

TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS

1.0 PREAMBLE:-

1.1 The Technical Specifications contained herein shall be read in conjunction with the other Bidding Documents as specified in this Volume.

1.2 Site Information:-

1.2.1 The information given here under provided elsewhere is given in good faith by the Employer but the Contractor shall satisfy himself regarding all aspects of site conditions and no claim will be entertained on the plea that the information supplied by the Employer is erroneous or insufficient.

2.0 GENERAL REQUIREMENTS:-

The technical specifications in accordance with which the entire work described herein after shall be constructed and completed by the Contractor shall comprise of the "SPECIFICATION"

2.1 Though "SPECIFICATION" for each item are attached with tender they are based on following.

(1) "SPECIFICATION FOR ROAD AND BRIDGE WORKS" (Fourth REVISION printed in year 2001) issued by the Ministry of Road Transport & Highways (MORT & H), Government of India and Published by the Indian Roads Congress, hereinafter to as MORT & H Specifications.

(2) The General Technical Specifications for Road works.

(3) The General Technical Specifications for Bridge works.

Note:- (2) To (3) are Conventional Specifications Booklets usually attached for (R&B) Works.

2.2 If, a particular clause (which is incorporated in "SPECIFICATION") of specification booklets (1) to (3) above is Amended / Modified/ Added upon then the Amendment/ Modification/Addition shall supersede the relevant clause incorporated in " SPECIFICATION"

2.3 In, so far as Amended / Modified / Added Clause may come in conflict or be inconsistent with any of the provisions of the MORT & H Specifications under reference, the Amended/Modified/ Added Clause and the additional specifications shall always prevail.

2.4 In the absence of any definite provisions on any particular issue in the aforesaid Specifications, reference may be made to the latest codes and specification, of IRC and BIS in that order. Where even these are silent, the construction and completion of the works shall conform to sound engineering practice as approved by the ' Engineer' and , in case of any dispute arising out of the interpretation of the above, the decision of the 'Engineer' shall be final and binding on the Contractor.

Name of Work :- Suvidhapath Yojana Year -2025-26
Constructing a C.C. road on Barumal Gurudham
Dudhabhavan to Amali Road. Km (0/0 to 0/800) Ta.
Dharampur, Dist. Valsad...

ITEM WISE SPECIFICATION

Item No.1 Clearing and grubbing road land including uprooting rank vegetation, grass bushes, shrubs, saplings and trees girth up to 300 mm removal of stumps of trees cut earlier and disposal of unserviceable materials.(D) By mechanical means in area of thorny jungle.

201.1. Scope

This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, top organic soil not exceeding 150 mm in thickness, rubbish etc., which in the opinion of the Engineer are unsuitable for incorporation in the works, from the area of road land containing road embankment, drains, cross-drainage structures and such other areas as may be specified on the drawings or by the Engineer. It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials. Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications.

201.2. Preservation of Property/Amenities

Roadside trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipelines, sewers and all highway facilities within or adjacent to the highway which are not to be disturbed shall be protected from injury or damage. The Contractor shall, provide and install at his own expense, suitable safeguards approved by the Engineer for this purpose.

During clearing and grubbing, the Contractor shall take all adequate precautions against soil erosion, water pollution, etc., and where required, undertake additional works to that effect vide Clause 306. Before start of operations, the Contractor shall submit to the Engineer for approval, his work plan including the procedure to be followed for disposal of waste materials, etc., and the schedules for carrying out temporary and permanent erosion control works as stipulated in Clause 306.3.

201-3. Methods, Tools and Equipments

Only such methods, tools and equipment as are approved by the Engineer and which will not affect the property to be preserved shall be adopted for the Work. If the area has thick vegetation/roots/trees, a crawler or pneumatic tyred dozer of adequate capacity may be used for clearance purposes. The dozer shall have ripper attachments for removal of tree stumps. All trees, stumps, etc., falling within excavation and fill lines shall be cut to such depth below ground level that in no case foil within 500 mm

of the subgrade. Also, all vegetation such as roots, under-growth, grass and other deleterious matter unsuitable for incorporation in the embankment/subgrade shall be removed between fill lines to the satisfaction of the Engineer. On areas beyond these limits, trees and stumps required to be removed as directed by the Engineer shall be cut down to 1 m below ground level so that these do not present an unsightly appearance.

All branches of trees extending above the trimmed as directed by the Engineer.

All excavations below the general ground level arising out of the removal of trees, stumps, etc., shall be filled with suitable material and compacted thoroughly so as to make the surface at these points conform to the surrounding area.

Ant-hills both above and below the ground, as are liable to collapse and obstruct free subsoil water flow shall be removed and their workings, which may extend to several metres, shall be suitably treated.

201.4. Disposal of Materials

All materials arising from clearing and grubbing operations shall be the property of Government and shall be disposed of by the Contractor as hereinafter provided or directed by the Engineer.

Trunks, branches and stumps of trees shall be cleaned of limbs and roots and stacked. Also boulders, stones and other materials usable in road construction shall be neatly stacked as directed by the Engineer. Stacking of stumps, boulders, stones etc., shall be done at specified spots with all lead and lift.

All products of clearing and grubbing which, in the opinion of the Engineer, cannot be used or auctioned shall be cleared away from the roadside in a manner as directed by the Engineer. Care shall be taken to see that unsuitable waste materials are disposed of in such a manner that there is no likelihood of these getting mixed up with the materials meant for embankment, subgrade and road construction.

201.5. Measurements for Payment

Clearing and grubbing for road embankment, drains and cross-drainage structures shall be measured on area basis in terms of hectares. Clearing and grubbing of borrow areas shall be deemed to be a part of works preparatory to embankment construction and shall be deemed to have been included in the rates quoted for the embankment construction item and no separate payment shall be made for the same. Cutting of trees upto 900 mm in girth including removal of stumps and roots, and trimming of branches of trees extending above the roadway shall be considered incidental to the clearing and grubbing operations. Removal of stumps left over after trees have been cut by any other agency shall also be considered incidental to the clearing and grubbing operations.

201.6. Rates

201.6.1. The Contract unit rates for the various items of clearing and grubbing shall be payment in full-for carrying out, the required operations including full compensation for all labour, materials, tools, equipment and incidentals necessary to complete the work. These will also include removal of stumps of trees less than 900 mm in girth as well as stumps left over after cutting of trees carried out by another agency, excavation and back-filling to required density, where necessary, and handling, salvaging, piling and disposing of the cleared materials with all lead and lifts.

Item No.2 Box cutting the road surface to proper slope and camber for making a base for road work including removing the excavated stuff and depositing on the road side slope as directed upto 50Mt.lead.

1. This work shall consist of excavation, removal and satisfactory disposal of all materials necessary for the construction of widening carriageway in accordance with requirements of these specifications and the lines, grades and cross sections shown in the drawings or as indicated by the Engineer.
2. After the site has been cleared the limits of excavation/ box cutting the road surface shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer.
3. Box cutting 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 box cutting/ excavation are satisfactorily utilized as directed.
4. The contractor shall not excavate outside the limits of box cutting. 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 as directed.
5. Cutting shall be done in proper grade & camber as per measurements given. Care must be taken that all slopes are evenly and truly dressed. Cutting shall be done to the exact depth required and shall be as per formation level in proper grade and the camber. If extra depth of cutting is done due to negligence of contractor the same shall be refilled with approved quality of materials duly consolidated to the satisfaction of the Engineer-in-charge (without extra cost).
6. The bottom level of box cutting i.e. sub grade shall be watered and well compacted with vibratory roller at OMC to the desired density as directed by the Engineer in charge. Rolling and compaction shall be deemed to be incidental to the work and no extra cost shall be paid for compaction of box cutting base surface.
7. The stuff received from the cutting shall be used for filling and correcting side slopes of bank and earthwork for embankment as directed by the Engineer in charge with all lead and lift.
8. The measurement of box cutting shall be taken on level basis & level shall be taken at 30 mt. interval. Volume shall be computed in cubic meters by average area method.
9. The payment shall be made on Cmt. basis.
10. The rate includes cost of all labour, machineries required, cost of carting and spreading the cutting stuff with all lead and lift and leveling the dumping ground/ embankment, rolling and consolidation of subgrade level etc. complete.

Item No.3 Rolling and consolidation of soling including filling in depression which occur during the process, with power roler 8 tonne to 12 tonne.

1. For spreading materials in layers and bringing the appropriate moisture content, the embankment materials shall be spread uniformly over the entire width of the

embankment in layers not exceeding 250mm in loose thickness.. Successive layers of embankment shall not be placed until the layer under construction has been thoroughly compacted to the requirements set down hereunder :-

Moisture content of the materials shall be checked at the source of supply and if found less than that specified for compaction, the same shall be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case, water shall be sprinkled directly from a hose line or from a truck mounted water tank, and flooding shall not be permitted under any circumstances.

If the materials delivered to the road bed is too wet it shall be dried, by evaporation and exposure to the sun, till the moisture content is brought down to acceptable, standard for compaction. Should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required level by the above procedure, work of compaction shall be suspended.

Moisture content of each layer of soil shall be checked in accordance with IS 2720 (Part-11) and unless otherwise mentioned shall be so adjusted, making due allowance for evaporation losses, so that at the time of the compaction it is in the range of 1 percent to 2 percent below the optimum moisture content determined in accordance with IS (Part-VII). Highly expansive clays shall however be compacted at 2 to 4 percent above the optimum moisture content.

After adding the required amount of water, the soil shall be processed by means of harrows, rotary mixers or as otherwise approved until the layer is uniformly wet.

Clods or hard lumps of earth shall be broken to have maximum size of 150mm when being placed in the lower layers of the embankment and a maximum size of 60mm when being placed in the top 0.5 meter portion of the embankment below the subgrade.

Hauling equipment shall be dispersed uniformly over entire surface of the previously constructed layer to minimise cutting of uneven compaction.

Where the embankment is to be constructed on low area ground that will not support the weight of trucks or other hauling equipment, the lower part of the fill should be constructed by dumping successive loads in a uniformly distributed layers of a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

2. **COMPACTION** : Only compacting equipment approved by the Engineer-in-charge shall be employed to compact the materials. The contractor shall demonstrate the efficiency of the plants he intends to use for carrying out compaction trials.

Each layer of the materials shall be thoroughly compacted to the densities specified in Table 1.2

Table 1.2 Compaction requirements for embankment.

Sr.	Type of work / materials	Field dry density as per centage of maximum laboratory dry density as per IS : 2720 (Part-VII)
1	Top 0.5 meter portion of embankment below subgrade level and shoulders.	Not less than 100
2	Other portion of embankment	Not less than 95
3	Highly expansive class	85 to 90

Subsequent layers shall be placed only after finished layer has been tested according to M.O.S.T. specification clause 902 and accepted by the Engineer-in-charge.

When density measurements reveal any soft areas in the embankment further compaction shall be earned out as directed by the Engineer-in-charge. If insite of that the specitcated compaction is not achieved, the materials in the soft areas shall be removed and replaced by approved materials and compacted to the density requirement. to the satisfaction of the Engineer-in-charge.

3. Measurements for Payment: Consolidation of earth embakment construction shall be measured by taking cross section at intervals in the origninal position before the work starts and after its completion and computing of the volume of earthwork in cubic meters by the method ot average and areas. The measurement of fill material from borrow are a shall be the difference between the net quantities of suitable materials brought from roadway and drainage excavation. For this purpose it shall be assumed that one cubic meter of suitable materials brought to site from roadway and drainage excavation froms one cubic meter of compacted till and all bulking or shrinkage shall be ignored.

Stripping including storing and reapplication of lop soil shall be measured as volume in cubic meter.

4. The contract unit rate includes cost of mechanical roller required lor consolidation including all labour. Equipments fuel, hire charges, toils, and incidentals necessary.

Item No. 4 Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts carrying heavy traffic as per IS 458-1991 specifications including setting the pipes in C.M. 1:2 watering and laying (to level or slopes) of class NP3 of following internal daimeters.(iii) 600mm dia.

1. The work shall consist of furnishing and installing reinforced cement concrete pipe of the type diameter and length required at the location shown on the drawings or as ordered by the Engineer-in-charge.
2. Reinforced concrete pipe shall be NP-3 type conforming to the requirements of IS: 458 and shall be of 300, 600, 900, 1200 mm internal dia. as specified in the item. Each consignment of cement concrete pipes shall be inspected, if necessary and approved by the Engineer-in-charge, either at the place of manufacture or at the site before their incorporation in the works.

NP3, NP2, NP1 pipes are used for R.C.C. Pipes, where testing of pipes will not be feasible. The contractors will have to produce a certificate from the manufacturers on company's letter head the given hereinafter form.

Production of such certificate will not however relieve the contractor from his responsibility of supplying pipes of required standard and will have to bear the loss or damage caused to the work on account of defects found subsequently during the execution. It will also be necessary to purchase these pipes from manufacturer having standard equipments for carrying out various test as per IS: 458 at his factory.

FORM OF CERTIFICATE FOR NP3, NP2, NP1 PIPES

We _____ manufacturer of R.C.C. pipes produce R.C.C. pipes as per the requirement of IS: 458 and also carry out the required test at our place. We have acquired equipments for carrying out test and are prepared to carryout test at our factory sites.

We have experience of manufacturing of pipes of _____ years The' pipes supplied by us to M/s. _____ satisfy the requirement of IS: 458

Date : _____

Place : _____ Manufacturer's Sign. _____

3. No pipe shall be placed in position until the foundations have been approved by the Engineer-in-charge. Where two or more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to minimum of 450 mm. The laying of pipes on the prepared foundation shall start from the outlet and proceed towards the inlet and be completed to the specified lines and grades. The pipes shall be fitted and matched so that when laid in works they form a culvert with a smooth uniform invert. Any pipe found defective or damaged during laying shall be removed at there cost of Contractor.
4. The pipes shall be jointed either by collar joint or by flush joint. In the former case, the collars shall be of R.C.C., 150 to 200 mm wide and having the same strength as the pipes to be jointed. Caulking space shall be between 13 and 20 mm according to the diameter of the pipes. Caulking material shall be slightly wet mix of cement and sand in the ratio of 1:2 rammed with Caulking irons. Before caulking the collar shall be so placed that its centre coincides with that of pipe and an even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self centering joint with a joining space 13 cm wide. The joining space shall be filled with cement mortar. 1 cement to 2 sand, mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care shall be taken to fill all voids and excess mortar shall be removed. All joints shall be made with care so that their interior surface is smooth and consistent with the interior surface of the pipes. After finishing, the joint shall be kept covered and damp for at least four days.
5. R.C.C. pipe shall be measured along their centre between their inlet and outlet ends in linear meters.
6. The rate for the pipes shall include the cost of pipe including loading, unloading, handling storing laying in position and joining complete.

Item No. 5 Filling with hard murrum on side of paver block in layer of 20cm thickness including watering, ramming and consolidating etc. complete.

401.1 Scope :

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

The materials to be used for the work shall be a UNSRCEEN GRAVEL, QUARRY SPALL AND **HARD MURRUM**. The material shall be free from organic

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

401.2.2 Physical requirements: The materials shall have a 10 percent fines value of 50 KN or more (for sample in soaked condition) when tested in compliance with B.S.: 812 (Part 111). The water absorption value of the coarse aggregate shall be determined as per IS : 2386 (Part 3) : if this value is greater than 2 percent, the soundness test shall be carried out on the material delivered to site as per IS : 383. For grading II and III materials, the CBR shall be determined at the density and moisture content likely to be developed in equilibrium conditions which shall be taken as being the density relating to a uniform air voids content of 5 percent.

401.3 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.

401.4 Construction Operations:

401.4.1 Preparation of Sub grade: Immediately prior to the laying of sub-base, the sub grade already finished to Clause 301 or 305 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.

401.4.2 Spreading and compacting: The sub-base material of grading specified in the Contract shall be spread on the prepared sub grade 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 401.2.1, of this item 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 adjusted 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 of 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 barrows, 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 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 cross fall and super elevation and shall commence at the edges and progress towards the centre for portions having cross fall 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 cross fall (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-compacted.

401.5. Surface Finish and Quality Control of work: The surface finish of construction shall conform to the requirements of Clause 902 of MORT & H specifications. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 of MORT & H specifications.

401.6 Arrangements for Traffic: During the period of construction, arrangement of traffic shall be maintained in accordance with Clause 112 of MORT & H specifications.

401.7 Measurements for Payment:

Granular sub base shall be paid as finished work in position on cross sectional measurements and computing the volume of GSB work in cubic meters by average area method.

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.

401.8 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 as above except for initial treatment to verges, shoulders and construction of diversions.
- [ii] Furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lift.
- [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.

Item No.6 Construction of Granular Sub Base by providing coarse graded machine crushed B. T. material satisfying MOST Specification of Grading - I using 53 mm to 26.5 mm @ 30% (M.C. Metal), 26.5 mm to 4.75 mm @ 60% (M.C.Metal), 2.36 mm below @ 10% (Stone Dust) including spreading in uniform layer with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC and compacting with vibratory roller to achieve the desired density with C.B.R. > 30% etc. complete.

401.1 Scope :

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

The materials to be used for the work shall be a machine crushed crushed stone aggregate. The material shall be free from organic or other deleterious constituents and conform to the Table 400.2 grading I.

TABLE 400-2.

GRADING FOR COARSE GRADED GRANULAR SUB-BASE MATERIALS.

IS sieve Designation	Percent by weight passing the IS sieve. Grading I
75.0 mm	100
83.0 mm	-
26.5 mm	55 – 75
9.5 mm	-
4.75 mm	10 – 30
2.365 mm	
0.425 mm	
0.075 mm	< 10
CBR Value (Minimum)	30

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

401.2.2 Physical requirements:

The materials shall have a 10 percent fines value of 50 KN or more (for sample in soaked condition) when tested in compliance with B.S.: 812 (Part 111). The water absorption value of the coarse aggregate shall be determined as per IS : 2386 (Part 3) : if this value is greater than 2 percent, the soundness test shall be carried out on the material delivered to site as per IS : 383. For grading II and III materials, the CBR shall be determined at the density and moisture content likely to be developed in equilibrium conditions which shall be taken as being the density relating to a uniform air voids content of 5 percent.

401.3 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.

401.4 Construction Operations:**401.4.1 Preparation of Sub grade:**

Immediately prior to the laying of sub-base, the sub grade already finished to Clause 301 or 305 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.

401.4.2 Spreading and compacting:

The sub-base material of grading specified in the Contract shall be spread on the prepared sub grade 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 401.2.1, of this item 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 adjusted 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 of 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 barrows, 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 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 cross fall and super elevation and shall commence at the edges and progress towards the centre for portions having cross fall 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 cross fall (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-compacted.

401.5. Surface Finish and Quality Control of work:

The surface finish of construction shall conform to the requirements of Clause 902 of MORT & H specifications. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 of MORT & H specifications.

401.6 Arrangements for Traffic:

During the period of construction, arrangement of traffic shall be maintained in accordance with Clause 112 of MORT & H specifications.

401.7 Measurements for Payment:

Granular sub base shall be paid as finished work in position on cross sectional measurements and computing the volume of GSB work in cubic meters by average area method.

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.

401.8 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 as above except for initial treatment to verges, shoulders and construction of diversions.
- [ii] Furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lift.
- [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.

Item No.7 Providing and laying wet mix macadam base course 150mm thick as per MORTH specification using machine crushed B.T. chips as per required gradation, mixing with required optimum quantity of water, conveying the mix to site of work, spreading in to grade and camber with paver/mechanical means and consolidation each layer with vibratory roller to achieve the desired density including cost of material labour plant and equipment etc. complete..

406.1 SCOPE

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass on a prepared subgrade sub base/ base or existing pavement as the case may be in accordance with the requirements of these specifications. The material shall be laid in one or more layers as necessary to lines, grades and cross-sections shown on the approved drawings or as directed by the Engineer.

The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75mm. When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the sub-base course may be increased to 20cm upon approval of the Engineer.

406.2 MATERIALS

406.2.1 AGGREGATES

406.2.1.1 PHYSICAL REQUIREMENTS :

Course aggregates shall be crushed stone. If crushed gravel / shingle is used, not less than 90 percent by weight of the gravel / shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 400-10 below.

TABLE 40-10 PHYSICAL REQUIREMENT OF COARSE AGGREGATES FOR WET MIX MACADAM FOR SUBBASE / BASE COURSES

Test	Test Method	Requirements
1.*Los Angeles Abrasion value	IS : 2386 (Part-4)	40 percent (Max)
Aggregate impact value	IS : 2386 (Part-4) or IS : 5640	30 percent (Max)
2. Combined Flakiness and Elongation indices (Total)**	IS : 2386(PART-1)	30 percent (Max)

- * Aggregates may satisfy requirements of either of the two tests.
- ** To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample only the elongated particles be separated out from the remaining (non flaky stone metal. Elongation index is weight of elongated particles divided by total non flaky particles. The value of flakiness index and elongation index so found are added up.
- If the water absorption value of the coarse aggregate greater than 2 percent, the soundness test shall carried out on the material delivered to site as per 2386 (Part – 5).

406.2.1.2 Grading requirements :

The aggregates shall conform to the grading given in Table 400-11

**TABLE 400-11. GRADING REQUIREMENTS OF
AGGREGATES FOR WET MIX MACADAM.**

IS sieve Designation	Percent by weight passing the IS sieve.
53.0 mm	100
45.0 mm	95 – 100
26.5 mm	--
22.4 mm	60 – 80
11.20 mm	40 – 60
4.75 mm	25 – 40
2.36 mm	15 – 30
600 micron	8 – 12
700 micron	0 – 8

Materials finer than 425 micron shall have plasticity index (P.I) not exceeding 6.

The final gradation approved within these limits shall be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice- versa.

406.3 Construction Operation :

406.3.1 Preparation of base : Clause 404.3.1 as below shall apply.

404.3.1 Preparation of base: The surface of the subgrade/sub-base/base to receive the water bound macadam course shall be prepared to the specification lines and cross fall(camber) and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled unit firm surface is obtained if necessary by sprinkling water. Any sub- base/base/surface irregularities, where predominant, shall be made good by proving appropriate type of profile corrective course(levelling course) to clause 501 of these specification.

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

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

406.3.2 Provision of lateral confinement of aggregates :

While constructing wet mix macadam arrangement shall be made for the lateral confinement of wet mix. This shall be done by laying materials in adjoining shoulders along with that of wet mix macadam layer and following the sequence of operations described in Clause 407.4.1 as below.

407.4 Construction Operations:

407.4.1 Shoulder: The sequence of operations shall be such that the construction of paved shoulder is done in layers each matching the thickness of adjoining pavement layer . Only after a layer of pavement and corresponding layers in paved and earth shoulder portion have been laid and compacted, the construction of next layer of pavement and shoulder shall be taken up.

Where the materials in adjacent layers are different ,these shall be laid together and the pavement layer shall be compacted first. The corresponding layer in paved shoulder portion shall be compacted thereafter, which shall be followed by compaction of earth shoulder layer.

The adjacent layers having same material shall be laid and compacted together.

In all cases where paved shoulders have to be provided along side of existing carriageway, the existing shoulders shall be excavated in full width and to the required depth as per clause 301.3.7 under no circumstances, box cutting shall be done for construction of shoulders.

Compaction requirement of earthen shoulder shall be as per table 300-2 in the case of bituminous courses, work on shoulder(earthen/hard/paved), shall start only after the pavement course has been laid and compacted.

During all stages of shoulder (earth/hard/paved) construction, the required cross fall shall be maintained to drain off surface water

Regardless of the method of laying, all shoulder construction material shall be placed directly on the shoulder. Any spilled material dragged on to the pavement surface shall be immediately removed, without damage to the pavement, and the area so affected thoroughly cleaned.

406.3.4 Preparation of mix :

Wet Mix Macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced / positive mixing arrangement like pug-mil or pan type mixer of concrete batching plant.

Optimum moisture for mixing shall be determined in accordance with IS : 2720 (Part – 8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 micron to 22.4 mm size. While adding water, due allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits. The mixed material should be uniformly wet and so segregation should be permitted.

406.3.4 Spreading of mix :

Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared sub grade / sub-base / base in required quantities. In no case should these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed

stretch be permitted.

The mix may be spread either by a paver finisher or motor grader. For portions where mechanical means cannot be used, manual means as approved by the Engineer shall be used. The motor grader shall be capable of spreading the material uniformly all over the surface. Its blade shall have hydraulic control suitable for initial adjustments and maintaining the same so as to achieve the specified slope and grade.

The paver finisher shall be self-propelled, having the following features :

- (i) Loading hoppers and suitable distribution mechanism
- (ii) The screed shall have tamping and vibrating arrangement for initial compaction to the layer as it is spread without rutting or otherwise marring the surface profile.
- (iii) The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes. The surface of the aggregate shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be tested by depth blocks during construction.

No segregation of larger and fine particles should be allowed. The aggregates as spread should be allowed. The aggregates as spread should be of uniform gradation with pockets of fine materials.

406.3.5 Compaction :-

After the mix has been laid to the required thickness, grade and camber the same shall be uniformly compacted, to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100mm, a smooth wheel roller of 80 to 100 KN weight may be used. For a compacted single layer up to 200mm, the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 KN or equivalent capacity roller. The speed of the roller shall not exceed 5 km/h. In portions having unidirectional cross fall / super elevation rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the center line of the road. Uniformly over-lapping each preceding track by at least one fourth width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop. In portions in camber, rolling should be at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall progress gradually towards the center parallel to the center line of the road uniformly overlapping each of the preceding track by at least one-fourth width until the entire surface has been rolled.

Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and / or removed and made good.

Along forms, Kerbs, walls or other places not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without scarifying the surface to permit proper bonding of the added material shall not be permitted.

Rolling should not be done when the sub grade is soft or yielding or when it causes a wave-like motion in the sub-base / base course or sub grade. If irregularities develop during rolling which exceed 12mm when tested with a 3 meter straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a conforming to the desired grade and cross fall.

In no case should the use of unmixed material be permitted to make up the depressions.

Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry the material as determined by the method outlined in IS : 2720 (Part-8) After completion, the surface of any finished layer shall be wellclose, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated of otherwise defective areas shall be made god to the full thickness of the layer and recompacted.

406.3.6 Setting and drying :

After final compaction of wet mix macadam course, the road shall be allowed to dry for 24 hours.

406.4 Opening to Traffic :

Preferably no vehicular traffic of any kind should be allowed on the finished wet mix macadam surface till it has dried and the wearing course laid.

406.5 Surface Finish and Quality control of work

406.5.1 Surface evenness :

The surface finish of construction shall conform to the requirements of Clause 902 of MORT & H specifications.

406.5.2 Quality Control :

Control on the quality of materials and works shall be exercised by the Engineer in accordance with section 901 of MORT & H specifications

406.6 Rectification of Surface Irregularity :

Where the surface irregularity of the wet mix macadam course exceeds the permissible tolerances or where the course is otherwise defective due to subgrade soil getting mixed with the aggregates, the full thickness of the layer shall scarified over the affected area. Reshaped with added premixed material or removed and replaced with fresh premixed material as applicable and recomputed in accordance with Clause 406.3 of this item . The area treated in the aforesaid manner shall not be less than 5m long and 2m wide. In no case shall depressions be filled up with unmixed and ungraded material or fines.

406.6.7 Arrangement for Traffic :

During the period of construction, arrangement of traffic shall be done as per Claus 112 of MORT & H specifications

406.8 Measurements for Payment :

Wet mix macadam shall be paid as finished work in position on cross sectional measurements and computing the volume of WMM work in cubic meters by average area method.

406.9 Rate : The Contract unit rate for wet mix macadam shall be payment in full for carrying out the required operations including full compensation for all components listed below.

- i) Making arrangement for traffic to Clause 112 as above Except for initial treatment to verges, shoulders and Construction of diversions
- ii) Furnishing wet materials o 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

Item No.8 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 220 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, laid with a paver with electronic sensor, compacting with 8-10 tonnes vibratory roller, finishing and curing.

601.1. **Scope**

601.1.1 This 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.

601.1.2 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.

601.2 **Materials**

601.2.1 **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.

601.2.2 **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 Pozzolana 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.

601.2.3 **Aggregates :**

601.2.3.1 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 dirt, the same may be washed and drained for at least 72 hours before batching, as directed by the Engineer.

601.2.3.2 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 25mm. The coarse aggregate shall comply with Clause 602.4.2.

601.3.3.3 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.

601.2.3.4 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 25mm. nominal single size, 12.5mm. 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 Sieve by Weight
26.50 mm.	100
19.00 mm	80 – 100
9.50 mm.	55 – 75
4.75 mm.	35 – 60
600 micron	10 – 35
75 micron	0 – 8

601.2.4 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 IS : 456.

601.2.5 Storage of Materials :

All material 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.

601.3 **Proportioning of Materials for the Mix**

601.3.1 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 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.

601.3.2 **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 upon 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 a moisture content between the optimum and optimum +2 percent, keeping in view the effectiveness of compaction achieved and to compensate for evaporation losses.

601.3.3 **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.

601.3.4 **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.

601.4 **Sub-grade :**

The sub-grade shall conform to the grades and cross section 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 stabilise loose surface.

If Engineer feels it necessary, another fine spray of water may be applied just before placing sub-base.

601.5 **Construction**

601.5.1 General :

The pace 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.

601.5.2 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. 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 arrs. 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 aggregates and ± 1 per cent 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 with the progress of the work.

601.5.3 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 will be adhered to.

601.5.4 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.

601.5.5 Compaction :

601.5.5.1 The compaction shall be carried out immediately after the material is laid and levelled. In order to ensure thorough compaction with 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 the achieved during the trial length construction vide Clause 601.7. The densities achieved at the edges i.e. 0.5m. from the edge shall not be less than 95 per cent of the achieved during the trial construction vide Clause 601.7.

601.5.5.2 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 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's work near the location where work was terminated the previous day.

601.5.5.3 Double drum smooth-wheeled vibratory rollers of minimum 80 to 100 kN static weight 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 compactibility 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.

601.5.5.4 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 smoothen 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.

601.5.5.5 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.

601.5.5.6 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 be such that the mix does not segregate.

601.5.6 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 been obtained.

601.5.7 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 white 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 sprinkling water.

601.6 **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 ravelling of surface.

601.7 **Trial Length :**

601.7.1 The trial length shall be constructed a 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 60m. 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.

601.7.2 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.

601.7.3 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. dia 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.

601.7.4 The hardened concrete shall be cut over 3 m. 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.

601.7.5 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.

601.8 **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 accordance with Section 900.

601.9 **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.

601.10 **Measurements for Payment**

The unit of measurement for dry lean 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 as directed by the Engineer.

601.11

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, 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.9

Construction of un-reinforced,dowel jointed at expansion and construction joint only,plain cement concrete pavement thickness as per design,over a prepared sub base with 43 grade cement or any other type as per engineer incharge directed M-30 (grade) using cement @ 500.00kg per Cum coarse and fine aggregate conforming to IS 363 maximum size of coarse aggregate not exceeding 25mm size in a concrete mixer of not less then 0.20cum.capacity and appropriate weigh batcher using approved mix design,laid in approved fixed side form work (Steel channel,laying and fixing of 125 micron thick polythene film,wedges,steel plates including levelling the formwork as per drawing),spreading the concrete with shovels,rakes,compacted using needle,screened and plate vibrators and finished in continuous,operation including strips,primer sealent,0.50mt long 25mm dia dowel bars and construction joints,admixture as approved curing of concrete for 14 days,curing compound (where specified) and water finishing to lines and grade as per drawing and technical specification clause 1501.

602.1

Scope

602.1.1

The work shall consist of construction of unreinforced, dowel jointed, plain 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. 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.

602.1.2

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

602.2

Materials

602.2.1

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.

602.2.2

Cement

Any of the following types of cement capable achieving the design strength may be used with prior approval of the engineer, but 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 sulphates 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. The cement shall be subjected to acceptance test just prior to its use.

602.2.3

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 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 5 ± 1.5 per cent for 25mm. nominal size aggregate.

602.2.4

Aggregates :

602.2.4.1

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 (SO_3) shall not exceed 0.25 percent by weight.

602.2.4.2

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 percent 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 hours before batching as directed by the Engineer.

602.2.4.3 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 lump	4.0 per cent
Coal and lignite	1.0 per cent
Material passing IS Sieve No. 75 micron	4.0 per cent

602.2.5 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.

602.2.6 Mild Steel Bars for Dowels and Tie Bars :

These shall conform to the requirements of IS ; 432, IS : 1139 and IS : 1786 as relevant. The dowel bars shall conform to Grade S 240 and tie bars to Grade S 415 of I.S.

602.2.7 Premoulded 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 2.5mm. 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 on the dowel bars.

602.2.8 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).

602.2.9 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 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 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.

602.3 **Proportioning of Concrete**

602.3.1 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.

602.3.2 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 cum. of concrete.

602.3.3 Concrete Strength :

602.3.3.1 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.

602.3.3.2 The ratio between the 7 and 28 day strengths shall be established for the 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 days strengths have been assessed for its conformity with the requirements as per Clause 602.3.1. Whenever the cement content is increased, the concrete mix shall be adjusted to maintain the required.

602.3.4 Workability :

602.3.4.1 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.

602.3.4.2 the workability requirement at the Batching Plant and paving site shall be established by 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 ± 15 mm. is reasonable for paving works but this may be modified depending upon the site requirement and got approved by the Engineer. These test 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.

602.3.5 Design Mix :

602.3.5.1 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 requirement of the design/drawings have been determined.

602.3.5.2 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.

602.3.5.3 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.

602.4 **Sub-Base**

the cement concrete pavement shall be laid over the sub-base constructed in accordance with the relevant drawings and Specification contained in Clause 601. If the sub-base is found damaged at some places or it has cracks wider than 10 mm, it shall be repaired with fine cement concrete or bituminous concrete before laying separation layer. Prior to laying of concrete it shall be ensured that the separation membrane as per Clause 602.5 is placed in position and the same is clean of dirt or other extraneous materials and free from any damage.

602.5 **Separation Membrane**

A separation membrane shall be used between the concrete slab and the sub-base. Separation membrane shall be impermeable plastic sheeting 125 microns thick laid flat without creases. Before placing the separation membrane, the sub-base shall be swept clean of all the extraneous materials using air compressor. Wherever overlap of plastic sheets is necessary, the same shall be at least 300mm. and any damaged sheeting shall be replaced at the Contractor's expense. The separation membrane may be nailed to the lower layer with concrete nails.

602.6 **Joints**

602.6.1 The location and type of joints shall be as shown in the drawing. Joints 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 1m. and 0,3m. apart respectively. Sawing of joints shall be carried out with diamond studded blades soon after the concrete has 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.

602.6.2 **Transverse Joints**

602.6.2.1 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 $\pm 10\text{mm}$.

- 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 602.11.

602.6.2.2 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 ± 5 mm. or as stipulated in the drawings and dowel bars complying with Clause 602.6.5 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.

602.6.2.3 Expansion Joints :

The expansion joints shall consist of a joint filler board complying with Clause 602.2.7 and dowel bars complying with Clause 602.6.5 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 tolerance Clause 602.2.1. and at such depth below the surface will be not import the passage of the finishing straight edges or oscillating beam of the paving machines. The adjacent slabs shall be completely separated from each other 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.

602.6.3 Transverse Construction Joint :

Transverse construction joint 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.

602.6.4 Longitudinal Joint :

602.6.4.1 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 ± 5 mm. as indicated in the drawing.

- 602.6.4.2 Tie bars shall be provided at the longitudinal joints as per dimensions and spacing shown in the drawing and in accordance with Clause 602.6.6.
- 602.6.5 Dowel Bars
- 602.6.5.1 Dowel bars shall be mild steel rounds in accordance with Clause 602.2.6 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.
- 602.6.5.2 Unless shown otherwise on the drawings, dowel bars shall be positioned at mid depth of the slab within a tolerance of ± 20 mm. and centered equally about intended lines of the joint within a tolerance of ± 25 mm. They shall be alignment parallel to the finished surface of the slab and to the centre line of the carriage way and to each other within tolerances given hereunder, the compliance of which shall be checked as per Clause 602.10.7.
- i) For bars supported on cradles prior to the laying of the slab :
 - a) All bars in a joint shall be within ± 3 mm. per 300mm. length of bar
 - b) 2/3 rd of the bars shall be within ± 2 mm. per 300mm. length of bar.
 - c) No bar shall differ in alignment from an adjoining bar by more than 3mm. per 300mm. 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.
- 605.6.5.3 Dowel bars, supported in 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 2mm. per 300mm. length of bar.
 - ii) The remainder of the bars in the assembly shall not deflect more than 3mm. per 300mm. length of bar.

- 602.6.5.4 The assembly of dowel bars and supporting cradles, including the joint filler board in the 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 13mm., 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 600mm. by means of a bar or timber packing, at mid depth and midway between individual fixings, or 300mm. 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 3mm.
 - 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 para of the assembly to the centre of the bar or timber packing.
- 602.6.5.5 Dowel bars shall be covered by a thin plastic sheath for at least two-thirds of the length from one end for dowel bars in contraction joints or half the length plus 50mm. for expansion joints. The sheath shall be tough, durable and of an average thickness not greater than 1.25mm. The sheathed bar shall comply with the following pull-out tests :
- i) Four bars shall be taken at random from stock and without any special preparation shall be covered by sheaths as required in this Clause. The ends of the dowel bars which have been sheathed shall be cast centrally into concrete specimens 150x150x600mm., made of the same mix proportions to be used in the pavement, but with a maximum nominal aggregate size of 20mm. and cured in accordance with IS : 516. At 7 days a tensile load shall be applied to achieve a movement of the bar of at least 0.25mm. The average bond stress to achieve this movement shall not be greater than 0.14 MPa.
- 602.6.5.6 For expansion joints, a closely fitting cap 100mm. long consisting of waterproofed cardboard 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.
- 602.6.6 Tie Bars

- 602.6.6.1 Tie bars in longitudinal joints shall be protected from corrosion for 75mm. 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 bar used.
- 602.6.6.2 Tie bars projecting across the longitudinal joint shall be protected from corrosion for 75mm. 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.
- 602.6.6.3 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 joints may be mechanically or manually inserted into the correct placement of the bars and recompaction of the concrete around the tie bars.
- 602.6.6.4 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 centre of each bar on the intended line of the joints within a tolerance of $\pm 50\text{mm}$. and with a minimum cover of 30mm. below the joint groove.
- 602.7 **Weather and Seasonal Limitations**
- 602.7.1 **Concreting 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.
- 602.7.2 **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 degree Centigrade. The 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.
- 607.8 **Side Forms, Rails and Guidewires**
- 602.8.1 **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. Side forms 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 rails shall be firmly secured in position by not less than 3 stakes/pins per each 3m. length so as to prevent movement in any direction. Forms and rails shall be straight within a tolerance of 3mm. in 3m. and when in place shall not settle in excess of 1.5mm. in 3m. while paving is being done. Form 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 $\pm 10\text{mm}$. and $\pm 3\text{mm}$. respectively. The bedding shall not extend under the slab and there shall be no vertical step between adjacent forms of more than 3mm. 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.

- 602.8.2 At all times sufficient forms shall be used and set to the required alignment for at least 200m. length of pavement immediately in advance of the paving operations, or the anticipated length of pavement to be laid within the next 24 hrs. whichever is more.
- 602.8.3 Use of Guidewires
 - 602.8.3.1 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 $\pm 3\text{mm}$. 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 $\pm 10\text{mm}$.
 - 602.8.3.2 The guidewires shall be supported on stakes not more than 8m. 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 20mm. when suspended at the mid point between any pair of stakes. The ends of the guidewires shall be anchored to fixing point or which and not on the stakes.
 - 602.8.3.3 The stakes 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 on the connectors at any section for at least 2 hours before concreting that section.

- 602.8.3.4 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.

602.9 **Construction**

602.9.1 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 300m. in one day.

602.9.2 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 mixing and the transporting arrangements available with the Contractor.

602.9.3 Equipment for proportioning of Materials and Paving :

- 602.9.3.1 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.

602.9.3.2 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 course 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 a 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 level 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 cleaned at suitable intervals. The pick-up 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 20mm. wear from new conditions. Drilled holes of 5mm. diameter near each end and at midpoint 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 centralised control cabin shall be provided for automatic operation of the equipment.

602.9.3.3 Paving Equipment :

The concrete shall be placed with an approved fixed form or slip form 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.

602.9.3.4 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 the activity on priority basis. The Contractor shall have at least one stand-by saw in good working condition. The concreting work shall not commence if the saws are not in working condition.

602.9.4 **Hauling and Placing of Concrete :**

602.9.4.1 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.

602.9.4.2 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 25⁰C and 90 minute when the concrete temperature is between 25⁰C to 30⁰C. 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 drawings, in a single pass and lift.

602.9.4.3 Where fixed form pavers are to be used, forms shall be fixed in advance as per Clause 602.8 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.

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

602.9.4.5 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.

- 602.9.4.6 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.
- 602.9.4.7 While the concrete is still plastic, its surface shall be brush textured in compliance with Clause 602.9.9 and the surface and edges of the slab cured by the application of a sprayed liquid curing membrane in compliance with Clause 602.9.9. After the surface texturing, but before the curing compound is applied, the concrete slab shall be marked with the chainage at every 100m interval.
- 602.9.4.8 As soon as the side form 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.
- 602.9.4.9 If the requirement of Clause 902.4 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.
- 602.9.5 Construction by fixed Form Paver :
- 602.9.5.1 The fixed form paving train shall consist of separate powered machines which spread, compact and finish the concrete in the continuous operation.
- 602.9.5.2 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 sub-base. 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 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 over working.
- 602.9.6 Construction by Slip fork Pave :
- 602.9.6.1 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 form with either a conforming plate or by vibrating and oscillating finishing beams. The concrete shall be deposited without segregation in front of slip from 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.

- 602.9.6.2 The level of the conforming plat and finishing beam shall be controlled automatically from the guide wire installed as per Clause 602.8 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.
- 602.9.6.3 Slip-form machines shall have vibrators of variable output, with a maximum energy output of not less than 2.5 K.W per metre width of slab per 300mm. depth of slab for a laying speed upto 1.5m. 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 situation.
- 602.9.6.4 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 602.14, 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 level.
- 602.9.7 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.
- 602.9.8 Surface Texture :
- 602.9.8.1 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 carriage-way.
- 602.9.8.2 The brushed surface texture shall be applied evenly across the slab in one direction by the use of a wire brush not less than 450mm. wide but longer brushes are preferred. The brush shall be made of 32 gauge tape wires grouped together in tufts spaced at 10mm. centres. The tufts shall contain an average of 14 wires and initially be 100mm. long. The brush shall have two rows of tufts. The rows shall be 20mm. apart and the tufts in one row shall be opposite the centre of the gap between tufts in the other row. the brush shall be replaced when the shortest tuft wears down to 90mm. long.

- 602.9.8.3 The texture depth shall be determined by the Sand Patch Test as described in Clause 602.12. 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 2m. apart anywhere along a diagonal line across a lane width between points 50m. apart along the pavement. No measurement shall be taken within 300mm. of the longitudinal edges of a concrete slab constructed in one pass.

- 602.9.8.4 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 of 1.25mm.

TABLE : 600-2
TEXTURE DEPTH

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

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

- 602.9.8.6 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 re-texturing the hardened concrete surface in an approval manner.

- 602.9.9 Curing :

- 602.9.9.1 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.

602.9.9.2 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 end. The mechanical sprayer shall incorporate an efficient mechanical device for continuous agitation and mixing of the compound during spraying.

602.9.9.3 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.

602.10 **Trial Length**

602.10.1 The trial length shall be constructed at least one month in advance of the proposed start of concrete paving work. At least one month prior to the construction of the trial length, the Contractor shall submit for the Engineer's approval a detailed method statement giving description of the proposed materials, plant, equipment and construction methods. All the major equipments like paving train, batching plant, tippers etc., proposed in the construction are to be approved by the Engineer before their procurement. No trials of new materials, plant, equipment or construction methods, nor any development of them shall be permitted either during the construction of trial length or in any subsequent paving work, unless they form part of further, approved trials. These trial lengths shall be constructed away from the carriage-way but with at least a sub-base layer below it.

602.10.2 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 60m. but not more than 300m. long for mechanised construction and at least 30m. 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.

602.10.3 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 30m. constructed each day for mechanised construction and a minimum of 15m. 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.

602.10.4 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 150m. of longitudinal construction joint for mechanised paving in the main work, shall be considered as the trial length for these joint.

602.10.5 The trial length shall comply with the specification in all respects, with the following additions and exceptions :

602.10.5.1 Surface Levels and Regularity :

- i) In checking for compliance with Clause 903.5 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. Shorter trial lengths shall be assessed pro-rata based on values for a 300m. length.

602.10.5.2 Joints :

- iii) Alignment of dowel bars shall be inspected as described in Clause 602.107 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 602.6.5, 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 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.

602.10.5.3 Density :

- v) Density shall be assessed as described in Clause 602.3 from at least 3 cores drilled from each part of the trial length.

602.10.5.4 Position of Tie Bars :

- vi) Compliance with Clause 602.6.6 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.

602.10.6 Approval and Acceptance :

602.10.6.1 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 that 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.

- 602.10.6.2 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 materials, 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.
- 602.10.6.3 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 602.9.8.6 shall be removed immediately upon notification of deficiencies by the Engineer and the Contractor shall construct a further trial length.
- 602.10.7 Inspection Dowel Bars :
- 602.10.7.1 Compliance with Clause 602.6.5 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.
- 602.10.7.2 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 2m. After sawing the transverse joint groove, the extended 2m. slab shall be removed carefully soon after concrete has set to expose dowels over half the length. These dowels can be tested for tolerances.
- 602.10.7.3 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.
- 602.10.7.4 After the dowel bars have been examined, the remainder of the concrete shall be removed over a width of 500mm. 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 1m. wide slab by drilling holes and grouting with epoxy mortar. Plastic sheath as per Clause 602.6.5.5 shall be provided on dowels on one of the joints. The Joint groove shall be widened and scaled as per Clause 602.11.

- 602.11 **Preparation and Sealing of Joint Grooves**
- 602.11.1 General :
All transverse joints in surface slabs shall be sealed using sealants described in Clause 602.2.8. Joints shall not be sealed before 14 days after construction.
- 602.11.2 Preparation of Joint Grooves for Sealing :
- 602.11.2.1 Joint grooves usually are not constructed to provided the minimum width specified in the drawings when saw cut joints are adopted. They shall be widened subsequently by sawing before scaling. Depth/width gauges shall be used to control the dimension of the groove.
- 602.11.2.2 If rough arises develop when grooves are made, they shall be ground to provide a chamfer approximately 5mm. 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 35mm. for transverse joints and 20mm. for longitudinal joints. If the spalling cannot be so eliminated then the arises shall be repaired by an approved thin bonded arise repair using cementitious materials.
- 602.11.2.3 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 pressurised water jets. Depending upon the requirement of the sealant manufacturer, the sides of the grooves may have to be sand blasted to increase the bondage between sealant and concrete.
- 602.11.2.4 The groove shall be cleaned and dried at the time of priming and sealing.
- 602.11.2.5 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 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.
- 602.11.3 Sealing with Sealants :
- 602.11.3.1 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.

- 602.11.3.2 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 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.
- 602.11.3.3 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.
- 602.11.3.4 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 construction 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.
- 602.11.3.5 Sealant shall be applied, slightly to a lower level than the slab with a tolerance of 5
- 602.11.3.6 During sealing operation, it shall be seen that no air bubbles are introduced in the sealant either by vapours or by the sealing process.
- 602.11.4 Testing of Applied Sealant :
- 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 602.2.8. The samples shall meet the requirement of AASHTO M282 for hot applied sealant or BS 5212 : (part-2) for cold applied sealant.
- 602.12 **Measurement of Texture Depth – Sand Patch Method**
- 602.12.1 The following apparatus shall be used :
- i) A cylindrical container of 25 ml. internal capacity
 - ii) A flat wooden disc 64mm. diameter with a hard rubber disc, 1.5mm. 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
- 602.12.2 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 angle and parallel to the carriage way. The cylindrical container shall be filled with the sane, tapping the base 3 times on the surface to ensure compaction, and striking off the sand level with the top of the cylinder. The 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.

602.12.3 The diameter of the patch shall be measured to the nearest 5mm. The texture depth of concrete surface shall be calculated from $31000/(D \times 1)$ mm. where D is the diameter of the patch in mm.

602.13 **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.

602.14 **Tolerances 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.

602.15 **Measurement for Payment**

602.15.1 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, dowel bar and tie rod.

602.15.2 **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 5m. x 3.5m. or 6.25m. x 3.5m. the former measurement being in longitudinal direction.

A day's 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 10mm. shall be considered as the specified thickness plus 10 mm.

Individual areas deficient by more than 25mm. 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 adjusted 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
Upto 5mm.	100
6 – 10mm.	87
11 – 15mm.	81
16 – 20mm.	75
21 – 25mm.	70

In the stretch where deficiency of average thickness is more than 25mm., the section whose thickness is deficient by 26mm. 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.

602.16

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.

Item No.10 Providing and fixing pre-cast Rubber Dye / steel Dye inter locking concrete block 60mm thick with grade of concrete M300 pneumatic compressed / vibrated mechanically and as per approved design Confirming to IS 15658 : 2006 including 35 mm Sand layer for levelling and filling the joint with sand in proper line and level as per guidelines of IRC : SP 63-2018 etc. Complete.

In general the work shall be carried out as per the standard specifications of P.W.D. / C.P.W.D. relevant drawings and as per the item description & as per instructions of Engineer in Charge.

Materials and Workmanship :

The Paver blocks of approved make only shall be used.

The paver block shall be manufactured on the latest Hi-tech plant. Paver block shall be of approved shape, size and colour or combination of them to attain desired aesthetics and environment. The Paver block shall be rubber dyed, pneumatic

compressed, mechanically pressed with top reflective surface & shall be highly durable and shall not require CEMENT for fixing (laying) and shall be easy for laying and it can reusable. **The compressive Strength of paver blocks shall be 200 kg/cm² and above.**

The surface of the paver blocks shall be slightly rough textured and the edges shall be tapered so as to give good skid resisting properties.

The minimum thickness of the paver block shall be 80 mm .

Installation :

Installation of paving blocks shall be so simple that it can be removed and relaid at a later date if repair is necessary or to accommodate service lines without the usual ugly scar as is now common with concrete or asphalt monolithic surfacing.

Preparing Base :

Special care shall be taken in preparing the base to assure a permanent installation. The depth of the base will be determined by the load factor and the condition of soil.

Base :

The base should be of sand.

The base of sand shall be total 75 mm thick and shall be well compacted with a vibrating type compactor. This should consist of a good Grade sand. This should then be covered with sand screeded level but not compacted.

Levelling the Base :

This is an important step in installation to achieve a good level job when finished. Make sure the base is levelled properly. Generally the most popular method of levelling is with a screed which is usually a long 2" x 6" board. It is very important that the board is straight, not warped or twisted. Although for larger commercial jobs screeding bars or pipes may be used. A frame is required to maintain the base. The levelling of this frame will indicate the level of the area.

Placing Paving Blocks :

Blocks should be placed in the desired pattern close together. The spaces between blocks should not exceed 1/4 " (3 mm). The spacing should be consistent. This will help maintain a uniform pattern. When laying each row the installer should stand on the previously laid stones. Cutting of stones where necessary can be done with a splitter chisel or masonry saw as required.

Completing the Job :

The paver blocks should then be tamped down and leveled with a vibrating plate compactor. This will bring them to their true grade as well as level the blocks. Sand will be forced into spaces to make blocks firm and free of movement. Finish the job by sweeping dry sand into the joints. The edges /ends of the pavement shall be finished with 1:2:4 concrete. The rate shall be inclusive of concrete.

Mode of Measurement and Payment :

The rate includes all materials, labour, tools, plants in satisfactory completion of work as specified above.

The rate shall be for unit of one sq.mt. for actual work done.

Item No.11 Providing and fixing ordinary kilometer stone of precast C.C. 1:2:4 including necessary reinforcement as per I.R.C. type design in C.C. 1:4:8 including lettering and painting etc. complete. (For OD.R. & V.R.)

1. Kilometer stone shall be of approved quality and shall be of precast 1:2:4 R.C.C. as specified in the item.
2. The size, manner of fixing, painting and lettering of K.M. stone shall conform specification as per I.R.C.-8 (Type design for kilometer stones). The fixing of K.M. stone shall be carried out in ordinary concrete of grade specified in the item using hand broken metal field metal or gravel.
3. The measurement for payment shall be made per No. of K.M. stone fixed in position.
4. Unit rate for Kilometer stone includes the cost of all materials, labour, tools, fixing, finishing curing, lettering and painting as directed by the Engineer-in-charge.

Item No.12 Providing and fixing Hectometer stone as per I.R.C. type design including lettering and painting etc. complete. (ii) Fixing in C.C. 1:5:10

1. Hectometer stone shall be of approved quality and as per I.R.C. 26 (Type design for 200 meter stones) and shall be fixed in C.C. 1:5:10 which will consist of one part of cement, five part of good sand and ten parts of machine crushed metal 40 mm nominal size. Rate includes all labour and curing etc. necessary for concrete.
2. The measurement for payment shall be made per No. of Hectometer stone fixed in position.
3. Unit rate for hectometer stone includes the cost of all materials, labour, tools, fixing, finishing curing, lettering and painting as directed by the Engineer-in-charge.

Item No.13 Informatory sings: Providing and fixing sing boards made out of 2mm aluminium sheet; size 80 x 60cms. rectangle as per the design of IRC-67-1977 pre treated with phospheting process & acid teching; coated with one coat of epoxyprimer and two coats of best qualityepoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand postand frame fabricated from suitable sizeiron angle of 35 x 35 x 3mm75x75x6mm as required; painted with best qualityepoxy coatings in black and whitebends. the details of symbol for eachboard shall details of symbol for eachboard shall be as per the instruction ofengineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x45 x 60cms. for each leg. including excavation curing tec. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)..

801.1 GENERAL

801.1.1 The colour, configuration, size and location of all traffic signs for highways other than Expressways shall be in accordance with Code of Practice for Road Signs, IRC:67 or as shown on the drawings. For Expressways, the size of signs, letters and their placement shall be as specified in the Contract drawings and relevant specifications. In the absence of any details or for any missing details, the signs shall be provided as directed by the Engineer. The Aluminum sheet size to be fixed shall be as specified in the Item.

801.1.2 The signs shall be reflectorised type and made of encapsulated lens type reflective sheeting vide Clause 801.3, fixed over aluminium sheeting as per these Specifications.

801.1.3 In general, cautionary and mandatory signs shall be fabricated through process of screen printing. In regard to informatory signs with inscriptions, either the message could be printed over the reflective sheeting, or cut letters of non-reflective black sheeting used for the purpose which must be bonded well on the base sheeting as directed by the Engineer.

801.2 MATERIALS :- The various materials and fabrication of the traffic signs shall conform to the following requirements :

801.2.1 Concrete : Concrete shall be of the grade shown on the contract drawings or otherwise as directed by the Engineer.

801.2.2 Reinforcing Steel : Reinforcing steel shall conform to the requirement of IS : 1786 unless otherwise shown on the drawing.

801.2.3 Bolts, nuts, washers: High strength bolts shall conform to IS: 1367 whereas precision bolts, nuts, etc. shall conform to IS: 1364.

801.2.4 Plates and supports: Plates and support sections for the sign posts. shall conform to IS:226 and IS:2062 or any other relevant IS Specifications.

801.2.5 Aluminium: Aluminium sheets used for sign boards shall be of smooth, hard and corrosion resistant aluminium alloy conforming to IS:736 Material designation 24345 or 1900.

801.2.6 Signs with a maximum side dimension not exceeding 600 mm shall not be less than 1.5 mm thick. All others shall be at least 2 mm thick. The thickness of the sheet shall be related to the size of the sign and its support and shall be such that it does not bend or deform under the prevailing wind and other loads.

801.2.7 In respect of sign sizes not covered by IRC:67, the structural details (thickness, etc.) shall be as per the approved drawings.

801.3 TRAFFIC SIGNS HAVING RETRO-REFLECTIVE SHEETING

801.3.1 General Requirements: The retro-reflective sheeting used on the sign shall consist of the white or coloured sheeting having a smooth outer surface which has the property of retro-reflection over its entire surface. It shall be weather-resistant and show colour fastness. It shall be new and unused and shall show no evidence of cracking, scaling, pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for these properties in an unprotected outdoor exposure facing the sun for two years and its having passed these tests shall be obtained from a reputed laboratory, by the manufacturer of the sheeting. The reflective sheeting shall be either of Engineering Grade material with enclosed lens or of High Intensity Grade with encapsulated lens. The type of the sheeting to be used would depend upon the type, functional hierarchy and importance of the road.

801.3.3 Engineering Grade sheeting : This sheeting shall be of enclosed lens type consisting of microscopic lens elements embedded beneath the surface of a smooth, flexible, transparent, water-proof plastic, resulting in a non-exposed lens optical reflecting system. The retro reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined in accordance with ASTM Standard :E-81 0) as indicated in Table 800-2.

Table 800 – 2

ACCEPTABLE MINIMUM COEFFICIENT OF RETRO-REFLECTION FOR
ENGINEERING GRADE SHEETING
(CANDELAS PER LUX PER SQUARE METRE)

Observation angle (in degrees)	Entrance Angle (in degrees)	White	Yellow	Orange	Green	Red	Blue
0.2	-4	70	50	25	9.0	14.5	4.0
0.2	+30	30	22	7.0	3.5	6.0	1.7
0.5	-4	30	25	13.5	4.5	7.5	2.0
0.5	+30	15	13	4.0	2.2	3.0	0.8

When totally wet, the, sheeting shall not show less than 90 per cent of the values, of retro-reflection indicated in Table 800-2. At the end of 5 years, the sheeting shall retain at least 50 per cent of its original retro reflectance.

801.3.4 Messages/Borders: The messages (legends, letters, numerals etc) and borders shall either be screen-printed or of cut-outs. Screen printing shall be processed and finished with materials and in a manner specified by the sheeting manufacturer. Cut-outs shall be of materials as specified by the sheeting manufacturer and shall be bonded with the sheeting in the manner specified by the manufacturer.

801.3.5 For screen-printed transparent coloured areas on white sheeting, the co-efficient of retro-reflection shall not be less than 50 per cent of the values of corresponding colour in Tables 800-1 and 800-2, as applicable.

801.3.6 Cut-out messages and borders, wherever used, shall be made out of retro-reflective sheeting (as per Clause 801.3.2 or 801.3.3 as applicable), except those in black which shall be of non-reflective sheeting.

801.3.7 Colour : Unless otherwise specified, the general colour scheme shall be as stipulated in IS:5 "Colour for Ready Mixed Paints", viz

Blue	-	IS	Colour	No.166: French Blue
Red	-	IS	Colour	No.537 : Signal Red
Green	-	IS	Colour	No.284 : India Green
Orange	-	IS	Colour	No.591 : Deep Orange

The colours shall be durable and uniform in acceptable hue' when viewed in day light or under normal headlights at night

801.3.8 Adhesives: The sheeting shall either have a pressure sensitive adhesive of the aggressive-tack type requiring no heat, solvent or other preparation for adhesion to a smooth clean surface, or a tack free adhesive activated by heat, applied in ct, heat-vacuum applicator, in a manner recommended by the sheeting manufacturer. The adhesive shall be protected by an easily removable liner (removable by peeling without soaking in water or other solvent) and shall be suitable for the type of material of the base plate used for the sign. The adhesive shall form a durable bond to smooth, corrosion and weather resistant surface of the base plate ,such that it shall not be possible to remove the sheeting from the sign base in one piece by use of sharp instrument. In case of pressure-sensitive adhesive sheeting, the sheeting shall be applied in accordance with the manufacturer's specifications. Sheeting with adhesives requiring use of solvents or other preparation for adhesive shall be applied strictly In accordance with the manufacturer's instructions.

801.3.9 Refurbishment: Where existing signs are specified for refurbishment, the sheeting shall have a semi-rigid aluminium backing pre-coated with aggressive-tack type pressure sensitive adhesive. The adhesive shall be suitable for the type of material used for the sign and should thoroughly bond with that material.

801.3.10 FABRICATION :

801.3.10.1 Surface to be reflectorised shall be effectively prepared to receive the retro reflective sheeting. The aluminium sheeting shall be degreased either by acid or hot alkaline etching and all scale/dust removed to obtain a smooth plain surface before the application of retro-reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable device or clean canvas gloves, between all cleaning and preparation operation and application of reflective sheeting/primer. There shall be no opportunity for metal to come in contact with grease, oil or other contaminants prior to the application of retro-reflective sheeting.

801.3.10.2 Complete sheets of the material shall be used on the signs except where it is unavoidable; at splices, sheeting with pressure sensitive adhesives shall be overlapped not less than 5 mm. Sheeting with heat activated adhesives may be spliced with an overlap not less than 5 mm or butted with a gap not exceeding 0.75 mm. Where screen printing with transparent colours is proposed, only butt jointing shall be used. The material shall cover the sign surface evenly and shall be free from twists, cracks and folds. Cut-outs to produce legends and borders shall be bonded with the sheeting in the manner specified by the manufacturer.

801.3.11 Warranty and durability: The contractor shall obtain from the manufacturer a seven year warranty for satisfactory field performance including stipulated retro-reflectance of the retro-reflective sheeting of high intensity grade and a five year warranty for the adhesive sheeting of engineering grade and submit the same to the Engineer. In addition, a seven year and a five year warranty for satisfactory in field performance of the finished sign with retro-reflective sheeting of high intensity grade and engineering grade respectively, inclusive of the screen printed or cut out letters/legends and their bonding to the retro-reflective sheeting shall be obtained from the Contractor/supplier and passed on to the Engineer. The Contractor/supplier shall also furnish a certification to that the signs and materials supplied against the assigned work meets all the stipulated requirements and carry the stipulated warranty.

Processed and applied in accordance with recommended procedures, the reflective material shall be weather resistant and, following cleaning, shall show no appreciable discolouration, cracking, blistering or dimensional change and shall not have less than 50 per cent of the specified minimum reflective intensity values (Tables 800-1 and 800-2) when subjected to accelerated weathering for 1000 hours, using type E or EH weatherometer (AASHTO Designation M 268).

801.4 INSTALLATION

801.4.1 Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind loads or displacement by vandalism. Normally, signs with an area upto 0.9 sq.m. shall be mounted on a single post, and for greater area two or more supports shall be provided. Sign supports may be of mild steel, reinforced concrete or galvanized iron (G.I.) Post

end(s) shall be firmly fixed to the ground by means of properly designed foundation. The work of foundation shall conform to relevant specifications as specified.

801.4.2 All components of signs and supports, other than the reflective portion and G.I. posts shall be thoroughly descaled, cleaned, primed and painted with two coats of epoxy paint. Any part of mild steel(M.S.) post , below ground shall be painted with three coats of red lead paint.

801.4.3 The signs shall be fixed to the posts by welding in the case of steel posts and by bolts and washers of suitable size in the case of reinforced concrete or G.I. posts. After the nuts have been tightened, the tails of the bolts shall be furred over with a hammer to prevent removal.

801.5 MEASUREMENTS FOR PAYMENT

The measurement of information signs shall be in numbers sign board supplied and fixed.

801.6 RATE

The Contract unit rate shall be payment in full for the cost of making the road sign, including all materials, installing it at the site and incidentals to complete the work in accordance with the specifications.

Item No.14 Logo Board:- Providing and fixing Logo Board made out of 2mm aluminium sheet, as per the drawing & design. Pre treated with phosphating process and acid etching coated with one coat of epoxy primer and two coat of best quality epoxy paint, reflectorized with retro reflective sheeting as per the latest M.O.S.T. specification, 3.1 Mt. long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3 mm, 75 x 75 x 6 mm as required painted with best quality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 cms for each leg, including excavation curing etc. complete under the supervision of Engineer-In-Charge (A)Engineer grade....

The work of providing and fixing LOGO board shall be executed as per relevant specifications of **Item No. 13** of this contract. The measurement shall be in numbers of board supplied and fixed in position

Item No.15 Village name/ Bump Ahead sign :-Providing and fixing sign boards made out of 2mm aluminium sheet; size 90 x 60cms. rectangle as as per the design of IRC-67-1977 pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968, 3.1m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50 x 50 x 5mm painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)...

The work of providing and fixing Village Name board shall be executed as per relevant specifications of **Item No. 13** of this contract. The measurement shall be in numbers of board supplied and fixed in position

- Item No.16 Direction sign (Junction board):-**Providing and fixing sing boards made out of 2mm aluminium sheet; size 244 x 122cms. rectangle as as per the design of IRC-67-1977 pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968, 3.1m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50 x 50 x5mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)...

The work of providing and fixing **Direction sign** board shall be executed as per relevant specifications of **Item No. 13** of this contract. The measurement shall be in numbers of board supplied and fixed in position

- Item No.17 Road marking with hot applied thermoplastic paints with reflectorising glass beads on bitumin surface providing and laying a hot applied thermoplastic compound 2.5 mm thick including reflectorising glass beads @ 250gms per sqm area, thickness of 2.5mm is excludingof surface applied glass beds as per IRC:35- 2015. The finished surface to be level, uniform and free from streaks and holes. zebra patta /bump patta lane/center line/ edge line/cut patta. The white color marking should provide liminance coefficinnet on cemend road shalll be min 130 mcd/m2/lux and Asphalt road shall be min 100 mcd/m2/lux during the service lifeduring the day time. The marking should meet the performance criteria for night time reflectivity, wet reflectivity and skid resistance as mentioned in the section-15 of IRC 35-2015. Warranty for the Retro reflectivity should be two years.**

General :-

Hot Applied Thermoplastic Road Marking.

- (i) The work under this section consists of marking traffic stripes using a thermoplastic compound meeting the requirements specified herein.
- (ii) The Thermoplastic compound shall be screened / extruded on to The pavement surface in a molten state by suitable machine capable of controlled preparation and laying with surface application of glass beads at a specific rate. Upon cooling to ambient pavement temperature, it shall be produce an adherent pavement marking of specified thickness and width and capable of resisting deformation by traffic.
- (iii) The colour of the compound shall be white or yellow (IS : colour No. 356) as specified in drawings or as directed by the Engineer.

- (iv) Where the compound is to be applied to cement concrete pavement sealing primer as recommended by the manufacture, shall be applied to the pavement in advance of placing of the stripes to ensure proper bonding of the compound. On new concrete surface any laitance and / or curing compound shall be removed before the marking are applied.

THERMOPLASTIC MATERIALS GENERAL :

The thermoplastic material shall be homogeneously composed of aggregate, pigment, resins and glass reflectorizing beads.

REQUIREMENT :

Composition: the pigment, beads and aggregate shall be uniformly dispersed in the resin. The material shall be free from all skins, dirt and foreign objects and shall comply with requirements indicated in Table 800 – 3.

**Table 800 – 3 PROPORTIONS OF CONSTITUENTS OF MARKING MATERIAL
(percentage by weight)**

Component	White	Yellow
Binder	18.00 min.	18.00 min.
Glass Beads	30 – 40	30 – 40
Titanium Dioxide	10.00 min.	- - -
Calcium Carbonate and Inert Fillers	42.00 max	See Note
Yellow Pigments	- - -	- do -

Note : Amount of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, provide all other requirement of this Specification are met.

- II Properties : The properties of thermoplastic material, when tested in accordance with ASTM D36/ BX-3262- (Pa. T1) shall be as below :

A) Luminance :

White : Daylight luminance at 45 degree 65 per cent min. as per AASHTO M 249.

- B) Drying time : When applied at a temperature specification by the manufactures and to the required thickness, the material shall set to bear traffic in not more than 15 minutes.

- C) Skid resistance : not less than 45 as per BS 6044.

- D) Cracking resistance at low temperature : The material shall show no cracks on application to concrete blocks.

- E) Softening point : $102.5 \div 9.5^{\circ}$ as per ASTM D 36.

- F) Flow resistance : Not more than 25 per cent as per AASHTO M 249.

- G) Yellowness index (for white thermoplastic paint) not more than 0.12 as per AASHTOM 249.

- III Storage life : The materials shall meet the requirement of there Specifications for period of one year. The thermoplastic material must also melt uniformly with no evidence of skins of un-melted particles for the one-year storage period. Any material not meeting the above requirements shall be replaced by the manufacturer/ supplier/ contractor.

- IV Reflectorisation : Shall be achieved by incorporation of beads, the grading and other properties of the beads shall be as specified in Clause 803.4.3 of MORT & H Specification.
- V Marking : Each container of the thermoplastic material shall be clearly and indelibly marked with the following information.
1. The name, trademark or other means of identification of manufacturer.
 2. Batch number.
 3. Date of manufacture.
 4. Colour (White or Yellow)
 5. Maximum application temperature and maximum safe heating temperature.
- VI Sampling and testing : The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM/BS method. The Contractor shall furnish to the Employer a copy of certified test report from the manufacturer of the thermoplastic material showing results of all tests specified therein and shall certify that the materials meets all requirements of this Specification.

REFLECTORIZING GLASS BEADS

GENERAL : This Specification covers two types of glass beads to be used for to production of reflectorised pavement markings. Type 1 beads are those which are a constituent of the basic thermoplastic compound vide Table 800 – 3 and type – 2 beads are those which are to be sprayed on the surface vide Clause 803.6.3.

The glass beads shall be transparent, colourless and free from milliness, dark particles and excessive air inclusions.

These shall conform to the requirements spelt out in clause 5.4.3.3.

SPECIFIC REQUIREMENTS. A GRADATION :

The glass beads shall meet the gradation requirements for the two types as given in Table 800 – 4.

TABLE 800-4 GRADATION REQUIREMENT FOR GLASSBEADS

Sieve Size	Per Cent Retained	
	Table – 1	Table – 2
1.18 mm	0 to 3	--
850 micron	5 to 20	0 to 5
600 micron	--	5 to 20
425 micron	65 to 95	--
300 micron	--	30 to 75
180 micron	0 to 10	10 to 30
Below 180 micron		0 to 15

B. ROUNDNESS :

The glass beads shall have a minimum of 70 per cent true spheres.

C. REFRACTIVE INDEX :

The glass beads shall have a minimum refractive index of 1.50.

D. FREE FLOWING PROPERTIES :

The glass beads shall be free of hard lumps and clusters and shall dispense readily under any condition suitable for paints striping. They shall pass the free flow-test.

TEST METHODS :

The specific requirement shall be tested with the following methods.

- I Free-flow test : Spread 100grams of beads evenly in a 100 mm diameter glass dish. Place the dish in a 250 mm inside diameter desiccators which is filled within 25 mm of the top of a desiccators plate with sulphur acid water solution (specific gravity 1.10) Cover the desiccators and let it stand for 4 hours at 20 to 29 degree C. Remove Sample from desiccators, transfer beads to a pan and inspect for lumps or clusters. Then pour beads into a clean dry glass funnel having a 100 mm stem and 6 mm orifice. If necessary, initiate flow by lightly tapping the funnel. The glass spheres shall be essentially free of lumps and clusters and shall flow freely through the funnel.
- II The requirements of gradation, roundness and refractive index of glass beads and the amount of glass beads in the compound shall be tested as per BS 6088 and BS 3262 (Part 1).
- III The Contractor shall furnish to the Employer a copy of certified test report from the manufacturer of glass beads obtained from a reputed laboratory showing results of all tests specified therein and shall certify that material meets all requirements of this Specification. However, if so required, these tests may be carried out as directed by the Engineer in charge.

APPLICATION PROPERTIES OF THERMOPLASTIC MATERIAL

The thermoplastic materials shall readily get screed / extruded at temperatures specified by the manufacturers for respective method of application to produce a line of specified thickness which shall be continuous and uniform in shape having clear and sharp edges. The materials upon heating to application temperatures shall not exude fumes which are toxic. Obnoxious or injurious to persons property.

PREPARATION :

- i) The material shall be melted in accordance with the manufacturer's instructions in a heater fitted with a mechanical stirrer to give a smooth consistency to the thermoplastic materials to avoid local overheating. The temperature of the mass shall be within the range specified by the manufacturer, and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material should be used as expeditiously as possible and for thermoplastic materials. Which has natural binders or is otherwise sensitive to prolonged heating the materials shall be maintained in a molten condition for more than 4 hours.
- II) After transfer to the laying equipment, the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.

PROPERTIES OF FINISHED ROAD MARKING :

- a) The stripe shall not be slippery when wet.
- b) The marking shall not lift from the pavement in freezing weather.
- c) After application and proper drying the stripe shall show no appreciable deformation or discoloration under traffic and under road temperatures up to 60 C.
- d) The marking shall not deteriorate by contact with sodium chloride calcium chloride or oil drippings from traffic.
- e) The stripe of marking shall maintain its original dimensions and position. Cold ductility of the material shall be such as to permit normal movement with the road surface without chipping or cracking.
- f) The colour of yellow marking shall conform to IS Colour No. 356 as given in IS : 164.

REFLECTORISED PAINT :

Reflectorised paint, if used shall conform to the specification by the manufacturers and approved by the engineer. Reflectorising glass beads for reflectorising paints where used shall conform to the requirements of Clause 5.3.

APPLICATION

Marking shall be done by machine. For locations where painting cannot be done machine, approved manual methods shall be used with prior approval of the Engineer. The Contractor shall maintain control over traffic while painting operations are in progress so as to cause minimum inconvenience to traffic compatible with protecting the workmen.

The thermoplastic materials shall be applied hot either by screening or extrusion process. After transfer to the laying apparatus, the material shall be laid at a temperature within the range specified by the manufacturer for the particular method of laying being used. The paint shall be applied using a screed or extrusion machine.

The pavement temperature shall not be less than 10 C. during application. All surface to be marked shall be thoroughly cleaned of all dust, dirt, grease, oil and all other foreign matter before application of the paint.

The material, when formed into traffic stripes, must be readily renewable by placing an overlay of new material directly over an old line of compatible material. Such new material shall so bend itself to the old line that no splitting or separation takes place.

Thermoplastic paint shall be applied in intermittent or continuous lines of uniform thickness of at least 2.5 mm unless specified otherwise. Where arrows or letters are to be provided, thermoplastic compound may be hand-sprayed. In addition to the beads included in the material, a further quantity of glass beads of Type 2, conforming to the above noted specification shall be sprayed uniformly into a mono layer on to the hot paint line quick succession of the paint spraying operation. The glass beads shall be applied at the rate of 250 grams per square meter area.

The minimum thickness specified in exclusive of surface applied glass beads. The method of thickness measurement shall be in accordance with Appendices B and C of BS- 3262 (Part 3).

The finished lines shall be free from ruggedness on sides and ends and be parallel to the general alignment of the carriageway. The upper surface of the lines shall be level, uniform and free from streaks.

MEASUREMENT FOR PAYMENT.

The painted marking shall be measured in sq. meters of actual area marked (excluding the gaps, if any).

In respect of markings line directional arrows and lettering. Etc., the measurement shall be in Square meter basis.

Rate

The contractor unit rate for road markings shall be payment in full compensation of furnishing all labour, materials, tools, equipment, including all incidental costs necessary for carrying out the work at the site conforming to these specifications complete as per the approved drawing (s) or as directed by the Engineer and other incidental cost necessary to complete the work to these Specifications.

Item No.18 Cat Eye / Road Stud / RPM: Supplying of Molded Twin Shanks Raised Pavement Markers made of polycarbonate and ABS moulded body and reflective panels with micro prismatic lens capable of providing total internal reflection of the light entering the lens face and shall support a load of 13635 kgs. tested in accordance to ASTM D 4280 Type H and complying to Specifications of Category A of MORTH Circular No RW/NH/33023/10-97 DO III Dt 11.06. 1997. The height, width and length shall not exceed 20mm, 130 mm and 130 mm and with minimum reflective area of 13 Sqcm on each side and the slope to the base shall be 35 +/- 5 degree. The strength of detachment of the integrated cylindrical shanks, (of diameter not less than 19 +/- 2 mm and height not less than 30 +/- 2 mm) from the body is to be a minimum value of 500 Kgf. Fixing will be by drilling holes on the road for the shanks to go inside, without nails and using epoxy resin based adhesive as per manufacturers recommendation and The color of the marker should be as per the IRC 35-2015 and as directed by Engineer-in-charge.

1.1 General

Reflective Pavement marker (RPM) or road stud is device which is bonded to or anchored within the road surface for lane marking and delineation for night time visibility. It reflects incident light in directions close to the direction from which it came.

1.2 Definitions

1.2.1 Description of Terms Specific to this standard

- 1.2.1.1** Coefficient of luminous intensity (CIL) or specific intensity = the ratio of luminous intensity of the retro-reflector in the direction of observation to luminance at the retro-reflector on a plane perpendicular to the direction of the incident light expressed in terms of Milaca deal as per incident lux (med / lx).
- 1.2.1.2** Horizontal entrance angle – the angle in the horizontal plant between the direction of incident light and the normal to the leading edge of the marker.
- 1.2.1.3** Observation angle – the angle in the reflector between the illumination axis and the observation axis.
- 1.2.1.4** Retro – reflection – reflection in which the radiation is returned in direction close to the direction from which it came, this property being maintained over were variations of the direction of incident radiation.
- 1.2.1.5** Head – that part of a road stud which is above the road surface where the road stud is fixed in position in the road.
- 1.2.1.6** Upper surface – that part of the external surface of road stud which is visible when the road stud is fixed in position in the road.
- 1.2.1.7** Anchorage – that part of a road stud which is below the road surface above the road stud is fixed position in the road.

1.3 Material

- 1.3.1** Plastic body of RPM road stud shall be molded from ASA (Acrylic Sterner Acrylonitrile) or HIPS (Impacts polystyrene) or ABS or any other suitable material approved by the Engineer-in-charge. The marker shall support a load of 13635 kg tested in accordance with ASTM D4280.

1.3.2 Reflective panels shall consist of number of lenses containing single or dual prismatic cubes capable of providing total internal reflection of the light entering the lens face. Lenses shall be molded of methyl methacrylate conforming to ASTM D 788 or equivalent.

1.4 Design

1.4.1 The slope of retro-reflecting surface shall preferably be 35 ± 5 degree to base.

1.4.2 The area of each retro-reflecting surface shall not be less than 13.0 Sq.cm.

1.5 Optical Performance

1.5.1 Unidirectional and bi-directional studs

1.5.1.1 Each reflector or combination of reflectors on each face of the stud shall have a CIL not less than given in Table 1 or 2 as appropriate.

Table 1 Minimum C.I.L. Values for Category "A" studs.

Entrance angle	Observation angle	C.I.L. in med 1 x		
		White	Amber	Red
0° U 5° L & R	0.3"	220	110	44
0° U 10° L & R	0.5"	120	60	24

Table 1 Minimum C.I.L. Values for Category "B" studs.

Entrance angle	Observation angle	C.I.L. in med 1 x		
		White	Amber	Red
0° U 6° L & R	0.3"	20	10	4
0° U 10° L & R	0.5"	15	7.5	3

Note: The entrance angle of 0°U corresponds to the normal aspect of the reflectors when the reflecting road stud is installed in horizontal road surface.

1.5.1.2 A stud that incorporates one or more corner cube reflectors shall be considered to be included in category "A". A stud that incorporates one or more biconvex reflectors shall be considered to be included in category "B".

1.5.2 Omni – directional studs

Each omni-directional stud shall have a minimum C.I.L. of not less than med/ lx.

1.5.3 Tests

1.5.3.1 Coefficient of luminance intensity can be measured by procedure described in ASTM D 809 "Practice for Measuring Photometric Characteristics" or as recommended in BS 873 Part 4:1973.

1.5.3.2 Under test conditions a stud shall not be considered to fail the photometric requirements of the measured C.I.L. at any one position of measurement is less than the values specified in Table 1 or 2 provided that.

(A) The value is not less than 80% of the specified minimum, and

(B) The average of the left and right measurements for the specific angle is greater than the specified minimum.

1.6 Fixing of Reflective Markers

1.6.1 Requirements

1.6.1.1 The enveloping profile of the head of the stud shall be smooth and the studs shall not present any sharp edges to traffic.

- 1.6.1.2 The reflecting portions of the studs shall be free from crevice or ledges where dirt might accumulate.
- 1.6.1.3 All road studs shall be legibly marked with the name, trade mark of other means of identification of the manufacture.
- 1.6.1.4 Marker height shall not exceed 20 mm.
- 1.6.1.5 Marker width shall not exceed 130 mm.
- 1.6.1.6 The base of the marker shall be flat within 1.3 mm. If the bottom of the marker is configured. The outermost faces of the configurations shall not deviate more than 1.3 mm from a flat surface.

1.6.2 Placement

- 1.6.2.1 The reflective marker shall be fixed to the road surface using the adhesives and the produced recommended by the manufacturer. No nails shall be used to affix the marker as nails are hazardous for the roads.
- 1.6.2.2 Regardless of the type of adhesive used. The markers shall not be fixed if the pavement is not surface dry and on new asphalt concrete surfacing unit the surfacing has been opened to traffic for a period of not less than 14 hours.
- 1.6.2.3 The portions of the highway surface, to which the marker is to be bonded by the adhesive, shall be free of dirt, curing compound, grease, oil, moisture, loose or unsound layers, paint and any other material which would adversely affect the bond of the adhesive.
- 1.6.2.4 Use a wire brush, if necessary to loosen and remove dirt. Then brush or blow clean.
- 1.6.2.5 The adhesive shall be placed uniformly on the cleaned pavement surface or on the bottom to the marker in a quantity sufficient to result in complete coverage of the area of contact of the marker with no voids present and with a slight excess after the marker has been lightly pressed in place.
- 1.6.2.6 For epoxy installations, excess adhesive around the edge of the marker, excess adhesive on the pavement and adhesive on the exposed surfaces of the markers shall be immediately removed. Soft rags moistened with mineral spirits or kerosene may be used as necessary to remove adhesive from exposed faces of pavement marker.

1.7 Warranty and durability

The contractor shall obtain from the manufacturer a two year warranty for satisfactory light performance including stipulated retro-reflectance of the reflecting panel and submit the same to the Engineer. In addition, a two year warranty for satisfactory infield performance of the finished road marker shall also be given by the contractor who carried out the work of fixing of reflective road markers. In case the markers are displaced, damaged get worn out or lose their reflectivity compared to stipulated standards, the contractor would be required to replace all such markers within 15 days of the intimation from the Engineer at his own cost and with no extra remuneration to be paid for such works.

1.8 Measurement for Payment

The measurement of Cats eye shall be in numbers of markers supplied and fixed.

1.9 Rate

The contact unit rate for Cats eye shall be payment in full compensation for furnishing all labour, material, tools, equipment including incidental costs necessary for carrying

out the work at site conforming to the specifications complete as per approved drawings or as directed.

- Item No.19 Chevron sign :-**Providing and fixing sign boards made out of 1.5mm aluminium sheet / 3mm ACP (Aluminum composite Panel); size 60x50cm rectangular as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.3 mtr long stand post of Iron Angle 75 x75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35x35x3mm; painted with bestquality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be.

The work of providing and fixing **Chevron signs** board shall be executed as per relevant specifications of **Item No. 13** of this contract. The measurement shall be in numbers of board supplied and fixed in position

- Item No.20 Hazard Marker Sign :-**Providing and fixing sign boards made out of 2.0 mm aluminium sheet / 4 mm ACP (Aluminum composite Panel); size 90x30 cms. rectangular as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 1.8mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective.

The work of providing and fixing **Hazard Marker SIGN** board shall be executed as per relevant specifications of **Item No. 13** of this contract. The measurement shall be in numbers of board supplied and fixed in position

Item No.21 Supplying & fixing R.C.C. Benches of RCC 1:2:4 Finished with chaina mozaq tiles chips and etc. Complete.(As per M.R.)



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Approx.

Rs 7,500

Per Piece

Mosaic Cement Garden Bench

Product Details:

Minimum Order Quantity	01 Piece
Material	RCC

Signature of the contractor

Executive Engineer,
Panchayat (R&B) Division
Valsad

- : SCHEDULE FOR TESTING OF MATERIALS :-

For ensuring quality control and workmanship Various tests prescribed below for materials shall be taken at periodical intervals as stipulated below. The materials shall be got tested at Government recognized Laboratory (R&B) or field Laboratory of GERI (R&B) for which 1% of the estimated amount put to tender shall be recovered from the contractor from the RA bills and final bills and the testing charges shall be paid to the GERI by the Government . However if the charges increase over 1% no excess recovery shall be made from the contractor as per resolution of B & C department dated 10th May 1985 vide TNC/ 1085/ (4)/ S

It. No. as per schedule "B"	Brief description of materials to be tested	Qty of material	Prescription of test which shall be carried out	Frequency at which test shall be carried out	Total No of test to be taken.
1]	Coarse Aggregate 40 to 63 H.B. 40 to 63 M.C 25 to 40 M.C 12 to 20 M.C. 40 mm 20 mm		- Gradation test - Impact value - Flakiness and elongation	1 to 100 cm 1 test 100 to 500 cm 3 test 500 to 1500 cm 5 test 1500 to 5000 cm 7 test Minimum 1 test/ work	
2]	Grit 6 to 10		- Stripping value	As above	
3]	Granular materials		- Gradation - Atterbeg limits	As above	
4]	Murum		- P I Value	One test per 50 cum.	
5]	Sand/ quarry spall		- Silt content - Gradation - CBR test	One test per work/ season One test per 200 cmt. One test per work	
6]	Asphalt		1 Penetration test as per IS 1203 2 Ductility test as per IS 1208 3 Specific gravity test as per IS 1202 4 Softening point test as per IS 1204 5 Viscosity test as per IS 1206	1 to 10 tanker 1 test 11 to 20 tanker 2 test 21 to 50 " 3 test 51 to 100 " 4 test Remaining every 50" 1 test	
7]	Cement		- Consistency - Setting time - Compressive strength - Fineness - Chemical analysis - Soundness	Up to 50 MT 1 test 100 MT 2 test 200 MT 3 test 300 MT 4 test 500 MT 5 test 800 MT 6 test 1300 MT 7 test and 8 test for larger consignment	

8]	CC Cubes C.C. 1:3:6 M-150 M-100		- Compressive Strength (I.S. 519 – 1959)	1 to 5 cms 1 No 6 to 15 cms 2 No 16 to 20 cms 3 No 21 to 50 cms 4 No 51 and above 4 + 1 (For each additional 50 m ³ or part thereof)	
9]	Water		- Chemical test	Once for approval of source of supply	
10]	Steel		- Tensile Strength - Yield Stress - Elongation - Size	1 test/ 40 tonnes/ per category	
11]	Bricks		- Water absorption - Efflorence - Size - Compressive Strength	1 test per 50,000 bricks	
12]	Prime coat/ Tack coat		- Quality of binder - Binder temperature for application - Rate of spread of binder	Number of samples per lot and test as per IS:73 At regular close intervals Two test per 500 m ² and not less than two test per day	
13]	Carpet and Seal coat mix/ B.M/ M.S.S.		- Quality of binder - Grading - Temperature of binder - Binder content vide 45 IMD 2172 - Rate of spread of mix materials	Number of samples per lot and test as per IS:73 1 test on individual contents and mix aggregate from the dryer for each 100 tonnes of mix subject to minimum of two test per plant per day At regular close intervals One test for each 100 tonnes of mix subject to mini. of Two per day Regular control through checks on layer thickness	
14]	Granular Sub-base		- Gradation - Atterberg limits - Moisture content prior to compaction - Density of compacted layer - Deleterious constituents - C.B.R.	As mentioned under serial number 3 As mentioned under serial number 3 As mentioned under serial number 3 One test per 500 m ² As required As required	

15]	Wet Mix Macadam		<ul style="list-style-type: none"> - Aggregate Impact Value - Grading - Flakiness and Elongation Index - Atterberg limits of portion of aggregate passing 425 micron sieve - Density of compacted layer 	As mentioned under serial number 1 As mentioned under serial number 1 As mentioned under serial number 1 As mentioned under serial number 3 One test per 500 m ²	
16]	Water Bound Macadam		<ul style="list-style-type: none"> - Aggregate Impact Value - Grading - Flakiness Index and Elongation index - Atterberg limits of binding material - Atterberg limits of portion of aggregate passing 425 micron sieve 	As mentioned under serial number 1 As mentioned under serial No.1 As mentioned under serial number 1 As mentioned under serial number 1 As mentioned under serial number 1	

The Number of tests will be as per Manual of quality control or latest Govt. G.R./Circular and it will be considered final

The contractor shall have to pay 1% of the estimated cost put to tender towards all testing of materials and the same shall be deducted from their bills for the works.

Testing charges of GERI shall be borne by Govt. No refund be made nor extra charges over 1% shall be recoverable from the contractor.

If directed by the Engineer in charge, the materials intended to be used for the work but not included in the above schedule shall also be got tested at Government recognized Laboratory or field Laboratory.

Signature of Contractor

Executive Engineer
Panchayat (R&B) Division
Valsad