

GENERAL TECHNICAL SPECIFICATIONS

1.0 General:

All measurements shall be made in the metric system. Different items of work shall be measured in accordance with the procedures set forth in the relevant sections read in conjunction with General Conditions of Contract. The same shall not however apply in the case of lump-sum items. All measurements and computations unless otherwise indicated shall be carried nearest to the following limits:

- (i) length and breadth 10mm
 - (ii) height, depth or thickness of earthwork, sub-base, bases, surfacing, and structural members 5mm
 - (iii) areas 0.01 Sq. Metre
 - (iv) cubic contents 0.01 cubic metre
- in recording dimension of work the sequence of length, width and height or depth or thickness shall be followed.

2.0 Measurement of lead for Materials:

Where lead is specified in the contract for construction materials, the same shall be measured as described hereunder.

Lead shall be measured over the shortest practicable route and not the one actually taken and the decision of the Engineer-in-charge in this regard shall be taken as final. Distance up to and including 100 meters shall be measured in units of 50 metres, exceeding 100 metres but not exceeding 1 km. in units of 100 metres and exceeding 1 km. in units of 500 metres. The half and greater than half of the units shall be reckoned as one and less than half of the units ignored. In this regard, the source of the material shall be divided into suitable blocks and for each block the distance from the centre of the block to the centre of placing pertaining to that block shall be taken as the lead distance.

3. Surface Regularity of Subgrade & Pavement Courses:

The surface regularity of completed sub-base courses and wearing surfaces in the longitudinal and transverse directions shall be within the tolerances indicated in Table below. The longitudinal profile shall be checked with a 3 metre long straight edge, at the middle of each traffic lane along a line parallel to the centre line of the road. The transverse profile shall be checked with a set of three camera boards at intervals of 10 metres.

PERMITTED TOLERANCES OF SURFACE REGULARITY FOR PAVEMENT COURSES

Sr. No.	Type of Construction	Longitudinal Profile with 3 metre straight edge				Cross Profile	
		Maximum Permissible undulation in mm	Maximum number of undulation permitted in any 300m. length exceeding in mm.				Maximum permissible variation from specified profile camber template—mm
			18	12	10	6	
1	2	3	4	5	6	7	8
1	Earth Subgrade	36	30	-	-	-	15
2	Granular/lime/Cement Stabilised Sub-base.	23	-	30	-	-	12
3	Water Bound Macadam with nominal size metal (20-50)mm	18	-	-	30	-	8
4	Semi-Dense Carpet @	15	-	-	-	20	6

Notes:-

- These are for machine laid surfaces. If laid manually, due to unavoidable reason, tolerance up to 50 percent above these values in this column may be permitted. However, this relaxation does not apply to the values of maximum undulation for longitudinal and cross profiles mentioned in columns 3 and 8 in the table.
- Surface evenness requirements in respect of both the longitudinal and cross profiles should be simultaneously satisfied.

3. **Rectification:** Where the surface irregularity of subgrade and the various pavement courses fall outside the specified tolerances, the contractor shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer-in-charge at his own cost.

(i) **Subgrade:** Where the surface is high, its nail bed trimmed and suitably compacted. Where the same is low, the deficiency shall be corrected by adding fresh material. The degree of compaction and the type of material to be used shall conform to the specified requirements.

(ii) **Granular/Sub-**

base: Same as at (i) above except that the degree of compaction and the type of material to be used shall conform to the specified requirements.

(iii) **Lime/Cement stabilized soil sub-**

base: For Lime/Cement treated materials where the surface is high, the same shall be suitably trimmed while taking care that the material below is not disturbed due to this operation. However, where the surface is low, the same shall be corrected as described herein below.

For cement treated material, when the time elapsed between detection of irregularity and the time of mixing of the material is less than 2 hours, the surface shall be scarified to a depth of 50 mm, supplemented with freshly mixed material as necessary and recomposed to the relevant specification. When this time is more than 2 hours, the full depth of the layers shall be removed from the pavement and replaced with fresh material to specification. In either case, the area treated shall not be less than 5 metres long by 2 metres wide. This shall also apply to lime treated material except that the time criteria shall be 3 hours instead of 2 hours.

(iv) **Water Bound Macadam Base:** Where the surface is high or low, the top 75 mm shall be scarified, reshaped with added material as necessary and recompact. The area treated at a place shall not be less than 5 metres long and 2 metres wide.

(v) **Bituminous Constructions:** For bituminous constructions, other than wearing course, where the surface is low, the deficiency shall be corrected by adding fresh material and recompact to specifications.

Where the surface is high, the full depth of the layers shall be removed and replaced with fresh material and compacted to specifications. For wearing course, where the surface is high or low, the full depth of the layers shall be removed and replaced with fresh material and compacted to specifications in all cases where the removal and replacement of a bituminous layer is involved, the area treated shall not be less than 5 metres long and not less than 1 lane wide.

4. **Quality Control Tests During Construction:**

The material supplied and the work carried out by the Contractor shall conform to the enclosed relevant specifications. For ensuring the requisite quality of construction, the materials and work shall be subjected to quality control tests as described hereinafter, by the Engineer-in-charge. The testing frequencies set forth are the desirable minimum and the Engineer-in-charge shall have the full authority to carry out tests as frequently as he may deem necessary to satisfy that the material at work complies with the appropriate specifications. Test procedures for the various quality control tests are indicated in the respective sections of the specifications or for certain tests within this section. Where no specific testing procedure is mentioned, the tests shall be carried out as per prevalent accepted engineering practice to the direction of the Engineer-in-charge.

5. **Tests on Earthwork for Embankment Construction:**

5.1 **Borrow Material:**

- (a) Sand Content (IS: 2720 Part IV)
Two tests per 8000 Cubic Metres of soil.
- (b) Plasticity Test (IS: 2720 Part-V)
Each type to be tested. Two tests per 8000 Cubic Metres of soil.
- (c) Density test (IS: 2720 Part VII)
Each soil type to be tested. Two tests per 8000 Cubic Metres of soil.
- (d) Moisture Content Test (IS: 2720 Part-II)
One test for every 250 Cubic Metres of soil.

5.2 **Compaction Control:**

Control shall be exercised by taking at least one measurement of density for each 1000 square metres of compacted area, or closer as required to yield the minimum number of test results for evaluating day's work on statistical basis. The determination of density shall be in accordance with IS: 2720 (Part XXVMI). Test locations shall be chosen only through random sampling techniques. Control shall not be based on the result of any one test but on the mean value of a set of 5-

10 density determinations. The number of tests in one set of measurements shall be 5 as long as it is felt that sufficient control over borrow material and the method of compaction is being exercised. If considerable variations are observed between individual density results, the minimum number of tests in one set of measurements shall be increased to 10. The acceptance of work shall be subject to the condition that the mean dry density equals or exceeds the specified density and the standard deviation for any set of results is below

0.08 gm/cc. However for earthwork in shoulders and top 500 mm portion of the embankment below the

subgrade, atleast one density measurement shall be taken for every 500 square meters of the compacted area provided further that the number of the tests in each set of measurements shall be at least 10. In other respects, the control shall be similar to that described earlier.

6. Following materials shall conform to the Indian Standards shown against them:

- (1)Cement.....
- (2)Sand for masonry.
- (3)..... Sand for concrete.
- (4)..... Coarse aggregate.
- (5)..... Mild Steel...
- (6)..... High yield strength deformed bars
 - (a) Hot Rolled..... IS:1139
 - (b) Cold Twisted..... IS:1786

7. Barrel thickness of pipes of different class shall be as under:

Sr.No.	Internal Diameter of pipe in mm	Barrel thickness (in mm).		
		NP1	NP2	NP2
1	80	25	25	-
2	100	25	25	-
3	150	25	25	-
4	250	25	25	-
5	300	30	30	-
6	350	32	32	75
7	400	32	32	75
8	450	35	35	75
9	500	-	35	75
10	600	-	40	80
11	700	-	40	80
12	800	-	45	90
13	900	-	50	100
14	1000	-	55	100
15	1100	-	60	115
16	1200	-	65	115

Item No.19: Excavation for foundation up to 1.50mt. depth including sorting out and stacking of useful material and disposing off the excavated stuff within all lead and duff for all sort of soil.

304.1 Scope

Excavation for structures shall consist of the removal of material for the construction of others similar structures, in accordance with the requirements of these Specifications and the lines and dimensions shown on the drawings or as indicated by the Engineer. The work shall include construction of the necessary cofferdams and cribs and their subsequent removal; all necessary sheeting, shoring, bracing, draining and pumping; the removal of all logs, stumps, grubs and other deleterious matter and obstruction, necessary for placing the foundations, trimming bottoms of excavations; backfilling and clearing up the site and the disposal of all surplus material.

304.2 Classification of Excavation

301.2.1. Classification: All materials involved in excavations shall be classified by the Engineer in the following manner:

- (a) Soil
This shall comprise top soil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose murrum, a mixture of these and similar material which yields to the ordinary application of pick, spade and/or shovel, rake or other ordinary digging equipment. Removal of gravel or any other modular material having dimension in any one direction not exceeding 75mm shall be deemed to be covered under this category.
- (b) Ordinary Rock (not requiring blasting) this shall include:
 - (i) Rock types such as laterites, shales and conglomerates, varieties of limestone and sandstone etc., which may be quarried or split with crowbars, also including any rock which in dry state may be hard, requiring blasting but which, when wet, becomes soft and manageable by means other than blasting;
 - (ii) macadam surfaces such as water bound and bitumen bound; soling of roads, cement concrete pavement, coddle stone etc. compacted murrum or stabilized soil requiring use of pickaxe or shovel or both.
 - (iii) lime concrete, stone masonry and brickwork in lime/cement mortar below ground level, reinforced cement concrete which may be broken up with crowbars or picks and stone masonry in cement mortar below ground level; and
 - (iv) boulders which do not require blasting found lying loose on the surface or embedded in river bed, soil, talus, slope wash and terrace material of dissimilar origin.

- (c) Hard Rock (requiring blasting) This shall comprise:
 - (i) any rock or cement concrete for the excavation of which the use of mechanical plant and/or blasting is required;
 - (ii) reinforced cement concrete below ground level and in bridge/ROB/RUB/flyover piers and abutments,
 - (iii) boulders requiring blasting.
- (d) Hard Rock (using controlled blasting)
Hard rock requiring blasting as described under (c) but where controlled blasting is to be carried out in locations where built-up area, huts and are situated at within 200m of the blast site.
- (e) Hard Rock (blasting prohibited)
Hard rock requiring blasting as described under (c) but where blasting is prohibited for any reason like people living within 20m of blast sites etc. and excavation has to be carried out by hiselling, wedging or any other agreed method.
- (f) Marshy Soil
This shall include soils like soft clays and peat excavated below the original ground level of marshes and swamps and soil excavated from other areas requiring continuous pumping or bailing out of water.

304.3 Construction Operations

304.3.1 Setting Out

After the site has been cleared according to Clause 201, the limits of excavations shall be set out true to lines, curves and slopes, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer. The Contractor shall provide all labour, survey instruments and materials such as strings, pegs, nails, bamboos, stones, lime, mortar, concrete etc. required in connection with the setting out of works and the establishment of benchmarks. The Contractor shall be responsible for the maintenance of benchmarks and other marks and stakes as long as in the opinion of the Engineer, they are required for the work.

304.3.2 Excavation

Excavations shall be taken to the width of the lowest step of the footing including additional width as required for construction operation. The sides shall be left plumb where the nature of soil allows it. Where the nature of soil or the depth of the trench and season of the year do not permit vertical sides, the Contractor at his own cost shall put up necessary shoring; strutting and planking or cut slope to a safer angle or both with due regard to the safety of personnel and works and to the satisfaction of the Engineer.

The depth to which the excavation is to be carried out shall be as shown on the drawings, unless the type of material encountered is such as to require changes, in which case the depth shall be as ordered by the Engineer. Propping shall be undertaken when any foundation or stressed zone from an adjoining structure is within a line of 1 vertical to 2 horizontal from the bottom of the excavation.

Where blasting is to be resorted to, the same shall be carried out in accordance with Clause 302 and all precautions indicated therein observed. Where blasting is likely to endanger adjoining foundations or other structures, necessary precautions such as controlled blasting, providing rubber mat cover to prevent flying of debris etc. shall be taken to prevent any damage.

304.3.3 Dewatering and Protection

Normally, open foundations shall be laid dry. Where water is met within excavation due to stream flow, seepage, springs, rain or other reasons, the Contractor shall take adequate measures such as bailing, pumping, constructing diversion channels, drainage channels, bunds, depression of water level by well-point system, cofferdams and other necessary work to keep the foundation trenches dry when so required and to protect the green concrete/masonry against damage by erosion or sudden rising of water level. The method to be adopted in this regard and other details thereof shall be left to the choice of the Contractor but subject to the approval of the Engineer. Approval of the Engineer shall, however, not relieve the Contractor of the responsibility for the adequacy of dewatering and protection arrangements for the quality and safety of the works.

Where cofferdams are required, these shall be carried to adequate depths and heights, be safely designed and constructed and be made as watertight as is necessary for facilitating construction to be carried out inside them. The interior dimensions of the cofferdam shall be such as to give sufficient clearance for the construction and inspection and to permit installation of pumping equipment etc. inside the enclosed area.

If it is determined before hand that the foundations cannot be laid dry or the situation is found that the percolation is too heavy for keeping the foundation dry, the foundation concrete shall be laid underwater by tremie pipe only. In case of flowing water or artesian springs, the flow shall be stopped or reduced as far as possible at the time of placing the concrete.

Pumping from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of the movement of water through any fresh concrete. No pumping shall be permitted during the placing of concrete and for a period of at least 24 hours thereafter, unless it is done from a suitable pump separated from the concrete work by a watertight wall or other similar means.

At the discretion of the Contractor, cement grouting or other approved methods may be used to prevent or reduce seepage and to protect the excavation area.

The Contractor shall take all precautions in diverting channels and in discharging the drained water as not to cause damage to the works, crops or any other property.

304.3.4 Preparation of Foundation

The bottom of the foundations shall be levelled both longitudinally and transversely or

stepped as directed by the Engineer. Before footing is laid, the surface shall be slightly watered and rammed. In the event of excavation having been made deeper than that shown on the drawings or as otherwise ordered by the Engineer, the extra depth shall be made up with concrete as per Clause 2104.1 at the cost of the Contractor. Ordinary fillings shall not be permitted to bring the foundation to the design level as shown in the drawing.

When rock or other hard strata is encountered, it shall be freed of all soft and loose material, cleaned and cut to a firm surface either level or stepped as directed by the Engineer. All seams shall be cleaned out and filled with cement mortar or grout to the satisfaction of the Engineer. In the case of excavation in rock, annular space around footings shall be filled with lean concrete M15 up to the top level of rock.

If the depth of fill required is more than 1.5m in soft rock or 0.6m in hard rock above the foundation level, the filling up to this level shall be done with M-15 concrete and portion above shall be filled by concrete or by boulders grouted with cement.

When foundation piles are used, the excavation for pile cap shall be done after driving/casting of all piles forming the group. After pile driving operations in a given pit are completed, all loose and displaced material therein shall be removed to the level of the bottom of the pile cap.

304.3.5 Slips and Slip-Outs

If there are any slips or slip-outs in the excavation, these shall be removed by the Contractor at his own cost.

304.3.6 Public Safety

Near towns, villages and all frequented places, trenches and foundation pits shall be securely fenced, provided with proper caution signs and marked with red lights at night to avoid accidents. The Contractor shall take adequate protective measures to see that the excavation operations do not affect or damage adjoining structures. For safety precautions, guidance may be taken from IS:3764.

304.3.7 Backfilling

Backfilling shall be done with approved material after concrete or masonry is fully set and carried out in such a way as not to cause undue thrust on any part of the structure. All space between foundation masonry or concrete and the sides of excavations shall be refilled to the original surface in layers not exceeding 150mm compacted thickness. The compaction shall be done with the help of suitable equipments such as trench compactor, mechanical tamper, rammer, plate vibrator etc. after necessary watering, so as to achieve the maximum dry density.

304.3.8 Disposal of Surplus Excavated Materials

All the excavated materials shall either be reused with the approval of the Engineer or disposed off with all loads and lifts as directed by Engineer in charge.

304.4 MeasurementsforPayment

ExcavationforstructuresshallbemeasuredinCu.mforeachclassofmaterialencountered,limitedtothedimensionsshownonthedrawingsorasdirectedbytheEngineer.Excavationoverincreasedwidth,cuttingofslopes,production/supporttotheexistingstructuresshoring,shutteringandplankingshallbedeemedasincidentaltothemainworkandshallnotbemeasuredandpaidseparately.

304.5 Rates

304.5.1 TheContractunitratefortheitemsofexcavationforstructuresshallbepaymentinfullfor carryingouttherequiredoperationsincludingfullcompensationfor:

- i. settingout;
- ii. transportingtheexcavatedmaterialsforuseordisposalwithallleadsandlifts;
- iii. constructionofnecessarycofferdams,cribs/sheeting,shoringandbracingandtheirs subsequentremoval;
- iv. removalofalllogs,stumps,grubsandotherdeleteriousmatterandobstructions,forplacingthefoundationsincludingtrimmingofbottomsofexcavations;
- v. foundationsealing,dewateringincludingpumpingwhennoseparateprovisionforitismadeintheContract;
- vi. backfilling,clearingupthesiteanddisposalofallsurplusmaterialwithallleadsandliftsorasotherwise specified;and
- vii. alllabour,materials,tools,equipment,safety measures,diversionoftrafficandincidentals necessarytocompletetheworktoSpecifications.

304.5.2 TheContractunitrateforpreparationofrockfoundationshallbefulldcompensationfor cutting,trimmingandcleaningthefoundationsurfaceandfilling/sealingofallseamswithcementgrout or mortarincludingallmaterials,labourandincidentalsrequiredforcompletingthework.

Item No. 21 Providing and filling in foundation with ordinary cement concrete M-

100 mix and providing necessary vertical pin headers including formwork, vibrating, ramming and curing complete.

1. In case of ordinary concrete, mix is not required to be designed by preliminary tests and proportions of cement, fine aggregate and coarse aggregates are specified by volume as given in table below for different four grades designated as ordinary M-100, M-150, M-200 and M-250.
2. In the designation of a concrete mix letter M refers to the mix and then the number to the specified 28 days work cube compressive strength of that mix on 100 mm cube expressed in kg./cm.
3. The ordinary concrete mix shall generally be specified by volume for cement which normally comes in bags and is used by weight, volumes shall be worked out taking 50 kg. of cement as 0.035 cubic metre in volume. While measuring aggregate by volume, shaking, ramming or hammering shall not be done proportioning of sand as per its dry volume. In case it is sand, allowance for bulking shall be made as per IS: 2386 (Part-III).
4. In gradients required for ordinary concrete containing one 50 kg. bag of cement for different proportions of mix shall be as given in Table below.

TABLE

Grade of concrete	Mix by volume	Total quantity of dry aggregates by volume per 50 kg. cement to be taken assuming aggregate of the individual volumes of fine & coarse aggregates, maximum	Proportion of fine aggregate to coarse aggregate	Quantity of water per 50 kg. of cement max.
(1 cubic metre: 1000 Litres)				
1	2	3	4	5
Ordinary	Litres			Litres
M-100	1:3:6	300	General 1:2 for fine aggregate to Coarse aggregate by volume but subject to upper limit of 1:1.1/2 & lower limit of 1:3.	34
M-150	1:2:4	220		32
M-200	1:1.1/2:3	160		30
M-250	1:1:2	100		27

Note:-

The proportion of the aggregates shall be adjusted from upper limit to lower limit progress grading off the final aggregate becomes finer and the maximum size of coarse aggregate becomes larger.

Example: For an average grading of fine aggregate (that is zone II of IS: 383-1963) the proportions 1:1 1/2, 1:2 and 1:3 for maximum size of aggregates 10 mm, 20 mm and 40 mm respectively (after carrying out sieve analysis).

Note:- A mix leaner than M-

100 (1:3:6) may be used for non-structural part, if provided in the contract. In such cases grading of aggregates shall be by volume. Other requirements for mixing, placing and curing shall be the same.

5. Following shall be the maximum nominal size of coarse aggregate for the different items of work.

Sr. No.	Item of construction	Maximum nominal size of coarse aggregate
i	R.C.C. well curb, R.C.C. well steining and R.C.C. Piles	40mm
ii.	R.C.C. well steining	63mm
ii	Well cap or pile cap, solid type piers, abutments and wing walls and their pier caps	40mm
iii	R.C.C. works in cross girders, deck slab, wearing coat, kerb, light post, blast walls, approach slab etc. and hollow type piers, abutments, wing walls and their pier caps	20mm
iv	R.C.C. bearings	20mm
v	For any other item of construction not covered in (i) to (v)	As specified on the drawing by it or as desired by the Engineer in charge in case it is not specified on drawing.

For heavily reinforced concrete members as in the case of ribs of main beams, nominal maximum size of aggregates shall usually be restricted to 5mm. less than the minimum lateral clear distance between them in bars or 5mm. less than the minimum cover to the reinforcement whichever is the smaller.

6. Fine aggregates shall be clean, hard, coarse sand. It shall be free from dust and such other substances. The sand shall be got approved by the Engineer-in-charge.
7. All materials shall be stored as to prevent their deterioration or intrusion of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the work.
8. Cements shall be stored above the ground level in perfectly dry and watertight sheds and shall be stocked not more than eight bags high. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. Cement more than 3 to 4 months old shall invariably be tested to ascertain that it satisfies the requirements. The aggregates shall be stored in such a way as to prevent admixture of foreign materials. Different sizes of the fine or coarse aggregates shall be stored in separate stock piles sufficiently removed from each other to prevent intermixing of the materials.
9. The water for mixing shall be portable water to the satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.
10. For all work concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working condition and so maintained throughout the construction. Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shows complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.
11. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons, it shall be done on a smooth watertight platform large enough to allow efficient turning over of the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign materials shall get mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate. Which shall also be spread in a layer of uniform thickness on the mixing platform. Dry coarse and fine aggregate and cement then shall be mixed thoroughly by turning over to get a mixture of uniform color. Enough water shall then be added gradually through a hose and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 percent above that specified.

12. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to by the Engineer-in-charge the first batch of concrete from the mixers shall contain only two thirds of normal quantity of coarse aggregate. Mixing plants shall be thoroughly cleaned before changing from one type of cement to another.
13. The method of transporting and placing concrete shall be approved by the Engineer-in-charge. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All formwork and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.
14. If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting then shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly designed agitators, operating continuously, when this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to by the Engineer-in-charge, concrete shall be disposed in horizontal layers to a compacted depth of not more than 0.45 metres when internal vibrators are used and not exceeding 0.30 metre in all other cases.
15. Unless otherwise agreed to by the Engineer-in-charge concrete shall not be dropped into place from a height exceeding 2 metres. When trucking or chutes are used they shall be kept clean and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept clean, thoroughly wetted, and cleaned with a 13 mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before replacing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brush, care being taken to avoid dislodgement of particles of coarse aggregate. The surface shall then be thoroughly wetted. All free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this, surface shall not exceed 150 mm. in thickness and shall be well rammed against old work particular attention being given to corner and close spots.
16. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting underwater, where vibrators cannot be used. Sufficient vibrators in serviceable condition shall be kept at sites so that spare equipment is always available in the event of breakdowns.
17. Immediately after compaction concrete shall be protected against the harmful effects of weather including rain, running water shocks, vibrations due to traffic, rapid temperature changes. Fast drying process, it shall be covered with wet sacking, Hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set. It shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over the foundation concrete may be started after 48 hours of its laying but the curing of concrete shall be continued for a minimum period of 14 days.
18. Formwork shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Formwork shall however be delivered into following two distinct categories:-
 - (1) Shuttering i.e. formwork required for forming the concrete
 - (2) Scaffolding i.e. formwork required for supporting shuttering.

Forms for shutterings shall be constructed only, in metals suitably lined. Forms for scaffoldings shall be constructed of metal or timber. Both shuttering and scaffoldings shall be of substantial rigid construction and shutterings shall be true to shape and dimension as shown on the drawings. All bolts and reverts shall be counter-sunk and well ground to provide a smooth, plane surface.

19. Forms shall be mortartight and shall be made sufficiently rigid by the use of ties and bracing to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribed lines occurring during and after placing the concrete. Screw jacks of hardwood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete. Suitable cambers shall be provided in horizontal members of structures especially in long spans to counteract the effects of any deflection. The framework shall be so fixed as to provide for such camber. Forms shall be as constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed. Chamfers or fillets of size 25mm x 25mm shall be provided at all angles of framework to avoid sharp corners.
20. The inside surface of forms shall except in the case of permanent formwork or where otherwise agreed to by the Engineer-in-charge be coated with an approved material to prevent adhesion of concrete to the formwork. Release agent shall be applied strictly in accordance with the manufacturer's instruction and shall not be allowed to come into contact with any reinforcement of prestressing tendons and anchorages shall be applied strictly in accordance with the manufacturer's instruction and shall not be allowed to come into contact with any reinforcement of prestressing tendons and anchorage. Different release agents shall not be used in formwork of concrete which will be visible in the finished works.
21. Special measures shall be taken to ensure that the framework does not hinder the shrinkage of concrete because without these cracking could occur before the formwork is removed. Wherever applicable arrangement must be made to ensure that the form does not restrain the shortening and hogging of beams or slabs during tensioning of the tendons. The formwork should take due account of the calculated amount of positive or negative cambers so as to ensure the correct final shape of the structures having regard to the deformation of falsework, scaffolding or propping and the instantaneous deformation due to various causes affecting prestressed structures. Where there are re-entrant angles in the concrete section, the formwork should be removed at these sections as soon as possible after the concrete has set in order to avoid cracking due to shrinking of concrete. Formworks shall be tight enough to prevent any appreciable loss of cement during vibrations. Suitable tolerances should be provided in the formwork, immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in-charge due notice before placing any concrete in the form to permit him to inspect and accept the falsework and forms as to their strength, alignment and general fitness, but such inspections shall not relieve the contractor of his responsibility for safety of machinery, materials and for results obtained.
22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of formworks. Due considerations shall be given to local condition, Character of the structure, the weather and other conditions that influence the setting of concrete, the removal of the loads supporting of soffit forms may commence when concrete has attained strength and of the materials used in the mix. Where field operations are controlled by the strength test of concrete, the removal of the loads supporting of soffit forms may commence when concrete has attained strength equal to at least twice the stress to which the concrete will be subject at the time of striking props including the effect of any further addition of loads. When field operations are not controlled by strength test of concrete the vertical forms of beams, columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All formwork shall be removed without causing any damage to the concrete. Centerings shall be gradually and uniformly lowered in such a manner as to avoid any shock or vibrations. Supports shall be removed in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually.

Where internal metal ties are permitted they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortars. No permanently embedded metal parts shall have less than 25mm. cover to the finished concrete surface. Where it is intended to reuse the framework R shall be cleaned and made good to the satisfaction of the Engineer-in-charge.

- 23** Immediately after the removal of forms, all exposed bars or bolts passing through the Cement concrete member and used for shuttering or any other purposes shall be cut inside the Cement Concrete member to a depth of at least 25mm. below the surface of the concrete and the resulting holes filled by cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honeycomb spots, broken edges or corner and other defects shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete with mortar or cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry a consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surface which has been pointed shall be kept moist for a period of 24 hours. If cracks, pockets/honeycombs, in the opinion of the Engineer-in-charge are of such extent of and character as to affect materially or to endanger the life of the strength of the steel reinforcement they may declare the concrete defective and require the removal and replacement of the portions of the structure affected.

24. In the case of reinforced concrete work, workability shall be such that the concrete surrounds and properly grips all reinforcement. The degree of consistency, which shall depend upon the nature of work and method of vibration of concrete shall be determined regular slump test. Following slump shall be adopted for different types of works.

	Type of Work	Slump where vibrator is used	Slump where vibrator is not used
1	Mass conc. In RCC, foundation footing and retaining walls	10 to 25mm	80mm
2	Beam slab and column with simply reinforced	25 to 40mm	100 to 120mm
3	Thin RCC section or congested steel	40 to 50mm	125 to 150mm

25. Works strength tests shall be made in accordance with IS:516. Each test shall be conducted on tensile specimens five of which shall be tested at seven days and the remaining five at 28 days. The samples of concrete shall be taken one each day of concreting and, cubes shall be made at the rate of one for every 5 cubic meter of concrete or a part thereof. However if concreting done in a day is less than 15 cubic meter, the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer-in-charge. Similar work tests shall be carried out whenever the quality and grading of materials is changed irrespective of the quantity of concrete poured, The number of specimens may be suitable increased as deemed necessary by the Engineer-in-charge when procedure to test given above reveals a poor quality of concrete and in other special cases.
26. The average strength of the group of cubes cast for each day shall not be less than the specified works cube strength. 20 percent of the cubes cast each day may have values less than the specified strength provided the lowest value is not less than 85 percent of the specified strength.
27. R.C.C. work shall have exposed concrete surface. Centering design and its erections shall be approved by the Engineer-in-charge. One carpenter with helper will invariably be kept throughout the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. For access to different parts, suitable mobile platform shall be provided so that steel reinforcement in position is not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to reinforcement. Timber, kapachi or metal pieces shall not be used for this purpose. Concreting of important structural members shall always be done in the presence and

under the supervision of departmental person not below the rank of Asstt. Engineer/Addl. Asstt. Engineer/Overseer or as instructed by the Engineer-in-charge. After removal of formwork and suturing, the executive Engineers shall inspect the work and satisfy by random checks that concrete produced is of good quality. Plastering shall not be allowed to the exposed faces of concrete.

28. In reinforced concrete the volume occupied by reinforcement shall not be deducted. The slab shall be measured as running continuously through and the beam as the portion below the slab.
29. All necessary labour, materials, equipment etc. for sampling, preparing test cubes, curing etc. shall be provided by the Contractor. Testing of the materials and concrete may be arranged by the Engineer-in-charge in an approved laboratory at the cost of the contractor.
30. The unit rate for concrete shall include the cost of all materials, labour, tools and plant required for mixing, placing in position, vibrating and compacting finishing as per directions of the Engineer-in-charge, curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as shown on the drawings and according to these specifications. The rates shall also include the cost of making fixing and removing of all centers and forms required for the work.
31. The payment will be made on cumt. basis of the finished work.

Item No. 22:- Providing and casting in situ ordinary cement concrete M-

150 mix and providing necessary pin headers including shuttering, scaffolding, laying, vibrating, curing and finishing complete without V-groove (A) height 0.0 to 5.0 mt.

The work shall be executed as per specification of **Item No. 21** except the work is for **providing and casting in situ ordinary cement concrete M-**

150 mix and providing necessary pin headers including shuttering, scaffolding, laying, vibrating, curing and finishing complete without V-groove (A) height 0.0 to 5.0 mt.

Measurements shall be taken and paid on Cum basis.

Providing and casting in situ controlled cement concrete M-250 mix with Trimix C.C. Road laid as directed including vibrating, curing and filling in joints with bitumen complete.

This work shall consist of furnishing and laying **controlled cement concrete M-250 mix with Trimix C.C. road** of the shape and dimensions shown on the drawings and conforming to these Specifications or as approved by the Engineer in charge.

Prior to the start construction the contractor shall design the mix in case of design mix concrete or propose nominal mix in case of nominal mix concrete and submit to the Engineer in charge for approval the proportions of materials including admixtures to be used water reducing admixtures (including plasticizers or super plasticizers) may be used at the contractors option subject to the approval of Engineer in charge Other types of admixtures shall be prohibited unless specifically permitted by the Engineer in charge.

O For Cement Concrete grade M-250

1.0. Materials

- 1.1. Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Grit shall conform to M-8. Coarse aggregate shall conform M-12.
- 1.2. The shuttering to be provided shall be of ordinary timber plank and shall conform to M-26.
- 1.3. The dimensions of scantlings and battens shall conform to the design. The strength of the wood shall not be less than that assumed in the design.

2.0. General

- 2.1. The concrete mix shall be designed from preliminary tests. The proportion of the concrete mix shall be 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. nominal size) by volume concrete work shall have exposed concrete surface or as specified in the item.
- 2.2. The proportioning of cement and aggregates shall be done by weight and necessary precautions shall be taken in the production to ensure that the required work cube strength is attained and maintained. The controlled concrete shall be in grades of M-100, M-150, M-200, M-250, M-300, M-350 & M-400 with prefix controlled added to it. The letter M refers to mix and the numbers specify 28 days works cube compressive strength of 250 mm. cubes of the mix expressed in Kg./cm.
- 2.3. The proportion of cement, sand and coarse aggregate shall be determined of weight. The weigh batch machine shall be used for maintaining proper control over the proportion of aggregates as per mix design. The strength requirements of different grades of concrete shall be as under:

	Grade of Concrete cms. cubes in kg/cmt. at accordance with I.S. 516-1959.	Compressive strength of 15 28 days, conducted in
	Preliminary test Min.	Work Test Min.
M 150	200	150
M 200	260	200
M 250	320	250
M 300	380	300
M 350	440	350
M 400	500	400

In all cases, the 28 days compressive strength specified in above the criteria for acceptance or rejection of the concrete. Where the strength of a concrete mix as indicated by tests, lies in between the strength of any two grades specified in the above table, such concrete shall be classified in for purpose as concrete belonging to the lower of the grades between which its strength lies.

3.0. Workmanship

- 3.1. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work question and can be property compacted with means available except where it can be shown to the satisfaction of the Engineer-in-charge, that supply of properly graded aggregate of uniform quality can be maintained till the completion of work, grading of aggregate shall be controlled by obtaining the coarse aggregates in different sizes and bending them in the right proportions as required. Aggregates of different sizes shall be stocked in separate stock piles. The required quantity of material shall be stock piled several hours, preferably a day before use. The grading of coarse and fine aggregate shall be checked as frequently as possible, the frequency for a given job being determined by Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests.
- 3.2. In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement is determined by accepting the maker's weight per bag, a reasonable number of bags shall be weighted separately to check the net weight. Where cement is weighted form bulk stocks at site and not by bags, it shall be weighed separately from the aggregate. Water, shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in clean and serviceable condition. Their accuracy shall be periodically checked.
- 3.3. It is most important to keep the specified water cement ratio constant and at its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined by the Engineer-in-charge according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture content. For the determination of moisture content in the aggregates I.S. 2386 (Part-III) shall be referred to. Suitable adjustments

shall also be made in the weights of aggregates due to variation in their moisture content. Minimum quantity of cement to be used in controlled concrete shall not be less than 220 kg./m³ in plain concrete and not less than 250 kg/m³ in reinforced concrete.

- 3.4** The form work shall conform to the shape lines and dimensions as shown on the plans and be constructed as to remain sufficiently rigid during the placing and compacting of the concrete. Adequate arrangements shall be made by the contractor to safe-guard against any settlement of the form-work during the course of concreting and after concreting. The form work of shuttering, centering, scaffolding, bracing etc. shall be as per design.

4.0. Clearing and Treatment of forms:

- 4.1.** All rubbish, particularly chipping shaving and saw dust shall be removed from the interior of the form before the concrete work is placed and the form in contact with concrete shall be cleaned and thoroughly wetted or treated. The surface shall be then coated with soap solution applied before concreting is done. Soap solution for the purpose shall be prepared by dissolving yellow soap in water to get consistency of paint. Alternatively a coat of raw linseed oil shall be applied after thoroughly cleaning the surface. Care shall be taken that the coating does not get on construction joint surface and reinforced bars.

5.0 Stripping time:

- 5.1.** In normal circumstances and where ordinary cement is used forms may be struck after expiry of following periods.
- (a) Sides of walls columns and vertical faces of beams.....24 to 48 hours.
 - (b) Beam soffits, (props, left under).....7 days.
 - (c) Removal of props slabs:
 - (i) Slabs spanning up to 4.5 m.....7 days.
 - (ii) Spanning over 4.5 m.....14 days.
 - (d) Removal of props to beams and Arches:
 - (i) Spanning up to 6 m.....14 days.
 - (ii) Spanning over 6 m.....21 days.

6.0 Procedure when removing the form work :

- 6.1.** All form work shall be removed without such shock or vibrations as would damage the reinforced concrete surface. Before the soffits form work and struts are removed, the soffits and the concrete surface shall be exposed where necessary in order to ascertain that the concrete has sufficiently hardened.

7.0 Centering:

- 7.1.** The centering to be provided shall be got approved. It shall be sufficiently strong to ensure absolute safety of the form work and concrete work before, during and after pouring concrete. Watch should be kept to see that behavior or centering and form work is satisfactory during concreting. Erection should also be such that it would allow removal of forms in proper sequence without damaging either the concrete or the forms to be removed.
- 7.2.** The props of centering shall be provided on firm foundation or base of sufficient strength to carry the loads without any settlement.
- 7.3.** The centering and form work shall, be inspected and approved by the Engineer-in-charge before concreting. But this will not relieve the contractor of his responsibility for strength, adequacy and safety of form work and centering. If there is a failure of form work or centering, contractor shall be responsible for the damages to property.

8.0 Scaffolding:

- 8.1.** All scaffolding, hoisting arrangements and ladders etc. required for the facilitating of concreting shall be provided and removed on completion of work by contractor at his own expense. The scaffolding, hoisting arrangements and ladders etc. shall be strong enough to withstand all live, dead and impact loads expected to act and shall be subject to the approval of the Engineer-in-charge. However contractor shall be solely responsible for the safety of the scaffolding, hoisting arrangement, ladders, work and workman etc.
- 8.2.** The scaffolding, hoisting arrangements and ladder shall allow easy approach to the work spot and afford easy inspection.
- 8.3.** The rate is applicable to all condition of working and height up to 4 mts. The rate shall include the cost of materials and labour for various operations involved such as :

- (a) Splayed edges, notching, allowance for overlaps and passing at angles, battens centering, shuttering propping, bolting, wedging easing, striking and removal.
- (b) Filleting to form stop chamfered edges or splayed external angles not exceeding 20 mm: width to beams, columns and the like.
- (c) Temporary openings in the forms for pouring concrete, if required removing rubbish etc. (d) Dressing with oil to prevent adhesion of concrete with shuttering and. (e) Raking or circular cutting.

9.0 Re-Use:

- 9.1.** Before re-use, all form shall be inspected by Engineer-in-charge and their suitability ascertained. The forms shall be scarred, cleaned and joints are gone over, repaired where required. Inside surface shall be retreated to prevent adhesion of concrete.

O General

- 5.1** Prior to the start construction the contractor shall design the mix in case of design mix concrete or propose nominal mix in case of nominal mix concrete and submit to the Engineer in charge for approval the proportions of materials including admixtures to be used water reducing admixtures Before stating concrete the bed of foundation trenches shall be cleared of all loose materials leveled watered and rammed as directed.

1.2 Complete including mixing plasticizer Conplast P - 211 @ 100 ML / bag including mixing shall be used including making c channel size required to level and slope and thickness of the concrete road leveling of placed concrete with surface vibrator and finishing with power floater shall be done Floater and trowel light booming the surface shall be done **expansions joints** shall be cut as directed.

- 5.3** For sub base shall be leveled up prior to start the Trimix concrete.

The channel shall be placed on both side and shall be check by plumb & to spirit level in true level and longitudinal slope and gradient and camber.

6.0 MIXING:

FOR MASS CONCRETE WORK :

- 6.1** Dry coarse and fine aggregate and cement shall then be mixed thoroughly by turning over to get a mixture of uniform colour.
- 6.2** Enough water shall then be added gradually and the mass turned over till a mix of required consistency is obtained. In case of hand mixing quantity of cement shall be increased by 10 per cent above that specified. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the purpose.
- 6.3** The concrete shall be mixed in a mechanical mixer. At the site of work Hand mixing may however be allowed for smaller quantity of work if approved by the Engineer-in-charge. When hand mixing is permitted by the Engineer-in-charge in case of break-down of machineries and in the interest of the work. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to be the Engineer in-charge, the first batch of concrete from the mixer shall contain only two thirds of normal quantity of coarse aggregate. Mixing plant shall be thoroughly cleaned before changing from one type of cement to another.
- 6.4** The method of transporting and placing concrete shall be approved by the Engineer-in charge. Concrete shall be so transported and placed so that no contamination, segregations or loss of its constituent material takes place. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.
- 6.5** Mixing shall be done on a smooth watertight platform large enough to allow efficient turning over the ingredients of concrete before and after adding water, Mixing platform shall be so arranged so that no foreign material shall get mixed with concrete nor does the mixing water flow out.
- 6.6** Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate, which shall also be spread in a layer of uniform thickness on the mixing platform.

- 6.7** Unless otherwise agreed to by the Engineer-in-charge, concrete shall not be dropped into place from a height exceeding 2 meters. When chutes are used they shall be kept clean and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, kept clean, thoroughly wetted, and covered with a 13 mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles of coarse aggregate. The Surface shall then be thoroughly wetted, all free water removed, and the coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150 mm. in thickness, and shall be well rammed against old work particular attention being given to corners and Close spots.
- 6.8** If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting being given, it shall proceed continuously over the Area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly design agitators, operating continuously, when this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to be the Engineer-in-charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.4-metre when internal vibrators are used and not exceeding 0.30 meter in all other cases
- 6.9** In the case of reinforced concrete work workability shall be such that the concrete surrounds and properly grips all reinforcement. The degree of consistency which shall depend upon the nature of work and methods of vibration of concrete shall be determined by regular slump, tests. Following slump shall be adopted for different types of works.

Type of work vibrators used.	Slumps	
	Where vibrators Are used	Where are not
Mass concrete in R.C.C. foundations footings and retaining walls.	10 - 25 mm	80 mm
(ii) Beams, slabs and columns simply reinforced	25 – 40 mm	100-120 mm
(iii) Thin R.C.C. section or section with mm. congested steel	40 – 50 mm	125 -150 mm

7.0 Segregation

- 7.1** When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept, clean, thoroughly wetted and covered with a 13 mm. thick layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, with neat cement grout. The first layer of concrete to be placed on the surface shall not exceed 150mm in thickness and shall be well rammed against old work particular attention being given to corners and close spots.

8.0 Transporting & Placing the Concrete

- 8.1** The concrete shall be handed from the place of mixing to the final position in not more than 15 minutes by the method as directed and shall be placed into its final position compacted and finished within 30 minutes of mixing with water i.e. before the setting commences.
- 8.2** The concrete shall be laid in layers of 15 cms to 20 cms.
- 8.3** All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting under water, where vibrators can not be used sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event of break downs. **8.4 After Placing**

The mechanical vibrator shall be installed on channel and it shall be run in forward direction of concrete placing. The vibrator shall be start and shall be use as per instruction of Engineer-in-charge.

The water shall be suck by dewaterization equipment by spreading vaccum sheet on concrete after sufficient vibrator the floating water shall be sufficiently suck from concrete so that the sufficient strength of concrete shall be achieved.

The mechanical trowel shall be start after dewatering from concrete. The trowel shall be run in such a way that the required finish top surface of concrete shall be achieved mat finish or glossy finish.

9.0 Curing :

9.1 Immediately after compaction, concrete shall. be protected against harmful effects of weather including rain, running water, shocks, vibration, traffic, rapid temperature charges, frost and driving out process shall be covered with wet jute bags or the similar absorbent material approved by the Engineer-in-charge soon after the initial set and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over the foundation concrete may be started after 48 hours of its laying but the curing of concrete shall be continued for a minimum period of 14 days.

9.2 After the final set, the concrete shall be kept continuously wet if required by pounding for a period of not less then 7 days form the date of placement. Hard and bitter water shall not be used for curing

9.3 The contraction joints shall be cut upto the required depth at the end of panel debonding strip 12mm thick shall be provided the contraction joints & construction joints of 10mm x 25mm by using concrete cutter machine etc. complete as directed by Engineer in charge.

10.0 Mode of Measurement & Payment :

10.1 The payment will be made on **Cum** basis of the finished work.

10.2 In reinforced concrete the volume occupied by reinforcement shall not be deducted. The slab shall be measured as running continuously through and the beam as the portion below the slab.

10.3 All necessary labour, materials equipment etc for sampling, preparing test cubes, curing etc. shall be provided by the Contractor. Testing of the materials and concrete may be arranged by the Engineer in charge in an approved laboratory at the cost of the contractor

10.4 The unit rate concrete shall include the cost of all materials, tools and plant required for mixing, placing in position, compacting, and cost water reducing concrete and mixture at 100 ml per bag of cement and making channel 75 mm x 75 mm required to level and slope and thickness of the concrete road leveling of placed concrete with surface vibrator and finishing with power floater and trowel light booming the surface and cutting Expansions joints by machine as directed by The Engineer in chargeand finishing as per direction of the Engineer-in-charge, curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as shown on the drawings and according to these specifications. They shall also include the cost of making, fixing and removing of all centering and forms required for the work.

10.5 The concrete shall be measured for its length breadth limiting dimensions to those specified on plan or as directed.

10.6 The rate shall be for a unit of one **Cum**.

Item No.23:-Providing and fixing I.S.I.mark T.M.T.Bar Fe-

500 D reinforcement for R.C.C. work including binding, bending and placing in position complete up to floor two level.

1.0 GENERAL

This work shall consist of furnishing and placing coated, or uncoated or high strength deformed reinforcement bars (intentioned) of the shape and dimensions shown on the drawings and conforming to these Specifications as approved by the Engineer in charge.

2.0 MATERIAL

2.1. TMT Bars

Reinforcements may be either T.M.T. tensile steel, conforming to IS 1786-2008 bars. They may be uncoated or coated with epoxy or with approved protective coatings.

2.2. T.M.T. bars reinforcement for RCC work shall conform IS 432 (Part II) 1982 (Reaffirmed 1995) and shall be of tested quality. It shall also comply with relevant part of IS 456-2000.

2.3. All reinforcements shall be clean and free from dirt, paint, grease or oil, all scale or loose or thick rust at the time of placing.

2.4. All steel shall be procured from original producers. No re-rolled steel shall be incorporated in the work.

2.5. Only new steel shall be delivered to the site. Every bar shall be inspected before placing to its position and defective brittle or burnt bar shall be discarded. Cracked ends of bars shall be discarded.

3.0. Pitch

3.1. Distance between bars shall be as specified in drawings and as directed by the Engineer in Charge. All bars shall be placed at an accurate distance from each other and shall be bound tightly to maintain the desired pitch. Suitable means shall be provided for holding bars securely in position.

4.0. Binding wire

4.1. Mild steel binding wire shall be of 1.63 mm or 1.22 mm (16 to 18 gauge) diameter and shall conform IS 280-2006.

4.2. The use of black wire will be permitted for binding reinforcement bars. It shall be free from dirt, paint, grease or oil, scale or loose or thick rust and any other undesirable coating which may prevent adhesion of cement mortar at the time of binding.

4.3. Only new binding wire shall be delivered to the site. All binding wire shall be inspected before binding to its position and defective brittle, rusted, used wire, shall be discarded.

5.0. PROTECTION OF REINFORCEMENT

5.1. Uncoated reinforcing steel shall be protected from rusting or chloride contamination. Reinforcement shall be free from rust, mortar, loose mill scale, grease, oil or paints. This may be ensured either by using reinforcement fresh from the factory or thoroughly cleaning all reinforcement to remove rust using any suitable method such as sand blasting, mechanical wire brushing, etc. as directed by the Engineer. Reinforcement shall be stored on bricks, racks or platforms and above the ground in a clean and dry condition and shall be suitably marked to facilitate inspection and identification.

5.2. Portions of uncoated reinforcing steel and dowels projecting from concrete shall be protected within one week after initial placing of concrete with a brush coat of neat cement mixed with water to a consistency of thick paint. This coating shall be removed by lightly tapping with a hammer or other tool not more than one week before placing of the adjacent pour of concrete. Coated reinforcing steel shall be protected against damage to the coating. If the coating on the bars is damaged during transportation or handling and cannot be repaired, the same shall be rejected.

6.0. Workmanship

6.1. The work shall consist of furnishing and placing reinforcement to the shape and dimensions shown on the drawings or as directed by The Engineer in charge.

6.2. Reinforcing steel shall conform accurately to the dimensions given in the bar bending schedules shown on relevant drawing.

7.0. BENDING OF REINFORCEMENT

7.1. Bar bending schedules shall be furnished by the Contractor and got approved by the Engineer before start of work.

7.2. Reinforcing steel shall conform to the dimensions and shapes given in the approved bar bending Schedules.

7.3. Bars shall be bent cold to the specified shape and dimensions or directed by the Engineer using a proper bar bender operated by hand power to obtain the correct radius of bends and shape.

Bars shall not be bent or straightened in a manner that will damage parent material or the coating bars bent during transport or handling shall, be straightened before being used on work and shall not be heated to facilitate straightening.

8.0. PLACING OF REINFORCEMENT

8.1. The reinforcement cages should generally be fabricated in the yard at ground level, and then shifted and placed in position. The reinforcements shall be placed strictly, in accordance with the drawings and shall be assembled in position, only when structure is otherwise ready for placing of concrete. Prolonged time gap, between assembling of reinforcements and casting of concrete, which may result in rust formation on the surface, shall not be permitted.

8.2. Reinforcement bars shall be placed accurately in position as shown on the drawings. The bars, crossing one another shall be tied together at every intersection with binding wire (annealed), conforming to IS: 280 to make the skeleton of the reinforcement rigid such that the reinforcement does not get displaced during placing of concrete, or any other operation. The diameter of binding wire shall not be less than 1mm.

8.3. Bars shall be kept in position usually by the following methods:

In case of beam and slab construction, industrially produced polymer cover blocks of thickness equal to the specified cover shall be placed between the bars and formwork subject to Satisfactory evidence that the polymer composition is not harmful to concrete and reinforcement. Cover blocks made of concrete may be permitted by the Engineer, provided they have the same strength and specification as those of the member.

8.4. In case of dowels for Columns and wall the vertical reinforcements shall be kept in position by means of timber templates with slots in them accurately, or with cover blocks tied to the reinforcement timber templates shall be removed after the concreting has progressed up to a level just below their location.

8.5. Layers of reinforcement shall be separated by spacer bars at approximately one meter intervals. The minimum diameter of spacer bars shall be 12mm or equal to maximum size of main reinforcement or maximum size of coarse aggregate, whichever is greater. Horizontal reinforcements shall not be allowed to sag between supports.

8.6. Necessary stays, blocks, metal chairs, spacers, metal hangers supporting wires etc, or other subsidiary, reinforcements shall be provided to fix the reinforcements firmly in its correct position.

8.7. Use of pebbles, broken stone, metal pipe, brick, mortar or wooden block set as devices for positioning reinforcements shall not be permitted.

8.8. Bars coated with epoxy or any other approved protective coatings shall be placed on supports that do not damage the coating. Supports shall be installed in a manner such that planes of weakness are not created in hardened concrete. The coated reinforcing steel shall be held in place by use of plastic or plastic coated binding wire specially manufactured for the purpose.

8.9. Placing and fixing of reinforcements shall be inspected and approved by the Engineer before concrete is deposited.

9.0. Lapping

9.1. All reinforcement shall be furnished in full lengths as indicated on the drawing. No splicing of bars, except where shown on the drawing; will be permitted without approval of the Engineer. The length of the splices shall be as indicated on drawing or as approved by the Engineer. Where practicable, overlapping bars shall not touch each other, and shall be kept apart by 25mm or $1\frac{1}{4}$ times the maximum size of coarse aggregate, whichever is greater. If this is not feasible, overlapping bars shall be bound with annealed steel binding wire, not less than 1mm diameter and twisted tight in such a manner as to maintain minimum clear cover to the reinforcement from the concrete surface. Lapped splices shall be staggered or located at points, along the span where stresses are low.

10.0. Welding

10.1 Splicing by welding of reinforcement will be permitted only if detailed on the drawing or approved by the Engineer. Weld shall develop an ultimate strength equal to or greater than that of the bars connected.

10.2. While welding may be permitted for T.M.T. reinforcing bars conforming to IS:432, welding of deformed bars conforming to IS:1786 shall in general be prohibited. Welding may be permitted in case of bars of other than S240 grade including special. Welding grade of S415 grade bars conforming to IS:1786, for which necessary chemical analysis has been secured and the carbon equivalent (CE) calculated from the chemical composition using the formula:

$$CE = C + \frac{Mn}{6} + \frac{Cr}{5} + \frac{Mg}{5} + \frac{V}{5} + \frac{Ni}{5} + \frac{Cu}{5}$$

is 0.4 or less.

10.3. The method of welding shall conform to IS:2751 and IS:9417 and to any supplemental specification to the satisfaction of the Engineer

10.4. Bars shall be bent cold to the specified shape and dimensions or as directed by Engineer in charge using the proper bending tool, operated by hand or power to attain proper radius of bends. Bars shall not be bent or straightened in a manner that will injure the material. Bars bent during transport or handling shall be straightened before being used in the work. Bars shall not be heated to facilitate bending

10.5. Unless otherwise specified a 'U' type hook at the end of each bar shall invariably be provided to main reinforcement. The radius of the bend shall not be less than twice the diameter of the round bar and the length of the straight part of the bar beyond the end of the curve shall be at least four times of the diameter of the round bar. In case of bars which are not round and in case of deformed bars, the diameter shall be taken as the diameter of circle having a neutral equivalent effective area. The hook shall be suitably encased to prevent any spalling of the concrete

10.6. All reinforcement bars shall be accurately placed in exact positions shown on the drawings and shall be securely held in position during placing of concrete by annealed binding wire not less than 1mm in size and by using any blocks or metal chair spacers, metal hangers, supporting wires or other approved devices at sufficiently close intervals. Bars shall not be allowed to sag between supports not displaced during concreting or any other operation of the work. All devices used for positioning shall be of non-corrodible material wooden and metal supports shall not extend to the surface of the concrete, except where shown in drawings. Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacings shall not be allowed. Pieces of broken stone or brick and wooden blocks shall not be used. Layers of bars shall be separated by spacer bars pre-cast mortar blocks or other approved devices. Reinforcement after bending placed in position shall be maintained in a clean condition until completely embedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed. To prevent reinforcement from corrosion, concrete cover shall be provided as indicated on drawings. All bars protruding from concrete and to which other bars are to be sliced and which are likely to be exposed for a period exceeding 10 days shall be protected by a thick coat of neat cement grout

10.7. Bars crossing each other where required shall be secured by binding wire (annealed) of size not less than 1mm in such a manner that they do not slip over at the time of fixing and concreting

As far possible bar of full length shall be used in case this is not possible, overlapping of bars shall be done as directed by the Engineer in charge. When practicable overlapping bars shall not touch each other, but be kept apart by 25mm. Where not feasible overlapping bars shall be bound with

annealed wires not less than 1 mm thick twisted tight. The overlap shall be staggered for different bars and locate at points along the span where neither shear nor bending moment is maximum.

10.8. Whenever indicated on drawing or desired the Engineer in charge bars shall be jointed by coupling which shall have a cross section sufficient to transmit the full stresses of bars. The end of the bar that are jointed by couplings shall be upset for sufficient length so that the effective cross section at the base of thread is not less than the normal cross section of the bar. Thread shall be standard threads. Steel for couplings shall conform to IS 226.

10.9. When permitted or specified on the drawings joints of reinforcement bars shall be butt-welded so as to transmit their full stresses. Welded joints shall preferably be located at points where steel will not be subject to more than 75 percent of the maximum permissible stresses and welds shall be staggered so that at any section not more than 20 percent of the rods are welded. Only electric arc welding using a process which excludes air from the molten metal and conforms to any other special provisions for the work shall be accepted. Suitable means shall be provided for holding bars securely in position during welding. It shall be ensured that no voids are left in welding and when welding is done in two or three stages previous surfaces shall be cleaned properly. End of bars shall be cleaned of all loose scale, rust, paint and other foreign matter before welding. Only competent welders shall be employed on the work. The MS electrodes used for welding shall conform to IS 814. Welded pieces of reinforcement shall be tested. Specimens shall be taken from the actual site and their numbers shall be frequently tested as directed by the Engineer in charge.

11.0 MODE OF MEASUREMENTS & PAYMENT

11.1. For the purpose of payment the bar shall be measured correct up to 10 mm length and weight payable work out at the rates specified below:

Sr. No	Diameter of steel	weight of steel per running meter	Sr. No	Diameter of steel	weight of steel per running meter
1	6mm	0.22Kg/Rmt	8	20mm	2.47Kg/Rmt
2	8mm	0.39Kg/Rmt	9	22mm	2.98Kg/Rmt
3	10mm	0.62Kg/Rmt	10	25mm	3.85Kg/Rmt
4	12mm	0.89Kg/Rmt	11	28mm	4.83Kg/Rmt
5	14mm	1.21Kg/Rmt	12	32mm	6.31Kg/Rmt
6	16mm	1.58Kg/Rmt	13	36mm	7.99Kg/Rmt
7	18mm	2.00Kg/Rmt	14	40mm	9.86Kg/Rmt

11.1. Excess consumption over 5% will be charged at penal rate.

11.2. Reinforcement shall be measured in length including hooks, if any, separately for different diameters as actually used in work, excluding overlaps. From the length so measured, the weight of reinforcement shall be calculated in tonnes on the basis of IS: 1732. Waste, overlaps, couplings, welded joints, spacer bars, chairs, stays, hangers and annealed steel wire or other methods for binding and placing shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.

11.3. The contract unit rate for coated/uncoated reinforcement shall cover the cost of material, fabricating, transporting, storing, bending, placing, binding and fixing in position as shown on the drawings as per these specifications and as directed by the Engineer, including all labour, equipment, supplies, incidentals, sampling, testing and supervision.

The unit rate for coated reinforcement shall be deemed to also include cost of all material, labour, tools and plant, royalty, transportation and expertise required to carry out the work. The rates shall also cover sampling, testing and supervision required for the work.

11.4. The rates shall be for a unit of **One Kg.**

Item No. 4 Providing and laying ordinary cement concrete M-200 mix and curing complete including the cost of formwork but excluding the cost of reinforcement for reinforced concrete work in foundations, footing, base or

columns and mass concrete.

1. In case of ordinary concrete, mix is not required to be designed by preliminary tests and proportions of cement, fine aggregate and coarse aggregates are specified by volume as given in table below for different four grades designated as ordinary M-100, M-150, M-200 and M-250.
2. In the designation of a concrete mix letter M refers to the mix and the number to the specified 28 days work cube compressive strength of that mix on 200 mm cubes expressed in kg./cm.
3. The ordinary concrete mix shall generally be specified by volume for cement which normally comes in bags and is used by weight, volume shall be worked out taking 50 kg. of cement as 0.035 cubic meter in volume. While measuring aggregate by volume, shaking ramming or hammering shall not be done proportioning of sand be as per its dry volume. In case it is damp, allowance for bulking shall be made as per IS : 2386 (Part-III).
4. In gradients required for ordinary / concrete containing one 50 kg. bag of cement for different proportions of mix shall be as given in Table below.

TABLE

Grade of concrete	Mix by volume	Total quantity of dry aggregates by volume per 50 kg. cement to be taken as sum aggregate of the individual volumes of fine & coarse aggregates, maximum	Proportion of fine aggregate to coarse aggregate	Quantity of water per 50 kg. of cement max.
(1 cubic metre : 1000 Liters)				
1	2	3	4	5
Ordinary	Litres			Litres
M-100	1:3:6	300	General 1:2 for fine aggregate to Coarse aggregate by volume but subject to a upper limit of 1:1.1/2 & a lower limit of 1:3.	34
M-150	1:2:4	220		32
M-200	1:1.1/2:3	160		30
M-250	1:1:2	100		27

Note :- The proportion of the aggregates shall be adjusted from upper limit to lower limit progress grading of the final aggregate becomes finer and the maximum size of coarse aggregate becomes larger.

Example : For an average grading of fine aggregate (that is zone II of IS : 383 - 1963) the proportions 1:1 1/2, 1:2 and 1:3 for maximum size of aggregates 10mm, 20 mm and 40mm respectively (after carrying out sieve analysis).

Note:- A mix leaner than M-100 (1:3:6) may be used for non structural part, if provided in the contract. In such cases grading of aggregates shall be by volume. Other requirements for mixing, placing and curing shall be the same.

5. Following shall be the maximum nominal size of coarse aggregate for the different items of work.

Sr. No.	Item of construction	Maximum nominal size of coarse aggregate
i	R.C.C. well curb, R.C.C. well steining and R.C.C. Piles	40 mm
ii.	R.C.C. well steining	63 mm
ii	Well cap or pile cap, solid type piers, abutments and wing walls and their pier caps	40 mm
iii	R.C.C. works in cross girders, deck slab, wearing coat, kerb, light post, blast walls, approach slab etc. and hollow type piers, abutments, wing walls and their pier caps	20mm
iv	R.C.C. bearings	20 mm
v	For any other item of construction not covered by items (i) to (v)	As specified on the drawing or as desired by the Engineer in charge in case it is not specified on drawing.

For heavily reinforced concrete members as in the case of ribs of main beams, nominal maximum size of aggregate shall usually be restricted to 5 mm. less than the minimum lateral clear distance between the main bars or 5 mm. less than the minimum cover to the reinforcement whichever is the smaller.

6. Fine aggregate shall be clean, hard, coarse sand. It shall be free from dust and such other substances. The sand shall be got approved by the Engineer-in-charge.
7. All materials shall be stored as to prevent their deterioration or intrusion of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the work
8. Cement shall be store above the ground level in perfectly dry and watertight sheds and shall be stocked not more than eight bags high. Wherever bulk storage containers are used. their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. Cement more than 3 to 4 months old shall invariably be tested to ascertain that R satisfies the ascertain requirements. The aggregates shall be stored in such a way as to prevent admixture of foreign materials. Different sizes of the fine or coarse aggregate shall be stored in separate stock piles sufficiently removed from each other to prevent intermixing the materials.
9. The water for mixing shall be portable water to the satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.
10. For all work concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working condition and so maintained throughout the construction. Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shows complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.
11. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons, it shall be done on a smooth watertight platform large enough to allow efficient. Turning over of the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material shall get mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate. Which shall also be spread in a layer of uniform thickness on the mixing platform ? Dry coarse and fine aggregate and cement then shall be mixed thoroughly by turning over to get a mixture of uniform color. Enough water shall then be added

gradually through a nose and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 percent above that specified.

12. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to by the Engineer-in-charge the first batch of concrete from the mixer shall contain only two third of normal quantity of coarse aggregate. Mixing plants shall be thoroughly cleaned before changing from one type of cement to another.
13. The method of transporting and placing concrete shall be approved by the Engineer-in-charge. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.
14. If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting then shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly designed agitators, operating continuously, when this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to by the Engineer-in-charge, concrete shall be disposed in horizontal layer to a compacted depth of not more than 0.45 metre when internal vibrators are used and not exceeding 0.30 metre in all other cases.
15. Unless otherwise agreed to by the Engineer-in-charge concrete shall not be dropped into place from a height exceeding 2 metres. When trucking or chutes are used they shall be kept clean and used in such way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened swept clean, thoroughly wetted, and cleaned with a 13 mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brush, care being taken to avoid dislodgement of particulars of coarse aggregate. The surface shall then be thoroughly wetted. All free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this, surface shall not exceed 150 mm. in thickness and shall be well rammed against old work particular attention being given to corner and close spots.
16. All concrete shall be compacted to produce a dense homogenous mass with the assistance of Vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting Under water, where vibrators cannot be used. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event, of break downs.
17. Immediately after compaction concrete shall be protected against harmful effects of weather including rain, running water shocks, vibrations due to traffic, rapid temperature changes. Fast drying put process, it shall be covered with wet sacking Hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set. It shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over the foundation concrete may be started after 48 hours of its laying but the curing of concrete shall be continued for a minimum period of 14 days.
18. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Formwork shall however be delivered into following two district categories :-

- (1) Shuttering i.e. from work required for forming the concrete
- (2) Scaffolding i.e. formwork required for supporting shuttering.

Forms for shuttering shall be constructed only, in metal suitably lined. Forms for scaffolding shall be constructed of metal or timber. Both shuttering and scaffolding shall be or substantial rigid construction and shuttering shall be true to shape and dimensions show on the drawings. All bolts and reverts shall be counter-suck and well ground to provide a smooth, plane surface.

19. Forms shall be mortar tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribed lines occurring during and after placing the concrete. Screw jacks of hardwood wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of structure specialty in long spans to counteract the effects of any deflection. The framework shall be so fixed as to provide for such camber. Forms shall be as constructed as too removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed. Chamfers or fillets of size 25 mm x 25 mm shall be provided at all angles of framework to avoid sharp comers.
20. The inside surface of forms shall except in the case of permanent from work or where otherwise agreed to by the engineer-in-charge be coated with an approved material to prevent adhesion of concrete to the from work. Release agents shall be applied strictly in accordance with the manufacture's instruction and shall not be allowed to come into contact with any reinforcement of prestressing tendons a and anchorage shall be applied strictly in accordance with the manufacturers instruction and shall not be allowed to come into contact with any reinforcement of prestressing tendons and anchorage. Different release agents shall not be used in from work of concrete which will be visible in the finished works.
21. Special measures shall be taken to ensure that the framework does no hinder the shrinkage of concrete because without these cracking could occur before the from work is removed. Wherever applicable arrangement must be made to ensure that the from does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The formwork should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape of the structures having regard to the deformation of false work, scaffolding or propping and the instantaneous deformation due to various causes affecting prestressed structures. Where there are re-entrant angles in the concrete section, the formwork should be removed at these sections as soon as possible after the concrete has set in order to avoid cracking due to shrinking of concrete. Formwork shall be tight enough to prevent any appreciable loss of cement during vibrations. Suitable tolerances should be provided in the formwork, immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-incharge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength alignment and general fitness, but such inspection shall not relieve the contractor of his responsibility for safety of machinery materials and for results obtained.
22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any for work. While fixing the time for removal of formworks. Due consideration shall be given to local condition, Character of the structure, the weather and other condition that influence the setting of concrete the removal of The load supporting of soffit forms any commence when concrete has attained strength and of the materials used in the mix. Where field operations are controlled by the strength test of concrete, the removal of the load supporting of soffit forms may commence when concrete has attained strength equal to at least twice the stress to which the concrete will be subject at the time of striking props including the effect of any further addition of loads. When

field operations are not controlled by strength test of concrete the vertical forms of beams, columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All form work shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to avoid any shock or vibrations. Supports shall be removed in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortars. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to reuse the framework R shall be cleaned and made good to the satisfaction of the Engineer-in-charge.

- 23** Immediately after the removal of forms, all exposed bars or bolts passing through the Cement concrete member and used for shuttering or any other purpose shall be cut inside the Cement Concrete member to a depth of at least 25 mm. below the surface of the concrete and the resulting holes filled by cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honeycomb spots, broken edges or corner and other defects shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete with mortar or cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry a consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surface which has been pointed shall be kept moist for a period of 24 hours. If rock, pockets/honeycombs, in the opinion of the Engineer-in-charge are of such extent and character as to affect materially or to endanger the life of the strength or the steel reinforcement he may declare the concrete defective and require the removal and replacement of the portions of the structure affected.
- 24.** In the case of reinforced concrete work, workability shall be such that the concrete surrounds and properly grips all reinforcement. The degree of consistency, which shall depend upon the nature of work and methods of vibration of concrete shall be determined regular slump test. Following slump shall be adopted for different types of works.

	Type of Work	Slump where vibrator is used	Slump where vibrator is not used
1	Mass conc. In RCC, foundation footing and retaining walls	10 to 25 mm	80 mm
2	Beam slab and column with simply reinforced	25 to 40 mm	100 to 120 mm
3	Thin RCC section or congested steel	40 to 50 mm	125 to 150 mm

- 25.** Works strength tests shall be made in accordance with IS : 516. Each test shall be conducted on ten specimens five of which shall be tested at seven days and the remaining five at 28 days. The samples of concrete shall be taken on each day of concreting and, cubes shall be made at the rate of one for every 5 cubic meter of concrete or a part thereof. However if concreting done in a day is less than 15 cubic meter, the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer-in-charge. Similar works tests shall be carried out whenever the quality and grading of materials is changed irrespective of the quantity of concrete poured, The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure to tests given above reveals a poor quality of concrete and in other special cases.
- 26.** The average strength of the group of cubes cast for each day shall not be less than the specified works cube strength. 20 per cent of the cubes cast each day may have values

less than the specified strength provided the lowest value is not less than 85 percent of the specified strength.

27. R.C.C. work shall have exposed concrete surface. Centering design and its erection shall be approved by the Engineer-in-charge. One carpenter with helper will invariably be kept throughout the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. For access to different parts, suitable mobile platforms shall be provided so that steel reinforcement in position is not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber, kapachi or metal pieces shall not be used for this purpose. Concreting of important structural members shall always be done in the presence and under the supervision of departmental person not below the rank of Asstt. Engineer / Addl. Asstt. Engineer / Overseer or as instructed by the Engineer-in-charge. After removal of form work and suturing, the executive Engineer shall inspect the work and satisfy by random checks that concrete produced is of good quality. Plastering shall not be allowed to the exposed faces of concrete.
28. In reinforced concrete the volume occupied by reinforcement shall not be deducted. The slab shall be measured as running continuously through and the beam as the portion below the slab.
29. All necessary labour, materials, equipment etc. for sampling, preparing test cubes, curing etc. shall be provided by the Contractor. Testing of the materials and concrete may be arranged by the Engineer-in-charge in an approved laboratory at the cost of the contractor.
30. The unit rate for concrete shall include the cost of all materials, labour, tools and plant required for mixing, placing in position, vibrating and compacting finishing as per directions of the Engineer-in-charge, curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as shown on the drawings and according to these specifications. The rate shall also include the cost of making fixing and removing of all centers and forms required for the work.
31. **The payment will be made on cumt. basis of the finished work.**