

**NAME OF WORK: - Repairs and widening of 800m R&B road from DMCC fatak to Entry gate at port Navlakhi**

**:: ITEM SPECIFICATIONS::**

**Note :** Refer the material specifications From section -5 for Material and Workmanship.

**Item No.01**

**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 1000 m.**

The sub grade / sub base / base to receive the water bound macadam course shall be prepared to the specified grade and camber and made of dust and other extraneous materials. Any nets of soft places shall be corrected in on approved manner and rolled until firm.

Cutting shall be paid on cross section area as established by the longitudinal level and cross sections for this purpose. The work shall be started after the initial longitudinal section of the ground and cross sections are taken and recorded.

The final surface shall confirm to proper profile, camber and super elevation etc. as directed by the Engineer. The earthwork shall be paid on sectional measurements, cross sectional etc. taken.

No allowance or payments shall be made for materials excavated prior to the taking of level by the Engineer.

The rate is inclusive of cutting in all soil and murrum including removal of all shrubs, jungle cutting, cutting stuff in slopes, side drain bank etc. complete.

This item also includes the clearing the sides and demarking the line as per requirement and cutting out the existing tress on the road side, not extra payment will be paid for.

At the time of preparing final bill, the road formation in embankment and cutting shall have be perfect condition true to grade, camber and side slope duly dressed and damages due to rain cuts etc. during entire working period shall have to be done by the contractor.

The work taken in length shall be completed in all respects viz. width, grades, camber, side drains, side slopes etc. and measurements for incomplete work shall not be taken otherwise.

**1.0 Mode of Measurement & Payment :**

The unit rate box cutting shall include the cost of all materials, tools and plant required for excavation in all type of soils in grade and camber, line and levels and finishing as per direction of the Engineer-in-charge, excavation and all other incidental expenses for producing item of box cutting of specified breadth and depth and grade to complete the item or its components as shown on the drawings and

according to these specifications.

The box cutting shall be measured for its cross section area and compacting volumes in cubic metres by the method of average areas.

The rate will be made on **Cubic Meter** basis of the finished work

### **Item No.02**

**Earthwork for embankment including breaking clods, dressing with all lead and lift and including watering rolling and consolidation of subgrade in layers at O.M.C. to required dry density including filling the depression which occur during the process using power roller 8T to 10T. (Minimum 97% Proctor Compaction Test Density and 8% CBR Minimum)**

#### **(A) From Borrow pits within land width**

1. The land width on which the earth work is to be done shall be cleared of all trees having a girth of 30 cm and less, loose, stones, vegetation, bushes, stumps and all other objectionable materials. Useful material shall be arranged in convenient stacks along the road boundary or as directed at places within 50 metres lead, and handed over to the department in convenient section- Unsuitable material shall be burnt or otherwise disposed off by the contractor at his own cozy without causing any nuisance, inconvenience or damage to the works property or people in the neighborhood. In all cases, the materials shall be disposed off in a neat manner.
2. After clearing the site, the alignment of the road shall be properly set out true to line. Curves, slopes grades and sections as shown on the plan or directed by the Engineer-in-charge. The contractor shall provide all labours and materials such as lime, strings, pegs, nails.- bamboos, stone, mortar, concrete etc. required for setting out, establishing. Bench Marks and giving profiles. The contractor shall be responsible for maintaining the B.Ms, profiles alignments and other marks as long as they are required for the work in the opinion of the Engineer-in-charge.
3. The soil to be used for embankment shall be free from trees, stumps, roots, rubbish or any other objectionable materials. Only material considered suitable by the Engineer-in-charge shall be used for the construction and that considered unsuitable other disposed off as directed by him. The selection of the materials to be used in the construction of embankment shall Minimum 97% Proctor Compaction Test Density and 8% CBR Minimum. The embankment shall consist of earth available from road-side borrow pits on either side with lead or all lifts, and within land-width in the manner specified in Para 12 below.

4.

Type of work	Laboratory Dry Density when tested as per IS: 2720 (Pt.VII)
- Embankment up to 3 meter height	Not less than 1.44 gm/cc.
- Embankment exceeding 3 meter height or embankment of any height subject to long period of inundation.	Not less than 1.52 gm/cc.

- Top 0.5 meter of embankment below the subgrade level and shoulder (Where earth shoulder are specified)	Not less than 1.65 gm/cc.
--	---------------------------

Field density shall be percentage of laboratory density as recommended by Gujarat Engineering Research Institute.

5. The embankment shall be constructed in uniform layers not exceeding 250mm in loose thickness. The soil shall be spread uniformly over the entire width of the embankment, unless otherwise directed by the Engineer-in charge. The consolidation including watering and rolling of earthwork shall be carried out by the Department. The operation of laying the successive layer of earth shall have to be suitably synchronized with the consolidation work. If the soil as delivered to the road bed is too wet. it shall be dried by exposure to the sun till the moisture content is acceptable for compaction. All clouds of hard tamps to earth shall be broken, to have maximum size of 15cm.when being placed in the embankment and a maximum of size 5 cm when being placed in the top 45 cm of the embankment. The work of next layer shall be allowed only after-the first layer below if has been thoroughly compacted to the density specified.
6. Where an embankment is to be placed on sloping ground, the surface of the ground shall be benched in the steps of trenches or broken up in such a manner that the new material shall have perfect bond with the existing surface. Where the embankment is lo be placed over an existing road surface, the surface shall be scarified to minimum depth of a 5 cm so as to provide ample Bond between the old and new material. However when the embankment is to be placed over an old concrete pavement and lies within 1 meter of new subgrade level the pavement shall be broken up in pieces not to exceed 0.1 m and may be left, under the new, embankment. If the existing road surface is of granular or bituminous type and lies within 1 mt, of the new subgrade level, the same shall be scarified to a depth of minimum 50 mm. so as to provide ample bond between the old and the new material.
7. The embankment shell is brought up simultaneously in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer-in-charge
8. The embankment shall be finished in conformity with the alignment, levels, and cross sections and dimension shown on the plans or as directed by Engineering-charge. Where the alignment of the road is in a curve, the top of the embankment shall be formed with the super F-lavation and the increased width shown on the drawings or as the Engineer-in-charge may direct. Finishing operations shall include the work of shaping and dressing the Shoulders, road bed and the side slopes to conform the cross section.
9. The consolidation of earthwork shall be carried out by the Department by watering at Optimum Moisture Content (OMC) and compacting with a power roller of 8 to 10 tonne capacity or equivalent equipment so as to achieve a minimum of 97% of Maximum Dry Density (MDD) as determined by the Proctor Compaction Test and a minimum soaked CBR of 8%. However, the contractor shall give full co- operation and shall be the charges for labours and collection of samples for testing at authorized Government laboratory. The work of laying of earthwork in layers shall be synchronized with the field and laboratory testing. When density measurements reveal any soft area as in the embankment the Engineering-in-charge shall direct that these areas shall be compacted further. If inspire of that. Specified compaction is not achieved the materials in the self areas shall be removed as directed and replaced by the approved materials.

## 10. Tests on earth work for embankment, subgrade construction and cut formation

### **Borrow Material**

Grid the borrow area at 25 m c/c (or close, if the variability is high) to full depth of proposed working, these pits should be logged and plotted for proper identification of suitable sources of material. The following tests on representative samples shall be carried out.

Sand content (IS: 2720 (part 4)) : 2 tests per 3000 cubic meters of soil

Plasticity test (IS: 2720 (part 5)) : Each type to be tested, 2 tests per 3000 cubic meters of soil

Density test (IS: 2720 (part 8)) : Each soil type to be tested, 2 tests per 3000 cubic meters of soil

Deleterious content test (IS: 2720 (part 7)) : As and when required by the EIC

### **Compaction control**

Control shall be exercised on each layer by taking at least one measurement of density for each 1000 square meters of compacted area, or closer as required to yield the minimum number of test results for evaluating a day's work on statistical basis. The determination of density shall be in accordance with IS: 2720 (Part-28). Test locations shall be chosen only through random sampling techniques. Control shall not be based on the result of any one test but on the mean value of a set of 5-10 density determinations. The numbers of the tests in one set of measurements shall be 6 (if non destructing tests are carried out, the number of tests shall be doubled) as long as it is felt that sufficient control over borrow material and the method of compaction is being exercised. If considerable variations are observed between individual density results, the minimum number of tests in one set of measurement shall be increased to 10. The acceptance criteria shall be subject to the condition that the mean density is not less than the specified density plus;

$1.65 - \{1.60 / (\text{No. of samples})^{0.50}\}$  times the standard deviation

However, for earthwork in shoulders (earthen) and in the sub grade, at least one density measurement shall be taken for every 500 square meters for the compacted area provided further that the number of tests in each set of measurements shall be atleast 10. In other respect, the control shall be similar to the described earlier

## 11. Mode of Measurements

The earthwork measurements shall be paid on cross sectional measurements and computing the volumes of earth work in cubic meters by average area method. The contractor shall sign day lo day leveling work and also original cross section, longitudinal section etc. in token of his acceptance. The working sections both longitudinal and cross of the ground shall he taken by the engineer-in-charge before the actual work is started. The contractor or his authorized representative shall attend day to day leveling work and sign with date the field book daily.

12. If usable approved materials are available within the land width of road, the same shall be permitted for use in the road embankment subject to the following condition
- 12.2 The borrow pits wilt be so excavated as to form a road side longitudinal gutter to drain the water interrupted by such gutter.
- 12.3 The width of the drain shall be restricted to 1.5 mts only. The depth will be restricted to such grade so as to drain the water efficiently. AH balance quantity of earth shall be brought from distant borrow areas only.
- 12.4 If there is top layer of black cotton or other objectionable soils, the same be removed and disposed off elsewhere and usable material found at the lower level will only be used in the

earthen embankment, if the contractor chooses to utilize this material.

- 12.5 The drain should be aligned along the boundary of the land width of the road. No pit, other than this drain. Shall be dug within 5 meters of the toe to the final section of the road embankment.
- 12.6 No borrow pits shall be allowed its the length in which earth obtained from cutting is specified to be used in embankments.
13. The rate of earthwork includes clearing Jungles, dog belling, fixing profiles; erecting necessary pillars for stones for bench marks for leveling purpose, excavating earth from borrow areas, breaking clods, conveying and Spreading earth in layers with all lead and Lift. Finishing the-entire embankment and incidentals necessary to complete the .work to the specifications. The cutting stuff of cutting in ordinary soil. Soft murrum, soft rock. Hard murrum and hard rock shall be utilized in embankment construction under this item within the lead specified in that particular item. No payment shall be made under this item for the cutting stuff used in the embankment but labour for cutting will be paid as per specifications in that particular item, and only balance quantity of earthwork, brought from borrow areas will be paid in this item.

#### **Modes of payment:**

The rate shall include the cost of the material, tools, machineries and labours involved in all the operations as described above.

The final measurement shall be done and paid in **cum** of work completed, shall be inclusive of all the works as per specification as directed by Engineer-In-Charge (EIC)

#### **Item No.03**

**Construction of granular sub-base by providing coarse graded material of required grading, spreading in uniform layers by mechanical means on prepared surface, mixing by mix in place method with rotavator at OMC, and compacting with vibratory roller to achieve the desired density, complete as per Clause 401 of MORT & H specification. {150mm thick GSB (Grade -1 as per MORTH)}**

##### **1. Scope of work**

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

##### **2. Materials**

The material to be used for the work shall be natural sand, crushed gravel, crushed stone, crushed slag, or combination thereof depending upon the grading required. Use of materials like brick metal, Kankar and crushed concrete shall be permitted in the lower sub-base. The material shall be free from organic or other deleterious constituents and shall conform to the grading given in Table I and physical requirements given in Table II. Where the sub-base is laid in two layers as upper sub-base and lower sub-base, the thickness of each layer shall not be less than 150 mm.

If the water absorption of the aggregates determined as per IS:2386 (Part 3) is greater than 2 percent, the aggregates shall be tested for Wet Aggregate Impact Value (AIV) (IS:5640). Soft aggregates like

Kankar, brick ballast and laterite shall also be tested for Wet AIV (IS:5640).

**TableI: Grading for Granular Sub-Base Materials**

IS Sieve Designation	Percent by weight passing the IS sieve
Grading I As per MORTH	
75.0 mm	-
53.0 mm	100
26.5 mm	55 -75
9.50 mm	-
4.75 mm	10 – 30
2.36 mm	-
0.425 mm	-
0.075 mm	< 5

**Table II: Physical Requirements for Materials for Granular Sub-base**

Aggregate Impact Value (AIV)	IS:2386 (Part 4) or IS:5640	40 maximum
Liquid Limit	IS:2720 (Part 5)	Maximum 25
Plasticity Index	IS:2720 (Part 5)	Maximum 6
CBR at 98% dry density (at IS:2720-Part 8)	IS:2720 (Part 5)	Minimum 30 unless otherwise specified in the Contract

### **3. Construction Operations**

#### **Preparation of Sub-grade**

Immediately prior to the laying of sub-base, the subgrade 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.

#### **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 the CBR and other physical requirements when compacted and finished.

When direct by the EIC, 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.

#### **Spreading and Compacting**

The sub-base material of the grading specified in the Contract (Table-I) and water shall be mixed mechanically by a suitable mixer equipped with provision for controlled addition of water and mechanical mixing. So as to ensure homogenous and uniform mix. The required water content shall be determined in accordance with IS:2720 (Part 8). The mix shall be spread on the prepared subgrade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation,

or other means as approved by the Engineer.

Moisture content of the mix shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted so that, at the time of compaction, it is from 1 to 2 percent below the optimum moisture content. Immediately after spreading the mix, rolling shall be done by an approved roller. 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, up to 200 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight 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 or on super-elevation. For carriageway having cross fall on both sides, rolling shall commence at the edges and progress towards the crown.

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.

### **Surface Finish and Quality Control of Work**

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

#### **4. Quality control test during construction operation**

##### **General**

The material supplied and the works carried out by the contractor shall conform to the specifications prescribed in the preceding clauses. For ensuring the requisite quality of construction, the materials and works shall be subject to requisite quality of construction, the materials and works shall be subjected to quality control tests, as described minimum and the EIC shall have the full authority to carry out additional tests as frequently as he may deem necessary, to satisfy himself that the materials and works comply with the appropriate specifications. However, the number of tests recommended in the below table may be reduced at the discretion of the EIC if it is felt that consistency in the quality of materials can still be maintained with the reduced number of tests.

#### **CONTROL TESTS AND THEIR MINIMUM REQUIREMENT FOR SUB-BASES AND BASES**

<b>Sr. No.</b>	<b>Type of Construction</b>	<b>Test</b>	<b>Frequency (min.)</b>
<b>1</b>	Granular Sub base	<b>a.</b> Gradation	One test per 200 cum
		<b>b.</b> Atterberg limits	One test per 200 cum
		<b>c.</b> Moisture content prior to compaction	One test per 250 cum
		<b>d.</b> Density of compacted layer	One test per 500 cum
		<b>e.</b> Deleterious constituents	As required
		<b>f.</b> CBR	As required

Tests procedures for the various quality control tests are indicated in the respective sections of these specifications or certain tests within this section where no specific testing procedure is mentioned, the tests shall be carried out as per the prevalent accepted engineering practice to the directions of the EIC.

## **5. Tests on earth work for embankment, subgrade construction and cut formation**

### **Borrow Material**

Grid the borrow area at 25 m c/c (or close, if the variability is high) to full depth of proposed working, these pits should be logged and plotted for proper identification of suitable sources of material. The following tests on representative samples shall be carried out.

- Sand content (IS: 2720 (part 4)) : 2 tests per 3000 cubic meters of soil
- Plasticity test (IS: 2720 (part 5)) : Each type to be tested, 2 tests per 3000 cubic meters of soil
- Density test (IS: 2720 (part 8)) : Each soil type to be tested, 2 tests per 3000 cubic meters of soil
- Deleterious content test (IS: 2720 (part 7)) : As and when required by the EIC

### **Compaction control**

Control shall be exercised on each layer by taking at least one measurement of density for each 1000 square meters of compacted area, or closer as required to yield the minimum number of test results for evaluating a day's work on statistical basis. The determination of density shall be in accordance with IS: 2720 (Part-28). Test locations shall be chosen only through random sampling techniques. Control shall not be based on the result of any one test but on the mean value of a set of 5-10 density determinations. The numbers of the tests in one set of measurements shall be 6 (if non destructing tests are carried out, the number of tests shall be doubled) as long as it is felt that sufficient control over borrow material and the method of compaction is being exercised. If considerable variations are observed between individual density results, the minimum number of tests in one set of measurement shall be increased to 10. The acceptance criteria shall be subject to the condition that the mean density is not less than the specified density plus;

$1.65 - \{1.60 / (\text{No. of samples})^{0.50}\}$  times the standard deviation

However, for earthwork in shoulders (earthen) and in the sub grade, at least one density measurement shall be taken for every 500 square meters for the compacted area provided further that the number of tests in each set of measurements shall be atleast 10. In other respect, the control shall be similar to the described earlier

## **6. Control of alignment, level and surface regularity**

### **General**

All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings or as directed by the EIC, subject to the permitted tolerances described herein after.

### **Horizontal alignment**

Horizontal alignments shall be reckoned with respect to the center line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of !

10mm there from the corresponding tolerance for edges of the roadway and lower layers of pavement shall be 25mm.

### **Surface levels**

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

#### **Tolerances in Surface Level**

<b>1</b>	Subgrade	+ 20 mm
<b>2</b>	Sub base + 10 mm	
	(A) Flexible Pavement	- 20 mm
	(B) Concrete Pavement	+ 6 mm -10 mm
<b>3</b>	Base course of flexible pavement	+ 10 mm
	(A) Bituminous course	- 6 mm
	(B) Other than bituminous	+ 10 mm
	(i) Machine laid	- 10 mm
	(ii) Manually laid	+ 15 mm
<b>4</b>	Wearing course for flexible pavement	
	(i) Machine laid	+ 6 mm - 6 mm
	(ii) Manually laid	+ 10 mm - 10 mm
<b>5</b>	Cement concrete pavement	+ 5 mm - 6 mm

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

For checking compliance with the above requirement for subgrade, sub base and base courses, measurements of the surface levels shall be taken on a grid of points placed at 6.25 m longitudinally and 3.5 m transversely. For any 10 consecutive measurements taken longitudinally or transversely not more than one measurement shall be permitted to exceed the tolerance as above this on measurement being not in excess of 5 mm above the permitted tolerance.

For checking the compliance with the above requirement for bituminous wearing courses and concrete pavements, measurements of the surface levels shall be taken on a grid of points placed at 6.25 m along the length and at 0.5 m from the edges and at the center of the pavement. In any length of pavement, compliance shall be deemed to be met for final road surface, only if the tolerance given above is satisfied for any point on the surface.

### **Surface regularity of pavement courses**

The longitudinal profile shall be checked with a 3 meter long straight edge / moving straight edge as desired by the EIC at the middle of each traffic lane along a line parallel to the center line of the road

The maximum permitted number of surface irregularities shall be as per below table;

	<b>Surfaces of carriageways and paved shoulders</b>				<b>Surfaces of laybys, service areas and all bituminous base courses</b>			
Irregularity	4 mm		7 mm		4 mm		7 mm	
Length (m)	300	75	300	75	300	75	300	75
National Highways/Expressways	20	9	2	1	40	18	4	2
Roads of lower category	40	18	4	2	60	27	6	3

The maximum allowable difference between the road surface and underside of a 3 m straight-edge when placed parallel with, or at right angles to the center line of the road at points decided by the EIC shall be:

For pavements surface (bituminous and cement concrete)      3 mm  
For bituminous base course      6 mm

## **7. Rectification**

Where the surface regularity of subgrade and the various pavement courses fall outside the specified tolerances, the contractor shall be liable to rectify this in the manner described below and to the satisfaction of the EIC;

### **Sub Grade**

Where the surface is high it shall be trimmed and suitably compacted. Where the same is low, the deficiency shall be corrected by scarifying the lower layer and adding fresh material and compacting to the required density.

## **8. Arrangement of traffic during construction**

During the period of construction, arrangements for the traffic shall be provided and maintained in accordance with Clause 112.

The Contractor shall at all time carry out work on the highway in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same. For all works involving improvements to the existing highway, the Contractor shall, in accordance with the directives of the Engineer, provide and maintain, during execution of the work, a passage for traffic either along a part of the existing carriageway under improvement, or along a temporary diversion constructed close to the highway. The Contractor shall take prior approval of the Engineer regarding traffic arrangements during construction.

## **9. Passage of Traffic along a part of the Existing Carriageway under Improvement.**

For widening /strengthening existing carriageway where part width of the existing carriageway is proposed to be used for passage of traffic, treated shoulders shall be provided on the side on which work is not in progress. The treatment to the shoulder shall consist of providing at least 150 mm thick granular base course covered with bituminous surface dressing in a width of at least 1.5 m and the surface shall be maintained throughout the period during which traffic uses the same to the satisfaction of the Engineer. The continuous length, in which such work shall be carried out, would

be limited normally to 500 m at a place. However, where work is allowed by the Engineer in longer stretches passing places at least 20m long with additional paved width of 2.5 m shall be provided at every 0.5 km interval.

In case of widening existing two-lane to four-lane, the additional two lanes would be constructed first and the traffic diverted to it and only thereafter the required treatment to the existing carriageway would be carried out. However, in case where on the request to the Contractor, work on existing two-lane carriageway is allowed by the Engineer with traffic using part of the existing carriageway, stipulations as in para above shall apply.

After obtaining permission of the Engineer, the treated shoulder shall be dismantled, the debris disposed of and the area cleared as per the direction of the Engineer.

### **10. Passage of Traffic along a Temporary Diversion**

In stretches where it is not possible to pass the traffic on part width of the carriageway, a temporary diversion shall be constructed with 7 m carriageway and 2.5 m earthen shoulders on each side (total width of roadway 12 m) with the following provision for road crust in the 7 m width:

- (i) 200 mm (compacted) granular sub base;
- (ii) 225 mm (compacted) granular base course; and
- (iii) Premix carpet with Seal Coat/Mix Seal Surfacing.

The alignment and longitudinal section of diversion including junctions and temporary cross drainage provision shall be as approved by the Engineer.

### **11. Traffic Safety and Control**

The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement. Before taking up any construction, and agreed phased programmed for the diversion of traffic on the highway shall be drawn up in consultation with the Engineer.

The barricades erected on either side of the carriageway/portion of the carriageway closed to traffic, shall be of strong design to resist violation, and painted with alternate black and white stripes. Red lanterns or warning lights of similar type shall be mounted on the barricades at night and kept lit through from sunset to sunrise.

At the points where traffic is to deviate from its normal path (whether on temporary diversion or part width of the carriageway) the channel for traffic shall be clearly marked with the aid of pavement markings, painted drums or a similar device to the directions of the Engineer. At night, the passage shall be delineated with lanterns or other suitable light source.

One-way traffic operation shall be established whenever the traffic is to be passed over part of the carriageway inadequate for two-lane traffic. This shall be done with the help of temporary traffic signals or flagmen kept positioned on opposite sides during all hours. For regulation of traffic, the flagmen shall be equipped with red and green flags and lanterns/lights.

On both sides, suitable regulatory/warning signs as approved by the Engineer shall be installed for

the guidance of road users. On each approach, at least two signs shall be put up, one close to the point where transition of carriageway begins and the other 120 m away. The signs shall be of approved design and of reflectory type, if so directed by the Engineer.

## **12. Maintenance of Diversions and Traffic Control Devices**

Signs, lights, barriers and other traffic control devices, as well as the riding surface of diversions shall be maintained in a satisfactory condition till such time they are required as directed by the Engineer. The temporary traveled way will be kept free of dust by frequent applications of water, if necessary.

## **13. Modes of measurements for payment**

The measurement shall be on level basis. For this purpose final level of underneath layer i.e. capping layer shall be considered as initial level for this item. The final levels shall be taken jointly after completion of length of road in all respect including compaction of vibratory roller as directed by EIC with all respect. If the contractor or his representative shall not remain present during the leveling, the levels taken by department shall be final and no arguments or claims shall be entertained. The quantity shall be derived by using Simpson's rule or as directed by Engineer in Charge. 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 for the same.

The rate shall include the cost of the tools, plants, machineries and labours involved in all the operations as described above.

The final measurement shall be done and paid in **cum** of work completed, shall be inclusive of all the works as per specification as directed by Engineer-In-Charge (EIC)

### **Item No.04**

**Construction of granular sub-base by providing coarse graded material of required grading, spreading in uniform layers by mechanical means on prepared surface, mixing by mix in place method with rotavator at OMC, and compacting with vibratory roller to achieve the desired density, complete as per Clause 401 of MORT & H specification0. {150mm thick GSB (Grade -7 as per IRC-58 Table-7)}**

Specification for this item in general shall be same as that of item No. 3 of this tender except that under this item is to be carried for **Point 3 Table**

### **GRADING FOR COARSE GRADED GRANULAR SUB BASE MATERIALS**

Grading 7 As per IRC 58 TABLE VI-I	
IS Sieve Designation	Percent by weight passing the IS sieve
19.5 mm	100
12.5 mm	79.5
9.50 mm	69.5

4.75 mm	43.5
2.36 mm	22
1.18 mm	5

### **Modes of measurements for payment**

The measurement shall be on level basis. For this purpose final level of underneath layer i.e. capping layer shall be considered as initial level for this item. The final levels shall be taken jointly after completion of length of road in all respect including compaction of vibratory roller as directed by EIC with all respect. If the contractor or his representative shall not remain present during the leveling, the levels taken by department shall be final and no arguments or claims shall be entertained. The quantity shall be derived by using Simpson's rule or as directed by Engineer in Charge. 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 for the same.

The rate shall include the cost of the tools, plants, machineries and labours involved in all the operations as described above.

The final measurement shall be done and paid in **cum** of work completed, shall be inclusive of all the works as per specification as directed by Engineer-In-Charge (EIC)

### **Item No.05**

**Construction of dry lean cement concrete sub base over a prepared sub grade with course and fine aggregate confirming to IS 383, the size of course aggregate not exceeding to 25mm, aggregate cement ration not to exceed 15 : 1, aggregate gradation after blending to be as per Table 600-1 of MORT & H specifications, cement content not to be less than 240 kg/cum, optimum moisture content to be determine during trail length construction, concrete strength not to be less than 15 Mpa at 7 days, mix in a batching plant, transported to site, laid with a paver, compacting with 8 to 10 tone vibratory roller, finishing and curing etc. complete as per clause no. 601 of MORT & H specifications.**

#### **1. Scope of work**

The work consists of construction of dry lean concrete sub base as per drawing for cement concrete pavement in accordance with the requirements of these specifications and in conformity with the lines, grades and cross-sections shown in the drawings or as directed by the EIC. The work shall include furnishing of all plant, equipment, materials and labour and performing all operations, in connection with work, as approved by the EIC.

The design parameters of dry lean concrete sub base, viz., width, thickness, grade of concrete, details of joints, if any, etc. shall be as stipulated in the contract drawings.

#### **2. Materials**

##### **A. Water**

The water shall conform to M-1

##### **B. Cement**

The cement shall conform to M-3

##### **C. Aggregates**

Aggregates for the dry 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 EIC 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 EIC.

#### **D. Coarse Aggregates**

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, flanky, elongated, very angular or splintery pieces. The maximum size of the coarse aggregate shall be 25 mm. The coarse aggregate shall comply with as below.

#### **E. Aggregates**

Aggregates for pavement concrete shall be natural material complying with IS: 383 but with a Los Angeles Abrasion Test result not more than 35 %. 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 alkalies in the cement. In addition, the total chlorides content expressed as chloride ion content shall not exceed 0.06 % by weight and the total sulphate content express as sulphuric anhydride (SO<sub>3</sub>) shall not exceed 0.25 % by weight.

#### **F. Coarse Aggregates**

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, flanky, elongated, very angular or splintery pieces. The maximum size of the 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 % 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 % if sodium sulphate solution is used or 18 % if magnesium sulphate solution is used.

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

#### **G. 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 below.

##### **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 not contain deleterious substances more than following:

Clay lumps	4 %
Coal and Lignite	1 %
Material passing IS sieve no. 75 micron	4 %

The coarse and fine aggregates may be obtained in either of the following manner:

- (i) In separate nominal sizes of coarse and fine aggregates and mixed together intimately before use.
- (ii) Separately as 25 mm nominal single size, 12.5 mm nominal size graded aggregates and fine aggregate of crushed stone dust or sand or a combination of these two.

The material after blending shall conform to the grading as indicated in below table;

**Aggregate Gradation for Dry Lean Concrete**

IS Sieve Designation	Percentage by weight passing the IS sieve
26.50 mm	100
19.00 mm	80 – 100
9.50 mm	55 – 75
4.75 mm	35 – 60
600 μ (micron)	10 – 35
75 μ (micron)	0 - 8

**3. Proportioning of Materials for the Mix.**

The mix shall be proportioned with a maximum aggregate cement ratio of 15:1. The water content shall be adjusted to the optimum so as to facilitate compaction by rolling. The strength and density requirements of concrete shall be determined by making trial mixes.

**A. Moisture content:**

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

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

**B. Cement content:**

The minimum cement content in the lean concrete shall not be less than 240 kg/cum 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.

**C. Concrete strength:**

The average compressive strength of each consecutive group of five cubes, prepared and tested in accordance with Clause 903.5.1.1 of MoRTH Specifications for Road and Bridge Works, shall not be less than 15 MPa at 7 days. Further, the compressive strength of any individual cube shall not be less than 15 MPa at 7 days.

The concrete design mix satisfying the above requirements shall be submitted to and approved by the Engineer prior to commencement of the work. The approved mix shall also be demonstrated through the construction of a trial length to the satisfaction of the Engineer.

#### **D. Sub grade:**

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

#### **4. Construction.**

##### **A. General**

The pace and programmed 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.

##### **B. 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 below (I).

- (I) Batching and mixing of the concrete shall be done at a central batching and mixing plant with automatic controls, located at a suitable place which takes into account sufficient space for stockpiling of cement, aggregates and stationary water tanks. This shall be, however, situated at an approved distance, duly considering the properties of the mix and the transporting arrangements available with the Contractor.

The cement from the bulk stock shall be weighed separately from the aggregates. The capacity of batching and mixing plant shall be at least 25 per cent higher than the proposed capacity for the laying arrangements. The batching and mixing shall be carried out preferably in a forced action central batching and mixing plant having necessary automatic controls to ensure accurate proportioning and mixing. Other types of mixes 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 weighbridge. The accuracy of weighing scales of the batching plant shall be within  $\pm 2$  per cent in the case of aggregates and  $\pm 1$  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.

##### **C. 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. Tripping 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, shall transport the concrete. The lead of batching plant to paving site shall be such that the travel time available from mixing to paving as specified in Clause no

601.6.5.2 will be adhered to.

#### **D. Placing**

Lean concrete shall be laid/placed as directed by EIC. 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 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 500-1000mm and 200-400mm respectively from the corresponding joints in the overlaying concrete slabs.

#### **E. Compaction**

- (a) The compaction shall be carried out immediately after the material is laid and leveled. In order to ensure thorough compaction which is essential, rolling shall be continued on the full width till there is no further visible movement under the roller and the surface is closed. The minimum dry density obtained shall be 98 per cent of that achieved during the trial length construction as per Morth Specification. The densities achieved at the edges i.e. 0.5 m from the edge shall not be less than 95 per cent of that achieved during the trial construction as per Morth Specification.
- (b) 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 degrees Celsius. If necessary, chilled water or addition of ice may be resorted to for bringing down in the temperature. It is desirable to stop concreting when the ambient temperature is above 35 degree 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.
- (c) Double drum smooth-wheeled vibratory rollers of minimum 80 to 100 KN static weight are considered to be suitable for rolling dry clean concrete. In case any other roller is proposed, the same shall be got approved from the Engineer, after demonstrating its performance. The number of passes required to obtain maximum compaction depends on the thickness of the lean concrete, the compatibility of the mix, and the weight and type of the roller etc., and the same as well as the total requirement of rollers for the job shall be determined during trial run by measuring the in-situ density and the scale of the work to be undertaken.
- (d) In addition to the number of passes required for compaction there shall be a preliminary pass without vibration to bed the clean 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.

- (e) 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 regularly also should be checked with 3 mm straight edge. The deficiency should be made up with concrete with aggregates of size 10 mm and below.

- (f) 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.

#### **F. 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 by sprinkling water.

#### **5. Trial mixes**

The contractor shall make trial mixes of dry lean concrete with moisture contents like 5.0, 5.5, 6.0 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 (Morth specification). 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 per prevailing morth specifications. 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 as per Clause 601.8. If during the construction of the trial length, the optimum moisture content determined as above is found to be unsatisfactory, the Contractor may make suitable changes in the moisture content to achieve a satisfactory mix. The cube specimens prepared with the changed moisture content should satisfy the strength requirement. Before production of the mix, Natural moisture content of the aggregate should be determined on a day-to-day basis so that the moisture content could be adjusted. The mix finally designed should neither stick to the rollers nor become too dry resulting in raveling of surface.

#### **6. Trial Length**

The trial length shall be constructed at least 14 days in advance of the proposed date of commencement of work. At least 30 days prior to the construction of the trial length, the Contractor shall submit for the Engineer's approval a "Method Statement" giving detailed description of the proposed materials, plant, equipment, mix proportion, and procedure for batching, mixing, laying, compaction and other construction procedures. The Engineer shall

also approve the location and length of trial construction, which shall be a minimum of 60 m length and for full width of the pavement. The trial length shall contain the construction of at least one transverse construction joint involving hardened concrete and freshly laid sub-base. The construction of trial length will be repeated till the Contractor proves his ability to satisfactorily construct the sub base.

In order to determine and demonstrate 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 no. 601.7 as per Morth Specification

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 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 prevailing morth specifications. A few cores may be cut as per the instructions of the Engineer to check segregation or any other deficiency.

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 honeycombing and the aggregates shall not be held loosely at the edges.

The trial length shall be outside the main works. The main work shall not start until 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.

## **7. Tolerances for surface regularity, level, thickness, density and strength**

### **(I) Sampling and testing**

Samples for dry lean concrete for making cubes shall be taken from the uncompacted material from different locations immediately before compaction at the rate of 3 samples for each 1000 Sqm or part thereof laid each day. Sampling of mix shall be done from the paving site.

Test cubes of 150 mm size shall be made immediately from each mix sample.

Cubes shall be made in accordance with the methods described in IS: 516 except that the cubes shall be compacted by means of vibratory hammer with the moulds placed on a level and rigid base. The vibrating hammer shall be electric or pneumatic type fitted with a square or rectangular foot having an area of between 7500 to 14000 square mm. The compaction shall be uniformly applied for  $60 \pm 5$  seconds with a downward force of between 300 N and 400 N and to each of the three layers of the lean concrete material placed into the mould. The surface of each compacted layer shall be scarified before the next layer is added to give key for the next layer. The final layer shall be finished flush with the top of the cube mould.

The dry lean concrete cubes shall be cured in accordance with IS: 516.

### **(II) In-situ density**

The dry density of the laid material shall be determined from three density holes at locations equally spaced along a diagonal that bisects each 2000 square meter or part thereof laid each

day and shall comply with the requirements as per clause no. Clause 601.6.5.1. This rate of testing may be increased at the discretion of the EIC in case of doubt or to determine the extent of defective area in the vent of non-compliance. Density holes at random may be made to check the density at edges.

### **(III) Thickness**

The average thickness of the subbase layer as computed by the level data of sub-base and subgrade or lower sub-base shall be as per the thickness specified in the contract drawings. The thickness at any single location shall not be 8 mm less than the specified thickness. Such areas shall be corrected as stated in Clause 601.6.5.5. Areas which cannot be repaired should be replaced over full width. The extent of deficient area should be decided based on cores.

### **8. Mode of measurement and payment: -**

The measurement shall be on level basis. For this purpose, final level of underneath layer i.e. Wet Mix Macadam shall be considered as initial level for this item. The final levels shall be taken jointly after completion of length of road after compaction with roller and curing etc complete as directed by EIC. The final level shall be taken in presence of EIC or his representative. The quantity shall be derived by using Simpson's rule or as directed by Engineer in Charge.

The rate shall include the cost of the tools, plants, machineries and labours involved in all the operations as described above.

The final measurement shall be done and paid in **cum** of work completed, shall be inclusive of all the works as per specification as directed by Engineer-In-Charge (EIC).

### **Item No.06**

**Cement concrete M40 grade of specified thickness in pavement using OPC 43 grade cement minimum @ 405 kg/cum and graded stone aggregates 25mm nominal maximum size laid to required using appropriate batching and mixing plant, vibrating system comprising of needle vibrator, surface (screed) vibrator, floater etc, heavy duty steel form work made from MS channels including provision of contraction, expansion, construction and longitudinal joints, joint filler board, joint sealant, sealant primer, debonding strip, MS round dowel bar, tie rod all as per drawing and technical specifications, admixture (super plasticizer) conforming to IS :9103 @ 0.4 % by weight of cement, broom finishing, curing etc complete (Reinforcement in form of dowel bars, tie rod etc to be paid for separately)**

Construction of un-reinforced, dowel, jointed, plain Controlled cement concrete pavement 25 Cm thick in M-300 grade concrete over a prepared sub-base with 53 grade cement @ 410 Kg/Cum. With coarse and fine aggregates confirming to IS:383, maximum size of coarse aggregates not exceeding 25mm as per approved mix design, laid with a fixed form, spread, compacted and finished in a continuous operation including provision of contraction, expansion, construction and longitudinal joints, filler separation member sealant primer, joint sealant, debonding, strip, dowel bar, tie rod, admixture as approved, curing compound, including vacuum dewatering, finishing to line and grade as per drawing and as directed. (As per specification MORT&H clause 602)

### **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 of achieving the design strength may be used with prior approval of the Engineer, but the preference should be to use at least the 43 Grade or higher.

(i) Ordinary Portland Cement, 33 Grade, IS : 269.

(ii) Ordinary Portland Cement, 43 Grade IS : 8112.

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

If the soil around has soluble salts like sulphates in excess of 0.5 percent, 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 on the laboratory concrete trial mixes and in trial paving works. If air entraining admixture is used, the total quantity of air in air-entrained concrete as a percentage of the volume of the mix shall be  $5 \pm 1.5$  per cent for 25 mm 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<sub>3</sub>) shall not exceed 0.25 per cent 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 per cent shall be used in the concrete mix. The aggregates shall be tested for soundness in accordance with IS : 2386 (Part-

5). After 5 cycles of testing the loss shall not be more than 12 per cent if sodium sulphate solution is used or 18 per cent 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 lumps 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  $\pm 1.5$  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.1 Clause 1015. It shall be 25 mm less in depth than the thickness of the slab within a tolerance of  $\pm 3$  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 stackyards. 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 18:10262 (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 405 kg per cum of concrete. If this minimum cement content is not sufficient to produce in the field, concrete of the strength specified in the 116 drawings/design, it shall be increased as necessary without additional compensation under the Contract. The cement content shall, however, not exceed 475 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 percent by weight or by an amount agreed by the Engineer. The increased cement content shall be maintained at least until the four corresponding 28 day strengths have been assessed for its conformity with the requirements as per Clause 602.3.1. Whenever the cement content is increased, the concrete mix shall be adjusted to maintain the required workability.

#### 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 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 the lead from Batching plant site to the paving site changes. The workability shall be established for the type of paving equipment avail-slump value in the range of  $30 \pm 15$  mm is reasonable for paving works but this may be modified depending upon the site requirement and got approved by the Engineer. These tests shall be carried out on every Truck/dumper at Plant site and paving site initially when the work commences but subsequently the frequency can be reduced to alternate truck 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 Specifications 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 subbase. 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 300 mm 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 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  $\pm 10$  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  $\pm$  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 tolerances given in Clause 602.6.2.1 and at such depth below the surface as will not impede the passage of the finishing straight edges or oscillating beams of the paving machines. The adjacent slabs shall be completely separated from each other by providing joint filler board. Space around the dowel bars, between the sub-base and the filler board shall be packed with a suitable compressible material to block the flow of cement slurry. Expansion Joint: 20 mm thickness of SILFLEX (CAPCELL HD -100) pre-moulded compressible filler board in black colour confirming to MoRT&H Specifications (Clause 1015), having minimum density 95kg/cum.metre, non-staining with less than 1% water absorption & compression recovery of 93% minimum as per specification for 20 mm wide & 100 mm deep Expansion Joint finished or sealed with two component pre packed capable of + or - 20% of joint movement sealing compound of elastic PU coal tar based having width 20 mm x depth 10 mm of black colour & available in pourable viscous liquid with a density of 1.3kg/litre & Shore A hardness 25 (mixing ratio by weight should be comp. A : comp. B 100 : 5.7) Scope This work shall consist of fabrication and placing of expansion joints as indicated on the drawing and conforming to these specifications or as directed by the Engineer.

## GENERAL

a) The expansion joints shall be designed and duly got approved by the Engineer. It shall cater for expected movement and rotation of the structure at the joints and provide smooth riding surface. It shall also be easy for inspection, maintenance and replacement.

b) Expansion joints shall be robust, durable, water-tight and replaceable. Site fabricated expansion joints shall be prohibited. Expansion joints shall be obtained by the Engineer either directly or through the Contractor from approved manufacturers and be of proven type.

c) Vehicular traffic shall not be allowed over expansion joints after its construction for such period as may be determined by the Engineer.

d) Proprietary type joints offered by the Contractor in lieu of the type specified shall comply in all respects with the manufacturer's specifications and meet the required range of movements and rotations and be fit for the purpose of ensuring satisfactory long term performance in the bridge. Where alternative type proprietary joints are proposed by the Contractor, the following information shall be provided.

(i) Name and location of the proposed manufacturer.

(ii) Dimensions and general details of the joint including material specifications, holding down bolt or anchorage details and installation procedures.

(iii) Evidence of satisfactory performance under similar environmental conditions of similar joints being produced by the manufacturer. Any acceptance of alternative types will be at the sole discretion of the Engineer. Such joints shall be installed in accordance with the manufacturer's

recommendations and to the general requirements of this Specification. No expansion joint shall be provided only for the width of the, carriageway. It shall follow the profile including the kerb and the footway and fascia, if provided. The type of expansion joint for the latter may be made different from that used for the carriageway expansion joint 2603. REQUIREMENTS 2603.1. The requirement criterion will be separately applicable for the expansion joint proper and the transition zone of attachment to the work. 2603.2. There are two types of performance requirements for the expansion joint proper viz. from the necessity of the bridge and from the road users e.g. man, animal and vehicle. 2603.3. Performance Requirement with Respect to work

The expansion joint shall :

- a) Withstand the imposed load including the impact load from live load and other sources.
- b) Allow expansion and contraction movement due to temperature, creep, shrinkage, pre-stressing and structural deformations.
- c) Permit relative rotation in elevation and plan due to the causes as noted above,
- d) Be waterproof. Expansion joint seals play a critical role in preventing the degradation of the structural components of the pavement system. Without effective joint seals, water passes through the pavement and works harmfully to corrode steel components and cause deterioration of the concrete. Rain water gathers various corroding additives from the atmosphere and also from the carriageway.
- e) Ensure sealing. In case joints are not sealed, apart from loss of waterproofing, grit and other forms of road debris may enter the joint. Debris, when impacted with the joint can seriously restrict the movement instead of facilitating the same. In the case of proprietary joints being accepted for adoption, the sealing shall be as specified by them,
- f) Ensure long life by being resistant to corrosion,
- g) Be easy to install,
- h) Be easy to maintain. Replaceability of expansion joint shall be one of the basic criteria for selection of type of expansion joint,
- i) Be resistant to the materials likely to collect/spill over the deck in its normal service. 2603.4.

Performance Requirement with Respect to User

The expansion joint shall :

- a) Provide smooth continuity at the top of the pavement for riding comfort,
- b) Be of skid resistant surface,
- c) Be non-damaging to the rubber tyre,
- d) Make minimum noise during vehicular crossing,
- e) Ensure that animal paws and hooves should not get entangled where bridges are used by animal drawn traffic,
- f) Permit passing of bullock cart steel tyre for bridges where bullock carts ply.
- g) Look good aesthetically. 2605. FILLER JOINTS

a) The components of this type of joint shall be at least 2 mm thick corrugated copper plate placed slightly below the wearing coat, 20 mm thick compressible fiber board to protect the edges, 20 mm thick pre-moulded joint filler filling the gap upto the top level of the wearing coat, sealed with a joint sealing compound.

b) The material used for filling expansion joint shall be bitumen impregnated felt, elastomer or any other suitable material, as specified on the drawings. Impregnated, felt shall conform to the requirements of IS: 1838, and shall be got approved from the Engineer. The joint filler shall consist of large pieces and assembly of small pieces to make up the required size shall be avoided.

c) Expansion joint materials shall be handled with care and stored under cover by the Contractor to

prevent damage.

d) Any damage occurring after delivery shall be made good to the satisfaction of the Engineer and at the expense of the Contractor.

e) Joint gaps shall be constructed as shown on the drawings. Surfaces joint grooves shall be thoroughly cleaned with a wire brush to remove all loose materials and dirt and debris, then washed or jetted out.

f) Pre-moulded expansion joint filler shall not be placed in position until immediately prior to the placing of the abutting material. If the two adjacent surfaces of the joint are to be placed at different times, this type of joint filler shall not be placed until the second face is about to be placed.

g) Sealants shall be installed in accordance with the manufacturer's recommendations and all appropriate requirements for joint face pining.

h) Sealants shall be finished approximately 3 mm below the upper surfaces of the joint

i) Joint materials spilt or splashed onto finished surfaces of the bridge during joint filling operations shall be removed and the surfaces made good to the Engineer's approval. No joint shall be sealed until inspected by the Engineer and approval is given to proceed with the work.

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

#### 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  $\pm 5$  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 prefabricated 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  $\pm 20$  mm, and centered equally about intended lines of the joint within a tolerance of  $\pm 25$  mm. They shall be aligned parallel to the finished surface of the slab and to the centre line of the carriageway and to each other within tolerances given hereunder, the compliance

of which shall be checked as per Clause 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  $\pm 3$  mm per 300 mm length of bar

(b) 2/3rd of the bars shall be within  $\pm 2$  mm per 300 mm length of bar

(c) No bar shall differ in alignment from an adjoining bar by more than 3mm per 300 mm length of bar in either the horizontal or vertical plane

(d) Cradles supporting dowel bar shall not extend across the line of joint i.e. no steel bar of the cradle assembly shall be continuous across the joint.

(ii) For all bars inserted after laying of the slab:

(a) Twice the tolerance for alignment as indicated in

(i) above 602.6.5.3. Dowel bars, supported on cradles in assemblies, when subject to a load of 110 N applied at either end and in either the vertical or horizontal direction (upwards and downwards and both directions horizontally) shall conform to be within the following limits:

(i) Two-thirds of the number of bars of any assembly tested shall not deflect more than 2 mm per 300 mm length of bar

(ii) The remainder of the bars in that assembly shall not deflect more than 3 mm per 300 mm length of bar.

602.6.5.4. The assembly of dowel bars and supporting cradles, including the joint filler board in the case of expansion joints, shall 'have the following degree of rigidity when fixed in position:- 130

(i) For expansion joints, the deflection of the top edge of the filler board shall be not greater than 13 mm, when a load of 1.3 kN is applied perpendicular to the vertical face of the joint filler board and distributed over a length of 600 mm by means of a bar or timber packing, at mid depth and midway between individual fixings, or 300 mm from either end of any length of filler board, if a continuous fixing is used. The residual deflection after removal of the load shall be not more than 3 mm.

(ii) The joint assembly fixings to sub-base shall not fail under the 1.3kN 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 3 mm with any form of fixing, under the test load. The displacement shall be measured at the nearest pan 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 50 mm for expansion joints. The sheath shall be tough, durable and of an average thickness not greater than 1.25 mm. 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 150 x 150 x 600 mm, made of the same mix proportions to be used in the pavement, but with a maximum nominal aggregate size of 20 mm 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 0.25 mm. 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 deformed steel bars of strength 415 MPa complying with IS: 1786 and in accordance with the requirements given below. The bars shall be free from oil, dirt, loose rust and scale.

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 plastic concrete from above by vibration using a method which ensures correct placement of the bars and re-compaction 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  $\pm 50$ 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° C. To bring down the temperature, if necessary, chilled water or ice flakes should be made use of.

No concreting shall be done when the concrete temperature is below 5 degree Centigrade and the temperature is descending. 602.8. Side Forms, Rails and Guide wires

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 3 m length so as to prevent movement in any direction. Forms and rails shall be straight within a tolerance of 3 mm in 3 m and when in place shall not settle in excess of 1.5 mm in 3 m 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  $\pm 10$  mm and  $\pm 3$  mm respectively. The bedding shall not extend under the slab and there shall be no vertical step between adjacent forms of more than 3 mm. The forms shall be got inspected from the Engineer for his approval before 12 hours on the day before the construction of the slab and shall not be removed until least 12 hours afterwards. 602.8.2. At all times sufficient forms shall be used and set to the required alignment for at least 200 m length of pavement immediately in advance of the paving operations, or 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  $\pm 3$ 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  $\pm 10$  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 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 winch 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 at least 300 m 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 mix 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. Using Weight Batching Concrete Mixer:

(1) General- The batching plant shall include minimum four bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. If cement is used in bulk, a separate scale for cement shall be included. The weighing hoppers shall be properly sealed and vented to preclude dust during operation. Approved safety devices shall be provided and maintained for the protection of all personnel engaged in plant operation, inspection and testing. The batch plant shall be equipped with 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 lever when the drum has been charged and release it at the end of the mixing period. The device shall be equipped with a bell or other suitable warning device adjusted to give a clearly audible signal each time the lock is released. In case of failure of the timing device, the mixer may be used for the balance of the day while it is being repaired, provided that each batch is mixed 90 seconds or as per the manufacturer's recommendation. The mixer shall be equipped with a suitable non-resettable batch counter which shall correctly indicate the number of batches mixed. The mixers shall be cleaned at suitable intervals. The pickup and throw-over blades in the drum or drums shall be repaired or replaced when they are worn down 20 mm or more. The Contractor shall (1) have available at the job site a copy of the manufacturer's design, showing dimensions and arrangements of blades in reference to original height and depth, or (2) provide permanent marks on blade to show points of 20 mm wear from new conditions. Drilled holes of 5 mm diameter near each end and at 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 from paver with independent units designed to (i) spread.(ii) consolidate, screed and float-finish, (iii) texture and cure the freshly placed concrete in one complete pass of the machine in such a manner that a minimum of hand finishing will be necessary and so as to provide a dense and homogeneous

pavement in conformity with the plans and Specifications. The paver shall be equipped with electronic controls to control/sensor line and grade from either or both sides of the machine. Vibrators shall operate at a frequency of 8300 to 9600 impulses per minute under load at a maximum spacing of 60 cm. The variable vibration setting shall be provided in the machine.

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

#### 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 25°C and 90 minutes when the concrete temperature is between 25°C to 30°C. Truck/tipper 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 paying the carriageway as shown in the 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 s 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 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 602.9.8 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 chainage at every 100 m interval.

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

602.9.4.9. If the requirement of Clause 902.4. for surface regularity 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 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 subbase. The spreader shall be operated to strike off concrete upto a level requiring a small amount of cutting down by the distributor of the spreader. The distributor of spreader shall strike off the concrete to the surcharge adequate to ensure that the vibratory compactor thoroughly compacts the layer. If necessary, poker vibrators shall be used adjacent to the side forms and edges of the previously constructed slab. The vibratory compactor shall be set to strike off the surface slightly high so that it is cut down to the required level by the oscillating beam. The machine shall be capable of being rapidly adjusted for changes in average and differential surcharge necessitated by changes in slab thickness or cross fall. The final finisher shall be able to finish the surface to the required level and smoothness as specified, care being taken to avoid bringing up of excessive mortar to the surface by overworking.

#### 602.9.6. Construction by slip form paver

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 forms with either a conforming plate or by vibrating and oscillating finishing beams. The concrete shall be deposited without segregation in front of slip form paver across the whole width and to a height which at all times is in excess of the required surcharge. The deposited concrete shall be struck off to the necessary average and differential surcharge by means of the strike off plate or a screw auger device extending across the whole width of the slab. The equipment for striking-off the concrete shall be capable of being rapidly adjusted for changes of the average and differential surcharge necessitated by change in slab thickness or crossfall.

602.9.6.2. The level of the conforming plate and finishing beams shall be controlled automatically from the guide wires 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 paving machines shall have vibrators of variable output, with a maximum energy output of not less than 2.5 KW per metre width of slab per 300 mm depth of slab for a laying speed upto 1.5 m per minute or pro-rata for higher speeds. The machines shall be of sufficient mass to provide adequate reaction during spreading and paving operations on the traction units to maintain forward movements during the placing of concrete in all situations.

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 levels.

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 earned cut 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 carriageway.

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 450 mm wide but longer brushes are preferred. The brush shall be made of 32 gauge tape wires grouped together in tufts spaced at 10 mm centres. The tufts shall contain an average of 14 wires and initially be 100 mm long. The brush shall have two rows of tufts. The rows shall be 20 mm apart and the tufts in one row shall be opposite the centre of the gap between tufts in the other row. The brush shall be replaced when the shortest tuft wears down to 90 mm 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 2 m apart anywhere along a diagonal line across a lane width between points 50 m apart along the pavement. No measurement shall be taken within 300 mm of the longitudinal edges of a concrete slab constructed in one pass.

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 1.25 mm. TABLE : 600-2. Texture Depth Number of Required Time of Test Measurements Texture Depth (m) Specified Value Tolerance 1. Between 24 hours and 7 days after the constn., of the slab or until the slab is first used by vehicles. An average of 5 measurements  $1.00 \pm 0.25$  2. Not later than 6 weeks before the road is opened to public traffic. An average of 5 measurements  $1.00 + 0.25 - 0.35$

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 retexturing the hardened concrete surface in an approved 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 Engineer. The mechanical sprayer shall incorporate an efficient mechanical device for continuous agitation and mixing of the compound during spraying.

602.9.9.3. In addition to spraying of curing compound, the fresh concrete surface shall be protected for at least 3 hours by covering the finished concrete pavement with tents as described in Clause 602.7.2, during adverse weather conditions as directed by the Engineer. After three hours, the pavement shall be covered by moist hessian and the same shall then be kept damp for a minimum period of 14 days after which time the hessian may be removed. The hessian shall be kept continuously moist. All damaged/torn hessian shall be removed and replaced by new hessian on a regular basis.

602.9.9.4. The Contractor shall be liable at his expense to replace any concrete damaged as a result of incomplete curing or cracked on a joint 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 carriageway but with at least a subbase 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 60 m but not more than 300 m long for mechanised construction and at least 30 m long for hand guided methods. If the first trial is unsatisfactory, the Contractor shall have to demonstrate his capability to satisfactorily construct the pavement in subsequent trials.

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 30 m constructed each day for mechanised construction and minimum of 15 m on each day for hand guided construction. The trial length shall be constructed at a similar rate (speed, around 1m/hr) to that which is proposed for the main work.

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 joints.

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 prorata based on values for a 300 m length.

602.10.5.2. Joints

(iii) Alignment of dowel bars shall be inspected as described in Clause 602.10.7 in any two consecutive transverse joints. If the position or alignment of the dowel bars at one of these joints does not comply with Clause 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 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 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 any deficiencies in any trial length within 10 days after the completion of that trial length, the Contractor may assume that the trial length, and the materials, plant, equipment and construction methods adopted are acceptable.

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 of 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 the pavement section at the end of day's work by extending slab length 2m. After sawing the transverse joint groove, the extended 2 m slab shall be removed carefully soon after concrete has set to expose 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 cement in the slab is unsatisfactory then the next two joints shall be respected. 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 more successive joints, the Contractor shall revert to the construction fresh trial lengths and make any necessary alteration to concrete mix, paving plant or methods until the dowel bar position and alignment satisfactory.

602.10.7.4. After the dowel bars have been examined, the remainder the concrete shall be removed over a width of 500 mm on each side the line of the joint and reinstated to the satisfaction of the Engineer, the dowels shall be inserted on both sides of the 1 m wide slab by drilling holes and grouting with epoxy mortar. Plastic sheath as per Clause 602.5.5. shall be provided on dowels on one of the joints. The joint above shall be widened and sealed 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 provide the minimum width specified in the drawings when saw cut joints are adopted. They shall be widened subsequently by sawing before sealing, depth/width gauges shall be used to control the dimension of the groove.

602.11.2.2. If rough arises develop when grooves are made, they shall be ground to provide a chamfer approximately 5 mm wide. If the groove at an angle upto 10 degree from the perpendicular to the surface, the overhanging edge of the sealing groove shall be sawn or ground perpendicular. If spalling occurs or the angle of the former is greater than 10 degrees, the joint sealing groove shall be sawn wider and perpendicular to the surface to encompass the defects upto a maximum width, including any chamfer, of 35 mm for transverse joints and 20 mm for longitudinal joints. If the spalling cannot be so eliminated then the arrases 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 Lime 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 that the sealant may not leak through the cracks. The width of debonding strip shall be more than the joint groove width so that it is held tightly in the groove. In the case of longitudinal joints, heat resistant tapes may be inserted to block the leakage through bottom of the joint.

### 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 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 (MAP) 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 consultation with the Engineer, shall establish the right temperature and time for applying the sealant. Thermometer shall be hung on a pole in the site for facilitating control during the sealing operation.

602.11.3.5. Sealant shall be applied, slightly to a lower level than the slab with a tolerance of  $5 \pm 2$  mm.

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 scaling process.

602.11.4. Testing of applied sealants: Manufacturer's certificate shall be produced by the Contractor for establishing that the sealant is not more than six months old and stating that the sealant complies with the relevant standard as in Clause 602.2.8. The samples shall meet the requirement of AASHTO M 282 for hot applied sealant or BS 5212: (Pan 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 64 mm 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 panicle shape passing a 300 micron IS sieve and retained on a 150 micron IS sieve.

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 angles and parallel to the carriageway. The cylindrical container shall be filled with the sand, tapping the base 3 times on the surface to ensure compaction, and striking off the sand level with the top of the cylinder. The sand shall be poured into a heap on the surface to be treated. The sand shall be spread over the surface, working the disc with its face kept flat in a circular motion so that the sand is spread into a circular patch with the surface depressions filled with sand to the level of peaks.

602.12.3. The diameter of the patch shall be measured to the nearest 5 mm. The texture depth of concrete surface shall be calculated from  $31000/(D \times D)$  mm where D is the diameter of the patch in mm. 2.0 Poker Vibration: As a first step, concrete is vibrated with an immersion vibrator in order to remove entrapped air & voids & make the concrete homogeneous. Ensure that the area close to channels & step ends are carefully vibrated. Do not distribute the concrete with poker vibrator as it would create a risk of over vibration & segregation. It is recommended poker vibration along with surface vibration.

3.0 Surface Vibration: Surface vibration should always start as soon as there is enough concrete in front of surface vibrator. Two passes with the surface vibrator are required. During the first pass, concrete must be distributed evenly in front of surface vibrator. There should always be a roll of concrete of about 10mm to 20 mm in front of leading beam along the entire length of the vibrator. When the concrete has been placed and vibrated to a length of about 5.0 metre, the second pass carried out. The machine shall be pulled at a speed of maximum 1.00 metre per minute and without interruption to avoid linings on the surface. Keep the surface of the channel clean from concrete. 4.0 Vacuum Processing: Place the filter pads as soon as the sufficient concrete surface is vibrated. Please note that the vacuum dewatering process must start within 30 minutes from the time of starting concrete pouring. Filter pads are placed in such a way that there is at least 100 mm fresh concrete visible around the filter pads on all four sides. Filter should be overlapped with each other by at least 250 mm. (all filter pads are marked with black line to ensure proper over lapping.) The recesses or other obstacles within the area to be vacuum processed must be covered & sealed using polythene sheet before the filter pads are placed. If the obstacles are flush with the surface level or above, filter pad must be folded. The rolled up top cover is placed centrally on the filter pads. It is rolled out in such a way that it covers all the filter pads & exposed concrete on the sides of the filter pads. The exposed concrete will ensure perfect sealing of the top cover from the top. Connect central pipe at the top cover in the suction hose, which in turn is connected to the vacuum pump. When the pump is started, vacuum will be created between the top cover & filter pads. Excess water from the concrete will be taken in to the vacuum pump tank & discharged. Normal suction cycle is 1 minute to 10 minute per 10 mm of concrete thickness. Guidelines for selecting dewatering time at normal condition are shown in the following table. Thickness mm inch Dewatering time (minute) Dewatering time largely depends upon ambient conditions viz. temperature, humidity etc. During the course of dewatering, the concrete surface gradually hardens & can be felt the top of the top cover. The extent of hardness achieved by the concrete decides when to stop dewatering process. When the vacuum processing is over, the top cover is rolled up to 100 mm so that the sides of the filter pads are visible. This will remove the water that may have remained on the concrete surface, filter pads & in the suction hose. After about 30 seconds, the top cover is rolled completely & vacuum pump is switched off. Simultaneously, the suction the suction hose & the top cover pipe are disconnected. Do not turn the pump while the ball valve is open as likely that small aggregates sucked into the pump due to vacuum. The entire process is repeated on the next concrete panel. After first patch in any given panel is dewatered, care should taken while placing filter pad on the concrete surface next to the dewatered concrete. First filter pad should start from the edges of last filter pad of the previously dewatered concrete. The remaining filter pads then can be placed as explained above. While repeating dewatering process subsequently, in order that top cover should get proper sealing against the side already vacuum processed, it should be rolled out at least 300 mm over the vacuum dewatered area.

Before spreading the top cover on the dewatered area, it is essential to give one pass of skin floater (with disc) along the edges of the dewatered concrete. The concrete surface will become wet as same will come on the top surface. This will provide the necessary sealing. Subsequently roll out top cover completely. Ensure that there are no wrinkles on the top cover.

**5.0 Floating:** The first finishing operation is floating where floating disc is used. Only the areas that cannot be reached by skim floater are floated by hand. Care should be taken while floating near channels & from edges. The skim floater is run over the channel up to the disc center in order to avoid unevenness at the joints. All four sides of dewatered panel must be floated first & the remaining central area is to be floated later. Any corrections, if required, are to be made at this stage with the concrete compound at the time of racking of top cover use any cement paste, mixture of cement & sand or fresh concrete for patch work. Such material will peel off or will leave black patches after the concrete floor is brought to use. Normally two passes with disc the skim floater operating at higher speed are sufficient for the skid free surface. This pass of skim floater should be given perpendicular to the previous pass. The floating operation brings up certain amount of water to the surface; this moisture helps in carrying out finishing operations. Intermixing of topping first pass can be started when topping has darkened because of the moisture from the under lying concrete. The topping materials are worked out with care into concrete surface with a skim floater equipped with a disc. The surface flatness shall be checked with straight edges and work the topping material into concrete surface the first time.

**6.0 Trowelling:** Trowelling is carried out with the same machine running on trowelling blades. Normally, two pass of Trowelling blades are required for smooth surface finish. However, the number of passes can be decided depending upon the surface finish required. The first Trowelling operation can start after about 30 minutes after the final floating operation & surface is sufficiently dry. This pass is to be made using low speed & minimum blade angle. Also use the lower speed when trowelling near the channels, from edges, obstacles etc. Blade angle & the speed can be increased for the subsequent passes to achieve surface finish. The first trowelling is carried out as normal power-trowelling. At the time of final power trowelling, surplus concrete must be scraped off from the rails and stop ends. There must not be any damage the rails when the floor is finished.

**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 Measurements for Payment**

**602.15.1. Cement Concrete pavement** shall be measured as a finished work in cubic metres with specified thickness. The volume to be paid for will be calculated on the basis of thickness and plans shown on 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 of oncrete placed, based on the net plan areas for the specified thickness hown on the Drawings or directed by the Engineer. The rate shall include ll provisions of this Specification and shall include the vision of all aterials including polythene film, concrete, stock piling, transport, placing, ompacting, finishing, curing together with all formwork, and including esting and submission

of test certificates and No deduction shall be made in easurement for openings provided that the area of each is less than 0.5 q. m. The unit rate as entered in the Bill of Quantities shall also include he 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 subbase taken on a grid of 4.5 m x 3.375 m or 6.25 m x 3.5 m, 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 10 mm shall be considered as the specified thickness plus 10 mm. Individual areas deficient by more than 25 mm shall be verified by the Engineer by ordering core cutting and if in his opinion the deficient areas warrant removal, they shall be removed and replaced with concrete of the thickness shown on the plans. When the average thickness for the lot is deficient by the extent shown in Table 600-3, the Contract unit price will be 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	Up to 5 mm
100		
6-10 mm	87	
11 - 15 mm	81	
16 - 20 mm	75	
21 - 25 mm	70	

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

#### 602.16. Rate

The Contract unit rate for the construction of the cement concrete road with all type of joints 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.

Rate shall be for a unit of one cubic metre.

**The payment shall be made for a unit of one cubic metre.**

#### **Item No.07**

**Providing and fixing precast cement concrete kerbs of M20 grade and sectional dimensions 300 mm x 600mm (300mm being width and 600 mm height) using table vibrated precast concrete units of approved size having one top edge chamfered or rounded as per approved design including setting in position with cement mortar 1:3 (1 cement, 3 coarse sand) 50 mm thick bedding with necessary excavation, filling the joints with cement mortar 1:2 (1 cement, 2 fine sand), cost of moulds, finishing curing etc. complete.**

#### **General:**

Providing and fixing precast cement concrete kerbs of M20 grade and sectional dimensions 300 mm x 600mm (300mm being width and 600 mm height) using table vibrated precast concrete units of approved size having one top edge chamfered or rounded as per approved design including setting in position with cement mortar 1:3 (1 cement, 3 coarse sand) 50 mm thick

bedding with necessary excavation, filling the joints with cement mortar 1:2 (1 cement, 2 fine sand)

**MATERIALS:**

(I) Cement:

The cement to be used in the work shall conform M-3

(II) Sand: The sand to be used in the work shall conform M-6.

(III) Coarse aggregate: The stone aggregate shall be prepared from black trap stone and well graded up to 10mm size and fulfills the requirements laid down in M-12.

(IV) Water: The water to be used in the work shall conform M-1.

**(V) Precast kerb Characteristic:** The concrete Precast kerb should have perpendicularities after release from the mould and the same should be retained until the laying. The Precast kerb should be able to possess 2MPa bending strength at 28 days before lying. The sectional dimensions 300 mm x 600mm of the Precast kerb shall require to be approved by EIC before commencing the work. Using above all materials the Precast kerb are required to be manufactured in weigh-batching plant using hydraulic compaction method with automatic machines for better uniformity in quality and strength brought from the reputed and authorized manufacturer.

The manufacturing company must be an ISO 9001:2000 certified Company or should have equivalent quality management systems in place to ensure quality product. The blocks must be cured in controlled environment to ensure efflorescence free material. The manufacture must have in house testing laboratory to carry out all testing including Compressive strength testing, Water absorption, abrasion resistance etc. The concrete kerbs should have perpendicularities after release from the mould and the same should be retained until the laying. Compaction of molds should be done by mechanical vibrators. The vibrator should vibrate in both horizontal & vertical directions simultaneously. Mold should be retained minimum 1&1/2 minutes on table type vibrator's platform.

Length of individual kerb unit shall be as per approved drawing/design.

Tolerance on dimensions shall not exceed  $\pm 5$  mm.

**(VI) Placement :**

Excavation shall be carried out to the required width, depth and alignment.

**Bedding**

A 50 mm thick cement mortar bedding of proportion 1:3 (1 cement : 3 coarse sand) shall be laid over the prepared foundation.

Bedding shall be properly leveled and compacted before placing kerbs.

Kerb units shall be placed carefully on the mortar bedding.

Proper line, level, grade and verticality shall be maintained throughout.

The top surface and face of kerbs shall form a smooth and continuous line without abrupt variation.

Curved portions shall be constructed using specially cast units where required.

**Jointing**

Joints between adjacent kerb units shall be kept uniform, generally not exceeding 10 mm.

Joints shall be completely filled with cement mortar 1:2 (1 cement : 2 fine sand).

Excess mortar shall be neatly removed and joints finished flush.

**Mode of Measurement and Payment:**

The item consist for this work shall be for providing & fixing precast cement concrete kerbs of particular shape and size, transporting to site with loading and unloading, laying with C.M. including all machineries, tools, plants, labours etc. complete.

The rate shall be paid for a unit of running meter (RM) .

### **Item No. :- 8**

**Providing and fixing precast cement concrete Drain of M20 grade and sectional dimensions 600 mm x 300 mm using table vibrated precast concrete units of approved size and approved design including setting in position with cement mortar 1:3 (1 cement, 3 coarse sand) 50 mm thick bedding with necessary excavation, filling the joints with cement mortar 1:2 (1 cement, 2 fine sand), cost of moulds, finishing curing etc. complete.**

Specification for this item in general shall be same as that of item No. 7 of this tender except that under this item is to be carried for **precast cement concrete Drain**.

The rate shall be paid for a unit of running meter (RM) . The rate shall be inclusive of all the works as per above specifications and as directed by Engineer-In-Charge

### **Item No. :- 9**

**Providing and Laying IS class NP3, RCC non pressure pipes (medium duty pipes suitable for carrying heavy traffic) with collars in single row jointed with stiff mixture of cement mortar in proportion 1:2 (1 cement : 2 fine sand) including testing of joints etc. complete (excavation, bedding, refilling etc. to be paid separately).**

**(iv) 600 mm dia**

**1. Material:** Pipes shall conform to IS: 458 specifications for NP3 class.

#### **2. Workmanship:**

- i. All pipes shall be handled, lowered, and laid with due care to avoid cracks, chips, or other damage.
- ii. Pipes shall be laid true to line and level, with collars properly aligned to ensure uniformity and watertight joints.
- iii. Mortar for jointing shall be freshly prepared in the specified proportion (1:2 cement: fine sand) and applied uniformly to achieve a dense, stiff mix.
- iv. Joints shall be finished smooth and cured adequately to prevent shrinkage cracks.
- v. Testing of joints shall be carried out after laying, ensuring no leakage under specified test pressure.
- vi. Any defective pipe or joint shall be replaced or rectified at the contractor's expense.
- vii. Work shall conform to IS: 458 and relevant MoRTH/IRC specifications, ensuring durability and suitability for heavy traffic loads.
- viii. The contractor shall maintain proper alignment, gradient, and continuity of the pipeline throughout the length.
- ix. Site cleanliness and safety shall be maintained during execution, with surplus mortar and debris removed promptly.

#### **3. Measurement**

- i. Measured in running meters (RM) of finished pipe length laid, jointed, and tested, excluding collars.
- ii. Length measured along the centerline of the pipe.

#### **4. Mode of Payment**

- i. Rate includes cost of pipes, collars, jointing materials, handling, laying, alignment, testing, and workmanship.
- ii. Excludes excavation, bedding, and refilling (covered in relevant item specifications)

The rate shall be paid for a unit of running meter (RM) . The rate shall be inclusive of all the works as per above specifications and as directed by Engineer-In-Charge

### **Item No.10**

**Providing and laying Separation membrane of impermeable plastic sheeting 125 micron thick laid flat without creases including cleaning the sub base using air compressor etc. complete.**

#### **Material Requirements**

- The separation membrane shall consist of impermeable polyethylene (PE) or approved plastic sheeting.
- Thickness shall be **125 microns (0.125 mm)** minimum.
- The sheeting shall be free from holes, tears, punctures, wrinkles and manufacturing defects.
- Material shall be supplied in rolls of approved dimensions and quality.

#### **Method of Execution**

##### **1. Surface Preparation**

- The sub-base shall be finished to the required line, level and grade.
- The entire surface shall be thoroughly cleaned of dust, loose particles, mud and foreign matter using an air compressor or other approved cleaning equipment.
- Any sharp projections or irregularities likely to damage the membrane shall be removed.

##### **2. Laying of Plastic Sheetting**

- Plastic sheeting shall be spread uniformly over the prepared surface.
- The membrane shall be laid flat without creases, wrinkles or folds.
- Adjacent sheets shall be overlapped by not less than **300 mm** or as specified in the drawings.
- Overlaps shall be arranged to prevent displacement during concreting or subsequent construction activities.
- Care shall be taken to avoid punctures, tears or displacement during laying.

##### **3. Protection and Repair**

- Damaged portions of the membrane shall be replaced or repaired by providing additional sheeting with adequate overlap.
- Construction traffic directly on the membrane shall be minimized to prevent damage.

#### **Mode of measurement and Payment**

- Measurement shall be made in **Square Metres (m<sup>2</sup>)** of separation membrane laid and accepted.
- No separate measurement shall be made for overlaps, wastage, cutting, repairs or fixing.

### **Item No.11**

**"Providing and Laying design mix concrete M25 using minimum cement 365 kg/cum, crushed stone aggregates 20 mm nominal maximum size and finishing smooth with curing etc. complete including cost of form work but excluding the cost of reinforcement for reinforced concrete work in..**

**(A) Beams and lintels**

**( III ) Having cross sectional area 0.05 to 0.08 sqm"**

#### **1.0. Materials**

1.1. Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Grit shall conform to M-8 Coarse aggregate shall conform M-12

#### **2.0. General**

2.1. The proportioning of cement and aggregates shall be done by weight and necessary precautions shall be taken in the production to ensure that the required work cube strength is attained and maintained. The controlled concrete shall be in grades of M-200, with prefix controlled added to it. The letter M refers to mix and the numbers specify 28 days works cube compressive strength of 150 mm. cubes of the mix expressed in Kg/cm<sup>3</sup>

2.2. The proportion of cement, sand and coarse aggregate shall be determined of weight. The weight batch machine shall be used for maintaining proper control over the proportion of aggregates as per mix design. The strength requirements of different grades of concrete shall be as under:

<b>Grade Concrete</b>	<b>Compressive strength of 15 cms. cubes in Kg. /Cmt. at 28 days, conducted in accordance with I.S. 516-1959.Preliminary test Min.</b>	<b>Work test Min.</b>
<b>M-25</b>	<b>320</b>	<b>250</b>

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

#### **3.0. Workmanship**

3.1. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work question and can be properly compacted with means available except where it can be shown to the satisfaction of the Engineer-in-charge, that supply of properly graded aggregate of uniform quality can be maintained till the completion of work, grading of aggregate shall be controlled by obtaining the coarse aggregates in different sizes and bending them in the right proportions as required. Aggregates of different sizes shall be stocked in separate stock piles. The required quantity of material shall be stock piled several hours, preferably a day before use. The grading of coarse and fine aggregate shall be checked as frequently as possible, the frequency for a given job being determined by Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests.

3.2. In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement is determined by accepting the maker's weight per bag, a

reasonable number of bags shall be weighted separately to check the net weight. Where cement is weighted from bulk stocks at site and not by bags, it shall be weighed separately from the aggregate. Water, shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in clean, and serviceable condition. Their accuracy shall be periodically checked.

3.3. It is most important to keep the specified water cement ratio constant and at its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined by the Engineer-in-charge according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture content. For the determination of moisture content in the aggregates, I.S. 2386 (Part-III) shall be referred to. Suitable adjustments shall also be made in the weights of aggregates due to variation in their moisture content. Minimum quantity of cement to be used in controlled concrete shall not be less than 280 kg. /M-3 in plain concrete and not less than 365 kg/M-3 in reinforced concrete.

### **3.4 form work:**

#### **3.4.1 Materials**

The shuttering to be provided shall be of ordinary timber plank and shall conform to M-26.

The dimensions of scantlings and battens shall conform to the design. The strength of the wood shall not be less than that assumed in the design.

#### **3.4.2 Workmanship**

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

#### **3.4.3 Clearing and Treatment of forms:**

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

#### **3.4.4 Stripping time:**

In normal circumstances and where ordinary cement is used forms may be struck after expiry of following periods.

- (a) Sides of walls columns and vertical faces of beams.....24 to 48 hours.
- (b) Beam soffits, (props, left under) .....7 days.
- (c) Removal of props slabs:
  - (i) Slabs spanning up to 4.5. m.....7 days.
  - (ii) Spanning over 4.5 m.....14 days.
- (d) Removal of props from beams and Arches:
  - (i) Spanning up to 6m.....14 days.
  - (ii) Spanning over 6 m.....21 days.

#### **3.4.5 Procedure when removing the form work:**

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

#### **3.4.6 Centering:**

The centering to be provided shall be got approved. It shall be sufficiently strong to ensure absolute safety of the form work and concrete work before, during and after pouring concrete. Watch

should be kept to see that behavior or centering and form work is satisfactory during concreting. Erection should also be such that it would allow removal of forms in proper sequence without damaging either the concrete or the forms to be removed.

The props of centering shall be provided on firm foundation or base of sufficient strength to carry the loads without any settlement.

The centering and form work shall be inspected and approved by the Engineer-in-charge before concreting. But this will not relieve the contractor of his responsibility for strength, adequacy and safety of form work and centering. If there is a failure of form work or centering, contractor shall be responsible for the damages to property.

#### **3.4.7 Scaffolding:**

All scaffolding, hoisting arrangements and ladders etc., required for the facilitating of concreting shall be provided and removed on completion of work by contractor at his own expense. The scaffolding, hoisting arrangements and ladders etc. shall be strong enough to withstand all live, dead and impact loads expected to act and shall be subject to the approval of the Engineer-in-charge. However, contractor shall be solely responsible for the safety of the scaffolding, hoisting arrangement, ladders, work and workman etc.

The scaffolding, hoisting arrangements and ladder shall allow easy approach to the work spot and afford easy inspection.

The rate is applicable to all condition of working and height up to 4 mts. The rate shall include the cost of materials and labour for various operations involved such as:

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

#### **3.4.8 Re-Use:**

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

#### **4.0 Mode of measurement & payment**

4.1. The consolidated cubical contents of controlled concrete R.C.C. work as specified in item shall be measured. No deduction shall be made for (a) Ends of dissimilar materials such as joints, beams, posts, girders, girders, purling trusses, corbels and steps etc., up to 500 Sq.Cm. in section.

4.2. The rate includes cost of all materials labour, tools and plant required for mixing, placing in position, vibrating and compacting, finishing, as directed, curing and all other incidental expenses for producing concrete of specified strength. The rate includes the cost of form work.

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

The final measurement shall be done and paid in **cum** of work completed, shall be inclusive of all the works as per specification as directed by Engineer-In-Charge (EIC)

#### **Item no -12 and 13**

**Providing and laying dry stone pitching on slopes using stones weighing not less than 40 kg. and stone spalls minimum 25 mm size to fill up voids between the stones, including preparing**

the surface etc. as per drawing and clause no. 2504 of MORT & H specification etc. complete (Filter layer below the stone pitching if any to be paid for separately).

Supplying, stacking and Spreading including filling the interstices to required camber and gradient of hard rubble stone for Gravel filter including conveyance etc.

### 2504.1 Description

The work shall consist of covering the river side slopes of guide bunds, training works and road embankments with stone, boulders, cement concrete blocks or stones in wire crates over a layer of granular material which will act as a filter. The rear slopes, not subjected to direct attack of the river, may be protected by 300 mm - 600 mm thick cover of clayey or silty earth and turfing.

### 2504.2 Pitching and Filter Medium

#### 2504.2.1 Pitching

The pitching shall be provided with stones of thickness and shape as indicated on the drawings. The stones shall be obtained from quarries and shall be sound, hard, durable and fairly regular in shape. Round boulders shall not be allowed. Stones showing marked deterioration by water or weather shall not be accepted. The size and weight of stone shall conform to Clause 5.3.5.1 of IRC: 89. No stone, shall weigh less than 40 kg. The size of spalls shall be a minimum of 25 mm and shall be suitable to fill the voids in the pitching.

2504.2.2 Filter Medium The material for the filter shall consist of coarse sand, gravel or stone. One or more layers of graded materials, to act as a filter medium, shall be provided underneath the pitching, to prevent loss of the embankment material and build up of uplift head on the pitching.

The gradation of the filter material shall satisfy the following requirements:

D 15 (Filter)

————— < 5

D 85 (Base)

D 15 (Filter)

4 < ————— < 20

D 15 (Base)

D 50 (Filter)

————— < 25

D 50 (Base)

Notes :

- 1) Filter design may not be required if embankment consists of CH or CL soils with liquid limit greater than 30, resistant to surface erosion. In this case, if a layer of material is used as bedding for pitching, it shall be well graded and its D 85 size shall be at least twice the maximum void size in pitching
- 2) In the foregoing, D 15 means the size of that sieve which allows 15 percent by weight of the filter material to pass through it and similar is the meaning of D 50 and D 85 (15 being replaced with 50 and 85 respectively).
- 3) If more than one filter layer is required, the same requirement as above shall be followed for each layer. The finer filter shall be considered as base material for selection of coarser filter.
- 4) The filter shall be compacted to a firm condition. The thickness of filter is generally of the order of 200 mm to 300 mm. Where filter is provided in two layers, thickness of each layer shall be 150 mm.

2504.3 Construction Operations Before laying the pitching, the side of banks shall be trimmed to the required slope and profiles by means of lines and pegs at intervals of 3 m. Depressions shall be filled and thoroughly compacted. The filter granular material shall be laid over the prepared base and compacted to the thickness specified on the drawings by means of suitable equipment.

The lowest course of pitching shall be started from the toe wall and built up in courses upwards. The toe wall shall be in dry rubble masonry (uncoursed) conforming to Clause 1405.3, of these Specifications in case of dry rubble pitching. It shall be in nominal mix cement concrete (M 15) conforming to Clause 1704.3, of these Specifications in case of cement concrete block pitching.

The stone pitching shall commence in a trench below the toe of the slope. Stone shall be placed by derrick or by hand to the required length, thickness and depth conforming to the drawings. Stones shall be set normal to the slope, and placed so that the largest dimension is perpendicular to the face of the slope, unless such dimension is greater than the specified thickness of pitching.

The largest stones shall be placed in the bottom courses and for use as headers for subsequent courses.

In hand placed pitching, the stone of flat stratified nature should be placed with the principal bedding plane normal to the slope. The pattern of laying shall be such that the joints are broken and voids are minimum by packing with spalls, wherever necessary, and the top surface is as smooth as possible.

When full depth of pitching can be formed with a single stone, the stones shall be laid breaking joints and all interstices between adjacent stones shall be filled in with spalls of the proper size wedged in with hammers to ensure tight packing.

When two or more layers of stones must be laid to obtain the design thickness of pitching, dry masonry shall be used and stones shall be well bonded. To ensure regular and orderly disposition of the full intended quantity of stone as shown, template cross walls in dry masonry shall be built about a metre wide and to the full height of the specified thickness at suitable intervals all along the length and width of the pitching. Within these walls the stones shall be hand packed as specified.

#### 2508 TESTS AND STANDARDS OF ACCEPTANCE

The materials shall be tested in accordance with these Specifications and shall meet the prescribed criteria. The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

#### 2509 MEASUREMENTS FOR PAYMENT

The filter and stone pitching shall be measured separately in cubic metres unless otherwise specified.

#### 2510 RATE

The contract unit rate for stone/cement concrete block pitching on slopes shall include the cost of preparing the bases, laying and compacting the filter and placing of stone pitching of dry rubble/cement concrete block revetment for embankment slopes to the specified thickness, lines, curves, slopes and levels and all labour and materials as well as tools and plant required for the work. The final measurement shall be done and paid in **cum** of work completed, shall be inclusive of all the works as per specification as directed by Engineer-In-Charge (EIC)

#### **Item no -14**

**Supplying and laying of thermally bonded 215 gsm non woven geotextile terram 2000 between specified layers as per technical specification including all taxes as directed by EIC.**

##### **General**

This work comprises supply of Non-woven Needle Punched Mechanically Bonded Polypropylene Geotextile conforming to the material specifications stated herein, as per the bill of quantity and schedule of supplies enclosed.

##### **Materials**

Non-woven Needle punched mechanically bonded Polypropylene Geotextile shall be made of polypropylene staple fibers. These engineered Geotextiles shall be stabilized to resist degradation due to ultraviolet exposure and shall be resistant to commonly encountered soil chemicals, mildew and insects, and shall be non-biodegradable.

Indigenously manufactured Non-woven Needle Punched Mechanically Bonded Polypropylene Geotextile should be preferred, considering advantages of shorter delivery periods, no inventory pile-up and rates being not affected by fluctuation of exchange rate of foreign currency.

A plant visit by the Engineer's representative to verify the manufacturer's quality control procedures and witness testing of products is also required prior to the dispatch of material.

##### **Transportation, storage and handling**

All rolls shall have a protective cover with a label or tag specifying name of the product, name of the manufacturer, roll number, date of manufacture and roll dimension. Material shall be protected from sunlight, mud, dirt, debris, any other harmful substances or mechanical damage during transportation.

Rolls shall be stored in a secured area sufficiently elevated above the ground and adequately covered to protect them from the following: site construction damage, precipitation, prolonged exposure to ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, high temperatures, and any other environmental conditions that may damage the physical property values of the Non-woven Needle Punched Mechanically Bonded Polypropylene Geotextile.

Any material, which is damaged during transportation, handling or storage and do not meet the minimum requirements of the specifications is liable for rejection by the Engineer.

##### **Quality control & testing**

The quality management system of the manufacturer shall conform to the requirements of ISO 9001:2008 and In-house Laboratory should have certificate of NABL Accreditation ISO/IEC 17025:2005. Manufacturer shall issue a test report stating minimum average roll values of material properties, at the time of shipment is made. CE-certification (BTTG certification) should be required for supply of material. Manufacturer shall submit the proof of supply and satisfactory performance for the quantity of 10000 Sqmt at least, for projects in India.

Contractor shall furnish proof of all above and it is mandatory.

##### **Physical and mechanical properties**

The Mechanical properties of Non-woven Needle Punched Mechanically Bonded Polypropylene

Geotextile shall conform to Table below

**PROPERTIES TEST METHOD UNIT M.A.R.V. (Minimum Average Roll Value)**

Property	Test Method	Units	Minimum Average Roll Value
<b>Weight (Typical)</b>	ASTM D5261	g/m <sup>2</sup>	160
<b>Grab Tensile</b>	ASTM D4632	kN	0.556
<b>Grab Elongation</b>	ASTM D4632	%	50
<b>Trapezoid Tear Strength</b>	ASTM D4533	kN	0.222
<b>CBR Puncture Resistance</b>	ASTM D6241	kN	1.512
<b>Permittivity*</b>	ASTM D4491	sec-1	1.6
<b>Water Flow*</b>	ASTM D4491	l/min/m <sup>2</sup>	4685
<b>A.O.S*</b>	ASTM D4751	mm	0.212
<b>UV Resistance</b>		%/hrs	70/500

### **Installation**

The site shall be prepared by clearing, grubbing, and excavation or filling the area to the design grade. This includes removal of topsoil and vegetation.

The Non-woven Needle Punched Mechanically Bonded Polypropylene Geotextile shall be laid smooth without wrinkles or folds on the prepared subgrade and or prepared surface if shown in the drawings with the machine direction oriented in the direction of traffic. Adjacent rolls shall be overlapped as shown on the drawings. Unless otherwise shown on the drawings or directed by the Engineer, the minimum overlap shall be 300 to 500 mm for subgrade of CBR greater than or equal to 3 and 600 to 1000 mm for CBR between 1 and 3.

All roll ends shall be overlapped by 1000 mm.

On curves, the Non-woven Needle Punched Mechanically Bonded Polypropylene Geotextile may be folded or cut to conform to the curves. The fold or overlap shall be in the direction of construction and held in place by pins.

Prior to placing sub grade or backfill material as per project requirements the installed Nonwoven Needle Punched Mechanically Bonded Polypropylene Geotextile shall be inspected and approved by the Engineer. Any damages shall be repaired by covering the damaged location with a Non-woven Needle Punched Mechanically Bonded Polypropylene Geotextile patch, which extends an amount equal to the required overlap beyond the damaged area, as directed by the Engineer.

The subgrade shall be placed by end dumping onto the Non-woven Needle Punched Mechanically Bonded Polypropylene Geotextile from the edge of the Non-woven Needle Punched Mechanically Bonded Polypropylene Geotextile.

Movement of construction equipment directly over the Non-woven Needle Punched Mechanically Bonded Polypropylene Geotextile shall not be permitted. Sudden breaking and sharp turning of construction equipment shall be avoided over the laid Non-woven Needle Punched Mechanically Bonded Polypropylene Geotextile. Any ruts occurring during construction shall be filled with additional subgrade material, and compacted to the specified density.

### **Method of Measurement**

Non-woven Needle Punched Mechanically Bonded Polypropylene Geotextile will be measured by the Square Meter of material received at the owner's / contractor's store.

## **Mode of Payment**

Payment for the supply of Non-woven Needle Punched Mechanically Bonded Polypropylene Geotextile shall be made at the contract unit price per Square Meter, which shall be full compensation for the cost of materials, transportation, duties and taxes. Geosynthetics, if used in pitching, shall conform to Section 700 of these Specifications.

## **Item no -15**

**Supplying, bending, hooking and binding thermomechanically treated (TMT) corrosion resistant Fe-500D grade bar reinforcement including placing in position etc. complete upto floor two level.**

### **1 MATERIALS:**

#### **1.0. GENERAL**

This work shall consist of furnishing and placing coated, T.M.T. or high strength deformed reinforcement, bars (intentioned) of the shape and dimensions shown on the drawings and conforming to these Specifications or as approved by the Engineer in charge. The T.M.T. FE-500D bar shall be TATA, JINDAL, JSW & see as per make list brand as directed by Engineer-in-charge.

#### **2.0. MATERIAL**

2.1. TMT Bars Reinforcements may be either TMT/medium tensile steel or high strength deformed bars.

2.2. TMT bars reinforcement for RCC work shall conform to IS 1786 FE-500D and shall be of tested quality. It shall also comply with relevant part of IS 456-1966

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

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

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

#### **3.0. Pitch**

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

#### **4.0. Binding wire**

4.1. Mild steel binding wire shall be of 1.63 mm or 1.22 mm (16 to 18 gauge diameter and shall conform IS 280-1972

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

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

#### **5.0. PROTECTION OF REINFORCEMENT**

5.1. Uncoated reinforcing steel shall be protected from rusting or chloride contamination. Reinforcements shall be free from rust, mortar, loose mill scale, grease, oil or paints. This may be

ensured either by using reinforcement fresh from the factory or thoroughly cleaning all reinforcement to remove rust using any suitable method such as sand blasting, mechanical wire brushing, etc. as directed by the Engineer. Reinforcements shall be stored on bricks, racks or platforms and above the ground in a clean and dry condition and shall be suitably marked to facilitate inspection and identification.

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

## **6.0. Workmanship**

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

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

## **7.0. BENDING OF REINFORCEMENT**

7.1. Bar bend g schedule shall be furnished by the Contractor and got approved by the Engineer before start of work.

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

7.3. Bars shall be bent cold to the specified shape and dimensions or directed by the Engineer using a proper bar bender operated by hand power to obtain the correct radius of bends and shape. Bars, shall not be bent or straightened in a manner that will damage parent material or the coating bars bent during transport or handling shall, be straightened before being used on work and shall not be heated to facilitate straightening.

## **8.0. PLACING OF REINFORCEMENT**

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

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

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

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

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

8.5. Layers of reinforcements shall be separated by spacer bars at approximately One meter intervals.

The minimum diameter of spacer bars shall be 12 mm or: equal to maximum size of main reinforcement or maximum size of coarse aggregate, whichever is greater. Horizontal reinforcement shall not be allowed to sag between supports.

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

8.7. Use of pebbles, broken stone, metal pipe, brick, mortar or wooden blocks etc as devices for positioning reinforcement shall not be permitted.

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

## **9.0. Lapping**

9.1. All reinforcement shall be furnished in full lengths as indicated on the drawing. No splicing of bars, except where shown on the drawing; will be permitted without approval of the Engineer. The lengths of the splice shall be as indicated on drawing or as approved by the Engineer. Where practicable, overlapping bars shall not touch each other, and shall be kept apart by 25mm or  $1:1.1/4$  times the maximum size of coarse aggregate, whichever is greater; if this is not feasible, overlapping bars shall be bound with annealed steel binding wire, not less than 1 mm diameter and twisted tight in such a manner as to maintain minimum clear cover to the reinforcement from the concrete surface. Lapped splices shall be staggered or located at points, along the span where stresses are low.

## **10.0 Welding**

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

10.2. While welding may be permitted for TMT. reinforcing bars conforming to IS: 432, welding of deformed bars conforming to IS: 1786 shall in general be prohibited. Welding may be permitted in case of bars of other than S 240 grade including special. Welding grade of S 500D grade bars conforming to IS: 1786, for which necessary chemical analysis has been secured and the carbon equivalent (CE) calculated from the chemical composition using the formula:  $CE = C + Mn + Cr + Mg + V + Ni + Cu$  6 5 15 are 0.4 or less.

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

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

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

10.6. All reinforcement bars shall be accurately placed in exact position shown on the drawings and shall be securely held in position during placing of concrete by annealed binding wire not less than 1 mm in size and by using say blocks or metal chairs spacers, metal hangers, supporting wires or other approved devices at sufficiently close intervals, Bars shall not be allowed to sag between supports not displaced during concreting or any other operations of the work All devices used for positioning shall be of not corrodible material wooden and metal supports shall not extended to the surface of the concrete, except where shown in drawings. Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacing shall not be allowed. Pieces of broken stone or brick and

wooden blocs shall not be used Layers of bars shall be separated by spacer bars pre-cast mortar blocks or other approved devices. Reinforcement after bending placed in position shall be maintained in a clean condition until completely embedded in concrete, Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed. To prevent reinforcement form corrosion, concrete cover shall be provided as indicated on drawings. All bars protruding from concrete and to which other bars are to be sliced and which are likely to be exposed for a period exceeding 10 days shall be protected by a thick coat of neat cement grout

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

10.7. As far possible bars of full length shall be used In case this is not possible, overlapping of bars shall be done as directed by the Engineer in charge When practicable overlapping bars shall not touch each other, but be kept apart by 25 mm Where no feasible overlapping bars shall be bound with annealed wires not less than 1 mm thick twisted tight The overlaps shall be staggered for different bars and located at points along the span where neither sheer not bending moments is maximum.

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

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

## 11.0 MODE OF MEASUREMENTS & PAYMENT

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

1.	6 mm.	0.22	Kg.	8.	20 mm	2.47	Kg.
2.	8 mm	/Rmt.		9.	22 mm	/Rmt.	
3.	10 mm	0.39	Kg.	10.	25 mm	2.98	Kg.
4.	12 mm	/Rmt.		11.	28 mm	/Rmt.	
5.	14 mm	0.62	Kg.	12.	32 mm	3.85	Kg.
6.	16 mm	/Rmt.		13.	36 mm	/Rmt.	
7.	18 mm	0.89	Kg.	14.	40 mm	4.83	Kg.
		/Rmt.				/Rmt.	
		1.21	Kg.			6.31	Kg.
		/Rmt.				/Rmt.	
		1.58	Kg.			7.99	Kg.
		/Rmt.				/Rmt.	
		2.00	Kg.			9.86	Kg.
		/Rmt.				/Rmt.	

11.1. Reinforcement shall be measured in length including overlaps, separately for different diameters as actually used in the work. Where welding or coupling is resorted to, in place lap joints, such joints shall be measured for payment as equivalent length of overlap as per design requirement. From the length so measured, the weight of reinforcement shall be calculated in Kg. on the same basis of as per table given above. Length shall include hooks at the ends. Wastage and annealed steel wire for binding shall not be measured and the cost of these items shall be deemed to be included in the rate for reinforcement.

11.2. The rate for reinforcement includes cost of steel binding wires, cutting, bending, placing in position, binding and fixing in position as shown on the drawings and as directed. It shall also include all devices for keeping reinforcement in approved position, cost of joining as per approved method and all wastage and spacer bars.

11.4. The contract rate shall be for a unit **of one kilogram** for completed item as directed. The payment will be made on one kilogram basis of the finished work.

The final measurement shall be done and paid in **Kilogram** of work completed, shall be inclusive of all the works as per specification as directed by Engineer-In-Charge (EIC)

### **Item no -16 and 17**

**Providing MS (Plain bar Fe-410) reinforcement for RCC work including bending, binding and placing in position complete upto floor two level. Dowel bars with PVC cap**

#### **Scope of work**

The item shall include providing and laying dowel bars and tie bars in the cement concrete pavement at the joints as per the design and drawing.

#### **Materials**

Dowel bars shall be Fe410 grade bars complying with IS:1786/85. The size and dimension of dowel bar shall be as per drawing.

#### **General**

The dowel bars shall be straight and free from oil, dirt, loose rust, scales, 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 bars shall be supported on cradles/dowel chairs in prefabricated joint assemblies positioned prior to the construction of the slab or mechanically inserted with vibration into the plastic concrete by method which ensures correct placement of the bars besides full re-compaction of the concrete around the dowel bars. Unless shown otherwise on the drawings, dowel bars shall be positioned at mid depth of slab within a tolerance of  $\pm 20$  mm, and centered equally about intended lines of the joint within a tolerance of  $\pm 25$  mm. Dowel bars shall be aligned parallel to the finished surface of the slab and to the center line of the carriageway and to each other within tolerance.

- (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 300 mm length of bar
  - (b) 2/3rd of the bars shall be within  $\pm 2$  mm per 300 mm length of bar
  - (c) No bar shall differ in alignment from an adjoining bar by more than  $\pm 3$  mm per 300 mm length of bar in either the horizontal or vertical plane.

- (d) Cradles supporting dowel bar shall not extend across the line of joint i.e. no steel bar of the cradle assembly shall be continuous across the joint.

(II) For bars inserted after laying of the slab

- (i) Twice the tolerance for alignment as indicated in (i) above

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

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

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

- (i) For expansion joints, the deflection of the top edge of the filler board shall be not greater than 13 mm, when a load of 1.3 KN is applied perpendicular to the vertical face of the joint filler board and distributed over a length of 600 mm by means of a bar or timber packing, at mid depth and midway between individual fixing, or 300 mm from either end of any length of filler board, if a continuous fixing is used. The residual deflection after removal of the load shall be not more than 3 mm.
- (ii) The joint assembly fixing 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 fixing 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 time of fixing as practicable.
- (iv) Fixing shall be deemed to fail when there is displacement of the assemblies by more than 3 mm with any from of fixing, under the test load. The displacement shall be measured at the nearest part of the assembly to the center of the bar or timber packing.

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 50 mm for expansion joints. The sheath shall be tough, durable and of an average thickness not greater than 1.25 mm. The sheathed bar shall comply with the following pullout 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 150 x 150 x 600 mm, made of the same mix proportions to be used in the pavement, but with a maximum nominal aggregate size of 20 mm 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 0.25 mm. The average bond stress to achieve this movement shall not be greater than 0.14 Mpa.

For expansion joints, a closely fitting PVC 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 dowels and cap it may be taped.

### **(III) Inspection of dowel bars.**

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.

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

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.

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

### **Mode of measurements and payment**

The measurement shall be on the weight basis and it shall be derived by multiplication of length of bars with its standard weight per meter as per IS code of practice. The rates quoted shall include the weight of Chairs, hangers, spacers or other device if used and binding wires for which no extra payment will be made.

**The rate shall be paid for a unit of one Kg.**

### **Item no -18**

**Painting Two coats with Road marking paint in all shades on new plastered / concrete surface.**

803.1 Scope

The work shall consist of providing road markings of specified width, layout and design using paint of the required specifications as given in the Contract and as per guidelines contained in from IRC:35-1997.

### 803.2 Materials

Road markings shall be of ordinary road marking paint hot applied thermoplastic compound, reflectorized paint or cold applied reflective paint as specified in the item and the material shall meet the requirements as specified in these Specifications. 803.3 Ordinary Road Marking Paint

803.3.1 Ordinary paint used for road marking shall conform to Grade I as per IS:164.

803.3.2 The road marking shall preferably be laid with appropriate road marking machinery

### 803.6 Application

803.6.1 Marking shall be done by machine. For locations where painting cannot be done by 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. Traffic Signs, Markings and other Road Appurtenances Section 800

803.6.2 Where the compound is to be applied to cement concrete pavement, a sealing primer as recommended by the manufacturer, 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 markings are applied.

803.6.4 The pavement temperature shall not be less than 10°C during application. All surfaces 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. Such new material shall so bond 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 in quick succession of the paint spraying operation. The glass beads shall be applied at the rate of 250 grams per square metre area.

803.6.5 The minimum thickness specified is 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).

803.6.6 The markings shall be done to accuracy within the tolerances given below:

- i) Width of lines and other markings shall not deviate from the specified width by more than 5 percent.
- ii) The position of lines, letters, figures, arrows and other markings shall not deviate from the position specified by more than 20 mm
- iii) The alignment of any edge of a longitudinal line shall not deviate from the specified alignment by more than 10 mm in 15 m.
- iv) The length of segment of broken longitudinal lines shall not deviate from the specified length by more than 150 mm. In broken lines, the length of segment and the gap between segments shall be as indicated on the drawings; if these lengths are altered by the Engineer, the ratio of the lengths of the painted sections shall remain the same

### 803.6.7 Properties of Finished Road Markings

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.

- 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 upto 60°C.
- d) The marking shall not deteriorate by contact with sodium chloride, calcium chloride or oil dripping from traffic.

e) The stripe or 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 chopping or cracking.

f) The colour of yellow marking shall conform to IS Colour No. 356 as given in IS:164

### **803.6.8 Measurements for Payment**

803.6.8.1 The painted markings shall be measured in sq. metres of actual area marked (excluding the gaps, if any). 803.6.8.2 In respect of markings like directional arrows and lettering, etc., the measurement shall be by numbers.

### **803.6.9 Rate**

The Contract unit rate for road markings shall be payment in full compensation for 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 all other incidental costs necessary to complete the work to these Specifications.

## **Item no -19**

**Supplying, transporting, stacking and spreading river silt / good earth / sludge / well decayed farm yard manure of approved quality at site in the required thickness, including all leads and lifts, complete as directed by the Engineer-in-Charge.**

The material shall be transported to the work site, stacked where required and spread uniformly over the designated area to the specified thickness, levels and slopes as directed by the Engineer-in-Charge. The material shall be broken up, dressed and leveled to achieve an even surface suitable for landscaping, horticulture, plantation or other intended purposes.

## **Material Requirements**

### **1. River Silt / Good Earth**

- Shall be fertile, friable and free from stones larger than 25 mm, weeds, roots, construction debris and other foreign matter.
- Shall have good moisture retention characteristics suitable for plantation and landscaping works.

### **2. Sludge**

- Shall be well-stabilized, non-toxic and free from industrial contaminants, plastics, glass, metal pieces and harmful substances.
- Shall be approved by the Engineer-in-Charge before use.

### **3. Farm Yard Manure (FYM)**

- Shall be thoroughly decomposed and well-rotted.
- Shall be free from fresh dung, weeds, stones and extraneous matter.
- Shall not emit objectionable odor indicating incomplete decomposition.

## **Method of Execution**

- The area shall be cleared of debris and unwanted vegetation before spreading.
- Material shall be spread evenly to the required thickness.
- High spots shall be trimmed and low spots filled to achieve the required profile.
- The finished surface shall be properly dressed and prepared for subsequent plantation, turfing or landscaping operations.

## **Measurement**

- Measurement shall be made in **Cubic Metres (m<sup>3</sup>)** of material supplied, transported and spread in position with all labour, machinery, tools.
- The volume shall be measured after spreading and dressing to the specified thickness.

The final measurement shall be done and paid per **Cum** of work completed, shall be inclusive of all the works as per specification as directed by Engineer-In-Charge (EIC)

### **Item no -20**

**Supplying and Planting trees, Flower plants and/or shrubs of specified variety by excavating pits of size 60\*60\*60 cm, refiln the same by providing and mixing farm yard manure at a rate of 0.06 cum per pit, watering and maintaining till well established (about 45 days) complete.**

### **Materials**

#### **1. Plants**

- Shall be healthy, vigorous, disease-free and true to the specified species.
- Shall have a well-developed root system and be free from pests and defects.
- Height and age shall be as specified in the drawings or schedule of quantities.

#### **2. Farm Yard Manure (FYM)**

- Shall be well-rotted, thoroughly decomposed and free from weeds, stones and foreign matter.
- Quantity: **0.06 m<sup>3</sup> per pit.**

### **Method of Execution**

#### **1. Excavation of Pits**

- Pits of size **60 cm × 60 cm × 60 cm** shall be excavated at the designated locations.
- Excavated material unsuitable for backfilling shall be removed from the site.

#### **2. Preparation of Pit**

- The excavated earth shall be mixed thoroughly with **0.06 m<sup>3</sup> of well-decayed FYM.**
- The pit shall be refilled partially with the prepared mixture before planting.

#### **3. Planting**

- Plants shall be carefully removed from containers or nursery bags without damaging the root ball.
- The plant shall be placed centrally in the pit and the remaining soil-manure mixture shall be filled and compacted gently around the roots.
- Adequate basin formation shall be made around each plant for watering.

#### **4. Watering and Maintenance**

- Immediate watering shall be carried out after planting.
- Regular watering, weeding, replacement of dead plants, soil loosening and general maintenance shall be performed until the plants are well established or for a period of approximately **45 days** after planting.
- Any plant that dies during the maintenance period shall be replaced at the contractor's cost.

### **Mode of Measurement and payment**

The final Measurement shall be made on **per number (Each)** basis for trees, shrubs or flower plants successfully planted and maintained as directed by Engineer-In-Charge (EIC)