

2.3.8.2 Welding

a. Do not weld reinforcement unless authorized by the Project Manager / Professional team and recommended by the manufacturers.
b. Site welding shall be done with suitable safeguards and techniques.
c. Welding, if approved, may be used for:
   i. Lapping reinforcement in position
   ii. Fixing reinforcement to other steel members.
d. The length of run deposited in a single pass shall not exceed 5 x bar diameters. If a
   longer welded length is required divide into sections with the space between runs
   not less than 5 x bar diameters.
e. Welded joints:
   i. Shall not be made at bends in reinforcement.
   ii. Stagger joints in parallel bars of principal reinforcement unless
       otherwise approved.
   iii. The distance between staggered joints shall not be less than the end
        anchorage length joints.
2.3.8.3 Mechanical Splicing

   Use as indicated in structural drawings.

b. Structural Consultants / Project Manager / Professional Team has to approve mechanical splices before use at site.

2.3.8.4 Inspection

a. Ensure that the reinforcement placing is checked by Project Manager / Professional Team.

b. Ensure that the Formwork to receive the reinforcement is clean and free from debris.

c. Cracked end of bars to be cut out.

2.3.8.5 Anchoring

Anchoring of bars and stirrups shall be provided exactly as detailed in the structural drawings or as directed by Project Manager / Professional Team.

In case of reinforcement steel in tension, deformed bars may be used without end anchorage provided the Construction length requirement is satisfied. Hoods shall normally be provided for plain bars in tension. Construction length of the bars shall be determined as per relevant clauses of IS: 456 - 2000.

The anchorage length of straight bar in compression shall be equal to the Construction length of the bars in compression as specified in relevant clause of IS: 456 - 2000.

2.3.8.6 Lapping of Bars

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

As far as possible bars of the maximum length available shall be used. Laps shown on drawings or otherwise specified by the Structural will be based on the Contractor using bars of maximum length.

In case Contractor wishes to use bars of shorter length, laps shall be provided at the Contractor's expense in the manner and the locations approved by the Structural. Splices shall be provided as far as possible away from the sections of maximum stress and be staggered.

Not more than half of the bars shall be spliced at a section. If more than half of the bars shall be spliced at a section, special care shall be ensured such as increasing length of lap or closer spacing of stirrups around the length of splice.

Lap splice shall not be used for bars having diameter larger than 36 mm. For larger diameters bars it may be welded. Lap length including anchorage value of hooks in flexural tension shall be \( L_s \) (as defined in Article 25.2.1 of IS: 456-2000) or 30 times the diameter of the bar whichever is greater and for direct tension 2\( L_s \) or 30 times the diameter of the bar whichever is greater. The straight length of lap shall not be greater than 15\( D \) or 20 cm, whereas \( D \) is the diameter of the bar.

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

Overlapping bars shall not touch each other and these shall be kept apart with concrete between them by 25mm or 1.25 times the maximum size of the coarse aggregate, whichever is greater.
When above is not possible, the overlapping bars shall be bound together at intervals not exceeding twice the diameter of such bars with two strands of annealed binding wire of 0.90mm to 1.6mm diameter twisted together tightly. As and when necessary welded laps shall be provided as specified by the Project Manager/Professional Team.

2.3.8.7 Securing Reinforcement

a. Adequately secure with tying wire or approved steel clips.
b. Bend the tying wires well back of forms.

2.3.8.8 Concrete Cover

a. Shall be in accordance with ISI: 456-2000 and as per the instructions in structural drawings.

i. Footings, retaining walls and similar members in contact with earth but not cast against earth - 50 mm
ii. Slabs - 20 mm
iii. Walls, ribs - 20 mm
iv. Beams:
   For main bars - Min. 25 mm or dia. of the bar
   For stirrups - 15 mm
v. Columns - 40 mm
   Columns less than 20 cms - 25 mm vi.

Water tanks:
   In contact with water - 40 mm
   In contact with air - 20 mm vii
Walls in contact with water/earth - 40mm

2.3.8.9 Spacers Chairs and Other Supports

a. Provide necessary supports to maintain reinforcement in its correct position.
b. Provide spacer bars of same diameter as longitudinal bars but not less than 25mm diameter between two layers at 1.5 mm centers except where bundled bars are detailed.

2.3.8.10 Precautionary Measures

a. Do not insert bars into placed concrete.
b. Do not damage forms and form linings, if any when fixing reinforcement.

2.3.8.11 Adjustment and Cleaning

a. Check reinforcement prior to and during placing concrete with particular attention to the top reinforcement in cantilever sections.
b. Ensure that reinforcement is clean and free from corrosive pitting, loose rust, loose mill scale, oil and other substances, which may adversely affect reinforcement concrete or the bond between the two.
c. Protect the projecting reinforcement from weather where the rust staining of exposed concrete surfaces may occur.
2.3.9 Measurements

Reinforcement shall be measured as follows:

Length of different diameters of bars actually used including laps shall be measured nearest to a centimeter and their weights calculated as shown on the drawings or as instructed by the Project Manager / Professional Team.
Weights per meter shall be as mentioned in Clause 2.3.7
Rolling margin to be considered in quoted Scope.
The Contractor shall account for all these in its quoted rate.
Rate build-up shall include, in addition to cost of material (ie will not be measured and paid for separately):
- Cover blocks (PVC or concrete) of required thickness for keeping reinforcement bars in position
- Unauthorized overlaps (allowed for Contractor's convenience), spacer bars, chairs and ties.
- Cutting, bending, placing and fixing in position in any size and shape and placing in position as per detailed drawings
- Binding wire as approved (will not be measured and hence not paid separately)
- Wastage
- Cleaning of bare reinforcement
- Welding where required as shown in drawings and specifications

2.3.10 Approved Makes

Reinforcement bars shall be procured from one of the following manufacturers only. (Reinforcement bars from other sources will not be approved)

Name of Makes

SAIL
TISCO
RINL
Equivalent brands approved by Consultants/Clients/ PMC

END OF SECTION
SECTION 2.4 - FORMWORK

2.4.1 Related Work

Concrete
Reinforcement

2.4.2 Applicable Standards

IS - 303 Specification for Plywood for general purposes
IS - 4990 Specification for plywood for concrete shuttering
IS - 1629 Rules for grading of cut size of timber
IS - 2750 Specification for steel scaffoldings.
IS - 4014 Code of practice for steel tubular, scaffolding

2.4.3 Section Includes

Design, Fabrication, erection and striking of formwork for in-situ concrete

2.4.4 Quality Assurance

Design and construction shall be executed and supervised by fully qualified personnel.

In accordance with quality assurance programme, the Contractor shall provide the Project Manager / Professional Team with information demonstrating that a system will be used to ensure that the work carried out under this section (including that done by sub-contractors) will comply with the requirements of the specifications.

2.4.5 Formwork

Related Work

Concrete Form Work
Concrete
Reinforcement
Cast - in situ Concrete

2.4.5.1 Quality Assurance

a. Supervisory staff shall have qualification and experience in the above field.
b. IS Standards - Note: Latest amendments shall be followed.

2.4.5.2 Design Criteria

Formwork system shall be executed and designed by a specialist qualified to the shapes, lines, forms and dimensions shown on drawings. The Contractor shall submit to the Project Manager / Professional Team a method statement backed by design calculations. Required drawings and sketches shall be enclosed along with the statement for the proposed area to be taken up for working at a time. The number of repetitions expected, type of material used, etc shall be detailed therein.

Formwork shall start only after written approval from the Project Manager / Professional Team has been received. Approval of the proposal in submitted form and acceptance of modification does not relieve the Contractor of its obligation to achieve the required line finish within accepted tolerance limits in terms of quality of works completed and safety. Neither will it diminish the Contractor’s responsibility for the satisfactory performance of formwork.

Basic points to be understood in designing of formwork are stated
below:

a) Erected Form work shall be watertight, shall conform to shape, lines, dimensions, verticality, rigid during placing, vibrating and configuring the concrete.

b) Formwork system shall be of steel or timber or 12mm thick water resistant Ply board, and shall be continuous, straight and without any warping.

c) Design of formwork shall take into account:
   • Height of pour
   • Thickness of member
   • Rate of pour
   • Concrete slump
   • Texture of finish
   • Placing temperature
   • Concrete density
   • Construction joints
   • Wind load
   • Method of Discharge
d) Form work design shall have
   • Dimensional Tolerance
   • De mountable without shock, disturbance or damage to concrete
e) All construction joints in beams and slabs shall be provided as shown in drawings.
f) Ties shall be provided where required
g) Cambers shall be provided where shown.
h) Props / supports of extra ceiling height shall be specially designed.

2.4.6 Form Work Material

Construction formwork with smooth faced plywood, steel or timber to produce smooth straight level and sharp profiles shall be used for the works. Panels shall be in largest practicable sizes to reduce the number of joints.

a) Form material shall have strength adequate to withstand pressure of newly placed concrete without excessive and adjustable bow or deflection.
b) Factory fabricated adjustable length removable or snap off metal form ties, designed to prevent form deflection and to prevent spalling of concrete surfaces on removal.
c) Ties shall be such that:
   • A portion remaining within the concrete shall be at least 38mm from the outer concrete surface.
   • That will not leave a hole larger than 25mm diameter on the concrete surface.
d) Form coating compound that will not bond with, stain, nor adversely affect concrete for required bond or adhesion nor hamper the wetting of surface to be covered with water or curing compound.

All propping and centering shall be of adjustable steel supports (built-up sections of rolled steel) and tubular props to full height without joints, and with sufficient bracing to take into account the construction loads, namely full load of concrete with any live load and impact load likely to occur during concreting.

Steel shuttering used for concreting shall be sufficiently stiffened. The steel shuttering shall also be properly repaired before use and properly cleaned to avoid stains and defects in concreting.

2.4.7 Workmanship

Formwork shall be classified based on the ultimate finishes required of the concrete surface as:
2.4.7.1 The Contractor shall account for all material and labour to achieve the above finishes to the satisfaction of the Project Manager / Professional Team in his quoted price.

2.4.7.2 Guidelines for Good Workmanship

Following are a few points as guidelines for good workmanship in formwork and shall be accounted for by the Contractor in its quoted price.

Erection of formwork may be from pre-moulded, pre-fabricated, pre-assembled plates or form reasonable enough to transport and erect at site to correct lines and levels as set at site.

Supports shall be firm and maintained in position by nails, cross bracing, tie-rods, locking bolts, nuts, etc. It shall be rigid and stiff so as to retain its shape during and after concreting.

Joints shall be water-tight and no cement slurry shall be allowed to get through.

Pre-fabricated or site forms shall be assembled so as to de-shutter without any jerk to the green concrete. For this double wedges shall be used. The wedges shall be nailed. The heads left with, allowing easy removal while de-shuttering.

Pre-fabricated or site formwork shall be sufficient thickness with supporting spans in both directions. These shall be standardized in size for easy replacement and universal use at site.

Props shall be of steel only. Its spacing shall be as per design. It shall be vertical and plumbed. Base shall be of proper steel plate or timber plank for equal distribution of load.

In case of multi-storied buildings, any upper floor shall be suitably supported on at least one floor below the same, or as approved by the Project Manager / Professional Team.

Props shall be adequately cross-braced horizontally.

At the design and erection stage following additional points shall be considered and be incorporated into the setting.

Opening of cleaning prior to the start of concreting

Pouring points shall avoid high drops and provide easy access to vibrating needles.

Surfaces shall be treated with suitable releasing oil or emulsion prior to the laying of reinforcement. Such releasing oil shall be got approved from the Project Manager / Professional Team.

Ensure that forms and adjacent surfaces are thoroughly cleaned to receive concrete and debris.

Locate construction joints in a manner so as not to impair strength and appearance of structure.

Following points shall be observed very carefully:

Joints of formwork shall be watertight. It is easy to check from the bottom and make sure no light is visible.

Props shall be on solid base, plumbed, in straight line, braced horizontally and cross.

Tie-bars, bracing and spacers in beams, walls and columns shall be at correct place/location and fully tight. Wedges shall be fully secured and nailed with heads left out for easy removal.

All saw dust, dirt, shavings and any other unwanted material shall be cleaned and hosed out. Provision shall be made for watching formwork while concreting and any other platform needed for movement of workers without any disturbance to the reinforcement. Provision is made for traffic on form work: not
to bear directly on reinforcing steel. Number of reuses shall be decided by the Project Manager/Professional Team on examining the condition of formwork after each use. If during concreting any weakness develops or formwork shows any distress, the work shall be stopped and remedial action taken.

2.4.7.3 Finishing Formed Surfaces

The Contractor shall:

- Repair and patch defective areas with fins and other projections completely removed or smoothed.
- To smooth concrete where fins and other projections have formed moisten concrete surface within a day after forms have been removed and rub with carborundum brick until surface is a uniform colour and texture within the projection limits.
- Not apply cement ground other than that produced by the rubbing process.
- Remove and replace concrete having defective surfaces if defects cannot be repaired to the satisfaction of the superintendent.

Surface defects shall include colour and texture irregularities, cracks, spills, air bubbles, honeycombs, rock pockets, fins and other projection on the surface, stain and form tie holes.

The Contractor shall:

- Undercut voids larger than 25mm diameter and fill with fresh concrete after thoroughly wetting concrete surfaces.
- Fill small holes and irregularities using 2:1 (Portland cement to fine sand by volume) grout mixed with approved bonding admixture according to manufacturer’s specification.
- Blend standard Portland cement with white Portland cement if necessary so that final colour of dry grout will match adjacent surfaces.
- After applying grout to repair area, wipe with Hessian cloth to match adjacent texture and within the specified surface tolerances.
- Keep concrete patch damp with fog ‘spray for at least 36 hours.

2.4.8 Tolerances

Tolerance is a specified permissible variation from lines, grades or dimensions given in drawings. No tolerances are specified for horizontal or vertical encroachments beyond the legal boundaries.

2.4.9 Removal of Formwork:

Formwork shall not be struck until the concrete has reached strength at least twice the stress to which the concrete may be subjected at the time of removal of formwork.

Formwork shall be removed carefully without jarring the concrete and curing of the concrete shall commence immediately. Sudden shocks / vibrations during removal of wedges shall be avoided. Where finished edges have re-entrant angles, remove formwork as early as possible to avoid shrinkage cracks.
Concrete surfaces to be exposed shall where required by the Project Manager/Professional Team, be rubbed with carborundum stone to give a smooth and even finish.
Where concrete requires plastering or other finish later, the concrete surface shall be hacked as directed.

No extra charge will be allowed to the Contractor for such work.

2.4.9.1 Minimum time Requirements
For other cements the stripping time shall be suitably modified in consultation with the Project Manager / Professional Team.

For precast moulds the stripping time shall be 24 hours. Striking time shall be as follows:

<table>
<thead>
<tr>
<th>Type of Formwork</th>
<th>Minimum period before striking (Excluding the day of casting)</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Walls, columns</td>
<td>12 hrs</td>
</tr>
<tr>
<td>ii. Vertical faces</td>
<td>12 hrs</td>
</tr>
<tr>
<td>iii. Removal of formwork with props fully left under spanning over 6m</td>
<td>7 days</td>
</tr>
<tr>
<td>iv. Between ribs not more than 1 to 2 m</td>
<td>7 days</td>
</tr>
<tr>
<td>v. Ribs, joists, beams, soffits</td>
<td></td>
</tr>
<tr>
<td>- Up 3m clear span - Beams</td>
<td>7 days</td>
</tr>
<tr>
<td>- Between 3m to 6m - Beams</td>
<td>14 days</td>
</tr>
<tr>
<td>- Above 6m clear span beams</td>
<td>21 days</td>
</tr>
<tr>
<td>vi. One way floor slabs - up to 3m</td>
<td>7 days</td>
</tr>
<tr>
<td>vii. One way floor slabs - between 3m to 6m</td>
<td>10 days</td>
</tr>
<tr>
<td>viii. One way floor slabs - over 6m</td>
<td>14 days</td>
</tr>
<tr>
<td>ix. Beams and Girder Sides</td>
<td>12 days</td>
</tr>
<tr>
<td>x. Removal of props below slabs spanning over 6m</td>
<td>21 days</td>
</tr>
</tbody>
</table>

Striking of Formwork within the time limits listed above is subject to successful crushing of cubes compressive strength results. However re-shuttering and re-propping can be done if the required strength is attained as per the instructions of Project Manager / Professional Team.

2.4.10 Cleaning and Oiling of Forms

The contractor shall ensure that the surface of the forms that will touch the concrete shall be free from encrustations of mortar, grout, or other foreign material. Temporary openings shall be left at the bottom of formwork to enable sawdust, shavings, wire offcuts and other foreign material to be removed from the interior of the forms before the concrete is placed. Compressed air shall be used to clean the complete formwork and remove all traces of duct and debris before pouring concrete the temporary holes shall then be closed.

The surface of the forms to be in contact with the concrete shall be coated with a reliable coating that will effectively prevent the adherence of concrete and will not stain the concrete surfaces. After each use, the surfaces of forms which have been in contact with concrete shall be cleaned of mortar and any other material sticking to them, then well wetted and treated with form oil approved by the Project Manager / Professional Team.

The Contractor shall provide commercial form release agent that will not bond with, stain or adversely affect concrete surfaces and will not impair subsequent treatment of concrete surfaces.

2.4.11 Openings / Inserts

Contractor shall provide all required openings, pockets, inserts as detailed in drawings. The Contractor shall provide required material and labour for fixing and supporting during concreting. In its quoted price, it is imperative to consider that all openings and pockets shall be de-shuttered with care and all corners of openings shall be preserved, i.e. shall be in correct line and level.

After concreting the openings shall be secured against any accident by proper covering
and guard rail, warning notice, lighting, etc for which no extra cost is payable to the Contractor.

2.4.12 Fair Face Finished Concrete

Scope

These are additional requirements for fair faced concrete and includes all visible concrete surfaces that are not specified or called for on drawings as plastered, including foundations and edges of slabs on ground.

2.4.13 Related work

The Contractor shall coordinate the work with masonry, electrical, mechanical, plumbing and other trades.

2.4.14 Samples

The Contractor shall provide samples of fair face cast in place concrete colour finish showing the limits of colour variation. These shall be kept with the Project Manager / Professional Team for reference.

2.4.15 Concrete

The Contractor shall ensure that only one brand of cement and only one source for aggregates is used throughout all fair face concrete work unless otherwise approved by the Project Manager / Professional Team. Limits of deleterious materials permissible in aggregates shall be as for aggregates listed in clause 5.2.

2.4.16 Formwork

The Contractor shall ensure that plywood, metal and other approved panel type material joined to provide continuous, straight, smooth surfaces in the largest possible practical sizes to minimize the number of joints and to conform to the location of movement joints shown on the drawings. Timber is to be finished instead of rough sawn to provide the concrete finish tolerances specified below. Chamfer exposed edges and water drips where shown to produce straight smooth lines and tight edge joints. Tolerances for irregularities such as fins and offsets in the form finish are 5mm for abrupt changes in level and 10mm over 1500mm for gradual surface irregularities.

2.4.17 Form Ties

Form ties may be used to prevent form deflection. They shall be evenly spaced for appearance. Form ties, steel reinforcement and tie wire to have sufficient cover as called for in clause 7.10 to prevent any spalling of concrete. The Contractor shall provide form ties that, when removed will not leave holes larger than 25mm diameter in the concrete surface.

2.4.18 Flooring

A Vacuum Dewatered Concreting & Flooring

i Preparation

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

ii Concreting

General

1. Concreting shall have a concrete base of minimum M20 of specified thick.
2. Flooring shall have hardtop on the concrete base.
3. Flooring shall be laid in strips, the size of which is mentioned on the drawings.

iii Materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>Portland</td>
</tr>
<tr>
<td>Sand</td>
<td>River sand</td>
</tr>
<tr>
<td>Aggregate</td>
<td>Max. size 10 to 20mm</td>
</tr>
<tr>
<td>Water</td>
<td>Potable</td>
</tr>
<tr>
<td>Nito hardener (Optional)</td>
<td>@ 3kg/sqm</td>
</tr>
<tr>
<td>Poly Sulphide sealant</td>
<td>At all control joints of size 10mmx6mm at every 200 sqm area</td>
</tr>
</tbody>
</table>

iv Execution

a) Mix cement, sand and aggregates in proportion 1:1.5:3 thoroughly with water to get appropriate consistency.
b) Prepared concrete shall be laid immediately after mixing.
c) The base shall be free from water and other foreign materials, dust and dirt.
d) A coat of cement slurry of the consistency of thick cream shall be brushed on surface of the base course.
e) The concrete shall then be spread over this base evenly and leveled carefully.
f) Low areas shall be filled with concrete and humps removed. Devacumisation shall be done for removing the voids.
g) The whole concrete surface shall be leveled, compacted by ramming and trowelling.
h) Prepared surface shall be allowed to set.
i) Hardener screed:
   - Hardtop to be prepared as per the specifications with Nito hardener and one part of dry cement.
   - The hardtop shall be provided over concrete base immediately after it is set, compacted and leveled with a steel trowel.
   - The surface shall be trowelled to bring the hardener coat to a leveled surface.
   - Excessive trowelling shall be avoided.
   - After the initial set, further compaction shall be done by steel trowelling.
   - Final brushing shall be made before the floor top becomes too hard.

v Curing

1. Curing shall commence as soon as the surface is hard enough to receive the water.
2. The surface shall be covered with sacks or sand and shall be kept continuously wet for a period of at least one week.

B Granolithic Flooring

GENERAL:

1 Granolithic flooring shall have a concrete base of 1:2:4, 75/63/50 mm thick as specified.
2 Granolithic flooring shall have 12 mm thick wearing coat on the top of the concrete base.

3 Granolithic flooring shall be laid in strips, the size of which is mentioned on the drawings.

MATERIALS:
Cement - Portland Cement
Sand - River sand
Aggregate - Max. size 12 mm
Water - Potable

EXECUTION:
1 Mix cement, sand and aggregates in proportion 1:2:4 thoroughly with water to get an appropriate consistency.
2 Prepared concrete shall be laid immediately after mixing.
3 The base shall be free from water and other foreign materials, dust and dirt.
4 A coat of cement slurry of the good consistency of thick cream shall be brushed on the surface of the base course.
5 The concrete shall then be spread over this base evenly and levelled carefully.
6 Low areas shall be filled with concrete and humps removed.
7 The whole concrete surface shall be levelled, compacted by ramming and trowelling.
8 Prepared surface shall be allowed to set.
9 Grano Wearing Coat:
   a) One part of dry cement shall be mixed with 1.5 parts of well graded granite chips, Size being 6 mm.
   b) The ingredients shall then be mixed with sufficient water as in the case of ordinary concrete. c) The wearing coat shall be laid to a thickness of 12 mm over 1:2:4 concrete bases immediately after it is set, compacted and levelled with a steel trowel.
   d) The surface shall be trowelled to bring the wearing coat to a levelled surface. e) Excessive trowelling shall be avoided.
   f) Bringing cement slurry to the surface by excess trowelling shall be avoided.
   g) After the initial set further compaction shall be done by steel trowelling.
   h) Final brushing shall be made before the topping becomes too hard.

CURING:
1 Curing shall commence as soon as the surface is hard enough to receive the water.
2 The surface shall be covered with sacks or sand and shall be kept continuously wet for a period of at least one week.

END OF SECTION
SECTION 2.5 - STRUCTURAL STEEL

2.5.1 General

2.5.1.1 Description

2.5.1.1 Extent and Intent

The Contractor shall furnish all materials, labour operation, equipment, tools and plant and incidentals necessary and required for the completion of all metal work in connection items of metal work as called for in the drawings. The drawings and specifications cover the major requirements only. The supplying of additional fastenings, accessory features and other items not mentioned specifically herein but which are necessary to make a complete installation shall be a part of the contract.

Works include anchorages in cast-in-situ concrete.

2.5.1.2 Related Work

i. Grouting base plates and bearing plates
ii. Metal fabricators
iii. Roofing sheets

2.5.1.3 Applicable Standards

- IS-226-1975 Structural Steel (standard quality) (fifth revision)
- IS-456-1978 Code of practice for plain and reinforced concrete (third revision)
- IS-696-1972 Code of practice for general engineering drawings (second revision)
- IS-786-1967 (Supplement) SI supplement to Indian Standard conversion factors and conversion tables (first revision)
- IS-812-1957 Glossary of terms relating to welding and cutting of Metals
- IS-813-1961 Scheme of symbols for welding
- IS-814 Covered electrodes for metal arc welding of structural steels: 814 (Part 1)-1974 Part 1 for welding products other than sheets (fourth revision)
- IS-816-1969 Code of practice for use of metal arc welding for general construction in mild steel (first revision)
- IS-817-1966 Code of practice for training and testing of metal arc welders (revised)
- IS-819-1957 Code of practice for resistance spot welding for light assemblies in mild steel
- IS-919-1963 Recommendations for limits and fits for engineering (revised)
- IS-961-1975 Structural steel (high tensile) (second revision)
- IS-962-1967 Code of practice for architectural and building drawings (first revision)
- IS-1024-1979 Code of practice for use of welding in bridges and structures subject to dynamic loading (first revision)
- IS-1030-1982 Carbon steel castings for general engineering purposes (second revision)
- IS-1148-1973 Hot-rolled steel rivet bars (up to 40 mm diameter) for structural purposes (second revision)
- IS-1149-1982 High tensile steel rivet bars for structural purposes
IS-1261-1959 - Code of practice for seam welding in mild steel
IS-1278-1972 - Filler rods and wires for gas welding (second revision)
IS-1323-1962 - Code of practice for oxy-acetylene welding for structural work in mild steel (revised)

IS-1363-1967 - Black hexagon bolts, nuts and lock nuts (diameter 6 to 39 mm) and black hexagon screws (diameter 6 to 24 mm) (first revision)
IS-1364-1967 - Precision and semi-precision hexagon bolts, screws, nuts and lock nuts (diameter range 6 to 39 mm) (first revision)
IS-1367-1967 - Technical supply conditions for threaded fasteners (first revision)
IS-1393-1961 - Code of practice for training and testing of oxy-acetylene welders
IS-1395-1982 - Molybdenum and chromium molybdenum vanadium low alloy steel electrodes for metal arc welding (second revision)
IS-1929-1961 - Rivets for general purposes (12 to 48 mm diameter)
IS-1977-1975 - Structural steel (ordinary quality) (second revision)
IS-2062-1984 - Weld able structural steel (third revision)
IS-2155-1962 - Rivets for general purposes (below 12 mm diameter)
IS-3613-1974 - Acceptance tests for wire-flux combinations for submerged-arc welding of structural steels (first revision)
IS-3757-1972 - High-tensile friction grip bolts (first revision)
IS-4000-1967 - Code of practice for assembly of structural joints using high tensile friction grip fasteners
IS-5369-1975 - General requirements for plain washers and lock washers (first revision)
IS-5370-1969 - Plain washers with outside diameter 3 x inside diameter
IS-6419-1971 - Welding rods and bare electrodes for gas shielded arc welding of structural steel
IS-6623-1972 - High tensile friction grip nuts
IS-6649-1972 - High tensile friction grip washers
IS-7205-1974 - Safety code for erection of structural steel work
IS-7215-1974 - Tolerances for fabrication of steel structures
IS-7280-1974 - Bare wire electrodes for submerged arc welding of structural steels
IS-8500-1977 - Weld able structural steel (medium and high strength qualities)

2.5.1.2 Shop Drawings

Contractor shall note that shop drawings are to be prepared and submitted to structural consultants for their review and comments

Include

a. Shop drawings for trusses, bracings, purlins, columns, ties, base plates, crane girders, etc.
b. Indicate profiles, sizes, spacing and locations of structural members, connections, attachments, fasteners, cambers, loads and designs of joints.
c. Indicate welded connections using standard welding symbols and nett weld lengths.
d. Indicate the method of erection, shop and field joints.
e. Indicate and identify all transportable parts and sub-assemblies, associates with special erection instructions, if any.
f. Provide design calculations for splices, joints, other details not specifically detailed in design drawings on fabrication drawings considering standard detailing practices and developing full member strengths.
g. Submit 3 sets of shop drawings to Project Manager / Professional Team for approval.

h. Allow three weeks for Structural consultants / Project Manager / Professional Team to approve Shop Drawings.

2.5.2 Products

2.5.2.1 Materials

a. Structural steel members.
b. Structural tubing.
c. Bolts, nuts and washers.
d. Welding materials.
e. Primer.
f. Shear studs.

All metal materials shall be free from defects impairing strength, durability and appearance and they shall have structural properties that comply fully with the standards set out in clause 2.6.1.1.3, which follows. All ferrous metal shall be free from rust, scale and other defects. All non-ferrous metal shall have uniform finished surfaces, machined and buffed, free from defects. All sections shall conform accurately to sizes and shapes required.

2.5.2.2 Fabrication

a. Fabricate structural
b. Steel members in accordance with IS Specifications 800 Section V and approved shop drawings.
c. Defective material used shall be replaced by the Contractor.
d. Fabricated items delivered at site shall be suitably protected from any damages.

2.5.2.3 Finish

Clean, prepare and shop prime structural steel members. Do not prime surfaces to be field welded or bolted or in contact with concrete.

2.5.3 Execution

a. Erect structural steel in accordance with IS Specifications.
b. Make provision for erection loads and for sufficient temporary bracing to maintain the structure in proper plumb and in true alignment until completion of erection and installation of permanent bracing.
c. Do not field cut or alter structural members without approval of Project Manager / Professional Team.
d. After erection, prime welds, abrasions and surfaces not shop primed, except surfaces to be in contact with concrete.
e. Members shall be cut mechanically by saw or shear or by oxy acetylene flame and not by electric metal arc.
f. Cut edges shall be ground as per IS 823.
g. Cutting tolerances shall be
   • Members connected at bolt ends: + or - 1 mm.
   • Other members: + or - 3 mm.
h. All bolt holes shall be drilled and to the sizes specified in drawings.
   • Tolerance for spacing between two holes: + or - 1 mm.
   • Tolerance between two perpendiculars of any oval hole: + or - 1 mm.
   • Bolt holes for field joints shall be drilled in the shop to the required diameters and tested.
i. Drilling holes for standard sizes if varies can be reamed to next higher sizes. The
tolerance for hole reaming shall not exceed 15% of the total number of holes for one joint.

2.5.3.1 Preparation of members for welding

Proper jigs and fixtures shall be used to ensure correct positioning of structural members during assembly.

Sharp edges, rusting of cutting edges, notches, irregularities, and fissures due to faulty cutting shall be chipped and ground.

Edge preparation for welding shall be done properly taking care of cleaning, providing dry surface, removing grease, dust or dirt, foreign matter, etc. Finished dimensions of structure shall be ensured after taking into account the shrinkage and distortions during welding.

2.5.4 Welding

2.5.4.1 Personnel:

a. Welders shall be fully trained, experienced and certified by the recognized welding institutes.

b. Welders' qualification tests shall be as per IS 823 and approved by Project Manager / Professional Team.

2.5.4.2 Execution:

a. Welding shall be done in accordance with IS 823.

b. Welded parts shall be marked with welders' identification.

c. Protect the welded parts, electrode wires against wind and rain.

d. Discontinued welded parts shall be melted before resuming welding operation.

e. Welding seams shall be cooled slowly and not by any other quick methods.

f. Before welding a second layer over the existing layer of weld, the layer shall be cleaned metal bright by light chipping and wire brushing.

g. Execution shall proceed in strict compliance with Section 2/7 Safety Procedures.

2.5.4.3 Approval:

a. Welded parts shall not have any deformations.

b. Welded joints should compensate for contractions due to welding.

c. Defective welds must be rectified.

d. Weld seams shall correspond to design shapes and dimensions.

e. Weld seams shall not have cracks, fusion, under cuts, rough surfaces, burns, blowholes, and incomplete penetration.

f. Approval of finished elements, inspections and tests shall be as per Annexure

2.5.5 Bolting

2.5.5.1 Material

a. Bolts, nuts shall be in accordance with IS 1367 and tested as per IS 1608.

b. Washers shall be as per IS 2016.

2.5.5.2 Preparation

a. Members shall be assembled for bolting with proper jigs and fixtures to sustain the assemblies without deformation and bending.

b. All sharp edges, shavings, rust, dirt, etc. shall be removed before assembly.

c. Before assembly the contacting surfaces of the members shall be cleaned and given
a coat of primer.
d. Temporarily the assembly shall be done and checked for co-axiality of the holes after which the assembly shall be finally bolted.

2.5.5.3 Execution

a. Bolts shall be fixed after all the defects have been rectified and approved by Project Manager / Professional Team.
b. Bolts shall be tightened from the centre of joint towards the edge.

2.5.5.4 Identification

Structural members prior to dispatch for erection shall be marked with weather proof light coloured paint. The size and thickness of members shall be so chosen as to facilitate easy identification. Structural members small in size shall be bundled or crated and shall be marked with metal tags for bundles and painted on crate so that there is scope for identification with particulars of the bundle / crate size, weight, etc.

2.5.6 Shop - approvals

2.5.6.1 Pre Assembly

2.5.6.1.1 Pre assembly of bolted structures shall be done for all elements as well as for the entire structure in conformity with the 'holes for field joints'.

2.5.6.1.2 Steel structures having same type of welding the shop test pre assembly shall be performed at least one member out of ten members.

2.5.6.2 Inspection

2.5.6.2.1 Contractor to provide facilities for Project Manager / Professional Team to inspect the steel assembly, welding, bolting, painting etc. at any time during fabrication of members.

2.5.6.2.2 Project Manager / Professional Team shall have the access to the fabrication shop at all times for satisfying himself regarding the fabrication of steel items to the drawings and specifications.

2.5.6.2.3 Shop approval by the Project Manager / Professional Team is only mandatory.

2.5.6.2.4 Contractor to bear all the expenses for testing required by the Project Manager / Professional Team for satisfying regarding the quality of workmanship.

2.5.6.2.5 Contractor to furnish necessary tools, gauges, instruments, technical and non-technical personnel for shop tests at his own cost.

2.5.6.3 Approvals

2.5.6.3.1 Intermediate approvals

a. For part of the work that cannot be inspected later.
b. For part of the work that will be difficult to perform inspection and even if done results are not satisfactory.
2.5.6.3.2 Partial approvals

a. To the structural steel members and assemblies before the primer coat is applied.
b. Of materials used for fabrication.
c. Of test erection.
d. Of markings.
e. Of fillet joints.
f. Of plain surfaces.
g. Of special features such as rollers, etc.

2.5.6.3.3 Final approval

a. To all elements and assemblies of steel structures after having a shop primer coat and ready for delivery.
b. Includes partial approval
c. Of shop primer coat.
d. Of mode of loading and transport.
e. Of storage of materials.

2.5.6.3.4 Approved Fabricators

All metal work fabricated shall be approved by the Structural / Project Manager / Professional Team. The entire work shall be carried out by workmen skilled in this kind of work in a shop fully equipped to carry out all phases of fabrication in accordance with the best-accepted trade practices.

2.5.6.4 Painting

2.5.6.4.1 Preparation:

a. Surface to receive primer coat shall be sand blasted / wire brushed, free of dust, oil, rust, etc.
b. Surfaces not accessible to painting shall be filled with approved type of oil and putty.
c. Surface shall be completely dry.
d. Surfaces where water or aggressive agents may collect during transportation, storage, erection and operation shall be filled with putty and provided with drainage holes.
e. Structural steel members are inspected and approved.
f. Welds are approved.
g. After satisfying the above criteria the surfaces are to be provided with one coat of red oxide / zinc chromate primer to the satisfaction of Project Manager / Professional Team before the material is dispatched for erection.

2.5.6.4.2 Do not prime the following areas:

a. Surfaces to receive weld at site.
b. Surfaces bearing markings.
c. Surfaces as indicated in drawings.
d. Planned surfaces shall receive a coat of hot oil or any approved resistant lubricant only.
e. To coat the surfaces with hot oil to holes for links.
f. To give a coat of cement wash for any members either embedded or in contact with concrete.
g. To give a bituminous coat for members in contact with ground, gravel, brickwork and moisture.
h. Contractor to give a further coat of red oxide paint after erection and placing in position of the assembly if called for by the Project Manager / Professional Team.

2.5.6.4.3 Packing, Transportation, Delivery:

a. Structural steel members shall be marked and approved in shop before packing and loading for transportation.
b. Adequate packing must be done for all the steel members to protect them against warping during loading and unloading.
c. Suitable lifting devises to be used for loading and unloading.
d. Additional steel bracing to be provided for all slender projecting members to prevent any warping during transportation loading and unloading.
e. Loading and transportation shall be done as per the transportation rules.
f. Professional Team in case the members to be transported are beyond the limitations of transporting system.
g. To secure all small parts including gusset plates fish plates by securing them with wire to their respective parts.
h. To crate all bolts, nuts and washers.
i. All structural parts to be delivered in the order required for construction and as per instructions of Project Manager / Professional Team and shall accompany the following documents

1. Quality and quantity of structure or members.
2. Location of members in the structure
3. Description of structure
4. Identification number
5. Building Job symbol

2.5.6.4.4 Storage and Preparation of Members Prior to Erection

a. Place for storage of steel member shall be prepared in advance and got approved by the Project Manager Professional Team.
b. To provide concrete platform at the site for preliminary erection work.
c. To verify the quality of material obtained at site and for workmanship to the specifications and drawings.
d. To verify whether the parts obtained at site is free from defects due to loading, unloading transportation.
e. To avoid warping of members during unloading by taking sufficient precautionary measures.
f. To store the members as per the symbol and markings and in order of erection.
g. To place the steel members at least 150mm above the platform on wooden or steel locks for protection against direct contact with ground and to permit drainage of water.
h. To equip for rectification of members like straightening at site and to provide sufficient space for the same.
i. To see that the parts are clean before erection.

2.5.6.4.5 Field Erection

a. To get approvals of foundation, columns, column pedestals or other related structure on which the structural steel members are to be erected.
b. To get approvals of the members receiving structural steel members regarding their levels, dimensions, alignments and verticality well in advance.
c. To carry out any minor discrepancies at no additional cost.
d. To get approvals of pockets, bolt locations, levels of base plates before erection. e. Erection to commence after satisfying the
above conditions.
f. Erection to be done in an organized way so that any individual member is not subjected to instability during the erection time.
g. Precautionary measures to be taken during erection of trusses, purlins and other steel members by providing proper bracing.
h. Faulty erections done without caring for safety of members and of personal shall be made good at no additional cost.
i. Contractor is not relieved of his responsibilities, guarantees even after the Project Manager / Professional Team approves the fabrication, erection, etc., at any stage of work.

2.5.6.4.6 Erection and Tolerance

a. To check and inspect before, during and after erection.
   1. Damage during transportation.
   2. Alignment of structure.
   3. Erection sequence
   4. Progress
   5. Workmanship

b. To erect members as per the predetermined plan approved by the Project Manager / Professional Team.

c. To position and level the structure including aligning and to plumb the stanchion and fixing every member in position with bolts, erection bolts, weld as per design and drawings.

d. To inform the Project Manager / Professional Team of any variation, deviation in location of foundations, anchor bolts which shall deviate the prefabricated members.

e. Project Manager / Professional Team to give suitable solutions in case of above deviations well in advance for the Contractor to proceed with the fabrication of members including any modifications necessary.

f. Contractor to rectify any minor deviations in foundations, location of steel bolts and orientation of bolt hole positions at no extra cost.

g. To erect structural steel members ensuring that the system is stable against inherent weight, wind and any erection trusses.

i. To anchor and fasten the erection joints after duly checking the plan, elevation positions of the members with reference to the drawings after the approval of Project Manager / Professional Team.

j. To fasten bolts to the final position with bolt heads and nuts resting on the member and on tapered washers with members having a sloping surface.

2.5.6.4.7 Final Acceptance and Handing Over the Structure

a. Contractor to submit As-built shop drawings for the approval of the Project Manager / Professional Team, as per the stipulation given in Conditions of Contract.

b. Documents to be submitted for final acceptance are as follows:
1. Shop acceptance drawings

2. Quality certificate for structural members, plates, flats, bolts.

3. Quality certificate for material used for fabrication including electrodes, welding wire, bolts, nuts, washers, etc.,

4. List of welders who welded the structures and their certificates for having undergone a welding course.

5. Acceptance and intermediate control procedure adopted during the process of fabrication, assembly, transportation, delivery and erection or structure.

2.5.7 Grouting

   a. To level, align and plumb the structural steel work and the base of stanchions by providing steel shim plates.

   b. To align anchor bolts in foundation to the required level, location and orientation by using templates.

   c. To clean the underside of base plates, pockets to receive grout by using compressed air.

   d. To use cement mortar 1:2, 1 of cement and 2 of sand, non-shrink grout under base plates.

   e. To use grade M 30 concrete to fill up the grout pockets left for fixing anchor bolts.

   f. To pour the grout under a sufficient head and tamp until the voids are thoroughly filled and the grout overflows.

2.5.8 Tolerances

   a. Steel work for line and level ±3mm

   b. For structural steel for plumb 3.5mm for 10M and not more than 7mm for 30M

   c. To follow any tolerance criteria provided on the drawings.

   d. To provide tolerances for all structural steel members as per IS code other than what is mentioned in a, b and c.

END OF SECTION
### ANNEXURE - A

<table>
<thead>
<tr>
<th>Inspection of test</th>
<th>Coverage</th>
<th>Procedure</th>
<th>Evaluation findings &amp; remedy of Defect</th>
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<tbody>
<tr>
<td>Inspection of weld seam</td>
<td>All welds</td>
<td>Naked Eye or Lens</td>
<td>All faulty welds shall be rectified</td>
</tr>
<tr>
<td>Checking of Sizes</td>
<td>At least one for each Weld</td>
<td>Ordinary measuring instruments (rule, templates)</td>
<td>Should any faulty welds be found all welds shall be checked &amp; all defects shall be rectified.</td>
</tr>
<tr>
<td>Mechanical tests for welding procedure Performance &amp; electrodes</td>
<td>As per IS: 823</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### ANNEXURE - B

**INADMISSIBLE WELD DEFECTS AND TOLERANCE ALLOWED FOR WELDS**

<table>
<thead>
<tr>
<th>Defects</th>
<th>Detailing of sketching of defect</th>
<th>Allowed tolerances &amp; remedy of defects</th>
<th>Cause of defects</th>
<th>Mode of finding defects</th>
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</thead>
<tbody>
<tr>
<td>Unsatisfactory appearance</td>
<td>Uneven width rugged seam</td>
<td>At discretion cut weld &amp; reweld</td>
<td>Uneven welding progress, voltage fluctuations, varying arc length, negligence inexperienced welded</td>
<td>External (visual inspection)</td>
</tr>
<tr>
<td>Unsatisfactory shape</td>
<td>Shallow or jutting welds</td>
<td>No variance from design shape shall be allowed</td>
<td>Negligence</td>
<td>Visual inspection template checking</td>
</tr>
<tr>
<td>Incomplete weld</td>
<td>Not allowed fill in weld</td>
<td></td>
<td></td>
<td>Template checking</td>
</tr>
<tr>
<td>Molten metal flow</td>
<td>Not allowed fill in weld wrong</td>
<td>Excessive melting, ions handling of electrodes</td>
<td></td>
<td>Visual inspection</td>
</tr>
<tr>
<td>Pits</td>
<td>Not allowed cut &amp; reweld</td>
<td>Wrong welding technique</td>
<td></td>
<td>Visual inspection</td>
</tr>
<tr>
<td>Surface cracks</td>
<td>Not allowed cut &amp; reweld</td>
<td>Greater stresses, sudden cooling, wrong type of electrodes</td>
<td></td>
<td>Visual inspection</td>
</tr>
</tbody>
</table>
| Incorrect sectional dimensions | B1 = ±2mm
B2 = ±2mm
B = ±1mm C = ±1mm Chisel & grid | Negligence | | Template checking |
| A) Depth weld | | | | |
| Insufficient | For weld lengths 11±5mm, for 12+10mm for shorter seams cur & reweld or complete to length | Negligence | | Rule checking |
| Back cuts | If 0.5mm for 10mm & C1mm for 10mm replace relevant members | Burnt material, excessive melting | | Visual inspection |
| Surface porosities | Max 5% of seam area cut & re-weld | Frequent interruptions or welding electrodes inadequately covered | | Visual inspection |
SECTION 2.6 - MASONRY

2.6.1 Block Work

Relevant Indian Standards

The Standards to be followed are:

- IS 264 Specification for Ordinary and Low heat Portland cement
- IS 383 Specification for Course and Fine Aggregate for Cement
- IS 455 Specifications for Portland Slag Cement
- IS 456 Code of Practice for Plain and Reinforced Cement Concrete
- IS 2185 Specification for Cement Concrete Block
- IS 2572 Code of practice for Construction of Concrete Walls
- IS 9103 Specification for Admixture of Concrete

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

2.6.1.1 Dimensions

The size of hollow blocks shall be as specified in the item of work. The maximum variation in dimensions shall not be more than +1.5mm in ht. and breadth and +/- 3mm in length.

2.6.1.2 Handling and Storage

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

2.6.1.3 Sampling

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

All 20 blocks shall be checked for dimension and inspected for visual defects. Out of the 20 blocks, 3 blocks shall be subjected to test for block density, 8 blocks for compressive strength, 3 blocks for test of water absorption, 3 blocks for drying shrinkage and rest for moisture movement. Block shall be approved if requirement of conditions mentioned in 11.2 to 11.5 of IS: 2185 Part 1 are satisfied.

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

2.6.1.4 Tolerances in Block work

Maximum variation in the dimensions shall not vary by 5% in length and 3% in width and height.
2.6.1.5 Preparatory Work

Wetting of blocks

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

2.6.1.6 Laying Concrete Block Masonry

Each block shall be set with bedding joints and vertical joints filled thoroughly. The wall shall be taken up truly plumb. All courses shall be laid truly horizontal and vertical joints truly vertical. Vertical joints in alternate courses shall come directly over the other. Thickness of the block courses shall be kept uniform.

Necessary tools comprising of wooden straight edge, mason’s spirit level, square, foot rule, plumb line and pins etc. shall be frequently and fully used by the masons to ensure that the walls are taken up true to plumb line and levels. All the connecting block masonry work shall be carried out at nearly one level and no portion of work shall be raised more than 1m above the rest of work. Any dislodged block shall be removed and reset in fresh mortar.

The construction of walls may be started either at the corners first, or started from one end and proceeding in the other direction. If the corners of the walls are built first, they shall be built four or five courses higher than the centre of the walls. As each course is prelaid at the corner, it shall be checked for alignment, level and for being plumb to ensure truly straight and vertical walls. Each course in building shall be stepped back by half block and the horizontal spacing of the block shall be checked by placing a mason’s level diagonally across the corners of the block, the mason’s line shall be stretched from corner to corner for each course and the top outside edge of each block shall be laid to this line. Handling or gripping the block shall be such as to position the block properly with minimum adjustment. Mortar shall not be spread too far ahead of actual laying of the block that it tends to stiffen and lose its plasticity.

2.6.1.7 Closure Block

When installing the closing block, all edges of the opening and all four vertical edges of the closure block shall be buttered with mortar the closure block shall be carefully lowered into place. If any of the mortar falls out leaving an open joint the closure block shall be removed, fresh mortar applied and the operation.

2.6.1.8 Joints

Horizontal (bedding) joints

Mortar shall be spread over the entire top surface of the block including front and rear shall as well as the webs to a uniform layer of 10mm thickness.

When filling in the wall between the corners Vertical (cross) joints for vertical joints, mortar shall be applied on the vertical edges of the front and rear shall the blocks. The mortar shall be applied on the edges of the succeeding unit when it is standing vertically and then placing it horizontally well pressed against the previously laid unit so as to provide well compacted vertical joints. In the case of two cell blocks, depression on either vertical sides shall also be filled with mortar.

The thickness of both horizontal and vertical joint shall be not more than 10mm. All face shall be raked to a minimum depth of 10mm by raking tool when the mortar is still green. Where pointing or plastering is not required to be done, the joints can be struck flush and finish at the time of laying, such decision lying solely with the Development Manager. The face of concrete block masonry shall be kept cleaned and all mortar droppings removed promptly.
Provision for doors and windows frames. A course of solid concrete block masonry shall be provided under doors and window openings or a 10cm tick pre cast concrete sill-block under windows. The solid course shall extend for atleast 20cm beyond the opening on either side. For jabs of doors and windows, either solid concrete blocks shall be provided or if hollow units are used, the hollows shall be filed with cement concrete 1:2:4

All block work shall be plumb, square and properly bonded. The joints shall be broken. The thickness of the courses shall be uniform with courses horizontal. All connected work shall be carried out at nearly one level and no portion of the work shall be left more than one course lower than the adjacent work.

Blocks shall be full height and no cut pieces shall be allowed.

Where blocks are to be used for load bearing walls, the uppermost layer of the blocks supporting slab or other structural members, shall be solid or treated as directed by the Development Manager.

Precast concrete screen blocks or ‘jali’ work may be used for decorative purposes. The sub-contractor shall furnish samples for approval.

Fire Stop: Has to be provided for top of partition and duct penetration.

2.6.1.9 Scaffolding

Independent double scaffolding free of the masonry work shall be provided. It shall be tied back in both directions. Planks shall be provided all around. Railing to outside faces shall be provided. Scaffolding must be strong & easy to maintain. Holes in masonry to support scaffolding will not be permitted.

2.6.1.10 Protection

Maintain protection against entry of moisture into block work when stored and whenever work is interrupted.

Exposed ledges are to be protected. External corners must be protected which may be damaged by construction activities.

2.6.1.11 Cleaning and Pointing:

Smooth finished block work to be cleaned by means of scrapes or stoning. Acids should not be used for cleaning.

Any loose or open joints are to be pointed as required. Replace finishes and materials that cannot be satisfactorily cleaned.

2.6.1.12 Measurements:

Solid Cement Concrete block work shall be measured in square meters for specified width. Rates for items shall include the following:

- Material and labour for the completion of items as specified including any centering, shuttering, curing etc
- Raking out joints
- Preparing tops and sides
• Forming and preparing expansion joints, construction joints, contraction joints
• Making holes, openings etc for outlets, embedding pipes and finishes exposed surfaces as instructed by the Development Manager.

Deductions such as lintels and openings shall be measured for net sizes of all such openings and recesses for 0.1 square meters and over.

2.6.2 BRICK MASONRY
2.6.2.01 GENERAL

All bricks shall be table moulded and shall be of the correct size and dimension.
Brick shall be well burnt having uniform colour and shall conform to IS-1077.
Table moulded bricks shall be soaked for at least 12 hours in fresh water before using for the brick masonry.
Brickwork, unless specified otherwise shall be done in English bond with frog upwards.
The brick masonry shall be carried out as per the drawings with setbacks, projection, cutting, footings.
Brick work shall be bedded into position in cement mortar 1:6, one of cement and six of sand.
Each brick shall be correctly bedded into position by tapping with the handle of the towel.
Grouting of mortar slurry will not be allowed.
Each brick course shall be truly in horizontal position and have perfect bond, face of the wall shall be straight, plum and even.
The mortar joint shall not be more than 10mm thickness except where extra thickness is required for the purpose of bringing the brickwork to the required height or level.
Half bricks shall not be used except for obtaining the bond and where absolutely necessary.
Brick masonry for 230mm wall shall be built with alternate course of header and stretcher.
The stretcher course has to match the header course at the external surface.
The stretcher courses are to be packed with cement mortar to achieve the same external surface.
The surfaces should be scarified to receive plaster.
Junctions of wall and cross wall shall be carefully bonded to the main walls.
Maximum height of masonry built in a day shall not be more than 100cms.
Brick masonry shall be protected from rain to prevent any mortar being washed away.
In case the mortar being washed away or disturbed because of the rains the work shall be removed and rebuilt at contractor's expenses.
Half brick masonry shall be done with cement mortar 1:4.
Provide 2 nos. - 6 mm mild steel bar with ties at one meter interval on top of the first course and at every 5th course thereafter.
The cost of half bricks masonry shall include the cost of reinforcement at its labour.
Half brick masonry shall not be built more than six courses in a day.
Half brick masonry shall be provided with concrete 75 mm thick at first course and at every 5th course thereafter embedding the steel. The cost of concrete shall also be included in the brick masonry.
Brick masonry shall be kept wetted for two weeks.

END OF SECTION
SECTION 2.7 - PLASTERING WORK

Relevant Bureau of Indian Standard Codes (BIS)

The Standards to be followed are:

IS 383  Specification for Course Aggregate and Fine Aggregate
IS 412  Specification for Expanded Metal sheet for General Purpose
IS 1542 Specification for Sand and Plaster
IS 1661 Code of Practice for Application of Cement Plaster Finishes
IS 2645 Specifications for Integral Cement Waterproofing Compound

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

2.7.1 General

Plaster as herein specified shall be applied to all internal and external surfaces where called for. Glazed tile dado, terrazzo dado and other wall finishes shall be provided where indicated on drawings and schedule of finishes. Areas called for on drawings and typical shall be considered to apply to appropriate adjoining areas whether shown on same drawings or not and whether indicated or not.

All plaster work and other wall finished shall be executed by skilled workmen in a workmanlike manner and shall be of the best workmanship and in strict accordance with the dimensions on drawings subject to the approval of the architect/contractor/consultant.

2.7.2 Plaster Work

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

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

Wherever directed by the Development Manager, all joints between concrete frames and masonry in filling shall be expressed by a groove cut in the plaster. The said groove shall coincide with the joints beneath as directed. Where grooves are not called for, the joints between concrete members and masonry in filling shall be covered by 24 gauge galvanized chicken mesh strips 400mm wide or as called for on drawings/documents which shall be in position before plastering.

2.7.3 Chasing & Breakage

All chasing, installations of conduits, inserts boxes etc., shall be completed before any plastering or other wall finish is commenced on a surface. No chasing or cutting of plaster or other finish on a surface shall be permitted, broken corners shall be cut back not less than 150mm on both sides and patched with Plaster of Paris as directed. All corners shall be rounded to a radius of 8mm or as directed by the Development Manager.
2.7.4 Samples

Samples of each type of plaster & other wall finish shall be prepared well in advance of undertaking the work for approval by the Development Manager. The Contractor shall also prepare Method Statement for plastering works.

2.7.5 Material:

Cement and Water shall conform to the respective Specification described under the section on Concrete of this volume. Sand shall conform to IS : 1542, specifications for sand plaster aggregate shall conform to IS :383, except that it shall be sieved so that it does not contain particles greater than 1/8″ and shall be carefully washed.

Sand from beds of rivers carrying saline water is not to be used.

Marble dust obtained from crushing of hard marble shall not contain more than 8% of silt determined by field test. Fineness Modulus shall be greater than 1.0. Integral waterproofing compound shall conform to IS: 2645.

2.7.6 Workmanship:

Mixing shall be done mechanically. Each mortar batch shall be within half-hour.

Surfaces to be plastered must be clean and free from dust, loose material, oil grease, mortar droppings, sticking of foreign matter, traces of algae etc. It is very important to ensure that there should not be any chance of plaster getting de bonded due to material harmful to bonding.

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

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

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

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

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

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

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

Scaffolding with railing gives more confidence to workers and increases quality of work.

Actual plastering work shall be undertaken only on the approval of the Development Manager. Following steps should be adopted prior to plaster:

• Surface of application should be thoroughly cleaned.
• Plaster Area must be provided with level dabs or spots allowing working and checking with 2-3 m straight edge. Depth of plaster must not be than 8 mm at any point.
• Required concealing services must be completed and tested.
• No further cutting of masonry will be required.
• Repairs carried out to masonry or concealed services must be cured and dry.
• Surface must be sufficiently damp
• Chicken wire mesh to be put in junctions of masonry and concrete abutments.
• Corner beads and angle stops finished to line and level (measured and paid for separately)

Plastering of entire or unobstructed areas shall be done at one stretch. On occasions when as a result of the extent of the area being too large, or other reason, the work is to be left over for completion on the next morning day. The work to be carried out in such a manner as to have no marks left on the finished work, and joints are to rubbed with carborundum stone to give an even surface without any impression.

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

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

All works shall be executed as per Method Statement approved by the Development Manager. If any marks develop during the Defects Liability Period as defined in the General Conditions of Contract, the Contractor shall rectify the same and make good the surface disturbed at its own cost.

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

2.7.7 Lime for Rendering

This wall be prepared out of best quality fat lime slaked at site with fresh water not less than one week or more than two weeks before use. All impurities, ashes, improperly burnt stuff shall be screened and picked out before slackening. Slaked lime shall be screened through to remove all un-slaked materials, stones etc., so that only a fine creamy paste is available for rendering. Slaking lime is diluted with just sufficient water to give a thick consistent liquid suitable for effective covering of base surface. Before the base coat sets the lime rendering is applied and finished smooth and the entire plastered surface is truly plane.

2.7.8 Measurement of Plastering works:

Plasterwork shall be measured in square meters of the actual work done to the second place of decimal.

No paint, distemper, colour wash or white wash shall be applied to the plastered surfaces for at least two months or until the Contractor has satisfied the Development Manager that the walls and plaster are thoroughly dry.

Thickness of plaster shall be minimum depth of plaster as specified. But if extra thicknesses occur due to bad workmanship or bad quality of bricks, they shall be to the Contractor's account. Nothing extra will be paid for work arises, rounded angles, fair edges, narrow returns, "V- joints", splays, drip mouldings, making good around pipes, conduits, cills, brackets, railings etc.
2.7.8.1 Deductions:

No deductions shall be made to opening of area less than 0.5 sqm.

2.7.8.2 Rates to include

Rates shall include wherever necessary, conveyance, delivery, handling, unloading, storing, fabrication, hoisting, all labour for finishing to required shapes and sizes, setting, fitting and fixing in position, straight cutting and other incidentals.

- Execution of work at all levels and heights as shown in drawings and specified.
- Preparation of Surfaces
- Protection of masonry, if required
- Protection of other finished surfaces.
- Providing, fixing, maintaining and removing the same on completion
- Scaffolding and working platform
- Curing
- Cleaning of adjacent areas, windows, doors etc
- Forming grooves
- Providing and fixing angle stops and corner beads (measured and paid separately)
- Providing and fixing chicken mesh at junctions of RCC, brick, block work edges, corners, repaired areas, concealed conduits etc as directed by the Development Manager. It shall be considered as a part of item and no separate charge will be payable.
- Edges of switch boxes, junction boxes and other services and fittings shall be finished next at no extra charge.
- Labour and material
- Raking out joints
- Hacking and hatching the concrete surface and providing the key for holding down the plaster
- tatering

END OF SECTION
SECTION 2.8 - MISCELLANEOUS WORKS

2.8.1 Anti Termite Treatment

2.8.1.1 Specifications for Anti Termite Treatment

All the buildings shall be adequately protected against attack by sub terrain termites by suitable chemical treatment measures. The work shall be carried out by a specialist pest control agency approved by Project Manager / Professional Team. The work to be carried out by the specialist firm shall carry a guarantee for the satisfactory performance of the treatment for a min. Period of ten (10) years.

The treatment shall be carried out generally in accordance with the stipulation laid down by IS 6313 - Part II latest edition (Code of practice for anti-termite measures in buildings and part II re constructional chemical treatment measures) subject to the min. Requirement given in this specification.

2.8.1.2 Minimum Specifications

The earth filling immediately under the stone soling (under floors) bottom and side fills of all foundations (excepting foundations) and soil along external perimeter of all buildings shall be chemically treated against termites. The chemical to be used for the treatment shall be Dieldrin, Aldrin, Heptachlor or Chlordane or as specified conforming to the requirement and concentration laid down in IS 6313 (Part II) - latest edition.

2.8.1.3 Application

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

2.8.1.3.1 Column Pits, Wall Trenches, etc.,

The bottom surface and sides of the excavations (up to a height of 30cm from the bottom) made for column foundations, wall foundations etc., (excepting RCC foundations) shall be treated with the chemical emulsion at the rate of 5 ltr/m² of surface area.

2.8.1.3.2 Treatment to Backfill

After the column foundations, wall foundations etc., are constructed, the back fill in immediate contact with the foundation structure shall be treated at the rate of 15 ltr/m² of the surface of the substructure for each side if water is used for ramming operation completely by rodding earth at 15cm centers close to the wall face and spraying the chemical with the above dose. The earth shall be filled in layers and the treatment shall also be carried out in similar stages. The chemical emulsion shall be directed towards the masonry wall surfaces so that the earth in contact with these surfaces is well treated with the chemicals.

In the case of RCC walls and columns, the treatment shall start at the depth of 50 cm. below natural ground level.

From this depth the back fill around the RCC columns, walls, etc., shall be treated at the rate of 15 ltr/m² of the surface.

2.8.1.3.3 Top Surface of Plinth Filling

The top surface of the plinth fill (just below the stone soling) shall be treated with chemical emulsion at the rate of 5 ltr/m² of the surface before the stone lay. If the filled earth has been well consolidated and does not permit the emulsion to seep through, holes up to 50 to 75mm deep at 150mm centers both ways may be made with crowbars to facilitate saturation of the soil with the chemical emulsion.
2.8.1.3.4 Junction of Wall and Floor

A channel size of 3x3 cm shall be made at all the junction of walls and columns with the floor (before laying soling) and rod holes made in the channels up to the ground level at 15cm centers. The solution is poured into the channels at the rate of 15 ltr/m² of the vertical surface and allowed to soak through the holes fully so that the soil is in contact with the chemical. The soil shall be tamped back into the channel and consolidation to the original conditions.

2.8.1.3.5 External Perimeter of Building

After the building is complete, holes shall be made along the external perimeter of the building at intervals 15cms and depth of 30cms and the emulsions shall be allowed to soak through these holes fully at the rate of 5 ltr/m² of the perimeter wall.

2.8.1.3.6 Soil Surrounding Pipes

Wherever any service pipes enter the soil inside the area of the foundations of any building, the solid surrounding the point of entry of each pipe at the foundation, floor etc., shall be fully soaked with the chemical solution for a distance of at least 1mtr from the point of such entry.

2.8.1.3.7 Expansion Joints

Soil beneath the expansion joints at ground floor level shall be specially treated as directed. The joints itself shall also be treated as directed by the Project Manager / Professional Team.

2.8.1.3.8 Treatment under Apron

The soil below the concrete for stone aprons to be provided around the perimeter walls of all buildings shall also be treated with the chemical solutions at the rate of 5 ltr/m².

2.8.1.3.9 Treatment over DPC

Top of concrete damp proof course in external and internal walls shall be given a liberal coat of chemical solution when the concrete is still green.

2.8.1.4 Spraying Equipment

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

2.8.1.5 Code of Practice:

Notwithstanding the above the specialist Contractor will ensure that all requirements in accordance with the relevant Indian Codes are met with regards to materials, application, handling and storage.

2.8.1.6 Guarantee:

On completion of the treatment in all respects, a guarantee that the building is safe from subterranean species of termite infestation for a period of 10 years is required on stamp paper in a format which shall be approved by the Developer who shall have the final decision.

In the event of re-infestation of the said structure at any time during guarantee period, an undertaking is required to carry out such treatment as may be necessary to render the structure free from termite infestation without any extra cost including any remedial work, resulting sleeves, cutout etc.

2.8.2 Admixtures and Additives

- Chemical admixtures are not to be used until permitted by the Project Manager / Professional Team. In case their use is permitted, the type, amount and method of use of any
admixture proposed by the Contractor shall be submitted to Project Manager / Professional Team for approval.

- The Contractor shall further provide the following information concerning each admixture to Project Manager / Professional Team.
  - Normal dosage and detrimental effects, if any, of under dosage and over dosage.
  - The chemical names of main ingredients in the admixture
  - The Chloride iron content, if any, expressed as a percentage by weight of admixture.
  - Whether or not the admixture leads to the entrainment of air when used in the manufacturer’s recommended dosage.
  - Where two or more admixtures are proposed to be used in any one mix, the manufacturer’s written confirmation of their compatibility.
  - In reinforced concrete, the chloride iron of any admixtures used shall not exceed 2 percent by weight of the admixtures in accordance with IS 6925 and the total chloride iron in all admixtures used in concrete mix shall not exceed 0.03 % by weight of cement
  - The admixtures when used shall conform to IS 9103 “The suitability of all admixtures shall be verified by trial mixtures”.
  - The addition of calcium chloride to concrete containing embedded metal will not be permitted under any circumstances.
  - Retarding admixtures when used shall be based on lingosulphonates with due considerations to IS 7861
  - Water proofing admixtures shall comply with IS 2645.

2.8.3 Grouts

2.8.3.1 Grouting

- Grouting shall be done in 1:2 cement mortar (one part cement and two parts coarse sand) of thickness 3" (75mm) or less, or as directed. Where the thickness is more than 3" (75 mm) thick grouting shall be done in plain or reinforced cement with coarse aggregate 3/8" and down gauge. The mix of concrete will be as shown in the relevant drawings as directed.
- The base plate shall be temporarily supported on steel wedges and properly aligned before grouting. Forms shall be built around the base and wet mortar shall be placed under pressure around and under the base. To ensure that no air pockets are left after grouting addition holes may have to be cut if directed in the base plate so that pressure grouting can be carried out thorough these holes also and proper inspection of the grout can be ascertained. The wedges shall be removed after the grouting has set and recess shall be properly pointed.
- Grouting of machine foundations shall be done only after taking the written instructions form the Project Manager / Professional Team.
- The grouting work is included in the respective item of concrete and the rate for these items and inclusive of proper pressure grouting after preparations of surfaces to be grouted, necessary form work providing and removing necessary wedges, cutting holes in the base plate to ensure that the air pockets are left etc. No extra rate will be paid for grouting or any work that will be necessary to carry out and ensure proper grouting entirely to the satisfaction of the Project Manager / Professional Team. If however a concrete mix richer than the foundation is specified for grouting, only the difference of the quantity of cement used in richer mix of grout and the mix of the footing shall be paid.

2.8.3.2 Special Grouts

Where so specified non-shrinking grouts such as ‘Conbextra’, ‘shrinkkomp’ or ‘Ferro grout’ shall be used as per the instructions and specifications of the manufacturers.

2.8.4 Precast Concrete

2.8.4.1 Precast Nominal Mix Concrete

General
All pre-cast concrete shall be cast over vibrating tables or by using form vibrators. The concrete mix shall conform in all respect to “Various Concretes” described in the appropriate paragraph under this section.

Exposed pre-cast surfaces shall be finished as called for on the drawing or as directed by the Project Manager / Professional Team. All surfaces coming in contact with in situ concrete shall be wire brushed and hosed down until the aggregate is free from cement slurry. Castellation shall be provided wherever called for. Leaving grouting holes, grooves, inserts, projections reinforcements, lifting hooks etc., to conform to the erection procedure. All edges and delicate projection likely to be damaged during erection shall be protected by means of wooden cover fillets, until placed in position.

2.8.4.2 Precast Jali Blocks Louvers, Shelves, etc

All pre-cast jali shall be exactly of the size and pattern shown on the drawings and shall be made face up in the following manner. All units shall be integrally cast, steel formwork shall be used for making jalis.

Provide the formwork as shown in the drawings. Stiff plastic concrete 1:1.5:3 shall be used with coarse aggregate 12mm and down size.

The pre-cast units shall not be removed from the forms for three days. Precast work shall be cured under cover and shall be kept under water for fifteen days before placing in position.

Samples of each part shall be approved by the Project Manager / Professional Team before proceeding with the work.

Unit may require wetting before bedding. The concrete base shall be wetted and coated with slurry and minimum of mixing water shall be used in the bedding mortar, which shall be Portland cement and sand 1:3.

The section shall apply also to pre stressed pre-cast controlled concrete work.

For all pre-cast controlled concrete work a specially equipped site factory, with casting yard, pre tensioning beds of individual moulds for vibrating plants, cement store, concrete laboratory erection equipment, etc., are to be provided. The Contractor is deemed to have included in his Scope all the above provisions needed for a workman like construction in pre-cast controlled concrete.

All pre-cast design mix concrete shall be weigh batched.

2.8.4.3 Placing and Compacting of Concrete

All precautions in handling and placing of high strength concrete mixes apply. The concrete placed shall be compacted thoroughly by using pin, vibrators, shutter vibrators or other suitable means. No construction joints shall be allowed in pre-cast design mix concrete work. Un-shuttered top surfaces are to be finished smooth with trowel.

During the period of initial setting special precautions are to be taken to keep pre-cast members sufficiently moist to protect them against vibrations and any adverse loading.

2.8.5 Waterproofing

Alternatives

1. Membrane Type
2. Cement Based Waterproofing

2.8.5.1A Membrane Method

Basements / Retaining walls

PCC surface to be cleaned brushed and ensured of clean surface.
PCC surface shall be coated with compatible primer / Cold sticker / blown bitumen of grade 85/25 or 90/15.

Waterproofing treatment with polymeric standard waterproofing membrane of 4mm thick with polyester reinforcement with 180GSM polyester (Polyplus / Fosroc / IWL / Texta ) shall be provided as per the manufacturer’s specification approved by clients with an overlap of 10cms. Then membrane shall be bound by torch application with 10cms overlap where required. Topping shall be done with laying of 3mm thick Bituboard or 12mm thick thermocole sheet of 25kg/cum density with necessary adhesive / hot blown bitumen.

As an alternative self adhesive, self healing, 2mm thick SBS based membrane with 250 gsm polyester topping mat and 1000N puncture resistance shall be used as per the manufacturer’s specification approved by consultants.

**Podium / Terrace**

RCC surface to be cleaned brushed and ensured of clean surface. Water stagnation test shall be done for terrace slabs.

Screed surface of an average thickness of 75mm shall be provided over the slab.

Screed surface shall be coated with compatible primer / Cold sticker / blown bitumen of grade 85/25 or 90/15. Waterproofing treatment with polymeric standard waterproofing membrane of 4mm thick with polyester reinforcement with 180GSM polyester (Polyplus / Deboer / Texta / IWL ) shall be provided as per the manufacturer’s specification approved by clients with an overlap of 10cms. Then membrane shall be bound by torch application with 10cms overlap where required. Topping shall be done with laying of 3mm thick Bituboard or 12mm thick thermocole sheet of 25kg/cum density with necessary adhesive / hot blown bitumen. Over Bituboard / thermocole sheet, brick coba / Grano concrete / Lightweight concrete of thickness as specified shall be laid to slope and curing shall be done. Groove cutting of size 10mm x 6mm at specified intervals (at every 25 sqm area) and filling with UV resistant sealant (Nito seal from Fosroc or equivalent) shall be carried as specified.

**Alternative**

As an alternative self adhesive, self healing, 2mm thick SBS based membrane with 250 gsm polyester topping mat and 1000N puncture resistance shall be used as per the manufacturer’s specification approved by consultants.

**2.8.5.18** Cement Based Waterproofing

Related Works

a. Includes de-watering, soling, PCC 1:3:6, drains.
b. Concreting for retaining walls, slab casting at toilets, terraces. c. Overhead tanks, sump tanks.

Material

a. Cement - @ 5 bags/100 Sft
b. Sand - Shall be clean river sand
c. Water Proofing Admixture - By approved Manufacturer
d. Aggregates - 20mm size
e. Brick bats

Execution

Box Method
A. **Basement**
   a. First layer shall be laid after cleaning, brushing the PCC layer/blinding concrete.
   b. First coat of waterproof plaster is done with CM 1:3 & approved waterproofing admixture as per manufacturer's specification to be used with cement.
   c. Low porosity 20mm thick cudadapah stone slabs of size not less than 450x450mm shall be laid over first layer. Joints shall be scraped and treated with waterproof cement grout.
   d. Grouting shall be done at selected points with cement slurry mixed with waterproof admixture.
   e. Third layer or finishing coat is done with waterproof admixture mixed cement mortar and surface is finished smooth. Curing shall be carried out for a minimum period of 7 days.
   f. Total thickness of water proofing layers shall be not less than 60mm.

B. **Retaining Wall**
   a. 20mm thick Low porosity cudadapah stone slabs of size not less than 450x450mm shall be laid leaving a gap of 15mm thick from retaining wall. Joints shall be scraped and treated/ sealed with waterproof cement grout.
   b. Grouting material mixed with cement and waterproofing admixture shall be poured into the gap and sealed properly and pressure grouting at every 1m intervals shall be carried out as specified.
   c. Water proof admixture to be used as per manufacturer’s specification with CM 1:3. d. Grouting wherever necessary and at construction joints shall be carried out.
   e. Curing shall be done till 7 days.
   f. Back filling shall be done carefully with specified material. Care to take not to puncture the layer.

**Surface Method**

A. **Roof**

**Part - 1**

a. RCC surface to be cleaned, brushed and watered.
   b. First coat of bituminous water proof coating (two part highly purified Coal tar and polyurethane polymer) shall be applied after necessary grouting at construction joints and honey comb areas with cement grout.
   c. Nylon fine mesh/Geo-fabric shall be fixed with minimum overlap of 100mm.
   d. First coat of bituminous water proof coating (two part highly purified Coal tar and polyurethane polymer) shall be applied over fabric layer.
   e. Treatment shall continue along the parapet for a height of 300mm above the finished level.

Material: TAR OTHANE of Choksey make / NITOPROOF100/ 120/600 of Fosroc make or equivalent)

**Part - 2**

a. RCC surface to be cleaned, brushed and watered.
   b. Cement slurry with waterproof compound shall be provided over the cleaned surface.
   c. Brick coba shall be laid for necessary gradient for easy flow of rain water (joints shall be filled with CM 1:1 with water proof compound) -OR-
   Metal coba shall be laid for specified thickness and necessary gradient for easy flow of rain water with CM 1:1 with waterproof compound.
   d. Coba to be covered with joint less water proof plaster with CM 1:2 with water proof compound as per manufacturer’s specification finish shall be smooth.
   e. Impression markings of 300mm x 300mm square to be done with 3mm rod.
   f. Parapet to be treated for a height of 600mm in shape of round water.
   g. Curing shall be carried for 7 days.

B. **Sump, OHTank and Toilets**

a. RCC surface to be cleaned, brushed and watered.
b. Toilets: Water proofing for floor shall be of 35mm thick, for walls shall be 25mm thick with CM 1:4
  c. For OHTank and UG Sump thickness of plaster shall be 35mm in two layers d.
  Waterproofing admixture shall be as per the manufacturer’s specification.
  e. Grouting shall be done with cement slurry wherever required and honeycombing in concrete
     is found.
  f. Curing shall be done for a minimum period of 7 days.

2.8.6 Expansion Joints, Water Stops, Premoulded Joint Fillers, Flashings

2.8.6.1 Expansion Joints

Expansion joints shall be provided with filler boards and backer rods. Silicon/ Polyurethane sealant of
approved make shall be provided at floor tops and gap filler at soffit of slab. The joint width shall be
uniform throughout and special care shall be taken to ensure proper bonding at expansion joints
and the same shall be carried under approvals from Project Manager / Professional Team

Option - 2

Expansion joints shall be provided with 20 gauge copper strips/m.s. hot dip galvanised strips of 250
mm width at locations shown on drawings or as approved by Project Manager / Professional
Team. The strips shall be bent to the shape indicated on the drawing and embedded properly in
masonry. The joint width shall be uniform throughout and special care shall be taken to ensure
proper bonding at expansion joints. Expansion joints shall be continuous and where two or more
strips meet, they shall be lapped to the extent of 75 mm and joints properly soldered. The
expansion joints shall be filled with pre moulded joint fillers and sealed with mastic compound. For
purposes of measurement, the laps provided will be neglected.

2.8.6.2 Water Stops

Water stops shall be of preformed plastic adhesive or swelling bar of approved make (Synkoflex
or Master flex or equivalents). These shall be provided at locations indicated on drawings. Water
stops shall be cleaned thoroughly of all concrete and mortar coating as directed before resuming
concrete work. Water stops shall be in long lengths to avoid joints as far as possible.

2.8.6.3 Joint Filler

Premoulded joint fillers shall be of a non-deteriorating and resilient type. A sample of material
shall be approved by the Project Manager / Professional Team before being brought to site. Installation
shall be carried out properly and as directed.

2.8.6.4 Flashings

Metal or tar felt flashing shall be fixed as directed by the Project Manager / Professional Team. Metal
flashing where provided shall be welded / soldered to obtain continuity. Tar felt flashing shall be
lapped for a minimum length of 150 mm.

Flashings shall be measured and paid for in linear meters for the specified width disregarding laps or
junctions.

2.8.7 Specification For Laminated Neoprene Pad

The scope of this specification shall apply to laminated free elastomeric bearings.

2.6.7.1 Material

2.8.7.1.1 Chloroprene shall only be used in the manufacture of bearing.

2.8.7.1.2 Grades of raw elastomer of proven use in elastomeric bearings, with low crystallization Scope and
adequate shelf life (e.g. Neoprene, WRT, Baypren 110 or equivalent) shall be used. No reclaimed
rubber or vulcanized wastes shall be used.
2.8.7.1.3 The raw elastomer content of the compound shall not be lower than 60%. The ash content shall not exceed 5% (as per test conducted in accordance with ASTM D-297)

2.8.7.2 Properties of Elastomer

2.8.7.2.1 The elastomer shall conform to all properties specified in the following table.

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Property</th>
<th>Unit</th>
<th>Test method IS specification reference</th>
<th>Value of the characteristic specified.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Physical properties</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Hardness</td>
<td>IRHD</td>
<td>IS : 3400 (Part II)</td>
<td>60 ± 5</td>
</tr>
<tr>
<td>1.2</td>
<td>Minimum tensile strength</td>
<td>Mpa</td>
<td>IS : 3400 (Part I)</td>
<td></td>
</tr>
<tr>
<td>1.3</td>
<td>Minimum elongation at break</td>
<td>%</td>
<td>IS : 3400 (Part I)</td>
<td>400</td>
</tr>
<tr>
<td>2.0</td>
<td>Maximum compression set</td>
<td>%</td>
<td>IS : 3400 (Part X)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Duration (h)</td>
<td>Temperature (°C)</td>
</tr>
<tr>
<td>3.0</td>
<td>Maximum compression set</td>
<td>%</td>
<td>IS : 3400 (Part IV)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C.R. (+0 to 24-2)</td>
<td>100 ± 1</td>
</tr>
<tr>
<td>3.1</td>
<td>Maximum change in hardness</td>
<td>IRHD</td>
<td></td>
<td>+ 15</td>
</tr>
<tr>
<td>3.2</td>
<td>Maximum change in tensile strength</td>
<td>%</td>
<td></td>
<td>- 15</td>
</tr>
<tr>
<td>3.3</td>
<td>Maximum change in elongation</td>
<td>%</td>
<td></td>
<td>- 40</td>
</tr>
</tbody>
</table>
2.8.7.4 Fabrication

Bearing with steel laminates shall be cast as a single unit in a mould and vulcanized under heat and pressure. Casting of elements in separate units and subsequent bonding is not permitted nor shall cutting from large size cast be permitted.

Bearings of similar size shall be produced by identical process and in one lot as far as practicable.

The moulds used shall have standard surface finish adequate to produce bearings free from any surface blemishes.

Steel plates for laminates shall be sand blasted, clean of all mill scales and shall be free from all contaminates prior to bonding by vulcanization. Rusted plates with pitting shall not be used. All edges of plates shall be rounded.

Spacers used in mould to ensure cover and location of laminates shall be of minimum size and number practicable. Any hole at surface or in edge cover shall be filled in subsequently.

Care shall be taken to ensure uniform vulcanizing conditions and homogeneity of elostomer through the surface and body of the bearing.

The bearings shall be fabricated with the tolerance specified in the following table.

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Items</th>
<th>Tolerances</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Overall plan dimensions</td>
<td>-0, +6mm</td>
</tr>
<tr>
<td>2.</td>
<td>Total bearing thickness</td>
<td>-0, +5%</td>
</tr>
<tr>
<td>3.</td>
<td>Parallelism</td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Of top surface of bearing with respect to the bottom surface as datum.</td>
<td>1 in 200</td>
</tr>
<tr>
<td>b.</td>
<td>Of one side surface with respect to the other as datum</td>
<td>1 in 100</td>
</tr>
<tr>
<td>4. a.</td>
<td>Thickness of individual internal layer of elastomer</td>
<td>± 20% (max of 2 mm)</td>
</tr>
<tr>
<td>b.</td>
<td>Thickness of individual outer layer</td>
<td>-0, +1mm</td>
</tr>
<tr>
<td>5. a.</td>
<td>Plan dimensions of laminates</td>
<td>-3mm, +0</td>
</tr>
<tr>
<td>b.</td>
<td>Thickness of laminate</td>
<td>±10%</td>
</tr>
<tr>
<td>c.</td>
<td>Parallelism of laminate with respect to bearing base as datum</td>
<td>1 to 100</td>
</tr>
</tbody>
</table>

The vulcanizing equipment press should be such that between the platens of the press the pressure and temperature are uniform and capable of being maintained at constant values as required for effecting an uniform vulcanization of the bearing.
The moulding dies utilized for manufacturing the bearings should be so set inside the platen of the press so that the pressure construction during vulcanization of the product is evenly distributed and the thickness maintained at all places is within acceptable tolerance limits taking into consideration, the shrinkage allowance of vulcanization.

The raw compound which has been introduced inside the metal dies for vulcanization should be accurately weighed each time and it must be ensured that sufficient quantity has been put inside the die for proper flow of material at every place so that a homogeneous and compact bearing is produced without any sign of sponginess or deficiency of material at any place.

Before any vulcanization of any batch of production is used for producing vulcanized bearings, test pieces in the form of standard slab and buttons should be prepared in accordance with prescribed standards and salient properties tested and recorded regularly against each batch of production to monitor the quality of the products.

2.8.7.5 Quality Control Certificate

2.8.7.5.1 The manufacturer shall certify for each lot of bearing under acceptance:

a. That an adequate system of continuous quality control was operated in his plant.

b. That the entire process remained in control during the production of the lot of bearings under acceptance as verified from the quality control records / charts which shall be open to inspection of the Project Manager / Professional Team on demand.

2.8.7.5.2 A certified copy of the results of process control testing done and samples of elastomer used in the production of the lot shall be appended and shall include at least the following information.

2.8.7.5.3 Composition of the compound- raw elastomer and ash content, the grade of raw clastomer used (include name, source, age on shelf), test results of hardness, tensile strength, elongation at break compression set, accelerated ageing etc.,