03 - GENERAL SPECIFICATIONS

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1 - TECHNICAL SPECIFICATIONS FOR CIVIL WORK

1.0 GENERAL

1.1 SCOPE

This specification applies to the Civil, Structural, Finishing and External Development Works and building works to be executed by the Contractor. It is to be read in conjunction with and subject to the general conditions of contract and in conjunction with the drawings, the schedule of rates and such other documents as may from time to time be agreed upon as comprising part of this contract. Where these specifications are not clear, relevant BIS codes and CPWD specifications shall be followed with prior permission of Owner.

1.2 CLEARING

The contractor shall clear the site of all rubbish and old buildings, remove all grass and low vegetation and remove all bush wood, trees, stumps of trees, and other vegetation only after consultation with the Owner as to which bushes and trees shall be saved. All disused foundations, drains or other obstructions met with during excavation shall be dug out and cleared.

1.3 SITE LEVELS

The contractor shall carry out the survey of the site and shall establish sufficient number of grids and level marks to the satisfaction of the Owner, who shall decide on the basis of this information, the general level of the plot and the plinth.

1.4 BENCH-MARKS

Prior to commencement of construction, the contractor shall in consultation with the Owner, establish several site datum bench-marks, their number depending on the extent of the site. The bench-marks shall be sited and constructed so as to be undisturbed throughout the period of construction.

1.5 SITE INVESTIGATION

The Owner might have got the soil investigation done and if so, the report will be handed over to the contractor for their scrutiny. The contractor shall however inspect the site and study the findings from the trial pits or bores in order to assess the problems involved in and methods to be adopted for excavation and earthwork. The contractor shall ascertain for himself all information concerning the sub-soil -conditions, Ground water table periods and intensity of rainfall, flooding of the site and all data concerning excavation and earthwork. Any extra work required on this account, nothing will be paid extra.

1.6 SETTING OUT THE WORK

The contractor shall set out the works and during the progress of the building shall amend at his own cost any errors arising from inaccurate setting out.

During the execution of the work contractor must cross check his work with the drawings.The contractor shall be responsible for all the errors in this connection and shall have to rectify all

defects and/or errors at his own cost, failing which the Owner reserves the right to get the same rectified at the risk and -cost of the contractor.

1.7 CLEANING UP AND HANDING OVER

Upon completion of the work all the areas should be cleaned. All floors, doors, windows, surface, etc. shall be cleaned down in a manner which will render the work acceptable to the Owner. All rubbish due to any reason, shall be removed daily from the site and an area of up to twenty metres on the outer boundaries of the premises will be cleaned by the contractor as a part of the contract. Upon completion of the project the contractor shall hand over to the Owner the following:

a. Written guarantee and certificates. b. Maintenance manuals, if any, and c. Keys.

1.8 SAMPLES

The contractor shall submit to the Owner samples of all materials for approval and no work shall commence before such samples are duly approved. Samples of pre-cast concrete panels, masonry units, building insulation, finished hardware, metal window and door frames, terrazzo flooring, kota stone, marble etc. and every other work requiring samples in the opinion of the Owner shall be supplied to the Owner, and these samples will be retained as standards of materials and workmanship. The cost of the samples shall be borne by the contractor.

Throughout this specification, types of material may be specified by manufacturers' name in order to establish standard of quality, price and performance and not for the purpose of limiting competition. Unless specifically stated otherwise, the tenderers may assume the price of 'approved equivalent' except that the burden is upon the contractor to prove such equality, in writing.

A detailed programme shall be submitted by the Contractor for the material approvals, within two weeks of the Owner's order to commence. The detailed programme shall include but not limited to:

Date/s of submitting the various material samples . Date/s by which the Owner's approval is required . Date/s of placing orders on the Manufacturers/Suppliers . Date/s of arrival of the approved material/s on to the site .

Date/s of the completion of the 'Mock-ups', wherever required, and the Date/s by which the Owner's inspection of such 'Mock-ups' should be completed and the Date/s by which the Owner should fully approve the said Mock-ups.

1.9 TESTS

All materials and methods of tests shall conform to the latest rules, regulation and/or specifications of the following authorities where specified herein as applicable. Bureau of Indian Standards . (BIS), British Standards Code of Practice (BS) in case no equivalent BIS is available. The Owner will have the option to have any of the materials tested and if the test results show that the materials do not conform to the specifications, such materials shall be

rejected. A reasonable number of representative tests will be deemed to be included in the rates tendered.

1.10 MODE OF MEASUREMENTS

All measurements will be taken in accordance with IS 1200 latest issue unless otherwise specified.

2.0 SITE DEVELOPMENT AND EARTH WORK

2.1 GENERAL

This specification deals with the clearance of the Site of Works and preparation of the same to commence the proposed construction activities. Wherever applicable, this is deemed to include all preliminary works like Dismantling/ Demolition, Site Clearance, General Levelling etc.

The contractor shall visit the site, inspect the same and decide for himself the nature of the ground and the sub-soil to be excavated. No claim on account of extras will be entertained in consequences of any misunderstanding or incorrect information or ignorance of the existing conditions.

2.2 DISMANTLING/ DEMOLITION

Existing Buildings and structures within the boundary of the site, and as indicated in the drawings or as instructed by the Owner, shall be carefully and gradually dismantled or demolished, as the case may be.

a. The contractor shall furnish to the Owner, a detailed scheme as well as a programme of these works, at least one week prior to the commencement of the actual demolition works and get the latter's approval of the same.

b. On approval of the above programme and scheme, the contractor shall serve notices to concerned authorities, owners, etc as and wherever applicable, informing them of the proposed demolition and get their approval of the same, prior to the demolition/dismantling.

c. The whole of the building/ structures that are to be demolished , shall be evacuated and cleared off any valuable life and/ or property to the satisfaction of the Owner. Where required, the employer shall provide alternative arrangements to house those who have been evacuated.

d. The site of demolition shall be well cordoned off from the other areas to the satisfaction of the Owner, with all-necessary warning and signals, erected in the vicinity by the Contractor.

e. Such of those parts of the building/ structures that are likely to fetch some returns from the market and/or those parts which are likely to be reused elsewhere, shall be first carefully removed from the existing buildings and then stored away properly to the complete satisfaction of the Owner. Such parts shall include items like woodwork, built in furniture, electrical fittings, sanitary wares etc. and all others that are listed out by the Owner. All such valuable / reusable material shall be the property of the Owner.

f. The demolition work shall then commence preferably from the top and proceed downwards, gradually. In case of buildings comprising more than one floor, the demolition shall commence from top and shall be dismantled floor by floor in such a way that all the debris are collected in the next lower floor. Dismantling of external walls/ cladding shall be done from outside inwards. The dismantling of the next lower floor shall commence only after the clearance of all debris collected in that floor from the floor above, is completed.

All dismantling/ demolition works shall include excavation of the ground, wherever necessary, to dismantle the existing foundations, and back filling, including compacting to the satisfaction of the Owner. The material used for back filling shall be as per specifications and as approved by the Owner.

All dismantling/ demolition works shall be carried out in such a manner, so as not to cause any damage, whatsoever, to the properties or persons in the vicinity of the site. If such damages occur, the contractor shall be liable for full reinstatement, of all such damages, at his own cost.

All services, like electrical, water supply and sanitary lines/ connections, to the existing buildings or structures that are to be dismantled and/or demolished, shall be properly cut off at points as per the instructions of the Owner. If any such service lines are feeding adjacent plots/ sites/ premises as well

as within the premises, the contractor shall inform the Owner, well in advance, and shall follow up with the Authorities concerned, to provide necessary reconnections to the users of these service lines.

Wherever applicable, the contractor shall apply for the various permits, for executing such works as may be required, from the relevant authorities.

2.3 DISPOSAL OF DEMOLISHED/ DISMANTLED MATERIALS

Demolished/dismantled materials shall not be stacked or dumped in such a manner, as to present a hazard to vehicles or pedestrians or properties or to cause blockage in drainage channels etc. In case Contractor fails to clear the malba from the site the same shall be cleared by the Owner at Contractor's risk and cost.

The contractor shall obtain necessary permission from the local Government Authorities, pay the necessary deposits, for the location and the manner in which the debris to be disposed and then carry out the disposal, as directed by the Owner.

Demolished/ Dismantled debris shall be dumped/ stacked in an area, primarily within the site, if required, subject to the approval of the Owner and shall cart away and dispose off, within the shortest possible time, as directed by the Owner.

All dismantling works shall be carried out by crow bar, chiselling or by Jack - hammering BUT IN NO CASE BLASTING OPERATION IS PERMITTED AT SITE.

All debris shall be transported from the site on daily basis during prescribed hours as approved by local authorities for transportation.

All dismantling works shall be carried out during daytime.

2.4 CLASSIFICATION OF SOILS

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

A. HARD DENSE SOIL

Generally any soil which requires the close application of picks or jumpers or scarifiers and rippers to loosen the same such as: -

i. Stiff clay, hard shale or compact moorum requiring grafting tool and/or pick and shovel.
ii. Shingle and river or nallah bed boulders.
iii. Lime concrete, stone masonry in lime or cement mortar below ground level
iv. Soft, conglomerate or soft laterite when the stone can be detached from the matrix with picks and shovel.
v. Existing WBM roads, pavements etc.

B. ORDINARY/ SOFT/ DECOMPOSED ROCK (NOT REQUIRING BLASTING)

Rock or boulders, which may be quarried or split with crowbars or wedges/picks; such as lime stone, sand stone, hard laterite, hard conglomerate or other sift or disintegrated rock.

C. HARD ROCK (REQUIRING BLASTING) :

Rock which is in solid beds, which can only be removed either by wedging or chiselling, shall be treated as hard rock. An isolated boulder or detached rock, measuring one cubic meter or more, shall also be treated as hard rock, if the same cannot be removed without wedging or chiselling. (If required, approved chemical may be used for loosening the materials).
Blasting is totally prohibited and will not be allowed under any circumstances.

D. AUTHORITY FOR CLASSIFICATION OF SOILS/ ROCKS

The classification of excavation shall be decided by the Owner and his decision shall be final and binding on the contractor.

E. BLASTING

Blasting shall not be permitted under any circumstances. Alternately chemicals can be used to split rock. The tenderer/contractor shall submit with his tender, the method which he intends to adopt for execution of the work of rock excavation. A list of specialised tools and plants to be used for rock excavation shall be enclosed.

f. TRIMMING-OF SLOPES

All slopes shall be trimmed by hand or mechanically true to line and profile and consolidated to the Owner's satisfaction. Any rock or boulders appearing on the face or likely to be unstable, shall be removed and the void thereof filled with approved material and compacted.

g. SHORING/EARTH WORK SUPPORT

The contractor shall shore and strut the sides of excavation to the satisfaction of the Owner. Should there be any slips or settlement, not withstanding the shoring, the contractor shall make good the same at his own expense, with concrete or other approved material, as directed by the Owner. Shoring shall be removed gradually side by side with backfilling to prevent any settlement and under no circumstances, until such time as the foundation concrete has hardened enough, to take any loads brought on by the removal. Under special circumstances, shoring shall be left in place, if so directed by the Owner. No extra payment shall be made for shoring. The rate for the same shall be included in the excavation items.

h. DEWATERING

All excavation shall be kept free from water from any source. The contractor shall provide and clear away on completion, all drains, pumps and other equipment, for this purpose. The contractor shall be responsible for preventing any subsidence of adjoining ground due to pumping.

Contractor shall keep site dewatered till all construction works in basement and all other areas are completed, including waterproofing. No extra amount shall be claimed by the contractor on this account and his quoted rates shall be deemed to have been included for total dewatering.

i. CONTRACTOR TO KEEP EXCAVATION CLEAR

Should any sand, mud, weed, rubbish or other materials be deposited on excavated area, by sandstorm, rain, flood, landslips or from any cause, whatsoever, such materials shall be removed by the contractor at his own expense.

j. BACK FILLING

All materials used as fill shall be to the Owner's approval and shall be well consolidated in layers not more than 200 mm thick. Final compacting must be 4one just before concrete is to be laid.

All fill materials shall be compacted at a moisture content appropriate to the material being used. The compacted filling shall achieve a density, which shall not be less than 95% of the maximum dry density obtained. Filling shall be free of any wood, organic matter or any other deleterious material.

Sand, soil, gravel etc. from the excavation may be used for backfilling of pits and trenches or for making up levels subject to approval of the Owner and subject to selection of proper materials. The contractor shall take instructions of the Owner regarding the location in which each type of excavated material is to be used according to its quality.

In case the excavated materials are not approved for backfilling, either totally or in part or if their quantity falls short of the quantity required for filling, suitable materials shall be brought to site from an approved source.

k. DISPOSAL OF SURPLUS

Surplus excavated materials and all excavated materials rejected for backfilling, shall be crted away from the site by the Contractor.

2.5 MEASUREMENTS

a. Existing Ground Level shall be taken jointly and recorded before commencing the excavation work. Depth of excavation in cutting shall be computed from these spot levels. The G. L. shall be

recorded, at maximum 5 mts interval. Average of these reading shall be taken as the average ground level for the pits.

b. Bottom width excavation shall be measured as given in foundation drawings and details showing the width of the bedding concrete only and hence side clearance if any will not measured separately. The contractor should cover this iii his rate.

c. Diagonal ridges, cross ridges, or dead man shall be left in position shown by the Owner to enable accurate measurements being taken on the completion of one work. Where the ground is not uniform or where the site is required to be levelled, levels shall be taken before the start of the work and after the completion of the work and the quantity of excavation in cutting computed from these levels. These ridges or deadman shall be removed by the Contractor at his own cost after the measurements.

d. Where soil, soft rock, and hard rock are mixed, the measurements for the entire excavation shall be computed from the levels & dimensions as described in (i) & (ii) above.

e. Excavated materials from 'HARD ROCK' and SOFT ROCK shall be stacked separately, measurement reduced by 50% to allow for voids to arrive at the quantity payable under 'hard rock' and 'soft rock' respectively.

f. The difference between the entire excavation (worked out from the levels) and the such of the quantities payable under 'hard rock' and 'soft rock' shall be paid for as excavation in all kind of soil.

g. Wherever rock excavation is encountered, contractor will be paid only up to required level, and any extra excavation if carried out due to any reason, no payment shall be done for the extra quantity.

2.6 EXCAVATION IN ALL SOILS

Excavation and/ or removal of any other material on the site, shall be carried out accurately to the lines, levels and dimensions shown in the drawings or as ordered by the Owner, so as to allow proper and efficient concrete work and other work in clean and dry condition. The method of excavation shall be at the discretion of the Owner but should the dimensions of any excavation exceed those shown on the drawings or ordered by the Owner or should the sides collapse, the contractor shall fill such extra space with concrete or other approved material, at his own expenses.

All founding levels will be inspected by the Owner and suitability for bearing of the bottom shall be determined before the concrete is placed. Records of all foundation levels shall be submitted by the contractor to the Owner.

The final 300mm depth of excavation shall be taken out by hand unless otherwise permitted by the Owner. Extra depth of excavation, if any, beyond those shown in the drawings or ordered by the Owner, shall be filled up with Grade 10 concrete for which payment shall not be made to the contractor.

The contractor shall excavate any soft patches or rock outcrops below the founding level and refill with M-10 concrete. The founding stratum shall be trimmed to required level and rammed to the satisfaction of the Owner before concrete is placed.

Foundations within any one building shall not rest on soil strata with differential bearing capacities. Strip foundations shall not be stepped along the length of the foundations. When excavating for individual footings at different levels care shall be taken not to disturb the bearing stratum of the higher foundations. The excavation bottom shall be watered as directed by the Owner before the foundations are laid.

2.7 SWEET EARTH

The Sweet earth for plantation areas, shall be from an approved source and shall be mixed with natural or artificial manure, as directed by the Owner.

2.8 PRE-CONSTRUCTION ANTI-TERMITE TREATMENT

a. CHEMICALS

The chemicals used for the soil treatment shall be any one or a combination of the following with concentration shown against each in adequous emulsion:

Chemicals (EC's)	Concentration
Chlorpyriphos /Landane	20% EC By weight

Chemicals are available in concentrated form in the market and concentration is indicated on the sealed containers. To achieve the percentage of concentration specified above, chemical should be diluted with water in required quantity before it is used. Graduated containers shall be used for dilution of chemical with water in the required proportion to achieve the desired percentage of concentration. e.g. to dilute chemical of 30% concentration add 59 parts of water to one part of chemical to achieve 0.5% concentration.

Chemical shall be brought to site of work in sealed original containers. The material shall be brought in at a time in adequate quantity to suffice for the whole or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the Owner. The empties shall not be removed from the site of work, till the relevant item of work has been completed and permission obtained from Owner.

Hand operated pressure pump shall be used to carry out spraying operations to facilitate proper penetration of chemicals in the earth. To have proper check for uniform spraying of chemical, graduated containers shall be used. Proper check should be kept that the specified quantity of chemical is used for the required area during the operation.

b. TIME OF APPLICATION

Soil treatment should start when foundation trenches and pits are ready to take mass concrete in foundations. Laying of mass concrete should start when e chemical emulsion has been absorbed by the soil and surfaces quite dry. Treatment should not be carried out when it is raining or soil is wet with rain or sub-soil water. The foregoing applies also in the case of treatment to the filled earth surface with the plinth before laying the sub grade for the floor.

The treated soil barrier shall not be disturbed after they are formed. If by chance, treated soil barriers are disturbed, immediate steps shall be taken to restore the continuity and completeness of the barrier system.

c. TREATMENT FOR MASONRY FOUNDATION AND BASEMENTS

The bottom surface and sides (up to a height of 30 .cm. from the bottom) of the excavations made for masonry foundations and basements shall be treated with the chemical emulsion mentioned above at 5 Ltrs. per Sq.m. of surface area.

d. TREATMENT TO BACKFILL EARTH

After the masonry foundations and retaining walls of the basement come up, the back fill in immediate contact with the foundation structure shall be treated with the chemical emulsion at the rate of 7.5 Ltrs. per Sq.m. of the vertical surface of the sub-structure for each side. The earth

is usually returned in layers and the treatment shall be carried out in similar stages. The chemical-emulsion shall be -directed towards the (concrete or masonry surface of the columns and walls so that the earth in contact with these surfaces is well treated with the chemical.

e. TREATMENT FOR RCC FOUNDATIONS AND BASEMENTS

The treatment described in (c) & (d) above applies essentially to masonry foundations where there are voids in the masonry through which termites can seek entry in to the superstructure. Hence the foundations require to be completely enveloped by a chemical barrier. In the case of RCC foundations the concrete is dense being a 1:2:4 mix or richer, the termites are unable to penetrate it. It is therefore unnecessary to start the treatment from the bottom of excavations. The treatment shall start at a depth of 50 cm. below the ground level except when ground level is raised or lowered by

filling or cutting after the foundations have been cast. In such cases the depth of 50 cm shall be determined from the new soil level resulting from filling or cutting mentioned above and soil in immediate contact with the vertical surface of RCC foundations. From this depth, the back fill around the columns, beams and RCC basement walls shall be treated at the rate of 7.5 Ltrs. per Sq.m. The other details of the treatment shall be as laid down in (d) above.

f. TREATMENT OF TOP SURFACE OF PLINTH FILLING

The top surface of the consolidated earth within the walls shall be treated with the chemical emulsion at the rate of 5 Ltrs. per sq.m of the surface before the sand bed or sub-grade is laid. If the filled earth has been well rammed and the surface does not allow the emulsion to seep through, holes up to 50 to 75 mm deep at 150 mm centres both ways may be made with 12 mm dia MS rod on the surface to facilitate absorption of the emulsion.

g. TREATMENT AT JUNCTION OF WALLS AND FLOOR . . . .

Special care shall be taken to establish continuity of the vertical chemical barrier on inner wall surfaces from the ground level (where it has stopped with the treatment described in (d) above up to the level of the filled earth surface. To achieve this, a small channel 3 x 3 cm shall be made at all the junctions of wall and columns with the floor (before laying the subgrade) and rod holes made in the channel up to the ground level 15 cm. apart and the rod moved back ward and forward to break up the earth and chemical emulsion poured along the channel at the rate of 7.5 Ltrs. per Sq.m. of the vertical wall or column surface of the sub structure so as to soak the soil right to the bottom. The soil should be tamped back in to place after this operation.

h. TREATMENT TO SOIL ALONG EXTERNAL PERIMETER OF BUILDING

After building is complete, the earth along the extern perimeter o the building should be roded at internal of 15 cm. and to a depth of 30 cm. The rods should be moved back ward and forward parallel to the wall to break up the earth and chemical emulsion poured along the wall at the rate of 7.5 Ltrs. per Sq.m. of vertical surfaces. After the treatment, the earth should be tamped back in to place. Should the earth outside the building be graded on completion of building, this treatment should be carried out on the completion of such grading. In the event of filling being more than 30 cm. the external perimeter treatment shall extend to the full depth of filling up to the ground level so as to ensure continuity of the chemical barrier.

i. TREATMENT FOR WALLS RETAINING SOIL ABOVE FLOOR LEVEL

Retaining walls like the basement walls or outer walls above the floor level retaining soil at need to be protected by providing chemical barrier by treatment of retained soil in the immediate vicinity of the wall, so as to prevent entry of termites through the voids in masonry, cracks and crevices etc. above the floor level . The soil retained by the walls shall be treated at the rate of 7.5 Ltrs. per sq.m. of the vertical surface so as to effect a continuous outer chemical barrier in continuation of the one formed under (c).

j. TREATMENT OF SOIL UNDER APRON ALONG EXTERNAL PERIMETER OF BUILDING

Top surface of the consolidated earth over which the apron is to be laid shall be treated with chemical emulsion @ 5 Ltrs. Per Sq.m of the vertical surface before the apron is laid. If consolidated earth does not allow emulsion to seep through, holes up to 50 to 75 mm deep at 150 mm centres both ways may be made with 12 mm dia mild steel rod on the surface to facilitate saturation of the soil with the chemical emulsion.

k. TREATMENT OF SOIL SURROUNDING PIPES, WASTES AND CONDUITS

When pipes, wastes and conduits enter the soil inside the area of the foundation, the soil surrounding the point of entry must be loosened around each such pipe waste or conduits for a distance of 15 cm. and up to a depth of 7.5 cm before the treatment is commenced. When they enter the soil . external to the foundations, they shall be similarly treated unless they stand clear of the walls of the building by about 7.5 cm. for a distance of over 30 cm.

1. TREATMENT FOR EXPANSION JOINTS

Expansion joints at ground floor level are one of the biggest hazards for termite infestation. The soil beneath these joints should receive special attention when the treatment under (e) is carried out.

This treatment should be supplemented by treating through the expansion joint after the sub-Trade has been laid, at the rate of 2 Litre per linear metre.

m. SAFETY PRECAUTIONS

All chemicals used for anti termite treatment are poisonous and hazardous to health. These chemicals can have an adverse effect upon health when absorbed through the skin, in haled as vapours or spray mists or swallowed. Person using or handling these chemicals should be warned of these dangers and advised that absorption through the skin is the most likely source of accidental poisoning. They should be cautioned to observe carefully the safety precautions given below:

These chemicals are usually brought to site in the form of emulsifiable concentrates. The containers should be clearly labelled and should be stored carefully so that children and pet cannot get at them. They should be kept securely dosed.

Particular care should be taken to prevent skin contact with concentrates. Prolonged exposure to dilute emulsions should also be avoided. Workers should wear clean clothing and should wash thoroughly with soap and water, especially before eating and smoking. In the event of severe contamination, clothing should be removed at once and the skin washed with soap and water. If chemicals splash in to the eyes they shall be flushed with plenty of soap and water and immediate medical attention should be sought

The concentrates oil solutions and present a fire hazard owing to use of petroleum solvent. Flame should not be allowed during mixing.

Care should be taken in the application of chemicals to see that they are not allowed to contaminate wells or springs, which serve as sources of drinking water.

n. SPRAYING EQUIPMENT

A pressure pump shall be used to carry out spraying operations to facilitate proper penetration of chemicals in to the earth.

3.0 CONCRETE WORKS (PLAIN AND RCC)

3.1 All concrete included in the works shall comply with the General requirements of this section of the specification except where those requirements are modified by the provisions of later Clauses relating to specialized uses for concrete in which case the requirements of those Clauses shall take precedence.

3.2 QUALITY ASSURANCE PLANS AND SUPERVISION:

A competent person shall be employed full time whose first duty will be to supervise all stages in the preparation and placing of the concrete. All test on materials, the making and testing of cubes and the maintenance and calibration of all mixing and measuring plant shall be carried out under his direct supervision in the presence of the Owner. Contractor shall set up a laboratory with all testing arrangement at site. On award of the work contractor shall submit their quality assurance plans, complete methodology & sequence of construction for all activities.

3.3 MATERIALS.

a. CEMENT

Cement shall in general comply the following specifications:-

i. Types

The cement used shall be Ordinary Portland Cement (0PC)/ Pajolona Portland Cement (PPC) conforming to IS 269 (Latest revision) of grade 43 for all works except where specifically mentioned in the Drawings, Bill of Quantities, and/or directed by the Owner (use of Grade 53 cement is strictly prohibited).

All cement shall be fresh when delivered. Cement shall be delivered in sound and properly secured bags or other packages ready for immediate use and shall be used direct from the bag. The contractor shall maintain for Owner's inspection a record of receipts and consumption of cement indicating the source, the age and the date of receipt of cement. Cement containing lumps which cannot be broken by a light touch of fingers shall not be used in the works. Admixtures shall not be used without written consent of the Owner.

ii. Sources

Cement shall be obtained from sources, which are approved by the Owner. Makes and sources of cement shall not be varied from those used for trial mixes; should a change be unavoidable the contractor shall submit his proposals for the prior approval of the Owner and then carry out new trial mixes unless otherwise directed by the Owner. Cement of different kinds shall not be mixed at any stage.

iii. Manufacturers' Test Certificates for Cement

The Contractor shall request the cement manufacturer to forward to his site office the Certificate of conformity in accordance with IS. 269 (Latest Revision), and he shall cause a copy to be supplied to the Owner within 48 hours of the arrival of the certificate, which shall not be later than 14 days from the day of delivery of the relevant consignment. The test certificate shall be related to the date of delivery at site of consignment. The frequency of deliveries shall be such as to ensure that no cement is more than 3 months old when used in the works.

iv. Samples of Cement

Samples of cement to be used in the works shall be deposited with the Owner for his approval together with a certificate stating the name and address the Manufacturer, and address of the supplier from who t was purchased. The Owner may from time to time take samples of the cement being used in the works for testing.

v. Storage of Cement

The contractor shall provide a proper separate weatherproof store building with raised water proof/ wooden floor for cement storage on the site, clear 25 to 35 cm from surrounding walls and shall at all times protect the cement from damp or any other deleterious influences. Each consignment of cement shall be kept separately and, the contractor shall be careful to ensure the consignments are used in the order in which they are received. First consignment to be used first.

Incase cement gets affected from damp or any other deleterious influence, such cement shall not be used for construction work.

b. AGGREGATES

Materials used as aggregates shall be obtained from a source known to produce aggregates satisfactory for concrete and shall be chemically inert, strong, hard, durable, of limited porosity and free from adhering, coating, clay lumps, coal residues and organic or other impurities that may cause corrosion of reinforcement or may impair the strength or durability of the concrete. Aggregates shall be tested in accordance with the requirements of IS: 383 or IS: 515 and the results of such tests shall be as hereinafter specified, the percentages being by weight unless the context indicates otherwise.

i. Fine Aggregate

Fine aggregates shall be natural sand or sand derived by crushing material like gravel or stone and shall be free from coagulated lumps. Sand derived from stone unsuitable for coarse aggregates shall not be used as fine aggregates. The caustic soda test for organic impurities shall show a colour not deeper than that of the Standard solution. The amount of fine particles as ascertained by the Laboratory Sedimentation test shall not exceed 10% for crushed stones. The settling test for natural sand or crushed stone shall - be made, and after being allowed to set in for three hours the thickness of the layer of silt deposited on the coarser material shall not exceed 8%.

The grading of a natural sand or crushed stone i.e. fine aggregates shall be such that not more than 5 (five) percent shall exceed 5 mm in size, not more than 10% shall pass IS sieve No. 150 not less than 45% or more than 85% shall pass IS sieve No. 1.18 mm and not less than 25% or more than 60% shall pass IS Sieve No. 600 micron.

Only washed sand of quality and grading specified herein above shall be used. Admixture of sand obtained by crushing natural stone may be permitted by the Owner, provided the mixture satisfies the requirements for the fine aggregates here in above specified. But not more than one part of the sand obtained by crushing natural stone
may be added to two parts of washed sand.

ii. Coarse Aggregate

Coarse Aggregates shall be crushed stone. The pieces shall be angular, rounded in shape and 'shall have granular or crystalline or smooth (but not glossy) non-powdery surface. Fragile, flaky and laminated pieces, and mica shall not be present.

The "Aggregates Crushing Value" shall not exceed 45%. The amount of fine particles occurring in a free state or as a loose adherent shall not exceed 1%. When determined by the laboratory sedimentation test, after twenty four hours immersion in water. A previously dried sample of the coarse aggregates shall not have gained in weight more than 5%.

Size of coarse aggregate shall be maintained within tolerance limit of 2.5%.

The grading of coarse aggregate shall be such that not more than 5% $ be larger than 20 mm and not more 10% shall be smaller than 5 mm and not less than 25% or more than 55% shall be smaller than 10 mm.

Maximum size of coarse aggregate shall be of 20 mm unless otherwise noted.

The grading of coarse aggregate of nominal size of 40 mm shall be such that not more than 5% shall be larger than 40 mm and not more than 5% shall be smaller than 5 mm and not less than 10% or more than 35% shall be of 10 mm size.
Aggregate (Fine and Coarse) shall be thoroughly washed with clean water if so directed by the Owner.

Fragile, flaky and laminated pieces, and mica shall not be present Aggregate should be free from fine holes and stone should not be weathered.

c. WATER

i. Type

Water for mixing concrete shall be dean and free from harmful material and comply with the requirements of Clause 5.4 of IS: 456 latest.

Water shall be only from sources/ bore wells approved by the Owner, and shall be used in a manner as directed by the Owner.

ii. Testing of Water

Prior to the commencement of the works, or whenever there is a change in the source of supply or when directed by the Owner, the contractor shall arrange for samples of water, for mixing concrete, to be submitted to an independent Government authorised testing laboratory, acceptable to the Owner for tests to determine that the water complies with this specification and is satisfaction in all other respects for the manufacture of high quality concrete.

3.4 GRADES AND STRENGTH REQUIREMENTS OF CONCRETE

a. GENERAL

Concrete shall consist of the material described under previous sections, using separate coarse and fine aggregate in an appropriate combination determined in the course of the preparation of mix design described hereinafter. The overall grading shall be such as to produce a concrete of the specified quality, which will work readily in to position without segregation and without the use of excessive water. In the case of mass concrete or blinding concrete specified by nominal mix the use of "all-in" (20 mm and down) aggregate may be approved by the Owner. No addition of water shall be made at site. It shall be a homogeneous mix before use at site.

b. SLUMP

Only specified quantity of water shall be added to the cement and aggregate during mixing to produce concrete having a sufficient workability to enable it to be well consolidated, to be worked in to the corners of the shuttering and around the reinforcement to give the specified surface finish, and to have the specified strength. Water cement ratio shall be maintained as per IS. 456-(latest) unless specified otherwise. When a suitable amount of water has been determined, the resulting consistency shall be maintained through out the corresponding parts of the work and tests shall be conducted to ensure the maintenance of this consistency according to the standard method of test for consistencies of concrete (slump test) as below:

Description of work	**Maximum slump in mm .**
Beams and slabs	25 to 75mm
Columns & Walls	50 to 100 mm
Slabs & Staircase	up to 25 mm
Footings	up to 25 mm

Incase of pumpable concrete the slump & workability required for pumping the concrete shall be achieved by the contractor at his own cost. Nothing extra shall be paid for use of extra cement and plasticisers.

c. CONCRETE GRADES

Grade of concrete used in the works shall be shown on the drawings or as directed by the Owner. Minimum cement contents shall be as per Is 456- (latest) or specified otherwise. The grade of concrete to be adopted in the construction shall be as follows:

i. For mud mat, lean concrete, mass filling the concrete mix will be nominal mix concrete of 1:5:10, 1:4:8, 1: 3:6 (Cement : Coarse sand : 20/ 40mm Down aggregates) grade as specified in the construction drawings. These mixes may be prepared using mechanical mixer.

ii. For all RC.0 work concrete used will be controlled concrete with grade of concrete M20 or more as per construction drawings. The cement contents in the mix design for both the case by using cast in situ concrete with batching plant or RMC, shall not be lesser than as indicated in the table

below. The water cement ratio and other parameters shall be strictly adhered to as per the table below:

Grade	Min cement Kg/Cum. (*)	Water Cement ratio	Compressive Strength (Kg/Sq.cm) 7 days Field test	28 days
M-10	170	0.6	70	100
M-15	240	0.6	100	150
M-20	320	0.55	135	200
M-25	320	0.50	170	250
M-30	350	0.45	200	300
M-35	380	0.45	235	350
M-40	430	0.43	270	400

* Note: The actual requirements of cement contents are likely to be more than the minimum indicated .The limit has been fixed strictly from the concrete's durability point of view.

Approved admixtures may be used strictly as per IS 456-(latest) and nothing extra will be paid for the use of the same. Admixture used should not impair durability of concrete nor combine with constituents to form harmful compounds nor increase the risk of corrosion of reinforcement. Dosages of retarders, plasticisers and super plasticisers if used shall not exceed 0.5, 1.0 and 2.0 percent respectively by weight of cementitious materials.

d. Mix Design

As the guarantor of quality of concrete used in the construction, contractor shall carryout mix design and the mix so designed shall be approved by the Owner, however approval by Owner shall not relive the contractor from his responsibility towards quality & sufficiency of design mixes. The mix shall be designed to produce the grade - of concrete having workability and a characteristic strength as indicated in the drawings. The target mean strength of concrete mix should be equal to the characteristic strength plus 1.65 times the standard deviation as indicted below.

Grade of Concrete	**Standard Deviation (N/Sq Mm)**
M10, M15	3.5
M20, M25	4.0
M30, M35	5.0

Mix design shell be carried out as per SP-23 (Hand book concrete mix Proportion/ Type of aggregates shall be made by trial in such a way so as to obtain d se possible concrete with required workability. All ingredients of concrete should be used by mass only.

Contractor shall carry out the mix design and get it tested from the laboratory/ Institution as per the instructions of Owner. Test -report shall indicate

i.	Workability Test of fresh concrete	< Initial setting time
ii.	Analysis of fresh concrete	Final setting time
iii.	Setting time of concrete	< 7 days
iv.	Strength Test	28 days
v.	Cement Type	

No substitutions in materials used on the work or alterations in the established proportions be made without additional test to show that the quality and strength of concrete are satisfactory. Design mix shall not be converted into volume mix under any circumstances.

3.5 BATCHING AND MIXING

Only controlled design mix will be used for concrete with strength more or equal to M20.
Volume batching may be allowed (Using mechanical Mixers) for mixes up to M10, for these leaner mixes mass volume relationship shall be checked frequently to ensure specified grading is maintained.

For the production of controlled concrete contractor shall set up, on site, automatic microchip controlled batching plant of capacity 30Cum/Hr or more, complete with silos/ stock piles for cement and aggregates and D.G sets to be provided to have uninterrupted supply of concrete. The batching plant shall be tested and calibrated as per manufacturers manual and to the satisfaction of Owner, before starting the production of concrete, to provide uniform & consistent cement concrete mix conforming to approved mix design Batching/ Mixing plant shall conform to the requirements of IS 4925 & 4926. Batching plant shall have facilities for presetting the quantities to be weighed with automatic cut off when the same is achieved and also shall be equipped with sensors to control water ratio as per moisture contents of aggregates. Printed reports of all the components of all the batches of concrete as separated by on line computer of batching plant shall be presented to Owner for his approval and records. Cube samples from each batch shall be taken as per the requirement of IS 456-(latest), in the presence of Owner: Cubes shall be tested to record 7days & 28Days cube strength. Contractor shall be responsible for the quality of concrete which will be indicated as per the cube strength results at the end of 7days & 28days. However 28days strength results will be treated as final.

Contractor shall make his own trial mixes for different grade and submit the report of the final design mix to be adopted for different grades to Owner for his approval and records (Contractor shall take in cognisance while !designing concrete mixes, time required for transporting and placing the cement concrete mix at final position). Contractor shall specify along its bid the type and make of the proposed batching plant with brief specifications.

The accuracy of the measuring equipment should be within plus or minus 2% of the quantity of cement being measured and within plus or minus 3% of the quantity of aggregate, water, admixture being measured. All measuring equipment should be maintained in a clean, serviceable condition.

Mixing with mechanical mixer (for MI5 or richer) will only be permitted in exceptional circumstances and then with the specific arrangement of the Owner. No water shall be added to mixed concrete other than the quantity of water allowed for in the mix design and incorporated in batching.

Concrete or mortar which has commenced to set shall not be remixed with additional water and in no circumstances shall such concrete or mortar be used in the work.

3.6 CONCRETE ADMIXTURES & PLASTISIZERS

Admixtures are materials added to the concrete before or during mixing with a view to modify one or more properties of concrete in plastic or hardened state. Concrete admixtures are proprietary items of manufacturers and shall be obtained from established manufacturers having proven track record, with Owner's approval.

3.7 TRANSPORTING CONCRETE

From batching plant 'concrete to the location of proposed construction shall be transported through transit mixers or concrete pumps only. Contractor shall specify the make & type and number of transit mixers to be deployed along with concrete pumps with their make, capacity. The path to be used by transit mixers will be strictly as per the instructions of Owner. From the transit mixers concrete shall be transported to the final floor level/ position through pumping or builders hoist only. Concrete and mortar shall be transported speedily and deposited in its place in the works without contamination, loss of ingredients or segregation. Buckets of builders hoist shall be large enough to contain an integral number of batches. No concrete shall be placed in the works until the contractor's proposed method of transporting concrete have been approved. When concrete is conveyed in chutes from transit mixers, the equipment shall be of such size and design as to ensue a continuous flow in the chute. The chute shall-be-of metal or metal lined, and if two or more lengths are used they all shall have approximately the same slope. If the distance of the discharge end of the chute above the surface of the concrete is more than 1 metre, a spout or "elephant trunk" shall be used and the lower end positioned as near to the surface of deposit as practicable. The chute or "elephant trunk" shall be thoroughly cleaned before and after each run. The debris and any water shall be discharged outside the forms.

3.8 CONCRETE PLACEMENT

a. GENERAl

Concrete, when deposited, shall have a temperature of not less than 5°C (41°F) and not more than 32°C (90°F) .

The concrete shall be placed in the positions and sequences indicated on the drawings, in this specification and/or as directed by the Owner.

Contractor shall-give adequate notice to the Owner of his intention to concrete any section of the works.

Except where otherwise directed, concrete shall not be placed unless the representative of the Owner is present and has previously examined and approved the positioning, fixing and condition of the reinforcement or any other items to be embedded and the cleanliness, positioning and suitability of the concreting surface.

The concrete shall be deposited as nearly as possible in its final position. It shall be placed in such a manner as to avoid segregation of the concrete and displacement of the reinforcement, other embedded items, or formwork. It shall be brought up in horizontal layers not exceeding 450 mm in compacted thickness unless otherwise authorised or directed by Owner. Concrete shall not be placed simultaneously on each side of large horizontal specified or approved construction joints.

Shutters for walls or thin sections of considerable height shall be provided with openings or other devices that will facilitate the cleaning of the accumulation of hardened concrete on the shutters or on the metal reinforcement above the level of the concrete and the removal of concrete in the case of segregations.

b. PLACING CONCRETE IN COLD WEATHER

No concrete shall be mixed or placed while the ambient temperature is above 40 degree C. on a rising thermometer or below 5 degree 5 degree C. on a falling thermometer. The contractor shall supply an accurate maximum and minimum thermometer and hang it in an approved position on the works. Aggregates that have been exposed to frost shall not be used until completely thawed. Concrete shall be maintained by approved means at a temperature of not less than 4 degree C. during placing, and for a period of three days thereafter. All concrete placed during cold weather or when a frost is predicated or is likely to occur or occurs contrary to expectation, shall be protected from freezing by approved means.

c. PLACING OF CONCRETE IN WET WEATHER

Concrete shall not be mixed and or placed in rainy weather or when there is likelihood of impending heavy showers. If it becomes necessary to place concrete during rainy weather, the contractor shall provide adequate protection by means of tarpaulin or similar other water proof material to immediately cover fresh concrete to prevent rain falling over it. This protection shall be left on the concrete for a period of 24 hours after placing of concrete.

d. CONCRETE PLACEMENT UNDER WATER

Concrete placed under water shall be deposited through a tremmie pipe the diameter of which shall be atleast 8 times the size of the largest aggregate used in the concrete mix.

The construction of and the method of handling the tremmie pipes shall be approved by the Owner. The pipes shall be waterproof and sufficiently strong to withstand severe handling conditions and any joints must be sealed with adequate gaskets.

At the commencement of tremmie work the bottom of the pipe shall be sealed before being lowered in to position. The seal shall only be broken by the concrete being placed. The concrete placed in contact with a horizontal construction joint shall have a lower proportion of coarse aggregate and a

higher proportion of cement than the remainder of the concrete. The proportion shall be agreed with the Owner's Representative.

All underwater concrete shall be placed in still water within a cofferdam or formwork which shall extend above water level.

The proportions of the mixes shall be agreed in accordance with the strength and workability required by the specification. To allow for losses an addition of 10% of cement shall be added to mixes of concrete scheduled to be placed under water.

3.9 MAINTENANCE OF PLANT AND EQUIPMENT

The contractor shall keep Bathing Plant, weight batching machines, mixing machines, compressors, vibrators and other plant and equipment for concrete and mortar work clean, well maintained and adjusted and where appropriate, shall check the accuracy of the measuring devices at regular intervals, all to the approval of the Owner's Representative. Mixer blades shall be replaced when worn down by 20 mm.

3.10 NIGHT WORK

Concrete shall not be mixed, placed, compacted or finished during the hours of darkness, except where necessary to complete a pour. However, concreting in darkness for these exceptions shall be only after obtaining the express permission in writing from the Owner's representative and in his presence only.

3.11 COMPACTING CONCRETE

The concrete shall be fully compacted through out the full extent of the layer. It shall be thoroughly worked against the moulds, and around any reinforcement and other embedded items without displacing them, and in to corners of the moulds. Successive of the same liksh211.lze thoroughly worked together adjacent to the common face. The date of laying concrete shall be marked for curing and removal of form work.

Immersion vibrators shall be of approved type and shall have frequency of not less than 10000 oscillations per minute. They shall penetrate the full depth of the concrete to be vibrated and be immersed at sufficiency close spacing so that the whole volume of the concrete is satisfactorily and uniformly compacted.

Where the underlying layer is of fresh concrete, immersion vibrators shall also penetrate that layer to ensure homogeneity. Immersion vibrators shall be withdrawn slowly to prevent formation of voids. Vibrators shall not be used to work the concrete along the moulds or in such a way as to damage shuttering or other parts of the structure or to displace the reinforcement or other embedded items. Immersion vibrators shall only be operated by those who have received proper instruction and training in their use.

External vibrators shall be of approved type and shall have a frequency of not less than 3000 oscillations per minute. They shall be securely and rigidly clamped to the shuttering. External vibrators shall only be used on shuttering which is strong enough to withstand the vibration without displacement, distortion or other damage.

The contractor shall ensure that sufficient standby vibrators and ancillary equipment are available during concreting operations.

3.12 QUALITY CONTROL

a. In order to ensure that the quality of materials and the mix proportions are suitable for the particular grade of concrete required are so maintained, sampling and testing shall be carried out regularly during the course or the works.

b. As frequently as the Owner's representative may require and in any case at least once a day while concreting is in progress, the contractor shall sample and carry out a determination of the moisture content and a mechanical analysis of the fine aggregate and each nominal size of coarse aggregate shall lie within the respective limits specified.

c. Workability testing shall be carried out in accordance with IS: 456. The results shall lie within the range upon which the accepted mix design is based. Testing shall be carried out at such a frequency that the requited workability is consistently achieved.

d. Samples of concrete shall be taken at random in accordance with IS: 516 at the time and place of deposition of the concrete.

e. Notwithstanding the foregoing, additional samples shall be taken by the contractor when directed by the Owner. The test cube procedure shall be in accordance with IS: 516 throughout.

f. Compliance with the specified characteristic strength shall be assumed if:

i. Each of the six cubes in a group has a test strength not less than the characteristic . . strength or,

ii. Not more than one cube has a test strength less than the specified characteristic strength but not less than 85% of the specified characteristic strength and the average strength of the group of four test results is not less than the specified characteristic strength plus the standard deviation of the group.

g. SEVEN DAY CUBE TESTS

Acceptance of concrete is based on the 28th day results. However, the contractor shall establish a relationship between 7 days and 28 days strengths by carrying out 7 days tests at the time of performing the laboratory testing and from subsequent quality control testing. The relationship shall be used in interpreting any further test results to predict the probable value of the corresponding 28 days cube Strengths. The contractor shall without delay advice the Owner of any sample that appears likely to fail to meet the specification and the contractor shall take any necessary action to minimize the effect of such failure.

Quantum of cubes & testing:

Concrete Quantity	**No. of Samples**
Up to 5 Cum	1
5 Cum to 15 Cum	2
15 Cum to 30 Cum	3
30 Cum to 50 Cum	4 plus one additional per 50 Cum or part thereof.

h. ACCEPTANCE CRITERIA

The general Acceptance Criteria of any and all of the concrete work shall be as per the relevant Clauses of IS. 456.

If any of the works tests are not up to the standard, the Owner shall have the power to stop the work until the reason is investigated and steps taken to prevent further low result. The contractor shall not be entitled to any claims on account of such delays. Any concrete carried out from the batch that is afterwards found to be faulty, will be liable for rejection and if so directed, the contractor shall at his own expenses dismantle and replace the defective work and any work built thereon or shall take such other measures as may be deemed necessary by the Owner. At the discretion of the Owner, the contractor may be allowed to prove by means of a load test to be carried out at his own expense, that the concrete is capable of safely withstanding the loads as specified in the test.

3.13 CONSTRUCTION-JOINTS

Construction joints shall be provided in the position described on the drawings or elsewhere and where not so described on the drawings or else shall be in accordance with the following: -

a. A joint shall be formed horizontally at the top of a foundation and 75 mm below the lowest soffit of the beams meeting at the head of a column.

b. A joint shall be formed in the rib of a large tee beam and all beams 25 mm below the soffit of the slab.

c. Concrete in a haunch or a splay on beam or a brace, and in the head of a column where one or more beams meet, shall be placed without a joint at the same time as that in the beam or beams or brace.

d. Concrete in the splay at the junction of a wall arid slab shall be placed throughout without a joint, but if the provision of a joint is unavoidable, the joint shall be vertical and the middle of a span.

e. A joint in a slab shall be vertical and parallel to the principal reinforcement, where it is at the unavoidable, right angles to the principal reinforcement, the joint shall be vertical and at the middle of the span.

f. Expansion joints, hinges or other permanent structural joints shall be provided in the positions and of the form described in the drawings or elsewhere. Before placing new concrete against concrete that has already hardened the face of old concrete shall be cleaned and roughened and scrubbed and loose aggregate removed from the form. Immediately before placing the new concrete Polymer based construction adhesive (epoxy resin) of approved make to be applied on the face. The new concrete shall be will rammed against the prepared face before the grout sets .

3.14 FORM WORK AND SCAFFOLDING/ STAGING :-

Form work to the fresh concrete shall be sufficiently rigid and shall be such as to prevent loss of slurry from the concrete and details and design of the form work shall conform to IS 14687. The tolerances on the shape, lines and dimensions shall be as per CL. 11 of IS 456 —2000.

All staging and scaffolding work shall comprise of MS Pipes/ Structural steel sections with necessary coupling arrangement. (NO WOODEN BALLIES/ PROPS WILL BE PERMMED). Adequate size foundation blocks/ base plates shall be provide below staging members to disperse the loads as per the founding strata.

a. FORM WORK CONSTRUCTION

i. The contractor should submit detailed drawing of the centering & shuttering and get the same approved from the Owner before laying concrete also he should get the centering shuttering approved in writing before start of concreting. The concreting should be done in the scientific and methodical manner so as to give a uniform finish in line and level, so that minimum rendering or plastering is done. The work found defective, should be dismantled & redone and site cleared.

ii. Form work-shall be -so constructed that concrete can be properly placed and thoroughly compacted. Form work shall be firmly supported and adequately strutted, braced or tied to maintain position and size. Forms -shall have sufficient strength and rigidity to with stand the weight of wet concrete and necessary pressure due to ramming and vibration of concrete and movement of men material and other loads without excessive deflection from prescribed limits. It shall be: capable of adjustment to the lines, levels and dimensions of the finished concrete.

iii. All form work shall be constructed to be rigid during the casting of concrete and constructed so that the surfaces adjacent to the concrete are with plus minus 6 mm or the required surfaces when supporting the concrete and sufficiently watertight to prevent loss of liquid from the concrete, and it shall be capable of being removed without shock or vibration to the concrete. Forms shall be cleaned with compressed air immediately before placing concrete to remove all rubbish. The inside

faces of the form work shall be treated with a mould oil of type to be approved by the Owner and every care shall be taken to prevent mould oil from getting on to the reinforcement.

iv. Beams boxes shall be erected with an upward camber of 6 mm for each 3 M. of span.

v. Around the periphery of the building beyond building line, staging shall be erected by the contractor free of cost, using structural steel members duly braced to sustain all loads, with all safety measures like netting, temporary railings/ parapets, platforms etc. - . to provide free access to external facade of the building at each floor level for construction and inspection. Staging shall grow along with the building.

b. REMOVAL OF FORM WORK (STRIKING TIME)

Unless certainly specified in the drawing, or directed by the Owner, the following shall be minimum intervals of time, which should be allowed between the placing of the concrete and the striking of the mould where ordinary portland cement is used and ambient temperature does not fall below 15 degree Celsius.

a.	Walls, column & vertical faces of all structural members	16 to 24 hours as may be decided by the r. Owner
b.	**b. Slab**	
	i. Spanning upto 4.50 m	7 days
	ii. Spanning over 4.50 M	14 days

Note: Soffit forms of the slab may be removed after 3 days, props to be fixed immediately after removal of shuttering.

c.	**Beams and arches**		
	i. Spanning up to 6 M	14	days
	ii. Spanning 6 M to 9 M	21	days
	iii. Spanning over 9 M	28	days

Note:

i. For other types of cement, the stripping time recommended for ordinary portland cement may be suitably modified. Forms shall not be released until the concrete has achieved strength of at least twice the stress to which concrete may be subjected to after removal of the form.

ii. The number of props left under, their sizes and disposition shall be such as to be able to safely carry the full dead load of the slabs, beam or arch as the case may be together with any live load likely to occur during curing or further construction.

However the Contractor shall delay the removal of shuttering as long as necessary in order to avoid damaging the work. Where shuttering to soffit is removed prior to the props this is only permissible if the design of the shuttering allows such a sequence of operations without the props being in any way disturbed. If the shuttering and props are not independent, both must be left in place until propping is no longer required.

Where shuttering to sides is removed prior to the shuttering soffit, the side shuttering shall be removed without disturbing the shuttering to the soffit.

No concrete structure shall be loaded until the concrete is at least 21 days old and only then with the approval of the Owner and subject to such conditions as may be imposed.

The contractor may be required to produce evidence that the concrete has attained strength sufficient to support the live and dead loads to which that part of the structure may be subjected. This evidence shall consist of reports of compression tests made on job cured test cubes. The cost of such tests shall be borne by the contractor. The foregoing provisions of this clause shall not

relieve the Contractor of his responsibility to ensure that the stability and strength of any structure or part of a structure is not impaired by the release of shuttering.

c. PROPOSALS FOR FORM WORK

Not less than 8 days before the contractor proposes to construct any form work his detailed proposals thereof shall be delivered to the Owner. Proposals shall comprise all relevant information including calculations, detailed drawings, rates of placing of concrete, sequence of placing of concrete and details of any external vibrators which are proposed to be used.

No form work shall be constructed until the Contractor's proposals have been received and approved by the Owner.

d. Type of form work

Two qualities of form work shall be used i.e Rough form work and wrought form work, as noted on the Owner's drawings or described hereafter.

Rough form work may be constructed of sawn timber or other material as agreed by the Owner. The edges of the boards shall be planned or otherwise rendered grout tight. Provided it remain grout tight, rough formwork may be used any number of time. This form work shall be adopted for surfaces not exposed/ buried needing no surface finish viz. Foundations/Pile caps.

Wrought form work, to all surfaces for which a smooth fair faced finish is required, shall be constructed of purpose-made metal, water proof ply wood panel, hardboard lined form work or of planed timber with edges shot so that tight joints can be formed which will prevent loss of liquid from the concrete. The use of a particular material for wrought form work shall be consistently maintained throughout the structure. The surfaces of the form work in contact with the concrete shall be smooth and free from all blemishes. The number. of times wrought form work may be used shall be subject to the surfaces, joints and edges being clean and undamaged.

e. SURFACES OF CONCRETE

The contractor shall ensure that the finished face of concrete offers a suitable keyed surface for the application of the finishing media, e.g. plaster, sand- and cement screed, etc. The contractor shall also ensure that where thin films of finished, e.g. skim coats "Snowcem", paint, etc. are to be applied that the previous provisions regarding supporting of form work are complied with, so that the concrete faces to be treated are left smooth, unblemished and true to line both vertically and horizontally and require no making good before applying the finish.

Should the contractor fail however, to comply with the provision of this Clause, he shall submit details of his proposed method of redoing the situation to the Owner and must obtain written consent from the Owner to the proposals before continuing with any further work on the affected surfaces.

f. TOLERANCES IN CONCRETE SURFACES

The permissible tolerance in the surface of the hardened concrete shall not exceed the following limits:

i. Type of irregularity

Departure of member planes from position and level.	+	12 mm
Variation in cross-sections	+	6 mm Sharp changes
in plane	+	2 mm Departure from
3 M. template of any part of planes	+	3 mm

3.15 CURING

Canvass, Hessian or other approved screens shall be erected at all points where concrete is being placed to protect the concrete from the direct sun or from drying winds and such screens shall be kept in position until the surface of the concrete has been protected as specified in the following Clauses. The contractor shall be responsible for removing such screens and preparing surface of concrete.

As soon as possible after it has been placed and concrete shall be covered with Hessian or other approved material to protect it from the sun and all concrete surfaces shall be kept visibly wet continuously for 14 days after placement, the Hessian being kept in position throughout this period. Surfaces cast against forms shall also be kept moist and covered with Hessian for these periods if the form work is removed before the periods have elapsed.

The top surface of slab shall be kept flooded with water at all times till the curing period of 14 days is over. Columns, wall and beam sides and other surface shall be completely covered by gunny bags and kept thoroughly wet continuously for the period specified for curing. The ceiling of slabs shall be frequently sprayed with water until the end of curing period.

The contractor shall ensure that all times there is an adequate supply of fresh water available for curing the concrete.

3.16 EXAMINATIONS AND REPAIRS

The contractor shall not proceed with the surface finish or making good of concrete surfaces until he has received the Owner's written permission to do so and he shall not apply cement slurry or mortar or any other coating to the concrete surfaces as struck from the shuttering or do anything else which would hinder the proper inspection of the concrete by the Owner.

Concrete which is defective, has honeycombs, or which contains defective parts shall be cut out completely unless the Owner agrees that a repair may be satisfactorily effected. This agreement shall not preclude subsequent condemnation of the repaired work.

The method of repairing defective concrete which the contractor proposes to adopt shall be submitted to the Owner for his prior written agreement in each particular case.

No repairs or remedial work shall be carried out without prior inspection and instructions of the Owner. (No extra payment shall be paid to the contractor for the repair works).

3.17 FAIR FACE FINISH TO CONCRETE SURFACES

Concrete surfaces shall be finished smooth fair faced where indicated-as-such-on-the-drawings. These areas shall be entirely free from honey combing, stains, fins, lipping, nail or screw marks, raised grain marks, air holes or any other imperfections. They shall also be of even texture throughout. Very slight variations between member and member may be acceptable but any such variations within a single member cannot be tolerated. The concrete faces shall not be marked with mould oil.

The form work to these areas shall be wrought form work as specified herein.

Following inspection by the Owner, the whole surface shall be rubbed down by hand. Any surfaces with major imperfections, i.e. greater than can be easily, completely and permanently obliterated by rubbing down shall be reported immediately to the Owner.

Remedial work is not normally possible to the above fair faced finish surfaces and the Contractor will be required to demolish and recast defective works.

3.18 STEEL REINFORCEMENT

The reinforcement steel shall in general comply the following specifications, these specifications shall also be binding on the contractor incase reinforcement steel is supplied by the Owner/ Owner.

a. TYPE

Steel for bar and fabric reinforcement shall conform to mild steel of tested quality conforming to IS. 432 (Latest), or high yield strength deformed bar/ TMT conforming to IS. 1786 or 1139 (Latest) as specified in the drawings. The steel shall be kept clean and free from pitting, loose rust, mill scale, oil, grease, earth, paint or any material which may impair the bond between the concrete and the reinforcement or which may cause corrosion of the reinforcement or deterioration of the concrete. Fabric reinforcement (IRC weld mesh or equivalent) shall be delivered to site in flat sheets only.

b. STORAGE OF REINFORCEMENT

Before and after bending, reinforcement shall be stored on raised racks in separate lots by size and type and protected from damage, contamination and the effects of the weather. For the purposes of identification -each lot shall be marked plainly and securely by approved methods.

c. FABRICATION

Fabrication shall be accurately done to the dimensions, spacing and minimum cover as per structural drawings. Spacers shall be of cement mortar (1:2) cubes however shall not be leaner than the approved design mix. Steel chairs, spacer bars shall be used in order to ensure accurate positioning of reinforcement. All joints in steel reinforcement shall be overlapped. The length of over lap for tension and compression joints in mild steel reinforcement above 16 mm diameter may be welded if permitted by the Owner in writing.

d. LAPPING OF BARS

Laps shall be strictly as per the drawings or as directed by the Owner. For general guidance, the following principles shall be followed as given in IS 456.

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

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

iii. Where more than one half of the bars are spliced at a section or where splices are made at points of maximum stress, special precautions shall be taken, such as increasing the length of lap and/ or using spirals or closely spaced stirrups around the length of the splice.

e. WELDED LAPS

Wherever specified, welded laps shall be provided and paid for separately unless specifically included in the item of work. No payment shall be made to the contractor for welding as per Owner's requirements, if the same is necessitated due to the reasons attributable to the Contractor. The welding of bars shall be carried out as per IS: 2751-1979, IS: 9417-1979. Before doing welding of bars at site, the contractor shall make minimum 3 joints and get them tested in an approved laboratory at his own cost. The following precautions shall be taken:

i. If the cold twisted deformed bar has an untwisted end at lapping point, then this portion shall be cut off prior to welding.

ii. Bars shall be free from rust at joints to be welded.

iii. Bars shall be aligned and kept in proper axis in order to minimize crookedness in bar after welding.

3.19 REINFORCEMENT FABRICATION

a. BENDING SCHEDULES

The Contractor shall submit to the Owner, for the Owner's approval, bending schedule for all the works, not less than Ten days before the contractor intends to bend the reinforcing steel.

The Approval of the Owner shall in no way absolve the contractor of his responsibilities under the Contract.

b. PROGRAMME OF REINFORCEMENT DETAILS REQUIRED

The Contractor shall provide a programme which gives the Owner at least 28 days prior notification of any reinforcement details required. The contractor shall justify the practicability of his programme to the Owner should it seem unreasonable before the programme be regarded as valid notification. If progress on site falls behind the contractors' programme, the issue of reinforcement details may be delayed by a period corresponding to the delay in construction.

c. BENDING AND PLACING REINFORCEMENT

Reinforcement shall be cut and bent to the shapes and dimensions shown on the finally agreed bending schedules in accordance with the requirements of IS: 2502 and to the tolerances set out therein.

Bending shall be carried out with an appliance which provides a continuous and uniform application of the bending deformation at every section of the bend. There shall be provision for the free movement of the surface of the bar during bending and the bends shall follow the contour of the former without peaking.

High Yield reinforcement must be bent without the application of artificial heating.

Mild steel reinforcement may be sent either hot or cold but shall not be heated to a temperature greater than 85°C., and if heated not cooled by quenching.

Mild steel reinforcement temporary left projecting from the concrete at construction or other joints shall not be bent out of position unless shown on the drawings or agreed by the Owner. Where such bending and subsequent rebinding takes place the radius of the bend shall not be less than 4 bar diameters.

Reinforcement shall be fixed without forcing in the position shown on the drawings within a tolerance of 5mm or 5% of the minimum dimension of cross section, whichever be the greater and maintained so that it is not displaced during concreting or other operations.

Horizontal bars shall be supported sufficiently to prevent displacement. This may be plastic spacers, chairs, bent from bar, or by concrete blocks. The method and sufficiency of the support shall be subject to the approval of the Owner.

Where concrete blocks are used, they shall be precast from concrete not mortar) of the same class as the concrete in which they are to be embedded, except that the largest size of aggregate shall be 10mm. Each block shall be secured to the reinforcement with wire or a clip embedded in the centre of the block so that, it shall not be in contact with the shuttering or subsequently cause rust marks on the concrete. Intersections of reinforcement shall be bound together with 16 gauge annealed soft iron binding wire conforming to IS 280. The binding wire shall be free from rust, oil, paint, grease, loose Mill scale or any other deleterious material undesirable for the reinforcement and concrete or which may prevent adhesion of concrete with reinforcement.

Unless otherwise noted on the drawings, no intersections of reinforcement may be fixed by welding without the permission of the Owner. High yield and cold worked steel shall, in no circumstances, be welded together.

Should any difficulty arise during the placing of steel in obtaining the appropriate cover, the contractor shall immediately draw the attention of the Owner to the difficulty and shall carryout such corrective measures as the Owner may suggest.

d. PROTECTION OF REINFORCEMENT AND CONCRETE

The Contractor shall ensure that movement of men and material subsequent to steel fixing is organized so that reinforcement is not thereby displaced.

Reinforcement left projecting from any concrete shall be protected so that there is no risk of corrosion staining to any exposed concrete surface or to any other part of the works. For this purpose a stiff grout wash will normally be acceptable to the Owner, this wash shall be wire-brushed vigorously before further concrete is placed to remove any ill- bonded material.

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3.20 PRECAST CONCRETE UNITS

Precast concrete materials and workmanship shall be in accordance with specifications unless indicated otherwise. Where different tolerances are indicated in this specification or on the drawings from these in the more severe -tolerances shall apply. The units shall all be cast in properly made strong moulds to form the shapes required. For work described as "finished fair" the mould shall be

lined with sheet steel or other approved material and care should be taken to ensure no damage is caused to edges or surfaces when units are removed from the moulds.

The concrete shall be of the mixes given on the drawings and shall be thoroughly vibrated in the moulds.

All precast work shall be cast under cover and shall so remain for seven days- and shall be kept damp in order that the units are properly matured. No units shall be lifted until 18 days have elapsed since casting and no unit shall be erected until it has been approved by the Owner as free from defects.

No cracked units will be accepted for incorporation in the works.

All reinforced structural precast units shall have the tops clearly marked

Un-reinforced precast units, such as sills and copings, shall be lightly reinforced as necessary to facilitate handling.

4.0 MASONRY WORKS

4.1 BRICK WORK:

a. The bricks shall conform to the IS No. 1077-1986 of minimum crushing strength of 75 Kg./cm^2. (First Class)

b. The building bricks are to be the best quality table moulded kiln burnt, patent bricks, hard sound, square with sharp arises, even and uniform in shape and colour free from cracks, stones, flaws and other defects. Samples of bricks are to be submitted to the Owner for approval before full quantity is ordered. All supply of brick to conform to the sample approved. No brick after 24 hours immersion in water shall absorb water more than 15% of its own weight.

c. The cement and sand shall be as described under 'Cement Concrete' and the mortar unless specified otherwise in Bill of Quantities is to be composed of one part cement to four parts of coarse sand by volume, thoroughly mixed by hand. Hydrophobic cement used in mortar shall be thoroughly machine mixed. No mortar that has started to set shall be used in the work.

d. Every brick shall be thoroughly soaked in water before use. Broken bricks shall not be used except as closers. The courses shall be truly horizontal and the work strictly plumb, joints shall be broken vertically and they shall not exceed 12mm in thickness. All joints in brick work are to be well filled with mortar.

e. The brick work shall not be raised more than 12 single courses per day and shall be built in English bond, except brick on edge and half brick thick walls shall be built in stretcher bond. Except for brick on edge work, the bricks shall be placed with "frog" facing upwards.

f. All joints in brick work on both the faces shall be raked out 6mm deep as the work proceeds, and before the mortar sets.

g. The brick work is to be carried out with all necessary set backs, projections, cuttings and toothings in conformity with the drawings.

h. The brick work shall be cured by watering and continuously kept wet for 10 days, and the work shall be well protected during rainy season.

i. All uneven, irregular and bad brick work poor in workmanship shall be demolished if deemed necessary by the Owner and rebuilt by the contractor at the contractor's expenses. If necessary the contractor will have to provide wooden plug, etc. for his own work and for which there will be no special payment on that account. The work will have to be executed at any height and lift and will not form the criterion for any extra amount.

j. Should any efflorescence be observed in brick work, it should be washed down by dean water and brick surface treated with such chemicals as are deemed necessary by the Owner without any extra charge and at the contractor's own expenses, till efflorescence subsides.

Should the efflorescence persist, the brick work shall be demolished if deemed necessary by the Owner and the work rebuilt with new bricks including making good all the work disturbed without any extra charge.

k. Half brick masonry: All brick work under 115 mm thick shall be reinforced with one no. 16 gauge 25mm wide MS flat in every fourth coarse. The said flat shall be cast in or securely fixed to adjoining concrete walls or columns by screw with fastener. No extra for the cost of MS flat will be paid.

1. Wall under structural members: Allowance shall be made for leaving, temporarily open courses immediately below all structural members built into the walls. The open courses shall be left to permit full deflection of structural members. The open courses shall then be made good and pointed up after the structural members have been fully loaded and before the completion of the work.

5.0 WATER PROOFING

5.1 GENERAL

It is the intent of this specification to secure a completely water tight basement, toilets and terraces etc. guaranteed for at least 10 (fen) years from the date of final completion. The guarantee shall be executed & extended by the Contractor & not by the water proofing agency. The contractor shall provide all materials, labour, plant, equipment, incidentals and everything necessary for securing a fully waterproof job as called for above.

All water proofing work shall be carried out by specialists as approved by the Owner. Installation and materials shall be as per best practices for obtaining water proof work and as recommended by the manufacturer.

Water proofing work shall be commenced only after the surface is prepared, smooth rendered, cleaned free of dirt, dust and foreign matters, inspected and approved. Compressed air shall be used for effective cleaning of all surfaces. The vents and other projections through the roof shall be made absolutely secure before flashing.

5.2 INJECTION METHOD WATERPROOFING TREATMENT

a. Horizontal Surface: After the excavation and PCC levelling course, water proofing course shall be laid consisting of cement mortar 1:3 (1 cement : 3 sand) and mixed with Acrylic water proofing chemicals and embedding aggregate by hand pack at random in two layers each of 25mm thick thus the total water proofing course shall be about 50mm thick. After the necessary curing, and fixing raft reinforce cement in partition provide 20 mm pipe .sleeves at 1.2 m c/c .on. both ways by tying it with reinforcement in such a manners to ensure that the bottom end of the pipe remain free from getting chocked and the length of the pipes shall be that of total thickness of the raft plus 25mm above to protrude from the surface of the raft.

After concreting the raft, grouting Acrylic based waterproofing chemical mixed with neat . cement slurry through the pipe sleeves shall be carried and for the required period. The projected pipe ends shall be cut after grouting the mouths. The same procedure shall be adopted for all joints around the column wall joints.

b. Vertical Surfaces: The vertical surfaces shall be treated by making holes on the surface at 1.20m centre to centre on both ways and also at 0.75 m along- construction joints, corners and fixing nozzles of 20mm dia pipe and inject Acrylic based chemicals mixed with neat cement slurry as explained above. After grouting the pipe, nozzles shall be removed and the packets shall be made good. The external-surface of the walls shall be neatly plastered with cement mortar (1:3) admixed with Acrylic Chemicals of 12 to 15mm thick.

5.3 TAPECRETE WATERPROOFING

All the chasings or cuttings in the floors and walls shall be carried out prior to the commencement of the treatment. The prepared surface than shall be plastered with 12mm thick cement mortar 1:4 mix (1 cement : 4 coarse sand), mixed with 'CICO' admixture, as per manufacturers' specifications. The plastering shall be carried out throughout the sunk portion and carried up to all sides of the walls. The specialist then shall carry out 'TAPECRETE' waterproofing treatment comprising of 3 coats of tapecrete with Ist coat of tapecrete mixed with grey cement in proportion of 1:2 (1 part tapecrete : 2 grey cement),

2nd coat of tapecrete mixed with grey cement and silica sand in proportion of 1:2:1.5 (1 Tapecrete : 2 grey cement : 1.5 silaca sand) , 3rd coat of tapecrete mixed with grey cement in proportion of 1:2 After the first coat of Tapecrete all corners, junctions, joints of pipes and masonry to be sealed with Epoxy putty. The treatment is laid underneath and behind all pipes. The specification on verticals is taken 150 mm above the finished floor level and to full height where tubs/ basin and WC are being fixed. The top surface shall be protected with 12mm thick plaster in cement mortar 1:4 mix (1cement: 4 coarse sand) .

5.4 ROOF AND SUNKEN AREA WATER PROOFING (BRICK BAT COBA)

Brick bat coba treatment shall be got done from an approved agency. The surface should be prepared and construction joint if any are to be raked and cleaned. Cement slurry mixed with approved chemical compound is to be spread on the surface so as to fill the undulation and other porous areas.

20mm thick cement mortar mixed with approved chemical in cement mortar 1:4 (1 cement : 4 coarse sand) is laid over the prepared surface.

A layer of brick bat is laid over the mortar to required slope. The joints between the brick bats should be kept 15-25 mm wide. These joints be filled with cement mortar 1:4 mixed with specialized chemical compound as approved by the Owner. Curing is done continuously for two days.

The top surface should be finished smooth with 20mm thick cement mortar (mixed with specified quantity of approved chemical). Curing of the treatment should be done for two weeks.

The side wall shall be provided with 20mm thick cement plaster 1:4 mixed with specialized chemical compound upto a height of 30 Cm. A 20mm thick gola with brick bats shall be provided and finished with cement mortar 1:4 mixed with approved chemicals compound. The gola shall be cured continuously for two weeks. The work shall be got done from a specialized agency duly approved by the Owner.

5.5 TERRACE WATERPROOFING WITH INSULATION

Wherever specified, waterproofing treatment may be carried out, over areas as directed by the Owner.

The waterproofing treatment shall commence with applying a course of primer comprising of blown grade bitumen in the ratio 60:40 by weight 1st layer of 1mm thick APP polymeric polyethylene felt (Direr a coat of hot refined mineral asphalt a 1.5 Kg./Sqm with 75mm & 100mm side & end laps. 2nd layer of 1mm thick APP polymeric polyethylene felt over a coat of hot -refined mineral asphalt @ 1.5 Kg./Sqm with 75mm & 100rrun side & end laps. 3rd layer of 50mm thick Expanded Polystyrene (THERMOCOLE or approved equivalent) of density 24 kg/. cum laid over hot refined mineral asphalt layer for adhesion. 4th layer of 1mm thick APP polymeric polyethylene felt spot stuck with bitumen with 75mm & 100mm side & end laps & further sealed with hot asphalt.

For vertical surface a layer of hessian based felt type 3 grades-1, 1 layer of Geo Textile (Wonder non woven polyester fibre) and 1 layer of APP polymeric polyethene felt and each layer is laid in hot asphalt over a coat of bitumenous primer with 75mm and 100mm side and end laps respectively. The vertical waterproofing overlaps with horizontal waterproofing by 100mm including cutting 50mm deep chase in walls and tucking the waterproofing.

Immediately after the waterproofing causes has been laid, it shall be covered with 75mm thick MI5 grade concrete with providing and fixing weld mesh fabric of size 150x150x2.25rnm including cutting, straightening and welding with each other wherever required, on horizontal surface. Provision of Khurrahs 450x450mm/ 300x300mm with average minimum thickness of 50mm cement concrete 1:2:4 to be made. The water- proofing course on the vertical shall be protected with a 115mm thick cladding of brick masonry to be measured and paid separately.

5.6 DECK SLAB WATERPROOFING

The waterproofing treatment shall commence with applying a course of primer comprising of blown grade bitumen in the ratio 60:40 by weight. 1st layer of 1mm thick APP polymeric polyethylene felt over a coat of hot refined mineral asphalt @1.5 Kg./Sqm with 75mm & 100mm side & end laps. 2nd layer of 1mm thick APP polymeric polyethylene felt over a coat of hot refined mineral asphalt @1.5 Kg./Sqm with 75mm & 100mm side & end laps. 3rd layer with a layer of Geo Textile (Wonder non woven polyester fibre) laid in semi hot asphalt with 75mm & 100mm side & end laps respectively.

For vertical surfaces a layer of hessian based felt type 3 grades-1, one layer of Geo Textile (Wonder non woven polyester fibre) and one layer of APP polymeric polyethene felt and each layer is laid in hot asphalt over a coat of bitumenous primer with 75mm and 100mm side and end laps respectively.

The vertical waterproofing overlaps with horizontal waterproofing by 100mm including cutting 50mm deep chase in walls and tucking the walls and tucking the waterproofing.

7.0 FLOORING/ CLADDING WORKS

7.1 GENERAL
All flooring shall be laid to the best practice known to the trade. The flooring shall be laid to the level except where slopes are called for on the drawings in which case the slopes shall be uniform and so arranged to drain in to the indicated outlets.

Particular care shall be exercised to ensure that all flooring, skirting and dado are perfectly matched for colour and finish. Sufficient extra tiles (not less than 5%) shall be cast/ ordered to ensure an adequate supply of matched floor tiles. The contractor shall furnish for approval by the Owner, samples of each type of floor finish.

7.2 CEMENT CONCRETE FLOORING (IPS FLOORING)
Indian patent stone flooring shall be 40mm or of specified thickness and laid in two layers, bottom layer 28mm thick or as specified in 1 part of Portland cement, 2 parts of coarse sand and 4 parts of crushed stone aggregate 12.5mm down well graded machine mixed with not more than 5.5 gallons of water for each bag of cement and top layer 12mm thick in one part of Portland cement, 2.5 parts of selected crushed stone chips -with just enough sand maximum part to make workable mix, machine mixed with not more than 5 gallons of water. Top layer to be laid before the bottom layer has hardened. Flooring shall be laid in squares or bays as directed and each layers shall be well compacted by ramming with heavy teak wood floats. The top shall be brought to a smooth and even surface free from blemishes and finished smooth with neat cement by steel trowelling. The flooring shall be kept wet for seven days for curing.

Where ironite/ hardonite topping is specified in the "Bill of Quantities" the bottom layer shall be 50nim thick or in the item of B.O.Q. and the top layer shall be 12mm thick mixed with ironite/ hardonite as per manufacturers specification and finished fair.

7.3 GRANOLITHIC FLOORING
The general specifications for granolithic floors, where called for, shall be as per the cement flooring except that the top 12mm finish shall be of granolithic consisting of 1 part of cement and 1.1/2 part of well graded crushed aggregate. The aggregate shall be of approved quality.

7.4 TILE FLOORING
All tiles shall be minimum 8mm thick of approved manufacturer or as stated in the Bill of quantities. Only first quality tiles of approved colour shall be used. No cracked or warped tiles shall be used in the work. All tiles shall be required to be set in cement mortar. Prior to setting the tiles, the contractor shall at his own cost, clear the whole surface and thoroughly saturate it with water. A layer of 12 to 20mm avg. thick cement mortar shall then be applied to the surface and the tiles laid firmly over a layer of clear cement slurry. The tiles shall be set in perfect line, level and true to plumb line. The joints of tiles shall have white, coloured cement filling/ tile grout. After the setting operation is completed, the contractor shall carefully remove all cement and dribbling and cure the tiled surface for at least seven days with water.

7.5 TILE DADO
Tile dado where called for in the drawings, shall be minimum 6mm thick tiles of approver] manufacture as stated in the Bill of quantities. The tiles shall be free from cracks, twists, uneven edges, cracking and such other defects. The rear face of tiles shall be grooved and/or recessed to provide an adequately key for the plaster. A layer of 12mm thick rough base plaster shall be done

with cement mortar 1:3 (1cement : 3 coarse sand). The tiles shall be finally set true to plumb with rich cement slurry over a 6mm average thick cement plaster in 1:3 (cement : 3 fine sand), the joints of tiles sh211 have white, coloured cement filling/ tile grout. After laying, the tiles shall be thoroughly washed and cleaned to the satisfaction of the Owner.

7.6 KOTA STONE FLOORING
The -best quality stone (Green/ Brown) from approved quarry, shall be laid either with rough stone or machine cut and machine polished as specified in respective items and shall be of specified thickness and of approved quality and size, free from cracks and flakes and shall be uniform in

colour, with straight edges. The sides of machine cut and machine polished stones shall have perfect right and finished. The stones shall be laid on adequate thickness of cement mortar 1:4 (1 Cement 4 coarse sand) mix to match the total thickness of flooring of 50mm thick & joint to be fitted with cement slurry mixed with pigment to match the shade of stone. The finished stone surface thus laid shall then be polished to the required degree as approved by the Owner. Flooring shall be finally mirror polished and protected till the handing over of the building.

7.7 MARBLE/ GRANITE STONE

Marble/ Granite shall be the best Indian Marble/ Granite to be approved by the Owner and a sample piece should be kept in the office of the Owner. The quality shall be uniform and it shall be hard and free from any discolorations, cracks, flaws, veins of foreign materials or any other defects. When marble/ Granite of different colour and kinds associated, care shall be taken to see that they are equal hardness so as to wear evenly. The marble/ Granite slabs shall be machine cut true to the shape and size and machine mirror polished. Care shall be taken to cut the slabs so as to provide a pattern as indicated. Marble/ Granite stone slabs for wall lining and dadoes shall be machine mirror polished edges. The wall shall be lined with the marble/ Granite in courses as indicated and grain of the marble/ Granite shall be arranged in pattern as per detailed drawings. The marble/ Granite shall be bedded in adequate thickness of cement mortar, backing covering the full area of the marble. The wall surface shall cleaned from all dirt, mortar droppings etc. before applying the base plaster. The marble/ Granite shall be fixed to the wall by-S.S cramps and pins of required sizes embedded firmly in to wall by cutting hole and grouting alternately stainless steel cramps and pins as per design inducing fixing small stone pieces with adhesive. The load of one marble/ Granite slab shall not be borne by the slab below. Joints between slabs shall be hair fine and filled with coloured cement to match the marble/ Granite. The marble/Granite lining and &does shall be finally polished by Carborundum stone, buffing with polishing felt and cleaned with diluted oxalic acid wash.

7.8 EXPANSION AND COMPRESSION JOINTS

These shall be clearly indicated on the shop drawings and formed of non-staining two parts polysulphide with polyethylene foam backing to full depth of screed in pavings.

In no instance shall expansion joints be less than 10mm. Supporting corbels cover shall be recessed into the back of the above slab and not placed in the expansion joint. Expansion joint shall be kept completely free of all fixing materials and are to be inspected by the Owner prior to filling.

7.9 VACUUM DEWATERED CONCRETING/ TREMIX FLOORING

a. Preparation

i. The surface to receive flooring shall be dean, free from dirt and free from for material.
ii. Any undulations or mortar remaining on the floor shall be trimmed.
iii. Base course shall be trimmed.
iv. The base shall be cleaned and watered before laying the floor.
v. Work includes a all depths and heights.
vi. The finished surface shall be kept wet for a maximum period of one week.

b. Concreting

i. Concreting shall have a concrete base of M20 of specified thick ii.
Flooring shall have hard top on the concrete base.
iii. Flooring shall be laid in strips, the size of which is mentioned on the drawings.

c. Materials

i.	Cement	-	Portland
ii.	Sand	-	River sand
iii.	Aggregate	-	Max. size 10 to 20mm
iv.	Water	-	Potable
v.	Floor hardener (Optional)	-	@ 3 Kg/ Sqm

d. Execution

i. Mix cement, sand and aggregates as per grade M20 thoroughly with water to get an appropriate consistency.

ii. Prepared concrete shall be laid immediately after mixing.

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

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

v. The concrete shall then be spread over this base evenly and leveled carefully.

vi. Low areas shall be filled with concrete and humps removed. Devacumisation shall be done for removing the voids.

vii. The whole concrete surface shall be leveled, compacted by ramming and trowelling.

viii. Prepared surface shall allowed to set .

e. Hardner screed

i. Hard top to be prepared as per the specifications with Nitohardner and one part of dry cement .

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

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

iv. Excessive trowelling shall be avoided.

v. After the initial set, further compaction shall be done by steel trowelling.

vi. Final brushing shall be made before the floor top becomes too hard.

f. Curing

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

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

8.0 FINISHING WORKS

8.1 GENERAL

a. All plaster work shall be of the best workmanship and in strict accordance with the dimensions of the drawings. All plastering shall be finished to true levels including plumbs, without imperfections, and square with adjoining work. It shall form proper foundations for finishing materials such as paint etc. Masonry and concrete surface to which plaster is to be applied shall be clean, free from efflorescence, sufficiently rough and keyed to ensure proper bond.

b. Wherever directed all joints between RCC frames and masonry walls, shall be expressed by a groove in the plaster. This groove will exactly coincide with the joint beneath. At the corners of all windows and doors or other openings and wherever instructed, 24 gauge expanded galvanized metal mesh strips 300 mm wide shall be placed diagonally to prevent plaster cracks.

c. Where grooves are not called for, the joint between concrete and masonry in filling, chasing for conduits, pipes, boxes etc. shall be covered by 24 gauge expanded galvanized metal mesh strips, 300 mm wide installed before plastering. The contractor shall supply all necessary labour, material, tools and scaffolding necessary for the completion of the work detailed. He shall be responsible to take proper precautions to -all works from damage. Any work rejected through non-compliance with the specifications or damaged work shall be removed and replaced at the expense of the contractor.

d. All chasing, installation of conduits, boxes, etc. shall be completed before any plastering is commenced on a surface. Chasing or cutting of plaster will not be permitted. Broken corners shall be cut back less than 150 mm on both sides and patched with plaster of Paris as directed. All corners shall be rounded to a radius. Contractor shall get samples of each type of plaster work approved by the Owner.

e. The materials used for plastering shall be proportioned by volume by means of gauge boxes. Alternatively it may be required to proportion the materials by weight.

8.2 PLASTER WORK

a. The joints in the brick work, concrete blocks, shall be raked to a depth of 15mm while the masonry is green. Concrete surfaces to receive plaster shall be suitably roughened. All walls shall be washed with water and kept damp for 10 hours before plastering.

b. The plaster unless specified otherwise shall be average of15 mm thick on walls and minimum 6mm thick for the ceiling. The finished texture shell be as approved by the Owner. The mix for plaster unless otherwise specified, shall be one part cement and four parts sand, to walls and one part cement, 3 parts sand to ceiling.

c. The interior plaster shall be applied in one coat only. The surface shall be towelled smooth to an approved surface. All plaster work shall be kept continuously wet for seven days.

d. The external plaster shall be minimum 20mm. Preparations of walls to receive plaster work shall be the same as in internal plaster. Both layers of all external plaster shall be waterproofed with approved water proofing powder added to cement in proportion of 1.5 Kg. to 50 Kg. of cement as per the manufacturer's instruction, for both the coats.

e. For sand faced cement plaster, the finishing coat shall be in cement mortar 1:3, sand used shall be, of selected colour, properly graded and washed so as to give a grained texture.

Finishing plaster coat shall be 8mm thick, uniformly applied and surface finished with special rubbing by sponge pads and other tools and recommended by the Owner.

f. For rough cast plaster, the backing shall be floated with 3mm thick cement mortar 1:4 with fine sand, spread in small areas not exceeding 2 'Sq.mt. at a time. While this coat is still wet, the rough cast containing a mixture of 1 part of cement, 2 parts of fine sand and 1 part of gravel, 3 to 6mm size, shall be dashed on the floating coat, to a uniform thickness of 15mm thick and finished even.

8.3 Painting

a. Painting priming coat on Iron & Steel surfaces
All rust and scales shall be removed by scrapping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during raking which becomes loose by rushing, shall be removed. All dust and dirt shall be thoroughly wiped away from
the surface.

b.Textured paint
The textured finish to external surfaces of walls as per manufacturer's specification and approved by the Owner including scaffolding etc. complete.

a. Painting on New Surface

i. Preparation of surface
The surface shall be thoroughly brushed free from mortar droppings and other foreign matter and sand papered smooth. Pitting in plaster shall be made good with plaster of Paris mixed with the colour to be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of paint shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular of acrylic emulsion paint is applied.

A priming coat shall be applied over the prepared surface. No white washing coat shall be used as a priming coat.

ii. Application
The number of coats shall be as stipulated in the item. The paint will be applied in the usual manner with brush and roller. The paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surfaces to 2 to 3 hours on non-absorbent surfaces.

The thinning of emulsion is to be done with water and not with turpentine. Thinning with water will be particularly required for the undercoat which is applied on the absorbent surface. The quantity of water to be added shall be as per manufacturer's instructions.

The surface on finishing shall present a flat velvety smooth finish. If necessary mo e ats will be applied till the surface presents a uniform appearance.

iii. Precautions
Old brushes and rollers if they are to be used with emulsion paints, should be completely dried of turpentine or oil paints by washing in warm soap water.

Brushes and rollers should be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush and roller.

In the preparation of walls for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.

Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.

Washing of surfaces treated with emulsion paints shall not be done within 3 to 4 weeks of application.

9.0 MISCELLANEOUS WORKS

9.1 STRUCTURAL STEEL WORK

a. This specification covers the fabrication and transportation to site and erection on prepared foundations and structural steel work consisting of beams, columns, vertical trusses, bracings, shear connections etc.

b. Fabrication, erection and approval of steel structures shall be in compliance with :
i. These General Specifications and IS : 800 - 1984
ii. Drawings and supplementary drawings to be supplied to the contractors during execution of the work .

c. Providing shop primer coat for steel structures. Grouting of holding-down bolt pockets and below base plates where required.

d. In case of conflict between the Clauses mentioned here and the Indian Standards, those expressed in this specification shall govern.

9.2 SCOPE

The fabrication and erection of the steel work consists of accomplishing of all jobs here-in enumerated including providing all labour, tools and plant all materials and consumables such as welding electrodes, bolts and nuts, oxygen and acetylene gases, oils for cleaning etc. of approved quality as per relevant IS. The work shall be executed according to the drawings, specifications, relevant codes etc. in an expeditious and workman like manner, as detailed in the specifications and the relevant Indian- Standard Codes and Standard Practice and to the complete satisfaction of the Owner.

9.3 FABRICATION DRAWINGS

a. The contractor shall prepare all fabrication and erection drawings on the basis of design drawings supplied to him and submit the same in triplicate to the Owner for review, Owner shall review and comment, if any, on the same. Such review, if any, by the Owner, does not relieve the contractor of any of his required guarantees responsibilities. The contractor shalt however be responsible to fabricate the structural strictly conforming to specifications and reviewed drawings.

b. Fabrication drawings shall include the following :
i. Member sizes and details.
ii. Types and dimensions of welds and bolts.
iii. Shapes and sizes of edge preparation for welding.
vi. Details of shop and field joints included in assemblies .

c. Bill of material
i. Quality of structural steels, welding electrodes, bolts, nuts and washers etc. to be used.
ii. Erection assemblies, identifying all transportable parts and sub-assemblies, associated with special erection instructions, if required.
iii. Calculations where asked for, for approval.

d. Connections, splices etc. other details not specifically detailed in design drawings shall be suitably given on fabrication drawings considering normal detailing practices and developing full member strengths. Where asked for calculations for the merit shall also b submitted for approval.

e. Any alternate design or change in section is allowed when approved in writing by the Owner.

f. However if any variation in the scheme is found necessary later, the contractor will be supplied with revised drawings. The contractor shall incorporate these changes in his drawings at no extra cost and resubmit for review.

g. Owner review shall not absolve the contractor of his responsibility for the correctness of dimensions, adequacy of details and connections. One copy will be returned reviewed with or

without comments to the contractor for necessary action. In the former case further three copies of amended drawings shall be submitted by the contractor for final review.

h. The contractor shall supply three prints each of the final reviewed drawings to the Owner within a week since final review, at no extra cost for reference and records.

i. The Owner will verify the correct interpretation of their requirements.

j. If any modification is made in the design drawing during the course of execution of the job, revised design drawings will be issued to the contractor. Further changes arising out of these shall be incorporated by the contractor in the fabrication drawings already prepared at no extra cost and the revised fabrication drawings shall be duly got reviewed as per the above Clauses.

9.4 MATERIALS:

a. Rolled Sections

The following grades of steel shall be used for steel structures:

Structural steel will generally be of standard quality conforming to IS: 226. Whenever welded construction is specified plates of more than 20mm thickness will generally conform to IS: 2062.

b. Welding Materials

Welding electrodes shall conform to IS: 814.

Approval of welding procedures shall be as per IS: 823.

c. Bolts, Nuts & Washers

Bolts and nuts shall be as per IS: 1367 and tested as per IS: 1608. It shall have a minimum tensile strength of 44 Kg/mm2 and minimum elongation of 23% on a gauge length of 5.65 (A-Original cross sectional area of the gauge length). Washers shall be as per IS: 2016.

d. All materials shall conform to their respective specifications. The use of equivalent or Higher grade or alternate materials will be considered only in very special cases subject to he approval of the Owner in writing.

e. Receipt & Storing of Materials

Steel materials supplied by the contractor must be marked for identification and each lot should be accompanied by manufacturer's quality certificate, conforming chemical anal ' is and mechanical characteristics.

All steel parts furnished by supplier shall be checked, sorted out, straightened, and arranged by grades and qualities in stores.

Structural with surface defects such as pitting, cracks, laminations etc. shall be rejected if the defects exceed the allowable tolerances specified in relevant standards or as directed by the Owner.

Welding wire and electrodes shall be stored separately by qualities and lots inside a dry and enclosed room, in compliance with IS: 816 - 1969 and as per instructions given by the Owner. Electrodes shall be perfectly dry and drawn from an electrode even, if required.

Checking of quality bolts of any kind as well as storage of same shall be made conforming to relevant standards.

Each lot of electrodes, bolts, nuts, etc. shall be accompanied by manufacturer's test certificate.

The contractor may use alternative materials as compared to design specification only with the-Aviitte4r-vproval-of-tfie-Owner.

f. Material Tests

The contractor shall be required to produce manufacturer's quality certificates for the materials supplied by the contractor. Notwithstanding the manufacturer's certificates, the Owner may ask for

testing of materials in approved test houses. The test results shall satisfy - the requirements of the relevant Indian Standards.

Whenever quality certificates are missing or incomplete or when material quality differs from standard specifications the contractor shall conduct all appropriate tests as directed by the Owner at no extra cost.

Materials for which test certificates are not available or for which test results do not tally with relevant standard specifications, shall not be used.

9.5 FABRICATION
Fabrication shall be in accordance with IS: 800 Section V in addition to the following:

Fabrication shall be done as per approved fabrication drawings adhering strictly to work points and work lines on the same. The connections shall be welded or bolted as per design drawings. Work shall also include fabricating built up sections.

Any defective material used shall be replaced by the contractor at his own expense, care being taken to prevent any damage to the structure during removal.

All the fabricated and delivered items shall be suitably packed to be protected from any damage during transportation and handling. Any damage caused at any time shall be made good by the Contractor at his own cost.

Any faulty fabrication pointed out at any stage of work shall be made good by the contractor at his own cost.

a. Preparation of Materials
Prior to release for fabrication, all rolled sections warped beyond allowable limit shall be pressed or rolled straight and freed from twists, taking care that a uniform pressure is applied.

Minor warping, corrugations etc. In rolled sections shall be rectified by cold working.

The sections shall be straightened by hot working where the Owner so direct and shall cooled slowly after straightening.

Warped members like plates and flats may be used as such only if wave like deformation does not exceed L/1000 but limited to 10mm (L-Length).

Surface of members that are to be joined by lap or fillet welding or bolting shall be even so that there is no gap between overlapping surfaces.

b. Marking
Marking of members shall be made on horizontal pads, of an appropriate racks or supports in order to ensure horizontal and straight placement of such members.
Marking accuracy shall be atleast + 1 mm.

c. Cutting
Members shall be cut mechanically (by saw or shear or by oxyacetylene flame).

All sharp rough, or broken edges, and all edges of joints-which are subjected to tensile or oscillating stresses, shall be ground.

No electric metal arc cutting shall be allowed.

All edges cut by oxyacetylene process shall be cleaned of impurities prior to assembly.

Cutting tolerances shall be as follows:
i. For members connected at both ends + 1 mm.
ii. Elsewhere + 3 mm.

The edge preparation for welding of members more than 12mm thick shall be done by flame cutting and grinding. Cut faces shall not have cracks or be rough.

Edge preparation shall be as per IS: 823 - 1964.

d. Drilling
Bolts holes shall be drilled.

Drilling shall be made to the diameter specified in drawings.

No enlarging of holes filling, by mandrolling or oxyacetylene flame shall be allowed.

Allowed variations for holes (out-of-roundness, eccentricity, plumb-line deviation) shall be as per IS: 800.
i. Maximum deviation for spacing of two holes on the same axis shall be + 1 min:
ii. Two perpendicular diameters of any oval hole shall not differ by more than 1 mm.

Drilling faults in holes may be rectified by reaming the holes to the next upper diameter, provided that spacing of new hole centres and distance of hole centres to the edges of members are not less than allowed and that the increase of hole diameter does not impair the structural strength. Hole reaming shall be allowed if the number of faulty holes does not exceed 15% of the total number of holes for one joint.

e. Preparation of Members for Welding
Assembly of structural members shall be made with proper jigs and fixtures to ensure correct positioning of members (angles, axes nodes etc.)

Sharp edges, rust of cut edges, notches, irregularities and fissures due to faulty cutting shall be chipped or ground or filled over the length of the affected area, deep enough to remove faults completely.

Edge preparation for welding shall be carefully and accurately made so as to facilitate a good joint.

Generally no special edge preparation shall be required for members under 8mm thick.

Edge preparation (bevelling) denotes cutting of the same so as to result in V. X K or U seam shapes as per IS: 823.

The members to be assembled shall be clean and dry on the welding edges. Under no circumstances shall wet, greasy, rust or dirt covered parts be assembled. Joints shall be kept free from any foreign matter likely to get in to the gaps between members to be welded.

Before assembly the edges to be welded as well as adjacent areas extending for atleast 20mm shall be cleaned (until metallic polish is achieved).

When assembling members, proper care shall be taken of welding shrinkage and distortions, as the drawing dimensions cover finished dimensions of the structure.

The elements shall be got checked and approved by the Owner or their authorised Its representative before assembly.

The permissible tolerances for assembly of members preparatory to welding shall be as per IS: 823-1964.

After the assemble has been checked, temporary tack welding in position shall be done by electric welding, keeping in view finished dimensions of the structure.

f. Welding procedures

Welding shall be carried out only by fully trained and experienced welders as tested and approved by the Owner. Any test carried out either by the Owner or their representative or the inspectors shall constitute a right by them for such tests and the cost involved thereon shall be borne by the contractor himself.

Qualification tests for welders as well as tests for approval of electrodes will be carried out as per IS: 823. The nature of test for performance qualification of welders shall be commensurate with the quality of welding required on this job as judged by the Owner.

The steel structures shall be automatically, semi-automatically or manually welded.

Welding shall begin only after the -checks mentioned in Clause 9.5.a to 9.5.e have been carried out.

The welder shall mark with his identification mark on each element welded by him.

When welding is carried out in open air, steps shall be taken to protect the face of welding against wind or rain. The electrodes, wire and parts being welded shall be dry.

Before beginning the welding operation, each joint shall be checked to ensure that the parts to be welded are clean and root gaps provided as per IS: 823.

For continuing the welding of seems discontinued due to some reason, the end the discontinued seem shall be melted in order to obtain a good continuity. Before res the welding operation, the groove as well as the adjacent parts shall be well cleaned or a length of approx.

For single butt welds (in V, 1/2 V or U) and double butt welds (in K, double U etc.) the rewelding of the root is mandatory but only the metal deposit on the root has been cleaned by back gouging or chipping.

The welding seams shall be left to cool slowly. The contractor shall not be allowed to cool the welds quickly by any other method.

For multi-layer welding, before welding the following layer, the formerly welded layer shall be cleaned metal bright by light chipping and wire brushing. Backing strips shall not be allowed.

The order and method of welding shall be so that
i. No unacceptable deformation appears in the welded parts.
ii. Due margin is provided to compensate for contraction due to welding in order to avoid any high permanent stresses.

The defects in welds must be rectified according to IS: 823 and as per instruction of Owner.

g. Weld Inspection
The weld seams shall satisfy the following
i. shall correspond to design shapes and dimensions.
ii. shall not have any defects such as cracks, incomplete penetration and fusion, under-cuts, rough surfaces, burns, blow holes and porosity etc. beyond permissible limits.

During the welding operation and approval of finished elements, inspections and tests shall be made as per IS Code.

The mechanical characteristics of the welded joints shall be as in IS: 823.

h. Preparation of Members for Bolting
The members shall be assembled for bolting with proper jigs and fixtures to sustain the assemblies without deformation and bending.

Before assembly, all sharp edges, shavings, rust dirt, etc. shall be removed.

Before assembly, the contacting surfaces of the members shall be cleaned and given a coat of primer as per IS: 2074.

The members which are bolt assembled shall be set according to drawings and temporarily fastened with erection bolts (minimum 4 pieces) to check the coaxiality of the holes.

The members shall be finally bolted after the deviations have been corrected, after which there shall not be gaps.

Before assembly, the members shall be checked and got approved by the Owner.

The difference in thickness of the sections that are butt assembled shall not be more than 3% or maximum 0.8mtn whichever is less. If the difference is larger, it shall be corrected by grinding or filling.

Reaming of holes to final diameter or cleaning of these shall be done only after the parts have been check assembled.

As each hole is finished to final dimensions (reamed if necessary) it shall be set and bolted up. Erection bolts shall not be removed before other bolts are set.

i. Bolting up
Final bolting of the members shall be done after the defects have been rectified and approval of joints obtained.

The bolts shall be tightened starting from the centre of joint towards the edge.

j. Planing of Ends
Planing of ends of members like column ends shall be done by grinding when so specified in the design.

Planing of butt welded members shall be done after these have been assembled, the spare edges shall be removed with grinding machines or files.

The following tolerances shall be permitted on members that have been planed.
i. On the length of the member having both ends planed, maximum + 2 mm with respect to design.
ii. Level differences of planed surfaces, maximum 0.3 mm.
iii. Deviation between planed surface and member's axis maximum 1/1500.

k. Holes for Field Joints
Holes for field joints shall be drilled in the shop to final diameters and tested in the shop, with trial assemblies.

When three-dimensional assembly is not possible in the shop, the holes for field joints may be drilled in shop and reamed on site after erection, on approval by the Owner.

For bolted steel structures, trial assembly in shop ii mandatory.

The tolerance for spacing of holes shall be + 1 mm.

l. Tolerances
All tolerances regarding dimensions, geometrical shapes and sections of steel structures, shall be as per IS Code, if not specified in the drawing.

m. Marking for Identification
All elements and members prior to despatch for erection shall be shop marked.

The members shall be visibly marked with a weather proof light coloured paint The size and thickness of the numbers shall be chosen as to facilitate the identification of members.

For the small members that are delivered in bundles or crates, the required marking shall b done on small metal tags securely tied to the bundle, while the crates shall be marked directly.

Each bundle or crate shall be packed with members for one and the same assembly; in same bundle or crate, general utility members such as bolts, quests etc. may be packed.

All bills of materials showing weight, quality and dimension of contents shall be placed in the crates.

The members shall be marked with a durable paint, in a visible location, preferably at one end of the member so that these may be easily checked during storage and erection.

All members shall be marked in the shop before inspection and acceptance.

When the member is being painted, the marking area shall not be painted but bordered with white paint.

The marking and job symbol shall be registered in all shop delivery documents (transportation, for erection etc.)

n. Shop Test Pre-assembly
For steel structures that have the same type of welding the shop test pre-assembly shall be performed on one out of every 10 members minimum.

For bolted steel structures, shop test pre-assembly is mandatory for all elements as well as for the entire structure in conformity with Clause 9.5.k.

9.6 Shop Inspection and Approval a. General
The Owner or their representative shall have free access at all responsible times to the contractors fabrication shop and shall be afforded all reasonable facilities for satisfying himself that the fabrication is being undertaken in accordance with drawings and specifications.

Technical approval of the steel structure in the shop by the Owner is mandatory.

The contractor shall not limit the number and kinds of tests, final as well as intermediate once, or extra tests required by the Owner.

The contractor shall furnish necessary tools, gauges, instruments etc. and technical non-technical personnel for shop tests by the Owner, free of cost.

b. Shop Acceptance
The Owner shall inspect and approve at the following stages :

The following approvals may be given in shop:
i. Intermediate approvals of work that cannot be inspected later.
ii. Partial approvals
iii. Final approvals

Intermediate approval of work shall be given when a part of the work is preformed later:
i. Cannot be inspected later
ii. Inspection would be difficult to perform and results would not be satisfactory.

Partial approval in the shop is given on members and assemblies of steel structures before the primer coat is applied and includes:
i. Approval of materials
ii. Approval of field joints .
iii. Approval of parts with planed surfaces
iv. Test erection
v. Approval of members
vi. Approval of markings

vii. Inspections and approvals of special features like Rollers, loading platform mechanism etc.

During the partial approval, intermediate approvals as well as all former approvals, shall be taken in to consideration.

c. Final approval in the Shop
The final approval refers to all elements and assemblies of the steel structures, with shop primer coat, ready for delivery from shop to be loaded for transportation, or stored.

The final approval comprises of:
i. Partial approval
ii. Approval of shop primer coat
iii. Approval of mode of loading and transport
iv. Approval of storage (for materials stored)

9.7 PAINTING AND DELIVERY
a. Preparation of parts for shop painting
Painting shall consist of providing one coat of red oxide zinc chromate primer to steel members before despatch from shop.

Primer coat shall not be applied unless:
i. Surface have been wire brushed, cleaned of dust, oil, rust etc.
ii. Erection gaps between members, spots that cannot be painted or where moisture or other aggressive agents may penetrate, have been filled with an approved type of oil and putty.
iii. The surfaces to be painted are completely dry. iv.
iv. The parts where water of aggressive agents may collect (during transportation, storage, erection and operation) are filled with putty and provided with holes for drainage of water.
v. Members and parts have been inspected and accepted.
vi. Welds have been accepted.

The following are not to be painted or protected by any other product:
i. Surface which are in the vicinity of joints to be welded at site.
ii. Surfaces bearing markings
iii. Other surfaces indicated in the design.

The following shall be given a coat of hot oil or any approved resistant lubricant only.
i. Planed surfaces
ii. Holes for links

The surfaces that are to be embedded or in contact with the concrete shall be given a cost of cement wash.

The surfaces which are in contact with the ground, gravel or brick work and subject to moisture, shall be given bituminous coat.

The other surfaces shall be given a primer coating.

Special attention shall be given to locations not easily accessible, where water can collect and which after assembly and erection cannot be inspected, painted and maintained. Holes shall be provided for water drainage and in accessible box type sections shall be hermetically sealed by welds.

If specified elsewhere, in the schedule of quantities, the contractor shall paint further coats of red-oxide after erection and placing in position of the steel structures.

b. Packing, transportation, delivery
After final shop acceptance and marking, the item shall be packed and loaded for transportation.

Packing must be adequate to protect item against warping during loading and unloading.

Proper lifting devices shall be used for loading, in order to protect items against warping.

Slender projecting parts shall be braced with additional steel bars, before loading, for protection against warping during transportation.

Loading and transportation shall be done in compliance with transportation rules.

If certain parts cannot be transported in the lengths stipulated in the design, the position and type of additional splice joints shall be approved by the Owner.

Items must be carefully loaded on platforms of transportation means to prevent warping, bending or falling during transportation.

The small parts such as fish-plates, quests etc. shall be securely tied with wire to their respective parts.

Bolts, nuts and washers shall be packed and transported in crates.

The parts shall be delivered in the order stipulated by the Owner and shall be accompanied by document showing.
i. Quality and quantity of structure or members
ii. Position of member in the structure
iii. Particulars of structure
iv. Identification number joy symbol

9.8 FIELD ERECTION
a. The erection work shall be permitted only after the foundation or other structure over which the steel work will be erected is approved and is ready for erection.

b. The contractor shall satisfy himself about the levels, alignment etc. for the foundations well in advance, before starting the erection. Minor chipping etc. shall be carried out by the contractor on his expense.

c. Any faulty erection done by the contractor shall be made good at his own cost.

d. Approval by the Owner or their representatives at any stage of work does not relieve the contractor of any of his required guarantees of the contract.

e. Storage and preparation of parts prior to erection
The storage place for steel parts shall be prepared in advance and got approved by the Owner before the steel structures start arriving from the shop.

A platform shall be provided by the Contractor near the erection site for preliminary erection work.

The contractor shall make the following verifications upon receipt of material at site.
i. For quality certificates regarding materials and workmanship according to these general specifications and drawings.
ii. Whether pants received are complete without defects due to transportation, loading and unloading and defects, if any, are well within the admissible limit.

For the above work sufficient space must be allotted in the storage area.

Steps shall be taken to prevent warping of items during unloading.

The parts shall be unloaded, stored and stored so as to be easily identified.

The parts shall be stored according to construction symbol and markings so that these may be taken out in order or erection.

The parts shall be at least 150mm clear from ground on wooden or steel blocks for protection against direct contact with ground and to permit drainage of water.

If rectification of members like straightening etc. are required, these shall be done in a special place allotted which shall be adequately equipped.

The parts shall be clean when delivered for erection.

f. ERECTION & TOLERANCES

Erection in general shall be carried out as required and approved by the Owner.

Positioning and levelling of the structure, alignment and plumbing of the stanchion and fixing every member of the structure shall be in accordance with the relevant drawings and to the complete satisfaction of the Owner.

The following checks and inspection shall be carried out before during and after erection.

i. Damage during transportation
ii. Accuracy of alignment of structures
iii. Erection according to drawings and specifications
iv. Progress and workmanship.

In case there are any deviations regarding positions of foundations or anchor bolts, which would lead to erection deviations, the Owner shall be informed immediately. Minor rectifications in foundations, orientation of bolts holes etc. shall be carried out as part of the work, at no extra cost.

The various parts of the steel structure shall be so erected so to ensure stability against inherent weight, wind and erection stresses.

The structure shall be anchored and final erection joints completed after plan and elevation positions of the structural members have been verified with corresponding drawings and approved by the Owner.

The bolted joints shall be tightened so that the entire surface of the bolt heads and nuts shall rest on the member. For parts with sloping surfaces tapered washers shall be used.

9.9 FINAL ACCEPTANCE AND HANDING OVER THE STRUCTURE a.

At acceptance, the contractor shall submit the following document :

i. Shop and erection drawings - either in tracings or reproducible.
ii. 4 copies of each of the following:

- shop acceptance documents
- Quality certificate for structural’s, plates, etc. <electrodes, welding wire, bolts, nuts, washers etc.)
- List of certified welders who worked on erection of structures.
- Acceptance and intermediate control procedure of erection operations.

b. Approval by the Owner at any stage of work does not relieve the contractor of any of his required guarantees of the contract.

9.10 METHOD OF PAYMENTS

a. Payment for steel work shall be made on basis of admissible weight of the structure accepted, the weight being determined as -described in such Clause 7.10.b below:

The rate for supply, fabrication, and erection, shall include cost of all handling and transportation to Owner's store/ site of work where supply and fabrication only involved, trimming, straightening, edge preparation, preparation and getting mewed f fabrication drawings, and providing one or more coat of red-oxide/ zinc chromate prime as specified in the schedule of quantity.

In the case, Owner supplies materials the rate shall include cost of steel materials taking delivery of the materials, from owner's store all handing and rehandling, loading and unloading, transport to site

or work, returning of surplus materials to owner's stores etc. complete as well as the cost of all handling and transport, scaffolding, temporary supports, tools and tackles, touching up primer coat, grouting etc.

b. The actual lengths installed shall be measured and the weight of structural material/ plate shall be calculated wherever necessary on the basis of IS handbook. If sections are different from IS section, then manufacturers handbook shall be adopted. No allowance in weights shall be made for rolling tolerance.

c. Sections built out of plates, structural shall be paid on the actual weight incorporated except for gussets which will be paid on the weight of the smallest rectangle enclosing the shape. No deductions shall be made for skew cuts in rolled steel sections.

d. Welds, bolts, nuts, washers, etc. shall not be measured. Rate for structural steel work shall be deemed to include the same.

e. No other payment either for temporary works connected with this contract or for any other item such as welds, shims, splicing plates etc. shall be made. Such item shall be deemed to have been allowed for in the rate quoted for steel work.

9.11 GROUTING OF POCKETS

a. Grouting of pockets and under base plates will be done only after the steel work has been . levelled and plumbed and the bases of stanchions are supported by steel shims. The space below the base plate and pockets shall be thoroughly cleaned.

b. The mortar used for grouting shall not be leaner than 1:2 (1cement : 2 sand) (grade M 30 in case of concrete) and shall be mixed to the minimum consistency required. It shall be poured under suitable head and tamped until the space has been completely filled.

10.0 ROAD WORKS:

10.1 SCOPE

This specification deals with general specifications of roadwork and also excavation for road work, preparation of sub-grade, sub-base, base and surface courses.

10.2 QUALITY CONTROL

For check on quality of Road item, refer IRC special publication 11 "Hand book of Quality Control for Construction of Roads and Runways".

10.3 EARTH WORK

a. Site Clearance

Site clearance shall be as specified and directed by the Owner.

b. SETTING OUT AND MAKING PROFILE

Masonry pillars shall be erected at suitable points in the area which is visible from the largest area-to-serve-as -bench-mark, for-the excavation-of the-work. pegs, bamboos and strings or 'Burjis' shall be made to show the correct formation levels before the work is started.

Ground levels shall be taken at 5 to 15 metres intervals <or as directed by the Architect/ Owner) in uniformly, sloping ground and at closer intervals where local mounds, pits or undulations are met with. The ground levels shall be recorded in field books and plotted on plans. The plans shall be drawn to a suitable scale as decided by the Architect/ Owner. These plans shall be signed by the Contractor and the Architect/ Owner or his representative before earth work is started. Labour and instruments required for taking levels shall be supplied by the contractor at his own cost and also shall bear the cost of making pillars for bench marks.

c. MEASUREMENTS

i. The length, breadth and depth shall be measured correct to a cm. in case the measurements are taken with tape. If the measurements are taken with staff and level, the level shall be recorded correct to 5 mm and depth of cutting and heights of filling calculated correct to 5mm. The cubical contents shall be worked out to the nearest two places of decimal, in cubic meter.

ii. Where excavation is in fairly uniform ground, the measurements of cutting in trenches or barrow pits shall be made.

iii. Where the ground is not fairly uniform or where the site is required to be levelled, levels shall be taken before the start and after the completion of the work and the quantity of excavation in cutting computed from these levels.

iv. Where it is not possible or convenient to take measurements from barrow pits or cutting, excavation shall be worked out from filling. The actual measurements of the fill shall be calculated by taking levels, of the original ground before start of the work after site clearance and after compaction of the fill at suitable intervals and the quantity of earth work so computed shall be reduced by 10% in case of consolidation fills, 5% in case the consolidation is done by heavy mechanical machinery to arrive at net cubical contents. No such deduction shall, however, be done in case of:

- Consolidation done by heavy machinery at optimum moisture contents.
- Consolidation fillings in confined situation such as under floors

10.4 SUB-GRADE

a. Preparation of sub-grade

The surface of the formation for a width of sub base, which shall be 15 cm. more on either side of base course, shall first be cut to a depth equal to the combined depth of such base (stone soling), base and surface courses below the proposed finished level. it shall be cleaned of all foreign substances and sub grade dressed off parallel to the finished profile and compacted and surface got approved from the Architect/ Owner. The density to be achieved shall not be less than 95% of the density obtained in the laboratory (Proctor Method).

10.5 SUB-BASE

a. With Stone soling

The size of stone should not be more than 22:5 cm nor less than 10 cm. in any direction, and height equal to the soling course with tolerance of 25 mm. After the preparation of sub grade, stone soling shall be laid. Care shall be taken that stones are laid on edges and packing with small stones shall be done as soling work proceeds blinding material shall then be spread and consolidation done with power roller (8 - 10 Tons). Irregularities in surface shall be—corrected as consolidation-proceeds. Rate shall include the cost of all materials and labour required for all operations mentioned above.

b. Water bound macadam

Water bound macadam with stone aggregate 90mm to 45mm size. This consists of clean crushed coarse aggregate mechanically interlocked by rolling, and voids thereof filled with screening and binding material with the assistance of water, laid on a -prepared subgrade, sub base or the case may be coarse aggregate.

i. Quantities of materials

Quantities of coarse aggregate screening and binding material required to be stacked for 100mm approximate compacted thickness of WBM sub base coarse for 10 Sqm shall be as per Table 10.1 below:

TABLE - 10.1

Coarse Aggregate	Stone screening	Binding material
Classification/ Size/ Loose Qty	Grading-Classification/ size/ loose qty	
Grading-I/90mm to 45mm/ 1.21 Cum to 1.28 Cum.	Type A/ 13.2mm/ 0.27 Cum to 0.30 Cum.	0.08 Cum to 0.10 Cum.

ii. The water bound macadam sub-base shall be normally constructed in layers of 100mm compacted thicknesses. No segregation of large or fine particles shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pockets of fine material.

10.6 BASE

a. WBM: Same as item 10.5.b except size of coarse aggregate, which shall be 63 mm to 45 mm size in this case.

i. Quantities of materials

Quantities of coarse aggregate and screening required for 75mm (approximate) compacted thickness of WBM base courses for 10 Sqm. shall be as specified below Table, 10.2.

TABLE-10.2

Coarse aggregate	Stone Screening
Classification/ Size range/ Loose Qty.	Grading Classification/Size/Loose QtY
Grading-2/63 — 45rnm/0.91 to 0.96 Cum. Grading-2/63 — 45mm/0.91 to 0.96 Cum	Type-A/13.2mm/0.12 to 0.15 Cum Type-B/11.2mm/0.20 to 0.22Cum

The quantity of binding material required for 75mm (approximate) compacted thickness will be 0.09 Cum/10 Sqm. in case of WBM base coarse and 0.13 Cum/10 Sqm. when the WBM is to function as surface coarse.

b. Spreading Aggregate

The coarse aggregate shall be spread uniformly and evenly upon the prepared base in required quantities with a twisting motion to avoid segregation. In no case shall these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a-partly-completed base be

permitted. The aggregates shall be spread uniformly to proper profile by using templates placed

across the road six metres apart. The levels along the longitudinal direction up to which the metal shall be laid, shall be first obtained at site to the satisfaction of the Owner and these shall be adhered to.

The surface of the aggregate spread shall be carefully trued up and all high or low spots remedied by removing or adding aggregate as may be required.

The WBM sub-base shall be normally constructed in layers of 100mm compacted thickness . No segregation of large or fine particles shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pockets of fine material.

c. Rolling

Immediately following the spreading of the coarse aggregate, it shall be compacted to the full width by rolling with either a three-wheel-power-roller of 8 to 10 tonnes capacity or an equivalent vibratory roller. Initially, light rolling is to be done, which shall be discontinued when the aggregate is partially compacted with sufficient void space in them to permit application of screenings.

The rolling shall begin from the edges with the roller running forward and backward and adding the screenings simultaneously until the edges have been firmly compacted. The roller shall then progress gradually from the edges to the centre, parallel to the centre line of the road and overlapping uniformly each preceding rear wheel track by one half

widths and shall continue until the entire area of the course has been rolled by the rear wheel. Rolling shall continue until the road metal is thoroughly keyed with no creeping of metal -ahead of the roller. Only slight sprinkling of water may be done during rolling, if required. On super elevated curves, the rolling shall proceed from the lower edge and progress gradually continuing towards the upper edge of the pavement.

Rolling shall not be done when the sub grade is soft or yielding or when the rolling causes a wave like motion in the sub-base or sub-grade. When rolling develops irregularities that exceed 12mm when tested with a three meter straight edge, the irregular surface shall be loosened and then aggregate added to or removed from it as required and the area rolled until it gives a uniform surface conforming to the desired cross-section and grade. The surface shall also be checked transversely by template for camber and any irregularities corrected in the manner described above. In no C2Se shall the use of screenings to m up depressions be permitted.

i. Test for finding if the consolidation has been fully done is:

A piece of about 25mm stone is put on the consolidated surface and roller passed over it, it will be driven in if the consolidation is incomplete. Or, a fully loaded bullock cart going over it makes no impression.

d. Application of Screenings

After the coarse aggregate has been lightly rolled to the required true surface, screenings shall be applied gradually over the surface to completely fill the interstices. Dry rolling shall be continued while the screenings are being spread so that the jarring effect of the roller causes them to settle in to the voids of the coarse aggregates. The screenings shall not be dumped in piles on the coarse aggregate but shall be spread uniformly in successive thin layers either by the spreading motion of the hand, shovels or a mechanical spreader.

The screenings shall be applied at a slow rate (in three or more applications) so as to ensure filling of all voids. Rolling and brooming shall continue with the spreading of the screenings. Either mechanical brooms or hand brooms or both may be used. In no case shall be screenings be applied, so fast and thick as to form cakes, ridges on the surface making the filling of voids difficult or to prevent the direct-bearing of-the-roller on the coarse aggregates. The spreading, rolling and brooming of screenings shall be performed on sections which can be completed within one day's operation of the coarse aggregate. Damp and wet screenings shall not be used under any circumstances.

e. Sprinkling and Grouting

After spreading the screening and rolling the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to seep the wet screening in to the voids and to distribute them evenly. The sprinkling, sweeping and rolling operations shall be continued and additional screenings applied where necessary until the coarse aggregates are well bonded and firmly set for the entire depth and until a grout has been formed of screening and water that will fill all voids and form a wave of grout ahead of the wheels of the roller. The quantity of water to be used during the construction shall not be excessive so as to cause damage to the sub-base or sub-grade.

f. Application of binding materials
After the application of screenings and rolling, a suitable binding material shall be applied at a uniform and slow rate in two or more successive thin layers. After each application of binding material the surface shall be copiously sprinkled with water and the resulting slurry swept in with hand brooms or mechanical brooms or both so as to fill the voids properly. The surface shall then be rolled by 8 - 10 tonne roller, water being applied to the wheels in order to wash down the binding material that may get stuck to the wheels. The spreading of binding material, sprinkling of water, sweeping with brooms and rolling shall continue until the slurry that is formed will, after filling the voids form a wave ahead of wheels of the moving roller.

g. Setting and Drying
After final compaction of the course, the road shall be allowed to cure overnight. Next morning defective spots shall be filled with screenings or binding material, lightly sprinkled with water, if necessary and rolled. No traffic shall be allowed till the macadam sets.

h. Surface evenness
The surface evenness of completed WBM sub-base in the longitudinal and transverse directions shall be as specified below: 66 75:1

TABLE - 10.3

Size of coarse aggregate	Longitudinal Profile	Cross Profile
	Maximum permissible I undulation when measured with I a 3 Mtr. straight edge.	Maximum permissible undulation when measured with a camber template
45 - 90mm .	12mm	8mm

The longitudinal profile shall be checked with a 3 Mtr. long straight edge at the middle of each traffic lane along a line parallel to the centre line of the road. The transverse profile shall be checked with a series of three camber boards at intervals of 10 metres.

i. Rectification of defective construction
Where the surface irregularity of the VC/BM sub-base course exceeds the tolerances specified in Table 10.3 or where the course is otherwise defective due to sub-grade soil mixing with the aggregates, the layer to its full thickness shall be scarified over the affected area, reshaped with added material or removed -and -replaced with fresh material as applicable and compacted. The area treated in the aforesaid manner shall not be less than 10 Sqm. In no case shall depressions be filled up with screenings and binding materials.

j. Measurements
The length and breadth shall be taken- to the nearest centimetre and thickness to the nearest half centimetre. The consolidated- cubical contents shall be calculated in cubic metres correct to two places of decimals.

10.7 PREMIX CARPET WITH HOT BITUMEN

a. The treatment consists of applying a tack coat on the prepared base followed immediately by spreading aggregates precoated with specified binder to camber and consolidated. Premix carpet shall not be laid during rainy weather or when the atmospheric temperature in the shade is 160C or below.

b. Aggregates

The aggregates shall consist of angular fragments and the clean, hard, tough, demolish and of uniform quality throughout. They shall be crushed rock and should be free of elongated or flaky pieces, soft and disintegrated material, vegetable or other deleterious matter. The aggregate shall also satisfy the following properties:

TABLE - 10.4

S.NO	Property	Value	Method of Test
1.	Abrasion value using Los angles machine or aggregate impact value	Max.35%	IS: 2386 (Part-IV)
2.	Flakiness index	Max.25%	IS: 2386 (Part-I)
3.	Stripping value	Max. 25%	IS : 6241
4.	Water absorption	Max. 1%	IS : 2386 (Part-III)

The aggregate shall be dry and heated to a temperature in the range of 155°C — 1630 before these are placed in the mixer. After about 15 seconds of dry mixing, the heated binder shall be distributed over the aggregates at the rate specified. At no time shall be difference in temperature between the aggregate and the binder exceeds 14°C.

The mixing of binder with chipping shall be continued until the chipping is thoroughly coated with the binder. The mix shall be immediately transported from the mixer to the point of use or suitable vehicles or wheel barrows. The vehicles employed for transport shall be clean and be covered over in transit if so directed. The temperature of mix at the time of laying shall be in the range of 1210 - 1630C.

c. QUANTITIES OF MATERIALS

Quantities of materials shall be as given in Table below. A proper record shall be kept to ensure daily out turn of work is co-related with the quantity of bitumen used.

TABLE - 10.5

Consolidated Thickness	Binder hot bitumen		Stone chipping	
	Track coat (Kg./Sqm)	Carpet	Cum /100Sqm 13.2mm	11.2mm
2.00 cm		53 Kg./Cum of 13.2mm size and 56 Kg./Cum of 11.2mm size stone chipping	1.80	0.90
2.50 cm	1.00	-Do-	2.25	1.12
4.00 cm	1.00	-Do-	3.60	1.80

d. Binder

The binder shall be straight run bitumen of penetration grade 80/100 complying with IS: 73 - 1961.

e. Preparation of surface and cleaning
Prior to the application of the binder, all dust, dirt, caked mud, animal dung, loose and foreign material etc. shall be removed 30 cm. on either side, beyond the full width to be treated. For water bound macadam surface, the interstices between the road metal shall be exposed up to a depth of 10mm by means of wire brushes. The surface shall then be brushed clean. The traces of fine dust shall be thoroughly removed from the surface by blowing air by air compressor.

f. Applying tack coat
The binder shall be heated in a boiler to a temperature shall be in the range of 1-60°C -1770C and maintained at that temperature. The use of thermometer is essential.

The binder shall be applied evenly by means of pressure sprayer at the specified rate and longitudinally along the length of the road and across it. The edges of binder shall be defined by wire or rope. Excessive deposits of binder cause by stopping or stirring of . . sprayer or any other reason shall be suitable corrected.

g. Preparation of premix
The aggregate shall be dry and suitably heated to temperature as directed by Architect/ Owner before these are placed in the mixer to facilitate mixing with the binder.

Mixers of approved type shall be employed for mixing the aggregate with the bituminous binder. The binder shall be heated to the temperature in the range of 1550 - 177°C in boilers suitable design avoiding local overheating and ensuring a continuous supply.

h. Spreading and Rolling
The premixed material shall be spread on the road surface with rakes to the required thickness and camber or distributed evenly with the help of a drag spreader, without any undue loss of time. The camber shall be checked by means of camber boards and inequalities evened out. As soon as sufficient length of bituminous material has been laid, rolling shall commence with 6 to 9 tonne power rollers, preferably of smooth wheel tandem type, or other approved plant. Rolling shall begin at the edges and progress towards the centre longitudinally. Except on the super elevated portions rolling shall progress from the lower to upper edge, parallel to the centre line of the pavement. The consolidated thickness shall in no place be less than the specified thickness by more than 25%.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding premixed materials. Rolling shall then be continued until the entire surface has been rolled to -compaction and all the roller marks eliminated. In each pass of the roller, preceding track shall be overlapped uniformly by at least 1/3 width. The roller wheels shall be kept damp to prevent the premix from adhering to the wheels and being picked up. In no case shall fuel/lubricating oil be used for this purpose.

Rollers shall not stand on newly laid material as it may get deformed thereby.

The edges along and transverse of the carpet, laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it.

Further, the prepared finished surface shall be protected from traffic for 24 hours or such period as may be specified by the Architect/ Owner.

i. Surface finishing
The surface regularity both in longitudinal and transverse directions shall be within the tolerances specified in Table below:

TABLE-10.6

Longitudinal Profile Max. Permissible undulations to when measured with 3 M. straight edge	**Cross Profile** Max. permissible variation from specified profile when measured with a camber template
10mm	6mm

The longitudinal profile shall be checked during rolling with a three metres long straight edge at the middle of each traffic lane along the road. Similarly the transverse profile shall be checked with a set of three camber boards at intervals of 10 metres.

j. Rectification
Where the surface irregularity falls outside the specified tolerances the contractor shall be liable to rectify it to the satisfaction of Owner by adding fresh material and recompacting to specifications where the surface is low. Where the surface is high the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications.

k. Measurements
The length and width of the finished work shall be measured correct to a cm. along finished surface of the road, the area shall be calculated in square meter, correct to two places of decimal.

For record purposes, the measurement for binder and stone chipping shall be taken before they are actually used on the work. Pre-measurements of materials taken for record purposes shall simply serve as a guide and shall not from the basis for payment.

1. Compaction test for carpet
The degree of compaction achieved after rolling at sill shall be determined by taking out cores from finished surface at random places. Any other method approved by the Architect/ Owner may also be used. The density of these field core samples shall be determined. For one field density test, a minimum of three samples for every 500 sqm. of compacted surface or less shall be tested. The work shall be accepted as satisfactory and full payment shall be made if the average field density of every set of samples is not less than 98% of the laboratory density. In case of work yielding a density less than 98% but higher than 95%, payment for the quality represented by the field density test shall be made at a reduced rate worked out in the proportion that the actual field density bears to the designed laboratory density.

In case the field density is less than 95% of the laboratory density, further rolling shall be done to improve the density. If the final density achieved is still less than 95$10 of the laboratory density, the work is liable to be rejected at the discretion of the Architect./ Owner. If such work is not rejected payment shall be made at such reduced rate as may be fixed by the Architect/ Owner.

10.8 CONCRETE PAVEMENTS

a. Processing and Construction

i. Weather and Seasonal Limitations.
Unless special precautions as specified are taken, concreting shall not be done during extreme weather conditions, e.g., during monsoon months and when atmospheric temperature in ihade is above 40°C or below 4°C. For guidelines for constru ction of cement concrete pavements in hot weather, reference may be made to IRC: 61-1976.

ii. Preparation of base

The base to receive the cement concrete shall be checked for line, grade and cross-section as per the drawing. All irregularities beyond the permitted tolerances shall be rectified as specified.

Where concrete is to be laid over an absorbent Surface, the latter shall be kept moist in saturated surface dry condition or covered over by a water-proof kraft/ Polyethylene sheeting as specified so as to prevent absorption of water from the concrete mortar.

b. Fixing of formwork

The formwork shall be of correct shape, free from bends and kinks and sufficiently rigid to maintain its shape and position under the weight and working conditions of the laying and compacting equipment. It shall be set to true lines and levels and securely fixed in position to prevent any subsequent disturbance during compaction. Trueness of the formwork from the specified profile shall be checked and any deviation greater than 3mm in 3m rectified. No deviation shall, however, be permitted at the joints.

c. Manufacture and Placement of Concrete

Shall be carried Pout as specified in 'Concrete Work'.

i. Adequate surcharges of concrete shill be given over the desired finished level. The amount of surcharge shall be determined in the field by actual trial. The surcharge Shall be uniform over the entire area and the concrete as spread shall be to the same camber and slope as the required finished surface.

ii. The concrete shall be compacted fully using vibrating screeds and/or internal vibrators as specified. The vibrating screeds and internal vibrators shall conform to IS: 2506 and IS: 2505 respectively. Compaction shall be so controlled as to prevent excess mortar and water working on to the top due to over vibration.

iii. During compaction, any low or high spots shall be made up by adding or removing concrete.

iv. After longitudinal floating has been completed but while concrete is still plastic, the slab surface shall be tested for trueness with a 3m straight edge in accordance with the procedure set forth in the relevant clauses of CPWD specification 2000. Any depressions or high spots showing departure from the true surface shall be immediately rectified. High spots shall be cut down and refinished. Depressions shall be enlarged to about 8-10 cm and filled up whir-fresh concrete, compacted and finished. All the above operations shall be completed within 75 minutes/ (60 minutes in hot weather) of 'nixing.

v. After correcting the surface for profile but just before the concrete becomes non-plastic, the surface shall be finished by belting, brooming and edging as specified.

vi. Where the slab is to be laid in two layers, the second layer shall be placed within 30 minutes of compaction of the lower layer.

d. Control of Concrete Strength

i. The strength of concrete shall be ascertained either from cube or beam specimens as specified. For this purpose, during the progress of work, cube/beam samples shall be cast for testing at 7 and 28 days. Sampling and testing Shall be in accordance with IS: 1199 and 516 respectively. Frequency of testing shall be as indicated in Table.

TABLE — 10.7

S.No	TEST	TEST METHOD	MINIMUM DESIRABLE FREQUENCY
1.	Workability of fresh concrete	IS : 1199	One test per 10 m^3
2.	Concrete strength	IS : 516	3 cube/beam samples as specified for each age of 7 days and 28 days for

			every 30 m^2 of concrete
3.	Core strength on hardened concrete.	IS: 516	2 cores for every 30 m^3 of concrete.

ii. Acceptance of the work shall not be based on a single test result but on statistical basis, such that the lower control limit calculated for a tolerance level of 1 in 15 test results, shall not be lower than the specified minimum strength. The lower contro limit is given by the mean value of the set of tests minus 1.61 times the standard deviation. The work shall be taken to meet the specification requirements when the lower control limit is above the specified strength Where the above requirements are not met with or where the quality of concrete or its compaction is suspected, the actual strength of the hardened concrete in the pavement, shall be checked as set forth.

e.. Joints .

1. All materials required for the joints viz., tie bars, dowel bars, expansion joint filler boards and joint sealing compound shall be checked for specification requirements before their incorporation in the work. The sealing compound shall conform to IS: 1834.

Dowel bars shall be placed parallel to each other and parallel to the surface and centre line of the pavement. The permissible tolerances in this regard shall be:
• ± 1mm in 100mm for dowels of 20mm and smaller diameters ;
• ± 0.5mm in 100mm for dowels of diameter greater than 20mm.

The dowel assembly shall be firmly secured in place to prevent dislocation during concreting. Bulkheads in pairs with tight fitting holes for dowels may be used for this purpose.

All joints spaces and grooves shall conform to the specified lines and dimensions.

During concreting special care shall be exercised to dowels and in the vicinity of joints. Care shall also be taken to ensure that joints do not cause any discontinuity_in the riding-surface.

At the end of the curing period before opening to traffic, the joint grooves shall be cleaned thoroughly and sealed as specified in IRC: 57-1974. Care shall be taken to see that the sealing compound is not heated beyond the specified temperature.

f. Curing of concrete
Curing shall commence soon after the finished pavement surface can take the weight of the wet burlap, cotton or jute mats normally employed for initial curing, without leaving any marks thereon. The mats shall extend beyond the pavement edges at least by 0.5 m and be constantly wetted. Initial curing shall be for 24 hours or till the concrete is hard enough to permit labour operations without damage.

Final curing, after the removal of the mats, etc., shall be carried out by wet earth, ponding of water or other means specified. Where water is used for curing it shall be ensured that the entire pavement surface is kept well saturated throughout the specified curing period. Where water is scarce or pavement is on a steep gradient, impervious membrane curing shall be adopted as per details specified. .

g. Checking the Quality of Hardened Concrete
Soon after the initial curing period, the surface of the hardened concrete shall be checked for surface regularity in accordance with the procedure set forth in the relevant clause of CPWD specification 2000. Surface irregularities beyond the permissible tolerances shall be rectified as indicated in IRC: 15-1970.

Where the strength of concrete tested vide Clause 10.8.d. falls below the specified limits or where the quality of concrete or its compaction is suspected, the actual strength of the hardened concrete shall be ascertained by carrying out tests on cores cut from the hardened concrete. Frequency of testing shall be as indicated in Table. Crushing strength tests on cores shall be corrected for height-

diameter ratio and age for obtaining the corresponding cube strength at 28-days in accordance with the procedure given in IRC: 15-1970. The corrected test results shall then be analysed for conformity with the specification requirement on the lines of Clause 10.8.d.i.

h. Reinforcement
Reinforcing steel, where required to be provided, shall be checked for specification requirements before incorporation in the pavement Reinforcement shall be placed as specified. Due care shall be taken to ensure that the reinforcement is not displaced during concreting operations.

10.9 PERMANENT TRAFFIC SIGNS
Permanent traffic signs, direction and place identification signs shall be located where ever directed by the Architect/ Owner according to his drawings or direction.

10.10 SPEED BREAKERS
Where ever directed speed breakers shall be provided as per drawing/ direction of the Architect/ Owner.

10.11 KERBS AND CHANNELS STONES
Kerbs and channels shall be either cast in situ or precast as shown on the drawings. These kerbs shall be laid on a prepared foundation of concrete as given in item and packed with a triangular section haunch of concrete as shown in the drawing. The kerbs shall be jointed at every 1 M. or as shown in the drawing and painted to follow road marking.

The kerbs to be fitted raised from punished carriage way level as shown in the drawing.

10.12 MARKING OF ROAD AND TRAFFIC BOARDS
The contractor shall mark all roads and parking areas with road marking paint as shown on the drawings.

10.13 MANDATORY TESTS APPENDIX
Physical requirements and other mandatory tests for coarse aggregate, fine aggregate, binding material and bitumen .

TABLE --10.7

Material Frequency	**Test**	**Test Method**	**Requirements**
Coarse aggregate for sub-base	Los Angeles abrasion value or Aggregate impact value	IS: 2386 (Part-IV) IS:2386 (Part-IV) IS:5640*** (Part-IV)	60% max. *50% max.
Coarse aggregate for base course	Los Angles abrasion value or Aggregate impact value b Flakiness index	IS: 2386 (Part-IV) IS:2386 (Part-IV) IS:5640*** (Part-TV) IS:2386 (Part-I)	50% max. *40% max. **15% max.
Coarse aggregate for Surface course	a) Los Angles abrasion value or Aggregate impact value b) Flakiness index	IS: 2386 (Part-IV) IS:2386 (Part-IV) IS:2386 (Part-I) IS:2386 (Part-I)	40% max. 30% max. **15% max
Grading for coarse aggregate		IS:2386 (Part-I)	-Do-
Fine aggregate for screening		IS:2386 (Part-III)	-Do-

* Aggregate may satisfy requirements of either of the two tests. .
** The requirements of flakiness index shall be enforced only in case of crushed/ broken stone and crushed slag.
*** Aggregates like brick metal, kankar and laterite which get softened in presence of water, shall be tested for impact value under wet conditions in accordance with IS :5640.

Binding Material

The Binding material to be used in WBM shall comprise of suitable material having PI value less than 6.

02 - LIST OF CODES

The materials and workmanship shall be in accordance with the requirement of the appropriate IS code wherever applicable together with any building regulations or bye-laws governing the works.

The following list is included for guidance only and the omission from the list does not relieve the contractor from compliance there with:

IS 1200	:	Mode of measurement.
IS 456	:	Code of practice for construction & design of reinforced concrete.
IS 269 IS 3812, 1981	:	Ordinary portland cement. Flyash for use as pozzolana and admixtures.
IS 2386 (Part I, II, III)	:	Method of test for aggregate for concrete. i) Particle size & shape. iI) Estimation of deleterious materials & organic impurities. iii) Specific gravity, density, voids, absorption & bulking.
IS 516		Method of test for strength of concrete.
IS 383		Specification for Coarse and fine aggregate from natural sources for concrete.
IS 460 (Part I, II, III)		Specification for test sieves. i) Wire cloth test sieve. ii) Perforated plate test sieve. iii) Method of examination of test sieve.
IS 515		Specification for natural and manufactured aggregates from natural sources for concrete.
IS 1199		Method of sampling and analysis of concrete
IS 1791		Batch type concrete mixers.
IS 1893		Earth quake resistant design.
IS 2505		General requirement for concrete vibrators.
IS 3025		Method of sampling & test (physical & chemical) for water.
IS 7861		Code of concrete for extreme weather concreting. _ i) Recommended practice for hot weather concreting. ii) Recommended practice for cold weather concreting.
IS 8112		Specification for 43 grade ordinary portland cement
IS 9103		Specifications for admixture for concrete.
IS 226		Specifications for steel standard quality
IS 228		Method of chemical analysis of steel.
IS 280		Specifications mild steel wire for general engineering purpose.
IS 432 (Part I, II)		Specifications for mild steel & medium tensile steel burn & hard drawn steel wires for concrete requirement
IS 1566		I Hard drawn steel wire fabric for concrete reinforcement.
IS 1599		Method of bent test.
IS 1785 (Part I)		Cold drawn stress relieved wire.
IS 1786		Specification for high strength deformed steel bars & wires for concrete reinforcement.
IS 2751		Code of practice for welding of MS bars.
IS 2502		Code of practice for bending & fixing of bars for concrete reinforcement.
IS 4082		Recommendation for stacking storage of construction materials at site.
IS 5525		Recommendation for detailing of reinforcement in RCC Work.
IS 9417		Recommendation for welding cold worked steel bars for reinforced concrete construction.
IS 303		Specification for plywood for general purpose.
IS 4014 (Part I,II)		Code of practice for steel tubular scaffolding.
IS 8989		Safety code of erection of concrete formed structures.
IS 3696 (Part I, II)		Safety code of scaffolds & ladders.
IS 1077, 1970		Method of test for Bricks.
IS 1597		Code of practice for construction of stone masonry.

IS 1597 PART 1		Code of practice for construction of rubble stone masonry.
IS 1130		Marble (blocks, slabs and tiles)
IS 287		Recommendation for maximum permissible moisture contents of Timber used for different purposes.
IS 1141		Code of practice for seasoning of timber.
IS 6313 PART 2		Anti-termite measures in buildings, pre-constructional chemical treatment measures.
IS 2571		Code of practice for laying in situ cement concrete flooring
IS : 226		Structural Steel (Standard Quality)
IS : 451		Technical Supply Conditions for Wood Screws
IS : 800		Code of Practice for Use of Structural Steel in General Building Construction
IS : 806		Code of Practice for Use of Steel Tubes in General Building Construction
IS : 813		Scheme of Symbols for Welding
IS : 814		Covered-Electrodes for Metal Arc Welding-of part-I-&-II)-Structural Steel
IS:816		Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel
IS : 822		Code of Practice for Inspection of Welds
IS : 961		Specification for structural steel (High Tensile).
IS 73		Paving bitumen.
IS 702		Industrial Bitumen
IS 1322		Bitumen felts for water proofing and damp proofing
IS 1609		Code of practice for laying damp proof treatment using bitumen felts.
IS 13711 & 13712		Ceramic tiles.
IS 13630 Part 1 to 13		Testing for Ceramic tiles.
IS 104		Specification for ready mixed painted, brushing, zinc chrome, priming
IS 137		Ready mixed paint, brushing, matt or egg-shell flat, finishing, interior to Indian standard colour as required.
IS 5410		Cement paint, colour as required.
IS 6241		Method of test for determination of stripping in value of road aggregate
IS 2720		Density test of aggregate.

03 - LIST OF APPROVED MAKES OF MATERIALS

1) Grey Cement 43 Grade (PPC/ OPC)	-	A. C. C., Birla, Vikram, Ambuja.
2) Reinforcement Steel Bars	-	Rathi, SAIL, TISCO, Rashtrya Ispat.
3) Chlorpyriphios/ Landane	-	DE-NOCIL, Cynamide
4) Structural Sealant	-	Wacker, Dow Corning, GE
5) 5. Structural Steel	-	SAIL
6) M.S. Pipe, Tubes, Bar, Flats, Angle, Tee Sections	-	SAIL
7) Concrete admixture	-	Fosroc/ Cico.
8) Polymer based Construction Adhesive (epoxy resin) for construction joints	-	Nito Bond or approved equivalent.
9) Polysulphide sealant	-	Pidilite, Chemetall-Rai
10) Bitumen Impregnated Board	-	Shalitex or approved equivalent.
11) Polyethylene back-up rod	-	Supreme Ind. Ltd. Or approved equivalent
12) White Cement	-	Birla, J.K
13) Water proofing compound	-	CICO or approved equivalent
14) Epoxy	-	Fosroc/ STP/ Cico.
15) Waterproof Ply	-	Green Ply, Century, Duro
16) APP Polymeric Polyethylene Felt	-	BITUMAT' or approved equivalent
17) 17. Expanded Polystyrene (Thermocole)	-	Beardshell or approved equivalent
18) Extruded Polystyrene	-	Iso board ND or approved equivalent
19) Hessian Based Felt	-	'BITUMAT' or approved equivalent

20) Geotextile Fabric	-	Netlon/ Ca Polyteck Pvt Ltd. or approved equivalent
21) UPVC Pipe	-	Finolex Industries Ltd. or approved equivalent
22) 22. Welding rod	-	ADVANI or approved equivalent
23) White washing lime	-	Dehradun (Source)
24) Paints	-	Asian Paints, ICI, Nerolac
25) Water proof cement paint	-	Snowcem India Ltd
26) Fire Retardant paint	-	Viper or approved equivalent
27) Wax Polish	-	Mansion or approved equivalent
28) Glass	-	Asahi, Saint Gobain, Modi Guard
29) Source for tempering Glass	-	GSC Toughened, Gold Plus, Allied Glass Float Glass Meerut
30) Standards being adopted for tempering/ Toughning	-	DIN — 1249 — Part — 12 (1990)
31) Mirror	-	Modi Guard or approved equivalent
32) Commercial ply	-	Green ply, Century, Duro
33) Veneer	-	Duro, Green ply, Donear, Century
34) Laminate	-	Greenlam, Century, Merino or approved equivalent
35) Cement Bonded Board	-	'BISON' by NCL or approved equivalent
36) Gypsum board.	-	India Gypsum Ltd.
37) False Ceiling Members a) Perimeter b) Ceiling section c) Intermediate d) Angle .	-	Gyp. Steel of India Gypsum Ltd.
38) Flush Door Shutter	-	Archid, Green, Century or approved equivalent
39) PVC strips	-	Fixopan or approved equivalent

Note: In the List of recommended above, out of makes mentioned in the list, only 1st make shall be quoted for and used. However if due to non-availability or any other technical reasons, the alternative make is allowed, it shall be subject to price adjustment.