

**RAJKOT MUNICIPAL CORPORATION**

e - Tender No. RMC/ENGG/EZ/25- 26 /

**Name of Work: - "Construction of Bridge on Kothariya  
main Road near Ranuja Temple in ward no 18 "  
(Re-Tender)**



**Volume II**  
**Technical Specifications:**

Milestone dates for e-tendering is as under	
1. Downloading of e-Tender documents	25-6-26 To 18-7-26 upto 17.00 Hrs.
2. Pre-bid Meeting	06-7-26 at 16.00 Hrs.
3. Online submission of e - Tender	18-7-26 upto 18.00 Hrs.
4. Physical submission of EMD, Tender fee and other documents required as per Financial and Experience criteria.	Before 23-7-26 and 18.00 Hours
5. Opening of online technical bid	24-7-26 at 11.00 Hours onwards
6 .Verification of Document submitted(EMD, e -Tender fee, etc.) agency/Bidder have to present along with original document as per submission on nprocure website and photocopy of said documents duly signed for physical submission	24-7-26 at 11.00 Hours onwards
7. Opening of Price Bid (If possible)	27-7-26 at 11.00 Hours onwards
8. Bid Validity	180 Days
For further details, pre-qualification criteria etc. Visit	<a href="http://www.tender.nprocure.com">www.tender.nprocure.com</a>

**2025-26**  
**CITY ENGINEER**  
**RAJKOT MUNICIPAL CORPORATION**  
**SHRI ZAVERCHAND MEGHANI BHAWAN**  
**EAST ZONE, BHAVNAGAR ROAD,**  
**RAJKOT - 360003(GUJARAT)**

# **Rajkot Municipal Corporation**

## **: Technical Specifications:**

### **Item No.1. Road item no.1**

**Clearing and grubbing road land including uprooting rank vegetation grass bushes, shrubs, sapling and trees girth up to 300 mm removal of stumps of trees cut earlier and disposal of unserviceable materials (C) By mechanical means in area of light jungle.**

**MORTH V<sup>th</sup> REVISION Cl. No. 200 Pg. No. 37**

### **201.1 Scope**

This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, rubbish, top organic soil, etc. to an average depth of 150 mm in thickness, which in the opinion of the Engineer are unsuitable for incorporation in the works, from the area of road land containing road embankment, drains, cross-drainage structures and such other areas as may be specified on the drawings or by the Engineer. It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials with all leads and lifts. Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications.

### **201.2 preservation of property/amenities**

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

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

### **201.3 Methods, tools and equipment**

Only such methods, tools and equipment as are approved by the Engineer and which will not affect any property to be preserved shall be adopted for the Work. If the area has thick vegetation/roots/trees, a crawler or pneumatic tyred dozer of adequate capacity may be used for clearance purposes. The dozer shall have ripper attachments for removal of tree stumps. All trees, stumps, etc., falling within excavation and fill lines shall be cut to such depth below ground level that in no case these fall within 500 mm of the bottom of the subgrade. Also, all vegetation such as roots, under-growth, grass and other deleterious matter unsuitable for incorporation in the embankment/subgrade shall be removed between fill lines to the satisfaction of the Engineer. All branches of trees extending above the roadway shall be trimmed as directed by the Engineer.

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

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

### **201.4 Disposal of Materials**

All materials arising from clearing and grubbing operations shall be taken over and shall be disposed of by the Contractor at suitable disposal sites with all leads and lifts. The disposal shall be in accordance with local, State and Central regulations

### **201.5 Measurements for payment**

Clearing and grubbing for road embankment, drains and cross-drainage structures shall be measured on area basis in terms of hectares. Cutting of trees upto 300 mm in girth and removal of their stumps, including removal of stumps upto 300 mm in girth left over after trees have been cut by any other agency, and trimming of branches of trees extending above the roadway and backfilling to the required compaction shall be considered incidental to the clearing and grubbing operations. Clearing and grubbing of borrow areas shall be deemed to be a part of works preparatory to embankment construction and shall be deemed to have been included in the rates quoted for the embankment construction item and no separate payment shall be made for the same. Ground levels shall be taken prior to and after clearing and grubbing. Levels taken prior to clearing and grubbing shall be the base level and will be accordingly used for assessing the depth of clearing and grubbing and computation of quantity of any unsuitable material which is required to be removed. The levels taken subsequent to clearing and grubbing shall be the base level for computation of earthwork for embankment.

Cutting of trees, excluding removal of stumps and roots of trees of girth above 300 mm shall be measured in terms of number according to the girth sizes given below:-

- i) Above 300 mm to 600 mm
- ii) Above 600 mm to 900 mm
- iii) Above 900 mm to 1800 mm
- iv) Above 1800 mm

Removal of stumps and roots including backfilling with suitable material to required compaction shall be a separate item and shall be measured in terms of number according to the sizes given below: -

- i) Above 300 mm to 600 mm
- ii) Above 600 mm to 900 mm
- iii) Above 900 mm to 1800 mm
- iv) Above 1800 mm

For the purpose of cutting of trees and removal of roots and stumps, the girth shall be measured at a height of 1 m above ground or at the top of the stump if the height of the stump is less than one metre from the ground.

## **201.6 Rates**

**201.6.1** The Contract unit rates for the various items of clearing and grubbing shall be payment in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment and incidentals necessary to complete the work. These will also include removal of stumps of trees less than 300 mm girth excavation and back- filling to required density, where necessary, and handling, giving credit towards salvage value disposing of the cleared materials with all lifts and leads. Clearing and grubbing done in excess of 150 mm by the Contractor shall be made good by the Contractor at his own cost as per Clause 301.3.3 to the satisfaction of the Engineer prior to taking up earthwork. Where clearing and grubbing is to be done to a level beyond 150 mm, due to site considerations, as directed by the Engineer, the extra quantity shall be measured and paid separately.

**201.6.2** The Contract unit rate for cutting trees of girth above 300 mm shall include handling, giving credit towards salvage value disposing of the cleared materials with all lifts and leads.

**201.6.3** The Contract unit rate for removal of stumps and roots of trees girth above 300 mm shall include excavation and backfilling with suitable material to required compaction, handling, giving credit towards salvage value disposing of the cleared materials with all lifts and leads.

**201.6.3** The Contract unit rate is deemed to include credit towards value of usable materials, salvage value of unusable materials and off-set price of cut trees and stumps belonging to the Forest Department. The off-set price of cut trees and stumps belonging to the Forest Department shall be deducted from the amount due to the Contractor and deposited with the State Forest Department. In case the cut trees and stumps are required to be deposited with

the Forest Department the Contractor shall do so and no deduction towards the off-set price shall be affected. The offset price shall be as per guidelines / estimates of the State Forest Department.

**201.6.5** Where a Contract does not include separate items of clearing and grubbing, the same shall be considered incidental to the earthwork items and the Contract unit prices for the same shall be considered as including clearing and grubbing operations.

## **202 Dismantling culverts, Bridges and other structures/ pavements:**

### **202.1 Scope**

This work shall consist of dismantling and removing existing culverts, bridges, pavements,

kerbs and other structures like guard-rails, fences, utility services, manholes, catch basins, inlets, etc., from the right of way which in the opinion of the Engineer interfere with the construction of road or are not suitable to remain in place, disposing of the surplus/unsuitable materials and backfilling to after the required compaction as directed by the Engineer.

Existing culverts, bridges, pavements and other structures which are within the highway and which are designated for removal, shall be removed upto the limit and extent specified in the drawings or as indicated by the Engineer.

Dismantling and removal operations shall be carried out with such equipment and in such a manner as to leave undisturbed, adjacent pavement, structures and any other work to be left in place. All operations necessary for the removal of any existing structure which might endanger new construction shall be completed prior to the start of new work.

### **202.2 Dismantling culverts and Bridges**

The structures shall be dismantled carefully and the resulting materials so removed as not to cause any damage to the part of the structure to be retained and any other properties or structures nearby. Unless otherwise specified, the superstructure portion of culverts/bridges shall be entirely removed and other parts removed up to at least 600 mm below the sub-grade, slope face or original ground level whichever is the lowest or as necessary depending upon the interference they cause to the new construction. Removal of overlying or adjacent material, if required in connection with the dismantling of the structures, shall be incidental to this item.

Where existing culverts/bridges are to be extended or otherwise incorporated in the new work, only such part or parts of the existing structure shall be removed as are necessary and directed by the Engineer to provide a proper connection with the new work. The connecting

edges shall be cut, chipped and trimmed to the required lines and grades without weakening or damaging any part of the structure to be retained. Due care should be taken to ensure that reinforcing bars which are to be left in place so as to project into the new work as dowels or ties are not injured during removal of concrete. Pipe culverts shall be carefully removed in such a manner as to avoid damage to the pipes. Steel structures shall, unless otherwise provided, be carefully dismantled in such a manner as to avoid damage to members thereof. If specified in the drawings or directed by the Engineer that the structure is to be removed in a condition suitable for re-erection, all members shall be match- marked by the Contractor with white lead paint before dismantling; end pins, nuts, loose plates, etc. shall be similarly marked to indicate their proper location; all pins, pin holes and machined surfaces shall be painted with a mixture of white lead and tallow and all loose parts shall be securely wired to adjacent members or packed in boxes. Timber structures shall be removed in such a manner as to avoid damage to such timber or lumber having salvage value as is designated by the Engineer.

### **202.3 Dismantling pavements and other structures**

In removing pavements, kerbs, gutters, and other structures like guard-rails, fences, manholes, catch basins, inlets, etc., where portions of the existing construction are to be left in the finished work, the same shall be removed to an existing joint or cut and chipped to a true line with a face perpendicular to the surface of the existing structure. Sufficient removal shall be made to provide for proper grades and connections with the new work as directed by the Engineer.

All concrete pavements, base courses in carriageway and shoulders etc., designated for removal shall be broken to pieces whose volume shall not exceed 0.02 cu.m and used with the approval of the Engineer or disposed of.

### **202.4 Back-filling**

Holes and depressions caused by dismantling operations shall be backfilled with excavated or other approved materials and compacted to required density as directed by the Engineer.

### **202.5 Disposal of Materials**

All surplus materials shall be taken over by the Contractor which may either be re-used with the approval of the Engineer or disposed of with all loads and lifts.

### **202.6 Measurements for payment**

The work of dismantling shall be paid for in units indicated below by taking measurements

before and after, as applicable:

- i) Dismantling brick/stone masonry/  
concrete (plain and reinforced) cu.m
- ii) Dismantling flexible and cement  
Concrete pavement cu.m

- iii) Dismantling steel structures tonne
- iv) Dismantling timber structures cu.m
- v) Dismantling pipes, guard rails, kerbs, gutters and fencing linear m
- vi) Utility services No.

As per Schedule mod of measurement for this item is hectare.

### **202.7 rates**

The Contract unit rates for the various items of dismantling shall be paid in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment, safeguards and incidentals necessary to complete the work. The rates will include excavation and backfilling to the required compaction and for handling, giving credit towards salvage value disposing of dismantled materials with all lifts and leads.

### **Item No.2**

**Marking out the center line of the Bridge and various other component structures and complete lining out and leveling with theodolite, levels, including constructing necessary masonry pillars for lines and levels and establishing necessary bench marks etc. complete as directed.**

#### **109 Setting Out**

109.1 The Contractor shall establish working bench marks tied with the Reference bench mark in the area soon after taking possession of the site. The Reference bench mark for the area shall be as indicated in the Contract Documents and the values of the same shall be obtained by the Contractor from the Engineer. The working bench marks shall be at the rate of four per km and also at or near all drainage structures, over-bridges and underpasses. The working bench marks/levels should be got approved from the Engineer. Checks must be made on these bench marks once every month and adjustments, if any, got approved from the Engineer and recorded. An up-to-date record of all bench marks including approved adjustments, if any, shall be maintained by the Contractor and also a copy supplied to the Engineer for his record.

109.2.1 The lines and levels of formation, side slopes, drainage works, carriageways and shoulders shall be carefully set out and frequently checked, care being taken to ensure that correct gradients and cross-sections are obtained everywhere.

109.2.2 In order to facilitate the setting out of the works, the center line of the carriageway or highway must be accurately established by the Contractor and approved by the Engineer. It must then be accurately referenced in a manner satisfactory to the Engineer, at every 50 m intervals in plain and rolling terrains and 20 m intervals in hilly terrain and in all curve points as directed by the Engineer, with marker pegs and chainage boards set in or near the fence line, and a schedule of reference dimensions shall be prepared and supplied by the Contractor to the Engineer. These markers shall be maintained until the

109.2.3 works reach finished formation level and are accepted by the Engineer.

109.2.4 On construction reaching the formation level stage, the centre line shall again be set out by the Contractor and when approved by the Engineer, shall be accurately referenced in a manner satisfactory to the Engineer by marker pegs set at the outer limits of the formation.

109.2.5 No reference peg or marker shall be moved or withdrawn without the approval of the Engineer and no earthwork or structural work shall commence until the centre line has been referenced.

109.2.6 The Contractor will be the sole responsible party for safe-guarding all survey monuments, bench marks, beacons, etc. The Engineer will provide the Contractor with the data necessary for setting out the centre line. All dimensions and levels shown on the drawings or mentioned in documents forming part of or issued under the Contract shall be verified by the Contractor on the site and he shall immediately inform the Engineer of any apparent errors or discrepancies in such dimensions and levels. The Contractor shall, in connection with the staking out of the centre line, survey the terrain along the road and shall submit to the Engineer for his approval, a profile along the road centre line and cross-sections at intervals as required by the Engineer. The construction staking shall be done by personnel who are trained and experienced in construction layout and staking of the type and kind required in the Contract. Field notes shall be kept in standard, bound field notebooks as approved by the Engineer. Field notes shall be subject to inspection by the Engineer and shall be the property of the Employer. The Contractor shall correct any deficient staking or construction work which resulted from inaccuracies in the staking operations or from the Contractor's failure to report inaccuracies in the plans or survey data furnished by the Department.

109.2.7 After obtaining approval of the Engineer, work on earthwork can commence. The profile and cross-sections as per Section 305, shall form the basis for measurements and payment. The Contractor shall be responsible for ensuring that all the basic traverse points are in place at the commencement of the contract and, if any, are missing, or appear to have been disturbed, the Contractor shall make arrangements to re-establish these points. A "survey File" containing the necessary data will be made available for this purpose. If in the opinion of the Engineer, design modifications of the centre line or grade are advisable, the Engineer will issue detailed instructions to the Contractor and the Contractor shall perform the modifications in the field, as required, and modify the ground levels on the cross-sections accordingly as many times as required. There will be no separate payment for any survey work performed by the Contractor. The cost of these services shall be considered as being included in the rate of the items of work in the Bill of Quantities.



109.2.8 Precision automatic levels, having a standard deviation of  $\pm 2$  mm per km, and fitted with micrometer attachment shall be used for all double run levelling work. Setting out of the road alignment and measurement of angles shall be done by using Total Station with traversing target, having an accuracy of one second. Measurement of distances shall be done preferably using precision instruments like Distomat. The work of setting out shall be deemed to be a part of general works preparatory to the execution of work and no separate payment shall be made for the same

**Item No.3**

**Shifting of Telephone /Electric poles and Lines (Removal of telephone/Electric poles including excavation and dismantling of foundation concrete and lines under the supervision of concerned department, disposal with all lifts and up to any lead and stacking the serviceable and unserviceable material included)**

**As per Detail specification and relevant IRC Code.**

**Item No.4**

**Dismantling the existing structure including removing and stacking the dismantled materials as and where directed. (A) R.C.C. work**

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

**Item No.5**

**Providing and installation of barricading with retroreflective paint /film /tapes as specified in the drawing @ 3m high & specifications on rental basis only for the construction of bridge,along with necessary diversion arrangement for existing traffic movement in an unobstructed condition, all relevant markings, sign boards and illumination as per relevant MORTH specification. Rate to be inclusive of all materials, fabrication works, paint works, foundation works, transportation, loading, unloading, installation, removing & relocating and inclusive of all taxes and including the same design for providing openable gates. No extra rental will be given to the contractor in case of any delays from his part for construction or due to any valid time limit extensions. Each barricading sheet is to be numbered with a unique number. The Contractor may reuse the same sheet for barricading elsewhere with in the project boundaries, however in such case, he will not have been titled for separate rent for reuse. After the completion of project, the owner ship of barricading will remain with the contractor. Blinkers are to be installed on the barricading. Barricading is to be cleaned by means of washing with water on a weekly basis or a sand when required as per the instructions of Engineer in Charge.**

The barricades may be portable or permanent. Barricades may be of wooden, metal or other suitable material panels. They shall be stable under adverse weather conditions and appear significant but not to cause damage to the vehicle if they are stuck. They can be classified in 3 types, namely Type-I, Type-II and Type-III. Type-I and Type-II are portable and Type-III permanent. Because of their vulnerable position and the hazard, they could create, they should be constructed of lightweight materials and should have no rigid stay bracing for A- frame designs.

**Type-I and Type II Barricade**

The rail/panel length shall be 2000 mm to 2500 mm for Type I and 1000 mm to 1200 mm for Type II barricade. The width of rails shall be 200 mm to 300 mm. The rails shall be painted in alternate yellow and white stripes of 150 mm width each, sloping away at an angle of 45° in the direction of traffic. The support shall be on a "A-Configuration" or otherwise at the top to permit convenient folding and staking for transportation. Their stability shall be improved by ballasting. On highways or in other situations where barricades may be susceptible to overturning in the wind, sandbags shall be used for ballasting. Sandbags may be placed on lower parts of the frame or stays to provide the required ballast but shall not be placed on top of any striped rail. Barricades shall not be ballasted by heavy objects such as rocks or chunks of concrete.

Type-III Barricade Type-III is the permanent type and may be made of wood, metal or other suitable material. The typical configuration shall include 3 or more panels/rails, of minimum 1000 mm length (maximum length as per site requirement) and 300 mm width each, painted with alternate yellow and white stripe of 150 mm width sloping at an angle of 45°. They shall be supported and secured on 2 or more vertical supports of same material. On highways or in other situations where barricades may be susceptible to overturning in the wind, sandbags should be used for ballasting. Sandbags may be placed on lower parts of the frame or stays to provide the required ballast but shall not be placed on top of any striped rail. Barricades shall not be ballasted by heavy objects such as rocks or chunks of concrete.

**Application**

Type I or Type II barricades shall be used in situations where traffic is maintained through the temporary traffic control zone. They may be used singly or in groups to mark a specific condition, or they may be used in a series for channelizing traffic. Type I barricades normally would be used on conventional roads or urban streets and arterials. Type II barricades have more retro-reflective area and are intended for use on highways and expressways or other high-speed roadways.

Type III barricades be used for road closure and may extend completely across a roadway or from kerb to kerb. Where provision is made for access of authorized equipment and vehicles, the responsibility should be assigned to a person to ensure proper closure at the end of each work day. When a highway is legally closed but access must still be allowed for local traffic, the Type III barricade should not be extended completely across a roadway. A sign with the appropriate legend concerning permissible use by local traffic shall be mounted. Signs may be erected on barricades, particularly those of the fixed type, that offer a most advantageous facility for this purpose. The ROAD CLOSED and DETOUR or ARROW signs, and the large arrow warning signs, for example, can be mounted effectively on or above the barricade that closes the roadway.

**Payment shall be made on No. basis.**

## **Item No.6 & 7, Road item no. 21**

**Excavation of Foundation in Soft Murrum, Soil or Sand from 0.0 mtr. to 1.50 & 1.51 mtr. to 3.0 mtr depth including dewatering with lifting and laying in limit as instructed mtr depth including dewatering with lifting and laying in RMC limit as instructed.**

### **1.0 General:**

- 1.1 Any soil which generally yields to the application of the pickaxes and shovels, payers rakes or any such ordinary excavation implement or organic soil, gravel, slit, sand turf loan, clay, peat etc. fall under this category.

### **2.0 Cleaning the site:**

- 2.1 The site on which the structure is to be built shall be cleared, and all obstructions, loose stone, materials and rubbish of all kind, bush, wood and trees shall be removed as directed. The materials so obtain shall be property of the government and shall be conveyed and stacked as directed within RMC limit. The roots of the tree coming in the sides shall be cut and coated with a asphalt.

- 2.2 The rate of side clearance is deemed to be included in the rate of earth work for which no extra will be paid.

### **3.0 Setting out:**

After clearing the site, the center lines will be given by the engineer-in-charge. The contractor shall assume full responsibility for alignment, elevation and dimension and of each and all parts of the work. Contractor shall supply labors, materials, etc required for setting out the reference marks and bench marks and shall maintain them as long as required and directed.

### **4.0 Excavation:**

The excavation in foundation shall be carried out in true line and level and shall have the width and depth as shown in the drawings or as directed. The contractor shall do the necessary shoring and strutting or providing necessary slopes to a safe angle, at his own cost. The bottom of the excavated area shall be leveled both longitudinally and transversely as directed by removing and watering as required. No earth filling will be allowed for bringing it to level, if by mistake or any other reason excavation is made deeper or wider than that shown on the plan or directed. The extra depth or width shall be made up with concrete of same proportion as specified for the foundation concrete at the cost of the contractor. The excavation up to 1.5 mt depth shall be measured under this item.

### **5.0 Disposal of the excavated stuff:**

The excavated stuff of the selected type shall be used in filling the trenches and plinth or leveling the ground in layers including ramming and watering etc. The balance of the excavated quantity shall be removed by the contractor from the site of work to a place as directed within RMC limit and all lift.

### **Mode of Measurement and Payment:**

The measurement of excavation in trenches for foundation shall be made according to the sections of trenches shown on the drawing or as per sections given by the engineer-in-charge. No payment shall be made for surplus excavation made in excess of above requirement or due to stopping and sloping back as found necessary on account of conditions of soil and requirements of safety.

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

**Item No.8, 47, & Road Item No 4, 14 & 22**

**Providing and filling PCC in foundation with ordinary cement concrete M15 grade and providing necessary pin headers including formwork, vibrating, ramming, compaction, leveling, curing, etc. complete.**

**Materials**

1.1 Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Stones aggregate 20 mm. nominal size shall conform to M-12.

**Workmanship**

**General**

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

**Proportion of Mix**

The proportion of cement, sand and coarse aggregate shall be 1 part of cement, 2 parts of sand and 4 parts of stone aggregate; / 1 part of cement, 3 parts of sand and 6 parts of stone aggregate and shall be measured by volume.

**Mixing**

The concrete shall be mixed in a mechanical mixer at the site of work. Hand mixing may however be allowed for smaller quantity of work if approved by the Engineer-in-charge. When hand mixing is permitted by the Engineer-in-charge in case of break-down of machineries and in the interest of the work, it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. However, in such cases 10% more cement than otherwise required shall have to be used without any extra cost. The mixing in mechanical mixer shall be done for a period 1. 1/2 to 2 minutes. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the purpose. Transporting & placing the concrete.

The concrete shall, be handed from the place of mixing to the final position in not more than 15 minute by the method as directed and shall be placed into its final position, compacted and finished within 30 minutes of mixing with water i.e. before the setting commences.

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

**Compacting:**

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

**Curing**

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

**Mode of measurements and payment:**

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

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

**The rate includes all materials, labour, and everything required to execute this item.**

**Item No.9, 10 & 11, Road item no. 23, 24 & 25**

**Providing and casting in situ-controlled cement concrete M35 for Base Slab Box Culvert Walls & Top Slab, Manhole top slab, base slab & walls**

**Item No.12**

**Providing and casting in situ-controlled cement concrete M-300 for Kerb/ Kerb blocks including formwork curing and finishing, complete.**

**Item No.23**

**Providing and casting in situ-controlled cement concrete M-300 for approach slab including formwork curing and finishing, complete.**

**Item No.25, Road Item No 5**

**Providing and casting in situ-controlled cement concrete M-200 for Toe Wall, Raft & Cutt-off wall, Head wall, including formwork curing and finishing, complete**

**Item No.21**

**Providing and casting in situ-controlled cement concrete M-40 for Crash Barriers including Formwork curing and finishing, complete**

The rate includes all materials, labour, and everything required to execute this item. MORT&H specifications as in section 1700, 2200, 2300 (5th Revision) shall be followed in connection with this item. All relevant provisions as have been included in the respective IRC and IS code specification are also applicable.

**The measurement shall be in cubic meter. The rate includes all materials, labour, and everything required to execute this item.**

**MORTH Vth IREVISION: Cl. No. 1500, 1700 & 2200 Pg. no. 519, 535 & 669MORT&H**

**Specifications Section (5th Revision): 2700.**

**1701Description**

The work shall consist of producing, transporting, placing and compacting of structural concrete including fixing formwork and temporary works etc. and incidental construction in accordance with these Specifications and in conformity with the lines, grades and dimensions, as shown on the drawings or as directed by the Engineer.

**1702Materials**

All materials shall conform to Section 1000 of these Specifications.

**1703Grades of Concrete**

The grades of concrete shall be designated by the characteristic strength as given in Table 1700-1, where the characteristic strength is defined as the strength of concrete below which not more than 5 percent of the test results are expected to fall.

The minimum grades of concrete and corresponding minimum cement content and maximum water/cement ratios for different exposure conditions shall be as indicated in Table 1700-2

**Table 1700-1 : Grades of Concrete**

<b>Type of Concrete/Grade designation</b>			<b>Characteristic strength in MPa</b>
<b>nominal Mix Concrete</b>	<b>standard Concrete</b>	<b>High Performance Concrete</b>	
M15	M15		15
M20	M20		20
	M25		25
	M30	M30	30
	M40	M35	35
	M45	M40	40
	M50	M45	45
		M50	50
		M55	55
		M60	60
		M65	65
		M70	70
		M75	75
		M80	80
		M85	85
		M90	90

Normal Mix Concrete is made on the basis of nominal mix proportioned by weight of its main ingredients – cement, coarse and fine aggregates and water.

Standard concrete is made on the basis of design mix proportioned by weight of its ingredients, which in addition to cement, aggregates and water, may contain chemical admixtures to achieve certain target values of various properties in fresh condition, achievement of which is monitored and controlled during production by suitable tests. Generally, concrete of grades up to M50 are included in this type.

High Performance Concrete is similar to standard concrete but contains additional one or more mineral admixtures providing binding characteristics and partly acting as inert filler material which increases its strength, reduces its porosity and modifies its other properties in fresh as well as hardened condition. Concrete of grades upto M90 are included in this type.

For concrete of grades higher than M90, the design parameters may be obtained from specialized literature and experimental results.

For concrete subjected to sulphate attack the minimum grades of concrete, minimum cement content and maximum water/cement ratios and types of cement for different concentration of sulphate content shall be as indicated in Table 1700-3

**Table 1700-2 : Requirement of Concrete for different exposure Condition using 20 mm aggregate**

<b>exposure Condition</b>	<b>Maximum Water Cement Ratio</b>	<b>Minimum Cement Content, kg/m<sup>3</sup></b>	<b>Minimum Grade of Concrete</b>
Moderate	0.45	380	M25
Severe	0.45	410	M30
Very Severe	0.40	440	M40

**Note:**

All three provisions given in the above table for a particular exposure condition, shall be satisfied.

The term cement for maximum w/c ratio and minimum cement content shown in Table includes all cementitious materials mentioned in Clause 1715.2. The maximum limit of flyash and ground granulated blast furnace slag in the blended cement shall be as specified in IS:1489 (Part 1) and IS:455 respectively.

For plain cement concrete, with or without surface reinforcement, the minimum grade of concrete can be lowered by 5 MPa and maximum water/cement ratio exceeded by 0.05. Cement content shown in the above table shall be increased by 40 kg/m<sup>3</sup> for use of 12.50 mm nominal size aggregates and decreased by 30 kg/m<sup>3</sup> for use of 40 mm nominal size aggregates.

**Table 1700-3: Requirement of Concrete exposed to sulphate attack**

Class	Concentration Of sulphates as so3			type of Cement (note ii)	Minimum Cement Content, kg/m <sup>3</sup>	Maximu m Water / Cement Ratio	Minimu m Grade of Concrete
	in soils						
	total so3 %	So3 in 2:1 Water: soil extract,					
1)	Traces	< 1.0	< 0.3	-OPC, PPC or PSC	380	0.5	M25
2)	2.0 to 0.5	1.0 to 1.9	0.3 to 1.2	OPC, PPC or PSC, SRPC	380	0.5	M25
3)	0.5 to 1.0	1.9 to 3.1	1.2 to 2.5	-SRPC, PPC or PSC	380	0.5	M25
					410	0.45	M30
4)	1.0 to 2.0	3.1 to 5.0	2.5 to 5.0	-SRPC	425	0.45	M35
5)	>2.0	>5.0	>5.0	-SRPC with protective Coatings	440	0.4	M40

**Note:** If the requirements of maximum water/cement ratio, minimum grade of concrete and minimum cement content from other durability considerations as given in Table 1700-2 are more stringent than those given in this table, then the former will govern.



OPC: Ordinary Portland Cement, PPC: Portland Pozzolona Cement. PSC: Portland Slag Cement, SRPC: Sulphate Resisting Portland cement.

The minimum cement content shall be as low as possible but not less than the quantities specified in Table 1700-2 and 1700-3.

The maximum cement content excluding any mineral admixtures (Portland cement component alone) shall not exceed 450 kg/cu.m.

- iii) Concrete used in any component or structure shall be specified by designation along with prescribed method of design of mix i.e. 'Design Mix' or 'Nominal Mix'. For all items of concrete, only design mix shall be used, except where nominal mix concrete is permitted as per drawing or by the Engineer. Nominal mix may be permitted only for minor bridges and culverts or other incidental construction, where strength requirements are upto M 20 only. Nominal mix may also be permitted for non-structural concrete or for screed below open foundations.
- iv) If the Contractor so proposes, the Engineer may permit the use of concrete of higher grade than that specified on the drawing, provided the higher grade concrete meets the specifications applicable. The additional cost of such
- v)
- vi) Higher grade concrete shall be borne by the Contractor.

#### **1704                      Proportioning of Concrete**

Prior to the start of construction, the Contractor shall design the mix in case of design mix concrete or propose nominal mix in case of nominal mix concrete, and submit to the Engineer for approval, the proportions of materials, including admixtures to be used. Water-reducing admixtures (including plasticisers or super- plasticisers) may be used at the Contractor's option, subject to the approval of the Engineer.

##### **Requirements of Consistency**

The mix shall have the consistency which will allow proper placement and compaction in the required position. Every attempt shall be made to obtain uniform consistency. Slump test shall be used to measure consistency of the concrete.

The optimum consistency for various types of structures shall be as indicated in Table 1700-4, or as directed by the Engineer. The slump of concrete shall be checked as per IS:516.

**Table 1700-4: Requirements of Consistency**

<b>Type</b>		<b>slump (mm) (at the time of Placing of</b>
	a) Structure with exposed inclined surface requiring low	25
	b) Plain cement concrete	25
2)	RCC structure with widely spaced reinforcements; e.g. solid columns, piers, abutments, footings, well	40 – 50
3)	RCC structure with fair degree of congestion of reinforcement; e.g. pier and abutment caps, box culverts, well curb, well cap, walls with thickness greater than 300 mm	50 – 75
4)	RCC and PSC structure with highly congested reinforcements e.g. deck slab girders, box girders, walls with thickness less than 300 mm	75 – 125
5)	Underwater concreting through tremie e.g. bottom plug, cast in-situ piling	150 – 200

Notwithstanding the optimum consistency indicated against Sl. No. 1 to 3, the situation should be property assessed to arrive at the desired workability with the adjustment of admixture in each case, where the concrete is to be transported through transit mixer and placed using concrete pump. Under these circumstances, the optimum consistency during placement for the items of work of Sl. No. 1 to 3, can be considered ranging from 75 mm to 150 mm. This is, however, subject to satisfying the other essential criteria of strength, durability etc. and approval of the Engineer

#### **Requirements for design Mixes**

##### **Target Mean strength**

The target mean strength of specimen shall exceed the specified characteristic compressive strength by at least the current margin. The current margin for a concrete mix shall be determined by the Contractor and shall be taken as 1.64 times the standard deviation of sample test results taken from at least 40 separate batches of concrete of nominally similar proportions produced at site by the same plant under similar supervision, over a period exceeding 5 days, but not exceeding 6 months.

Where there is insufficient data to satisfy the above, the current margin for the initial design mix shall be taken as given in Table 1700-5 :

**Table 1700-5: Current Margin for initial design Mix**

Concrete Grade	Current (MPa)	Margin	target strength (MPa)(for mix design preparation)	Mean
M 15	10		25	
M 20	10		30	
M 25	11		36	
M 30	12		42	
M 35	12		47	
M 40	12		52	
M 45	13		58	
M 50	13		63	
M 55	14		69	
M 60	14		74	
M 65	15		80	
M 70	15		85	
M 75	15		90	
M 80	15		95	
M85	16		101	
M90	16		106	

The initial current margin given in Table 1700-5 shall be used till sufficient data is available to determine the current margin as per Sub-Clause 1704.2.1(i).

### **Trial Mixes**

The Contractor shall give notice to the Engineer to enable him to be present at the time of carrying out trial mixes and preliminary testing of the cubes. Prior to commencement of trial mix design, all materials forming constituents of proposed design mix should have been tested and approval obtained in writing from the Engineer. Based on test results of material, draft mix design calculation for all grades of concrete to be used in the works, shall be prepared after taking into account the provisions in the Contract Technical Specifications, Guidelines of IS:10262, IS:SP:23 and IRC:112 and submitted to the Engineer for approval. Prior to commencement of concreting, trial mix design shall be performed for all grades of concrete and trial mix which has been found successful, shall be submitted by the Contractor and

approval obtained. During concreting with the approved trial mix design, if source of any constituents is changed, the mix design shall be revised and tested for satisfying the strength requirements.

The initial trial mixes shall be carried out in a laboratory approved by the Engineer. However, Engineer may permit the initial trial mixes to be prepared at the site laboratory of the Contractor, if a full-fledged concrete laboratory has been established well before the start of construction, to his entire satisfaction. Sampling and testing procedures shall be in accordance with these Specifications. When the site laboratory

is utilized for preparing initial mix design, the concrete production plant and means of transport employed to make the trial mixes shall be similar to those proposed to be used in the works. For each trial mix, a set of six cubes shall be made from each of three consecutive batches for purposes of testing. Three cubes from each set of six shall be tested at an age of 28 days and three at an earlier age approved by the Engineer. The cubes shall be made, cured, stored, transported and tested in accordance with these Specifications. The mean strength of the nine cubes at 28 days shall exceed the specified characteristic strength by the current margin minus 3.5 MPa.

#### **Control of strength of design Mixes**

##### **Adjustment to Mix Proportions**

Adjustment to mix proportions arrived at in the trial mixes, shall be made subject to the Engineer's approval, in order to minimize the variability of strength and to maintain the target mean strength. Such adjustments shall not be taken to imply any change in the current margin.

##### **Change of Current Margin**

When required by the Engineer, the Contractor shall recalculate the current margin in accordance with Clause 1704.2.1. The recalculated

Value shall be adopted as directed by the Engineer, and it shall become the current margin for concrete produced thereafter.

##### **Additional Trial Mixes**

In case any changes are observed in the properties of fresh concrete and/or strength of hardened concrete on the basis of early age tests, additional mixes and tests shall be carried out during production, so as to control and bring the quality of concrete within acceptable limits. In case of any change in the source or properties of materials, the design of mix shall be established afresh.

#### **Requirements of nominal Mix Concrete**

Requirements for nominal mix concrete unless otherwise specified shall be as given in

**Table 1700-6.**

**Table 1700-6 : Requirements for nominal Mix Concrete**

Concrete	Total Quantity of dry by Mass per 50 kg of Cement to be taken as the sum of  Coarse aggregates (kg)	Proportion of Fine to Coarse aggregate (by	Maximum of Water for 50 kg	
			PCC	RCC
M 15	350		25	
M 20	250		25	22

### **Additional Requirements**

Concrete shall meet any other requirements as specified on the drawing or as directed by the Engineer. The overall limits of deleterious substances in concrete shall be as follows:

Total acid soluble chloride content in the concrete mix expressed as chloride ions shall not exceed the following values by mass of cement.

Restressed concrete	0.10 percent
---------------------	--------------

Reinforced concrete (in severe, very severe Or extreme exposure condition)	0.20 percent
---	--------------

Reinforced concrete in moderate exposure Condition	0.30 percent
---	--------------

The total water soluble sulphate content of the concrete mix expressed as SO<sub>4</sub>, shall not exceed 4 percent by mass of cement in the mix.

For concrete made with Portland pozzolona cement, Portland blast furnace slag cement or mineral admixtures, the setting time and rate of gain of strength are different from those for concrete made with OPC alone. Such modified properties shall be taken into account while deciding the de-shuttering time, curing period, early age loading and time of prestressing. Additional cube samples may be required to be taken for verifying the concrete properties

### **Suitability of Proposed Mix Proportions**

The Contractor shall submit the following information for the Engineer's approval:

- i. Nature and source of each material
- ii. Quantities of each material per cubic metre of fully compacted concrete
- iii. Either of the following:
- iv. Appropriate existing data as evidence of satisfactory previous performance for the target mean strength, current margin, consistency and water/cement ratio and any other additional requirement (s) as specified.
- v. full details of tests on trial mixes.
- vi. Statement giving the proposed mix proportions for nominal mix concrete

Any change in the source of material or in the mix proportions shall be subject to the Engineer's prior approval.

### **Checking of Mix Proportions and Water/Cement Ratio**

In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement per bag as given by the manufacturer is accepted, a reasonable number of bags shall be weighed separately to check the net weight. Where cement is weighed from bulk stock at site and not by bag, it shall be weighed separately from the aggregates. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in a clean and serviceable condition. Their accuracy shall be periodically checked.

The specified water/cement ratio shall always be kept constant and at its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined

as frequently as possible, the frequency for a given job being determined by the Engineer according to the weather conditions. The amount of water to be added shall then be adjusted to compensate for variations in the moisture content. For the determination of moisture content in the aggregates IS:2386 (Part III) shall be referred. Suitable adjustments shall also be made in the weight of aggregates to allow for their variation in weight due to variation in their moisture content.

### **Grading of aggregates for Pumped Concrete**

Materials for pumped concrete shall be batched consistently and uniformly. Maximum size of aggregate shall not exceed one-third of the internal diameter of the pipe.

The grading of aggregates shall be continuous and shall have sufficient ultra-fine materials (material finer than 0.25 mm). Proportion of fine aggregates passing through 0.25 mm shall be between 15 and 30 percent and that passing through 0.125 mm sieve shall not be less than 5 percent of the total volume of aggregate.

Admixtures to increase workability can be added. When pumping long distances and in hot weather, set-retarding admixtures can be used. Fluid mixes can be pumped satisfactorily after adding plasticizers and super plasticizers. Suitability of concrete shall be verified by trial mixes and by performing pumping test.

### **1705                      Admixtures**

#### **Chemical admixtures**

Chemical admixtures such as superplasticizers, or air entraining, water reducing, accelerating and retarding agents for concrete, may be used with the approval of the Engineer.

As the selection of an appropriate concrete admixture is an integral part of the mix design, the manufacturers shall recommend the use of any one of their products only after obtaining complete information of all the actual constituents of concrete as well as methodologies of manufacture, transportation and compaction of concrete proposed to be used in the work. Admixtures/additives conforming to IS:9103 may be used subject to approval of the Engineer. However, admixtures/additives generating hydrogen or nitrogen and containing chlorides, nitrates, sulphides, sulphates or any other material likely to adversely affect the steel or concrete, shall not be permitted.

The general requirements for admixtures are given in Clause 1007 of these Specifications.

Compatibility of the admixtures with the cement and any other pozzolona or hydraulic addition shall be ensured by for avoiding the following problems

- i) Requirement of large dosage of superplasticiser for achieving the desired workability,
- ii) Excessive retardation of setting,
- i) Excessive entrainment of large air bubbles,
- ii) Unusually rapid stiffening of concrete,
- iii) Rapid loss of slump
- iv) Excessive segregation and bleeding

#### **Mineral admixtures**

For use of mineral admixtures, refer Clauses 1714.1 and 1715.2.

#### **1706 Size of Coarse Aggregates**

The size (maximum nominal) of coarse aggregates for concrete to be used in various components shall be as given in Table 1700-7.

**Table 1700-7 : Maximum nominal size of Coarse aggregates**

<b>Components</b>	<b>Maximum nominal size of Coarse aggregate (mm)</b>
I) RCC well curb	20
ii) RCC/PCC well steining	40
iii) Well cap or Pile Cap Solid type piers and abutments	40
iv) RCC work in girder, slabs wearing coat, kerb, approach slab, hollow piers and abutments, pier/abutment caps, piles	20
v) PSC Work	20
vi) Any other item	As specified by the Engineer

Maximum nominal size of aggregates shall also be restricted to the smaller of the following values :

- a) 10 mm less than the minimum lateral clear distance between individual reinforcements
- b) 10 mm less than the minimum clear cover to the reinforcement
- c) One quarter of minimum thickness of member

The proportions of the various individual sizes of aggregates shall be so adjusted that the grading produces the densest mix and the grading curve corresponds to the maximum nominal size adopted for the concrete mix.

## **1707                      Equipment**

Unless specified otherwise, equipment for production, transportation and compaction of concrete shall be as under:

- a) Production of Concrete:
- b)
  - i) For overall bridge length of less than 200 m – batch type concrete mixer, diesel or electric operated, with a minimum size of 200 litres automatic water measuring system and integral weigher (hydraulic/pneumatic type).
  - ii) For overall bridge length of 200 m or more – concrete batching and mixing plant fully automatic, with minimum capacity of 15 cum per hour.

All measuring devices of the equipment shall be maintained in a clean and serviceable condition. Their accuracy shall be checked over the range in use, when set up at each site and thereafter, periodically as directed by the Engineer.

The accuracy of the measuring devices shall fall within the following limits:

Measurement of Cement cement	:	$\pm 3$ percent of the quantity of in each batch
Measurement of Water water in	:	$\pm 3$ percent of the quantity of each batch
Measurement of Aggregate aggregate	:	$\pm 3$ percent of the quantity of in each batch
Measurement of Admixture admixture	:	$\pm 3$ percent of the quantity of in each batch

- c) Transportation of Concrete:
  - i) Concrete dumpers                      minimum 2 tonnes capacity
  - ii) Powered hoists                      minimum 0.5 tonne capacity
  - iii) Chutes
  - iv) Buckets handled by cranes
  - v) Transit truck mixer
  - vi) Concrete pump
  - vii) Concrete distributor booms
  - viii) Belt conveyor
  - ix) Cranes with skips
- d) Tremies For Compaction of Concrete :



i)	Internal vibrators	size 25 mm to 70 mm
ii)	Form vibrators	minimum 500 watts
iii)	Screed vibrators	full width of carriageway (upto two lanes)

## **1708           Batching,       Mixing,       Transporting,       Placing       And Compaction General**

Prior to start of concreting, the Contractor shall submit for approval of the Engineer, his programmer along with list of equipment proposed to be used by him for batching, mixing, transporting and placing concrete.

### **Batching of Concrete**

In batching concrete:

- I. The quantity of cement, aggregate and mineral admixtures, if used, shall be determined by mass.
- II. Chemical admixtures, if solid, shall be determined by mass.
- III. Liquid admixtures may be measured in volume or mass, and
- IV. Water shall be weighed or measured by volume in a calibrated tank.

The concrete shall be sourced from on-site or off-site batching and mixing plants, or from approved Ready Mixed Concrete plants, preferably having quality certification. Except where supply of properly graded aggregate of uniform quality can be maintained over a period of work, the grading of aggregate should be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions when required, the different sizes being stocked in separate stock piles. The materials should be stock piled several hours, preferably a day before use. The grading of coarse and fine aggregate should be checked as frequently as possible to ensure that the specified grading is maintained.

The water/cement ratio shall always be maintained constant at its correct value. To this end, Determination of moisture content in both fine and coarse aggregates shall be made as frequently as possible, depending on weather conditions. The amount of added water shall be adjusted to compensate for any observed variations in the moisture content. To allow for the variation in mass of aggregate due to variation in moisture content, suitable adjustment in the mass of aggregate, shall also be made. Accurate control shall be kept on the quantity of mixing water, which when specified, shall not be changed without approval.

## **Mixing Concrete**

### **Mixing at site**

All concrete shall be machine mixed. In order to ensure uniformity and good quality of concrete the ingredients shall be mixed in a power driven batch mixer with hopper and suitable weigh batching arrangement or in a central mix plant. Hand mixing shall not be permitted. The mixer or the plant shall be at an approved location considering the properties of the mixes and the transportation arrangements available with the Contractor. The mixer or the plant shall be approved by the Engineer.

Mixing shall be continued till materials are uniformly distributed, a uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shows complete coating of mortar containing its proportionate amount of cement. In no case shall mixing be done for less than 2 minutes. It shall be ensured that the mixers are not loaded above their rated capacities and are operated at a speed recommended by the manufacturer. When mineral admixtures are added at the mixing stage, their thorough and uniform blending with cement shall be ensured, if necessary by longer mixing time. The addition of water after the completion of the initial mixing operation, shall not be permitted.

Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch and also before changing from one type of cement to another.

### **Ready Mix Concrete**

Use of ready mix concrete proportioned and mixed off the project site and delivered to site in a freshly mixed and unhardened state conforming to IS:4926, shall be allowed with the approval of the Engineer.

### **Transporting Concrete**

Mixed concrete shall be transported from the place of mixing to the place of final deposit as rapidly as possible by methods which will prevent the segregation or loss of the ingredients. The method of transporting or placing of concrete shall be approved by the Engineer. Concrete shall be transported and placed as near as practicable to its final position so that no contamination, segregation or loss of its constituent's materials take place.

Concrete may be transported by transit mixers or properly designed buckets or by pumping. Transit mixers or other hauling equipment when used should be equipped with the means of discharge of concrete without segregation. During hot or cold weather, concrete shall be transported in deep containers. Other suitable methods to be reduce the loss of water by evaporation in hot weather and heat loss in cold weather may also be adopted.

When concrete is conveyed by chute, the plant shall be of such size and design as to ensure practically continuous flow. Slope of the chute shall be so adjusted that the concrete flows without excessive quantity of water and without any segregation of its ingredients. The delivery end of the chute shall be as close as possible to the

point of deposit. The chute shall be thoroughly flushed with water before and after each working period and the water used for this purpose shall be discharged outside the formwork.

In case concrete is to be transported by pumping, the fresh concrete should have adequate fluidity and cohesiveness to be pumpable. Proper concrete mix proportioning and initial trials should ensure this.

The conduit shall be primed by pumping a batch of mortar through the line to lubricate it. Once the pumping is started, it shall not be interrupted, as concrete standing idle in the line is liable to cause plug. The operator shall ensure that some concrete is Always there in the pump's receiving hopper during operation. The lines shall always be maintained clean and free of dents.

Pipelines from the pump to the placing area shall be laid with minimum bends. For large quantity placements, standby pumps shall be available. Suitable air release valves, shutoff valves etc. shall be provided as per site requirements. The pumping of priming mix i.e. rich mix of creamy consistency, to lubricate the concrete pump and pipelines, shall precede the pumping of concrete. Continuous pumping shall be done to the extent possible. After concreting, the pipelines and accessories shall be cleaned immediately. The pipes for pumping shall not be made of material which has adverse effect on concrete. Aluminium alloy pipelines shall not be used.

### **Placing of Concrete**

All formwork and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete.

No concrete shall be placed in any part of the structure until the approval of the Engineer has been obtained. If concreting is not started within 24 hours of the approval being given, the approval shall have to be obtained again from the Engineer. Concreting shall proceed continuously over the area between the construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes, unless a proper construction joint is formed.

The concrete shall be deposited as nearly as practicable in its original position to avoid re- handling. Methods of placing should be such as to preclude segregation. Care should be taken to avoid displacement of reinforcement or movement of formwork. To achieve this, concrete should be lowered vertically in the form and horizontal movement of concrete inside the forms should, as far as practicable, be minimised.

The concrete shall be placed and compacted before its initial setting so that it is amenable to compaction by vibration. The workability of concrete at the time of placement shall be adequate for the compaction equipment to be used. If there is considerable time gap between mixing and placing of concrete, as in the case of ready Mixed concrete plants or off-site batching and mixing plants, concrete mix shall be designed to have appropriately higher workability at the time of discharge from the mixer, in order to compensate the loss of workability during transit. This is generally achieved by suitable chemical admixtures. Keeping these considerations in view,

the general requirement for ready mixed concrete plants or off-site batching and mixing plants, is that concrete shall be discharged from the truck mixer within two hours of the time of loading. A longer period may be permitted if suitable retarding admixtures are used.

In wall forms, drop chutes attached to hoppers at the top should preferably be used to lower concrete to the bottom of the form. As a general guidance, the permissible free fall of concrete may not exceed 1.5 metres and under no circumstances shall it be more than 2 metres. When free fall of larger height is involved, self-compacting concrete having adequate fluidity, cohesiveness and viscosity and which uniformly and completely fills every corner of the formwork by its own weight without segregation, shall be used.

Except where otherwise agreed to by the Engineer, concrete shall be deposited in horizontal layers to a compacted depth of not more than 450 mm when internal vibrators are used and not more than 300 mm in all other cases.

Concrete when deposited shall have temperature of not less than 5°C and preferably not more than 30°C and in no case more than 40°C. In case of site mixing, fresh concrete shall be placed and

Compacted in its final position within 30 minutes of its discharge from the mixer. When the concrete

is carried in properly designed agitator operating continuously, the concrete shall be placed and compacted within 1 hour of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. It may be necessary to add retarding admixtures to concrete, if trials show that the periods indicated above are unacceptable. In all such matters, the Engineer's decision shall be final

### **Compaction of Concrete**

Concrete shall be thoroughly compacted by vibration or other means during placing and worked around the reinforcement, tendons or duct formers, embedded fixtures and into corners of the formwork to produce a dense homogeneous void-free mass having the required surface finish. When vibrators are used, vibration shall be done continuously during the placing of each batch of concrete until the expulsion of air has practically ceased and in a manner that does not promote segregation. Over-vibration shall be avoided to minimize the risk of forming a weak surface layer. When external vibrators are used, the design of formwork and disposition of vibrator shall be such as to ensure efficient compaction and to avoid surface blemishes. Vibrations shall not be applied through reinforcement and where vibrators of immersion type are used, contact with reinforcement and all inserts like ducts etc., shall be avoided. When internal vibrators are used, they shall be inserted vertically to the full depth of the layer being placed and ordinarily shall penetrate the layer below for a few centimeters. The vibrator should be kept in place until air bubbles cease escaping from the surface and then withdrawn slowly to ensure that no hole is left in the concrete, care being taken to see that it remains in continued operation while being withdrawn. The internal vibrators shall be inserted in an orderly manner and the distance between insertions should be about one and half times the radius of the

area visibly affected by vibration. Additional vibrators in serviceable condition shall be kept at site so that they can be used in the event of breakdown. Mechanical vibrators used shall comply with IS:2502, IS:2506, IS:2514 and IS:4656.

### **1709                      Construction Joints**

Construction joints shall be avoided as far as possible. In no case shall the locations of such joints be changed or increased from those shown on the drawings except with the express approval of the Engineer. Joints should be positioned where they are readily accessible for preparation and concreting. Construction joints should be positioned to minimize the effects of the discontinuity of the durability, structural integrity and appearance of the structure. As far as possible, joints should be provided

in non-aggressive zones, but if joints in aggressive zones cannot be avoided, they should be sealed. Joints should be located away from the regions of maximum stress caused by loading; particularly where shear and bond stresses are high. In beams and slabs joints should not be near the supports. Construction joints between slabs and ribs in composite beams, shall be avoided. For box girders, there shall be no construction joint between the soffit and webs. Joints should be either vertical or horizontal. For a vertical construction joint, the lifts of concrete shall finish level or at right angles to the axis of the member. Concreting shall be continued right up to the joint. Before resuming work at a construction joint when

Concrete has not yet fully hardened, all laitance shall be removed thoroughly. The surface shall be roughened, taking care to avoid dislodgement of coarse aggregates. Concrete shall be brushed with a stiff brush soon after casting, while the concrete has only slightly stiffened. If the concrete has partially hardened, it may be treated by wire brushing or with a high pressure water jet, followed by drying with an air jet, immediately before the new concrete is placed. Fully hardened concrete shall be treated with mechanical hand tools or grit blasting, taking care not to split or crack aggregate particles. The practice of first placing a layer of mortar or grout when concreting joints, shall be avoided. The old surface shall be soaked with water, without leaving puddles, immediately before starting concreting. The new concrete shall be thoroughly compacted against it.

Where there is likely to be a delay before placing the next concrete lift, protruding reinforcement shall be protected. In all cases, where construction joints are made, the joint surface shall not be contaminated with release agents, dust, or sprayed curing membrane and reinforcement shall be firmly fixed in position at the correct cover.

The sequence of concreting, striking of forms and positioning of construction joints for every individual structure, shall be decided well in advance of the commencement of work.

When it is necessary to deposit concrete under water, the methods, equipment, Materials and proportions of mix to be used, shall be got approved from the Engineer before any work is started.

Concrete shall not be placed in water having a temperature below 5°C. The temperature of the concrete, when deposited, shall not be less than 16°C, nor more than 30°C.

Coffer dams or forms shall be sufficiently tight to ensure still water conditions, if practicable, and in any case to reduce the flow of water to less than 3 m per minute through the space into which concrete is to be deposited. Coffer dams or forms in still water shall be sufficiently tight to prevent loss of mortar through the joints in the walls. Pumping shall not be done while concrete is being placed, or until 24 hours Thereafter. To minimize the formation of laitance, care shall be exercised not to disturb the concrete as far as possible while it is being deposited. All under water concreting shall be carried out by tremie method only. The number and spacing of the tremies should be worked out to ensure proper concreting. However, it is necessary to have a minimum number of 2 tremies for any concreting operation, so that even if one of the tremies goes out of commission during concreting, the other one can be used to complete the work. The tremie concreting when started, should continue without interruption for the full height of the member being concreted. The capacity of the concrete production and placement equipment should be sufficient to enable the underwater concreting to be completed uninterrupted within the stipulated time. The top section of the tremie shall have a hopper large enough to hold one full batch of the mix or the entire contents of the transporting bucket, as the case may be. The tremie pipe shall not be less than 200 mm in diameter and shall be large enough to allow a free flow of concrete and strong enough to withstand the external pressure of the water in which it is suspended, even if a partial vacuum develops inside the pipe. Preferably, flanged steel pipe of adequate strength shall be used. A separate lifting device shall be provided for each tremie pipe with its hopper at the upper end. Unless the lower end of the pipe is equipped with an approved automatic check valve, the upper end of the pipe shall be plugged with a wadding of gunny sacking or other approved material before delivering

The concrete to the tremie pipe through the hopper, so that when the concrete is forced down from the hopper to the pipe, it will force the plug (and along with it any water in the pipe) down the pipe and out of the bottom end, thus establishing a continuous stream of concrete. It will be necessary to raise the tremie slowly in order to allow a uniform flow of concrete. At all times after placing of concrete is started and until all the required quantity has been placed, the lower end of the tremie pipe shall be kept below the surface of the plastic concrete and shall not be taken out of concrete. This will cause the concrete to build up from below instead of flowing out over the surface and thus avoid formation of layers of laitance. It is advisable to use retarders or suitable superplasticizers to retard the setting time of concrete, which shall be established before the commencement of work.

**1711****Concreting In Extreme Weather****Concreting in Cold Weather**

Where concrete is to be deposited at or near freezing temperature, precautions shall be taken to ensure that at the time of placing, it has a temperature of not less than 5°C and that the temperature shall be maintained above 4°C until the concrete has hardened. When necessary, concrete ingredients shall be heated before mixing but cement shall not be heated artificially other than by the heat transmitted to it from other ingredients of the concrete. Stock- piled aggregate may be heated by the use of dry heat or steam. Aggregates shall not be heated directly by gas or on sheet metal over fire. In general, the temperature of aggregates or water shall not exceed 65°C. Salt or other chemicals shall not be used for the prevention of freezing.

No frozen material or materials containing ice shall be used. All concrete damaged by frost shall be removed. Concrete exposed to freezing weather shall have entrained air and the water content of the mix shall not exceed 30 litres per 50 kg of cement. To counter slower setting of concrete, accelerators can be used with the approval of the Engineer. However, accelerators containing chloride shall not be used.

**Concreting in Hot Weather**

When depositing concrete in hot weather, precautions shall be taken so that the temperature of wet concrete does not exceed 30°C while placing. This shall be achieved by using chilled mixing water, using crushed ice as a part of mixing water, shading stock piles of aggregates from direct rays of the sun, sprinkling the stock piles of coarse aggregate with water to keep them moist, limiting temperature of cement below 30°C at the time of use, starting curing before concrete dries out and restricting time of concreting as far as possible to early mornings and late evenings. When ice is used to cool mixing water, it will be considered as part of the water in design mix. Under no circumstances shall the mixing operation be considered complete until all ice in the mixing drum has melted. The Contractor will be required to state his methodology for the Engineer's approval when temperatures of concrete are likely to exceed 30°C during the work.

**1712****Protection And Curing****General**

Concreting operations shall not commence until adequate arrangements for concrete curing have been made by the Contractor. Curing and protection of concrete shall start immediately after compaction of the concrete.

The concrete shall be protected from:

- a. Premature drying out particularly by solar radiation and wind
- b. High internal thermal gradients
- c. Leaching out by rain and flowing water
- d. Rapid cooling during the first few days after placing
- e. Low temperature or frost
- f. Vibration and impact which may disrupt the concrete and interfere with its bond to the reinforcement.



- g. Vibration caused by traffic including construction traffic.

Concrete shall be protected, without allowing ingress of external water, by means of wet (not dripping) gunny bags, hessian etc. Once the concrete has attained some degree of hardening (approximate 12 hrs after mixing), moist curing shall commence and be continued through the requisite period. Where members are of considerable size and length, with high cement content, accelerated curing methods may be applied, as approved by the Engineer.

### **Water Curing**

Water for curing shall be as specified in **section 1000** of these specifications. Sea water shall not be used for curing. Sea water shall not come into contact with concrete members before they have attained adequate strength.

The concrete should be kept constantly wet by ponding or covering or use of sprinklers/ perforated pipes for a minimum period of 14 days after concreting, except in the case of concrete with rapid hardening cement, where it can be reduced to 5 days. Water should be applied on surfaces after the final set. Curing through watering shall not be done on green concrete. On formed surfaces, curing shall start immediately after the forms are stripped. The concrete shall be kept constantly wet with a layer of sacking, canvas, hessian or similar absorbent material.

### **Steam Curing**

Where steam curing is adopted, it shall be ensured that it is done in suitable enclosure to contain the live steam in order to minimize moisture and heat losses. The initial application of the steam shall be after about four hours of placement of concrete to allow the initial set of the concrete to take place.

Where retarders are used, the waiting period before application of the steam shall be increased to about six hours.

The steam shall be at 100 percent relative humidity to prevent loss of moisture and to provide excess moisture for proper hydration of the cement. The application of steam shall not be directly on the concrete. Steam curing is applied in enclosures or tunnels through which concrete members are transported on a conveying system. Alternatively, portable enclosures or plastic covers are placed over precast members and steam is supplied to the enclosures. The rate of increase or decrease of temperature should not be more than 10°C to 20°C per hour and the maximum temperature shall be about 70°C. The maximum temperature shall be maintained until the concrete has attained the desired strength required at the end of steam curing period and shall be decided by prior trials. When steam curing is discontinued, the air temperature shall not drop at a rate exceeding 10°C per hour, until a temperature of about 10°C above the ambient temperature outside has been reached. Steam curing of concrete shall be followed by water curing for at least 7 days. The concrete shall not be exposed to temperatures below freezing for at least six days after curing.



## **Curing Compound**

Membrane forming curing compounds consisting of waxes, resins, chlorinated rubbers etc. may be permitted by the Engineer in special circumstances. Curing compounds shall not be used on any surface which requires further finishing to be applied. All construction joints shall be moist cured and no

curing compound shall be permitted in locations where concrete surfaces are required to be bonded together.

Liquid membrane forming compounds shall conform to ASTM C 309 and the curing efficiency shall be as per ASTM C 156.

Curing compounds shall be continuously agitated during use. All concrete cured by this method shall receive two applications of the curing compound.

The first coat shall be applied immediately after acceptance of concrete finish. If the surface is dry, the concrete shall be saturated with water and curing compound applied as soon as the surface film of water disappears. The second application shall be made after the first application has set. Placement in more than two coats may be required to prevent streaking. The membrane formed shall be stripped off after 14 days, when curing is complete. Impermeable membranes, such as sheet materials for curing concrete conforming to ASTM C 171 or polyethylene sheeting covering closely the concrete surface, may also be used to provide effective barrier against evaporation.

## **1713 Finishing**

Immediately after the removal of forms, exposed bars or bolts, if any, shall be cut inside the concrete member to a depth of at least 50 mm below the surface of the concrete and the resulting holes filled with cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honeycomb spots, broken edges or corners, and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar. The mortar shall be of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry a consistency as possible. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been pointed shall be kept moist for a period of twenty four hours. Special pre-packaged proprietary mortars shall be used where appropriate or where specified in the drawing.

All construction and expansion joints in the completed work shall be left carefully tooled and free from any mortar and concrete. Expansion joint filler shall be left exposed for its full length with clean and true edges.

Immediately on removal of forms, the concrete work shall be examined by the Engineer before any defects are made good. The work that has sagged or contains honeycombing to an extent detrimental to structural safety or architectural appearance of the member, shall be rejected. Surface defects of a minor nature may

be accepted. On acceptance of such work, the same shall be rectified as directed by the Engineer.

#### **1714 Concrete with Blended Cements or Mineral Admixtures Production of Concrete**

In order to improve the durability of the concrete, use of blended cement or blending of mineral admixtures, is permitted. The maximum limit of flyash and ground granulated blast furnace slag in concrete, shall be as specified in Clause 1715.2. Blending at site shall be permitted only through a specific facility with complete automated process control to achieve the specified design quality or through RMC plants with similar facility.

#### **Modified Properties**

For concrete made with Portland Pozzolona Cement, Portland Blast furnace slag cement or mineral admixtures, the setting time and rate of gain of strength are

different from those of concrete made with OPC alone. Cognizance of such modified properties shall be taken in deciding de-shuttering time, initial time of restressing, curing period and for early age loading.

#### **Compatibility of Chemical admixtures**

Compatibility of chemical admixtures and superplasticizers with Portland Pozzolona cement, Portland blast furnace slag cement and mineral admixtures shall be ensured by trials outlined in **Clause 1705**.

#### **Additional tests**

In addition to the strength tests prescribed in other Sections of these Specifications, the following additional tests are required to be carried out from considerations of durability.

- i) Rapid Chloride Ion Permissibility Test

Rapid Chloride Ion permeability test on as per ASTM C 1202 at 56 days for extreme, very severe and severe conditions of exposure. The permissible value of Chloride-Ion permeability for extreme condition 800 Coulombs very severe condition 1200 coulombs and severe exposure condition 1500 coulombs.

- ii) Water Permeability Test

Water permeability test as per DIN: 1048 Part 5-1991 shall be carried out as described in Clause 1717.2.5.5.

#### **1715 High Performance Concrete General**

High Performance Concrete shall be used where special performance requirements of high strength, high early strength, high workability, low permeability and high durability for severe service environments, are required. Production and use of such

concrete in the field shall be carried out with high degree of uniformity between batches and very stringent quality control.

### **Materials**

Cement, mineral admixtures, chemical admixtures, aggregates and water shall conform to

**Section 1000** of these Specifications and this Section.

fly ash when used, shall neither be less than 20 percent nor shall be greater than 35 percent of the total by mass of ordinary Portland cement and fly ash and shall conform to grade-1 of IS:3812.

Ground granulated blast furnace (GGBS) slag when used, shall neither be less than 50 percent nor greater than 70 percent of the total mass of ordinary Portland cement and GGBS and shall conform to IS:12089. Silica fume conforming to IS:15388 shall be used.

The cement content of concrete inclusive of any mineral admixtures shall not be less than  $380 \text{ kg/m}^3$ . The cement content excluding any mineral admixtures

(Portland cement content alone) shall not exceed  $450 \text{ kg/m}^3$ . The water/cement (cement plus all cementitious materials) ratio should generally not exceed 0.33 but in no case shall be more than 0.40.

### **Compatibility of admixtures**

Compatibility of the superplasticizer and admixtures with the cement and any other Pozzolanic or hydraulic dilutes shall be ensured by trials as outlined under Clause 1705.

### **Characteristic strength and target Mean strength**

Characteristic strength and the initial target mean strength of concrete, shall be as given in

#### **Table 1700-8.**

The target mean strength shall be calculated as per Clause 1704.2 after obtaining data on standard deviation from sufficient samples.

**Table 1700-8 : Characteristic Compressive strength and target Mean strength**

<b>Grade designation</b>	<b>Specified Compressive strength at 28 days (MPa)</b>	<b>Characteristic strength at 28 days (MPa)</b>	<b>target Mean strength (MPa)</b>
M 40	40		52
M 45	45		58
M 50	50		63
M 55	55		69
M 60	60		74
M 65	65		80

M 70	70	85
M 75	75	90
M 80	80	95
M85	85	101
M90	90	106

### **Workability and other Requirements**

Workability, concrete mix design, field trial mixes, chloride and sulphate contents shall be as laid down in other Sections of these Specifications.

### **Mixing of Concrete**

The concreting plant and means of transportation employed to make trial mixes and to transport them to representative distances shall be similar to the corresponding plant and transport to be used in the works. The optimum sequence of mixing of ingredients shall be established by trials. Mixing time may be longer than in normal grade concrete mixes.

The temperature of concrete at the time of placement shall not exceed 25°C. The temperature of concrete at the mixing stage should be lower, to allow for rise in temperature during transport. When considerable distance of transport is involved, particular attention should be paid to ensure retention of slump as targeted for placement.

**Prototype testing** Mock-up trials or prototype testing may be carried out to ensure that the concrete can be satisfactorily placed and compacted, taking into account the location of placement and Provision of reinforcement, and required adjustments made in concrete mix design and/or detailing of reinforcement.

### **Curing of Concrete**

High performance concrete containing silica fume is more cohesive than normal mixes hence, there is a little or no bleeding and no bleed water to rise to the surface to offset water loss due to evaporation. Plastic shrinkage cracking is possible, if curing is not proper. Initial curing should commence soon after initial setting of concrete. Concrete should be covered with moist covers, opaque colour plastic sheets or suitable curing compound. Final moist curing should commence after final setting of concrete and continue for at least 14 days.

### **Additional tests for Concrete**

Apart from the strength tests prescribed in other Sections of these Specifications, the additional tests as specified under Clause 1714.3, shall also be carried out.

## **1716 Tolerances**

Tolerances for dimensions/shape of various components shall be as indicated in these Specifications or shown on the drawings or as directed by the Engineer.

## **1717 Tests and standards of acceptance**

Concrete shall conform to the surface finish and tolerance as prescribed in these Specifications for respective components.

Random sampling and lot by lot acceptance inspection, shall be made for the 28 days cube strength of concrete.

Concrete under acceptance, shall be notionally divided into lots for the purpose of sampling before commencement of work. The basis of delimitation of lots shall be as follows:

- i) No individual lot shall be more than 30 cu.m in volume
- i) Different grades of mixes of concrete shall be divided into separate lots.
- ii) Concrete of a lot shall be used in the same identifiable component of the bridge.

## **Sampling and testing**

Concrete for preparing 3 test cubes shall be taken from a batch of concrete at point of delivery for construction, according to procedure laid down in IS: 1199.

A random sampling procedure shall be adopted which ensures that each of the concrete batches forming the lot under acceptance inspection has equal chance of being chosen for taking cubes. 150 mm cubes shall be made, cured and tested at the age of 28 days for compressive strength in accordance with IS:516. The 28 day test strength result for each cube shall form an item of the sample. Tests at other age shall also be performed, if specified. Where automated batching plant/Ready Mixed Concrete Plant is located away from the place of use and the time gap between production and placement is more than the initial setting time or where any

Ingredients are added subsequent to mixing, separate sets of samples shall be collected and tested at batching plant and at location of placement. The results shall be compared and used to make suitable adjustment at batching plants so that properties of concrete at placement are as per the requirements.

## **Test specimen and sample strength**

Three test specimens shall be made from each sample for testing at 28 days. Additional cubes may be required for various purposes such as to determine the strength of concrete at 7 days or for any other purpose.

The test strength of the sample shall be the average of the strength of 3 cubes. The individual variation should not be more than  $\pm 15$  percent of the average.

If variation is more, the test results of the sample are invalid.

Frequency

The minimum frequency of sampling of concrete of each grade shall be in accordance with Table 1

**Table 1700-9 : Minimum Frequency of sampling**

<b>Quantity of Concrete in Work,</b>	<b>no. of samples</b>
1 – 5	1
6 – 12	2
For more than 12 CuM upto 150 CuM	1 set for each 6 to 9 CuM or per transit mixture
More than 150 CuM	1 set for each 6 to 9 CuM or per transit mixture or mutually decided by client and contractor

At least one sample shall be taken from each shift of work.

### **Special Condition**

**The contractor at his own expense shall carry out adequate no of NDT tests i.e. UPV test & Rebound hammer test to confirm the quality of work done as Per tender specification no separate payment for NDT test will be given to the contractor. The said NDT is mandatory as pre commission check list. Bill process for payment can be initiated after submission of reports only.**

## Acceptance Criteria

**Compressive Strength – for cube sample collected during cast in situ at site**

### Concrete Grade and Criteria of Acceptance-

	Coulmn A	Column B	Column C	Column D	Column E	Column F	Column G
Sr No	Cement Concrete Grade	28 days Characteristic Strength in N/mm2 in field for actual casting work	Target compressive strength for Cube at 28 days in N/mm2	Minimum Ordinary Portland Cement content per Cubic meter	Minimum req strength of Cube at 7 days	Minimum req strength of Cube at 28 days in N/mm2	Action
1	M-7.5 for PCC Work	7.5 N/mm2	13.28	160 kg	8.89	13.28	
2	M-10 for PCC Work	10 N/mm2	15.78	220 kg	10.57	15.78	
3	M-15 for PCC Work	15 N/mm2	25.00	290 kg	16.75	25.00	
4	M-20 for RCC Work	20 N/mm2	30.00	360 kg	20.10	30.00	
5	M-25 for RCC Work	25 N/mm2	36.00	380 kg	24.12	36.00	
6	M-30 for RCC Work	30 N/mm2	42.00	410 kg	28.14	42.00	
7	M-35 for RCC Work	35 N/mm2	47.00	425 kg	31.49	47.00	
8	M-40 for RCC Work	40 N/mm2	52.00	440 kg	34.84	52.00	
9	M-45 for RCC Work	45 N/mm2	58.00	450 kg	38.86	58.00	

10	M-50 for RCC Work	50 N/mm2	63.00	465 kg	42.21	63.00
11	M-55 for RCC Work	55 N/mm2	69.00	480 kg	46.23	69.00
12	M-60 for RCC Work	60 N/mm2	74.00	495 kg	49.58	74.00
13	M-65 for RCC Work	65 N/mm2	80.00	510 kg	53.60	80.00
14	M-70 for RCC Work	70 N/mm2	85.00	525 kg	56.95	85.00
15	M-75 for RCC Work	75 N/mm2	90.00	540 kg	60.30	90.00
16	M-80 for RCC Work	80 N/mm2	95.00	555 kg	63.65	95.00
17	M-85 for RCC Work	85 N/mm2	101.00	570 kg	67.67	101.00
18	M-90 for RCC Work	90 N/mm2	106.00	585 kg	71.02	106.00

#### Clarification

1	Cube Sample may be collected as per Transite mixer/batch of fresh concrete (from 0.01 CuM to 12 CuM). For such samples, Testing for each set should be carried in NABL approved lab instructed by Engineer-in-chagre and expense for sampling, transportation, testing have to be born by Bidder/Contractor
2	However sample of consecutive or non consecutive will be decided by Engineer-in-charge
3	Each concrete work will be mentioned on site with red paint including details of casting of concrete date and grade
4	Clarification 1 is for Departmental Collection of concrete cube, however Vigilance Tech can order for separate and additional sample from any batches
5	In any case, Sample of Vigilance and Departmental Sample have deviation, difference; the action may be taker with consideration of worst value of concrete cube
6	Rajkot Municipal Corporation gives the concrete rate with criteria of Minimum cement consupction . for the same; in any case, actual Sample of Concrete(core ) pass as per Column B , but Value/result is lower than the value mentioned in Column F, Engineer -in-charge have right to take decision on merit- demerit base for reduce rate as per pro-rate basis on cement consumption
7	Interpretation: In any para of tender. If any specification shown easy parameter rather than mentioned strict parameter anywhere in tender or either in any IRC, IS, Morth specifications; strick paramenter should be in consideration



1) **Cubes**

The concrete shall be taken as having the specified compressive strength when both the following conditions are met:

- a) The mean strength determined from any group of four consecutive non-overlapping samples exceeds the specified characteristic compressive strength by 3 MPa.
- b) Strength of any sample is not less than the specified characteristic compressive strength minus 3 MPa.

The quantity of concrete represented by the test results include the batches from which the first and last samples were taken, together with all intervening batches.

2) **Cores**

When the concrete does not satisfy both the conditions given in (1) above, representative cores shall be extracted from the hardened concrete for compression test in accordance with the method described in IS: 1199 and tested to establish whether the concrete satisfies the requirement of

Compressive strength. Evaluation of compressive strength by taking cores may also be done in case of doubt regarding the grade of concrete used either due to poor workmanship or based on results of cube strength tests.

The locations from which core samples are to be taken and their number shall be decided so as to be representative of the whole of the concrete under consideration.

However, in no case shall fewer than three cores be tested. Cores shall be prepared and tested as described in

IS: 516. Concrete in the member represented by a core test shall be considered acceptable if the average equivalent cube strength of the cores is equal to at least 85 percent of the cube strength of the grade of concrete specified for the corresponding age and no individual core has strength less than 75 percent of the specified strength.

**Chloride and sulphate Content**

The total chloride and sulphuric anhydride (SO) content of all the constituents of concrete as a percentage of mass of cement in the mix, shall not exceed the values given in this Section.

**Density of Fresh Concrete**

Where minimum density of fresh concrete is specified, the mean of any four consecutive non-overlapping samples shall not be less than the specified value and any individual sample result shall not be less than 97.5 percent of the specified value.

**Density of Hardened Concrete**

Where minimum density of hardened concrete is specified, the mean of any four consecutive non-overlapping samples shall not be less than the specified value and any individual sample result shall not be less than 97.5 percent of the specified value.

**Permeability test**

Water permeability test as per DIN:1048 Part 5-1991 shall be carried out as described below

- i) A cylindrical test specimen 150 mm dia and 160 mm high shall be prepared.
- ii) After 28 days of curing, the test will be conducted between 28 and 35 days. The test specimen shall be fitted in a machine such that specimen can be subjected to a water pressure of up to 7 bars. A typical machine is shown in Appendix-1700/1.
- iii) The concrete specimen shall be subjected to a water pressure of 0.5 N/mm<sup>2</sup> from the top for a period of 3 days. The pressure shall be maintained constant throughout the test period. If the water penetrates through to the underside of the specimen, the test may be terminated and the specimen rejected as failed.
- iv) After 3 days, the pressure shall be released and the sample shall be taken out. The specimen shall be split in the middle by compression applied on two round bars on opposite sides above and below.
- v) When the split faces show signs of drying (after 5 to 10 minutes), the maximum depth of penetration in the direction of height shall be measured with the scale and extent of water

vi) penetration established.

vii) The mean of maximum depth of penetration obtained from three specimens thus tested, shall be taken as the test result and it shall not exceed 25 mm.

If the concrete is not able to meet any of the standards of acceptance as prescribed, the effect of such deficiency on the structure shall be investigated by the Contractor as directed by the Engineer. The Engineer may accept the concrete as sub-standard work. Any additional work required by the Engineer for such acceptance, shall be carried out by the Contractor at his cost. In case the concrete is not found to be acceptable even after investigation, the Contractor shall remove the rejected concrete forthwith.

When durability of concrete is desired the rapid chloride ion permeability test as stated under Clause 1714.3.1 shall also be performed in addition to above tests.

#### **1718 Measurements For Payment**

Structural concrete shall be measured in cubic meters. In reinforced or prestressed concrete, the volume occupied by reinforcement or prestressing cables and sheathing shall not be deducted. The slab shall be measured as running continuously through and the beam as the portion below the slab.

#### **1719 Rate**

The contract unit rate for structural concrete shall cover costs of all materials, labour, tools, plant and equipment required for mixing, transporting and placing in position, vibrating and compacting, finishing and curing as per this Section or as directed by the Engineer, including all incidental expenses, sampling and testing, quality assurance and supervision. Unless mentioned separately as an item in the contract, the contract unit rate for concrete shall also include the cost of providing, fixing and removing formwork

Required for concrete work as per **section 1500** of these Specifications.

If the concrete is found to be acceptable by the Engineer as sub-standard work, the Contractor shall be subjected to reduction in his contract unit rate. For deficiency in compressive strength of concrete when accepted by the Engineer, the reduction in rate shall be applied as under:

$$\text{Percentage reduction in rate} = \frac{\text{Design Strength} - \text{Observed Strength}}{\text{Design Strength}} \times 100$$

## **Item No.13, 14,15,16. Road Item No. 6 ,26 ,27 & 28**

**Providing and fixing in position Fe 550D TMT bar reinforcement including cutting, bending and tying complete as per detailed drawings.**

### **MORT&H Specifications Section (5th Revision) : 1600.**

#### **1601 Description**

This work shall consist of furnishing and placing coated or uncoated mild steel or high strength deformed reinforcement bars of the shape and dimensions shown on the drawings and conforming to these Specifications or as approved by the Engineer.

#### **1602 General**

Steel for reinforcement shall meet the requirements of section 1000 of these Specifications. Reinforcements may be either mild steel or high strength deformed bars. They may be uncoated or coated with epoxy.

#### **1603 Protection of Reinforcement**

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 by thoroughly cleaning it using any suitable method such as sand blasting, mechanical wire brushing etc., as directed by the Engineer. Reinforcements shall be stored above the ground in a clean and dry condition, on blocks, racks or platforms and shall be suitably marked to facilitate inspection and identification. 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. In case of fusion bonded epoxy coated reinforcement or hot dipped galvanized bars used, reference shall be made Clause 1010.3.2 of Section 1000 of these specifications.

#### **1604 Bending Of Reinforcement**

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

#### **Steel Reinforcement Section 1600**

Reinforcing steel shall conform to the dimensions and shapes given in the approved Bar Bending Schedules.

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

Bars shall not be bent or straightened in a manner that will damage the parent material or the coating.

Bars bent during transport or handling shall be straightened before being used on work. They shall not be heated to facilitate straightening.

#### **1605 Placing Of Reinforcement**

- a) 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

- b) when the structure is otherwise ready for placing of concrete. Prolonged time gap between assembling of reinforcement and casting of concrete, which may result in rust formation on the surface of the bars, shall not be permitted.

b) 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.

c) Bars shall be kept in position usually by the following methods:

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

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

iii) Layers of reinforcements shall be separated by spacer bars at approximately one metre 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

Steel Reinforcement Section 1600 not be allowed to sag between supports.

- iii) Necessary stays, blocks, metal chairs, spacers, metal hangers, supporting wires etc. or other

- iv) subsidiary reinforcement shall be provided to fix the reinforcement firmly in its correct position.

v) Use of pebbles, broken stone, metal pipe, brick, mortar or wooden blocks etc., as devices for positioning reinforcement shall not be permitted. d) Bars coated with epoxy shall be placed on supports that do not damage the coating. Supports shall be installed in a manner such that planes of weakness are not created in hardened concrete. The coated reinforcing steel shall be held in place by use of plastic or plastic coated binding wires especially manufactured for the purpose. Refer Section 1000 of these Specifications for other requirements') Placing and fixing of reinforcement shall be inspected and approved by the Engineer before concreting is commenced.

### **1606 Bar Splices**

Lapping all reinforcement shall be furnished in full lengths as indicated on the drawing. No splicing of bars, except where shown on the drawing, shall 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 25 mm or 1.25 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. Welding 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. While welding may be permitted for mild steel 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 Fe 240 grade including special

Section 1600 Steel Reinforcement welding grade of Fe 415 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 is 0.4 or less. The method of welding shall conform to IS:2751 and IS:9417, any Supplemental specifications and Clause 1904.8 of these Specifications to the satisfaction of the Engineer. Welding may be carried out by metal arc welding process. Oxy-acetelene welding shall not be permissible. Any other process may be used subject to the approval of the Engineer and necessary additional requirements to ensure satisfactory joint performance. Precautions on overheating, choice of electrode, selection of correct current in arc welding etc., should be strictly observed. All bars shall be butt welded except for smaller diameter bars (diameter of less than 20 mm) which may be lap welded.

Single-V or Double-V butt joints may generally be used. For vertical bars single bevel or double bevel joints may be used. Welded joints shall be located well away from bends and shall be not less than twice the bar diameter away from a bend. Generally, shop welding in controlled conditions is to be preferred, where feasible. Site welding where necessary shall, however, be permitted when the facilities, equipment, process, consumables, operators and welding procedure, are adequate to produce and maintain uniform quality at par with that attainable in shop welding, to the satisfaction of the Engineer. Joint welding procedures which are to be employed shall invariably be established by procedure specification. All welders and welding operators to be employed shall be qualified by tests prescribed in IS:2751. Inspection of welds shall conform to IS:822 and destructive or non- destructive testing may be undertaken when deemed necessary. Joints with weld defects detected by visual inspection or dimensional check inspection, shall not be accepted. Suitable means shall be provided for holding the bars securely in position during welding. It must be ensured that no voids are left in welding. When welding is done in two or three stages, the surface shall be cleaned properly after each stage. Bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before carrying out welding. Only competent and experienced welders shall be employed on the work with the Approval of the Engineer. No welding shall be done on coated bars. M.S. electrodes used for welding shall conform to IS: 814. Substructure Section 2200 Welded joints shall preferably be located at points where steel will not be subject to more

than 75 percent of the maximum permissible stresses and welds so staggered that at any one section, not more than 20 percent of the bars are welded. Specimens of welded pieces of reinforcement taken from the site, shall be tested. The number and frequency of tests shall be as directed by the Engineer.

## **Mechanical Couplers and Anchorages**

### **Mechanical Couplers**

Bars may be joined with approved patented mechanical devices as indicated on the drawing or as approved by the Engineer e.g. by special grade steel sleeves swaged on to bars in end to end contact or by screwed couplers. In case such devices are permitted by the Engineer, they shall develop at least 125 percent of the characteristic strength of the Reinforcement bar.

### **Anchorage**

Bars may be anchored with approved patented mechanical anchorages as indicated on the drawing or as approved by the Engineer. The anchorages shall be connected to the reinforcing bar by the use of taper thread system. The anchorage shall be capable of developing the characteristic strength of reinforcement without damage to concrete and shall have sufficient diameter and width to develop adequate shear cone strength. The connection shall develop 125% of the characteristic strength of reinforcement bar.

### **1607 Testing And Acceptance**

The material shall be tested in accordance with relevant IS specifications and necessary test certificates shall be furnished. Additional tests, if required, will be got carried out by The Contractor at his own cost. The supply, fabrication and placing of reinforcement shall be in accordance with These Specifications and shall be as checked and accepted by the Engineer. Manufacturer's test certificate regarding compliance with Indian Standards for each lot of Steel, shall be obtained and submitted to the Engineer. If required by the Engineer, the Contractor shall carry out confirmatory tests in the presence of a person authorized by the Engineer. Cost of these tests shall be borne by the Contractor. The sampling and Testing procedure shall be as laid down in IS:1786. If any test piece selected from a lot fails, no re-testing shall be done and the lot shall be rejected.

### **1608 Measurement For Payment**

Reinforcement shall be measured in length including hooks, if any, separately for different diameters as actually used in work, excluding overlaps. From the length so

Measured, the weight of reinforcement shall be calculated in tones on the basis of

### **Substructure Section 2200**

IS:1732. Wastage, overlaps, couplings, welded joints, spacer bars, chairs, stays, hangers and annealed steel wire or other methods for binding and placing, shall not be measured and cost of these items shall

be deemed to be included in the rates for reinforcement.

As per Schedule mod of measurement for this item is tones.

### **1609 Rate**

The contract unit rate for coated/uncoated reinforcement shall cover the cost of material, royalty, fabricating, transporting, storing, bending, placing, binding and fixing in position as shown on the drawings and as per these Specifications and as directed by the Engineer, including all labour, equipment, supplies, incidentals, sampling, testing and supervision. The unit rate for coated reinforcement shall be deemed to also include cost of all material, labour, tools and plant, royalty, transportation and expertise required to carry out the coating work as well as sampling, testing and supervision required for the work

**Item No. 18**

**Providing & laying weep hole in External walls and Retaining walls by using AC/UPVC/HDP pipe of 100mm including laying in proper grade and jointing the completed as per detailed Specification.**

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

**Item No. 19**

**Providing and filling sand behind Box Culvert and between Retaining Wall/Tow Wall in Layers as directed**

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

**Item No. 20**

**Providing and laying - Filter Media 600mm thick directed at the back of External walls Retaining walls as per detailed specifications.**

MORT&H specifications as in section 2504 (5th Revision) shall be followed in connection with this item. All relevant provisions as have been included in the respective IRC and IS code specification are also applicable.

The measurement shall be in square meter.

The rate includes all materials, labor, and everything required to execute this item.

- 1 Well graded pebbled or metal of 40 mm to 63 mm. size shall be used. The grading and tolerances of metal of pebbles shall be as under: -

Sr. No.	No. of Size Range	Sieve designation	Percentage by weight passing through the Sieve
1	63 mm. to 40 mm	90 mm.	100-00
		63 mm.	85-100
		50 mm.	35-70
		40 mm.	00-15
		20 mm.	00-05

The size shall be 40 mm. to 63 mm. where in tolerance limit for oversize shall be up to 15% and that for lower size should be up to 15% and below 20 mm. it shall be allowable up to 5% the filter Materials shall be tightly placed to a thickness of not less than 600 mm. and provided over the entire surface behind

Abutments, wings or return walls to the full height.



- 2 Materials shall be first stacked in boxed of 2 m. 1. 1/2 m. X 0.5 m. size on fairly level ground and measured.
- 3 **The measurement for payment shall be made on Sq. basis of Specified Thickness.**
- 4 The unit rate includes the cost of materials, scaffolding labour and tools to complete the work.

### **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 buildup of uplift head on the pitching.

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

$$\frac{D 15 (Filter)}{D 85 (Base)} < 5$$
$$4 < \frac{D 15 (Filter)}{D 15 (Base)} < 20$$

$$\frac{D 50 (Filter)}{D 50 (Base)} < 25$$

Notes:

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

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).

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.

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.

**Item No. 22****Providing P.V.C. 100 mm diameter water spouts including necessary iron gratings as per Drawings**

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

**MORTH Vth REVISION Cl. No. 2705, Pg. no. 754****2705 Drainage Spouts**

Drainage along longitudinal direction shall be ensured by sufficient number of drainage fixtures embedded in the deck slab. The spouts shall be of not less than 100 mm in diameter and shall be of corrosive resistant material such as galvanised steel with suitable cleanout fixtures. The spacing of drainage spouts shall not exceed 10 m. The discharge from drainage spout shall be kept away from the deck structure by means of suitable down pipes upto 500 mm above High Flood Level. In case of viaducts in urban areas, the drainage spouts should be connected with suitably located runners and down pipes to discharge the surface run-off into drains provided at ground level.

**Fabrication**

The drainage assembly shall be fabricated to the dimensions shown on the drawings. All materials shall be corrosion resistant; Steel components shall be of mild steel conforming to IS:226. The drainage assembly shall be seam welded for water tightness and then hot-dip galvanised.

**Placement**

The galvanised assembly shall be given two coats of bituminous paint before placement. The whole assembly shall be placed in true position, lines and levels as shown on the drawings with necessary cut-outs in the shuttering for deck slab and held in place firmly. Where the reinforcements of the deck are required to be cut, equivalent reinforcements shall be placed at the corners of the cut out.

**Finishing**

After setting of the deck slab concrete, the shrinkage cracks around the assembly shall be sealed with polysulphide sealant or bituminous sealant as per IS:1834 and the excess sealant trimmed to receive the wearing coat. After the wearing coat is completed, similar sealant shall be provided to cover at least 50 mm on the wearing coat surface all-round the drainage assembly.

**2708 Measurements for Payment**  
**Drainage spouts shall be measured in numbers.****2709 Rate**

The contract unit rate for drainage spout shall include the cost of all labour, material, tools and plant required for completing the work as per these Specifications. It shall also include the cost of providing runners and down pipes with all fixtures upto 500 mm above high flood level or up to the drains at ground, as applicable or as shown on the drawings.

**Item No. 24**

**Providing and laying boulders apron on river bed for protection against scour with stone Boulders weighing not less than 40 kg each complete as per drawing and technical specification.**

**MORTH Vth REVISION: Cl. No. 2505, Pg. no. 711**

**2505.1 Rubble stone/cement concrete block flooring over cement concrete bedding**

The work shall consist of constructing rubble stone/cement concrete block flooring laid over a bedding of cement concrete (M15).

Excavations for laying the bedding and floor protection works shall be carried out as per specifications under proper supervision. Before laying the foundation and protection walls, the excavated trenches shall be inspected by the Engineer to ensure that:

- a) There are no loose pockets and unfilled depressions left in the trench.
- b) The soil at the founding level is properly compacted to true lines and level so as to have an even bedding.
- C) All concrete and other elements are laid in dry bed.

Bedding of cement concrete nominal mix (grade M15) of 300 mm thickness shall then be laid in accordance

with Section 1700 of these Specifications except that the surface of the concrete shall not be given a smooth finish. Flooring shall consist of 150 mm thick flat stone/cement concrete block M15 grade conforming to Section 1700 of these Specifications. It shall be bedded on a layer of cement mortar (1:3) prepared to Section 1300 of these Specifications. Spalls shall be used to fill in the voids. The joints shall be filled with cement mortar and finished neat. The stone shall break joints and the thickness of joints shall not exceed 20 mm. The top of flooring shall be kept 300 mm below the lowest bed level.

**2509 MEASUREMENTS FOR PAYMENT**

Rubble stone/cement concrete block flooring and cement concrete bedding shall be measured in cubic meters for each class of material.

As per Schedule mod of measurement for this item is Cu.m.

**2510 RATE**

The contract unit rate for rubble stone/cement concrete block flooring shall include the cost of all material, labour and tools and plant for completing the work as per specifications for the relevant item.

**\*\***

**Providing and laying Pitching on slopes laid over prepared filter media including boulder apron laid dry in front of toe of embankment complete as per drawing and Technical specifications**

**MORTH Vth REVISION VTH REVISION: Cl. No. 2500, Pg. no. 703**

**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. Where the stones of required size are not economically available, cement concrete blocks in minimum M15 grade concrete conforming to Section 1700 of these Specifications or stones in wire crates, shall be used. Geosynthetics, if used in pitching, shall conform to Section 700 of these Specifications.

### **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 (uncaused) 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.

### **2504.4 Toe Protection**

A toe wall shall be provided at the junction of slope pitching and launching apron of a guide bund so as to prevent the slope pitching from sliding down. The toe wall shall be in dry rubble masonry (uncaused) conforming to Section 1400 of these Specifications or in cement concrete of M15 grade. The pitching/revetment shall be of stones in wire crates or cement concrete blocks in M15 grade. For protection of ties of bank slopes terminating either in short aprons at bed levels or anchored in flooring/rocky bed, the provision of Clause 8.2.2 of IRC: 89 may be complied with.

### **2509 MEASUREMENTS FOR PAYMENT**

The filter and stone pitching shall be measured separately in cubic metres unless otherwise specified. As per Schedule mod of measurement for this item is Cu.m

## **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.

### **Item No. , 35. Road Item No2.**

**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. (E) From Borrow area within 3.0 Km. lead 100mm extra taken for stage construction.**

## **305 Embankment construction**

### **305.1 General**

#### **Description**

These Specifications shall apply to the construction of embankments including sub-grades, earthen shoulders and miscellaneous backfills with approved material obtained from approved source, including material from roadway and drain excavation, borrow pits or other sources. All embankments sub-grades, earthen shoulders and miscellaneous backfills shall be constructed in accordance with the requirements of these Specifications and in conformity with the lines, grades, and cross-sections shown on the drawings or as directed by the Engineer.

### **305.2 Materials and general requirements**

#### **305.2.1 Physical requirements**

The materials used in embankments, subgrades, earthen shoulders and miscellaneous backfills shall be soil, moorum, gravel, reclaimed material from pavement, fly ash, pond ash, a mixture of these or any other material as approved by the Engineer. Such materials shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate or affect the stability of the embankment.

The following types of material shall be considered unsuitable for embankment:

- a) Materials from swamps, marshes and bogs;
- b) Peat, log, stump and perishable material; any soil that classifies as OL, OI, OH or Pt in accordance with IS:1498;
- c) Materials susceptible to spontaneous combustion;
- d) Materials in a frozen condition;
- e) Clay having liquid limit exceeding 50 and plasticity index exceeding 25; and
- f) Materials with salts resulting in leaching in the embankment.

Expansive clay exhibiting marked swell and shrinkage properties ("free swelling index" exceeding 50 percent when tested as per IS:2720 – Part 40) shall not be used as a fill material. Where an expansive clay having "free swelling index" value less than 50 percent is used as a fill material, subgrade and top 500 mm portion of the embankment just below sub-grade shall be non-expansive in nature.

Any fill material with a soluble sulphate content exceeding 1.9 grams of sulphate (expressed as SO ) per liter when tested in accordance with BS:1377, Part 3, but using a 2:1 water-soil ratio shall not be deposited within 500 mm distance(or any

other distance described in the Contract), of permanent works constructed out of concrete, cement bound materials or other cementitious material.

Materials with a total sulphate content (expressed as SO) exceeding 0.5 percent by mass, when tested in accordance with BS:1377, Part 3 shall not be deposited within 500 mm, or other distances described in the Contract, of metallic items forming part of the Permanent Works.

The size of the coarse material in the mixture of earth shall ordinarily not exceed 75 mm when placed in the embankment and 50 mm when placed in the sub-grade. However, the Engineer may at his discretion permit the use of material coarser than this also if he is satisfied that the same will not present any difficulty as regards the placement of fill material and its compaction to the requirements of these Specifications. The maximum particle size in such cases, however, shall not be more than two-thirds of the compacted layer thickness.

Ordinarily, only the materials satisfying the density requirements given in Table 300-1 shall be employed for the construction of the embankment and the sub-grade.

**Table 300-1 : density requirements of embankment and sub-grade Materials**

s.	type of work	Maximum laboratory dry unit
1)	Embankments up to 3 m height,	Not less than 15.2 kN/cu.m
2)	Embankments exceeding 3 m height or embankments of any height subject to	Not less than 16 kN/ cu.m
3)	Subgrade and earthen	Not less than 17.5 kN/cu.m

**Notes:** 1) This Table is not applicable for lightweight fill material, e.g., cinder, fly ash, etc.

- 2) The material to be used in subgrade shall be non-expansive and shall satisfy design CBR at the specified dry density and moisture content. In case the available materials fail to meet the requirement of CBR, use of stabilization methods in accordance with Clauses 403 and 404 or by any stabilization method approved by the Engineer shall be followed.

The material to be used in subgrade shall conform to the design CBR value at the specified dry density and moisture content of the test specimen. In case the available materials fails to meet the requirement of CBR, use of stabilization methods in accordance with Clauses 403 and 404 or by any stabilization method approved by the Engineer or by the IRC Accreditation Committee shall be followed.

The material to be used in high embankment construction shall satisfy the specified requirements of strength parameters.

### **305.2.2 General requirements**

The materials for embankment shall be obtained from approved sources with preference given to acceptable materials becoming available from nearby roadway excavation under the same Contract. The work shall be so planned and executed that the best available materials are saved for the subgrade and the embankment portion just below the subgrade.

### **Borrow Materials**

The arrangement for the source of supply of the material for embankment and sub-grade and compliance with the guidelines, and environmental requirements, in respect of excavation and borrow areas as stipulated, from time to time by the Ministry of Environment and Forests, Government of India and the local bodies, as applicable shall be the sole responsibility of the Contractor. Borrow pits along the road shall be discouraged. If permitted by the Engineer, these shall not be dug continuously.

Ridges of not less than 8 m width should be left at intervals not exceeding 300 m. Small drains shall be cut through the ridges to facilitate drainage. The depth of the pits shall be so regulated that their bottom does not cut an imaginary line having a slope of 1 vertical to 4 horizontal projected from the edge of the final section of the bank, the maximum depth in any case being limited to 1.5 m. Also, no pit shall be dug within the offset width of a minimum of 10 m. Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction plant is operating at the place of deposition. Where the excavation reveals a combination of acceptable and unacceptable materials, the Contractor shall, unless otherwise agreed by the Engineer, carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the permanent works without contamination by the unacceptable materials. The acceptable materials shall be stockpiled separately. The Contractor shall ensure that he does not adversely affect the stability of excavation or fills by the methods of stockpiling materials, use of plants or siting of temporary buildings or structures

### **fly-ash**

Use of fly-ash shall conform to the Ministry of Environment and Forest guidelines. Where fly-ash is used the embankment construction shall conform to the physical and chemical properties and requirements of IRC:SP:38-2001, "Guidelines for Use of Flyash in Road Construction". The term fly-ash shall cover all types of coal ash such as pond ash, bottom ash or mound ash.

Embankment constructed out of fly ash shall be properly designed to ensure stability and protection against erosion in accordance with IRC guidelines. A suitable thick cover may preferably be provided at intervening layers of pond ash for this purpose. A thick soil cover shall bind the edge of the embankment to protect it against erosion. Minimum thickness of such soil cover shall be 500 mm.

### **compaction requirements**

The Contractor shall obtain representative samples from each of the identified borrow areas and have these tested at the site laboratory following a testing programmer approved by the Engineer. It shall be ensured that the subgrade material when compacted to the density requirements as in Table 300-2 shall yield the specified design CBR value of the sub-grade.

**table 300-2 : compaction requirements for embankment and sub-grade**

<b>s. no.</b>	<b>type of work/material</b>	<b>relative compaction as percentage of max. laboratory dry density as per is:2720 (part 8)</b>
1)	Subgrade and earthen shoulders	Not less than 97%
2)	Embankment,	Not less than 95%
3)	Expansive Clays a) Subgrade and 500 mm portion just below the subgrade b) Remaining portion of embankment	Not allowed 90-95%

The Contractor shall at least 7 working days before commencement of compaction submit the following to the Engineer for approval:



- i) The values of maximum dry density and optimum moisture content obtained in accordance with IS:2720 (Part 8), appropriate for each of the fill materials he intends to use.
- ii) A graph of dry density plotted against moisture content from which each of the values in (i) above of maximum dry density and optimum moisture content were determined.

The maximum dry density and optimum moisture content approved by the Engineer shall form the basis for compaction.

### **305.3 Construction operations**

#### **305.3.1 Setting out**

After the site has been cleared to Clause 201, the work shall be set out to Clause 301.3.1 The limits of embankment/sub-grade shall be marked by fixing batter pegs on both sides at regular intervals as guides before commencing the earthwork. The embankment/sub-grade shall be built sufficiently wider than the design dimension so that surplus material may be trimmed, ensuring that the remaining material is to the desired density and in position specified and conforms to the specified side slope

#### **305.3.2 Dewatering**

If the foundation of the embankment is in an area with stagnant water, and in the opinion of the Engineer it is feasible to remove it, the same shall be removed by bailing out or pumping, as directed by the Engineer and the area of the embankment foundation shall be kept dry. Care shall be taken to discharge the drained water so as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair/restore it to original condition or compensate for the damage at his own cost.

If the embankment is to be constructed under water, Clause 305.4.6 shall apply

#### **305.3.3 Stripping and storing topsoil**

When so directed by the Engineer, the topsoil from all areas of cutting and from all areas to be covered by embankment foundation shall be stripped to specified depths not exceeding 150 mm and stored in stockpiles of height not exceeding 2 m for

Covering embankment slopes, cut slopes and other disturbed areas where re-vegetation is desired. Topsoil shall not be unnecessarily subjected to traffic either before stripping or when in a stockpile. Stockpiles shall not be surcharged or otherwise loaded and multiple handling shall be kept to a minimum.

#### **305.3.4 Compacting ground supporting embankment/sub-grade**

Where necessary, the original ground shall be levelled to facilitate placement of first layer of embankment, scarified, mixed with water and then compacted by rolling in accordance with Clauses 305.3.5 and 305.3.6 so as to achieve minimum dry density as given in Table 300-2.

In case where the difference between the sub-grade level (top of the sub-grade on which pavement rests) and ground level is less than 0.5 m and the ground does not have 97 percent relative compaction with respect to the dry density (as given in Table 300-2), the ground shall be loosened upto a level 0.5 m below the sub-grade level, watered and compacted in layers in accordance with Clauses 305.3.5 and

305.3.6 to achieve dry density not less than 97 percent relative compaction as given in Table 300-2.

Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation (500 mm portion just below the sub-grade) shall be

removed, suitably disposed and replaced by approved materials laid in layers to the required degree of compaction.

Any foundation treatment specified for embankments especially high embankments, resting on suspect

foundations as revealed by borehole logs shall be carried out in a manner and to the depth as desired by the Engineer. Where the ground on which an embankment is to be built has any of such material types (a) to (f) in Clause 305.2.1.1 at least 500 mm of such material must be removed and replaced by acceptable fill material before embankment construction commences.

### **305.3.5 spreading Material in layers and Bringing to appropriate Moisture content**

The embankment and sub-grade material shall be spread in layers of uniform thickness in the entire width with a motor grader. The compacted thickness of each layer shall not be more than 250 mm when vibratory roller/vibratory soil compactor is used and not more than 200 mm when 80-100 kN static roller is used. The motor grader blade shall have hydraulic control suitable for initial adjustment and maintain the same so as to achieve the specific slope and grade. Successive layers shall not be placed until the layer under construction has been thoroughly compacted to the specified requirements as in Table 300-2 and got approved by the Engineer. Each compacted layer shall be finished parallel to the final cross-section of the embankment.

Moisture content of the material shall be checked at the site of placement prior to commencement of compaction; if found to be out of agreed limits, the same shall be made good. Where water is required to be added in such constructions, water shall be sprinkled from a water tanker fitted with sprinkler capable of applying water uniformly with a controllable rate of flow to variable widths of surface but without any flooding. The water shall be added uniformly and thoroughly mixed in soil by blading, using disc harrow until a uniform moisture content is obtained throughout the depth of the layer.

If the material delivered to the roadbed is too wet, it shall be dried, by aeration and exposure to the sun, till the moisture content is acceptable for compaction. Should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedure, compaction work shall be suspended.

Moisture content of each layer of soil shall be checked in accordance with IS:2720 (Part 2), and unless otherwise mentioned, shall be so adjusted, making due allowance for evaporation losses, that at the time of compaction it is in the range of 1 percent above to 2 percent below the optimum moisture content determined in accordance with IS:2720 (Part 8) as the case may be. Expansive clays shall, however, be compacted at moisture content corresponding to the specified dry density, but on the wet side of the optimum moisture content obtained from the laboratory compaction curve.

After adding the required amount of water, the soil shall be processed by means of graders, harrows, rotary mixers or as otherwise approved by the Engineer until the layer is uniformly wet. Clods or hard lumps of earth shall be broken to have a maximum size of 75 mm when being placed in the embankment and a maximum size of 50 mm when being placed in the sub- grade.

Embankment and other areas of fill shall, unless otherwise required in the Contract or permitted by the Engineer, be constructed evenly over their full width and their fullest possible extent and the Contractor shall control and direct construction plant and

other construction vehicles. Damage by construction plant and other vehicular traffic shall be made good by the Contractor with material having the same characteristics and strength of the material before it was damaged.

Embankments and unsupported fills shall not be constructed with steeper side slopes or to greater widths than those shown in the drawings, except to permit adequate compaction at the edges before trimming back, or to obtain the final profile following any settlement of the fill and the underlying material,

Whenever fill is to be deposited against the face of a natural slope, or sloping earthworks face including embankments, cuttings, other fills and excavations steeper than 1 vertical to 4 horizontals, such faces shall be benched as per Clause 305.4.1 immediately before placing the subsequent fill.

All permanent faces of side slopes of embankments and other areas of fill shall, subsequent to any trimming operations, be reworked and sealed to the satisfaction of the Engineer by tracking a tracked vehicle, considered suitable by the Engineer, on the slope or any other method approved by the Engineer.

### **305.3.6      Compaction**

Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Static three-wheeled roller, self-propelled single drum vibratory roller, tandem vibratory roller, pneumatic tyre roller, pad foot roller, etc., of suitable size and capacity as approved by the Engineer shall be used for the different types and grades of materials required to be compacted either individually or in suitable combinations.

The compaction shall be done with the help of self-propelled single drum vibratory roller or pad foot vibratory roller of 80 to 100 kN static weight or heavy pneumatic tyre roller of adequate capacity capable of achieving the required compaction. The Contractor shall demonstrate the efficacy of the equipment he intends to use by carrying out compaction trials. The procedure to be adopted for the site trials shall be submitted to the Engineer for approval.

Earthmoving plant shall not be accepted as compaction equipment nor shall the use of a lighter category of plant to provide any preliminary compaction to assist the use of heavier plant be taken into account.

Each layer of the material shall be thoroughly compacted to the densities specified in Table 300-2.

Subsequent layers shall be placed only after the finished layer has been tested according to Clause 903.2 and accepted by the Engineer. The Engineer may permit measurement of field dry density by a nuclear moisture/density gauge used

in accordance with agreed procedure and provided the gauge is calibrated to give results identical to that obtained from tests in accordance with IS:2720 (Part 28). A record of the same shall be maintained by the Contractor.

When density measurements reveal any soft areas in the embankment/sub-grade/earthen shoulders, further compaction shall be carried out as directed by the Engineer. If in spite of that the specified compaction is not achieved, the material in the soft areas shall be removed and replaced by approved material, compacted using appropriate mechanical means such as light weight vibratory roller, double drum walk behind roller, vibratory plate compactor, trench compactor or vibratory tamper to the density requirements and satisfaction of the Engineer.

### **305.3.7 Drainage**

The surface of the embankment/sub-grade at all times during construction shall be maintained at such a cross fall (not flatter than that required for effective drainage of an earthen surface) as will shed water and prevent ponding.

### **305.3.8 Repairing of damages caused by rain/spillage of water**

The soil in the affected portion shall be removed in such areas as directed by the Engineer before next layer is laid and refilled in layers and compacted using appropriate mechanical means such as small vibratory roller, plate compactor or power rammer to achieve the required density in accordance with Clause 305.3.6. If the cut is not sufficiently wide for use of required mechanical means for compaction, the same shall be widened suitably to permit their use for proper compaction. Tests shall be carried out as directed by the Engineer to ascertain the density requirements of the repaired area. The work of repairing the damages including widening of the cut, if any, shall be carried out by the Contractor at his own cost, including the arranging of machinery/equipment for the purpose.

### **305.3.9 Finishing operations**

Finishing operations shall include the work of shaping and dressing the shoulders/verge/ roadbed and side slopes to conform to the alignment, levels, cross-sections and dimensions shown on the drawings or as directed by the Engineer subject to the surface tolerance described in Clause 902. Both the upper and lower ends of the side slopes shall be rounded off to improve appearance and to merge the embankment with the adjacent terrain.

The topsoil, removed and conserved earlier (Clauses 301.3.2 and 305.3.3) shall be spread over the fill slopes as per directions of the Engineer to facilitate the growth of vegetation. Slopes shall be roughened and moistened slightly prior to the application of the topsoil in order to provide satisfactory bond. The depth of the topsoil shall be sufficient to sustain plant growth, the usual thickness being from 75 mm to 150 mm.

Where directed, the slopes shall be turfed with sods in accordance with Clause 307. If seeding

and mulching of slopes is prescribed, this shall be done to the requirements of Clause 308.

When earthwork operations have been substantially completed, the road area shall be cleared of all debris, and ugly scars in the construction area responsible for objectionable appearance eliminated

## **305.4 construction of embankment and sub-grade under special conditions**

### **305.4.1 Earthwork for widening existing road embankment**

When an existing embankment and/or sub-grade is to be widened and its slopes are steeper than 1 vertical on 4 horizontals, continuous horizontal benches, each at least 300 mm wide, shall be cut into the old slope for ensuring adequate bond with the fresh embankment/sub- grade material to be added. The material obtained from cutting of benches could be utilized in the widening of the Embankment/subgrade. However, when the existing slope against which the fresh material is to be placed is flatter than 1 vertical on 4 horizontals, the slope surface may only be ploughed or scarified instead of resorting to benching. Where the width of the widened portions is insufficient to permit the use of conventional rollers, compaction shall be carried out with the help of light weight vibratory roller, double drum walk behind roller, vibratory plate compactor or vibratory tamper or any other appropriate equipment approved by the Engineer. End dumping of material from trucks for widening operations shall

be avoided except in difficult circumstances when the extra width is too narrow to permit the movement of any other types of hauling equipment.

#### **305.4.2 Earthwork for embankment and sub-grade to be placed against sloping ground**

Where an embankment/subgrade is to be placed against sloping ground, the latter shall be appropriately benched or ploughed/scarified as required in Clause 305.4.1 before placing the embankment/sub-grade material. Extra earthwork involved in benching or due to ploughing/ scarifying etc. shall be considered incidental to the work. For wet conditions, benches with slightly inward fall and subsoil drains at the lowest point shall be provided as per the drawings, before the fill is placed against sloping ground.

Where the Contract requires construction of transverse subsurface drain at the cut-fill interface, work on the same shall be carried out to Clause 309 in proper sequence with the embankment and sub-grade work as approved by the Engineer.

#### **305.4.3 Earthwork over existing road surface**

Where the embankment is to be placed over an existing road surface, the work shall be carried out as indicated below:

- i) If the existing road surface is of granular type and lies within 1 m of the new formation levels, it shall be scarified to a depth of 50 mm or as directed so as to provide ample bond between the old and new material ensuring that at least 500 mm portion below the top of new sub-grade level is compacted to the desired density;
- ii) If the existing road surface is of bituminous type or cement concrete and lies within 1 m of the new formation level, the bituminous or cement concrete layer shall be removed completely;
- iii) If the level difference between the existing road surface and the new formation level is more than 1 m, the existing surface shall be roughened after ensuring that the minimum thickness of 500 mm of subgrade is available.

#### **305.4.4 Embankment and sub-grade around structures**

To avoid interference with the construction of abutments, wing walls or return walls of culvert/bridge structures, the Contractor shall, at points, to be determined by the Engineer suspend work on embankment forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of damage to the structure.

Unless directed otherwise, the filling around culverts, bridges and other structures up to a distance of twice the height of the road from the back of the abutment shall be carried out Independent of the work on the main embankment. The fill material shall not be placed against any abutment or wing wall, unless permission has been given by the Engineer but in any case not until the concrete or masonry has been in position for 14 days. The embankment and sub-grade shall be 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.

The material used for backfill shall not be an organic soil or highly plastic clay having plasticity index and liquid limit more than 20 and 40 respectively when tested according to IS:2720 (Part 5). Filling behind abutments and wing walls for all structures shall conform to the general guidelines given in IRC:78. The fill material shall be

deposited in horizontal layers in loose thickness and compacted thoroughly to the requirements of Table 300-2.

Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers simultaneously with the laying of fill material. The material used for filter shall conform to the requirements for filter medium spelt out in Clause 2504 unless otherwise specified in the Contract.

Where it may be impracticable to use conventional rollers, the compaction shall be carried out by appropriate mechanical means such as small vibratory roller, plate compactor or power rammer. Care shall be taken to see that the compaction equipment does not hit or come too close to any structural member so as to cause any damage to them or excessive pressure against the structure.

#### **305.4.5 Construction of embankment over ground incapable of supporting construction equipment**

Where embankment is to be constructed across ground which will not support the weight of repeated heavy loads of construction equipment, the first layer of the fill may be constructed by placing successive loads of material in a uniformly distributed layer of a minimum thickness required to support the construction equipment as permitted by the Engineer. The Contractor, if so desired by him, may also use suitable geosynthetic material to increase the bearing capacity of the foundation. This exception to normal procedure will not be permitted where, in the opinion of the Engineer, the embankments could be constructed in the approved manner over such ground by the use of lighter or modified equipment after proper ditching and drainage have been provided. Where this exception is permitted, the selection of the material and the construction procedure to obtain an acceptable layer shall be the responsibility of the Contractor. The cost of providing suitable traffic conditions for construction equipment over any area of the Contract will be the responsibility of the Contractor and no extra payment will be made to him. The remainder of the embankment shall be constructed as specified in Clause 305.3

#### **305.4.6 Embankment construction under water and waterlogged areas embankment construction under water**

Where filling or backfilling is to be placed under water, only acceptable granular material or rock shall be used unless otherwise approved by the Engineer. Acceptable granular material shall be of GW, SW, GP, SP as per IS:1498 and consist of graded,

hard durable particles with maximum particle size not exceeding 75 mm. The material should be non-plastic having uniformity coefficient of not less than 10. The material placed in open water shall be deposited by end tipping without compaction.

#### **Embankment construction in waterlogged and Marshy areas**

The work shall be done as per IRC:34.

#### **305.4.7 Earthwork for High embankment**

The material for high embankment construction shall conform to Clause 305.2.1.7. In the case of high embankments (more than 6 m), the Contractor shall normally use fly ash in conformity with Clause 305.2.1.1 or the material from the approved borrow area. Where provided, stage construction of embankment and controlled rates of filling shall be carried out in accordance with the Contract including installation of instruments and its monitoring.

Where required, the Contractor shall surcharge embankments or other areas of fill with approved material for the periods specified in the Contract. If settlement of Surcharged fill results the Contractor shall bring the resultant level up to formation level with acceptable material for use in fill.



#### **305.4.8 Settlement period**

Where settlement period is specified in the Contract, the embankment shall remain in place for the

required settlement period before excavating for abutment, wing wall, retaining wall, footings, etc., or driving foundation piles. The duration of the required settlement period at each location shall be as provided for in the Contract or as directed by the Engineer.

#### **305.5 Plying of Traffic**

Construction and other vehicular traffic shall not use the prepared surface of the embankment and/or sub-grade without the prior permission of the Engineer. Any damage arising out of such use shall, however, be made good by the Contractor at his own cost as directed by the Engineer.

#### **305.6 Surface finish and Quality control of work**

The surface finish of construction of sub-grade shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised in accordance with Clause 903.

#### **305.7 Sub-grade strength**

It shall be ensured prior to actual execution that the material to be used in the Sub-grade satisfies the requirements of design CBR.

Sub-grade shall be compacted and finished to the design strength consistent with other physical requirements. The actual laboratory CBR values of constructed sub-grade shall be determined on remolded samples, compacted to the field density at the field moisture content and tested for soaked/unsaturated condition as specified in the Contract.

#### **305.8 Measurements for payment**

Earth embankment/sub-grade construction shall be measured separately by taking cross sections at intervals given in Sub-Section 113.3 after completion of clearing and grubbing and after completion of embankment/sub-grade. The volume of earthwork shall be computed in cubic metres by the method of average end areas.

The measurement of fill material from borrow areas shall be the difference between the net quantities of compacted fill and the net quantities of suitable material brought from roadway and drainage excavation. For this purpose, it shall be assumed that one cu.m of suitable material brought to site from road and Drainage excavation forms one cu.m of compacted fill and all bulking or shrinkage shall be ignored. The embankment constructed with fly ash will be measured in cu.m, separately for the fly ash portions and for the soil cover and intervening layers of soil, unless otherwise specified in the Contract.

Construction of embankment under water shall be measured in cu.m. Construction of high embankment with specified material and in specified manner shall be measured in cu.m. Stripping including storing and reapplication of top soil shall be measured in cu.m. Work involving loosening and compacting of ground supporting embankment/sub-grade shall be measured in cu.m. Removal of unsuitable material at embankment/sub-grade foundation and Replacement with suitable material shall be measured in cu.m.

Scarifying existing granular/bituminous road surface shall be measured in Square meters. Dismantling and removal of existing cement concrete pavement shall be measured vide Clause 202.6.

Filter medium and backfill material behind abutments, wing walls and other retaining structures shall be measured as finished work in position in cu.m.

## **Rates**

The Contract unit rates for the items of embankment and sub-grade construction shall be payment in full for carrying out the required operations including full compensation for:

- i) Cost of arrangement of land as a source of supply of material of required Quantity for construction unless provided otherwise in the Contract;
- ii) Setting out;
- iii) Compacting ground supporting embankment/sub-grade except where removal and replacement of suitable material or loosening and recomposing is involved;
- iv) Scarifying or cutting continuous horizontal benches 300 mm wide on side slopes of existing embankment and sub-grade as applicable;
- v) Cost of watering or drying of material in borrow areas and/or embankment and sub-grade during construction as required;
- vi) Spreading in layers, bringing to appropriate moisture and compacting to Specification requirements;
- vii) Shaping and dressing top and slopes of the embankment and sub-grade including rounding of corners;
- viii) Restricted working at sites of structures;
- ix) Working on narrow width of embankment and sub-grade;
- x) Excavation in all soils from borrow pits/designated borrow areas including clearing and grubbing and transporting the material to embankment and sub-grade site with all leads and lifts unless otherwise provided for in the Contract;
- xi) All labour, materials, tools, equipment and incidentals necessary to Complete the work to the Specifications;
- xii) Dewatering; and
- xiii) Keeping the embankment/completed formation free of water as per Clause 311.
- xiv) Transporting unsuitable excavated material for disposal with all leads and lifts.

Clause 301.9.5 shall apply as regards Contract unit rates for items of stripping and storing top soil including reapplication of topsoil.

**Clause 301.9.2** shall apply as regards Contract unit rate for the item of Loosening and recomposing the embankment/sub-grade foundation.

Clauses 309.1.1 and 305.8 shall apply as regards Contract rates for items of removal of unsuitable material and replacement with suitable material, respectively.

The Contract unit rate for scarifying existing granular/bituminous road surface shall be payment in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment and incidentals, necessary to complete the work. This will also comprise of handling, giving credit towards salvage value and disposal of the dismantled materials with all leads and lifts or as otherwise specified.

**Clause 202.7** shall apply as regards Contract unit rate for dismantling and removal of existing cement concrete pavement.

The Contract unit rate for providing and laying filter material shall be payment in full for carrying out the required operations including all materials, labour, tools, equipment and incidentals to complete the work to Specifications.



The Contract unit rate for providing and compacting backfill material behind abutments and retaining walls shall be payment in full for carrying out the required operations including all materials, labour, tools, equipment and incidentals to complete the work to Specifications.

**Clause 305.4.6** shall apply as regards Contract unit rate for construction of Embankment under water.

**Clause 305.4.7** shall apply as regards Contract unit rate for construction of high embankment. It shall include cost of instrumentation, its monitoring and settlement period, where specified in the Contract or directed by the Engineer

### **Road Item No. 3**

(B) Excavation for foundation in sand, gravel, clay soft soils and murrum etc. including shoring, strutting dewatering as necessary and disposing of the excavated stuff as directed.

(B) Depth from 3.0 to 6.0 M.and lead upto 100m for 10 Cum.

**MORTH V<sup>th</sup> REVISION Cl. No. 300 Pg. No. 45**

Refer Item no. 06 for Detail specification, This item is only for Excavation for Foundation for 3.0 to 6.0m depth and 100m for 10Cum lead.

As per Schedule mod of measurement for this item is Nos.

**\*\***

**Providing and laying Filter material underneath pitching in slopes complete as per drawing and Technical specification**

**MORTH V<sup>th</sup> REVISION: Cl. No. 2500, Pg. no. 703**

#### **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 buildup 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
- 2) 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
- 3) 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
- 4) 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.

#### **2504.4 Toe Protection**

A toe wall shall be provided at the junction of slope pitching and launching apron of a guide bund so as to prevent the slope pitching from sliding down. The toe wall shall be in dry rubble masonry (uncoursed) conforming to Section 1400 of these Specifications or in cement concrete of M15 grade. The pitching/revetment shall be of stones in wire crates or cement concrete blocks in M15 grade. For protection of ties of bank slopes terminating either in short aprons at bed levels or anchored in Flooring/rocky bed, the provision of Clause 8.2.2 of IRC:89 may be complied with.

#### **2509 MEASUREMENTS FOR PAYMENT**

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

**As per Schedule mod of measurement for this item is Cu.m**

#### **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.**

#### **Item No. 26 & 27**

**Providing Fusion Bonded Epoxy Coating not less than 175-micron thickness and up to 300 microns to reinforcement bars as per IS-13620-1993/ASTM-775 M including testing of coating at plant and all taxes (A) 10mm to 16 mm dia bar & 20mm to 32mm dia**

**This item includes Pre Production QAP and witness testing at plant facility. QAP-Quality Assured Plan should be submitted with appropriate brand of epoxy coating from Plant facility with QC Department Sign and Stamp. After the approval of QAP, RMC official allow production/treatment in witness**

The heated bar shall pass through an electrostatic spray booth where the dry epoxy powder is applied. The electrostatically charged powder particles will attract to the grounded bar, melt, flow, and form a continuous, uniform film.

#### **3.4 Curing**

The coated bar is then passed through a curing oven where the residual heat ensures the epoxy fully cures into a hard, cross-linked, thermoset coating.

#### **4.0 Testing and Inspection**

All tests shall be performed at the coating plant on a systematic basis for each production lot, as stipulated in IS 13620. Records of all tests shall be maintained and submitted to the Engineer-in-Charge.

Visual Inspection: The coated bars shall be visually inspected for uniformity, color, and texture. They must be free from defects such as holidays (pinholes), sags, blisters, and bare patches.

Coating Thickness: The thickness shall be measured using a calibrated magnetic gauge. Measurements shall be taken at multiple points along the bar's length and around its circumference. The average thickness must be within the 175-300-micron range.

Holiday Test: 100% of the coated bars shall be checked with a low-voltage holiday detector (e.g., 67.5 V) to detect any pinholes or discontinuities in the coating. Any bar showing holidays shall be repaired or rejected.

Adhesion Test (Bend Test): A representative sample bar from each lot shall be bent to 120 degrees around a mandrel of a specified diameter. After bending, the coating shall be examined for cracking or disbandment. There shall be no cracking visible to the naked eye.

#### **5.0 Handling, Transportation, and Storage**

The coated bars must be handled with extreme care to prevent damage to the coating.

Handling: Use nylon slings, padded hooks, or other approved methods for lifting and moving. Dragging or dropping the bars is strictly prohibited.

Stacking: Bars shall be stacked on padded wooden or plastic bearers.

Transportation: During transit, the bars shall be secured and padded to prevent abrasion and impact damage.

#### **6.0 Measurement for Payment**

**The measurement for payment shall be by weight in Metric Tonnes (MT), based on the standard weight of the uncoated reinforcement bars as per IS 1786. No separate measurement or payment shall be made for the weight of the epoxy coating itself.**

#### **7.0 Rate**

**The contract unit rate per Metric Tonne shall be an all-inclusive price for the complete job. The rate shall include, but not be limited to: The cost of the epoxy powder and all other consumables. All labor, plant, and machinery costs. Costs associated with surface preparation, coating**

**Application, and curing. All in-plant testing and quality control checks as specified. Handling, loading, and unloading at the coating plant. The cost of repairing minor damages to the coating, if any. All applicable central, state, and local taxes, duties, and levies. Contractor's overhead and profit.**

#### **Item No. 28**

**Material and Labour for applying two or more coats of 100 % Premium Acrylic emulsion paint having VOC less than 50 gm/litre and UV resistance as per IS: 15489:2004, Alkali & Fungal resistance, Dirt Resistance Exterior Paint of required shade (Company Depot Tinted) with Silicon Additives @ 1.43 litre / Sqm over and including priming coat of exterior primer applied @ 0.90 litre/10 sqm over new surfaces.**

##### **MATERIALS**

**Dulux Aquatech Flexible Waterproof BaseCoat (2 Coat)+**

**Dulux Weathershield Max/Elastomeric (2 Coat)**

**OR**

**Asian Paint Apex Ultima Protek Base Coat (2 Coat)+**

**Asian Paint Apex Ultima Protek Top Coat (2 Coat)**

**OR**

**Jotun Jotashield Waterxt BaseCoat (2 Coat)+**

**Jotun Jotashield Waterxt top A (2 Coat)**

### **1.0 Exterior Emulsion Paint**

Exterior emulsion paint shall be of specified colour as approved by Engineer in charge the ready mixed exterior emulsion paint shall not be allowed, If however ready mix emulsion paint of specified shade or tint is not available white ready mixed paint with approved Steiner will be allowed in such case the contractor shall ensure that the shade of the paint so allowed shall be uniform exterior emulsion paint shall meet with the following general requirements

1. Exterior emulsion paint shall not show excessive setting in freshly opened full can and shall easily be readdressed with a paddle to a smooth homogeneous state. The exterior emulsion paint shall show no curding, livering cracking or colour separation and shall be free from lumps and skins.
2. The exterior emulsion paint as received shall brush easily possess good leveling properties and show no running or sagging tendencies.
3. The exterior emulsion paint shall not skin within 48 hours in a three quarters filled closed container
4. The exterior emulsion paint shall dry to a smooth uniform finish free from roughness grit unevenness and other imperfections
5. Ready mix exterior emulsion paint if allowed for specified shade, shall be used exactly as received from the manufacturers and generally according to their instruction and without any admixtures whatsoever.

## **2.0 WORKMAN SHIP**

### **2.1 Scaffolding:**

Where scaffolding is required, it shall be erected in such a way that as far as possible no part of scaffolding shall rest against the surface to be distempered. A properly secured strong and well tied suspended platform (joola) may be used for distempering. Where ladders are used, pieces of old gunny bags.

### **3.0 Application coat:**

The weather proof exterior emulsion paint on wall surfaces shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturer only. Sufficient quantity of distemper required for a day's work shall be prepared

- 3.1** For undecorated surfaces, after the primer coat is dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth for receiving the exterior emulsion paint, taking care not to rub out the priming coat. All loose particles shall be dusted off after rubbing. Minimum two coats of the exterior emulsion paint shall be applied with brushes in horizontal strokes followed immediately by vertical strokes which together shall constitute one coat. The subsequent coats shall be applied after a time interval of at least 24 hours between consecutive coats to permit proper drying of the preceding coat. The finished surface shall be even and uniform without patches, brush marks, distemper drops etc.

- 3.2** Sufficient quantity of the weather proof exterior emulsion paint shall be mixed to finish one room at a time.

### **3.0 MODE OF MEASUREMENT & PAYMENT :**

- 3.1.** The unit rate wall painting with weather proof exterior emulsion paint shall include the cost of all materials, tools and plant required for mixing, cleaning brushing sand papering & painting with all required specials and Lapi compound, finishing as per direction of the Engineer-in-charge, and all other incidental expenses for producing pipe line work of specified diameter to complete the structure or its components as shown on the drawings and according to these specifications. They shall also include the cost of making, fixing and removing of all scaffolding and forms required for the work
- 3.2** The rate of wall painting with weather proof exterior emulsion paint shall include the cost of all labour, materials tools and plant scaffolding and all incidental expenses as described herein above.
- 3.3.** The wall painting with weather proof exterior emulsion paint shall be measured for its length and height limiting dimensions to those specified on plan or as directed. The rate shall be for a unit of one square meter.
- 3.4.** The payment will be made on **square meter** basis of the finished work. (2 Coat of Waterproofing Base Coat + 2 Coat of premium Exterior paint mentioned in tender)

### **Item No. 29**

**Providing & applying Synthetic Enamel paint alternate black & yellow on crash barrier, median and Kerb with one coat of primer and two or more coat of paint as per manufacture's Specification including cleaning all dust, dirt and other foreign matters with all material labour Equipment's with all leads & lift etc complete.**

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

**MORTH Vth REVISION Cl. No. 2808, 2809, Pg. no. 773****2808 Protective Surface Coating of Concrete by Acrylic Elastomeric Coating**

The acrylic elastomeric coating shall be water based (solvent free), modified with selected mineral fillers applied over the prepared surface. The coating should have anti-carbonation and water vapor diffusion property and should be resistant to action of ultra violet (UV) radiation. It should be waterproof and capable of bridging crazing's and cracks. The shelf life for such coatings shall not be more than 6 months. It is necessary that the system should be capable of protecting the surfaces of pre-stressed and reinforced concrete members from all deleterious elements such as chlorides and sulphates. The protective treatment should allow excess water vapor in the concrete to evaporate out (breathing) without rupturing itself due to vapor pressure. The protective system itself should not deteriorate from

Exposure to UV rays and weathering. The acrylic elastomeric coating system shall satisfy the requirements given in Table 2800-2.

**Table 2800-2: Properties of Acrylic Elastomeric Coating**

Sl.No.	Parameter	Requirement	Reference
1)	Specific Gravity	1.4±0.05	IS:345
2)	Solid contents	70±3%	IS:345
Sl.No.	Parameter	Requirement	Reference
3)	UV resistance	No colour change	ASTM-G-53/DIN-EN-150-105
4)	IR-Spectrum	As per Acrylic Polymer	IR-Spectrometer standards
5)	Adhesion with concrete	1.5 N/m <sup>2</sup>	ASTM-D-4541-02/DIN500014
6)	Dry film thickness	200-225 Microns (for minimum 2 coats)	
7)	Coverage	400-450 gm /m <sup>2</sup> (2 Coats)	
8)	Physical properties Diffusion resistance against carbon	Equivalent air layer thickness S CO shall be	DIN 53122 Part -I
9)	Diffusion resistance against water vapour	Equivalent air thickness S H 0 <4 m	DIN 52615
10)	Water proofing Characteristics	Percentage reduction in flux should be >50%	
11)	Re-coatability	Min. 2h to 72 h or as per manufactures specification	

The primer shall satisfy the following requirements

- i) System : Single component universal polymer primer
- ii) Base : Acrylic Resin dispersion
- iii) Curing : Air Curing
- iv) Colour : Milk white, transparent application



- v) Shelf life : 6 months from date of manufacturing in tightly sealed container.
- vi) Coverage : 75 gm/m<sup>2</sup> to 100 gm/m<sup>2</sup> (depending upon smoothness and absorption of concrete surface)

### **Quality Assurance**

The Acrylic elastomeric material should be tested in GOI accredited laboratories where such laboratories are available, otherwise in other standard laboratories where similar facilities exist for properties specified above. Random samples during execution shall be taken from consignments brought to site to verify that the test results match with the earlier certificates produced before approval of the product. Both the test results (prior to approval and during execution), shall conform

to the requirements as per Table 2800-1, failing which the consignment shall be rejected. It shall be made mandatory that the stock register for the materials are

maintained at site and signed by the Engineer periodically.

### **Surface Preparation**

The work shall commence after carrying out any repair to the concrete surface as directed by the Engineer. The concrete surface shall be free from all adhesion inhibiting substances such as oil, grease release agents as well as laitance and dust. The surface shall be cleaned by wire brushing, mechanical scraping and any loose material shall be removed by chiseling with small hammer and washed with clean

water. The substrata shall be structurally sound for effective bond of the acrylic polymer with the concrete surface. All pin holes shall be filled with non-shrink polymer modified fine repair mortar.

### **Application**

After preparing the surface and filling the pin holes, primer coat (75-100 gm/sq.m.) shall be applied with brush/lambskin roller/spray gun and shall be cured for 60 minutes or as specified by the manufacturer. Subsequently, 1<sup>st</sup> and 2<sup>nd</sup> coats of polymer coating shall be applied with brush/spray gun/ roller keeping the time between coats not less than 2 h and not more than 72 h. Consumption per coat shall be 200-225 gm/m<sup>2</sup>. The total dry film thickness of the protective coating for all coats shall be in the range of 200-225 microns. The wet film thickness shall be measured at a number of selected locations at the time of application with painting gauges. For measuring the dry film thickness, suitably located painting gauge shall be used. At least one gauge shall be located on each face of superstructure in each span but not less than one gauge/100 sqm. For the given solid content in the application, the dry film thickness to wet film thickness ratio should be established by prior testing in the laboratory using appropriate panels like glass plates, flat concrete, steel plates (300 x 300 mm) with similar coatings. Alternatively, the dry film thickness may be calculated from the measured wet film thickness by multiplying with the solid contents per unit volume.

**Performance Guarantee**

This type of protective coating shall be executed only through authorized technical applicators of standard manufactures who have requisite work experience for having carried out similar type coating works. The Engineer shall take performance guarantee from the agency responsible for the execution of the work for a minimum period of 5 years.

**2809 PROTECTIVE SURFACE COATING OF CONCRETE BY PATENTED SYSTEMS OF COATING**

Patented system of protective coating like epoxy polyurethane painting system, epoxy phenolic protective system and other systems shall be used only with the approval of Engineer after the assessment of the performance of the product, backed by certificates from users, acceptance tests as per published standards, pertinently to cover the material, processes, carbonation resistance, water vapour diffusion Property, crack bridging properties, and UV resistance. The Engineer shall take performance guarantee from the agency responsible for the execution of the work for a minimum period of 5 years

**2814                      Measurements for Payment**

Measurement for application of epoxy mortar/protective surface coating of concrete for specified thickness shall be in square meter of surface area of application.

**2815                      Rate**

The contract unit rate for application of epoxy mortar/protective surface coating for specified thickness shall include cost of all materials, labour, tools and plant, placing in

Position, testing and other incidental expenses including surface preparation for the satisfactory completion of the work as per these Specifications and as shown on the drawings.

**Item No. 33****Premould Asphalt Filler Joint - 20 mm Thick****2604                      FILLER JOINTS****2604.1                  Components**

The components of this type of joint shall be corrugated copper plate at least 2 mm thick 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 up to the top level of the wearing coat and sealant of suitable joint sealing compound

**2604.2                  Material**

i)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. Assembly of small pieces to make up the required size shall be avoided.

ii) Expansion joint materials shall be handled with care and stored under cover by the Contractor to prevent damage.

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

### **2604.3 Fabrication and Installation**

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

Pre-molded expansion joint filler shall not be placed in position until immediately prior to the placing of the abutting material. If the two adjacent faces of the joint are to be installed at different times, the joint filler shall be placed only when the second face is ready to be kept in position

Sealants shall be installed in accordance with the manufacturer's recommendations. Sealants shall be finished approximately 3 mm below the upper surfaces of the joint, 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.

### **2614 MEASUREMENTS FOR PAYMENT**

**The expansion joint shall be measured in running meters.**

### **2615 RATE**

In the case of supply and installation contract, the contract unit rate shall include the cost of all material, labour, equipment and other incidental charges for procuring and fixing the joints complete in all respects as per these Specifications. For filler joints, the rate per running meter shall include the cost of sealant for the depth provided in the drawing. In the case of supply contract, the contract unit rate shall include cost of all components of expansion joint including anchorage system, pre-installation fabrication, and transportation of assembled joints, handling and other incidental charges. In the case of installation only contract, the contract unit rate shall include the cost of all material, labour, equipment and other incidental charges for installation of the joints complete in all respects as per these Specifications.

#### **Item No. 31**

**Providing and fixing marble slab including transporting, engraving and painting all Complete. (ii) Size 60cm x 60cm x 40mm**

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

**Item No. 32**

**Acoustic Barrier H 2.0 M, 3.00 M c/c composed of: No.1 Acoustic Panels in Aluminium, powder coated. 1.2 mm, 2950 x 500 x 100mm with noise absorbing 50mm thick, 90 kg/Cu.m density water repellent Rockwool slabs. No.1 Post UC 152 or Equivalent, height 2000 mm with welded Base Plate 220 x 300 x 16 thk duly hot dip galvanised. No. 04 Anchor bolts as required.**

As per Detail Specification and relevant IRC Code.

**Item No. 33**

**Supply & Fixing of MS Black Sheet on angle frame with angle pole and required Painting etc. complete.**

As per Detail Specification and relevant IRC Code.

**Item No. 34**

**Iron work as per drawing and instruction including all**

All structural steel shall confirm to IS 266 - Latest edition. The steel shall be free from the defects mentioned in IS 226 (Latest edition) and shall have a smooth finish. The material shall be free from loose mill scale, rust, pits or other defects affecting the strength and durability. River bars shall confirm to IS 1148 Latest edition. When the steel is supplied by the contractor, test certificate of the manufacturer shall be obtained according to IS 226 Latest edition and other relevant Indian Standards. The design should be made as per the instructions of engineer-in-charge. The rate includes supplying and welding (along with labours), transportation and fixing in position of the steel work.

**The rate shall be for a unit of one Kilogram.**

**Item No. 36. Road Item No.7**

**Construction of granular sub-base by providing close graded Material, mixing in a Mechanical mix plant at OMC, carriage of mixed Material to work site, spreading in uniform layers with motor grader on prepared surface and compacting with Vibratory power roller to achieve the desired density, complete as per clause 401 (Plant Mix)**

**The work is to be carried out as per MoRTH Specification Clause No.401.**

The material to be used for granular sub base must be confirming to MoRTH and the grade specified with respect to CBR value and the rate should be considered as per Schedule-B. The material used in the design must be used for the construction.

**The payment for this item will be made on Cubic Meter basis**

**Item No. 37. Road Item No 8.**

**Wet Mix Macadam laying Using Mechanical Paver (Providing, laying, spreading and Compacting graded stone aggregate to wet mix macadam specification including Premixing the Material with water at OMC in mechanical mix plant carriage of mixed Material by tipper to site, laying in uniform layers with paver in sub- base / base Course on well prepared surface and compacting with vibratory roller to achieve the Desired density.)**

**MORTH CI No. 406 Pg. no. 131**

**406.1 Scope: -**

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

The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75 mm. When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the sub-base course may be up to 200 mm with the approval of the Engineer.

## **406.2 Materials**

### **406.2.1 Aggregate**

#### **406.2.1.1 Physical Requirements**

Coarse aggregates shall be crushed stone. The aggregates shall conform to the physical requirements set forth in Table 400-12. **Vadagam special aggregate is only acceptable.** If the water absorption value of the coarse aggregate is greater than 2 percent, the soundness test shall be carried out on the material delivered to site as per IS:2386 (Part-5).

**Table 400-12: Physical Requirements of Coarse Aggregates for Wet Mix Macadam for Sub-base/Base Courses**

<b>Sr. No.</b>	<b>Test</b>	<b>Test Method</b>	<b>Requirements</b>
<b>1.</b>	<b>Los Angeles Abrasion value or Aggregate Impact value</b>	<b>IS:2386 (Part-4) IS:2386 (Part-4) or IS:5640</b>	<b>40 percent (Max.)</b> <b>30 percent (Max.)</b>
<b>2.</b>	<b>Combined Flakiness and Elongation indices (Total)</b>	<b>IS:2386(Part-1)</b>	<b>35 percent (Max.) *</b>

To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The values of flakiness index and elongation index so found are added up

#### **406.2.1.2 Grading Requirements**

The aggregates shall conform to the grading given in Table 400-13.

**Table 400-13: Grading Requirements of Aggregates for Wet Mix Macadam**

<b>IS Sieve Designation</b>	<b>Percent by weight passing the IS Sieve</b>
<b>53.0 mm</b>	<b>100</b>
<b>45.0 mm</b>	<b>95-100</b>
<b>26.5 mm</b>	<b>-</b>
<b>22.40 mm</b>	<b>60-80</b>

<b>11.20 mm</b>	<b>40-60</b>
<b>4.45 mm</b>	<b>25-40</b>
<b>2.36 mm</b>	<b>15-30</b>
<b>600 micron</b>	<b>8-22</b>
<b>75 micron</b>	<b>0-5</b>

Material finer than 425 micron shall have Plasticity Index (PI) not exceeding 6. The final gradation approved within these limits shall be graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa.

#### **406.3 Construction Operations: -**

##### **406.3.1 Preparation of Base**

The surface of the sub-grade/sub-base/base to receive the Wet mix macadam course shall be prepared to the specified grade and camber and cleaned of dust, dirt and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained.

Where the Wet mix macadam is to be laid on an existing metalled road, damaged area including depressions and potholes shall be repaired and made good with the suitable material. The existing surface shall be scarified and re-shaped to the required grade and camber before spreading the coarse aggregate for Wet mix macadam.

##### **406.3.3 Preparation of Mix**

Wet Mix Macadam should be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/positive mixing arrangement like pugmill or pan type mixer of concrete batching plant. For small quantity of wet mix work, the Engineer may permit the mixing to be done in concrete mixers. Quantity of water should not vary from OMC determined as per IS : 2720 (part VIII) by more than agreed limit. The mixed material should be uniformly wet and no segregation should be permitted.

##### **406.3.4 Spreading of mix**

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

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

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

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

The layer may be tested by depth blocks during construction. No segregation of layer and fine particles should be allowed. The aggregates as spread should be of uniform gradation with no pockets of fine materials.

#### **406.3.5 Compaction:**

After the mix has been laid to the required thickness, grade and cross fall/camber the same shall be uniformly compacted, to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100 mm, smooth wheel 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 vibratory roller of minimum static weight of 80 to 100 KN or equivalent capacity roller. The speed of the roller shall not exceed 5 km/h. In portions having unidirectional cross fall/super elevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the center line of the road, uniformly over-lapping each preceding track by at least one third width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop. In portions in camber, rolling should begin at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the center parallel to the centre line of the road uniformly overlapping each of the preceding track by at least one-third width until the entire surface has been rolled. Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good. Along forms, kerbs, walls or other places not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without scarifying the surface to permit proper bonding of the added material shall not be permitted. Rolling should not be done when the subgrade is soft or yielding or when it causes a wave-like motion in the subbase/base course or subgrade. If irregularities develop during rolling which exceed 12 mm when tested with a 3 metre straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a uniform surface conforming to the desired grade and cross fall. In no case should the use of unmixed material be permitted to make up the depressions. Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material as determined by the method outlined in IS : 2720 (Part-8). After completion, the

surface of any finished layer shall be well-closed, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of the layer and re compacted.

#### **406.3.6 Setting and drying:**

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

#### **406.4 Opening to Traffic**

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

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

##### **406.5.1 Surface evenness:**

The surface finish of construction shall conform to the requirements of Clause in Item No. 902

**406.5.2 Quality control:**

Control on the quality of materials and works shall be exercised by the Engineer as per 900.

**Test and Frequency for Materials for Wet Mix Macadam**

Type of Construction	Test	Frequency (As per Circular No. 66)	IS Code
Wet Mix Macadam	Gradation	One test per 200 Cu.m.	IS:2386, Part-I-1963
	Aggregate Impact Value	One test per 1000 Cu.m.	IS:2386, Part-IV
	Combined Flakiness and Elongation Indices	One test per 500 Cu.m.	IS:2386, Part-I
	Atterbarg Limits of portion of aggregates passing 425-micron sieve	One test per 200 Cu.m.	IS:2720, Part-V
	Density of compacted layer	One set of three tests per 1000 sq.	IS:2720, Part

**406.6 Rectification of Surface Irregularity**

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

**406.7 Arrangement for Traffic**

During the period of construction, arrangements for the traffic shall be provided. The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, marking, flags, lights and flagmen as per instruction of the Engineer-in-charge.

**406.8 Measurements for Payment**

Wet mix macadam shall be measured as finished work in position in cubic meters.  
As per Schedule mod of measurement for this item is Cu.m.

**406.9 Rate**

The Contract unit rate for wet mix macadam shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.7.

**Item No. 38. Road Item No.9**

**Prime coat (Providing and applying primer coat with bitumen emulsion on prepared surface of granular Base including Clearing of road surface and spraying primer at the rate of 0.70 kg/sqm using mechanical means.)**



**MORTH Cl. No. 502 Pg No. 166****502.1 Scope**

This work shall consist of the application of a single coat of low viscosity liquid bituminous material to a porous granular/ stabilized surface preparatory to the superimposition of bituminous treatment or mix.

**502.2 Materials**

**502.2.1** The primer shall be cationic bitumen emulsion SS1 grade conforming to IS: 8887.

Quantity of SS1 grade bitumen emulsion for various types of granular surface shall be as per given Table.

**502.2.2** Quantity of SS1 grade bitumen emulsion for various types of granular surface shall be as given in Table 500-3.

**Table 500-3: Quantity of Bitumen emulsion for various types of granular surfaces**

Type of Surface	Rate of Spray (kg/Smt)
WMM/WBM	0.7-1.0

**502.2.3** Cutback for primer shall not be prepared at the site. Type and quantity of cutback bitumen for various types of granular surface shall be as given in Table 500-4

**Table 500-4: type and Quantity of cutback Bitumen for Various types of granular surface**

Type of surface	type of cutback	rate of spray (kg/sq.m)
WMM/WBM	MC 30	0.6-0.9
Stabilized soil bases/ Crusher Run Macadam	MC 70	0.9-1.2

**502.2.4** The correct quantity of primer shall be decided by the Engineer and shall be such that it can be absorbed by the surface without causing run-off of excessive primer and to achieve desired penetration of about 8-10 mm.

**502.3 Weather and Seasonal Limitations**

Primer shall not be applied during a dust storm or when the weather is foggy, rainy or windy Surfaces which are to receive emulsion primer should be damp, but no free or standing water shall be present. Surface can be just wet by very light sprinkling of water.

**502.4 Construction****502.4.1 Equipment**

The primer shall be applied by a self-propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at specified rates and temperatures. Hand spraying shall not be allowed except in small areas, inaccessible to the distributor, or in narrow strips where primer shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

**502.4.2 Preparation of Road Surface**

The granular surface to be primed shall be swept clean by power brooms or mechanical sweepers and made free from dust. All loose material and other foreign material shall be removed completely. If soil/murum binder has been used in the WBM surface, part of this should be brushed and removed to a depth of about 2 mm so as to achieve good penetration.

**502.4.3 Application of Bituminous Primer**

After preparation of the road surface, the primer shall be sprayed uniformly at the specified rate. The method for application of the primer will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar and speed of forward movement. No heating or dilution of SS1 bitumen emulsion and shall be permitted at site.

#### **502.4.4 Curing of Primer and Opening to Traffic**

A primed surface shall be allowed to cure for at least 24 hours or such other higher period as is found to be necessary to allow all the moisture/volatiles to evaporate before any subsequent surface treatment or mix is laid. Any unabsorbed primer shall first be blotted with a light application of sand, using the minimum quantity possible. A primed surface shall not be opened to traffic other than that necessary to lay the next course.

#### **502.5 Quality Control of Work**

For control of the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

#### **502.6 Arrangements for Traffic**

During the period of construction, arrangements for the traffic shall be provided. The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, marking, flags, lights and flagmen as per instruction of the Engineer-in-charge.

#### **502.7 Measurement for Payment**

Prime coat shall be measured in terms of surface area of application in **Smt.** As per Schedule mod of

Measurement for this item is Smt.

#### **502.8 Rate**

The contract unit rate for prime coat shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.7 (i) to (v) and as applicable to the work specified in these Specifications. Payment shall be made on the basis of the provision of prime coat at an application rate of quantity at 0.6 kg per square metre or at the rate specified in the Contract, with adjustment, plus or minus, for the variation between this quantity and the actual quantity approved by the Engineer after the preliminary trials referred to in Clause 502.4.3.

### **Item No. 39. Road Item No.10.**

**Tack Coat on Cement concrete pavement (Providing and applying tack coat with Bitumen emulsion using emulsion Pressure distributor at the rate of 0.30 to 0.35 kg Per sqm on the prepared bituminous surface cleaned with mechanical Broom.)**

#### **503            tack    coat scope**

The work shall consist of the application of a single coat of low viscosity liquid bituminous material to existing bituminous, cement concrete or primed granular surface preparatory to the superimposition of a bituminous mix, when specified in the Contract or as instructed by the Engineer. The work shall be carried out on a previously prepared surface in accordance with Clause 501.8.

#### **Materials**

The binder used for tack coat shall be either Cationic bitumen emulsion (RS 1) complying with IS:8887 or suitable low viscosity paving bitumen of VG 30 grade conforming to IS:73. The use of cutback bitumen RC:70 as per IS:217 shall be restricted only for sites at sub-zero temperatures or for emergency applications as directed by the

Engineer. The type and grade of binder for tack coat shall be as specified in the Contract or as directed by the Engineer.

#### **weather and seasonal limitations**

Bituminous material shall not be applied during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10°C. Where the tack coat consists of emulsion, the surface shall be slightly damp, but not wet. Where the tack coat is of cutback bitumen, the surface shall be dry.

#### **construction equipment**

The tack coat shall be applied by a self-propelled or towed bitumen pressure sprayer, equipped for spraying the material uniformly at a specified rate. Hand spraying shall not be permitted except in small areas, inaccessible to the distributor, or narrow strips, shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

**preparation of Base**

The surface on which the tack coat is to be applied shall be clean and free from dust, dirt, and any extraneous material, and be otherwise prepared in accordance with the requirements of Clause 501.8. The granular or stabilized surfaces shall be primed as per Clause 502. Immediately before the application of the tack coat, the surface shall be swept clean with a mechanical broom, and high pressure air jet, or by other means as directed by the Engineer.

**application of tack coat**

The application of tack coat shall be at the rate specified in Table 500-5, and it shall be applied uniformly. If rate of application of Tack Coat is not specified in the contract, then it shall be the rate specified in Table 500-5. No dilution or heating at site of RS1 bitumen emulsion shall be permitted. Paving bitumen if used for tack coat shall be heated to

appropriate temperature in bitumen boilers to achieve viscosity less than 2 poise. The normal range of spraying temperature for a bituminous emulsion shall be 20°C to 70°C and for cutback, 50°C to 80°C. The method of application of tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar, and speed or forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

**table 500-5 : rate of application of tack coat**

<b>type of surface</b>	<b>rate of spray of Binder in kg per sq. m</b>
Bituminous surfaces	0.20 – 0.30
Granular surfaces treated with primer	0.25 – 0.30
Cement concrete pavement	0.30 – 0.35

**curing of tack coat**

The tack coat shall be left to cure until all the volatiles have evaporated before any subsequent construction is started. No plant or vehicles shall be allowed on the tack coat other than those essential for the construction.

**Quality control of work**

For control of the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

**Arrangements for Traffic**

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

**Measurement for payment**

Tack coat shall be measured in terms of surface area of application in square metres.

**rate**

The contract unit rate for tack coat shall be payment in full for carrying out the required operations including for all components listed in Clause 401.8 (i) to (v) and as applicable to the work specified in these Specifications. The rate shall cover the provision of tack coat, at

0.2 kg per square metre or at the rate specified in the Contract, with the provision that the variation between this quantity and actual quantity of bitumen used will be assessed and the payment adjusted accordingly.

**Item No. 40. Road Item No.11.**

**Providing and laying dense graded bituminous macadam with higher capacity batch type HMP using crushed Aggregates of specified grading, premixed with bituminous binder @ 6.0 percentage by weight of total mix and filler, Transporting the hot mix to work site, laying with hydrostatic paver finisher with sensor control to required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction as per MORTH specification clause no. 505 complete in all respect. (Grading - I, VG-40)**

**505 DENSE BITUMINOUS MACADAM**

**Scope**

The specification describes the design and construction procedure for Dense Bituminous Macadam, (DBM), for use mainly, but not exclusively, in base/binder and profile corrective courses. The work shall consist of construction in a single or multiple layers of DBM on a previously prepared base or sub-base. The thickness of a single layer shall be 50 mm to 100 mm.

**Materials**

**Bitumen**

The bitumen shall be viscosity grade paving bitumen complying with the Indian Standard Specification IS:73, modified bitumen complying with Clause 501.2.1 or as otherwise specified in the Contract. The type and grade of bitumen to be used shall be specified in the Contract.

**Coarse Aggregates**

The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on 2.36 mm sieve. They shall be clean, hard, durable, of cubical shape, free from dust and soft or friable matter, organic or other deleterious substances. Where the Contractor's selected source of aggregates has poor affinity for bitumen, the Contractor shall produce test results that with the use of anti-stripping agents, the stripping value is improved to satisfy the specification requirements. The Engineer may approve such a source and as a condition for the approval of that source, the bitumen shall be treated with an approved anti-stripping agent, as per the manufacturer's recommendations, at the cost of the Contractor. The aggregates shall satisfy the requirements specified in Table 500-8.

Where crushed gravel is proposed for use as aggregate, not less than 90 percent by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces.

### **Fine Aggregates**

Fine aggregates shall consist of crushed or naturally occurring mineral material, or a combination of the two, passing the 2.36 mm sieve and retained on the 75 micron sieve. These shall be clean, hard, durable, dry and free from dust, and soft or friable matter, organic or other deleterious matter. Natural sand shall not be allowed in binder courses. However, natural sand upto 50 percent of the fine aggregate may be allowed in base courses. The fine aggregate shall have a sand equivalent value of not less than 50 when tested in accordance with the requirement of IS:2720 (Part 37).

The plasticity index of the fraction passing the 0.425 mm sieve shall not exceed 4, when tested in accordance with IS:2720 (Part 5).

### **Filler**

Filter shall consist of finely divided mineral matter such as rock dust, hydrated lime or cement approved by the Engineer. The filler shall be graded within the limits indicated in Table 500-9.

The filler shall be free from organic impurities and have a plasticity Index not greater than 4. The Plasticity Index requirement shall not apply if filler is cement or lime. Where the aggregates fail to meet the requirements of the water sensitivity test in Table 500-8, then 2 percent by total weight of aggregate, of hydrated lime shall be used and percentage of fine aggregate reduced accordingly.

### **Aggregate Grading and Binder Content**

When tested in accordance with IS:2386 Part 1 (wet sieving method), the combined grading of the coarse and fine aggregates and filler for the particular mixture shall fall within the limits given in Table 500-10 for grading 1 or 2 as specified in the Contract. To avoid gap grading, the combined aggregate gradation shall not vary from the lower limit on one sieve to higher limit on the adjacent sieve.

**Table 500-8 Physical Requirements for Coarse Aggregate for Dense Bituminous Macadam**

<b>Property</b>	<b>Test</b>	<b>Specification</b>	<b>Method of Test</b>
Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075 mm sieve	IS:2386 Part I
Particle shape	Combined Flakiness and Elongation Indices*	Max 35%	IS:2386 Part I
Strength	Los Angeles Abrasion Value or Aggregate Impact Value	Max 35% Max 27%	IS:2386 Part IV
Durability	Soundness either :Sodium Sulphate or Magnesium Sulphate	Max 12% Max <b>18%</b>	IS:2386 Part V

Water Absorption	Water Absorption	Max 2%	IS:2386 Part III
Stripping	Coating and Stripping of Bitumen Aggregate Mix	Minimum retained coating 95%	IS:6241
Water Sensitivity	Retained Tensile Strength**	Min. 80%	AAS I-1TO 283

To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal, Elongation index is weight of elongated particles divided by total non-flaky particles. The values of flakiness index and elongation index so found are added up.

\*\*If the minimum retained tensile test strength falls below 80 percent, use of anti-stripping agent is recommended to meet the requirement.

**Table 500-9: Grading Requirements for Mineral Filler**

IS sieve (mm)	Cumulative Percent Passing by Weight of Total Aggregate
0.6	100
0.3	95 - 100
0.075	85 - 100

**Table 500-10: Composition of Dense Graded Bituminous Macadam**

Grading	1	2
Nominal aggregate size*	37.5 mm	26.5 mm
Layer thickness	75 - 100 mm	50 - 75 mm
IS Sieve' (mm)	Cumulative % by weight of total aggregate passing	
45	100	
37.5	95 - 100	100
26.5	63-93	90-100
19	-	71-95
13.2	55-75	56-80
9.5	-	
4.75	38-54	38-54
2.36	28-42	28-42
1.18		
0.6		
0.3	7-21	7-21
0.15		-
0.075	2 - 8	2-8
Bitumen content % by mass of total mix	Min 6.0**	Min 6.0**

The nominal maximum particle size is the largest specified sieve size upon which any of the aggregate is retained. Corresponds to specific gravity of aggregates being 2.7. In case aggregate have specific gravity more than 2.7, the minimum bitumen content can be reduced proportionately. Further the region where highest daily mean air temperature is 30°C or lower and lowest daily air temperature is 10°C or lower, the bitumen content may be increased by 0.5 percent. Bitumen content indicated in Table 500-10 is the minimum quantity. The quantity shall be determined in accordance with Clause 505.3.

### Mix Design

The bitumen content required shall be determined following the Marshall mix design procedure contained in Asphalt Institute Manual MS-2.

The Fines to Bitumen (F/I<sub>3</sub>) ratio by weight of total mix shall range from 0.6 to 1.2.

### Requirements for the Mix

Apart from conformity with the grading and quality requirements for individual ingredients, the mixture shall meet the requirements set out in Table 500-1

**Table 500-11 Requirements for Dense Graded Bituminous Macadam**

Properties	Viscosity Grade Paving Bitumen	.Modified bitumen		Test Method
		Hot climate	Cold climate	
Compaction level	75 blows on each face of the specimen			
Minimum stability (kN at 600C)	9.0	12.0	10.0	AASHTO T245
Marshall flow (mm)	2 — 4	2.5 —4	3.5 — 5	AASHTO T245
Marshall Quotient	2 — 5	2.5 — 5		MS-2 and ASTM D2041
Stability Flow				
°A air voids	3 — 5			
% Voids Filled with Bitumen (VFB)	65 — 75			
Coating of aggregate particle	95% minimum			IS:6241
Tensile Strength ratio	80% Minimum			AASHTO T 283
I/0 Voids in Mineral Aggregate (VMA)	Minimum percent voids in mineral aggregate (VMA) are set out in Table 500-13			

### Binder Content

The binder content shall be optimized to achieve the requirements of the mix set out in Table 500-11. The binder content shall be selected to obtain 4 percent air voids in the mix design. The Marshall method for determining the optimum binder content shall be adopted as described in the Asphalt Institute Manual MS-2,

Where maximum size of the aggregate is more than 26.5 mm, the modified Marshall method using 150 mm diameter specimen described in MS-2 and ASTM D 5581 shall

be used. This method requires modified equipment and procedures. When the modified Marshall test is used, the specified minimum stability values in Table 500-12 shall be multiplied by 2.25, and the minimum flow shall be 3 mm.

**Table 500-12: Minimum Percent Voids in Mineral Aggregate (VMA)**

Nominal Maximum Particle	Minimum Design Percentage	VMA Air voids	Percent Related	to
	3.0	4.0	5.0	
26.5	11.0	12.0	13.0	
37.5	10.0	11.0	12.0	

**Note :** Interpolate minimum voids in the mineral aggregate (VMA) for designed percentage air voids values between those listed.

### Job Mix Formula

The Contractor shall submit to the Engineer for approval at least 21 days before the start the work, the job mix formula proposed for use in the works, together with the following details:

- i) Source and location of all materials;
- ii) Proportions of all materials expressed as follows:
  - a) Binder type, and percentage by weight of total mix;
  - b) Coarse aggregate/Fine aggregate/Mineral filler as percentage by weight of total aggregate including mineral filler;
- iii) A single definite percentage passing each sieve for the mixed aggregate;
- iv) The individual gradings of the individual aggregate fraction, and the proportion of each in the combined grading;
- v) The results of mix design such as maximum specific gravity of



loose mix (Gmm), compacted specimen densities, Marshall stability, flow, air voids, VMA, VFB and related graphs and test results of AASHTO T 283 Moisture susceptibility test;

- vi) Where the mixer is a batch mixer, the individual weights of each type of aggregate, and binder per batch;
- vii) Test results of physical characteristics of aggregates to be used;
- viii) Mixing temperature and compacting temperature.

While establishing the job mix formula, the Contractor shall ensure that it is based on

a correct and truly representative sample of the materials that will actually be used in the work and that the mix and its different ingredients satisfy the physical and strength requirements of these Specifications.

Approval of the job mix formula shall be based on independent testing by the Engineer for which samples of all ingredients of the mix shall be furnished by the Contractor as required by the Engineer.

The approved job mix formula shall remain effective unless and until a revised Job Mix Formula is approved. Should a change in the source of materials be proposed, a new job mix formula shall be forwarded by the Contractor to the Engineer for approval before the placing of the material.

#### **Plant Trials — Permissible Variation in Job Mix Formula**

Once the laboratory job mix formula is approved, the Contractor shall carry out plant trials to establish that the plant can produce a uniform mix conforming to the approved job mix formula. The permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula to be used shall be within the limits as specified in Table 500-13 and shall remain within the gradation band. These variations are intended to apply to individual specimens taken for quality control tests in accordance with Section 900.

**Table 500-13: Permissible Variations in the Actual Mix from the Job Mix Formula**

<b>Description</b>	<b>Base/binder Course</b>
Aggregate passing 19 mm sieve or larger	± 8%
Aggregate passing 13.2 mm, 9.5 mm	± 7%
Aggregate passing 4.75 mm	± 6%
Aggregate passing 2.36 mm, 1.18 mm, 0.6 mm	± 5%
Aggregate passing 0.3 mm, 0.15 mm	± 4%
Aggregate passing 0.075 mm	± 2%

Binder content	± 0.3%
Mixing temperature	± 10°C

### **Laying Trials**

Once the plant trials have been successfully completed and approved, the Contractor shall

carry out laying trials, to demonstrate that the proposed mix can be successfully laid and

compacted all in accordance with Clause 501. The laying trial shall be carried out on a suitable area which is not to form part of the works. The area of the laying trials shall be a minimum of 100 sq.m of construction similar to that of the project road, and it shall be in all respects, particularly compaction, the same as the project construction, on which the bituminous material is to be laid.

The Contractor shall previously inform the Engineer of the proposed method for laying and compacting the material. The plant trials shall then establish if the proposed laying plant, compaction plant, and methodology is capable of producing satisfactory results. The density of the finished paving layer shall be determined by taking cores, no sooner than 24 hours after laying, or by other approved method. The compacted layers of Dense Graded Bituminous Macadam (DBM) shall have a minimum field density equal to or more than 92% of the density based on theoretical maximum specific gravity (Grnm) obtained on the day of compaction in accordance with ASTM D 2041. Once the laying trials have been approved, the same plant and methodology shall be applied to the laying of the material on the project, and no variation of either shall be acceptable, unless approved in writing by the Engineer, who may at his discretion require further laying trials.

### **Construction Operations**

Weather and Seasonal Limitations

The provisions of Clause 501.5.1 shall apply,

### **Preparation of Base**

The base on which Dense Graded Bituminous Material is to be laid shall be prepared in accordance with Clauses 501 and 902 as appropriate, or as directed by the Engineer.

### **Geosynthetics**

Where Geosynthetics are specified in the Contract, this shall be in accordance with the requirements stated in Clause 703.

### **Stress Absorbing Layer**

Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements of Clause 517.

**Prime Coat**

Where the material on which the dense bituminous macadam is to be laid is other than a bitumen bound layer, a prime coat shall be applied, as specified, in accordance with the provisions of Clause 502, or as directed by the Engineer.

**Tack Coat**

Where the material on which the dense bituminous macadam is to be laid is either bitumen bound layer or primed granular layer, tack coat shall be applied, as specified, in accordance with the provisions of Clause 503, or as directed by the Engineer.

**Mixing and Transportation of the Mix**

The provisions as specified in Clauses 501.3 and 501.4 shall apply. Table 500-2 gives

the mixing, laying and rolling temperature for dense mixes using viscosity grade bitumen. In case of modified bitumen, the temperature of mixing and compaction shall be higher than the mix with viscosity grade bitumen. The exact temperature depends

upon the type and amount of modifier used and shall be adopted as per the Recommendations of the manufacturer. In order to have uniform quality, the plant shall be calibrated from time to time.

**Spreading**

The provisions of Clauses 501.5.3 and 501.5.4 shall apply.

**Rolling**

The general provisions of Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials. The compaction process shall be carried out by the same plant, and using the same method, as approved in the laying trials, which may be varied only with the express approval of the Engineer in writing.

**Opening to Traffic**

It shall be ensured that the traffic is not allowed without the approval of the Engineer in writing, on the surface until the dense bituminous layer has cooled to the ambient temperature.

**Surface Finish and Quality Control of Work**

The surface finish of the completed construction shall conform to the requirements of Clause 902. All materials and workmanship shall comply with the provisions set out in Section 900 of these Specifications.

**Arrangements for Traffic**

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

### Measurement for Payment

Dense Graded Bituminous Materials shall be measured as finished work either in cubic metres, tonnes or by the square metre at a specified thickness as indicated in the Contract drawings, or documents, or as otherwise directed by the Engineer.

### Rate

The contract unit rate for Dense Graded Bituminous Macadam shall be payment in full for carrying out all the required operations as specified and shall include, to all components. The rate shall include the provision of bitumen, at 6 percent by weight of the total mixture for grading 1 and grading 2 respectively.

### Item No. 41. Road Item No.12

**Bituminous Concrete (Providing and laying bituminous concrete with 100-120 TPH batch type hot mix plant /DMP60- 90 TPH capacity/80-100 TPH Capacity using crushed aggregates of specified grading, premixed with bituminous binder @6% as per MoRTH Specification specification clause No.509 complete in all respects) (for Grading-I, VG-40) 507 Bituminous Concrete**

### Scope

This work shall consist of construction of Bituminous Concrete, for use in wearing and profile corrective courses. This work shall consist of construction in a single layer of bituminous concrete on a previously prepared bituminous bound surface. A single layer shall be 30 mm/40 mm/50 mm thick.

### MATERIALS

#### BITUMEN

The bitumen shall conform to Clause 504.2.1.

#### COARSE AGGREGATES

The coarse aggregates shall be generally as specified in Clause 504.2.2, except that the aggregates shall satisfy the physical requirements of Table 500-16 and where crushed gravel is proposed for use as aggregate, not less than 95 percent by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces.

**TABLE 500-16 : PHYSICAL REQUIREMENTS FOR COARSE AGGREGATE FOR BITUMINOUS CONCRETE**

property	Test	Specification	Method of
Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075 mm sieve	IS:2386 Part I
Particle shape	Combined Flakiness and Elongation Indices	Max 35%	IS:2386 Part I
Strength	Los Angeles Abrasion Value or Aggregate Impact Value	Max 30% Max 24%	IS:2386 Part IV
Durability	Soundness either:Sodium Sulphate or	Max 12% Max 18%	IS:2386 Part V
Polishing	Polished Stone Value	Min 55	BS:812-114
Water Absorption	Water Absorption	Max 2%	IS:2386 Part

Stripping	Coating and Stripping of Bitumen Aggregate Mix	Minimum retained	IS:6241
Water Sensitivity	Retained Tensile Strength*	Min 80%	AASHTO 283

If the minimum retained tensile test strength falls below 80 percent, use of anti-stripping agent is recommended to meet the requirement.

#### **FINE AGGREGATES**

The fine aggregates shall be all as specified in Clause 505.2.3.

#### **FILLER**

Filler shall be as specified in Clause 505.2.4.

#### **AGGREGATE GRADING AND BINDER CONTENT**

When tested in accordance with IS:2386 Part 1 (Wet grading method), the combined grading of the coarse and fine aggregates and filler shall fall within the limits shown in Table 500-17. The grading shall be as specified in the Contract.

**Table 500-17 : composition of Bituminous concrete pavement layers**

Grading	1	2
<b>nominal aggregate</b>	<b>19 mm</b>	<b>13.2 mm</b>
<b>layer thickness</b>	<b>50 mm</b>	<b>30-40 mm</b>
<b>is sieve<sup>1</sup> (mm)</b>	<b>cumulative % by weight of total aggregate</b>	
45		
37.5		
26.5	100	
19	90-100	100
13.2	59-79	90-100
9.5	52-72	70-88
4.75	35-55	53-71
2.36	28-44	42-58
1.18	20-34	34-48
0.6	15-27	26-38
0.3	10-20	18-28
0.15	5-13	12-20
0.075	2-8	4-10
Bitumen content % by mass of total mix	Min 6.0*	Min 6.0**

**Notes:**

The nominal maximum particle size is the largest specified sieve size up on which any of the aggregate is retained Corresponds to specific gravity of aggregate being 2.7. In case aggregate have specific gravity more than 2.7, the minimum bitumen content can be reduced proportionately. Further the region where highest daily mean air temperature is 30°C or lower and lowest daily air temperature is – 10°C or lower, the bitumen content may be increased by 0.5 percent

**MIX DESIGN****REQUIREMENTS FOR THE MIX**

Clause 505.3.1 shall apply.

**BINDER CONTENT**

Clause 505.3.2 shall apply.

**JOB MIX FORMULA**

Clause 505.3.3 shall apply.

**PLANT TRIALS – PERMISSIBLE VARIATION IN JOB MIX FORMULA**

The requirements for plant trials shall be as specified in Clause 505.3.4, and permissible limits for variation as given in Table 500-18.

**TABLE 500-18 : PERMISSIBLE VARIATIONS IN PLANT MIX  
FROM THE JOB MIX FORMULA**

<b>Description</b>	<b>permissible Variation</b>
Aggregate passing 19 mm sieve or larger	± 7%
Aggregate passing 13.2 mm, 9.5 mm	± 6%
Aggregate passing 4.75 mm	± 5%
Aggregate passing 2.36 mm, 1.18 mm, 0.6 mm	± 4%
Aggregate passing 0.3 mm, 0.15 mm	± 3%
Aggregate passing 0.075 mm	± 1.5%
Binder content	± 0.3%
Mixing temperature	± 10°C

**LAYING TRIALS**

The requirements for laying trials shall be as specified in Clause 505.3.5. The compacted layers of bituminous concrete (BC) shall have a minimum field density equal to or more than 92 percent of the average theoretical maximum specific gravity (G) obtained on the day of compaction in accordance with ASTM D2041.

## **CONSTRUCTION OPERATIONS**

### **Weather and seasonal limitations**

The provisions of Clause 501.5.1 shall apply.

### **PREPARATION OF BASE**

The surface on which the bituminous concrete is to be laid shall be prepared in accordance with Clauses 501 and 902 as appropriate, or as directed by the Engineer. The surface shall be thoroughly swept clean by mechanical broom and dust removed by compressed air. In locations where a mechanical broom cannot get access, other approved methods shall be used as directed by the Engineer

### **GEOSYNTHETICS**

Where Geosynthetics are specified in the Contract, this shall be in accordance with the requirements stated in Clause 703.

### **STRESS ABSORBING LAYER**

Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements of Clause 517.

### **TACK COAT**

The provisions as specified in Clause 504.4.6 shall apply.

### **MIXING AND TRANSPORTATION OF THE MIX**

The provisions as specified in Clauses 501.3, 501.4 and 504.4.7 shall apply.

### **SPREADING**

The general provisions of Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials.

### **ROLLING**

The general provisions of Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials.

### **507.5 OPENING TO TRAFFIC**

Provisions in Clause 504.5 shall apply.

### **507.6 SURFACE FINISH AND QUALITY CONTROL**

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

All materials and workmanship shall comply with the provisions set out in Section 900 of these Specifications.

#### **507.7 ARRANGEMENTS FOR TRAFFIC**

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

#### **507.8 MEASUREMENT FOR PAYMENT**

**The measurement shall be as Cum.**

#### **507.9 RATE**

The contract unit rate for Dense Graded Bituminous Macadam shall be payment in full for carrying out all the required operations as specified and shall include, to all components. The rate shall include the provision of bitumen, at 6 percent by weight of the total mixture for grading 1 and grading 2 respectively.

#### **Item No. 42. Road Item No.16**

**Cat Eye / Road Stud / RPM: Supplying Raised Pavement Markers made of polycarbonate and ABS moulded body and Reflective panels with Micro prismatic lens (No Glass bead lens) capable of providing total internal reflection of the light entering the lens face and shall support a load of 13635 kgs. Tested in accordance to ASTM D 4280 Type H and Complying to Specifications of Category A of MORTH Circular No RW/NH/33023/10-97 & DO III Dt 11.06. 1997. The height, width and length shall not exceed 20 mm, 130 mm and 130 mm and with minimum reflective area of 13 Sq cm on each side and the slope to the base shall be 35 +/- 5 degree. The body of the marker should have finger grip for easy and accurate placement and Application with epoxy / bituminous Adhesive as recommended by the manufacturer of the marker. The color of the marker should be as per the IRC 35- 2015 and as directed by Engineer-in-charge.**

**804 Reflective Pavement Markers (Road Studs) And Solar Powered Road Markers (Solar Studs)**

#### **Scope**

The work shall cover the providing and fixing of reflective pavement marker (RPM) or road stud, a device which is bonded to or anchored within the road surface, for lane marking and delineation for night-time visibility, as specified in the Contract.

#### **Material**

Plastic body of RPM/road stud shall be moulded from ASA (Acrylic Styrene Acrylonitrile) or HIPS (Hi-impact Polystyrene) or Acrylonitrile Butadiene Styrene (ABS) or any other suitable material approved by the Engineer. The markers shall support a load of 13,635 kg tested in accordance with ASTM D 4280.

Reflective panels shall consist of number of lenses containing single or dual prismatic cubes capable of providing total internal reflection of the light entering the lens face.



Lenses shall be molded of methyl methacrylate conforming to ASTM 0 788 or equivalent.

### Design

The slope or retro-reflecting surface shall preferably be  $35 \pm 5^\circ$  to base and the area of each retro-reflecting surface shall not be less than 13.0 [sq.cm](#).

### Optical Performance

Unidirectional and Bt-directional Studs

Each reflector or combination of reflectors on each face of the stud shall have a Coefficient of Luminous Intensity (CIL). not less than that given in Tables 800-13 or 800-14 as appropriate.

### Omni-directional Studs

Each Omni-directional stud shall have a C.I.L. of not less than 2 mcd/lx.

**Table 800-13 : Minimum C.I.L. Values for Category 'A' Studs**

Entrance Angle	Observation Angle	C.I.L. in mcd/lx		
		White	Amber	Red
0° U 5° L & R	0.3°	220	110	44
0° U 10° L&R	0.5°	120	60	24

**Table 800-14: Minimum C.I.L. Values for Category '13 Studs**

Entrance Angle ●	Observation Angle	C.I.L. in mcd/lx		
		White	Amber	Red
0° U 6° L&R	0.3°	20	10	4
0° U 10° L&R	0.5°	15	7.5	3

### Note :

- i) The entrance angle of 0° U corresponds to the normal aspect of the reflectors when the reflecting road stud is installed in horizontal road surface.
- ii) The stud incorporating one or more corner cube reflectors shall be included in Category 'A'. The stud incorporating one or more bi-convex reflectors shall be included in Category 'B'.

### Tests

Co-efficient of luminance intensity can be measured by procedure described in ASTM E 809 "Practice for Measuring Photometric Characteristics" or as recommended in BS: 873-Part 4: 1973. Under test conditions, a stud shall not be considered to fail the photometric requirements if the measured C.I.L. at any one position of measurement is less than the values specified in Tables 800-13 or 800-14 provided that the value is not less than 80 percent of the specified minimum, and the average of the left and right measurements for the specific angle is greater than the specified minimum.

### **Solar Powered Road Markers (Solar Studs)**

The solar studs shall be made of Aluminum alloy and poly carbonate material which shall be absolutely weather resistant and strong enough to support a load of 13,635 kg tested in accordance with ASTM D4280. Its color may be white, red, yellow, green or blue or combination as directed by the Engineer. Its water resistance shall meet the requirements of IP 65 in accordance with IS: 12063:1987 Category 2, for Protection against water ingress. The dimensions of solar studs shall not be less than

100 mm x 100 mm x 10 mm. It shall have super bright LEDs so as to provide long visibility from a distance of more than 800 m. Its flashing rate shall not be less than

1 Hz. Its should be able to give the prescribed performance in the temperature range of -40°C to +55°C. Its life shall be not less than 3 years.

### **Fixing of Reflective Markers**

#### **Requirements**

The enveloping profile of the head of the stud shall be smooth and the studs shall not present

any sharp edges to traffic. The reflecting portions of the studs shall be free from crevices or ledges where dirt might accumulate. Marker height shall not be less than 10 mm and shall not exceed 20 mm. and its width shall not exceed 130 mm. The base of the marker shall be flat within 1.3 mm. If the bottom of the marker is configured, the outermost faces of the configurations shall not deviate more than 1.3 mm from a flat surface. All road studs shall be legibly marked with the name, trade mark or other means of identification of the manufacturer.

#### **Placement**

The reflective marker shall be fixed to the road surface using the adhesives and the procedure recommended by the manufacturer. No nails shall be used to affix the marker so that they do not pose safety hazard on the roads. Regardless of the type of adhesive used, the markers shall not be fixed if the pavement is not surface dry and on new asphalt concrete surfacing until the surfacing has been opened to traffic for a period of not less than 14 hours. The portions of the highway surface, to which the marker is to be bonded by the adhesive, shall be free of dirt, curing compound, grease, oil, moisture, loose or unsound layers, paint and any other material which would adversely affect the bond of the adhesive. The adhesive shall be placed uniformly on the cleaned pavement surface or on the bottom of the of the marker in a quantity sufficient to result in complete coverage of the area of contract of the marker with no voids present and with a slight excess after the marker has been lightly pressed in place. For epoxy installations, excess adhesive around the edge of the marker, excess adhesive on the pavement and adhesive on the exposed surfaces of the markers shall be immediately removed.

#### **Warranty and Durability**

The contractor shall submit a two year warranty for satisfactory field performance including stipulated retro-reflectance of the reflecting panel, to the Engineer.

In addition, a two year warranty for satisfactory infield performance of the finished road marker shall also be given by the contractor who carries out the work of fixing of reflective road markers. In case the markers are displaced, damaged, get worn out or lose their reflectivity compared to stipulated standards, the contractor would be required to replace all such markers within 15 days of the intimation from the Engineer, at his own cost

#### 804.8 Measurement for Payment

The measurement of reflective road markers/solar powered road studs shall be in numbers of different types of markers supplied and fixed.

#### 804.9 Rate

The contract unit rate for reflective road markers/solar powered road studs shall be payment in full compensation for furnishing all labour, material, tools, equipment including incidental costs necessary for carrying out the work at site conforming to the specification complete as per approved drawings or as directed by the Engineer.

#### **Item No. 43. Road Item No.13**

**Providing and laying of Hot applied Thermoplastic compound 2.5 mm thick including Reflectorizing Glass Beads @ 250 gms per sqm area, thickness of 2.5 mm is exclusive of surface applied glass beads as per IRC : 35 & finished surface to be level, uniform and free from streaks and holes. (As per Government letter No.SOR 102003/94/S-1/Dated.20-7-2004)**

**MORTH Vth IREVISION: Cl. No. 803, Pg. no. 338**

The painted markings shall be measured in sq. metres of actual area marked (Excluding the gaps, if any).

As per Schedule mod of measurement for this item Sqm.

#### **Item No. 44. Road Item No.17**

**Cautionary Warning Sign:-Providing and fixing sign boards made out of 2mm aluminium Sheet / 4mm ACP (Aluminium composite Panel); size 90 x 90 x 90 cms. Equilateral triangle as per design of IRC-67-2012. Pre-treated with phosphating process & acid Etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorized with Micro Prismatic Grade retro reflectivesheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.6mtr long stand post of 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with best quality epoxy coatings in black and white bends. Details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 Cms. for each leg. Including excavation, curing etc. Complete under the supervision of engineer in charge. A warranty for 10 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor.**

**(A) Class-C Type-11 Retro Reflective sheeting**

**MORTH Vth REVISION Cl. No. 801, Pg. no. 325**

**As per Schedule mod of measurement for this item is Nos.**

**Road Item No.18**

**Chevron sign :-Providing and fixing sign boards made out of 1.5mmaluminium sheet / 3mm ACP (Aluminum composite Panel); size60x50 cm as per design of IRC-67-2012. Pretreated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ;reflectorized with Micro Prismatic Grade retro reflectivesheeting of Type-11 as pe ASTM D-4956 and latest M.O.S.T. Specifications; 3.3 mtr long stand post of 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 50 x 50 x 5mm; painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in**

**Charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 Cms. For each leg. Including excavation, curing etc. Complete under the supervision of Engineer in charge. A warranty for 10 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report From third party test lab for the product offered shall be submitted by contractor.**

**(A) Class-C Type- 11 Retro Reflective sheeting**

**MORTH Vth REVISION VTH REVISION VTH IREVISION: Cl. No. 801, Pg. no. 325**

**As per Schedule mod of measurement for this item is Nos.**

**Item No. 45. Road Item NO.20**

**Regulatory / Mandatory Sign:-**Providing and fixing sign boards made out of 2mm Aluminium sheet / 4mm ACP (Aluminium composite Panel); size 900 cms Dia Circle as per design of IRC-67- 2012. Pre-treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorized with Micro Prismatic Grade retro reflectivesheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.6mtr long stand post of 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; Painted with best quality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 Cms. for each leg. Including excavation, curing etc. Complete under the supervision of engineer in charge. A warranty for 10 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor Exposure test report from third party test lab for the product offered shall be submitted by contractor.

**(A) Class-C Type-11 Retro Reflective sheeting**

**MORTH Vth REVISION : Cl. No. 801, Pg. no. 325**

**As per Schedule mod of measurement for this item is Nos.**

**Item No. 46**

**Supply of Swiss Type Bollard** made out of 1.25 mm thick M.S. sheet, total height 135 cm, the lower portion is made in tapered circular section having upper dia 15 cm And lower dia 20 cm with attachment of one mandatory plate 7 mm thick & fixed with the help of 7 cm long, 30mm dia chrome plated M.S. tube this part is fixed on the Body with another attachment of a cap 30x7 cm. whole body is processed in black stoving enamel and mandatory plate in Azure blue, with one compulsory keep left Arrow with 10mm border reflective strip each of 7.5 cm on body complete in all respect.

**MORTH Vth REVISION Cl. No. 801, Pg. no. 325**

**As per Schedule mod of measurement for this item is Nos.**

**Item No. 48**

**Direction (Junction) Sign:-**Providing and fixing sign boards made out of 2mm Aluminium sheet / 4mm ACP (Aluminium composite Panel); size 244x122 cms. Rectangular as per design of IRC-67- 2012. Pre-treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality Epoxy paint; reflectorized with Micro Prismatic Grade retro reflectivesheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T.Specifications; 4.0mtr long (2Nos.) Stand post of 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame Fabricated from suitable size iron angle of 50 x 50 x 5mm; painted with best quality Epoxy coatings in black and white bends. The details of symbol foreach board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 Cms. for each leg. Including excavation, curing etc. Complete under the supervision of engineer in charge. A warranty for 10 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor.

**(A) Class-C Type-11 Retro Reflective sheeting**

**MORTH Vth REVISION : Cl. No. 801, Pg. no. 325**

**As per Schedule mod of measurement for this item is Nos**

**Item No. 49. Road Item No. 19.**

**Hazard Marker Sign:-**Providing and fixing sign boards made out of 2.0 mm Aluminium sheet / 4 mm ACP (Aluminum composite Panel); size 90x30 cms. Rectangular as per design of IRC-67-2012. Pre-treated with phosphating process & Acid etching; coated with one coat of epoxy primer and two coats of best quality Epoxy paint; reflectorized with Micro Prismatic Grade retro reflective sheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T. Specifications; 1.8mtr long stand Post of 75x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from Suitable size iron angle of 35 x 35 x 3mm; painted with best quality epoxy coatings in Black and white bends. The details of symbol for each board shall be as per the Instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of siz 45 x 45 x 60 Cms. for each leg. Including excavation, curing etc. Complete under the Supervision of engineer in charge. A warranty for 10 years for the Retro reflective Sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor.

**(A) Class-C Type-11 Retro Reflective sheeting****MORTH Vth REVISION: Cl. No. 806, Pg. no. 357 806**

**806.1** road delineators scope The work shall cover supplying and fixing roadway indicators, hazard markers and object markers. Roadway indicators shall be properly installed to indicate the horizontal alignment and vertical profile of the roadway so as to outline the vehicle path for safe driving. Hazard markers shall be installed immediately ahead of obstruction of vehicular path such as just before a narrow bridge. Object markers shall be erected where obstruction within the roadway starts such as Channelizing Island in approaches to intersections.

**806.2** The design, materials to be used and the location of the road delineators (roadway indicators, hazard markers and object markers) shall conform to Recommended Practice for Road Delineators, IRC:79, and to relevant drawings or as otherwise directed by the Engineer. The steel drums such as empty bitumen drums shall not be used as they could pose safety hazards, The delineators shall be retro- reflectorized as shown on the drawings or as directed by the Engineer. The reflectors on the delineators shall be of retro reflective sheeting with encapsulated lens and with the visibility of 300 m under clear weather conditions, when illuminated by the upper beam of the car headlights.

**806.3** installation The delineators shall be so installed that their posts do not change their orientation and the reflectorized faces are always perpendicular to the direction of travel.

**806.4** Measurement for payments The measurement shall be made in number of delineators supplied and fixed at site.

**As per Schedule mod of measurement for this item is Nos.**

**806.5 rates** The Contract unit rates of delineators shall be payment in full compensation for Furnishing all labour, materials, tools, equipment including incidental costs necessary to complete the work to these Specifications.

**Road Item No.15**

**Supplying and fixing reinforced concrete heavy duty no pressure pipes with Collars for culverts including setting and joining the pipes in C.M. 1:2 watering and laying (To level of slops of I.S. 458 / 1971 Class NP4 casted by vertically Vibrated technology of following internal diameter. 1200mm dia**

**As per detail specification Sample must be approved from EIC / PMC or representative of EIC As per Schedule mod of measurement for this item is Rmt**

**This item inculdes Pre Production QAP and witness testing at plant facility. QAP-Quality Assured Plan should be submitted with appropriate brand of cement and steel reinforcement from Plant facilty with QC Department Sign and Stamp. After the approval of QAP, RMC official allow production/treatment in w**

**Item No. 50.**

**Drainage manhole should be done according to design given with ratio are at the bottom it should be C C 1:3:6 with brick masonry 1:4 cum plaster 1:3 cm coping 1:1:2 and also benching around it with 1:2:4 should be done with finishing, curing, manhole frame cover and also with PVC step. excluding excavation or suply of frame cover) Type ---A--- :Round : Up to 1.50 m depth \* inside dia. 1200 mm ( for drainage lines from 150 mm to 500 mm dia.) (Menhole type - A up to 1.00 meter depth)**

**And**

**Drainage manhole should be done according to design given with ratio are at the bottom it should be C C 1:3:6 with brick masonry 1:4 cum plaster 1:3 cm coping 1:1:2 and also benching around it with 1:2:4 should be done with finishing, curing, manhole frame cover and also with PVC step. excluding excavation or suply of frame cover) Type ---A--- :Round : Up to 1.50 m depth \* inside dia. 1200 mm ( for drainage lines from 150 mm to 500 mm dia.) (Menhole type - A (for extra depth 1.01 to 1.50mt)**

The said drainage manhole as per drainage type design is to carried out in brick masonry in CM 1:4 and CC in foundation in 1:3:6 including bedding, benching in 1:2:4 and the inside plaster work in niru finishing in CM 1:3 as per drainage drawing is to be carried out whereas the outer plaster in CM 1:3 is to be done with necessary fixing of HDPE reinforced plastic steps of size 385 x 165 x 0.25 mm as per given type design is to be done. Precast RCC manhole frame and cover is to be done 1:1.5:3 by filling cop ing and fixing work. The work shall be such that there shall not be no leakage in the manhole, in which, the rate for excavation shall be paid separately which is not included the prescribed rate.

If The frame and cover is provided by RMC Store : for the same, items have to be transported from Store/said location to Site at the cost of contractor and fixing work is to be carried out accordingly, for which, the rate for only fixing work shall be paid.

The rate for manhole shall be for one number in which, the rate for frame and cover shall be paid separately where for additional depth, the rate shall be paid on one running meter basis as shown in Schedule of this tender.

**THE MANHOLE AND DEPTH OF MANHOLES :-**

The manholes on the sewers shall be constructed in the form and of the dimensions shown in the Drawing. The depth of the manholes shall be measured from the top of cover to the invert level of the manhole.

The manholes shall be constructed at places shown on the drawings or whatever directed by the Engineer. Type designs for these manholes are shown on the drawings but the actual type and dimensions shall in each case be determined by the Engineer as the circumstances may require. (Refer drawing No. R.M.C.- DRN - PHASE-III - 01 to 09 )

**CONSTRUCTION OF BRICK MASONRY MANHOLES :**

The brick masonry shall be constructed as per the type design shown in the drawing enclosed. The various types of manholes to be adopted as per the requirement have been indicated in the L-section and sewer layout drawing in general. The manhole will be fitted with R.C.C. pre-cast medium or heavy duty manhole frame and cover as the case may be. The brick masonry manhole shall be plastered from inside and outside as shown in the drawing and as shown CM proportion and thickness.

**FLOORS AND 0.80 ID CHANNEL PIPES :**

The floor shall consist of cement concrete. Concrete of R.C. 0.80 ID channel pipes of the required size and curves shall be laid and bedded in cement on the concrete base to the same lines and fall as sewers unless otherwise directed. Both sides of the channel pipes shall be trenched up in concrete and rendered in cement mortar 20 mm thick and formed to a slope of not less than 1 in 12 to the channel.

**STEPS :**

Where the depth of the invert exceeds 0.90 M below the surface of the ground, HDPE reinforced steps of approved pattern shall be provided as per type design shown in manhole drawings.

**RATE OF MANHOLES :**

The rate for construction of manhole to be quoted in the bill of quantities shall include complete masonry, structure, concrete cap, plastering with cement from inside and outside, bottom concrete or channels including providing and fixing of HDPE reinforced steps and fixing of R.C.C. manhole frame & covers complete as per type design drawing and cutting the pipes flush with the inside plaster of the wall. The manholes will be paid per numbers up to the minimum depth shown in the type design and for depth beyond the specified minimum depth for a particular type of manhole, extra will be paid per running meter depth. The rates includes dewatering during all stages of construction.

The brick masonry will be paid per number excluding excavation but including masonry, bottom concrete, plastering, benching channel fixing of RCC frame and covers. (Refer R.M.C. DRG for H.C.1, H.C.2)

**The rate for Item No.50 shall be for a unit of one number whereas rate for and Menhole type - A (for extra depth 1.01 to 1.50mt) shall be in running meter.**



**Item No. 51****Construction of B type MH upto 1.50 mt depth  
And  
Extra depth for B type MH upto 4.00mt depth**

The said drainage manhole as per drainage type design is to be carried out in brick masonry in CM 1:4 and CC in foundation in 1:3:6 including bedding, benching in 1:2:4 and the inside plaster work in niru finishing in CM 1:3 as per drainage drawing is to be carried out whereas the outer plaster in CM 1:3 is to be done with necessary fixing of HDPE reinforced plastic steps of size 385 x 165 x 0.25 mm as per given type design is to be done. Precast RCC manhole frame and cover is to be done 1:1.5:3 by filling coping and fixing work. The work shall be such that there shall not be no leakage in the manhole, in which, the rate for excavation shall be paid separately which is not included the prescribed rate.

If The frame and cover is provided by RMC Store : for the same, items have to be transported from Store/said location to Site at the cost of contractor and fixing work is to be carried out accordingly, for which, the rate for only fixing work shall be paid.

The rate for manhole shall be for one number in which, the rate for frame and cover shall be paid separately where for additional depth, the rate shall be paid on one running meter basis as shown in Schedule of this tender.

**THE MANHOLE AND DEPTH OF MANHOLES :-**

The manholes on the sewers shall be constructed in the form and of the dimensions shown in the Drawing. The depth of the manholes shall be measured from the top of cover to the invert level of the manhole.

The manholes shall be constructed at places shown on the drawings or whatever directed by the Engineer. Type designs for these manholes are shown on the drawings but the actual type and dimensions shall in each case be determined by the Engineer as the circumstances may require. (Refer drawing No. R.M.C.-DRN - PHASE-III - 01 to 09 )

**CONSTRUCTION OF BRICK MASONRY MANHOLES :**

The brick masonry shall be constructed as per the type design shown in the drawing enclosed. The various types of manholes to be adopted as per the requirement have been indicated in the L-section and sewer layout drawing in general. The manhole will be fitted with R.C.C. pre-cast medium or heavy duty manhole frame and cover as the case may be. The brick masonry manhole shall be plastered from inside and outside as shown in the drawing and as shown CM proportion and thickness.

**FLOORS AND 0.80 ID CHANNEL PIPES :**

The floor shall consist of cement concrete. Concrete of R.C. 0.80 ID channel pipes of the required size and curves shall be laid and bedded in cement on the concrete base to the same lines and fall as sewers unless otherwise directed. Both sides of the channel pipes shall be trenched up in concrete and rendered in cement mortar 20 mm thick and formed to a slope of not less than 1 in 12 to the channel.

**STEPS :**

Where the depth of the invert exceeds 0.90 M below the surface of the ground, HDPE reinforced steps of approved pattern shall be provided as per type design shown in manhole drawings.

**RATE OF MANHOLES :**

The rate for construction of manhole to be quoted in the bill of quantities shall include complete masonry, structure, concrete cap, plastering with cement from inside and outside, bottom concrete or channels including providing and fixing of HDPE reinforced steps and fixing of R.C.C. manhole frame & covers complete as per type design drawing and cutting the pipes flush with the inside plaster of the wall. The manholes will be paid per

numbers up to the minimum depth shown in the type design and for depth beyond the specified minimum depth for a particular type of manhole, extra will be paid per running meter depth. The rates includes dewatering during all stages of construction.

The brick masonry will be paid per number excluding excavation but including masonry, bottom concrete, plastering, benching channel fixing of RCC frame and covers. (Refer R.M.C. DRG for H.C.1, H.C.2)

**The rate for Item No.51 shall be for a unit of one number whereas rate for item and Extra depth for B type MH upto 4.00mt dept shall be in running meter.**

## **Item No. 52**

### **Construction of C type MH upto 6 mt depth**

The said drainage manhole as per drainage type design is to be carried out in brick masonry in CM 1:4 and CC in foundation in 1:3:6 including bedding, benching in 1:2:4 and the inside plaster work in niru finishing in CM 1:3 as per drainage drawing is to be carried out whereas the outer plaster in CM 1:3 is to be done with necessary fixing of HDPE reinforced plastic steps of size 385 x 165 x 0.25 mm as per given type design is to be done. Precast RCC manhole frame and cover is to be done 1:1.5:3 by filling, coping and fixing work. The work shall be such that there shall not be no leakage in the manhole, in which, the rate for excavation shall be paid separately which is not included the prescribed rate.

If The frame and cover is provided by RMC Store : for the same, items have to be transported from Store/said location to Site at the cost of contractor and fixing work is to be carried out accordingly, for which, the rate for only fixing work shall be paid.

The rate for manhole shall be for one number in which, the rate for frame and cover shall be paid separately where for additional depth, the rate shall be paid on one running meter basis as shown in Schedule of this tender.

### **THE MANHOLE AND DEPTH OF MANHOLES :-**

The manholes on the sewers shall be constructed in the form and of the dimensions shown in the Drawing. The depth of the manholes shall be measured from the top of cover to the invert level of the manhole.

The manholes shall be constructed at places shown on the drawings or whatever directed by the Engineer. Type designs for these manholes are shown on the drawings but the actual type and dimensions shall in each case be determined by the Engineer as the circumstances may require. (Refer drawing No. R.M.C.-DRN - PHASE-III - 01 to 09 )

**CONSTRUCTION OF BRICK MASONRY MANHOLES :**

The brick masonry shall be constructed as per the type design shown in the drawing enclosed. The various types of manholes to be adopted as per the requirement have been indicated in the L-section and sewer layout drawing in general. The manhole will be fitted with R.C.C. pre-cast medium or heavy duty manhole frame and cover as the case may be. The brick masonry manhole shall be plastered from inside and outside as shown in the drawing and as shown CM proportion and thickness.

**FLOORS AND 0.80 ID CHANNEL PIPES :**

The floor shall consist of cement concrete. Concrete of R.C. 0.80 ID channel pipes of the required size and curves shall be laid and bedded in cement on the concrete base to the same lines and fall as sewers unless otherwise directed. Both sides of the channel pipes shall be trenched up in concrete and rendered in cement mortar 20 mm thick and formed to a slope of not less than 1 in 12 to the channel.

**STEPS:**

Where the depth of the invert exceeds 0.90 M below the surface of the ground, HDPE reinforced steps of approved pattern shall be provided as per type design shown in manhole drawings.

**RATE OF MANHOLES :**

The rate for construction of manhole to be quoted in the bill of quantities shall include complete masonry, structure, concrete cap, plastering with cement from inside and outside, bottom concrete or channels including providing and fixing of HDPE reinforced steps and fixing of R.C.C. manhole frame & covers complete as per type design drawing and cutting the pipes flush with the inside plaster of the wall. The manholes will be paid per numbers up to the minimum depth shown in the type design and for depth beyond the specified minimum depth for a particular type of manhole, extra will be paid per running meter depth. The rates includes dewatering during all stages of construction.

The brick masonry will be paid per number excluding excavation but including masonry, bottom concrete, plastering, benching channel fixing of RCC frame and covers. (Refer R.M.C. DRG for H.C.1, H.C.2)

The rate for This Item shall be for a unit of one number.



**LIST OF APPROVED VENDORS FOR CIVIL WORKS:**

<b>ITEMS</b>	<b>Approved Brands / Quality</b>
CEMENT	Ultra Tech, Ambuja, ACC, Sanghi, Hathi, TATA
	<b>For Bridge Structure</b> Fe 550D or higher grade steel procured from approved manufacturer like TISCO [TATA] , SAIL, VIZAG , Electrotherm, JSW , Essar <b>For Non bridge Structure</b> Fe 550D or higher grade steel procured from approved vendor of GWSSB
Base coat and two coats of weather proof exterior premium paint	Dulux Aquatech Flexible Waterproof Basecoat (1 coat) + Dulux Weathershield Max (2 coat ) OR Asian Paint Apex Ultima Protek Base Coat ( 2 coat ) + Asian Paint Apex Ultima Protek Top Coat ( 2 coat ) OR Jotun Jotashield Waterxt Basecoat (1 coat ) + Jotun Jotashieldwaterxt Top A ( 2 coat)
Plastic emulsion paint	Akzonobel Dulux Super clean/Asian Paints Apcolite premium Emulsion
water based cement paint	<b>Asian apex weather proof / Akzonobel Dulux Weathershield Protect</b>
Oil Paint	Asian / Dulux/ Jotun/ Indigo/ Global
CAST IRON PIPES and FITTINGS.	TATA, SAIL, ESSAR , ESPAT AND JINDAL [JSW],RATNAMANI
MS PIPES & SPECIALS	SAIL, ESSAR , ESPAT AND JINDAL [JSW], WELSPUN, RATNAMANI
D.I. DF PIPE K-9 TYPE WITH SPECIALS AND FITTINGS OF K - 9/K-12 TYPE	JINDAL, ELECTROTHERM, , TATA, ESL Steel Ltd, Welspun D.I. Pipes Ltd
M.S. ANGLE SECTION	Any I.S.I. BRAND
WATER PROOFING MATERIALS	Zycosil, Dr. Fixit, Polychem SIKKA FORCEROCK, Mapie, or as directed by engineer in charge
PVC Pipe	approved vendor of GWSSB
UPVC PIpe	approved vendor of GWSSB
Paver Block	BIS approved manufacture with ISI Mark product
*Due to any shortage of product from above and over approved vendor list; Engineer-In-charge may allow equivalent product based on merits.	

