GENERAL SCOPE

REV. NO.	PRAPARED	APPROVED	DATE

1) These Specifications establish and define the material and constructional requirements for civil, structural and architectural works.
2) Method of measurement are indicated in these specifications. Where not so specified, latest version of IS: 1200 shall be applicable.
3) Providing and operating necessary measuring and testing devices and materials including all Consumables are included in the scope of work. No separate measurement or payment for testing the work shall be made but rates quoted for various items shall be deemed to include the cost of such tests which are required.
4) All materials shall be standard quality, manufactured by renewed concerns, conforming the Indian standards or equivalent and shall have "IS" mark as far as possible unless other wise approved by engineer in-charge prior to procurement and use. The contractor shall furnish manufacture's certificates, for the materials tested from an approval test house, if asked for by the engineer-in-charge. The costs of all test and the test certificates, shall be borne by the contractor. No separate payment shall be made for the testing. The Engineer –in-charge shall have the right to determine whether all or any of the materials are suitable. Any materials procured or brought to sight and not conforming the specifications and satisfaction of the Engineer-in-charge shall be rejected and the contractor shall have to remove the same immediately from sight at his own expenses and with out any claim for compensation due to such rejection.
5) Where ever referred to in third tender document, only the latest revision which shall be enforced in the completion of work of specifications, codes of practice and other publications of the Bureau of Indian Standards shall be applicable.
6) Wherever contractor executes civil and structural works involving building and equipment foundations, structural work or building pipe etc the following works are deemed to have been included in the quoted rates for various works.

    1. Mark of center lines or foundations

    2. Marking of top levels of foundations, floors etc and establishment of reference lines, bench marks on various floors, plat forms etc.

    3. Preparation of "as built" scheme of structural foundation and indicating designed and achieved levels, center line and dimensions of pockets, position and level of anchor bolt etc.

7) In case of conflict amongst the provisions of schedule of rate specifications and drawings, all of them shall be read in conjunction with other and clarification shall be obtained from the Engineer-in- charge whose decision shall be final and binding.
Following procedure may generally followed

    7.1 Description of items in schedule of rates shall be followed when provisions therein are different from those in specifications
    7.2 Where the description of items doesn't call out for some specific requirement but the same are given in specifications, the specifications shall be followed, in addition to the requirements given in description of items

7.3 Where drawings call out for requirements different from or additional to those given item description and specifications, the decision of the Engineer-In-Charge shall be obtained as to what to shall be followed.

PROPERTIES, STORAGE & HANDLING OF COMMON BUILDING MATERIALS

REV. NO.	PRAPARED	APPROVED	DATE
00	MARINA	PMISHRA	30.10.09

1.00.0 Scope

The scope for this section is to specify the properties, storage and handling of Common building materials unless otherwise mentioned in drawings or Schedule items.

2.00.0 MATERIALS

a) Bricks

Bricks for general masonry work shall be conform to IS: 10 and for face Bricks work shall conform to the specifications in IS: 2691.

Bricks for general masonry work shall be of first class (Class A) quality, WellBurnt, of uniform size, shape and colour free cracks, flaws or nosules Or free lime and emit clear ringing sound when struck. Fractured surface Shall show uniform texture free from grits, lumps holes etc. Compressive Strength shall be 75kg/cm^2 minimum for common bricks and 150/kg/cm^2 Minimum for face bricks. Water for common bricks absorption after 24 Hours Immersion shall not exceed 15% by weight for common bricks and 12%For Face bricks. Dimensional tolerance shall not exceed 8% of the size shown in Drawing for common bricks and 3% for face bricks. All bricks shall haveRectangular faces and shape bricks shall be 6mm at the edges and 10mmFor Corners. The bricks shall show no effluences after socking in water and
In shade.

Each bricks shall have manufacturer's identification marks elearly marked on The frog. Representative samples shall be submitted and approved sample shall be retained by the of face bricks shall be limited to the range of samples submitted. Any brick not found the specification should be removed immediately from site at the contractor's own cost.

b) stone

All stones shall be from approved quarries. Hard, tough, durable compact Drained, uniform in texture and colour and free from decay, flaws, veins, Cracks and sand holes. The surface of freshly broken stone shall be bright, Clean and sharp and shall show uniformity of texture, without loose grains And free from any dull, chalky or earthy appearance. Stone showing mottled Colours shall not be used for face works. A stone shall not absorb more than 5 present of its weight of water after 24 hours immersion. The type of stone Shall be as specified on drawings and/or instructed by Engineer. Samples Shall be submitted by the contactor and approved samples shall be retained by By the engineer for comparison of bulk supply.

c) Lime

Lime shall be stone lime and conform to the specification Building lime IS: 712. Lime putty may be prepared from hydrated lime or quick lime. Hydrated lime shall be mixed with water to from putty and stored with Reasonable care to prevent evaporation for at least 24 hours before use. Quick Lime shall be shacked with enough water to make a cream passed through a No. O Sieve and then stored with reasonable care to prevent evaporation for At least 7 days before use.

d) Cement

Cement used shall be ordinary Portland cement conforming to Code for Ordinary cement in IS: 8112 and shall be fresh when delivered. The contractor Shall submit the manufacture's certificate for each consignments of cement Procured to the contractor, the Contractor shall satisfy himself at the time of Taking delivery that the quality, quantity and freshness of cement are up to the Specified standards No. Shall be entertained and all rectification work on Account shall be done by the contractor at his own expense. If at any time, the Engineer feels that the work and send the samples of the cement to a testing Laboratory for standard tests and all expenses incurred thus shall be borne by the Contractor. The contractor shall else have no claim for this type of Suspension of work.

e) Coarse Aggregates

Coarse aggregates shall be as per IS: 383 latest editions, consisting of hard, Strong and durable pieces of crushed stone and shall and be free organic or clay coatings and other impurities like disintegrated stone. Soft flaky particles etc. and Any other materials liable to affect the strength durability or appearance of Concrete.

Aggregates other than crushed stone conforming to the provisions of Specification may be used if permitted by the Engineer.

Washing of aggregates by approved means shall be carried out, if desired by The Engineer.

Grading of coarse aggregates shall generally conform to IS: 383 and shall be Such as produce dense concrete of the specified proportions and strength and of Consistency that will work readily into position without segregation.

f) Sand

Sand shall be hard, durables, clean and free from adherent coating or organic matter and shall not contain clay balls or pellets, the sand shall be free from impurities such as iron pyrities. Alkalise, salts, coal, mica, shale or other laminated materials in such forms or quantities as to affect adversely the Harding, strength, durability or appearance of mortar. Plaster or concrete or to cause corrosions to any metal in contact with such mortar, plaster

or concrete. All sand shall be properly graded. Unless otherwise directed by the Engineer all sand shall pass through IS Sieve NO< 240 and 15 to 30% of and for masonry mortar and 5 to 50% of sand for plaster shall pass through IS Sieve No 30. Sand for concrete shall conform to IS: 383.

e) Water

Water shall be clean, fresh and free from organise matters, acids or soluble salts And other deleterious substances which may cause corrosion, discolouration, Efflorescence etc.

g) Reinforcement

Reinforcement steel shall be clean and free from loose mill scales, dust, loose Rust, oil and grease or other coatings, which may impair proper, bond Structural Steel shall conform to IS: 226. Mild steel and medium tensile steel and medium Tensile steel bars and hard-drawn steel wire for concrete reinforcement shall Conform is IS: 432 Cold twisted steel bars shall conform to IS:1786 Hexagonal Wire netting shall conform toIS: 3150. All steel bars including and above 10mm Diameter shall be of tested quality. All wire netting shall be galvanised.

3.00.0 **STORAGE AND HANDLING OF MATERIALS.**

a) Bricks

Bricks shall not dumped at sits. They shall be stacked in regular tires. Even as They are unloaded, to minimise breakage and defacement of bricks. Bricks Selected for different situation of use in the work shall be stacked separately.

b) Stones

Stones shall be stored at site in manner approved by the Engineer. Dressed stone For wall facing, paving etc. shall be stored with special care to avoid Defacement of faces and edges or damp and rust stains.

c)Lime

Lime shall be in weatherproof sheds.

d) Cement

The cement shall be stored above the ground level in perfectly dry and watertight sheds. The bags shall be stacked in a manner so as to facilitate removal or first in first out basis. Any material considered defective by the Engineer shall not be used by the contractor and shall be removed from the Site immediately.

e) Coarse and Fine Aggregates

Aggregates shall be stored on brick soiling or an equivalent platform so that
They do not come in contact with dirt. Grass or any other injurious substances at any stage. Aggregate of different size shall be kept in separate stacks. If so desired by the Engineer aggregate from different sources shall be stacked
Separately with proper care to prevent intermixing.

f) Reinforcement

Reinforcement bars shall be stored off the ground and under cover if so desired by the Engineer. If necessary. A coat of cement wash shall be given to the bars to guard against rusting.

EARTHWORK IN EXCAVATION AND BACKFILLING

REV. NO.	PRAPARED	APPROVED	DATE
00	MARINA	PMISHRA	00

1.0.0 SCOPE

This specification covers excavation in all types of soil, soft and decomposed rock not requiring blasting and rocks requiring blasting, shoring, dewatering, filling around foundations and to grade, compaction of fills and approaches, protective fencing, lighting, etc relevant to structures and locations covered under the scope of this contact.

2.00.0 **GENERAL**

2.1.0 **WORK TO PROVIDED FOR BY THE CONTRACTOR**

The work to provided for by the contractor, unless specified otherwise. Shall include but not be the following.

a) Furnish all labour, supervision, services including facilities as required under statutory labour regulations, materials, equipment, tools and plants, transportation, etc, required by the Engineer
b) Prepare and submit working drawing showing the approaches, slope, beam, shoring, sumps for dewatering, including drains and outfall for drainage, space for temporary stacking of spoil, disposal area, fencing, etc and all other details as may be required by the Engineer.
c) To carry out sampling and testing and submit to the Engineer, results of soil compaction tests if required by the Engineer to assess the degree of compaction.
d) Construction, maintenance and removal after completion of Magazine of proper capacity as well as design for storing of explosives required for blasting work to be carried out scope of this tender.

2.2.0 **WORK TO PROVIDED FOR BY OTHERS.**

No work under this specification will be provided by any agency other than the Contractor unless specifically mentioned elsewhere in the Contract

2.3.0 **CODES AND STANARDS**.

All works under this specification, unless specified otherwise shall conform to the Latest revision and /or replacement of the following or any other Indian Standard Specifications and codes of practice. In case any particular aspect of work is no Covered specially by Indian Standard Specification any other standard practice as May be specified by the Engineer shall be followed: -

IS: 3664: Indian Standard for Safety Code for Excavation work.

IS: 1200: Indian standard Method of Measurement of Building and Civil Engineering Work, (Part-I): Earthwork.
IS: 4701: Indian standard Code of Practice for Earthwork on Canals

2.4.0 **CONFORMITY WITH DESIGNS.**

The Contractor is to carry out the work as per the drawings issued to him and/ or Contractor's drawings which are approved by the Engineer and/or Engineer's instructions.

2.5.0 MATERIALS TO BE USED

2.5.1 GENERAL

All material required for the work shall be of best commercial variety and approved By the Engineer.

2.5.2 BORROW METERIAL.

Borrow material required for back-filling shall be excavated from approved locations and levels and shall consist of material, approved by the Engineer, free roots, Vegetations, decayed organic matter, harmful salts and chemicals, free from lumps and codes. If specified, clean graded sand free from harmful and deleterious Material from approved quarries, shall be as fill material.

2.6.0 QUALITY CONTROL

The contractor shall establish and maintain quality control for the various aspects of the work, method, materials and equipment used. The quality control operation shall Include but not be limited to the following items of work: -

a) Lines, Levels and Grades: I) periodic surveys
II) Establishment of markers, boards etc.

b) Back- filling: I) Checking the quality of fill material
II) Checking moisture content of the backfill
III) Checking the degree of compaction

3.3.0 EXECUTION

3.1.0 SETTING OUT

Within 15 days of award of Contract, the contractor will prepare and submit to the Engineer, detailed drawings of the excavation work as proposed to be executed by The Showing the diminutions as per drawings and specification adding his proposals of Slopes, shoring, approaches, dewatering sumps, beams, etc. On Receiving, approval From the engineer with modifications and corrections, if necessary, the Contractor Will set out the work from the control points furnished by the Engineering and fix Permanent point s furnished by the Engineer and fix permanent point and markers for case of future checking. These permanent points and markers for case of furnished by the engineer and fix permanent points and markers will be fixed at intervals prescribed by the Engineer and checked by the Engineer and certified by him after which the Contractor will proceed with the work. It should be noted that this checking by the Engineer prior to start of the carrying work will in no way

absolve the Contractor of responsibility of carrying out the work to true lines and levels and grades as per drawing and subsequent corrections. If necessary, free of cost to the Owner in case any errors are noticed in the Contractor's work at any stage.

3.2.0 INITIAL LEVELS

Initial level of the ground either in a definite grid pattern or as directed by the Engineer will be taken by the Contractor jointly with the Engineer over the original Ground prior to starting actual excavation work and after setting out. These initial Level will be used for preparing cross-sections for volume measurement or for Crosschecking the depths obtained from tape measurement.

All records of levels, measurements etc. and also any drawing, cross section etc. Made there from, shall be jointly signed by the authorised representative of the Contractor and the engineer before the commencement of and they shall from the Basis of all payments in future.

3.3.0 CLEARING AND GRUBBING, ETC.

The area to be excavated shall be cleared out of fences, trees, logs, stumps, bush, Vegetation, rubbish, slush, etc. and levelled up. Trees unto 300mm girth shall be Uprooted. Trees above 300mm girth to be cut, shall be approved by the engineer And then Marked. Felling of trees shall include taking out roots up to 600mm below ground level or 150mm below formation level whichever is lower. After the tree is cut and roots taken out the pot–holes formed shall be filled with good earth in 250mm layers and consolidated unless directed by the Engineer otherwise. The trees shall be cut in suitable pieces as instructed by the Engineer.

Before earthwork is started, all the spoil and unserviceable materials and rubbish Shall be burned or removed from the site to approved disposal areas as may be Specified. Ash shall be spread or removed. Useful materials, saleable timber, Firewood, etc, shall be the property of the Owner and shall be stacked properly at the worksite in a manner as directed by the Engineer.

3.4.0 CLASSIFICATION

All earthworks shall be classified under the following categories:

a) ORDINARY SOIL

This shall comprise vegetable or organic soil, turf, sand, loam, clay, mud, peat, black Cotton soil, soft shale or loose moorum, a mixture of these and similar material which Yields to the ordinary application of pick and shovel, rake or other ordinary digging implement. Removal or any other modular material having diameter in any one direction not exceeding 75mm occurring in such strata shall be covered under this category.

b) HARD SOIL.

This shall include

i) Stiff heavy clay, hard shale, or compact mooruum, requiring grafting tool or pick or both and chovel, closely applied,
ii) Gravel and cobble stone having maximum diameter in any one direction between 75 and 300mm,
iii) Soiling of roads, paths, etc, and hard core,
iv) Macadam surface such as water bound, and bitumen/ tar bound,
v) Lime concrete, stone masonry in lime mortar and brick work in lime/cement Mortar, below ground level,
vi) Soft conglomerate, where the stones may be detached from the matrix with Picks, and

vii) Generally any material, which requires close application of picks, or scarifies to loosen and not affording resistance to digging greater than the hardest of any soil mentioned in (i) And (vi) above.

c) SOFT AND DECOMPOSED ROCK

This shall include:

i) Limestone, sandstone, late rite, hard conglometerate or other soft or Disintegrated rock which may be quarried or spilt with crowbar,

ii) Unreinforced cement concrete, which may be broken up with crowbars or picks And stone masonry in cement mortar belowground level.

iii) Boulders, which do not require blasting having maximum diameter in any Direction of more than 300mm, found laying loose on the surface or embedded In river bed, soil, talus, slope wash and terrace material of dissimilar origin, and

iv) Any rock which in dry state may be hard, requiring blasting, but which when Wet becomes soft and manageable by means other than blasting.

d) HARD ROCK (requiring blasting)

This shall include:

i) Any rock or cement concrete for the excavation of which the use of mechanical plant or blasting is requiring.
ii) Reinforced cement concrete (reinforcement cut trough but separated from the concrete) below ground level, and

iii) Boulders requiring blasting.

c) HARD ROCK (blasting prohibited)

Hard rock requiring blasting as described under (d) but where blasting is Prohibited for any reason and excavation has to be carried out by chiselling, Wedging or other agreed method.

In case any dispute regarding classification, the decision of the Engineer shall be final.

3.4.0 **EXACAVATION FOR FOUNDATIONS AND TRENCHES**

3.5.1 **GENERAL**

All excavations shall be done to the minimum dimensions as required for safety and Working facility. Prior approval of the Engineer shall be obtained by the Contractor, In each individual case, for the method he proposes to adopt for the Excavations including dimension, side slopes, shoring, dewatering, disposal, etc. This approval, however, shall not in any way make Engineer responsible for any Consequent loss Damage. The excavation must be carried out in the most Expeditious and efficient Manner.

All excavation in open cuts shall made true to line, slopes and grades shown on the Drawing or directed by the Engineer. No material shall project within the dimension Of minimum excavation lines marked. Boulders projecting out of the excavated Surfaces shall be removed, if in the opinion of the Engineer they are likely to be a Hindrance to the workers.

Method of excavation shall be in every case subject to the approval of the Engineer And the Contractor shall ensure that stability and safety of the excavation, adjacent Structures, to be works.

The Contractor shall be in every case subject to the approval of the excavation and Safety of the workmen. If any slip occurs, the Contractor shall remove all slipped Material from the excavated pit.

All loose boulders, semi-detached rocks, not directly in excavation but so close to The Area to be excavated as to be liable, in the opinion of the Engineer, to fall or Otherwise endanger the workmen, equipment of the work, etc, shall be stripped Off Removed away from the areas of excavation. The method used shall be such as Not to Shatter or render unstable or unsafe the portion which was originally sound And safe any materials not requiring removal as contemplated in the work, but Which In the Option of the Engineer, is later to become loose or unstable shall Also be Promptly and satisfactory directed by the Engineer.

Prior starting the excavation, the ground level at the location shall be checked Jointly With the Engineer.

The rough excavation may be carried unto a maximum depth of 150mm above the

Final level. The balance shall be excavated with special care. If directed by the Engineer, soft and undesirable spots shall be removed even below the final level. The extra excavation shall be filled up as instructed by the Engineer and the Contractor shall be paid for the extra excavation and the filling appropriate item Rates.

If the excavation is done to a depth greater than shown on the drawing, or directed By The Engineer, due to the Contractor's fault, the excess shall be filled unto the Required level at the latter's cost (with cement concrete not leaner than 1:4:8 Ordinary Concrete or richer) as directed by the engineer in each individual case.

Information of rock requiring blasting, those over cuts which are unavoidable will be Made unto ordinary cement concrete 1:2:4 which will be paid for under appropriate rate, provided this over cut is not due to negligence of the contractor. The decision of the Engineer as to the admissibility of such over cut for payment will be final. All excavated materials such hard rock, boulders, bricks, dismantled concrete blocks, etc. Shall be stacked separately as directed by the Engineer and shall be the property of the Owner.

3.5.2 EXACAVATION IN ORDINARY SOIL, HARD SOIL AND SOFT AND DECOMPOSED ROCK

The excavation in ordinary soil, soft and decomposed rock will be carried out as per the approved proposal, modified and corrected where necessary by the Engineer. The work will be carried out in a workman like manner without endangering the safety of nearby structure/ services or works wnd without causing hindrance to other activates in the area. As the excavation reaches the required dimensions, lines, levels and the grades, the work will be carried out carefully to avoid any over- excavation. On completion, the work will be finally checked and approved by the Engineer. In certain cases, where deterioration of the ground, upheaval, slips etc. are expected the engineering may order to suspend the at any stage and instruct the Contractor to carryout the balance work just before the foundation work of the structure can be started. No extra will be paid to the Contractor for such unviable temporary suspension of work.

3.5.3 EXCAVATION IN HARD ROCK

In case where excavation, both in ordinary soil and hard rock, are involved, the Ordinary soil comprising of soft, hard and dense soil (including literate formation) And rock including weathered rocks, lateritic rocks, etc. Which can be excavated Without blasting, shall be completely stripped off and the levels of the hard rock Wall be taken to be enable measurements. Further work in hard shall be resumed Clearance from the Engineer. Personal deployed for track excavation shall be Protected from all hazards such as loose rock/boulder rolling down and from general Slips of excavated surfaces. Where the excavated surface is such that it is not stable Against sliding, necessary from the excavated surfaces is such that it is not stable Against sliding, necessary supports, props, bracing or bulkheads shall be provide and Maintained .

In case where blasting, though otherwise required, is prohibited for any reasons, the

Excavation shall be carried out by chiselling, wedging or any other approved Method and payment appropriate to blasting shall be made, unless otherwise Mentioned in the Schedule.

3.5.4 **BLASTING**

3.5.4.1 **GENERAL**

Storage, handling and use of explosives shall be governed by the current explosive Rules laid down by the state Governments. The Contractor shall ensure that these Rules are strictly adhered to. The following instruction, wherever found in variance With the variance with the above rules, shall be considered as superseded by the Above rules.

No child under the age of 16 and no person who is in a state of intoxication shall be allowed to enter the premises where explosives are stored not they Be allowed to handle the explosives.

3.5.4.2. **STORAGE OF EXPLOSIVE**:

Storage of explosive shall be governed by the current explosive rules. Explosive shall be stored in aclean, dry, well ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400mm of the actual work site or any source of fire. A space surrounding the magazine shall be fenced in. the ground inside the fence shall be kept class and free from tress, bushes etc. the admission ti this fence without permission of the officer-in-charge. The clear space between the fence and the magazine shall. shall not be less than 90m. The magazine shall be perfectly well drained.

Two lightning conductors shall be provided to the magazine, one at each end. The Lightning conductors shall be once in every year.

Fuses and detonators shall be stored in separate magazines. However, detonators can be kept in an annexe adjoining the magazines. However, provided that their number does not exceed 25,000 and that the annexe is so constructed that not less than 60cm masonry and 100cm of air space shall intervene between any detonators in such annexe and not to be opened in a magazine. Cases containing explosives are not to be opened in a magazine. Explosives in open cases are not to be received into a magazine. Explosives which appear to be in damaged or dangerous condition are not to be kept in any magazine, but must be removed without delay to a safe distance and destroyed.

Artificial light is to be allowed in any magazine. No smoking shall be allowed within 100m of a magazine.

Magazine shoes without nails shall be used while entering the magazine.

The mallets, levers, wedges etc, for opening barrels or cases are to be of wood. Inside a magazine the cases of explosives are to be carried by hand and shall not be rolled or dragged. Explosives, which have been issued and returned to the magazine
are to be issued first, otherwise those which have been longest of cases in store are to be issued first.

Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides, special care is to be taken to kept the floor free from grains of powder of portions of explosive matter fallen on the floors due to leakage of cases etc.

The magazine shall not be opened during any dustsorm or thunderstorm nor any person shall be allowed in the vicinity of the magazine.

All magazines shall be officially inspected at definite intervals and a record kept of the results of such inspections.

3.5.4.3. **Carriage of Explosive**

Detonators and explosives shall be transported separately to the blast site. Explosives shall be kept dry and away from the direct rays of the sun, naked lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each cage or package is to be carefully examined to ascertain that it is properly closed and shows no sign of leakage.

No persons expect the driver shall be allowed to travel on a vehicle conveying Explosives. No carriage or vessel shall be used for transporting explosives unless all all iron or steel therein with which a package containing any explosive is likely to Come or other suitable material. No lights shall be carried on the vehicle carrying Explosives.

No operation contracted with the leading, unloading and handling of explosives Shall be conducted after sunset.

3.5.4.4 **USE OF EXPLOSIVES**

The contractor shall appoint an agent who shall personally superintend the firing And All operations connected therewith. The contractor
Shall Satisfy himself that the person so appointed is fully acquainted with the Responsibilities imposed on him.

Holes for charging explosives shall be drilled with Pneumatic drills, the drilling Pattern being so planned that the rock pieces after blasting will be suitable for Handling.

The hole diameter shall be of such a size that cartridges can easily pass down them And undue force is not required during charging. Charging operations shall be Carried out by or under the personal supervision of the shot firer. Wrappings shall neve be removed from explosive cartridges. Only wooden rods shall be used for

Loading and steaming shot holes. Only one cartridge at a time shall be inserted and gently passed home with the wooden tamping rod.

Only such quantities of explosives as are required for the particular amount of work To be done shall be brought to the works. Should any surplus remain when all the holes have been charged, it shall be carefully removed to a point at least 300m from the firing point.

The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges the electric detonators shall be connected with the exploder through the shot firing able in a simple series circuit. Due precautions shall be taken to keep the firing circuit insulated from the ground., bare wires, rails pipes or any other path of stray current and to keep the lead wires short circuited until ready to fire. Any kinks in detonator leading wire shall be avoided.

For simultaneous firing of a large number of shot holes, use of cordtex may be done. Cordtex shall be initiated by electric detonator attached to its side with adhesive tape, connecting wire or string.

All connection shall be made by authorised shot firer himself. The shot firing cable shall not be dragged along the ground to avoid possible damage to the insulation. The shot firing cable shall be tested for continuity and possible short circuiting be fore it is used each time.

The shot firer shall always carry the exploder handle on his person until he is ready to fire shots. The number or shots fired at a time shall not exceed the permissible limits.

Blasting shall is carried out at certain specified times to be agreed jointly by the Contractor and the Engineer.

Before any blasting is carried out. It shall be censured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300 meters radius from the firing point, or as required by statutory regulation, at least ten minutes before the time or firing by sounding a warning siren. The area shall be encircled by red flags.

At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations the authorised shot firer shall return to the blast area and inspect carefully the work and satisfy himself that all charged holes have exploded. Cases of misfired unexploded charges shall be employed by drilling a
Parallel fresh holes hot less than 600mm from the misfired hole and by exploding new charges. The authorised shot fire shall be present during removal of the debris liable to contain unexploded explosive near the misfired hole. The workmen shall not return to the site of firing until at least half an hour after firing.

When blasting is conducted in the neighbourhood of roads, structures, buildings etc. controlled blasting has to be carried out by drilling shallow shot holes and filling the same with light charge of explosives.

Adequate safety precautions as per building bye-laws, safety code, statutory regulations etc. shall be taken during blasting operations.

3.5.5 **DISPOSAL**

The excavated spoil will be disposed of in any or all the following manners.

a) By using it for backfilling straightway.
b) By stacking it temporarily for use in back filling at a later date during execution of the Contract.
c) I) By either spreading, or
ii)Spreading and compacting at designated disposal areas.
d) By selecting the useful material and stacking it neatly in areas designated by the Engineer for use in backfilling by some other agency.

3.5.6 **DISPOSAL OF SURPLUS**

All surplus material from excavation shall be carried away from the excavation site to designated disposal area selected by Engineer.

All good and sound rock excavated from the pits and all assorted materials of dismantled structures shall be the property of the owner and if the Contractor wants to use it, he shall have to obtain it from the Engineer at a mutually Agreed rate for the same.

All sound rock and other assorted materials like excavated bricks, etc shall be stacked separately and shall be measured in stacks deducting 50% volumetric
Measure for voids.

3.5.7 **PROTECTION**

The Engineer shall be notified by the contractor as soon as the excavation is Expected to the completed within a day so that it may be inspected by him at the Earliest. Immediately after approval of the engineer, the excavation must be Covered up in the shortest possible time. But, in no case the excavation shall be Covered up or worked On before approval and measurement by the Engineer. Excavated material shall be placed beyond 1.5 metres from the edge of the pit or Trench or half the depth of the pit or trench whichever is more or further away if Directed by the Engineer.

Excavation shall not be carried out below the foundation level of structure close by until required precautions have been taken.

Adequate fencing is to be made enclosing the excavation.

The Contractor shall protect all under- ground services exposed by excavation. The

Contractor shall also divert all surface drains, etc. affected by the excavation to Maintain the working area neat and clean.

3.5.8 **DEWATERING**

All excavations shall be kept free of water and slush. Grading in the vicinity of Excavations shall be controlled to prevent surface water running into excavated Areas. The Contractor shall remove by pumping or other means approved by the Engineer any water inclusive of rainwater and subsoil water accumulated in Excavation and keep the trench dewatered until the construction of foundation Structure and backfilling are complete in all respects. (Expect where such separate Payment will be made.) Sumps made for dewatering must be kept clear of the Foundations. Method of pumping shall be approved by the Engineer but in any Case, the pumping arrangement shall be no movement of subsoil or blowing in due To Differential head of water during pumping.

If necessary, the Engineer may the contractor to Contractor to continue dewatering Beyond his original or extended contract period in which case will be paid Separately for dewatering as terms mentioned elsewhere under payment and Measurement, provided the contractor has completed all the work satisfactorily

3.5.9.**TIMBER SHORING**

Timber shoring made out of approved quality of timber shall be 'close' or 'open' Type, depending on the nature of soil and the depth of pit or trench and the type of The contractor to take all necessary steps to prevent the sides of Trenches and pits from collapsing.

3.5.9.1 **CLOSE TIMBERING**

Close timbering shall be done by completely covering the sides of the trenches and Pits generally with short, upright members called 'polling board'. These shall be of Minimum 250x40 mm sections as directed by the Engineer. The boards shall generally be placed in pairs, one board on each side of cutting ,and shall be apart by Horizontal walers of strong wood at maximum 1.2 metres spacing, cross struts shall depend of the trench or pit.

In case where the soil is very soft and loose, the boards shall be placed horizontally against the sides of the excavation and supported by vertical walers, which shall be strutted to similar timber piece on the opposite face of the ground. No portion of the sides shall be taken into the ground. No portion of the vertical side of the trench or pit shall remain exposed, so that the earth is not libel to slip out.

The withdrawal of the timber shall be done very carefully to prevent the collapse of

the pit or trench. It shall be started at one end and proceeded systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber. No claim shall be entertained for any timber which cannot be withdrawn and is lost or buried.

3.5.9.2 **OPEN TIMBERING.**

In the case of open timbering, the entire surface of the side of trench pit is not required to be covered. The vertical board of minimum 250mm width and minimum 40mm depth shall be spaced sufficiently apart to leave unsupported strips of maximum 500 mm average width. The detailed arrangement, sizes of the timber and the distances apart shall be subject to the approval of the Engineer. In all other respects, specification for close timbering shall apply to open timbering.

3.10.0 **TREATMENT OF SLIPS**

The Contractor will take all precautions to avoid high surcharges and provide proper surface drainage drainage to prevent flow of water over the sides. These precautions along with proper slopes, berms, shorting and control of ground water should cause no slips to occur. If however slips do occur due to causes beyond the control of the contractor, the same shall be removed by him and payment shall be made to him on appropriate item rate of earthwork. Slips caused due to negligence of the Contractor will be cleared and back-filled later by him at his own expenses.

3.7.0 **BACK FILLING**

3.7.1 **GENERAL**

The material used for backfilling shall consist of material, approved by the Engineer obtained directly from nearly areas where excavation work by the same agency is in Progress, from temporary stacks of excavated spions or from borrow pits from Lumps and clods, roots and vegetations, harmful salts and chemicals, organic Materials, etc.

In certain locations, the Engineer may direct sand fillings. The sand should be Cleaned, well graded and be of quality normally acceptable for use in concrete.

3.7.2 **FILLING AND COMPACTION IN PITS AND TRENCHES AROUND STRUCTURES**

As soon as the work in foundations has been accepted and measured, the spaces Around The foundations structures in pits and trenches shall be cleared of all debris, brick bats,Mortar droppings etc, and filled with earth in layers not exceeding 250mm in loose Thickness each layer being watered, rammed and properly compacted to the Satisfaction of the Engineer. Earth shall be rammed with approved mechanised. Usually, no manual compaction shall be allowed unless specifically permitted by

the Engineer. The final surface shall be trimmed and levelled to proper profile as Desired by the Engineer.

Since the degree of compaction depends on the moisture content of the soil, a close watch should be kept on it and corrections to optimise the moisture content.

3.7.3 **PLINTH FILLING**

The plinth shall be filled with earth in layers not exceeding 250mm in loose Thickness, watered and compaction machine or manually, if specifically permitted By the Engineer. When the filling reaches the finished level, the surface shall be Flooded with water for at least 24 hours, allowed to dry and the rammed and Compacted, in order to avoid any settlement at a later stage. The finished level of The following shall be trimmed to the slope intended to be given to the floor.

3.7.4 **FILLING IN TRENCHES FOR WATER PIPES AND DRAIIN**

Earth used for filling shall be free from salts, organic or other foreign matter. All Clods of earth shall be broken or removed. Where excavated material is mostly Rock, the boulders shall be broke into pieces not bigger than 150mm size in any Direction, mixed with fine material consisting of disintegrated rock, moorum or Earth as available, so as to fill up the voids as far as possible and then the mixture Used for filling.

Filling in trenches for pipes and drains be commenced as soon as the joints of pipes And drains have been tested and passed.

Where the trenches are excavated in soil, the filling shall be done with earth on the Sides and top of pipes in layers not exceeding 150mm, watered, rammed and Compacted taking care that no damage is caused to the pipe below.

In case of excavation of trenches in rock, the filling unto a depth of 300mm or the Diameter of the pipe whichever is more, above the crown of pipe or barrel shall be Done with fine material such as earth, moorum, disintegrated rock or ash according To the availability at site. The remaining filling shall be done with rock filling of Boulders of size not exceeding 150mm mixed with fine material as available to fill Up the voids, watered, rammed and compacted.

3.7.5 **FILLING IN DISPOSAL AREA**

Surplus material from excavation which is not required for backfilling will be Disposed of in disposal areas. The spoil shall not be dumped haphazardly but Should be spread in layers approximately 250mm thick when loose and compacted With the help of compacting equipment. In wide areas rollers will be employed and Compaction done to the satisfaction of the Engineer as the optimum moisture Content, which shall be checked and controlled by the Contractor.

In certain cases the Engineer may direct disposal without compaction which can be Done by typing the spoils from a high bench neatly maintaining always a proper Level and grade of the bench.

3.8.0 **APPROCHES AND FENCING**

The Contractor should provide and maintain approaches for workmen and for Inspection, the roads and approaches around the excavation pits should be kept Clear at all times so that there is no hindrance to the movement of men, material And equipment of various agencies connected with the project. Sturdy and elegant Fencing is to be provided around the top edge of excavation as well as the bottom Of the filling at the surplus disposal area where dumping from a high bench is in Progress.

3.9.0 **LIGHTING**

Full-scale area lighting is to be provided if night work is permitted or directed by The Engineer. If no night work is in progress, red warning lights should be provided At the corners of the excavated pit and the edges of the fill.

4.0.0 **TESTING AND ACCEPTANCE CRITERIA**

4.1.0 **EXCAVATION**

On completion of the excavation, the dimensions of the pits will be checked as per The drawings after the pits are completely dewatered the work will be accepted After all undercuts have been set right and all over excavations filled back to Required lines, levels and grades by compacted earth, as directed by the Engineer At the Contractor's cost. The choice of grade of concrete will be a matter of unfettered discretion of the Engineer. Over excavation of sides will be made good free of cost by the contractor while carrying out the back filling. The excavation work will be accepted after the above requirements are fulfilled and all temporary Approaches encroaching inside the required dimension of the excavation have been Removed.

4.2.0 **BACK FILLING**

The degree of compaction required will be as the per the stipulation laid down in IS: 4701, if not otherwise mentioned in the Schedule and the actual method of Measuring the compaction achieved will be as decided by the Engineer. Is Satisfied With the degree of compaction achieved.

5.0.0 **INFORMATION TO BE SUBMITTED**

5.1.0 **WITH TENDER**

Detail of equipment proposed to be used for excavation, back filling and Compactions have to be submitted along with the tender.

5.2.0 **AFTER AWARD**

After award of the Contractor the successful tender shall submit the following for Approved and adoption

a) Within 30days of award of the Contractor, the Contractor shall submit a detailed Programme of the work as proposed to be executed giving completion dates of Excavation of the various foundations and the time required for back-filling and Compaction after completing the foundation for structure. In case the earthwork Contractor is also the agency for the foundation work, the Earthwork programme is To be contracted with the foundation programme. The programme should also show How the excavation and back-filling quantities will be balanced, minimising Temporary stacking of spoils. It is to be noted that Engineer even after initial Approval of the programme, may instruct to enhance or retard the progress of Foundations without attracting any claims from the Contractor. The initial Programme being submitted by the Contractor should have sufficient flexibility to Take care of such reasonable variations.

b) Within 15days of award, the Contractor shall submit showing details of slopes, Shorings, approaches, sump pits, dewatering lines, fencing etc, for approval of the Engineer for adoptions.

6.00 **RATES**

The rates for the items shall include cost of all materials consumed in the works, Hire Charges of materials, tools and plant, cost of labour, insurance, all transport, Taxes, Royalties, security and safety arrangements, supervision, profit etc. The rates of Excavation shall be also include the cost of dewatering and stacking the Excavated Spoils properly within a lead of 30 m unless otherwise mentioned in the Schedule of items.

The Contractor will have to give a rebate if the excavated earth is directly used for Back-filling.

Where back- filling is to be done with sand, it shall be of good quality from quarries Approved by the Engineer. The rate shall include all operations including the cost Of sand.

In cases the Contractor is required to continue dewatering of the excavated pits Beyond of the contract, original or extended, he will be paid separately for it as the Schedule of items only for the period beyond the final terminal date of the contact. The rate will be complete in all respects including the cost all respect including the cost of consumables, if any.

7.0.0 **MEASUREMENTS**

7.1.0 **CLEARING AND GRUBBING**

No separate measurement shall be done for this item for the purpose of payment in General except for cutting of trees having girth more than 30cms and works Connected to this.

7.2.0 **EXCAVATION**

Actual quantity of excavation required and approved by the Engineer shall be Measured in Cu.M.No extra shall be paid for keeping the excavations dewatered as Required for completion of the structure to come in. Necessary disposal of the spoil As described in the schedule of items shall be included in the quoted rate.

7.3.0 **SHORING**

The actual efficient area of shoring as approved by the Engineer, shall be measured In Sq.m.All planks, walling, verticals, struts, props and all other materials as Required for the shoring and subsequent safe dismantling and removal shall be Included in the rates quoted.

7.4.0 **BACK-FILLING**

7.4.1 **WITH ASSORTED EARTH FROM EXCAVATIONS, TRENCHES ETC**

Actual quantity of consolidated backfill shall be measured in Cu.M. The cost of Lead, Lift, etc. shall be as per schedule of items and included in the rate quoted.

7.4.2 **WITH EARTH FROM BORROW PITS AND STACKS**

Actual quantity of consolidated back-filling or actual quantity of excavation in the Borrow pits, or the excavated volume of the stack with a deduction of 30% for Voids, in case filling is done by earth from stack, whichever is less, shall be paid in Cu. M. The lead, lift, etc. as mentioned in the Schedule of item shall be included in The rates Quoted.

7.4.3 SAND FILLING

Actual quantity of consolidated sand filling shall be measured in Cu. M. The rate shall include cost of sand and all necessary works for execution of the item.

7.5.0 **LEADS AND LIFTS**

The leads for excavation and/or back filling will be measured between the centroid of the actual disposal area and that of the plan of pit. The distance between these Two points will two points will be measured along the shortest practicable haulage

Path as decided by the Engineer.

Lift will be measured vertically between the average ground level from where the Pit Excavation was started and the bottom level of the excavated pit. Level lines Corresponding to the stages where lifts become payable will be drawn on the cross Section of the pit and the volumes of excavation contained between these horizontal Planes will be computed and paid according to the corresponding rates.

7.6.0 **DEWATERING**

Dewatering for work beyond the contract period original or excavated will be Measured on the basis of horse power –hour which will be obtained by multiplying The estimated requirement of horse power required to run the pumps or actually Employed, whichever is less, by the actual hours run, approximated to the nearest Half hour.

7.7.0 **TRANSPORTATION OF SURPLUS EARTH**

7.7.1 Payment shall be made only for the lead beyond initial 100M from construction Area. Rate shall include reexcavation, loading, transportation, dumping, stacking or Spreading (as per directions of the engineer-in-charge) the surplus earth and the soil In the area demarcated by the Engineer-in – charge. Payment shall be made on Cubic Meter (M^3) basis on the difference of measurements of the volumes of the Excavated Pits and the measurement of the back filling. Quantity generated due to Voids in back Filled volume of earth, shall also be removed by the Contractor at no Extra cost and This disposal of earth shall not measured and paid under any item.

7.7.2 In exceptional circumstances the Engineer- in-charge may direct the Contractor to Remove surplus earth, concrete of debris or any other material from site to the area Of disposal on the basis of truck measurement. In such cases volume of material Shall be calculated on the basis of truck volume reduce by 30% for voids in case of Soft/hard soil sand 50% for soft/hard rock. All other provisions of disposal such as Spreading, levelling, grading shall apply in this case also.

ANNEXXURE F3.1- VERY BROAD SPECIFICATIONS FOR SOIL TO BE CONSIDERED AS CNS MATERIAL

SL.NO.	PROPERTY	VERY BROAD SPECIFICATION RANGE
1.	Grain size analysis	
	(i) Clay	15-25%
	(ii) Silt	35%-50%

	(iii) Sand	30-40%
	(iv) Gravel	< 10%
2.	Consistency limits	
	(i) Liquid limits	30-50%
	(ii) Plastic limit	20-25%
	(iii) Plasticity index	10-25%
	(iv) Shrinkage limit	15% and above
3. (a)	Swelling pressure when compacted to Maximum dry density corresponding to Standard proctor compaction with zero Initial compaction moisture constant, for No volume charge condition.	Less than 0.1kg/cm^2 10kN/m^2
(b)	Swelling pressure when compacted to Maximum corresponding to standard Proctor compaction and initial compaction Moisture corresponding to optimum moisture Content for no volume change condition	less than 0.05kg/cm^2
4.	Clay minerals	Preferable kaolinite Illite
5.	Shear strength of/ compacted to maximum dry Density correspond to standard proctor compaction And initial moisture content corresponding to Optimum moisture content, but sample test on Saturation.	
	(a) From unconfined compression	Cu0.15- 0.35 Kg/cmsq.
	(b) From consolidated undrained direct Shear test	Cu0.0.1-0.3 kg/cmsq. (10-30 kN/m sq)

ADDENDUM TO SPECIFICATION NO. PEDC/STD.SPEC/032 REV 00 FOR EARTHWORK

Add under clause 3.70 back filling.

If it is required to use clayey soil exhibiting swelling properties for filling Around foundations and under pavement and floor slabs due to non Availability of suitable filling material nearby, then the back filled clayed Swelling soil should be well compacted and a layer of not less than 250m Thick cohesive non-swelling (CNS) soil shall be placed on top of the clayey soil and well compacted. Very broad specifications for soil to be Considered as CNS material is given in Annexure F3:1 enclosed at the end of the section.

CEMENT CONCRETE
PLAIN AND REINFORCED

REV. NO.	PRAPARED	APPROVED	DATE
00	MARINA	PMISHRA	00

TEBLE OF CONTENT

CLAUSE NO. DESCIRIPTION

1.0 SCOPE……

2.0 GENERAL……..

2.1 Work To Be Provided For By The Contractor……

2.2 Work By Others……

2.3 Information To Be Submitted By The Tenderer……

2.3.1 With Tender……

2.3.2 After Award……

2.4 Conformity with Design……

2.5 Materials To Be Used…….

2.5.1 General Requirement……..

2.5.2 Cement……

2.5.3 Coarse Aggregate……

2.5.4 Final Aggregate……..

2.5.5 Water……..

2.5.6 Admixture……..

2.5.7 Reinforcement……

2.6 Storage of Materials…….

2.6.1 General……

2.6.2 Cement……

2.6.3 Aggregates……..

2.6.4 Reinforcement…….

2.7 Quality Control……

3.0 INSTALLATION……

CONTENT (CONT…)

3.1 Washing And Screening Of Aggregates……

3.2 Admixture……..

3.3 Grades of Concrete……

3.4 Proportioning and Works Control……

3.4.1 General……

3.4.2 Mix Design Criteria……

3.5 Strength Requirements……..

3.6 Minimum Cement Content……

3.7 Water-Cement Ratio……..

3.7.1 Strength Requirement…….….

3.7.2 Durability Requirement……...

3.8 Workability…….

3.9 Size of Coarse Aggregate…….….

3.10 Mixing Of Concrete……

3.11 Conveying Concrete……

3.12 Placing And Compacting Concrete…….

3.13 Construction Joints and Cold Joints……..

3.13.1 Construction Joints……..

3.13.2 Cold Joints……...

3.14 Repairs, Finishes and Treatment Of Concrete Surfaces……....

.

3.14.1 Finishing Unformed Surface…….….

3.15 Protection And Curing Of Concrete……...

3.16 Reinforcement…….

3.16.1 Bar Bending Schedule…….

CONTENT (Contd…)

3.16.2 Cleaning……..

3.16.3 Bending…….

3.16.4 Placing In Position……

3.16.5 Welding…….

3.16.6 Control…….

3.17 Cold Weather Concreting…….

3.18 Hot Weather Concreting……..

3.19 Concreting Under Water…….

3.20 Formwork…….

3.20.1 General……..

3.20.2 Cleaning and Treatment of Forms……..

3.20.3 Design……

3.20.4 Inspection ……

3.20.5 Removal of Forms……

3.20.8 Classification……..

3.21 Opening, Chases, Grooves, Recess, Blackouts Etc……..

3.22 Anchor Bolts, Anchors, Sleeves, Inserts,
Hangers /Conduits/Pipe and Other Misc.
Embedded Fixtures…….

3.23 Expansion And Isolation Joints…….

3.23.1 General……

3.23.2 Bitumen Board /Expended Polystyrene Boards……

3.23.2.1 Bitumen Boards……..

3.23.2.2 Expanding Polystyrene Boards……..

3.23.3 Joint Sealing Strips……..

CONTENT (Counted…)

3.23.3.1 Metal Sealing Strips…….

3.23.3.2 Non- Metallic Sealing Strips……

3.23.4 Joint Sealing Strips…….

3.23.5 Isolation Joints……..

3.23.6 Rubber Pad…….

3.24 Grouting Under Machinery Or
Structural Steel Bases……...

3.25 Precast Concrete……

3.26 Waterproofing Of Concrete Structure……..

3.26.1 General……

3.26.2 Water Bar /Seal……..

3.26.3 Waterproofing Admixtures…….

3.26.4 Bituminous Or Tar Coating……

3.26.5 Bitumen Felt Application For Tanking……..

3.26.6 Polyethylene Films: Application
In Walls & Base of Structures……..

4.0 SAMPLING AND TESTING……

3.21 General……

3.22 Comment……

3.23 Aggregates…….

3.24 Water…….

3.25 Admixture……..

3.25.1 Air Entraining Agent……..

3.25.2 Other Admixture…….

3.26 Concrete……..

CONTENT (Counted…)

5.0 ACCEPTANCE CRTTERIA……

5.2 Standard Deviation…….

5.2 Acceptance Criteria……

5.3 Inspection and core Tests……

5.4 Load Test……..

6.0 Rates……..

7.0 MATHOD OF MEASUREMENT……

7.1 Concrete……

7.2 Admixture ……

7.3 Reinforcement……..

7.4 Formwork ……

7.5 Anchor Bolts, Anchor Sleeve, Inserts, Hangers, Conduit Pipes and Other Miscellaneous Embedded Fixtures……..

7.6 Expansion and Isolation Joints……

7.7 Joins Seals: G.I. Copper, Aluminium, Rubber or P.V.C ……

7.8 Rubber Pad…….

7.9 Grouting Under Base Plates Etc……

7.10 Waterproof Plaster……

7.11 Bitumen Coating /Tar Coating……..

7.12 Bitumen Felt ……

7.13 Polyethylene Film ……

7.14 Tests …….

8.0 LIST OF I. S. CODES AND STANDARDS FOR

REFERENCE……

SCOPE

1.1 **General**

This specification covers all the requirements described hereinafter for general use of plain and reinforced cement concrete work in structures and locations, cast-in-situ or precast, and shall include all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work.

1.2 This specification shall also supply to the extent it has been referred to or applicable with the special requirements of structures covered in scope of is: 456.

1.3 IS: 456 shall from a part of these specifications and shall be complied with unless permitted otherwise. for any particular aspect not covered by these code, appropriate is code, specifications and/ or replacement by an international code of practices as may be specified by the engineer shall be followed. all code and standards shall conform to its latest revisions. a list of is codes and standards is enclosed hereinafter for reference.

2.0 General

2.1 **Work to provided for by the contractor**

The work to be provided for by the contractor, unless otherwise specified shall include but not be limited to the following:-

a) Furnish all labour, supervision, services including facilities as may be required under statutory labour regulations, materials, forms, templates, supports, scaffolds, approaches, mids construction equipment, tools and plants, transportations- etc. required for the work.

b) Except where it is excluded from the scope of contract, contractor shell prepare progressively and submit for approval detailed drawing and bar bending schedules for reinforcement bars showing the positions and details of spacers, supports, chairs, hangers etc.

c) Design and prepare working drawing of formworks, scaffolds supports, etc. and submit for approval.

d) Submit for approval shop drawing for various inserts, anchors, anchor, bolts. pipe sleeves, embodiments, hangers opening, frames etc.

e) Submit for approval detailed drawing of supports, templates hangers etc. required for installation of various embedments like inserts, anchor bolts, pipe sleeves, frames, joint seals, frames, openings etc.

f) Submit for approval detailed schemes of all operation required for executing the work, e. g. material handing, concrete mixing, placement of concrete, compaction, curing , services, approaches , etc.

g) Design and submit for approval concrete mix designs required to be adopted on the job.

h) Furnish samples and submit for approval results of tests of various properties of the following: -

i) The various ingredients of concrete

ii) Concrete

iii) Embedment

iv) Joint seals

i) Provide all incidental items not shown or specified in particular but reasonably implied or necessary for successful completion of the work in accordance with the drawings, specifications and schedule of items.

j) For supply of certain materials normally manufactured by specialist firms, the contractor may have to produce, if directed by the engineer, a guarantee in approved, perform for satisfactory performance for a reasonable period as may be specified , binding the manufactures and the contractor, jointly and severally.

2.2 work by others

No work under this specification will be provided by any agency other then the contractor unless specifically mentioned elsewhere in the contract.

2.3 Information to be submitted by the tenderer

2.3.1 With tendered

The following technical information are required with the tender.

a) Source and arrangement of processing of aggregates proposed to be adopted.
b) Type of plant and equipment proposed to be used.
c) Names of firms with which association is sought for to execute the special items of work in the contract.
d) Types of formwork proposed to be used.

2.3.2 After award

The contractor shall submit the following information and dada including samples where necessary, progressively during the execution of the contract.

a) Programme of execution and requirement of materials

within 30 days of the award of contract, the contractor will submit a master programme for completion of the work giving month wise requirements of materials, particularly mentioning in details the materials witch are to be supplied by the owner, and for the procurement of which the help of the of the owner is required as per the terms and conditions of the contract. in case the contractor proposes to take on hire any machineries or tools and plants from the owner, the detailed phased out programme of such hire is also to be submitted.
this master programme may have to be reviewed and updated by the contractor, quarterly or at more frequent intervals as may be directed by the engineer depending on the exigencies of the work.
detailed day-to-day programme of every month is to be submitted by the contractor before the end of the previous month.

b) Samples

Samples of the following materials and any other materials proposed to be used, shall be submitted as directed by the engineer, insufficient quantities free of cost, for approval. Approved samples will be preserved by the engineer for future reference. the approval of the engineer shall not, in any way , relieve the contactor of his responsibility of supplying materials of specified qualities:-

i) Coarse and fine aggregates
ii) admixtures
iii) Plywood for from work.
iv) Embedded and anchorage materials as may be desired by the engineer.
v) Joint sealing strips and other water proofing materials.
vi) Joints filling compounds
vii) Foundations quality rubber pads

c) Design mix

Design mix as per clauses 2.1 (g) & 3.4 of this specification giving proportions of the ingredients. sources of aggregates and cement. along with accompanying test results of trial mixes as per relevant i. s. .is be submitted to the engineer for his approval before it can be used on the works.

d) Detail drawing and bar bending schedules

Detailed working drawings and bar bending schedules in accordance with clause 2.1 (b) and 3.16.1 of this specification.

e) Detailed drawing and designs of formworks to be used

Detailed design data and drawings of standard formworks to be used as per clauses 2.1 (c).

Detailed drawing for templates &temporary supports for embodiments

As per clause 2.1(e).

g) Mill test report for cement &reinforcing steel

mill test report for cement and reinforcing steel in case these Materials are supplied by the contractor.

H) Inspection reports

Inspection reports in respect of from work and reinforcement and any other item of work as may be desired by engineer in accordance with clause 2.4 of this specification.

i) **test reports**

Reports of tests of various materials and concrete as required under clause 4.0: sampling & testing of this specification.

j) any other data which may be required as this per this specification

2.4 Conformity With Design

The contractor will prepare check in approved Performa, which will be called pour cards. These pour cards will list out all items of work involved the contractor will inform the engineer, sufficiently in advance, whenever any particular pour is ready for concreting he shall accord all necessary help and assistance to the engineer for all checking required in the pour. On specification, the engineer will give written permission on the same poured card allowing the contractor to commence placement of concrete. Details of all instruction issued by the engineer and any other relevant information will be written on accompany sheets,

termed as progress cards, will be prepared by the contractor on approved Performa. The pour cards along with accompaniments will be handed over to the engineer before starting placement of concrete. One of the mix designs developed by the contractor as per the I. S. specifications and established the satisfaction of the engineer by trial mixes shall be permitted to be used by the engineer, the choice being dictated by the requirements of designs and workability. The methods of mixing, of concrete will be as approved or directed by the engineer.

2.5 Materials to be used

2.6 **General Requirement**

2.7 All materials whether to be incorporated work or used temporarily for the construction shall conform to the relevant IS specifications unless stated otherwise and be of best-approved quality.

2.5.2 Cement

Generally,cement shall be ordinary Portland cement conforming to IS :8112. In special case, rapid hardening Portland cement, low heat cement etc. May be permitted or directed to be used by the engineer.

2.5.3 Coarse Aggregate

Aggregate of size ranging between 4.75 mm and 150mm will be termed as coarse aggregate. only coarse aggregate from approved quarries and conforming to is: 383 will be allowed to be used on the works.

2.5.4 Fine Aggregate

Aggregate smaller than 4.75 mm and within the grading limits and other requirement set in is:383 is termed as fine aggregate or sand. only fine aggregate from approved sources and conforming to the above is specification will be allowed to be used on works.

2.5.5 Water

Water for use in concrete shall be clear and free from injurious oils, acids, alkalis, organic matter, salt, silts or other impurities. Normally potable water is found to be suitable. generally, is:3550 will be followed for routine tests. in

case of doubt, the acceptance test for water shall be as per is: 3025, and table-i of is: 456.

2.5.6 Admixture

Only admixture of a quality will be used when directed or permitted by the engineer. the admixture shell conform to is: 9103.

2.5.7 Reinforcement

Reinforcement shell be as per relevant is specification as mentioned in the contract/drawing/instruction. all bars above 10mm dia. shall be tested quality.

2.6.0 Storage of materials

2.6.1 General

All materials shall be so as to prevent deterioration or intrusion of
Foreign matter and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged or is otherwise considered defective by the engineer, shell not be used for concrete and shell be removed from site immediately, failing which, the engineer shall be at liberty to get the materials removed from site immediately, failing which, the engineer shall be at
Liberty to get the materials removed and the cost incurred there of shall be realised from the contractors dues. The contractor shall maintain up to- date

2.6.2 Cement:

1) Sufficient space for storage, with open passages between stacks, shall arranged by the contractor to the satisfaction of the engineer.
2) Cement shall be stored off the ground in dry, leak proof, well-ventilated ware-houses at the works in such in such a manner as to prevent deterioration due to the moisture or intrusion of foreign matter.
Cement shall be stored in easily countable stacks with consignment identification marks.
3) Consignment shall be used in the order of their receipts at site. Sub – standards or partly set cement shall be removed from the site, with the knowledge of the engineer, as soon as it is detected
.

2.6.3 Aggregate:

Aggregate shall be stored on planks or steel plates or on concrete or masonry surface. Each size shall be kept separated with wooden or steel or concrete or masonry bulk-heads or in separate stacks and sufficient care shall be taken to prevent the material at the edges of the stock piles from getting intermixed. Stacks of fine and coarse aggregates shall be kept sufficiently apart with proper arrangement of drainage. The aggregates shall be stored in easily measurable stacks of suitable depths as may be directed by the engineer.

2.6.4 Reinforcement:

Reinforcement steel shall be stored consignment-wise and size wise off the ground and under cover, if desired by the engineer, it shall be protected from rusting, oil, grease and distortions. If necessary, the reinforcing steel may be coated with cement wash before stacking to prevent scale and rust at no extra cost to the owner. The stacks shall be easily measurable. Steel needed for immediate use shall be removed from storage.

2.7 Quality Control:

Contractor shall be establish and maintain quality control for different items of work and materials as may be directly by the engineer to assure compliance with contract requirement and maintain and submit to the engineer records of the same. The quality control operation shall include.

a) Admixture : Type, quantity, physical and properties that affect Strength, workability and durability of concrete. For air entraining admixtures, dosage to be adjusted to Maintain air contents within desirable limits.

b) Aggregate : physical, chemical and mineralogical qualities. Grading, Moisture content and impurities.

c) Water : Impurities tests.

d) Cement : Test of satisfy relevant IS specification (only association With Owner s tests, if the supply is made by Owner).

e) formwork : material , shapes dimensions, lines elevation , surface Finish, adequacy of form , ties, bracing and shoring and Coating.

f) Reinforcement : shapes, dimensions, length of splices, clearances, items and supports . Quality and requirement of welded splices.

g) Grades of concrete : Usage and mix design, testing of all properties.

h) Batching & mixing : Types and capacity of plant, concrete mixers and transportation equipment.

i) joints : Location of joints, water stops and filler materials.

Dimension of joints, quality and shape of joint material and Splices.

j) Embedded and

Anchorage items : Material, shape, location, setting.

k) Placing : preparation, rate of pouring weather limitations, time intervals between mixing and placing and between two successivelifts, covering over dry or wet surfaces, cleaning and proper bond , prevention of cold joint, types of chutes or conveyors.

1) Compaction : numbers of vibration, their prime mover, frequency and amplitude of vibration , diameter and weight of vibrators, duration of Vibration, hand – spreading, rodding and tamping.

m) Setting of base & Beaming plates : Lines, elevations and bedding mortar.

n) Concrete finishes : Repairs of surface defects, screening, floating, steel trowel ling and Booming, special finishes.

o) Curing : Methods and length of time.

Copies or records and tests for the items noted above, as well as, records of corrective Action taken shall be submitted to the engineer for approval as may be desired.

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3.0 INSTALLATION

All installation requirements shall be in accordance with IS: 456 and as supplemented or modified herein or by other best possible standards where the specific requirement Mentioned in this section of the specification do not cover all the aspects to the full Satisfaction of the Engineer.

3.1 Washing and screening of Aggregates

Washing and screening of coarse and fine aggregates to remove fines, dirt or other deleterious materials shall be carried out by approved means as desired by the Engineer.

3.2 Admixture

All concrete shall be designed for normal rate of setting and hardening at normal temperature. Variations in temperature and humidity under different climatic conditions will affect the rate of setting and hardening, which will, in turn, affect the workability and quality of the concrete. Admixtures may be permitted to be used in accordance with IS: 456 to modify the rate of hardening, to improve workability or as an aid to control concrete quality. The Engineer reserves the right to require laboratory test or use test data, or other satisfactory reference before granting approval. The admixture shall be used strictly in accordance with the manufacture s directions and /or as directed by the Engineer.

3.3 Grades of Concrete

Concrete shall be in any of the grades designated in IS: 456.Grade of concrete to be used in different parts of work shall be as shown on the drawing or as per the Engineer's instruction. In case of liquid retaining structures, IS: 3370 will be followed.

3.4 Proportioning and Works Control

3.4.1 General

Proportioning of ingredients of concrete shall be made by any of the two following Methods as directed by the Engineer.

a) With preliminary tests by designing the concrete mix. Such concrete shall be called "Design Mix Concrete"

b) Without preliminary tests adopting nominal concrete mix. Such concrete shall be called "Nominal mix Concrete.

As far as possible, design mix concrete shall be used on all concrete works. Ordinary concrete, in grades permitted in accordance with IS: 456 may be used if shown on drawing or approved by the Engineer. In all cases the proportioning of ingredient and works control shall be in accordance with IS: 456 and shall be adopted for use after the Engineer is satisfied regarding its adequacy and after obtaining his approval in writing.

3.4.2 Mix Design Criteria

Concrete mixing will be designed by the Contractor to achieve the strength, durability and workability necessary for the job, by the most economical use of the various ingredients. In general, the design will keep in view the following considerations: -

a) Consistent with various other requirements of the mix , the quantity of water should be kept at the lowest possible level.

b) The nominal maximum size of coarse aggregate shall be as large as possible within the limits specified.

c) The various fractions of coarse and fine aggregates should be mixed in such a proportion as to produce the best possible combined internal grading giving the densest and most workable mix.

d) The finished concrete should have adequate durability in all conditions to withstand satisfactorily the weather and other destruction agencies which it is expected to be subjected to in actual services.

The requirement of adequate structural strength is catered for by the choice of proper grade of concrete by the Engineer. The Contractor will strictly abide by the same in his design of concrete mix installation.

Not withstanding anything mentioned in various tables given in IS:456 giving specific values and degrees of workability for different condition of concrete placing, minimum cement content and maximum water cement ratio for concrete exposed to sulphate attack and for concrete to ensure durability under different condition of exposure , strength requirement for different grades of concrete, proportion for nominal mix concrete, the following tables in the specification are included. For identical condition is values given in the tables shown herein below are different from those mentioned in IS:456, the values as indicated in the table shown herein below shall prevail.

TABLE – 1

STRENGTH REQUIREMENT OF CONCRETE

Grade of Concrete	Specific Characteristic Compressive Strength of 15cm cubes at 28 days conducted in accordance with IS: 516(All values in N/Sq.mm)
M – 10	10
M –15	15
M – 20	20
M – 25	25
M – 30	30
M – 35	35
M – 40	40

Note: 1.Notwithstanding anything mentioned above, the cement/total aggregate ratio is not be increase beyond 1:9.0 without specific permission of the Engineer

Note: 2. It should be noted that such high aggregate cement ratio will be required for concretes of very low slump and high water – cement ratio which may be required to be used in mass concrete work only .

Note: 3. The above figures are guidance only , the actual cement /aggregate ratios are to be worked out from the specific gravities of coarse aggregates and sand being used and from trial mixes.

3.5 Strength Requirements

Strength Requirements of both design mix and nominal mix concrete where ordinary Portland Cement or Portland Blast furnace slag cement is used, shall be as per IS: 456. All other relevant clauses of IS: 456 shall also apply.

3.6 Minimum Cement Content

The minimum cement content for each grade of concrete shall be as shown below unless specified in schedule of items: -

TABLE –III

Minimum Cement CONTENT, Maximum Water Cement Ratio and Minimum Grade of Concrete for Different Exposures with Normal Weight Aggregates of 20 mm nominal maximum Size

SI No.	Exposure	Plain Concrete			Reinforced Concrete		
		Minimum Cement Concrete Kg/m3	Maximum Free Water Cement Ratio	Minimum Grade of Concrete	Minimum Cement Concrete Kg/m3	Maximum Free Water Cement Ratio	Minimum Grade of Concrete
1	2	3	4	5	6	7	8
i)	Mild	220	0.60		300	0.55	M20
ii)	Moderate	240	0.60	M15	300	0.50	M25
iii)	Severe	250	0.50	M20	320	0.45	M30
iv)	Very severe	260	0.45	M20	340	0.45	M35
v)	Extreme	280	0.40	M25	360	0.40	M40

Note: 1.Cement content prescribed in this table is irrespective of the grades of cement and it is inclusive of additions mentioned in 5.2. The additions such as fly ash or ground granulated blast fumace slag may be taken into account in the concrete composition with respect to the cement content and water – cement ratio if the suitability is established and as long as the maximum amounts taken in to account do not exceed the limit of pozzolona and slag specified in IS 1489 (part I) and IS 455 respectively.

2. Minimum grade of plain concrete under mild exposure condition is not specified.

TABLE - II

MIX PROPORTIONS (BY WEIGHT) EXPECTED TO GIVE DIFFENT DEGREES OF WORKABILTY WITH DIFFERENT VALUES OF WATER – CEMENT RATIO

(FOR GUIDANCE)

CEMENT/TOTAL AGGREGATE RATIOS

WORKABILTY	WATER/ CEMENT RATIO	RATIO BY WEIGHT OF CEMENT TO GRAVEL AGGREGATE		RATIO WEIGHT OF CEMENT TO CRUSHED STONE AGGREGTE	
		20mm size	30mm size	20mm size	38mm size
Very low slump 0-25 mm	0.4 0.5 0.6 0.7	1:4.8 1:7.2 1:9.4 1:10	1: 5.3 1: 7.7 1: 10 1: 12	1: 4.5 1: 6.5 1: 7.8 1: 8.7	1: 5.0 1: 7.4 1: 9.6 1: 10.6
Low slump 25-50 mm	0.4 0.5 0.6 0.7	1:3.9 1:5.5 1:6.8 1:8.0	1: 4.5 1: 6.7 1: 7.4 1: 8.5	1: 3.5 1: 5.0 1: 6.3 1: 7.4	1: 4.0 1: 5.5 1: 7.0 1: 8.0
Medium slump 50-100 mm	0.4 0.5 0.6	1:3.5 1:4.8 1:6.0	1: 3.8 1: 5.7 1:7.3	1: 3.1 1: 4.2 1: 5.2	1: 3.6 1: 5.0 1: 6.2

High slump 100-175 mm	0.4 0.5 0.6 0.7	1:3.2 1:4.4 1:5.4 1:6.2	1: 3.5 1: 5.2 1: 6.7 1: 7.4	1: 2.9 1: 3.9 1: 4.7 1: 5.5	1: 3.3 1: 4.6 1: 5.7 1: 6.5

Note: 1- notwithstanding anything mentioned above, the cement/ Total aggregate ratio is not be increased be yond 1; 9.0 without specific permission of the Engineer

Favourable conditions, on of better quality of cement control, then the Engineer may instruct lower cement content, and Contractor shall abide by the stipulations laid down hereunder:

a) The contractor shall design the mixes for 10% (ten percent) higher strength over and above those specified in table-I under Clause 3.4, for the various grades of concrete and different slump requirement.

b) Sufficient number of trial mixes (to be decided by the Engineer) will be taken at the laboratory for the various designs and graphs of w/c ratio Vs crushing strengths at various ages will be plotted.

c) All tests will be done in presence of the Engineer who shall be the final authority to decide upon the adoption of any revised minimum cement content. The contractor will always be responsible to produce quality concrete of the required grade as per the acceptance criteria of IS: 456.

d) The Engineer will always have the unquestionable right to revise the minimum cement content as decided above, if in his opinion, there is any chance of deterioration of quality on account of use of lower cement content or any other reason.

In case there is a downward revision of the minimum cement content from that specified in the contract, the particular unit rate of concrete will be reduced by an amount equal to the cost of cement saved, calculated at the issue rate. The relevant cost of wastage and handling on the cement saved, which is inherent in the total cost of structure, will not be deducted from the unit rate and will thus pass on the Contractor.

3.7 Water Cement Ratio

The choice of water-cement ratio is designing a concrete mix will depend on

a) The requirement of strength

b) The requirement of durability.

3.7.1 Strength Requirement

In case of "Design Mix Concrete", the water-cement ratio of such value as to Give acceptable test results as per IS: 4 56, will be selected by trial and error. The values of water – cement ratio for different grade and mix designs will have to be established after conducting sufficiently large number of preliminary test laboratory to the satisfaction of Engineer. Frequent checks on test will have to be carried out and the water – cement ratio will be revised if the tests produce unsatisfactory results. Notwithstanding anything stated above all the consequences in case of default remains unaltered.

In case of ordinary concrete, the maximum water – cement ratio for different grades of concrete is specified in table –III of IS: 456 and no tests are necessary. The acceptance test criterion for nominal mix concrete shall be as per IS: 456.

3.7.2 Durability Requirement

Tables 19 & 20 of IS: 456 give the maximum water – cement ratio permissible from the point of view of durability of concrete subjected to adverse exposure to weather, sulphate attacks, and contact with harmful chemical. Impermeability may also be an important consideration.

Whenever the water – cement ratio dictated by Durability consideration is lower then that required from strength criterion, the form shall be adopted.

However, water – cement ratio, from the point of durability as well as from strength consideration, should meet the requirement given in Table No.IV.

TABLE IV

MAXMIUM PERMISSIBLE WATER / CEMENT RATIOS FROM DURABILITYCONSIDERATIONS FOR DIFFEREN TYPES OF STRUCTURES AND DEGREES OF EXPOSURE USING ORDINARY PORT LAND CEMENT

	Exposure Conditions					
	Severe wide range of Temperature. Frequent alterations of freezing and thawing (use Air Entrained concrete only)			Mild Temperature rarely below Freezing or rainy or arid		
Type of structure	At the water line or within the range of fluctuating water level or spray.			At the water line or within the range of fluctuating water level or spray.		
	In air			In air		

		In Fresh water	In sea water or in contact with sulphate (concentrati on more then 0. 2p.c)		In fresh water	In sea water or in contact with sulphate (concentration more then 0. 2p.c)
Thin sections such as railing kerbs, sills ledges, ornamental or Architectural concrete reinforced concrete piles, pipes and all sections with less then I" concrete cover to reinforcement	0.49	0.44	0. 40	0.53	0.49	0.40
Moderate sections such as Retaining Walls, abutments, piers, girders, beams	0.53	0.49	0.40	*	0.53	0.44
Exterior portions of heavy mass sections	0.58	0.49	0.44	*	0.53	0.44
Concrete deposited by Tremie under water	-	0.44	0.44	-	0.44	0.44
Concrete slabs laid on ground	0.53	-	-	*	-	-
Concrete which will later be protected by enclosure or backfill but which may be exposed to freezing & thawing for several years before such protection is offered	0.53	-	-	*	-	-

Concrete protected from the water, interiors of building concrete below ground which is free from sulphate attacks	*	-	-	*	-	-

Note: * Water/Cement ratios be selected on basis of strength and workability requirements.

3.8 Workability

The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formwork and around the reinforcement and embodiments and to give the required surface finish shall depend on the type and nature of structure and shall be based on experience and tests. The usual limits of consistency for various types of structures are given below: -

TABLE - V
LIMITS OF CONSISTENCY

Degree of Workability	Slump in mm with standard Cone as per IS: 1199		Use for which concrete is suitable
	Min	Max	
Very low	0	25	Large mass concrete structure with heavy compaction equipments, roads and like
Low	25	50	Uncontested wide and shallow R.C.C. Structures
Medium	50	100	Deep but wide R.C.C. Structures with congestion or reinforcement and inserts
High	100	150	Very narrow and deep R.C.C. structures with congestion due to reinforcement and inserts**.**

(Note: Notwithstanding anything mentioned above, the slump to be obtained for work in professes shall be as per direction of the engineer)

With the permission of the engineer, for any grads of concrete, if the water has to be increased in special cases, cement shall also be increased Proportionately to keep the ratio of water to cement same as adopted in trial mix design for each grade of concrete. No extra payment will be made for this additional cement.

Workability of concrete shall be checked at frequent intervals by slump tests. Alternative where facilities exist or if required by the engineer, the compacting factor test in accordance with IS: 1199and Clause 6 of IS: 456 shall be carried out.

3.9 Size of Coarse Aggregates

The maximum size of coarse aggregates for different locations shall be as follows unless otherwise directed by the Engineer: -

Very narrow space	-	12mm
Reinforced concrete except foundation	-	20mm
Ordinary plain concrete and Reinforced	-	40mm
Mass concrete	-	80mm
Mass concrete very large structure	-	150mm

Grading of coarse aggregates for a particular size shall concrete to relevant I.S. Codes and shall also be such as to produce a dense of the specified proportion, strength and consistency that will work readily into position without segregation.

Course aggregate will normally be separated in to the following size and stacked separately in properly designed stockpiles ; 150mm to 80mm, 80mmto 40mm, 40mm to 20mm and 20mm to 5mm. In certain it may be necessary to further spilt the 20mm to 5mm fraction into 20mm to 10mm and 10mm to 5mm fractions.

This separation of aggregates in different size fraction is necessary so that they may be remixed in the desired proportion to arrive at a correct internal grading to produce the best mix.

3.10 Mixing of Concrete

Concrete shall always be mixed in mechanical mixer unless specifically approved by the Engineer for concrete be used in unimportant out of the way locations in small quantities. Water shall not normally be charged into
the drum of the mixer until all the cement and aggregates consisting the batch are already in the drum and mixed for at least one minute. Mixing of each batch shall be continued until there is a uniform distribution of the materials and the mass is uniform in color and consistency, but in no case shall mixing be done for lass then 2

(two) minutes and at least 40 (forty) revolutions after all the material and water are in the drum. When absorbent aggregates are used or when the mix is very dry, the mixing time shall be extended as may be directed by the Engineer. Mixers shall not be loaded above their rated capacity as this prevents thorough mixing.

The entire contents of the drum shall be discharged before the ingredients for the next batch are fed into the drum. No partly set of remixed or excessively wet concrete shall be used. Such concrete shall be immediately removed from site. Each time the work stops, the mixes, shall be thoroughly cleaned & when the next mixing commences, the first batch shall have 10% additional cement at no extra cost to the Owner to allow for loss in the drum.

Regular checks on mixer efficiency shall be carried out as directed by the engineer as per IS: 4634 on all mixers employed at site. Only those mixers whose efficiencies are within the tolerances specified in IS: 1791 will be allowed to be employed.

Batching plant where used shall conform to IS: 4925.

When hand mixing is permitted by engineer, it shall be carried out on a water – tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. In case of hand –mixing, 10% extra cement shall be added to each batch at no extra cost to the Owner.

3.11 **Conveying concrete**

Concrete shall be handled and conveyed from the place of mixing to the place of laying as rapidly as practicable by approved means and placed and compacted in the final position –before the Initial settings of the cement starts. Concrete should be conveyed in such a way as will prevent segregation of loss of any of the ingredients. For long distance haulage, agitator cars of approved design will be used.If in spite of all precautions, segregation does occur during transport, the concret shall be properly remixed before placement. During hot or cold weather, if directed by the Engineer, concrete shall be transported in deep containers which will reduce the rate of loss of water evaporation or loss of heat. If equipments for concrete shall be well maintained and thoroughly cleaned before commencement of concrete mixing. Such equipments shall be kept free from set concrete.

A layer of mortar of thickness 12mm of the same or less w/c ratio and the same proportion as that of the concrete being placed and cement slurry will be spread thoroughly on the rock foundation or construction joint just prior to placement of concrete. The cost of application of such cement slurry and mortar will be deemed to be included in the unit rate of concrete.

After concrete has been placed, it shall be spread, if necessary and thoroughly compacted by approved mechanical vibration to maximum subsidence without segregation and thoroughly worked around shape. Vibrators shall not be used for pushing concrete into adjoining areas. Vibrators must be operated by experienced

workmen and the work carried out as per relevant IS Code of Practice. In thin members with heavy congestion of reinforcement or other embedments, where effective use of internal vibrator is, in the opinion of the Engineer, doubtful, in addition to immersion vibration the contractor may have to employ form vibrators conforming to IS: 4656. For slabs and other similar structures, the contractor will additionally employ screed vibrator as per IS:2506. Hand tamping may be allowed in rare cases, subject to the approval of the Engineer. Care must be taken to ensure that the inserts, fixtures, reinforcement and formwork are not displaced or distorted during placing and consolidation of concrete.

The rate of placement of concrete shall be such that no cold joint is formed and fresh concrete is placed always against green concrete which is still plastic and workable. No concrete shall be placed in open, during rains. During rainy season, no placement in the open is to be attempted unless sufficient tarpaulins or other similar protective arrangement for completely covering the still green concrete from rain is kept at the site of placement. If there has been any sign of washing of cement and sand, the entire affected concrete shall be removed immediately. Suitable precautions shall be taken in advance to guard against rains before leaving the fresh concrete unattended. No accumulation of water shall be permitted on or around freshly laid concrete,.

Slabs, beams and similar members shall be poured in one operation, unless otherwise instructed by the Engineer. Moulding, throating, drip course, etc. shall be poured as shown on the drawings or as directed by the Engineer. Holes shall be provided and bolts, sleeves, anchor's fastenings or other fixtures shall be embedded in concrete as shown on the drawings or as directed by the engineer. Any deviation there from shall be set right by the Contractor at his own expense as instructed by the Engineer.

In case the forms or supports get displaced during or immediately after the placement and bring the concrete surface out of alignment beyond tolerance limits, the Engineer may direct to remove the portion and reconstruct or repair the same at the Contractor's expense.

3.12 **Placing and Compacting Concrete**

Where specifically covered the relevant IS Code will be followed for the procedure of surface preparation, placement, consolidation, curing, finishes, repairs and maintenance of concrete. If, however, there is no specific provision in the relevant IS Code for any particular aspect or work, any other standard Code of Practice, as may be specified by the Engineer, will be adopted. Concrete may have to be placed against the following types of surfaces:-

a) Earth foundations

b) Rock foundations

c) Formwork

d) Construction joint in concrete or masonry.

The surface on or against which concrete is to be placed has to be cleaned thoroughly. Rock or old construction joint has to be roughened by wire brushing, chipping sand blasting or any other approved means for proper bond. All cutting's dirt, oil, foreign and deleterious material, laitance, etc., are to be removed by the air water jetting or water at high pressure. Earth foundation on which direct placement of concrete is allowed, will be crumble and consolidated as directed by the Engineer such that it does not crumble and get mixed up with the concrete during or after placement, before it has sufficiently set and hardened.

Formwork, reinforcement, preparation of surface, embodiments, joint seals etc., shall be approved in writing by the Engineer before concrete is placed. As far as possible, concrete shall be placed in the formwork by means approved by the Engineer and shall not be dropped from a height or handled in manner which may cause segregation. Any drop over 1500 mm shall have to be approved by the Engineer.

Rock foundation or construction joint will be kept moist for at least 72 hours prior to placement. Concrete will be placed always against moist surface but never on pools of water. In case the foundation cannot be dewatered completely, special procedure and precaution, as directed by the engineer will have to be adopted.

Formwork will be cleaned thoroughly and smeared lightly with form oil or grease of approved quality just prior to placement.
The Engineer shall decide upon the time interval between two placements of concrete of different ages coming in contact with each other, taking in consideration the degree of maturity of the older concrete, shrinkage, heat dissipation and the ability of the older concrete to withstand the load imposed upon it by the fresh placement.

Once the concrete is deposited, consolidated and finished in its final position., it shall not be distributed.

3.13 Construction Joints and Cold Joint

3.13.1 Construction Joints

It is always desirable to complete any concrete structure by continuous pouring in one operation. However, due to practical limitation of methods and equipment and certain design considerations, construction joints are formed by discontinuing concrete at certain predetermined stages. These joints will be formed in a manner specified in the drawings/Instruction. Vertical construction joints will be made with rigid stop-board forms having slots for allowing passage of reinforcement rods and any other embodiments and fixtures that may be shown. For water retaining structures and leak proof buildings suitable and approved water stops may be installed at the construction joints as per clause12.4 of IS: 456.

Where the location of the joints are not specified, it will be in accordance with the following: -

a) In a column, the joint shall be formed 75 mm below the lowest soft of the beam framing into it.

b) Concrete in a beam shall preferably be placed without a joint, but if provision of a joint is unavoidable, the joint shall be vertical and it the middle of the span.

c) A joint in a suspended floor slab shall be vertical and at the middle of the span and at right angles to the principal reinforcement.

d) Feather-edges in concrete shall be avoided while forming a joint.

e) A construction joint should preferably be placed in a low-stress zone and at right angles to the direction of the principal stress.

f) In case the Contractor proposes to have a construction joint anywhere to facilitate his work, the proposal should be submitted well in advance to the Engineer for study and approval with which no construction joint will be allowed.

3.13.2 Cold joint

An advancing face or a concrete pour, which could not be covered by fresh concrete before expiry of initial setting time (due to an unscheduled stoppage or delay on account of breakdown in plant, inclement weather, low rate of placement or any other reason), is called a cold joint. The Contractor should always remain vigilant to avoid cold joints.

If, however, a cold joint is formed due to unavoidable reasons, the following procedure shall be adopted for treating it:-

a) If the concrete is so green that it can be removed manually and if vibrators can penetrate the surface without much effort, fresh concrete can be placed directly against the old surface. The old concrete should be covered by fresh concrete as quickly as possible and the joint thoroughly and systematically vibrated.

b) In case concrete has hardened a bit more than (a) but can still be easily removed by a light hand pick, the surface will be raked thoroughly and the loose concrete removed completely without disturbing the rest of the concrete in depth. A rich mortar layer 12 mm in thickness, will be placed on the cold joint. fresh concrete shall be placed on the mortar layer and the joint will be thoroughly and systematically vibrated penetrating the vibrator deep into the old layer of concrete.

c) In case the concrete at the joint has become so stiff that it cannot be remoulded and mortar or slurry does not rise in spite of extensive vibration,

the joint will b3ee left to harden for at least 12 – 24 hrs. It will then be treated as a regular construction joint, after cutting the concrete to required shape and preparing the surface as described under clause 3.12.

3.14 Repairs, Finishes and Treatment of Concrete surfaces

3.14.1 Adequate and sound concrete surfaces, whether formed or unformed, can be obtained by employing a concrete mix of proper design, competent formwork, appropriate methods of handling, placing and consolidation by experience workmen.

Unsound concrete resulting from improper mix design, incompetent methods, equipment and formwork poor workmanship and protection will not be accepted and will have to be dismantled, removed and replaced by sound concrete at the Contractor's cost. The Engineer may, at his sole discretion, allow to retain concrete with minor defects provided the Contractor is able to repair it by approved methods at no extra cost to the Owner. All concrete work shall be inspected by the Contractor immediately after the forms are removed and the will promptly report occurrence of any defects to the Engineer. All repair works will be carried out as per the instructions and in the presence of the Engineer or his representative. Generally, repair work will consist of any or all of the following operations:-

a) Sack rubbing with mortar and stoning with carborundum stone
b) Cutting away the defective concrete to the required depth and shape.
c) Cleaning or reinforcement and embodiments.
d) Roughening by sand blasting or chipping
e) Installing additional reinforcement/welded mesh fabric
f) Dry packing with stiff mortar
g) Plastering, guniting, shotcreting etc
h) Placing and compacting concrete in the void left by cutting out defective concrete.

Grouting with cement sand slurry of 1:1 mix.

3.14.1.1 Finishing Unformed Surfaces

The requirements of finishes of formed surfaces are given separately under clause 3.20.7 of this specification. The Contractor is to include in his quoted rate for concrete, the provision of normal finishes in unformed surfaces which can be achieved by screening, floating, trowel ling etc., as and where required by the Engineer without any extra cost of the Owner. A few typical and common cases of treatment of concrete surface are cited below:-

a) Floor

Wherever a non-integral floor finish is indicated, the surface of reinforcement concrete slab shall be struck off at the specified levels and slopes and shall be finished with a wooden float fairly smooth removing all laitance No over trowel ling, to obtain a very smooth surface, shall be done at it will prevent adequate bond with the subsequent finish.

If desired by the Engineer, the surface shall be scored and marked without any extra cost to the Owner to provide better bond.

Where monolithic finish is specified or required, concrete shall be compacted and struck off at the specified levels and slopes with a screed, preferably a vibrating type and then floated with a wooden float. Steel trowelling is then started after the moisture film and shine have disappeared from the surface and after the concrete has hardened enough to prevent excess of fines and water to rise to the surface but not hard enough to prevent proper finishing of aberration Steel trowel ling properly done will flatten and smoothen sandy surface left by wooden floats and procedure a dense surface free from blemishes, ripples and trowel mark. A fine textured surface that is not slick and can be obtained by trowel ling the surface lightly with a circular motion after initial towelling keeping the steel trowel flat on the surface.

To provide a better grip the Engineer may instruct marking the floor in a regular geometric pattern after initial trowel ling.

b) Beams, Columns & Walls

If on such or any other concretes structure it is intended to apply plaster or such concrete surfaces against which brick work or other allied works are to be built. The Concrete shall hack the surface adequately as soon as the from it stripped off so that proper bond can develop pattern adequacy and details of such hacking shall meet with the approval of the Engineering who shall be informed to inspect such surfaces before they are covered up.

3.15 **Protection and curing of concrete**

i) Newly placed concrete shall be protected approved means from rain sun and wind. Concrete placed below the ground level shall be protected aghast contamination from falling earth during and after placing. Concrete placed in ground containing deleterious substances. Shall be protected from contact with such ground. Or with water draining from such ground, during placing of concrete and for a period of at least three days or as otherwise instructed by the Engineer. The ground water around newly poured concrete shall be kept to an approved level by pumping out or other adequate means of drainage to prevent floatation of flooding. Steps, as approved by the Engineer, shall be taken to protect immature concrete from damage b debris, excessive loadings, vibration, abrasion, mixing with earth or, other deleterious materials, etc, that may impair the strength and durability of the concrete.

As soon as the concrete has hardened sufficiently, it shall be covered either with sand, hession, canvas or similar materials and kept continuously wet for at least 14 (fourteen) days after final setting. Curing by continuous sprinkling of water will be allowed if the Engineer is satisfied with the adequacy of the arrangements made by the Contractor.

The Contractor shall remain extremely vigilant and employ proper equipment and workmen under able supervision for curing. The Engineer's decision regarding the adequacy of curing is final. In case any lapse on the part of the Contractor is noticed by the Engineer, he will inform the Contractor or his supervisor verbally or in writing to correct the deficiency in curing. If no satisfactory action is taken by the Contractor within 3 (three) hours of issuance of such instruction, the Engineer will be at liberty either to employ sufficient means through any agency to make good the deficiency and recover the cost there of from the contractor, or pay for the part where adequate curing was noticed at a reduced rate, entirely at the discretion of the Engineer.

3.16 Reinforcement

Mild steel round bars, cold twisted and deformed bars as medium tensile or high yield strength steel, plain hard drawn steel wire fabric etc., will be used as reinforcement as per drawings and directions.

3.16.1 Bar Bending Schedules

The Contractor shall submit the Engineer for approval Bar Bending Schedules with working drawing in triplicate, showing clearly the arrangements proposed by the Contractor to match available stock of reinforcing steel, within one month of receipt of the Letter of Intent or of the receipt of the relevant design drawings whichever is later. Upon receipt of the Engineer's final approval of the Bar Bending Schedule and drawings, the Contractor shall submit 6 (six) prints of the final drawings with one reproducible print after incorporating necessary modifications or corrections, for final record and distribution. Approval of such detailed drawings by the Engineer shall not relieve the Contractor of his responsibility for correctness nor of any of his obligations to meet the other requirements of the Contract.

3.16.2 Cleaning

All steel for reinforcement shall be free from loose scales, oil, grease, paint or other harmful matters immediately before placing the concrete.

3.16.3 Bending

Unless otherwise specified, reinforcing steel shall be bent in accordance with the procedure specified in IS:2502 or as approved by the Engineer. Bends and shapes shall comply strictly with the dimensions corresponding to the approved Bar Bending Schedules. Bar Bending Schedules shall be rechecked by the Contractor before any bending is done.

No reinforcement shall be bent when already in position in the work, without approval of the Engineer, whether or not it is partially embedded in concrete. Bars shall not be straightened in a manner that will injure the material. Bars shall not be

straightened in a manner that will injure the material. Rebinding can be done only if approved by the Engineer. Reinforcing bars shall be bent by machine or other approved means producing a gradual and even motion. All the bars shall be cold bent unless otherwise approved. Bending hot at a cherry-red heat (not exceeding 845 Deg. C) may be allowed under very exceptional circumstances except for bars whose strength depends on clod working. Bars bent hot shall not be cooled by quenching.

3.16.4 Placing in Position

All reinforcements shall be accurately fixed and maintained in position as shown on the drawings by such approved and adequate means like mild steel chairs and/or concrete spacer blocks irrespective of whether such supports are payable or not. Bars intended to be in contact at crossing points, shall be securely tied together at all such points by No. 20 G annealed soft iron wire or by tack welding in case of Bar larger than 25 mm die., as may be directed by the Engineer. Binders shall be securely held. The vertical distance between successive layers of bars shall be maintained by provision of mild steel spacer bars. They should be spaced such that the main bars do not sag perceptibly between adjacent spacers. Before actual placing, the contractor shall study the drawings thoroughly and inform the Engineer in case he feels that placement of certain bars is not possible due to congestion. In such cases he should no start placing any bar before obtaining clearance from the Engineer.

3.16.5 Welding

Normal bond laps in reinforcement may be placed by lap or but welding reinforcement bars, if asked by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant India Standards for welding of mild steel bars used in reinforced concrete construction as per IS:2751 and IS:456. Welded mesh fabrics conforming to IS: 1566 may also be used if specified in the Schedule of Items and Drawings.

3.16.6 Control

The placing of reinforcements shall be completed well in advance of concrete pouring. Immediately before pouring, the reinforcement shall be examined by the Engineer for accuracy of placement and cleanliness. Necessary corrections as directed by him shall be carried out. Laps and anchorage lengths of reinforcing bars in a lap are not of the same diameter, the smaller will guide the lap length. The laps shall be staggered as for as practicable and as that reinforcement in position do not have to bear extra load and get disturbed.

The cover for concrete over the reinforcement shall be as shown on the approved drawings unless otherwise directed by the Engineer. Where concrete blocks are used for ensuring the cover and postioning reinforcement, they shall be made of morar not

leaner than 1 (one) part cement to 2 (two) parts sand by volume and cured in a pond for at least 14 (fourteen) days. The type, shape, size and location of the concrete blocks shall be as approved by the Engineer.

3.17 Cold Weather Concreting

When conditions are such that the ambient temperature may be expected to be 4.5 Deg. C or below during the placing and curing period, the work shall conform to the requirement of Clause 13 of IS:456 and IS:7861.

3.18 Hot Weather Concreting

When depositing concrete in very hot weather, the Contractor shall take all precautions as per IS:7861 and stagger the work to the cooler parts of the day to ensure that the temperature of wet concrete used in massive structures does not exceed 38 Deg. C while placing. Positive temperature control by precooling, post cooling or any other method, if required, will be specified and paid for separately.

3.19 **Concreting under water**

When it is necessary to deposit concrete under water it shall be done in accordance with the requirements of clause 13 of IS:456.

3.20 FORM WORK

3.20.1 General

If it is so desired by the Engineer, the contractor shall prepare, before commencement of actual work, designs and working drawings for form work and cantering and get them approved by the Engineer. The formwork shall conform to the shape, grade, lines, levels and dimensions as shown on the drawings:

Materials used for the formwork inclusive of the supports and cantering shall be capable of withstanding the working load and remain undistorted throughout the period it is left in service. All supports and scaffolds should be manufactured from structural or tubular steel except when specifically permitted otherwise by the Engineer.

The cantering shall be true to vertical, rigid and thoroughly braced both horizontally and diagonally. Rekers are to be used where forms are to support inclined members. The forms shall be sufficiently strong to carry without undue deformation, the dead weight of the concrete as a liquid as well as the working load, in case the Contractor wishes to adopt any other design criteria, he has to convince the Engineer about its acceptability before adopting it. Where the concrete is vibrated, the form work shall be strong enough to withstand the effects of vibration without appreciable deflection, bulging, distortion or loosening of its components. The joints in the formwork shall be sufficiently tight to prevent any leakage of slurry or mortar.

To achieve the desired rigidity, tie bolts, spacer blocks, tie wires and clamps as approved by the Engineer shall be used but they must in no way impair the strength of concrete or cause stains or marks on the finished surface. Where there are chances of these fixtures being embedded, only mild steel or concrete of adequate strength shall be used. Bolts passing, completely through liquid retaining walls/slabs for the purpose of securing and aligning the formwork shall not be used.

The formwork shall be such as to ensure a smooth uniform surface free from honeycombs, air bubbles, bulges, fins and other blemishes. Any blemish or defect found on the surface of the concrete must be brought to the notice of the Engineer immediately and rectified free of charge as directed by him.

For exposed interior and exterior concrete surfaces of beams, columns and wall, plywood or other approved form shall be thoroughly cleaned and tied together with approved corrosion-resistant devices. Rigid care shall be exercised in ensuring that all Colum forms are plumb and true thoroughly cross-braced to keep them so. All floor and beam centering shall be crowned not less than 8 mm in all directions for every 5 meters span. Unless specifically described on the drawings or elsewhere to the contrary, bevelled forms 25 mm by 25 mm shall be fixed in the form-work at all corners to provide chamfering of the finished concrete edges without any extra charge. The formwork should lap and be secured sufficiently at the lift joints to prevent bulges and offsets.

Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base of vertical forms and at other places, where they are necessary and as may be directed by the Engineer. The temporary openings shall be so formed that they can be conveniently closed when required, during pouring operations without leaving any mark on the concrete.

3.20.2 Cleaning and Treatment of Forms

All parts of the forms shall be thoroughly cleaned of old concrete, wood shavings, saw dust, dirt and dust sticking o them before they are fixed in position. All rubbish, loose concrete, chippings, shavings, saw dust etc shall be scrupulously removed from the interior of the forms before concrete is poured. Compressed air jet and/or water jet along with wire brushes, brooms etc. shall be used for cleaning. The inside surface of the formwork shall be treated with approved non-staining oil or other compound before it is placed in position. Care shall be taken that oil or other compound does not come in contact with reinforcing steel or construction joint surfaces. They shall not be allowed to accumulate at the bottom of the formwork. The oiling of the formwork will be inspected just prior to placement of concrete and redone wherever necessary.

3.20.3 Design

The formwork shall be so designed and erected that the forms for slabs and the sides of beams, columns and walls are independent of the soffits of beams and can be removed without any strain to the concrete already placed or affecting the remaining

formwork. Removing any props or repropping shall not be done except with the specific approval of the Engineer. If formwork for column is created for the full height of the column, one side shall be left open and built up in sections, as placing of concrete progress. Wedger, spacer, bolts, clamps or other suitable means shall be provided to allow accurate adjustment and alignment of the form work and to allow it to be removed gradually without jarring the concrete.

30.20.4.1 Inspection of forms

Casting of Concrete shall start only after the formwork has been inspected and approved by the Engineer. The concreting shall start as early as possible within 3 (three) days after the approval of the formwork and during this period the formwork shall be kept under constant vigilance against any interference. In case of delay beyond three days, a fresh approval from the Engineer shall be obtained.

3.20.4 Removal of Forms

Before removing any formwork, the Contractor must notify the Engineer well in advance to enable him to inspect the concrete if he so desires.

The Contractor shall record on the drawing or in any other approved manner, the date on which concrete is placed in each part of the work and the date on which the formwork is removed there from and have this record checked and countersigned by the Engineer regularly. The Contractor shall be responsible for the safe removal of the formwork and any work showing signs of damage through premature removal of formwork or loading shall be rejected and entirely reconstructed by him without any extra cost of the Owner. The Engineer may, however, instruct to postpone the removal of formwork if he considers it necessary.

Form for various types of structural components shall not be removed before the minimum periods specified herein and the removal after the minimum periods shall also be subject to the approval of the Engineer in each case.

TABLE – VI
SCHEDULE OF REMOVAL OF FORM

part of Structure	Ordinary Portland Cement Concrete				Rapid Hardening Portland Cement Concrete			
	Temperature ^{0}C				Temperature ^{0}C			
	Above 40^{0}C	40^0 20^0	20^0 5^0	Below 5^0	Above 40^{0}C	40^0 20^0	20^0 5^0	Below 5^0
	Days	Days	Days	Days	Days	Days	Days	Days
a) Columns & Walls	2	1	1	Do not remove forms until site cured test specimen develop at least 50% of the specified 28 days 12 strength	1	1	1	Do not remove forms until site cured test specimen develop at least 50% of the specified 28 days strength
b) Beam sides	3	2	3		2	1	1	
c) Slabs, 125 mm	10	7	8		7	4	5	
d) Slabs over 125 mm thick and soffit of minor beams	18	14	16		12	8	9	
e) Soffit of main beams	24	21	22		14	10	12	

Wherever exposed surfaces of concrete can be effectively sealed to prevent loss of water, the periods specified for temperature above 40 Deg. C can be reduced to those of the temperature range of 20 Deg. C to 40 Deg. C subject to approval of the Engineer.

Construction joints in beams, if required to be provided, will be located at the middle of span according to clauses 3.13.1 (b) of this specification. In such cases, however, entire span of beam shall have to be kept supported by form work till its removal for the portion of beam, cast at a later date, is due and so approved by the Engineer.

3.20.5 Tolerance

The from work shall be so made as to produce a finished concrete true to shape, lines, levels, plump and dimensions as shown on the drawings subject to the following to lerances otherwise specified in this Specification or drawings or directed by the Engineer:

For a) Sectional dimension - $\pm$ 5mm

b) Plumb - 1 in 1000 of height

c) Levels - ± 3mm before any deflection has Taken place

The tolerance given above are specified for local aberration in the finished concrete surface and should not be taken as tolerances for the entire structure taken as a whole or for the setting and alignment of formwork, which should be as accurate as possible to the entire satisfaction of the Engineer. Any error, within the above tolerance limits or any other as may be specially set up by the Engineer, if noticed in any lift of the structure after stripping of forms, shall be corrected in the subsequent work to bring back the surface of the structure to its true alignment.

3.20.6 Re-use of Forms

Before re-use, all forms shall thoroughly scraped, cleaned, joints and planes examined and when necessary required, and inside surface treated as specified here in before. From work shall not be used/re-used if declared unfit or unserviceable by the Engineer.

3.20.7 Classification

Generally, the 'ordinary 'class from work shall be used unless otherwise directed by the Engineer:

a) **Ordinary :** These shall be used in places where ordinary surface finish is required and shall be composed of steel and/or approved good quality partially seasoned timber.

b) **Plywood :** These shall be used in exposed surfaces, where a specially good finish is required and shall be made of approved brand of heavy quality plywood to produce a perfectly uniform and smooth surface conforming to the shape described in the drawing with required grain texture on the concrete.
Re- use may only be permitted after speciation and approval by the Engineer. He may also permit utilisation of used plywood for the ordinary class, if it is still in good condition.

c) Ornamental: These shall be used where ornamental and curved surface are required and shall be made of selected best quality well seasoned timbers or of plywood, which can be shaped correctly.

3.21 Opening, Chases, Grooves, Rebates, blackouts etc.

The Contractor shall leave all openings, grooves, chase, etc. In concrete work as shown on the drawings or as specified by the Engineer.

3.22 Anchor Bolts, Anchors, Sleeves, Inserts, Hangers/Conduits/Pipe and Other Miscellaneous Embedded Fixtures

The Contractor shall build into concrete work all the items noted below and shall embed them partly or fully as directed and secure the same as may be required. The materials, if required to be supplied by the Contractor, shall be as specified and be of best quality available according to relevant Indian Standards of approved manufacture and to the satisfaction of the Engineer. Exposed surfaces of embedded materials are to be painted with one coat of approved anti-corrosive paint and / or bituminous paint without any extra cost to the Owner. If welding is to be done subsequently on the exposed surface of embedded material the paint shall be cleaned off the member to a minimum length of 50 mm beyond each side of the weld line.

Necessary templates, fixtures, supports etc. shall be used as may be required or directed by the Engineer, free of cost to the Owner.

Items to be embedded

a) Inserts, hangers, anchors, frames around openings, manhole covers frames, floor clips, sleeves, conduits and pipes.

b) Anchor bolts and plates for machinery, equipment and for structural steel work.

c) Steel structural to be left embedded for future extension. Special connection etc.

d) Dowel bars, etc. for concrete work falling under the scope of the contractors.

e) Lugs or plugs for door and window frames occurring in concrete work.

f) Flashing and jointing in concrete work.

g) Any misc. embodiments and fixture as may be required.

Correct location and alignment as per drawings/instruction of all these embedded items shall be entirely the responsibility of the Contractor.

3.23 Expansion and Isolation Joints

3.23.1 General

Expansion and isolation joints in concrete structures shall be provided at specific places as per details indicated on the drawings. The materials and types of joints shall be as specified herein after. In case, of liquid retaining structures, additional precautions shall be taken to prevent leakage of liquids as may be specified on the drawings or as directed by the engineer. All materials are to be procured from reliable manufacturers and must have the approval of the engineer. Where it is the responsibility of the Contractor to supply the material, the Engineer may demand test certificates for the materials and/or instruct the

Contractor to get them tested in an approved laboratory free of cost to the Owner. Joints shall be formed true to line, level, shape, dimension and quality as per drawings and specifications. Prior approval of the method of forming the joints should be obtained from the engineer before starting the work.

3.23.1 Bitumen Board/Expanded Polystyrene Board

3.23.2.1 Bitumen Board

Bitumen impregnated fibre board of approved manufacturer as per IS: 1838 may be used as fillers for expansion joints. It must be durable and waterproof. It shall be compressible and posess a high degree or rebound. The dimensions of the board should be equal to that of the joint being formed. It should preferably be manufactured in one piece, matching the dimension of the joint and not prepared by cutting to size smaller piece, from larger boards at site. At the exposed end, the joint shall be sealed with approved sealing compound to a depth of at least 25 mm after application of an approved primer. The sealing compound and the primer shall be applied as specified by the manufacturer.

3.23.2.2 Expanded Polystyrene Boards

If required, commercial quality of expanded polystyrene products commonly used for thermal insulations may also be sued as filler material in expansion joints. The thickness may vary from 12 mm to 50 mm. The material will have to be procured from reliable manufacturers as approved by the Engineer. The method of installations will be similar to that recommended by the manufacturers for fixing on cold storage walls. A coat of Bitumen paint may have to be applied on the board against which concrete will be placed.

3.23.2 Joint Sealing Strips

Joint sealing strips may be provided at the construction, expansion and isolation joints as a continuous diaphragm to contain the filler material and/ or to exclude passage of water or any other material into or out of the structure. The sealing strips will be either metallic like G.I. Aluminium or Copper, or non-metallic like rubber or P.V.C.

Sealing strips will not have any longitudinal joint and will be procured and installed in largest practicable lengths having a minimum number of transverse joint. The material is to be procured from reputed manufacturers having proven records of satisfactory supply of joint strips of similar make and shape for other jobs. The jointing procedure shall be as per the manufacturer's recommendations, revised if necessary , by the Engineer. The Contractor is to supply all labour and material for installation including the material and tools required for jointing testing, protection, etc. If desired by the Engineer joints in rubber seals may have to be vulcanized.

3.23.3.1 Metal Sealing Strips

Metal sealing strips shall be either G.I. Aluminium or Copper and formed straight, U shaped, Z shaped or any other shape and of thickness as indicated in the drawing and schedule of items and/or as instructed by the Engineer.

The transverse joints will be gas welded using brass rods and approved flux and will be tested by an approved method to establish that it is leak proof, longer lap lengths and different method of brazing which will tender it leak proof, will be adopted by the Contractor without any additional cost to the Owner. The edges shall be neatly crimped and bent to ensure proper bond with the concrete.

a) **G.I. Strips**

G.I. Strips shall be minimum 1.5 mm thick and 150 mm in width unless specified otherwise. The Standard of Galvanising shall be as per relevant Indian Standards for heavy duty work. At the joints, the overlapping should be for a minimum length of 50 mm.

b) **Aluminium Strips**

Aluminium strips shall be minimum 10 SWG thick and 300 mm wide unless specified otherwise and shall conform to IS:737 of 19000 grade or 31000 grade (Designation as per IS: 6051. A minimum lap of 50 mm length is required at the joints.

c) **Copper Strips**

The Copper strips shall be minimum 18 SWG in thickness and 300 mm wide unless specified other wise and shall conform to the relevant Indian Standards.

It should be cleaned thoroughly before use to expose fresh surface, without any reduction in gauge. A minimum lap of 50 mm in length is required at the joints.

3.23.3.2 Non-metallic Sealing Strips

The will be normally in Rubber or P.V.C. joint be of shape having any combination of the following features:-

a) Plain

b) Central bulb

c) Dumb-bell or flattened ends.

d) Ribbed and Corrugated Wings

e) V shaped

As these types of seals be easily handled in very lengths unlike metal strips, transverse joints will be only under unavoidable circumstances and with the specific approval of the Engineer.

The method of forming these joint, laps etc. shall be specified by the manufacturer and /or as approved by the Engineer taking particular care to match the central bulbs and the edges accurately

a) **Rubber Sealing Strips**

The minimum thickness of Rubber sealing strips shall be 3mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings/schedule of items and/or as directed by the Engineer. The material will be natural rubber and be resistant to corrosion, abrasion and tear and also service. The physical properties will be generally as follows. The actual requirements may be slightly different as decided by the Engineer.

Specific Gravity	:	1.1 to 1.15
Shore Hardness	:	65 A to 75 A
Tensile Strength	:	25-30 N/Sq.mm
Maximum Safe Continuous Temperature	:	75 Deg.C
Ultimate Elongation	:	Not less then 350 %

b) **P.V.C. Sealing Strips**

The minimum thickness of P.V.C. sealing strips will be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings / Schedule of items and / or as directed by the Engineer. The material should be of good quality polyvinyl Chloride highly resistant to tearing, abrasion and corrosion as well as to chemicals likely to come in contact with during use. The physical properties will generally be as follows, which will be directed by the Engineer, may very slightly:-

Specific Gravity	:	1.3 to .1. 35
Shore Hardness	:	60 A to 80 A
Tensile Strength	:	10 – 15 N/Sq.mm
Maximum Safe Continuous Temperature	:	70 Deg.C
Ultimate Elongation	:	Not less then 275 %

3.23.4 Bitumen Compound

When directed, the gap in expansion joints shall be thoroughly cleaned and bitumen compound laid as per manufacturer's specifications. The compound to be used shall be of approved manufacture and shall conform to the requirements of IS: 1834.

3.23.5 Isolation Joints

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

3.23.6 Rubber Pad

Hard Foundation quality rubber pads of required thickness and shapes shall be put below machine or other foundations as shown on the drawings or as directed by the Engineer. The rubber shall have a unit weight of 1,500Kg/Cu.m., a shore hardness – 65A to 70A and be of best quality of approved manufacture, durable, capable of absorbing vibration and must be chemically inert in contact with moist or dry earth or any earth or any earth or any other deleterious material expected under normal conditions.

3.24 Grouting under Machinery or Structural Steel Bases

If required, grouting under base plates of machines or structural steel etc., shall be carried out by Contractor. In general, the mix shall be 1 (one) part cement and 1 (one) part sand and just enough water to make it flow as required. The areas to be grouted shall be cleaned thoroughly with compressed air jet and/or with water in locations where accumulated surplus water can be removed. Where directed by the Engineer, 6mm down stone chips may have to be used in the mix. Surface to be grouted shall be kept moist for at least 24 hours in advance. The grout shall be placed under expert supervision, so that there is no locked up air. Edges shall be finished properly. If desired by the Engineer, admixtures like Aluminium powder, 'Ironite' etc. may have to be added with the grout in proportions to be decided by the Engineer Admixture, if directly to be added, will be measured and paid sep[separately.

3.25 Precast Concrete

The specification for precast concrete will be similar as for the cast-in-place concrete described herein and as supplemented in this section. All precast work shall be carried out in a yard made for the purpose.

This yard shall be dry, properly levelled and have a hard and even surface. If the ground is to be used as a soffit former of the units, it shall be paved with concrete or masonry and provided with a layer of plaster (1:2 proportions) with smooth neat cement finish or a layer of M.S. sheeting. Where directed by the Engineer, casting will have to be done on suitable vibrating table. The yard , lifting equipment , curing tank, finished material storage space etc. shall be designed such that the units are not lifted from the mould before 7 (seven)days of curing and can be removed for erection after 28 days of curing. The moulds shall preferably be of steel or of timber lined with G.I. sheet metal. The yard shall preferably be fenced.

Lifting hooks, where necessary or as directed by the Engineer, shall be embedded in correct position of the units to facilitate erection, even though they may not be shown on the drawings, and shall be burnt off and finished after erection.

Precast concrete units, when ready, shall be transported to site by suitable means approved by the Engineer. Care shall be taken to ensure that no damage occurs during transportation. All adjustments, levelling and plumbing shall be done as per instructions of the Engineer. The Contractor shall render all help with instruments, materials and men to the Engineer for cheeking the proper erection of the precast units.

After erection and alignment, the joints shall be filled with grout or concrete as directed by the Engineer. If centrings have to be used for supporting the precast units, they shall not be removed until the joints have attained sufficient strength and in no case before 14 (fourteen) days. The joint between precast roof planks shall be pointed with 1:2 cement: sand mortar where called for in the drawings.

3.26 Water Proofing of Concrete Structure

3.26.1 General

Waterproofing of concrete structures shall be by either suitable extraneous treatments like applying paints, fixing bitumen felts etc. or internally by suitable design of the concrete mix, addition of suitable admixtures in the concrete or mortar at the time of mixing and/or installing water bars at the joints.

The design, material and workmanship shall conform to the relevant I.S.Codes where applicable. The Engineer's approval of the materials shall be obtained by the Contractor before procurement. If desired by the Engineer, test certificates for the materials and samples shall be submitted by the Contractor free of charge. The materials shall be of best quality available indigenously. Fresh clean and suitable for the duties called upon.

3.26.2 Water Bar/Seal

Water bearing structures and under ground structures may have water bar/seals installed at the joints. They may be either metallic rubber or P.V.C. The materials and installation will be as described under Clause 3.23.3.

3.26.3 Waterproofing Admixtures

a) In Concrete:
The admixtures shall be procured from reliable and reputed manufacturers and approved by the Engineer. The method of application and other details shall conform to the manufacturer's specification and /or as instructed by the Engineer. The contractor shall have the services of the manufacturer's supervisor at no extra cost to the Owner to supervise the work, if des8ired by the Engineer.

b) In Plaster:
The concrete surface, to be plastered, shall be hacked to Engineer's satisfaction, cleaned thoroughly and kept wetted for 24 hours. The plaster shall be in cement sand mortar mixed in proportion varying from 1:1to 1:4 by volume along with the approved water

proofing 15 mm/layer or as per manufacturer's specification. The additive shall be of quality and type approved by the Engineer. If desired by the manufacturer's supervisor at no extra cost to the Owner. On completion, the plastered surface shall be cured continuously for a minimum period of 14 days like concrete.

3.26.4 Bituminous of Tar Coating

The surface to be waterproofed shall be render ed absolutely dry , clean and dust free. The surface shall be sand papered, cleaned and completely coated with hot coal tar pitch of approved manufacture and quality as per IS: 216 (not heated above 375 Deg.F) using not less then 2 kg per Sq. M or with hot asphalt i.e., bitumen according to IS: 73 (not heated above 400 Deg.F) using not less then 1.5 kg. Per Sq. m when the first coat has completely dried up and approved by the Engineer, the second coat shall be applied in the same manner using hot less then 1.25 kg .per sq. M in case of coal tar and 1 kg per Sq. M. in case of asphalt Immediately after application of the second coat and be for it is dried up, sand shall be spread on the surface to cover it completely sufficient time shall be allowed after spreading of before back filing is done in order to allow the final coat to dry up completely.

3.26.5 Bitumen Felt: Application for Tanking

This specification shall cover laying the waterproof coarse on the outside and inside of the walls and bases of structures

The materials shall conform to IS: 1322, and the workmanship to IS: 1609. The bitumen felt shall be Hessian base and/or fibre base as specified in Drawing/Schedule of Items. If required by the Contractor without charging any extra to the Owner.

Cleaning the surface, keeping it dry, proving necessary corner fillets and cement rendering and cutting chases, etc., shall be included in the rate for this item. If any protective brickwork on/against concrete sub-bases or walls are required, this will be paid extra under suitable items in the contract. A 20 years guarantee for satisfactory performances shall be given by the Contractor as well as his specialist sub- contractor jointly and severally, for this item of work. Free rectification of any defects noted in the work within this guarantee period will be carried out by the contractor even if is beyond the specified maintenance period of the contract as a whole.

3.26.6 Polyethylene films: Application in Walls or base of Structures

Waterproof treatment shall be applied as outlined and as per sequence given here under.

i) The concrete surface shall be made smooth with 12 mm cement plaster 1:6

ii) apply hot bitumen 80/100 grade (IS 73-1961)at the rate of 1.0 Kg/Sq m Minimum

iii) Lay back poly ethylene film 250 micro (IS 2508- 1977) with cut back bitumen adhesive in overlaps over hot bitumen surface, gently pressed,

taking care not puncture the film.

Alternatively, the overlaps shall be sealed by an electric iron having three parallel sealing bars. A long piece of plywood is to be placed below the Polyethylene film to be heat spread a cushion for better welding of the LDPE film, with 100 mm overlap, is to be stretched. On the overlapped film another Cellophane tape is to be placed to prevent the heat heat sealer from sticking to the LDPE film After this, the electric iron is to be pressed on the overlap join for sufficient time so as to allow perfect welding. The operation is to be repeated for subsequent lengths of joints. After heat sealing, the Cellophane tape is to be removed and the joints are to be tested for leaks.

iv) Lay 100 gm brown craft paper laminated with a layer of straight run bitumen
v) Lay hot bitumen 80/200 grade (IS: 73-1961)at 1.0 Kg/Sq.m minimum.
vi) Lay 250-micron polyethylene film as second layer similar to (iii) above.
vii) Lay second layer of 100 gm brown craft paper laminated similar to (iv) above.
viii) Apply hot bitumen (straight run grade) to IS: 73-1961 at 1.0 Kg/Sq.m. dusted with fine sand.
ix) Protecting with a layer of 75 mm plain cement concrete M-100, or a layer of brick laid in cement mortar 1:6. In case of wall apply a 12 mm thick plaster as shown on the drawing or a protective brick wall in 1:6 cement mortar as shown on the drawing.

4.0 SAMPLING AND TESTING

4.1 General

The Contractor shall carry out all sampling and testing in accordance with the relevant India Standards and as supplemented here in for the following items at his own cost unless otherwise specified in this specification. The Contractor shall get, the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate with in 3 (three) days after completion of the test.

4.2 Cement

Representative samples will be taken from each consignment of cement received from the manufacturer/supplier for carrying out the tests for fineness (by hand sieving), setting time and compressive strengths as per IS:269. soundness Tests may also be required to be carried out if required by the Engineer. The test shall be carried out free of charge by the Owner, if Cement is supplied by him or by the Contractor is directed arrange for the supply as per the terms and conditions of the Contract. In case due to any circumstances, the agency of supply is changed in the middle of the Contract, the party who bore the original contractual obligation will carry on with the test, free of charge to the other, till the end of the works unless satisfactory 3(three) days and 7 days test results for compressive strength are know. The Owner, Engineer and Contractor will jointly associate themselves with the tests irrespective of whether they are carried out by the Owner or the Contractor. These tsets are of great importance as

their results will have a bearing on the acceptance of concrete or otherwise as per the terms and conditions of the Contract.

4.3.1 Aggregates

The Contractor shall carry out any or all the tests aggregates as may be required by the Engineer in accordance with IS2300 (PARTS-I to VIII). The acceptance criteria of the samples tested shall be in accordance with the requirements of the relevant Indian Standards.

4.4 Water

Sampling and Testing of water being used for concrete works per IS:3550 will be carried out by the Contractor at regular intervals and whenever directed by the Engineer. The final acceptance criteria in case of doubt will be as per IS: 3025 & IS: 456.

4.5 **Admixture**

4.5.1 Air Entraining Agents

Initially, before starting to use A.E.A., relationship between the percentage of air entrained and the cylinder cube crushing strength via-a via quantity of A.E.A. used for all types of concrete will be established by the Contractor free of change by carrying out sufficiently large number of tests. Contractor will check up free of charge, the actual presented by the Engineer, the Contractor with earlier test results.

4.5.2 Other Admixtures

Tests for establishing the various of any other admixtures which may be Required to be added shall be carried out by the Contractor free of charge to Owner.

4.6 **Concrete**

The sampling of concrete, making the test specimens, curing and testing procedure etc. shall be in accordance with IS:516 and IS:1199 the size of specimen being 15 cm cubes. Normally, only compression tests shall be perfumed but under special circumstances the Engineer may require other tests to be performed in accordance with IS:516

Sampling procedure, frequency of sampling and test specimen shall conform to Clause 14 of IS: 456.

To control the consistency of concrete from every mixing plant, slump tests and/or compacting factor tests in accordance with IS:1199 and as mentioned in Clause 3:6 of this Specification shall be carried out by the Contractor every two hours or as directed

by the Engineer. Slump corresponding to the test specimens shall be recorded for reference.

The acceptance criteria of concrete shall be in accordance with Clause 15 of IS:456. However, in exceptional circumstances, the Engineer may, at his discretion, accept a concrete of lower strength then specified and which is otherwise unacceptable according to IS:456.

Payment for concrete which is normally unacceptable as per the criteria laid down in IS: 456, but which has been accepted by the Engineer shall be made at a reduced rate prorate to the strength obtained.

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

5.0 ACCEPTANCE CRITERIA

5.1 Standard Deviation

Standard deviation shall be based on test results and determination of Standard deviation shall conform to clause 14.5 of IS: 456.

5.2 Acceptance Criteria

The strength requirements and acceptance criteria shall conform to Clause 15 of IS:456.

5.3 Inspection and Core Tests

Inspection of concrete work immediately after stripping the formwork and core test of structures shall conform to Clause 16 of IS: 456.

5.4 Load Test

Load tests of structural members may be required by the Engineer, when the strength of test specimen results fall below the required strength as per “Load Test on parts of structures”, .Clause 16.5 of IS:456. If load testing is decided by the Engineer, the member under consideration shall be subjected to a test load equal to 1:25 (one and a quarter)times the specified live load user for design and this load shall be maintained for a period of 24 (twenty-four)hours before removal. The detailed procedure of the test is to be decided by the Engineer. Load tests shall not be made until the structure is at least 56 days old.

If the member shows evident failure, such changes as are necessary to make the structure adequately strong shall be made by the Contractor free of cost to the Owner.

Alternatively, if permitted under Statutory Regulations and at the discretion of the Engineer .the structure under test or a portion thereof may be retained as such without any modification by dearating its load bearing capacity, provided the design criteria allows such dearating.

A reinforced concrete beam, floor or roof shall be deemed to have passed the test if the maximum deflection at the end of 24 hours dose not exceed the deflection given in Clause 16.5 of IS: 456.

The entire cost of load testing shall be borne by the Contractor. If a portion of the structure is found to be unacceptable, it shall be dismantled and replaced by a new structure as per specification. The entire cost of dismantling and replacement and restoration of the site being borne by the Contractor.

If in the course of dismantling, any damages done to the embedded items and or other adjacent to the satisfaction of the Engineer.

6.0 RATES

The rate for any item in the schedule, unless specifically excluded in the contract, shall be deemed to include the cost of all materials consumed or used in the work or incidental to it a labour, tools, plants, equipment, templates, supports, scaffolds approaches, security, and safety measures, power, fuel, lubricants, storage, handing transport, testing, insurances, taxes overheads, profits etc., the various items of work which are to be provided are mentioned under Clause 2.1 and elsewhere in this specification. If no separate item is provided for any such wok in the schedule of items. It is implied that the contractor shall not claim for any of the connected items of the schedule viz., detailed drawings and drawings of formwork in the item of from work of concrete etc., rate for R.C.C. items shall include for carrying out specimen tests as per specifications.

7.0 METHOD OF MEASUREMENT

7.1 Concrete

a) Actual volume of work as executed or as per drawings issued, whichever is less shall be measured in Cu.M. Deductions for openings, conduits, pipes, ducts pockets, chases etc. shall be made, provided they are larger then 0.1 sq. M. in area each.

No deduction shall be made for embedded fixtures including reinforcements, sleeves, anchor bolts and similar items.

b) Precast concrete work shall be measured in the same way as specified in foregoing paragraph. No separate payment shall be made for formwork. Lifting hook where required in the design, shall be treated as reinforcement steel and paid accordingly. Payment shall be due only after erection, grouting and curing of the precast units in proper position unless otherwise provide for

in the contract. All breakages and damages of the precast units will be to the Contractor's account and shall be replaced free of charge to the Owner.

7.2 Admixture

Admixture will be measured on the basis of theoretical requirement or actual consumption, whichever is less.

7.3 Reinforcement

a) Bar or any other type of reinforcement used like Hard drawn steel Wire fabric etc. for reinforced shall be measured by weight in tonnes. The weight will be arrived at by multiplying the actual or theoretical length; whichever is less, by the sectional weights. In case the Owner issues the reinforcing steel, the section weights will be the same as were applied at the time of issue. In case the steel is to be supplied by the contractor, the sectional weight to be adopted will be the I.S. Sectional Weight or as per actual which will be arrived at by accurately measuring representative samples as directed by the Engineer, whichever is less.

b) Standard hooks; cranks, bonds, authorised laps etc. shall be measured.

c) Lap welding or butt welding if permitted will be, measured diameter wise per Joint. The actual length of steel in lap will be measured separately in case of lap welding. The rate quoted for the smaller size bar will be applied in case of joint between two bars of different diameters.

d) Separator pieces between two or more layers of steel shall be measured.

e) No payment shall be made for binding wires,spacer block, supports, chairs, hangers, etc. of height 300 mm and less, required of keeping the steel in position unless otherwise specified in the contract. For supporting horizontal reinforcement at heights larger then 300 mm support drawings will be prepared by the Engineer, or as actually placed, whichever is less, at the same rate as for Reinforcement.

f) No extra will be paid for modification of already embedded reinforcement, if required due to faulty fabrication or placement.

g) Dowels neither shown on the drawings not instructed by the Engineer, but required for construction facilities and/or sequence, shall not be measured.

7.4 Form work

a) Formwork shall be measured as the actual surface in contact with the concrete and paid in Sq.M unless included in the rate for concrete.

b) Formwork shall not be measured separately for precast concrete work which shall be included in the cncrete rates.

c) No payment for from work or any other requirement in construction joints shall be made.

d) Openings upto 0.1 Sq.M shall be neglected as if non-existent for the purpose of from work measurement.

e) No extra measurement or payment shall be made for making the from work waterproof or for supports, scaffolding, cantering approaches, etc.

f) No measurement shall be taken for he from work in pockets, openings, chases etc. in concrete if the cross-sectional area is less then or equal to 0.1 Sq.M. in each case if the cross-sectional area of any opening exceeds 0.1 Sq.M the from work shall be measured under appropriate classification.

g) Fixing and removing pockets and openings of sectional area less then 0.1 Sq.M. shall be measured on number basis and paid separately.

7.5 Anchor Bolts, Anchor Sleeves, Inserts, Hangers, Conduit Pipes and Other Miscellaneous Embedded Fixtures

a) These will be measured on theoretical weight basis of the complete insert handled by the Contractor irrespective of the amount of insertion. Where theoretical weight cannot be assessed satisfactorily, the actual weight shall be allowed under certification of the Engineer.

b) No extra shall be to be paid for templates and other arrangements required to secure these in position. The protection of these materials with proper anticorrosive paints/grease and covering with gunny bags against any damages till the structure is handed over, shall be the responsibility of the Contractor at no extra cost.

c) Any ‘boxing ‘ left for inserts, etc. during construction , for facility of the Contractor’s work , and later on filled in by the same Contractor after placing the inserts shall be considered for measurement purpose, as if the inserts, etc. were placed before concreting.

d) No extra payment shall be made for cleaning of the inserts, etc. required for bond with the concrete.

7.6 Expansion and Isolation Joints

a) Expansion and isolation joints will be measured and paid on area basis. The drawings and or schedule of items will describe the thickness. Painting, filling material, sealing, strips, metal fixtures, inserts, etc. to be used in the joint.

b) Formwork for the 'leading side' of the joint will be measured and paid under the relevant item. No payment for the formwork for the 'following side' will be made even if the Contractor is required to use from work for constructional facilities.

c) Joints sealing strips made out of Copper, Aluminium or G.I.or P.V.C.or rubber, will be measured and paid on area basis under relevant items. Rubber pads below foundation will be measured on area basis under the relevant item.

d) Any other fixtures and inserts like dowels, installed as per drawing, riding plates etc., will be measured and paid if under the respective items of the schedule of Items.

e) All other work like installing Bitumen coating, Bitumen boards, Expanded polystyrene Boards, Alkathene sheets, Bitumen filler etc. and trimming the top , repair, finishes and other connected items will be deemed to be included in the unit rate for expansion/Isolation joints.

7.7 Joints Seals: G.I. Copper, Aluminium, Rubber or P.V.C.

All seals, whether used as water bars or in expansion or Isolation Joints shall be measured as joint seals and on area basis. In case of Metallic seals like G.I. copper or Aluminium the developed area will be measured. In case of Rubber and P.V.C. seals also, developed area will be measured but the central bulb, corrugation ribs etc. will be neglected. In all cases laps will not be measured.

7.8 Rubber pad

Rubber pads will be measured on area basis. The theoretical or actual area, whichever is less, will be recorded.

7.9 Grouting under Base Plates etc.

Grouting shall be measured on theoretical volume basis neglecting the volume of embedded items. The cost shall include the cost of backing the old concrete
Plus necessary from work if any Edges of the groutting shall be measured equal even if chamfered. Necessary curing shall also be included Admixtures. If added, Will be measured and paid separately under the relevant items.

7.10 Water proof Plaster

The measurement will be no finished square area basis. The thickness, method of applications, waterproofing additive to be used etc. will be specified in the specification/drawings/schedule of items.

The waterproofing additive will be measured and paid separately under admixtures (Clause 7.2) .No deduction will be made for opening less then 0.1 Sq .m in area each.

7.11 Bitumen Coating/Tar Coating

These shall be measured on next useful area, neglecting openings up to 0.1 Sq.M in area each.

7.12 Bitumen Felt

Bitumen felt waterproofing shall be measured nett on area of structure cover, neglecting openings up to 0.1 Sq.M . in area each, measuring only once for the completed work and once for each layer.

7.13 Polyethylene Film

Polyethylene Film waterproofing shall be measured nett on area of structure covered, neglecting openings up to 0.1 Sq.M. in area each, measuring only once for the completed work and not once for each layer.

7.14 Tests

a) Tests on concrete specimens shall not be paid for separately. The specimen shall be either in the from of 15 cubes or 15 cm dia. 30 cm along cylinders. No separate measurement shall be made for column of concrete used in the specimen or for the mould.

b) No payment shall be made for tests carried out for approval of samples or different materials in accordance with the specification.

c) Load Test, if required to be made as per terms and conditions of the contract, shall not be paid.

8.0 LIST OF IS: CODES AND STANDARDS FOR REFERANCE

All work under this specification shall, unless specified other wise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specifications and Codes of practice. In case any particular aspect of work is not specifically covered by Indian standard Specifications, any other standard practice, as may be specified by the Engineer, shall be followed: -

IS : 73 - Indian Standard Specification for paying Bitumen.

IS : 216 - Indian Standard Specification for Coal Tar Pitch.

IS : 226 - Indian Standard Specification for Structural Steel (Standard quality).

IS : 269 - Indian Standard Specification for Ordinary, and Low Heat Portland Cement.

IS:8112	-	43 garde ordinary portlant cement.
IS : 383	-	Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete..
IS : 432	-	Indian Standard Specification for Mild Steel land Medium Tensile Steel Bars and Hard Drawn Steel Wire for concrete Reinforcement.
IS : 455	-	Indian Standard Specification for Slag Cement.
IS :456	-	Indian Standard Code of Practice for Plain and Reinforced Concrete.
IS : 457	-	Indian Standard Code of Practice for General Construction of plain and Reinforced Concrete for Dams and other Massive Structures.
IS : 516	-	Indian Standard Specification for Methods of Test for Strength of Concrete.
IS :1139	-	Indian Standard Specification for Mild Steel and Medium Tensile Steel Bars and High yield Strength Steel; Deformed Bars for concrete Reinforcement.
IS : 1199	-	Indian Standard Specification for Methods of Sampling and Analysis of Concrete.
IS : 1200 (part-II)	-	Indian Standard Specification for Method of measurement Cement Concrete work.
IS : 1200 (part-V)	-	Indian Standard Specification for Method of measurement Form work.
IS : 1322	-	Indian Standard Specification for Bitumen Felts for waterproofing and Damp-proofing.
IS : 1489	-	Indian Standard Specification for Portland – Pozzolana Cement.
IS : 1566	-	Indian Standard Specification for Methods for sampling and Analysis of Concrete.
IS : 1609	-	Code of practice for laying Damp-Proof Treatment using Bitumen Felts.
IS : 1786	-	Indian Standard Specification for Cold-twisted Steel Bars for Concrete Reinforcement.
IS : 1791	-	Indian Standard Specification for Batch Type Concrete Mixers.

IS : 2185	-	Indian Standard Specification for Hollow Cement Concrete Blocks.
IS : 2210	-	Indian Standard Specification for Design of Reinforced Concrete shall Structures and Folded plates.
IS : 2386	-	Indian Standard Specification for methods of Test for Aggregates for Concrete – part-I to VIII.
IS : 2502	-	Indian Standard Code of practice for Bending and Fixing of Bars for Concrete Reinforcement.
IS :2505	-	Indian Standard Specification for Concrete Vibrators. Immersion Type.
IS ; 2506	-	Indian Standard Specification for Screed Board Concrete Vibrators.
IS : 2514	-	Indian Standard Specification for Concrete vibrating Tables.
IS : 2722	-	Indian Standard Specification for portable Swing Weigh Batches for Concrete (Single and Double Bucket type).
IS : 2751	-	Code of practice for Welding of Mild Steel Bars used for Reinforced Concrete Construction.
IS : 2770	-	Indian Standard Specification for Method of Testing Bond in Reinforced Concrete Construction.
IS : 3025	-	Indian Standard Specification for methods of sampling and Test (physical and Chemical) for Water used in Industry.
IS : 3201	-	Indian Standard Specification for Design and construction of precast Concrete Trusses.
IS : 3370	-	Indian Standard Specification for Code of practise for Concrete structures for Storage of Liquids.
IS ; 3550	-	Indian Standard Specification for Method of Test for Routine Control for water used in Industry.
IS : 3558	-	Code practice for use of Imersion Vibrator for Consolidating Concrete.
IS : 3590	-	Indian Standard Specification for Load Baring Light Weight Concrete Blocks.
IS : 3696	-	Safety code for Scaffolding and Ladders.

IS : 3812	-	Indian Standard Specification for fly Ash for use as Admixture for Concrete.
IS : 4031	-	Indian Standard Specification for Method of Tests for Hydraulic Cement.
IS : 4031	-	Indian Standard Specification for Method of Test for Hydraulic Cement.
IS :4082	-	Indian Standard Specification for Recommendation on Stacking and Storage of Construction Materials at site.
IS : 4090	-	Indian Standard Specification for Design of Reinforced Concrete Archs.
IS : 4634	-	Indian Standard Specification Method of Testing performance of batch- type Concrete Mixes.
IS : 4656	-	Indian Standard Specification for From Vibrators for Concrete.
IS : 4925	-	Indian Standard Specification for Concrete Batching and mixing Plant.
IS : 4926	-	Indian Standard Specification for read mixed Concrete.
IS : 4990	-	Indian Standard Specification for Plywood for Concrete Shuttering work.
IS : 4991	-	Indian Standard Specification for Blast Resistant Design of Structure for Explosion above ground.
IS : 4995 Part I & II	-	Indian Standard Specification for Design of reinforced Concrete Bins for the Storage of granular and powdery Materials.
IS : 4998	-	Indian Standard Specification for Design of reinforced Concrete Chimneys.
IS : 5512	-	Indian Standard Specification for Flow table for use in Testes of Hydraulic Cement and Pozzolanic Materials.
IS : 5513	-	Indian Standard Specification for Vie at Apparatus
IS : 5515	-	Indian Standard Specification for Compaction factor Apparatus.
IS : 5751	-	Indian Standard Specification for precast concrete Copying Blocks.

IS : 5816 - Indian Standard Specification for method of Test for Splitting Tensile Strength of concrete Cylinders.

IS : 5891 - Indian Standard Specification for Hand Operated Concrete Mixers.

IS : 6452 - Indian Standard Specification for High Aluminium Cement for Structural Use.

IS : 6909 - Indian Standard Specification for super-sulphated Cement.

IS : 6923 - Indian Standard Specification for method of Test for Performance of Screed Board Concrete Vibrators.

IS : 5891 - Indian Standard Specification for Hand Operated Concrete Mixers.

IS : 6452 - Indian Standard Specification for High Aluminium Cement for Structural Use.

IS : 6909 - Indian Standard Specification for super-sulphated Cement.

FABRICATION OF STRUCTURAL STEEL WORK

REV. NO.	PRAPARED	APPROVED	DATE

1.0.0 SCOPE

This specification covers supply fabrication, testing, painting and delivery to site of structural steelwork including supply of all consumable stores and rivets. Bolts, nuts, washers, electrodes and other materials required for fabrication and field connections of all structural steelwork covered under the scope of the contract.

2.00.0 GENERAL

2.1.0 WORK TO PROVIDED FOR BY THE CONTRACTOR

The work to provided for by the contractor, unless specified otherwise. Shall include but not be the following.

a) Furnish all labour, supervision, services including facilities as required under statutory labour regulations, materials, equipment, tools and plants, transportation, etc, required by the Engineer
b) Prepare and submit working drawing showing the approaches, slope, beam, shoring, sumps for dewatering, including drains and outfall for drainage, space for temporary stacking of spoil, disposal area, fencing, etc and all other details as may be required by the Engineer.
c) To carry out sampling and testing and submit to the Engineer, results of soil compaction tests if required by the Engineer to assess the degree of compaction.
d) Construction, maintenance and removal after comp lection of Magazine of proper capacity as well as design for storing of explosives required for blasting work to be carried out scope of this tender.

2.2.0 WORK TO PROVIDED FOR BY OTHERS.

No work under this specification will be provided by any agency other than the Contractor unless specifically mentioned elsewhere in the Contract

2.3.0 CODES AND STANARDS.

All works under this specification, unless specified otherwise shall conform to the Latest revision and /or replacement of the following or any other Indian Standard Specifications and codes of practice. In case any particular aspect of work is no Covered specially by Indian Standard Specification any other standard practice as

May be specified by the Engineer shall be followed: -

IS: 226: Structural steel (Standard Quality)

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

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

IS:808: Rolled steel beams channels and angle sections

IS:813: Scheme of symbols for welding

IS:814: Covered electrodes for metal are welding of structural steel

IS:815: Classification and coding of covered electrodes for metal are welding mild steel and low ally high tensile steel.

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

IS:817 : Code of practice for training and testing metal are welders.

IS:818: Code of practice for safety, and health requirements in electric and gas welding and cutting operations.

IS:822: Code of practice for inspection of welds.

IS:9595: Recommendations for metal are welding of carbon and carbon manganese steel:

IS:919: Recommendations for limits and fits for Engineer.

IS:961:Structural Steel (High tensile)

IS:1148: Rivets bars for structural purposes.

IS:1149:High tensile rivets bars for structural purposes

IS:1161: Steel Tubes for structural purposes

IS:1200: Method of measurement of steelwork and ironwork (Part-B)

IS:1239: Mild Steel Tubes

IS:1363: Black hexagon bolts, nuts and lock nuts (dia. 6 to 30mm) and black hexagon screws (dia 6 to 24mm)

IS:1363: Black hexagon bolts, nuts and lock nuts (dia. 6 to 30mm) and black hexagon screws (dia 6 to 24mm)

IS 1346: Precision and semi-precision hexagon bolts, screws, nuts and locknuts.(dia 6 to 24 mm

IS:1367: Technical supply conditions for threaded fasteners

IS:1442: Covered electrodes for the metal are welding of high tensile structural steel.

IS:1600: Method for tensile testing of steel products other than sheet strip, wire and tube

IS1730: Dimensions for steel plates, sheet and strip for structural and general engineer purposes.

IS: 1731: Dimensions for steel flats for structural and general engineering Purposes.

IS: 1852: Rolling and cutting tolerance for hot-rolled steel products

IS:1977: Structural steel (Ordinary quality) St-42-0

IS:2062: Structural steel (fusion welding quality)

IS:2074: Ready mixed paint red oxide Zinc chromate painting

IS:2629: Recommended practice for Hot – Dip Galvanising of Iron and Steel

IS:2633: Method for testing uniformly of coating on Zinc Coated Articles

IS:3757: High Tensile Fraction Grip bolts

IS:4759: Specifications for Hot – Dip Zinc coatings on structural Steel and other Allied products

IS 7215: Tolerance for fabrication of steel structures

2.4.0 CONFORMITY WITH DESIGNS.

Except where the standard connection details are furnished, the contractor shall design all connection, supply and fabricate all steelwork and furnish all connection materials in accordance with the approved drawings and/or as instructed by the Engineer keeping in view the maximum utilization of the available sizes and sections of steel materials. The methods of painting, marking, packing and delivery of all fabricated materials shall be in accordance with the provisions of the contract and/or as approved by the Engineer. Provision of all relevant Indian standard Specifications and codes of Practice shall be followed unless otherwise specified in the contract

2.5.0 MATERIALS TO BE USED

2.5.1 GENERAL

All steel material required for the work will be supplied by the contractor unless otherwise specified elsewhere in the contract. The materials shall be free from all imperfections, mill scales slag intrusions, laminations, pitting, rusts etc. that may

impair their strength, durability and appearance all materials shall be of tested quality only unless otherwise permitted by the Engineer and/ of Consultant. If desired by the Engineer. Test Certificates in respect of each consignment shall be submitted in triplicate. Whenever the materials are required to be used from unidentified stocks. If permitted by the Engineer. A random sample shall be tested at an approved laboratory from each lot of 50 tonnes or less of any particular section.

The arc welding electrodes shall conform to the relevant Indian Standard Codes of Practice and Specifications and shall be of heavily coated type and the thickness of the coating shall be uniform and concentric with each container of electrodes, the manufacturer shall be uniform and concentric with each container of electrodes, the manufacturer shall furnish instructions giving recommended voltages and amperage (polarity in case of D.C supply) for which the electrodes are suitable.

2.5.2 **STEEL**

All steel materials to be used in construction within the purview of this specification shall comply with any of the following Indian Standard Specifications as may be applicable.

1) IS 226 - Structural steel (Standard quality)

2) IS 961 - Structural steel (high Tensile)

3) IS 1977 - Structural steel (Ordinary quality) St-42-0

4) IS 2062 - Structural steel (Fusion Welding Quality)

In case of imported steel materials being used, these shall conform to specifications equivalent to any of the above as may be applicable.

2.5.3 **Rivet Steel**

All rivets steel used in construction within the purview of this Specification shall comply with one of the following Indian Standard Specifications as may be applicable

1) IS 1148 – Rivet Bars for Structural purpose

IS 1149- High tensile rivet bars for structural for purposes where high tensile steel is specified for rivets, steps shall be taken on ensure that the rivets are so anufactured that they can be driven and heads formed satisfactorily without the physical properties of steel being impaired.

2.5.4 **ELECRODES**

All electrodes to be used the Contract shall comply with any of the following Indian Standard Specifications as may be applicable:-

IS:814: Covered electrodes for metal are welding of structural steel

IS:815: Classification and coding of covered electrodes for metal are welding mild steel and low ally high tensile steel.

IS:1442: Covered electrodes for the metal are welding of high tensile structural steel.

2.5.5 **BOLTS AND NUTS**

All bolts and nuts shall conform to the requirements of Indian Standard Specification IS:1367: Technical supply conditions for threaded fasteners.

Materials for Bolts and nuts under the purview of this contract shall comply with any of the following Indian Standard Specifications as may be applicable.

a) Mild steel all mild steel for bolts and nuts when tested in accordance with the following Indian Standard, Specification shall have a tensile strength of not lees than 44kg/mm^2 and a minimum elongation of 23 per cent on a gauge length of 5.6 A, Where A is the cross sectional area of the test specimen:-

   1) IS:1367: Technical supply conditions for threaded fasteners.
   2) IS:1600: Method for tensile testing of steel products other than sheet strip, wire and tube.

b) High Tensile Steel (Structural Quality) The material used for the manufacture of high tensile steel bolts and nuts shall have a minimum tensile strength 58kg/mm^2 . Other mechanical properties shall conform to grade HT of IS 961.

c) High Tensile Steel (Special Quality). The material used for the manufacture of special quality high tensile steel bolts and nuts shall have the mechanical properties appropriate to the particular class of steel as set out in IS:1367 or as approved by the Engineer.

2.5.6 **WASHERS**

Washers shall be made of steel conforming to any of the following Indian Standard Specifications as may be applicable under the provisions of the Contract:-

1) IS: 226: Structural steel (Standard Quality)
2) IS:961: Structural Steel (High tensile)
3) IS:1977: Structural steel (Ordinary quality) St-42-0

2.5.7 **PAINTS**

Paints to be used for shop coat of fabricated steel under the purview of this contract shall conform to the Indian to Standard Specifications IS:2074: Ready mixed paint red oxide Zinc chromate painting.

2.6.0 STORAGE OF MATERIAL

2.6.1 GENERAL

All materials shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for the work. Any material which has deteriorated or has been damaged shall be removed from the contractor's yard immediately, failing which, the Engineer shall be at liberty to get the material removed and the cost incurred thereof shall be realised from the Contractor. The Contractor shall maintain up to date accounts in respect of receipt, use and balance of al sizes and sections of steel and other materials. In case the fabrication is carried out in contractor's fabrication shop outside the plant site where other fabrication works are also carried out, all materials meant for use in this contract shall be stacked separately with easily identifiable marks.

2.6.2 STEEL

The steel to be used in fabrication and the resulting cut-pieces shall be stored in Separate stacks off the ground section wise and lengthwise so that they can be easily inspected. Measured and accounted for at any time. If required by the Engineer, the materials may have to be stored under cover and suitably painted for protection against weather.

2.6.3 ELCTRODES

The electrodes for electric are welding shall be stored in properly designed racks, separating different types of electrodes in distinctly marked compartments. The electrode shall be kept in dry and warm condition if necessary by resorting to heating.

2.64 BOLTS, NUTS AND WASHERS

Bolts, nuts and washers and other fastening materials shall be stored on racks of the ground with a coating of suitable protective oil. These, shall be stored in separate gunny bags or compartments according to diameter, length and quality.

2.6.4 PAINTS

Paints shall be stored under cover in air tight containers paints supplied in sealed containers shall be used up as possible once the container is opened.

2.7.0 QUALITY CONTROL

The Contractor shall establish and minimum quality control procedures for different items of work and materials to the extent the deems necessary to ensure that all work is performed

in accordance with this specification. In addition to the Contractor's quality control procedures, materials and workmanship at all times shall be subjected to inspection by the Engineer or Engineer's representative. As far as possible, all inspection by the engineer or Engineer's representative shall be made at the Contractor shall co-operative with the Engineer or Engineer's representative in permitting access for inspection to all places where work is being done and in providing free of cost all necessary help in respect of tools and plants, instrument, labour and materials required to carry out the inspection. The inspection shall be so scheduled as to provide the minimum interruption to the Contractor.

Materials or workmanship not in reasonable conformance with the provisions of this Specification may be rejected at any time during the progress of the work.

The quality control procedure shall cover but not limited to the following items of works:-

1) Steel	- Quality. manufacturer's test certificates, test reports of representative samples of materials from unidentified stocks if permitted to be used.
2) Rivets, Bolts, Nuts & Washers	- Manufacturer's certificate, dimen sion checks, material testing.
3) Electrodes	- Manufacturer's certificate, thickness and quality of plus coating.
4) Welders	- Quality Tests.
5) Welding sets	- Performance Tests.
6) welds	- Inspection, x-ray. Ultrasonic tests.
7)Paints	- Manufacturer's certificate, physical inspection reports.
8) Galvanizing	- Tests in accordance with IS: 263 Method for testing uniformity of coating of Zinc Coated Articles and IS 4759: Specifications for Hot – Dip Zinc coatings on structural Steel and other Allied products

2.8.0 STANDARD DIMENSIONS, FORMS AND WEIGHTS

The dimensions, forms, weights and tolerances of all rolled shapes rivets, bolts, nuts, studs, washers etc. and other members used in the fabrication of any structure shall, wherever applicable, conform to the requirements of the latest relevant Indian Standards, wherever they exist, or, in the absence of Indian Standards, to other equivalent standards.

2.9.0 SHOP DRAWINGS

The contractor shall within 15 days after the award of the Contract submit to the Engineer the Schedule of Fabrication and erection of structural steel work for approval. He shall, within 15 days after the award of the contract start to for approval. The shop drawings based on the Design Drawings furnished to him and, before proceeding with in fabrication work, shall get the said shop drawings approved in accordance with the contract.

The sequence of submission of shop drawings for approval shall match with the approved fabrication and erection schedule. The approval for the shop drawings will be accordance only towards general conformity with the design requirements as well as specifications and will ensure the correctness of general arrangement for centreline dimensions and level, Section sizes, and adequacy of connections including splice joints as to the no. of bolts, welds length, size of gusset/ end plated. The correctness of all other details like cutting lengths, matching of holes, notch dimensions, match markings, bill of materials, bolt list etc. will be entirely the contractor's responsibility. The approval of the drawing however shall not relieve the contractor of his sole responsibility in carrying out the work correctly and fulfilling the complete requirements of contract documents.

The shop drawings shall include but not be limited to the following:-

a) Assembly drawings giving exact sizes of the sections to be used and identification marks of the various sections.
b) Dimensional drawings of base plates, foundation bolt location etc.
c) Comparison sheet to show that the proposed alternative section, if any, are as strong as the original sections shown on the Design Drawings.
d) Complete Bill of Materials and detailed drawings of all sections as also their billing weights.
e) Any other drawings or calculations that may be required for the clarification of the works or substituted parts thereof

The preparation of shop drawings shall not be submitted without prior approval of Engineer. These drawings shall give all the necessary information for the fabrication. Erection and painting of the steelwork in accordance with the provisions of this Specification shop drawings shall be made in accordance with the best modern practice and with due regard to sequence, speed and economy in fabrication and erection. Shop drawings shall give complete information necessary for fabrication of two various components of the steelwork, including the location. Type, sizes and extent of welds. These shall also clearly distinguish between shop and field rivets, bolts and welds and specify the class of bolts and nuts The drawings shall be drawn to a scale large enough to covey all the necessary information adequately. Notes on the shop drawings shall indicate those joints or groups of joints in which it is particularly important that the welding sequence and technique of welding symbols used shall be in accordance with the requirements of the Indian Standard Specification.

IS:813: Scheme of symbols for welding shall be consistent throughout Weld lengths called for on the drawings shall mean the net effective length.

The Contractor shall be responsible for and shall pay for any alterations of the work due to any discrepancies, errors or omissions on the drawings or other particulars supplied by him. Whether such drawings or other particulars have been

duly approved or not in accordance with the Contact, provided that such particulars on the Design furnished to the Contractor. In the Contractor. In the latter case, the Contractor will be paid for any alteration that has to be made after materials have been fabricated by the Contactor.

3.0.0 WORKMANSHIP

3.1.0 FABRICATION

3.1.1 GENERAL

All workmanship shall be equal to the best practice in modern structural shops, and shall conform to the provisions of the Indian Standard IS:800: Code of practice for user of steel tubes in general building construction and other relevant Indian Standards or Equivalent.

3.1.2 STRAIGHTENING MTERIAL

Rolled materials before being laid off or worked, must be clean, free from sharp kinks, bends or twists and straight within the tolerances allowed by the Indian Standard Specification IS: 1852: Specification Rolling and cutting tolerance for hot-rolled steel products. If straightening it necessary, it may be done by mechanical means or by the application of limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 600sq.c

3.1.3 CUTTING

Cutting shall be effected by shearing. Cropping or sawing use of mechanically controlled gas cutting torch be permitted for mild steel only. Gas cutting of high tensile steel may also be permitted provided special care is taken to leave sufficient metal to be removed by machining, so that all meal that has been hardened by flame is removed. Gas cutting without a mechanically controlled torch may be permitted if special care is taken and done under expert hand, subject to the approval of the Engineer.

To determine the effective size of members cut by gas, 3mm shall be deducted from each cut edge. Gas cut edges, which will be subjected to substantial stress or which are to have weld metal deposited on ‘them, shall be reasonably free from gouges, occasional notches or gauges not more than 4mm deep will be permitted Gouges greater than 4mm, that remain from cutting, shall be removed by girding. All re-entrant corners shall be shaped notch-free to a radius of at least 12mm. Shearing, cropping and gas cutting shall be clean, reasonably squire and free from any distortion.

3.1.4 PLANNING OF EDGES

Planning of finishing of sheared or cropped edges of plates or shapes or of edges Gas-cut with a mechanically controlled torch shall not be required, unless specifically required by design and called for on the drawings, included in a stipulation for edge preparation for welding or as may be required after the inspection of the cut surface. Surface

cut with hand-flame shall generally be ground, unless specifically instructed otherwise by the Engineer.

3.1.5 **CLEARNCES**

The erection clearance for cheated ends of members connecting steel to steel shall preferably be not greater than 2mm at each end. The erection clearance at ends of beams without web cleats shall be not more than 3mm at each end, but where, for particular reasons, greater clearance is necessary, suitably designed clearings shall be provided.

3.2.0 **RIVETED AND BOLTED CONSTRUCYION**

3.2.1 **HOLES**

Holes through more than one thickness of material for members, such as compound stanchions and girder flanges. Shall be drilled after the members are assembled and tightly clamped or bolted together punching may be permitted before assembly, if the thickness of the materials is not greater than the nominal diameter of river or bolts plus 3mm subject to a maximum thickness of 16mm provided that the holes are punched 3mm less in diameter than the required size and rammed after assembly to the full diameter.

Holes for rivets or black bolts shall be not more than 1.5mm or 2.0mm (depending on whether the diameter of the rivet or bolt is less or more than or equal to 25mm) Larger in diameter than the nominal diameter of the rivet or black bolt passing through them.

Holes for turned bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject top a tolerance grade of HB as specified in IS:919. Parts to be connected shall be firmly held together by tacking welds or clamps and the holes drilled through all the thickness in one operation and subsequently reamed to size. Holes not drilled through all thickness in one operation shall be drilled to a smaller size and reamed out after assembly.

Holes for rivets or bolts shall not be formed by gas cutting process.

3.2.2 **ASSEMBLY**

All parts of riveted member shall be well pinned or bolted and rigidly held together while riveting drafting to enlarge unmatching holes shall not generally be permitted. In case drafting is permitted to a slight extent during assembly it shall not distort the metal on enlarge the holes. Holes that must be enlarged to admit the rivets or bolts shall be to assembled that they are neither twisted not otherwise damaged, and shall be so prepared that the specified cambers, if any, are maintained.

Rivets shall ordinarily be hot driven, in which case their finished heads shall be approximately hemispherical in shape and shall be or uniform size throughout the work for rivets of the same size full, neatly finished and concentric with the holes. Rivets shall be heated uniformly to a temperature not exceeding the holes. Rivets shall be heated uniformly

to a temperature not exceeding 1065^0C. They shall not be driven after their temperature has fallen below 540^0C.

Rivets shall be driven by power riveters, of either compression or manually operated type, employing pneumatic, hydraulic or electric power Hand driven rivets shall not be allowed unless in exceptional cases specially approved by the Engineer. After driving, rivets shall be tight, shall, completely fill the holes and their heads shall be in full contact with the surface. In case of countersunk rivets, the countersinking shall be fully filled by the rivets any proud ness of the countersunk head being dressed off flush, if required.

Rivets member shall have all parts firmly drawn and held together before and during riveting and special care shall be taken in this respect for all single riveted connections. For multiple riveted connections, a service bolts shall be provided in every third or fourth hole.

All loose, burnt or otherwise defective rivets shall be cut out and replaced and special care shall be taken to inspect all single riveted connections. Special care shall also be taken in heating and driving long rivets the Contractor shall prove the quality of riveting by cutting some rivets chosen at random by the Engineer. No extra payment will be made to the Contractor for such cutting and replacing to the extent of ten sound rivet per five hundred done Riveting work, for any particular section or group, will be considered satisfactory when at least 90% of the corresponding cut rivets are found to be sound. If the ratio is below 75%, all the rivets in the particulars section or group shall be cut, removed and replaced and tested again at the Contractor's expense. For cases between 75% and 905 the Engineer shall have the option to instruct cutting and replacing any number of further rivets at the Contractor's cosy as he deems necessary.

Bolted construction shall be permitted only in case of field connections if called for on the Drawings and is subjected to the limitation of particular connections as may be specified. In special cases, however, shop bolt connections may be allowed if directed by the Engineer.

Washers shall be tapered or otherwise suitably shaped, where necessary, to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project out through the nut at least one thread. In all cases the bolt shall be provided with a washer of sufficient thickness under the nut to avoid any threaded portion of the bolts being within the thickness of the parts bolted together. In addition to the normal washer one spring washer or lock-nut shall be provided for each bolt for connections subjected to vibrating forces or otherwise forces or otherwise as many by specified on the Drawings.

3.3.0 WELDED CONSTRUCTION

3.3.1 GENERAL

Welding shall be in accordance with relevant Indian Standards and as supplemented in the Specification. Welding shall be done by experienced and good welders who have been qualified by tests in accordance with IS:817.

3.3.2 **PREPARATION OF MATERIAL**

Surface to be welded shall be free from loose scale, slag, rust, grease, paint and any other foreign material except that mill scale which withstands vigorous wire brushing may remain. Joint surface shall be free from fine and tears. Preparation of edges by gas-cutting shall, wherever practicable, be done by a mechanically guided torch.

3.3.3 **ASSEMBLING**

Parts to be fillet welded shall be brought in close contact as practicable and in no event shall be separated by more than 4mm. If the separation is 1.5mm or greater, the size of the filet welds shall be increased by the amount of the fillet welds shall be increased by the amount of the separation. The fit at joints at contact surfaces which are not completely sealed by welds, shall be close enough to exclude water after painting.

Abutting parts to be butt-welded shall be carefully aligned Misalignments greater than 3mm shall be corrected and in making the correction the parts shall not be drawn into a sharper slope than two degrees (2^0)

The work shall be positioned for that welding whenever practicable.

3.3.4 **WELDING SEQUENCE**

In assembling and jointing parts of a structure of built-up members, the procedure and sequence of welding shall be as will avoid needless distortion and minimize shrinkage stresses. Where it is impossible to avoid high residual stresses in the closing welds of welds of a rigid assembly, such closing welds shall be made in compression elements.

In the fabrication of cover-plated be beams and built-up members, all shop splices in each component part shall be made before such component part is welded to other parts of the member. Long girders or girder sections may be made by shop splicing not more than three sub-sections, each made in accordance with this paragraph.

When required by the Engineer, welded assembles shall be stress relieved by heat treating in accordance with the provisions of the relevant Indian Standard or any other Standard approved by the Engineer.

3.5.5 **WELDING TECHNIQUE**

All complete penetration groove welds made by manual welding, except when produced with the aid of backing materials not more than 8mm thick with root opening not less than shall have the root of the initial layer gouged out on the back side before welding is started from that side, and shall be so welded as to secure sound metal and, complete fusion throughout the entire cross-section. Groove welds made with the use of the backing of the same material as the base metal shall have the weld metal thoroughly fused with the backing

material. Backing strips need not removed. If required, they maybe removed by gouging or gas cutting after welding is completed, provided no injury is done to the base metal and weld metal and the weld metal surface is left flush or slightly convex with full throat thickness

Groove welds shall be terminated at the ends of a joint in a manner that will ensure their soundness. Where possible, that should be done by use of extension bars or run-off plates. Extension bars of run-off plates need not be removed upon completion of the weld unless otherwise specified elsewhere in the Contract.

To get the best and consistent quality of welding, automatic submerged are process shall be preferred. The technique of welding employed, the appearance and quality of welds made, and the methods of correcting defective work shall all conform to relevant Indian Standards.

3.3.6 TEMPERATURE

No welding shall normally be done on parent material at temperature below (-) 5^0 C. However, if welding is to be undertaken at low temperature, adequate precautions as recommended in relevant Indian Standard shall be taken. When the parent material is less than 40mm thick and the temperature is between (-) 5^0 C. and 0^0 C, the surface around the joint to a distance of 100mm or 4 times the thickness of the material, whichever is greater, shall be preheated till it is hand warm. When the parent material is more than 40mm thick, the temperature of the area mentioned above shall be in no case be less than 20^0 C. all requirements regarding preheating of the parent material shall be in accordance with the relevant Indian Standard.

3.3.7 PEENING

Where required, intermediate layers of multiple-layer welds may be peened with light blows from a power hammer, using a round-nose tool. Peening shall be done after the welds has cooled to a temperature warm to the hand Care shall be exercised to prevent sealing or flaking of weld and base metal from over peening.

3.3.8 **EQUIPMENT**

There shall be capable of producing proper current so that the operator produce satisfactory welds. The welding machine shall be of a type and capacity as recommended by the manufactures of electrodes or as may be approved by the Engineer.

3.4.0 **FINISH**

Column splices and butt joint compression members deepening on contact for stress transmission shall be accurately machined and close-butted over the whole section with a clearance not exceeding 0.1 mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets angles, channels etc, after welding/riveting together, should be accurately machined so that the parts connects butt over the entire surface of contact, Care should be taken that those connecting angles on channels are fixed with such accuracy that they are reduced in thickness by machining by more than 1.0mm.

3.5.0 **SLAB BASES AND CAPS**

Bases and caps fabricated out of steel slabs, except when cut from material with true surface, shall be accurately machined over the bearing surface and shall be in effective contact with the end of the stanchion. A bearing face which is to be grouted direct to a foundation need be machined if such face is true and parallel to the upper face.

3.6.0 **LACING BARS**

The ends of lacing bars shall be neat and free from burns.

3.7.0 **SEPARATORS**

Rolled section or built-up steel separated or diaphragms shall be required for all double beams except where encased in concrete, in which case, pipe separators shall be used.

3.8.0 **BEARING PLATES**

Provision shall be made for all necessary, steel bearing plates to taken up reaction of beams and columns and the required stiffeners and gussets whether or not specified in Drawings.

3.9.0 **ARCHITECTURAL CLEARANCES**

Bearing plates and stiffener connections shall not be permitted to encroach the designed architectural clearances.

3.10.0 **SHOP COMMUNICATIONS**

a) All shop connections shall be either riveted or welded at specified on the Drawings

b) Heads of rivets on surfaces carrying brick walls shall be flattened 10mm thick projection.

c) Certain connections, specified to be shop connections, may be changed to field connections if desired by the Engineer for convenience of erection and Contractor will have to make the desired changes at no extra cost to the Owner.

3.11.0 **CASTINGS**

Steel castings shall be annealed

3.12.0 **SHOP ERECTION**

The steelwork shall be temporarily shop-erected complete or as directed by the Engineer so that accuracy of fit may be checked before despatch. The parts shall be shop-erected with a sufficient member of parallel drifts to bring and keep the parts in place in case of parts

drilled or punched using steel jigs to make all interchangeable, the steelwork shall be shop erected in will facilitate the check of interchange ability

3.13.0 **SHOP PAINTING**

3.13.1 **GENERAL**

Unless otherwise specified, steelwork which will be concealed by interior building finish need not be painted, steelwork to be uncared in concrete shall not be painted. Unless specifically exempted, all other steelwork shall be given one coat of shop paint, applied thoroughly and evenly to dry substances which have been cleaned, in accordance with the following paragraph, by brush, spotty, roller coating, flow-coating or dripping as may be approved by the Engineer.

After inspection and approved and before leaving the shop, all steel work specified to be painted shall be cleaned by hand-wire brushing or by other method of loose mill scale loose rust, weld slag or flux deposit, dirt and other foreign matter. Oil and grease deposits shall be removed by solvent. Steelwork specified to have no shop paint shall, after fabrication, be cleaned of oil of grease by solvent cleaners and be cleaned of dirt and other foreign material by through sweeping with a fibre brush.

3.13.2 **INACCESSIBLE PARTS**

Surface not in contact, but inaccessible after assembly, shall receive two coats of shop paint, positively of different colours to prove application of two coats before assembly. This does not apply to the interior of sealed hollow sections.

3.13.3 **CONTACT SURFACES**

Contact surface shall be cleaned in accordance with Sub-clause 3.13.1 before assembly.

3.13.4 **FINISHED SURFACES**

Machine finished surface shall be protected against corrosion by a rust inhibiting coating that can be easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

3.13.5 **SURFACES ADJACENT TO FIELD WELDS**:

Unless otherwise provided for surfaces within 50 mm of any field weld location shall be Free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

3.14.0 **GALVANIZING**

3.14.1 **GENERAL**

Structural steelwork for switchyard or other structures as may be specified in the Contract shall be not dip galvanized in accordance with the American Society for Testing and Materials Specification ASTH-A 123 or IS:2629: Recommended practice for Hot – Dip Galvanising of Iron and Steel. Where the steel structures are required to be galvanized the field connection materials like bolts, nuts and washers hall also be galvanized.

3.14.2 **SURFACE PREPARATION**

All members to be galvanized shall be cleaned, by the process of picking of rust, loose scale, dirt, oil, grease, slag and spatter of welded areas and other foreign substances prior to galvanizing pickling shall be carried out by immersing the steel in an acid bath containing either sulphuric or hydrochloric acid at a suitable concentration and temperature. The concentration of the acid and the temperature of the bath can be varied, provided that the pickling time is adjusted accordingly.

The pickling process shall be completed by thoroughly rising with water, which should preferably be warm, sop as to remove the residual acid.

3.14.3 **PROCEDURE**

Galvanizing shall be carried out by hot dip process in a proper and uniformly heated bath. It shall meet all the requirements when tested in accordance with
IS:2633: Method for testing uniformly of coating on Zinc Coated Articles and
IS:4759: Specifications for Hot – Dip Zinc coatings on structural Steel and other Allied products.

After finishing the threads of bolts, galvanizing shall be applied over the entire surface uniformly. The threads of bolts shall not be machined after galvanizing and shall not be clogged with zinc. The threads of nuts may be tapped after galvanizing but care shall be taken to use oil in the threads of nuts during erection.

The surface preparation for galvanizing and process of galvanizing itself, shall not adversely affect the mechanical properties of the materials to be galvanized where members are of such lengths as to prevent complete dipping in one operation, great care shall be taken to prevent warping.

Materials on which galvanizing has been damaged shall be acid stripped and re-galvanized unless otherwise directed, but if any member becomes damaged after having been dipped twice, it shall be rejected. Special care shall be taken not to injure the skin on galvanized surface during transport, handling and erection. Damages, if occur, shall be made good in accordance with the provision or as directed by the Engineer.

4.0.0 **INSPECTION TESTING, ACCEPTANCE CRITERIA**

4.1.0 Inspection

Unless specified otherwise, inspection to all work shall be made by the Engineer or Engineer's representative at the place of manufacture prior to delivery . The Engineer or his representative shall have free access at all responsible times to those parts of the manufacturer's works which are concerned with the fabrication of the steel work under this contract and he shall be afford al responsible facilities for satisfying himself that the fabrication if being done in according with the provisions, of this specification.

The contractor shall provide free of charge, such labour, materials, electricity, fuel, water, stores, tools and paint, apparatus and instruments as may be required by the engineer to carry out inspection and/or tests in accordance with the contract.

The contractor shall guarantee compliance with the provisions of this specification.

4.2.0 TESTING AND ACCEPTANCE CRITERIA

4.2.1 General

The contractor shall carry out sampling and testing in accordance with the relevant Indian standards and as supplemented here in for the following items at his own cost, unless otherwise specified in the contract. The contractor shall get the specimens tested in a laboratory approved by the engineer and submit to the engineer the test results in triplicate within 3 (three) days after completion of the test.

4.2.2 Steel

All steel supplied by the contractor shall conform to the relevant Indian standards except otherwise mentioned in the contract, only tested quality steel having mill test reports shall be used. In case unidentified steel materials are permitted to be used by the engineer, random samples of materials will be taken from each unidentified lot of 50 MT or less of any particular section for tests to confirm to relevant Indian standards. Cost of all tests shall be borne by the contractor.

All materials shall be free from all imperfections, mill scales, slag intrusions, laminations, pittings, rusts etc. That may impair their strength, durability and appearance.

4.2.3 Welding

All electrodes shall be procure from reliable manufacturers with test certificates.
The correct grade and size of electrode which has not deteriorated in storage shall be used. The inspection and testing of welding shall be performed in accordance with the provisions of the relevant Indian standards or other equivalents. For every 50 tonnes of welded fabrication , the engineer may ask for 1 (one) test-destructive or non- destructive including X-ray, ultrasonic test or similar., the cost of which shall be borne by the contractor in the event of further tests as may be desired by the engineer, the cost of such tests shall be borne by the contractor if the results are found to be unsatisfactory; and if the test shows no defect, the cost shall be borne by the owner. In cases of the test results showing deficiency,

the engineer shall have option to reject or instruct any remedial measures to be taken free of charge to the owner.

4.2.4 RIVETS, BOLTS, NUTS AND WASHERS

All rivets, bolts, nuts and washers shall be produced from M/s Guest Keen Williams ltd, or equivalent and shall conform to the the relevant Indian Standards. If desired by the Engineer, representative samples of these materials may have to be tested in an approved laboratory and in accordance with the procedures described in relevant Indian Standards. Cost of all such testing shall have to be borne by the Contractor. In addition to testing the rivets by hammer, 2% (two percent) of the rivets done shall be cut off by chisels to ascertain the fit. Quality of material and workmanship. The removal of the cut rivets and reinstallation new rivets shall be done by the Contractor at his own cost.

4.2.5 SHOP PAINTING

All paints and primers shall be of standard quality and produced from approved manufactures and shall conform to the provisions of the relevant Indian Standards.

4.2.6 GALVANIZING

All galvanizing shall be uniform and of standard quality when tested in accordance with IS:2633: Method for testing uniformly of coating on Zinc Coated Articles and IS:4759: Specifications for Hot – Dip Zinc coatings on structural Steel and other Allied products.

4.3.0 TOLERANCE

The tolerance on the dimensions of individual rolled steel components shall be as specified in IS: 1852: Rolling and cutting tolerance for hot-rolled steel products. The tolerance on straightness, length etc. of various fabricated components (such as beams and girders, columns, crane gantry girder etc.) of the steel structures shall be as specified in IS 7215: Tolerance for fabrication of steel structures.

4.4.0 ACCEPTANCE

Should any structure or part of a structure be found not to comply with any of the provisions of this Specification, the same shall be liable to rejection. No structure or part of the structure, once rejected, shall be offered again for test, except in cases where the Engineer considers the defects rectifiable. The Engineer may, at his discretion, check the test results obtained at the Contractor's works by independent tests at an approved laboratory and should the items, so tested, be found to be unsatisfactory, the costs shall be borne by the Contractor, and if satisfactory, the costs shall be borne by the Owner.

When all tests to be performed in the Contractor's shop under the terms of this contract have been successfully carried out, the steelwork will accepted forthwith and the Engineer will issue an acceptance certificate, upon receipt of which, the

items will be shop painted, picked and despatched. No item to be delivered unless an acceptance certificate for the same has been issued. The satisfactory completion of these tests or the issue of the certificates shall not bind the Owner to accept the work., should it, on further tests before or after erection, be found not in compliance with the Contract.

4.5.0 DELIVERY OF MATERIALS

4.5.1 GENERAL

The Contractor will deliver the fabricated structural steel materials to site with all necessary field connection materials in such sequence as will permit the most efficient and economical performance of the erection work. The Owner may prescribe or control the sequence of delivery of materials, at his own discretion.

4.5.2 MARKING

Each separate piece of fabricated steel work shall be distinctly marked on all surface before delivery in accordance with the markings shown on approved erection drawings and shall bear such other marks as will further facilitate identification and erection.

4.5.3 SHIPPING

Shipping shall be strictly in accordance with the sequence stipulated in the agreed programme. Payment may held up for items sent in advance of the sequence till they could be erected. The contractor shall include and provide for in his rates, the Freight and other charges for despatching the materials to avoid loss or damage during transport by rail, road or water. All packing shall allow for easy removal and checking at site. Special precautions shall be taken against rusting, corrosion, breakage or damage otherwise of the materials. All parts shall be adequately braced to prevent damage in transit.

Each bundle, bale or package delivered under this contract shall be marked on as many sides as possible and distinct marking (all previous irrelevant markings being carefully obliterated)shall show the following:-

a) Name and address of the consignee

b) Name and address of the consignor

c) Gross weight of the package in tonnes and its dimensions

d) Identification marks and / or number of the package

e) Custom registration number, if required

All markings shall be carried out with such materials as would ensure quick drying and indelibility.

Each component or part or piece of material when shipped, shall be indelibly marked and/or tagged with reference to assembly drawings and corresponding piece numbers.

Each packing case shall contain in duplicate in English a packing list pasted on to inside of the cover in water-proof envelope, quoting especially:-

a) Name of the Contractor

b) Number and date of the Contract

c) Name of the office placing the contact

d) Nomenclature of stores

e) A schedule of parts or pieces, giving the parts or piece number with reference to assembly drawing and the quantity of each

The shipping dimensions of each package shall not exceed the maximum dimensions permissible for transport over the Indian Railways/ Roads.

After delivery of the materials at site, all packing materials shall automatically become the property of the Owner without any extra payment.

Not withstanding anything stated hereinbefore, any loss or damage resulting from inadequate packing shall be made good by the Contractor at no additional cost to the Owner. When facilities exist, all shipments shall be covered by approved Insurance Policy for transits at the cost of the Contractor.

The contractor shall ship the complete materials or part on board a vessel belonging to an agency approved by the Owner or on rail and / or road transport
As directed. The Contractor shall take all reasonable steps to ensure correct appraisal of freight rates, weights and volumes and in no volumes and in no case will the Owner be liable to pay any warehouse, wharf age, demurrage and other charges.

If, however, the Owner has to make payment of any of above mentioned charges, the amount paid will be deducted from the progressive bills of the Contractor.

Necessary advise regarding the shipment with relevant details shall reach the Engineer at least a week in advance.

5.0.0 WITH TENDER

The following information are required to be submitted with the Tender.

a) Progress Schedule.

The Contractor shall quote in his tender a detailed schedule of progress of work and total time of completion, itemising the time required for each of the following aspects of work.

1) Preparation and approval of shop drawings

2) Procurement of materials

3) Fabrication and shipping of all anchor bolts

4) Fabrication and shipping of main steel work

5) Fabrication and shipping of main steel work for bunkers Tanks and / or silos as applicable.

6) Fabrication and shipping of all other remaining steelwork including miscellaneous steelwork.

7) Final date of completion of all shipments

Time required for completion being one of the main criteria for selecting the successful bidder, it is desired that the bidder quotes the minimum time required by him for completing the work

b) Shop

Location of the Tender's fabrication workshop giving details of equipment, manpower, the total capacity that will be available exclusively for this contract shall be submitted.

c) **MATCHING STEEL**

A rough indication fop the quantities and details of matching steel section required to start the work shall be furnished.

d) **TRANSPORT OF STEEL**

In case the tendered is to draw steel materials from the Owner's stores at site as per terms and conditions of the Contract, the mode of transport proposed by the Tender shall be stated.

5.1.0 **AFTER AWARD**

After award of the Contract the successful Tender is to submit the following:-

a) Complete fabrication drawings, material lists, cutting lists, rivet and bolt lists, field welding schedules based on the design drawings furnished to him in accordance with the approved schedule.

b) List of phase wise requirement of matching steel section in six (6) copies in accordance with the approved schedule shall be submitted within 2(two) weeks after the award of the contract, and/or receipt of the design drawings

c) Monthly progress Report with necessary, photographs in six (5) coppice to reach the Engineer on or before the 7th day of each month, giving the up to date status of preparation of detailed shop drawings bill of materials. Procurement of materials, actual fabrication done, shipping and all other relevant information.

d) Detailed monthly material reconciliation statements relevant to the work done and reported in the progress report, giving the stock at the hand of raw steel, work in progress, finished materials and scrap.

e) Results of any test and when conducted and as required by the Engineer.

f) Manufacturer's mill test report in respect of steel materials, rivets, bolts, nuts and electrodes as may be applicable.

6.0.0 ADDOTIONAL CODES AND STANDARD

IS:823	Code of Procedure for manual Metal ARC welding of Mild Steel
IS:1024	Code of practice for the use of welding in Bridges and Structures subjected to Dynamic loading
IS:1365	Slotted counter sunk Head and slotted Raised counter sunk Head Screw (dia 1.6 to 20mm)
IS:1447	Code of practice for Finishing of Ferrous Metals in Buildings Painting and Allied finisher
IS:2016	Plain Washers
IS:3664	Code of practice for Ultrasonic Testing by Pulse Echo Method
IS:5334	Code of practice for Magnetic particle Flow detection of Welds.
IS:7318	Approval Test for Welds when welding procedure Approval is not Required
IS:7318	Fusion welding of Steel (part I)

METHOD AND BASIS FOR PAYMENT FOR FABRICATION & ERECTION OF STRUCURAL STEEL.

1) Payment for structural steel works shall be made on the basis of admissible weight in tons (determined as described in clause between of structure accepted by the Engineer-in-charge. The rate shall include supplying, fabrication, erecting in position (at al level & location), testing/examining (excluding radiography only) of bolted and/or welded structural steel works of all types(including all built up/compound sections made out of rolled sections and/or plates) including all handling, transporting, storing, straightening if required, cutting, edge preparation, preheating, bolting and welding),of joints (including sealing the joints of ox sections with continuous welding), finishing edges by grinding, fixing in line & level with temporary staging & bracing and removal of the same erection, grouting with ordinary/non-shrink grout as specified, including preparation of fabrication & erection drawings, erection schedule and getting them reviewed, preparing the surfaces for painting, surface cleaning, wire brushing, removal or mill scale, dust, rust, oil or grease and applying one coat of red oxide zinc chromate primer after fabrication etc. all complete as specified.

2) The weight for payment shall be determined from the fabrication drawings and respective Bill of materials prepared by the contractor wherever applicable. In case sections used are different from IS sections, then Manufactures Hand Book shall be adopted No allowance in weight shall be made for rolling tolerances.

3) Welds, bolts, nuts, washers, shims, pack plates, wedges and grout shall not be measured. The quoted rate shall be deemed to include the same.

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

IS:817 : Code of practice for training and testing metal are welders.

IS:818: Code of practice for safety, and health requirements in electric and gas welding and cutting operations.

IS:822: Code of practice for inspection of welds.

IS:9595: Recommendations for metal are welding of carbon and carbon manganese steel:

IS:919: Recommendations for limits and fits for Engineer.

IS:961:Structural Steel (High tensile)

IS:1148: Rivets bars for structural purposes.

IS:1149:High tensile rivets bars for structural purposes

IS:1161: Steel Tubes for structural purposes

IS:1200: Method of measurement of steelwork and ironwork (Part-B)

IS:1239: Mild Steel Tubes

IS:1363: Black hexagon bolts, nuts and lock nuts (dia. 6 to 30mm) and black hexagon screws (dia 6 to 24mm)

IS:1367: Technical supply conditions for threaded fasteners

IS:1442: Covered electrodes for the metal are welding of high tensile structural steel.

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ERECTION OF STRUCTURAL STEEL WORK

REV. NO.	PRAPARED	APPROVED	DATE

1.0.0 **SCOPE**

This specification covers the erection of structural steelwork including receiving and taking delivery of fabricated structural steel materials arriving at Site, and/or from Owner's Site stores and store Yard. Installing the same in position, painting and grouting the stanchion bases all-complete as per drawings, this Specification and provision of the Contract.

2.0.0 **GENERAL**

2.1.0 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless otherwise specified in the Contact, shall include but not be limited to the following:-

a) The Contractor shall provide all construction and transport equipment, tools, tackle, consumables, materials, labour and supervision required for the erection of the structural steelwork.

b) Receiving, unloading, checking and moving to storage yard at site including prompt attendance to all insurance matter as necessary, for all fabricated steel materials arriving at site. The Contractor shall pay all demurrage and/ at Wharf age charges etc. on account of default on his part.

c) Transportation of all fabricated structural steel materials Site storage yard, handling, rigging, assembling, riveting, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location according to approved erection drawings and/or as directed by the Engineer. If necessary suitable temporary approach roads transportation of fabricated steel structures.

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

e) Aligning, plumbing, levelling, riveting, bolting, welding and securely fixing the fabricated steel structures in accordance with the Drawings or as directed by the Engineer.

f) Painting of erected steel structures if required by the Contract.

g) All minor modifications of the fabrications of the fabricated steel structures as directed by the Engineer including but not limited to the following:-

1) Removal of bends, kinks, twists etc. for parts damaged during transport and Handling.

2) Cutting, chipping, filling, grinding etc. if required for preparation and Finishing of site connections.

3) Reaming of holes for use of higher size rivet or built if required.

4) Welding of connections in place of riveting or bolting for which holes are

Either not drilled at all or wrongly drilled during fabrication. Welding in place of riveting or bolting will be permitted only the discretion of the Engineer.

5) Refabrication of parts damaged beyond repair during transport and Handling of Refabrication of parts, which are incorrectly fabricated.

6) Fabrication of parts omitted during fabrication by error, or subsequently Found necessary.

7) Drilling of holes which are either not drilled at all or are drilled in incorrect location during fabrication.

8) Carry out tests in accordance with this Specification if directed.

2.2.0 WORK BY OTHERS

No work under this specification will be provided for by any agency other than the contractor unless specifically mentioned elsewhere in the contract

2.3.0. CODES AND STANDARDS:

All work this specification unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specification and codes of practice of equivalent:-

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

IS - 456: Code of practice for plain or reinforced concrete.

2.4.0 CONFORMITY WITH DESIGNS

The Contractor will erect the entire fabricated steel fabricated steel structure, align the all members, complete all field connections and group the foundations all as per the provisions of this specification and sequence and the design criteria laid down by the Engineer. All work shall conform to the provisions of the relevant Indian Standard Specifications and/ or the instructions the engineer. The testing and acceptance of the erected structures shall be in accordance. The testing and acceptance of the erected structures shall be in accordance with the provisions of this Specification and / or the Instruction of the Engineer.

2.5.0 MATERIAL

2.5.1 GENERAL

All fabricated steel structures and connection materials shall be supplied by the Contractor for fabrication work through the Owner. The Contractor for erection work will take delivery of all the materials from the Owner’s Stores or storage yard at sire. The Contractor may also have to take delivery directly from railway wagons or trucks at Site, in which case he shall

have to unload the materials and perform all formalities like checking of materials and attend to insurance matters in accordance with Sub-Clause 2.1.0 and as specified hereinbefore.

While taking delivery, the Contractor will check the quantity, quality and the sizes of the materials and verify the adequacy of the same in accordance with the Drawings and Specifications. In case the Contractor finds any materials inadequate, he shall inform the Engineer immediately prior to taking delivery of the same. No claim whatsoever, in respect of bad quality, shortage or difference in size will be entertained once the delivery is taken and the Contractor shall make good any such deficiency, if detected later, either by repair or with fresh material as be directed, by the Engineer at the Contractor's Own cost.

Excepting all field connection materials like rivets, bolts, nuts, washers and electrodes, which will be supplied by the fabrication Contractor to the extent of 10% in excess of the estimated requirements as per Drawings, all other consumables like Oxygen and acetylene gas, paints, fuels, lubricants, oil, grease, cement, sand, aggregates and any other materials that may be required for the execution of the works in accordance with the contract will be supplied by the contractor for erection work and will be deemed to have been including in this rates.

2.5.2 **MATERIALS TO CONFORM TO INDIAN STANDARDS**

All materials required to the supplied by the Contractor under this Contract shall conform to the relevant Indian Standard Specifications.

2.6.0 **STORAGE OF MATERIALS**

2.6.1 **GENERAL**

All material shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for use in the works. Any material which has been deteriorated or damaged beyond repairs and has become unfit for use be removed immediately from the site, failing which, the Engineer shall be at liberty to get the materials removed by agency and the cost incurred thereof shall be realised from the Contractor's dues.

2.6.2 **YARD**

The Contractor will have to be establishing a suitable yard in the approved location at site for storing the fabricated steel structures and other materials will be delivered to him by the Owner recording to the Contract. The yard shall have proper facilities like, drainage, lighting, suitable access for large cranes, trailers and other heavy equipment and shall be of sufficiently large area to permit systematic storage of the fabricated steel structures without overcrowding and with suitable access for cranes, trailers and other equipment for use in erection work in proper sequence in accordance with the approved programme of work.

The Tender should visit the site prior to submission of his Tender to acquaint himself with the availability of land and the development necessary by way of filling, drainage, access

roads, fences, sheds etc. all of which shall be carried out by the Contractor at his own cost as directed by the Engineer.

2.6.3 **COVERED STORE**

All field connection materials, paints, cement etc. shall be stored on well designed racks and platforms off the ground in the ground in a property covered store building to be built at the cost of the Contractor.

2.2.0 QUALITY CONTROL

The Contractor shall establish and maintain quality control procedures for different items of work and materials as may be directed by the Engineer to assure compliance with the provisions of the Contract and shall submit the record of the same to the Engineer. The quality control operation shall include but not be limited to the following items of work:-

1) Erection: Lines, levels, grades, plumbs, joint characteristics including Tightness of bolts.
2) Grouting: Cleaning and roughness of foundation, quality of materials used for grouting, administers, consistency and strength of grout.
3) Painting: Preparation of surface for painting, quality of primers and paints, thinners, application and uniformity of coats.

2.2.0 **TAKING DELIVERY**

The erection Contractor shall take delivery of fabricated structural steel and necessary connection materials supplied by the Fabrication Contractor from railhead, trucks and/or the Owner's stores at site as may be necessary and as directed by the Engineer. He shall check, unload; transport the materials to his stores for proper storing at his own cost. The erection Contractor shall submit claims to insurance or other authorities and pursue the same in case of loss or damaged during transit and handling and all loss there of shall be borne by him.

The erection contractor shall also take all precautions against damage of the materials in his custody after taking delivery and till the same are erected in place and accepted. The Contractor shall salvage, collect and deliver all the packing materials to the Owner free of charge.

3.0.0 **WORKMANSHIP**

3.1.0 **ERECTION**

3.1.1 **PLANT AND EQUIPMENT**

The suitability and adequacy of all erection tool s and equipment proposed to used shall be efficient, dependable, in good working condition and shall have the approval of Engineer.

3.1.2 **METHOD AND SEQUENCE OF ERECTION**

The method and sequence of erection shall have the prior approval of the Engineer. The Erection shall arrange for most economical method and sequence available to him consistent with the Drawings and Specifications and such information as may be furnished to him prior to the execution of the contract.

3.1.3 TEMPORARY BRACING

Unless adequate bracing is included as a part of the permanent framing, the erector during erection shall install, free of cost to the owner, temporary guys and bracings
Where needed to secure the framing against loads such as wind or seismic forces comparable in intensity to that for which the structure has been designed, acting upon exposed framing as well loads due to erection equipment and erection operations.

If additional temporary guys are required to resist or seismic forces acting upon components of the finished structure installed by others during the course of the erection of the steel framing, arrangement for their installation by the erecter shall be made free of cost to the owner.

The responsibility of the contractor in respect of temporary bracings and guys shall cease when the structural steel is once located, plumbed, levelled, aligned and grouted within the tolerances permitted under the specification and guyed and braced to the satisfaction of the Engineer.

The temporary guys, braces, false work and cribbing shall not be the property of the Owner and they maybe removed immediately upon completion of the steel erection unless other agreed arrangements are made. The Owner shall remove and return the same in good condition to the Contractor without any charge if they have been left in place under such other agreed arrangements.

3.1.4 TEMPORARY FLOORS FOR BUILDINGS

It shall be the responsibility of the Contractor to provide free of cost planking and to cover such floors during the work in progress as may be required by any Act of parliament and/or by laws of state, Municipal or other local authorities.

3.1.5 SETTING OUT

Positioning and levelling of all steelwork, plumbing of stanchions and placing of every part of the structure with accuracy shall be in accordance with the approved Drawings and to the satisfaction of the Engineer. Concrete foundations, where required, shall be made by other agencies. The Contractor shall check the positions and levels of the anchor bolts, etc. before concreting and get them properly secured against disturbance during pouring operations. He shall remain responsible for correct positioning. For heavy columns, etc. the Contractor shall set proper screed bars if desired by the Engineer, to maintain proper level. No extra payment shall be made for this. Each tire of column shall be plumbed and maintained in a true vertical position subject to the limits of tolerance allowable under this Specification.

No permanent field connections by riveting bolting or welding shall be carried out until proper alignment and plumbing has been attained.

3.1.6 Filed riveting

All riveting shall be heated and driven with pneumatic tools. Hand passing or 'throwing' of rivets are desirable. Any other method of conveying hot rivets from the furnace to the driving point must be approved by the engineer. No cold rivets shall be driven. All other requirements of reverting including quality and acceptance criteria shall be in accordance with the relevant portions of the Specification for Fabrication of Structural Steel work of the project.

3.1.7 Field bolting

All relevant portions in respect of bolted construction of the Specification for Fabrication of structural Steelwork applicable the Project shall also be applicable for filed bolting in addition to the following: -

Bolts shall be inserted in such a way so that they may remain in position under gravity even before fixing the nut. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials. When assembled, all joint surfaces, including those adjacent to the washers shall be free of scale except tight mill scale. They shall be free of dirt, loose scales, burns, and other defects that would prevent solid seating of the parts. Contact surfaces within friction-type joints shall be free of oil, paint, lacquer, or galvanizing.

All high tensile bolts shall be tightened to provide, when all fasteners in the joint are tight, the required minimum bolt tension by any of the following methods.

a) Turn-of-nut-method

When the turn-of-nut method is used to provide the bolt tension, there shall first be enough bolts brought to a 'snug tight' condition to ensure that the parts of the joint are brought into good contract with each other. 'Snug tight' is defined as the tightness attained by a few impacts of an impact wrench or the full effort of man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the applicable amount of nut rotation specified in table-1 with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation there shall be no rotation of part not turned by the wrench.

TABLE-1

Bolts length not	Bolts length	Remarks
Exceeding 8 dia. Or 200mm	Exceeding 8 dia. or 200mm	
½ turn	2/3 turn	Nut rotation is relative To bolt regardless of The

Element (nut or bolt) being turned. Tolerance on rotation - 30^0 over or under.

Bolts may be installed without hardened washers when tightening is done by the Turn- of – nut method. How ere, normal washers shall be used.

Bolts tightened by the turn- of – nut method may have the outer face of the nut Match-marked with the protruding bolt point before final tightening, thus affording the inspector visual means of noting the actual not rotation such marks can be made by the wrench operator by suitable means after the bolts have been brought up snug tight.

b) Torque wrench tightening
When torque wrenches are used to produce the bolt tensions, the bolts shall be tightened to the torques specified in TABLE-II. Nuts shall be in tightening motion when torque wrenches to install several bolts in a single joints, the wrench shall be returned to touch up bolts previously tightened, which may have been loosened by the tightening of subsequent bolts, until all are tightened to the required tension.

TABLE-II

Nominal Bolt Diameter (mm)	Torque to be applied (keg's) for bolts Class 8.8 of IS: 1367
20	59.94
22	81. 63
24	103. 73

In either of the above two methods, if required, if required, for bolt entering and wrench operation clearances, tightening may be done by turning the bolt while the nut is prevented from rotating.

Impact wrenches if used shall be of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt in approximately ten seconds.

Holes for turned bolts to be inserted in the field shall be reamed in the field. All drilling and reaming for turned bolts shall be done only after the parts to be connected are assembled. Tolerances applicable in the fit of the bolts shall be in accordance with relevant Indian Standard Specifications. All other requirements regarding assembly and bolt tightening shall be in accordance with this clause.

3.1.8 **FIELD WELDING**

All field assembly and welding shall be carried out in accordance with the requirements of the specification for fabrication work applicable to the project, excepting such provisions herein which manifestly apply to shop conditions only. Where the fabrication structural steel

members have been delivered paints, the paint shall be removed before field welding for a distance of at least 50 mm on either side of joints.

3.1.9 **HOLES, CUTTING AND FITTING**

No cutting of sections, flanges, webs, cleats, rivets, bolts, welds etc. shall be done unless specifically approved and/or instructed by the Engineer.

The erector shall not cut, drill or otherwise alter the work of other trades, or his own work to accommodate other trades, unless such work is clearly specified in the Contractor or directed by the Engineer. Wherever such work is specified the Contractor shall obtain complete information as to size, location and number of alterations prior to carrying out any work. The Contractor shall not be entitled for any payment on account of any such work.

3.2.0 **DRIFTING**

Correction of minor misfits and reasonable amount of reaming and cutting of excess stock from rivets will be considered as permissible. For this, light drifting may be used to draw holes together and drills shall be used to enlarge holes as necessary to make connection. Reaming, that weakens the member or makes it impossible to fill the holes property or to adjust accurately after reaming, shall not be allowed
Any error in shop which prevents the prevents the proper assembling and fitting of parts by moderate use of drift pins and reamers shall immediately be called to the attention of the Engineer and approval of the method of correction obtained. The use of gas cutting torches at erection site is prohibited.

3.2.0 **GROUTING OF STANCHION BASES AND BEARINGS OF BEAMS AND GRIDERS ON STONE, BRICKS OR CONCRETE (PLAIN OR REINFORCE)**

Grouting shall be carried out with Ordinary Cement grout as described bellow:-
The mix shall be one (1) part cement and one (1) part sand just enough water to Make it workable. The positions to be grouted shall be cleaned thoroughly with Compressed air jet and placed under expect supervision, taking care to avoid air-Looks. Edges shall be finished properly. If the thickness of grout is 25 mm or More, two (2) parts of 6 mm down graded stone chips may be added to the above Noted cement-sand grout mix, if required, by the Engineer or shown on the Drawings.

No grouting shall be carried out until a sufficient number of bottom lengths of Stanchions have been properly lined, levelled and plumbed and sufficient floor Beams are tied in position.

Whatever method of grouting is employed, the operation shall not be carried out until the steelwork has been finally levelled and plumbed, the stanchion bases being supported meanwhile by steel wedges, and immediately before grouting, the space under steel shall thoroughly cleaned.

If required by the Engineer, certain admixtures like aluminium powder, "ironies" or equipment, may be required to the grout. The Contractor will, when so directed by the Engineer, take delivery of the material from the Owner's site stores and use it in the grout in proportions to be decided by the Engineer and carry out the allowance of 5% (five percent) for wastage shall be allowed over the above theoretical requirement of the admixtures. Cost of any wastage beyond the above limits shall be paid for by the Contractor or will be realised from his dues at the rates prescribed by the owner.

3.3.0 PAINTING AFTER ERECTION

Field painting, if required to be done by the Contract, shall only be done after the structure is erected, levelled, plumbed, aligned and grouted in its final position, tested and accepted by the Engineer. However, touch up painting, making good any damaged shop painting and completing any unfinished portion of the shop coat shall be carried out by the erection Contractor free of cost to the Owner. The materials and specification for such painting in the field shall be in accordance with the requirements of the specification for fabrication of structural Steel work applicable for the project.

Painting shall not be done in frosty or foggy, weather or humidity is such as to cause condensation on the surfaces to be painted. Before painting of steel, which is delivered unpainted, is commenced, all surfaces to be painted shall be dried and thoroughly cleaned from all loose scale and rust.

All field rivets, bolts, welds and abrasions to the shop coat shall be spot painted with the same paint used for the shop coat. Where specified, surfaces which will be in contact after site assembling shall receive a coat of paint (in addition to the shop coat, if any) and shall be brought together while the paint is still wet.

Surface which will be inaccessible after field assembly shall receive the full specified protective treatment before assembly. Bolts and fabrication steel members which are galvanized or otherwise treated and steel members to be encased in concrete shall not be painted.

The specification for paint and workmanship shall be in accordance with the requirements of the specification for fabrication for fabrication of structural of structural steelwork applicable to the project. The number of coats and the shades to be used shall be as specified or as directed by the Engineer.

3.4.0 FINAL CLEANING UP

Upon completion of erection and before final acceptance of the work by the Engineer, the Contractor shall remove free of cost all false work. Rubbish and all Temporary works resulting in connection with the performance of his work.

4.0.0 TESTING AND ACCEPTANCE CRITERIA

4.1.0 GENERAL

Loading tests shall be carried out on erected structures, if required by the Engineer, to check adequacy of fabrication and/or erection. Any structure on a part thereof found to be unsuitable for acceptance as a result of the test shall have to be dismantled and replaced with suitable member as per the Contract of either fabrication or erection of steelwork whoever is responsible for it and no payment towards the cost of the dismantled portion and any connected work shall be made to the Contractor, unless it is proved that the deficiency is due to reasons beyond the Contractor's scope. On the basis of the tests, the Engineer will decide whether the fabricator or the erector is responsible for the unacceptable member or structure and his decision will be final. In case it is established that the unacceptability of the member or structure is due to design deficiency, the cost of replacement and/or modifications will borne by the Owner. In course of dismantling, if any damage is done to any other parts of the Contractor responsible, to the satisfaction of the Engineer, The cost of the tests specified hereinafter shall be borne by the Owner. Any extra claim due to loss of time, idle labour, etc. arising out of these testing operations shall not be entertained, however, only reasonable and appropriate time extensions will be allowed.

The structure or structural member under consideration shall be loaded with its actual dead as long a time as possible before testing and the tests shall be conducted as indicated in the following. Sub-clauses 4.1.1,4.1.2 and 4.1.3. The method of testing and application of loading shall be as approved by the Engineer.

4.1.1 STIFFNESS TEST

In this test, the structure or member shall be subjected, in addition to its actual dead load, to a test load equal to 1.5 times the specified superimposed load, and this loading shall be maintained for 24 hours. The maximum deflection attained during the test shall be within the permissible limits. If after removal of the tests load, the member or structure dose not show are recovery of at least 80 % of the maximum strain or deflection shown during 24 hours under to have load, the test shall be repeated. The structure or member shall be considered to have sufficient stiffness, provided that the recovery, after this second test not less than 90% of the maximum increase in stain or deflection recorded during the second test.

4.1.2 STRENGTH TEST

The structure or structural member under consideration shall be subjected, in addition to its actual dead load, to a test load equal to the sum of the dead load and twice the specified Superimposed load, and shall be maintained for 24 hours.

In the case of wind load, a load corresponding to twice the specified wind load Shall be applied and maintained for 24 hours, either with or without the vertical Test load for more severe condition in the member under consideration or the structure as a whole. Complete tests under both conditions may be necessary to verify the strength of the structure. The structure shall be deemed to have adequate strength if, during the test, no part falls and if on removal of the test load, the structure shows a recovery of at least 20% of the maximum deflection or strain recorded during the 24 hours under load.

4.1.3 **STRUCTURE OF SAME DESIGN**

Where several structures are built to the same design and it is considered unnecessary to test all of them, one structure, as a prototype, shall be fully tested, as described in previous Sub-clauses, but in addition, during the first application of the test load, particular note shall be taken of the strain or deflection when the test load 1,5 times the specified superimposed load has been maintained for 24 hours. This information is required as basis of comparison in any check test carried out on sample of structure.

When a structure of the same type is selected type is selected for a check test, it Shall be subjected, in addition to its actual dead load, to a superimposed test load, Equal to 1.5 time the specified live load, to a superimposed test load, equal to 1.5 Time the specified live load. In a manner and to an extent prescribed by the Engineer. This load shall be maintained for 24 hours, during which time, the Maximum deflection shall be recorded. The check test shall be considered Satisfactory, provided that the maximum strain or deflection should be recorded. The check test shall be considered satisfactory, provided that the maximum strain or deflection recorded at similar load in test on the prototype.

4.1.4 **REPAIR FOR SUBSEQUENT TEST AND USE AFTER STRENGTH TESTS**

An actual structure, which has passed the "Strength Test" as specified in Sub-Clause 4.1.2 herein before and is subsequently to be erected for use, shall be Considered satisfactory for use after it has been strengthened by replacing any Distorted members and has subsequently satisfied the 'Stiffness Test' as specified In Sub-clause 4.1.1 hereinbefore.

4.2.0 TOLERANCES

Some variation is to be expected in the finished dimensions of structural steel Frames. Unless otherwise specified, such variations are deemed to be within the Limits of good practice when they are not in excess of the cumulative effect of Detailed erection clearances, fabricating tolerances for the finished parts and the Rolling tolerance for the profile dimensions permitted under the Specifications for fabrications of structural steel work applicable to this project and as specified Below:

1 For Building Containing Cranes

Component	**Description**	**Variation Allowed**
1.	**2.**	**3.**
Main column	a) Shifting of column axis at foundation Level with respect to building line	
	i) In longitudinal direction	i) $\pm$ 3.0 mm

	ii) In lateral direction	ii) ± 3.0 mm
	b) Deviation of both major or column axis From vertical between foundation and Other member connection levels:	
	i) For a column up to and including IOM height true vertical	i) ± 3.5 mm from
	ii) For a column greater than IOM but less than 40M height not more than ± 7.0 mm per	ii) ± 3.5 mm from vertical for any 10M length measured between connection levels, but 3.0mm length
	c) For adjacent pairs of columns across the width of the building prior to placing shown on drawings	± 9.0 mm on true span
	d) For any individual column deviation of Any bearing from levels shown on drawings	± 3.0 mm
	e) For adjacent pairs of column either across The width of building or longitudinally level difference allowed between bearing or seating Level supposed to be at the same level	3 mm.
Trusses	a) Deviation at centre of span of upper chord Member from vertical plane running through Canter of bottom chord.	1/1500 of the span or not greater than 10mm Whichever is the least.
Trusses	b) Lateral displacement of top chord At centre of span from vertical plane running through centre of support.	1/250 of depth of truss or 20mm which Ever is the least
Crane Girders& Tracks	a) Difference in levels of crane rail measured between adjacent columns	2.0 mm
	b) Deviation to crane rail gauge	± 3.0 mm
	c)Relative shifting of ends of adjacent Crane rail in plan and elevation after thermit welding	1.0mm
	d) Deviation to crane rail axis from centre line of web	± 3.5 mm
Setting of Expansion Gaps	At the time of setting of the expansion gaps, due regard shall be taken of the ambient temperature above or Below 30^0 C. The coefficient of expansion or contraction shall be taken as 0.000012 per^0 C per unit length.	

iv) For Building without Cranes

The maximum tolerances for line and level of the steel works shall be ± 3.0mm on Any part of the structure. The structure shall not be out plumb more than 3.5mm On each 10M section of height and not more than 7.0 mm 30 M section.

These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.

4.3.0 ACCEPTANCE

Structures and members which have passed the tests and conform to all requirements specified in the foregoing sub-clause 4.1, 4.1.1, 4.1.2, 4.3.1 and 4.1.4 and other applicable provisions of this Specification and are within the limits of tolerances specified in Sub-clause 4.2.0 and / or otherwise approved by the Engineer shall be treated as approved and accepted for the purpose of fulfilment of the provisions of this Contract.

5.0.0 **INFORMATION TO BE SUBMITTED**

5.1.0 **Before t ender**

Along with the tenders the Tenderers will be required to submit the following Information:

5.1.1 **TENTATIVE PROGRAMME**

The Tender shall submit a tentative programme based on the information available in the Tender Document and visit to Site indicating the structure wise erection schedule proposed to be maintained by the Contractor to complete the job in time accordance with the Contract.

5.1.2 **CONSTRUCTIONAL PLANT AND EQUIPMENT, TOOLS, TEMPORARY WORKS & MANPOWER.**

A detailed list of all Constructional Plant & Equipment like cranes, derricks, winches, welding sets, erection tools etc. along with their make, model, present condition and location available with the Tender which he will be able to employ on the job to maintain the progress of work in accordance with the contract hall be submitted along with the Tender. The total number of each category of experienced personnel like fitters, welders, riggers etc. that he will be able to employ on the job shall also be indicated.

5.1.3 **ERRECTION YARD**

A site showing the layout and location of the erection yard proposed to be established by the Tender shall be attached with the Tender indicating the storage space for fabricated steel materials, site-fabrication and repair shop, covered stores, offices, locations of erection equipments and other facilities. The Engineer shall have the right to modify the arrangement and location of the proposed yard to suit site conditions and the Contractor shall comply with the same without any claim whatsoever.

5.2 **AFTER AWARD OF THE CONTRACT**

After award of the contract, the Contractor shall submit the following:-

5.2.1 **DETAILED PROGRAMME**

The Contractor shall submit a detailed erection programme within a month of the award of the Contract for completion of the work in time in a accordance with in Contract. This will show the target programme, with details of erection proposed to be carried out in each fortnight, details of major equipment required and an assessment of required strength of various categories of workers in a perform a approved by the Engineer.

5.2.2 **FORTNIGHTLY PROGRESS REPORT**

The Contractor shall submit fortnightly progress reports in triplicate to the Engineer showing along with necessary photographs, 125 mm x 90 mm size, and All details of actual achievements against the target programme specified in Sub-clause 5.2.1 above. Any shortfall in the achievement in a particular fortnight must be made up within the next fortnight. Along with this report, the Contractor shall Also furnished details of fabricated materials in hand at site and the strength of his workers.

MISCELLANEOUS STEEL WORK

REV. NO.	PRAPARED	APPROVED	DATE

1. ANCHOR BOLTS

All materials supplied by the Contractor shall be of tested quality as per specification below and test certifications of raw materials shall be provided by the Contractor.

a) Bolts shall be turned from M.S. conforming to IS: 226 and IS: 422 Grade I.

b) Nuts shall be hexagonal type conforming to IS: 1363 and IS: 3138.

c) Plain washers shall be of mild conforming to IS: 226.

d) Sleeves shall be M.S Tubes (Medium) conforming to IS: 1239.

1.1 FABRICATION

Fabrication of anchor bolts shall be in compliance with the specification
Complete anchor bolts assembly shall be as per drawings, and will include the
Cost of sleeve pipes, fine gussets, bottom plate, and other fixtures including all welding work if involved.

a) Threads shall be of coarse type conforming to IS: 1367 and IS: 4218

a) Plain washers shall be of mild steel conforming IS: 2016.

c) Bolt shall conform to IS: 1367.

1.2 The anchor bolt assembly to be anchored or embedded in concretes shall be placed and securely held in position strictly as per drawings before and during pouring of concrete, with necessary wooden or steel templates and other devices.

1.3 Tolerances allowed for anchor bolts positioning shall be:

- For sleeved bolts, and one tenth of bolt nominal diameter.
- For bolts without sleeves one twentieth of the bolt nominal dia.

1.4 The surface not to covered with concrete shall be greased and protected from damage by wrapping and typing just cloth/polythene.

1.5 Payment

1.5.1 Payment for supply and fabrication of anchor bolts including sleeves and nuts Shall be on weight basis of the finished product and shall include greasing etc. A sample bolt shall be got approved from Engineer –in-Charge.

1.5.2 Payment for fixing where separately specified shall be on weight basis and rate

shall including carting, fixing, providing and tying Hessian cloth, welding, if required etc. complete.

2 M.S Metal Inserts

2.1 All metal inserts its fabrication, bolting, riveting welding, etc. shall conform to the requirement specified under Specification of structural " Steel ". The metal inserts shall be fabricated as per – drawing and direction of the Engineer- in-Charge.

2.2 The placement of the metal inserts shall be securely placed in brick masonry, plain or reinforced concrete members. It shall be so securely placed in member that its position is not disturbed while concreting. Suitable templates, spacer blocks, dummy structures and staging shall be provided. Necessary cutting in the shuttering and adjustment for the placement of metal inserts if situation so desires. Where indicated, it shall be welded to the reinforcement.

2.3 The exposed surfaces shall be given one coat of red oxide primer and where directed, protected by jute cloth wrapping and tying.

2.4 PAYMENT

Payment shall be made on the basis of actual weight of metal inserts shall include supply, fabrication tying, turning, tack wielding, welding on other embedded items such as pipe (for puddle flanges) cutting and adjusting the shuttering and reinforcement and dry packing, if required with cement motor 1:3 painting, protecting with jute cloth etc. complete.

3 M.S. Chequered Plates

3.1 Chequered plates shall be 6mm thick (7mm, over chequers and shall conform To IS: 3502). Steel for Chequered plate shall conform to IS: 226. It shall be rolled, and free from harmful surface defects such as cracks, surface flaws etc. The plates shall be cut to shape and fixed to bearing members as shown in the relevant drawing and as directed by Engineer-in-Charge. The edges shall be made smooth and no burs or jagged end shall be left. The plates may be spliced with prior consent of Engineer –in-Charge but in that case care should be taken so that there is continuity in the pattern of the plates between the two portions.

3.2 Payment

Payments shall be made on the basis of weight of Chequered plate actually laid. The rate shall include cost of cutting to size, making holes to required shape, smoothing ends, transporting and welding, bolting, fixing, in positions etc. complete. No deductions will be made for openings up to size of 300mm square.

4. M.S. Grating

4.1 Material: Both the types of Gratings shall be fabricated, out of M.S. Flats. The steel shall conform to IS; 236 and shall be of weld able quality. It shall be clearly rolled and shall be free from harmful surfaces defects.

4.3 Fabrication Drawings: Based on the arrangement of supporting beams of design Drawings, the Contractor shall prepare shop fabrication drawings and get the Same approved as per the procedure outlined for shop fabrication drawings for structural steel work.

4.2 Type I Gratings

4.5.1 These shall be of ready made bought out type and designed to carry specified loads with limits.

4.5.2 Unless other wise mentioned in schedule of rates these shall be capable of carrying a uniformly distributed load of 500 kg. per square metre or a concentrated loads of 1000 kg. at mid span , whichever is governing . The maximum span for the above loading condition shall be 1200 millimetres. The deflection shall not exceed span /200 or 6mm whichever is less. The design shall be done as per IS: 800. Before fabrication or procurement the contractor shall submit the design calculations, drawings and manufacturer's Literature and gets the same approved from Engineer –in-Charge.

4.5.2 The gratings for stair treads shall be provided with nosing of Chequered plate of approved size and thickness.

4.6 Payment

4.6.1 Gratings shall be paid on the basis of weight of the area of M.S. Grating and frame actually laid.

4.6.3.1 The rate shall include cost of preparation of fabrication drawings, calculations, cost of cutting to size fabricating, welding, bolting, smoothing ends if necessary shop coat of red oxide zinc chromate primer, transporting and fixing in positions by welding or clips as per the design drawings.

Loading, unloading, strong, safe custody, watch and ward, returning back of surplus materials to go down of issue where applicable.

5 M.S. Tube Hand Rails.

5.1 All mild steel tubes and fittings shall conform IS: 1239 and shall be of medium grade. All screwed pipes shall have threads as per IS: 554. All fittings shall be malleable iron fittings as approved by Engineer-in-Charge.

5.2 All pipes shall either be directly welded or jointed with screwed couplings. Care shall be taken to remove burrs from the ends of the pipe and if required the vertical members should be grouted with cement mortar as specified. The pipe shall be fixed to pipe or angle uprights by means of suitable

clamps or by means of welding. After fixing, the pipe shall be painted with two coats of white paint over a coat of primer as directed by Engineer-in-Charge.

5.3 Payment

The payment shall be made on running metre basis of the actual of handrails fixed and shall include the cost of pipes. Clamps and fittings, if any, transportation, cutting of pipes as required, threading or welding, fixing painting etc .all complete as per direction of the Engineer-in-Charge.

6 M.S. Rungs

6.1 M.S.bars used for rungs shall conform IS: 432 and shall be fixed in positions as per detailed drawings and directions of Engineer-in-Charge.

6.2 Payment

Payment shall be made of the basis of actual weight in kilogram (kg) of M.S. rungs.

7 EXPANSION FASTENERS

7.1 SCOPE

The specification deals with the use of expansion fasteners for providing fixture to concrete surfaces.

7.5 Installation Procedure

The Contractor shall install the expansion at the specified places according to the approved manufactures specification with the help of necessary tools specified by the manufactures with the prior approval of Engineer –in-Charge for the approval of Engineer-in-Charge for every installation of expansion fasteners in regard to its correct location and strength.

7.6 Payment

Payment shall be made on number basis. The rate shall include cost of fasteners, nuts, washers and bolts of required sizes necessary scaffolding, drilling with electric drill, labour, materials, complete.

MISCELLANEOUS METAL

REV. NO.	PRAPARED	APPROVED	DATE

0.0 SCOPE

This shall include supply, fabricators and erection of miscellaneous metal items of light nature in gates, grills balcony and steps handrails particulars structural mullions and transoms, ladders hangers masonry anchors, shell angles, anchor bolts fasters etc. as shown or drawing or as instructed by the Engineer. The above items shall be of fabricated or cast M.S./Aluminium Brass. Cast iron .M.S. and galvanised M.S sheets aluminium sheets expanded metal with mesh etc. as shown on drawings and/or described in the Schedule of items.

1.0 INSTALLATION

2.1 Fabrication/Casting

2.1.1 General

All work shall be done according to approved shop drawings. All workmanship shall be equal to the best practice in modern structural foundry shop.

2.1.2 Shop Connections

a) All shop connections shall be riveted or welded except when noted otherwise on drawings.

b) Welding of steel shall be done on accordance with the IS: 816. Use of metal are welding for general construction in Mild Steel.

c) Welding of Aluminium shall be done in accordance with IS : 2912. Are welding of aluminium and alloys. Special care shall be taken to grind smooth all welded surface that shall remain exposed to view Welds shall be electrically continuous if so required by ; the Engineer.

2.1.3 Shop Coat

Before leaving the shop, all metal work shall be thoroughly cleaned by effective means of all loose mill/scale, rust and foreign matter. Except where encased in concrete all steel work shall be given one coat of approved metal protective paint, applied by ; brush thoroughly evenly, well worked in to joints and other open spaces. All paint shall be applied to dry surfaces. When specified on Schedule, steel work shall be galvanised or galvanised and painted with a coat of zinc chromate primer Aluminium surfaces which shall come in contact with masonry shall be given one coat of bituminous paint

2.2 Erection

2.2.1 Bracing

The Contractor shall provide all necessary temporary guys and braces to ensure alignment and stability of the members and to take ; care of all loads to which the structure may be subjected including erection of equipment and operation of the same.

2.2.2 Temporary Bolting- Up

As erection proceeds the Contractor shall plumb up and level all members and shall securely bolt up to take care of all dead load. Wind load and erection stresses. Wherever piles of materials erection equipment or other loads are carried during erection . proper provision shall be made to take care of the stresses resulting from the same.

2.2.3 Turned Bolt

For field connections where bolting is specified, holes for the turned bolts may be reamed in the field, if required. All drilling or reaming for turned bolts shall be done after the parts to be connected are assembled.

2.2.4 Welding

Where specified on drawings, welding shall be done in accordance with IS:816 for steel and IS:2812 for Aluminium and Alloys.

2.2.5 Cutting and Fitting

No cutting of sectors, flanges, webs of angles should be done without the approval of the Engineer. Where indicated on the drawings, holes cuttings etc. shall be provided as regulated for installation, to the work by the other Contractors. No additional holes or cuttings their those shown on drawings, shall be made without the approval of the Engineer.

2.2.6 Drifting

Correction of minor misfits and a reasonable amount of reaming and cutting of excess stock from rivets may be permitted. For this, light drifting may be allowed to draw holes together. Twist drills shall be used to enlarge as necessary to make connections Reaming that weakens the members or make it impossible to first the holes properly or to adjust accurately after ream one shall not be allowed.

Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of draft pans of a moderate amount of reaming and slight chipping and cutting shall immediately be called to the attention of the Engineer and approval of the method of confection obtained. The sue of cutting torches to enlarge or alter rivet holes shall not be permitted.

2.2.7 Grouting

All beaming plates, loose, lintels and beams etc. shall be set to proper grade and level by the Contractor and the Engineer's approval obtained before proceeding with the Grouting. Grouting shall be done in 1:11/2:3 concrete with 5mm down stone chips.

2.2.8 Anchor Bolting

When shown on drawings, the miscellaneous metal items shall be fixed to crete by case hardened and drawn carburizing steel expander nut and bolt. The contractor shall submit the manufacturer's literature shown the average pull out and average shear values for bolts of various sizes. The bolts shall be fixed strictly as per the manufacturer's instructions.

2.2.9 Pipe Joints

M.S. Pipes shall be joined by threaded sockets or by welding Cast iron pipes shall be socket and spigot jointed and caulked with hemp and molten head.

2.2.10 Spot Painting

All field rivets and bolts and also any serious abrasion to shop paint shall be spot painted with the same materials and used for the shop paint or equivalent.

2.2.11 Making Good

All cutting to concrete or masonry shall be made good to the satisfaction of the Engineer.

3.0 ACCEPTANCE CRITERIA

a) All items shall be of correct shape, size, weight etc., shown on drawings and schedule of items.

b) For installed items, the tolerances shall be follows:

   i) Permissible deviation from straightness –1 in 1000.

   ii) Seats, stiffener connections etc, shall be as per approved drawings and shall not interfere with architectural clearances.

c) All castings shall be free from blow holes, cracks and other blemishes.

4.0 RATES

The Contractor shall quote unit rate for supply of materials fabrication, shop paint and erection. This shall also include transporting the fabricated materials to the site, unloading storing and erection, including furnishing necessary temporary bracings guys, staging and planking. This shall also include cutting and drilling to steel, concrete or masonry and welding, bolting, grouting and making good damages after erection and removing all rubbish and clearing the site upon completion of erection.

Where only erection of materials supplied by the Owner at site to actual erection site, erection including free of cost is involved, the rate shall include handling, transportation from the Owner's stores at site to actual erection site, erection including furnishing necessary temporary bracing, guys, staging and planking etc., complete with all cutting drilling welding grouting bolting etc., making good damages removing all debris on completion of the job.

5.0 METHOD OF MEASUREMENT

a) For supply and/installation generally, cast items except pipes shall be measured for actual numbers used or for weight as mentioned in the Schedule.
b) Cast Iron rain water down corners or drain pipes shall be measured for length along the center line of piping including all bends, joints shoes and specials.
c) Fabricated items shall be measured for weight.
d) Ornamental metal grills, gates etc., shall be measured either for weight or area or such grills, gates etc.

6.0 I.S CODES

IS:226	-	Structural Steel (Standard Quality)
IS:800	-	Code of Practice for use of structural steel in general building construction.
IS:816	-	Use of metal arc welding for general construction
IS:2812	-	Arc Welding of Aluminium and Alloys
IS:3150	-	Hexagonal Wire Netting
IS:4948	-	Welded steel wire fabric for general use.

PAINTING ON STRUCTURAL STEEL

REV. NO.	PRAPARED	APPROVED	DATE

1.0 SCOPE

1.1 This specification covers the general requirements for painting structural steel work. It covers the supply and delivery of all necessary materials, labour, scaffolding, tools, equipment and everything that for the job completion on schedule.

1.2 The scope of painting work could be one or more of the following.

a) Shop painting after fabrication.
b) Painting after erection.
c) Painting after fabrication and painting after erection.
d) Routing maintenance painting or repainting of erected structural steel.

1.3 Shop painting shall be understood to mean painting prior to erection whether such Materials are fabricated in shop or at site. In case the contract covers shop painting only, the contractor shall ensure that the painted surfaces are not abrased/scratched etc, as they leave his works/shops. In case of ex-works delivery contract and in case of FOR site contracts, the materials as received at site should be good condition. Otherwise all damaged, abraded and scratched surfaces shall be touched up on receipt of materials at site as specified. If the contract covers both shop painting and painting after erection, the responsibility would be total. In
Case of routine maintenance painting of erected steel work, the surface preparation, primer application and painting shall be as per the instructions of the Engineer.

2.0 APPLICABLE CODES

The following Specifications, Standards and Codes are made a part of this Specification. All standards, tentative specifications, Specifications and Codes of Practice referred to here in shall be the latest editions including all applicable official amendments and revisions.

In case of discrepancy between this Specification and those referred to herein, this Specification shall govern, In case as discrepancy between tender drawings and this Specification of the tender drawings shall govern.

In case of discrepancy between this Specification and those referred to herein, this Specification shall govern, In case as discrepancy between tender drawings and This Specification of the tender drawings shall govern.

a) IS : 800 Code of practice for Use of Structural Steel in General Building Construction.

b) IS: 012 Ready Mixed paints, Brushing, Red Lead, Non setting, Priming.

c) IS : 129 Ready Mixed Paint, Brushing, Finishing, Interior, Oil glass, for General purposes, to Indian Standard colours.

d) IS : 157 Ready Mixed Pints, Brushing, Acid and Alkali Resisting, Lead Free, for General Purposes, to Indian Standard Colours No.446 Red Oxide, NO.632 Dark Admiralty Grey and other colours as required.

e) IS : 159 Ready Mixed paint, Spraying, Acid Resisting, for protection against Acid Fumes, Colour as required.

f) IS : 160 Ready Mixed paint, Spraying, Acid Resisting, for protecting against Acid Fumes, Colour as required.

g) IS : 341 Black Japan, Types A,B,c

h) IS : 1236 Ready Mixed Paint, Brushing, Oil Gloss, Heat Resisting, to Indian Standard Colour No630 Deep Buff.

i) IS : 1477 code of practice for painting of Ferrous Metals in Buildings.
(part-I) - pre-treatment
(part-I) – painting.

j) IS : 2074 Ready Mixed paints, Red Oxide – Zinc chrome, priming.

k) IS : 2330 Aluminium paint for General purposes, in Dual Container.

l) IS : 5905 Sprayed Aluminium and Zinc Coatings on Iron and Steel.

2.0 **PAINT**

3.1 All paints delivered to the fabrication shop/site shall be ready mixed, in original Sealed containers, as packed by the paint manufactures and no thinners shall be Permitted.

3.2 Paint shall be stirred frequently to keep the pigment in suspension.

3.0 **WORKMANSHIP**

4.1 The surface of steel works to be painted in the shop shall be thoroughly cleaned for All loose mill scale, rust, grease, dirt and foreign matter by hand tool cleaning, Power tool cleaning, flame cleaning or sand / shot blasting as specified in Data Sheet A. In power tool brushing, sufficient care shall be exercised no to burnish mill scale to a slick finish to which paint may not adhere property.

4.2 All fabricated steel martial, except those to be galvanised shall receive protective Paint coating of red Oxide Zinc chromate or as specified in schedule of items.

4.3 The paint treatment shall be applied either by brushing or spraying on the

thoroughly cleaned and dry surface, Airless spraying shall be done if so specified. The number or coats of paint shall be one or as specified in schedule of items.

4.4 Surface inaccessible after assembly shall receive an additional coat for the specified paint prior to assembly.

4.5 Steel delivered at the erection site be touched up with the specified paint on surface which are scratched.

4.6 After steel has been erected, all bare and abraded spots, rivet heads, field welds, Bolt heads and nuts shall be painted with primer specified in Data Sheet A. Before paint is applied, the surface shall be dry and free from dust, dirt, scale, oil and grease.

4.7 Surface inaccessible after erection, including top surface of floor beams shall Receive treatment with one additional coat of red oxide zinc chromate primer.

4.8 No painting shall be done in frosty/foggy weather or when the humidity is high Enough to cause condensation on the surface to be painted. Paint shall not be applied when the temperature of surface to be painted in 5^0C or lower.

4.9 In addition, colour code marking as specified shall be clearly painted in the Fabrication shop on the member in the manner specified.

4.10 Separate colours code of identification mark shall be adopted in the fabrication Shop for member fabricated from steel supplied by the OWNER and the VENDOR/CONTRACTOR

4.11 Surfaces coming in contact with concrete, and such other areas should not be painted, if so specified or directed by Engineer.

4.12 All machine finished surface shall be provided with a coat of white lead tallow Before despatch to site to prevent rust formation.

4.0 METHOD OF PAYMENT

5.1 Payment for painting of structural steel works shall be made on the basis of weight in metric tons of the painted structures accepted by the Engineer-in- charge. The rate shall include supplying and applying two coats of synthetic enamel paint of approved quality and shade over a coat of ed oxide zinc chromate primer besides one coat of shop primer already applied to structure steel works of all types/ shapes at all locations & positions including storage, surface preparation, degreasing, cleaning, drying, touching up of shop primer coat, providing temporary staging, testing etc, all complete as specified.

INSERTS/EMBEDMENTS IN CONCRETE WORK

REV. NO.	PRAPARED	APPROVED	DATE

1.0 SCOPE

This specification source the general the requirement for providing insert and cut oust concrete work as indicated in the drawings supplied to the contractor.

2.0 GENERAL

Numerous insert are requirement to be fixed/embedded in concrete as indicated In construction drawing/as directed by the Engineer. These insert comprise plates, angle, pipe sleeves, anchor bolts assemblies, owner, etc to be supplied by owner free of coat at his stores, for incorporation in the works, other inserts are required to be supplied and fabricated, by the Contractor These would be indicated clearly on the construction drawings.

3.0 MATERIALS AND INSTALLATION

3.1 Steel templates shall be used by the CONTRACTOR to locate and very accurately position bolts, group of inserts, inserts, embedded parts, etc, at his cost. Such templates shall be got previously approved by the Engineer. Templates shall invariably be supported such that the same is not disturbed due to vibration, movement of labours, materials, shuttering work, reinforcement, etc, while concreting. The CONTRACTOR will have to suitably bend, cut or otherwise adjust the reinforcement in concrete at the location of inserts, as directed by the Engineer. If the Engineer so directs, the insert will have to be welded to reinforcement to keep these in place. The contractor shall be responsible for the accuracy of dimensions, levels, alignments and canter lines of the insert in accordance with the drawings and for maintenance of the same until the erection of equipment structure or final acceptance by the Owner.

3.2 The Contractor shall ensure proper protection of all bolts, inserts, etc, from weather by greasing or other approved means such as applying white lead putty and wrapping them in gunny bags or canvas or other means as directed by the Engineer to avoid damage due to movement of his labourers, materials, equipment etc. No extra claim from the Contractor on this account shall be entertained. The contractor shall be solely responsible for all the damage caused to bolts inserts, etc, due to his negligence and in case damage does occur, they shall be rectified to the satisfaction of the Engineer at the Contractor's cost.

4.0 RATE

4.1 The rate quoted by the Bidder for embedment works shall hold good for accurately fixing the inserts at the correct-levels/alignment and shall include the cost of templates and any temporary supports/anchors etc, including cutting, bending , welding, etc as requirement.

5.0 MEASUREMENT:

All embedment will be measured by weight including lugs.

Templates and temporary supports, if any will not be measured.

Permanent supports such as road, structural sections etc, used exclusively for supporting the embodiments shall be paid for under ordinary embodiments (not under Foundation hardware).

GROUTING

REV. NO.	PRAPARED	APPROVED	DATE

1.00.0 **GROUTING OF BASE PLATES**

1.01.0 **GENERAL**

Grouting under base plates constitute a special kind of work requiring judicious selection of materials and careful execution of work. Grouting should ensure complete filling of the space and perfect bond. The grouting shall be done under Expert supervision. Care must be taken to ensure that there is no locked air in the grouting.

1.02.0 **MATERIALS**

1.02.01 CEMENT : Only fresh Portland conforming to IS:8112

1.02.02 SAND : Fine aggregate shall comply in general with requirement of concrete aggregate (IS:383) and shall have a fineness modules of 2.5 to 3.0

1.02.03 ANTI-SHRINKAGE MATERIAL : Aluminium powder or anti-shrinkage admixture like Groutex CRS-NS grout (by Cement Research Institute of India) or conbextra GP2 its equivalent shall be of standard brand from reputed manufactures And shall be approved by the Engineer prior to use in work.

1.02.03 **MORTAR**

Water cement ratio should not exceed 0.5 Mortar shall be made up of cement and sand in the proportion 1:1 by weight and blended with Aluminium powder (about 0.005 by weight of cement or with anti –shrinkage admixture) in a suitable proportion to cement mortar in accordance with the recommendation of the manufacturer and subject to the approval of the Engineer.

1.04.0 **SCOPE**

The work covers all operation connected with grouting including all labour and materials. Any damage to the concrete foundation works caused during such operations due to the carelessness, or negligence shall be made good by the Contractor in a manner to be decided by the Engineer, whose decision shall be final and binding.

1.05.00 **SURFACE PREPARATION: CONCRETE**

Concrete surface receiving the grout shall be properly roughened removing latency and exposing good concrete. The preparation of the surface may be accomplished through the use of a chipping hammer or hand bush hammer and wire brush. The surface shall be thoroughly cleaned removing all the free water from the surface but keeping it wet before the grouting begins.

1.06.0 **SURFACE PREPARATION:STEEL**

The steel surface coming in contact with the grout should be cleaned or rust, mill scales, paints, oil or grease and be wet before setting into place for grouting.

1.07.0 **WORKMANSHIP**

Grouting arrangements should ensure mortar to fill all the voids completely. Provisions of grout holes and rod ding arrangements should be checked before commencement of grouting. If necessary, pressure grouting with grout pump shall be restored to. Edges shall be finished properly.

1.08.0 **METHODS OF GROUTING**

1.08.01 **USE OF DRY PACK CONCRETE**

The widely used method of obtaining satisfactory grout is based on the principle of using lowest water cement ratio reducing the shrinkage to a minimum. Pozzolana cement having less shrinkage than ordinary Portland cement is preferred for this grouting. Only enough water shall be added to produce a grout. The proper amount of mixing water and proper consistency are those which will produce a grout which is at the point of becoming rubbery when the material is solidly packed. Any mortar which has been mixed for period longer than an hour shall not be used.

1.08.0 **USE OF DRY PACK CONCRETE**

To reduce the shrinkage anti-shrinkage materials as specified earlier to be added.

1.08.02 **LEVELLING & PLUMBING**

No grouting shall be carried out until the steel-works shall been finally levelled and plumbed and sufficient number of floor beams are tied in position. The stanchions, meanwhile, are to be supported by steel wedges, and immediately
Before grouting, the space under steel base plate shall be thoroughly cleaned. The steel wedges must not be welded to the underside of base places.

2.00.0 **DISMATLING, ALTERATION AND RE-ERECTION OF STEEL WORK**

In case it is found that alteration are to be done for certain portions of steel work already erected for any reasons what so ever, this shall be done only on the written orders of the Engineer. Complete scheme of alterations shall be detailed and got approved by Engineer before work is taken up at site.

The sections requiring modifications which cannot be done in the erected position shall be dismantled carefully without damaging other structure, lowered dismantling, cutting, re-welding or supporting, re-aligning of other adjacent connected member as well.

3.00.0 **MEASUREMENT**

3.00.01 Grouting under base plates of structures erected by the Contractor will not be

measured. The rate for erection is expected to include cost of grouting However, Volume of grout will be considered for the purpose of theoretical consumption of cement.

3.00.02 Grouting under base plates and machine bases erected by other will be measured for actual volume of grout. The volume of embedded base plate/machine basis will be deducted from the overall volume of grout.

3.00.03 Grouting in pocket for erection done by other will be measured for the volume of Of pockets. No deduction will be done for volume of bolts etc.

MASONRY AND ALLIED WORKS

REV. NO.	PREPARED	APPROVED	DATE

1.0.0 SCOPE

This specification covers furnishing, installation, repairing, finishing, cutting, protection, maintenance and handing over of masonry and allied works of use in structures and locations covered under the scope of the Contract.

2.0.0 INSTALATION

2.1.0 SOLING

2.1.1 BRICK SOLING

The ground shall be dressed, consolidated by ramming or by light rolling and a 12mm thick cushion of sand laid. On the sand cushion the bricks shall be laid with fine joints and placed firmly in position by hammering with wooded mallet. The surface shall be free from undulations. The “frog” side shall be on the underside. The joints shall be broken the in all direction and bricks cut as required. The pattern of laying and number of layers shall be as per Schedule of item. Orientation shall be as designed by the Engineer. After laying of each layer of brick sand shall be spread over and worked into the joints to pack the bricks tight.

2.1.2 STONE SOILING

The stones for soling shall be selected on the basis of thickness of soling specified in the Schedule of Items. The larger stones shall be laid and the gaps filled by smaller stones. The interstices shall then be firmly packed with sand by flooding with water.

2.2.0 BRICKS EDGING

Excavation shall be done closed to the brick dimensions in perfect alignment. Bricks shall be firmly placed by hammering with wooden mallets and sides and joints packed firmly with earth so that the edging is not disturbed easily. Alignment and level shall be acceptable to the Engineer.

2.3.0 MASONRY

2.3.1 GENERAL

All masonry work shall be true to lines and levels and as shown on drawings. All Masonry shall be tightly built against structural members and bonded with dowels, inserts etc, as shown on drawings.

2.3.2 MORTAR

Mix for mortar shall be specified in the Schedule of Items.

When lime is used hydrated lime shall be mixed with water to from a putty and stored with care to prevent evaporation for at least 24 hours before use, Quick lime shall be slaked with enough water to make a cream, passed through a No.10 sieve and stored avoiding evaporation for seven days before use.
Lime putty and sand in proper proportion shall be mixed on a water-light platform with necessary addition of water and thoroughly ground in a mortar mill. This mix shall be transferred to a mechanical mix, required quantity of cement added and the content mixed for at least 3 minutes. Mixtures of lime putty and sand may be stored avoiding drying out. For cement sand mortar cement and sand in requisite proportions shall be mixed dry in a mechanical mixer and then water added and mixed further. Minimum quantity of water shall be added to achieve working consistency. Surplus mortar droppings from masonry, if received on surface free from dirt may be mixed with rest mortar if permitted by the Engineer who may direct addition of additional cement without any extra payment. No mortar which has stood for more than half an hour shall be used.

2.3.3 BRICK MASONRY

Bricks shall be soaked by submergence in clean water for at two hours in approved vats before use. Bricks shall be laid in English bond unless specified otherwise. Broken bricks shall not be used. Cut bricks shall be used if necessary to complete bond or as closures. Bricks shall be laid with frogs upwards over full mortar beds. Bricks shall be pressed into mortar and tapped into final position so as to embed fully in mortar. Inside faces shall be buttered with mortar before the next bricks is placed and passed against it. Thus, all joints between bricks shall be fully filled with mortar.

Mortar joints shall be kept uniformly 10mm thick. All joints on face shall be racked to minimum 10 mm depth using raking tool while the mortar is still green to provided bond for plaster or pointing. Where plaster or pointing is not provided, the joints shall be struck flush and finished immediately. Brickworks two bricks thick or more shall have both faces in true plane. Brickwork of lesser thickness shall have one selected face in true plane.

2.3.4 EXPOSED BRICKWORK

Brickwork in superstructures which is not covered by plaster shall be as shown on drawing and executed by specially skilled mason. Courses shall be truly horizontal and vertical truly vertical. Wooden straight edges with brick course graduations and position of window sills and lintels shall be used to control uniformly of brick courses. Masons must check workmanship frequently with plumb, sprit level, rule and strings. All brickwork shall be cleaned at the end of dry work. If face bricks are specified in the Schedule of item, the brickwork shall be in routine bricks, but maintaining the bond fully. Where face bricks are not specified, bricks for the exposed brickwork on completion of work shall be rubbed down, washed clean and

pointed as specified. Where face bricks are are used carborundum stone shall be used for rubbing down.

2.3.5 REINFOCED BRICKWORKS

Reinforcements shall be as specified in the Schedule of Items. All reinforcements Shall be thoroughly cleaned and fully embedded in mortar. Where M.S. bars are used as reinforcement, these shall be laced with dowels if left in R.C. columns or welded to steel stanchions.

2.3.6 REINFORCED BRICKWORKS

Reinforcements shall be as specified in the Schedule of Items. All reinforcements shall be thoroughly cleaned and fully embedded in mortar. Where M.S bars are used as reinforcement, these shall be laced with dowels if left in R.C. columns or welded to steel stanchions.

2.3.7 STONE MASONRY

Stones shall be thoroughly socked before laying. Stones shall laid on their natural quarry beds. Individidual stones shall be executed by specially skilled mason. Stones used for exposed face shall be specially selected. All exposed stone faces shall be kept clean and free from mortar and pointed up neatly as the work proceeds in a manner called for in the drawings or the Schedule of Items or Instructions. A sample wall, 10 sq.m. In area shall be build and approved by the Engineer and all works shall match with this sample.

2.3.8 COMPOSITE MASONRY

Where stonework facing with brick masonry backing is specified the bond between them shall be achieved by bond stones of dimensions and frequency as desired by the Engineer.

2.3.9 EXPANSION & SEPARATION JOINTS

Location of joints shall strictly be as shown on drawings or as instructed by the Engineer. Expansion joints shall be as shown on drawings and specified in the Schedule of Items. Expansion joint filler boards and sealing strip shall have minimum traverse joints. Transverse joints shall meet the approval of the Engineer.

Separation joints shall be with standard water proof paper or with alkathene sheets about 1mm in thickness. Length and sealing of laps shall be to the satisfaction of the engineer.

2.3.10 MOULDINGS, CORNICES, DRIP COURSE

These shall be made as shown in drawings. Bricks or stone shall be cut and dressed as required. If no subsequent finish is envisaged, these shall be rubbed to correct profile with carborundum stone.

2.3.11 CURING

Masonry shall be cured by keeping it wet for seven days from the date of laying. In dry whether at the end of days work top surface of masonry shall be kept wet by ponding.

2.3.12 EMBEDDING OF FIXTURES

All fixtures shall generally be embedded in mortar and masonry units shall cut as required.

2.3.13 ENCASING OF STRUCTURE STEEL

This shall be done by masonry work round flanges, webs etc. and filling the gap between steel and masonry by minimum 12 mm thick mortar. Encased members shall be warped with checked wire mesh shown on drawings of instructed by the Engineer. The minimum lap is checked wire mesh shall be 50mm

2.4.0 DAMP PROOF COURSE

Unless otherwise specified Damp-proof course shall be 40 mm Thick 'artificial stone' proportion 1:1-2/3 cement sand stone-chips (10mm down) with admixture of a waterproof compound as approved by the Engineer. The percentage of admixture shall be as manufacture's specifications but not less than 2% weight of cement. The top surface shall be double chequered cured by ponding for seven days.

2.5.0. DAMP PROOF MEMBRANE

Damp proof treatment using fibre or hessian base bitumen felt shall be 6,8 or 10 course treatment is specified in IS:1609. The number of courses shall be as mentioned in the schedule of items. Sequence or work shall be as directed by the Engineer. Extreme sequential care shall be taken to prevent damage to felt during and after laying. The contractor shall be obliged at the own expense, if to rectify and leakage appearing within 5 years of installation by removing and renewing the coats at the point of leakage.

Where shown on drawing damp proof measurance with one layer bitumen paper or one land alkathene sheet shall be laid with minimum 150 mm lap under sides on grade.

3.0.0 RATES

Rates shall be units rates for the complete work as detailed out in the Specification unless any particular portion is specifically in the Schedule of Item.

4.0.0 METHOD OF MEASUREMENT

4.1.0 SOLING

Soling of different types as enumerated in the Schedule of Items shall be measured on actual area basis.
Deductions shall not be made for areas less than 0.1 Sq.M.

4.2.0 BRICK EDGING

Edging shall be measured on running length unless included in other relevant items.

4.3.0 MASONRY

4.3.1 Thickness of brick walls shall be measured in normal brick sizes.

4.3.2 For masonry work exceeding 150mm in thickness, actual volume of work shall be measured and deductions for opening, lintels, sills, conduit ducts, pipes etc., shall be made. No opening less than 0.1 Sq.M Min area shall however be deducted.

4.3.3 No deductions shall be made for embedded fixtures nor any extra by paid for the mortar used for fixing or for necessary cutting of bricks.

4.3.4 For encasing of steel beams, columns etc. the sizes as shown on drawings shall be measured and deductions made for the volume of encased steel.

4.3.5 No extra payment shall be for cutting of masonry units.

4.3.6 Walls 150mm in thickness or les shall be measured for actual area of works and deductions made as in Clause 4.3.2.

4.3.7 Exposed brickwork using selected ordinary brick or free bricks for the exposed face shall be measured in area as an extra over the ordinary brickwork if no provided in the Schedule of Items. It shall be measured by volume including the composite backing if so provided in the Schedule. Deductions shall be as described in Clause 4.3.2

4.3.8 Reinforcements shall be measured and paid separately under relevant items in the schedule unless included in the items for masonry work.

Laps in wire mesh reinforcements shall not be measured. Reinforcing mesh shall be measured on actual area basis. Reinforcing bare shall be measured by weight.

The weight shall be arrived at on the basis sectional weights as per I.S. No extra Shall be paid for necessary modifications of existing dowels, if any, to tie up with the Contractor's work.

4.3.9 EXPOSED STONE WORK

Exposed stone work using selected stone for exposed face shall be measured in area as an extra over ordinary stone work if as provided in the Schedule of Items. Deductions shall be made as described in Clause 4.3.2.

4.3.10 COMPOSITE MASONRY

Composite masonry shall be measured for vale including backing if so provided in the Schedule of taxes. If not, brickwork and stone-work shall be measured separately and paid under relevant items.

4.3.11 EXPANSION AND SEPARATION JOINTS

Joints shall be measured for length or area for the complete work as shown on drawings including filler boards, sealant strips, sealing compounds, painting, cover etc. If so provided in the Schedule of items unless any particular work is specifically excluded from the item.

4.3.12 MOULDING, CORNICE, DRIP COURSE:

Mouldings, cornice, drip course unless indicated specifically under separate items shall be considered in masonry items. However, cut in bricks or stone shall be neglected in measurements.

4.3.13 EMBEDDED FIXTURES

Inserts etc shall be measured by weight or by number and paid separately under relevant item is the Schedule of Items.

4.4.0 DAMP PROOFING:

Damp proofing shall be measured and paid in net area. No deductions shall however be made for opening less than 0.1sq.m in area. No separated payment shall be made for preparation of base, formworks and additive for cast-in-situ damp proofing unless specified otherwise.

5.0.0 I.S.CODES

Some of the important relevant codes these sections are:-

IS:1127	: Recommendations for dimensions and workman ship of natural building stones for masonry work
IS:1597	: Code of practice for construction of Stone Masonry.
IS:1609	: Code of practice for laying Damp-proof treatment using bitumen felts.
IS:2212	: Code of practice for Brickwork.
IS:2250	: Code of practice for preparation and use of Masonry Mortar.
IS: 5134	: Bitumen Impregnated paper & Board.

FINISH TO MASONRY AND CONCRETE

REV. NO.	PRAPARED	APPROVED	DATE

1.0.0 **SCOPE**

The Specification covers furnishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over or finishing items for masonry and concrete. This shall also include the work to be done to make the surface suitable for receiving the finishing treatment.

Before commencing finishing items the Contractor shall obtain the approval of the Engineer regarding the scheduling of work to minimise damage by other trades. He shall also undertake normal precaution to prevent damage or disfiguration to work of other trades or other installation.

2.0.0 **INSTALATION**

2.1.0 **PREPARATION OF SURFACE**

All joints masonry walls shall be racked out to a depth of 10mm with a hooked tool made for the purpose while the mortar is still green. Walls shall be brushed down with stiff wire brush to remove all loose dust from joints and thoroughly washed with water. All latency shall be removed from concrete to be plastered.

For all types of flooring, skirting and dado work, the base cement concrete slab or masonry surface shall be roughened by chipping and cleaned of all dirt, grease or loose particles by hard brush and water from the base course. Any excess of water shall be mopped up.

At any point, the level of base shall be lower than the theoretical finished floor level by the thickness of floor finish. Any chipping or filling to be done to bring the base in the required level shall be brought to the notice of the Engineer and his approval shall be taken regarding the method and extent of rectification work required.

Prior to commencement of actual finishing work, the approval of the Engineer shall be taken as to the acceptability of the base.

2.2.0 **PLASTERING**

2.2.1 **MORTAR**

Mortar for plastering shall be as specified in the Schedule of Items.

For sand cement plaster, sand and cement in the specified proportion shall be mixed dry on a watertight platform and minimum water added to achieve working consistency.

For lime gauged plaster, lime putty or hydrated lime and sand in the required proportion shall be mixed platform with necessary addition of the water and thoroughly ground in mortar mill. This mix shall then be transferred to a mechanical mixer to which the required quantity of cement is added and mixed for at least 3 minutes.

No plaster which has stood for more than half an hour shall be used; plaster than shows tendency to become dry before this time, shall have become dry before this time, shall have water added to it.

2.2.2 APPLICATION OF PLASTER

Plaster, when more than 12mm thick, shall be applied in two costs a base coat followed by the finishing coat. Thickness of the base cost shall be sufficient to fill up all unevenness in the surface, no single cost, however, shall exceed 12mm in thickness. The lower coat shall be thicker than the upper coat, the over all thickness of the coats shall not be less than the minimum thickness shown on the drawings. The undercoat shall be allowed to dry and shrink before applying the second coat at plaster. The undercoat shall be scratched or roughened before Appling the second coat at plaster. The undercoat shall be scratched or roughened before it is fully hardened to from a mechanical key. The method of application shall be thrown on rather than 'applied by trowel'.

To ensure even thickness and true surface, patches of plaster about 10 mm to 150mm square or wooden screen 75mm wide and of the thickness of the plaster, shall be fixed vertically about 2000mm to 3000mm apart, to act as gauges. The finished wall surface shall be true to plumb, and the Contractor shall, without any extra cost to the Owner, make up any irregularity in the brickwork with plaster.

All vertical edges of brick pillars, doorjambs etc., shall be chamfered or rounded off as directed by the Engineer. All drips, grooves, mol dings and cornices as shown on drawing or instructed by the Engineer shall be done with special care to maintain true lines, levels and profiles. After the plastering work is completed, all debris shall be removed and the area left clean. Any plastering that is damaged shall be repaired and left in good condition at the completion of the job.

2.2.3 FINISH

Generally, the standard finish shall be used unless otherwise shown on drawing or directed by the Engineer. Where ever, any special treatment to the plastered surface is indicated, the work shall be done exactly as shown on the drawings, to the entire satisfaction of the Engineer regarding the texture, colour and finish.

a) **Standard Finish**
Where punning is indicated, the interior plaster shall be finished rough. Otherwise, the interior plaster shall generally be finished to a smooth surface. The exterior surface shall generally be finished with a wooden float.

b) **Neat cement finish**
Immediately after achieving a true plastered surface with the help of a wooden straight edges, the entire area shall be uniformly treated with a paste of neat cement at the rate of one (1)kg. Per Sq.M. and rubbed smooth with a trowel.

c) **Coloured plaster Finish**
This shall be done in the same way as specified in Clause 2:2:2 but using coloured cement in place of ordinary cement. When coloured plastering is specified in more one coat, the top coat shall be made with coloured cement. Colored cement shall be either ready mixed material or may be obtained by mixing pigments and cement at site, as approved by the Engineer. The pigments to be mixed with cement shall conform to Appendix – A of IS : 2114 latest edition

Samples of colouring material shall be submitted to the Engineer for approval and material produced, shall conform in all respects to the approved samples, Which shall remain with the Engineer. All coloured cement and/ or pigments Shall be stored be stored in an approved manner on order to prevent deteriorations.

d) **Pebble-dash Finish**
Mortar of required thickness consisting of 1 part cement and 4 parts sand by volume shall be applied in the usual manner as described under plastering Clause 2.2.2. While the mortar is still plastic small pebbles or crushed stone of size generally from 10mm to 20 mm as approved by the Engineer shall be thrown on the plastered surface. The aggregate shall be lightly tapped into the mortar with a wood float end of a trowel, in order to ensure satisfactory bond between the dashing and the mortar.

e) **Rough-Cast Finish**
A wet plastic mix of 3 parts coloured cement 6 parts sand and 4 parts aggregate by volume (gravel or crushed stone of size from 6mm to 12mm as approved by the Engineer) shall be thrown on to the wall by means of a plaster's trowel and left in the rough condition.

f) **Scraped Finish**
Ordinary plaster as described under Clause 2.2.2 after being levelled and allowed to stiffen for a few hours, shall be scraped with a steel straight edges to remove the surface skin. The Patten shall be as approved by the Engineer.

g) **Textured Finish**
Mortar consisting of 1 part cement and 3 parts sand by volume shall be applied in a manner as specified under "Plastering" Clause 2.2.2 Ornamental requirements in the from of horizontal or vertical rib texture fan texture etc. shall be applied by means of suitable tools to the freshly applied plastered surface, as approved by the Engineer.

2.2.4 **CURING**

All plastered surface after laying, shall be watered, for all minimum period of seven days, by an approved method, and shall be protected from excessive heat and sunlight by suitable approved means. Moistening shall commence, as soon as the plaster has hardened sufficiently and not susceptible to damage, Each individual coat of plaster shall be kept damp continuously, for at least two days, and then dried thoroughly, before applying the next coat.

2.3.0 **POINTING TO MASONRY**

All joints of brick shall be racked out to a depth of 10mm with a hooked tool made for the purpose while the mortar is still green. The brickwork shall then be brushed down with a stiff wire brush, so as remove all loose from the joints and thoroughly washed with water. Mortar consisting of 1 part cement and 3 parts clean, sharp, well graded sand by volume shall be pressed carefully into the joints and finishes with suitably tools to shape as shown on the drawings. Any surplus mortar shall be scraped off the wall face lagging the surface clean.

The pointed surface shall be kept wet for at least three days for curing.

2.4.0 **PLASTER WITH METAL LATH**

The supports, hangers, brackets, cleats etc., shall be as shown on drawings and/or approved by the Engineer. These shall have a coat of prime paint before and another coat of approved paint after erection.

The metal lath shall be expanded metal, with 12mm x 38mm mesh, 16 BC thick and 3 mm wide strands. Side laps shall be minimum 12mm and end laps 25mm minimum. The plastering shall be minimum 20mm thick measured from the back of latch and applied in two layers. The mortar for plastering shall consist of 1 part cement, ½ part lime and 4 parts sand by volume mixed as specified in plastering, Clause 2.2.1. The application, finish etc., shall be as specified under relevant clause above. Where called for in the Schedule of Items, a 2mm Plaster of Pair punning shall be applied over plaster as a finishing coat to give perfectly smooth and even finish

2.5.0 **LIME PUNNING**

For plastered surfaces, where an even smooth surface is specified, lime punning with 5 parts of shell lime properly slacked, strained and aged, mixed with 1 part clean, washed, sleeved, fine sand by volume shall be done. The thickness of lime punning shall be not less than 2mm and more than 3mm. The plastered surface shall be saturated with water before application of the lime punning. The punning shall be applied by skilled workman and given a smooth and even finish free from undulations, cracks etc. and to the satisfaction of the Engineer.

2.6.0 **PLASTER OF PAIRS PUNNING**

Plastered surfaces, where specified shall be finished with plaster of parts punning. The material shall be from approved manufactures and approved by

The Engineer. The thickness of the punning shall be 2mm and shall be applied by skilled workmen. The finish shall be smooth, even and free from undulation, cracks etc.Before bulk work is taken in hand, a sample of punning shall be done on roughly 10 Esq. area and approval of the span Engineer taken. The work shall then be taken in hand as per approved sample.

2.7.0 STONE FANCING

Stone facing where specified shall be done as shown on design drawings and approved shop drawings. The stone shall be as specified on drawings and/or schedule of items. Samples of stone shall be submitted to the Engineer for approval and then bulk purchase made. The Contractor shall submit three copies of shop drawing for the Engineer's approval before commencing the work.

The thickness of facing stone shall be not less than 25mm unless otherwise specified on drawings.

The stone slabs shall be cut and finished to sizes as per pattern shown on drawings. They shall be fastened to wall with suitable non corrodible anchorage as approved by the Engineer. Where mild steel clamps, stays etc., are sued for anchorage, they shall by galvanized (weight of zinc coating shall not be less than 700gms per squire meter of surface) to prevent rust stains developing on the finished surface. There shall be at least 12mm gap between the stone and masonry, which shall be filled up and packed by a mortar of 1 part cement and 3 parts of sand by volume. After the mortar to set and cured for at least four days, the exposed surface shall be rubbed and polished as approved by the Engineer.

The completed surface shall be neat, or uniform texture and acceptable to the Engineer.

Where pointing is specified on drawings it shall be done by mortar as specified on drawings and/or Schedule of items.

3.0.0 ACCEPTANCE CRITERIA

Finish to masonry and concrete shall fully comply with the Specifications, approved samples and instructions of the Engineer with respect to lines, levels, thickness, colour, texture, pattern and any other special criteria as mentioned in the body of the specifications or as shown on drawings.

4.0.0 RATES

Rates shall be for the complete work as detailed out in the specification unless any particular portion is specifically excluded in the Schedule of Items. Rate shall include for rounding of corners.

5.0.0 METHOD OF MEASUREMENT

a) All surface finish shall be measured on actual area laid. No deductions shall be made for openings, pipes, sleeves etc. unto 0.1 Sq.m in area.
b) Unless separate item is provided for special corner or edges finish, drip course, grooves, mouldings, curbs etc., these shall not be measured separately. Where separate item is provided in the Schedule of Items, such work shall be measured for length.
c) No separate payment shall be made for finishing round openings, sleeves, pipes, etc. No separate payment shall be made for from work, templates etc., required for achieving true lines and profiles as shown on drawing.
d) Finishes applied integrally with walls, floors, steps and ceilings shall be measured separately and paid under relevant items.
e) Any reinforcement incorporated in the finish shall be measured and paid separately under relevant items.
f) Unless otherwise mentioned in the Schedule of Items, hangers, supports and lath plastering shall be measured and paid separately under relevant items.

6.0.0 **I.S. CODE**

Important relevant code for this Section:-

a)IS:1661 : Code of practice for cement and Cement-lime plaster finish on walls & ceilings.

b)IS:4101 : Code of practice for external facings and veneers.

DEMOLITION AND DISMANTLING

REV. NO.	PRAPARED	APPROVED	DATE

1.0 SCOPE

This specification defines the demolition, dismantling of reinforced concrete, plain concrete, brick work and structural steel work or any such other work. Any special requirement as shown or noted on the drawing shall govern provision of this specification.

1.1 DEMOLITION

The term demolition implies breaking up. This shall consist of demolishing whole or part of work including all relevant items as specified or shown on the drawings.

1.2 DISMANTLING

The term dismantling implies carefully removing without damage (up or down). This shall consist of dismantling one or more part of the buildings as specified or shown on the drawings.

2.0 GENERAL

2.1 PRECAUTIONS

2.1.1 All materials obtained from dismantling or demolition shall be the property of the "Owner" unless otherwise specified and shall be kept in surface custody handed over to the Engineer-in-Change.

2.1.2 The demolition shall always be planned before hand and shall be done in reverse order of those in which the structure was constructed. The scheme shall be got approved from the Engineer-in-Charge before starting the work.

2.1.3 Necessary propping and/or under – pinning shall be provided for the safety of the adjoining work or property before dismantling and demolishing is taken up and the works shall be carried out in such a way that no damage is caused to the adjoining work or property. Whenever specified temporary enclosures or partition shall also be provided.

2.1.4 Necessary precautions shall be taken to keep down, dust, nuisance.

2.1.5 Dismantling shall be done in a systematic manner. All materials which are likely to be damaged by dropping from a height of demolishing roofs, masonry etc. shall be carefully removed first. The dismantled articles shall be passed by hand, where necessary lowered to the ground (and not thrown) and then properly stacked as directed by the Engineer – in – Charge.

2.1.6 Where fixing is done by nails, screws, bolts etc. dismantling shall be done by taking out the fixing with proper tools and not by tearing or ripping off.

2.1.7 Any serviceable materials, obtained during dismantling or demolition, shall be separated out and stacked properly as directed by the Engineer-in Charge within a lead of 50meters. All unserviceable materials etc. shall be disposed off as directed by the Engineer-in-Charge.

2.1.8 The contractor shall maintain disconnected services whether temporary or permanent, if required.

2.2.0 **PAYMENT**

2.2.1 All works shall be measured in the decimal system, as fixed in its place, subject top
The following limits unless otherwise stated hereinafter:-

a. Dimensions shall be measured correct to a cm.
b. Areas shall be worked out correct to two places of decimal.
c. Cubic contents shall be worked out to the nearest 0.01.

2.2.2 Parts of work required to be dismantled and demolished shall be measured separately.

2.2.3 Measurement of all works except hidden work shall be taken before demolition or dismantling and no allowance for increase in bulk shall be allowed.

2.2.4 Specifications for deductions for voids, openings etc., shall be on the same basis as that employed for construction of the work.

2.2.5 The rate shall include the cost of all labour involved and tools used in demolishing including scaffolding. The rate shall also include the charges for separating out and stacking the serviceable material properly within a distance of 50 meters and disposing off unserviceable materials as directed by Engineer-in-charge.

3.0 **Roofs**

Ridges, heaps and valleys shall be girthed and included with the roof area. Corrugated or semi corrugated surfaces shall be measured flat and not girthed.

Supporting members, such as rafters, purlins, beams, joints, trusses etc. shall be measured in metric tonnes.

4.0 **Concrete and Brick Roofs and Suspended Floors**

Demolition of floors and roof of concrete or brick shall be measured in cubic

meters(M) beams, cantilevers or other subsidiary supports of similar materials, shall be included in the item. In measuring thickness of roofs provided with water proofing treatments with bitumen felts, the thickness of water proofing treatment shall be ignored.

5.0 **Walls and Piers**

5.1 Taking down walls and independent piers or columns of brick stone or concrete shall be measured in cubic metres (M). All copings, corbels, cornices and other projections shall be included with the measurements.

In measuring thickness of plaster, walls, the thickness of plaster shall be ignored.

5.2 Ashlar face stones, dressed stone work, precast concrete article etc. if required to be taken down shall be so stated, and measured separately in cubic meters (m).

5.3 Cleaning bricks, stacking for measurements including all extra handling and Removed and disposing rubbish as stated shall be enumerated in the thousand of cleaned bricks.

5.4 Cleaning stone obtained from demolished/dismantled stone masonry of any Description including ashlars facing, dressed stone slabs or flanging and precast concrete blocks including all extra handling and disposing of rubbish as stated shall be measured in cubic meters (m) of cleaned stone.

5.5 Honey comb work of cavity walls of bricks , stone or concrete as solid.

6.0 **Reinforced Concrete and Brick work**

Reinforced concrete structures and reinforced brick roofs and walls shall be measured in cubic meters and square metres as specified in schedule of rates and reinforcement if required to be salvaged, shall be stated.

Where reinforcement is required to be separated, scraped and cleaned, the work shall be measured separately in metric tonnes (MT) of salvaged steel.

7.0 **Steel and Iron Work**

7.1 All steel and iron work shall be measured in metric tonnes(MT). The weight shall be computed from standard tables unless the actual weight can readily to determined.

7.2 Riveted work, where rivets are required to be cut, shall be measured.

7.3 Marking of structural steel required top be re-erected shall be measured

separately.

7.4 In framed steel items, the weight of any covering material or filling such as iron sheets and expanded metal shall be included in the weight of the main article unless such covering is not ordered to be taken out separately.

TYPE AND MAKE OF MATERIALS TO BE USED

REV. NO.	PRAPARED	APPROVED	DATE

Only the follwing makes of materials are approved for use the contractor on this work. In case of items not listed here and also if products of listed vendors are not available in the market for some reason, advice of Projec Engineering Department, BHEL, Hyderabad shall be sought for suggesting alternate vendors.

All the material shall be got approved by site inchrge prior to their use

1. Mortice lock	Godrej/Harrison
2. Hinges/tower bolt	ECIE/GARNISH/Everite
3. GLUE	Movicol/Fevicol
4. Door Handles	Godrej/ECIE/HARDIMA
5. Screws	Nettle Fold/Guest keen william
6. Hydraulic door closer	Everite/Prabhat/Garnish
7. Double action hydraulic door closer	Everite/Prabhat/Garnish
8. Ply Wood	Mysore/Seastic/National/Indian Plywood
9. Teak wood	First class Indian Teak wood.
10. Flush door shutter	Sitapur/Mysore with phenol formal dehyde resin
11.Wooden panneled shutter	1st class teak wood frame work with 12mm thk Nova teak/Novapan/Eco board.
12. Prelaminate board	Novapan/Anchor/Bhutan/Ecoboard.
13.Mirror	Modi/Atual/Swastic
14. Sanitry ware	Hidustan/Nycer/Parry/Classica
15. Plumbing fixture	Parco,Gem.
16.False ceiling tiles	Nova teak/Jolly lotone/Armstrong
17.Metallic false ceiling	Tracdek/Luxalon
18.Interior Paints	ICI/Berger/Asian paints/Jenson&Nicolson Garware/Goodlac nerolac/ shalimar
19. Exterior water proof	Snowcem.
20.PVC tiles	Caliplast/Brite.
21. Acid proof tiles	Coromandel.
22.Floor tiles	Spartek/Kataria/Bell/Decora/Murudeshwar/ Regency/Cera.
23.PVC tiles	Bhor.
24.Gypsum Board	India Gypsum/Trac.
25.Plate glass	Modi-Gurdian/Atual.
26.Asbestos cement sheets &accessories.	Charminar/Everest/Visakha/Ramco
27.Non shrink grout	Shrinkomp 30/Conbextra GP2/Pagel V12
28.MS Doors	Shaktimet.
29. Polymeric Waterproofing	IWL Ltd.