

**RASHTRIYA ISPAT NIGAM LIMITED
VISAKHAPATNAM STEEL PLANT
VISAKHAPATNAM**

BALANCE CIVIL ENGINEERING WORKS

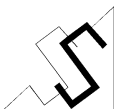
FOR

HEALTH CENTRE

AT

PEDAGANTYADA IN VISAKHAPATNAM

Consultants:



S.S CONSULTANTS
Project Consultants
HYDERABAD-16.

Tender Document
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SPECIFICATIONS FOR BALANCE CIVIL ENGINEERING WORKS FOR PROPOSED HEALTH CENTRE AT PEDAGANTYADA IN VISAKHAPATNAM

GENERAL

- 1.1.1 The scope of work under this contract covers Balance Civil Engineering Works for proposed Hospital at Pedagantyada in Visakhapatnam. Comprising of building, including internal water supply, sanitary installation complete in all respects as shown in the drawing as indicated in the specifications and Bill of Quantities.
- 1.1.2. The Specifications shall be read in conjunction with other documents forming the Contract Viz; Tender Notice, General Conditions of Contract including Form of Tender, Invitation to Tender and Articles of Agreement for Construction work, Special Conditions of Contract, Bill of Quantities and Drawings.
- 1.2 **Local Conditions:** The Tenderer shall visit the site and ascertain the local conditions, entry, traffic restrictions, obstructions, if any and also site conditions, whether the Tenderer visits the site or not, he is deemed to have visited the site and ascertained all the site conditions. The tenderer shall allow in his tender for all extras likely to be incurred due to such conditions. No claim will be allowed on this account under any circumstances from the contractor.
- 1.3 **Safety:** The Contractor shall take adequate precautions to ensure complete safety and prevention of accidents at site, the safety precautions shall conform to the following Indian Standard Codes, wherever applicable:
- | | | |
|----------------|---|---|
| <i>IS:3696</i> | : | <i>Safety Code for Scaffolding and ladders.</i> |
| <i>IS:3764</i> | : | <i>Safety Code for excavation work.</i> |
| <i>IS:4081</i> | : | <i>Safety Code for drilling and blasting operations.</i> |
| <i>IS:4130</i> | : | <i>Safety Code for demolition of buildings.</i> |
| <i>IS:4138</i> | : | <i>Safety Code for working in compressed air.</i> |
| <i>IS:7923</i> | : | <i>Safety Code for working with construction machinery.</i> |
- 1.4 **Bench Marks, Reference Pillars etc.:** The Contractor shall protect Surveyor's bench marks and reference lines, ground water gauges and control points from damage or movement during work. In case of any damage, the Contractor shall have to restore to original conditions at his own cost.
- 1.5 **Cutting of Trees:** The Contractor is not permitted to cut down any tree without prior written permission from the Engineer. Trees with a girth of more than 450 mm. measured at a height of one meter above the ground level shall be measured and paid as per the items available in Bill of Quantities.

1.0 EARTH WORK

2.1 Codes and Standards:

<i>IS:1200</i>	:	<i>Method of measurement of building and Civil Engineering works (all the Parts)</i>
<i>IS:3764</i>	:	<i>Safety cod for excavation work.</i>
<i>IS:1498</i>	:	<i>Classification and identification of soils for general Engineering purposes.</i>

2.2 Classifications of Soil: The soil shall be classified for payment according to IS:1200 and /or as per the items of bill of quantities.

2.3 Setting Out: The work shall be set out to exact dimensions as shown on the drawings and excavation shall be commenced only after prior approval of the Engineer.

Side slopes, berms or shoring / strutting etc. for excavation work shall be as directed by the Engineer and prior approval of the Engineer shall be obtained for a suitable method of protection before excavation work is commenced.

2.4 Sequence of Site Levelling: The Contractor shall level the site in accordance with the sequence of earth levelling as shown on the drawings and /or as directed by the Engineer.

2.5 Cleaning and grubbing work: All areas to be excavated for attaining specified levels and for obtaining fill material and areas where filling has to be done shall be cleared of all vegetation. The cleared areas shall be maintained free from vegetation and any vegetable growth during the progress of the work.

2.6 Stripping: The area to be filled shall be stripped of all materials such as vegetation, organic soil, silt etc. The surface shall be stripped to a depth of 80 mm to 200 mm as may be necessary to obtain a foundation of satisfactory density and stability. All materials that may be soft or yielding or likely to become unstable with saturation or which may interfere with the creation of proper bond between the foundation and filling shall be removed. The material obtained from stripping should be dumped in allotted areas.

2.7 Keeping works free from water:

2.7.1 The excavation for foundation and building area shall be kept free from water by the Contractor at his own expense either by bailing out water with buckets manually or by pumping. Bailing out or pumping of water shall be carried out either directly from the excavation or from sumps made outside the excavation as directed. Adequate care shall be taken to prevent movement of water through freshly laid concrete or masonry work.

- 2.7.2 Pumping: The Contractor shall provide and operate pumps or other equipment necessary to drain and keep all excavation pits, trenches etc. free from water at all times during the continuance of the Contract.
- 2.7.3 De-silting: If any excavation for foundations gets filled up with water due to rain, seepage or for any other reason, the water shall be removed and the bottom of the excavation shall be cleared of all silt slush by the Contractor at his own expense.
- 2.8 Excavation for foundation and trenches: The Contractor shall excavate to remove materials of any nature or description that may be encountered and excavate to depths, widths and inclinations as shown on the drawings and /or as directed. The bed of the excavation shall be made level and firm.

2.9 Variation in Excavation:

- 2.9.1 Bad Ground: Should the bottom of any excavation appear to be soft, unsound or unstable the Contractor shall report the matter to the Engineer and if the Engineer so directs, shall excavate the same to indicated depths. In case of such extra excavations the extra depths shall be filled up with concrete or such other materials as the Engineer shall direct and all such extra excavations and filling shall be valued and paid for as authorized.
- 2.9.2 Excavation too deep: If the Contractor excavates to levels lower than those shown on the drawings for any un-authorized reasons, he shall fill it up at his own expense to the proper level with concrete or such other materials as directed. No payment will be made for excavation taken down to depths lower than those shown on the drawings and for the filling carried out as directed.
- 2.9.3 Slips and Falls: Every precaution shall be taken against slips and falls of earth, clay, sand or other materials in the excavations, but in the event of any such occurring, the Contractor shall at his own expense make good the space affected by the slips or falls, even if the affected area may be outside the dimensions of the work ordered.

The Engineer will determine in each case whether such affected area is to be filled up in whole with concrete, brickwork or masonry of the quality used in the adjoining work or where only a part is to be so filled, the materials to be used for the remaining part.

If in the opinion of the Engineer there is a possibility of the newly constructed work having been damaged or disturbed by such collapse, the work shall be laid bare at the expense of the Contractor for inspection. The Contractor at his expenses shall make any damage good.

- 2.10 Shoring and strutting: Shoring and strutting shall be used as specified / directed when the excavation is to be carried out in soft and slushy soil, which are likely to collapse during the excavation of the work. The shoring shall be either open or close boarded type depending on the nature of the soil and depth of excavation and the type adopted shall be as directed by the Engineer. While excavating in very unstable ground requiring support throughout the period of excavation, runners shall be used and shall be driven always in advance of excavation. The size and spacing of different members to be used in shoring shall be as directed by the Engineer depending on the site conditions.

- 2.11 Protection work: The Contractor shall support and maintain adjoining and abutting property and structures to render work safe to persons, property and structures/installations.

The Contractor shall provide necessary decking, guard, fences, planking, with red flags and red lights at night to maintain safe pedestrian and vehicular traffic near all open excavations.

The Contractor shall replace or repair at his own cost in an approved manner, all work damaged through removal of such temporary work or improper protective work.

- 2.12 Filling under floors:

- i) Filling under floor with excavated earth: The excavated earth shall be used for filling in the sides of the foundations and under floor where specified between the plinth walls in layers not exceeding 20cms, properly watered and rammed. No lumps or rubbish are to be used in filling. All surplus left over shall be either spread, deposited on the side or shall be carted away to desired places as per direction of the Engineer. Original ground within the plinth walls shall be scraped to make it absolutely free from grass vegetation growth or any other objectionable materials before earth filling is taken up without any extra charges.
- ii) Filling under floors with borrowed earth: The earth required for filling under floors with borrowed earth shall be free from sulphates, white ants and organic matters and shall be approved by the Engineer. Filling shall be done in layers not exceeding 20cm and is to be well watered and rammed in respect of each layer. No lump or rubbish are to be used in filling.

The borrowed earth shall only be brought from the site as directed and approved by the Engineer and the Contractor shall allow in his rate for 1Km lead and 1.5m lift in this regard including necessary excavation.

- 2.13 Sand Filling under Foundation and floor: Sand for filling under foundation and floor shall be fine river sand of approved quality and free from salt earth dust or other impurities. Sand filling shall be done in layers not exceeding 20 cm and is to be profusely watered and rammed in respect of each layer.

2.0 Blasting

- 3.1 Codes and standards.

IS: 4081 : Safety code for blasting and related drilling operations.

- 3.2 Compliance to Rules: All aspects of work in connection with blasting and the materials used for the purpose, which includes inter alia transportation, storage, drilling and loading of holes, circuiting, firing, post explosion search and disposal of misfired / unused materials are governed by the Indian Explosives Act and the rules framed thereunder.

- 3.3 Serviceable rock available during the execution of hard rock to be properly stacked. Quantity shall be calculated considering 40% for voids in the above stacks such stacked serviceable boulders are the property of VSP.

- 3.4 Preparation for Blasting: Explosive shall be kept dry and away from the direct rays of the sun, naked lights, steam pipes or heated metal, etc. only the quantity of explosive required for a particular amount of firing to be done shall be brought to the site of work. All surplus explosive left after filling the holes shall be removed atleast 400 metres from the firing point.

A wooden stemming rod shall be used to push the cartridge into the shot hole. Metal rod or hammer shall not be permitted on the site of the works. The charges shall be pressed firmly into place and not rammed or pounded.

The explosive shall be fired by means of an electric detonator placed inside a cartridge and connected to the firing cable.

Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray currents and to keep the lead wires short circuited until ready to fire.

- 3.5 Drilling Rock for Blasting: Holes for charging explosives shall be drilled with pneumatic drills, the drilling pattern being so planned that rock pieces after blasting will be suitable for handling without secondary blasting. The rock pieces so blasted shall be neatly stacked at allotted places.

- 3.6 Blasting operation: Before any blasting is carried out, the Contractor shall ensure that all workmen, vehicles and equipment's on the site are cleared from an area of 300 metres radius from the firing point, atleast 15 minutes before the firing time by sounding a warning siren. The area shall be encircled by red flags.

The Contractor shall employ a competent and experienced licensed supervisor in-charge of each set of operation, which shall be held responsible to ensure that all the safety regulations are followed.

A Supervisor shall conduct the firing and the number of shots fired at a time shall not exceed the permissible limits. In case of misfires the unexploded charges shall be carefully located after half an hour and shall be exploded by drilling a fresh hole along side the misfired hole (but not nearer than 600 mm from it) and by exploding a new charge. The workmen shall not return to the site of firing until at least half an hour after firing.

- 3.7 Controlled Blasting: When blasting is conducted in the neighborhood of roads, structures, building or any place which requires controlled blasting, the contractor shall drill only shallow shot holes. These holes shall be filled with a light charge of explosive and the blast controlled by placing steel plates loaded with gunny bags filled with sand or earth over the hole and covering them with wire net fixed to the ground, so as to ensure that the blasted materials do not scatter.

In such cases short delay detonators shall be used for blasting purposes.

4.0 Plain and Reinforced Cement Concrete work.

4.1 Codes and Standards. Cement

<i>IS:269</i>	:	<i>Ordinary, rapid hardening and low heat Portland cement.</i>
<i>IS:455</i>	:	<i>Portland blast furnaces slag cement.</i>
<i>IS:6909</i>	:	<i>Super Sulphate cement.</i>
<i>IS:1298</i>	:	<i>Method of test for determination of free lime in Portland Pozzolona cement.</i>
<i>IS:6452</i>	:	<i>High Alumina cement for structural use.</i>
<i>IS:1489</i>	:	<i>Portland Pozzolona cement.</i>

Aggregates

<i>IS:383</i>	:	<i>Coarse and fine aggregate from natural sources for concrete.</i>
<i>IS:2386</i>	:	<i>Method of test for aggregates for concrete.</i>
<i>IS:2430</i>	:	<i>Method for sampling of aggregates for concrete.</i>

Concrete plain & Reinforced

<i>IS:456</i>	:	<i>Code of practice for plain and reinforced concrete.</i>
<i>IS:1196</i>	:	<i>Methods of sampling and analysis of concrete.</i>
<i>IS:516</i>	:	<i>Method of test for strength of concrete.</i>
<i>IS:460</i>	:	<i>Test Sieves.</i>
<i>IS:1607</i>	:	<i>Method for dry sieving.</i>
<i>IS:1834</i>	:	<i>Hot applied sealing compounds for jointing concrete.</i>
<i>IS:2204</i>	:	<i>Code of practice for construction of reinforced concrete shell roof, liquid retaining structure bins, chimneys, etc.</i>

Steel

<i>IS:226</i>	:	<i>Code for structural steel standard quality.</i>
<i>IS:432</i>	:	<i>Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement.</i>
<i>IS:1566</i>	:	<i>Hard-drawn steel wire fabric for concrete reinforcement.</i>
<i>IS:1568</i>	:	<i>Wire gauze for general purpose.</i>
<i>IS:1139</i>	:	<i>Hot rolled mild steel and medium tensile steel deformed bars for concrete reinforcements.</i>
<i>IS:1786</i>	:	<i>Cold twisted steel bars for concrete reinforcement.</i>
<i>IS:2502</i>	:	<i>Code of practice for bending and fixing of bars for concrete reinforcement.</i>
<i>IS:2751</i>	:	<i>Code of practice for welding of mild steel bars used for reinforced concrete work.</i>

4.2 Materials:

Cement:

Ordinary Portland cement shall conform to IS:269. Portland blast furnace slag cement shall conform to IS:455 and super Sulphate cement shall conform to IS:6909.

Aggregates:

All aggregates shall conform to IS:383. Fine aggregates shall be approved river or pit sand. Coarse aggregates shall be approved crushed stone.

Reinforcement:

Reinforcement shall be M S. round rods conforming to IS:432 or IRC mesh fabric reinforcement conforming to IS:1566 or mild steel and medium tensile steel deformed bars conforming to IS:1139 or cold twisted steel bars conforming to IS:1786 and shall be free from oil, paint rust coatings. The binding wire shall be black annealed wire.

Jointing Materials:

All rubber and PVC water stops, joint fillers, sealing materials etc. used in joints in concrete work shall be of standard manufacture as per relevant IS codes wherever applicable and /or as approved by the Engineer. Usage of these materials shall be in accordance with manufacturer's recommendations.

Admixtures:

Admixtures, if used, shall be of approved quality and shall conform to relevant IS codes. The extent, type method of use and control shall be subject to approval of the Engineer in all cases.

Water:

Water shall be as per clause 4.3 of IS:456 sea water shall not be used for mixing and curing of concrete.

4.3 Concrete

- 4.3.1 Production and control of concrete shall be as per IS:456. The grades of concrete shall conform to Table-2 of IS:456, and shall be as indicated on the drawings and / or bill of quantities. The Contractor shall at his own cost, grade the aggregate and control that water cement ratio, design the different mixes to required strength and workability. The design mix concrete shall conform to the requirement of IS:456. Minimum cement content and maximum water cement ratio of concrete shall also fulfil the requirement of durability considered by the condition of exposure in case of superstructures and exposure to Sulphate attack in case of underground structures and as per Table-19 and Table-20 of IS:456 and /or as indicated in drawings or bill of quantities.

The maximum size of aggregates used shall be as indicated in the drawings and / or bill of quantities. Where reinforcement is to closely spaced for the maximum size of stone in a range, the largest suitable range will be used with the approval of Engineer. Before commencement of work, the contractor shall submit to the Engineer for his approval complete details of the tests for design mixes together with the grading analysis and mix design calculations. No concrete shall be placed on site until the Engineer has approved the mix design.

If any change is made in the source/grading of the aggregates, water content of the mix, manner of making compacting the concrete or any other deviations from the preliminary test procedure, the Engineer may instruct for fresh preliminary test which shall be carried out by the Contractor at his own cost. Over the full period of construction the Contractor shall carry out the works tests as per clause 4.5 (3) of this specification at his own cost to satisfy the Engineer that correct grade of concrete is being used.

- 4.3.2 Where ‘nominal mix concrete’ as defined by IS:456 is permitted by the Engineer for any specific reason, proportion of materials shall be as indicated in Table-3 of IS:456. However, for concrete grade M10 and above minimum cement content and maximum water cement ratio requirements for durability shall also be considered taking into account the exposure and subsoil conditions as indicated in Table-19 and Table-20 of Appendix ‘A’ of IS:456.

4.4 Plain cement concrete in foundation under the floors

Before laying concrete, the bed shall be well watered, rammed and dressed properly. Concrete shall be deposited gently in the trenches in horizontal layers of not more than 30 cm thick, gently rammed and finished off in perfect level. The concrete shall be kept wet for a week.

The specification for plain cement concrete work shall generally comply with that for reinforced cement concrete work as given under this section. For large areas, concrete shall be laid in panels with proper construction joints as directed with proper floors drainage slopes as per drawing or direction of the Engineer. The top surface shall be finished evenly with straight edge, and when hard, chipped and left clean to receive floor finishing as per requirement.

4.5 Reinforce cement concrete work

4.5.1 *Proportion of concrete*

Aggregate and sand shall be measured in measuring boxes, which, shall be accurate in dimensions and shall be approved by the Engineer. Allowance for bulking of sand shall be given as directed by the Engineer. Cement shall be measured by weight only.

The above proportions are approximate and minimum. These shall be varied to obtain the densest concrete but shall in no case be leaner than as specified.

All reinforced cement concrete work shall be vibrated with suitable mechanical vibrators.

Suffix A,B,C and D to the grade of concrete indicate the use of size of the graded aggregates in concrete as per details given below.

- A- 75 mm down graded
- B- 40 mm down graded
- C- 20 mm down graded
- D- 10 mm down graded

4.5.2 *Strength of concrete:*

Concrete mixed in the proportion stated shall have minimum compressive strength at 28 days after placing for work test, not less than the following:

<i>Concrete Designated as</i>	<i>Equivalent mark of concrete</i>	<i>Minimum Crushing strength at 28 days Work test in kg/cm²</i>
<i>1:4:8</i>	<i>M 7.5</i>	<i>75</i>
<i>1:3:6</i>	<i>M 10</i>	<i>100</i>
<i>1:2:4</i>	<i>M 15</i>	<i>150</i>
<i>1:1½:3</i>	<i>M 20</i>	<i>200</i>
<i>1:1:2</i>	<i>M 25</i>	<i>250</i>

The standard of acceptance of concrete shall be as per relevant clause of IS:456.

Where strengths are specified in the bill of quantities, the mixes to be adopted and the slump to be allowed to give the specified strengths and proper workability shall be determined previously by experiment as per IS: 456 with representative samples of the materials used and under conditions similar to those to be adopted in actual job. The experiments are to be done by the contractor at his own cost under the direction and supervision of the Engineer, as and when necessary. When the mix to be adopted is decided upon, it shall in no case be altered without specific written permission of the Engineer. The contractor shall, however, remain fully responsible for producing concrete of specified strengths in the actual job.

4.5.3 *Tests of concrete:*

The Contractor shall, as and when directed by the Engineer, take 15 cm test cubes of the concrete being used in the work and after curing shall get them tested at VSP Laboratory/ designated test house, approved by the Engineer and whose report shall be accepted by both the parties. For this purpose, the contractor shall keep sufficient number of steel moulds ready at site.

Materials that could be tested in VSP laboratory will be tested free of cost. For materials that could not be tested in VSP laboratory, the Contractor at other approved laboratories at his own cost shall be tested the same. The test certificate shall be submitted for the necessary approval.

4.5.4 *Mixing of Concrete:*

For the purpose of each and every batch of concrete measuring boxes corresponding to proper quantities of sand and coarse aggregate respectively shall be used. All

proportioning shall be carried out in such a manner that the proportion of the ingredients may be easily and readily checked. The quantities are to be adjusted in the specified proportion so as to enable use of full bag of cement.

As the bulking of sand may vary from day to day and at different parts of the day on account of varying moisture content, frequent tests for bulking shall be carried out with sand to be used at Contractor's cost and amount of bulking allowed as per direction of the Engineer.

Mixing of concrete shall be done in a mechanical rotary mixer in a good running condition. The capacity of the mixer is to be approved by the Engineer. If desired by the Engineer, more than one mixer shall be kept at site to cope up with the progress of the work. The mixer and the mixing platform shall be suitably protected from the wind and rain. The aggregates coarse and fine and cement shall be first mixed dry. After the addition of water mixing shall be carried out until the concrete is of even colour and consistency throughout. The quantity of water used shall be varied as required by the Engineer to suit moisture content of the aggregate, to produce concrete having desired water-cement ratio and the specified slump. Mixing shall be carried out for a minimum period of two and a half minutes.

Mixing of concrete of different proportions shall not be allowed to be carried out at one time.

No more concrete shall be mixed than can be used within twenty minutes after mixing.

Hand mixing of concrete shall not be allowed unless specially permitted for minor work in writing by the Engineer. In case such hand mixing is permitted, 10% extra cement shall have to be used but the contractor shall have no claim for any extra payment on this account. Hand mixing shall be done on approved platform to prevent loss of mortar and the materials turned over thoroughly in the dry state and also after addition of water until the ingredients are well mixed to produce concrete of uniform colour, texture and consistency throughout to the satisfaction of the Engineer.

4.5.5 *Consistency of concrete:*

The consistency of the concrete shall be checked from time to time by means of slump tests as and when required by the Engineer at Contractor's cost as the work proceeds. The samples shall be taken at the point where the concrete is being delivered for placing in the moulds. Slumps for different kinds of concrete specified by mixes as well as for concrete in various members shall not exceed the amounts approved by the Engineer.

The slump tests shall be carried out in a steel mould in the manner specified in relevant Indian Standard specification and/or code of practice.

The slump test, however, is only intended to act as guide and the contractor should, in consultation with the Engineer, carefully adjust the amount of water to suit the particular part of the work being carried out and always keeping in mind that the object is to obtain the strongest concrete possible consistent with workability in the forms.

4.5.6 *Placing of concrete:*

Concrete shall be transported from the place of mixing to the place of final deposit as rapidly as practicable by methods which, will prevent segregation or loss of ingredients; it shall be placed in forms within twenty minutes of its being mixed with water. It shall be deposited. As early as practicable in its final position to avoid re-handling or flowing unless specially permitted by the Engineer. Concrete shall not be dropped freely from a height of more than the 60 cm. A properly constructed inclined chute must be used in such cases where it is necessary to exceed this height.

Before placing the concrete the form shall be cleared off shavings or pieces of wood or other rubbish, and thoroughly damped with water. When placing the concrete, the fine materials must be carefully worked against the forms so that the faces of concrete shall be left perfectly smooth and free from honeycombing after withdrawing the forms. The contractor as directed by the Engineer shall deal with the defects in this respect. If honey combed concrete is allowed to remain, grouting shall be done with 1:1 cement and sand slurry to the satisfaction of the Engineer without any extra charges immediately after removal of shuttering.

Where concrete is deposited against stonework, brickwork or other surfaces likely to absorb moisture, such surfaces must be well watered immediately prior to deposition of concrete.

During placing and immediately after deposition, the concrete shall be thoroughly compacted with mechanical vibrators until it fills all the space between and around the rods to ensure a solid mass entirely free from voids and air-bubbles. Excessive vibration must be avoided.

It is imperative that the work shall be done quickly and efficiently and adequate number of hands, therefore, must be employed to ensure this to the satisfaction of the Engineer.

Great care must be taken in placing and vibrating the concrete so that the reinforcement is not displaced.

Concrete shall be placed and compacted in its final position before setting has commenced and shall not subsequently be disturbed. Concreting shall be carried out continuously up to construction joints, the positions and arrangements of which shall be pre-determined by the Engineer. Any rest pauses, such as for meals, shall also be subject to his approval. All concreting work shall be so programmed as not to necessitate work at night. If for any reason, this becomes imperative, the contractor shall obtain previous written permission of the Engineer and make proper lighting arrangement at his own cost.

4.5.7 *Construction joints in concrete:*

The work of filling in beams and slabs shall be complete in one operation, as far as possible. If concreting has to be stopped, permission shall be obtained from the Engineer and it shall be stopped at places approved by the Engineer. Joints in slabs shall be made in a direction parallel to the main reinforcements.

All joints in beams and other horizontal members are to be formed inserting temporary vertical boards against which concrete deposited can be properly rammed.

When the work has to be commenced on a surface which, has hardened, each surface shall be well roughened and all laitance removed. The surface then shall be brushed clean, thoroughly wetted and well grouted with cement and sand slurry of proportion 1:1. Such works shall be held to be covered by the rates for concrete work.

4.5.8 *Protection and curing of concrete:*

The Contractor shall adequately protect freshly laid concrete from too rapid drying due to strong sunshine, dry winds etc. And also from run off water from any other sources. During first 21 days after deposition, the concrete shall be kept thoroughly damp by suitable means as approved by the Engineer. Watering during this period required for this purpose shall be continued daily including this period required for this purpose shall be continue daily including Sundays and holidays and said to be covered by the rates for concrete work.

The Contractor shall make satisfactory arrangement to protect freshly laid concrete during showers by providing tarpaulin on top and sides failing which the casting of all concrete work shall be stopped at the risk and cost of the Contractor.

No heavy extraneous load shall be placed on the structural concrete until after 28 days from the date of completion of concreting in that particular portion.

4.5.9 *Steel reinforcement:*

Reinforcement work shall be done accurately as per reinforcement drawings and direction of the Engineer. The bars shall be cut to exact lengths, accurately bent cold to specified shapes, placed and fixed in position as per drawings and tied tightly at each and every intersection with double 20 gauge black annealed wires, the loops of which must be tightened with pliers without snapping. The contractor's rate for reinforcement shall include also above.

The Contractor shall without extra charges provide all the supports and fixtures required and shall take precaution to see that all such temporary fixtures are removed before the concrete is brought up the Contractor's rate shall also include any initial straightening of bars, if necessary and removing all grease, dirt, bituminous materials, loose rust or scales, if any, and other incidental works in this connection. The Contractor shall also provide without any extra charges precast cover blocks in cement mortar 1:2 and steel chairs of suitable dimension as per direction of the Engineer at regular intervals under the reinforcement rods for keeping the rods in position and to ensure correct depth of cover to the rods. Unless otherwise mentioned in the drawings reinforcements shall be placed in position so as to allow concrete cover to reinforcements as per IS: 456.

The Contractor shall get the reinforcement work approved by the Engineer before concreting can be started.

Reinforcement bars will be issued to the contractor for work from the employer's store in standard or random length either straight or in coils, if bars of exact required length are not available, these shall be cut from such length of available bars as will involve minimum wastage of cut pieces. No lapping shall be allowed and paid for within available stock lengths. However, if any lapping is required due to short length of bars, the lapping should be provided as per relevant I.S. specification and/or code of practice and the bars shall be bound together by wires tightly.

4.5.10 *Shuttering of R.C.C. work:*

The contractor shall supply all necessary centering and shuttering including props, bracing's, runners, staging, nails, bolts and nuts etc. as required and all necessary labour, plant and machinery etc. for fixing shuttering and boxing as well as labour and tolls for striking and removing them.

Shuttering and form-work for reinforced concrete work shall be composed of either steel plates 12mm thick shuttering plywood with adequate bracing's and supports or of 25mm thick approved timber planks planed smooth, with cross bearer, vertical and horizontal struts in such a manner that the shuttering or form work remains perfectly rigid during the filling, ramming, vibrating and setting of the concrete. The shuttering and form-work are to be close-boarded and the joints lined with craft paper or other types of approved materials to make it reasonably watertight. Form-work for beams, lintels and columns shall be framed up perfectly true with all necessary cross bracings or battens, distance pieces and bolts, so that the beams, lintels or columns when cast, shall be approved by the Engineer.

Rough dressed timbers or sal-ballis or steel pipe supports of adequate stiffness and strength and not bamboo, are to be used as supports for centering or form-work. Care is to be taken that no timber chips or shavings are left and cast in with the concrete. The supports shall be resting on Base plates.

If shuttering is to be re-used, it should be carefully cleaned before such re-use, properly aligned and open joints repaired.

In fixing shuttering, the levelling shall be done with levelling instrument and the shuttering shall be perfectly in specified levels. Before concrete can be laid, the Engineer shall approve shuttering.

Drawings showing shuttering details shall be submitted by the Contractor to the Engineer for his approval, if required by him.

All shuttering shall be removed without shock and vibration. The wedges are to be first eased gently and violent movements avoided. The shuttering shall be removed with the utmost care in all cases, so as not to cause any injury to any construction or to any stored material. Before the shuttering is stripped, the concrete surface shall be exposed where necessary in order to ascertain that the concrete has hardened sufficiently. The contractor shall take previous written permission from the Engineer before removal of the

shuttering. Where necessary in the opinion of the Engineer, temporary supports shall be installed to support any concrete work when the shuttering is removed.

The minimum period for keeping the centering and shuttering in position after final deposition of concrete shall be as follows and the contractor shall not be permitted to strip off shuttering before the specified period as per IS.

No plugs, bolts, ties, holdfasts or any other appliances whatsoever for the purpose of supporting the shuttering are to be fixed in the structure or placed in such a way that damage might result to the work in removing the same when the shuttering is struck down. In no case shuttering shall be jailed to the door and window frames.

4.5.11 *Sundry items.*

All chases and holes are to be formed as may be shown or directed without any extra charges. The contractor shall furnish all materials and labour and do all grouting required filling chases and holes. Grouting shall be done with cement mortar 1:1.

The contractor shall fix all necessary inserts in all concrete works for the supports of hangers for pipes, cables, etc. as directed by the Engineer and will be paid in relevant item.

Expansion joints shall be provided in such position and in such manner as indicated in the drawing or as per direction of the engineer.

All exposed faces of concrete shall be properly chipped to receive sand cement rendering or plastering as specified in the bill of quantities.

The general specification for all plain cement concrete shall comply to that for RCC work as per IS:456.

At the junction of RCC column or beam with brickwork/RR masonry 6 mm dia. M.S. dowel bars of required length shall be provided for bonding brickwork with RCC work at suitable intervals as per direction of the Engineer for which no extra payment shall be made. The contractor shall allow for this in his rate for RCC and reinforcement work.

5.0 Cement Based Water Proofing/Terracing:

5.1 Waterproofing over building roof slabs: (Cement based)

Following specifications shall be followed for providing waterproofing over RCC slabs, parapet walls etc., on building roofs, terraces etc.,

5.2 Over Slabs – Plain or Sloping

- A. Clean the surface of the slab by removing all loose materials, dust etc., and wash with clean water.

- B. Provide and lay a screed of CM (1:3) over the clean and damp surface including waterproofing agent mixed with CM. Total average thickness shall be 20 mm.
- C. Lay an average thickness of 115 mm consisting of brickbat layer laid in random pattern to avoid continuity of joints and 10 mm thk. Bedding, 10 mm thk. Jointing with waterproof cement mortar of (1:5). This layer shall be laid to appropriate slopes towards rainwater down take outlets already provided by civil contractor. This brickbat layer shall be continuing in rounded manner over at least 200 mm of vertical surface of parapet walls. This layer shall be cured for minimum 3 days before taking up the next layer. The surface, which is not taken up for next layer shall be continued to cure for minimum 10 days.

5.3 *Final layer*

Provide and lay minimum 40 mm thick IPS layer in cement concrete (1:2:4) with maximum size of aggregate 3 mm to 6 mm, simultaneously with polishing trowel, using CM (1:2) wherever necessary level. Use waterproofing agent as approved in this layer and finally finishing the surface with towel with near cement slurry and making of 300 x 300mm Square.

5.4 *Curing*

This layer shall be cured for 21 days by flooding the water to 25 mm depth in panel of 1 m x 1m formed by weak cement mortar bonding.

6.0 **Brick-work :**

6.1 *Codes and standards*

IS:2212	:	Code of practice for brick work.
IS:1077	:	Common burnt clay building bricks.
IS:2691	:	Burnt clay facing bricks.
IS:3495	:	Method of sampling and testing clay building bricks.
IS:3696	:	Safety code for scaffolds and ladders.

6.2 *Materials*

6.2.1 *Cement:*

Cement used shall conform to IS:269 or IS:455.

6.2.2 *Sand:*

The sand shall be salt-free, well-graded river or pit sand and it shall conform to IS:1542 for plaster and to IS:1542 for plaster and to IS:2116 for masonry mortar. Sand for the mortar shall be evenly graded from coarse to fine, free from loam, clay, dust or organic matter etc.

6.2.3 *Water:*

Water shall be clean and reasonably free from deleterious materials such as oil, acids, alcohol, salts and vegetable growth.

6.2.4 *Bricks:*

The bricks used shall be conforming to IS:1077. Bricks shall be whole, sound, well burnt, free from cracks, well defined edges, well shaped, uniform in size and shall emit a clear ringing sound when struck. The compressive strength of brick shall be as given in Bill of Quantities.

6.2.5 *Wire netting:*

Woven, hexagonal wire shall conform to type N3 of IS:3150 and be galvanized. The width shall suit the thickness of the wall.

6.2.6 *Scaffolding:*

Generally, scaffolding shall conform to IS:2212, and shall be designed to withstand the required loads and to ensure complete safety of workmen and materials.

The scaffolding shall be double, i.e. it shall have two sets of stands. Where this is not possible, the inner end of the scaffolding poles shall rest in a hole provided in a header course only. Only one header for each pole shall be left out. Holes if provided shall be filled in and made good by the Contractor at his own cost to the satisfaction of the Engineer.

6.2.7 *Cleaning:*

The contractor shall carry out work in as clean a manner as possible and shall remove excess materials and mortar droppings and rubbish daily. Where brick walls and stone masonry are to receive plaster, the joints shall be cleaned of excess mortar and raked to a depth of 12 mm and the surface shall be brushed clean. During cleaning operations, adjacent work shall be protected and any damage resulting from improper protection shall be made good by the Contractor at his own cost.

6.2.8 *Workmanship:*

The whole of the brickwork shall be carried out by the Contractor in an uniform manner according to IS:2212. All the bricks shall be kept under water till they are completely soaked and used on the works on their becoming skin dry. The Contractor shall set out and build all brickwork to the dimension, thickness and heights shown on the drawings. The contractor shall build all brickwork in English bond and half brick shall not be used except where required for bond.

The contractor shall lay bricks in full mortar beds with shoved joints. The joints shall not exceed 10 mm in thickness and shall be full of mortar, close, well finished and neatly

struck. The vertical joints in any course shall not be nearer than a quarter of brick length from those in the course below. All joints shall be of same width except for small variations to maintain the bond. The brickwork shall be laid plumb and true to line and level. No portion of brick work shall be raised more than 1 metre above another in a day. If the mortar in any course has begun to set, the joints shall be raked out before another course is laid. The topmost course of brick work under a reinforced concrete beam shall be wedged against reinforced concrete surface and the joint well filled with mortar.

The contractor shall flush up all the joint thoroughly with mortar as the work proceeds. Where brickwork is to receive plaster the joints shall be raked to a depth of 12 mm to provide proper bond.

The brick work as it is in progress shall be thoroughly watered on its faces and top. New work shall be properly bonded with the old work. Old surface of unfinished work shall be cleaned and thoroughly watered before joining new work to it.

Any work in which the mortar perishes shall be dismantled and rebuilt by the Contractor at his own expense.

Walls whose thickness is less than a full brick length shall be reinforced with wire netting of width equal to that of the wall. The wire mesh shall be of type N3 of IS:3150 and galvanized. Half brick wall and 75 mm thick brickwork shall be reinforced at every fourth course and third course respectively. The free ends of the reinforcement shall be keyed into the mortar joint of the main brickwork.

The workmanship shall conform to IS: 2250 for preparation of masonry mortars and to IS:1661 for plaster mortars.

The cement and sand shall be proportioned by volume in gauge boxes and thoroughly mixed dry. The water shall be added by sprinkler just sufficient to make a stiff and workable paste. In case of mechanical mixing the mortar shall be mixed for atleast 3 minutes and for hand mixing the mortar shall be heeded back and forth for 10 to 15 minutes with additions of water.

Mortars shall be used up within two hours of the first contractor of the cement with water. All materials remaining after this period shall be discarded.

6.3 Curing:

All brickwork shall be kept wet for atleast 10 days after it is laid.

7.0 Stone Masonry

7.1 Codes and Standards:

IS:3696	:	Safety code for scaffolds and ladders.
IS:1127	:	Recommendations for dimensions and workmanship Of natural building stone for masonry work.
IS:1129	:	Recommendations of dressing of natural building stones.

7.2 *Materials:*

7.3 *Cement mortar:*

Cement mortar shall be as specified for brickwork in clause 7.0 of this specifications.

7.4 *Water:*

Water shall be clean and reasonably free from deleterious materials such as oils, acids, alcohol, salt and vegetable growth.

7.5 *Stone:*

Building stone shall conform to IS:1127. Rubble stone shall be strong, dense, compact, close grained and uniform in texture and colour with reasonable facility of working. It shall be free from cracks, flaws, decay and sand holes and shall be taken from approved quarries.

A fresh fracture of stone should be bright, clean and sharp without loose grains and free from any dull earthy appearance. The stone shall be properly dressed after quarrying before they are put to use in the structure.

7.5.1 General requirements for construction shall conform to IS:1597 (Part-I) and shall be generally as specified below:

7.5.2 All stones shall be staggered as far as possible.

7.5.3 Vertical joints shall be staggered as far as possible.

7.5.4 All necessary chases for joggles, dowels and cramps shall be formed in the stone before hand.

7.5.5 Transverse bond shall be provided by the use of stones extending from the front to the back of the wall. Two numbers bond stone shall be provided per square metre of front face area. Plain cement concrete 1:3:6(1 cement, 3 coarse sand, 6 graded stones aggregate 20 mm nominal size) may be used in bond stones if approved by the Engineer.

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

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

7.5.8 All joints shall be full of mortar. The maximum thickness of joints shall be 20 mm for random rubble and 10 mm for square rubble. Raking the joints to expose the edges of all face stones for a depth of atleast 20 mm shall be done at the time of building the masonry wherever separate sunk pointing is to be done. All surfaces shall be brushed clean to expose rock face after everyday work.

7.6 *Scaffolding:*

Single scaffolding having one set of vertical support shall be used and one end of the horizontal scaffolding member shall rest in a hole provided in the masonry. The support shall be sound and strong tied together with horizontal pieces over which the scaffolding planks/jallis shall be fixed. The holes which provide resting space for horizontal members shall not be left in pillars under one metre in width, and the holes in any part of the masonry shall be made good as the scaffolding is dismantled. The scaffolding shall be strong enough to withstand all loads likely to come on it.

7.7 *Cleaning:*

The Contractor shall carry out work in as clean a manner as possible and shall remove excess material and mortar droppings and rubbish daily. Where stone walls are to receive plaster, the joints shall be cleaned of excess mortar and raked to a depth of 12mm and the surface shall be brushed clean. During cleaning operations, adjacent work shall be protected and any damage resulting from improper protection shall be made good by the Contractor at his own cost.

7.8 *Random rubble masonry:*

7.8.1 Workmanship for stone masonry shall conform to IS:1597.

7.8.2 *Dressing:*

The stone after being fully cleaned and wetted are to be set in the work as received from the quarry and without further dressing of any sort except that of knocking of weak corners and edges with the mason's hammer.

7.8.3 *Bond and laying:*

The stones shall be carefully laid so as to break joints by at least 75 mm and solidly bedded with close joints. No joints shall exceed 20 mm in thickness. Chips of stones and spalls shall be wedged into the work, wherever necessary so as to avoid thick beds or joints of mortar. No dry work or hollow spaces shall be allowed in the masonry anywhere.

Every stone whether large or small be set flush in mortar, smaller stones used in the filling being carefully selected to fit into interstices between the larger ones roughly. The outside and the inside faces of masonry in walls must be carried out in the same plane as the faces of the preceding length.

7.8.4 *Insertion of chips:*

Chips and spalls of stones shall be used wherever necessary to avoid thick mortar beds or joints and it shall also be ensured that no hollow spaces are left in the masonry. The chips shall not be used below hearting stones to bring these up to the level of face stones.

The use of chips shall be restricted to the filling of interstices between adjacent stones in hearting and these shall not exceed 20 percent of the quantity of stone masonry.

7.8.5 *Hearting Stones:*

The hearting or interior filling of a wall face shall consist of rubble stones not less than 150 mm in any direction and shall be carefully laid by hammering down with a wooden mallet into position and solidly bedded in the mortar. The hearting shall be laid nearly level with facing and backing.

Face stones:

The face stones shall be laid as far as possible without pinning in front and they shall be selected from the mass of quarry stone for greater size, good beds and uniform in colour. They shall be laid so that they shall tail back and bond well into the work and shall not be of greater height than either the breadth or face or length of tail in the work.

7.8.6 *Bond or header stones:*

Atleast two per square metre of front face area shall be through stones evenly distributed throughout the wall. The through stones will fulfill all the conditions of the face stone except as regards their length which must be not less than the wall thickness for walls upto 600 mm thickness and must run right through the wall. In thicker walls a line of two or more through stones must be laid from face to back overlapping each other atleast 150 mm. Through stones should not be in the same vertical plane in successive courses. For facility of checking, they shall be marked and the marks shall be capable of being easily rubbed out.

7.8.7 *Quoins:*

The quoins or corner stones shall be selected stones neatly dressed with hammer and/or chisel to form the required corner angle and laid header and stretcher alternately. The bed and top surface of quoins shall be chisel dressed to give horizontal joints. The quoins shall have a uniform chisel draft of atleast 25 mm width at four edges of each exposed face, all the edges of the same face being in one place. No quoin stone shall be smaller than 0.025 cum. (25 dm^3) in volume and it shall also not be less than 300 mm in length; 25% of them being not less than 500 mm in length.

7.8.8 *Jamb stones:*

The jambs shall be made with stones specified for quoins except that the stones provided on the jambs shall have their length equal to the thickness of the wall for walls up to 600 mm and a line of headers shall be provided for walls thicker than 600 mm as specified for bond.

7.8.9 *Finishing:*

Where lime mortar is used, the exposed faces of work shall be cement flush pointed, unless otherwise specified. When cement mortar is used the joints may be flushed as the work proceeds. Where stone work is to receive plaster or to be pointed other than flush pointing, the joints shall be raked to a minimum depth of 12 mm to provide proper bond. Any work in which mortar perishes shall be dismantled and rebuilt by the Contractor at his own expenses.

7.8.10 *Curing:*

Curing shall be done for a period of seven days.

8.0 **Plastering, Pointing and surface treatments:**

8.1 *Codes and Standards:*

<i>IS:1542</i>	:	<i>Sand for plaster.</i>
<i>IS:161</i>	:	<i>Code of practice for cement and cement-lime plaster finishes on walls and ceilings.</i>
<i>IS:712</i>	:	<i>Building limes.</i>
<i>IS:1625</i>	:	<i>Code of practice for preparation and use of lime mortar in building.</i>

8.2 *Materials:*

All materials for cement mortar shall be as specified under clause 7.2 of this specification.

8.3 *Mortar Proportion:*

Unless otherwise specified, cement plaster shall be composed of 1 part of cement and 6 parts of sand. The composition for ceiling plaster shall be of 1 part of cement and 3 parts of sand.

The proportion of cement mortar for pointing shall be one part of cement and four parts of sand (1:4) or as shown in the drawing in volumetric measure.

8.4 *Thickness of plaster:*

The thickness of plaster shall be as shown in drawings, specified in bill of quantities and as directed by the Engineer.

8.5 *Cleaning of Joints:*

All the joints must be raked, cleaned and well wetted as directed by the engineer before pointing/plastering.

8.6 *Type of pointing:*

The pointing shall be sunk pointing or flush pointing as indicated in the drawing/bill of quantities and as directed by the Engineer.

8.7 *Workmanship:*

8.8 *Pointing:*

For sunk pointing the mortar shall be applied firmly to raked out and well wetted joints with a trowel and pressed well home. It shall not spread on the face of rubble/brick work but shall be strictly restricted to width of the joint. All superfluous mortar shall be properly removed with a trowel. When pointing is air dry, it shall be rubbed smooth with the trowel and pointing tool. The pointing line shall be regular and uniform in breadth and depth. No false joints shall be made. The size of the finished sunk pointing shall be as indicated in the drawing and/or bill of quantities and the edges of all face stone/bricks shall be clearly exposed.

For flush pointing, the mortar shall be pressed into the joints and shall be finished of slush and levelled. The edges shall be neatly trimmed and made straight.

All surplus mortar shall be properly removed.

8.9 *Plastering:*

8.9.1 *Proportion:*

Unless otherwise specified, all plaster work shall be carried out according to IS:1661. The thickness and proportion of cement plaster shall be as shown in the drawing and indicated in bill of quantities.

8.9.2 *Workmanship:*

The surface to be plastered shall be cleaned of all extraneous matter and rubbish. In brick work the joints shall be raked and concrete surface roughened by chipping or hacking. Any shuttering material adhering to the concrete shall be removed. The surface shall be thoroughly watered and soaked, aerated and all putlog holes shall be closed before starting plastering operation. Plaster pads of required thickness of plaster for correctness of plumb, line and level shall be established before starting plaster work.

For single coat plaster work, the plaster shall be laid slightly thicker than the specified thickness and the surface then levelled with a wooden rule to the required thickness. The plaster shall be well pressed into the joints and the surface finished as specified. Single coat plaster shall be followed to a maximum thickness upto 15 mm.

Where two coat plaster work is specified, the backing coat shall be left rough and keys formed for the application of second coat. The finishing coat shall be applied a day or two after the backing coat has set, but the backing coat shall not be allowed to dry. The

second coat shall be laid on with a wooden rule to a specified thickness, rubbed smooth and levelled and the surface plastered completely on the same day. The levelling shall be continued till the plaster shall be wiped off with fine cloth. The surface shall be kept dry until exudation of moisture ceases, during the process of rubbing. In case of 20 mm thick plaster, backing coat and finishing coat shall be of 12 mm and 8 mm thickness respectively.

8.9.3 *Rough cast plastering:*

The surface shall be cleaned off all dust and dirt and the brick work/stone masonry thoroughly watered. The backing coat shall be 12 mm thick of cement plaster 1:4 (1 cement, 4 coarse sand) and keys shall be formed on the surface. After curing this coat sufficiently, the finishing coat 10 mm thick consisting of either grey or white cement or cement mixed with pigments for required colour and fine sand to required gradation (1:3 mixed with 10% finely ground hydrated lime by volume of cement shall be applied and then while green, dashed with a mixture of sand and crushed stone of 2.36 mm 12.5 mm size.

STEEL AND ALLUMINIUM JOINERY

9.0 STEEL JOINERY

9.1 General requirements:

Steel windows, ventilators and fixed lights shall conform generally to the provisions prescribed in IS: 1033 and IS: 1361 and also dimensionally to the details shown on the drawing. Rolled steel sections for the fabrication of steel joinery and material to be used in the manufacture of the sections shall conform to the requirements specified in IS: 7452, 18.1.2 Pre-stressed steel door frames:

- a) Steel door frames shall be manufactured from commercial mild steel sheet of 1.25mm thickness, conforming to IS: 226 and 4351.
- b) Steel door frames shall be made true to profile and dimensions as specified in IS: 4351 or as per drawing.
- c) Each door frame shall be consist of hinge jamb, lock jamb, head and if required angle threshold. The whole shall be welded or rigidly fixed together base tie shall be screwed to the feet of frames in order to form a rigid unit.
- d) Base ties shall be of pressed mild steel 1.25mm thick adjustable to suit floor thickness of 25,30,35 or 40mm and removable or alternatively, thresholds of mild steel angle of section 50X25mm minimum shall be provided for external door frames.
- e) Fixing lugs shall have a head made of 25 wide x 1.6mm thick steel strip of specified length and a split and tall 40mm wide x 1mm thick and 200 long. There shall be a minimum of three lugs to each jamb.
- f) Hinges shall be made of 2.5mm thick mild steel with a Zinc coated removable pin of 6mm diameter (conforming to IS: 1341).
- g) Mortar guards shall be provided as specified and these shall be welded to the frame at the head of the frame for double shutter doors to make provision for bolts.
- h) There shall be an adjustable lock strike plate of steel, complete with mortar guard to make provision for locks or latches complying with the relevant Indian standards. Lock-strike plates shall be of galvanized mild steel and fixed at 75cm to 90cm from finished floor level.

- i) For side hung door there shall not be less than three buffers of rubber or other suitable material inserted in holes in the rebate and one shall be located on the centre line of the lock strike plate lock strike plate. For double shutter doors there shall be two buffers of rubber or similar suitable material inserted in holes in the rebate in the lock jamb only at the head and spaced 15cm at either side of the center line of the door.

9.2 *Steel Windows & Ventilators*

- a) Steel windows, and ventilators shall be manufactured from ordinary quality structural steel conforming to IS: 1977. In case of composite units consisting of a combination of two or more units of windows and ventilators different units shall be coupled by using coupling sections made from the MS steel 3.15mm thick as per IS: 1038. The weight of various rolled steel sections used for the manufacture of windows and ventilators shall be as per those specified in IS: 1038. unless otherwise specified.
- b) Frames shall show no warp or inferior workmanship. All openable windows shall be designed to open outside with glazing on the outside of the frames unless mentioned otherwise. The hinges for side-hung shutters shall be of projecting non-friction type and for top hung plain type unless specified. Hinge pins and washers shall be of galvanized steel or Aluminium alloy of suitable thickness. Weather bars shall be fitted to fabricated coupling section wherever required.
- c) Steel ventilators with fixed louvers shall comprise of 16 gauge pressed steel guides spaced at 50mm c/c for receiving glass louvers 4mm thick. MS pressed steel louvers shall be fabricated out of 16 gauge steel bent to 'Z' shape and shall be tack welded to frames.

9.3 *Rolling Shutters*

- a) Rolling shutters shall in general conform to IS: 6248 and shall be fabricated out of mild steel laths having interlocking curls at both edges with 12mm minimum depth of corrugation for resisting manual pressure and normal wind pressure. The laths shall be fabricated out of cold rolled steel trips. Conforming to IS: 4030. Each lath section shall be continuous single piece without any welded joint. The water shielding surface shall be kept on the side exposed to atmosphere. When interlocked the rolling centers of the laths shall be a 75mm centres minimum. Each alternate lath section shall be fitted with malleable cast iron (conforming to IS: 2108) or mild steel clips securely riveted at either end and thus preventing their lateral movement and wearing of their edges against the guide channels. The clips shall be so designed so as to fit the contour of the lath sections.
- b) The shutter shall be provided with bottom lock plate fabricated out of 3.15mm thick mild steel sheet reinforced by an angle iron stiffener of not less than 35x35x5mm size at the bottom and MS flat at the top. It shall be interlocked with the bottom lath so as to have a firm contact against the sill while the shutter is in closed position. The lock plate shall be fitted with necessary sliding bolts and pulling handles usable from both interior and exterior sides of the plate.
- c) The guide channels shall be either of rolled section or one piece pressed construction and shall be of thickness not less than 3.15mm. The depth and width of guides shall be such that, there is sufficient clearance between the curtain and the inner surface of guides to ensure not only free movement of curtain but holding it firmly at the ends upto a maximum wind pressure of 200 Kg/Sq.M and preventing it from rattling as well. The

minimum depth of channel shall be 65mm for widths upto 3.50m and 75mm for widths more than 3.50m. Width of guide channel shall be 25mm for lath sections with depth of corrugation 12mm. The guide channel shall have minimum 3 numbers of MS hold fasts and the maximum spacing shall however, not exceed 750mm. Provision of MS stopper at the maximum height shall be made on the guide channels.

- d) Bracket plates shall be of hexagonal square or circular contour and shall have a U-shaped cast iron or mild steel clamp welded to it at the centre. The bracket plate shall be made out of 3.15mm thick mild steel plate and size shall conform to the requirements in IS > the plate shall be held in position rigidly by means of suitable foundation bolts and in the case of push and pull type shutter, extra tying to the guide channel by means of a square bar not less than 20mm size shall be provided.
- e) The suspension shaft of the roller shall be made of heavy duty steel pipe conforming to IS: 1161 and shall be of adequate diameter to have minimum deflection with suitable flange coupling. The pipes of the shaft that, are clamped to the brackets shall be fitted with rotatable cast iron pulleys to which the curtain is attached. The pulleys and the pipe shaft shall be connected by means of pre-tensioned helical springs, flat or coil type conforming to grade 2 of IS: 4454 hardened and tempered.
- f) Ball bearings provided for rolling shutters shall be two-row self aligning type with special cast iron catnips at the extreme pulleys at either end. The pulleys shall be interconnected with a cage formed out of mild steel flats of at least 32x6mm and spaced at 15cm.
- g) The hood cover shall be made of 0.9mm thick MS sheets with necessary stiffeners and framework. The cover shall be of hexagonal, square or circular contour depending on the bracket plate contour. This shall be supported at regular intervals to prevent sagging.
- h) Unless otherwise specified for overall area of rolling shutters upto 10 square meters, put and push type hand operated shutters with ball bearings shall be provided. For areas more than 10 Sq.M and upto 35 Sq.M mechanical operated gear type will ball bearings shall be provided. A pulling hook shall be provided for each of the rolling shutters. The pulling hook shall consists of 12mm diameter rod with a hook at one end and a ring at the other end of length.
- i) Power operating shutter shall be suitable for 3 phase, 50 cycle, 400 volts AC power supply and shall be either floor or wall mounted unit. The motor shall be of sufficient capacity to move the shutter in either direction at a speed of 0.3m/sec. In addition to the gear motor, each standard power unit shall included a magnetic brake, reversing starter with built-in overload protection, a geared limit switch and one push button station located inside the building with sensitive edge, electrically connected stop the travel of the door on meeting an obstruction. Operating chains shall be tested quality, heavy galvanized and with all ends rounded to assure smooth operation and hand moulded from machine cut pattern. These shall be operable from a push button station conveniently located beside the door. One emergency hand chain/crank operation shall be provided for use in case of failure of the electrical system.

All door-frames, windows and ventilators shall be dispatched with the opening parts suitably secured to preserve alignment when fixing and glazing.

Fixing lugs, couplings, fittings and all hardware shall be dispatched separately.

Composite windows shall be dispatched uncoupled.

10.0 Aluminium Joinery

10.1 2.1 General requirements

- a) Anodized Aluminium joinery shall conform to the requirements specified in IS: 1948 and 1949 and shall be of HINDALCO, INDAL or equivalent reputed make with size and design as per relevant drawings. The average thickness of anodic coat shall not be less than 20 microns (IS: 7088) and shall be matt finished.
- b) Aluminum doors, windows, ventilators shall be made of Aluminium alloy conforming to IS: 733 and sections shall generally conform to IS: 1948. Coupling members forming composite sections shall be of extruded true right angle. For side hung shutters, hinges shall normally be of projecting type made of Aluminium alloy and riveted / machine jointed to frame and shall have stainless steel / Aluminium alloy pins. Irrespective of the hinges being anodized or not, the Aluminium alloy pins shall be anodised to a minimum film thickness of 25 microns and shall be sealed with oil or wax. Handles, peg stays shall be of approved heavy-duty quality Aluminium or its alloy conforming to IS specifications.
- c) The doorframe and shutters shall be single action or double action as indicated in the drawing with hydraulic door closer in the floor. The doors shall be provided with anodized Aluminium door handles for full width of door inside and outside. The door frame shall be provided with approved anchors spaced not more than 900mm centres.
- d) Before erecting, frames coming into contact with concrete, masonry, plaster or dissimilar metals, shall be coated with a thick layer of clear transparent lacquer based on methacrylates or cellulose butyrate, which is compatible with zinc chromate to protect the surface from wet cement during installation. This lacquer coating shall be removed after installation is completed. Before handing over, the Aluminum work shall be washed with mild solution of non-alkali soap and water.

Gaskets to be used shall be made of neoprene / EDPM of approved make and shall be approved by the Client / Contractor before fixing in position. The sealant shall be of approved make and shall be duly approved before application. Aluminium doors, windows and ventilators after fixing in position shall be watertight and airtight.

Aluminium material used shall be specially anodised for protection against corrosion in marine environment in approved shade. The anodic coating shall conform to IS: 1868 and shall be of AC25 grade with minimum thickness of 20 microns when measured as per IS 660/2 and density shall be at least 32 MG/Sq.M. The anodic coating shall be double sealed or alternatively sealed with steam and shall be of minimum thickness of 50 microns. The anodic coating shall be tested in a laboratory by 6 Eddy current method as per IS: 6012 for thickness. Sulphuric acid shall be used as the electrolyte for the anodic process.

Wherever specified, polyester grade machine power coating of minimum thickness 20 microns shall be provided and such coating shall be of approved shade.

10.2 Supply

Same as for steel joinery.

10.3 Unloading and Stacking

The fabricated frames shall be transported, unloaded, stacked and handled in a careful manner. They shall be stacked on edge on level bearers and supported evenly. All precautions shall be taken to ensure that, the frames are not damaged or distorted in any manner. As decided by the Client / Consultant, the damaged or distorted frames shall be replaced and made good at the expense of the contractor. Generally, storage of doors and frames shall conform to IS: 4082.

10.4 Sampling

Sampling and criteria for conformity for steel / Aluminium doors, windows, ventilators and fixed light shall be as prescribed in the respective Indian Standards.

11.0 Hardware for Joinery Works

11.1 General requirements

- a) Fittings shall be of MS bars or Aluminium or as specified. These shall be smooth and free from sharp edges, corners, flaws and other defects. Screw holes shall be corner sunk to suit the head of specified wood screws. All hinge pins shall be of steel and their riveted heads shall be well formed.
- b) MS fittings shall be finished bright or black enameled or copper oxidized or painted as specified. Brass fittings shall be finished bright (brass), oxidized or Chromium plated (electroplated) on Aluminium fittings shall be finished bright or anodized or as specified. Fittings shall be approved by the Client / Consultant before fixing. Screws used for fittings shall be of the same metal as that of the fittings. However, anodized cadmium / chromium plated brass screws of approved quality shall be used for fixing Aluminium fittings. In case of renewal works, the new fittings shall as far as possible, match with the existing ones. Screws shall be driven home with screw driver and not hammered in.

11.2 Hinges

11.2.1 Butt Hinges

These shall be mild steel butt hinges (medium), brass butt hinges (light/ordinary), brass butt hinge (heavy), brass oxidized butt V (light/ordinary), brass oxidised butt V (heavy), extruded Aluminium alloy butt V or as specified. Brass and MS butt hinges shall generally conform to IS: 205 and IS: 1341 respectively.

11.2.2 Parliament Hinges

These shall be mild steel or cast brass or as specified and shall generally conform to IS: 362.

11.2.3 Spring Hinges

These shall be made of MS or brass casing with steel spring and shall conform generally to IS 453. Hinges shall work smoothly and hold the door shutters truly vertical in closed position. The size of spring hinges shall be taken as length of its plate.

11.2.4 Piano Hinges

These shall conform to IS: 3818 and shall be made of mild steel, brass, Aluminium alloy sheets. Mild steel hinges shall be finished with anticorrosive treatment or plating of brass or nickel as specified. Piano hinges shall be fixed for the full height of cupboard shutters.

11.2.5 Tee Hinges

These shall be made of MS sheets and finished bright. They shall conform to IS: 206.

11.3 Sliding Door Bolts

These shall be of Aluminium and conform to IS: 2681. They shall be capable of smooth sliding action. Alternative materials may be adopted on the approval of the Client / Consultant for specific locations.

11.4 Door latch

This shall be mild steel, brass or as specified and shall be capable of smooth sliding action.

11.5 Tower Bolts

Tower bolts may be of one of the following types:

Brass barrel tower bolt with cast brass barrel and rolled or drawn brass bolt.

Brass barrel tower bolt with brass sheet barrel and rolled or drawn brass bolt.

Anodised Aluminium barrel tower bolt with barrel and bolt of extruded sections of Aluminium alloy (10 / 12mm dia shoot).

MS tower bolt with barrel.

These shall generally conform to IS: 204 Parts 1&2 steel spring and ball shall be provided between the bolt and the barrel.

11.6 Door handles

These shall be cast brass or MS or Aluminium of specified size and of the shape and pattern as approved by Client / Consultant. These shall generally conform to IS: 208. The size of the

handle shall be determined by the inside grip of the handle. Door handles should be of 100mm size and window handles of 75mm size unless otherwise specified. These shall be fixed with 25mm long screws.

11.7 Mortice lock

Mortice lock with a pair of lever handles shall have steel casing and brass bolts and shall be or left handed as shown in the drawing or as directed by the Client / Consultant. It shall be of the approved quality and shall conform to IS: 2209. The shape and pattern shall be approved by the Client / Consultant. The size of the lock shall be determined by its length. The lock for single leaf door shall have plain face and that for double leaf door shall have a rebated face. Lever handles with springs shall be mounted on plates and shall weight not less than 0.5 kg per pair. These shall be of brass, finished bright chromium plated or oxidised.

11.8 Floor door stopper

This shall be made of cast brass or anodised Aluminium and shall have a rubber cushion. The type and pattern shall be as approved by the Client / Consultant.

11.9 Hooks and Eyes

These shall be of hard drawn brass or steel and shall generally conform to IS: 207.

11.10 Hydraulic door closer

These shall conform to IS: 3564 and be of brand approved by the Client / Consultant for both left and right hand openings.

Hardware and fixtures shall be as specified in the drawings or schedule of quantities. All hardware and fixtures shall be made able to withstand repeated use. Door closer shall be suitable for doors weighing 61-80 kg. Unless otherwise stated. Each closer shall be guaranteed against manufacturing defect for one year and any defect found within this period shall be rectified or the closer replaced free of charge. Concealed door closures shall be either floor mounted or transoms suited suitable for installation with metal doors. It shall conform to the performance requirements and endurance test stated in IS:3564.

12.0 Glazing

12.1 General requirements

The glass used for glazing works shall be of the best quality transparent and free from blisters, specks, bubbles, stones, scratches, veins, air holes and other defects also as to give a clear visibility through the glass.

All glass shall be procured from a reputed manufacturer and duly approved by Client / Consultant. The glass supplied at site shall conform to the requirements indicated in the schedule of items and the following Indian Standards listed below:

- a) Sheet glass of selected quality as per IS: 2835.

- b) Wired and wired-figured glass as per IS: 5437.

12.2 Sheet glass

General

Sheet glass is a flat transparent glass made by blowing or drawing and it shall be to the extent possible, colour-less as judged by the un-aided eye except when viewed edgewise showing a light blue to green tint.

Unless otherwise specified sheet glass shall weight 7.5 kg/Sq.M for panes upto 600x600mm. For panes larger than 600x600mm and upto 800x800mm glass weighing not less than 8.7 Kg/Sq.M shall be used. For bigger panes upto 900x900mm glass weighting not less than 11.25 Kg/Sq.M shall be used.

Sheet glass shall be patent flattened glass of best quality and for glazing and framing purposes shall conform to IS: 1761.

12.3 Testing

Tests for waviness, warpage, lines etc., shall be done as per Appendix-A of IS: 2835 and test for thickness shall be done as per Appendix-B of IS: 2835.

Any glass found to suffer from defects beyond allowable limits (as per Table-2, IS: 2835) shall be rejected.

12.4 Sampling

Representative samples of the material shall be drawn and adjudged for conformity with this specification as prescribed in Appendix-C, IS: 2835.

12.5 Packing and making

Sheet glass shall be packed as agreed to between the purchaser and the supplier. The packages shall be marked with ISI certification mark. Packages shall also be marked with name and quality of the material, nominal thickness and cut size, name of the manufacturer, as per Clause 6.0 of IS: 2835.

12.6 Wired glass and wire-figured glass

Wire glass apart from serving as a rigid glazing material helps in providing reasonable protection against spreading of fire across.

The wire mesh used in the wired glass or wired figured glass should be made of steel wire 0.46 to 0.56mm in diameter. The pattern of mesh shall be square or diamond with wired welded or hexagonal with wires twisted. The wire mesh shall be embedded completely in the glass sheet at least 1mm from the surface and shall not be exposed at any place. Wire mesh shall not contain more than 3 broken wires per square meter of glass.

12.7 Sampling and testing

Tests for flame proof-ness, thickness etc., and sampling shall be in accordance with the methods prescribed in IS: 5437.

12.8 Plate glass

Plate glass shall be polished patent flat glass of best quality. It shall have both the surfaces ground flat and parallel and polished to obtain clear undisturbed vision and reflection. The plate glass shall be of thickness mentioned in the item or as shown in detailed drawings or as specified. In absence of any specified thickness, the thickness of plate glass to be supplied shall be 6mm and a tolerance of 0.2mm shall be admissible.

12.9 Obscured glass

This type of glass transmit light so that, vision is partially or almost completely obscured. Glass shall be plain rolled figure, ribbed or fluted or frosted glass as may be specified.

The material shall be a homogenous paste and shall be free from dust, grill and other visible impurities and shall conform to the specifications prescribed in IS: 419.

Putty may be prepared by mixing one part of white lead with three parts of finely powdered chalk or then adding boiled linseed oil to the mixture to form a stiff paste and adding varnish to the paste at the rate of 1 liter to varnish to 18 Kg of paste.

13.0 Builder's Hardware.

13.1 Code and Standards:

<i>IS:204</i>	<i>:</i>	<i>Tower bolts.</i>
<i>IS:205</i>	<i>:</i>	<i>Non-ferrous metal butt hinges.</i>
<i>IS:208</i>	<i>:</i>	<i>Door handles.</i>
<i>IS:281</i>	<i>:</i>	<i>Mild steel sliding door bolts aldrops for use with padlocks.</i>
<i>IS:2681</i>	<i>:</i>	<i>Non-ferrous metal sliding door bolts (aldrops) for use with padlocks.</i>
<i>IS:451</i>	<i>:</i>	<i>Wood screws.</i>
<i>IS:723</i>	<i>:</i>	<i>Mild steel wire nails.</i>
<i>IS:1823</i>	<i>:</i>	<i>Floor door stopper.</i>
<i>IS:2209</i>	<i>:</i>	<i>Mortice lock (vertical type)</i>
<i>IS:6607</i>	<i>:</i>	<i>Rebated mortice locks (Vertical type)</i>
<i>IS:3564</i>	<i>:</i>	<i>Door closers (Hydrualically regulated)</i>
<i>IS:3847</i>	<i>:</i>	<i>Door handles for mortice lock (vertical type)</i>
<i>IS:363</i>	<i>:</i>	<i>Hasps and staples.</i>
<i>IS:419</i>	<i>:</i>	<i>Putty for use on window frames.</i>
<i>IS:412</i>	<i>:</i>	<i>Expanded metal steel sheets for general purposes.</i>
<i>IS:4218</i>	<i>:</i>	<i>Commercial bolts and nuts.</i>

13.2 Builder's Hardware:

Builder's hardware shall conform to the relevant Indian Standards and shall be provided as shown in the drawings or as indicated in the bill of quantities. They shall be of the best quality and complete with all necessary screws, bolts, plugs and other fittings. The finish on all the exposed faces of lever handles, plates and fittings shall be of silver anodized aluminum.

13.3 Hardware fittings for door, window & ventilators:

All mortice or rim locks, latches, cabinet and wardrobe locks, hydraulic door closers, floor springs etc. shall be of approved make. The rate shall include for all necessary screws, other adjuncts, fixing in position and is for the completed work. The finish shall be as specified in the bill of quantities.

Door, window and ventilator fittings shall be as per bill of quantities. The rates for doors, windows and ventilators shutters shall include the cost of fixing the fittings, with necessary brass screws to the shutters and the frame. The cost of fittings only shall be separately paid.

13.4 Fixing of Iron monger:

Iron-monger shall be fixed solidly to all doors, cupboards and panels and in accordance with the manufacturer's instructions.

Hinges shall be carefully housed or led into doors and frames.

Iron monger shall be carefully wrapped and protected until completion.

The contractor should allow for removing and re-fixing of fitting during any painting operations.

Metal sockets shall be provided to all tower, barrel and drop bolts where the shoots enter brick masonry, stone masonry or concrete. The shall be securely fixed flush with the surface into mortise and cemented. Mortise plates shall be used over holes in wood work.

On completion all locks, catches and similar items of ironmongery shall be properly cleaned, tested and oiled. All keys shall be clearly labeled with metal or hardboard tags of approximate size 50 mm x 20 mm securely fixed to the keys and handed over to the Engineer.

14.0 Steel Work

14.1 Codes and Standards:

<i>IS:226</i>	<i>:</i>	<i>Specification for structural steel (standard quality).</i>
<i>IS:1038</i>	<i>:</i>	<i>Steel doors, windows, and ventilators.</i>
<i>IS:1361</i>	<i>:</i>	<i>Steel windows for industrial building.</i>

<i>IS:16248</i>	:	<i>Metal rolling shutters and rolling grills.</i>
<i>IS:1977</i>	:	<i>Structural steel (Ordinary quality).</i>
<i>IS:2108</i>	:	<i>Black heart malleable iron casting.</i>
<i>IS:412</i>	:	<i>Expanded metal steel sheets for general purposes.</i>
<i>IS:4351</i>	:	<i>Specification for steel door frames.</i>

14.2 Steel for Reinforcement:

The mild steel bars for reinforcement shall conform to IS:432-1960 and cold- twisted steel bars shall conform IS:1786-1961.

14.3 Steel grills:

The grills of windows, verandahs, balconies etc. shall be of mild steel. The design of grills and shapes and sizes of various components shall be in accordance with the drawings. The edges, angles and corners shall be clean and true to shape. The joints shall be interlocked and over-lapping and neatly spot welded in such a way that the grill is rigid.

Where moulded grills are specified, the moulded work shall be according to the drawings and shall have clear, straight and sharply define profile.

14.4 Steel Gates:

Steel gates shall be fabricated and fixed in position strictly as per design and drawing. All intersections or meeting of all members shall be welded and the workmanship shall be of high quality to the entire satisfaction of the engineer. After fixing in position, these shall be cleaned off dust, dirt, rust or scales and rubbed with emery paper. Two coats of synthetic enamel paint over a coat of zinc chromate primer shall be applied. The rates for the gate shall include the cost of locking arrangements, hanging arrangement, jamming pintos with P.C.C 1:3:6 with 20 mm nominal size aggregate etc. the rate is for the completed work in all respects.

15.0 Finishing works

15.1 Codes and Standards:

White washing:

<i>IS:6278</i>	:	<i>Code of practice for white washing and colour washing.</i>
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Painting:

<i>IS:106</i>	:	<i>Ready mixed paint, brushing, priming for enamels for use on wood.</i>
<i>IS:102</i>	:	<i>Ready mixed pint, brushing, red lead, non-setting priming.</i>
<i>IS:123</i>	:	<i>Ready mixed paint, brushing, finishing semi-glass, for general purpose.</i>

<i>IS:1477</i>	:	<i>Code of practice for painting of ferrous metals in buildings.</i>
<i>IS:2074</i>	:	<i>Ready mixed paint, red oxide zinc chromate priming.</i>
<i>IS:2339</i>	:	<i>Aluminium paint for general purposes in dual container.</i>
<i>IS:2932</i>	:	<i>Enamel, synthetic, exterior, type-1</i>
	a)	<i>under coating.</i>
	b)	<i>Finishing, colour as required.</i>

15.2 Varnishing and polishing:

<i>IS:337</i>	:	<i>Varnish, finishing, interior.</i>
<i>IS:338</i>	:	<i>Varnish, undercoating, exterior natural resin.</i>
<i>IS:339</i>	:	<i>Varnish, undercoating, exterior synthetic resin.</i>
<i>IS:340</i>	:	<i>Varnish, mixing.</i>
<i>IS:345</i>	:	<i>Wood filter, transparent liquid.</i>
<i>IS:346</i>	:	<i>Varnish, spirit, clear, hard.</i>
<i>IS:347</i>	:	<i>Varnish, Shellac for general purposes.</i>
<i>IS:348</i>	:	<i>French polish.</i>
<i>IS:349</i>	:	<i>Lacquer, cellulose, clear.</i>

15.3 Colour washing:

<i>IS:427</i>	:	<i>Distemper, dry, colour as required.</i>
<i>IS:428</i>	:	<i>Oil-bound washable distemper, oil Emulsion, Colour as required.</i>
<i>IS:540</i>	:	<i>Cement paints, colour as required.</i>

15.4 Materials:

15.4.1 Cement:

Cement shall conform to IS:269 and IS:455.

15.4.2 Water:

Water shall be clean and reasonably free from deleterious materials such as oils, alcohol, salts and vegetable growth.

15.4.3 Lime:

Lime used shall conform to IS:712.

15.4.4 Colour:

Colour used for colour wash shall be of approved colour as specified as indicated in the drawings.

15.4.5 Distemper:

Distemper shall be of approved quality and shall conform to IS:427 and IS:428.

15.4.6 Gum and blue pigment:

Gum and blue pigment for white wash shall be best quality and of approved make.

15.4.7 Paint:

The painting and finishing materials for use in the work shall conform to relevant Indian standards and work. Ready mixed paints shall be used for the work unless otherwise specified, or if the Engineer is satisfied that they are not available they may be prepared at site.

If paints mixed at site to be used, they shall be prepared by mixing appropriate ingredients in approved proportions. The Contractor shall submit samples of each material for approval of the Engineer. The Contractor shall not construe approval of samples as acceptance of materials, as these materials shall be tested from time to time during the progress of the work.

The materials for succeeding coats on any one surface shall be products of the same manufacturer supplying the first coat for that particular surface.

15.4.8 Pigments:

All colours shall be non-fading pigments of approved make.

15.4.9 Primer coat:

Unless otherwise specified, the primer coat for wood work, steel and iron work shall be as indicated in the bill of quantities.

15.4.10 Brushes:

Paint shall be applied by brushes. Brushes required for painting shall be of type and size suitable for the work, conforming to relevant Indian Standards. Rags, inferior quality brushes or the like shall not be used on the work.

15.5 White washing and colour washing:

15.5.1 Mixing:

The slaked lime shall be dissolved in a tub with sufficient quantity of water and shall be well mixed to give a thin creamy consistency. It shall be strained through a clean coarse cloth and gum dissolved in hot water added to it at the rate of 2 kg. For each Cu. m. of lime and ultramarine blue added to the mixture in small proportion just sufficient to give a very light bluish tint.

Colour wash shall be prepared in the same way as for the white washing except that necessary amount of colouring matter shall be added to lime wash in this case. The entire quantity shall be mixed strictly in accordance with the manufacturer's instructions unless these are varied by the Engineer.

15.5.2 Preparation of surface:

Before the prescribed wall finish is laid on new wall, the surface of wall shall be well cleaned and brushed and all pitching's must be scrapped properly. After cleaning the surface, all holes, cracks and patches shall be made good with approved materials.

15.5.3 Application:

15.5.3.1 White washing:

White wash shall be applied with brush, each coat consisting of vertical stroke from top downwards followed by opposite stroke upwards over the first stroke and horizontal stroke from left to right followed by stroke right to left.

Each coat must be allowed to dry before the next coat is applied, on completion, the surface when it becomes dry, shall present a uniform white appearance. When dry, no coat of white wash shall show any patches, hair cracks or strokes nor shall it come off when rubbed with hands.

White wash shall be done in three coats unless otherwise specified. Doors and windows, floor etc. must be protected from white wash splashes. Any splashes and dropping shall be removed and cleaned.

15.5.3.2 Colour washing:

Colour wash shall be applied in the same manner as specified for white wash. During application, the solution shall be stirred continuously and wash shall be applied with care to avoid any cut shade or brush marks on the walls when the work is complete. For all new work, the surface to be colour washed shall first be treated with a priming coat of lime wash. Unless otherwise specified, two coats of white wash shall be applied before colour wash is applied. Number of coats of colour wash shall be specified in the drawings and/or in the bill of quantities. The colour wash, whether applied inside or outside of a building shall be of uniform tint and shade. Any splashes and droppings shall be removed and cleaned.

15.6 Distempering:

15.6.1 Mixing:

Distemper shall not be mixed in larger quantity than actually required for a day's work and hot water shall be used in preparing the mixture.

15.6.2 Preparation of Surface:

Before distemper is applied the surface shall be thoroughly cleaned of dust, dirt, grease, oil-marks, cement marks, loose scale etc. After cleaning the surface all holes, cracks, patches, etc. shall be made good with approved material and finally rubbed with a sand-paper to give a uniform surface. The distemper shall not be applied on damp walls and shall be applied in dry weather.

15.6.3 The workmanship:

The workmanship for distempering shall conform the IS:427 and IS:428. Distempering shall be done with proper distemper bushes of approved quality. The finished surface shall be of absolutely uniform shade throughout and free from brush marks. On drying the distemper shall not come off when rubbed with hands or shall not crack. The priming shall be in accordance with the recommendations of the manufacturer. Succeeding coats shall not be applied until the previous coat has been approved. The first coat shall always be of a lighter tint and shall be applied with care. In case the finish be not upto the satisfaction, the entire surface shall be sand papered to remove the work and fresh coats of distemper shall be applied by the Contractor without any extra cost to produce the desired result. All splashes of distemper shall be removed by the contractor at his own cost.

15.7 Cement Paint:

15.7.1 Materials:

Cement paint shall be of approved manufacture and quality. It should be mixed and applied in accordance with the manufacturer's instructions/directions.

15.7.2 Preparation of surface:

Before painting is commenced on a surface, all dirt, oil, grease, efflorescence and pints of organic type shall be completely removed. Traces of oil forms remaining on concrete work shall be carefully removed by steel brushes or abrasive stone. If there is a general coating of oil on the surface, the entire area to be painted shall be lightly sand blasted. Efflorescence on concrete surface shall be removed by wetting the surface and then scrubbing with 20% solution of Muric Acid.

When the surface to be painted is very smooth it shall be acid washed or rubbed with abrasive stone to obtain a slightly roughened surface.

Before the paint is applied, the surface to be painted shall be damped uniformly. The surface shall be sprayed several times with a few minutes interval between each spraying to allow the moisture to soak in the surface.

15.7.3 Mixing:

To start mixing only half ($\frac{1}{2}$) the required amount of water shall be added to the powder and thoroughly mixed to a stiff paste. Water shall then be gradually added till desired consistency is obtained. The paint shall be kept stirred during used and no paint which has been mixed for a period longer than one hour shall be used.

15.7.4 Application:

The cement paint shall be applied only in specified number of coats. After the first coat of paint has hardened sufficiently, it shall be cured by keeping the surface damp for at least 24 hours.

The surface shall be wetted again just before applying the second coat. At least 24 hours should elapse between application the two coats. The second coat shall be moistened with a fine spray as soon as the paint has hardened sufficiently to prevent marring the surface. It shall be kept wet for at least two days.

In so far as practicable, cement paint shall be applied in the shade. Open sunshine, be avoided especially during warm windy weather.

15.8 Painting:

15.8.1 Storage of paint:

All paints shall be stored strictly in accordance with the manufacturer's instructions. The storage area shall be well ventilated and protected from spalls, flame, direct exposure to sun or excessive heat. The contractor shall take proper care not to damage the label identifying the paint, date of manufacture, batch number and special instructions. The container shall be opened only at the time of use. Paint which, was liveried, griled or otherwise deteriorated during storage or otherwise shall not be used. Paints for which self life specified by the manufacturer has expired shall not be used without prior inspection and approval by the Engineer.

15.8.2 Mixing and thinning:

All ingredients in a paint container shall be thoroughly mixed to break-up lumps and disperse pigments before used and during application to maintain homogeneity. All pigmented paints shall be strained after mixing process and the type and quality of the thinner shall be in accordance with the instructions of the paint manufacturer.

15.8.3 Preparation of paint:

Normally, only ready mixed paints shall be used. Where ready mixed paints are not available and if oil base paints are prepared at site, the ingredients shall be thoroughly ground and thinned with double boiled linseed oil in specified proportion to the required consistency and added to the prepared base. The mixture shall be well stirred and strained through a piece of cloth. The painting materials, when applied, shall spread evenly in a thin coat and flow on smoothly without runs and sags and shall dry quickly forming a tough durable film without showing any brush marks or cracks.

15.8.4 Preparation of surface:

The surface of iron and steel work to be painted shall be cleaned free of dirt, oil, rust, mill-scale and be thoroughly dry before painting. Cleaning, degreasing, derusting and descaling wherever necessary shall be carried out as specified in IS:1477 (Part-I)

The surfaces of woodwork to be painted shall be cleaned and rendered dry, free of dirt, grit and grease and shall be rubbed with the appropriate quality of sand paper. All knots, pitch streaks and sappy spots shall be touched up with shellac varnish.

15.8.5 Painting iron and steel work:

Painting of iron steel work shall generally be carried out as per IS:1477. The number of coats including the primer coat shall be applied as specified in the bill of quantities. Each coat shall be allowed to dry sufficiently before the succeeding coat is applied.

The type of intermediate and finish coat and the number of coats to be applied shall be as specified in the bill of quantities. Intermediate and finish coats may be oil bound, bituminous, aluminium or other type of paints. Aluminium paints shall conform to IS2339. The intermediate and finish coats for structural steelwork, sheet metal work and cast iron work shall be applied as specified in IS:1477 (Part-II)

15.8.6 Painting woodwork:

After the primer coat has dried, nail holes, cracks and the like shall be filled up with approved wood putty and the surface finished smooth. The type of intermediate and finish coats and the number of coats shall be as specified in the bill of quantities. The surface shall be rubbed smooth before application of each coat.

15.8.7 Iron work under water:

Approved anti-corrosive black enamel paint shall be used for iron works in water such as cast iron pipes, etc. Coal tar paint may also be used with the approval of the Engineer.

15.8.8 Painting steel tanks:

Unless otherwise specified steel tanks for the storage of water shall be painted with approved paint before erecting them in position.

16.0 WATER SUPPLY

16.1 Codes and Standards:

<i>IS:404</i>	<i>:</i>	<i>Lead pipe.</i>
<i>IS:458</i>	<i>:</i>	<i>Concrete pipes with or without reinforcements.</i>
<i>IS:638</i>	<i>:</i>	<i>Rubber and insertion joining.</i>
<i>IS:778</i>	<i>:</i>	<i>Gunmetal gate, globe and check valves for water service.</i>
<i>IS:781</i>	<i>:</i>	<i>Sand cast bras screw-down bib taps and stop taps for water services.</i>
<i>IS:782</i>	<i>:</i>	<i>Caulking lead.</i>
<i>IS:783</i>	<i>:</i>	<i>Code of practice for laying concrete for laying concrete pipes.</i>
<i>IS:804</i>	<i>:</i>	<i>Rectangular pressed steel tanks.</i>
<i>IS:1239</i>	<i>:</i>	<i>Mild steel tubes and tubulars.</i>
<i>IS:1536</i>	<i>:</i>	<i>Centrifugally cast (spun) iron pressure pipes for</i>

		<i>water, gas and sewage.</i>
<i>IS:1537</i>	:	<i>Vertically cast iron pressure pipes for water, gas and sewage.</i>
<i>IS:1538</i>	:	<i>Cast iron fittings for pressure pipes for water, gas and sewage.</i>
<i>IS:1703</i>	:	<i>Ball valves (horizontal plunger type) including floats for water supply purposes.</i>
<i>IS:1711</i>	:	<i>Self-closing taps.</i>
<i>IS:1729</i>	:	<i>Sand cast iron spigot and socket soil, waste and ventilating pipes, fittings & accessories.</i>
<i>IS:1742</i>	:	<i>Code of practice for building drainage.</i>
<i>IS:1795</i>	:	<i>Pillar tap for water supply purposes.</i>
<i>IS:2065</i>	:	<i>Code of practice for water supply in buildings.</i>
<i>IS:2104</i>	:	<i>Water meter boxes (domestic type)</i>
<i>IS:3004</i>	:	<i>plug cocks for water supply purposes.</i>
<i>IS:3114</i>	:	<i>Code of practice for laying of cast iron pipes.</i>
<i>IS:3589</i>	:	<i>Electrically welded steel pipes for water gas and sewage.</i>
<i>IS:3597</i>	:	<i>Method of test for concrete pipes.</i>
<i>IS:4346</i>	:	<i>Washers for water taps for cold water services.</i>
<i>IS:4984</i>	:	<i>High density polyethylene pipes for potable water supplies.</i>
<i>IS:4985</i>	:	<i>Unplasticised PVC pipes for potable water supply.</i>
<i>IS:5822</i>	:	<i>Code of practice for laying of welded steel pipes for water supply.</i>
<i>IS:7634</i>	:	<i>Laying and jointing of polyethylene pipe and PVC pipes.</i>
<i>IS:8008</i>	:	<i>Injection moulded HDPE fitting fittings for potable water supplies.</i>

16.2 Jointing and laying of galvanized steel water supply pipes:

Screwed galvanized steel pipes conforming to IS:1239 shall be jointed with screwed socket joints and screwed fittings of the same materials as that of the pipes. Any burrs remaining on the pipe ends after the threads are cut shall be removed. An approved jointing compound together with a grummet of a few strands of fine yarn shall be used for jointing pipes and fittings. Any pipe threads exposed after jointing shall be painted or in the case of underground piping thickly coated with approved bituminous compound to prevent corrosion.

The depth at which the underground water supply pipe is to be laid shall be as shown on the drawings. The service pipe passing into or beneath the building shall be laid at least 200 mm below the ground floor level and be accommodated in a previously laid sleeve in the structure where it enters the building. The space between the sleeves and the pipe at its entry into and exit from the building shall be filled with a bituminous material for a minimum of 150 mm at both ends.

Piping shall not be buried in walls or floors as far as possible. However, when unavoidable, piping shall be buried for the shortest distance necessary and adequate protection shall be provided against damage. The embedded part shall be painted with bitumen.

Galvanized steel piping shall be secured by iron or steel clamps and hooks when fixed on walls. Metallic contact shall be avoided by coating the clamp inside with bitumen.

All pipe work shall be completed water tight and the joints shall be such that there are no projections of jointing materials or the like in the interior of pipes. Before the pipeline is commissioned all piping and fitting shall be flushed clean.

16.3 Laying and jointing of polyethylene pipes:

Polyethylene pipes shall be laid to conform with IS:7634 (Part-II). The pipes shall have screwed ends. Ordinary metal cutting dies of adjustable and guided variety may be used to thread the ends preferably in one operation. Before such threading, the end of the pipe shall be plugged to avoid distortion. Tapered threads shall be provided and their member shall be such as to be totally enclosed in the fitting.

Some permanent deformation take place under prolonged loading and this in time may loosen the thread. A jointing compound shall be used to avoid this condition.

For neat surface installations, straight lengths of pipe shall be used. Standard pipe clips may be used but these should not be so tight as to restrain thermal movement. Failing continuous support, clipping of the pipe should be performed at distance recommended by the pipe manufacturer. Generally the spacing shall not exceed 60 cm on horizontal runs and 1.2 m on vertical runs for HDPE.

These pipes shall not be installed near hot water pipes or other sources of heat and never painted. Storage and handling should be such as to avoid damage by cutting edges.

The radius of bend shall be greater than 20 times the outside diameter of the pipe for cold bent high density polyethylene pipes (12 times for LDPE) operating at ambient temperatures. For hot bent pipes of diameter up to 50 mm the radius shall be a minimum of 5 and 3 times the outside pipe diameter for HDPE and LDPE respectively.

Permanent bends shall be made by heating the pipe in boiling water for a few minutes or by careful application of a blow lamp, with a fine, warm and dry sand packed inside the bore.

16.4 Lead pipes:

Joints in lead pipes shall be wiped solder joints, shall be wiped in a continuous circular motion in one direction so as to leave neatly formed elliptical shaped joints free tears, burrs, droppings, etc. all exposed lead pipes, exceeding 25 mm in diameter shall be secured to walls by iron clips or lead ears. The spacing of the clips shall not exceed 900 mm.

16.5 Storage of Water:

All tanks for storage of water shall be completely watertight and properly covered with dust, light and mosquito-proof cover of approved type as shown on the drawings or as described in the bill of quantities. They shall be fitted with an approved type ball valve securely fixed to the inlet pipe. A mosquito proof overflow pipe shall be fixed to the tank

with pipe invert about 25 mm above the top of water line or at a height as shown in the drawing. A stop valve shall be provided for every outlet pipe except for the overflow. The outlet and drain pipes shall be as shown on the drawings. Support of the tanks shall be as indicated on drawings. In case of galvanized steel tanks, inside surface shall be painted with anticorrosive drinking water tank paints.

16.6 Testing of Water System:

To eliminate the danger of unknowingly attaching the pipe system to a pressure source higher than the pressure rating of the pipe, adequate pressure reduction devices shall be installed.

It may be necessary to isolate items of equipment from the pressure test if they are not capable of withstanding the test pressure and where these items are removed, blank flanges or plugs shall be installed temporarily.

The mains shall be tested in sections as the work of laying proceeds and joints should be left exposed for inspection during testing. After completion of each section, the main shall be carefully and slowly charged with water so that all air is expelled from the main, allowed to stand full of water for one/two days and then tested under pressure. The test pressure shall be the maximum working pressure +50%. Precautions must always be taken to see that the test pressure is not exceeded. Pressure gauges must be accurate and if necessary it shall be re-calibrated before the test. The test pressure shall be maintained as long as is necessary to inspect the whole of the pipe work under test and in any event not less than half-an-hour. Open ends of the mains shall be temporarily closed for testing under moderate pressure, by fitting water tight expanding plugs. If the section of the main terminates with a sluice valve the wedge of the valve shall not be used to retain the water because this might lead to permanent distortion of the working parts of the valve. Instead, the valve shall be fitted with a blank flange or socket plug and the valve left in the open position whilst testing. The end of the main and any test plug shall be well secured to resist the end thrust of the water pressure in the main, i.e. maximum test pressure times the cross-section area of pipe.

16.7 Sterilization of Water System:

The plumbing contractor shall carry out the sterilizing process in accordance with the following:

After cleaning the tank of all debris, the tank and pipe work shall be filled with water and whole thoroughly flushed out. The system shall then be filled with water a second time, but as the tank is filling, a sterilizing chemical containing chlorine shall be added to ensure thorough mixing of the chemical and water. The dose shall be such as to give 50 parts of chlorine to one million parts of water. If ordinary bleaching powder is employed, the proportion used shall be 150 g of powder to 1.000 litres of water, the powder shall first be mixed with water to a creamy consistency before being added. Proprietary brands of sterilizing chemicals shall be added in the proportions as per the manufacturer's instructions.

After filling the system, the incoming water supply shall be shut off and each tap of the distributing pipes opened successively, starting with that nearest the tank. As the water

which issues from each tap begins to smell of chlorine, the tap should be closed. The tank shall then be filled again to the water line with water to which has been added the correct dose of chemical.

The whole system shall then be allowed to stand charge with treated water for a period of at least three hours, after which a test shall be made by smell of residual chlorine. If non is found, the sterilization shall be repeated.

Before any water is used for domestic purposes, the whole system shall be emptied and thoroughly flushed out with clean water.

16.8 *C.I. Pipes and Accessories:*

The cast iron spigotted and socketed pipes required for the work shall be arranged by the Contractor. These pipes may also be supplied on “ free issue” basis, wherever indicated in the BOQ, depending on the availability. The Contractor shall make necessary arrangements for transporting the pipes from VSP Stores, located near the Plant Site, to the work site and safe custody of stores at site.

All specials, fittings and accessories shall be of best quality and of reputed manufacture and shall conform to the relevant codes and specifications.

16.8.1 *Size of the trench:*

The trench shall be so dug that the pipe can be laid to the required alignment and at the required depth. The size of the trench shall be as per the following table unless specified otherwise due to the site conditions.

Sl. No	Pipe Dia (mm)	Depth (cm)	Width (cm)
A.	<i>C.I. Pipes</i>		
1	80	105	75
2	100	105	75
3	150	105	75
4	200	110	80
5	250	120	80
6	300	135	80
7	350	145	90
8	400	155	90
9	450	170	100
10	500	185	100
11	600	205	110
B.	<i>G.I. Pipes</i>		
1	15 to 50	60	30
2	65 to 100	75	45

16.9 Laying of Pipes

The pipes shall be carefully aligned to the required line and level. The spigot end shall be centred into the socket of the next pipe and forced home and aligned to gradient. The pipe shall be secured in place with approved backfill material tamped under it except at the socket.

On level ground, the socket ends should face upstream. When the line runs uphill, the socket ends should face the upgrade.

Wherever it is necessary to deflect a pipe from a straight line either in the vertical or horizontal plane to avoid obstructions or where long radius curves are permitted, the deflection allowed at joint shall not exceed 2.50 as per IS:3114 1965.

The cutting of pipe, for inserting valves, fittings or closure pieces, shall be done in a neat and workman like manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe.

Flame cutting of cast iron pipes by means of an oxyacetylene torch shall be avoided.

16.10 Jointing of Pipes:

Jointing of socket and spigot pipes shall be carried out by the following techniques.

16.10.1 Rubber Joints:

The joint is of the push-in-type in which a specially designed high grade rubber gasket compressed against the inner surface of the socket by the insertion of the pipe spigot, provides the seal.

The rubber gasket shall be wiped clean, fixed and place in the annular recess of the modified socket. It shall be ensured that the gasket fits evenly around the whole circumference. Any bulge which would prevent the proper entry of the spigot and shall be removed.

A thin film of lubricant such as soap solution or grease shall be applied to the inside surface of the gasket and to the outer surface of the entering spigot for a distance of 25 mm from the spigot end.

The spigot end of the entering pipe shall be forced past the gasket carefully, which is thus compressed, until the spigot end reaches the bottom end of the socket. Crowbar or any other fork tool can be used to shove the spigot into the socket.

16.10.2 Collar Joints:

Wherever rubber-joints and joints are not possible, the C.I. pipes and specials shall be provided with C.I. collar joints using cement mortar.

16.11 Testing of Pipes and Joints:

After laying and jointing, the pipe lines shall be subjected to pressure test and leakage test as required by the Engineer. The entire length of the pipeline shall be carefully inspected.

Any joint found leaking shall be redone and also all leaking pipe shall be removed and replaced at no extra cost i.e. replacement of burst pipes by new pipes shall be done at the contractor's cost.

The test pressure for C.I.LA class pipes is 12 kg/cm² and that for C.I. A class pipes is 18 kg/cm². The pipes shall be slowly and carefully charged with water allowing air to escape and avoiding any shock.

Or water hammer. The draw-off taps and stopcocks shall then be closed and the specified hydraulic pressure shall be applied gradually. Pressure gauge must be accurate and preferably should have been re-calibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least half an hour. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing.

The test should be done at the cost of the contractor. The testing equipment such as pump, pressure gauge etc. and water required for testing should be provided by the contractor at his own cost.

The gaps i.e. lengths of pipe lines which come in between the tested lengths shall be carefully laid, jointed and rendered water tight. Any defect noticed during commissioning shall be made good by the contractor at his own cost.

The valve section of the pipe shall be slowly filled with water and all air shall be expelled from the pipe through hydrants and blow-off. If these are not available at high places, necessary tapings may be made at points of highest elevation before the test is made and plugs inserted after the tests are completed.

All exposed pipes, fittings, valves, hydrants and joints should be carefully examined during the open trench test. When the joints are made with lead. All such joints showing visible leaks shall be re-caulked until watertight. Any cracked or defective pipe fitting, valve or hydrant discovered during the pressure test shall be removed and replaced by sound material and the test shall be repeated to the satisfaction of the Engineer.

If the trench has been backfilled to the top, the section shall be first subjected to water pressure normal to the area and the exposed parts shall be carefully examined. If any defects are found, they shall be repaired and the pressure test repeated until no defects are found. The duration of the final pressure test shall be at least one hour.

16.12 Line Testing Log Book:

Line testing log book are to be maintained at site, This log book shall be so prepared that the following information can be recorded on each page Sector Number, Name of branch, Diameter of pipe to be tested, Date of pipe laying and jointing. Date

and Time of testing. Duration of testing. Result and Remarks on testing, signature of the Engineer present during the testing.

Backfill of the trench shall be progressed only after obtaining the signature of the Engineer in the Line Testing Log Book.

16.13 APPURTENANCES

16.13.1 Fixing sluice Valves/Butterfly Valve:

Only sluice valves with chrome-steel spindles shall be used. The butterfly valves will be of Audco make equivalent and approved. The sluice valves/ butterfly valves should be fixed as per drawing. The walls of the valve chamber shall be built with bricks of class designation 50 in cement mortar 1:5 on a bed of concrete 1:5:10 (M15) with 40 mm and down size broken stone aggregate. The sluice valve shall rest on a base of brick work. The chamber shall be plastered in cement mortar 1:3, 12 mm thick inside including flooring and 15 mm thick outside. The top of the chamber shall be covered with a RCC 1:2:4 (M15) slab in two or three strips with lap joints and having grooves in the slabs for fixing surface boxes. The CI surface box shall be fixed with cement concrete M15 and finished with earth filling. The rates shall include necessary earthwork in excavation and backfilling after completion of work and cost of surface box, etc.

16.13.2 Fixing wheel valves:

Brass full way wheel valve should be fixed as per the drawing. The walls of the valve chamber shall be built with bricks of class designation 50 in cement mortar 1:6 on a bed of concrete 1:4:8 with 40 mm and down size broken stone aggregate. The wheel valve shall rest on a base of brick work. The chamber shall be plastered in cement mortar 1:3, 12 mm thick inside including flooring and 15 mm thick outside. The top of the chamber shall be covered with the precast slab as shown in the drawing mentioned above. The rates shall include necessary earthwork in excavation and backfilling after completion of work.

16.13.3 Fixing Scour Valves:

Scour valve chambers shall be constructed as indicated in Drawing. The valve chamber walls shall be built with bricks of class designation 50 in cement mortar 1:5. The chamber shall be plastered in cement mortar 1:3, 12 mm thick inside including flooring and 15 mm thick outside. The RCC cover slab shall be of concrete M 15. The duck foot bend shall be fixed in cement concrete M 15. The duck foot bend shall be fixed in cement concrete M 15 as indicated in the drawing. The valve shall rest on a brick pedestal as indicated in the drawing.

Air valves shall be fixed as indicated in drawing. The valve chamber walls shall be built with bricks of class designation 50 in cement mortar 1:5 on the bed of concrete 1:4:8 with hard broken stone aggregate of 40 mm and down size, the thickness being as per drawing. The chamber will be plastered in cement mortar 1:3, 12 mm thick inside

including flooring and 15 mm thick outside. The C.I. Surface box shall be fixed flush with the top of masonry and set properly in M 15 concrete. The rate quoted by the contractor should include the cost of excavation for foundations and backfilling. Arrangements for disposal of spill water shall be provided as shown in the drawing.

16.13.4 Fixing Water Materials

Water meters shall be of approved manufacture shall conform to Indian Standards. They shall fixed to the pipelines at places indicated in layout drawing. The masonry chamber shall be built as per typical.

The walls of the chamber shall be 230 mm thick and built with bricks of class designation 50 in cement mortar 1:5 on the bed of concrete 1:4:8 using 40 mm and down size aggregates. The faces of the chamber shall be plastered in cement mortar, 12 mm thick inside including flooring and 15 mm thick outsides. The flooring shall be given a gentle slope. The CI surface box shall be fixed flush with top of masonry and set properly in cement concrete 1:2:4 (M15).

The rate quoted shall include the cost of earth-work excavation and refilling and the cost of surface box.

16.13.5 Fixing Fire Hydrants:

Fire hydrants shall be fixed as indicated in Drawing.

16.14 Interconnections:

GI branch connection with CI Main shall be done as per the typical drawing.

16.15 Dis-infection of Water Mains.

All CI water mains shall be thoroughly and efficiently disinfected before being commissioned by flushing with water containing bleaching powder at 0.5 gram per litre of water and cleaned with fresh water. This operation shall be repeated three times. This samples of water from the disinfected water mains shall be tested in an approved laboratory.

17.0 Sanitary, plumbing work, drainage and sewerage.

17.1 General:

All water supply, drainage and sanitary work shall be executed by a licensed or authorized plumbing supervisor or a licensed or authorized plumber supervisor or licensed or authorized plumber and shall be in accordance with the requirements of relevant by-laws of municipal or other Authorities in whose jurisdiction the works being carried out.

For items such as earthwork, excavation, concrete, brickwork, stonework and painting, etc. relevant specifications for these shall apply unless otherwise specified.

Unless otherwise specified, all exposed work such as cisterns, brackets etc. shall be painted with one coat of red oxide paint and two coats of synthetic enamel paint of approved colour.

The diameter of pipes and fittings wherever mentioned shall mean the nominal bore, otherwise specified.

17.2 Codes and Standards:

<i>IS:405</i>	<i>:</i>	<i>Lead sheet.</i>
<i>IS:638</i>	<i>:</i>	<i>Rubber and insertion jointing.</i>
<i>IS:651</i>	<i>:</i>	<i>Salt-glazed stoneware pipes and fittings.</i>
<i>IS:771</i>	<i>:</i>	<i>Glazed earthenware sanitary appliances.</i>
<i>IS:774</i>	<i>:</i>	<i>Flushing cistern for water-closets & urinals valveless siphonic type.</i>
<i>IS:775</i>	<i>:</i>	<i>brackets and supports for wash basing and sinks.</i>
<i>IS:782</i>	<i>:</i>	<i>Caulking lead.</i>
<i>IS:1536</i>	<i>:</i>	<i>Centrifugally cast iron pressure pipes for water, gas and sewage.</i>
<i>IS:1537</i>	<i>:</i>	<i>Vertically cast iron pressure pipe for water, gas and sewage.</i>
<i>IS:1538</i>	<i>:</i>	<i>Cast iron fittings for pressure pipes for water, gas and sewage.</i>
<i>IS:1726</i>	<i>:</i>	<i>Cast iron manhole covers and frames intended for use in drainage works.</i>
<i>IS:1729</i>	<i>:</i>	<i>Sand cat iron spigot soil, waste and ventilating pipes, fittings and accessories.</i>
<i>IS:1742</i>	<i>:</i>	<i>Code of practice for building drainage.</i>
<i>IS:2065</i>	<i>:</i>	<i>Code of practice for water supply in buildings.</i>
<i>IS:2326</i>	<i>:</i>	<i>Automatic flushing cisterns for urinals.</i>
<i>IS:2470</i>	<i>:</i>	<i>Code of practice for design & construction of septic tank.</i>
<i>IS:2548</i>	<i>:</i>	<i>Plastic water-closet seats and covers.</i>
<i>IS:2556</i>	<i>:</i>	<i>Vitreous sanitary appliances (Vitreous China).</i>
<i>IS:2963</i>	<i>:</i>	<i>Non-ferrous waste fittings for wash basins and sink.</i>
<i>IS:3006</i>	<i>:</i>	<i>Chemically resistant salt – glazed stones ware pipe sand fittings.</i>
<i>IS:3314</i>	<i>:</i>	<i>Code of practice for laying cast iron pipes.</i>
<i>IS:4311</i>	<i>:</i>	<i>Waste plug & its accessories for sink & wash basins</i>
<i>IS:3589</i>	<i>:</i>	<i>Electrically welded steel pipes for water, gas and sewage.</i>
<i>IS:4127</i>	<i>:</i>	<i>Code of practice for laving of glazed stoneware pipes.</i>
<i>IS:5329</i>	<i>:</i>	<i>Code of practice for sanitary pipe work above ground for buildings.</i>

17.3 Materials:

Materials, fittings and appliances:

The materials, fittings and appliances used in the work shall be as specified hereunder. The type, quality. The contractor shall submit to the Engineer samples of all materials, fitting and appliances for approval well in advance of starting the work. All materials, fittings and appliances used in the work shall conform to the approved samples which will be retained by the Engineer if he deems it necessary. Until completion of the work.

Lead pipe:

Lead pipes shall conform to IS:404. Weight and thickness of pipes shall be as indicated in the drawings or in the bill of quantities.

Lead sheets:

Sheet lead for finishing shall weigh at least 30 kg. Per sq.m unless specified otherwise and shall conform to IS:405.

Bottle trap:

Bottle trap shall be of approved quality, heavy brass chromium plated trap and made particularly smooth on the inside and shall have minimum 50 mm water seal (detachable).

Cast iron pipes and accessories:

Cast iron pipes conform to IS:1729,1536,1537 and 1538.

Manhole covers:

Manhole covers shall conform to IS:1726.

Salt-glazed stoneware pipes:

Salt –glazed stoneware pipes shall conform to IS:651; Class AA.

17.4 Workmanship

Laying of cast iron pipes:

Laying of cast iron pipes shall follow IS:3114.

17.5 Trenching:

The width of the trench at its bottom shall be such as to provide 20 cm clearance on either side of the pipeline. Trench shall be dug wider to permit convenient placing of supports handling of specials, and at positions of sockets and flanges for jointing to be made properly. At joints the depths of the trench shall also permit easy finishing of the

joint. In case of rocky areas, the minimum clearance all-round shall be 15 cm for pipes below 600 mm id diameter and 20 cm for larger pipes. Normally, the trench shall be excavated so that the pipe rests on a solid and undisturbed ground when laid. Where drilling or blasting becomes necessary. The excavation shall be trimmed to a depth 8 to 15 cm below the bottom of pipe and filled to a like depth with broken stone of size 13 mm and below and well rammed to form a fair bed.

All excavated material shall be placed on one side of the trench. All pipes, water mains, cables or other utilities met within the course of excavation shall be carefully protected and supported.

17.6 Handling:

Pipes shall be unloaded from trucks on wooden skids with a steadying rope to prevent bumping with other pipes on that side of the trench, which does not have the excavated material. All pipes, fittings, valves and hydrants shall be carefully lowered into the trench by means of a derrick, ropes, tripod or other tools to prevent damage to the materials or protective linings on the pipe.

17.7 Laying underground:

The pipe shall be checked for cracks by being rung with a hammer, preferably when suspended. Pipes shall be placed with their sockets facing upstream. After placing a length of pipe in the trench the cleaned spigot end shall be centered in the socket and the pipe forced home and aligned to gradient. Then it shall be secured in place in place and approved backfill material tamped under it except at the socket. Then the pipes, shall be jointed by caulking.

17.8 Jointing:

If the pipes used are of the spigot and socket type, the spigot shall be carefully centered in the socket by one or more laps of clean white hemp/spun yarn with about 25 mm over lap sufficient varn only shall be forced into the socket to leave a correct depth for caulking. The pipe shall then be examined again for line and level and the proper depth of each joint shall be tested before running the molten lead. For pouring of the molten lead a ring of sterilized hemp rope shall be wrapped round the pipe at the end of the socket and the joint shall be covered with stiff damp clay. The top shall then be removed carefully leaving a V-shaped large hole at the top the joint to pour the molten lead. Lead shall be poured in one operation only. After a convenient length of pipe has been laid, lead shall be caulked sufficiently with a pneumatic tool or hand hammer till the excess lead is removed and the joint shall be made neat and clean.

If it is necessary to deflect the pipe from its desired alignment to avoid any obstruction the deflection at the joint shall not exceed $2\frac{1}{2}^{\circ}$

17.9 Back fill

The pipeline laid may partially backfilled except at the joints the following manners:

- a) Up to the level of the centre line of the pipe by hand with sand, fine gravel or approved material in layers of 8 cm and compacted by tamping.
- b) Beyond (a) upto 30 cm above the top of pipe by hand or mechanical methods without injuring or moving the pipe. Approved material shall be used for backfill and well rammed.
- c) Beyond (b) upto the finished ground level by hand or mechanical methods in well compacted 30 cm layers. Suitable material containing stones upto 20cm as their greatest dimension may be used.

17.10 Testing

The pipe shall now be pressure tested to double the maximum working pressure. The pipe and joints shall be absolutely water tight while the test pressure is maintained for 5 minutes.

36 hours after the successful completion of the water tightness test, a two hour leakage test shall be performed at 1.5 times the designed pressure by slowly filling the pipeline with water and expelling all the air.

The permissible leakage shall be allowed in IS:3114, clause 6.6.

On completion of testing, the trench shall be completely backfilled with approved non-deleterious material. The backfill shall be neatly rounded over the trench to a sufficient height to allow for settlement to the specified level.

17.11 Laying of Salt- glazed stoneware pipes:

Shall conform to IS:4127.

17.12 Trenching:

The width of the trench at its bottom shall be diameter of the pipe +30 cm for trench depths up to 1.2 m and diameter +40 cm for greater depths but subject to a minimum of 75 cm for trenches deeper than 0.9 metre. At joints the width and depth of trench shall be such as to facilitate easy installation.

The trench shall normally be excavated to the specified gradient to give a continuous bearing to the pipe. If any unstable area or unsound material is encountered, they shall be removed and the specified gradient attained by backfilling with approved material in non-compacted 80 mm layers. Then the bed concrete shall be laid.

Where rock is met, the trench shall be trimmed to a depth of 80 mm. Below the level of the bottom of the pipe and filled to a like depth with broken stone of size 13 mm and below and well rammed.

All excavated materials shall be cast on one side of the trench. All pipes, water mains, cables and other utilities met with within the course of excavation shall be carefully protected and supported.

17.13 Concrete Encasement:

The pipe shall be completely encased in concrete where

- a) The highest water table is likely to rise above the top the pipe.
- b) The sewers are to be laid adjacent to growing trees.
- c) The depth of the pipe is less than 1.2 m under the road surface.
- d) The intensity of load on the pipe exceeds 1,600 kg per metre lenth.

The dimensions of concrete shall be as specified in IS:4127.

17.14 Handling:

Pipes shall be unloaded from trucks on timber skids with a steadying rope to prevent bumping with other pipes on that side of the trench which, does no have the excavated materials. In shallow trenches manual handling is enough but for deep trenches tripods and rope shall be used to lower the pipes.

17.15 Laying and Jointing:

The pipes shall be inspected for defects and be rung with a light hammer, preferably when suspended to detect cracks. The pipes shall be laid with the socket ends upstream.

After placing a length of pipe in the trench, on concrete bedding where so specified, the cleaned spigot end shall be centred in the socket and the pipe forced home and aligned to gradient. The pipe shall be secured in place with approved backfill material except at the socket. Then the pipes shall be jointed.

Spun yarn soaked in neat cement slurry or tarred gasket shall be passed around the joint and inserted in it by means of a caulking tool and wooden mallet. More skeins of yarn or gasket shall be added if necessary and shall be well caulked, till they occupy one fourth the depth of the socket. Cement sand mortar 1:1 shall be slightly moistened and inserted by hand to fill the remaining space and caulked tightly. The mortar joint shall then be finished off neatly outside the socket at an angle of 45 degree to the face of the socket. The Cement mortar shall be cured for seven days by covering with wet gunny bags.

17.16 Testing:

All underground pipe-lines shall be subjected to a test pressure of 2.5 meter head of water at the highest point of the section under test. A tolerance of 2 litres per centimetre of diameter per kilometre may be allowed during a period of 10 minutes.

In accordance with IS:4127, the test shall be carried out by suitable plugging the low end of the drain and the ends of connections, if any, and filling the system with water. A knuckle bend shall be temporarily jointed in at the top end and sufficient length of vertical pipe jointed to it so to provide the required test head.

Subsidence of the test water may be due to one or more of the following causes: absorption by pipes and joints; sweating of pipes or joints; leakage at joints or from

defective pipes; trapped air. Allowance shall be made for absorption by adding water until absorption has ceased, after which the test may be commenced. Since any leakage will be visible, the defective part shall be drained, cut out, made good and the test repeated. Slight sweating, if uniform, may be overlooked but excessive sweating shall be considered as indicating faulty pipes, joints or fittings, any faulty joint shall be rectified or embedded in m15 concrete, 300 mm long and the relevant section retested.

17.17 Back fill

Backfilling shall be commenced only upon satisfactory completion of testing. The method and materials used shall be the same as specified for back-filling cast iron pipes.

17.18 Concrete pipes

The laying of concrete pipelines shall conform to clause 9 of IS:783. Pipes shall be laid true to line and grade. Laying of pipes shall always proceed upgrade of a slope. The type of jointing for concrete pipes shall be with loose concrete collars and the joints shall be packed from either side with spun yarn dipped in cement slurry as specified for jointing stoneware pipes. Stiff cement mortar (1:1) shall be filled from both sides and splayed at an angle of 45 degree on both sides. The joints shall be adequately cured as specified for joints in stoneware pipes. The pressure test indicated for underground stoneware pipes shall apply to concrete pipes with the same leakage factor.

17.19 Installation of Sanitary Appliances:

All sanitary appliances shall be fixed in position rigidly on floor and walls as indicated in the drawings/bill of quantities or as directed by the Engineer.

Water closet-squatting type:

The pan shall be sunk into the floor and embedded in a cushion of average 15 cm cement concrete 1:5:10 (1 Cement, 5 coarse sand 10 graded brick aggregate 40 mm nominal size) or as specified in bill of quantities and shown in drawings. This concrete shall be left to the sufficient depth below so as to allow for flooring and its bed concrete. The floor should be suitably slopped so that the waste water drained into the pan. The pan shall be provided with a 100 mm 'P' or 'S' trap as specified in the bill of quantities with an approximately 50 mm seal. The joint between the pan and the trap shall be made leak proof with cement mortar 1:1: (1 cement, 1 fine sand). Rim of the pan shall be levelled properly and set flush with the finished floor. The pan shall be connected to cast iron high level pull and let go type flushing cistern of capacity 12.5 litres or as indicated in the bill of quantities. The flushing cistern shall be supported on a pair of CI cantilever brackets firmly embedded in the wall in cement mortar (1:4). The height of the bottom of the cistern from the top of the pan shall be two metres or as shown in drawing. The flush pipe from the cistern shall be 32 mm dia tested quality galvanized steel pipe (light) and connected to the pan inlet by means of hemp and putty joint. The flush pipe shall be securely connected to the cistern outlet by means of coupling nut made of any non corrosion material non corrosion material non ferrous metal or galvanized steel.

Water closet – Pedestal type:

Pedestal type water closet shall be of white vitreous china of the washdown type. They shall be rigidly fixed on the finished floor by means of 75 mm long brass screws with suitable plugs, with the top of the pan sloping about 8 mm towards the rear. The flushing cistern shall be of white vitreous china, of low level with a push down handle and of 15 litres capacity as indicated in the bill of quantities. The cistern shall be supported on pair of cast iron or rolled steel cantilever brackets firmly fixed on wall with brass screws and suitable plugs. The cistern shall have a removable cover, a vitreous china symphony and a ball valve float, the overflow pipe shall be covered with a brass wire net on the outside to prevent ingress of mosquitoes. The flush pipe from the cistern shall be as specified in bill of quantities. The closet shall be provided with double plastic seat cover conforming to IS:2548 and chromium plated hinges.

Urinals:

Standing type urinals wherever shown in bill of quantities shall be firmly fitted on finished wall by means of 50 mm long brass screws and suitable plugs. Height of the lip from the standing point shall be as shown in the drawings. Urinals shall be fitted with cast iron automatic flushing cistern of capacity as described in bill of quantities and as shown in the drawings. Flushing pipe shall be of galvanized steel of required sizes and connected to the urinal as shown in drawing. The joint to the inlet of urinal shall be, neatly finished with putty joints.

Wash basin:

Wash basin shall be fitted in position to true level on a pair of cast iron brackets rigidly fixed on wall with 50 mm long brass screws and suitable plugs. The basin shall be fitted with 15 mm dia approved quality chromium plated pillar tap and 32 mm dia waste fittings. The type of waste pipe and their connections shall be as given in bill of quantities. And directed by the Engineer.

Sinks:

These shall be as per bill of quantities and of parryware or similar approved Indian make and quality. Unless otherwise specified these, shall comprise of all the accessories given in bill of quantities.

The cast iron brackets if any and GI waste pipe of 40 mm dia shall be painted two coats of approved paint over a coat of approved priming. The rate shall include for supplying, fitting and fixing the above including any other fittings and is for the completed work.

Other miscellaneous fittings:

a) Mirrors:

All such fittings shall be of type and sizes prescribed in the bill of quantities and shall be fitted in position true to line, level and place as shown on the drawings as directed by the Engineer.

Mirror glass shall be AA grade silvering quality polished plate glass silvered on one side copper backed, varnished and painted. Edge of mirrors shall be levelled.

The mirror shall be mounted on asbestos sheet 6 mm thick and shall be fixed in position by means of 4 C.P. brass screws and C.P. brass washers and wooden lugs firmly embedded in the wall. The plugs shall be of hard wood and of size 50 mm x 50 mm at base tapering to 38 mm x 38 mm at top and of length 50 mm. These shall be fixed in wall in cement mortar 1:3 (1 cement, 3 coarse sand). After the plugs are fixed in the wall, the mortar shall be cured till it is set. The height of the bottom edge of the mirror shall be cured till it is set. The height of the bottom edge of the mirror shall generally be 120 cms above floor level unless otherwise shown in drawings. The shorter sides shall be fixed horizontally or as shown in drawings.

b) Glass shelf unit:

The brackets of the unit shall be fixed with C.P. brass screws to wooden plugs firmly embedded in the wall with cement mortar 1:3 (1 cement, 3 coarse sand). The height of the glass shelf above the floor level shall be 115 cm. Unless otherwise shown in drawings.

c) Towel rail:

The brackets of the towel rail shall be fixed by means of C.P. brass screws to wooden plugs firmly embedded in the wall with cement mortar 1:3: (1 cement, 3 coarse sand).

The height of the towel rail above the floor level shall be 75 cms unless otherwise shown in drawings.

d) Toilet paper holder and soap tray:

The size and make of the toilet paper holder and soap tray shall be as indicated in bill of quantities and shall be fixed with C.P. brass screws on wooden plugs embedded in the wall.

Bibcock and Stop cock:

Bibcock and stopcock shall be either plain or C.P. brass of easy clean, screw down pattern of medium weight and with crutch head as indicated in bill of quantities. These shall be of approved manufacture and shall conform to relevant Indian Standard specifications.

Valves:

Unless otherwise mentioned in the bill of quantities, these shall be of petco pattern gun metal full way valves of heavy type conforming to relevant Indian Standard Specification.

17.20 Testing of drains and sewers:

Testing shall be done to establish that the drainage system will function satisfactorily under working conditions, no work shall be covered up or buried until inspected and approved by the Engineer. All drains and sewers laid underground shall be tested for water tightness, by means of water pressure maintained for not less ten minutes. Where possible, testing shall be carried out from manhole to manhole and short branches to a main drain between manholes included in the test for the main drain. Manholes should be tested separately.

Water test method:

The test shall be carried out by suitably plugging the low end of the drain and the end of the connections, if any, and filling the system with water. A knuckle bend shall be temporarily jointed in at the top end and sufficient length of vertical pipe jointed to it so as provide the required test head.

Subsequence of the test water may be due to one or more of the following cause3; Absorption by pipes and joints; sweating of pipes or joints; leakage joints or from defective pipes; trapped air. Allowance shall be made for absorption by adding water until absorption has ceased, after which the test may be commenced. Since any leakage will be visible, the defective parts shall be drained, cut out, and made good and the test repeated. Slight sweating. If uniform, may be overlooked but excessive sweating shall be considered as indicating faulty pipes, joints of fittings. The loss of water after equilibrium has been achieved for drains upto 300 mm diameter over a period of 10 minutes shall not exceed two litres. Per centimetre of diameter per kilometre of drain.

Water tests for cast iron pipes:

Cast iron drains or sewers laid underground shall be tested to a minimum pressure of 1.5 m head of water. The drain plugs shall be suitably structured to prevent their being forced out of the pipe. Alternatively an air test may be applied.

Water test for pipes other than cast iron:

Vitrified clay ware pipes and concrete pipes, laid underground shall be subjected to a test pressure of at least 1.5m head of water at the highest point of the section under test, but not more than 2.4m at the low end.

Testing of cast iron soil and waste pipeline:

On completion of laying all above ground, cast iron soil, waste and ventilation pipelines shall be smoke tested by the Contractor under a pressure of 2.5 m head of water for 15 minutes to detect leakages. This shall be done after all trap seals have been filled with water.

The test shall be conducted using proper apparatus with attachments for applying smoke to the pipelines under pressure. Cotton waste or brown paper soaked in creosote oil shall be fired to obtain dense and pungent smoke. While conducting smoke test, top of soil, waste and ventilation pipes shall be kept open till smoke starts coming out of the

openings. The openings shall then be securely plugged with expanding rubber or any other approved plug. The floor traps and other openings for connecting sanitary fixtures shall be sealed with water or other approved plug. The entire pipelines shall be tested in suitable sections as directed by the Engineer. The entire length of the pipelines including all joints under test shall be closely observed for any sign of smoke leakages. All leakages and defects shall be rectified before the system is put to use.

Testing of straightness and obstruction:

Drains may be tested by the following two methods:

For freedom from obstruction:

A smooth ball of a diameter 12 mm less than the diameter of the pipe shall be inserted at the high end of the drain or sewer, provided that no obstruction exists, the ball should freely roll down the pipe and emerge at the lower end. Projection into the drain or sewer of any jointing material will usually stop the ball.

For straightness of run:

Insert a lamp at one end of the drain and a mirror placed at 45 degree to the invert at the other end. If the pipe is straight the full circle of light can be observed. Any deviation or obstruction can be readily seen.

Test for manholes:

Manholes shall be tested for water tightness by filling them with water, and observing any subsidence. It will also be necessary to fill the downstream length of drain in order that the drain plug may be removed on completion of test.

18.0 ANTI TERMITE TREATMENT

SCOPE

The scope of job is to form a chemically treated soil barrier to prevent growth of nests of colonies of the subterranean termites.

MATERIALS

The following chemical (as specified) in water emulsion shall be used:

Chemicals	-	Concentration (by weight)
Chlorophyriphos	-	1.0%

PRE-CONSTRUCTION CHEMICAL TREATMENT

Hand operated pressure pumps shall be used for uniform spraying and proper check shall be maintained to ensure that, specified quantity of chemicals is used for the required area.

TIME OF APPLICATION

Anti-termite treatment shall start in foundation trenches and pits before laying the leveling course of PCC. The shall be done only after the chemical emulsion has been observed by the soil and surface is quite dry. Treatment should not be carried out when it is raining or the soil is wet. The treatment soil barriers shall not be disturbed after they are formed and if by chance, they are disturbed, the same shall be made good before laying the PCC.

PROCEDURE

Treatment of column pits, wall trenches and basement excavation:

The bottom surface and sides shall be treated with chemical at the rate of 5 li/sq.m.

The portion of the column foundations and the retaining walls coming in contact with the backfill the structure shall be treated at the rate of 15 li/sq.m of the vertical surface. If water is used for ramming the earth fill then treatment shall be carried out after the ramming operation is completed by rodding the earth at 150mm c/c close to the structure surface and spraying the required quantity of chemical. For RCC framed structures using 1:2:4 or richer concrete, the treatment shall start from a depth of 500mm below ground level and there is no need to start the treatment from the bottom of excavation for columns and plinth beams. The earth from 500mm below the ground level and above shall be treated as described in previous paragraph. However, for RCC frame structure, there shall be no chemical treatment for column foundations.

Treatment of top surface of plinth filling:

The top surface of filled earth within plinth walls shall be treated with chemical emulsion at the rate of 5 li/sq.m before the sub-grade of floor is laid. Holes upto 50-70mm deep of 150mm centres shall be made to facilitate saturation of the soil with chemical emulsion.

Treatment of junction of wall and floor:

To achieve continuity of vertical chemical barrier on inner wall surfaces, small channels of 30x30mm shall be made at all the junctions before laying the sub-grade and rod holes shall be made upto ground level at 150mm centres and chemical emulsion shall be poured at 15 li/sq.m of the vertical surface.

Treatment of soil along external perimeter of building:

After the building is complete, rod holes shall be made along external perimeter at 150mm centres and 300mm deep and these holes shall be filled with chemical emulsion at 5 li/running metre of perimeter.

RECORD OF CHEMICAL USED

A detail record of quantity of chemical used for each operation shall be kept at site duly approved by the Engineer-in-charge/Architect.

GUARANTEE

The contractor shall give a guarantee of 5 years for effective anti-termite treatment barrier.

MEASUREMENT

The measurement shall be made in square metres on the basis of the plinth area of the building at plinth level only for all operations described above. Nothing extra shall be measured.

19.0 ADDITIONAL SPECIFICATIONS:

19.1 Shuttering for R.C.C Work:

Para-6 & 9 of Clause 4.5.10 of Specifications may be deleted and the following be substituted.

Forms shall not be struck until the concrete has attained a strength at least twice the stress to which the concrete may be subjected at the time of removal of formwork. The strength referred to shall be that of concrete using the same cement and aggregates, with the same proportions and cured under conditions of temperature and moisture similar to those existing on the work. Where so required, form work shall be left longer. In normal circumstances and where ordinary Portland cement is used, forms may generally be removed after the expiry of the following periods:

- | | |
|---|----------------|
| a) Walls, columns and vertical faces of all structural member | 16 – 24 hours. |
| b) Slabs (props left under) | 3 days. |
| c) Beam Soffits (props left under) | 7 days. |
| d) Removal of props under slabs | |
| i) Spanning upto 4.5m | 7 days. |
| ii) Spanning over 4.5 m | 14 days. |
| e) Removal of props under beams and arches | |
| i) Spanning upto 6 m | 14 days. |
| ii) Spanning over 6 m | 21 days. |

In case of bad weather, these periods may be increased at the discretion of Engineer-in-charge. The stripping time recommended for ordinary Portland cement may be suitable

may be suitably modified for other cements. In case of slag cement is host, the above criteria for removal of props differs.

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

20.0 STRUCTURAL STEEL

All material shall be new and shall conform to their respective specifications. The use of equivalent or higher grade or alternative materials will be considered only very special cases subject to the approval of client / consultant.

20.1 GENERAL REQUIREMENTS:

All structural steel sectional shall conform to IS: 2062 unless otherwise specified and shall be clearly rolled to proper dimensions and weight subject to permissible tolerances as per IS: 1852

The finished materials shall be reasonably free from cracks. Surface flaws. Laminations rough are imperfect edges and all other harmful defects and shall have a smooth finish. The material shall be free from loose mill scale, rust pits or other defects affecting the strength and durability.

Structural steel work shall be painted by applying two coats of zinc phosphate primer, conforming to relevant IS and 2 coats of synthetic enamel paints (Conforming to IS:2933) or aluminium paint (conforming to IS:2339). However, steel shall be galvanized if so required by the client / consultant.

Normal hexagonal nuts and bolts shall conform to IS: 3138-1966. High strength structural bolts shall conform to IS:3757. Countersunk bolts shall conform to either IS:8352 or IS:8353 depending on the type of bolt. Black bolts, nuts and screws shall be in accordance with IS:1363 for black hexagonal with nuts of 6 to 39 mm and black hexagon screw of 6 to 24 mm and IS:1364 and IS:1367 for other sizes.

Hot rolled rivet bars shall conform to IS: 1148 and high tensile steel rivet bars for structural purposes shall conform to IS: 1149.

Welding electrodes for space frame shall be octagonal or spherical in shape. It shall be a minimum tensile strength as specified in the bills of quantities. Minimum elongation shall be 7% and hardness 170-240 BHN. The nodes machined out of solid bars shall conform to IS:2062 and the casing shall be as per IS: 1030.

The following variety of steel shall be used for structural purposes.

ST-42S : It shall be used for all types of structures (riveted and Bolted) including those subjected to dynamic loading and where fatigue, wide fluctuations of stresses, reversal of stresses and great restraint are involved. It shall be suitable for welded structures provided that the thickness of the materials does not exceed 20mm.

		Upto 20mm over 10mm	42 to 54	24	23
ST-42-0 (ordinary quality)	Plate sections (for example angles, tees, beams, channels, etc) and flats.	Below 6 only bend test shall be required 6mm and above.	42 to 45	26	23
	Bars (round, square and hexagonal).	Below 10mm only bend test shall be required. 10mm and above.	42 to 54	26	23

20.2 TEST CERTIFICATE:

When the steel supplied by the contractor, test certificate of the manufacturer shall be obtained according to IS:2062 and other relevant Indian Standards. Notwithstanding the manufacture's certificates, the consultant/ architect may ask for testing of material in approved test laborator. The test results shall satisfy the requirement of the relevant Indian Standards. Whenever quality certificates are missing or incomplete or where material quality differs from standard specifications, the contractor shall conduct all appropriate tests as directed by the consultant / architect at his own cost. Materials for which test certificates are not available or for which test results do not comply with relevant IS standard shall not be used.

20.3 STORAGE:

Storage of structural steel shall be as per IS:4082. Steel materials supplied by contractor shall be marked for identification and each lot shall be accompanied by manufacture's quality certificate, conforming to chemical and mechanical characteristics as per relevant IS codes. All steel furnished by suppliers shall be checked stored out, straightened and arranged by grade and quantities in stores.

Welding wire and electrodes shall be stored separately by qualities and lots inside a dry enclosed room in compliance with IS :816 and as directed by Engineering-in-charge. Each lot of electrode, bolts, nuts etc., shall be accompanied by Manufacture's test certificate.

21.0 PAVING AND FLOORING WORKS:

21.1 General

The Contractor shall be responsible for the preparation of the surface to be paved or faced to the satisfaction of the Engineer with particular reference to the levels given must be rectified by him in order that the paving above may be laid to the requisite thickness. Proper floor drainage slopes shall also be given to the paving work as directed by the Engineer. The surface to be covered shall be picked and hatched, brushed, thoroughly cleaned of dust and other foregone matters and well watered before the paving is laid. The Contractor's rate shall also include dishing of floors particularly in bath rooms, W.C., etc. as directed by the Engineer. No extra shall be paid for forming corners at internal angles and also nosing at plinth, steps or window sills. The thickness mentioned shall be finished and minimum thickness only. Rate quoted for dado and skirting shall include for cutting to line and fair finish to top edge.

21.2 Codes and Standards

IS:1237	:	Specification for cement concrete flooring tiles.
IS:1443	:	Code of practice for laying and finishing of cement concrete flooring tiles.
IS:2571	:	Code of practice for laying in-situ cement concrete flooring.
IS:5491	:	Code of practice for laying in-situ granolithic concrete flooring topping.
IS:2114	:	Code of practice for laying in-situ terrazzo floor finish.

21.3 Cuddappah / Granite Slab:

Black and polished Cuddapah slab or granite slab of 25 mm minimum thickness shall be laid in locations wherever shown in drawings and indicated in Bill of Quantities in cement mortar 1:4 (1 cement, 4 Coarse sand). The edges of the slabs shall be in straight line and the shape of slab shall be perfect square or rectangular and approved by the Engineer. The joints shall be pointed with white cement mortar 1:2 (1 White cement, 2 stone dust) with an admixture of approved pigment to match the stone shade.

21.4 White glazed tiles work:

The tiles shall be of approved make and 5 mm minimum thickness with straight edges, true and even and of white colour and the surface free from warping. These shall be laid truly vertical for walls or to slope floors as directed. In the case of flooring, the tiles shall be laid on bedding of 20 mm thick lime mortar (1 lime, 3 surkhi) with sprinkling of cement (half a bag per 10 m²) and in the case of skirting risers of steps or dado, these shall be laid on 12 mm thick cement mortar (1 cement and 3 coarse sand). The joints shall be invisible and filled in with non-staining white cement. All junction shall be provided with angles wherever required.

21.5 Kota / Shahbad / Cuddapah / Granite Stone:

Kota / Shahbad / Cuddapah / Granite Stone blocks / slabs / tiles to be used for flooring, stairs, dados, skirtings, linings, veenering etc., shall conform to the requirements specified in the schedule of items.

21.5.1 General requirements:

The natural stone slabs shall be procured from selected quality / stock with no cracks, decay, weathering, soft veins and flaws.

They shall be hard and machine-cut of requisite thickness along planes parallel to the natural bed of stone and shall be of uniform size and colour as required.

The exposed surface of stone slabs shall be machine polished to a smooth, even and true plane and the edges shall be chiseled to half its depth, true and square to ensure uniform width of joint.

21.5.2 Marking:

Each type of stone blocks, slabs and tiles supplied at site shall bear the manufacturer's identification marks or initials.

Samples shall be selected and tested separately for each lot for determining its conformity or otherwise to the requirements of the specification.

The number of blocks / slabs/ tiles to be selected for sampling shall depends upon the size of the lot and shall be in accordance with IS: 1130.

Contractor shall procure a certificate from the supplier stating that the blocks, slabs and tiles supplied, comply with the relevant Indian Standards and shall submit it to Client / Consultant.

Tests shall be carried out as per methods described in IS: 1124 and IS: 1122 as applicable.

21.5.3 Causes for rejection:

Stone slabs not conforming to the size, colour, texture and other criteria mentioned above shall be rejected by the Client / Consultant.

21.6 Vitrified Tiles:

Vitrified ceramic unpolished / polished tiles: these tiles are of different shades having monolithic body that is pressed in very high tonnage press and fired to high temperature. The tiles shall be homogeneous and compact through out the entire body with very high strength, low porosity and extreme surface hardness, high resistance to abrasion by chemicals and shall conform to IS:4457. The tiles shall be with smooth surface or textured anti-skid finish surface. Polished vitrified ceramic floor tiles hall be homogeneous heavy and tough with highly reflective polished surface but non – slippery.

21.6.1 Sampling & Testing :

Sampling shall be done as per IS: 13711 and testing shall be done as per IS:13630. samples of each type / design / finish / print / size / colour of tiles shall be submitted well in advance to the architect / consultant for approval at the contractor's cost. The consultant / architect shall retain approved sample. Tiles shall be procured from a single approved source who can provide products of consistent quality and physical properties.

21.6.2 Storage

The files shall be delivered in original containers with seal unbroken. Adequate precaution shall be taken to prevent accidental damage to tiles while unloading and these shall be stored under cover in manner approved by the Engineer-in-Charge.

Acceptance criteria

Acceptance criteria shall be as per IS: 13711

21.7 Anti-skid tiles:

21.7.1 General Requirements

The tiles shall be free from any flaw, fissure, crack or any other manufacturing defect that may adversely affect their utility. They shall be flat, square, true to shape and sound.

Finish shall be mat finish.

Compressive strength shall not be less than 70 N/mm²

Maximum permissible water absorption shall be 2 percent.

Maximum permissible average wear shall be 2mm . however, for an individual specimen this value shall be 2.5mm.

Tiles meant for dadoing purposes shall not be used for flooring.

22.0 Road Work

22.1.1 Setting and Leveling:

The contractor shall set out and level the works and will be responsible for the accuracy of the same. He is to provide all instruments and proper qualified staff with labour for getting his work checked by the Engineer.

22.2 Earth Work

22.2.1 Preparation of cut formation:

The section to be constructed shall be excavated or formed to levels shown on the drawings. The bottom of the excavation shall be compacted as specified and the bottom and size checked for conformance to drawings in respect of cross section and gradient with a scratch template moving over guided locate suitably. The template shall have points placed not more than 200 mm apart and shall be an exact elevation of the cross section. All high points shall be removed and low areas back filled after scarifying and providing proper bond. The surface shall be rolled with 8 to 10 ton power roller to attain the specified compaction. Haulage of materials over the formed surface shall not be permitted.

a) No soft spots shall be present.

- b) It shall be properly drained during construction.
- c) The minimum compaction at sub-grade level shall be not less than 100% of maximum laboratory dry density as per IS:2720 (Part-VII).

Where the material in the sub-grade (that is within 0.5 metre of the lowest part of the pavement) has density less than 100% of the maximum dry density determined according to IS:2720 (Part—VII), the same shall be loosened to a depth of 500 mm and compacted in 250 mm thick loosed layers in accordance with the requirements of clause 22.3. Any unsuitable material encountered at the formation level shall be removed to a depth indicated by the Engineer and replaced with suitable material compacted in accordance with Clause 22.3. In rocky formations, the surface irregularities shall be corrected and the levels brought up to the specified elevation with sub-base or base material as directed by the Engineer, laid and compacted in accordance with respective specifications for these materials.

22.2.2 Formation of Shoulders:

To confine the aggregates laterally, the side shoulders graded to the required cross-section, watering the rolling it in a single layer with a power roller.

Construction of WBM in a trench section excavated in the finished formation must be avoided.

22.3 WATER BOUND MACADAM SUB-BASE/BASE COARSE.

22.3.1 Scope

The work shall consist of clean, crushed aggregates mechanically interlocked by rolling and bonded together with screening; binding material where necessary and water laid on a properly prepared subgrade/subbase/base or existing pavement;, as the case may be and finished in accordance with the requirements of these specifications and in close conformity with the lines, grades, cross sections and thickness as per approved plans or as directed by the Engineer.

It is, however, not desirable to lay water bound macadam on an existing thin black topped surface without providing adequate drainage facility for water that would get accumulated at the interface of existing bituminous surface and water bound macadam.

Materials:

22.3.2 Coarse aggregates:

22.3.3 General requirements:

Coarse aggregates shall be either crushed or broken stone, crushed slag. Overburnt (Jhama) brick aggregates or any other naturally occurring aggregates such as kanakar, laterites of suitable quality (which shall be used in sub-base course only). The aggregates shall conform to the physical requirements set forth in table mentioned below. The type and size range of the aggregate shall be specified in the contract or shall be as specified by the Engineer.

TABLE-5
PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR WATER BOUND
MACADAM FOR SUB-BASE/BASE-COURSES

Test	Test Method	Requirements
1.*Los Anglses Abrasion value Or	IS:2386 (Part-IV)	50 percent (MAX)
*Aggregate Impact Value	IS:2386 (Part-IV) or IS:5640	40 percent (MAX)
*Flakiness Index	IS:2386 (Part-I)	15 percent (MAX)

Aggregate may satisfy requirements of either of the two tests.

Aggregates like brick metal, kankar, laterite etc., which get softened in presence of water shall be tested for impact value under wet condition in accordance with IS:5640.

The requirement of flakiness index shall be enforced only in the case of crushed broken stone and crushed slag.

22.3.4 Crushed or broken stone:

The crushed or broken stone shall be hard, durable and free from excess flat, elongated, soft and disintegrated particles, dirt and other deleterious material.

22.3.5 Crushed slag:

Crushed slag shall be made from air-cooled blast furnace slag. It shall be of angular shape, reasonably uniform in quality and density and generally free from thin, elongated and soft pieces, dirt or other deleterious materials. The weight of crushed slag shall not be less than 1120 kg per m³ and the percentage of glossy material shall not be more than 20. It should also comply with the following requirements:

- i) Chemical Stability : To comply with requirements of appendix of BS 1047
- ii) Sulphar content : Maximum 2 percent.
- iii) Water absorption : Maximum 10 percent.

22.3.6 Overburnt (Jhama) brick aggregates:

Jhama brick aggregates shall be made from over burnt bricks or brick bats and be free from dust and other objectionable and deleterious materials.

22.3.7 Grading requirement of coarse aggregates:

The coarse aggregate shall conform to one of the gradings given in below table as specified, provided, however, the use of grading No.1 shall be restricted sub-base courses only.

TABLE – 6**GRADING REQUIREMENTS OF COARSE AGGREGATES**

Grading No	Size Range	Sieve Designation	Percent by Weigh passing
1	90 mm to 45 mm	125 mm	100
		90 mm	90-100
		63 mm	25-60
		45 mm	0-15
		22.4mm	0-5
2	63 mm to 45mm	90 mm	100
		63 mm	90-100
		53 mm	25-75
		45 mm	0-15
		22.4mm	0-5
3	53 mm to 22.4mm	63 mm	100
		53 mm	95-100
		45 mm	65-90
		22.4mm	0-10
		11.2 mm	0-5

Note: The compacted thickness of a layer with Grade 1 shall be 100 mm while for layer with other grades i.e 2&3, it shall be 75 mm

22.3.8 Screening

Screening to fill voids in the coarse aggregate shall generally consist of the same material as the coarse aggregate. However, where permitted predominantly non-plastic material such as morrum or gravel (other than rounded river borne material) may be used for this purpose provided liquid limit and plasticity index of such material are below 20 and 6 respectively and fraction passing 75 mm sieve does not exceed 10 percent.

Screenings shall conform to the gradings set forth in Table-7 mentioned below. The consolidated details of quantity of screenings required for various grades of stone aggregates are given in Table-8. Table – 8 also gives the quantities of materials (loose) required for 10 m² for sub-base/base compacted thickness of 75/100 mm.

The use of screening shall be omitted in the case of soft aggregates such as brick maetail, kankar, laterite, etc., as they are likely to get crushed to a certain extent under rollers.

TBALE-7

Grading for Screenings

Grading Classification	Size of Screenings	Sieve Designation	Percent by wt. Passing the sieve.
A	13.2 mm	13.2 mm	100
		11.2 mm	95-100
		5.6 mm	15-35
		180 um	0-10
B	11.2 mm	11.2 mm	100
		5.6 mm	95-100
		180 um	15-35

22.3.9 Binding Material:

Binding material to be used for water bound macadam as filler material meant for preventing ravelling shall comprise of a suitable material approved by the Engineer having a plasticity Index (PI) value of less than 6 as determined in accordance with IS:2720 (Part-V)

The quantity of binding material where it is to be used, will depend on the type of screenings. Generally, the quantity required for 75 mm compacted thickness of water bound macadam will 0.06-0.09 m³/10 m² and 0.08-0.10m³/10m² for 100 mm compacted thickness.

The above mentioned quantities should be taken as a guide only, for estimation of quantities for construction, etc.

Application of binding materials may not be necessary when the screenings used are of crushable type such as moorum or grave.

Construction Operations

22.3.10 Preparation of base:

The surface of the sub-grade/sub-base/base to receive the water bound macadam course shall be prepared to the specified lines and cross fall (camber) and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm sub base/ base surface irregularities, where predominant, shall be made good by providing appropriate type of profile corrective course (leveling course).

As far as possible, laying water bound macadam course over an existing thick bituminous layer may be avoided since it will cause problems of internal drainage of the pavement at the interface of two courses. It is desirable to completely pick out the existing thin bituminous wearing course where water bound macadam is proposed to be laid over it. However in exceptional cases, where the intensity of rain is low and the interface drainage facility is efficient water bound macadam can be laid over the existing thin bituminous surface by cutting 50 x 50 mm furrows at an angle of 45 degrees to the centre line of the pavement at one meter intervals in the existing road. The directions and the depth of furrows shall be such that they provide adequate bondage and also

serve to drain water to the existing granular base course beneath the existing thin bituminous layer.

22.3.11 Inverted choke:

if water bound macadam is to be laid directly over the sub grade without any other intervening pavement course, a 25mm course or screenings (Grading B) or coarse sand shall be spread on the prepared sub grade before application of the course aggregate is taken up. In case of a fine sand or silty or clayey sand sub grade it is advisable to lay 100 mm insulating layer of screening or course sand on top of fine grained soil, the gradation of which will depend upon whether it is intend to act as drainage layer as well. Alternatively appropriate geosynthesis performing functions of separation and drainage may be used for the prepared subgrade as directed by engineer.

22.3.12 Spreading course aggregates:

the course aggregate shall be spread uniformly and evenly upon the prepared subgrade/ sub base to proper profile by using templates placed across the road about 6.0 M apart, in such quantities that the thickness of each compacted layer is not more than 100 mm grading 1 and 75 mm for grading 2 and 3, as specified in clause 22.5.7. where ever possible, approve mechanical devices shall be used to spread the aggregates uniformly so as to minimise the need for manual rectification afterwards. Aggregates placed at locations which are inaccessible to the spreading equipment, may be spread in one or more layers by any approve means so as to achieve the specified results.

The spreading shall be done from stock piles along the side of the roadway or directly from vehicles. In no case shall the aggregates be dumped in heaps directly on the surface prepared to receive the aggregates nor shall hauling over uncompacted or partially compacted base be permitted. No segregation of large or fine aggregates shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pockets of fine material.

The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregates as may be required. The surface shall be checked frequently with a straight edge while spreading and rolling so as to ensure a finished surface as per approved plan.

The coarse aggregates shall not normally be spread more than 3 days in advance of the subsequent construction operations.

22.3.13 Rolling:

Immediately following the spreading of the coarse aggregate, rolling shall be started with three wheeled power rollers of 8 to 10 tonne capacity or random or vibrator rollers of approved type. The type of roller to be used shall be approved by the engineer based on trial run.

Except on super elevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the center. First the edge/ edges shall be compacted with the roller running forward and backward. The roller shall then move inwards parallel to the center line of the road, in successive passes uniformly lapping proceeding tracks by at least one half width.

Rolling shall be discontinued when the aggregates are partially compacted with sufficient void space in them to permit application of screenings. However, where screenings are not applied, as in the case of crushed aggregates like brick metal, laterite and kankar, compaction shall be continued until the aggregates are thoroughly keyed. During rolling, slight sprinkling of water may be done, if necessary. Rolling shall not be done when the subgrade is soft or yielding or when it causes a wave like motion in the sub-grade or sub base course.

The rolled surface shall be checked transversely and longitudinally, with templates and any irregularities corrected by loosening the surface, adding or removing necessary amount of aggregates and re-rolling until the entire surface conforms to the desired crossfall camber and grade. In no case shall the use of screenings be permitted to make up depressions.

Material, which is crushed excessively during compaction or becomes segregated shall be removed and replaced with suitable aggregates.

It shall be ensured that shoulders are built up simultaneously along with water bound macadam courses.

22.3.14 Application of screenings:

After course aggregate has been rolled to the clause 22.5.13 screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so the vibrations of the roller cause them to settle into the voids of the course aggregate. The screenings shall not be dumped in piles but spread uniformly in successive thin layers either by spreading motions of hard shovels or by mechanical spreaders, or directly from tipper with suitable grit spreading arrangement. Tipper operating for spreading the screenings shall be so driven so as not to disturb the course aggregate.

The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms, hand brooms or both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the course aggregate. These operations shall continue until no more screenings can be forced into the voids of the course aggregate. The spreading, rolling and brooming of screenings shall be carried out only in such lengths of road, which could be completed in one day's operation.

22.3.15 Sprinkling of water and grouting:

After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into the voids and to distribute them evenly. The sprinkling, sweeping and rolling operation shall be continued, with additional screenings applied as necessary until the course aggregate has been thoroughly laid, well bounded and firmly set in its full depth and a grout has been formed of screenings. Care shall be taken to see that the base sub-grade does not get damaged due to the addition of excessive quantities of water construction.

TABLE-8

APPROXIMATE QUANTITIES OF COARSE AGGREGATES AND SCREENING REQUIRED FOR 100/75MM COMPACTED THICKNESS OF WATER BOUND MACADAM (WBM) SUB-BASE/BASE COURSE/FOR 10m².

Course Aggregates				Screenings			
Classification	Size Range	Compacted thickness	Loose qty.	Stone screening		Crushable Type	
				Grading classification & size	For WBM sub-base/ base course (Loose quantity)	Grading/ classification	Loose quantity
GRADING-1	90mm to 45mm	100mm	1.21 to 1.43m ³	Type A 13.2mm	0.27 to 0.30m ³	Not uniform	0.30 to 0.32m ³
GRADING-2	63mm to 45mm	75mm	0.91 to 1.07m ³	Type A 13.2mm	0.12 to 0.15m ³	- do -	0.22 to 0.24m ³
- do -	- do -	- do -	- do -	Type B 11.2mm	0.20 to 0.22m ³	- do -	- do -
GRADING-3	53mm to 22.4mm	75mm	- do -	- do -	0.18 to 0.21m ³	- do -	- do -

22.3.16 Application of binding material:

After the application of screenings in accordance with clause 22.5.14 and 22.5.15 the binding material where it is required to be used (clause 22.5.9) shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water resulting slurry swept in with hand brooms, or mechanical brooms to fill the voids properly; and rolled during which water, shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, forms a wave ahead of the wheels of the moving roller.

22.4 Bituminous Courses

Preparation of base for laying bituminous courses

22.4.1 Description

This work shall consist of preparing base, on which bitumen courses are to be laid, by repairing pot-holes and bringing the surface to the specified lines, grade and cross sections, through a leveling course as and where necessary. The base to be prepared may be an existing water bound macadam course or black topped surface and the work shall be performed on such widths and lengths as may be directed by the Engineer-in-charge. This work also includes cutting and / or dressing of damaged surfaces or high areas etc.

Materials

22.4.2 For pot-holes

For filling pot-holes, the materials used shall be coarse aggregate, screenings, stone chipping, straight run bitumen of a penetration grade 30/40 to 80/100 or a combination thereof as specified, conforming to the quality requirements of these materials in the specification for road and bridge works of ministry of surface transport (road wing).

22.4.3 For leveling course

The leveling course, as and where required, shall be the following types: -

- | | |
|---------|---|
| Type-A: | Premixed bituminous material corresponding to clause 4.6 open-graded premixed carpet, excepting the seal coat. |
| Type-B: | Premixed bituminous material corresponding to clause 4.5 with binder content of 3 per cent by weight of total mix. The aggregate may conform to grading in table-13 of clause 4.5 |

Construction operations

22.4.4 Patching of pot-holes

Potholes shall be drained of water and cut to regular shapes with vertical sides. All loose and disintegrated material shall be removed. The pothole shall then be filled either with (i) coarse aggregate and screenings and compacted with heavy hand rammers or approved mechanical tampers, or with (ii) premixed chipping mixed after painting the sides and bottom of the holes with a thin application of bitumen or a combination of both, as directed by the Engineer-in-charge.

22.4.5 Repairing cracked surface

Bituminous layer of cracked road surface shall be cut open and all disintegrated material shall be removed.

22.4.6 Laying of leveling course

After filling the pot-holes the base on which the leveling course is to be laid including the cracked surfaces which are cut open shall be thoroughly swept and scrapped clean of dust and any other extraneous material. The contractor shall assess the extent of undulations in the existing road and make up by laying a leveling course as and where necessary in order to provide a uniform smooth and leveling surface as per the tolerance limits prescribed in the specification.

Primer Coat over granular base:

22.4.7 Scope:

This work shall consist of application of single coat of low viscosity liquid bituminous material to an absorbent granular surface preparatory to any superimposed bituminous treatment or construction.

22.4.8 Materials:

The choice of a bituminous primer shall depend upon the porosity characteristics of the surface to be primed as classified in IRC:16-1965 clause 3.1 to 3.3

These are : - I) Surface of low porosity
 ii) surfaces of medium porosity
 iii) surfaces of high porosity.

The different ranges of viscosity requirements for the primers to be used for the different types of the surface to be primed as given in table 9.

TABLE 9
VISCOSITY REQUIREMENTS OF PRIMERS

Types of surfaces	standard tar viscosity of primer 60°
Low porosity	0-5
Medium porosity	6-12
High porosity	16-32

The bituminous primer shall be medium curing (MC) or slow curing (SC) cut backs as per ISI 217/61. Apart from bitumen cut backs emulsions coal tar pitch, creosote etc., also can be used subject to the viscosity and surface requirements as in the table 9 being adhered to.

22.4.9 Weather and seasonal limitations:

The bituminous primer shall not be applied on a wet surface or during storm or when the weather is foggy or rainy. The primer coat for the surface treatment should not be applied when the temperature in the shade is less than 10°C.

Construction:

22.4.10 Equipment

The primer distributor shall be equipped for the spraying the material uniformly at the specified rates and temperatures.

22.4.11 preparation of road surface:

The surface be primed shall be swept clean free from dust and shall be dry. It shall be shaped to the specified and grades and section. It shall also be free from rust, any other irregularities and segregated materials. Minor depressions and pot holes may be ignored until the surface is primed, after which they shall be patched with a suitable premix material prior to the surface treatment.

22.4.12 Application of bituminous primer:

The bituminous primer shall be sprayed/distributed uniformly over the dry surface as prepared as per the clause 22.6.13 using either self propelled or towed pressure sprayer with self heating arrangement and spraying nozzle capable of spraying primer at specified rates and temperature so as to provide a uniformly unbroken spread of primer. The primer shall be applied at the rate as specified in table-10

TABLE – 10
QUANTITY OF BITUMINOUS PRIMERS

Grade o primer	quantity per 10SqM/Kg
Primer for surfaces of low porosity	7.3 to 9.8
Primer for surface of medium porosity	9.8 to 12.2
Primer for surface of high porosity	12.2 to 14.6

Temperature of application of a primer need only be high enough t permit the primer to be effectively sprayed through the jets of the spray bar and to carry the granular base of surface uniformly.

The temperature of the bituminous cutback primer at the time of application may vary from 40°C to 80°C and that of bitumen emulsion between 10°C to 60°C. the quantity of primer as given in table 10 can vary +/- 1.5 kg as directed by the engineer where specifically required.

Any pools of excess primer left on any part of the surface should be swept out over the adjacent surface and a light spreading of sand or stone grit shall be applied.

The primer coat shall be applied only on the top most water bound macadam on any granular layer, over which the bituminous base course/ wearing course is to be laid.

22.4.13Curing of the primer and opening to traffic:

It shall always be ensured that while opening to any kind of traffic, the primed surface is fully cured and is not sticky to avoid being picked up by traffic. Normally the primed surface shall be allowed to cure for not less than 24 hours and during this period no traffic of any kind shall be permitted.

22.4.14Laying of bituminous course over primed surface:

Bituminous base course or wearing course shall be laid over the primed water bound macadam or any other granular base course, in the usual manner as per the relevant specification for the same including the requirements of the tack coat as per clause 22.7

22.5 TACK COAT

22.5.1 Scope:

This work shall consist of application of a single coat of low viscosity liquid bituminous material to an existing road surface preparatory to another bituminous construction over it.

22.5.2 Materials:

Binder : the binder used for tack coat shall be bitumen of a suitable grade appropriate to the region, traffic, rainfall and other environmental conditions as directed by the engineer and confirming to IS:73, 217 or 454 as applicable or any other approved cutback.

22.5.3 Construction Operation

22.5.3.1 Preparation of base:

The surface on which the tack coat is to be applied shall be cleaned of dust and any extraneous material before the application of the binder, by using a mechanical broom or any other approved equipment/method as specified by the Engineer.

22.5.4 Application of binder

Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer and sprayed on the base at the rate specified in Table-II The rate of spread is in terms of straight run bitumen.

TABLE-11

RATE OF APPLICATION OF TACK COAT

Type of Surface	Bitumen quantity in kg/10 sqm area.
i) Normal bituminous surfaces	5 to 5.5
ii) Dry and hungry bituminous surface	6.0 to 7.5
iii) Granular surfaces treated with primer	6.0 to 7.5
iv) Non bituminous surfaces	
a) Granular base (not primed)	10.0
b) Cement concrete pavement	7.5

Note: There is no need to apply a tack coat on a freshly laid bituminous course if overlaid immediately without opening it to traffic.

22.6 BITUMINOUS MACADAM:

22.6.1 Materials:

a) Bitumen:

The bitumen shall be paving bitumen of penetration grade of S-65 (60/70) grade and with softening point 45-55°C as per Indian Standards specification for “paving Bitumen” IS: 73-1992.

b) Aggregates:

The aggregates shall consist of crushed stone, crushed gravel/shingle or other stones. They shall be clean, strong, durable of fairly cubical shape and free from disintegrated pieces, organic or other deleterious matters and adherent coating. The aggregates shall preferably be hydrophobic and of low porosity. If hydrophilic aggregates are to be used, the bitumen shall preferably be treated with anti stripping agents of approved quality in suitable doses. The aggregates shall satisfy the following physical requirements.

PHYSICAL REQUIREMENTS OF AGGREGATES FOR BITUMINOUS MACADAM

Property	Test	Specification
Cleanliness (dust)	Grain size analysis ¹	Max 5% passing 0.075mm sieve
Particle shape	Flakiness and Elongation Index (Combined) ²	Max 30%
Strength*	Los Angeles Abrasion Value ³ Aggregate Impact Value ³	Max 40% Max 30%
Durability	Soundness ⁴ Sodium Sulphate Magnesium Sulphate	Max 12% Max 18%
Water Absorption	Water absorption ⁵	Max 2%
Stripping	Coating and Stripping of Bitumen Aggregate Mixtures ⁶	Minimum retained coating 95%
Water Sensitivity ⁷	Retained Tensile Strength	Min 80%

Notes: 1. IS: 2386 Part1

2. IS: 2386 Part 1

3. IS:2386 Part 4*

4. IS: 2386 Part 5

5. IS: 2386 Part 3

(The elongation test to be done only on non-flaky aggregates in the sample)

6. IS: 6241

7.The water sensitivity test is only to be carried out if the minimum retained coating in the stripping test is less than 95%.

*Aggregate may satisfy requirements of either of these two tests.

The aggregate for bituminous macadam for different thickness shall conform to the Grading given below:

Mix designation	Grading 1	Grading 2
Nominal aggregate size	40 mm	19 mm
Layer thickness	80 – 100 mm	50 – 75 mm
IS Sieve (mm)	Cumulative % by weight of total aggregate passing	
45	100	
37.5	90-100	
26.5	75-100	100
19	-	90-100
13.2	35-61	56-88
4.75	13-22	16-36
2.36	4-19	4-19
0.3	2-10	2-10
0.075	0-8	0-8
Bitumen content % by weight Of total mixture	3.1 – 3.4	3.3 – 3.5
Bitumen grade	S- 65	S- 65

c) Proportioning of materials:

The bitumen content for premixing of Grading1 or Grading2 shall be per cent by weight of the total mix as per the above table except when otherwise directed by the engineer. The quantities of aggregates to be used shall be sufficient to yield the specified thickness after compaction.

d) Variation in proportioning of material :

The Contractor shall have the responsibility for ensuring proper proportioning of materials and producing a uniform mix. A variation in binder content ± 0.3 per cent by weight of total mix shall, however, be permissible for individual specimens taken for quality control tests vide Section 900 of IRC specifications.

22.6.2 LAYING:

a) Weather and seasonal limitations:

The work of laying shall not be taken up during rainy or foggy weather or when the base course is damp or wet, or during dust storm or when the atmospheric temperature in shade is 15⁰C or less.

b) Preparation of the base :

The base on which bituminous macadam is to be laid shall be prepared, shaped and conditioned to the specified lines, grades and cross sections and a priming coat where needed shall be applied as per the Table 500-1 both in accordance with IRC specification and as directed by the engineer.

c) Tack Coat :

This shall be provided in case of laying bituminous course over an existing road surface and shall be as per the Table 500-2 of IRC specifications.

d) Mixing and transportation:

Bituminous macadam mix shall be prepared in a hot mix plant of adequate capacity and capable to yield a mix of proper and uniform quality with thoroughly coated aggregates. The plant may be either a weight batch or volumetric proportioning continuous or drum mix type. The plant shall have coordinated set of essential units capable of producing uniform mix within the job mix formula such as :

The temperature of binder at the time of mixing shall be in the range of 140-160⁰C and that of the aggregate in the range of 140-165⁰C, provided that the difference in temperature between the binder and aggregate at no time exceeds 14⁰C.

Mixing shall be thorough to ensure that a homogenous mixture is obtained in which all particles of the aggregates are coated uniformly and the discharge temperature of mix shall be at 155⁰ C(Maximum)

The mixture shall be transported from the mixing plant to the point of use in suitable tipper vehicles. The vehicles employed for transport shall be clean and be covered over in transit if so directed by the Engineer.

e) Spreading:

The mix transferred from the tipper at site to the paver shall be spread immediately by means of self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix true to the specified lines,

grades and cross sections. The paver finisher shall have the following essential features:

- a) Loading hoppers and suitable distributing mechanism.
- b) All drives having hydrostatic drive/control.
- c) The machine shall have a hydraulically extendable screed for appropriate width requirement.
- d) The screed shall have tamping and vibrating arrangement for initial compaction to the layer as it is spread without rutting or otherwise marring the surface. It shall have adjustable amplitude and infinitely variable frequency.
- e) The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.
- f) The paver shall be fitted with an electronic sensing device for automatic leveling and profile control within the specified tolerances.
- g) The screed shall have the internal heating arrangement.

However, in restricted locations and in narrow widths where the available plant can not be operated in the opinion of the Engineer, he may permit manual laying of the mix.

The temperature of the mix at the time of laying shall be in the range of 115 °C (Minimum). In multi layer construction the longitudinal joint in one layer shall offset in the layer below by about 150mm. However, the joint in the top most layer shall be at the centre line of the pavement.

Longitudinal joint and edges shall be constructed true to the delineating line parallel to the central line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

f) Rolling:

After the spreading of mix, rolling shall be done by 8 to 12 tonne power rollers or other approved equipment. Rolling should start as soon as possible after the material has been spread. Rolling shall be done with care to keep from unduly roughening the pavement surfaces.

Rolling of the longitudinal joints shall be done immediately before the paving operation. After this the rolling shall commence at the edges and progress towards the centre longitudinally except that on super elevated portions, it shall progress from the lower to the upper edge parallel to the central line of the pavement.

The initial or break down rolling shall be done, with 8 to 12 tonnes three wheel steel roller, as soon as it is possible to role the mix without cracking the surface or having the mix pick up on the roller wheels. The second or intermediate

rolling shall follow the break down rolling as closely as possible and be done while the paving mix is still at a temperature that will result in maximum density. The final rolling shall be done while material is still workable enough for removal of roller marks. All the compaction operations i.e., break down rolling, intermediate rolling and final rolling can be accomplished by using 8-12 tonne power roller. The joints and edges shall be rolled with 8 to 10 tonne power roller.

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 mix material. The rolling shall then be continued till the entire surface has been rolled to compaction, there is no crushing of aggregates and all roller marks have been eliminated. Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. The roller wheel shall be kept damp if necessary to avoid bituminous material from sticking to the wheels and being picked up. In no case shall fuel lubricating oil be used for this purpose, nor excessive water poured on the wheels.

Rolling operations shall be completed in every respect before the temperature of the mix falls below 80 °C.

Roller(s) shall not stand on newly laid material while there is a risk that it will be deformed thereby. The edges along and transverse of the bituminous macadam 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.

21.10 BITUMINOUS CONCRETE:

21.10.1 Materials:

a) Bitumen:

Clause no. 14.1 (a) shall apply.

b) Coarse aggregate:

Clause no.14.1(b) shall apply.

The physical properties of coarse aggregates shall conform to below:

**PHYSICAL REQUIREMENTS FOR COARSE AGGREGATE FOR BITUMINOUS
CONCRETE PAVEMENT LAYERS**

Property	Test	Specification
Cleanliness (dust)	Grain size analysis ¹	Max 5% passing 0.075mm sieve
Particle shape	Flakiness and Elongation Index	Max 30%(Combined) ²
Strength*	Los Angeles Abrasion Value ³ Aggregate Impact Value ⁴	Max 30% Max 24%
Polishing	Polished stone value ⁵	Min 55%
Durability	Soundness ⁶ Sodium Sulphate Magnesium Sulphate	Max 12% Max 18%
Water Absorption	Water absorption ⁷	Max 2%
Stripping	Coating and Stripping of Bitumen Aggregate Mixtures ⁹	Minimum retained coating 95%
Water Sensitivity**	Retained Tensile Strength ⁸	Min 80%

Notes: 1. IS: 2386 Part 1

6. IS: 2386 Part 5

2. IS: 2386 Part 1

7. IS: 2386 Part 3

(the elongation test to be done only on non-flaky aggregates in the sample)

3. IS:2386 Part 4*

4. IS:2386 Part 4*

8.AASHTO T283**

5. BS:812 Part 114

9. IS: 6241

* Aggregate may satisfy requirements of either of these two tests.

** The water sensitivity test is only to be carried out if the minimum retained coating in the stripping test is less than 95%.

c) Fine aggregate:

Clause no.16.1 (c) shall apply

d) Filler :

Clause no.16.1 (d) shall apply

e) Aggregate gradation:

When tested in accordance with IS:2386 Part 1 (wet sieving method), the combined grading of the coarse and fine aggregates and added filler for the particular mixture shall fall within the limits shown in Table below, for grading 1 or 2 as specified in the Contract. The type and quantity of bitumen, and appropriate thickness, are also indicated for each mixture type.

COMPOSITION OF BITUMINOUS CONCRETE PAVEMENT LAYERS

Grading	1	2
Nominal aggregate size	19 mm	13 mm
Layer Thickness	50-65 mm	25-45 mm
IS Sieve ¹ (mm)	Cumulative % by weight of total aggregate passing	
45		
37.5		
26.5	100	
19	79-100	100
13.2	59-79	79-100
9.5	52-72	70-88
4.75	35-55	53-71
2.36	28-44	42-58
1.18	20-34	34-48
0.6	15-27	26-38
0.3	10-20	18-28
0.15	5-13	12-20
0.075	2-8	4-10
Bitumen content % by mass of total mix ²	5.0-6.0	5.0-7.0
Bitumen grade (pen)	S-65	S-65

Notes: 1.The combined aggregate grading shall not vary from the low limit on one sieve to the high limit on the adjacent sieve.

2. Determined by the Marshall method.

21.10.2 Mix Design :

a) Requirement of mix:

Apart from conformity with grading and quality requirements of individual ingredients, the mix shall meet the requirements set out in the Table below.

REQUIREMENTS FOR BITUMINOUS CONCRETE LAYERS

Minimum stability (kN at 60°C)	9.0
Minimum flow (mm)	2
Maximum flow (mm)	4
Compaction level (Number of blows)	75 blows on each of the two faces of the specimen
Per cent air voids	3-6
Per cent voids in mineral aggregate (VMA)	See Table below
Per cent voids filled with bitumen (VFB)	65-75
Loss of stability on immersion in water at 60°C (ASTM D 1075)	Min 75% retained strength

The requirements for minimum per cent voids in mineral aggregate (VMA) are set out in Table as below

MINIMUM PER CENT VOIDS IN MINERAL AGGREGATE (VMA)

Nominal Maximum Particle Size ¹ (mm)	Minimum VMA, Per cent Related to Design Air Voids, Per cent ²		
	3.0	4.0	5.0
9.5	14.0	15.0	16.0
12.5	13.0	14.0	15.0
19	12.0	13.0	14.0
25	11.0	12.0	13.0
37.5	10.0	11.0	12.0

- Notes: 1. The nominal maximum particle size is one size larger than the first sieve to retain more than 10 per cent
2. Interpolate minimum voids in the mineral aggregate (VMA) for design air voids values between those listed.

b) **Binder Content** :

The binder content shall be so fixed to achieve the requirements of the mixture set out in Table above. The Marshall method for determining the optimum binder content shall be adopted as described in The Asphalt Institute Manual MS-2, replacing the aggregates retained on the 26.5 mm sieve by the aggregates passing the 26.5 mm sieve and retained on the 22.4 mm sieve, where approved by the Engineer.

c) **Job mix formula**:

Clause no.14.2(c) shall apply except that the requirements of Bituminous Concrete mix shall be as per Table vide Clause no.17.2 (a) & (b).

d) **Permissible variations from the job mix formula**:

The contractor shall have the responsibility of ensuring proper proportioning of materials in accordance with the approved job mix formula and producing a uniform mix. The permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula may be within the limits as specified in the Table in the Clause no.16.2(c) shall apply. These variations are intended to apply to individual specimens taken for quality control tests vide IRC Specifications Section 900.

21.10.3 Laying:

The provisions as specified in Clause no 14.2 shall apply

21.10.4 Opening to Traffic :

Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

21.11 ROAD MARKINGS :

The colour width and layout of road markings shall be in accordance with the code of practice for road markings with paints IRC – 35 – 1970.

21.11.1 Lane Markings :

Traffic lane lines shall be single broken lines, their width shall be 10 cm (4 inches) and the length of segments and gaps shall be as under :

On straight reaches	1.5 metres segments and 4.5 metres gaps
On Curves and Approaches to intersection	1.5 metres segments and 1.5 metres gaps

21.11.2 Arrow Markings :

The size and location shall be as indicated in the drawings.

21.12 QUALITY CONTROL FOR ROAD WORKS :

Quality control in respect of materials, workmanship, finished layers of road, etc., is to be achieved and tested as stipulated vide Section 900 of IRC Specifications for Road and Bridge Works(Fourth Revision)

21.12.1 Surface Levels:

The levels of the sub-grade and different pavement courses as constructed shall not vary from those calculated with reference to the longitudinal and cross profile of the road shown on the drawings or as directed by the Engineer beyond the tolerances mentioned in table below.

TOLERANCE IN SURFACE LEVELS

1. Subgrade	+20 mm - 25 mm
2. Sub-base +10mm (a) Flexible Pavement (b) Concrete Pavement (Dry lean concrete or Rolled concrete)	-20 mm + 6 mm -10 mm
3. Base-course for flexible pavement (a) Bituminous course (b) Other than bituminous i) Machine laid ii) Manually laid	+ 6 mm - 6 mm +10 mm - 10 mm +15 mm - 15 mm
4. Wearing course for flexible pavement a) Machine laid b) Manually laid	+ 6 mm - 6 mm + 10 mm - 10 mm

Provided, however, that the negative tolerance for wearing course shall not be permitted in conjunction with the positive tolerance for base course, if the thickness of the former is thereby reduced by more than 6mm for flexible pavements and 5mm for concrete pavements.

CONTROL TESTS AND THEIR MINIMUM FREQUENCY FOR SUBBASES AND BASES (EXCLUDING BITUMEN BOUND BASES)

Sl. No.	Type of construction	Test	Frequency (Min.)
1.	Granular	i) Gradation ii) Atterberg limits iii) Moisture content prior to compaction iv) Density of compacted layer v) Deleterious constituents vi) CBR	One test per 200 m ³ One test per 200 m ³ One test per 250 m ³ One test per 500 m ³ As required As required
2.	Water bound macadam	i) Aggregate impact value ii) Grading	One test per 200m ³ of aggregate One test per 100m ³

		iii) Flakiness Index and Elongation Index iv) Atterberg limits of binding material v) Atterberg limits of portion of aggregate passing 425 micron sieve	One test per 200m ³ of aggregate One test per 25 m ³ of binding material One test per 100 m ³ of aggregate.
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CONTROL TESTS FOR BITUMINOUS WORKS, AND THEIR MINIMUM FREQUENCY

Sl. No.	Type of construction	Test	Frequency 9Min.)
1.	PrimeCoat/ Tack Coat/ Fog Spray	i) Quality of binder ii) Binder temperature for application iii) Rate of spread of Binder	Number of samples per lot and tests as per IS:73, IS:217 and IS:8887 as applicable. At regular close intervals. One test per 500 m ² and not less than two tests per day.
2.	Seal Coat/Surface Dressing	i) Quality of Binder ii) Aggregate impact Value/ Los Angels Abrasion value iii) Flakiness Index and Elongation Index iv) Stripping value of aggregates (Immersion Tray Test) v) Water absorption of aggregates vi) Water sensitivity of mix	Same as mentioned under Sl.No.1 One test per 50m ³ of aggregate -do- Initially one set of 3 representative specimens for each source of supply. Subsequently when warranted by changes in the quality of aggregates. -do- Initially one set of 3 representative specimens for each source of supply. Subsequently when warranted by changes in the quality of aggregates (if required). One test per 25 m ³ of aggregate

		vii) Grading of aggregates viii) Soundness (Magnesium and Sodium Sulphate) ix) Polished stone value x) Temperature of binder at application xi) Rate of spread of materials xii) Percentage of fractured faces	Initially, one determination by each method for each source of supply, then as warranted by change in the quality of the aggregates. As required. At regular close intervals. One test per 500m ² of work, and not less than two tests per day. When gravel issued, one test per 50 m ³ of aggregate.
3.	Bituminous Macadam	i) Quality of Binder ii) Aggregate Impact value/Los Angeles Abrasion value iii) Flakiness Index and Elongation Index iv) Stripping Value v) Water Sensitivity of Mix vi) Grading of Aggregates vii) Water absorption of aggregates viii) Soundness (Magnesium and Sodium Sulphate) ix) Percentage of fractured faces x) Binder content and aggregate grading xi) Control of temperature of binder and aggregate for mixing and of the mix at the time of laying and rolling xii) Rate of spread of mixed material xiii) Density of compacted layer	Same as mentioned under Sl.No.1. Same as mentioned under Sl.No.2 Same as mentioned under Sl.No.2 Same as mentioned under Sl.No.2 -do- Two Tests per day per plant both on the individual constituents and mixed aggregates from the dryer. Same as in Sl.No.2 Same as mentioned under Sl.No.2 Same as mentioned under Sl.No.2. Periodic, subject to minimum of two tests per day per plant. At regular close intervals. Regular control through checks of layer thickness. One test per 250m ² area.

4.	Bituminous/P enetration Macadam /Built-up spray-Grout	i) Quality of binder ii) Aggregate impact value/ Los Angels Abrasion Value iii) Flakiness Index and Elongation Index iv) Stripping value v) Water absorption of aggregates vi) Water sensitivity of mix vii) Aggregate grading i) Soundness (Magnesium and Sodium Sulphate) Percentages of fractured faces Temperature of binder at application Rate of spread of binder	Same as mentioned under Sl.No.1. One test per 200 m ³ of aggregate. -do- Same as mentioned under Sl.No.2 Same as Sl.No.2 Same as Sl.No.2 One test per 100 m ³ of aggregate Same as mentioned under Sl.No.2 Same as mentioned under Sl.No.2 At regular close intervals Same as mentioned under Sl.No.2
5.	Dense bituminous macadam/sem i-dense bituminous concrete/Bitu minous concrete	i) Quality of binder ii) Aggregate impact value/Los Angeles abrasion value iii) Flakiness Index and elongation index iv) Stripping value v) Soundness (Magnesium and Sodium Sulphate) vi) Water absorption of aggregates vii) Sand equivalent test viii) Plasticity Index ix) Polished stone value x) Percentage of fractured faces xi) Mix grading	Same as mentioned under Sl.No.1 Same as mentioned under Sl.No.2 -do- Same as mentioned under Sl.No.2 Same as mentioned under Sl.No.2 As in Sl.No.2 As required As required As required, for semi- dense bituminous concrete/bituminous concrete. Same as mentioned under Sl.No.2 One set of tests on individual constituents and mixed aggregate from the dryer for each 400 tonnes of mix subject to a minimum of 2 tests per

		xii) Stability of mix xiii) Water sensitivity of mix (retain tensile strength) xiv) Swell test on the mix xv) Control of temperature of binder in boiler, aggregate in the dryer and mix at the time of laying and rolling xvi) Control of binder content and grading of the mix xvii) Rate of spread of mixed material xviii) Density of compacted layer	plant/per day For each 400 tonnes of mix produced, a set of 3 Marshall specimens to be prepared and tested for stability, flow value, density and void content subject to a minimum of 2 sets of being tested per plant per day Same as mentioned under Sl.No.2 As required for the bituminous concrete As regular close intervals One test for each 400 tonnes of mix subject to a minimum of two tests per day per plant. Regular control through checks on the weight of mixed materials and layer thickness One test per 250m² area
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WELDING

General: Welded joints are permitted in reinforcement (mild steel and deformed bars) important connections, tests shall be done to prove that the joints are of the full strength of bars connected.

1. Welding of mild steel plain and hot tolled deformed bars:

1.0 The requirements for welding mild steel round and deformed bars conforming to mildsteel. Grade I, conforming to IS:432 (Part-1)-1982 'Specification for mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement: Part-1 mild steel and medium tensile steel bars (third revision)' and hot rolled deformed bars conforming to IS:1786-1985' Specification for high strength deformed steel bars and wires for concrete reinforcement (third revision)' are given in IS:2751-1979' Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction (First revision)'.

Note: 1- Hot rolled deformed bars/ wires conforming to IS:1786-1985 will have their transverse and longitudinal ribs in straight lengths.

Note:2- For guaranteed weldability, the percentage of carbon shall be restricted to 0.25 percent, maximum.

1.1 Electrodes and Filler Rods

1.1.1 **Electrodes** – Covered electrodes for manual metal arc welding shall conform to IS:814 (Part-1)-1974 'Specification for covered electrodes for metal arc welding of structural steel: Part 1 For welding products other than sheets (fourth revision)' and IS:814 (Part-1)-1974' Specification for covered electrodes for metal arc welding of structural steel : Part2 for welding sheets (fourth revision)

1.1.2 **Filler Rods** – Mild steel filler rods for oxy-acetylene welding shall conform to type S-FS7 of IS:1278-1972' Specification for filler rods and wires for gas welding (second revision)' provided they are capable of giving a minimum butt weld tensile strength of 410 MPa.

1.1.3 Mixtures for thermit welding shall be capable of yielding weld meta of the required composition and the tensile strength shall be at least 410MPa.

1.2 **Flash Butt Welding** – Electrical flash butt welding may be adopted if a number of welds have to be done at the same place and when the electric supply is available of the required capacity in respect of the cross-sectional area of the maximum size of bar to be welded.

1.2.1 **Preparation for Welding** – The ends of the bars to be welded shall be sheared off so that fresh steel surfaces are available for welding. The surfaces of

the ends of the bars to be clamped shall be cleaned free from rust to enable free flow of electricity in the bars.

1.2.2 Procedure – The procedure for flash butt welding shall generally be in accordance with the ‘Indian Standard Recommended Procedure for Flash Butt Welding’ (under print).

1.2.2.1 The ends of the bars to be welded are placed in proper alignment in the clamps so that bend or eccentric joints do not result. The clamps should be cleaned before each welding operation to avoid current losses and also to eliminate harmful notches or grooves due to burning in of spots of arcing.

1.2.2.2 Welding should be done without any preheating of bars. The bar ends shall be uniformly pushed against each other from the moment of contact up to the upsetting. The transformer regulator should be so set that the current at the contact up to the upsetting. The transformer regulator should be so set that the current at the contact area is between 85 and 90A/mm².

1.2.2.3 If the butt welding machine or the available power is not sufficient to take the load for welding the bar in the cold condition, welding may be done after preheating. By repeated making and breaking of the contact arc, heat can be made to spread over the entire cross-section of the bar. The number of short circuits (contacts and reversing) should be kept to the minimum possible so that the welding time and spread of heat in the longitudinal directions in the bar is minimum. Satisfactory joints with only slight reduction in the original strength of the bar can be achieved with current densities up to 25 A/mm².

1.2.2.4 In automatic machines, the flash rate should be so set that a continuous flash without interruption can be achieved. If too high a rate is set, then additional short circuits are required leading to a heat spreading. If the rate is too low, the flash will be interrupted, consequently air penetrating into the joint will form oxides. If the machine is hand operated, the flash should be maintained to avoid interruption.

1.2.2.5 Burn- off length – For bars with sheared ends a burn-off (flash-off) length of about 10mm is required, this length being practically independent of the bar diameter. Very short burn-off length leads to defective welding because all the impurities will not have been removed from increase in the burn-off length of the bar thus reducing the strength of the bar.

1.2.2.6 Upsetting – The upsetting should result from the burning off, that is, without interruption in the rain for sparks. The electric supply should be switched off about 1/3 to 1 second after the start of the start of the upsetting or in the case of automatic machine, after 1 to 3 minutes of upset travel.

The voltage and frequency of the current should be checked before commencing the welding operation. Such deviations from the nominal value or large

fluctuations during the operation may lead to gross defects in the welding. Wherever possible, welding should be done in periods of the day when the total load on the network is fairly balanced.

1.3 Fusion Welding of Mild Steel Bars – Steel bars shall be either butt welded or lap welded using any of the following fusion welding processes:

- a) Manual metal –arc welding.
- b) Oxy-acetylene welding,
- c) Gas pressure welding, and
- d) Thermit welding

Thermit welding shall be generally in accordance with the ‘Recommended practice for fusion welding of ferrous metal by alumino-thermic process (under print)

1.3.1 Butt Welding of Mild Steel Bars – Bars may be spliced by butt welding them directly or through a splice member such as angle, sleeve, bars, etc.

1.3.1.1 The edges shall be prepared by shearing, machining or oxy-acetylene flame cutting. Beveling may be done by chipping, machining grinding or oxygen cutting. The joint faces and the surrounding portion of the bars shall be free from scale, dirt, grease, paint, rust and contaminants.

1.3.1.2 When it is not possible to rotate the bars for welding in flat position, the axis of the bars shall be horizontal and the respective axes of welds shall be vertical, that is, welds being carried out in the vertical position.

1.3.1.3 In the case of inclined bars, the edge preparation shall be such that welding is done only on sides.

1.3.1.4 All the bars to be welded should be aligned and set up in position with their axes in one straight line. The joint may not be out of alignment by more than 25 percent of the thickness of the thinner material for material up to and including 12mm thick, or by more than 3mm for thicker material. Alignment may be accomplished in a jig, or by means of a clamp or by using guides. Rotation of the bars should be avoided until they are adequately welded, so that no disturbance to the alignment is caused and no twist is introduced in the bars during the process of welding.

1.3.1.5 In the case of details and back chipping in the root is recommended before welding is commenced on second side. The root run and one further run should be deposited on the first side. Where possible the back chipping and root run on the second side should then follow and the remaining runs should preferably be deposited on alternate sides of the joint to assist in controlling distortion

1.3.1.5 Indirect butt splices may be made by welding bars to splice plate, angle, sleeve, etc, using single or double fillet welds. The splice member used, that is, plate, angle, bar, sleeve, etc, should have a cross sectional area such that its strength is at least 5 percent higher than the strength of the bars being welded. The bars shall not be eccentric by more than 3 percent of the bars joined. The angles when used may be flattened to suit for welding higher size bars.

1.3.2 Lap Welding of Mild steel Bars

1.3.2.1 Edge preparation is not necessary for lap welds. The length of bars to be welded should be free from scale, dirt, grease, paint, rust and contaminants.

1.3.2.2 The bars may be lap welded using the details is used when the bars are in contact with each other. If the bars are bent, the maximum gap shall be 6mm

When the gap between bars is more than 6mm the joint should be made using a splice bar or plate. The gap between the and splice plate should not exceed 0.25 times the diameter of the bar or 5mm whichever is less. The area of the splice material shall be at least 5 percent more than the area of the higher size bar being welded.

Some information regarding throat thickness and reinforcement is given in table A-2.

Table A-2 details for Lap welded Joints\

Bar Diameter Thickness	Throat Between Reinforcement	Gap
(1)	(2)	(3)
mm	mm	mm
Upto12	3	1.5
Over 12 up to 16	3	3
Over16	5	3

Note 1 – If any overhead weld is required, it should be made prior to the flat welds.

Note 2 – If the bars are bent, the maximum gap should not exceed 6mm.

1.3.2.3 The dimensions of the fillet welds (length and throat thickness) shall be capable of developing the full strength of the bar. The eccentricity in the joint should be taken into consideration in the design calculation.

1.3.3 **Square Butt Welds** – Square butt welds may be used for direct butt welding and shall be made using hydrogen controlled electrodes or the thermit welding process.

1.4 Selection of Welded joints.

1.4.1 Direct butt splices and, as second choice indirect butt splices should be specified for bars of diameter 20mm and over in order to reduce effects of eccentricity.

1.4.2 For bars of diameter up to 20mm indirect splicing may be used although lap welds are normally adopted for such bars.

1.4.3 **Square Butt Welds**- The bars may be directly jointed with square butt welds provided the welds are made using hydrogen controlled electrodes or thermit welding process.

1.5 **Location of Welded joints** – Welded joints should be staggered in the length of the reinforced concrete components. The joints should also not be positioned in highly stressed areas.

1.6 Quality Control Tests.

1.6.1 **Butt welds** – Test pieces containing butt welds at the centre in the ‘as welded’ condition shall be selected at the rate of one for tensile test and one for nick break test for every 500 joints.

1.6.1.1 **Tensile test** – The selected pieces, when subjected to a tensile test, shall have a tensile strength not less than 410 MPa (42 kgf/mm²)

1.6.1.2 **Nick break test** – The test specimen shall be notched as given in and shall be broken open along the weld, the fractured surface visually examined for fusion, root penetration, gas cavities and quality of weld metal. The surface should be reasonably free from cavities, inclusions, etc. there shall be no lack of fusion. Small porosity may, however, be permitted.

1.6.1.3 **Bend test** – The specimen shall be bent using any suitable jig. The weld joint should be capable of being bent to an angle of 60° around a mandrel of diameter equal to diameter of bar before any crack appears.

1.6.2 **Lap joints** – Test pieces containing lap joints at their centre shall be selected at the rate of 1 per 500 joints.

1.6.2.1 **Tensile test** – the load required to shear the joint shall be at least equal to the tensile load required to fracture the bar.

Note – When pulling lap weld specimens to determine the tensile strength a jig should be used to prevent distortion due to secondary stresses. The jig may be of

design and detail preferred by the testing agency but should prevent change in geometry of the specimen as it is being pulled.

1.7 Retests – If a sample selected for testing fails to meet the requirements given under 1.6.1 or 1.6.2, the purchaser or his representative shall select two further samples from the same lot. If on testing, either of the samples fails to meet the specified requirements, the whole lot shall be rejected.

1.8 Inspection – For purpose of inspection reference shall be made to IS:822-1970'Code of procedure for inspection of welds.

1.8.1 The weld size, length and location shall as stipulated in the drawings, and the metal designated shall be free from cracks, excessive slag inclusions and excessive porosity.

1.8.2 The weld meal shall be properly fused with the parent metal without overlapping at the toes of the weld.

1.8.3 There shall be no cracks in the heat affected zones of the reinforcing bars or splice members.

1.8.4 There shall be no serious undercuts in joint subjected to tension.

1.8.5 All craters shall be filled to the cross section of the welds.

1.8.6 The visible surfaces of all welds shall be free from entrapped slag and shall be regular and of consistently uniform contour.

1.8.7 All direct butt welds shall be of full cross section with maximum reinforcement of 3mm and shall blend smoothly into the face of bars.

1.8.8 The profile of fillet welds shall be substantially flat or slightly convex.

2. Welding of cold worked steel bars.

2.0 The recommendation for welding cold worked steel bars conforming to IS:1786-1985 is given in IS:9417-1979.

Note: 1- Cold worked deformed bars conforming to IS:1786-1985 will have their longitudinal and transverse ribs twisted and not in straight lines.

Note: 2-For guaranteed weldability, the percentage of carbon shall be restricted to 0.25 percent, maximum.

2.1 Electrodes – Electrodes used shall conform to IS:814 (Part1)-1974 and IS:814 (Part-2)-1974.

2.2 Procedure – Cold worked steel bars shall be either butt-welded or lap-welded. Butt-welding may be carried out either by resistance butt or flash butt or by manual metal arc welding process.

2.2.1 Resistance Butt Welding and flash butt welding of cold worked bars – Flash or resistance butt welding may be adopted if a large number of welding has to be done at the same place and when the electric supply is available of the required capacity in respect of the cross sectional area of the maximum size of bar to be welded.

2.2.1.1 Preparation for welding – The ends of the bars and the extreme untwisted ends of new bar shall be sheared off so that fresh steel surfaces are available for welding. The surfaces of the ends of the bars to be clamped shall be cleaned free from rust to enable free flow of current in the bars.

2.2.1.2 Procedure – The ends of the bars to be welded are placed in proper alignment in the clamps so that bent or eccentric joints do not result. The clamps should be cleaned before each welding operation to avoid current loss and to eliminate harmful notches or grooves due to burning in of spots of arcing.

The bar ends shall be uniformly pushed against each other from the moment of contact up to the upsetting. The transformer regulator should be so set that the current density is between 85 and 90 A/mm².

If the capacity of butt welding machine or the available power is not sufficient to take the load for welding from cold, welding may be done after preheating. By making and breaking of the contact arc repeatedly, heat can be made to spread over the entire cross sections of the bars. The number of short circuits (contacts and reversing) should be kept to the minimum possible so that the welding time and spread of heat in the longitudinal direction in the bar is minimum. Satisfactory joints with only slight reduction in the original strength of the bar can be achieved with a current densities up to 25 A/mm².

In automatic machines the flash rate should be so set that a continuous flash without interruption can be achieved. If too high a rate is set, then additional short circuits are required leading to a heat spreading. If the rate is too low, the flash will be interrupted, consequently air penetrating into the joint will form oxides. If the machine is hand-operated, the flash should be maintained to avoid interruption. Too long flashes lead to generation of large quantities of heat thus removing the effect of cold-working in the bar.

Burn off length – For bars with sheared ends, a burn off (flash off) length of about 5 to 7mm is required, this length being practically independent of the bar diameter. Very short burn-off lengths lead to defective welding because all the impurities will not have been removed from the place of welding. Increase in the

burn off length will spread heat along the length of the bar thus reducing the strength of the bar.

Upsetting – The upsetting should result from the burning off, that is, without interruption in the rain of sparks. The electric supply should be switched off about 1/3 to 1 second after the start of the upsetting or in the case of automatic machine after 1 to 3mm of upset travel.

The voltage and frequency of the current should be checked before commencing the welding operation. Such deviations from the nominal value or large fluctuations during the welding. Wherever possible, welding should be welding. Wherever possible welding should be done in periods of the day when the total load on the network is fairly balanced.

2.2.2 Butt-Welding by Metal –Arc Welding process- Butt-welds are normally adopted to join bars of thickness more than 20mm. Welding electrodes with flux covering of Type -3 or 6 (see IS:815-1974 ‘Classification and coding of covered electrodes for metal arc welding of structural steel (second revision)’ are recommended for better results depending on the size of bar to be welded.

2.2.2.1 Preparation for welding

The preparation of the edges for the rods. The edges shall be prepared by shearing, machining or oxy-acetylene flame cutting. Beveling may be made by machining, grinding or oxy-acetylene cutting. The fusion faces and the surrounding material shall be free from scale, dirt, grease, paint, rust and contaminants.

When it is not possible to rotate the bars for welding in flat position, the axis of the bars shall be horizontal and the respective welding shall be vertical, that is, the welds being carried out in the vertical position.

In the case of non-rotatable inclined bars, the edge preparation shall be such that welding is done only on sides.

All the bars to be butt welded should be aligned and set up in position with their axis in one straight line. This may be done in a jig or by means of a clamp or by using guides. Rotation of the bars should be avoided until they are adequately welded, so that no disturbance to the alignment is caused and no twist is introduced in the bars during the process of welding. The joints may not be out of alignment by more than 25 percent of the thickness of the thinner material up to and including 12mm thick, or by more than 3mm or, thicker material.

2.2.2.2 Electrodes – The electrodes shall be so selected that relatively short beads can be rapidly made, since with each bead only a small quantity of heat is transferred to the steel which the steel can conduct away without any harmful effects on the material. If the electrodes move out slowly, a concentration of heat takes place thus removing the effects of cold working on the bar.

The size of electrode depends upon the length of the bead and thickness of the bar to be welded. The root runs should be made with electrodes of size 3.15mm. with the number of beads the size of electrode should be gradually increased from 3.15 to a maximum size of 5mm for the top bead.

2.2.2.3 Welding procedure and technique -

The sequence of welding beads is for information. The runs 1 to 4 are made in the position of welding best suited for the quality of the weld. Besides the interruption in welding required for cleaning of each bead, a pause shall be made after every second bead and the bar is allowed to cool down. The temperature of the bars at a distance of about 20mm from the joint shall not exceed 3000C. The temperatures can be checked approximately using temperature indicating crayons.

After completing the bead 4, the bars are rotate by 1800 about their axes, and the beads 5 to 8 are made in a manner described above. The final bead 9 is made in the case of horizontal and freely rotatable bars by weaving in the direction of the bar periphery, the bars being continuously rotated during welding.

In the case of vertical, inclined and non-rotatable bars the beads 1 to 4 shall be made as explained in this clause. The top bead is made by making separate annular runs , the electrode being drawn up to the edge of the top bead. The starting and withdrawal position of the electrodes. The top beads are made by drawing the adjacent beads in the longitudinal direction of the bar. The diameter measured over the top of the butt welded joint shall be equal to at least 1.2times the diameter of the bar.

2.2.3 Lap Welding of Cold worked bars – Lap joints may be made in bars of all sizes and qualities of cold worked bars. They are preferred when access for welding is from only one side and while connecting prefabricated units. Use of electrodes with flux covering of type 3 or 6 are recommended for better results depending on the size of bar being welded.

2.2.3.1 Edge preparation is not necessary for lap welds. The joint faces and the surrounding material shall be free from scale, dirt, grease, paint, rust and contaminants.

2.2.3.2 **Electrodes** – The size of electrodes according to the diameter of the bar to be welded shall be as follows:

Size of Bar	Size of Electrode,
Mm	Min mm
Up to and including 6	1.6
Over 6 up to and including 10	2.0
Over 10 up to and including 14	2.5
Over 14 up to and including 20	3.15
Over 20	4

2.2.3.3 **Procedure** – The arc should be struck somewhere in the middle of the joint and not at its beginning.

The movement of the electrode for welding lap joints in the horizontal and vertical position.

In given the various lap joints used to connect cold worked bars.

2.3 **Quality Control Test**

2.3.1 **Butt welds** – Test pieces containing butt welds at the centre in the as welding condition shall be selected at the rate of one for tensile test and one for bends test for every 500 joint.

2.3.1.1 **Tensile test** – The selected pieces, when subjected to a tensile test, shall have a tensile strength not less than 90 percent of the actual tensile strength of the bar but in no case less than the tensile strength of the bar specified in IS:1786-1985. The fracture shall take place away from the weld.

2.3.1.2 **Bend test** – The welded joint should be capable of being bent to angle of 60° around a mandrel of diameter equal to diameter of bar before any crack appears.

2.3.2 **Lap Joints** – The pieces containing lap joints at their centre shall be selected at the rate of one in 500 joints.

2.3.2.1 **Tensile test** – The load required to shear the lap joint shall be at least equal to the tensile load required to fracture the bar.

2.4 **Retests** – If a sample selected for testing fails to meet the requirements given under 2.3.1 and 2.3.2, the purchaser or his representative shall take two further samples from the same lot. If on testing either of the samples fails to meet the specified requirements, the whole lot

NORMS FOR CEMENT CONSUMPTION

<u>ANNEXURE TO SPECIFICATION</u>				
NORMS FOR CEMENT CONSUMPTION				
Sl.No	Item	Unit	Grade/ Proportion	Cement Consumption/unit (kg)
1	Cement Concrete	Cum	M 5A	164
		Cum	M 5B	196
		Cum	M 5C	200
		Cum	M 7.5A	194
		Cum	M 7.5B	226
		Cum	M 7.5C	222
		Cum	M 10A	218
		Cum	M 10B	250
		Cum	M 10C	288
		Cum	M 15A	252
		Cum	M 15B	284
		Cum	M 15C	322
		Cum	M 20A	303
		Cum	M 20B	335
		Cum	M 20C	373
		Cum	M 25B	400
		Cum	M 25C	438
		Cum	M 30B	480
		Cum	M 30C	518
2	Cement Concrete	Cum	1:5:10	134
		Cum	1:4:8	173
		Cum	1:3:6	227
		Cum	1:2:4	320
		Cum	1:1.5:3	407
3	Cement Concrete Grout	Cum	M 15D	359
		Cum	M 20D	422
		Cum	M 25D	496
		Cum	M 30D	591
4	Cement mortar Grout	Cum	1:2	718
		Cum	1:3	540
5	Masonry			
	I) Rubble masonry work in cement mortar	Cum	1:4	125
		Cum	1:5	102

		Cum	1:6	83
	ii) Full Brick work in cement mortar	Cum	1:4	95
		Cum	1:5	78
		Cum	1:6	63
	iii) Half Brick work in cement mortar	Sqm	1:3	14.30
		Sqm	1:4	10.60
		Sqm	1:5	8.70
6	Plaster			
	i) Cement Plaster 10 mm thick	Sqm	1:4	4.30
		Sqm	1:5	3.70
		Sqm	1:6	3.00
	ii) Cement Plaster 15 mm thick	Sqm	1:6	3.00
		Sqm	1:3	7.91
		Sqm	1:4	6.50
		Sqm	1:5	5.40
		Sqm	1:6	4.50
	iii) Cement Plaster 20 mm thick	Sqm	1:3	10.54
		Sqm	1:4	8.70
		Sqm	1:5	7.30
		Sqm	1:6	6.00
	iv) Cement Plaster 25 mm thick	Sqm	1:4	10.80
		Sqm	1:5	9.10
		Sqm	1:6	7.50
	v) Cement mortar	cum	1:6	250
7	Pointing			
	i) Cement pointing for masonry work	Sqm	1:2	2.00
	Do	Sqm	1:3	1.50
	ii) Flush pointing for dry rubble masonry	Sqm	1:4	3.00
	iii) Raised and cut pointing on stone	Sqm	1:3	2.35
	masonry with cement mortar			
8	Flooring			
a)	i) 25 mm thick granolithic layer with 10 mm down graded chips	Sqm	M15	9.50
	ii) Extra for each additional thickness of 5 mm granolithic layer	Sqm	M20	11.30

		Sqm	M15	1.90
		Sqm	M20	2.30
b)	I)M 10B grade PCC rubbed smooth	Sqm	100 mm thk	26.00
		Sqm	75 mm thk	19.50
	ii) Extra over above for each additional 10 mm thickness	Sqm		2.50
c)	I) 75 mm thick with 20 mm stone RCC floor	Sqm	M 15	24.50
		Sqm	M 20	28.00
	ii) Extral over above for additional 25 mm thickness	Sqm	M 15	8.10
		Sqm	M 20	9.20
d)	I) Cast-in-situ terrazzo floor 40 mm thick with top layer of 50% grey and 50% white Cement	Sqm		13.00
9	Finishing			
	I) Cement Plaster 10 mm thick	Sqm	1:6	3.00
		Sqm	1:5	3.70
		Sqm	1:4	4.30
		Sqm	1:3	5.70
	ii) Cement plaster 15 mm thick	Sqm	1:6	4.50
		Sqm	1:5	5.40
		Sqm	1:4	6.50
		Sqm	1:3	8.80
	iii) Ceiling plaster 6 mm thick	Sqm	1:4	2.80
		Sqm	1:3	3.70
	iv) Flush/ruletuck/weather/struck pointing	Sqm	1:3	1.50
		Sqm	1:2	2.00
10	Jointing RCC Pipes and SW Pipes Jointing RCC Pipes	MM dia (nominal)		Kg/Joint
	A	100		0.889
	B	150		1.27
	C	230		2.285
	D	300		3.048
	E	375		4.572

	F	450		6.773
	G	530		7.959
	H	600		9.144
	I	675		10.33
	J	750		11.515
	K	825		12.7
	L	900		13.715
	M	975		14.90
	N	1050		16.08
	O	1125		17.10
	P	1200		18.28
	Q	1400		21.33
	R	1600		24.37
	S	1800		27.43
	T			
Jointing SW Pipes in Cement Mortar				
	U	100		2.041
	V	150		2.948
	W	230		4.572
	X	300		5.588

Preferred Makes		
S.No	Description	Make
1	Water Proofing Compound	CICO/NOLEEK/SCOTT/FOSROC
2	Factory Made Shutters	COT/AWP/VANYA/STANDARD
3	Glass	TRIVENI/HINDUSTAN/WINDOW
4	Particle Board	IPM/SWASTIK/NOVOPAN
5	Laminate Sheet	FORMICA/NEOLUXE
6	Curtain Rail	JINDAL/INDAL
7	Aluminum Fittings	SLAI/SAI/EZZI
8	CPMS Screws	NE11" LEFOLD/SK/SAMRAT
9	Mortice Lock	GODREJ
10	Mutipurpose Lock	GODREJ
11	Hydraulic Floor Spring	HARDWYN/KELVIN/EVERITE
12	Hydraulic Door Closer	DYNA/EVERITE/KELVIN
13	M.S.Aldrop	CROWN/GURG
14	Piano Hinges	RRD/DEEPAK/LAKSHMI
15	CP Brass Rollers	VIJAY/SURESH
16	Glass Sliding Rollers	JINDAL/INDAL/FLYRIAL
17	CP Brass Lock	HARSHAD/FLORA
18	Aluminum Coat & Hat Hook	SLAI/SAI/EZZI
19	Brass Ball Catch	HARSHAD/FLORA/ATUL/VIJAY
20	Ceramic Floor Tiles	NAVEEN/SPARTEK/JOHNSON
21	PVC Floor Tiles	BHOR/VINYL/CARARA
22	Glazed Tiles	JOHNSON/SOMANY & PILKINGTON
23	Acid Proof Tiles	MITSUGEN/KERA/REGENCY
24	Burnt Clay Tiules	BTI/SBTI/SBTI
25	AC Pipes & Fittings	INDO/EVEREST
26	Water Proofing Cement Paint	SNOWCEM//BERGER
27	Washable Distemper Paint	J&N/BERGER/ASIAN
28	Emulsion Paint	J&N/BERGER/GARCOAT/ASIAN
29	Chlorinated Rubber Paint	J&N/BERGER/COROMANDEL
30	Enamel Paint	J&N/BERGER LUXOL H-GLOSS/ NEROLAC/COROLUX
31	Cement/Wood/Redoxide/Zinc Chromate/Zinc Chrome Yellow Primer	J&N/BERGER/GARCOAT COROMANDEL/ASIAN
32	Vitreous Water Closet Wash Basin/Urinal	PARRYWARE /HINDUSTAN/ NYCER
33	Fire Clay Kitchen Sink/Drain Board	SANFIRE/PAMALI/RKCP
34	CI High Level Flush Tank	RELIANCE
35	Flushing Cistern	PARRYWARE/PRINCE
36	Glass Mirror	CROWN/GOLDENFISH/MODI
37	CP Brass Towel Ring	BESTO/PLUMBER
38	Anodized Aluminum Towel Rail	BESTO/PLUMBER
39	SCI Pipes and Fittings	BIC/ALC/AMC

40	SCI Floor Trap	BIC/ALC/AMC
41	Galvanized Steel	JTC/JINDAL/PRAKASH/GST/ZENITH/QST
42	Galvanized Steel Fittings	HB/SUN/SRI
43	Rigid PVC Pipes & Fittings	PRINCE/FINOLEX/SUPERME/BHARAT
44	HDPE Pipes & Fittings	EMCO/ORIPLAST/MANIKYA
45	Stainless Steel Sinks	NIRALI/KINGSTON/DIAMOND
46	Wast Coupling	KINGSTON/NOVA/SPECTRUM
47	CP Brass Shower	BESTO/PLUMBER/METRO/ESSCO
48	CP Brass Water Supply Fittings	METRO/SOMA/SPECTRUM/NOVA
49	CP Brass Bottle Trap	SOMA/NOVA/SPECTRUM/KINGSTON
50	CP Brass Flush Valve	METRO/NOVA/SPECTRUM
51	15 mm PVC Inset Connection	ROYEL/SUMDEEP
52	Plastic Toilet Seat Cover	PATEL/COMMANDER
53	Asbestos Cement Sheets	CHARMINAR/VEVEREST
54	GunMetal Non-return Valve	LEADER/LDR
55	Plastic Bibcock	BELNAL/PRINCE/PRAYAG
56	Float Valve, Push Cock	PRAYAG
57	Brass Full Way Wheel Valve	LEADER/ZOLOTO
58	32 mm Dia/40 mm Dia Waste Pipes	BRIGHT/CAISPO
59	Stoneware Gully Trap	INDO/SRMC
60	CI Fittings	UPADYAYA/RONA/VENUS
61	Manhole Covers	POLYCRETE/SFRC
62	Glazed stoneware Pipes	INDO/SRMC
63	PVC Conduits / Sleeves	VISHAL/RATNA/MERCURY/PLAZA
64	GI Chain link Fence	SUMA/ADVANI
65	CI Pipes & Fittings	KESOPUNI/IISCO/ELECTROSPUN
66	Sluice Valves	IVC/FOURESS/RONEX
67	Air Valves	IVC/UPADHYAYA
68	Water Meter	DASHMESH/RAJKAMAL
69	PVC Water Tank	SYNTEX
70	GI Pipes	TATA/ZENITH
71	Structural Steel	TISCO/SAIL/VSP
72	Alluminium composite panel	ALSTRONG / ALUCO PANEL
73	Polycarbonate Sheet	POLY GLASS/GE PLASTICS

ISI Stamped/marked items will be treated as commercial/technical equivalents to the brands specified in the above list of specification or as approved by the VSP Engineer-in-charge.

PREAMBLE TO BILL OF QUANTITIES

BALANCE CIVIL ENGINEERING WORKS FOR PROPOSED HEALTH CENTRE AT PEDAGANTYADA IN VISAKHAPATNAM

- 1.0 The scope of work under this contract covers Balance Civil Engineering Works for Proposed Health Centre at Pedagantyada in Visakhapatnam.
- 1.1 Completion period: **Six Months** from the date of order.
- 2.0 The tenderer shall carefully go through the clauses in the invitation of Tender, Articles of Agreement, General and Special Conditions of Contract, Specifications, Bill of Quantities and Drawings and shall include in his rates any sum he may consider necessary to cover the fulfillment of the various clauses contained therein. The items of work and the unit prices stated in the Bill of Quantities shall be inclusive of everything necessary to complete the said items of work within the contemplation of the contract and beyond the unit price no extra payment will be allowed for any incidental or contingent work, labour, tools, plant and materials. The contractor shall visit the site and ascertain the site conditions before quoting.
- 3.0 The quotation submitted by the tenderer should be based on the probable quantities of the several items of work which are furnished for the tenderer's convenience in Bill of Quantities and it must be clearly understood that the contract is not a lumpsum contract, that neither the probable quantities nor the value of the individual items nor the aggregate value of the entire tender will form part of the contract and the Employer does not in any way assure the tenderer or guarantee that the probable quantities are correct or that the work should correspond thereto.
- 4.0 No change in the unit rate will be admissible for any variation in quantities, unless otherwise specified. All measurements will be in metric units.
- 5.0 Ascertainment of prices for variation:
 - 5.1 No variation shall vitiate this contract. All variations authorized by the Employer/Engineer shall be subsequently sanctioned by him in writing.
- 6.0 The rates in the Bill of Quantities shall include the cost of the following.
 - a) Transport of Construction plant, personnel etc., to the site at the start of the work and their withdrawal on completion of the work.
 - b) Storage of materials at site and hoisting and lowering to all levels.
 - c) Supplying, transporting to site, unloading protecting and installation of materials in accordance with the specification.
 - d) Accommodation to the Contractor's staff and labour.
 - e) Insurance of men and materials at site as directed by the Employer.
 - f) Protecting of all equipment falling within the section of the specifications.

- g) Necessary care and precautions against damage to equipment, if any, supplied by the Employer and/or by other contractor.
 - h) Cost of water and power (with respect to conditions as specified elsewhere.)
 - i) All waste.
 - j) Mix designs of concretes.
 - k) All enabling works and temporary works like approaches and roads, necessary equipment, etc., required for executing the works within or out side the area whether mentioned or not in the BOQ.
 - l) All taxes and duties excluding service tax.
 - m) All settlement benefits to contract labour as per the prevailing rules of contract labour cell.
- 7 Materials: All the works shall be executed with approved materials only, whether specified or not, in the BOQ and the contractor shall get the approvals of Engineer before incorporation in the works. Materials supplied by the contractor shall be tested as per the instructions and directions of the Engineer. Reinforcement steel & Cement will be issued free of cost in VSP stores.
- 8.0 All tests including mix designing of concrete whether specified or not in the BOQ shall be carried out as per the specifications, B.I Standards and or as per the instructions and directions of the Engineer. These tests shall be carried out in VSP laboratory or in any other approved laboratory. Materials that could be tested in VSP laboratory will be tested free of cost. For materials that could not be tested in VSP laboratory, the same shall be got tested by the Contractor at other approved laboratories at his own cost. The test certificate shall be submitted for the necessary approval.
- 9.0 Scaffolding & curing: The work to be performed at all heights and depths above or below plinth level and locations unless otherwise stated specifically. Adequate curing for all cement works shall be carried out as per the relevant standards and specifications.
- 10.0 The agency should satisfy him self about the site conditions by visiting site of work. Failure to do so will not absolve the agency from their responsibility abuts the proper execution of the work. The work shall be carried out as per Technical specification (TS) enclosed with the tender.
- 11.0 The agency shall arrange for the inspection of the bought-out items and materials, etc., before dispatching the same. Inspecting authority for this shall be Engineer-in-charge or his authorized representative.
- 12.0 Payment shall be made at the quoted rates based on the quantity of work executed subject to statutory deductions.
- 13.0 Reinforcement steel and cement will be issued free of coat at VSP Stores. BF slag will be issued free of cost at BF stack yard.

- 14.0 Except for the above, all material required to complete the work shall be arranged by the agency.
- 15.0 The agency shall prepare temporary roads, if required, for movement of their equipments to facilitate the work as per direction of the Engineer-in-charge without any extra financial implication to Visakhapatnam Steel Plant.
- 16.0 All pollution control and safety measures as per statutory requirements as per instruction of the Engineer-in-charge are to be adopted during and up to such period of time as required without any extra financial implication to VSP.
- 17.0 The agency shall ensure adequate number of qualified quality personnel for day to day quality control of jobs.
- 18.0 The agency shall ensure sufficient number of steel scaffolding pipes/steel cribs for centering and supporting arrangements of form-work.
- 19.0 The agency shall obtain necessary work permits, safety clearances etc., while carrying out works.
- 20.0 The cost of test which can be carried out in VSP laboratory will be done free of cost and all other tests will be borne by the contractor. The cost of the Design mixes if done outside are to be borne by the contractor.
- 21.0 Compliance and acceptance criteria for materials and quality of work shall be in accordance to IS: 456 for Concrete works and MOST specifications (fourth revision) published by IRC for road works.
- 22.0 Water and power required for construction work are to be Arranged by the Contractor at his own cost.
- 23.0 Weight batches are to be used for mixing concrete materials for RCC works.
- 24.0 Technical abbreviations used in the Bill of Quantities or elsewhere in the tender documents are as follows:

IS	means	“Indian Standard”
Ton	means	“1,000 kilograms”
mm	means	“Millimetre”
m or M	means	“Metre”
cum	means	“Cubic Metre”
sqm	means	“Square metre”
rm	means	“Running Metre”
km	means	“Kilometre”
No.	means	“Number or Each”
Do	means	“Ditto”
RC	means	“Reinforced Concrete”

PCC	means	“Plain cement concrete”
MS	means	“Mild Steel”
CI	means	“Cast Iron”
AC	means	“Asbestos cement”
CP	means	“Chromium Plated”
MP	means	“Madhy Pradesh”
HB	means	“Half Brick”
GL	means	“Ground Level”
FFL	means	“Finished floor Level”
Plinth Level	means	“Finished floor level / $\pm$ 00.000 level”
Kg	means	“Kilogram”

PROJECT: ADDITIONAL WORKS FOR VISHAKAPATNAM STEEL PLANT							
<u>ESTIMATE FOR HEALTH CENTRE AT PEDAGANTYADA IN VISAKHAPATNAM</u>							
Note :-	1	The quantities are approximate and may be modified by the Engineer according to the requirements. Payment shall be made according to the actual work carried out at site and the corresponding unit rate quoted. In this connection, tenderer's attention is drawn to clause No: 3.0 of the preamble to Bill of Quantities.					
	2	Reinforcement steel and cement will be issued free of cost at Visakhapatnam Steel Plant Stores. Note: Binding wire will not be issued.					
S.No		Description	Quantity	Unit	Rate (Rs.)	Amount (Rs.)	
<u>SUB HEAD - I EARTH WORK EXCAVATION</u>							
E 1.A		Excavation down to following depths below ground level in foundations, trenches and pits in all types of soils except hard rock in both dry and wet conditions including shoring and strutting wherever necessary, dewatering subsoil and rainwater to keep the excavation dry, levelling & dressing the bottom of excavation to correct level and slope as shown in the drawing and as directed and transporting the excavated material upto a lead of 50M and depositing in spoil dumps and fill areas including spreading, levelling, grading etc., as specified and as directed by the Engineer, all materials, and labour complete.					
	a)	Upto 1.5m depth	100.00	Cu.M	101.85	10185.00	
	b)	1.5M to 3.0m depth	50.00	Cu.M	120.75	6037.50	
E 2		Earthwork in filling in layers not exceeding 200mm in thickness with excavated earth as specified in all positions, heights and descents around and over the foundations, trenches etc with excavated materials kept else where within a lead of 50M at all heights & descents, transporting, depositing and breaking lumps, watering, dressing the top surface to correct level and grade as specified and as directed by Engineer In charge, all materials, tools, plant & labour complete.	10	Cu.M	45.70	457.00	
E 3		Filling in layers not exceeding 200mm in thickness with Good selected Gravel borrowed from outside with in a lead of 10Km, in all positions heights and descent around and over the foundations and area filling including transporting, unloading, spreading, watering proper consolidating using 1T vibro roller or heavy duty power earth rammer in layers not exceeding 200mm thick and dressing the surface complete as directed.	1450.00	Cu.m	232.09	336530.50	

E 4		Filling with Sand in layers not exceeding 200mm in thickness under the foundations including transporting, unloading, spreading, watering proper consolidating in layers not exceeding 200mm thick and dressing the surface complete as directed.	10.00	Cu.m	347.20	3472.00	
<u>SUB HEAD II - PLAIN & REINFORCED CEMENT CONCRETE, REINFORCEMENT AND FORMWORK</u>							
C 1		Providing and laying plain cement concrete 1:4:8 (1 cement:4 Coarse Sand: 8 graded stone aggregate 40mm nominal size) in leveling courses, under foundations, under floors etc., complete at all levels and locations.	85.00	Cu.M	1684.00	143140.00	
C 2		Providing and laying plain cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded granite stone aggregate of approved quality 20mm nominal size) in string or lacing courses, coping, bed blocks, anchor blocks, foundatons wherever necessary and like including necessary shuttering and centering at all levels and locations etc., complete as shown in drawings and directions of Engineer-in-charge.	10.00	Cum	3041.10	30411.00	
C 3		Providing and laying in position machine batched, machine mixed and machine vibrated design mix cement concrete of specified grade at all levels for reinforced cement concrete structural elements, excluding the cost of centering, shuttering and reinforcement including admixtures in recommended proportions. (As per IS 9103) to accelerate, retard setting of concrete improve workability without impairing strength and durability as per direction of Engineer-in-charge - M25 grade reinforced cement concrete with a minimum cement content of 350 kgs per Cum of concrete					
	a)	All work upto Plinth level	10.00	Cu.M	2302.40	23024.00	
	b)	Columns, walls, pillars above plinth level	35.00	Cu.M	2302.40	80584.00	
	c)	Beams, cantilevers, lintels, roofs, chajjas and staircases etc.,	220.00	Cu.M	2302.40	506528.00	
C 4		<u>Steel reinforcement</u>					
		Fabricating and fixing in position reinforcement steel of grade Fe415 conforming to IS:1786, at all levels and locations including straightening, cutting, bending, binding and placing in position etc., all as per drawings and specifications including the cost of binding wire, labour etc., all complete laps, chairs and pins shall be provided and all authorised laps shall be measured.					
	a)	Tor Steel (Tor steel will be issued by VSP free of cost at VSP Stores).	20.00	M.T	7000.00	140000.00	

C 5		Formwork: Supplying, erecting, fixing striking, removing, and clearing formwork as specified for all concrete work including splays, ties, keys, wedges, props, nails, bracings brackets, cutting holes for passing embedments and applying one coat of waste lubricant oil on form surfaces in contact with concrete, all materials, tools and labour complete.					
	a)	Footings	400.00	Sq.M	119.25	47700.00	
	b)	Roofs, landings, balconies and access platform	2526.00	Sq.M	187.35	473246.10	
	c)	Columns	50.00	Sq.M	238.40	11920.00	
C 6		Making plinth protection with 50mm thick PCC 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20mm nominal size) over 75mm thick bed of dry brick ballast of 40mm nominal size well rammed and consolidated and grouted with fine sand including finishing the top smooth with extra cement and filling the construction joints with a mix of sand and bitumen etc., complete all as directed. (600mm wide)	175.00	Sq.M	172.66	30215.50	
SUB HEAD III - MASONRY							
M 1		Random rubble masonry with CM (1:6) hard stone in foundation and plinth including fair cutting, waste , bonding, plumbing, lining, pointing, curing scaffolding and leveling with cement concrete 1:6:12 (1 cement : 6 coarse sand : 12 graded stone aggregate 20mm nominal size) at upto plinth level all materials, tools and labour complete.	170.00	Cu.M	1467.65	249500.50	
M 2		Brick work with bricks of class designation 50 in superstructure with cement mortar 1:6 (1 cement : 6 coarse sand) at all levels and locations including fair cutting, waste, bonding, plumbing, lining, levellings, flushing and raking joints, scaffolding and curing as directed, all materials, tools and labour complete.	60.00	Cu.M	1930.50	115830.00	
M 3		Half brick masonry with bricks of class designation 50 in foundations and plinth in cement mortar 1:4 (1 cement : 4 coarse sand) including fair cutting, waste, bonding, plumbing, lining, levelling, flushing and raking joints, scaffolding, wire netting at every 4th layer and curing as specified all materials, tools and labour complete.	205.00	Sq.M	229.12	46969.60	

SUB HEAD IV - ALUMINUM WORK, JOINERY & STEELWORK							
AW 1		Providing and fixing anodized aluminum work for doors, windows, ventilators, partitions with extruded built up standard tubular and other sections of approved made confirming to IS 733 and IS 1285, anodic or transparent or dyed to required shade according to IS:1868 (Minimum anodic coating of grade AC 15- Bronze anodized), fixed with rawl plugs and screws, or with fixing clips, or with expansion hold fasteners including necessary filling up the gaps at junctions, Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically, wherever required including cleat angle, Aluminium snap beading for glazing / panelling, CP brass / Stainless steel screws, all complete as per architectural drawings and the directions of Engineer - in-charge (Glazing and panelling to be paid separately).					
	a	For Fixed Portions (Chowkets and frames etc)	505.00	Kgs	290.45	146677.25	
	b	For Shutters of door, windows and ventilators including providing and fixing hinges / pivots including the cost of fittings and PVC neoprene gasket etc.,	800.00	Kgs	310.45	248360.00	
AW 2		Providing and fixing glazing in aluminium door, window, ventilator shutters and partitions etc., with PVC neoprene gasket etc. complete as per the architectural drawings and the directions of engineer-in-charge.					
	a	5.5 mm thick float glass (for doors)	88.50	Sqm	673.55	59608.50	
	b	With 6mm thick toughened glass (for structural glazing)	25.00	Sqm	1800.00	45000.00	
AW 3		Providing and fixing 12mm thick prelaminated three layer medium density (exterior grade) particle board Grade-I, Type-II conforming to IS: 12823 bonded with phenol formaldehyde synthetic resin, of approved brand and manufacture in panelling fixed in aluminium doors, windows shutters and partition frames with CP brass/ stainless steel screws etc., complete as per architectural drawings and directions of Engineer-in-charge.					
		Pre-laminated particle board with decorative lamination on both sides.	60.00	Sqm	812.60	48756.00	
AW 4		Providing and fixing double action hydraulic floor spring of approved brand and manufacture IS: 6315 marked, hardwyn make(model 3000) or equivalent for doors including cost of cutting floors as required, embedding in floors and cover plates with brass pivot and single piece M.S sheet outer box with side plate etc. complete as per the direction of Engineer-in-charge.					
		a) with Stainless Steel Cover plate.	4.00	Each	1733.50	6934.00	

AW 5		Providing and fixing Aluminium hardware ISI marked anodised (anodic coating not less than grade AC 10 as per IS: 1868) transparent or dyed to required colour or shade with necessary screws etc., complete.					
	a)	Tower Bolts - 250x10mm long	45.00	Each	62.20	2799.00	
	b)	ii) 150X10mm long	40.00	Each	42.75	1710.00	
	c)	ii) 100X8mm long	144.00	Each	32.15	4629.60	
	d)	Aldrop (300 x 16mm)	45.00	Each	175.00	7875.00	
	e)	Handles - 125mm long	76.00	Each	48.80	3708.80	
	f)	100mm long	110.00	Each	35.30	3883.00	
	g)	Providing and fixing aluminium hanging of Twin rubber stopper ISI marked anodised (anodic coating not less than grade AC 10 as per IS:1868) transparent or dyed to required colour and shade with necessary screws etc. complete.	40.00	Each	53.90	2156.00	
	h)	Rubber Bushes 50mm fixed on wall	40.00	Each	20.00	800.00	
AW 6		Providing and fixing ISI: 12817 marked 125X64X1.90mm Stainless steel butt hinges with stainless steel screws etc., complete	190.00	Each	47.05	8939.50	
AW 7		Providing and fixing ISI: 12817 marked 75x47x1.80mm Stainless steel butt hinges with stainless steel screws etc., complete	216.00	Each	23.75	5130.00	
AW 8		Providing and fixing bright finished brass 100mm mortise latch and lock with six levers and pair of lever handles with necessary screws etc., complete (Best make of approved quality)	40.00	Each	332.65	13306.00	
AW 9		Providing 40 x 5mm flat iron holdfast 40cm long fixing to frame with 10mm diameter bolts, nuts and wooden plugs and embeddings in cement concrete block 30 x 10 x 15cm 1:3:6 mix (1 cement : 3 coarse sand: 6 graded stone aggregate 20mm nominal size)	320.00	Each	56.55	18096.00	
AW10		Supplying and fixing rolling shutters of approved make, made of 80 x 1.25mm size MS laths interlocked together through their entire length and joined together at the end by end locks mounted on specially designed pipe shaft with brackets, size guides and arrangements for inside and outside with push and pull operation including locking the cost of providing and fixing necessary 27.5cm long wire springs grade no. 2 and MS laths with top cover of 1.25mm thickness etc., complete all as specified and directed.	30.00	Sq.M	1206.88	36206.25	

AW1 1		Extra over item W8 for providing grilled rolling shutters manufactured out of 8mm dia. M.S. bar instead of laths as per design approved by Engineer-in-Charge. (area of grill to be measured.)	30.00	Sq.M	214.90	6447.00	
AW1 2		Providing and fixing T- iron frames for doors, windows and ventilators of mild steel Tee-sections, joints mitred and welded with 15x3 mm lugs 10cm long embedded in cement concrete blocks 15x10x10 cm of 1:3:6 (1cement :3coarse sand : 6 graded stone aggregate 20mm nominal size) or with wooden plugs and screws or rawl plugs and screws or with fixing clips or with bolts and nuts as require including fixing of necessary butt hinges and screws and applying a primer coat of approved steel primer.	700.00	Kg	50.66	35458.50	
AW1 3		Providing and fixing 1mm thick M.S sheet door with frame of 40x40x6mm angle iron, 3mm M.S. gusset plates at the junctions and corners and angles 40x40x6mm for diagonal braces, all necessary fittings complete, including applying a priming coat of approved steel primer	30.00	Sq.M	1,693.83	50814.75	
AW1 4		Providing and fixing ISI marked steel glazed windows and ventilators of standard rolled steel sections, joints mitred and welded with 15x3mm lugs, 10cm long, embedded in cement concrete blocks 15x10x10cm of 1:3:6(1cement :3coarse sand : 6 graded stone aggregate 20mm nominal size) or with wooden plugs and screws or rawl plugs and screws or with fixing clips or with bolts and nuts as required, including providing and fixing of glass panes with glazing clips and special metal sash putty of approved make complete including applying a priming coat of approved steel primer, excluding the cost of metal beading and other fitting except necessary hinges or pivots as required.					
	a	Widows-Fixed	12.00	Sq.M	776.90	9322.80	
	b	Widows-side hung	53.00	Sq.M	1,065.75	56484.75	
	c	Ventilators-top hung	12.00	Sq.M	1,070.20	12842.40	
AW1 5		Providing and fixing MS grills of required pattern in frames of windows etc., with M.S. flats, square or round bars etc. all complete, fixed to openings/ wooden frames with rawl plugs screws etc.	250.00	Kgs.	64.40	16100.00	

SUB HEAD V - FLOORINGS							
F1		Flooring with 25.0mm thick polished Shahabad stone of (Tandur Blue variety) first quality of size not less than 45cm x 45cm set over a base CM (1:4) of 20mm thick (joints of stone must be flushed) over C.C bed already laid or RCC roof slab including neat cement slurry of honey like consistency spread at the rate of 3.3kg of cement/Sqm and jointed with neat cement to full depth, including cost and conveyance of all materials like sand, water, flooring stones etc., to site cost of seignorage charges and all materials, labour charges like dressing of flooring, mixing of cement mortar, laying, curing, lift charges, cost of base cost etc ., complete for finished item of work.	37.00	Sq.M	307.91	11392.49	
F2		Flooring with Kota stone slab of 25mm thickness over 20mm (average) thick base laid over and jointed with grey cement slurry mixed with pigment to match the shade of the slab including rubbing and polishing complete with base of 1:4 (1 cement : 4 coarse sand)	150.00	Sq.M	627.31	94095.75	
F 3		Kota stone slabs 25mm thick in risers of steps laid on 12mm (average) thick cement mortar 1:3(1 cement 3 coarse sand) and jointed with grey cement slurry mixed with pigment to match the shade of the slabs, including rubbing and polishing complete.	19.00	Sq.M	614.92	11683.48	
F4		Extra for providing edge moulding to 25mm thick Kota stone Nosing to Steps&Treads etc., over the above item including machine polishing to edge to give high gloss finish etc., complete as per design approved by the Engineer-in-charge.	20.00	metre	26.40	528.00	
F 5		Providing and laying Cement concrete flooring 40mm thick with 20mm nominal size stone aggregate in 1:2:4 (1 Cement, 2 Coarse sand, 4 Graded stone aggregate) finished with a floating coat of neat cement including cement slurry, but excluding the cost of nosing of steps etc. complete.	110.00	Sq.M	116.45	12809.50	
F 6		Providing & laying Vitrified floor tiles having water absorption less than 1% and flexural strength not less than 30N/sqmm, in all colours and shades , laid on 20mm thick cement mortar 1:4 (1 cement : 4 coarse sand) including pointing the joints with white cement and matching pigment etc., the size& colour/shade as approved by the Engineer-in-charge. complete.	116.00	Sqm	1244.11	144316.76	

F 7		Providing & laying Ceramic nonskid floor tiles of 300x300mm size of specified thickness of 1st quality confirming to IS: 13755 of NITCO, ORIENT, SOMANY KAJARIA, or equivalent make in colours as approved laid on 20mm thick cement mortar 1:4 (1 cement : 4 coarse sand) including pointing the joints with white cement and matching pigment etc., complete.	58.00	Sqm	542.76	31480.08	
	a)	300X300mm					
	b)	INVIZA Glazed Ceramic tiles 395X395mm	217.00	Sqm	704.01	152770.17	
F 8		Providing & laying Eurocon tiles of different sizes and flexural strength not less than 30N/mm ² , in all colours and shades, laid on 20mm thick cement mortar 1:4 (1 cement : 4 coarse sand) including pointing the joints with white cement and matching pigment etc., complete.	40.00	Sqm	837.92	33516.60	
		Skirting					
F 9		Supply and fixing 25mm thick Shahbad stone in skirting 100mm high with C.M 1:3 (1 Cement: 3 coarse sand) finished with floating coat of neat cement.	35.00	Rm	138.17	4835.95	
F10		Supply and fixing 25mm thick Kota stone in skirting 100mm high with C.M 1:3 (1 Cement: 3 coarse sand) finished with floating coat of neat cement.	166.00	Rm	188.17	31236.22	
F11		Supplying and laying Cement plasters skirting 18mm thick upto 100mm ht. with C.M 1:3 (1 Cement: 3 coarse sand) finished with floating coat of neat cement.	111.00	Rm	105.50	11710.50	
F12		Skirting 150mm Ht. Vitrified tiles with water absorption less than 1% and flexural strength not less than 30N/sqmm, in all colours and shades, laid on 20mm thick cement mortar 1:4 (1 cement : 4 coarse sand) including pointing the joints with white cement and matching pigment etc., complete.	139.00	Rm	238.17	33105.63	
		DADO					
F13		Providing and fixing 1st quality ceramic glazed tiles confirming to IS: 13753 of minimum thickness 5mm of approved make like NITCO, ORIENT, SOMANY KAJARIA, or equivalent make in all colours, shades except begundy, bottle green, black of any size as approved by Engineer -in-charge in skirting, raisers of steps and dado over 12mm thick bed of CM 1:3 (1 cement : 3 coarse sand) and jointing with grey cement slurry @ 3.3kg/sqm including pointing in white cement mixed with pigment of matching shade complete.	959.00	Sq.M	500.71	480180.89	

SUB HEAD VI - ROOFING							
RF 1		Providing and laying integral cement based water proofing treatment including preparation of surface as required for treatment of roofs, balconies, terraces etc., consisting of following operations.					
		a) Applying and grouting a slurry coat of neat cement using 2.75 kg/Sqm and lay a screed of CM (1:3) over the clean and damp surface including waterproofing agent mixed with CM. Total average thickness shall be 20 mm including cleaning the surface before treatment. The water proofing compound conforming to IS 2645.					
		b) Laying cement concrete using broken bricks/brick bats 25mm to 100mm size with 50% of CM 1:5 admixed with proprietary water proofing compound conforming to IS :2645 to required slope and treating similarly the adjoining walls upto 300mm height including rounding of junctions of walls and slabs.					
		c) After two days of proper curing applying a second coat of cement slurry admixed with proprietary water proofing compound conforming to IS:2645					
		d) Finishing the surface with 20mm thick jointless cement mortar of mix 1:2 admixed with proprietary water proofing compound conforming compound conforming to IS 2645 and finally finishing the surface with towel with near cement slurry and making of 300 x 300mm Square.					
		e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. All above operations to be done in order and as directed and specified by the Engineer-in-charge.	969.00	Sq.M	362.25	351020.25	
RF 2	a)	Providing and fixing on wall face unplasticised - Rigid 110mm dia PVC rain water pipes conforming to IS : 13952 Type A (4kgs/ Sqcm) including jointing with seal ring conforming to IS 5382 leaving 10mm gap for thermal expansion.	146.00	R.M	163.40	23856.40	
	b)	Bends - 110mm dia	28.00	Each	134.20	3757.60	
	c)	Shoes (Plain)- 110mm dia	28.00	Each	263.10	7366.80	
RF 3		Providing corrugated GS sheet roofing fixed with polymer coated J or L hooks, bolts and nuts 8mm diameter with bitumen and GI limpet washers or with GI limpet washers filled with white lead and including a coat of approved steel primer and two coats of approved paint on overlapping of sheets complete (upto a pitch of 60 degrees) excluding the cost of purlins, rafters and trusses.					

		0.8mm thick with zinc coating not less than 275 gm/sqm in curved surfaces.	33.00	Sq.M	515.30	17004.90	
SUB HEAD VII - PLASTERING AND SURFACE TREATMENT							
FN 1		Providing 18mm thick sand faced cement plaster on external walls in two layers consisting of 6mm thick in cement mortar 1:6 (1 cement : 6 fine sand) mixed with integral water proof compound mixed as per manufacturers specifications over a base coat 12mm thick cement 1:5 finished sand face with sponge including necessary scaffolding and curing etc., complete at all levels.	1450.00	Sq.M	86.92	126026.75	
FN 2		Providing 15mm thick cement plaster on internal surfaces of walls in CM 1:6(1 cement: 6 fine sand) at all levels and locations to the faces of all pillars, columns, posts, lintel projections, rarrow bands and joints, chipping and hacking of concrete surfaces immediately after the removal of formwork, scaffolding, cleaning and curing, all materials, tools and labour complete.	1985.00	Sq.M	59.20	117512.00	
FN 3		Providing 6mm thk. cement plaster in cement mortar 1:3, (1 cement: 3 fine sand) to ceilings and concrete surfaces including curing etc., all levels, all materials, tools and labour complete.	677.00	Sq.M	45.64	30894.90	
FN 4		Providing two coats of approved oil bound distermper of approved colour and shade over a coat of primer as specified at all heights above plinths level including scaffolding etc, all materials, tools and labour etc., complete.	2045.00	Sq.M	41.55	84969.75	
FN 5		Applying two coats of synthetic enamel paint of approved brand and manufacture of required colour to given even shade on new steel work inlcuding applying priming coat with ready mixed red oxide zinc chromate primer of approved (brand and manufacture), by the Engineer In Charge,Including scaffolding, all materials and labour etc., complete.	150.00	Sq.M	45.90	6885.00	
FN 6		Providing and painting 2 coats of synthetic enamel paint of approved brad and manufacture to give an even shade on new walls.	125.00	Sq.M	33.25	4156.25	
FN 7		Providing painting 2 costs of synthetic enamel paint of approved brand and manufacture of required colour to given even shade on new wood work including applying priming coat with ready mixed pink or grey primer of approved brand and manufacture.	73.00	Sq.M	51.30	3744.90	

FN 8		Providing three coats of white wash to internal and external surfaces as specified at all heights above plinth level including scaffolding, all materials and labour etc., complete.	617.00	Sq.M	8.00	4936.00	
FN 9		Finishing walls with water proofing cement paint "Snowcem-plus" of M/s Snowcem India Ltd., or equivalent of required shade for new work(Two or more coats applied @ 3.84 Kg/10Sq.M) over a coat of cement primer of approved (brand and make), by the Engineer In Charge,Including scaffolding, all materials and labour complete.	1450.00	Sq.M	48.00	69600.00	
FN 10		Providing an laying cinder concrete mix 1:5:10 (1 Cement: 5 concrete sand: 10 cinder aggregate 40mm size) laid in layers and compacted as per directed for filling sunken floors. Including seignorage, cost and conveyance of all materials and water from approved sources to work complete for finished item of work.	18.00	Cu.M	1494.60	26902.80	
FN 11		18MM thick plain raised cement mortar band in cement mortar 1:4 (1 cement : 4 fine sand)	495.00	Cm/mt	1.71	845.46	
SUB HEAD VIII - STRUCTURAL STEEL (Supply of Structural Steel is in the scope of Contractor)							
ST 1		Supplying, fabricating and fixing steel work welded in built up sections/ framed work including cutting hoisting, fixing in position and applying a priming coat of approved zinc primer using structural steel etc., as required.					
		In gratings, frames, guard bar, ladders, railings, brackets, gates, inserts & similar works.	2.00	MT	51200.00	102400.00	
SUB HEAD IX - INTERNAL WATER SUPPLY							
IWS 1		Supplying, fitting and fixing galvanised steel tested pipes, conforming to IS:1239 medium quality including necessary galvanised steel fittings and bends, elbows, tees, sockets, clamps etc including testing of pipelines as specified, all materials, tools and labour complete.					
	a)	15mm	60.00	RM	94.05	5643.00	
	b)	20mm	60.00	RM	116.60	6996.00	
	c)	25mm	90.00	RM	156.85	14116.50	
	d)	32mm	60.00	RM	193.60	11616.00	
	e)	40mm	65.00	RM	219.60	14274.00	
IWS 2		Painting with anti-corrosive bitumastic paint two or more coats					
	a)	15mm	58.00	RM	2.60	150.80	

	b)	20mm	47.00	RM	3.05	143.35	
IWS 3		Supplying, fitting and fixing tested heavy duty gun metal fullway gate valve of approved make, all materials, tools and labour complete.					
	b)	20mm	24.00	Nos.	225.00	5400.00	
	c)	25mm	10	Nos.	285.5	2855	
	d)	32mm	8.00	Nos.	358.00	2864.00	
	d)	40mm	2.00	Nos.	399.00	798.00	
SUB HEAD X - INTERNAL SANITARY WORKS							
ISW 1		Supplying, fitting and fixing in position 570mm x 440mm white glazed vitreous China 'JAMUNA' wash basin with taxary type pedestal made of Parryware or other approved equivalent make with central tap hole including supplying and fixing CI brackets painted with one coat primer and two coats of approved flat oil paint, 15mm dia chromium plated brass eary clean approved dulex pillar trap, 32mm dia CP waste fittings, chain and rubber plug etc., all materials, tools and labour complete.	10.00	Each	1321.65	13216.50	
ISW 2		Supplying, fitting and fixing in position Porcelain Kitchen sink of approved equivalent make with central tap hole including supplying and fixing CI brackets painted with one coat primer and two coats of approved flat oil paint, 15mm dia chromium plated brass eary clean approved dulex pillar trap, 32mm dia CP waste fittings, chain and rubber plug etc., all materials, tools and labour complete.	2.00	Each	5263.00	10526.00	
ISW 3		Providing and fixing white vitreous china laboratory sink size 600X450X200mm with C.I. brackets, C.P. brass chain with rubber plug 40mm C.P brass waste and 40mm C.P.brass necessary C.P. brass unions complete including painting of fittings and brackets, cutting and making good the wall whether required:	10.00	Each	2187.80	21878.00	
ISW 4		Providing and fixing white vitreous china pedestal type water closet (European type W.C PAN) with white solid plastic seat and lid, C.P.brass hinges and rubber buffers, 10 litre low level P.V.C flushing cistem fittings, C.I. / M.S. brackets 40mm diameter flush bend with fittings and clamps, overflow arrangement with specials and mosquito proof coupling of approved municipal design complete including painting of fittings and brackets, cutting and making good the walls and floors wherever required:	7.00	No.	2100.95	14706.65	

ISW 5		Providing and fixing white vitreous china water closet (Indian type W.C.pan)with 100mm sand cast iron P or S trap, 10 litre low level P.V.C. flushing cistem (of approved make) with fittings, C.I./M.S brackets, 32mm diameter flush pipe with fittings and clamps, overflow arrangement with specials and mosquito proof coupling of approved municipal design including painting of fittings and brackets, cutting and making good the walls and floors wherever required Orissa pattern W.C pan of size 580x440mm with intergral type foot rests flush pipe and overflow arrangement.	3.00	No.	2282.15	6846.45	
ISW 6		Providing and fixing white vitreous china flat back range of 2 half stall urinal 580x380x350mm with 5 lt. of white PVC automatic flushing cistern, Parryware/ Hindware/ Seabird/ Oreint (Coral) with fittings, standard size CP brass flush pipe, spreaders with unions and clamps (all in CP brass) with waste fitting as per IS: 2556, CI trap with outlet grating and other couplings in CP brass including painting of fittings and cutting and making good the walls and floors wherever required.	3.00	No.	3697.35	11092.05	
ISW 7		Providing and fixing in position 150mmx150mm recess type CP soap dish of approved make with necessary CP screws and washers fixed into the wall including cutting the wall, fixing and making good the surface etc. Complete all as specified.	15.00	No.	300.00	4500.00	
ISW 8		Providing and fixing towel rail of 20mm dia 900mm long complete with brackets fixed to wooden cleats with C.P.bras screws.					
		CP Brass towel rail with two CP brass brackets	15.00	No.	300.00	4500.00	
ISW 9		Providing and fixing 600 x 450mm bevelled edge mirror of superior glass (of approved quality) complete with 6mm thick hard board ground fixed to wooden cleats with C.P.brass screws washers complete.	8.00	No.	493.65	3949.20	
ISW 10		Providing and fixing C.P. brass stop cock (concealed)of standard design and of approved make conforming to IS:8931.					
		15MM Nominal Bore.	20.00	No.	262.55	5251.00	
ISW 11		Providing and fixing 15mm CP brass pillar cock of approved make with hot or cold water indication as required conforming to IS: 1795 with minimum weight of 577 gms.	15.00	No.	325.00	4875.00	

ISW 12		Providing and fixing PTMT Bottle Trap for wash Basin and sink (Prayag or equivalent) Bottle trap 31mm single piece mounded with height of 270mm, effective length of tail pipe 260mm from the centre of the waste coupling 77mm breadth with 25mm minimum water seal, weighing not less than 260gms.	8.00	No.	366.20	2929.60	
ISW 13		Supply& fixing of 75mm dia C I Nahny trap/Floor trap at required level including caulking of joint etc., complete.	35.00	No	158.00	5530.00	
ISW 14		Providing and placing on terrace (at all floor levels) polyethylene water storage tank of approved brand and manufacture with cover and suitable locking arrangement and making necessary holes for inlet, outlet and overflow pipes but without fittings and the base support for tank.	10000.00	Lit.	5.25	52500.00	
ISW 15		Providing and fixing PTMT Ball cock 25mm nominal size, 155mm long,96mm high and 52mm wide with piston travel of minimum 8mm, having weight not less than 455gms (170+85+200) (body+rod+ball)of approved quality, colour & make complete with Epoxy coated aluminium rod with LP/HPHD plastic ballof 152mm dia.	10.00	Nos	497.40	4974.00	
ISW 16		Providing and fixing soil, waste and vent pipes:					
		Supplying, fitting and fixing C.I. Soil pipes conforming to IS:1729 of following sizes at all heights and depths above and below plinth level including all C.I soil fittings such as junctions, bends, tees, inspection pieces, caulking joints with lead as specified, clamps, C.I. Bobbins, wooden plugs, nails, etc and testing of pipes, all materials, tools and labour complete.					
	a)	I) 100mm dia pipe	75.00	RM	736.67	55250.25	
	B)	ii) 75mm dia pipe	50.00	RM	600.76	30038.00	
ISW 17		Supplying and laying in slope 150mm dial glazed stoneware pipes conforming to grade AA of IS:651 of the following diameters at all depths below plinth level as specified and as shown in the drawings including spigot and socket jointing with joints fillen in (1:1) cement mortar with necessary hemp yarn etc, curing joints and testing of pipes but excluding excavation, belding, haunching of concrete and backfilling, all materials, tools and labour complete.	100.00	RM	137.12	13711.50	

ISW 18		Providing and fixing 180x100mm size P type square-mouth SW gully trap grade 'A' complete with CI grating and FPS bricks class designation 50 masonry chamber with water tight CI cover with frame of 300mm x 300mm size (inside) the weight of cover to be not less than 4.50 kg and frame to be not less than 2.70 kg as per standard design.	10.00	No.	924.25	9242.50	
ISW 19		Constructing brick masonry chamber for under- ground C.I. Inspecting chamber and bends with 50 class designation bricks in cement mortar 1:5(1cement:5 fine sand)C.I cover with frame (light duty)455x610mm internal dimensions total weight of cover with frame to be not lees than 38 KG (Weight of cover 23kg and weight of frame 15kg)R.C.C. top slab with 1:2:4 mix (1 cement :2coarse sand : 4 graded stone aggregate 20mm nominal size)foundation concrete 1:5:10 (1 cement :5 fine sand:10 graded stone aggregate 40mm nominal size), inside plastering 12mm thick with cement mortar 1:3 (1 cement : 3 coarse sand)finished smooth with a floating coat of neat cement on walls and bed concrete etc., complete as per standard design: Inside dimensions 455 x 610 mm and 45cm depth for single pipe line.	6.00	No.	2709.36	16256.18	
ISW 20		Constructing brick masonry(F.P.S class designation 50) manhole in cement mortar 1:4(1cement:4 fine sand) R.C.C top slab with 1:2:4 (1cement:2 coarse sand:4graded stone aggregate20mm nominal size), foundation concrete 1:4:8(1cement:4coarse sand:8graded stone aggregate 40mm nominal size) inside plastering 12mm thick with cement mortar 1:3(1cement:3 coarse sand) finished with floating coat of neat cement and making channels in cement concrete 1:2:4(1cement:2 coarse sand:4graded stone aggregate20mm nominal size) finished with a floating coat of neat cement complete as per standard design.Inside size 900mmx800mm and 600mm deep including C.I cover with frame(light duty)455x610mm internal dimensions total weight of cover and frame to be not less than 38Kg(weight of cover 23kg and weight of frame 15kg)	4.00	Each	4024.56	16098.24	
ISW 21	c)	Same as above but extra for depth for manholes	1.20	Rm	2020.84	2425.01	

ISW 22		Constructing brick masonry(F.P.S class designation 50) manhole in cement mortar 1:4(1cement:4 fine sand) R.C.C top slab with 1:2:4 (1cement:2 coarse sand:4graded stone aggregate20mm nominal size), foundation concrete 1:4:8(1cement:4coarse sand:8graded stone aggregate 40mm nominal size) inside plastering 12mm thick with cement mortar 1:3(1cement:3 coarse sand) finished with floating coat of neat cement and making channels in cement concrete 1:2:4(1cement:2 coarse sand:4graded stone aggregate20mm nominal size) finished with a floating coat of neat cement complete as per standard design.Inside size 1200mmx900mm and 900mm deep including C.I cover with frame(medium duty)500mm internal diameter total weight of cover and frame to be not less than 116Kg(weight of cover 58kg and weight of frame 58kg)	4.00	Each	9673.48	38693.94	
ISW 23		Same as above but extra for depth for manholes	2.40	Rm	2417.51	5802.02	
SUB HEAD XI - MISCELLENIOUS WORKS							
MC 1		Providing and fixing in RCC works during laying, 95mm dia x 60mm deep fan hook box fabricated out of 16G steel sheet with 10mm dia MS hook cum lug and 25mm dia x 50mm long conduit extension, closed at one end, suitable for insertion of bolts with 4 numbers of 25mm dia knockouts for conduit entry including painting with two coats of red oxide primer of approved brand complete.	50.00	No.	145.00	7250.00	
MC 2	a)	Supplying and fixing at all heights, PVC heavy class conduits conforming to IS: 9537 Part-III of Vishol, make or approved equivalent with all accessories such as bends, corners, 65mm deep CI junction boxes, fish wire and GI draw boxes in concrete/masonry as shown in the drawings and / or as directed.					
		19mm dia PVC conduit	1000.00	RM	30.00	30000.00	
	b)	25mm dia PVC conduit	1000.00	RM	40.00	40000.00	
MC 3		Supplying, fabricating and fixing in position at all levels above and below plinth medium class GI pipe sleeves conforming to IS: 1239 Part-I 1979 with all accessories including necessary bends and GI pull wire, embedded in concrete / masonry as shown in the drawings and / or directed.					
	a)	40mm dia GI pipe sleeves	10.00	RM	250.00	2500.00	
	b)	50mm dia GI pipe sleeves	10.00	RM	350.00	3500.00	

MC 4		Cutting chase in brick walls/ concrete surfaces for embedding conduits and making good the same with (1:2) cement mortar / matching floor/ wall finish after fixing the conduits, including curing, all materials, tools and labour complete	350.00	RM	24.15	8452.50	
MC5		Chipping of R.C.C works by manually means including disposal of unserviceable materials with in 100M lead as per direction of Engineer in charge	15.00	Cum	1500.00	22500.00	
MC6		Lap weldings to provide anchorage to beams and slab of existing reinforcement(12mm to 25mm dia) as per Specification.	648	Nos	50.00	32400.00	
SUB HEAD XII - ROAD WORKS							
RD 1		Earth work in excavation over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10sqm on plan) including disposal of excavated earth, lead upto 50m and lift upto 1.5m, disposed earth to be levelled and neatly dressed					
		a) All kinds of soil	200	Cum	120.15	24030.00	
RD 2		Consolidation of road sub-grade with 8 - 10 MT road roller including dressing the subgrade to correct levels and camber.	662	Sqm	33.90	22441.80	
RD 3		Providing and laying base course of WBM 100 mm thick (consolidated thickness) using hard aggregate of graded size 90mm to 40mm (Grading - 1) including, screening, spreading to template, and consolidating with 8 - 10 MT road roller including carriage, spreading and consolidation, with approved quality of stone screening and binding material obtained from approved quarry etc., complete.	70	Cu.M	981.45	68701.33	
RD 4		Same as Item No. RD -3 above, but of 75mm (consolidated thickness) using hard granite stone aggregate of graded size 63mm to 40mm (Grading - 2)	90	Cu.m	1011.00	90990.00	

[illegible]

