



GMDC GRAMYA VIKAS TRUST

C/o. GUJARAT MINERAL DEVELOPMENT CORPORATION LTD
(A Govt. of Gujarat Enterprise)
CIN :L14100GJ1963SGC001206
GST :24AAACG7987P1ZT

TENDER NO. : 7/LR/CONCRETE ROAD WORK/2022

**Construction of Concrete road at Amalzar and Gundecha -2 village
near
GMDC lignite Project Rajpardi,
Tal: Jhagadia, Dist- Bharuh**

TECHNICAL BID-IV

GUJARAT MINERAL DEVELOPMENT CORPORATION LTD
(A Govt. of Gujarat Enterprise)
Khanij Bhavan, near University Ground, 132 feet Ring Vastrapur,
Ahmedabad-380 052
Phone: (079) 27913200, 27913501 Fax No: (079) 27911540
Email: civil@gmdcltd.com Website: www.gmdcltd.com

ITEM NO.1:

Box cutting the road surface to proper slope and camber for making a base for road working incl. removing the excavated stuff and depositing on the road side slopes as directed for all lead including making good the bottom with rolling by using per roller of minimum 8 to 10 MT capacity with watering, consolidation, machineries, tools, tackles, manpower, labours etc. complete.

2.1. Scope

This work shall consist of excavation, removal and satisfactory disposal of all materials necessary for the construction of roadway, side drains and waterways in accordance with requirements of these Specifications and the lines, grades and cross-sections shown in the drawings or as indicated by the Engineer. It shall include the hauling and stacking of or hauling to sites of embankment and subgrade construction, suitable cut materials as required, as also the disposal of unsuitable cut materials in specified manner, trimming and finishing of the road to specified dimensions or as directed by the Engineer.

2.2 Classification of Excavated Material

2.2.1. Classification: All materials involved in excavation shall be classified by the Engineer in the following manner :

(a) Soil

This shall comprise topsoil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose moorum, a mixture of these and similar material which yields to the ordinary application of pick, spade and/or shovel, rake or other ordinary digging implement. Removal of gravel or any other nodular material having dimension in any one direction not exceeding 75 mm occurring in such strata 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 crow bars, 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 surface such as water bound and bitumen/tar bound; soling of roads, paths etc. and hard core; compact moorum or stabilised soil requiring grafting tool or pick or both and shovel, closely applied; gravel and cobble stone having maximum dimension in any one direction between 75 and 300 mm;
- (iii) lime concrete, stone masonry in lime mortar and brick work in lime/cement mortar below ground level, reinforced cement concrete which may be broken up with crow bars or picks and stone masonry in cement mortar below ground level; and
- (iv) boulders which do not require blasting having maximum dimension in any direction of more than 300mm, 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 (reinforcement cut through but not separated from the concrete) below ground level ; and
 - (iii) boulders requiring blasting.
- (d) Hard Rock (blasting prohibited)

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

- (e) Marshy Soil

This shall include soils like soft clays and peats excavated below the original ground level of marshes and swamps and soils excavated from other areas requiring continuous pumping or bailing out of water.

2.2.2. Authority for classification: The classification of excavation shall be decided by the Engineer and his decision shall be final and binding on the Contractor. Merely the use of explosives in excavation will not be considered as a reason for higher classification unless blasting is clearly necessary in the opinion of the Engineer.

2.3. Construction Operations

2.3.1. Setting out : After the site has been cleared as per Clause 201, the limits of excavation shall be set out true to lines, 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 bench marks. The Contractor shall be responsible for the maintenance of bench marks and other marks and stakes as long as in the opinion of the Engineer, they are required for the work.

2.3.2. Stripping and storing topsoil: When so directed by the Engineer, the topsoil existing over the sites of excavation shall be stripped to specified depths constituting Horizon "A" and stockpiled at designated locations for re-use in covering embankment slopes, cut slopes, berms and other disturbed areas where re-vegetation is desired. Prior to stripping the topsoil, all trees, shrubs etc. shall be removed along with their roots, with approval of the Engineer.

2.3.3 Excavation - General: All excavations shall be carried out in conformity with the directions laid here-in-under and in a manner approved by the Engineer. The work shall be so done that the suitable materials available from excavation are satisfactorily utilized as decided upon beforehand.

While planning or executing excavations, the Contractor shall take all adequate precautions against soil erosion, water pollution etc. as per Clause 306, and take appropriate drainage measures to keep the site free of water in accordance with Clause 311.

The excavations shall conform to the lines, grades, side slopes and levels shown on the drawings or as directed by the Engineer. The Contractor shall not excavate outside the limits of excavation. Subject to the permitted tolerances, any excess depth/width excavated beyond the specified levels/dimensions on the drawings shall be made good at the cost of the Contractor with suitable material of characteristics similar to that removed and compacted to the requirements of Clause 305.

All debris and loose material on the slopes of cuttings shall be removed. No backfilling shall be allowed to obtain required slopes excepting that when boulders or soft materials are encountered in cut slopes, these shall be excavated to approved depth on instructions of the Engineer and the resulting cavities filled with suitable material and thoroughly compacted in an approved manner.

After excavation, the sides of excavated area shall be trimmed and the area contoured to minimize erosion and ponding, allowing for natural drainage to take place. If trees were removed, new trees shall be planted, as directed by the Engineer. The cost of planting new trees shall be deemed to be incidental to the work.

2.3.4. Methods, tools and equipment: Only such methods, tools and equipment as approved by the Engineer shall be adopted/used in the work. If so desired by the Engineer, the Contractor shall demonstrate the efficacy of the type of equipment to be used before the commencement of work.

2.3.5. Rock excavation: Rock, when encountered in road excavation, shall be removed upto the formation level or as otherwise indicated on the drawings. Where, however, unstable shales or other unsuitable materials are encountered at the formation level, these shall be excavated to the extent of 500 mm below the formation level or as otherwise specified. In all cases, the excavation operations shall be so carried out that at no point on cut formation the rock protrudes above the specified levels. Rocks and large boulders which are likely to cause differential settlement and also local drainage problems should be removed to the extent of 500 mm below the formation level in full formation width including drains and cut through the side drains.

Where excavation is done to levels lower than those specified, the excess excavation shall be made good as per Clauses 301.3.3 and 301.6 to the satisfaction of the Engineer.

Slopes in rock cutting shall be finished to uniform lines corresponding to slope lines shown on the drawings or as directed by the Engineer. Notwithstanding the foregoing, all loose pieces of rock on excavated slope surface which move when pierced by a crowbar shall be removed.

Where blasting is to be resorted to, the same shall be carried out to Clause 302 and all precautions indicated therein observed.

Where presplitting is prescribed to be done for the establishment of a specified slope in rock excavation, the same shall be carried out to Clause 303.

2.3.6 Marsh excavation: The excavation of soils from marshes/swamps shall be carried out as per the programme approved by the Engineer.

Excavation of marshes shall begin at one end and proceed in one direction across the entire marsh immediately ahead of backfilling. The method and sequence of excavating and backfilling shall be such as to ensure, to the extent practicable, the complete removal or displacement of all muck from within the lateral limits called for on the drawings or as staked by the Engineer, and to the bottom of the marsh, firm support or levels indicated.

2.3.7. Excavation of road shoulders/verge/median for widening of pavement or providing treated shoulders: In works involving widening of existing pavements or providing treated shoulders, unless otherwise specified, the shoulder/verge/median shall be removed to their full width and to levels shown on drawings or as indicated by the Engineer. While doing so, care shall be taken to see that no portion of the existing pavement designated for retention is loosened or disturbed. If the existing pavement gets disturbed or loosened, it shall be dismantled and cut to a regular shape with sides vertical and the disturbed/loosened portion removed completely and relaid as directed by the Engineer, at the cost of the Contractor.

2.3.8. Excavation for surface/sub-surface drains: Where the Contract provides for construction of surface/sub-surface drains to Clause 309, excavation for these shall be carried out in proper sequence with other works as approved by the Engineer.

2.3.9 Slides: If slips, slides, over-breaks or subsidence occur in cuttings during the process of construction, they shall be removed at the cost of Contractor as ordered by the Engineer. Adequate precautions shall be taken to ensure that during construction, the slopes are not rendered unstable or give rise to recurrent slides after construction. If finished slopes slide into the roadway subsequently, such slides shall be removed and paid for at the Contract rate for the class of excavation involved, provided the slides are not due to any negligence on the part of the Contractor. The classification of the debris material from the slips, slides etc. shall conform to its condition at the time of removal and payment made accordingly regardless of its condition earlier.

2.3.10. Dewatering: If water is met with in the excavations due to springs, seepage, rain or other causes, it shall be removed by suitable diversions, pumping or bailing out and the excavation kept dry whenever so required or directed by the Engineer. Care shall be taken to discharge the drained water into suitable outlets as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair/restore to the original condition at his own cost or compensate for the damage.

2.3.11. Disposal of excavated materials: All the excavated materials shall be the property of the Employer. The material obtained from the excavation of roadway, shoulders, verges, drains, cross-drainage works etc., shall be used for filling up of (i) roadway embankment, (ii) the existing pits in the right-of way and (iii) for landscaping of the road as directed by the Engineer, including levelling and spreading with all lifts and lead upto 1000 m and no extra payment shall be made for the same.

All hard materials, such as hard moorum, rubble, etc., not intended for use as above shall be stacked neatly on specified land as directed by the Engineer with all lifts and lead upto 1000 m.

Unsuitable and surplus material not intended for use within the lead specified above shall also, if necessary, be transported with all lifts and lead beyond initial 1000 m, disposed of or used as directed by the Engineer.

2.3.12 Backfilling: Backfilling of masonry/concrete/hume pipe drain excavation shall be done with approved material after concrete/masonry/hume pipe is fully set and carried out in such a way as not to cause undue thrust on any part of the structure and /or not to cause differential settlement. All space between the drain walls and the side of the excavation shall be refilled to the original surface making due allowance for settlement, in layers generally not exceeding 150 mm compacted thickness to the required density, using suitable compaction equipment such as mechanical tamper, rammer or plate compactor as directed by the Engineer.

2.4 Plying of Construction Traffic

Construction traffic shall not use the cut formation and finished subgrade without the prior permission of the Engineer. Any damage arising out of such use shall be made good by the Contractor at his own expense.

2.5 Preservation of Property

The Contractor shall undertake all reasonable precautions for the protection and preservation of any or all existing roadside trees, drains, sewers or other sub-surface drains, pipes, conduits and any other structures under or above ground, which may be affected by construction operations and which, in the opinion of the Engineer, shall be continued in use

without any change. Safety measures taken by the Contractor in this respect, shall be got approved from the Engineer. However, if any of these objects is damaged by reason of the Contractor's negligence, it shall be replaced or restored to the original condition at his expense. If the Contractor fails to do so, within the required time as directed by the Engineer or if, in the opinion of the Engineer, the actions initiated by the Contractor to replace/restore the damaged objects are not satisfactory, the Engineer shall arrange the replacement/restoration directly through any other agency at the risk and cost of the Contractor after issuing a prior notice to the effect.

2.6. Preparation of Cut Formation

The cut formation, which serves as a subgrade, shall be prepared to receive the sub-base/base course as directed by the Engineer.

Where the material in the subgrade (that is within 500 mm from the lowest level of the pavement) has a density less than specified in Table 300-2, the same shall be loosened to a depth of 500mm and compacted in layers in accordance with the requirements of Clause 305.

Any unsuitable material encountered in subgrade level shall be removed as directed by the Engineer and replaced with suitable material compacted in accordance with Clause 305.

In rocky formations, the surface irregularities shall be corrected and the levels brought up to the specified elevation with granular base material as directed by the Engineer, laid and compacted in accordance with the respective Specifications for these materials. The unsuitable material shall be disposed of in accordance with Clause 301.3.11. After satisfying the density requirements, the cut formation shall be prepared to receive the subbase/base course in accordance with Clauses 310 and 311 to receive the sub-base/base course.

2.7. Finishing Operations

Finishing operations shall include the work of properly shaping and dressing all excavated surfaces.

When completed, no point on the slopes shall vary from the designated slopes by more than 150 mm measured at right angles to the slope, except where excavation is in rock (hard or soft) where no point shall vary more than 300 mm from the designated slope. In no case shall any portion of the slope encroach on the roadway.

The finished cut formation shall satisfy the surface tolerances described in Clause 902.

Where directed, the topsoil removed earlier and conserved (Clauses 301.3.2. and 305.3.3) shall be spread over cut slopes, where feasible, berms and other disturbed areas. Slopes may be roughened and moistened slightly, prior to the application of topsoil, in order to provide satisfactory bond. The depth of topsoil shall be sufficient to sustain plant growth, the usual thickness being from 75 mm to 100 mm.

2.8. Measurements for Payment

Excavation for roadway shall be measured by taking cross-sections at suitable intervals in the original position before the work starts and after its completion and computing the volume in cu.m. by the method of average end areas for each class of material encountered. Where it is not feasible to compute volumes by this method because of erratic location of isolated deposits, the volumes shall be computed by other accepted methods.

At the option of the Engineer, the Contractor shall leave depth indicators during excavations of such shape and size and in such positions as directed so as to indicate the

original ground level as accurately as possible. The Contractor shall see that these remain intact till the final measurements are taken.

For rock excavation, the overburden shall be removed first so that necessary cross-sections could be taken for measurement. Where cross sectional measurements could not be taken due to irregular configuration or where the rock is admixed with other classes of materials, the volumes shall be computed on the basis of stacks of excavated rubble after making 35 per cent deduction therefrom. When volumes are calculated in this manner for excavated material other than rock, deduction made will be to the extent of 16 per cent of stacked volumes.

Works involved in the preparation of cut formation shall be measured in units indicated below :

(i)	Loosening and recompacting the loosened material at subgrade	...cu. m.
(ii)	Loosening and removal of unsuitable material and replacing with a suitable material and compacting to required density	...cu. m.
(iii)	Preparing rocky subgrade	...sq. m..
(iv)	Stripping including storing and reapplication of topsoil	...cu. m.
(v)	Disposal of surplus material beyond initial 1000 m lead	..cu. m.

2.9. Rates

2.9.1. The Contract unit rate for the items of roadway and drain excavation shall be payment in full for carrying out the operations required for the individual items including full compensation for:

- (i) setting out;
- (ii) transporting the excavated materials and depositing the same on sites of embankments, spoil banks or stacking as directed within all lifts and lead upto 1000 m or as otherwise specified;
- (iii) trimming bottoms and slopes of excavation;
- (iv) dewatering;
- (v) keeping the work free of water as per Clause 311; and
- (vi) all labour, materials, tools, equipment, safety measures, testing and incidentals necessary to complete the work to Specifications.

Provided, however, where presplitting is prescribed to achieve a specified slope in rock excavation, the same shall be paid for vide Clause 303.5.

2.9.2. The Contract unit rate for loosening and recompacting the loosened materials at subgrade shall include full compensation for loosening to the specified depth, including breaking clods, spreading in layers, watering where necessary and compacting to the requirements.

2.9.3. Clause 301.9.1 and 305.8 shall apply as regards Contract unit rate for item of removal of unsuitable material and replacement with suitable material respectively.

2.9.4. The Contract unit rate for item of preparing rocky subgrade as per Clause 301.6 shall be full compensation for providing, laying and compacting granular base material for correcting surface irregularities including all materials, labour and incidentals necessary to complete the work and all leads and lifts.

2.9.5. The Contract unit rate for the items of stripping and storing topsoil and of reapplication of topsoil shall include full compensation for all the necessary operations including all lifts, but leads upto 1000 m.

2.9.6. The Contract unit for disposal of surplus earth from roadway and drain excavation shall be full compensation for all labour, equipment, tools and incidentals necessary on account of the additional haul or transportation involved beyond the initial lead of 1000 m.

ITEM NO.2:

Supplying & spreading of coarse clean sharp sand for crust in layers, including transportation, loading, unloading, ramming with labours, tools, tackles etc. as per direction of Engineer in charge.

1. The sand for the purpose shall be of approved quality. Any material which is found inferior shall be rejected and the contractor shall remove such rejected materials from the site at his own cost. The material shall be approved by the Executive Engineer of his authorized agent
2. River or nala or sea sand required for the work shall be clear, sound, properly graded, free from organic material silt clay etc. and shall be got approved by the Engineer – in – charge. The sand shall be obtained and brought from the source approved by the Engineer-in-charge. The sand shall be well graded.
3. Stacking shall be done by filling in the standard steel boxes of 2 m X 1.5 m X 0.5 m size which shall be supplied by the department if available on rent. Otherwise contractor shall make his own arrangement. No deduction for voids shall be made from the grade measurements. Where any doubt exists as to whether the quality of stacked sand in an hectometer is not confirming with the cubic content of the standard pharas (2 X1.5X0.5 M) the same shall be got corrected by the contractor if so order by the Engineer-in-charge for which no extra pay shall be claimed by the contractor. If the quality of the sand in any stack in a particular hectometer is found to less than the standard measurement viz., 1.5 cmt. The entire collection in the hectometer shall be paid on the basis of the quality so found. Regular stacks shall be done by the contractor on a fairly level ground. Stacking of the sand shall be done in a manner as directed by the Engineer-in –Charge.
4. For road work complete stacking of sand as per requirement shall be carried out in 2 km length before spreading. The collection shall always, be commenced at one end of the km and be continuously towards the other end unless the Engineer-in-charge shall direct otherwise.
5. The payment shall be made on cubic meter basis without deduction for voids. The contractor shall maintain all stacks in regular and proper size till the whole material are collected, measured and finally accepted by the department. The spreading of the material shall not be allowed till the materials are fully stacked and completed kilometer wise.
6. The rate includes cost of collection, conveyance to the site with all lead and lift and filling the boxes including all labour, tools equipment and other incidental expense.

7. The rate quoted are inclusive of all such tools , duties, fees ,royalties , taxes etc.

8. Preparation of base:

The sub-grade/sub-base/base to receive the water bound macadam course shall be prepared to the specified grade and camber and made free of dust and other extraneous material. Any ruts or soil yielding places shall be corrected in an approved manner and roiled until from where water bound macadam is to be laid over. An existing black topped surface 50 mm x 50 mm furrows shall be cut at an angle of 45 degrees to the road at 1 meter intervals in the latter before laying the coarse aggregate.

9. Spreading course aggregate:

The coarse aggregates shall be spread uniformly upon the prepared base in arch quantities that the thickness of the compacted layer is 100 mm (or grading 1 and 75-100 mm for grading 2 and 3 as specified. The spreading shall be done from stock piles along the side of the roadway or directly from vehicle. In no case shall the aggregate be dumped in heaps directly on the surface prepared to receive the aggregate nor shall hauling over uncarpeted or partiality compacted base be permitted. The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. No segregation on large or fine particles shall be allowed and the coarse aggregate as may be required. No segregation of large or line particles shall by allowed and the coarse aggregate as spread shall be of uniform gradation with no pockets of fine material. The coarse aggregate shall not normally be spread more than 3 days in advance of the subsequent construction operations.

10. Rolling:

Immediately following the spreading of the coarse aggregate rolling shall be started with three wheeled power rollers of 6 to 10 tonne capacity or tandem or vibratory rollers of approved type. The weight of the roller shall depend upon the type of the aggregate and as may be indicated by the Engineer-in-charge. Except on super elevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the center. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to the center line of the road. In successive passes uniformly lapping proceeding tracks by at least one half widths. Rolling shall continue until the aggregate are thoroughly keyed and the creeping of aggregates ahead or toiler is longer visible, during rolling slight sprinkling of water may be done. If necessary rolling shall not be done when the sub grade is soft or yielding or when it causes a wave-like motion in the sub grade or sub-base course. The rolled surface shall be checked transversely and longitudinally with templates and any irregularities corrected by loosening the surface, adding and removing necessary amounts of aggregates and re-rolling until the entire surface conforms to desired number and grade, in no case shall the use of screenings be permitted to make up depressions.

11. Application of screenings/ sand/ gritty material:

After the coarse aggregate has been rolled to Clause 3.3 screenings/sand/gritty material to completely till the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application-Dry rolling shall be done while the screenings /sand/gritty material are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregate. The screenings/sand/gritty material shall not be dumped in piles but spread uniformly in

successive thin layers either by the spreading motion of hand shovels or by mechanical spreaders or directly from trucks. Trucks operation for spreading the screenings/sand/gritty material shall be driven as not to disturb the coarse aggregate. The screenings/approved quality sand/gritty material shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms, hand-brooms or both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregate.

The spreading, rolling and brooming of screening/sand/gritty material shall be carried out in only such lengths of the road which could be completed within one day's operation.

12. Sprinkling and grouting:

Alter the screenings /sand/gritty material have been applied the surface shall be continuously sprinkled with water, swept and rolled Hand brooms shall be used to sweep the wet screenings /sand/gritty material into void and to distribute them evenly. The sprinkling sweeping and rolling operations shall be continued with additional screenings applied as necessary until the coarse aggregate has been thoroughly well-bonded and firmly set in full depth and a grout has been formed of screenings /sand/gritty material. Care shall be taken to see that the base or sub grade does not get damaged due to the addition of excessive quantities of water during construction.

13. Setting and drying:

Alter the final compaction of water bound macadam course, the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings /sand/gritty material as directed, slightly sprinkled with water if necessary and roiled. No traffic shall be allowed on the road until the macadam has set. The Engineer-in-charge shall have the discretion to stop having traffic from using the completed water bound macadam course if in his opinion it would cause excessive from to the surface.

14. Surface Finish:

The surface finish of construction shall confirm to the following requirements:

15. General:

All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings or as directed by the Engineer-in-charge subject to the permitted tolerances described hereinafter.

15.1. Horizontal Alignments:

Horizontal alignments shall be reckoned with respect to the centre line of the carriage way as shown on the drawings. The edges of the carriage way as constructed shall be correct within a tolerance of ± 25 mm thick. The corresponding tolerance for edges of the roadway and lower layers of pavements shall a 40 mm.

15.2. Longitudinal profile:

The levels of the sub grade and different pavement course as constructed shall not - very from those calculated with reference to the longitudinal and cross-profile of the

road shown on the drawings or as directed by the Engineer-in charge Beyond the tolerances mentioned below;

Sub grade ± 25 mm

Sub-base ± 20 mm

Base course ± 15 mm

Wearing course ± 10 mm

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

15.3. Surface Regularity:

The surface regularity of completed sub-base, base course and wearing surface in the longitudinal and transverse directions shall be within the tolerance indicated in Table below:

Table show permitted tolerance of surface Regularity for payment course

Sr. No.	Type of Construction	Longitudinal Profile with 3 meter straight edge		Cross profile
		Maximum permissible undulation mm	Maximum number of undulations permitted in any 300 m, length exceeding	Maximum Permissible variation from specified Profile under camber
1	Water Bound Macadam with Normal size metal (20-50 mm and 40-63 mm size)	12	30	8

The longitudinal profile shall be checked with a 3 meter 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 cambers at intervals of 10 meters.

15.4. Rectification:

Where the surface irregularly of sub grade and the various pavement course fall outside the specified tolerances, the shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer-in-charge. When the surface is high or low, the top 75 mm shall be scarified, reshaped with added material as necessary and recompact as per the specification of W.B.M. The area treated at a place shall not be less than 5 meters long and 2 meters wide.

ITEM NO.3:

Construction of Granular sub base (grade-II) by providing well graded material mixing in a mechanical mix plant at OMC carriage of mixed material to work at site, spreading in uniform layer (two layers) with motor grader on prepared surface and compacting with smooth wheel roller to 80/100 KN static weight achieve desired density technically complete for grading complete as per clause 401 of MORTH. As per detail specification mentioned in technical bid.

4. 1. Scope

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

4.2. Materials

Granular sub-base material shall be natural sand, moorum, gravel, crushed stone, or combination thereof. Materials like crushed slag, crushed concrete, crushed brick and kankar may be allowed with the approval of the Engineer. The material shall be free from organic or other deleterious constituents and conform with the requirements in Table 400-1.

TABLE 400-1 SPECIFICATION FOR GRANULAR SUB-BASE MATERIAL

Grading Sieve Size (mm)	Percent by weight passing
53	100
37.5	95 - 100
19.0	70 - 100
9.5	50 - 90
4.75	35 - 85
2.36	25 - 65
0.425	10 - 40
0.075	4 - 25
Liquid Limit (%)	# 25
Plasticity Index (%)	# 6
Soaked CBR (%)*	# 30

* At a depth greater than 480mm below top of base course the strength requirement can be relaxed to a soaked CBR of 15 %. This material shall be termed a lower sub-base material.

TABLE 400-1. GRADING FOR CLOSE-GRADED GRANULAR SUB-BASE MATERIALS

IS Sieve <i>Designation</i>	Per cent by weight passing the IS sieve		
	<i>Grading I</i>	<i>Grading II</i>	<i>Grading III</i>
75.0 mm	100	-	-
53.0 mm	80-100	100	-
26.5 mm	55-90	70-100	100
9.50 mm	35-65	50-80	65-95
4.75 mm	25-55	40-65	50-80
2.36 mm	20-40	30-50	40-65
0.425 mm	10-25	15-25	20-35
0.075 mm	3-10	3-10	3-10
CBR Value (Minimum)	30	25	20

TABLE 400-2. GRADING FOR COARSE GRADED GRANULAR SUB-BASE MATERIALS

IS Sieve	Per cent by weight passing the IS Sieve		
Designation	Grading I	Grading II	Grading III
75.0 mm	100	-	-
53.0 mm		100	
26.5 mm	55-75	50-80	100
9.50 mm			
4.75 mm	10-30	15-35	25-45
2.36 mm			
0.425 mm			
0.075 mm	<10	<10	<10
CBR Value (Minimum)	30	25	20

Note : The material passing 425 micron (0.425 mm) sieve for all the three gradings when tested according to IS : 2720 (Part 5) shall have liquid limit and plasticity index not more than 25 and 6 percent respectively.

4.3. Strength of sub-base

It shall be ensured prior to actual execution that the material to be used in the sub-base satisfies the requirements of CBR and other physical requirements when compacted and finished.

When directed by the Engineer, this shall be verified by performing CBR tests in the laboratory as required on specimens remolded at field dry density and moisture content and any other tests for the "quality" of materials, as may be necessary.

4.4. Construction Operations

4.4.1 . Preparation of subgrade: Immediately prior to the laying of sub-base, the subgrade already finished to Clause 301 or 305 of MOST as applicable shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with two passes of 80-100 kN smooth wheeled roller.

The existing pavement, where it is to be overlaid by a granular base and embankment of less than 500mm total thickness shall be scarified in accordance with Sub-Clause 501.3.2 of MOST. Where the existing pavement contains multiple bituminous layers the scarification shall be to the underside of the lowest bituminous layer. General areas within the Works where multiple bituminous layers exist will be advised by the Engineer. The Contractor will verify that all bituminous layers have been removed using appropriate methods approved by the Engineer. The bituminous surfacing material removed from the existing pavement may be used in other parts of the works provided it complies with the relevant specification clauses.

After scarification and removal to the satisfaction of the Engineer of the bitumen surface from the existing pavement to be overlaid, the existing pavement shall be lightly sprinkled with water if necessary and rolled with three passes of an 80-100kN smooth wheeled roller. The existing pavement shall then be proof rolled with a 18 tonne single drum vibrating roller in the presence of the Engineer who shall determine the suitability of the existing pavement for overlay.

After proof rolling, the surface of the existing pavement shall be lightly tined as directed by the Engineer where the overlay includes a sub-base layer but the compacted depth of the sub-base layer is less than 75mm. In other cases tining is not necessary.”

4.4.2. Spreading and compacting: Where a lower sub-base material is used the minimum compacted layer thickness shall be 75mm. The sub-base material of grading specified in the Contract shall be spread on the prepared subgrade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation or other means as approved by the Engineer.

When the sub-base material consists of combination of materials mentioned in Clause 7.2.1. mixing shall be done mechanically by the mix-in-place method.

Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs. The equipment used for mix-in-place construction shall be a rotavator or similar approved equipment capable of mixing the material to the desired degree. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for the work.

Moisture content of the loose material shall be checked in accordance with IS : 2720 (Part 2) and suitably by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 percent above to 2 percent below the optimum moisture content corresponding to IS : 2720 (Part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means like disc harrows, rotavators until the layer is uniformly wet.

Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer upto 225 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight with plain drum or pad foot-drum or heavy pneumatic tyred roller of minimum 200 to 300 kN weight having a minimum tyre pressure of 0.7 MN/m² or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall and super elevation and shall commence at the edges and progress towards the centre for portions having crossfall on both sides.

Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS: 2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compact.

4.5. Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902 of MOST.

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 of MOST.

4.6. Arrangements for Traffic

During the period of construction, arrangement of traffic shall be maintained in accordance with Clause 112 of MOST.

4.7. Measurements for Payment

Granular sub-base shall be measured as finished work in position in cubic meters under the following items:

- i. Upper sub-base
- ii. Lower sub-base (greater than 480mm below top of base course).

The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

Preparation of the surface of the existing pavement to be overlaid shall be measured in sq.m.

4.8 . Rate

The Contract unit rate for granular sub-base shall be payment in full for carrying out the required operations including full compensation for:

- (i) making arrangements for traffic to Clause 112 except for construction of diversions;
- (ii) furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lifts;
- (iii) all labour, tools, equipment and incidentals to complete the work to the Specifications;
- (iv) carrying out the work in part widths of road where directed; and
- (v) carrying out the required tests for quality control.

The rate for preparation of existing pavement in areas of overlay shall include all items necessary to prepare the surface for overlay including scarifying and removal of bituminous surfacing, watering and re-compaction of the surface, proof rolling and re-scarifying before placement of sub-base where necessary. Payment for preparation of existing pavement in areas of overlay shall be made only for areas of existing pavement retained for overlay and treated in the specified manner.

ITEM NO.4:

Construction of dry lean cement concrete Sub- base over a prepared sub-grade with coarse and fine aggregate conforming to IS: 383, the size of coarse aggregate not exceeding 25 mm, aggregate cement ratio not to exceed 15:1, aggregate gradation after blending to be as per table 600-1, cement content not to be less than 150 kg/ cum, optimum moisture content to be determined during trial length construction, concrete strength not to be less than 10 Mpa at 7 days, mixed in a

batching plant, transported to site, spreading the concrete with shovels, rakes and levelling to grade and camber, compacting with 8-10 tonnes vibratory roller, finishing and curing including finished in a continuous operation for completion of one panel, transportation, loading, unloading, ramming with labours, tools, tackles etc. as per direction of Engineer in charge.

1. Scope

- 1.1. The work shall consist of construction of dry lean concrete sub-base for cement concrete pavement in accordance with the requirements of these Specifications and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer. The work shall include furnishing of all plant and equipment, materials and Labour and performing all operations, in connection with the work, as approved by the Engineer.
- 1.2. The design parameters of dry lean concrete sub-base, viz., width, thickness, grade of concrete, details of joints, if any, etc. shall be as stipulated in the Contract drawings.

2. Materials

2.1. Source of Materials:

The Contractor shall indicate to the Engineer the source of all materials with relevant test data to be used in the lean concrete work sufficiently in advance and the approval of the Engineer for the same shall be obtained at least 45 days before the scheduled commencement of the work. If the Contractor later proposes to obtain the materials from a different source, he shall notify the Engineer for his approval at least 45 days before such materials are to be used.

2.2. Cement:

Any of the following types of cement may be used with prior approval of the Engineer:

- | | | | |
|-------|---------------------------|-----|------|
| (i) | Ordinary Portland cement | IS: | 269 |
| (ii) | Portland Slag Cement | IS: | 455 |
| (iii) | Portland Pozzolona Cement | IS: | 1489 |

If the sub-grade is found to consist of soluble sulphates in a concentration more than 0.5 per cent, cement used shall be sulphate resistant and shall conform to IS: 6909.

Cement to be used may preferably be obtained in bulk form. It shall be stored in accordance with stipulations contained in Clause 1014 and shall be subjected to acceptance test prior to its immediate use.

3. Aggregates:

- 3.1. Aggregates for lean concrete shall be natural material complying with IS: 383. The aggregates shall not be alkali reactive. The limits of deleterious materials shall not exceed the requirements set out in IS: 383. In case the Engineer considers that the aggregates are not free from this, the same may be washed and drained for at least 72 hours before batching, as directed by the Engineer.

3.2. Coarse aggregate:

Coarse aggregate shall consist of clean, hard, strong, dense, non-porous and durable pieces of crushed stone or crushed gravel and shall be devoid of pieces of disintegrated stone, soft, flaky, elongated, very angular or splintery pieces. The maximum size of the coarse aggregate shall be 25 mm. The coarse aggregate shall comply with Clause 602.2.4.2.

3.3. Fine aggregate:

The fine aggregate shall consist of clean, natural sand or crushed stone sand or a combination of the two and shall conform to IS: 383. Fine aggregate shall be free from soft particles, clay, shale, loam, cemented particles, mica, organic and other foreign matter. The fine aggregate shall comply with Clause 602.2.4.3.

- 3.4. The coarse and fine aggregates may be obtained in either of the following manner:
- (i) In separate nominal sizes of coarse and fine aggregates and mixed together intimately before use.
 - (ii) Separately as 25 mm nominal single size, 12.5 mm nominal size graded Aggregates and fine aggregate of crushed stone dust or sand or a combination of these two. The material after blending shall conform to the grading as indicated in Table 600-1.

TABLE 600-1. AGGREGATE GRADATION FOR DRY LEAN CONCRETE

Sieve Designation	Percentage passing the sieve by weight
26.50mm	100
19.00mm	80-100
9.50mm	55-75
4.75mm	35-60
600.00 micron	10-35
75.00 micron	0-8

3.4. Water:

Water used for mixing and curing of concrete shall be clean and free from injurious amounts of oil, salt, acid, vegetable matter or other substances harmful to the finished concrete. It shall meet the requirements stipulated in IS: 456.

3.5. Storage of materials:

All materials shall be stored in accordance with the provisions of Clause 1014 of these Specifications and other relevant IS Specifications. All efforts must be made to store the materials in proper places so as to prevent their deterioration or contamination by foreign matter and to ensure their satisfactory quality and fitness for use in the work. The storage place must also permit easy inspection, removal and storage of materials. All such materials even though stored in approved godowns must be subjected to acceptance test immediately prior to their use. The requirement of storage yard specified in Clause 602.2.9 shall also be applicable.

4. Proportioning of Materials for the Mix

- 4.1. The mix shall be proportioned with a maximum aggregate cement ratio of 15:1. The water content shall be adjusted to the optimum as per Clause 601.3.2 of MOST for facilitating compaction by rolling. The strength and density requirements of concrete shall be determined in accordance with Clause 601.6 by making trial mixes.

4.2. Moisture content:

The right amount of water for the lean concrete in the main work shall be decided so as to ensure full compaction under rolling and shall be assessed at the time of rolling the trial length. Too much water will cause the lean concrete to be heaving up before the wheels and picked up on the wheels of the roller and too little will lead to inadequate compaction, a low in-situ strength and an open- textured surface.

The optimum water content shall be determined and demonstrated by rolling during trial length construction and the optimum moisture content and degree of compaction shall be got approved from the Engineer. While laying in the main work, the lean concrete shall have moisture content between the optimum and optimum +2 per cent, keeping in view the effectiveness of compaction achieved and to compensate for evaporation losses.

4.3. Cement content:

The minimum cement content in the lean concrete shall not be less than 150 kg/cu.m. of concrete. If this minimum cement content is not sufficient to produce concrete of the

specified strength, it shall be increased as necessary without additional cost compensation to the Contractor.

4.4. Concrete strength:

The average compressive strength of each consecutive group of 5 cubes made in accordance with Clause 903.5.1.1 shall not be less than 10 MPa at 7 days. In addition, the minimum compressive strength of any individual cube shall not be less than 7.5 MPa at 7 days. The design mix complying with the above Clauses shall be got approved from the Engineer and demonstrated in the trial length construction.

4.5. Sub-grade

The sub-grade shall conform to the grades and cross sections shown on the drawings and shall be uniformly compacted to the design strength in accordance with these Specifications and Specification stipulated in the Contract. The lean concrete sub-base shall not be laid on a sub-grade softened by rain after its final preparation; surface trenches and soft spots, if any, must be properly back-filled and compacted to avoid any weak or soft spot. As far as possible, the construction traffic shall be avoided on the prepared sub-grade. A day before placing of the sub-base, the sub-grade surface shall be given a fine spray of water and rolled with one or two passes of a smooth wheeled roller after a lapse of 2-3 hours in order to stabilize loose surface. If Engineer feels it necessary, another fine spray of water may be applied just before placing sub-base.

5. Construction

5.1. General:

The place and programme of the lean concrete sub-base construction shall be matching suitably with the programme of construction of the cement concrete pavement over it. The sub-base shall be overlaid with cement concrete pavement only after 7 days after sub-base construction.

5.2. Batching and mixing:

The batching plant shall be capable of proportioning the materials by weight, each type of material being weighed separately in accordance with Clause 602.9.3.2 of MOST. The cement from the bulk stock shall be weighed separately from the aggregates. The capacity of batching and mixing plant shall be at least 25 per cent higher than the proposed capacity for the laying arrangements. The batching and mixing shall be carried out preferably in a forced action central batching and mixing plant having necessary automatic controls to ensure accurate proportioning and mixing. Other types of mixers shall be permitted subject to demonstration of their satisfactory performance during the trial length. The type and capacity of the plant shall be got approved by the Engineer before commencement of the trial length. The weighing balances shall be calibrated by weighing the aggregates, cement, water and admixtures physically either by weighing with large weighing machine or in a weigh bridge. The accuracy of weighing scales of the batching plant shall be within ± 2 per cent in the case of aggregates and ± 1 percent in the case of cement and water.

The design features of Batching Plant should be such that the shifting operations of the plant will not take very long time when they are to be shifted from place to place with the progress of the work.

5.3. Transporting:

Plant mix lean concrete shall be discharged immediately from the mixer, transported directly to the point where it is to be laid and protected from the weather by covering the

tippers/ dumpers with tarpaulin during transit. The concrete shall be transported by tipping trucks, sufficient in number to ensure a continuous supply of material to feed the laying equipment to work at a uniform speed and in an uninterrupted manner. The lead of the batching plant to paving site shall be such that the travel time available from mixing to paving as specified in Clause 601.5.5.2 of MOST will be adhered to.

5.4. Placing:

Lean concrete shall be laid/placed by a paver with electronic sensor. The equipment shall be capable of laying the material in one layer in an even manner without segregation, so that after compaction the total thickness is as specified. The paving machine shall have high amplitude tamping bars to give good initial compaction to the sub-base.

The laying of the two-lane road sub-base may be done either in full width or lane by lane. Preferably the lean concrete shall be placed and compacted across the full width of the road, by constructing it in one go or in two lanes running forward simultaneously. Transverse and longitudinal construction joints shall be staggered by 500-1000 mm and 200-400 mm respectively from the corresponding joints in the overlaying concrete slabs.

5.5. Compaction

- 5.5.1. The compaction shall be carried out immediately after the material is laid and leveled. In order to ensure thorough compaction which is essential, rolling shall be continued on the full width till there is no further visible movement under the roller and the surface is closed. The minimum dry density obtained shall be 97 per cent of that achieved during the trial length construction vide Clause 601.7 of MOST. The densities achieved at the edges i.e. 0.5m from the edge shall not be less than 95 per cent of that achieved during the trial construction vide Clause 601.7 of MOST.
- 5.5.2. The spreading, compacting and finishing of the lean concrete shall be carried out as rapidly as possible and the operation shall be so arranged as to ensure that the time between the mixing of the first batch of concrete in any transverse section of the layer and the final finishing of the same shall not exceed 90 minutes when the concrete temperature is above 25 and below 30 degree Celsius and 120 minutes if less than 25 degree Celsius, this period may be reviewed by the Engineer in the light of the results of the trial run but in no case shall it exceed 2 hours. Work shall not proceed when the temperature of the concrete exceeds 30 degree Celsius. If necessary, chilled water or addition of ice may be resorted to for bringing down the temperature. It is desirable to stop concreting when the ambient temperature is above 35°C. After compaction has been completed, roller shall not stand on the compacted surface for the duration of the curing period except during commencement of next day work near the location where work was terminated the previous day.
- 5.5.3. Double drum smooth-wheeled vibratory rollers of minimum 80 to 100 KN static weights are considered to be suitable for rolling dry lean concrete. In case any other roller is proposed, the same shall be got approved from the Engineer, after demonstrating its performance. The number of passes required to obtain maximum compaction depends on the thickness of the lean concrete, the compatibility of the mix, and the weight and type of the roller etc., and the same as well as the total requirement of rollers for the job shall be determined during trial run by measuring the in-situ density and the scale of the work to be undertaken.
- 5.5.4. In addition to the number of passes required for compaction there shall be a preliminary pass without vibration to bed the lean concrete down and again a final pass without vibration to remove roller marks and to smooth the surface.

Special care and attention shall be exercised during compaction near joints, kerbs, channels, side forms and around gullies and manholes. In case adequate compaction is not achieved by the roller at these points, use of plate vibrator shall be made, if so directed by the Engineer.

- 5.5.5. The final lean concrete surface on completion of compaction and immediately before overlaying shall be well closed, free from movement under roller and free from ridges, low spots, cracks, loose material, pot holes, ruts or other defects. The final surface shall be inspected immediately on completion and all loose, segregated or defective areas shall be corrected by using fresh lean concrete material laid and compacted as per Specification. For repairing honeycombed surface, concrete with aggregates of size 10 mm and below shall be spread and compacted. It is necessary to check the level of the rolled surface for compliance. Any level/thickness deficiency should be corrected after applying concrete with aggregates of size 10 mm and below after roughening the surface. Similarly the surface regularity also should be checked with 3m straight edge. The deficiency should be made up with concrete, with aggregates of size 10 mm and below.
- 5.5.6. Segregation of concrete in the dumpers shall be controlled by premixing each fraction of the aggregates before loading in the bin of the batching plant, by moving the dumper back and forth while discharging the mix on it and other means. Even paving operation shall such that the mix does not segregate.

5.6. Joints:

Contraction and longitudinal joints shall be provided as per the drawing. At longitudinal or transverse construction joints, unless vertical forms are used, the edge of compacted material shall be cut back to a vertical face where the correct thickness of the properly compacted material has obtained.

5.7. Curing:

As soon as the lean concrete surface is compacted, curing shall commence. One of the following two methods shall be adopted:

(a) The initial curing shall be done by spraying with liquid curing compound. The curing compound shall be while pigmented or transparent type with water retention index of 90 per cent when tested in accordance with BS 7542. Curing compound shall be sprayed immediately after rolling is complete. As soon as the curing compound has lost its tackiness, the surface shall be covered with wet hessian for three days.

(b) Curing shall be done by covering the surface by gunny bags/hessian which shall be kept continuously moist for 7 days by sprinkling water.

6. Trial Mixes

The Contractor shall make trial mixes of dry lean concrete with moisture contents like 5.0, 5.5, 6.0, 6.5 and 7.0 per cent using cement content specified and the specified aggregate grading but without violating the requirement of aggregate-cement ratio specified in Clause 601.3.1. Optimum moisture and density shall be established by preparing cubes with varying moisture contents. Compaction of the mix shall be done in three layers with vibratory hammer fitted with a square or rectangular foot as described in Clause 903.5.1.1. After establishing the optimum moisture, a set of six cubes shall be cast at that moisture for the determination of compressive strength on the 3rd and the seventh day. Trial mixes shall be repeated if the strength is not satisfactory either by increasing cement content or using higher grade of cement. After the mix design is approved, the Contractor shall construct a trial section in accordance with Clause 601.7. If during the construction of the trial length, the optimum moisture content determined as above is found to be unsatisfactory, the Contractor may make suitable changes in the

moisture content to achieve a satisfactory mix. The cube specimens prepared with the changed moisture content should satisfy the strength requirement. Before production of the mix, natural moisture content of the aggregate should be determined on a day-to-day basis so that the moisture content could be adjusted. The mix finally designed should neither stick to the rollers, nor become too dry resulting in raveling of surface.

7. Trial Length

- 7.1. The trial length shall be constructed at least 14 days in advance of the proposed date of commencement of work. At least 30 days prior to the construction of the trial length, the Contractor shall submit for the Engineer's approval a "Method Statement" giving detailed description of the proposed materials, plant, equipment, mix proportion, and procedure for batching, mixing, laying, compaction and other construction procedures. The Engineer shall also approve the location and length of trial construction which shall be a minimum of 60 m length and for full width of the pavement. The trial length shall contain the construction of at least one transverse construction joint involving hardened concrete and freshly laid sub-base. The construction of trial length will be repeated till the Contractor proves his ability to satisfactorily construct the sub-base.
- 7.2. In order to determine and demonstrate the optimum moisture content which results in the maximum dry density of the mix compacted by the rolling equipment and the minimum cement content that is necessary to achieve the strength stipulated in the drawing, trial mixes shall be prepared as per Clause 601.6.
- 7.3. After the construction of the trial length, the in-situ density of the freshly laid material shall be determined by sand replacement method with 20 cm diameter density cone. Three density holes shall be made at locations equally spaced along a diagonal that bisects the trial length; average of these densities shall be determined. These main density holes shall not be made in the strip 50 cm from the edges. The average density obtained from the three samples collected shall be the reference density and is considered as 100 per cent. The field density of regular work will be compared with this reference density in accordance with Clause 601.5.5.1 and 903.5.1.2. A few cores may be cut as per the instructions of the Engineer to check segregation or any other deficiency.
- 7.4. The hardened concrete shall be cut over 3m width and reversed to inspect the bottom surface for any segregation taking place. The trial length shall be constructed after making necessary changes in the gradation of the mix to eliminate segregation of the mix. The lower surface shall not have honey-combing and the aggregates shall not be held loosely at the edges.
- 7.5. The trial length shall be outside the main works. The main work shall not start until the trial length has been approved by the Engineer. After approval has been given, the materials, mix proportions, moisture content, mixing, laying, compaction plant and construction procedures shall not be changed without the approval of the Engineer.

8. Tolerances for Surface Regularity, Level, Thickness, Density and Strength:

The tolerances for surface regularity, level, thickness, density and strength shall conform to the requirements given in Clause 903.5. Control of quality of materials and works shall be exercised by the Engineer in charge with Section 900.

9. Traffic

No heavy commercial vehicles like trucks and buses shall be permitted on the lean concrete sub-base after its construction. Light vehicles if unavoidable may, however, be allowed after 7 days of its construction with prior approval of the Engineer.

10. Measurements for Payment

The unit of measurement for dry lean concrete pavement shall be the cubic meter of concrete placed, based on the net plan areas for the Specified thickness shown on the drawings or as directed by the Engineer.

11. Rate

The Contract unit rate payable for dry lean concrete sub-base shall be payment in full for carrying out the required operations including full compensation for all labour, materials and equipment's, mixing, transport placing, compacting, finishing, curing, testing and incidentals to complete the work as per Specifications, all royalties, fees, storage and rents where necessary and all leads and lifts.

ITEM NO.5:

Construction of reinforced cement concrete pavement over a prepared sub-base of M-25 with 53 grade cement, coarse and fine aggregate conforming to IS:383, maximum size of coarse aggregate not exceeding 25mm, mixed in batching plant or in well equipped mixer machine as per approved mix design, transported to site, laid with trimix vacuum de watering process using vacuum dewatering , machine mechanical vibrator , mechanical floter , mechanical Towel for finishing by mixture as directed including cutting grooves of size etc. as per drawing and finished in a continuous operation for completion of one panel(4 mt X 4Mt, however dimension will be as per the drawing) including provision of contraction, expansion, construction and longitudinal joints, joint filler as per the drawings, separation membrane, sealant primer, joint sealent, bonding strip, cost of admixture as approved, curing compound, formwork, rails, guidewires, finishing to lines and grades as per drawings as specified in clause 602 of MORTH including the cost of all material, labour charges, transportation and conveyance, loading and unloading etc. complete with all lead and lift as per specification and directed by the engineer. (Min. Cement consumption:400 Kg/Cmt)

7.1. Scope

7.1.1 The work shall consist of construction of cement concrete pavement in accordance with the requirements of the Specifications and in conformity with the lines, grades and cross sections shown on the drawings. The work shall include furnishing of all plant and equipment, materials and labour and performing all operations in connection with the work, as approved by the Engineer.

7.1.2. The design parameters, viz., thickness of pavement slab, grade of concrete, joint details etc. shall be as stipulated in the drawings.

7.2. Materials

7.2.1. Source of materials: The Contractor shall indicate to the Engineer the source of all materials to be used in the concrete work with relevant test data sufficiently in advance, and the approval of the Engineer for the same shall be obtained at least 45 days before the scheduled commencement of the work. If the Contractor later proposes to obtain materials from a different source, he shall notify the Engineer for his approval, at least 45 days before such materials are to be used with relevant test data.

7.2.2. Cement: Any of the following types of cement capable of achieving the design strength may be used with prior approval of the Engineer, but the preference should be to use at least the 43 Grade or higher.

- i) Ordinary Portland Cement, 33 Grade IS : 269.
- ii) Ordinary Portland Cement, 43 Grade IS : 8112.

iii) Ordinary Portland Cement, 53 Grade IS : 12269.

If the soil around has soluble salts like sulphate in excess of 0.5 per cent, the cement used shall be sulphate resistant and shall conform to IS : 12330.

Guidance may be taken from IS: SP: 23, Handbook for Concrete Mixes for ascertaining the minimum 7 days strength of cement required to match with the design concrete strength. Cement to be used may preferably be obtained in bulk form. If cement in paper bags are proposed to be used, there shall be bag-splitters with the facility to separate pieces of paper bags and dispose them of suitably. No paper pieces shall enter the concrete mix. Bulk cement shall be stored in accordance with Clause 1014 of MOST. The cement shall be subjected to acceptance test just prior to its use.

7.2.3. Admixtures: Admixtures conforming to IS : 6925 and IS : 9103 shall be permitted to improve workability of the concrete or extension of setting time, on satisfactory evidence that they will not have any adverse effect on the properties of concrete with respect to strength, volume change, durability and have no deleterious effect on steel bars. The particulars of the admixture and the quantity to be used, must be furnished to the Engineer in advance to obtain his approval before use. Satisfactory performance of the admixtures should be proved both on the laboratory concrete trial mixes and in trial paving works. If air entraining admixture is used, the total quantity of air in air-entrained concrete as a percentage of the volume of the mix shall be 56 1.5 per cent for 25 mm nominal size aggregate.

7.2.4. Aggregates

7.2.4.1. Aggregates for pavement concrete shall be natural material complying with IS : 383 but with a Los Angeles Abrasion Test result not more than 35 per cent. The limits of deleterious materials shall not exceed the requirements set out in IS : 383.

The aggregates shall be free from chert, flint, chalcedony or other silica in a form that can react with the alkalis in the cement. In addition, the total chlorides content expressed as chloride ion content shall not exceed 0.06 per cent by weight and the total sulphate content expressed as sulphuric anhydride (SO₃) shall not exceed 0.25 per cent by weight.

7.2.4.2. Coarse aggregate: Coarse aggregate shall consist of clean, hard, strong, dense, non-porous and durable pieces of crushed stone or crushed gravel and shall be devoid of pieces of disintegrated stone, soft, flaky, elongated, very angular or splintery pieces. The maximum size of coarse aggregate shall not exceed 25 mm for pavement concrete. Continuously graded or gap graded aggregates may be used, depending on the grading of the fine aggregate. No aggregate which has water absorption more than 2 per cent shall be used in the concrete mix. The aggregates shall be tested for soundness in accordance with IS : 2386 (Part-5). After 5 cycles of testing the loss shall not be more than 12 per cent if sodium sulphate solution is used or 18 percent if magnesium sulphate solution is used.

Dumping and stacking of aggregates shall be done in an approved manner. In case the Engineer considers that the aggregates are not free from dirt, the same may be washed and drained for at least 72 hrs before batching as directed by the Engineer.

7.2.4.3. Fine aggregate: The fine aggregate shall consist of clean natural sand or crushed stone sand or a combination of the two and shall conform to IS : 383. Fine aggregate shall be free from soft particles, clay, shale, loam, cemented particles, mica and organic and other foreign matter. The fine aggregate shall not contain deleterious substances more than the following:

Clay lumps	4.0 percent
Coal and lignite	1.0 percent

Material passing IS Sieve No. 75 micron

4.0 percent

7.2.5. Water: Water used for mixing and curing of concrete shall be clean and free from injurious amount of oil, salt, acid, vegetable matter or other substances harmful to the finished concrete. It shall meet the requirements stipulated in IS : 456.

7.2.6. Mild steel bars for dowels and tie bars: Reinforcing steel for concrete pavements shall comply with the requirements of IS : 432, IS : 1139 and IS : 1786 as appropriate.

All steel shall be clean and free from mill scale, loose rust and oil.

Tie bars shall be Grade S 415 and dowels shall be Grade S 240 in accordance with IS.

Dowels shall be straight, one-piece and cut accurately to length. Ends of dowels shall be square and free from burrs.

7.2.7. Pre moulded joint filler: Joint filler board for expansion joints which are proposed for use only at some abutting structures like bridges and culverts shall be of 20-25 mm thickness within a tolerance of ± 1.5 mm and of a firm compressible material and complying with the requirements of IS :1838, or BS Specification Clause No. 2630 or Specification for Highway Works, Vol .I Clause 1015. It shall be 25 mm less in depth than the thickness of the slab within a tolerance of ± 3 mm and provided to the full width between the side forms. It shall be in suitable lengths which shall not be less than one lane width. Holes to accommodate dowel bars shall be accurately bored or punched out to give a sliding fit in the dowel bars.

7.2.8. Joint sealing compound: The joint sealing compound shall be of hot poured, elastomeric type or cold polysulphide type having flexibility, resistance to age hardening and durability. If the sealant is of hot poured type it shall conform to AASHTO M282 and cold applied sealant shall be in accordance with BS 5212 (Part 2).

7.2.9. Storage of materials: All materials shall be stored in accordance with the provisions of Clause 1014 of the Specifications and other relevant IS Specifications. All effort must be made to store the materials in proper places so as to prevent their deterioration or contamination by foreign matter and to ensure their satisfactory quality and fitness for the work. The platform where aggregates are stock piled shall be levelled with 15 cm of watered, mixed and compacted granular sub-base material. The area shall have slope and drain to drain off rain water. The storage space must also permit easy inspection, removal and storage of the materials. Aggregates of different sizes shall be stored in partitioned stack-yards. All such materials even though stored in approved godowns must be subjected to acceptance test as per Clause 903 of these Specifications immediately prior to their use.

7.3. Proportion of Concrete

7.3.1. After approval by the Engineer of all the materials to be used in the concrete, the Contractor shall submit the mix design based on weighed proportions of all ingredients for the approval of the Engineer. The mix design shall be submitted at least 30 days prior to the paving of trial length and the design shall be based on laboratory trial mixes using the approved materials and methods as per IS : 10262 (Recommended Guidelines for Mix Design) or on the basis of any other rational method agreed to by the Engineer. Guidance in this regard can also be obtained from IS : SP : 23 Handbook on Concrete Mixes. The target mean strength for the design mix shall be determined as indicated in Clause 903.5.2. The mix design shall be based on the flexural strength of concrete.

7.3.2. Cement content: The cement content shall not be less than 350 kg per cu.m. of concrete. If this minimum cement content is not sufficient to produce in the field, concrete of the strength specified in the drawings/design, it shall be increased as necessary without additional

compensation under the Contract. The cement content shall, however, not exceed 425 kg per cu.m. of concrete.

7.3.3. Concrete strength

7.3.3.1. While designing the mix in the laboratory, correlation between flexural and compressive strengths of concrete shall be established on the basis of at least thirty tests on samples. However, quality control in the field shall be exercised on the basis of flexural strength. It may, however, be ensured that the materials and mix proportions remain substantially unaltered during the daily concrete production. The water content shall be the minimum required to provide the agreed workability for full compaction of the concrete to the required density as determined by the trial mixes or other means approved by the Engineer and the maximum free water cement ratio shall be 0.50.

7.3.3.2. The ratio between the 7 and 28 day strengths shall be established for mix to be used in the slab in advance, by testing pairs of beams and cubes at each stage on at least six batches of trial mix. The average strength of the 7 day cured specimens shall be divided by the average strength of the 28 day specimens for each batch, and the ratio 'R' shall be determined. The ratio 'R' shall be expressed to three decimal places.

If during the construction of the trial length or during normal working, the average value of any four consecutive 7 day test results falls below the required 7 day strength as derived from the value of 'R', then the cement content of the concrete shall, without extra payment, be increased by 5 per cent by weight or by an amount agreed by the Engineer. The increased cement content shall be maintained at least until the four corresponding 28 day strengths have been assessed for its conformity with the requirements as per Clause 10.3.1. Whenever the cement content is increased, the concrete mix shall be adjusted to maintain the required workability.

7.3.4. Workability

7.3.4.1. The workability of the concrete at the point of placing shall be adequate for the concrete to be fully compacted and finished without undue flow. The optimum workability for the mix to suit the paving plant being used shall be determined by the Contractor and approved by the Engineer. The control of workability in the field shall be exercised by the slump test as per IS : 1199.

7.3.4.2. The workability requirement at the Batching Plant and paving site shall be established slump tests carried during trial paving. These requirements shall be established from season to season and also when the lead from Batching plant site to the paving site changes. The workability shall be established for the type of paving equipment available. A slump value in the range of 30 to 15 mm is reasonable for paving works but this may be modified depending upon the site requirement and got approved by the Engineer. These tests shall be carried out on every truck/dumper at Plant site and paving site initially when the work commences but subsequently the frequency can be reduced to alternate trucks or as per the instructions of the Engineer.

7.3.5. Design mix

7.3.5.1. The Contractor shall carry out laboratory trials of design mixes with the materials from the approved sources to be used. Trial mixes shall be made in presence of the Engineer or his representative and the design mix shall be subject to the approval of the Engineer. They shall be repeated if necessary until the proportions that will produce a concrete which complies in all respects with this Specification, and conforms to the design/drawings have been determined.

7.3.5.2. The proportions determined as a result of the laboratory trial mixes may be adjusted if necessary during the construction of the trial length. Thereafter, neither the materials nor the mix proportions shall be varied in any way except with the written approval of the Engineer.

7.3.5.3. Any change in the source of materials or mix proportions proposed by the Contractor during the course of work shall be assessed by making laboratory trial mixes and the construction of a further trial length unless approval is given by the Engineer for minor adjustments like compensation for moisture content in aggregates or minor fluctuations in the grading of aggregate.

7.4. Sub-base

The cement concrete pavement shall be laid over the sub-base constructed in accordance with the relevant drawings and Specifications contained in Clause 601. If the sub-base is found damaged at some places or it has cracks wider than 10mm, it shall be repaired with fine cement concrete or bituminous concrete laying separation layer. Prior to laying of concrete it shall be ensured that the separation membrane as per Clause 10.5 is placed in position and the same is clean of dirt or other extraneous materials and free from any damage.

7.5. Separation Membrane

A separation membrane shall be used between the concrete slab and the sub-base. The separation membrane shall be a primer seal produced and placed in accordance with Sub-Clause 508.4.

7.6. Joints

7.6.1. The location and type of joints shall be as shown in the drawing. Joint shall be constructed depending upon their functional requirement as detailed in the following paragraphs. The location of the joints should be transferred accurately at the site and mechanical saw cutting of joints done as per stipulated dimensions. It should be ensured that the full required depth of cut is made from edge to edge of the pavement. Transverse and longitudinal joints in the pavement and sub-base shall be staggered so that they are not coincident vertically and are at least 1 m and 0.3 m apart respectively. Sawing of joints shall be carried out with diamond studded blades soon after the concrete has hardened to take the load of the sawing machine and personnel without damaging the texture of the pavement. Sawing operation could start as early as 6-8 hours depending upon the season.

7.6.2. Transverse joints

7.6.2.1. Transverse joints shall be contraction and expansion joints constructed at the spacing described in the Drawings. Transverse joints shall be straight within the following tolerances along the intended line of joints which is the straight line transverse to the longitudinal axis of the carriageway at the position proposed by the Contractor and agreed to by the Engineer, except at road junctions or roundabouts where the position shall be as described in the drawings:

- (i) Deviations of the filler board in the case of expansion joints from the intended line of the joint shall not be greater than 6 10 mm.
- (ii) The best fit straight line through the joint grooves as constructed shall be not more than 25 mm from the intended line of the joint.
- (iii) Deviations of the joint groove from the best fit straight line of the joint shall not be greater than 10 mm.

- (iv) Transverse joints on each side of the longitudinal joint shall be in line with each other and of the same type and width. Transverse joints shall have a sealing groove which shall be sealed in compliance with Clause 10.11.

7.6.2.2. Contraction joints: Contraction joints shall consist of a mechanical sawn joint groove, 3 to 5 mm wide and 1/4 to 1/3 depth of the slab 6 5 mm or as stipulated in the drawings and dowel bars complying with Clause 10.6.5 and as detailed in the drawings.

The contraction joints shall be cut as soon as the concrete has undergone initial hardening and is hard enough to take the load of joint sawing machine without causing damage to the slab.

7.6.2.3. Expansion joints: The expansion joints shall consist of a joint filler board complying with Clause 10.2.7 and dowel bars complying with Clause 10.6.5 and as detailed in the drawings. The filler board shall be positioned vertically with the prefabricated joint assemblies along the line of the joint within the tolerances given in Clause 10.6.2.1 and at such depth below the surface as will not impede the passage of the finishing straight edges or oscillating beams of the paving machines. The adjacent slabs shall be completely separated from each other by providing joint filler board. Space around the dowel bars, between the sub-base and the filler board shall be packed with a suitable compressible material to block the flow of cement slurry.

9.6.3 Transverse construction joint: Transverse construction joints shall be placed whenever concreting is completed after a day's work or is suspended for more than 30 minutes. These joints shall be provided at the regular location of contraction joints using dowel bars. The joint shall be made butt type. At all construction joints, steel bulk heads shall be used to retain the concrete while the surface is finished. The surface of the concrete laid subsequently shall conform to the grade and cross sections of the previously laid pavement. When positioning of bulk head/stop-end is not possible, concreting to an additional 1 or 2 m length may be carried out to enable the movement of joint cutting machine so that joint grooves may be formed and the extra 1 or 2 m length is cut out and removed subsequently after concrete has hardened.

7.6.4. Longitudinal joint

7.6.4.1. The longitudinal joints shall be saw cut as per details of the joints shown in the drawing. The groove may be cut after the final set of the concrete. Joints should be sawn to at least 1/3 the depth of the slab 6 5 mm as indicated in the drawing.

7.6.4.2. Tie bars shall be provided at the longitudinal joints as per dimensions and spacing shown in the drawing and in accordance with Clause 10.6.6.

7.6.5. Dowel bars

7.6.5.1. Dowel bars shall be mild steel rounds in accordance with Clause 10.2.6 with details/dimensions as indicated in the drawing and free from oil, dirt, loose rust or scale. They shall be straight, free of irregularities and burring restricting slippage in the concrete. The sliding ends shall be sawn or cropped cleanly with no protrusions outside the normal diameter of the bar. The dowel bar shall be supported on cradles/dowel chairs in pre-fabricated joint assemblies positioned prior to the construction of the slabs or mechanically inserted with vibration into the plastic concrete by a method which ensures correct placement of the bars besides full re-compaction of the concrete around the dowel bars.

7.6.5.2. Unless shown otherwise on the drawings, dowel bars shall be positioned at mid depth of the slab within a tolerance of 6 20 mm, and centered equally about intended lines of the joint within a tolerance of 6 25 mm. They shall be aligned parallel to the finished surface of the

slab and to the centre line of the carriageway and to each other within tolerances given hereunder, the compliance of which shall be checked as per Clause 10.10.7.

- (i) For bars supported on cradles prior to the laying of the slab:
 - (a) All bars in a joint shall be within 6 3 mm per 300 mm length of bar
 - (b) 2/3rd of the bars shall be within 6 2mm per 300 mm length of bar
 - (c) No bar shall differ in alignment from an adjoining bar by more than 3 mm per 300 mm length of bar in either the horizontal or vertical plane
 - (d) Cradles supporting dowel bar shall not extend across the line of joint i.e. no steel bar of the cradle assembly shall be continuous across the joint.
- (ii) For all bars inserted after laying of the slab:
 - (a) Twice the tolerance for alignment as indicated in (i) above

7.6.5.3 Dowel bars, supported on cradles in assemblies, when subject to a load of 110 N applied at either end and in either the vertical or horizontal direction (upwards and downwards and both directions horizontally) shall conform to be within the following limits:

- (i) Two-thirds of the number of bars of any assembly tested shall not deflect more than 2 mm per 300 mm length of bar
- (ii) The remainder of the bars in that assembly shall not deflect more than 3 mm per 300 mm length of bar.

9.6.5.4.The assembly of dowel bars and supporting cradles, including the joint filler board in the case of expansion joints, shall have the following degree of rigidity when fixed in position:-

- (i) For expansion joints, the deflection of the top edge of the filler board shall be not greater than 13 mm, when a load of 1.3 kN is applied perpendicular to the vertical face of the joint filler board and distributed over a length of 600 mm by means of a bar or timber packing, at mid depth and midway between individual fixings, or 300 mm from either end of any length of filler board, if a continuous fixing, is used. The residual deflection after removal of the load shall be not more than 3 mm.
- (ii) The joint assembly fixings to sub-base shall not fail under the 1.3 kN load applied for testing the rigidity of the assembly but shall fail before the load reaches 2.6 kN.
- (iii) The fixings for contraction joint shall not fail under 1.3 kN load and shall fail before the load reaches 2.6 kN when applied over a length of 600 mm by means of a bar or timber packing placed as near to the level of the line of fixings as practicable.
- (iv) Fixings shall be deemed to fail when there is displacement of the assemblies by more than 3mm with any form of fixing, under the test load. The displacement shall be measured at the nearest part of the assembly to the centre of the bar or timber packing.

7.6.5.5 The free portion of dowels shall be painted with two coats of bituminous emulsion. The unpainted portion of the dowels shall be located in the initially placed concrete slab.

7.6.5.6. For expansion joints, a closely fitting cap 100 mm long consisting of waterproofed card board or an approved synthetic material like PVC or GI pipe shall be placed over the sheathed end of each dowel bar. An expansion space at least equal in length to the thickness of the joint filler board shall be formed between the end of the cap and the end of the dowel bar by using compressible sponge. To block the entry of cement slurry between dowel and cap it may be taped.

7.6.6. Tie bars

7.6.6.1. Tie bars in longitudinal joints shall be deformed steel bars of strength 415 MPa complying with IS:1786 and in accordance with the requirements given below. The bars shall be free from oil, dirt, loose rust and scale.

7.6.6.2. Tie bars projecting across the longitudinal joint shall be protected from corrosion for 75 mm on each side of the joint by a protective coating of bituminous paint with the approval of the Engineer. The coating shall be dry when the tie bars are used.

7.6.6.3. Tie bars in longitudinal joints shall be made up into rigid assemblies with adequate supports and fixings to remain firmly in position during the construction of the slab. Alternatively, tie bars at longitudinal joint may be mechanically or manually inserted into the plastic concrete from above by vibration using a method which ensures correct placement of the bars and recompaction of the concrete around the tie bars.

7.6.6.4 Tie bars shall be positioned to remain within the middle third of the slab depth as indicated in the drawings and approximately parallel to the surface and approximately perpendicular to the line of the joint, with the center of each bar on the intended line of the joints within a tolerance of ±50 mm, and with a minimum cover of 30 mm below the joint groove.

7.7. Weather and Seasonal Limitations

7.7.1. Concrete during monsoon months: When concrete is being placed during monsoon months and when it may be expected to rain, sufficient supply of tarpaulin or other water proof cloth shall be provided along the line of the work. Any time when it rains, all freshly laid concrete which had not been covered for curing purposes shall be adequately protected. Any concrete damaged by rain shall be removed and replaced. If the damage is limited to texture, it shall be retextured in accordance with the directives of the Engineer.

7.7.2. Concreting in hot weather: No concreting shall be done when the concrete temperature is above 30 degree Centigrade. Besides, in adverse conditions like high temperature, low relative humidity, excessive wind velocity, imminence of rains etc., if so desired by the Engineer, tents on mobile trusses may be provided over the freshly laid concrete for a minimum period of 3 hours as directed by the Engineer. The temperature of the concrete mix on reaching the paving site shall not be more than 30°C. To bring down the temperature, if necessary, chilled water or ice flakes should be made use of.

No concreting shall be done when the concrete temperature is below 5 degree Centigrade and the temperature is descending.

7.8. Side Forms, Rails and Guidewires

7.8.1 Side forms and rails: All side forms shall be of mild steel of depth equal to the thickness of pavement or slightly less to accommodate the surface regularity of the sub-base. The forms can be placed on series of steel packing plates or shims to take care of irregularity of

sub-base. They shall be sufficiently robust and rigid to support the weight and pressure caused by a paving equipment. Sideforms for use with wheeled paving machines shall incorporate metal rails firmly fixed at a constant height below the top of the forms. The forms and rail shall be firmly secured in position by not less than 3 stakes/pins for each 3m length so as to prevent movement in any direction. Forms and rails shall be straight within a tolerance of 3 mm in 3m and when in place shall not settle excess of 1.5 mm in 3 m while paving is being done. Forms shall be cleaned and oiled immediately before each use. The forms shall be bedded on a continuous bed of low moisture content lean cement mortar or concrete and set to the line and levels shown on the drawings within tolerances 610 mm and 6 3 mm respectively. The bedding shall not extend under the slab and there shall be no vertical step between adjacent forms of more than 3 mm. The forms shall be got inspected from the Engineer for his approval before 12 hours on the day before the construction of the slab and shall not be removed until at least 12 hours afterwards.

7.8.2. At all times sufficient forms shall be used and set to the required alignment for at least 200 m length of pavement immediately in advance of the paving operations, or anticipated length of pavement to be laid within the next 24 hrs whichever is more.

7.8.3. Use of guidewires

7.8.3.1. Where slip form paving is proposed, a guidewire shall be provided along both sides of the slab. Each guidewire shall be at a constant height above and parallel to the required edges of the slab as described in the contract/drawing within a vertical tolerance of 6 3 mm. Additionally, one of the wires shall be kept at a constant horizontal distance from the required edge of the pavement as indicated in the contract/drawing within a lateral tolerance of 6 10 mm.

7.8.3.2. The guidewires shall be supported on stakes not more than 8 m apart by connectors capable of fine horizontal and vertical adjustment. The guidewire shall be tensioned on the stakes so that a 500 gram weight shall produce a deflection of not more than 20 mm when suspended at the mid point between any pair of stakes. The ends of the guidewires shall be anchored to fixing point or winch and not on the stacks.

7.8.3.3. The stack shall be positioned and the connectors maintained at their correct height and alignment from 12 hours on the day before concreting takes place until 12 hours after finishing of the concrete. The guidewire shall be erected and tensioned the connectors at any section for at least 2 hours before concreting that section.

7.8.4. The Contractor shall submit to the Engineer for his approval of line and level, the stakes and connectors which are ready for use in the length of road to be constructed by 12 hours on the working day before the day of construction of slab. Any deficiencies noted by the Engineer shall be rectified by the Contractor who shall then re-apply for approval of the affected stakes. Work shall not proceed until the Engineer has given his approval. It shall be ensured that the stakes and guidewires are not affected by the construction equipment when concreting is in progress.

7.9. Construction

7.9.1 General: A systems approach may be adopted for construction of the pavement, and the Method Statement for carrying out the work, detailing all the activities including indication of time-cycle, equipment, personnel etc., shall be got approved from the Engineer before the commencement of the work. The above shall include the type, capacity and make of the batching and mixing plant besides the hauling arrangement and paving equipment. The capacity of paving equipment, batching plant as well as all the ancillary equipment shall be adequate for a paving rate of atleast 300 m in one day.

7.9.2. Batching and mixing: Batching and mixing of the concrete shall be done at a central batching and mixing plant with automatic controls, located at a suitable place which

takes into account sufficient space for stockpiling of cement, aggregates and stationary water tanks. This shall be, however, situated at an approved distance, duly considering the properties of the mix and the transporting arrangements available with the Contractor.

7.9.3. Equipment for proportioning of materials and paving

7.9.3.1. Proportioning of materials shall be done in the batching plant by weight, each type of material being weighed separately. The cement from the bulk stock may be weighed separately from the aggregates and water shall be measured by volume. Wherever properly graded aggregate of uniform quality cannot be maintained as envisaged in the mix design, the grading of aggregates shall be controlled by appropriate blending techniques. The capacity of batching and mixing plant shall be at least 25 per cent higher than the proposed capacity of the laying/paving equipment.

7.9.3.2. Batching plant and equipment:

- (1) General-** The batching plant shall include minimum four bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. If cement is used in bulk, a separate scale for cement shall be included. The weighing hoppers shall be properly sealed and vented to preclude dust during operation. Approved safety devices shall be provided and maintained for the protection of all personnel engaged in plant operation, inspection and testing. The batch plant shall be equipped with suitable non-resettable batch counter which will correctly indicate the number of batches proportioned.
- (2) Bins and hoppers-** Bins with minimum number of four adequate separate compartments shall be provided in the batching plant.
- (3) Automatic weighing devices-** Batching plant shall be equipped to proportion aggregates and bulk cement by means of automatic weighing devices using load cells.
- (4) Mixers-** Mixers shall be pan type, reversible type or any other mixer capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform mass within the specific mixing period, and of discharging the mixture, without segregation. Each stationary mixer shall be equipped with an approved timing device which will automatically lock the discharge lever when the drum has been charged and release it at the end of the mixing period. The device shall be equipped with a bell or other suitable warning device adjusted to give a clearly audible signal each time the lock is released. In case of failure of the timing device, the mixer may be used for the balance of the day while it is being repaired, provided that each batch is mixed 90 seconds or as per the manufacturer's recommendation. The mixer shall be equipped with a suitable non-resettable batch counter which shall correctly indicate the number of batches mixed.

The mixers shall be cleared at suitable intervals. The pickup and throw-over blades in the drum or drums shall be repaired or replaced when they are worn down 20 mm or more. The Contractor shall (1) have available at the job site a copy of the manufacturer's design, showing dimensions and arrangements of blades in reference to original height and depth, or (2) provide permanent marks on blade to show points of 20 mm wear from new conditions. Drilled holes of 5 mm diameter near each end and at mid point of each blade are recommended. Batching Plant shall be calibrated in the beginning and thereafter at suitable interval not exceeding 1 month.

- (5) Control cabin-** An air-conditioned centralized control cabin shall be provided for automatic operation of the equipment.

7.9.3.3. Paving equipment: The concrete shall be placed with an approved fixed form or slip paver with independent units designed to (i) spread, (ii) consolidate, screed and float-finish, (iii) texture and cure the freshly placed concrete in one complete pass of the machine in such a manner that a minimum of hand finishing will be necessary and so as to provide a dense and homogeneous pavement in conformity with the plans and Specifications. The paver shall be equipped with electronic controls to control/sensor line and grade from either or both sides of the machine.

Vibrators shall operate at a frequency of 8300 to 9600 impulses per minute under load at a maximum spacing of 60 cm. The variable vibration setting shall be provided in the machine.

7.9.3.4. Concrete saw: The Contractor shall provide adequate number of concrete saws with sufficient number of diamond-edge saw blades. The saw machine shall be either electric or petrol/diesel driven type. A water tank with flexible hoses and pump shall be made available in this activity on priority basis. The Contractor shall have at least one standby saw in good working condition. The concreting work shall not commence if the saws are not in working condition.

7.9.4. Hauling and placing of concrete

7.9.4.1. Freshly mixed concrete from the central batching and mixing plant shall be transported to the paver site by means of trucks/tippers of sufficient capacity and approved design in sufficient numbers to ensure a constant supply of concrete. Covers shall be used for protection of concrete against the weather. The trucks/tippers shall be capable of maintaining the mixed concrete in a homogeneous state and discharging the same without segregation and loss of cement slurry. The feeding to the paver is to be regulated in such a way that the paving is done in an uninterrupted manner with a uniform speed throughout the days work.

7.9.4.2. Placing of concrete

Concrete mixed in central mixing plant shall be transported to the site without delay and the concrete which, in the opinion of the Engineer, has been mixed too long before laying will be rejected and shall be removed from the site. The total time taken from the addition of the water to the mix, until the completion of the surface finishing and texturing shall not exceed 120 minutes when concrete temperature is less than 25°C and 90 minutes when the concrete temperature is between 25°C to 30°C. Trucks/tippers delivering concrete shall not run on plastic sheeting nor shall they run on completed slabs until after 28 days of placing the concrete. The Paver shall be capable of paving the carriageway as shown in the drawings, in a single pass and lift.

7.9.4.3. Where fixed form pavers are to be used, forms shall be fixed in advance as per Clause 10.8 of the Specifications. Before any paving is done, the site shall be shown to the Engineer, in order to verify the arrangement for paving besides placing of dowels, tie-bars etc., as per the relevant Clauses of this Specification. The mixing and placing of concrete shall progress only at such a rate as to permit proper finishing, protecting and curing of the pavement.

7.9.4.4. In all cases, the temperature of the concrete shall be measured at the point of discharge from the delivery vehicle.

7.9.4.5. The addition of water to the surface of the concrete to facilitate the finishing operations will not be permitted except with the approval of the Engineer when it shall be applied as a mist by means of approved equipment.

7.9.4.6. If considered necessary by the Engineer, the paving machines shall be provided with approved covers to protect the surface of the slab under construction from direct sunlight and rain or hot wind.

7.9.4.7. While the concrete is still plastic, its surface shall be brush textured in compliance with Clause 10.9.8 and the surface and edges of the slab cured by the application of a sprayed liquid curing membrane in compliance with Clause 10.9.9. After the surface texturing, but before the curing compound is applied, the concrete slab shall be marked with the chainage at every 100 m interval.

7.9.4.8. As soon as the side forms are removed, edges of the slabs shall be corrected wherever irregularities have occurred by using fine concrete composed of one part of cement to 3 parts of fine chips and fine aggregate under the supervision of the Engineer.

7.9.4.9. If the requirement of Clause 902.4 of MOST for surface regularity fails to be achieved on two consecutive working days, then normal working shall cease until the cause of the excessive irregularity has been identified and remedied.

7.9.5. Construction by fixed form paver

7.9.5.1. The fixed form paving train shall consist of separate powered machines which spread, compact and finish the concrete in a continuous operation.

7.9.5.2. The concrete shall be discharged without segregation into a hopper spreader which is equipped with means for controlling its rate of deposition on to the subbase. The spreader shall be operated to strike off concrete upto a level requiring a small amount of cutting down by the distributor of the spreader. The distributor of spreader shall strike off the concrete to the surcharge adequate to ensure that the vibratory compactor thoroughly compacts the layer. If necessary, poker vibrators shall be used adjacent to the side forms and edges of the previously constructed slab. The vibratory compactor shall be set to strike off the surface slightly high so that it is cut down to the required level by the oscillating beam. The machine shall be capable of being rapidly adjusted for changes in average and differential surcharge necessitated by changes in slab thickness or cross fall. The final finisher shall be able to finish the surface to the required level and smoothness as specified, care being taken to avoid bringing up of excessive mortar to the surface by overworking.

9.9.6 Construction by slip form paver

7.9.6.1. The slip form paving train shall consist of power machine which spreads, compacts and finishes the concrete in a continuous operation. The slip form paving machine shall compact the concrete by internal vibration and shape it between the side forms with either a conforming plate or by vibrating and oscillating finishing beams. The concrete shall be deposited without segregation in front of slip form paver across the whole width and to a height which at all times is in excess of the required surcharge. The deposited concrete shall be struck off to the necessary average and differential surcharge by means of the strike off plate or a screw auger device extending across the whole width of the slab. The equipment for striking-off the concrete shall be capable of being rapidly adjusted for changes of the average and differential surcharge necessitated by change in slab thickness or crossfall.

7.9.6.2. The level of the conforming plate and finishing beams shall be controlled automatically from the guide wires installed as per Clause 10.8 by sensors attached at the four corners of the slip form paving machine. The alignment of the paver shall be controlled automatically from the guide wire by at least one set of sensors attached to the paver. The alignment and level of ancillary machines for finishing, texturing and curing of the concrete shall be automatically controlled relative to the guide wire or to the surface and edge of the slab.

7.9.6.3. Slip-form paving machines shall have vibrators of variable output, with a maximum energy output of not less than 2.5 KW per meter width of slab per 300 mm depth of slab for a laying speed upto 1.5 m per minute or pro-rata for higher speeds. The machines shall be of sufficient mass to provide adequate reaction during spreading and paving operations on the traction units to maintain forward movements during the placing of concrete in all situations.

7.9.6.4. If the edges of the slip formed slab slump to the extent that the surface of the top edge of the slab does not comply with the requirements of Clause 10.14, then special measures approved by the Engineer shall be taken to support the edges to the required levels and work shall be stopped until such time as the Contractor can demonstrate his ability to slip form the edges to the required levels.

7.9.7. Construction by hand-guided method: Areas in which hand-guided methods of construction become indispensable shall be got approved by the Engineer in writing in advance. Such work may be permitted only in restricted areas in small lengths. Work shall be carried out by skilled personnel as per methods approved by the Engineer. The acceptance criteria regarding level, thickness, surface regularity, texture, finish, strength of concrete and all other quality control measures shall be the same as in the case of machine laid work.

7.9.8. Surface texture

7.9.8.1. After the final regulation of the slab and before the application of the curing membrane, the surface of concrete slab shall be brush-textured in a direction at right angles to the longitudinal axis of the carriageway.

7.9.8.2. The brushed surface texture shall be applied evenly across the slab in one direction by the use of a wire brush not less than 450 mm wide but longer brushes are preferred. The brush shall be made of 32 gauge tape wires grouped together in tufts spaced at 10 mm centers. The tufts shall contain an average of 14 wires and initially be 100 mm long. The brush shall have two rows of tufts. The rows shall be 20 mm apart and the tufts in one row shall be opposite the center of the gap between tufts in the other row. The brush shall be replaced when the shortest tuft wears down to 90 mm long.

7.9.8.3. The texture depth shall be determined by the Sand Patch Test as described in Clause 10.12. This test shall be performed at least once for each day's paving and wherever the Engineer considers it necessary at times after construction as under:

Five individual measurements of the texture depth shall be taken at least 2 m apart anywhere along a diagonal line across a lane width between points 50 m apart along the pavement. No measurement shall be taken within 300 mm of the longitudinal edges of a concrete slab constructed in one pass.

7.9.8.4. Texture depths shall not be less than the minimum required when measurements are taken as given in Table 600-2 nor greater than a maximum average 1.25 mm.

TABLE : 600-2 Texture Depth

	Time of Test	Number of Measurements	Required Texture Depth (mm)	
			Specified Value	Tolerance
1.	Between 24 hours and 7 days after the constn., of the slab or until the slab is first used by vehicles.	An average of 5 measurements	1.00	±0.25
2.	Not later than 6 weeks before the road is opened to public traffic.	An average of 5 measurements	1.00	+0.25 -0.35

--	--	--	--	--

7.9.8.5. After the application of the brushed texture, the surface of the slab shall have a uniform appearance.

7.9.8.6. Where the texture depth requirements are found to be deficient, the Contractor shall make good the texture across the full lane width over length directed by the Engineer, by retexturing the hardened concrete surface in an approved manner.

7.9.9. Curing

7.9.9.1. Immediately after the surface texturing, the surface and sides of the slab shall be cured by the application of approved resin-based aluminised reflective curing compound which hardens into an impervious film or membrane with the help of a mechanical sprayer.

Curing compounds shall contain sufficient flake aluminium in finely divided dispersion to produce a complete coverage of the sprayed surface with a metallic finish. The compound shall become stable and impervious to evaporation of water from the surface of the concrete within 60 minutes of application and shall be of approved type. The curing compounds shall have a water retention efficiency index of 90 per cent in accordance with BS Specification No. 7542.

7.9.9.2. The curing compound shall not react chemically with the concrete and the film or membrane shall not crack, peel or disintegrate within three weeks after application. Immediately prior to use, the curing compound shall be thoroughly agitated in its containers. The rate of spread shall be in accordance with the manufacturer's instructions checked during the construction of the trial length and subsequently whenever required by the Engineer. The mechanical sprayer shall incorporate an efficient mechanical device for continuous agitation and mixing of the compound during spraying.

7.9.9.3. In addition to spraying of curing compound, the fresh concrete surface shall be protected for at least 3 hours by covering the finished concrete pavement with tents as described in Clause 10.7.2, during adverse weather conditions as directed by the Engineer. After three hours, the pavement shall be covered by moist hessian and the same shall then be kept damp for a minimum period of 14 days after which time the hessian may be removed. The hessian shall be kept continuously moist. All damaged/torn hessian shall be removed and replaced by new hessian on a regular basis.

7.9.9.4. The Contractor shall be liable at his expense to replace any concrete damaged as a result of incomplete curing or cracked on a line other than that of a joint.

7.9.10 Reinforcement

Reinforcement shall be in accordance with Sub-Clause 10.2.6. Reinforcement shall be placed prior to pouring of the concrete using wiring and bar chairs, in the arrangement indicated in the drawings. The wiring and bar chairs shall be sufficient to prevent distortion of the reinforcement during placement of the concrete.

7.10. Trial Length

7.10.1.

7.10.2. The Contractor shall demonstrate the materials, plant, equipment and methods of construction that are proposed for concrete paving, by first constructing a trial length of slab, at least 60 m but not more than 300 m long for mechanized construction and at least 30 m long for hand guided methods. If the first trial is unsatisfactory, the Contractor shall have to demonstrate his capability to satisfactorily construct the pavement in subsequent trials.

7.10.3. The trial length shall be constructed in two parts over a period comprising at least part of two separate working days, with a minimum of 30 m constructed each day for mechanized construction and a minimum of 15 m on each day for hand guided construction. The trial length shall be constructed at a similar rate (speed, around 1m/hr) to that which is proposed for the main work.

7.10.4. Transverse joints and longitudinal joints of each type that are proposed for dowel-jointed unreinforced concrete slabs in the main work shall be constructed and assessed in the trial length. If in the trial length the construction of expansion joint and longitudinal joint is not demonstrated, the first 2 expansion joints and at least the first 150 m of longitudinal construction joint for mechanized paving in the main work, shall be considered as the trial length for these joints.

7.10.5. The trial length shall comply shall the Specification in all respects, with the following additions and exceptions:

9.10.5.1 Surface levels and regularity

- (i) In checking for compliance with Clause 903.5 of MOST the levels shall be taken at intervals at the locations specified in this Clause along any line or lines parallel to the longitudinal centre line of the trial length.
- (ii) The maximum number of permitted irregularities of pavement surface shall comply with the requirements of Clause 902.4 of MOST. Shorter trial lengths shall be assessed pro-rata based on values for a 300 m length.

9.10.5.2 Joints

- (iii) Alignment of dowel bars shall be inspected as described in Clause 10.10.7 in any two consecutive transverse joints. If the position or alignment of the dowel bars at one of these joints does not comply with Clause 10.6.5, if that joint remains the only one that does not comply after the next 3 consecutive joints of the same type have been inspected, then the method of placing dowels shall be deemed to be satisfactory. In order to check sufficient joints for dowel bar alignment without extending the trial length unduly, the Contractor may, by agreement with the Engineer, construct joints at more frequent joint intervals than the normal spacing required in the Contract.
- (iv) If there are deficiencies in the first expansion joint that is constructed as a trial, the next expansion joint shall be a trial joint. Should this also be deficient, further trial expansion joints shall be made as part of the trial length which shall not form part of the permanent works, unless agreed by the Engineer.

7.10.5.3. Density

- (v) Density shall be assessed as described in Clause 10.3.3. from at least 3 cores drilled from each part of the trial length.

7.10.5.4. Position of tie bars

- (vi) Compliance with Clause 10.6.6 for the position and alignment of tie bars shall be checked by drilling additional cores from the slab unless they can be determined from cores taken for density.

7.10.6. Approval and acceptance

7.10.6.1. Approval of the materials, plant, equipment and construction methods shall be given when a trial length complies with the Specification. The Contractor shall not proceed with normal working until the trial length has been approved and any earlier defective trial lengths have been removed, unless that can be remedied to the satisfaction of the Engineer. If the Engineer does not notify the Contractor of any deficiencies in any trial length within 10 days after the completion of that trial length, the Contractor may assume that the trial length, and the materials, plant, equipment and construction methods adopted are acceptable.

7.10.6.2. When approval has been given, the materials, plant, equipment and construction methods shall not thereafter be changed, except for normal adjustments and maintenance of plant, without the approval of the Engineer. Any changes in material, plant, equipment and construction methods shall entitle the Engineer to require the Contractor to lay a further trial length as described in this Clause to demonstrate that the changes will not adversely affect the permanent works.

7.10.6.3. Trial lengths which do not comply with the Specification, with the exception of areas which are deficient only in surface texture and which can be remedied in accordance with Clause 10.9.8.6 shall be removed immediately upon notification of deficiencies by the Engineer and the Contractor shall construct a further trial length.

7.10.7. Inspection of dowel bars

7.10.7.1. Compliance with Clause 10.6.5. for the position and alignment of dowel bars at construction and expansion joints shall be checked by measurements relative to the side forms or guide wires.

7.10.7.2 When the slab has been constructed, the position and alignment of dowel bars and any filler board shall be measured after carefully exposing them in the plastic concrete across the whole width of the slab. When the joint is an expansion joint, the top of the filler board shall first be exposed sufficiently in the plastic concrete to permit measurement of any lateral or vertical displacement of the board. During the course of normal working, these measurements shall be carried out in the pavement section at the end of day's work by extending slab length by 2 m. After sawing the transverse joint groove, the extended 2 m slab shall be removed carefully soon after concrete has set to expose dowels over half the length. These dowels can be tested for tolerances.

7.10.7.3 If the position and alignment of the bars in a single joint in the slab is unsatisfactory then the next two joints shall be inspected. If only one joint of the three is defective, the rate of checking shall be increased to one joint per day until the Engineer is satisfied that compliance is being achieved. In the event of non-compliance in two or more successive joints, the Contractor shall revert to the construction of fresh trial lengths and make any necessary alteration to concrete mix, paving plant or methods until the dowel bar position and alignment are satisfactory.

7.10.7.4. After the dowel bars have been examined, the remainder of the concrete shall be removed over a width of 500 mm on each side of the line of the joint and reinstated to the satisfaction of the Engineer. The dowels shall be inserted on both sides of the 1 m wide slab by drilling holes and grouting with epoxy mortar. Plastic sheath as per Clause 10.6.5.5 shall be provided on dowels on one of the joints. The joint groove shall be widened and sealed as per Clause 10.11.

7.11. Preparation and Sealing of Joint Grooves

7.11.1. General

All transverse joints in surface slabs shall be sealed using sealants described in Clause 8.2.8. Joints shall not be sealed before 14 days after construction.

7.11.2. Preparation of joint grooves for sealing

7.11.2.1. Joint grooves usually are not constructed to provide the minimum width specified in the drawings when saw cut joints are adopted. They shall be widened subsequently by sawing before sealing. Depth/width gauges shall be used to control the dimension of the groove.

7.11.2.2. If rough arises develop when grooves are made, they shall be ground to provide a chamfer approximately 5 mm wide. If the groove is at an angle upto 10 degree from the perpendicular to the surface, the overhanging edge of the sealing groove shall be sawn or ground perpendicular. If spalling occurs or the angle of the former is greater than 10 degrees, the joint sealing groove shall be sawn wider and perpendicular to the surface to encompass the defects upto a maximum width, including any chamfer, of 35 mm for transverse joints and 20 mm for longitudinal joints. If the spalling cannot be so eliminated then the arises shall be repaired by an approved thin bonded aris repair using cementitious materials.

7.11.2.3. All grooves shall be cleaned of any dirt or loose material by air blasting with filtered, oil-free compressed air. If need arises the Engineer may instruct cleaning by pressurized water jets. Depending upon the requirement of the sealant manufacture, the sides of the grooves may have to be sand blasted to increase the bondage between sealant and concrete.

7.11.2.4 The groove shall be cleaned and dried at the time of priming and sealing.

7.11.2.5. Before sealing the temporary seal provided for blocking the ingress of dirt, soil etc., shall be removed. A highly compressible heat resistant paper-backed debonding strip as per drawing shall be inserted in the groove to serve the purpose of breaking the bond between sealant and the bottom of the groove and to plug the joint groove so that the sealant may not leak through the cracks. The width of debonding strip shall be more than the joint groove width so that it is held tightly in the groove. In the case of longitudinal joints, heat resistant tapes may be inserted to block the leakage through bottom of the joint.

7.11.3. Sealing with sealants

7.11.3.1. When sealants are applied, an appropriate primer shall also be used if recommended by the manufacturer and it shall be applied in accordance with their recommendation. The sealant shall be applied within the minimum and maximum drying times of the primer recommended by the manufacturer. Priming and sealing with applied sealants shall not be carried out when the naturally occurring temperature in the joint groove to be sealed is below 7°C.

7.11.3.2. If hot applied sealant is used it shall be heated and applied from a thermostatically controlled, indirectly heated preferably with oil jacketed melter and pourer having recirculating pump and extruder. For large road projects, sealant shall be applied with extruder having flexible hose and nozzle. The sealant shall not be heated to a temperature higher than the safe heating temperature and not for a period longer than the safe heating period, as specified by the manufacturer. The dispenser shall be cleaned out at the end of each day in accordance with the manufacturer=s recommendations and reheated material shall not be used.

7.11.3.3 Cold applied sealants with chemical formulation like polysulphide may be used. These shall be mixed and applied within the time limit specified by the manufacturer. If primers are recommended they shall be applied neatly with an appropriate brush. The Movement Accommodation Factor (MAF) shall be more than 10 per cent

7.11.3.4. The sealants applied at contraction phase of the slabs would result in bulging of the sealant over and above the slab. Therefore, the Contractor in consultation with the Engineer, shall establish the right temperature and time for applying the sealant. Thermometer shall be hung on a pole in the site for facilitating control during the sealing operation.

7.11.3.5. Sealant shall be applied, slightly to a lower level than the slab with a tolerance of 5 ± 2 mm.

7.11.3.6. During sealing operation, it shall be seen that no air bubbles are introduced in the sealant either by vapors or by the sealing process.

7.11.4. Testing of applied sealants: Manufacturer's certificate shall be produced by the Contractor for establishing that the sealant is not more than six months old and stating that the sealant complies with the relevant standard as in Clause 10.2.8. The samples shall meet the requirement of AASHTO M 282 for hot applied sealant or BS 5212 : (Part- 2) for cold applied sealant.

7.12. Measurement of Texture Depth - Sand Patch Method

7.12.1. The following apparatus shall be used:

- (i) A cylindrical container of 25 ml internal capacity
- (ii) A flat wooden disc 64 mm diameter with a hard rubber disc, 1.5 mm thick, stuck to one face, the reverse face being provided with a handle.
- (iii) Dry natural sand with a rounded particle shape passing a 300 micron IS sieve and retained on a 150 micron IS sieve.

7.12.2. Method: The surface to be measured shall be dried, any extraneous mortar and loose material removed and the surface swept clean using a wire brush both at right angles and parallel to the carriageway. The cylindrical container shall be filled with the sand, tapping the base 3 times on the surface to ensure compaction, and striking off the sand level with the top of the cylinder. The sand shall be poured into a heap on the surface to be treated. The sand shall be spread over the surface, working the disc with its face kept flat in a circular motion so that the sand is spread into a circular patch with the surface depressions filled with sand to the level of peaks.

7.12.3. The diameter of the patch shall be measured to the nearest 5 mm. The texture depth of concrete surface shall be calculated from $31000/(D \times D)$ mm where D is the diameter of the patch in mm.

7.13. Opening to Traffic

No vehicular traffic shall be allowed to run on the finished surface of a concrete pavement within a period of 28 days of its construction and until the joints are permanently sealed. The road may be opened to regular traffic after completion of the curing period of 28 days and after sealing of joints is completed including the construction of shoulder, with the written permission of the Engineer.

7.14. Tolerance for Surface Regularity, Level, Thickness and Strength

The tolerances for surface regularity, level, thickness and strength shall conform to the requirements given in Clause 903.5. Control of quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

9.15.1 Measurements for Payment

7.15.1 Cement Concrete pavement shall be measured as a finished work in square metres with specified thickness. The volume to be paid for will be calculated on the basis of thickness and plans shown on the project drawings and adjusted for the deficiency in thickness. No additional payment shall be made for extra thickness of the slab. The full payment will be made to this item after 28 days strength of the concrete is found to be satisfactory.

The unit for measurement for concrete pavement shall be the cubic metre of concrete placed, based on the net plan areas for the specified thickness shown on the Drawings or directed by the Engineer. The rate shall include all provisions of this Specification and shall include the provision of all materials including polythene film, concrete, stock piling, mixing, transport, placing, compacting, finishing, curing together with all formwork, and including testing and submission of test certificates and records. No deduction shall be made in measurement for openings provided that the area of each is less than 0.5 sq.m. The unit rate as entered in the Bill of Quantities shall also include the full costs of contraction, expansion, construction, and longitudinal joints. It shall also include joint filler, keys, caulking rod, debonding strip, sealant primer, joint sealant.

7.15.2. Pavement thickness

All precautions and care shall be taken to construct pavement having uniform thickness as called for on the plans.

Thickness of the cement concrete pavement shall be calculated on the basis of level data of the cement concrete pavement and the underlying sub-base taken on a grid of 5 m x 3.5 m or 6.25 m x 3.5 m, the former measurement being in longitudinal direction.

A days work is considered as a 'lot' for calculating the average thickness of the slab. In calculating the average thickness, individual measurements which are in excess of the specified thickness by more than 10 mm shall be considered as the specified as thickness plus 10 mm.

Individual areas deficient by more than 25 mm shall be verified by the Engineer by ordering core cutting and if in his opinion the deficient areas warrant removal, they shall be removed and replaced with concrete of the thickness shown on the plans.

When the average thickness for the lot is deficient by the extent shown in Table 600-3, the Contract unit price will be adjust as per this Table.

TABLE 600-3 PAYMENT ADJUSTMENT FOR DEFICIENCY IN THICKNESS

Deficiency in the average thickness of day's work	Per cent of Contract unit price payable
Up to 5mm	100
6 –10 mm	87
11-15 mm	81
16 – 20 mm	75
21 –25 mm	70

In the stretch where deficiency of average thickness is more than 25 mm, the section whose thickness is deficient by 26 mm or more is identified with the help of cores. Such slabs shall be removed and reconstructed at the cost of the Contractor. During such rectification work, care shall be taken to replace full slab and to the full depth.

7.16. Rate

The Contract unit rate for the construction of the cement concrete shall be payment in full for carrying out the operations required for the different items of the work as per these Specifications including full compensation for all labour, tools, plant, equipments, testing and incidentals to complete the work as per Specifications, providing all materials to be incorporated in the work including all royalties, fees, storage, rents where necessary and all leads and lifts.

The separation membrane shall be measured and paid in accordance with Sub-Clause 508.4.14, 508.4.15 and 508.4.16 of MOST. Reinforcement, dowel bars and tie rods shall be measured in Nos. The Contract unit rate for reinforcement shall include dowel bars, tie rods and all items included in Clause 1609 of MOST.

ITEM NO.6

Providing and fixing in position TMT bar of all diameter in longitudinal direction as per IS 1786 (Latest) including cutting, placing of same, with all machinery, tools, tackles, labours etc. complete.

The work includes providing & laying in position HYSD / Mils steel / Thermo Mechanically Treated bar of the following grade. Grade Designation Bar type confirming to governing IS specification Characteristic strength by MPa Elastic Modulus GPa S 415 IS 1786 High yield strength deformed bar 415 200 S 240 IS 432 Part-II 240

TMT BAR 415 TMT bar shall conform to min 415 MPa yield strength. Tensile strength of in 500 MPa and elongation percentage min 22. The chemical composition of bars shall be as below.

	% Max
Carbon	0.25
Sulphur	0.05
Phosphorus	0.05
Sulphur & Phosphorus	0.01

All steel shall be procured from original procedures no rolled steel shall be incorporated in the work. Only new steel bars shall deliver to the site. Every bar discarded cracked ends of bars shall be discarded.

1. The work shall consist of furnishing and placing reinforcement the shape and dimensions shown on the drawings or as directed by the engineer-in-charge.
2. Steel shall be clean and free from loose and loose scale at the having position and subsequent concreting.
3. Reinforcing steel conform accurately to the dimensions given in the bar bending schedules shown on relevant drawings. Bars shall be bent cold to the specification shape and dimensions or as directed by the Engineer-in-Charge using a proper bar bender, operated by hand power to attain proper radius of bends. Bars shall be bending or straightened in such a manner that will not injure the material. Bars bent during transport or handing shall be straightened before being used on work they shall be not heated to facilitate bending. Unless otherwise specified a "U" type hook at the end of each bar shall be invariably provided. 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 beyond the ends of the curve shall be at least four times the diameter of the round bar. In the case of bars which are not round and in the case of deformed bars ten diameter shall be taken as the

diameter of circle having an equivalent effective area. The hooks shall be suitably encased to prevent any splitting of the concrete.

4. All reinforcement bars shall be accurately placed in exact position shown on the drawings, and shall be security held in position during placing of concrete by annealed binding wire not less than 1 mm in size and confirming to IS: 280 by using stay block or metal chairs, spacers, metal hangers supporting wires or other approved device at sufficiently close intervals. Bars will not be allowed to sag between supports nor displaced during concreting or any other operation of the work. All devices used for positioning shall be on non corrodible material wooden and metal support will not extent to the surface or concrete, except where shown on the drawings. Placing bars on layers of freshly laid concrete as the work progress for adjusting for spacing will not be allowed pieces of brocket stone or brick and wooden block shall not be used layers of bars shall be separated by spacer bars, precast mortar blocks or other approved devices, reinforcement after being placed in position shall be maintained in a clean condition unit completely embedding concrete special care shall be exercised to prevent any displacement of reinforcement from corrosion concrete cover shall be provided as indicated on the drawing. All bars producing from concrete and to which other bars to be spliced and which are likely to be exposed for an indefinite period shall be protected by a thick coat of neat cement grout.
5. Bars crossing each other, where required shall be secured by bidding wire (annealed) of size not less than 1 mm and confirming to IS 28 in such a manner that they do not slip over each other at the time of fixing and concreting.
6. As far as possible bars of full length shall be used. In case this is not possible overlapping bars shall be done as directed by the Engineer-in-Charge. When practicable overlapping bars shall not tough each other but the kept apart of 25mm or 1.25 times the maximum size of the coarse aggregate whichever is greater by concrete between them, where not feasible overlapping bars shall be bound with annealed steel wire, and not less than 1 mm thickness twisted tight. The overlaps shall be staggered for different bars and located at points, along the span where neither sphere not bending moment is maximum.
7. Whenever indicated on the drawings or desired by the Engineer-in-charge. Bar transmit the full stresses of bars. The ends of the bars that are joined by coupling shall be upset for a sufficient length so that the effective cross section at the base of treads is not less than the normal cross section of the bar. Threads shall be standard white worth threads still for coupling shall conform to IS 226.
8. When permitted or specified on the drawing joints reinforcement bars shall be but welded so as to transmit their full stresses. Welded joints shall preferably by located at points where steel not be subjected to more than at any one section and not more than 20 percent of the folds are welded. Only electric arc welding using a proves which excludes air form the molten metal and confirms to any of all other special provision for the work will be accepted. Enable means slab be provided for holding the bars supply as position during welding. It must be ensured that no voids are left in welding and when welding is done in 2 or 3 stages, previous surface shall be cleaned properly ends of the bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before welding shall conform to IS 814 welded pieces of reinforcement shall be tested. Specimen shall be taken from the actual site and their number and frequency of test shall be as directed by the Engineer-in-charge.
9. Reinforcement shall be measured in length including overlaps separately for different diameters as actually used in the work , where welding or coupling is restored to in place of lap-joints such joints shall be measured for payment as the equivalent length of overlap as power design requirement .From the length so measured the weight of

reinforcement shall be calculated in tons on the same basis of I.S. 1732 Length shall include hooks at ends wastage and annealed steel wire for binding shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.

10. Rate for reinforcement shall include of all steel, the carting to work site cutting, bending, placing binding and fixing in position as shown on the drawing Sqm. And as directed by the Engineer-in-charge. It shall also include cost of all devices for keeping reinforcement in approved position cost of joints as per approved methods and all wastage and spacer bars.
11. The rate shall be paid for complete item on "Kg." Basis.

ITEM NO.7:

Providing and laying HDPE sheet of 75-100 micron thick and provide lap of 0.3m length in longitudinal and transverse direction of approved quality as directed by engineer in charge.

A separation membrane shall be used between the concrete slab and the sub base. Separation membrane shall be impermeable plastic sheeting 125 micron thick laid flat without creases. Before placing the separation membrane, the sub-base shall be swept clean of all the extraneous material using air compressor. Wherever overlap of plastic sheets is necessary, the same shall be at least 300, mm and any damage sheeting shall be replaced at the contractor's expense .The separation membrane may be nailed to the lower layer with concrete nails as per Morth Section 600. Clause no.602.5

Payment should be done based on Plan area only. No overlapping is considered for payment

ITEM NO.8

Supplying and Fixing reinforced concrete heavy duty non- pressure pipes with collars for culverts including setting and joining the pipes in C.M. 1:2 watering and laying (To level of slopes of I.S. 458 / 1971 Class NP4 casted by vertically vibrated technology of following internal diameter 300mm dia. including transportation, loading, unloading, ramming with labours, tools, tackles etc. as per direction of Engineer in charge.

1 R.C.C. SPUN PIPES :

The pipes shall be R.C.C. spun pipes NP4 class, conforming to I.S. 458-1971 and shall be approved by the Engineer-in-Charge for soundness before incorporation in the work.

2 LAYING R.C.C. SPUN PIPES :

The work consist of providing, laying, jointing and testing R.C.C. spun pipe storm water drain of required diameter as mentioned in the schedule to discharge storm water to the main nallah as shown in the drawing.

After the cement concrete cradle has been laid properly, if specified or as directed by the Engineer-in-Charge, the pipes shall be lowered gradually into the trenches over the concrete cradle or bed. Necessary working space/gap for collars shall be made at every joint. Laying of pipe shall proceed upgrade of a slope. The collars shall be slipped-on before the next pipe is laid.

The pipe drain shall rest on the bed at every point through its length. To ensure this the space between the underside of the pipe on the invert of the cradle shall be carefully grouted solid with cement slurry consisting of one part of cement to one part of clean washed sand in such a manner that no void is left. It shall be ensured that the load of the

pipes and the super imposed load of the earth filling is evenly distributed on the cradle or bed.

The contractor shall take precautions to see that no dirt, earth or other foreign matter is allowed on the surface of the cradle or bed of the pipe resting there-on, all to the full satisfaction of the Engineer-in-Charge. After the alignment and grading of the pipes is checked by the authorised representative of the Department, the grouting shall be done with specified stiff mix of cement mortar.

The cradle of concrete shall be allowed to set at least for three days before any pipe is placed on it and the contractor shall take due care in setting the pipe in the cradle so that no damage is occur to the cradle. If any damage to the cradle occurs, it shall be rectified to the satisfaction of Engineer-in-Charge and in any particular case where damage to the cradle is beyond repair in the opinion of the Engineer-in-Charge, the contractor shall cut out the damaged section of the cradle and re do the same at his own expenses to the complete satisfaction of the Engineer-in-Charge.

No pipe shall be laid or placed till the alignment of the pipe drain and its levels and gradient have been carefully checked and found correct/approved by the Engineer-in-Charge.

a. **JOINTS :**

The joints for the pipes shall be made by loose collars and the connecting space shall be as minimum as possible. The collars shall be specifically roughened inside to provide a better grip.

The two adjacent pipes will be so designed and manufactured that when butted together concentrically, a dowel is left between the two ends. In this dowel, cement mortar of (1:1) proportion or mix. as specified in the schedule be filled and then between the ends a paste of cement mortar of the same proportions will be placed. The space remaining between the pipe ends and the collar being then caulked with cement mortar of (1:1) or other specified proportion so that an even space appears all round the external diameter of the pipes. All the joints shall be finished off smooth at an angle of 45^o with the longitudinal axis of the pipe on either side of the collars.

The interior of the pipe drains shall be cleaned off all dirt, cement mortar and superfluous materials and joints shall be cured for atleast 7 days.

b. **TESTING OF R.C.C. SPUN PIPES:**

After sufficient interval has been allowed for the joints to set, the pipe drains will be tested under a water head of at least 1.2 m. and in no case under a head greater than 1.8 m. of water above the top of the pipes. In addition, the pipe drains shall be examined for leaks of land/sub-soil water making its way through the joints. The contractor shall make the pipe drains water tight against the entrance of land/sub-soil water from outside and also against the leakages of water from the inside of the pipe drains at the test heads specified above to the full satisfaction of the Engineer-in-Charge.

All defective or leaking pipes or joints shall be cut out and replaced and made good by the contractor at his own cost. In case of the joints that may be defective and cannot be made good, shall be entirely embedded/surrounded externally with cement concrete of 1:2:4 proportion to render the joint (s) water tight and this shall be allowed to set before encasing or back filling is done. A strong colour shall be added to the water used for testing of the pipes, in order to detect any leakage easily. The cost of testing of the pipe drain shall be borne by the contractor and is deemed to be included in the rates quoted by the contractor.

c. **ENGINEER-IN-CHARGE MAY ORDER CONCRETE TO BE INCREASED OR**

DIMINISHED:

The Engineer-in-Charge may increase or decrease the concrete on the pipe drains as to the quantity and quality or to omit the same entirely according to the nature of the ground that may be revealed when the storm water drain trenches are excavated.

d. Back filling/filling Trenches:

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 20 cm. watered, rammed and consolidated, taking care that no damage is caused to the pipe below. In case of excavation of trenches in rock, the filling upto a depth of 30 cm. above the crown of pipe or barrel shall be done with fine material such as earth, murrum or pulverized decomposed rock according to the availability at site. The remaining filling shall be done with rock filling or boulders of size not exceeding 15 cm. mixed with fine material as available to fill up the voids, watered, rammed and consolidated in layers not exceeding 30 cm.

e. MODE OF MEASUREMENT:

The length of pipes shall be measured in running meter nearest to a centimeter along the center line of the pipes over all fittings such as collars, bends, junctions etc. Fittings/specials shall not be measured separately.

The rate shall include the cost of materials and labour including jointing, grouting, cutting of pipes to the required lengths, wastages etc. involved in all the operations described above.

Excavation, back filling, shoring and timbering in trenches and cement concreting wherever required shall be measured separately under relevant items of work.

ITEM NO.10

Providing & filling Pre-moulded asphalt filler joints as per drawings for 12mm width including with labours, tools, tackles etc. as per direction of Engineer in charge & As per detail specification mentioned in technical bid.

1. Open joints shall be constructed at the locations as directed by the Engineer-in-charge using a wood strip, metal plate, other suitable material which is subsequently removed. When removing the material, care shall be exercised to avoid chipping or breaking the corners of the concrete. The edge of the concrete at the joints shall be edge finished. Reinforcement shall not extend across as open joint.
2. When performed filler is to be provided the filler shall be placed in correct position before concrete is placed against the filler. The filler material shall form part of the joint and while concreting the slab, care shall be taken to prevent the former from being displaced. After the work is completed, the exposed face of the joint shall be cleaned of all loose material sticking to it.
3. The material used for filling expansion joint shall be bitumen impregnated felt which shall conform to the requirements of IS: 1838, and shall be got approved from the Engineer-in-charge. The joint shall consist of large pieces and assembly of small pieces to make up the required size shall be avoided.
4. The expansion joint shall be measured in running meters. Thickness of the expansion joint will be 20 to 25 mm. Width of the expansion joint shall be equal to full depth of the slab.

- 5 The rate shall include the cost of all materials, labour, equipments and other incidental charges for fixing the joints complete in all respect as per these specifications and as shown in the drawings.

ITEM NO. NIL

Filling with available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth consolidating each deposited layer by ramming & watering with machineires, tools, tackles, manpower, labours etc. complete.

Workmanship

1.1. The earth to be used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken

1.2. As soon as the work in foundation has been completed and measured the site of foundation shall be cleared of all debris, brick bats, mortar dropping EIC., and tilled with earth in layers not exceeding 20 cross Each layer shall be adequately watered, rammed and consolidated before the succeeding layer is laid. The earth shall be rammed with iron rammers where feasible and with the but ends of crow-bars, where rammer cannot be used

1.3. The plinth shall be similarly tilled with earth in layers not exceeding 20 cms adequately watered and consolidated by ramming with iron or wooden rammers when filling reaches finished level the surface shall be flooded with water for at least 24 hours and allowed to dry and then rammed and consolidated.

1.4. The finished level of filling shall be kept to shape intended to be given to floor.

1.5. In case off large heavy duty flooring like factory flooring the consolidation may be done by power rollers, where so specified the extent of consolidation required shall also be as specified.

1.6. The excavated stuff of the selected type shall be allowed to be used in filling the trenches and plinth. Under no circumstances black cotton soil be used for filling the plinth.

2.0. Mode of Measurements & Payment

2.1. The payment shall be made for filling in plinth and trenches. No deduction shall be made for shrinkage or voids, if consolidated as instructed above.

2.2. The rate shall be for a unit of one cubic meter.

ITEM NO. NIL

Providing and fixing in position mild steel dowel bar of 32mm diameter and 500 mm length at 200 mm c/c in transverse direction at expansion joint which is provided at 4.0 m c/c longitudinally with plastic cap of 3 to 5 mm thick black coloured as a cover of dowel bar which sustain the movement of dowel bar including cutting, placing of same, with all machinery, tools, tackles, labours etc. complete.

1. This item provides for necessary mild steel bar of 32 mm. diameter for anchoring in foundations strata as per detailed drawings and as directed by Engineer-in-charge. For this purpose, 100 mm holes shall be kept in staining itself at regular intervals as shown in drawing or as directed by Engineer in-charge. Mild steel bars shall be supplied by the department at the rate and place shown in schedule A of the tender. The item includes transporting the bars to the site of work, handling, and cutting, bending, hooking and placing the same in position as required as per drawing. The grout holes shall be not less than 100 mm. diameter. The anchorage length of bars shall not be less than 60 times diameter of bar. Grouting shall be of 1:2 proportions (1 part of cement, 2 parts of sand) and shall be done under pressure as directed. These dowels bars shall be inserted through holes kept in the well staining to the bottom of the grout holes. Grout holes shall not be less than 1 Mt. in depth. In case, no dowel bars are ultimately decided to be provided in the holes of the staining kept for the purpose, the same shall be filled with the concrete of the same proportion as of well staining at the cost of the contractor.
2. Mode of measurement will be per number of dowel bar considered as one number from bottom of grout hole to the top of staining,
3. Unit rate includes cost of material, labour, tools and plant and grouting the staining holes to complete the work.

For Plastic Cap

- I. Plastic cap shall be of 3 to 5 mm thick
- II. Plastic cap shall be as Approved by the Engineer-In-Charge
- III. Payment shall be made on Nos. Basis.

ITEM NO. NIL

Providing and Casting in situ controlled reinforced cement concrete M200 Including necessary shuttering & including reinforcement laying, vibrating, ramming, curing etc. complete as per approved Design. Having Bottom width of 0.6 mt. upto 0.1 Mt. Top width of 0.45 mt. & ht. is 0.65 Mt. Having 1.5 Mt. Length(NJB) including transportation, loading, unloading, ramming with labours, tools, tackles etc. as per direction of Engineer in charge. (To be provided alternately)

1. For Controlled design of the mix shall be approved after preliminary tests and all necessary precautions shall be taken in its production to ensure that the required works cube strength is attained and maintained. The controlled concrete shall be in eight grades designated as M-100, M-150, M-200, M-300, M- 350, M-400 and M-450 with the suffix controlled added to it.
2. In the designation of a concrete mix, letter "M" refers to the mix and the number the specified 28 days works cube compressive strength of that mix on 150 mm cubes expressed in kg./cm² where ordinary port land cement conforming to IS : 269 or Port land blast furnace Cement conforming to IS : 455 is used, the compressive strength requirements for various grades of concrete shall be as given below on the next page :-

Grade of Concrete Compressive works test strength in Kg/Cm² on 150mm, cubes, conducted in accordance with IS: 516

Grade of Concrete	Compressive works test strength in kg/cm ² On 150 mm cubes, conducted in accordance with IS '516		
	Min. at 7 days	Min. at 28 days	Cement level
100	70	100	220
150	100	150	320
200	135	200	400
250	170	250	450
300	200	300	475
350	235	350	
400	270	400	
450	300	450	

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

- 3 Concrete mix shall be designed on the basis of preliminary tests so as to attain strength at least 33 percent higher than that required on work tests. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with the 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 should be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions as required. Aggregates of different sizes shall be stocked in separate stock piles. Required quantity of material shall be stock piled several hours, preferably a day, before use, grading of coarse and fine aggregate shall be checked as frequently as possible frequency for a given job being determined by the Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests.
4. 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 marker's weight per bag, a reasonable number of bags shall be weighed separately to check the net weight. Where cement is weighed from bulk stocks at site and by bags, it shall be weighed separately from the aggregates. 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.
- 5 It is most important to keep the specified water cement ratio constant and as its correct value. To this end, moisture content in both fine and coarse aggregate 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 aggregate, IS : 2386 (Part-III) shall be referred to, suitable adjustments shall also be made in the weights of aggregates to allow for the variation in 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 210 Kg. per cubic meter in plain concrete and not less than 300 Kg/Per cubic meter in reinforced concrete structural members. The minimum quantity of cement for pre-stressed concrete work shall not less than 360 Kg. per cubic meter of concrete nor

shall it be more than 540 Kg. per cubic meter of concrete. 6. Following shall be maximum nominal size of coarse aggregate for the different items of work:-

Sr.no	Item of construction	Maximum nominal size coarse aggregate
i)	R.C.C. well curb, R.C.C. well staining and R.C.C. Piles	40mm
ii)	R.C.C. well steining	63mm
iii)	Well cap or pile cap; solid type piers, abutment and wing-walls, and their pier caps	40mm
iv)	R.C.C. works in cross girder deck slab, wearing coarse, kerb, light posts, blast walls, approach slab girders deck slab, wearing etc. and hollow type piers, abutments, wing-walls and their pier caps	20mm
v)	R.C.C. bearings	20mm
vi)	For any other item of construction not covered As specified on the drawing by items (i) to (v) 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 cleat 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 get approved by the Engineer-in-charge.
7. All materials shall be stored as to prevent their deterioration of true quantity 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 works.
8. Cement shall be stored above the ground level in perfectly dry and water tight sheds. 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. The aggregate shall be stored in such a way as to prevent admixture of foreign materials. Different size of fine or coarse aggregate shall be stored in separate stock - piles sufficiently away from such other to prevent; intermixing the materials.
9. The water for mixing shall be potable water to satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce 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 uniform distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate show 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. For all work concrete shall be mixed in 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 be mixing be done for less than 2 minutes after all ingredients have been put into the mixer.

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 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.
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 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 3 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 0.45 meter when internal vibrators are used and not exceeding 0.30 more 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 meters. 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 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 well surface with wire or bristly 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 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 corners 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 is 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, vibration, traffic, rapid temperature changes, frost and driving out process. It shall be covered with wet sacking, Hussein or other 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.

18. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Form work shall however be divided into following two distinct categories:
 - (1) Shuttering i.e., form work required for forming the concrete.
 - (2) Scaffolding i.e., form-work required for supporting shuttering.Forms for shuttering shall be constructed only in metal suitably lined. Forms for scaffolding are constructed of metal or timber. Both shuttering and scaffolding shall be of substantial rigid construction and shuttering shall be true to shape and dimensions shown on the drawings. All bolts and rivets shall be counter-sunk 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 or hard wood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of structure, especially in long spans to counteract the effects of any deflection. The form work shall be so fixed as to provide for such camber. Forms shall be so 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, chambers or fillers of size 25mm x 25mm shall be provided at all angles of form work to avoid sharp corners.
20. The inside surfaces of shuttering shall, except in the case of permanent form work or where otherwise agreed to by the Engineer-in-charge, be coated with an approved material to prevent adhesion of concrete to the form work. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not be allowed to come into contact with any reinforcement or pre-stressing tendons and anchorages. Different release agents shall not be used in form work for concrete which will be visible in the finished works.
21. Special measures shall be taken to ensure that the form work does not hinder the shrinkage of concrete because without these cracking could occur before the form work is removed. Where ever applicable arrangements must be made to ensure that the form work does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons, The form work should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape the structures having regard to the deformation of a false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting pre-stressed structures. Where they are reentrant angles in the concrete sections the form work should be removed at those sections as soon as possible after the concrete has set in order to avoid cracking due to shrinkage of concrete. Form work shall be tight enough to prevent any appreciable loss of cement during vibrations; suitable tolerances should be provided in the form work. The dietary before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in-charge 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 men, 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 formwork, due consideration shall be given to local conditions, that influence the setting of concrete and of the materials

used in the mix. Where field operations are controlled by strength tests of concrete, the removal of the load-supporting or soffit forms may commence when concrete has attained strengthening props including the effect or any further additional of loads. When field operation is not controlled strength tests 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. Centering shall be gradually and uniformly lowered 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 mortar. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to refuse the formwork, it 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 to a depth of at least 25 mm. below the surface of the concrete and the resulting holes are 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 corners 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 that is being finished and of as dry as consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been pointed shall be kept moist for a period of twenty four hours. If rock pockets / honeycombs, in the opinion of the Engineer-in-charge are of such an extent or character as to affect the strength of the structure materially or to endanger the life of 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 by regular slump tests. Following slump shall be adopted for different types of works.
- Type of Work Slumps Where Slump Where vibrators are used vibrators are not used
- (i) Mass concrete in R.C.C. foundations, 10 mm to 80 mm. footings and retaining walls 25 mm.
 - (ii) Beams, slabs and columns simply reinforced. 25 mm. to 100 mm. to 40 mm. 120 mm.
 - (iii) Thin R.C.C. section or section with congested 40 mm. to 125 mm. to steel 50 mm. 150 mm.
25. For Controlled concrete preliminary tests shall consist of three sets of separate tests and in each set; tests shall be conducted on six specimens. No more than one set of six specimens shall be made on any particular day of the six specimens in each set; three shall be tested at seven days and the remaining three at 28 days. The preliminary tests at 27 days are intended only to indicate the strength likely to be attained at 28 days. Work 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 & 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 charged irrespective of the quantity of concrete proud. The number of specimens may be suitably increased as deemed necessary by the Engineer-

in-charge when procedure of tests given above reveal 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 for each day may have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specifies strength.
27. R.C.C. work shall have exposed concrete surface. Centering design and its erection shall approved by the Engineer-in-charge. One carpenter with helper will invariably be kept present 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 provided so 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, kapchi 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 Astd. Engineer /Addis. Astd. Engineer Overseer or as instructed by the Engineer-in-charge. After removal of form work checks that concrete produced is of good quality. Plastering shall not be allowed to the expressed 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 payment will be made on cmt. Basis of the finished work.
31. The unit rate for concrete shall include the cost of all materials, labour tools and plan 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 show on the drawings and according to these specifications. The rate shall also include the cost of making/fixing and removing of all contras

ITEM NO. NIL

Supplying and Fixing reinforced concrete heavy duty non- pressure pipes with collars for culverts including setting and joining the pipes in C.M. 1:2 watering and laying (To level of slopes of I.S. 458 / 1971 Class NP4 casted by vertically vibrated technology of following internal diameter 600mm dia. Including transportation, loading, unloading, ramming with labours, tools, tackles etc. as per direction of Engineer in charge.

1 R.C.C. SPUN PIPES :

The pipes shall be R.C.C. spun pipes NP4 class, conforming to I.S. 458-1971 and shall be approved by the Engineer-in-Charge for soundness before incorporation in the work.

2 LAYING R.C.C. SPUN PIPES :

The work consist of providing, laying, jointing and testing R.C.C. spun pipe storm water drain of required diameter as mentioned in the schedule to discharge storm water to the main nallah as shown in the drawing.

After the cement concrete cradle has been laid properly, if specified or as directed by the Engineer-in-Charge, the pipes shall be lowered gradually into the trenches over the concrete cradle or bed. Necessary working space/gap for collars shall be made at every joint. Laying of pipe shall proceed upgrade of a slope. The collars shall be slipped-on before the next pipe is laid.

The pipe drain shall rest on the bed at every point through its length. To ensure this the space between the underside of the pipe on the invert of the cradle shall be carefully grouted solid with cement slurry consisting of one part of cement to one part of clean washed sand in such a manner that no void is left. It shall be ensured that the load of the pipes and the super imposed load of the earth filling is evenly distributed on the cradle or bed.

The contractor shall take precautions to see that no dirt, earth or other foreign matter is allowed on the surface of the cradle or bed of the pipe resting there-on, all to the full satisfaction of the Engineer-in-Charge. After the alignment and grading of the pipes is checked by the authorised representative of the Department, the grouting shall be done with specified stiff mix of cement mortar.

The cradle of concrete shall be allowed to set at least for three days before any pipe is placed on it and the contractor shall take due care in setting the pipe in the cradle so that no damage is occur to the cradle. If any damage to the cradle occurs, it shall be rectified to the satisfaction of Engineer-in-Charge and in any particular case where damage to the cradle is beyond repair in the opinion of the Engineer-in-Charge, the contractor shall cut out the damaged section of the cradle and re do the same at his own expenses to the complete satisfaction of the Engineer-in-Charge.

No pipe shall be laid or placed till the alignment of the pipe drain and its levels and gradient have been carefully checked and found correct/approved by the Engineer-in-Charge.

a. **JOINTS :**

The joints for the pipes shall be made by loose collars and the connecting space shall be as minimum as possible. The collars shall be specifically roughened inside to provide a better grip.

The two adjacent pipes will be so designed and manufactured that when butted together concentrically, a dowel is left between the two ends. In this dowel, cement mortar of (1:1) proportion or mix. as specified in the schedule be filled and then between the ends a paste of cement mortar of the same proportions will be placed. The space remaining between the pipe ends and the collar being then caulked with cement mortar of (1:1) or other specified proportion so that an even space appears all round the external diameter of the pipes. All the joints shall be finished off smooth at an angle of 45^o with the longitudinal axis of the pipe on either side of the collars.

The interior of the pipe drains shall be cleaned off all dirt, cement mortar and superfluous materials and joints shall be cured for atleast 7 days.

b. **TESTING OF R.C.C. SPUN PIPES:**

After sufficient interval has been allowed for the joints to set, the pipe drains will be tested under a water head of at least 1.2 m. and in no case under a head greater than 1.8 m. of water above the top of the pipes. In addition, the pipe drains shall be examined for leaks of land/sub-soil water making its way through the joints. The contractor shall make the pipe drains water tight against the entrance of land/sub-soil water from outside and also

against the leakages of water from the inside of the pipe drains at the test heads specified above to the full satisfaction of the Engineer-in-Charge.

All defective or leaking pipes or joints shall be cut out and replaced and made good by the contractor at his own cost. In case of the joints that may be defective and cannot be made good, shall be entirely embedded/surrounded externally with cement concrete of 1:2:4 proportion to render the joint (s) water tight and this shall be allowed to set before encasing or back filling is done. A strong colour shall be added to the water used for testing of the pipes, in order to detect any leakage easily. The cost of testing of the pipe drain shall be borne by the contractor and is deemed to be included in the rates quoted by the contractor.

c. ENGINEER-IN-CHARGE MAY ORDER CONCRETE TO BE INCREASED OR DIMINISHED:

The Engineer-in-Charge may increase or decrease the concrete on the pipe drains as to the quantity and quality or to omit the same entirely according to the nature of the ground that may be revealed when the storm water drain trenches are excavated.

d. Back filling/filling Trenches:

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 20 cm. watered, rammed and consolidated, taking care that no damage is caused to the pipe below. In case of excavation of trenches in rock, the filling upto a depth of 30 cm. above the crown of pipe or barrel shall be done with fine material such as earth, murrum or pulverized decomposed rock according to the availability at site. The remaining filling shall be done with rock filling or boulders of size not exceeding 15 cm. mixed with fine material as available to fill up the voids, watered, rammed and consolidated in layers not exceeding 30 cm.

e. MODE OF MEASUREMENT:

The length of pipes shall be measured in running meter nearest to a centimeter along the center line of the pipes over all fittings such as collars, bends, junctions etc. Fittings/specials shall not be measured separately.

The rate shall include the cost of materials and labour including jointing, grouting, cutting of pipes to the required lengths, wastages etc. involved in all the operations described above.

Excavation, back filling, shoring and timbering in trenches and cement concreting wherever required shall be measured separately under relevant items of work.

ITEM NO. NIL

Providing and laying cement concrete 1:4:8 (1- Cement : 4- coarse sand : 8- stone aggregates 40 mm nominal size) and curing complete excluding cost of formwork in Foundation and Plinth including transportation, loading, unloading, ramming with labours, tools, tackles etc. as per direction of Engineer in charge.

Materials

1. Water shall be conforming to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Brick bat shall conform to M-14.

2.0. Workmanship

2.1. General

2.1.1. Before stating concrete the bed of foundation trenches shall be cleared of all loose materials, leveled, watered and rammed as directed

2.2. Proportion of Mix:

2.2.1. The proportion of cement, sand and coarse aggregate shall be one part of cement 3 parts of sand and 6 parts of stone aggregates and shall be measured by volume.

2.3. Mixing:

2.3.1. 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, it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. However, in such case 10% more cement than otherwise period 1. 1/2 to 2 minutes. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the purpose.

2.4. Transporting & Placing the Concrete:

2.4.1. 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.

2.4.2. The concrete shall be laid in layers of 15 cms to 20 cms

2.5.1. The concrete shall be crammed with heavy iron rammers and rapidly to get the required compaction and to allow all the interstices to be filled with mortar.

2.6. Curing:

2.6.1. After the final set, the concrete shall be kept continuously wet if required by ponding for a period of not less than 7 days from the date of placement

3.0. Mode of Measurements & Payment

3.1. The Concrete work shall be measured in length, breadth and depth as specified on drawing limiting dimensions to those specified on drawings or as directed.

3.2. The rate shall be for a unit of one cubic meter.

ITEM NO. NIL

Providing and laying controlled cement concrete M.200 for curing complete including cost of formwork for reinforced concrete work for Walls, Raft etc.

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.
- 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, and 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 150 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 weight 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 per table provided above:

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 EIC 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 expire 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 t 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 EIC. required for the facilitating of conceding shall be provided and removed on completion of work by contractor at his own expense. The scaffolding, hoisting arrangements and ladders EIC shall be strong enough to with stand 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 EIC.
- 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 EIC.
 - (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.
- 10.0. Mode of measurement & payment**
- 10.1.** The consolidated cubical contents of concrete work as specified in item shall be measured. No deduction shall be made for
- (a) Ends of dissimilar materials such as joints, beams, posts, girders, fallers, purling trusses, corbels and steps EIC. up to 500 Sq, Cm. in section.
- 10.2.** Form work shall be measured as the area in square meters to shuttering in contract with concrete except in the case of inclined member and portion of curved profile and upper side in which case on area of underside shall be measured for payment.
- 10.3.** Form work to secondary beams shall be measured up to the sides of main beams but no deduction shall be made from the form work of the main beam at the inter section point. No deduction shall be made from the form work of a column at inter section of beams.
- 10.4.** The rate includes cost of all materials labour, tools and plant required for mixing, placing in position, vibrating and compacting, finishing, as directed, curing and all other incidental expenses for producing concrete of specified strength. The rate **includes** the cost of form work.

10.5. The rate shall be for a unit of **one cubic meter.**

ITEM NO. NIL

Providing, cutting, placing of FE 415, reinforcement steel of all diameter confirming relevant IS including bending , binding with 18 gauge enameled wire & placing in position complete up to any height, including providing of all laps & chairs etc. complete.

The work includes providing & laying in position HYSD / Mils steel / Thermo Mechanically Treated bar of the following grade. Grade Designation Bar type confirming to governing IS specification Characteristic strength by MPa Elastic Modulus GPa S 415 IS 1786 High yield strength deformed bar 415 200 S 240 IS 432 Part-II 240

TMT BAR 415 TMT bar shall conform to min 415 MPa yield strength. Tensile strength of in 500 MPa and elongation percentage min 22. The chemical composition of bars shall be as below.

	% Max
Carbon	0.25
Sulphur	0.05
Phosphorus	0.05
Sulphur & Phosphorus	0.01

All steel shall be procured form original procedures no rolled steel shall be incorporated in the work. Only new steel bars shall deliver to the site. Every bar discarded cracked ends of bars shall be discarded.

1. The work shall consist of furnishing and placing reinforcement the shape and dimensions shown on the drawings or as directed by the engineer-in-charge.
2. Steel shall be clean and free from loose and loose mall scale at the having position and subsequent concreting.
3. Reinforcing steel conform accurately to the dimensions given in the bar bending schedules shown on relevant drawings. Bars shall be bent cold to the specification shape and dimensions or as directed by the Engineer-in-Charge using a proper bar bender, operated by hand power to attain proper radius of bends. Bars shall be bending or straightened in such a manner that will not injure the material. Bars bent during transport or handing shall be straightened before being used on work they shall be not heated to facilitate bending. Unless otherwise specified a "U" type hook at the end of each bar shall be invariably provided. 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 beyond the ends of the curve shall be at least four times the diameter of the round bar. In the case of bars which are not round and in the case of deformed bars ten diameter shall be taken as the diameter of circle having an equivalent effective area. The hooks shall be suitably encased to prevent any splitting of the concrete.
4. All reinforcement bars shall be accurately placed in exact position shown on the drawings, and shall be security held in position during placing of concrete by annealed binding wire not less than 1 mm in size and confirming to IS: 280 by using stay block or metal chairs, spacers, metal hangers supporting wires or other approved device at sufficiently close intervals. Bars will not be allowed to sag between supports nor displaced during concreting or any other operation of the work. All devices used for positioning shall be on non corrodible material wooden and metal support will not extent to the surface or concrete, except where shown on the drawings. Placing bars on layers

of freshly laid concrete as the work progress for adjusting for spacing will not be allowed pieces of brocket stone or brick and wooden block shall not be used layers of bars shall be separated by spacer bars, precast mortar blocks or other approved devices, reinforcement after being placed in position shall be maintained in a clean condition unit completely embedding concrete special care shall be exercised to prevent any displacement of reinforcement from corrosion concrete cover shall be provided as indicated on the drawing. All bars producing from concrete and to which other bars to be spliced and which are likely to be exposed for an indefinite period shall be protected by a thick coat of neat cement grout.

5. Bars crossing each other, where required shall be secured by bidding wire (annealed) of size not less than 1 mm and confirming to IS 28 in such a manner that they do not slip over each other at the time of fixing and concreting.
6. As far as possible bars of full length shall be used. In case this is not possible overlapping bars shall be done as directed by the Engineer-in-Charge. When practicable overlapping bars shall not touch each other but be kept apart of 25mm or 1.25 times the maximum size of the coarse aggregate whichever is greater by concrete between them, where not feasible overlapping bars shall be bound with annealed steel wire, and not less than 1 mm thickness twisted tight. The overlaps shall be staggered for different bars and located at points, along the span where neither sphere not bending moment is maximum.
7. Whenever indicated on the drawings or desired by the Engineer-in-charge. Bar transmit the full stresses of bars. The ends of the bars that are joined by coupling shall be upset for a sufficient length so that the effective cross section at the base of treads is not less than the normal cross section of the bar. Threads shall be standard white worth threads still for coupling shall conform to IS 226.
8. When permitted or specified on the drawing joints reinforcement bars shall be but welded so as to transmit their full stresses. Welded joints shall preferably be located at points where steel not be subjected to more than at any one section and not more than 20 percent of the folds are welded. Only electric arc welding using a proves which excludes air form the molten metal and confirms to any of all other special provision for the work will be accepted. Enable means slab be provided for holding the bars supply as position during welding. It must be ensured that no voids are left in welding and when welding is done in 2 or 3 stages, previous surface shall be cleaned properly ends of the bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before welding shall conform to IS 814 welded pieces of reinforcement shall be tested. Specimen shall be taken from the actual site and their number and frequency of test shall be as directed by the Engineer-in-charge.
9. Reinforcement shall be measured in length including overlaps separately for different diameters as actually used in the work , where welding or coupling is restored to in place of lap-joints such joints shall be measured for payment as the equivalent length of overlap as power design requirement .From the length so measured the weight of reinforcement shall be calculated in tons on the same basis of I.S. 1732 Length shall include hooks at ends wastage and annealed steel wire for binding shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.
10. Rate for reinforcement shall include of all steel, the carting to work site cutting, bending, placing binding and fixing in position as shown on the drawing Sqm. And as directed by the Engineer-in-charge. It shall also include cost of all devices for keeping reinforcement in approved position cost of joints as per approved methods and all wastage and spacer bars.

11. The rate shall be paid for complete item on "MT." Basis.

ITEM NO.-NIL

Providing and fixing pre-cast concrete kerb stone of gray cement based concrete block 30cm length,30cm height and 15cm thick of M250 grade concret as per approved design and including excavation for fixing in proper line and level, filling the joint with C:M 1:3 (1cement:3fine sand) etc complete including base of 75 mm thick PCC 1:4:8 to place the precast kerbstone with transportation, loading, unloading, labours, tools, tackles etc. as per direction of Engineer in charge.

1. Laying

Trenches shall first be made along the edge of the wearing course of the road to receive the kerb stones of cement concrete of specified grade. The bed of the trenches shall be compacted manually with steel rammers to a firm and even surface and then the stones shall be set in cement mortar of specified proportion.

The kerb stones with top 20 cm. wide shall be laid with their length running parallel to the road edge, true in line and gradient at a distance of 30 cm. from the road edge to allow for the channel and shall project about 12.5 cm. above the latter. The channel stones with top 30 cm. wide shall be laid in position in chamber with finished road surface and with sufficient slope towards the road gully chamber. The joints of kerb and channel stones shall be staggered and shall be not more than 10 mm. Wherever specified all joints shall be filled with mortar 1:3 (1 cement : 3 coarse sand) and pointed with mortar 1:2 (1 cement: 2 fine sand) which shall be cured for 7 days.

The necessary drainage openings of specified sizes shall be made through the kerb as per drawings or as directed by the Engineer-in-Charge for connecting to storm water drains.

2. Finishing

Berms and road edges shall be restored and all surplus earth including rubbish etc. disposed off as directed by the Engineer-in-charge. Nothing extra shall be paid for this.

3. Measurements

It shall be measured in cubic meters with Length of the finished work (for specified width and height of stone) shall be measured in running metre along the edge of the road correct to a cm.

4. Rate

The rate shall include the cost of all the materials and labour involved in all the operations described above.

ITEM NO.0

Constructing Manhole with R.C.C. top slab with provision of placing of cover of size 560mm X 560mm with providing of hook for placing & opening in M-400 grade concrete using 20mm nominal size & down grade aggregate and reinforcement at minimum 50kg/Cmt, with foundation concrete 1:3:6 mix (1-cement : 3- coarse sand :6- Brick bats 40 + 50mm size) inside plastering 15mm thick with Cement Mortar 1:5 (1-Cement : 5-coarse sand) finished with a floating coat of neat cement and making channels in cement concrete 1:2:4 mix (1-Cement :2-Coarse sand :4-stone aggregate 20mm nominal size) finished smooth complete including curing and testing (i) Inside size 900mm x 1200mm

and 1.5M. deep including (A) With 230mm thick walls of brick masonry using brick having crushing strength not less than 35Kg. / Sq.cm. in Cement Mortar 1:5 (1- Cement: 5- Coarse sand) including material, transportation, loading, unloading, ramming with labours, tools, tackles etc. as per direction of Engineer in charge.

1.0. Materials:

Water shall conform to M-1. Cement shall conform to M-o. Burnt bricks shall conform to M-15.

Brick bats of 40 to 50 mm. size shall conform to M-14. Stone coarse aggregate of 20 mm. nominal size shall conform to M-12. Grit shall conform to M-8. Cement mortar of specified proportion shall conform to M-11. The cast iron manhole cover of 550 mm. dia. with frame shall conform to IS. 1726-1966.

2.0. Workmanship

2.1. The manholes of different types and sizes as specified shall be constructed in sewer line at such places and to such levels and dimension as shown in drawings of as directed.

2.2. The manholes shall be built on a bed of cement concrete 1:3:6 (1 cement: 3 coarse sand: 6 brick bats) (40) to 50 mm. nominal size) to the thickness of the bed concrete shall be 15 cms for manhole up to 1. M. Depth and 20 cms for manholes over meter and up to over meter and up to 2 meters, depth and 30 cms for manholes of greater depth.

2.2.2. Projection of bed concrete beyond the masonry wall shall be 15 cms.

2.3. Walls

2.3.1. The walls of manhole shall be carried out with burnt bricks using having bricks, crushing strength not less Than 35 Kg/Cms in CM. 2 in CM. 1:5 (1 cement: 5 coarse sand). The thickness of brick masonry wall shall be 230 mm. The jointing face of such brick shall be well buttered with cement mortar before laying so as to ensure full joints.

2.4. Plaster

2.4.1. The inside of walls shall be plastered 15 mm. thick with CM. 1:5 (1 cement: 5 coarse sand) and finished With floating coat of neat cement. All angles shall be rounded to 7.50 cms. Radius and all rendered inner surface shall have hard impervious finish.

2.5. Channels & Benching:

2.5.1. Channels shall be semicircular in the bottom half and of diameter equal to the sewer. Above the horizontal diameter, the sides shall be extended vertically to the same level as the crown of the outgoing pipe and the top edge shall be suitably rounded off. The branch channels shall also be similarly constructed with respect to the benching but at their junction with the main channel an appropriate fall suitably rounded off in the direction of flow in the main channel shall be given.

2.5.2. The channel and benching shall be done in C.C. 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm. nominal size) rising at a slop in line from edges of channel. The channels of the bottom of the chamber shall be plastered with CM. 1:2 (1 cement: 2 coarse sand) and steel troweled smooth.

2.6. Cover slab:

2.6.1. The cover slab of R.C.C. 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm. nominal size) 15 cms. Thick reinforced with 10 mm. bars at 15 cms. C/C both ways, surface and edges finished fair. Full bearing equal to the width to the width of wall shall be given

to the slab on all sides. The frame of manhole cover shall be embedded firmly in R.C.C. slab so that the top of the frame remains flush with the top of R.C.C. slab.

2.7. Testing:

2.7.1. Manhole shall be tested by filling with water to a depth not exceeding 1.2 M. as directed.

2.7.2. After completion of work, manhole cover shall be seated by means of thick grease.

3.0. Mode of measurements and payment

3.1. The depth of manholes shall be distance between the top of the manhole cover and the invert level of the Main drain. The rate includes all labours, materials, tools, and plant etc. for satisfactory completion of this item as directed above.

3.2. The rate shall be for a unit of the one number.