Name of work :-	WORK OF CONSTRUCTING,WIDENING,STRENGTHENING AND RESURFACING VARIOUS IMPORTANT ROADS AND WHEN REQUIRED OR IN EMERGENCY UNDER KUTCH-BHUJ (PANCHAYAT) ANNUAL BASIS DIST.KUTCH (Bhachau & Rapar)

GENERAL TECHNICAL SPECIFICATION

1.0 GENERAL :

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

1. Length and breadth 10 mm
2. height, depth or thickness *of* earthwork, sub-base, bases. surfacing, and structural members 5 mm
3. Areas 0.01 Sq. Mt
4. Cubic contents 0.01 Cu. Mt.

in recording dimensions of work the sequence of length, width and height or depth or thickness shall be followed.

2.0 MEASUREMENT OF LEAD FOR MATERIALS

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

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

3.0 SURFACE REGULARITY OF SUBGRADE & PAVEMENT COURSES :

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

Permitted tolerance of surface regularity for pavement courses

Sr.	Type of Construction	Longitudinal Profile with 3 meter straight edge					Cross Profile
		Maximum permissible undulation in mm	Maximum number of undulation permitted in any 300 m length exceeding in mm				Maximum permissible variation from specified profile camber template in mm
1	Earth sub-grade	36	30	--	--	--	15
2	Granular lime / Cement Stabilized Sub-base	23	--	30	--	--	12
3	Water Bound Macadam with nominal size metal {20 – 50 mm}	18	--	--	30	--	8
4	Semi Dense carpet @@	18	--	--	--	20	6

Notes :

1. @ @ These are for machine laid surfaces. If laid manually, due to unavoidable reason, tolerance upto 50 percent above these values in this column may be permitted. However, this relaxation does not apply to the values of maximum undulation for longitudinal and cross profiles mentioned in columns *3* and *8* in the TABLE.

2 Surface evenness requirements in respect of both the longitudinal and cross profiles should be simultaneously satisfied.

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

(i) Sub-grade : Where the surface is high, it shall be trimmed and suitably compacted. Where the same in low, the deficiency shall be corrected by adding fresh material The degree of compaction and the type of material to be used shall conform to the specified requirements.

(ii) Granular 1 Sub- base : Same as at (i) above except that the degree of compaction and the type of material to be used shall conform to the specified requirements.

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

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

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

(V) Bituminous Construction : For bituminous constructions, other than wearing course, where the surface is low. the deficiency shall be corrected by adding fresh material and re-compaction to specifications. Where this surface is high, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications. For wearing course, where the surface is high or low. the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications in all cases where the removal and replacement of a bituminous layer is involved, the area treated shall not be less than 5 metre long and not less than 1 lane wide.

4. QUALITY CONTROL TEST DURING CONSTRUCTION :

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

5. TESTS ON EARTH WORK OF EMBANKMENT CONSTRUCTION :

5.1 Borrow Material :

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

d	Moisture Content Test (IS :2720 Part -11)	One test for every 250 Cubic Metres of soil.

5.2 Compaction Control :

Control shall be exercised by taking at least one measurement of density for each 1000 square metres of compacted area, or closer as required lo yield !lie minimum number of test results for evaluating day's work on statistical basis. The determination of density shall be accordance with IS : 2720 (Part XXVIII). Test locations shall be chosen only through random sampling techniques. Control shall not be based on the result of any one test but on the mean value of a set of 5-10 density determinations. The number of tests in one set of measurements shall be 5 as long as it IS felt that sufficient control over borrow material and the method of compactions is being exercised. If considerable variations are observed between individual density results, the minimum number of tests in one set of measurement shall be increase to 10.. The acceptance of work shall be subject to the condition that the mean dry density equals or exceeds the specified density and the standard deviation for any set of results is below 0.08 gm/cc. However for earthwork in shoulders and in top 500 mm portion of the embankment below the sugared, at least one density measurement shall be taken for every 500 square meters of the compacted area provided further that the number of the tests in each set of measurement shall be at least 10. In other respects, the control shall be similar to that described earlier.

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

(1) Cement IS : 269

(2) Sand for masonry IS 2116

(3) Sand for Concrete IS 383

(4) Coarse aggregates IS 383

(5) Mild Steel IS 432

(6) High yield strength deformed bars

(a) Hot Rolled IS : 1139

(b) Cold Twisted IS : 1786

7. BARREL THICKNESS OF PIPES OF DIFFERENT CLASS SHALL BE AS UNDER

Sr. No.	internal Diameter of pipe in mm	Barrel thickness (in mm)		
		NP_1	NP_2	NP_3
1	80	25	25	--
2	100	25	25	--
3	150	25	25	--
4	250	25	25	--
5	30	30	30	--
6	350	32	32	75
7	400	32	32	75
8	450	35	35	75
9	500	--	35	75
10	600	--	40	80
11	700	--	40	80
12	800	--	45	90
13	900	--	50	100
14	1000	--	55	100
15	1100	--	60	115

Sr. No.	internal Diameter of pipe in mm	Barrel thickness (in mm)		
		NP_1	NP_2	NP_3
16	1200	--	65	115

SPECIFICATION FOR MATERIALS

M-1 Water:

1.1 Water shall not be salty or brackish and shall be clean, reasonably clear and free from objectionable quantities of silt and traces of oil and injurious alkalis, salts, organic matter and other deleterious material which will either weaken the mortar or concrete or cause efflorescence or attack the steel in R.C.C. Container for transport, storage and handling of water shall be clean. Water shall conform to the standards specified in LS. 456-1978.

1.2. 1f required by Engineer-in-charge it shall be tested by comparison with distilled water. Comparison shall he made by means of standard cement tests for soundness, time of setting and mortar strength as specified in LS. 269-1976. Any indication of unsoundness, change in time of setting by 30 minutes or more or decrease of more than 10 per cent in strength of mortar prepared with water sample when compared with the results obtained with mortar prepared with distilled water shall be sufficient cause for rejection of water under test.

1.3. Water for curing mortar, concrete or masonary should not be too acidic or too alkaline. It shall be free of elements which significantly affect the hydration reaction or otherwise interfere with the hardening of concrete during curing or those which produce objectionable stains or other unsightly deposits on concrete or mortar surfaces.

1.4. Hard and bitter water shall not be used for curing.

1.5. Potable water will be generally found suitable for curing mortar or concrete.

M-3 Cement:

3.1 Cement shall be ordinary Portland slag cement as per LS. 269-1976 or Portland slag cement as pr I.S. 455-1976.

M-6 Sand:

6.1. Sand shall be natural sand, clean, well graded, hard strong durable and gritty particle free from injurious amounts of dust clay, kankar nodules, soft or flaky particles shale, alkali; salts organic, matter, loam, mica or other deleterious substance and shall be got approved from the Engineer-in-charge. The sand shall not contain more than 8 percent of silt as determined by field test, if necessary the sand shall be washed to make it clean.

6.2. Coarse Sand:

The fineness modulus of coarse sand shall not be less than 2.5 and shall not exceed 3.0. The sieve analysis of coarse shall be as under:

I. S. Sieve Designation	Percentage by weight passing sieve	I. S. Sieve Designation	Percentage by weight passing sieve
4.75 mm.	100	600 Micron	30 – 10
2.36 mm.	90 To 100	300 Micron	5 – 70
1.18 mm.	70 – 100	150 Micron	0 – 50

6.3 Fine Sand:

The fineness modulus shall not exceed 1.0. The sieve analysis of fine sand shall be as under

I. S. Sieve Designation	Percentage by weight passing sieve	I. S. Sieve Designation	Percentage by weight passing sieve
4.75 mm.	100	600 Micron	40 – 85
2.36 mm.	100	300 Micron	5 – 50
1.18 mm.	70 – 100	150 Micron	0 - 10

M-12 Stone Coarse Aggregate for Nominal Mix Concrete:

12.1. Coarse aggregate shall be machine crushed stone of black trap or equivalent and be hard, strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar.

12.2. The aggregate shall generally be cubical in shape. Unless special stones of particular quarries are mentioned aggregates shall be machine crushed from the best black trap or equivalent hard stone as approved. Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement concrete and ordinary reinforced cement concrete shall generally be as per the table given below. However in case of reinforced cement concrete the maximum limit may be restricted to 6 mm. less than the minimum lateral clear distance between bars or 6 mm. less than the cover, whichever is smaller.

TABLE

I. S. Sieve Designation	Percentage passing for single sized aggregates of Nominal size			I. S. Sieve Designation	Percentage passing for single sized aggregates of Nominal size		
	40 mm	20 mm	10 mm		40 mm	20 mm	10 mm
80 mm.	---	---	---	12.5 mm.	---	---	---
63 mm.	100	---	---	10 mm.	0.5	0.02	0.30
40 mm.	85 – 100	100	---	4.75 mm.	---	0.5	0.5
20 mm.	0 – 20	85 – 100	100	2.35 mm.	---	---	---
16 mm.	---	---	85 – 100				

Note: This percentage may be varied some what by Engineer-in-charge when considered necessary for obtaining better density and strength of concrete.

12.3. The grading test shall be taken in the beginning and at the change of source of materials. The necessary test indicated in I.S. 383-1970 and I.S. 456-1978 shall have to be carried out to ensure the acceptability. The aggregates shall he stored separately and handled in such a manner as to prevent the intermixing of different aggregates. If the aggregates are covered with dust, they shall be washed with water to make them clean.

M-13 Black Trap or Equivalent Hard Stone Coarse Aggregate:

13.1. Aggregate For Design Mix Concrete: Coarse aggregate shall be of machine crushed stone of black trap or equivalent hard stone and be hard strong dense- durable clean and free from skin and coating likely to prevent proper adhesion of mortar.

13.2. The aggregates shall generally be cubical in shape. Unless special stones of particular quarries are mentioned, aggregates shall be machine crushed from the best, black trap or equivalent hard stones as approved. Aggregate shall have no deleterious reaction with cement.

13.3. The necessary tests indicated in I.S. 383-1970 and I.S. 456-1978 shall have to be carried out to ensure the acceptability of the material.

13.4. If aggregate is covered with dust it shall be washed with water to make it clean.

M-14 Brick Bats Aggregate:

14.1. Brick bat aggregate shall be broken from well burnt or slightly over burnt and dense brick. It shall be homogeneous in texture roughly cubical in shape, clean and free from dirt of any other foreign material. The brick bats shall be of 40 mm. to 50 mm. size unless otherwise specified in the item. The under burnt of over burnt brick bats shall not be allowed.

14.2. The brick hats shall be measured by volume by suitable boxes or as directed.

M-18 Mild Steel Bars:

18.1 Mild steel bars reinforcement for R.C.C. work shall conform to I.S. 432 (Part-II) 1966 and shall be of tested quality. It shall also comply with relevant part of I.S. -t56- 1978.

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

18.3. For the purpose of payment, the bar shall be measured correct up to 100 mm. length and weight payable worked out at the rate specified below:

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

M-19 High Yield Strength Steel Deformed Bars:

19.1. High yield strength steel deformed bars be either cold twisted or hot rolled shall conform to I.S. 1739-1966 and I.S. 1139- 1966 respectively.

19.2. Other provision and requirements shall conform to specification No. M-18 for Mild steel bars.

M-20 High Tensile Steel Wires:

20.1. The high tensile wires for the use in pre stressed concrete work shall confirm to I.S. 2090-1962.

20.2. The tensile strength of the high tensile steel bars shall be as specified in the item. In absence of the given strength, the minimum strength shall he taken as per Para 6.1 of I.S. 1785-1962. Testing shall be done as per I.S. requirements. 20.3. The high tensile steel shall be free from loose mill scale, rust oil, grease, or any other harmful matter. Cleaning of steel bars may he carried out by immersion in solvent solution, wire brushing or passing through a pressure box containing carborandum.

20.4. The high tensile wire shall be obtained from manufactures in coil having diameter not less than 350 times the diameter of wire itself so that wire springs back straight on being uncoiled.

M-21 Mild Steel Binding Wires:

21.1. The mild steel wire shall be of 1.63 mm. or 1.22 mm. (16 or 18 gauge) diameter and shall conform to I.S. 280-1972.

21.2. The use of black wire will be permitted for binding reinforcement bars. It shall be free from rust, oil paint, grease, loose mill scale or any other undesirable coating which may prevent adhesion of cement mortar.

ITEM WISE SPECIFICATIONS

Item No. 1

Clearing and Grubbing road land including uprooting rank, vegetation, grass bushes, shrubs, saplings and trees girth up to 300 mm removal of stumps of trees cut earlier and disposal of unseviceable materials and stacking of serviceable materials to be use (A) By mechanical means in area of light jungle

1.Before starting the work the site shown on plans shall be cleared of all obstructions loose stones and materials, rubbish of all kinds as well as all trees and brush wooden except those marked for prevention, the roots being entirely grubbed up. No trees to be cut down before obtaining permission from Engineer in charge.

2.The stuff obtained from clearance shall be stacked in such a place and in such a manner as ordered by the Engineer in charge and the ground shall be left in a perfectly clean condition.

3.In jungle cleaning, all trees, not specially marked for preventions, bamboos, jungle wood and brush wood shall be cut down their roots rubbed up. All wood and materials available as directed by the Engineer in charge.

4.All holes or hollows, where originally or products by digging up roots shall be carefully filled up with earth well rammed and leveled up neatly as directed.

5.After completion of the work, but before its acceptance, the site shall be cleared of all scaffolding, surplus materials and rubbish etc. as per contract. No extra payment shall be made for site clearance.

The rate for this item of work shall be for the complete job and shall be paid at the hector rate tendered for the work on completion of the entire work.

Item No. 2 :

Scarifying /Dismentalling gravelled macadam or bitumen macadam surface 6 cm to 10 cm.depth including stacking useful materials on road side and disposing off remaining stuff.

1.0 The layer of the existing layer B.T.Surface metal/ ling shall be excavated and shall be screened on site of work stacking of metal obtained from screening shall be done by filling in the standard steel boxes of 2m x 1.5 m x 0.5 mt. size which shall be supplied by department if available on rent. Otherwise contractor shall make his own arrangements. No deductions for voids shall be made from the gross measurements. Where any doubt exist as to whether the quantity of stacks of metal in any hectometer is not confirming with cubical content of the standard pharas (2m x 1.5m x 0.5 m) shall be got corrected by the contractor if so ordered by the Engineer-in-charge for which no extra payment shall be claimed by the contractor. If the quantity of metal in any stack in a particular hectometer is found to be less then the standard measurements viz. 1.5 cmt the entire collection in the hectometer shall be paid on the basis of the quantity so found. Regular stacks shall be done by the contractor on a fairly level ground. Stacking of the metal shall be done in a manner as directed by the Engineer-in-charge.

2.0 The remaining material except metal obtained from screening process shall be used in embankment with all lead and lift. It shall be directly deposited at the required location in specified layers. No handling or conveyance charges shall be paid if the materials is temporarily deposited else where and subsequently convey to site of deposition. The sequence of operations should be arranged properly. Material not required for any use whatsoever may be disposed off by the contractor at his own cost in manner approved by the Engineer-in-charge. The material utilised in the embankment will be deducted from the net quantity of earthwork arrived at within the chain age measured.

3.0 The payment shall be made on sq.mt. the contractor shall maintain all stacks in regular and proper size till the whole materials shall not be measured and finally accepted by the department. The spreading of materials shall not be allowed till the materials are fully stacked and completed kilometer wise.

4.0 The rate includes the cost of scarifying macadam, screening, deposting, conveyance with all lead and lift. Filling the boxes including all labour, tools, equipments and all other incidental expenses.

Item No.3

Box cutting the road surface to proper slope and camber for making a base for road work including removing the excavated stuff and depositing on the road side slope as directed up to 50mt. Lead

1. This work shall consist of excavation, removal and satisfactory disposal of all materials necessary for the construction of widening carriageway in accordance with requirements of these specifications and the lines, grades and cross sections shown in the drawings or as indicated by the Engineer.
2. After the site has been cleared the limits of excavation/ box cutting the road surface shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer.
3. Box cutting shall be carried out in conformity with the directions laid here in under and in a manner approved by the Engineer. The work shall be so done that the suitable materials available from box cutting/ excavation are satisfactorily utilized as directed.
4. The contractor shall not excavate outside the limits of box cutting. Subject to the permitted tolerances, any excess depth/ width excavated beyond the specified levels/ dimensions on the drawings shall be made good at the cost of the contractor with suitable material of characteristics similar to that removed and compacted as directed.
5. Cutting shall be done in proper grade & camber as shown on drawing or as directed. Care must be taken that all slopes are evenly and truly dressed. Cutting shall be done to the exact depth required and shall be as per formation level in proper grade and the camber. If extra depth of cutting is done due to negligence of contractor the same shall be refilled with approved quality of materials duly consolidated to the satisfaction of the Engineer-in-charge (without extra cost).
6. The stuff received from the cutting of existing crust shall be screened on site and stone aggregates shall be stacked at suitable place which shall be reused for modified sub base as directed by the Engineer in charge. The unsuitable materials shall be removed from the site and same shall be used for filling and correcting side slopes of bank and earthwork for embankment as directed by the Engineer in charge with lead up to 50 mtr..
7. The measurement of box cutting shall be taken on level basis & level shall be taken at 30 mt. interval. Volume shall be computed in cubic meters by average area method.
8. The payment shall be made on Cmt. basis.

Item No - 4

Earth work for embankment with selected soil C.B.R.not less than 6.0 including breaking clods, dressing, with all, lead and lift (excl. watering and consolidation) From borrow area with all lead & lift

1.The land width on which the earth work is to be done shall be cleared off all the trees having girth of 30 cm and less, loose stones, vegetations, bushes, slumps and all other objectionable material shall be arranged in convenient stack along the road boundary or as directed at place within 50 meters lead and handed over to the department in convenient section. Unsuitable material shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance, inconvenience or damage to the works property or people in the neighborhood. In all cases the materials shall be disposed off in an a neat manner.

2.After cleaning the site, the alignment of the road shall be properly set out true to line, curves, slopes, graded and sections as shown on the plan or directed by the Engineer in charge. The contractor shall provide all labours and materials such as lime, strings, pegs, nails, bamboos, stone, mortar, concrete etc. required for setting out, establishing bench marks and giving profiles. The contractor shall be responsible for maintaining

benchmarks, profiles, alignments and other marks as long as they are required for the work in the opinion of the Engineer in charge. If the contractor defaults in this respect they may be restored by the department at the cost of contractor.

3.When existing embankment is to be widened, continuous horizontal benches, each at leas 0.30meter wide shall be cut into the existing slops for insuring adequate bond with the fresh embankment material to be added. The material obtained from the cutting of benches can be utilized in the widening of the embankment. Where the width of widened portion, if insufficient to permit the use of rollers. Compaction shall be careered out with the help of tandem / sheep foot rollers, hand rollers, mechanical tampers or other approved plant. The 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 type of hauling equipment.

4.The soil to be used for the embankment shall be free from trees, slumps, roots, rubbish or any other objectionable materials. Only materials considered suitable by the Engineer in charge shall be used for the construction and that considered unsuitable other disposed off as directed by him. The selection the materials to be used in the construction of embankment shall be made after the soil surveys and investigations are carried out by the department. The embankment shall consist of earth available from road side borrow pits on either side with lead and all lifts and within land width in the manner specified in para 12 below. The road, if any required for the purpose haulage of earth by men, animals or vehicles will be constructed (if not existing) and maintained by the contractor at his own cost. The material satisfying the density requirements given in the table below shall be employed for embankment construction

Type of Work	Laboratory Dry Density when tested as per IS 2720 {Part VII}
Embankment upto 3 meter height	Not less than 1.44 gm/cc
Embankment exceeding 3 meter height or embankment of any height subject to lon period of inundation.	Not less than 1.52 gm/cc
Top 0.50 meter of embankment below the subgrade level and shoulder {where earth shoulder are specified}	Not less than 1.65 gm/cc

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

5.Department will extend all necessary cooperation in helping contractor to bet borrow area form nearby Government or Panchayat Land, if available. However, department is not responsible, if no such are is made available to the contractor in that case, contractor will have to make his own arrangement to get borrow area for borrowing earth of the approved quality even by making temporary arrangement with the private land owners.

6.The embankment shall be constructed in uniform layers not exceeding 250mm in loose thickness. The soil shall be spread uniformly over the entire width of the embankment unless otherwise directed by the Engineer in charge. The consolidation including watering and rolling of earthwork shall be carried out by the contractor. The operation of laying successive layers of earth shall have to suitably ***** with the consolidation work. If the soil as delivers to the road bed us too wet, it shall be dried by exposure to the sun till the moisture content is acceptable for compaction. All clods of hard lumps of earth shall be broken to have maximum size of 15 cm, when being placed in the embankment and a maximum of size 5 cm when being placed in the top 45cm of the embankment and a maximum size of 15cm when being placed in the top 45cm of the embankment. The work of next layer shall be allowed only after the first layer below it has been thoroughly compacted to the density specified.

7.Where an embankment is to be placed on sloping ground the surface of the ground shall be benched in the steps of trenches or broken up in such a manner that the material shall have perfect bond with the existing surface. Where the embankment is to be laid over an existing road surface the surface shall be scarified to minimum depth of 5 cm so as to provide ample bond between the old and new material. However when the pavement shall be broken up in please not to exceeding 0.1 mt and may be left under the new embankment. If the existing road surface is of granular or bituminous type and line within 1 mt. of the new subgrade level the same shall be scarified to a depth of minimum 50mm so as to provide ample bond between the old and the new material.

8.To avoid interference with the construction of abutment, wing walls or return wall, culvers / bridge structures, the contractor shall at point to be determined by the Engineer in charge, suspend the 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 interference or damage to the bridge work. Unless directed otherwise the filling ground culverts, bridges and other structure upto a distance to twice the height of the embankment from the back of the embankment shall be carried out independent of the work on the main embankment. The fill material shall not be placed against any abutment or wing walls unless permission has been given by the Engineer in charge but in any case not until the concrete or masonry has been in position for 14 days. The embankment shall be brought up simultaneously with the laying of fill material. The material used for the filter shall conform to the requirements for filter medium and will be paid extra in the relevant item. Where it may be impracticable to use power roller or other heavy equipment, the compaction shall be carried out by mechanical tampers or other methods approved by the Engineer in charge. Care shall be taken to see that the compaction plant does not hit or come to close to any structural member so as to cause any damage to them.

9.The Embankment shall be finished in conformity with the alignment, levels, cross section and dimensions shown on the plans or as directed by Engineer in charge. Where the alignment of the road is a curve, the top of the embankment shall be formed with the super elevation and the increased width shown on the drawing or as the Engineer in charge may direct. Finishing operations shall include the work of shaping and dressing the shoulders, road bed and the side slopes to conform the cross section.

10. The consolidation of earth work including rolling and watering at OMC as per laboratory requirement shall be carried out by the contractor. The field and laboratory investigations and testing of sample shall be carried out by the department. However, the contractor shall give full co operations and shall be made the charges for labours and collection of samples for testing at authorized Government laboratory. The work of laying of earthwork in layers shall be synchronized with the field and laboratory testing. When density measurements reveal any soft area as in the embankment the Engineer in charge directed that these areas shall be compacted further. If inspire of that, specified compaction is not achieved the materials in the soft areas shall be removed as directed and replaced by the approved materials.

11. The earthwork measurements shall be paid on cross sectional measurements and computing the volumes of earthwork in cubic meter by average area method. The contractor shall sign day to day leveling work and also original cross section, longitudinal section etc., on token of his acceptance. The working section both longitudinal and cross of the ground shall be taken by the Engineer in charge before the actual work is started. The contractor or his authorized representative shall attend day to day leveling work and sigh with date the field book daily, in token of his acceptance. If there is any disagreement, the contractor shall inform of it in writing the officer concerned with specified reference to the section officer before starting further work. Once the work is started, no cognizance of any complaint will be taken. Merely not signing of level books shall not be deemed as disagreement. The Executive Engineer shall also verify leveling work to the extent of 5% before commencement of earthwork and on finalization. The contractor shall maintain the embankment by filling the rust, raincuts, depressions due to shrinkage etc. to proper formation and grade till this item is finally measured and accepted by the Department. The measurements shall be taken on compacted earthwork. No deduction for shrinkage shall be made from gross measured quantity of compacted earthwork. However the contractor shall have to bear loss of quantity due to all settlement as well as other types of deformations etc., if any, that might have taken place at the time of taking final measurements of this item.

12. If approved usable materials is available within the land width of road same shall be permitted for use in the road embankment subject to the following conditions.

(i) The borrowpits will be so excavated as to form a road side longitudinal gutter to drain the water, interrupted by such gutter.

(ii) The width of the drain shall be restricted to 1.50 mts. only. The depth will be restricted to such grade as to drain the water efficiently. All balance quantity of earth shall be brought from distant borrow areas.

(iii) If there is top layer of black cotton or other objectionable soils, the same be removed and disposed off elsewhere and usable material found at the lower level will only be used in the earthen embankment, if the contractor choose to utilize material.

(iv) The drain should be aligned along the boundary of land width of the road. No pit other than this drain shall be dug within 5 meters of the toe to the final section of the road embankment.

(v) No borrowpits shall be allowed in the length in which earth obtained from cutting is specified to be used in embankments.

13. The rate of earthwork includes clearing jungles, dogbelling, fixing profiles erecting necessary pillars for stones for bench marks for leveling purpose, excavating earth from borrow areas, breaking clods, conveying and spreading earth in layers with all lead and lift, finishing the entire embankment and incidentals necessary to complete the work to the specifications. The cutting stuff of cutting in ordinary soils, soft murrum, soft rock, hard murrum and hard rock shall be utilized in embankment construction under this item within the lead specified in that particular item. No payment shall be made under this item for the cutting stuff used in the embankment but labour for cutting will be paid as per specifications in that particulars item and only balance quantity of earthwork brought from borrow areas will be paid in this item.

Item No - 5

Earthwork in cuting in all sorts of soil and soft murrum including conveying and spreading the stuff, embankment as and where directed within 200meters from the end of the cutting with all required lead and lift.

The land width required for the roadway , gutter side slopes and catch water gutters shall be cleared of all tree having a girth of 30 cms. And less , loose , stones, vegetation , bushes , stumps and all other objectionable materials. The roots of trees and stumps shall be removed to a depth of 30 cms below the grade formation and slopes and excavation filled up with excavated materials and compacted. All the materials cleared will be the property of Government. Useful materials shall be arranged in convenient stacks along the road boundary or as directed at places within 50 mts . Lead and handed over to the department in convenient sections .Unsuitable material shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance, inconvenience of damage to the work , property or people in the neighborhood . If the materials are to be disposed of outside the road land , necessary permission from the private land owners shall be taken by the contractor and royalty etc. If any paid by him without claiming compensations. In all cases, the materials shall be disposed off in a neat manner.

2. After clearing the site , the alignment of the road shall be properly set out true to lines, curves slopes , grades and sections as shown on the plans or directed by the Engineer-in-charge. The contractor shall provide all labour and materials such as lime, strings , pegs , nails , bamboos , stones mortar , concrete etc. required for setting out alignment establishing bench marks and giving profiles . The contractor shall be responsible for maintaining the B. Ms. Profiles alignments and other stakes and marks as long as they are required for the work in the opinion of the Engineer. If the contractor defaults in this respect even after the direction by the Engineer within the specified time, they may be restored by the Engineer at the levels etc. If there is any disagreement the contractor shall inform of it in writing to the officer concerned with the specific reference to the sections before starting further work .Once the work has started , no cognizance of any complaint shall be taken Merely not signing of the book shall not be deemed as disagreement.

3. Profiles of the section including the road side gutters to be excavated shall be laid at suitable intervals of 10 m to 50 m. or other intervals as directed by Engineer to conform to the curved or straight alignment, sections, grades and side slopes. The line out shall be clearly marked and profiles of embankments where excavated materials are to be used shall be set up with the toe line marked on each side. The road way section shall first be excavated with vertical side for each lift and the sides slopes for the lift shall be excavated in steps. These steps shall be smoothened to the required slope when the excavation reaches the road formation. The contractor shall on no account excavate beyond the slopes or below the specified grade unless so directed by the Engineer in writing If excavation is done below the specified level or outside the section , it shall not be paid for and the contractor shall be required to fill up at his own cost such extra excavation in the road portion with approved materials of the embankment grade in layers, watered and fully compacted to attain maximum density laid down for the embankment in its relevance item. The Engineer may require measurement ridges and dead man to be left at specified intervals or places and kept intact till ordered to be removed for the purpose of check measurements. The excavation shall be finished neatly, smoothly, and evenly to the correct lines, curves, grades , if loose shall be scarified , watered and compacted to the same density as the embankment. The section side slopes and catch water gutter shall be maintained by the contractor at his own cost in such a way that the formation and gutters will be drained by providing for necessary diversions etc, and not damaged due to obstruction of any drainage. Necessary passages shall be provided for leading way seepage, springs, surface flow or rainwater safely without damaging the work . If any damage occurs due to default of the contractor in this respect, he shall make

good the damage at his own cost. If it is necessary in the execution of the work to interrupt existing surface drainage , irrigation channels , sewers or under drainage , temporary arrangements shall be provided till such time as is necessary. The contractor at his own cost shall make the existing works or work in hand caused as a result of his operations or negligence shall be made good by the contractor at his own cost . Road side gutters shall be excavated to the specified sections and shall be measured along with the main cutting in cubic meters.

4. If slides occur in the cutting they shall be removed as ordered by the Engineer. If finished slopes slide in to the roadways before the final acceptance of the work , such slides shall be removed by the contractor and shall be paid for at the contract rate for the class of excavation involved provided the slides are not due to any negligence of the contractor . The classification of the material in slides shall conform to its conditions at the time of removal and payment made accordingly regardless of its prior condition . Care shall be taken to see that excavation is arranged in a safe way so that there will be no risk to the workmen by slides, falling materials , boulders and collapsing sides etc.

5. If there is traffic nearby or if there are towns and villages in the neighborhood, barricades and or traffic signals shall be provided day and night for the duration of the work in such aay as to prevent accidents. Warning signals shall be displayed at 7 mt. from the danger point on both sides giving sufficient warning. If necessary signalers shall be stationed at each end to regulate traffic where it is heavy Measures shall be taken to see that the excavation does not affect or damage adjoining structures or property. If there is damage to property, injury to workers , the members of the public , animals etc., due to the negligence of the contractor, he ill be responsible and liable to all the consequences including compensation.

6. All the excavated materials shall be property of Government. When the useful excavated material is to be used in embankment within a lead of 200 metre and all lift , shall be directly deposited at the required location in specified layers. No handing or conveyance charges shall be paid if the materials is temporarily deposited elsewhere and subsequently conveyed to site of deposition. The sequence of operations at convenient places. Without interfering with the drainage in any way . If no Government land is available but the excavated useful stuff is to be stacked temporarily be for use under the same agreement , the contractor shall make his own arrangement for the stacking of this material not required for use on embankment or unsuitable materials may be used on his own to uniformly widen embankment to flatten slopes and to fill low places in the road land , if so permitted by the Engineer. Material not required for any use whatsoever may be disposed off by the contractor at his own cost in a manner approved by the Engineer. The excavated material shall not be deposited within 3 m from the top edge of slope or toe of the bank. The lead shall be measured from the junction point of cutting and embankment up to 200 mt. on either side.

7. If the contractor does not wish to utilized the quantity of cutting within the specified lead for any reason then he may do the embankment work with the earth from other sources (except borrow pits in the length of the road where cutting stuff is to be utilized) but in that case the full or part quantity on acceptable quality stuff for which payment is made or to be made will be deducted from the net quantity of the earth work in the embankment arrived at within the chainage measured as above.

8. The Contract rate shall be a unit of one cubic metre for the start mentioned in the wording of the item of excavation acceptably completed limited to the dimensions shown on the plans or as directed by the Engineer. Excavation shall be measured in its original positions by taking cross sections before the work starts and after it is entirely completed. The quality shall be worked by the average end area method. When the classification of the strata changes , the contractor shall bring this to notice of the Engineer, who will then verify and if necessary take levels for the changed strata for purpose of measurement .

Item no. - : 6

Rolling and consolidation using vibratory road roller 8 - 10 tonne capacity (incl.watering)(A) Earth work (layer not exceeding 200mm thickness)

1 For spreading materials in layers and bringing the appropriate moisture content, the embankment materials shall be spread uniformly over the entire width of 'the embankment in layers not exceeding 200mm in loose thickness Successive layers of embankment shall not be placed until the layer under construction has been thoroughly compacted to the requirements set down hereunder

Mositure content of the materials shall be checked at the source of supply and if found less than that Specified for compaction, the same, shall be made good either at the source or after spreading the soil in

loose thickness for compaction in the latter case, water shall. be sprinkled directly from a hoseline, or from a truck mounted Water tank, and flooding shall not be permiitted under any circumstances.

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

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

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

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

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

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

2. COMPACTION Only compacting equipment approved by the Engineer-incharge Shall be employed to compact the materials. The contractor shall demonstrate the efficiency of the plants he intents to use for carrying out compaction trials.

Each layer of the materials shall be thoroughly compacted to the densities specified in Table 1.2 Compaction requirements for embankment.

Sr. No.	Type of Work/ materials	Field dry density as per centage of maximum laboratory dry density as per IS:2720 (Part-VII)
1.	Top 0.5 meter portion of embankment below subgrade level and shoulders.	Not less than 100.
2.	Other portion of embankment.	Not less than 95
3.	Highly expensive class	85 to 90

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

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

3 Measurements for Payment Consolidation of earth embankment construction shall be measured by taking cross section at intervals in the original position before the Work starts and after its completion and computing of the volume of earthwork in cubic meters by the method of average areas. The measurement of fill material from borrow area shall be the difference between the net quantities of suitable materials brought from roadway and drainage excavation For this purpose It shall be assumed that one cubic meter of suitable materials brought to site from roadway and drainage excavation from 1 cubic meter of compacted fill and all bulking or shrinkage shall be ignored. Stripping including storing and reapplication of top soil shall be measured as volume In cubic meter

4 The contract unit rate includes cost of mechanical roller required for consolidation including all labour equipments fuel hire charges, tolls, and incidentals necessary

Item No. 7

Providing and laying 100 mm Compacted of Specified quarry Spall in side shoulder including carraige of material and spreading on prepared base including compacting as per MOST Specification etc. complete.

1. Scope:- The work shall consist of constructing shoulder on either side of pavement with quarry spalls with the requirement of these specifications and in conformity with the lines, grades and cross sections shown on the drawings or as directed.

2. Materials : Matrerials shaal be Quarry spalls confirming to the requirements as specified below.

2.1 The quarry spalls to be used for the work shall be free from organic or other deleterious constituent and conform to grading given the Table 2.1

Table 2.1

IS Sieve Designation	Per Cent by weight passing the I S Sieve
53.0 mm	100
26.5 mm	50-80
9.50 mm	
4.75 mm	15-35
2.36 mm	
0.425 mm	
0.075 mm	>10
CBR Value (Minimum)	**30**

Note: - The material passing 425 micron (0.425 mm) sieve when tested according to IS 2720 (Part-5) shall have liquid limit and plasticity index not more than 25 and 6 per cent respectively.

2.2 **Physical requirement:-**

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

3. **Mode of Measurement and Payment:-**

The side shoulder with quarry spalls shall be measured as finished work in position in cubic meters. The finished thickness of work done shall be paid on volume basis.

Item No. 8

Laying and spreading available soil in the sub-grade on a prepared surface, pulverising, mixing the spread soil in place with rotavator with 3 per cent slaked lime having minimum content of 70 per cent of CaO, grading with motor grader and compacting with the road roller at OMC to the desired density to form a layer of improved sub grade.

402. LIME TREATED SOIL FOR IMPROVED SUB-GRADE/SUB-BASE

402.1. Scope

This work shall consist of laying and compacting an improved sub-grade/lower sub-base of soil treated with lime on prepared sub-grade 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. Lime treatment is generally effective for soils which contain a relatively high percentage of clay and silty clay.

402.2. Materials

402.2.1. Soil : Except when otherwise specified, the soil used for stabilisation shall be the local clayey soil having a plasticity index greater than 8.

402.2.2. Lime : Lime for lime-soil stabilisation work shall be commercial dry lime slaked at site or pre-slaked lime delivered to the site in suitable packing. Unless otherwise permitted by the Engineer, the lime shall have purity of net less than 70 per cent by weight of Quicklime (CaO) when tested in accordance with IS :1514. Lime shall be properly stored to avoid prolonged exposure to the atmosphere and consequent carbonation which would reduce its binding properties.

402.2.3. Quantity of lime in stabilised mix : Quantity of lime to be added as percentage by weight of the dry soil shall be as specified in the Contract. The quantity of lime used shall be related to its calcium oxide content which shall be specified. Where the lime of different calcium oxide content is to be used, its quantity shall be suitably adjusted to the approval of the Engineer so that equivalent calcium oxide is incorporated in the work. The mix design shall be done to arrive at the appropriate quantity of lime to be added, having due regard to the purity of lime, the type of soil, the moisture-density relationship, and the design CBR/Unconfined Compressive Strength (UCS) value specified in the Contract. The laboratory CBR/UCS value shall be at least 1.5 times the minimum field value of CBR.AJCS stipulated in the Contract.

402.2.4. Water : The water to be used for lime stabilisation shall be clean and free from injurious substances. Potable water shall be preferred.

402.3. Construction Operations

402.3.1. Weather limitations : Lime-soil stabilisation shall not be one when the air temperature in the shade is less than 10° C.

402.3.2. Degree of pulverisation: For lime stabilisation, the soil before addition of stabiliser, shall be pulverised using agricultural implements like disc harrows and rotavators to the extent that it passes the requirements set out in Table 400-3 when tested in accordance vith the method described in *Appendix* 3.

TABLE 400-3. SOIL PULVERISATION REQUIREMENTS FOR LIME STABILISATION

IS Sieve designation	Minimum per cent by weight passing the IS Sieve
26.5 mm	100
5.6 mm	80

402.3.3. Equipment for construction: Stabilised soil sub-bases shall be constructed by mix-in-place method of construction 01 as otherwise approved by the Engineer. Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs.

The equipment used for mix-in-place construction shall be a rotavator or similar approved equipment capable of pulverising and mixing the soil with additive and water to specified degree to the full thickness of the layer being processed, and of achieving the desired degree of mixing and uniformity of the stabilised material. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for work.

The thickness of any layer to be stabilised shall be not less than 100 mm when compacted. The maximum thickness shall be 200 mm, provided the plant used is accepted by the Engineer.

402.3.4. Mix-in-place method of construction: Before deploying the equipment, the soil after it is made free of undesirable vegetation or other deleterious matter shall be spread uniformly on the prepared subgrade in a quantity sufficient to achieve the desired compacted thickness of the stabilised layer. Where single-pass equipment is to be employed, the soil shall be lightly rolled at the discretion of the Engineer.

The equipment used shall either be of single-pass or multiple pass The mixers shall be equipped with an appropriate device for controlling the depth of processing and the mixing blades shall be maintained or reset periodically so that the correct depth of mixing is obtained at all times.

With single-pass equipment the forward speed of the machine shall be so selected in relation to the rotor speed that the required degree of mixing, pulverisation and depth of processing is obtained. In multiple-pass processing, the prepared subgrade shall be pulverised to the required depth with successive passes of the equipment and the moisture content adjusted to be within prescribed limits mentioned hereinafter. The blending or stabilising material shall then be spread uniformly and mixing continued, with successive passes until the required depth and uniformity of processing have been obtained.

The mixing equipment shall be so set that it cuts slightly into the edge of the adjoining lane processed previously so as to ensure that all the material forming a layer has been properly processed for the full width.

402.3.5. Construction with manual means: Where manual mixing is permitted, the soil from borrow areas shall first be freed of all vegetation and other deleterious matter and placed on the prepared Subgrade. The soil shall then be pulverised by means of crow-bars, pick axes or other means approved by the Engineer.

Water in requisite quantities may be sprinkled on the soil for aiding pulverisation. On the pulverised soil, the blending material(s) in requisite quantities shall be spread uniformly and mixed thoroughly by working with spades or other similar implements till the whole mass is uniform. After adjusting the moisture content to be within the limits mentioned later, the mixed material shall be levelled up to the required thickness so that it is ready to be rolled.

402.3.6. Addition of lime: Lime may be mixed with the prepared material either in slurry form or dry state at the option of the Contractor with the approval of the Engineer.

Dry lime shall be prevented from blowing by adding water to the or other suitable means selected by the Contractor, with the approval of the Engineer.

The tops of windrowed material may be flattened or slightly trenched to receive the lime. The distance to which lime may be spread upon the prepared material ahead of the mixing operation shall be determined by the Engineer.

No traffic other than the mixing equipment shall be allowed to pass over the spread lime until after completion of mixing.

Mixing or remixing operations, regardless of equipment used, shall continue until the material is free of any white streaks or pockets of lime and the mixture is uniform.

Non-uniformity of colour reaction, when the treated material is tested with the standard phenolphthalein alcohol indicator, will be considered evidence of inadequate mixing.

402.3.7. Moisture content for compaction: The moisture content at compaction checked vide IS :2720 (Part 2) shall neither be less than the optimum moisture content corresponding to IS: 2720 (Part 8) nor more than 2 per cent above it.

402.3.8. Rolling: Immediately after spreading, grading and levelling of the mixed material, compaction shall be carried out with approved equipment preceded by a few passes of lighter rollers if necessary. Rolling shall commence at edges and progress towards the centre, except at superelevated portions where it shall commence at the inner edge and progress towards outer edge. During rolling the surface shall be frequently checked for grade and crossfall (camber) and any irregularities corrected by loosening the material and removing/ adding fresh material. Compaction shall continue until the density achieved is at least 98 per cent of the maximum dry density for the material determined in accordance with IS: 2720 (Part 8).

Care shall be taken to see that the compaction of lime stabilised material is completed within three hours of its mixing or such shorter period as may be found necessary in dry weather.

During rolling it shall be ensured that roller does not bear directly on hardened or partially hardened treated material previously bid other than what may be necessary for achieving the specified compaction at the joint. The final surface shall be well closed, free from movement under compaction planes, ridges, cracks or loose material. All loose or segregated or otherwise defective areas shall be made good to the full thickness of the layer and recompacted.

402.3.9. Curing: The sub-base course shall be suitably cured for a minimum period of 7 days after which subsequent pavement courses shall be laid to- prevent the surface from drying out and becoming friable. No traffic of any kind shall ply over the completed sub-base unless permitted by the Engineer.

402.4. Surface Finish and Quality Control of Work

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

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

402.5. Strength

When lime is used for improving the subgrade, the soil-lime mix shall be tested for its CBR value. When lime stabilised soil is used in a sub-base, it shall be tested for unconfined compressive strength (UCS) at 7 days. In case of variation from the design CBR/UCS, in situ value being lower, the pavement design shall be reviewed based on the actual CBR/UCS values. The extra pavement thickness needed on account of lower CBR/UCS value shall be constructed by the Contractor at his own cost.

402.6. Arrangements of Traffic

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

402.7. Measurements for Payment

Stabilised soil sub-base shall be measured as finished work in position in cubic metres.

402.8. Rates

The Contract unit rate for lime stabilised soil sub-base shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.8 (i) to (v).

Item No. 9

Providing, laying and Spreading 150 mm Granular sub-base (Grade-I) by providing close graded B.T.M.C. material in single layer with motor graderon prepared surface, mixing by mix in place method with rotovator at OMC and compacted withvibratory roller 80 to 110 KN static weight to achieve desire density etc completed.

401. GRANULAR SUB-BASE

401.1. Scope

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

401.2. Materials

401.2.1. The material to be used for the work shall be natural sand, moorum, gravel, crushed stone, or combination thereof depending upon the grading required. Materials like crushed slag, crushed concrete, brick metal and kankar may be allowed only with the specific approval of the Engineer. The material shall be free from organic or other deleterious constituents and conform to one of the three gradings given in Table 400-1.

While the gradings in Table 400-1 are in respect of close-graded granular sub-base materials, one each for maximum particle size of 75 mm, 53 mm and 26.5 mm, the corresponding gradings for the coarse-graded materials for each of the three maximum particle sizes are given at Table 400-2. The grading to be adopted for a project shall be as specified in the Contract.

401.2.2. Physical requirements: The material shall have, a 10 per cent fines value of 50 kN or more (for sample in soaked condition) when tested in compliance with BS:812 (Part 111). The water absorption value of the coarse aggregate shall be determined as per IS : 2386 (Pan 3); if this value is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS : 383. For Grading II and III materials, the CBR shall be determined at the density and moisture content likely to be

developed in equilibrium conditions which shall be taken as being the density relating to a uniform air voids content of 5 per cent.

TABLE 400-1. GRADING FOR CLOSE-GRADED GRANULAR

SUB-BASE MATERIAL

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

TABLE 400-2. GRADING FOR COARSE GRADED GRANULAR

SUB-BASE MATERIAL

Sieve Designation	**Per cent passing by IS sieve**		
	Grading I	**Grading II**	**Grading III**
75.0 mm	100	--	--
53.0 mm	--	100	--
26.5 mm	55-75	50-80	100
9.50 mm	--	--	--
4.75 mm	10-30	15.35	25-45
2.36 mm	--	--	--
0.425 mm	--	--	--
0.075 mm	<10	<10	<10
CBR Value (Minimum)	30	25	20

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

401.3. Strength of sub-base

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

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

401.4. Construction Operations

401.4.1. Preparation of subgrade : Immediately prior to the laying of sub-base, the subgrade already finished to Clause 301 or 305 as applicable shall be prepared by removing all vegetation and other

extraneous mailer, lightly sprinkled with water if necessary and rolled with two passes of 80 -100 kN smooth wheeled roller.

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

When the sub-base material consists of combination of materials mentioned in Clause 401.2.1, mixing shall be done mechanically by the mix-in-place method.

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

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

Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed[1] 100 mm, a smooth wheeled roller of 80 100 kN weight may be used. For a compacted single layer upto 215 mm the compaction shall be done with the help of a vibratory roller minimum 80 to 100 kN static weight with plain drum or pad foot-drum or heavy pneumatic tyred roller of minimum 200 to 300 kN weight a minimum tyre pressure of 0.7 MN/m^2 or equivalent capacity capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall and super-elevation and shall commence at the edges and progress towards the centre for portions having crossfall on both sides.

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

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

401.5. Surface Finish and Quality Control of Work

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

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

401.6. Arrangements for Traffic

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

401.7. Measurements for Payment

Granular sub-base shall be measured as finished work in position in cubic metres.

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

401.8. Rate

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

(i) malting arrangements for traffic to Clause 112 except for initial treatment to verges, shoulders and construction of diversions;

(ii) furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lifts;

(iii) all labour, tools, equipment and incidentals to complete the work to the Specifications;

(iv) carrying out the work in part widths of road where directed; and (v) carrying out the required test for quality control.

Item No. 10

Providing and laying 100 mm compacted WBM of using B.T.M.C. metal of size 90mm to 45mm in layersincluding 27% stone screening 13.2mm size and 8% stone dustas filler, including spreading, watering and cosolidation by vibratory roller as per MoRTH specifications etc. complete as directed by Engineer-in-charge. (Grade-I)

And

Item No. 11

Providing and laying 75 mm compacted WBM of using B.T.M.C. metal of size 45mm to 63mm in layers including 16% Grit and 8% stone dust as filler, including spreading, watering and cosolidation by vibratory roller as per MoRTH specifications etc. complete as directed by Engineer-in-charge. (Grade-II)

404.1. Scope

404.1.1. This work shall consist of clean, crushed aggregates mechanically interlocked by rolling and bonding together with screening, binding material where necessary and water laid on a properly prepared subgrade/ sub-base/ base or existing pavement, as the case may be and finished in accordance with the requirements of these Specifications and in close conformity with the lines, grades, cross-sections and thickness as per approved plans or as directed by the Engineer.

404.1.2. It is, however, not desirable to lay water bound macadam on an existing thin black topped surface without providing adequate drainage facility for water that would get accumulated at the interface of existing bituminous surface and water bound macadam.

404.2. Materials

404.2.1. Coarse aggregates : Coarse aggregates shall be either crushed or broken stone, crushed slag, overburnt (Jhama) brick aggregates or any other naturally occurring aggregates such as kankar and laterite of suitable quality. Materials other than crushed or broken stone and crushed slag shall be used in sub-base courses only. If crushed gravel/ shingle is used, not less than 90 per cent by weight of the gravel/ shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 400-6. The type and size range of the aggregate shall be specified in the Contract or shall be as specified by the Engineer. If the water absorption value of the coarse aggregate is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS : 2386 (Part 5).

404.2.2. Crushed or broken stone: The crushed or broken stone shall be hard, durable and free from excess flat, elongated, soft and disintegrated particles, dirt and other deleterious material.

TABLE 400-6. PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR WATER BOUND MACADAM FOR SUB-BASE/BASE COURSES

	Test	Test Method	Requirements
1	* Los Angeles Abrasion value Or	IS:2386 (Part-4)	40 per cent (Max)
	* Aggregate Impact value	IS:2386 (Part-4) or IS:5640**	30 per cent (Max)
2	Combined Flakiness and Elongation Indices (Total) ***	IS:2386 (Part-1)	30 per cent (Max)

* Aggregate may satisfy requirements of either of the two tests.

** Aggregates like brick metal, kankar, laterite etc. which get softened in presence of water shall be tested for Impact value under wet conditions in accordance with IS: 5640.

*** The requirement of flakiness index and elongation index shall be enforced only in the case of crushed broken stone and crushed slag.

404.2.3. Crushed slag : Crushed slag shall be made from air-cooled blast furnace slag. It shall be of angular shape, reasonably uniform in quality and density and generally free from thin, elongated and soft pieces, dirt or other deleterious materials. The weight of crushed slag shall not be less than 11.2 kN per m^3 and the percentage of glossy material shall not be more than 20. It should also comply with the following requirements:

(i) Chemical stability : To comply with requirement of appendix of BS : 1047

(ii) Sulphur content : Maximum 2 per cent

(iii) Water absorption : Maximum 10 per cent

404.2.4. Overburnt (Jhama) brick aggregates : Jhama brick aggregates shall be made from overburnt bricks or brick bats and be free from dust and other objectionable and deleterious materials.

404.2.5. Grading requirement of coarse aggregates : The coarse aggregates shall conform to one of the Gradings given in Table 400-7 as specified, provided, however, the use of Grading No.1 shall be restricted to sub-base courses only.

TABLE 400-7. GRADING REQUIRMENTS OF COARSE AGGREGATES

Grading No.	Size Range	IS Sieve Designation	Per cent by weight passing
1.	90 mm to 45 mm	125 mm	100
		90 mm	90-100
		63 mm	25-60
		45 mm	0-15
		22.4 mm	0-5
2.	63 mm to 45 mm	90 mm	100
		63 mm	90-100
		53 mm	25-75
		45 mm	0-15
		22.4 mm	0-5
3.	53 mm lo 22.4 mm	63 mm	100
		53 mm	95-100
		45 mm	65-90
		22.4 mm	0-10
		11.2 mm	0-5

Note : The compacted thickness for a layer with Grading 1 shall be100 mm while for layer with other Gradings i.e. 2 & 3, it shall be 75 mm

404.2.6. Screenings: Screenings to fill voids in the coarse aggregate shall generally consist of the same material as the coarse aggregate. However, where permitted, predominantly non-plastic material such as moorum or gravel (other than rounded river borne material) may be used for this purpose provided liquid limit and plasticity index of such material are below 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 10 per cent.

Screenings shall conform to the grading set forth in Table 400-8. The consolidated details of quantity of screenings required for various grades of stone aggregates are given in Table 400-9. The table also gives the quantities of materials (loose) required for 10 m^2 for sub-base/base compacted thickness of 100/75 mm.

The use of screenings shall be omitted in the case of soft aggregates such as brick metal, kankar, laterites, etc. as they arc likely to get crushed to a certain extent under rollers.

TABLE 400-8. GRADING FOR SCREENINGS

Grading Classification	Size of Screenings	IS Sieve Designation	Per cent by weight passing the IS Sieve
A	13.2 mm	13.2 mm	100
		11.2 mm	95-100
		5.6 mm	15-35
		180 micron	0-10
B	11.2 mm	11.2 mm	100
		5.6 mm	90-100
		180 micron	15-35

TABLE 400-9. APPROXIMATE QUANTITIES OF COARSE AGGREGATES AND SCREENINGS REQUIRED FOR 100/75 MM COMPACTED THICKNESS OF WATER BOUND MACADAM (WBM) SLB-BASE/BASK COURSE FOR 10M^2 AREA

Classification	Size Range	Compacted thickness	Lose Qty.	Screenings			
				Stone Screening		Crushable type such as Moorum or Gravel	
				Grading Classification & Size	For. WHM Sub-base/ base course (Loose quantity)	Grading Classification & Size	Loose Qty.
Grading 1	90 mm to 45 mm	100 mm	1.21 to 1.43m^3	Type A 13.2mm	0.27 to 0.30 m^3	Not uniform	0.30 to 0.30 m^3
Grading 2	63 mm to 45mm	75 mm	0.91 to 1.07 m^3	Type A 13.2mm	0.12 to 0.15 m^3	-do	0.22 to 0.24 m^3
-do-	-do-	-do-	-do-	Type B 11.2mm	0.20 to 0.22 m^3	-do-	-do-
Grading 3	53mm to 22.4mm	75 mm	-do-	-do-	0.18 to 0.21 m^3	-do-	-do-

404.2.7. Binding material : Binding material to be used for water bound macadam as a filler material meant for preventing ravelling, shall comprise of a suitable material approved by the Engineer having a Plasticity Index(PI) value of less than 6 as determined in accordance with IS: 2720 (Part-5).

The quantity of binding material where it is to be used, will depend on the type of screenings. Generally, the quantity required for 75 mm compacted thickness of water bound macadam will be 0.06-009 m^3/10m^2 and 0.08-0.10m^3/10m^2 for 100 mm compacted thickness.

The above mentioned quantities should be taken as a guide only, for estimation of quantities for construction etc.

Application of binding materials may not be necessary when the screenings used are of crushable type such as moorum or gravel.

404.3. Construction Operations

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

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

404.3.2. Inverted choke : If water bound macadam is to be laid directly over the subgrade, without any other intervening pavement course, a 25 mm course of screenings (Grading B) or coarse sand shall be spread on the prepared subgrade before application of the aggregates .is taken up. In case of a fine sand or silty or clayey subgrade, it is advisable to lay 100 mm insulating layer of screening or coarse sand on top of Fine grained soil, the gradation of which will depend upon whether it is intended to act as a drainage layer as well. As a preferred alternative to inverted choke, appropriate geosynthetics performing functions of separation and drainage may be used over the prepared subgrade as directed by the Engineer. Section 700 shall be applicable for use of geosynthetics.

404.3.3. Spreading coarse aggregates : The coarse aggregates shall be spread uniformly and evenly upon the prepared subgrade/sub-base/ base to proper profile by using templates placed across the road about 6 m apart, in such quantities that the thickness of each compacted layer is not more than 100 mm for Grading 1 and 75 mm for Grading 1 and 3, as specified in Clause 404.2.5. Wherever possible, approved mechanical devices such as aggregate spreader shall be used to spread the aggregates uniformly so as to minimise the need for manual rectification afterwards. Aggregates placed at locations which are inaccessible to the spreading equipment, may be spread in one or more layers by any approved means so as to achieve the specified results.

The spreading shall be done from stockpiles along the side of the roadway or directly from vehicles. No segregation of large or fine aggregates shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pockets of fine material.

The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregates as may be required. The surface shall be checked frequently with a straight edge while spreading and rolling so as to ensure a finished surface as per approved drawings.

The coarse aggregates shall not normally be spread more than 3 days in advance of the subsequent construction operations.

404.3.4. Rolling: Immediately following the spreading of the coarse aggregate, rolling shall be started with three wheeled power rollers of 80 to 100 kN capacity or tandem or vibratory rollers of 80 to 100 kN static weight. The type of roller to be used shall be approved by the Engineer based on trial run.

Except on superelevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inward parallel to the centre line of the road, in successive passes uniformly lapping preceding tracks by at least one half width.Rolling shall be discontinued when the aggregates arc partially compacted with sufficient void space in them to permit application of screenings. However, where screenings are not to be applied, as in the case of crushed aggregates like brick metal, laterite and kankar, compaction shall be continued until the aggregates are thoroughly keyed. During rolling, slight sprinkling of water may be done, if necessary. Rolling shall not be done when the subgrade is soft or yielding or when it causes a wave-like motion in the subgrade or sub-base course.

The rolled surface shall be checked transversely and longitudinally, with templates and any irregularities corrected by loosening the surface, adding or removing necessary amount of aggregates and re-rolling until the entire surface conforms to desired crossfall (camber) and grade. In no case shall the use of screenings the permitted to make up depressions.

Material which gets crushed excessively during compaction or becomes segregated shall be removed and replaced with suitable aggregates.

It shall be ensured that shoulders are built up simultaneously along with water bound macadam courses as per Clause 407.4.1.

404.3.5. Application of screenings: After the coarse aggregate has been rolled to Clause 404.3.4, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregate. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motions of hand shovels or by mechanical spreaders, or directly from tipper with suitable grit spreading arrangement. Tipper operating for spreading the screenings shall be so driven as not to disturb die coarse aggregate.

The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms, hand-brooms or both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregate.

The spreading, rolling, and brooming of screenings shall be carried out in only such lengths of (he road which could be completed within one day's operation.

404.3.6. Sprinkling of water and grouting : After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling operation shall be continued, with additional screenings applied as necessary until the coarse aggregate has beer thoroughly keyed, well-bonded and firmly set in its full depth and a grout has been formed of screenings. Care shall be taken to sec that the base or subgrade does not get damaged due to the addition of excessive quantities of water during construction.

In case of lime treated soil sub-base, construction of water bound macadam on top of it can cause excessive water to flow down to the lime treated sub-base before it has picked up enough strength (is still "green") and thus cause damage to the sub-base layer. The laying of water bound macadam layer in such cases shall be done after the sub-base attains adequate strength, as directed by the Engineer.

404.3.7. Application of binding material: After the application of screenings in accordance with Clauses 404.3.5 and 404.3.6. the binding material where it is required to be used (Clause 404.2.7) shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting slurry swept in with hand brooms, or mechanical brooms to fill the voids properly, and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, form a wave ahead of the wheels of the moving roller.

404.3.8. Setting and drying: After the final compaction of water bound macadam course, the pavement shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set. The Engineer shall have the discretion to stop hauling traffic from using the completed water bound macadam course, if in his opinion it would cause excessive damage to the surface.

The compacted water bound macadam course should be allowed to completely dry and set before the next pavement course is laid over it.

404.4. Surface Finish and Quality Control of Work

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

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

404.4.3. The water bound macadam work shall not be carried out when the atmospheric temperature is less than 0°C in the shade.

404.4.4. Reconstruction of defective macadam: The finished surface of water bound. macadam shall conform to the tolerance of surface regularity as prescribed in Clause 902. However, where the surface irregularity of the course exceeds the tolerances or where the course is otherwise defective due to subgrade soil mixing with the aggregates, the course to its full thickness shall be scarified over the affected area, reshaped with added material or removed and replaced with fresh material as applicable and recompacted. In no case shall depressions be filled up with screenings or binding material.

404.5. Arrangement for Traffic

During the period of construction, the arrangement of traffic shall be done as per Clause 112.

404.6. Measurements for payment

Water bound macadam shall be measured as finished work in position in cubic metres.

404.7. Rate

The Contract unit rate for water bound macadam sub-base/base course shall be payable in full for carrying out the required operations including full compensation for all components listed in Clause 401.8 (i) to (v) including arrangement of water used in the work as approved by the Engineer.

Item No.:-12

Providing, Laying, spreading and compacting 250 mm thick graded stone aggregates to wet mix macadam in two each layers (125+125) mm as per MORTH 5th Revision specification as per clause 406 including premixing the material with water at OMC in mechanical mix plant, carriage of mixed material by tippers 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.

406. WET MIX MACADAM SUB-BASE/BASE

406.1. Scope

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

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

406.2. Materials

406.2.1. Aggregates

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

TABLE 400-10. PHYSICAL REQUIRMENTS OF COARSE AGGREGATES FOR WET MIX MACADAM FOR SUB-BASE/BASE COURSES

	Test	Test Method	Requirements
1	* Los Angeles Abrasion value	IS:2386 (Part-4)	40 per cent (Max)
	Or		
	* Aggregate Impact value	IS:2386 (Part-4) or IS:5640	30 per cent (Max)
2	Combined Flakiness and Elongation Indices (Total)	IS:2386 (Part-1)	30 per cent (Max)**

* Aggregate may satisfy requirements of either of the two tests.

** To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation

index is weight of elongated particles divided by total non-flaky particles. The value of flakiness index and elongation index so found are added up.If the water absorption value of the coarse aggregate is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS:2386(Part-5).

406.2.1.2. Grading requirements : The aggregates shall conform to the grading given in Table 400-11.

TABLE 400-11. GRADING REQUIREMENTS OF AGGREGATES FOR

WET MIX MACADAM

IS Sieve Designation	Per cent by weight passing the IS sieve
53.00 mm	100
45.00 mm	95-100
26.50 mm	--
22.10 mm	60-80
11.20 mm	40-60
4.75 mm	25-40
2.36 mm	15-30
600.00 micron	8-22
75.00 micron	0-8

Materials finer than 425 micron shall have Plasticity Index (PI) not exceeding 6.

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

406.3. Construction Operations

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

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

406.3.3. Preparation of mix: Wet Mix Macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled, addition of water and forced/positive mixing arrangement like 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.

Optimum moisture for mixing shall be determined in accordance with IS:2720 (Part-8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size. While adding water, due allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits. The mixed material should be uniformly wet and 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 subgrade/sub- base/bass 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 may be required. The layer may be tested by depth blocks during construction. No segregation of larger and fine panicles 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 seen laid to the required thickness, grade and crossfall/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, a smooth wheel roller of 80 to 100 kN weight may be used. For a compacted single layer upto 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/superelevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the centre 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 centre 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 sub-base/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 crossfall. 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 recompacted.

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

406.4. Opening to Traffic

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

406.5. Surface Finish and Quality Control of Work

406.5.1. Surface evenness : The surface finish of construction shall conform to the requirements of Clause 902.

406.5.2. Quality control : Control or, the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

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 recompacted in accordance with Clause 406.3. 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, arrangement of traffic shall be done as per Clause 112.

406.8. Measurements for Payment

Wet mix macadam shall be measured as finished work in position in cubic metres.

406.9. Rates

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 401.8.

Item No.:-13

Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts carrying heavy traffic as per IS 458-1991 specifications including setting the pipes in C.M. 1:2 watering and laying (to level or slopes) of class NP3 of following internal daimeters.(i) 300mm dia.

And

Item No.:-14

Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts carrying heavy traffic as per IS 458-1991 specifications including setting the pipes in C.M. 1:2 watering and laying (to level or slopes) of class NP3 of following internal daimeters.(iii) 600mm dia.

And

Item No.:-15

Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts carrying heavy traffic as per IS 458- 1991 specifications including setting the pipes in C.M. 1:2 watering and laying (to level or slopes) of class NP3 of following internal daimeters.900mm dia.

1 The work shall consist of furnishing and installing reinforced cement concrete pipe of the type dia meter and length required at the location shown on the drawing or as ordered by the Engineer in charge.

1. Reinforced concrete pipe shall be NP3 type confirming to the requirements of IS :458 and shall be of dia as specified in the item. Each consignment of cement concrete pipes shall be inspected. If necessary and approved by the Engineer in charge, either at the place of manufacture or at the site before their incorporation in the works.

NP3 pipes are used for R.C.C. pipes where testing of pipe will not be feasible the contractor will have to produce a certificate from the manufacture on company's latter head the given herein after form.

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

FORM OF CERTIFICATE FOR NP3 PIPES

We……. Manufacture of R.C.C. pipes produce R.C.C. pipe as per requirement of IS : 458 and also carry out the required test at our place. We have required equipment for carrying out test and are prepared to carry out test at our factory site,

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

Date:……..

Place :…… Manufacture's sign……

2. No pipe shall be placed in position until the foundation have been approved by the Engineer in charge . where two or more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to minimum of 450 mm. The laying of pipes on the prepared foundation shall start from outlet and proceed towards the inlet and be completed to the specified lines and grades. The pipes shall be fitted and matched so that when laid in works they form a culvert with smooth uniform invert. Any pipe found defective or damaged during laying shall be removed at there cost of contractor.

3. The pipe shall be jointed either by collar or by flush joint. In the former case, the collars shall be of RCC 150 to 200 mm wide and having the same strength as the pipes to be jointed. Caulking space shall be between 13 and 20 mm according to the diameter of the pipes. Caulking material shall be slightly wet mix of cement and sand in the ratio of 1:2 rammed with Caulking iron. Before caulking the collar shall be so placed that its center coincides with that of pipe and an even annular space is left between the collar and pipes. Flush joint may be shaped to form a self centering joint with a jointing space 13 cm wide. The joining space shall be filled with cement mortar, 1 cement to 2 sand, mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care shall be taken to fill all void sand excess mortar shall be removed. All joints shall be made with care so that their interior surface is smooth and consistent with the interior surface of the pipes. After finishing the joint shall be kept covered and damp for at least four days.

4. R.C.C. pipe shall be measured along their center between their inlet and outlet ends in linear meters.

The rate for the pipes shall include the cost of pipes including loading, unloading handling ,storing, laying in position and joining complete..

Item No.:-16

Providing and laying evenly Priming coat with emulsion Bitumen RS1 (IS) at rate of 4.0 Kg / 10 Sq.M. etc complete as directed with all labour and materials.

And

Item No.:-17

Providing and Spraying of Priming Coat using slow setting asphalt emulsion(SS-1) on Water Bound macadam / Wet mix Macadam at the rate of 7.50kg Per 10 sqm. Complete including cleaning the surface with all cost of labour & Material..

502. PRIME COAT OVER GRANULAR BASE

502.1. Scope

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

502.2. Materials

502.2.1. Primer: The choice of a bituminous primer shall depend upon the porosity characteristics of the surface to be primed as classified in IRC: 16. These are:

(i) Surfaces of low porosity; such as wet mix macadam and water bound macadam,

(ii) Surfaces of medium porosity; such as cement stabilised soil base,

(iii) Surfaces of high porosity; such as a gravel base.

502.2.2. Primer viscosity: The type and viscosity of the primer shall comply with the requirements of IS 8887, as sampled and tested for bituminous primer in accordance with these standards. Guidance on viscosity and rate of spray is given in Table 500-1.

TABLE 500-1. VISCOSITY REQUIREMENT AND QUANTITY OF LIQUID BITUMINOUS PRIMER

Type of surface	**Kinematic Viscosity of Primer at 60°C** (Centistokes)	Quantity of Liquid Bituminous Material per 10 Sq.m. (kg)
Low porosity	30-60	6 to 9
Medium porosity	70- 140	9 to 12
High porosity	250 - 500	12 to 15

502.2.3. Choice of primer: The primer shall be bitumen emulsion, complying with IS 8887 of a type and grade as specified in the Contract or as directed by the Engineer. The use of medium curing cutback as per IS 217 shall be restricted only for sites at sub-zero temperatures or for emergency applications as directed by the Engineer.

502.3. Weather and Seasonal Limitations

Bituminous primer shall not be applied to a wet surface (see 502.4.2) or during a dust storm or when the weather is foggy, rainy or windy or when the tempeiature in the shade is less than 10°C. Surfaces which are to receive emulsion primer should be damp, but no free or standing water shall be present.

502.4. Construction

502.4.1. Equipment: The primer distributor shall be a self-propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at specified rates and temperatures. Hand spraying of small areas, inaccessible to the distributor, or in narrow strips shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

502.4.2. Preparation of road surface: The surface to be primed shall be prepared in accordance with Clauses 501.8. and 902 as appropriate. Immediately prior to applying the primer the surface shall be carefully swept clean of dust and loose particles, care being taken not to disturb the interlocked aggregate. This is best achieved when the surface layer is slightly moist (lightly sprayed with water and the surface allowed to dry) and the surface should be kept moist until the primer is applied.

502.4.3. Application of bituminous primer: The viscosity and rate of application of the primer shall be as specified in the Contract, or as determined by site trials carried out as directed by the Engineer. Where a geosynthetic is proposed for use, the requirements of Clauses 703.3.2 and 703.4 shall apply. The bituminous primer shall be sprayed uniformly in accordance with Clause 501 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. 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.

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 period as is found to be necessary to allow all the volatiles to evaporate before any subsequent surface treatment or mix is laid. Any unabsorbed primer shall first be blotted with an 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. A very thin layer of clean sand may be applied to the

surface of the primer, to prevent the primer picking up under the wheels of the paver and the trucks delivering bituminous material to the paver.

502.4.5. Tack coat: Over the primed surface, a tack coat should be applied in accordance with Clause 503.

502.5.Quality Control of Work

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

502.6. Arrangements for Traffic

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

502.7. Measurement for Payment

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

502.8. Rate

The contract unit rate for prime coat with adjustments as described in Clause 502.7 shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.8 (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 0.5 kg per square metre, with adjustment, plus or minus, for the variation between this amount and the actual amount approved by the Engineer after the preliminary trials referred to in Clause 502.4.3.

No. 18

Providing and laying Tack coat with Bitumen Emulsion (RS-1) at the rate of 2.50 Kg / 10 Sq.M. on the prepare bituminous surface etc complete as directed with all labour and materials

503. TACK COAT

503.1. Scope

This work shall consist of the application of a single coat of low viscosity liquid bituminous material to an existing bituminous road surface preparatory to the superimposition of a bituminous mix, when specified in the Contract or instructed by the Engineer.

503.2. Materials

503.2.1. Binder: The binder used for tack coat shall be bitumen emulsion complying with IS 8887 of a type and grade as specified in the Contract or as directed by the Engineer. The use of cutback bitumen, as per IS 217 shall be restricted only for sites at sub-zero for emergency applications as directed by the Engineer.

503.3. Weather and Seasonal Limitations

Bituminous material shall not be applied to a wet surface or 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.

503.4. Construction

503.4.1. Equipment: The tack coat distributor shall be a self-propelled or towed bitumen pressure sprayer, equipped for spraying the material uniformly at a specified rate. Hand spraying of small areas, inaccessible to the distributor, or in narrow strips, shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

503.4.2. Preparation of base: The surface on which the tack coat is to De applied shall be clean and free from dust, dirt, and any extraneous material, and be otherwise prepared in accordance with the requirements of Clauses 501.8 and 902 as appropriate. 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.

503.4.3. Application of tack coat: The application of tack coat shall be at the rate specified in the Contract, and shall be applied uniformly. If rate of application of Tack Coat is not specified in the contract then it shall be at the rate specified in Table 500-2.

The normal range of spraying

TABLE 500-2. RATE OF APPLICATION OF TACK COAT

	Type of Surface	Quantity of liquid bituminous material in Kg per sq. m. area
i)	Normal bituminous surfaces	0.20 to 0.25
ii)	Dry and hungry bituminous surfaces	0.25 to 0.30
iii)	Granular surfaces treated with primer	0.25 to 0.30
iv)	Non bituminous surfaces	
	a) Granular base (not primed)	0.35 to 0.40
	b) Cement concrete pavement	0.30 to 0.35

temperature for a bituminous emulsion shall be 20°C to 70°C and for a cutback, 50°C to 80°C if RC-70/MC-70 is used. Where a geosynthetic is proposed for use, the provisions of Clauses 703.3.2 and 703.4.4 shall apply. The method of application of the tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar, and speed of 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.

Where the material to receive an overlay is a freshly laid bituminous layer, that has not been subjected to traffic, or contaminated by dust, a tack coat is not mandatory where the overlay is completed within two days.

503.4.4. 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.

503.5. Quality Control of Work

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

503.6. Arrangements for Traffic

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

503.7. Measurement for Payment

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

503.8. 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, with the provision that the variance in actual quantity of bitumen used will be assessed and the payment adjusted accordingly.

No. 19

Providing, laying and rolling of built-up spray grout layer over prepared base consisting of a two layer composite construction of crushed coarse aggregates using motor grader for aggregates. Key stone chips spreader may be used with application of bituminous binder after each layer, and with key aggregates placed on top of the second layer to serve as a base, conforming to the line, grades and cross-section specified, the compacted layer thickness being 75 mm as per Technical Specification Clause 505.

506. BUILT-UP SPRAY GROUT

506.1. Scope

This work shall consist of a two-layer composite construction of compacted crushed coarse aggregates with application of bituminous binder after each layer, and with key aggregates placed on top of the second layer, in accordance with the requirements of these Specifications, to serve as a base course and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer. The thickness of the course shall be 75 mm.

Built-up spray grout shall be used in a single course in a pavement structure.

506.2. Materials

506.2.1. Bitumen: Clause 504.2.1. shall apply. Where permitted by the Engineer, an appropriate grade of emulsion complying with IS 8887 may be used.

506.2.2. Aggregates: The coarse aggregate shall conform to Clause 504.2.2.

The aggregate shall satisfy the physical requirements set out in Table 500-3. The coarse and key aggregates for built-up spray grout shall conform to the grading given in Table 500-7.

TABLE 500-7. GRADING REQUIREMENTS FOR COARSE AND KEY AGGREGATES FOR BUILT-UP SPRAY GROUT

IS Sieve Designation (mm)	Cumulative per cent by weight of total aggregate passing	
	Coarse Aggregate	Key Aggregate
53.0	100	--
26.5	40-75	--
22.4	--	100
13.2	0-20	40-75
5.6	--	0-20
2.8	0-5	0-5

596.3. Construction Operations

506.3.1. Weather and seasonal limitations: The provisions of Clause 501.5.1 shall apply.

506.3.2. Equipment: The provisions of Clause 505.3.2 shall apply.

506.33. Preparation of base: The base on which the built-up spray grout course is to be laid shall be prepared, shaped and compacted to the specified lines, grades and cross-sections in accordance with

Clauses 501 and 902 as appropriate. A prime coat shall be applied in accordance with Clause 502 with approved primer as directed by the Engineer.

506.3.4. Tack coat: A tack coat shall be applied in accordance with the procedure described in Clause 503, as directed by the Engineer.

5063.5. Spreading and rolling coarse aggregates for the first layer: Immediately after the application of prime or tack coat, the clean, dry and dust free coarse aggregates shall be spread uniformly and evenly, by mechanical means, at the rate of 0.5 cu.m. per 10 sq.m. area.Immediately after spreading of the aggregates, the entire surface shall be rolled with an 8 - 10 tonnes smooth wheel steel roller. Rolling shall commence at the edges and progress towards the centre except in super-elevated and uni-directional cambered portions where it shall proceed from the lower edge to the higher edge. Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass.

The surface of the layer shall be carefully checked, after rolling, with a template and straight edge and shall be within the tolerances specified, and any deficiencies corrected by reworking and recompacting the layer.

Care shall be taken not to over-compact the layer.

506.3.6. Application of binder - first spray: The binder shall be heated to the temperature appropriate to the grade of bitumen approved by the Engineer and sprayed on the aggregate at the rate of 15 kg/10 sq.m. (measured in terms of residual bitumen content) at a uniform rate of spray by mechanical sprayers capable of spraying bitumen uniformly at the specified rates and temperatures. Excessive deposits of binder caused by stopping or starting of the sprayers or through leakage or for any other reason shall be removed and made good.

506.3.7. Spreading and rolling of coarse aggregate for the second layer: Immediately after the first application of the binder, the second layer of coarse aggregates shall be spread and rolled in accordance with the procedure detailed in Clause 506.3.5.

506.3.8. Application of binder - second spray: The second aggregate layer shall then be sprayed with binder at the rate of 15 kg/10 sq. m. (measured in terms of residual bitumen content) in accordance with Clause 506.3.6.

506.3.9. Application of key aggregate: Immediately after the second application of binder, key aggregates shall be spread uniformly and evenly, preferably by mechanical means, at the rate of 0.13 cu.m./10 sq.m. so as to cover the surface completely. The key aggregate shall be clean, dry and free from dust and deleterious matter. If necessary, the surface shall be swept to ensure uniform application of the key aggregates. The entire surface shall then be rolled with an 8-10 tonnes smooth wheel steel roller in accordance with Clause 506.3.5. While-rolling is in progress, additional key aggregates, where required, shall be spread by hand. Rolling shall continue until the entire course is thoroughly compacted and the key aggregates are firmly in position.

506.4. Surface Finish and Quality Control

The surface finish of construction shall conform to the requirements of Clause 902. All materials shall comply with the requirements of the relevant provisions in Section 900 of the Specifications.

506.5. Final Surfacing

The built-up-spray-grout shall be provided with final surfacing within a maximum of forty-eight hours. If there is to be any delay, the course shall be covered by a seal coat to the requirement of Clause 513 before it is open to traffic. Where the seal coat is required as a result of the selected method of performing this operation, then it shall be considered incidental to the work and shall not be paid for separately.

506.6. Arrangements for Traffic

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

506.7. Measurement for Payment

Built-up spray grout shall be measured as finished work in square metres.

506.8. Rate

The contract unit rate for built-up spray grout shall be payment in full for carrying out the required operations as specified. The rate shall include for, but not necessarily be limited to the components listed in Clause 501.8.8.2. (i) to (xi).

Item No. 20

Providing & laying Bituminous grout 37.50 mm thick with asphalt of grade of VG-30 at the rate of 1.99% by weight of mix for mixing using B.T. Chips of required gradation including cleaning and heating asphalt premix materials by hot mix process in proper gradation and laying with paver finisher and consolidation by roller of 8 to 10 tonnes including cost of all materials, Asphalt, aggregates, labour Charges, royalty charges etc.completed as directed. including flushing key aggregate @0.13 Cum/10 Sq.m.

Scope:- The work shall consist of construction 37.5 mm. thick BUSG on a previously prepared base to the requirement of these specifications.

Over and above MORT & H Clause 506 specification. The work shall be carried out by premixing the aggregates in drum mix plant & spreading by paver finisher. Payment shall be made on M.T. basis of work done.

Materials:-

Binder:- The binder shall be straight on bitumen of V.G.-30 grade satisfying the requirement of I.S. :73

Coarse Aggregate:- The coarse aggregate shall consist of crushed stone. These shall be strong, durable of fairly cubical shape and free from disintegrated pieces, organic or other low porosity and shall satisfy the physical requirement as per Schedule for testing of materials attached herewith / as directed by Engineer-in-charge.

Fine Aggregate:- The line aggregate shall consist of crusher run screening, natural sand or mixture of both. These shall be clean, hard, durable, uncoated dry and free injurious soft pr flaky pieces and organic deleterious substances.

Aggregate Gradation:- The mineral including mineral shall be so graded to combined as to conform to the grading set forth in table below.

Sieve Size	Percent by Weight aggregate
53.0	100
26.5	75-100
22.4	50-25
13.2	20-40
5.6	5-20
2.8	0-5

Proportion using Minerals:- The bitumen content for pre-mixing shall be 1.99 % by total weight of mix. The quantities of aggregate to be used shall be sufficient to yield the specified thickness after compaction.

Variation in Proportioning of Material:- The contractor shall have the responsibility for ensuring proper proportioning of materials and producing a uniform mix. A variation in binder content $\pm$ 0.3 percent by weight of total mix shall however, the permissible for individual specimen taken for quality control test vide Schedule for Testing of Materials attached herewith / as directed Engineer in charge Asphalt VG-30 at rate of 19.90 Kg / MT i.e. 1.99% by weight of the total mix shall be used for mixing.

Construction Operations:-

Weather and Seasonal Limitations:- The work of laying shall not be taken up during rainy or foggy weather or when the base course is damp or wet or during dust storm or when the atmospheric temperature in shade is 10^0 C or less.

Preparation of Base:- The base on which B.S.G. is to be laid shall be prepared shapped and conditioned to the specified lines, grade and cross sections in accordance with Clause 501 and a priming coat where needed shall be applied in accordance with Clause 502 as directed by Engineer in charge.

Tack coats:- A tack coat as per Clause 503 shall be applied over the base as detailed in item description. Asphalt VG-30@ 2.50 Kg / 10 Sq.mt. on existing B.T. surface & 4 Kg / 10 Smt. on WBM surface.

Preparation of Transportation of Mix:-

Mix shall be prepared in Drum mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregates.

The plant shall be drum mix type. The plant shall co-ordinate set of essential units capable of producing uniform mix within the job mix formula a such a laid down in Appendix-A.

(A) In case of drum mix plant the cold feed system shall have variable speed conveyors / or other suitable devices for regulating the accurate proportion of aggregates in to even flood flow automatically from a control operation / control cabin.

(B) Bitumen control unit:- Capable of measuring / metering and spraying required quantity of bitumen at specified temperature with automatic synchronization of bitumen and aggregate feed.

(C) Filter system:- A fines feeder system suitable to receive bagged or bulk supply of filler materials and its incorporation to the mix in the correct quantity shall be necessary auxiliary.

(D) Dust Control:- A suitable built in dust control equipment for the dryer to contain the exhaust of fine dust in to atmosphere for environmental control, wherever so specified by the Engineer.

(E) Suitable auxiliary bitumen boiler of adequate with the self heating arrangement and temperature control device. The boiler should be fitted with temperature indicating instruction.

The temperature of binder at the time of mixing shall be in the range of 150^0 C to 165^0 C and that of the aggregate in the range of 150^0 C to 170^0C provided that the difference in the temperature between the binder and aggregate at no time exceeds 14^0 C.

Mixing shall be through to ensure that a homogenous mixture is obtained in which all particles of the aggregates are coated uniformly and the discharge temperature of mix shall be between 150^0C to 160^0C.

The mix shall be transported from the mixing plant to the point of use in suitable tipper vehicles. The vehicles employed for transport shall be clean and be covered in transit if so directed by the Engineer. Any tipper causing excessive segregation of materials by its spring suspension or other contributing factor of that which shows undue shall be removed from the work until such conditions are corrected.

Spreading :-

The mix transferred from the tipper at site to the paver shall be spread immediately by means of self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix true to the specified lines, grades ad cross sections. The paver finisher shall have the following essential features.

a) Loading hoppers and suitable distributing mechanism.

b) All drives having hydrostatic drive / control

c) The machine shall have hydraulically extendable screed for appropriate width requirement.

d) The screed shall temping and vibrating arrangement for initial compaction to the layer as it is spread without rutting or otherwise marring the surface. It shall have adjustable amplitude and variable frequency.

e) The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.

f) The paver shall be fitted with an electronic sensing device for automatic leveling and profile control within the specified tolerances.

g) The screen shall have the internal heating arrangement.

h) The paver shall be capable of laying either 2.5 to 4.0 mt. width or 4.0 to 7.0 mt. width as stipulated in the contract.

i) The paver shall be so designed as to eliminate skidding / slippage of the tyres during operation

However in restricted locations and in narrow width, where the available plant cannot be operated in the opinion of the Engineer, he may permit mannual laying of the mix.

The temperature of the mix at the time of laying shall be in the range of 100^0 C to 125^0 C. in the multi layer construction, the longitudinal joint in one layer shall offset that in the layer below by about 150 mm. However, the joint in the top most layer shall be at the lane line of the pavement.

Longitudinal joints and edges shall be constructed true to the delineating line parallel to the center line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with drum bitumen before placing fresh materials. Longitudinal and transverse joints shall by offset by a least 250 mm from the those in the lower courses and the joint on the top most layer shall not be allowed to fall within the wheel path. All transverse joint shall be cut vertically to the full thickness of the previously laid mix with asphalt cutter. Pavement breaker and surface painted with Drum bitumen before placing fresh material, longitudinal joint shall be preferably Drum joints. Cold longitudinal joints shall be properly heated with joint hearer to attain a suitable temperature of about 80^0C before laying of adjacent material.

Compaction:-

After the spreading mix, rolling shall be done by 8T to 10T rollers or other approved equipment. Rolling shall start as soon as possible after the material has been spread deploying set of rollers as the rolling is to be competed in limited tile frame. The roller shall move at a speed not more than 5 Km/ HR. Rolling shall be done with care to avoid undue roughening of the pavement surface.

Rolling of the longitudinal joints shall be done immediately behind the paving operation. After this the rolling shall commence at the edges and progress towards the center longitudinal except that in super elevated and uni directional cambered portions. It shall progress from the lower to the upper edge parallel to the centre line of the pavement.

The initial break down rolling shall be done with 8T to 10T. Static weight smooth wheel roller (3 wheel or tendem), as soon as it is possible to roll the mix without cracking the surface or having the mix pick up on the roller wheels. The second of intermediate rolling shall follow the break down rolling with vibratory roller of 80 to 100 KN static weight of pneumatic tyred roller of 150 to 200 KN weight, with minimum 7 wheels and minimum tyre pressure of 0.7 mpa as closely as possible to the paver and be done while the paver mix is still at a temperature that will result in maximum density. The final rolling shall be done while materials is still workable enough for removal of roller marks with 60-80 KN tendem roller. During the final rolling, vibratory system shall be switches off. The joints and edges shall be rolled with a 80to 100 KN static roller.

When the roller has passed over the whole area once. Any high spots or depressions, which become aparent shall be corrected by removing or adding mix material. The rolling shall than be continued till the entire surface has been rolled to 95 percent of the average laboratory density. (Obtained for Marshall specimens compacted as defined in Table 500-100) There is no crushing of aggregates and all rollers marks have been eliminated, each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. The roller wheel shall be kept damp, if necessary to avoid bituminous material from sticking to the wheels and being picked up. In no case shall fuel, lubricating oil be used for this purpose nor excessive water poured on the wheels.

Rolling operation shall be competed in every respect before the temperature of the mix falls below 100^0C.

Roller(s) shall not stand on newly laid material while there is a risk that surface will be deformed there by. The edges along and transverse of the BSG laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it.

Surface Finish and Quality Control of Work:-

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

The mix shall be converted with either the next pavement course or wearing course. As the case may be without any delay. If there is to be any delay, the course shall be covered by seal coat to the requirement of clause 513 before allowing any traffic over it. The seal coat is such case shall be considered incidental to the work and shall not be paid for separately.

Arrangement of Traffic:- During the period of construction of arrangement of traffic shall be done to clause 112.

Measurement for payment:-

The payment shall be made on the tonnage basis of the weight of mix of aggregates and bitumen for this purpose. The contractor shall have to install a weigh bridge of suitable capacity for the purpose of weight of dumpers at suitable place at his own cost as directed. Weight of empty and weight of loaded dumper will be recorded in bound and numbered register on plant site. Department will be free to get some loaded dumpers test checked at other weight bridge. Weight bridge will be periodically got calibrated and verified from weight and measure authorities.

For the purpose of application of tack coat, if the theoretical area as per sanctioned estimate for basis of tone differs with actual area of work done in the field, the reduction in or addition for payment shall have to be exceed respectively.

Weight of mix materials will be done in presence of responsible person, not less than rank of supervisor of department and the measurements shall be recorded by the Deputy Executive or Assistant Engineer or Addl. Assistant Engineer. If so authorised. Record of each dumper will be maintained separately in bound and numbered register, which will be maintained by the departmental representatives and signed by the contractor, proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer and meter in which individual dumper are unloaded be recorded carefully.

Rates:- The contract unit rate for B.S.G. work shall be payment in full for carrying out the required operations including full compensations for:-

(i) Making arrangement to traffic to clause 112 except for initial treatment to the shoulders and constructions of diversions.

(ii) Preparation of base except for laying of profile corrective course but including filling of potholes.

(iii) Providing all materials to be incorporated in the work including arrangement for stock yards. All royalties, fees, rents where necessary and all lead and lift.

(iv) All labour, tools, equipment, plants including installation of Drum mix plant paver supply units and all machineries, incidentals to complete the work to the specifications.

(v) Carrying out the work in part widths of the road where directed.

(vi) Carrying out all tests for control of quality

Item No. 21

Providing laying and rolling 25 mm thick open graded premixed bitumineous carpet with B.T. aggregate as specified and using bitumen (Grade VG-30) for mixing with agreegate at the rate of 3.36%i.e 33.60 kg/M.T. of total mix including heating and mixing in drum mix plant and spreading the same with paver finisher and consolidation with power roller including necessary firewood, oil, lubricants, labour charges etc. using contractor's own drum mix plant and equipment, tool etc. completed in accordance with the requirement of specific

The work shall consist of construction in single course of 25 mm thick premixed carpet as course on previously prepared base single course shall also include assitional thickness if any to remove unevenness of the existing surface.

1. The coarse aggregate shall consist of coursed stone only. These shall be clean, strong, durable of fairly cubical shape , free of disintergrated piece, organic orother deterious matter and adherent coating. The aggregate shall preferably by hydrophobic and of low porosity and shall saisfy the physical requirement set forth as under

Physical reuirement of Aggregate for Bituminous Macadam

Sr.No	Test	Test Method	Requirement
1	Los angles abrasion value	IS : 2386 (Part IV)	35 % Maximum
2	Aggregate Impact Value	IS : 2386 (Part IV)	30 % Maximum
3	Flakiness Index	IS : 2386 (Part I)	30 % Maximum
4	Stripping Value	IS : 6241	25 % Maximum
5	Water Absorption	IS : 2386 (Part III)	2 % Maximum

Aggregate may satisfy requirement of either of the two test.

2. The fine aggregate shall consist of crusher run screening, natural sand or mixture of both. These shall be clean, hard durable, uncoated , dry and free from injurious, soft or flaky piece and organic or deleterious substance.

3. The mineral aggregate including mineral filler shall be so graded or combined as to confirm to the grading as under.

Aggregate	
(a)	Nominal stone size 13.2 mm { Passing 22.4 mm sieve and retained on 11.20 mm sieve } 0.44 Cu.m
(b)	Nominal stone size 11.20 mm { Passing 13.20 mm sieve and retained on 5.60 mm sieve } 0.22 Cu.m.

4. The sample of aggregate of require grading for the work shall be got approved from the Engineer in charge prior to transportation and collection on plant site. Unapproved materials shall have to be removed from the plant site by the contractor at his own cost. If contractor fails to remove the inferior type of materials from the plant site. The same will be removed by the Department at the cost of contractor. Collection of aggregate shall be in different stacks according to various sizes of aggregate.

5. For the purpose of collection of material, plant site shall be established at suitable place, where drum mix plant shall be installed. Department will extend all necessary co-operation in helping contractor to get near by Government land for establishing Plant site. However department is not responsible if no such land made available to the contractor and in that case, the contractor will have to make his own arrangement for the same. Incoming material shall be recorded in register for the purpose of record.

6. The binder shall be straight run bitumen of a **V.G.-30** grade satisfying the requirement of IS; 73 . Bitumen shall be **V.G.-30** grade and shall be brought by the contractor to the site of work at his own cost for the purpose of calculating consumption, wastage will not be allowed beyond 2.5 percent.

7. Department shall be keep a day to day account of supply and consumption of bitumen in seprate bound register having numbered pages and the proforma prescribed by the Department. Day to Day signature of the contractor's representative shall be obtained in this register.

8. Open graded pre mixed carpet shall not be laid during rainy whether or when the base course in damp or wet.

9. The base on which open graded pre mixed carpet is to be laid shall be thoroughly swept and scraped clean and free of dust and foreign matter.

10. The work shall consist of application of a single coat of bituminous to an existing road surface preparatory to another bituminous construction. The temperature of bitumen at the time of application shall be in the range of 160 degree centigrade to 175 degree centigrade .

11. The binder content for premix shall be **3.36** percent be weight of total mix unless otherwise specified. The quantities of aggregate shall be sufficient to yield the specified thickness after compaction.

12. Drum mix plant of adequate capacity and capable of producing a proper and uniform Quality shall be used for preparing the mix. The plant may be either a batch type or a continous one, having coordinated set of essential unit such as dryer for heating the aggregate a binder heating and control

unit for metering out the corrected quantity of heated binder together with a paddle mixer for intimate mixing of the binder and aggregate.

13. The temperature of binder at the time of mixing shall be range of 150 degree-177 degree centigrade and the aggregate in the range of 155-163 degree centigrade. Provided also that at no time shall the difference in temperature between the aggregate and the binder exceed 14 degree centigrade.

14. Mixing shall be through to ensure that a homogeneous mixture is obtained in which all the particle to the mineral aggregate are coated uniformly.

15. The mix shall be transported from the mixing plant to the point of use in suitable vehicle . The vehicle employed for transport shall be clean and be covered over during transit if so directed by engineer in charge.

16. The mix transported from the drum mix plant to the site shall be spread by means of a self propelled mechanical paver with suitable screeds capable of spreading , tamping mix at the time of laying shall be in range 121-163 degree centigrade.

17. Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the center line of the road. Longitudinal joints shall be offset by at least 150 mm from those in the binder course. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material

18. Immediately after the spreading of mix it shall be thoroughly compacted by 80 to 100 Kn static weight Vibratory roller moving at a speed not exceeding 5 km per hour.

19. The roller wheels shall be kept damp to prevent the mix from adhering to them but in no case shall fuel lubricating oil be used for these purpose. Rolling shall commence longitudinally from the edge and progress towards the center except on super elevated portions. When it shall progress from the lower to upper edge parallel to the center line of pavement. The roller should proceed on the fresh material with rear or mixed wheel leading or as to minimize the pushing of the mix and each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. Rolling shall continue until the entire surface has been rolled to compaction and all the roller marks eliminated.

20. sand or stone dust flushing at the rate of 0.03 Cu.m / 10 Sq.Mt shall be done on asphalt surface for which no seprate payment will be made.

21. Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

22. Surface finish and quality control of work: Controll on the quality of materials and works shall be exercised by the Engineer in charge by carrying out the following test at frequencies shown against each:

23. An 100% organo saline neno technology based antistripping agent@rate of 0.10% of weight of asphalt i.e.1kg/M.T. shall be added as directed by Engineer-in-charge for mixing.

Sr.No	Type of Construction	Test	frequency
1	Tack coat	(i) Binder temperature for application (ii) Rate of spread of binder	At regular close intervals. Two test per day.
2	Open graded carpet	(i) Aggrgate Impact value (ii) Flakiness index of aggregate (iii) Stripping Value (iv) Mix grading (v) Temerature of binder in the boiler, aggregate in the dryer and mix at the time of laying and rolling (vi) Control of binder content and gradation in the mix (Binder's content test vide ASTM D-2172) (vii) Rate of spread of mix	One test per 100 Cu.M of aggregate --Do— --Do— One set of test on individual constituents and mixed aggregates from the dryer for each 100 tonnes of mix subject to minimum of two test per day. One test for each 100 tones of mix subject to max of two trest per day per plant Regular control through checks on layer thickness.

MEASUREMENT FOR PAYMENT

The payment shall be made on the tonnage basis of the weight of mix of aggregates and bitumen. For this purpose the contractor shall have to install a weigh bridge of suitable capacity for the purpose of weighment of dumpers at suitable place at his cost as directed. Weight of empty dumper and weight of loaded dumper will be recorded in bound and numbered register on plant side.

Department will be free to get some loaded, dumper test checked at other weigh bridge. Weigh bridge will be periodically got calibrated and verified from weight and measure authorities.

For the purpose of application of tack coat if the theoretical area as per sanctioned estimate for basis of tonne differs with the actual area of work done in the field, then the reduction in or addition to payment shall have to be effected to the contractor on proportionate basis depending upon the area reduced or exceeded respectively.

Weigh of mix materials will be done in presence of responsible person, not less than the rank of supervisor of Department, Deputy Executive Engineer or Assistant Engineer or Addl. Assistant Engineer if so authorized. Record of each dumper will be maintained separately inbound and numbered register which will be maintained by the departmental representatives and signed by the contractor. Proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of The kilometer, hectometer in Which individual dumper are unloaded will be recorded carefully.

8. RATE: The Contract unit rate for seal coat shall be for payment for carrying out the required operations including full compensation for all components listed in MOST Specification MORD Spe. Clause 503.7

Item No. 22

Providing & Laying 50 mm Compacted thick Bituminous Macadam with B.T. Aggregate as per MORT & H specification & Emulsion RS1 for tack coat @ 2.5 Kg / 10 Sq.m. on B.T surface With Mechanical Sprayer & Bitumen Grade VG-30 for mixing @ 35 Kg. / M.T. i.e. 3.5% of total weight of mix including heating & mixing the aggregate & asphalt in continuous batching mix plant and spreading the same by paver finisher & consolidation with vibratory roller including providing all materials equipments, tools & plants, fire wood, oil, kerosene, labour charges etc. complete using contractor's own machinery drum mix plant & paver finisher etc. complete.

Scope :- The work shall consist of construction one layer of 50 mm thick B.M. on a previously prepared base to the requirement of theses specifications

Materials :-

Binder :- The binder shall be straight run bitumen of V.G-30 grade satisfying the requirement of I.S. : 73. For tack Coat Emulsion Grade RS-1 Shall be used @ rate as specified in Item.

Coarse Aggregate :- The coarse aggregate shall consist of crushed stone, crushed gravel. These shall be strong, durable of fairly cubical shape and free from disintegrated pieces, organic or other low porosity and shall satisfy the physical requirement as per Schedule for Testing of Materials attached herewith / as directed by Engineer in Charge.

Fine Aggregate :- The fine aggregate shall consist of crusher run screening, natural sand or mixture of both. These shall be clean, hard, durable, uncoated dry and free injurious soft pr flaky pieces and organic deleterious substances.

Aggregate Gradation:-

The mineral including mineral shall be so graded to combined as to conform th the grading set forth in table below.

Bituminous. Macadam

Sieve Size	Percent by Weight aggregate
26.5	100%
19.0	90-100%
13.2	56-88%
4.75	16-36%
2.36	4-19%
0.90	2-10%
0.075	0-8%

Proportioning Materials :-

The bitumen content for pre-mixing shall be 3.5% by weight of the total mix

The quantities of aggregate to be used shall be sufficient to yield the specified thickness after compaction.

Variation in Proportioning of Material :-

The contractor shall have the responsibility for ensuring proper proportioning of materials and producing a uniform mix. A variation in binder content $\pm$ 0.3 percent by weight of total mix shall however, the permissible for individual specimen taken for quality control test vide Schedule for Testing of Materials attached herewith / as directed Engineer in Charge

Construction Operations:-

1 Preparation of bae : The surface on which the tack coat is to be applied shall be cleaned of dust and extraneous material before the application of the binder by using mechanical broom or any other approved equipment / method as specified by the Engineer

2 Application of binder : Binder may be heated to the the temperature appropriate to the grade of bitumen used and approved by the engineer and sprayed on the base at the rate specified in item of work .The normal range of spraying temperature for bitumen V.G-30 grade. It shall be the responsibility of the contractor to carefully handle the inflammable nituminous material so as to safe guard against any fire mishap. The binder shall be applied uniformaly with the aid of either self propelled or towed bitumen pressure sprayer with self heating arrangement and spraying bar with nozzles having constant volume or pressure system, capable or spraying bitumen at specified rate and temperature so as to provide a uniformly unbroken spread of bitumen. Work should be planned so that no more than the necessary tack coat for the day's operation is placed on the surface. After application and prior to succeeding construction allow the tack coat to cure, without being disturbed, until the water/ cutter has completely evoparated as determined by Engineer.

3. Quality control of work : Control on the quality of material and works shall be exercised by the Engineer in charge in accordance with section 900 of MORTH specification.

4. Arangement of traffic: During the period of application of binder for tack coat the arrangement of traffic shall be done to MORD specification clause 112 of MORTH Specification.

5. Mode of measurement and payment:

The payment shall be mad on sq.mt basis of for rate of application as specified in tender item. The rate is inclusive of cost of asphalt, tools and plants required for applying binder.

504.3.3. Tack Coat: A tack coat in accordance with Clause 503 shall be applied as specified in the Contract or as directed by the Engineer. For tack Coat Emulsion Grade RS-1 Shall be used @ rate as specified in Item

Weather and Seasonal Limitations:-

The work of laying shall not be taken up during rainy or foggy weather or when the base course is damp or wet or during dust storm or when the atmospheric temperature in shade is 10°C or less.

Preparation of Base:-

The base on which bituminous macadam is to be laid shall be prepared shaped and conditioned to the specified lines, grade and cross sections in accordance with Clause 501 and a priming coat where needed shall be applied in accordance with Clause 502 as directed by Engineer in charge.

Preparation and Transportation of Mix:-

Bituminous macadam mix shall be prepared in hot mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregates

The plant shall be drum mix type. The plant shall co-ordinate set of essential units capable of producing uniform mix within the job mix formula a such as laid down in Appendix A

(A) In case of drum mix plant the cold feed system shall have variable speed conveyors / or other suitable devices for regulating the accurate proportion of aggregates in to even flood flow automatically from a control operation / Control cabin.

(B) Bitumen control Unit:- Capable of measuring /metering and spraying required quantity of bitumen at specified temperature with automatic synchronization of bitumen and aggregate feed.

(C) Filler system :- A fines feeder system suitable to receive bagged or bulk supply of filler materials and its incorporation to the mix in the correct quantity shall be necessary auxiliary

(D) Dust Control – A suitable built in dust control Equipment for the dryer to contain the exhaust of fine dust in to atmosphere for environmental control, wherever so specified by the Engineer.

(E) Suitable auxiliary bitumen boiler of adequate with the self heating arrangement and temperature control device. The boiler should be fitted with temperature indicating instruction.

The temperature of binder at the time of mixing shall be in the range of 150ºC. to 165ºC. and that of the aggregate in the range of 150ºC. to 170ºC. provided that the difference in the temperature between the binder and aggregate at no time exceeds 14ºC.

Mixing shall be through to ensure that a homogenous mixture is obtained in which all particles of the aggregates are coated uniformly and the discharge temperature of mix shall be between 150ºC. to 160ºC.

The mix shall be transported from the mixing plant to the point of use in suitable tipper vehicles. The vehicles employed for transport shall be clean and be covered in transit if so directed by the Engineer. Any tipper causing excessive segregation of materials by its spring suspension or other contributing factors of that which shows undue shall be removed from the work until such conditions are corrected.

Spreading :-

The mix transferred from the tipper at site to the paver shall be spread immediately by means of self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix true to the specified lines, grades ad cross sections. The paver finisher shall have the following essential features.

a). Loading hoppers and suitable distributing mechanism

b). All drives having hydrostatic drive / control

c). The machine shall have hydraulically extendable screed for appropriate width requirement.

d). The screed shall temping and vibrating arrangement for initial compaction to the layer as it is spread without rutting or otherwise marring the surface. It shall have adjustable amplitude and variable frequency.

e). The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.

f). The paver shall be fitted with an electronic sensing device for automatic leveling and profile control within the specified tolerances.

g). The screen shall have the internal heating arrangement.

h). The paver shall be capable of laying either 2.5 to 4.0 mt. width or 4.0 to 7.0 mt. width as stipulated in the contract.

i). The paver shall be so designed as to eliminate skidding / slippage of the tyres during operation.

However in restricted locations and in narrow width, where the available plant can not be operation in the opinion of the Engineer, he may permit manual laying of the mix.

The temperature of the mix at the time of laying shall be in the range of 100ºC. to 125ºC. in the multi layer construction, the longitudinal join in one layer shall offset that in the layer below by about 150mm. However, the joint in the top most layer shall be at the lane line of the pavement.

Longitudinal joints and edges shall be constructed true to the delineating line parallel to the center line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with Drum bitumen before placing fresh materials. Longitudinal and transverse joints shall by offset by at least 250mm from the those in the lower courses and the joint on the top most layer shall not be allowed to fall within the wheel path. All transverse joint shall be cut vertically to the full thickness of the previously laid mix with asphalt cutter. Pavement breaker and surface painted with Drum bitumen before placing fresh material, longitudinal joint shall be preferably Drum joints. Cold longitudinal joints shall be properly heated with joint heater to attain a suitable temperature of about 80ºC. before laying of adjacent material.

Compaction.;-

After the spreading of mix, rolling shall be done by 8T to 10T rollers or other approved equipment. Rolling shall start as soon as possible after the material has been spread deploying set of rollers as the rolling is to be competed in limited tile frame. The roller shall move at a speed not more than 5 Km / Hr. Rolling shall be done with care to avoid undue roughening of the pavement surface.

Rolling of the longitudinal joints shall be done immediately behind the paving operation. After this the rolling shall commence at the edges and progress towards the center longitudinal except that in

super elevated and uni directional cambered portions. It shall progress from the lower to the upper edge parallel to the center line of the pavement.

The initial break down rolling shall be done with 8T to 10T. Static weight smooth wheel roller (3 wheel or tendem), as soon as it is possible to roll the mix without cracking the surface or having the mix pick up on the roller wheels. The second of intermediate rolling shall follow the break down rolling with vibratory roller of 80 to 100KN static weight or pneumatic tyred roller of 150 to 200 KN weight, with minimum 7 wheels and minimum tyre pressure of 0.7 mpa as closely as possible to the paver and be done while the paving mix is still at a temperature that will result in maximum density. The final rolling shall be done while materials is still workable enough for removal of roller marks with 60-80 KN tendem roller. During the final rolling, vibratory system shall be switches off. The joints and edges shall be rolled with a 80 to 100 KN static roller.

When the roller has passed over the whole area once. Any high spots or depressions, which become apparent shall be corrected by removing or adding mix material. The rolling shall than be continued till the entire surface has been rolled to 95 percent of the average laboratory density. {Obtained for Marshall specimens compacted as defined in Table 500-10}. There is no crushing of aggregates and all roller marks have been eliminated, each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. The roller wheel shall be kept damp, if necessary to avoid bituminous material from sticking to the wheels and being picked up. In no case shall fuel, lubricating oil be used for this purpose nor excessive water poured on the wheels.

Rolling operation shall be competed in every respect before the temperature of the mix falls below 100ºC

Roller(s) shall not stand on newly laid material while there is a risk that surface will be deformed there by. The edges along and transverse of the bituminous macadam laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it.

Surface Finish and Quality Control of Work :-

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

The bituminous macadam shall be converted with either the next pavement course or wearing course. As the case may be without any delay. If there is to be any delay, the course shall be covered by seal coat to the requirement of Clause 513 before allowing any traffic over it. The seal coat is such case shall be considered incidental to the work and shall not be paid for separately.

Arrangement of Traffic.:- During the period of construction arrangement of traffic shall be done to Clause-112

Measurement for payment:- The payment shall be made on the tonnage basis of the weight of mix of aggregates and bitumen for this purpose. The contractor shall have to install a weight bridge of suitable capacity for the purpose of weightment of dumpers at suitable place at his cost as directed. Weight of empty and weight of loaded dumper will be recorded in bound and numbered register on plant site. Department will be free to get some loaded dumpers test checked at other weight bridge. Weight bridge will be periodically got calibrated and verified from weight and measure authorities.

For the purpose of application of tack coat, if the theoretical area as per sanctioned estimate for basis of tone differs with the actual area of work done in the field, the reduction in or addition to payment shall have to be exceed respectively.

Weight of mix materials will be done in presence of responsible person, not less than rank of supervisor of department and the measurements shall be recorded by the Deputy Executive or Assistant Engineer or Addl. Assistant Engineer. If so authorised. Record of each dumper will be maintained separately in bound and numbered register, which will be maintained by the departmental representatives and signed by the contractor, proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer and meter in which individual dumper are unloaded be recorded carefully

Rates:- The contract unit rate for B.M. work shall be payment in full for carrying out the required operations including full compensations for :-

(i) Making arrangement for traffic to clause 112 except for initial treatment to verge shoulders and constructions of diversions.

(ii) Preparation of base except for laying of profile corrective course but including filling of potholes

(iii) Providing all materials to be incorporated in the work including arrangement for stock yards. All Royalties, fees, rents where necessary and all lead and lift.

(iv) All labour , tools, equipment, plants including installation of Drum mix plant paver supply units and all machineries, incidentals to complete the work to the specifications.

(v) Carrying out the work in part widths of the road where directed.

(vi) Carrying out all tests for control of quality

Item No : 23

Providing & Laying 20 mm thick mix seal surface using B.T. stone chips as per MORT&H gradation Type - A and Specification with bitumen grade VG-30 for mixing at the rate of 51.00 kg/M.T. of total weight of mix (i.e. 5.10 % of total wt. of mix) and mixing aggregate and asphalt by drum mix plant and spreading the same by paver finisher including rolling and consolidation with static roller and providing tools and plant fire wood, oil, kerosene, labour charges using contractor own machineries etc.

1 512.1. Scope

512.1.1. This work shall consist of the preparation, laying and compaction of a close-graded premix surfacing material of 20 mm thickness composed of graded aggregates premixed with a bituminous binder on a previously prepared surface, in accordance with the requirements of these Specifications, to serve as a wearing course.

512.1.2. Close graded premix surfacing shall be of Type A or Type B as specified in the Contract documents.

512.2. Materials

512.2.1. Binder : The provisions of Clause 511.1.2.1 shall apply

512.2.2. Coarse aggregates : The provisions of Clause 511.1.2.2 shall apply.

512.2.3. Fine aggregates : The fine aggregates shall consist of crushed rock quarry sands, natural gravel / sand or a mixture of both. These shall be clean, hard, durable, un-coated, mineral particles, dry and free from injurious, soft or flaky particles and organic or deleterious substances.

512.2.4. Aggregate gradation: The coarse and fine aggregates shall be so graded or combined as to conform to one or the other gradings shown in Table 500-26, as specified in the contract.

TABLE 500-26. AGGREGATE GRADATION

IS Sieve Designation (mm)	Cumulative per total weight of total aggregate passing	
	Type A	Type B
13.2mm	--	100
11.2mm	100	88-100
5.6mm	52-88	31-52
2.8mm	14-38	5-25
0.090 mm	0-5	0-5

512.2.5. Proportioning of materials: The total quantity of aggregates used for Type A or B close-graded premix surfacing shall be 20mm thickness. The quantity of binder used for premixing in terms of straight-run bitumen shall be 22.0 kg and 19.0 kg per 10 square metre area for Type A and Type B surfacing respectively.

512.3. Construction Operations

The provisions of Clause 511.1.3.1 through 511.1.3.5 shall apply.

512.4. Opening to Traffic

Traffic may be allowed after completion of the final rolling when the mix has cooled down to the surrounding temperature. Excessive traffic speeds should not be permitted.

512.5. Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902. For control on the quality of materials supplied and the works carried out, the relevant provisions of Section 900 shall apply.

512.6. Arrangements for Traffic

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

512.7. Measurements for Payment

Measurement for payment:- The payment shall be made on the tonnage basis of the weight of mix of aggregates and bitumen for this purpose. The contractor shall have to install a weight bridge of suitable capacity for the purpose of weightment of dumpers at suitable place at his cost as directed. Weight of empty and weight of loaded dumper will be recorded in bound and numbered register on plant site. Department will be free to get some loaded dumpers test checked at other weight bridge. Weight bridge will be periodically got calibrated and verified from weight and measure authorities.

For the purpose of application of tack coat, if the theoretical area as per sanctioned estimate for basis of tone differs with the actual area of work done in the field, the reduction in or addition to payment shall have to be exceed respectively.

Weight of mix materials will be done in presence of responsible person, not less than rank of supervisor of department and the measurements shall be recorded by the Deputy Executive or Assistant Engineer or Addl. Assistant Engineer. If so authorised. Record of each dumper will be maintained separately in bound and numbered register, which will be maintained by the departmental representatives and signed by the contractor, proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer and meter in which individual dumper are unloaded be recorded carefully

Rates:- The contract unit rate for M.S.S. work shall be payment in full for carrying out the required operations including full compensations for :-

(i) Making arrangement for traffic to clause 112 except for initial treatment to verge shoulders and constructions of diversions.

(ii) Preparation of base except for laying of profile corrective course but including filling of potholes

(iii) Providing all materials to be incorporated in the work including arrangement for stock yards. All Royalties, fees, rents where necessary and all lead and lift.

(iv) All labour , tools, equipment, plants including installation of Drum mix plant paver supply units and all machineries, incidentals to complete the work to the specifications.

(v) Carrying out the work in part widths of the road where directed.

(vi) Carrying out all tests for control of quality

Item No : 24

Providing and laying seal coat with B.T aggregate as specified using aggregate at the rate of 0.18 cum/10 Sqmt and bitumen grade VG-30 for mixing with aggregate at the rate of 4.5 % i.e 45.00 Kg/M.T of total mix including heating and mixing in drum mix plant and spreading the same by paver finisher and consolidation with Power roller including necessary fire wood oil, lubricans ,labour charges using conractor's own drum mixplant, machineries and equipment ,tools (including flushing & screened stone dust etc .complete in accordance with the requirement of specification.

1 DESCRIPTION

The work shall consist of construction of premix seal coat as wearing course, on a previously prepared base, to the requirement of these specification.

2. MATERIALS:-

2.1 Binder :-

The binder shall be straight run bitumen of V.G.-30 grade satisfying the requirement of lS:73. The actual grade of the binder to be used shall be decided by the Engineer-in-charge and it shall have to be brought by contractor to the site at his own cost unless otherwise specified in schedule 'A'.

2.2 Coarse aggregates :

The coarse aggregate shall consist of crushed stone or crushed gravel. These shall be clean, durable, of cubical shape, free disintegrated pieces, organic or other deleterious matter and adherent coatings. The aggregates shall preferably be hydrophobic and of low porosity and shall satisfy the physical requirements set forth in Table given in Item No. 18 Para 2. Except that the upper limit for water absorption value shall be one percent.

2.3 Fine aggregates :

The fine aggregates shall consist of crusher run screenings, natural sand or a mixture of both. These shall be clean, hard, durable, uncoated, dry and free from injurious, soft of flaky pieces and organic or deleterious substances.

2.4 Filler :

The filler where required, shall be an inert material the whole of which passes 600 micron sieve at least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve. The filler shall be cement, stone dust, hydrated time, fly ash and other non-plastic mineral matter approved by the Engineer in Charge

2.5 Aggregate gradation :

The mineral aggregates, including mineral filler, shall be so graded or combined as to conform to grading set forth below

The gradation for Sealcoat {Type C} should be followed as stated hereunder instead of Para 2.5 of Item

Stone Chips for Type C Seal Coat : The stone chips shall consist of angular fragment of clean, hard and durable rock of uniform quality throughout. The stone chips shall be free of soft of disintegrated organic or other deleterious matter and shall be of 6.7 mm size defined as 100 percent passing through 9.5mm sieve and retained on 2.36 mm sieve. The quantity used for spreading shall be 0.18 Cu.M. per 10 Sq.Mt.area./ ~~0.24 Cu.M. per 10 Sq.Mt.~~ The chips shall satisfy the quality requirement in Table 500.3 {M.O.R. T. & H.} except that the upper limit for water absorption value shall be 1 percent

2.6 Proportioning of materials :

The binder content for premixing shall be 45.00 kg per M.T. (4.50% by weight) for mixing aggregate.

The quantities of aggregates shall be sufficient to yield the specified thickness after compaction.

The contractor shall get the job-mix formula for the mix approved by the Engineer-in-charge before starting work.

2.7 Variation in Proportioning of material :

The Contractor shall have the responsibility of ensuring proper proportioning of materials in accordance with the approved job mix formula and producing a uniform mix' A variation in binder content of ± 0.3

percent by weight of total mix shall, however, be permissible in individual specimen taken for quality control tests vide MOST Specification Section 900.

3. CONSTRUCTION OPERATIONS

3.1 Weather and seasonal limitation :

Premix seal coat shall not be laid during rainy weather or when base course is damp or wet.

3.2. Preparation of base :

The base on which premix seal coat is to be laid shall be prepared shaped and conditioned to the specified, lines, grade and cross section in accordance with MOST specification MOST Spe. Clause 601 as directed by the Engineer-an-charge: The surface shall be thoroughly swept and spreaded clean and free of dust and foreign matter.

3.3 Preparation of the mix:

Drum mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant should be continuous type having a coordinated set essential units such as dryer for heating the aggregates; device for feeding by weight or volume the required quantities of aggregates, a binder heating and control unit for metering out the correct quantity of heated binder together with a paddle mixer for intimately mixing of the binder and aggregates. For details regarding Drum mix plant Annexure 'A' may be referred.

The temperature of binder at the time of mixing shall be in the range of 150° C - 177° C and aggregates in range of 150° C - 163° C provided also that at no time shall the difference in temperature of the aggregates and binder exceed 14° C.

Mixing shall be throughout to ensure that a homogeneous mixture is obtained in which all the particles of the mineral aggregates are coated uniformly.

The mix shall be transported from the mixing plant to the point of use in suitable vehicles. The vehicles employed for transport shall be clean and be covered over in the transit if so directed by the Engineer-in-charge.

3.4 Spreading :

The mix, transported from the hot mix plant to. the site, shall be spread by means of self propelled mechanical paver with suitable screens capable of spreading, tamping and finishing the mix, true to specified grade, line and cross sections. The temperature of mix at the time of laying shall be in the range of 121° C - 163° C.

Longitudinal joints and edges shall be constructed true to the delineating lines parallel o. the centre line of road, Longitudinal joints shall be offset by at least 150 mm from those in the binder course. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with lot bitumen before placing fresh material. .

3.5 Rolling:

Immediately after the spreading of mix, it shall be thoroughly compacted by rolling with a set rollers moving at a speed not exceeding 5km per hour. The initial or break-down rolling shall be with 8-12 tonne three wheeled rollers and the surface finished by final rolling with 8-10 tonne tandem rollers, or suitable pneumatic rollers. Rolling temperature shall not be less than 100°C in any case the rolling shall be completed the temperature of mix falls about 80°C.

The roller wheels shall be kept damp to prevent the mix adhering to them but in no case shall fuel lubricating oil be used for this purpose. Rolling shall commence longitudinally from the edge and progress towards the centre except that at super elevated portions, it shall progress from the lower to upper. edges parallel to the centre line of the payment. The roller should proceed on the fresh material with rear or fixed wheel leading so as to minimize the pushing of the mix and each pass of the roller shall .uniformly overlap not less than one third of the track made in the preceding pass Rolling shall continue until the entire surface has been roller to compaction and all the roller marks eliminated.

4. OPENING TO TRAFFIC

Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

5. SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to the requirements of most specification MORD Spe. Clause 901 Control on the quality of material and works shall be exercised by the Engineer-in-chare in accordance with MOST Specification MORD Spe. Clause 902.

6. ARRANGEMENT FOR TRAFFIC

The provision of MOST Specification MORD Spe. Clause 105 shall apply as regards the flow to traffic during construction.

7. MEASUREMENT FOR PAYMENT

The payment shall be made on the tonnage basis of the weight of mix of aggregates and bitumen. For this purpose the contractor shall have to install a weigh bridge of suitable capacity for the purpose of weighment of dumpers at suitable place at his cost as directed. Weight of empty dumper and weight of loaded dumper will be recorded in bound and numbered register on plant side.

Department will be free to get some loaded, dumper test checked at other weigh bridge. Weigh bridge will be periodically got calibrated and verified from weight and measure authorities.

For the purpose of application of tack coat if the theoretical area as per sanctioned estimate for basis of tonne differs with the actual area of work done in the field, then the reduction in or addition to payment shall have to be effected to the contractor on proportionate basis depending upon the area reduced or exceeded respectively.

Weigh of mix materials will be done in presence of responsible person, not less than the rank of supervisor of Department, Deputy Executive Engineer or Assistant Engineer or Addl. Assistant Engineer if so authorized. Record of each dumper will be maintained separately inbound and numbered register which will be maintained by the departmental representatives and signed by the contractor. Proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer in Which individual dumper are unloaded will be recorded carefully.

8. RATE: The Contract unit rate for seal coat shall be for payment for carrying out the required operations including full compensation for all components listed in MOST Specification MORD Spe. Clause 503.7

Item No. 25

Excavation for foundation upto 1.5 m depth including sorting out and stacking of useful materials and disposing off the excavated stuff upto 50 Meter lead.

And

Item No. 26

Excavation for foundation in sand,gravel,clay soft soils and murrum etc. including shoring and strutting and dewatering as necessary and disposing of the excavated stuff as directed . (A) Depth up to 3.0 mt

And

Item No. 27

Excavation for foundation in hard murrum and boulders and very stiff or sticky, clays and other similar strata including shoring and strutting and dewatering as necessary and disposing of the excavated stuff as directed .

1. Excavation for structures shall consist of the removal of material for the construction of foundations for culverts, retaining walls, cut of walls pipe, culverts and other structures in accordance with the requirements of these specifications and the lines and dimensions shown on the drawing or as indicated by the Engineer in charge. The work shall include all necessary sheeting, sorting, soaring, bracing, draining and pumping and the removal of all logs, slumps, grubs, and other deleterious matter and

obstructions necessary for placing the foundations, trimming bottoms of excavations, backfilling and clearing up the site and the disposal of all surplus materials.

2. After the site has been cleared the limits of excavation shall be set out true lines, curves and slopes grades and section as shown on the drawings or as directed by the Engineer in charge. The contractor shall provide all labour, survey instruments and material such as strings, pegs, nails, bamboos, stones, lime, mortar, concrete etc. required is connection with the setting out of works and the establishment of bench mark, centerline stones and other marks and stakes as long as in the opinion of the Engineer in charge, they are required for the work.

3. Excavation shall be taken to the width of the lowest step of the footing, The contractor at his own expenses shall put up necessary shoring, strutting and planking or cut slopes to a safer angle or both with due regard to the safety of persons and works and to the satisfaction of the Engineer in charge.

4. The depth to which the excavation is to be carried out shall be as shown, on the drawings unless the type of material encountered is such as to require changes, in which case the depth shall be as ordered by the Engineer in charge.

5. Where water is met with in excavation due to stream flow, sappy springs, rain or other reasons, the contractor shall take adequate measures such a billing, pumping, construction of diversion channels, drainage channels and other necessary works to keep the foundation trenches dry when so required and to protect green concrete / masonry against damage by erosion or sudden rising of water level. The method to be accepted in this regard and other details there of shall be left to the choice of the contractor but subject to approval of the Engineer in charge. Approval of the Engineer in charge shall however not relieve the contractor of the responsibility for the adequacy of dewatering and protection arrangements and for the quality and safety of the work.

6. Pumping from the interior of any foundation enclosures shall be done in such manner as to preclude the possibility of the movement of water through any fresh concrete. No pumping shall be permitted during the placing of concrete of for any period of at least 24 hors thereafter. Unless it is done from a suitable sum separated from the concrete work by a water tight wall or other similar means.

7. The bottom of the foundation shall be leveled by both longitudinally and transversely or stepped as directed by the Engineer in charge. Before footing is laid, the surface shall be slightly watered and rammed. In the event of excavation having been made deeper than that shown of the drawings or as otherwise ordered by the Engineer in charge the extra depth shall be maded up with concrete or masonry of the foundation grade at the cost of the contractor. Ordinary filling shall not be used for the purpose of bringing the foundations to level. If there are any slips or blows in the excavation these shall be removed by the contractor at his own cost.

8. Near towns, villages and all frequented places, trenches and foundations pits shall be securely fences, provided with proper caution signs and marked with red lights at nit to avoid accidents. The contractor shall be required to take adequate protective measures to see that the excavation operation done affect or damage adjoining or damage adjoining structures.

9. Backfilling shall be done with approved material after concrete or masonry if fully set and carried out in such a way as not to cause under thrust on any part of the structure. All space between foundation masonry or concrete and the side of excavation shall be refilled to the original surface making due allowance for settlement in 250mm loose layer which shall be watered and compacted.

10. All the excavated material shall be the property of the Government. Where the excavated material is directed to be used in the construction of embankment, it shall be directly deposited at the required locations.

11. All useful materials not intended for use in the bank shall be stacked neatly on Government land as directed by the Engineer in charge within 50 meter lead. Unsuitable and surplus materials not intended for use in any part of the road shall be disposed off as directed by the Engineer in charge.

12 Excavation for structures shall be measured in Cu.M. for each class of materials encountered, limited to the dimensions excavation over increased width cutting of slopes, shoring, strutting and planking shall be deemed as convenience for the contractor in executing the work and shall not be measured and paid for separately.

13. The contract unit rate for the items of excavation for structure shall be paid in full for carrying out the required operation including

1. Setting out

2. Construction of necessary shoring and bracing and their subsequent removal.

3. Removal of all logs, stumps, grubs, and other deleterious matter and obstruction for placing the foundations including trimming of bottoms of excavations.

4. Foundation sealing, dewatering including pumping.

5. Backfilling clearing up the site and disposal of all surplus materials within all lifts and leads upto 100 meters.

6. All labours, materials, tools, equipments safeguard and incidentals necessary to complete the work to the specification.

14. Excavation shall be for ordinary soil such as vegetable or organic soil, surf silt and loan clay, mud plat, black cotton soil, soft shale or soft murrum a mixtures of theses and similar material which yields to the ordinary application of pick and shovel, rake or other ordinary digging equipment. Removal of gravel or any other nodular materials having diameters in any one direction not exceeding 75 occurring in such strata shall be deemed to be covered under this category. The classification of excavation shall be decided by the Engineer in charge and his decision shall be final and binding on the contractor.

Item No. 28

Providing and filling in foundation with ordinary Cement concrete M-100 mix and providing necessary vertical pin headers including formwork, vibrating, ramming and curing complete.

And

Item No. 29

Providing & casting in situ oridinary cement concrete M-150 Mix and providing necessary pin headers including shuttering, scaffolding, laying, vibrating and finishing concrete without v-grooves

And

Item No. 30

Providing and filling in foundation with ordinary Cement concrete M-150 mix and providing necessary vertical pin headers including formwork, vibrating, ramming and curing complete.

And

Item No. 31

Providing and casting in situ Ordinary cement concrete M-150 for R.C.C. Raft and cut-off walls including necessary shuttering laying, vibrating, ramming and curing complete. And

Item No. 32

Providing and casting in situ ordinary cement concrete M-200 mix and providing necessary pin headers including shuttering, scaffolding, laying, vibrating, curing and finishing complete without V-Groves.(A) Height from 0.0 M. to 5.0 M.

1. In case of ordinary concrete mix in not required to be designed by preliminary tests and proportions of cement, fine aggregates and coarse aggregates are specified by volume as given in tables below for different grades of concrete designated as ordinary M100, M150, M200 and M250.

2. IN the designation of a concrete mix, letter "M" refers to the mix and the number the specified 28 days works cube compressive strength of that mix on 150mm cubes expressed in Kg/Cm^2.

3. The ordinary concrete mix shall generally be specified by volume. For cement which normally comes in bags and issued by weight, volume shall be worked out taking 50 Kg. of cement as 0.035 Cu.M. in volume. While measuring aggregates by volume, shaking, ramming or hammering shall not be done. Proportioning of sand shall be as per its dry volume. In case it is dump, allowance for bulking shall be made as per IS : 2386 {Part : III}

3. Ingredient required for ordinary cement concrete containing one 50 Kg. bag of cement for different proportions of mix shall be as given the table below.

Grade of Concrete	Mix by Volume	Total Quantity of dry aggregates by volume per 50 Kg. of cement to be taken as sum of the individual volumes of fine and coarse aggregates mix	Proportion of fine aggregates to coarse aggregates	Quantity of water per 5 Kg. of cement max.
Ordinary	Liter	One Cubic meter = 1000 liters		Liter
M100	1:3:6	300	General 1:2 for fine agg. To coarse agg. By volumes but subject fo a upper limit of 1 : 1 ½ & a lower limit of 1:3	34
M150	1:2:4	220		32
M200	1:1 ½ : 3	160		30
M250	1:1:2	100		27

Note :- The proportion of the aggregates shall be adjusted from upper limit to lower limit progressively as the grading of the fine aggregates becomes finer & the maximum size of cares aggregates becomes larger.

Example : For an average grading of fine aggregates (that is zone II or IS 383-1963) the proportions shall be 1 : 1 ½ 1:2 and 1:3 for maximum size of aggregates 10mm, 20mm and 40mm respectively (after carrying out sieve analysis.

Note : 2 A mix leaner than the M100 (1:3:6)m may be used for non structural parts, if provided in the contract, in such case grading of aggregates shall be by volume. Other requirement for missing and placing & curing shall be the same.

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

Sr. No.	Item of Construction	Maximum nominal size of coarse aggregates
1.	R.C.C. Well curbs, R.C.C. well staining and R.C.C. piles	40mm
2.	R.C.C. well staining	63mm
3.	Well cap or pile cap, solid type piers, abutment and wing walls and other pier caps	40mm
4.	R.C.C. work in cross girders, deck slab, wearing course, kerb, light post, blast walls, approach slab, etc. and hollow type piers, abutments, wing walls, and their pier cap	20mm
5.	R.C.C. bearings	20mm
6.	For any other items of construction not covered by Item 1 to 4.	As specified on the drawing or as desired by the Engineer in charge in case it is not specified on drawing.

For heavily reinforced concrete members as in the case of ribs of main beams nominal maximum size of aggregate shall be usually be restricted to 5mmless than the minimum cover to the reinforcement which is the smaller.

6. Fine aggregates shall be clean hard, coarse sand. It shall be free from dust and such other substance. The sand be got approved by the Engineer in charge.

7. All materials shall be stored as to prevent their deterioration or destruction of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer in charge shall not be used in the works.

8. Cement shall be stored above the ground level in perfectly dry and watertight sheds. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at leas one very 3 to 4 months. The aggregates shall be stored in such a way as to prevent admixture of foreign materials different sizes of the fore or coarse aggregates shall be stored in separate stock piles sufficiently removed from each other to prevent inner mixing of the materials.

9. The water for mixing shall be potable water to satisfaction of the Engineer in charge. The quality of water shall be just sufficient to produce a dense concrete of required workability for the job.

10. For all work concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working condition and so maintained throughout the construction. Mixing shall be continued till materials are uniformly distributed and uniform colour of ht entire mass is obtained and each individual particle of the coarse aggregates show complete coating of mortar containing its proportionate amount of cement. In no case shall be mixing be done for less than 2 minutes after all ingredients have been put into the mixer.

11 When hand mixing is permitted by the Engineer in charge for small jobs or for certain other reasons. It shall be done on a smooth watertight platform large enough to allow efficient turning over of the ingredient of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material shall bet mixed with concrete nor does the mixing water flow out. Cement in required numbers of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregates, which shall also be spread in a layers of uniform thickness on the mixing platform. Dry coarse and fine aggregates and cement shall then be mixed thoroughly by turning over to get a mixture of uniform colour, enough water shall then be gradually thoroughly by and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 percent above that specified.

12. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in new batch. Unless otherwise agreed to be the Engineer in charge, the first batch of concrete from the mixer shall contain only two thirds of normal quantity of coarse aggregates. Mixing plant shall be thoroughly cleaned before changing from one type cement to another.

13. The method of transporting and placing concrete shall be approved by the Engineer in charge. Concrete shall be so transported and place that no contamination, segregation or loss of its constituent material takes place. All formwork and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer in charge has been obtained.

14. If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer in charge. Concreting being given it shall proceed continuously over the area between construction joints. Fresh concrete shall not be laced against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly design agitators, operating continuously. When this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise depth of not more than 45 minutes when internal vibrators are used and not exceeding 0.30 meter in all other cases.

15. Unless otherwise agreed to by the Engineer in charge concrete shall not be dropped into place from a height exceeding 2 meters. When trunking or chutes are used they shall be kept clean and used in such a way as to avoid segregation. When concreting has to resumed on surface which has hardened it shall be roughened swept, clean thoroughly wetted and covered with a 13mm thick layer of mortar composed of cement and sand in the same ratios as in the concrete mix itself. This 13mm layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. where concrete has not fully hardened all laitance shall be removed by scrubbing the wall surface with wire or bristly brushed, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150mm in thickness and shall be well rammed against old work particular attention being give to corner and close spots.

16. All concrete shall be compacted to produce a dense homogenous mass with the assistance of vibrators unless otherwise permitted by the Engineer in charge for exceptional cases such as concrete under water, where vibrators can not be used. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event of breakdowns.

17. Immediately after compaction, concrete shall be protected against harmful effect of weather including rains, running water, shocks, vibration, traffic, rapid temperature changes, frost and driving out process. It shall be covered with wet sacking hessain or other similar absorbent material approved

by the Engineer in charge soon after the initial set and shall be kept continuously wet for a periods not less than 14 days from the date of placement. Masonary work over the foundation concrete may be started after 48 hours of its laying but the curing of concrete shall be continued for a minimum period of 14 days.

18. Formwork shall include all temporary or permanent forms required for forming the concrete together with all temporary construction required for their support. Formwork shall however be divided into following two distinct categories.

1. Shuttering i.e. formwork required for forming the concrete
2. Scaffolding i.e. formwork required for supporting shuttering.

Forms for shuttering shall be constructed only in metal suitably line. Forms for scaffolding shall be constructed of metal or timer. Both shuttering and scaffolding shall be of substantial rigid construction and shuttering shall be true to shape and dimension shown on the drawings. All bolts and rivers shall be counter sunk and well ground to provided as smooth plane surface.

19. Forms shall be mortar tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribe line occurring during and after the placing the concrete. Screw jack or hard wood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete. Suitable camber shall be provided in horizontal member of structure, specially in long spans so counteract the effect of any fixed as to provide for such camber. Forms shall be so constructed as to be removable is sections in the desired sequence, without damaging the surface of concrete or disturbing other section. Unless otherwise specified or directed, chambers or fillets of size 25mm x 25mm shall be provided at all angles of formwork to avoid sharp corners.

20. The inside surfaces of shuttering shall except in the case of permanent formwork or where otherwise agreed to by the Engineer in charge be coated with an approved material to prevent adhesion of concrete to the formwork. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not be allowed to come into contact with any reinforcement or prestressing tendons and anchorages. Different release agents shall not be used in formwork for concrete which will be visible in the finished work.

21. Special measures shall be taken to ensured that the formwork does not hinder or shrinkage or concrete because without these cracking could occur before the formwork is removed. Where ever applicable arrangements must be made to ensure that the formwork does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The formwork should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape for the structure having regard to the deformation of a false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting prestressed structures. Where there are re entrant angles in the concrete sections the formwork should be removed at those sections as soon as possible after the concrete has set in order to avoid cracking due to shrinkage of concrete. Formwork shall be tight enough to prevent any appreciable loss of cement during vibrations, suitable tolerance cleaned. Contractor shall give the Engineer in charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength alignment and general fitness but such inspection shall not relive the contractor of his responsibility for safety of men, machinery, material and results obtained.

22. The Engineer in charge shall be informed in advance be the contractor of his intentions to strike any formwork. Whole fixing the time for removal of formwork due consideration shall be given to local condition, character of the structure, the weather and other conditions that influence the setting of concrete and of the materials sued in the mix. Where field operations are controlled by the strength tests of concrete the removal of the load supporting or soffit forms any commence when concrete has attained strength equal to at least twice the stress to which the concrete will be subjected at the time of striking props including the effect of any further addition of loads. When field operations are not controlled by strength tests of concrete the vertical forms of beams, columns and wall may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 day respectively. All formwork shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stress due to its own weight

uniformly and gradually. Where internal metal ties are permitted they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanent embedded metal part shall have less than 25mm cover to the finished concrete surface. Where it is intended to refused the formwork, it shall be cleaned and made good to the satisfaction of the Engineer in charge.

23. Immediately after the removal of forms all exposed bars or bolts passing through the cement concrete members and used for shuttering or any other purpose shall be cut inside the cement concrete member to a depth of at least 25mm below the surface of the concrete and the resulting holes be filled by cement mortar. All fins caused by form joints all cavities produced by the removal of the form ties and all other holes and depressions, honeycomb spots, broken edges or corners and other defects shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry as consistency as is possible to sue. Considerable pressure shall be applied in filling and pointing to ensure through filling in all voids. Surface which have been pointed shall be kept moist for a periods of twenty four hours. If rock pockets / honeycombs in the opinion of the Engineer in charge are of such an extent or character as to affect the strength of the structure materially or to endanger the lime of the steel reinforcement he may declare the concrete defective and required the removal and replacement of the portion of the structure affected.

24. In the case of reinforcement work workability shall be such that the concrete surrounds and properly grips all reinforcement. The degree of consistency which shall depend upon the nature of work and methods of vibration of concrete shall be determined by regular slumps tests. Following slump shall be adopted for different type of works.

	Type of work	Slumps	
		Where vibrator are used	Where vibrator are not used
(i)	Mass concrete in RCC foundations, footing and retaining walls.	10mm to 25mm	80 mm
(ii)	Beams, slab and columns simply reinforced.	25mm to 40 mm	100mm to 120 mm
(iii)	Thin RCC section or section with congested	40mm to 50mm	125mm to 150mm

25. Works strength test shall be made in accordance with IS 516. Each test shall be conducted on ten specimens five of which shall be tested at seven days and the remaining five at 28 days. The sample of concrete shall be taken on each day of concreting and cubes shall be made at the rate of one for every 5 Cu.M. of concrete or a part thereof. However if concreting done in a day is less than t15 Cu.M. the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer in charge. Similar works test shall be carried out whenever the quality and grading of materials is charges irrespective of the quantity concrete proud. The number of specimens may be suitably increased as deemed necessary by the Engineer in charge, when procedure of tests given above reveal a poor quality of concrete and in other special cases.

26. The average strength of the group of cubes cast for each day shall not be less than the specified work cub strength 20 percent of the cubes cast for each day may have values less than the specified strength, provided the lowest value is not less than 85 percent of the specific strength.

27. R.C.C. work shall have exposed concrete surfaces. Centering design and its erection shall approved by the Engineer in charge. One carpenter with helper will invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. For access to different parts, suitable mobile platforms shall provided so that steel reinforcement in position is not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber kapachi or metal pieces shall not be used for this purpose. Concreting of important structural members shall always be done in the presence and under the supervision of departmental person not below the rank of Assistant Engineer /

Addi. Asst. Engineer, Overseer or as instructed by the Engineer in charge. After removal work checks that concrete produced is of good quality. Plastering shall not be allowed to the expressed faces of concrete.

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

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

30 The payment shall be made on Cu.M. basis for the finished work.

31. The unit rate for concrete shall include the cost of all materials, labour, tools and plant required for mixing, placing in position, vibrating and compacting, finishing as per the directions of the Engineer in charge, curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as shown on the drawings and according to these specifications. The rate shall also include the cost of making / fixing and removing of all centers and forms required for the work.

Item No. - 33

Providing and casting in situ Controlled cement concrete M-250 for R.C.C. Raft and cut-off walls including necessary shuttering laying, vibrating, ramming and curing complete.. .

AND

Item No.-34

Providing and casting in situ Controlled cement concrete M-250 mix and providing necessary pin headers including shuttering, scaffolding, laying vibrating, curing and finishing etc., complete without grooves(Height from 0.0 to 5.0 mt.}

AND

Item No.-35

Providing and casting in situ Controlled cement concrete M-250 for R.C.C. works in pier cap abutment cap and dirt wall including controlled cement concrete M-300 Bed block or pedestal or required size below bearings as per detailed drawings, centering, scaffolding, curing &, vibrating & finishing etc. competed.

AND

Item No.-36

Providing and casting in situ controlled cement concrete M-250 for R.C.C. solid slab including centering, scaffolding, curing and finishing complete.

AND

Item No.-37

Providing and casting in situ Controlled Cement concrete M-250 for R.C.C. solid slab including centering, scaffolding curing and finishing complete.

AND

Item No.-38

Providing and Casting in situ controlled cement concrete M-250 for average 75 mm thick Wearing Coat laid as directed including tempering, Vibrating, finishing,curing and filling in joints with bituminious complete .

AND

Item No.-39

Providing and casting in situ Controlled cement concrete M-250 for average 75 mm thick wearing coat laid as directed including tamping ,vibrating, finishing, curing and filling in joints with bitumen complete.

1. Controlled concrete, design of the mix shall be approved after preliminary tests and all necessary precautions shall be taken in its production to ensure that the required works cube strength is attained and maintained. The controlled concrete shall be in eight grades designated as M 100, M 150 M 200, M. 250 M 250, M 350 M 400 and M. 450 with the suffix controlled added to it.
2. In the designation of a concrete mix, letter "M" refers to the mix and the number to the specified 28 days works cubs compressive strength of that mix on 150 mm, cubes, expressed in kg/cm2 where ordinary Portland cement conforming to IS 269 or Portland cement conforming to IS 455 is used, the compressive strength requirements for various grades of concrete shall be as given below on the next page

Grade of Concrete	On 150 mm	Compressive works test strength in kg/cm2 on 150 mm cubes, conducted in accordance with IS : 516 Min. at 7 days	
		Min. at 7 days	Min. at 29 days
M 100	..	70	100
M 150	..	100	150
M 200	..`	135	200
M 250	..	170	250
M 250	..	200	250
M 350	..	235	350
M 400	..	270	400
M 450	..	250	450

NOTE : In all cases, the 28 days compressive strength specified in the above Table shall alone be the criterion for acceptance or rejection of the concrete.

Where the strength of a concrete mix, as indicated by tests, lies in between the strength for any two grades specified in the above Table such concrete shall be classified for all purpose as a concrete belonging to the lower or the two grades between which its strength lies.

3. Concrete mix shall be designed on the basis of preliminary tests so as attain a strength at least 33 per cent higher than that required on work tests. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with the means available. Except where it can be shown to the satisfaction of the Engineer-in-charge that supply of properly graded aggregate of uniform quality can be maintained till the completion of work, grading of aggregate should be controlled by obtaining the coarse aggregates in different sizes and bleding them in the right proportions as required aggregates of different sizes shall be stocked in separate stock piles. Required quantity of material shall be stock piled several hours, preferably a day, before use. Grading of coarse and fine aggregate shall be checked as frequently as possible, frequency for a given job being determined by the Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests.
4. In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement is determined by accepting the maker's weight per bag a reasonable number of bags shall be weighed separately to check the net weight. Where cement is weighed from bulk stocks at site and not by bags, it shall be weighed separately from the aggregates water shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in clean, and serviceable condition. Their accuracy shall be periodically checked.
5. It is most important to keep the specified water cement ratio constant and at its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined by the Engineer-

in-charge according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture cement. For the determination of moisture content in the aggregates, IS : 2386 (Part-III) shall be referred to. Suitable adjustments shall also be made in the weights of aggregates to allow for the variation in weights of aggregates due to variation in their moisture content. Minimum quantity of cement to be used in controlled concrete shall not be less than 210 Kg. per cubic metre in plan concrete and not less than 250 Kg/per cubic metre in reinforced concrete structural members. The minimum quantity of cement for priestesses concrete work shall not less than 360 Kg/per cubic meter of concrete not shall it be more than 540 kg/per cubic metre of concrete.

6.

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

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

7. Fine aggregate shall be clean, hard, coarse sand it shall be free dust and such other substances. The sand be get approved by the Engineer-in-charge.

8. All materials shall be stored as to prevent their deterioration of there quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the works.

9. Cement shall be stored above the ground level in perfectly dry and watertight sheds. Wherever bulk storage containers are used. Their capacity should be sufficient to cater to the requirements at site and should be cleaned atleast once every 3 to 4 months. The aggregates shall be stored in such a way as to prevent admixture of foreign materials. Different sizes of fine or coarse aggregate shall be stored in separate stock piles sufficiently away from such other to prevent intermixing the materials.

10. The water for mixing shall be potable water to satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.

11. For all work concrete shall be mixed in a mechanical mixer which alongwith other accessories shall be kept in first class working condition and so maintained throughout the construction Mixing shall be continued till materials are uniformaly distributed and uniform colour of the entire mass is obtained and each indiual particle of the coarse aggregate shows complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.

12. Mixer which have been out of use more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to be the Engineer-in-charge. The first batch of concrete

from the mixer shall contain only two thirds of normal quantity of coarse aggregate. Mixing plant shall be thoroughly cleaned before changing from one type of cement to another.

13. The method of transporting and placing concrete shall be approved by the Engineer-in-charge Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be palced in any part of the structure until the approved of the Engineer-in-charge has been obtained.

14. If concreting is not started within 24 hours of the approved being given. It shall have to be obtained again from the Engineer-in-charge. Concreting then shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly design agitators. Operating continuously when this time shall be within 3 hours of the addition of cement to the mix an within 30 minutes of its discharge from the agitator. Except where otherwise agreed to be the Engineer-in-charge. Concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 metre when internal vibrator are used not exceeding 0.30 metre in all other cases.

15. Unless otherwise agreed to be the Engineer-in-charge concrete shall not be dropped into place from a height exceeding 2 metres. When trunking or chutes are used they shall be kept clean and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept clean, thoroughly wetted and covered with a 10 mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm, layer of mortar shall be freshly mixed palced immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes. Care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first layers of concrete to be placed on this surface shall not exceed 150 mm. in thickness and shall be well rammed against old particular attention being given to corners and close sports.

16. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of Vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting under water, where vibrators can not be used. Sufficient vibrator in serviceable condition shall be kept at site so that spare equipment is always available in the event of break downs.

17. Immediately after compaction, concrete shall be protected against harmful effects of weather including rain, running water, shocks, vibration, traffic, RAPID TEMPERATURE CHANGES. FROST AND DRYING OUT PROCESS. It shall be covered with wet scking, Hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set, and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonary work over the foundation concerete may be started after 48 hours of its laying but the curing of concrete shall continued for a minimum period of 14 days.

18. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Formwork shall however be delived into following two district categories.

    (1) Shuttering i. e. from work required for forming the concrete.

    (2) Scaffolding i.e. form work required for supporting shuttering.

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

19. Forms shall be mortar-tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to with stand all pressure, ramming and vibration, without defection from the prescribed lines occurring during

and after placing the concrete. Screw jacks or hardwood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of structure specially in long spans to counterate the effects of any deflection. The formwork shall be so fixed as to provide for such camber. Forms shall be so constructed as to be removable in sections in the desired sequence, Without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed, chambers or fillets of sizes 25 mm x 25 mm shall be provided at all angles of formwork to avoid sharp corners.

20. The inside surface of shuttering shall, except in the case of permanent form work or where otherwise agreed to be Engineer-in-charge, be coated with an approved material to prevent adhesion of concrete to the form work. Release agents shall be applied strictly in accordance with the manufacture's instructions and shall not be allowed to come into contact with any reinforcement or prestressing tendons and anchorages. Different release agent shall not be used in form work for concrete which will be visible in the finished works.

21. Special measures shall be taken to ensure that the form does not hinder the shrinkage of concrete because without these cracking could occur before the form work is removed. Wherever applicable arrangements must be made to ensure that the form work does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The formwork should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape of the structure having regard to the deformation due of false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting priestesses structures. Where they are re-entrant angles in the concrete sections the form work should be removed at these sections as soon as possible after the concrete has set in order to avoid cracking due to shrinkage of concrete. Form work shall be tight enough to prevent any appreciable loss of cement during vibrations. Suitable tolerance should be provided in the formwork. Immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength, alignment and general fitness. But such unspection shall not relieve the contractor of his responsibility for safty of men, machinery. Materials and for results obtained.

22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of formwork, due consideration shall be given to local conditions that influence the setting of concrete and of concrete and of the materials used in the mix. Where filed operations are controlled by strength tests of concrete the removal of the load supporting of soffit forms may commence when concrete has attained strengthing props including the effect or any further additions of loads. When field operations are not controlled by strength tests of concrete the vertical forms of beams. Columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All formwork shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to cleaned and made good to the satisfaction of Engineer-in-charge.

23. Immediately after the removal of forms. All exposed bars or bolts passing through the Cement Concrete member to a depth of at least 25mm. below the surface of the concrete and the resulting holes be filled by cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honeycomb spots. Broken edges of corners and other defects, shall be thoroughly cleaned, asteriated with water and carefully pointed and rendered true with mortar of cement and fine aggregated mixed in the proportions used in the grade of concrete that is being finished and of as dry a consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure through filling in all voids. Surface which have been pointed, shall be kept moist for a period of twenty four hours. If rock pockets/honey-combs, in the opinion of the Engineer-in-charge are of such an extent or character as to effect the strength of the structure materially or to endanger the life of the steel reinforcement, be may

declare the concrete defective and require the removal and replacement of the portions of the structure affected.

24.

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

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

25. For controlled concrete preliminary test shall consist of three sets of separate tests, and in each set, tests shall be conducted on six speciments. Not more than one set of six specimens shall be made on any particular day. Of the six specimen in each set, three shall be tested at seven days and the remaining three at 28 days. The preliminary tests at 27 days are intended only to indicate the strength likely to be attained at 28 days. Work strength tests shall be made in accordance with IS 516 EACH test shall be conducted on ten specimens five of which shall be tested at seven days and the remaining five at 28 days. The samples of concrete shall be taken on each day of concreting and cubes shall be made at the rate of one for every 5 cubic metre of concrete or a part thereof. However, if concreting done in a day is than 15 cubic metre the minium number of cubes can be reduced to 6 with the specific permission of the Engineer-in-charge. Similar works tests shall be carried out when ever the quality and grading of materials is changed irrespective of the quantity of concrete poured. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure to tests given above reveals a poor quality of concrete and in other special cases.
26. The average strength of the group of cubes cast for each day shall not be less than the specified works cube strength 20 percent of the cubes cast each day may have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specified strength.
27. R. C. C. Work shall have exposed concrete surface. Centering design and its erection shall be approved by the Engineer-in-charge. One carpenter with helper will invariably be kept through out the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. For access to different parts, suitable mobile platforms shall be provided so that steel reinforcement in position as not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber, kapachi or metal places shall be used for this purpose. Concreting of important structural member shall always be done in presence and under the supervision of departmental person not below the rank of Astt. Engineer / Addl. Astt. Engineer/ Overseer or as instructed by the Engineer-in-charge. After removal of form work and shuttering, the executive Engineer shall inspect the work and satisfy by random checks that concrete produced is of good quality, Plastering shall not be allowed to the exposed faces of concrete.
28. In reinforced concrete the volume occupied by reinforcement shall not be deducted. The slab shall be measure as running continuously through and the beam as the portion below the slab.
    All necessary labour, materials. Equipment etc., for sampling preparing test cubes, curing etc., shall be provided by the Contractor. Testing of the materials and concrete arranged by the Engineer-in-charge in an approved laboratory at the cost of the contractor.
29. The payment will be made on cmt. Basis of the finished work.
    The unit rate for concrete shall include the cost of all materials, labour, tools and required for mixing. Placing in position, vibrating and compacting finishing as per directions of Engineer-in-charge. Curing and

all other incidental expenses for producing concrete of specified strength to complete the structure or its components as shown on the drawings and according to these specifications. The rate shall also include the cost of making fixing and removing of all centers and forms required for the work.

Item No. - 40

Providing and fixing in position mild steel dowel bars in pier cap or abutments caps for anchorage in fixed end as per detailed drawings including cutting, bending and welding complete.

The dowel bars shall conform to Grade S 240 . Dowel bars shall be 25mm dia of sufficient length. One end of sufficient length of dowel shall be fixed in concrete in pier cap.and other end shall be fixed in slab

The rate shall be for a unit of one No.

Item No. - 41

Providing and fixing in position mild steel dowel bars in pier caps for anchorage in free end as per detailed drawings including cutting, bending and welding complete.

The dowel bars shall conform to Grade S 240 . Dowel bars shall be 25mm dia of sufficient length.A P.V.C.pipe of 75 mm dia of sufficient length shall be fixed in concrete at top of abutment or pier.Pier cap shall be filled with sand and dowel bar .A sufficient length of dowel shall be fixed in concrete in slab.. This assembly and Holes to accommodate dowel bars shall be accurately bored or punched out to give a sliding fit on the dowel bars.

The rate shall be for a unit of one No.

Item No. – 42

Providing and filling sand between abutments and between returns in layers as directed.

1. Sand filling shall carried out between abutments and between returns in layer wise as directed by Engineer-in-charge.For compaction sufficient water shall be poured..
2. Sand shall be clean and free from earth, clay clods, roots, boulders, shingles, etc. and shall be compacted as directed. Sand filling shall be carried out upto the level shown on the drawing, or as directed by the Engineer.

The rate shall be for one cubic metre

Item No.- 43

Providing & Casting in situ ordinary cement concrete M-250 mix with Trimix C.C Road laid as directed including temping, vibrating, finishing, curing and filling in joints with bitumen etc as per Engineer Incharge.

1. In case of ordinary concrete mix is not required to be designed by preliminary tests and proportions of cement, fine aggregates and coarse aggregates are specified by volume as given in tables below for different grades of concrete designated as ordinary M100, M150, M200 and M250.

2. IN the designation of a concrete mix, letter “M” refers to the mix and the number the specified 28 days works cube compressive strength of that mix on 150mm cubes expressed in Kg/Cm^2.

3. The ordinary concrete mix shall generally be specified by volume. For cement which normally comes in bags and issued by weight, volume shall be worked out taking 50 Kg. of cement as 0.035 Cu.M. In volume. While measuring aggregates by volume, shaking, ramming or hammering shall not be done. Proportioning of sand shall be as per its dry volume. In case it is dump, allowance for bulking shall be made as per IS : 2386 {Part : III}

3. Ingredient required for ordinary cement concrete containing one 50 Kg. bag of cement for different proportions of mix shall be as given the table below.

Grade of Concrete	Mix by Volume	Total Quantity of dry aggregates by volume per 50 Kg. of cement to be taken as sum of the individual volumes of fine and coarse aggregates mix	Proportion of fine aggregates to coarse aggregates	Quantity of water per 5 Kg. of cement max.
Ordinary	Liter	One Cubic meter = 1000 liters		Liter
M100	1:3:6	250	General 1:2 for fine agg. To coarse agg. By volumes but subject fo a upper limit of 1 : 1 ½ & a lower limit of 1:3	34
M150	1:2:4	220		32
M200	1:1 ½ : 3	160		30
M250	1:1:2	100		27

Note :- The proportion of the aggregates shall be adjusted from upper limit to lower limit progressively as the grading of the fine aggregates becomes finer & the maximum size of cares aggregates becomes larger.

Example : For an average grading of fine aggregates (that is zone II or IS 383-1963) the proportions shall be 1 : 1 ½ 1:2 and 1:3 for maximum size of aggregates 10mm, 20mm and 40mm respectively (after carrying out sieve analysis.

Note : 2 A mix leaner than thM100 (1:3:6)m may be used for non structural parts, if provided in the contract, in such case grading of aggregates shall be by volume. Other requirement for missing and placing & curing shall be the same.

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

Sr. No.	Item of Construction	Maximum nominal size of coarse aggregates
1.	R.C.C. Well curbs, R.C.C. well staining and R.C.C. piles	40mm
2.	R.C.C. well staining	63mm
3.	Well cap or pile cap, solid type piers, abutment and wing walls and other pier caps	40mm
4.	R.C.C. work in cross girders, deck slab, wearing course, kerb, light post, blast walls, approach slab, etc. and hollow type piers, abutments, wing walls, and their pier cap	20mm
5.	R.C.C. bearings	20mm
6.	For any other items of construction not covered by Item 1 to 4.	As specified on the drawing or as desired by the Engineer in charge in case it is not specified on drawing.

For heavily reinforced concrete members as in the case of ribs of main beams nominal maximum size of aggregate shall be usually be restricted to 5mmless than the minimum cover to the reinforcement which is the smaller.

6. Fine aggregates shall be clean hard, coarse sand. It shall be free from dust and such other substance. The sand be got approved by the Engineer in charge.

7. All materials shall be stored as to prevent their deterioration or destruction of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer in charge shall not be used in the works.

8. Cement shall be stored above the ground level in perfectly dry and watertight sheds. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at leas one very 3 to 4 months. The aggregates shall be stored in such a way as to prevent admixture of foreign materials different sizes of the fore or coarse aggregates shall be stored in separate stock piles sufficiently removed from each other to prevent inner mixing of the materials.

9. The water for mixing shall be potable water to satisfaction of the Engineer in charge. The quality of water shall be just sufficient to produce a dense concrete of required workability for the job.

10. For all work concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working condition and so maintained throughout the construction. Mixing shall be continued till materials are uniformly distributed and uniform color of ht entire mass is obtained and each individual particle of the coarse aggregates show complete coating of mortar containing its proportionate amount of cement. In no case shall be mixing be done for less than 2 minutes after all ingredients have been put into the mixer.

11 When hand mixing is permitted by the Engineer in charge for small jobs or for certain other reasons. It shall be done on a smooth watertight platform large enough to allow efficient turning over of the ingredient of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material shall bet mixed with concrete nor does the mixing water flow out. Cement in required numbers of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregates, which shall also be spread in layers of uniform thickness on the mixing platform. Dry coarse and fine aggregates and cement shall then be mixed thoroughly by turning over to get a mixture of uniform color, enough water shall then be gradually thoroughly by and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 percent above that specified.

12. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in new batch. Unless otherwise agreed to be the Engineer in charge, the first batch of concrete from the mixer shall contain only two thirds of normal quantity of coarse aggregates. Mixing plant shall be thoroughly cleaned before changing from one type cement to another.

13. The method of transporting and placing concrete shall be approved by the Engineer in charge. Concrete shall be so transported and place that no contamination, segregation or loss of its constituent material takes place. All formwork and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer in charge has been obtained.

14. If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer in charge. Concreting being given it shall proceed continuously over the area between construction joints. Fresh concrete shall not be laced against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly design agitators, operating continuously. When this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise depth of not more than 45 minutes when internal vibrators are used and not exceeding 0.30 meter in all other cases.

15. Unless otherwise agreed to by the Engineer in charge concrete shall not be dropped into place from a height exceeding 2 meters. When trucking or chutes are used they shall be kept clean and used in such a way as to avoid segregation. When concreting has to resumed on surface which has hardened it shall be roughened swept, clean thoroughly wetted and covered with a 13mm thick layer of mortar composed of cement and sand in the same ratios as in the concrete mix itself. This 13mm layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened all laitance shall be removed by scrubbing the wall surface with wire or bristly brushed, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150mm in thickness and shall be well rammed against old work particular attention being given to corner and close spots.

16. All concrete shall be compacted to produce a dense homogenous mass with the assistance of vibrators unless otherwise permitted by the Engineer in charge for exceptional cases such as concrete under water, where vibrators can not be used. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event of breakdowns.

17. Immediately after compaction, concrete shall be protected against harmful effect of weather including rains, running water, shocks, vibration, traffic, rapid temperature changes, frost and driving out process. It shall be covered with wet sacking Hessian or other similar absorbent material approved

by the Engineer in charge soon after the initial set and shall be kept continuously wet for a periods not less than 14 days from the date of placement. Masonry work over the foundation concrete may be started after 48 hours of it's laying but the curing of concrete shall be continued for a minimum period of 14 days.

18. Formwork shall include all temporary or permanent forms required for forming the concrete together with all temporary construction required for their support. Formwork shall however be divided into following two distinct categories.

1. Shuttering i.e. formwork required for forming the concrete
2. Scaffolding i.e. formwork required for supporting shuttering.

Forms for shuttering shall be constructed only in metal suitably line. Forms for scaffolding shall be constructed of metal or timer. Both shuttering and scaffolding shall be of substantial rigid construction and shuttering shall be true to shape and dimension shown on the drawings. All bolts and rivers shall be counter sunk and well ground to provide as smooth plane surface.

19. Forms shall be mortar tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribe line occurring during and after the placing the concrete. Screw jack or hard wood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete. Suitable camber shall be provided in horizontal member of structure, especially in long spans so counteract the effect of any fixed as to provide for such camber. Forms shall be so constructed as to be removable is sections in the desired sequence, without damaging the surface of concrete or disturbing other section. Unless otherwise specified or directed, chambers or fillets of size 25mm x 25mm shall be provided at all angles of formwork to avoid sharp corners.

20. The inside surfaces of shuttering shall except in the case of permanent formwork or where otherwise agreed to by the Engineer in charge be coated with an approved material to prevent adhesion of concrete to the formwork. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not be allowed to come into contact with any reinforcement or prestressing tendons and anchorages. Different release agents shall not be used in formwork for concrete which will be visible in the finished work.

21. Special measures shall be taken to ensured that the formwork does not hinder or shrinkage or concrete because without these cracking could occur before the formwork is removed. Where ever applicable arrangements must be made to ensure that the formwork does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The formwork should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape for the structure having regard to the deformation of a false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting prestressed structures. Where there are re entrant angles in the concrete sections the formwork should be removed at those sections as soon as possible after the concrete has set in order to avoid cracking due to shrinkage of concrete. Formwork shall be tight enough to prevent any appreciable loss of cement during vibrations, suitable tolerance cleaned. Contractor shall give the Engineer in charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength alignment and general fitness but such inspection shall not relive the contractor of his responsibility for safety of men, machinery, material and results obtained.

22. The Engineer in charge shall be informed in advance be the contractor of his intentions to strike any formwork. Whole fixing the time for removal of formwork due consideration shall be given to local condition, character of the structure, the weather and other conditions that influence the setting of concrete and of the materials used in the mix. Where field operations are controlled by the strength tests of concrete the removal of the load supporting or soffit forms any commence when concrete has attained strength equal to at least twice the stress to which the concrete will be subjected at the time of striking props including the effect of any further addition of loads. When field operations are not controlled by strength tests of concrete the vertical forms of beams, columns and wall may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 day respectively. All formwork shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stress due to its own weight

uniformly and gradually. Where internal metal ties are permitted they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanent embedded metal part shall have less than 25mm cover to the finished concrete surface. Where it is intended to refused the formwork, it shall be cleaned and made good to the satisfaction of the Engineer in charge.

23. Immediately after the removal of forms all exposed bars or bolts passing through the cement concrete members and used for shuttering or any other purpose shall be cut inside the cement concrete member to a depth of at least 25mm below the surface of the concrete and the resulting holes be filled by cement mortar. All fins caused by form joints all cavities produced by the removal of the form ties and all other holes and depressions, honeycomb spots, broken edges or corners and other defects shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry as consistency as is possible to sue. Considerable pressure shall be applied in filling and pointing to ensure through filling in all voids. Surface which have been pointed shall be kept moist for periods of twenty four hours. If rock pockets / honeycombs in the opinion of the Engineer in charge are of such an extent or character as to affect the strength of the structure materially or to endanger the lime of the steel reinforcement he may declare the concrete defective and required the removal and replacement of the portion of the structure affected.

24. In the case of reinforcement work workability shall be such that the concrete surrounds and properly grips all reinforcement. The degree of consistency which shall depend upon the nature of work and methods of vibration of concrete shall be determined by regular slumps tests. Following slump shall be adopted for different type of works.

	Type of work	Slumps	
		Where vibrator are used	Where vibrator are not used
(i)	Mass concrete in RCC foundations, fotting and retaining walls.	10mm to 25mm	80 mm
(ii)	Beams, slab and columns simply reinforced.	25mm to 40 mm	100mm to 120 mm
(iii)	Thin RCC section or section with congested	40mm to 50mm	125mm to 150mm

25. Works strength test shall be made in accordance with IS 516. Each test shall be conducted on ten specimens five of which shall be tested at seven days and the remaining five at 28 days. The sample of concrete shall be taken on each day of concreting and cubes shall be made at the rate of one for every 5 Cu.M. of concrete or a part thereof. However if concreting done in a day is less than t15 Cu.M. the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer in charge. Similar works test shall be carried out whenever the quality and grading of materials is charges irrespective of the quantity concrete proud. The number of specimens may be suitably increased as deemed necessary by the Engineer in charge, when procedure of tests given above reveal a poor quality of concrete and in other special cases.

26. The average strength of the group of cubes cast for each day shall not be less than the specified work cub strength 20 percent of the cubes cast for each day may have values less than the specified strength, provided the lowest value is not less than 85 percent of the specific strength.

27. R.C.C. work shall have exposed concrete surfaces. Centering design and its erection shall approved by the Engineer in charge. One carpenter with helper will invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. For access to different parts, suitable mobile platforms shall provided so that steel reinforcement in position is not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber kapachi or metal pieces shall not be used for this purpose. Concreting of important structural members shall always be done in the presence and under the supervision of departmental person not below the rank of Assistant Engineer / Addi. Asst. Engineer, Overseer or as instructed by the Engineer in charge. After removal work checks

that concrete produced is of good quality. Plastering shall not be allowed to the expressed faces of concrete.

~~28. Recron 3s 125 gram shall be added to per bag (50 Kg) of cement in concrete~~.

28 Tremix process (Vaccume dewatering service) on cement concrete road surface :

Providing extra labour charges for tremix (vaccum dewatering service) process on C. C. road surface by using vaccum dewatering pump, floater surface vibrator making groves on surface as instruction incl. leveling etc. complete.

28.1. Working Method :

Concrete Placing

Concrete can be placed & distributed by transit mixer, or elso sufficient man power is required it is important to distributed the concrete evenly & as near the final level as possible.

28.2 Poker Vibration :

As a first step, concrete is vibrated with as immersion vibrator in order to remove, entrapped air & voids 7 make the concrete homogeneous. Please ensure that the areas close to channels & stop ands carefully vibrated. Do not distributed the concrete with the poker vibration along with the surface vibration.

28.3. Surface Vibration :

Surface Vibration should always start as soon as there is enough concrete in front of surface vibrator. Two passes with surface vibrator are required. During the first pass, concrete most be distributed evenly in front of surface vibrator. There should be a roll of concrete of about 10-20 mm in front of leading beam along the entire length of the vibrator. When the concrete has been placed and vibrated to a length of the vibrator. When the concrete has been placed and vibrated to a length of about 5 mm. the second pass is carried out. The machine should be pulled at a speed of maximum 1 mtr. / min and without interruption 'avoid finings' on the surface Keep the surface of the channel. Clean from concrete.

28.4. Vacuum Processing :

Please the filter pads as soon as the sufficient concrete surface is vibrated. Please note that the vacuum dewatering process must start within 30 minutes front the time of starting concrete pouring. Filter pads are placed in such away that there is at least 100 mm fresh concrete visible around the filter pads on all four sides. Filter should be overlapped with each other by at least 250 mm. (all filter are marked with black line to ensure proper overlapping).

The recesses or other obstacles within the area to be vacuum processed must be covered & sealed using polythene sheet before the filter pads are placed. If the obstacles are flush with the surface level or above. Filter pad must be found.

The rolled top cover is placed centrally on the filter pads. It is rolled out in such a way that it covers all filter pads & exposed concrete on the sides of the filter pads. Please note that the exposed concrete will ensure perfect sealing of the cover from the top.

Connect the central pipe of the top cover to the suction hose which in trun is connected to the vacuum pumps. When the pump is started vacuum will be created between the top cover & filter pads. Excess water will be taken in to the vacuum pump tank & discharged. Normal suction cycle is 1-1.5 min. per 10 mm of concrete thickness, Guidelines for selecting dewatering time (a) normal condition are shown in the following table.

Thickness in		Dewatering Time (min.)
MM	Inch	
50	2	7
100	4	15
125	6	20
150	8	30
200	10	40
250	12	45

Please note that dewatering time largely depends upon ambient conditions viz. Temperature, humidity, etc. During the course of dewatering. The concrete surface gradually hardens & can be felt from the top of the top cover. The extent of hardness achieved by the concrete decides when to stop dewatering process.

When the vacuum processing is over the cover is rolled up to 100 mm so that the sides of the filter pads are visible. This will remove the water that may have remained on the concrete surface. Filter pads & in the section hose. After about 30 seconds, the top cover is rolled completely & vacuum pump is witched off simultaneously. The suction hose & the top cover pipe are disconnected. Do not run the pump while the ball valve is open as likely that small aggregate are sucked in to the pump due to vacuum. The entire process is repeated on the next concrete panel.

After first patch in any / given panel is dewatered, care should be taken while piecing filter pad on the concrete surface next to the dewatered concrete. First filter pad should start from the edges of last filter pad of the previously dewatered concrete. The remaining filter pads then shall be placed as explained above.

While repeating dewatering process subsequently, in order that top cover should get proper sealing against the side already vacuum processed, it should be rolled out at reast 250 mm over the vacuum dewatered area, Before spreading the top cover on the dewatered area, it is essential to give on pass of skim floater (with disc.) along the edges of the dewatered concrete. The concrete surface will become wet as some will come on the top surface. This will provide the necessary sealing. Subsequently roll out top cover completely. Check that there are no wrinkles on the top cover.

28.5. Floating :

The first finishing operating is floating where floating disc is used. Only the that can not be reached by skim floater are floated by hand. Care should be taken while floating. Near channels & edges. The skim floater is run over the channel up to disc center in order to avoid unevenness at the joint. All four sides of dewatered panel must be floated first central area is to be floated later. Any corrections, if required are to be this stage with the concrete collected at the time of raking only. Never use any cement paste.

Mixture of cement & sand or fresh for patchwork. Such material will pool off will leave black patches after the concrete floor is brought to use

Normally two passes with disc with the skim floater operating at higher speed are sufficient for the skid free surfaces. This pass of skim floater should be given, perpendicular to the previous pass. Please note that the floating operation brings up certain amount of water to the surface. This moisture helps in carrying out finishing operation.

28.6. Trowel ling

Trowel ling is carried out with the same machine running on trowel ling blades, Normally, two pass of trowel ling blades are required for the smooth surface finish. How ever, the number of passes can be decided depending upon the surface finish required. The first trowel ling operation can start after the about 30 minutes after the final floating operation & surface is sufficiently dry. This pass is to be made using low speed & minimum blade angle. Please also use the lower speed when trowel ling near the channels, from edges obstacles etc. Blade angle & the speed can be increased for subsequent passed to achieve smoother surface finish.

28.7. Curing : Concrete has to be protected from rapid drying which may result in cracking. Curing can be done by pending, covering with plastic sheet or gunny bags. In any method, the surface should be always kept wet with water. Curing can also be jone by application of curing compound. Curing must be done for at-least 7 days.

Intermixing of Topping

First Pass : You can start the work when Topping has darkened because of the moisture from the under using concrete. The Topping material is worked with care into concrete surface with a skim floater equipped with a dise.

Intermixing of Topping

Second Pass : Check the surface flatness with straight edge and work the topping material into concrete as the first time.

Power trowel ling

First Pass : The first trowel ling is carried out as a normal power – trowel ling.

At the time of final power – trowel ling, surplus concrete must be off from the rails and stop ends.

There must not be damage at the rails when the floor is finished

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

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

31 The payment shall be made on Cu.M. basis for the finished work.

32. The unit rate for concrete shall include the cost of all materials, labour, tools and plant required for mixing, placing in position, vibrating and compacting, finishing as per the directions of the Engineer in charge, curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as shown on the drawings and according to these specifications. The rate shall also include the cost of making / fixing and removing of all centers and forms required for the work.

Item No. 44

Providing TMT Bar FE 500D reinforcement for R.C.C. work including bending, binding and placing in position complete upto floor two level for temperature reinforcement.

And

Item No. 45

Providing and laying in position FE 500D TMT bar reinforcement including cutting, bending, hooking and tying complete as per detailed drawings for the following.(A) Piers (B) Abutments (C) R.C.C. Returns

The work include P & L. in position / HYSD / Mild Steel / Thermo – Mechanically Treated bar of the following grade.

Grade Designation	Bar Type Conforming to governing IS specification	Characteristic strength Fy MPa	Elastic Modulus GPa
S 415 & 500 D	IS 1786 High yield strength deformed bar	415 & 500	200
S 240	IS 432 Part II	240	

TMT Bar

415 /500 D TMT Bar shall conform to min 415/500 MPa yield strength. Tensale strength of min 500 MPa and elongation percentage min 32. The chemical composition of bars shall be as below:-

	Max
Carbon	0.25
Sulphour	0.05
Phosphorus	0.05
Sulphur & Phosphorus	0.01

1. All steel shall be procured from original producers, no re-rolled steel shall be incorporated in the work. Only new steel bars shall delivered to the site, Every bar shall be inspected before assembling in the work and defective brittle or brunt bar shall be discarded Cracked ends of bars hall be discarded.
2. The work shall consist of furnishing and placing reinforcement of the shape and dimensions shown on the drawings or as directed by the Engineer in charge.
3. Steel shall be clean and free from loose rust and loose mill scale at the tune of fixing in position and subsequent concreting .Steel shall apply treatment of anticorrosive with powder of polymer base material before use.
4. Reinforcing steel conform accurately to the dimensions given in Bar bending schedules shown on relevant drawings. Bars shall be bent cold to the specified shape and dimensions or as directed by the Engineer in charge using a proper bar bender operated by hand or power to attain proper radius of bends. Bars shall not be bent or straightened in a manner that will injure the material. Bars bent during transport or handling shall be straightened before being used on work they shall be not heated to facilitate bending. Unless otherwise specified a 'U' type hook at the end of each bar shall invariably provided. The radius of the bend shall not be less than twice the diameter of the round bar and the length of the straight part of the bar beyond the end of the curve shall be at least four times the diameter of the round bar. In the case of bars which are not round and in the case of deformed bars ten diametre shall be taken as the diameter of circle having an equivalent effective area. The hooks shall be suitably encased to prevent any spliting of the concrete.
5. All reinforcement bars shall be accurately placed in exact position shown on the drawings and shall be securely held in position during placing of concrete by annealed binding wire not less than 1 mm in size and conforming to IS: 280 and by using stay blocks or metal chairs, spacers, metal hangers supporting wires or other approved device at sufficiently close intervals. Bars will not be allowed to sag between supports nor displaced during concreting or any other operation of the work. All devices used for positioning shall be of non corrodible material wooden and metal supports will not extent to the surface of concrete except where shown on the drawings, placing bars on layers of freshly laid concrete laid concrete as the work progresses for adjusting bar spacing will not be allowed pieces of broken stone or brick and wooden blocks shall not be used layers of bars shall be separated by spacer bars precast mortar blocks or other approved devices. Reinforcement after being placed in position shall be maintained in a clean condition until completely embedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed. To protect reinforcement from corrosion concrete cover shall be provided as indicated on the drawings. All bars pronuding from concrete and to which other bars are to be spliced and which are likely to be exposed for an indefinite period shall be protected by a thick coat of neat cement grout.
6. Bars crossing each other where required, shall be secured by binding wire (annealed) of size not less than 1 mm and conforming to IS:280, in such a manner that they do not slip over each other at the time of fixing and concreting.
7. As far as possible bars of full length shall be used. In case this is not possible overlapping of bars shall be done as directed by the Engineer in charge when practicable overlapping bars shall not touch each other but be kept apart of 25 mm or 1.25 times the maximum size of the coarse aggregate whichever is greater by concrete between them where not feasible overlapping bars shall be bound with annealed steel wire, not less than 1 mm thickness twisted tight. The overlaps shall be staggered for different bars and located at points along the span where neither sphere not bending moment is a normal.
8. Whenever indicated on the drawings of desired by the Engineer-in-charge bar shall be jointed by couplings which shall have a cross-section sufficient to transits the full stresses of bars. The ends of the bars that are jointed by coplings shall be upset for a sufficient length so that the effective cross-section at the base of threads is not less than the normal cross-section of the bar. Threads shall be standard white worth threads steel for couping shall conform to IS :226
9. When permitted or specified on the drawings joints of reinforcement bars shall be butt welded so as to transmit their full stresses welded joints shall preferably be located at points where steel not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that at any one section not more than 20 percent of the rods are welded metal and conforms to any or all other special provisions for the work will 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 and when welding is done in 2 or 3 stages, previous scale, rust, grease, paint and other foreign matter before welding shall conform to IS 814 welded pieces of reinforcement shall be tested specimen shall be taken from the actual site and their number and frequency of tests shall be as directed by the Engineer – in – charge.

10. Reinforcement shall be measured in length excluding overlaps, separately for different diameters as actually used in the work, where welding or couping is restored in place of lap-joints such joints shall be measured for payment as the equivalent length of over-lap as paver design requirement, From the length so measured the weight of reinforcement shall be calculated in tones on the same basis of IS : 1732. Length shall include hooks at ends wastage and anneakled steel wire for binding shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.

11. Rates for reinforcement shall include cost of all steels carrying to work site and cutting, bending , placing, binding and fixing in position as shown on the drawings and as directed by the Engineer – in – Charge. It shall also include cost of all devices for keeping reinforcement in approved position cost of joint age as per approved methods and all wastage and spacer bars.

9. Reinforcement shall be measured in length as per Govt Circular No.PDW-10-2017-01-C Dt.15-02-2019 as actually used in the work, where wildlife or coupling is restored to, in place of lap-joints, such joints shall be measured for payment as the, equivalent length of over-lap as per design requirement. From the length so measured the weight of reinforcement shall be calculated in tonnes on the same basis of IS: 1732 even though steel is supplied to the contractor by the Departmental actual weighrnent. Length shall include hooks at ends. Wastage and annealed steel wire for binding shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.

10. Rate for reinforcement shall include cost of cutting, bending, placing, binding and fixing in position For it.No. 44 the unit of T.M.T. bar for will be measured on K.G. basis.and for it.No.45 the unit of T.M.T. bar for will be measured on M.T. basis.

Item No. – 46

Providing & laying weep hole in Aburtments, and returns by using A.C. pipe of 100mm including laying in proper grede and jointing the completed as per detailed specification.

2706 WEEP HOLES

Weep holes shall be provided on all plain concrete, reinforced concrete, brick masonry and stone masonry structures such as, abutment, wing wall and return walls as shown on the drawings or as directed by the Engineer to permit water to flow out without building up pressure in the back fill. Weep holes shall be provided with 100 mm diameter AC/PVC/HDPE pipe for structures in plain/reinforced concrete or brick masonry. In case of stone masonry, weep holes shall be of rectangular shape 80 mm wide, 150 mm high or circular with 150 mm diameter. Weep holes shall extend through the full width of concrete/masonry with slope of about 1 vertical: 20 horizontal towards the draining face. The spacing of weep holes shall be 1 m in either direction or as shown in the drawings with the lowest at 150 mm above the low water level or ground level whichever is higher or as directed by the Engineer.

2707 TESTS AND STANDARDS OF ACCEPTANCE

The material shall be tested in accordance with these Specifications and shall meet the prescribed criteria and requirements.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

2708 MEASUREMENTS FOR PAYMENT

The measurement for payment for wearing coat, railing/crash barrier, approach slab, drainage spout and weep holes shall be made as under:

i) Bituminous and cement concrete wearing coat shall be measured in cubic metres. Steel reinforcement in wearing coat shall be measured in tonnes.

ii) Railing and metal beam crash barriers shall be measured in running metres.

iii) For concrete crash barriers concrete shall be measured in cubic metres and steel shall be measured in tonnes.

iv) Approach slab and its base shall be measured separately in cubic metres.

v) Drainage spouts shall be measured in numbers.

vi) Weep holes in concrete/brick masonry structure shall be measured in numbers. For structures in stone masonry, weep holes shall be deemed to be included in the item of stone masonry work and shall not be measured separately.

2709 RATE

The contract unit rate for wearing coat shall include the cost of all labour, material, tools and plant and other costs necessary for completion of the work as per these specifications.

The contract unit rate of railing and crash barrier shall include the cost of all labour, material, formwork, tools and plant required for completing the work as per these Specifications.

The contract unit rate for approach slab shall include the cost of all labour, material, tools and plant required for completing the work as per these Specifications. The rate for base shall include cost of all labour, material, tools and plant required, including preparation of surface and consolidation complete in all respects.

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. – 47

Providing and laying - Fitter Media 600mm thick directed at the back of abutments, returns and wing walls as per detailed specifications.

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 over size 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 Material shall be tightly placed to a thickness of not less that 600 mm. and provided over the entire surface behind abutments. Wings or return walls to the full height.

1. The measurement for payment shall be made on Smt. Basis . No deduction shall be made for voids. The unit rate includes the cost of materials scaffolding labour and tools to complete the work.

Item No. – 48

Supplying and laying premoulded bituminous joint filler 20mm thick

2605. FILLER JOINTS

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

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

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

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

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

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

g) Sealants shall be installed in accordance with the manufacturer's recommen-dations and all appropriate requirements for joint face priming.

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

i) Joint materials spilt or splashed onto finished surfaces of the bridge during joint filling operations shall be removed and the surfaces made good to the Engineer's approval.

j) No joint shall be sealed until inspected by the Engineer and approval is given to proceed with the work.

1. The measurement for payment shall be made on Cubic .Mt basis..

The unit rate includes the cost of materials scaffolding labour and tools to complete the work

Item No. – 49

Providing P.V.C. 100mm diamenter water spouts including necessary iron gratings as per drawing.

2705. DRAINAGE SPOUTS

2705.1. This work shall consist of furnishing and fixing in position of drainage spouts and drainage pipes for bridge decks.

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 P.V.C. material with suitable clean-out fixtures. The spacing of drainage spouts shall not exceed 10 m. The discharge from drainage spout shall be kept away from the deck structure. In case of viaducts in urban areas,

the drainage spouts should be connected with suitably located pipelines to discharge the surface run-off to drains provided at ground level.

2705.2. Fabrication

The drainage assembly shall be fabricated to the dimensions shown on the drawings;

2705.3. Placement

The whole assembly shall be placed in true position, lines and levels as shown in the drawing with necessary cut-out 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 assembly.

2705.4. Finishing

After setting of the deck slab concrete, the shrinkage cracks around the assembly shall be totally 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 finished to cover at least SO mm on the wearing coat surface all round the drainage assembly.

The measurement for payment shall be made on Number Basis .

The unit rate includes the cost of materials scaffolding labour and tools to complete the work

Item No. 50

Providing of an reinforced cement concrete crash barrier at the edges of the bridge, approached to bridge structure, constructed with M-250 grade cocncrete with fe 500 D reinforcement conforming to IS 1786 with asphalt filler joint at every 10 meter and painting on cocnrete surface 15cm yellow and black alternate as per detailed drawing and engineer in charge.

809. CONCRETE CRASH BARRIER

809.1. General

809.1.1. This work shall consist of construction, provision and installation of concrete crash barrier at the edges of the road and median at locations and of dimensions as shown on the drawings or as directed by the Engineer.

809.1.2. Concrete barrier shall generally be located on approaches to bridge structures, at locations where the embankment height is more than 3 metres and at horizontal curves.

809.2. Materials

809.2.1. All materials shall conform to Section 1000-Materials for Structures as applicable, and relevant Clauses in Section 1600 shall govern the steel reinforcement. The concrete barriers shall be constructed either by the “cast-in-place with fixed forms” method or the “extrusion or slip form” method or a combination thereof at the Contractor’s option with the approval of the Engineer. Where “extrusion or slip form” method is adopted, full details of the method and literature shall be furnished.

809.2.2. Concrete barriers shall be constructed with M : 20 grade concrete and with High Yield Strength deformed reinforcement conforming to IRC: 21.

809.2.3. An expansion joint with pre-moulded asphalt filler board shall be provided at the junction of crash barrier on structure and crash barrier on the fill. The crash barrier on the fill shall be constructed in pieces of length not exceeding 20 m, with, pre-moulded asphalt filler board joints.

809.3. Construction Operations

809.3.1. The location of crash barrier shall be strictly adhered to as shown on the drawing and as directed by the Engineer. Concrete crash barriers shall present a smooth, uniform appearance in their final position, conforming to the horizontal and vertical lines shown on the plans or as ordered by the Engineer and shall be free of lumps, sags or other irregularities. The top and exposed faces of the barriers shall conform to the specified tolerances, as defined in Clause 809.4, when tested with 3 m straight edge, laid on the surface.

809.3.2. When concrete barriers are to be constructed on recently completed bridges, the height of the barriers shall be adjusted to compensate for the camber and dead load deflection of the superstructure.

The amount of adjustment shall be determined by the Engineer and shall be ordered before the concrete is placed. Such barriers shall be placed after form work has been released and as long after the superstructure construction as possible without hampering the progress of the work.

809.3.3. Backfilling to the concrete barriers shall be compacted in layers to the compaction of the surrounding earthwork.

809.4. Tolerance The overall horizontal alignment of rails shall not depart from the road alignment by more than ± 30 mm, nor deviate in any two successive lengths from straight by more than 6 mm and the faces shall not vary more than 12 mm from the edge of a 3 m straight edge. Barriers snail be at the specified height as shown in the plans above the edge of the nearest adjacent carriageway or shoulder, within a tolerance of ± 30 mm.

809.5. Measurements for Payment

All barriers will be measured by linear metres of completed and accepted length in place, corresponding end to end along the face of concrete barriers including approach and departure ends.

809.6. Rate

The Contract unit rate shall include full compensation for furnishing all labour, materials, tools, equipment and incidental costs necessary for doing all the work involved in constructing the concrete barrier complete in place in all respects as per these Specifications.

Item No. 51

White washing with lime on wall surface (two coats) to give an even shade including thoroughly booming the surface to remove all dirt, dust; mortar drops and other foreign matter.

1.0. Materials:

1.1. The clcarcolle shall be made from glue and boiling water by Mixing I kg. mixture shall be suitably tinted where required use under coloured distemper if directed. Glue shall conform to I.S. 852-1969 (Specifications for animal glue). 1.2 Lime used shall be freshly burnt class 'C' Lime (fat lime) and white in colour conforming to I.S. 712-1973/ Water shall conform to M-l Best quality of gum shall be used in the preparation of white wash. Ultramarine blue or Indigo: This shall conform to I.S. 55-1970 for points, and shall be used f

2.0. Workmanship : 2.1. Preparation of white wash solution :

Surface already white or colour. The fat lime shall be slaked at site and shall be mixed and stirred with about five litres of water for 1 kg. of unslaked lime to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth, 4 Kg. of gum dissolved in hot water shall be added to each cubic metre of lime cream. Small quantity of ultramarine blut (Upto 3 gms. per kg. of lime) shall also be added to the last two coats of white wash solution and the whole solution shall be stirred throughly before use.

2.1. Preparation of surface:

2.2.1. The surface shall be throughly cleaned of all dust, dirt, mortar croppings and other foreign matter before .white wash is to be applied.

2.2.2. The surface spoiled by smoke soot shall be scraped with steel wire brushes or steel scrapers or shall be rubbed with over-burnt surkhi or brick bats. The surface shall be then broomed to remove all dust, dirt and shall be washed with clean water.

2.1.3. Oil or grease spots shall be removed by suitable chemical and smooth surface shall be rubbed with wire brushes.

2.2.4. All unsound portion of the surface plaster shall be removed to full depth of plaster in rectangular patches and plastered again after raking the masonry joints properly. Such portion shall be wetted and allowed to dry. They shall then be given one cat of white wash.

2.2.5. All unnecessary nails shall be removed, the holes cracks patches etc. shall be made good with materials similar in imposition to the surface to be prepared.

2.3. Scaffolding : Wherever scaffolding is necessary it shall be erected in such a way that as far as possible on part of scaffolding shall rest against the surface to be white or colour washed. A properly secured strong and well tied suspended platform (Zoola) may be used for white washing. Where ladders arc used, pieces of old gunny bag shall be teid at top and and bottom to prevent scratches to the floors and walls. For white washing of ceilings proper stage scaffolding shall be erected where necessary.

2.4. Application of white wash:

2.4.1 On the surface prepared the white wash shall be applied with 'Moon' brush. The first stoke of the brush shall be from top downwards another, from bottom upwards over the first stroke and similary one stoke from the right another from the left, over the first stroke brush before it dries. This will from one coat. Each coat shall be allowed to dry before next coat applied. Number of coats as specified in item shall be applied. It shall present smooth and uniform finish free from brush marks and it should not come off easily when rubbed with finger.

2.4.2. Splashing and dropping if any on the doors and windows, ventilators etc. shall be removed and the surface cleaned.

2.4.3. Priming and Alkali resistant treatments, scraping of surface washing etc. surface spoiled by smoke soot removed of oil and great spots treatment for infection with effloresence moulds moss, funji, algae and letchen and patch repairs to plaster wherever done shall not be paid extra.

3.0. **Mode of measurements & payment :**

3.1. All the work shall be measured in the decimal system as under :

(a) Dimensions shall be measured to the nearest 0.01 M.

(b) Area in individual items shall be worked out to the nearest 0.01 Sq. M.

All the work shall be measured in sq. mt. Deductions for jambs, soffits, sills etc. for opening not exceeding 0.5 sq. mt. each in area for ends of joints, posts, beams, girders, steps etc. not exceeding 0.5 sq. mt. each in area and for opening exceeding 0.3 sq. mt. and not exceeding 3.0 sq. mt. each in area deductions and additions shall be made as under :

3.2. No deductions shall be made for ends of joints beams, posts etc. and openings not exceeding 0.5. sq. mt. each. No addition shall be made for reveals, jambs, soffits, sills etc. of these openings nor for finish arounds ends of joints, beams, posts etc.

3.3. Deductions for openings exceeding 0.5 sq. mt. but not exceeding 3 sq. mt. each shall be made as follows and no addition shall be made for reveals, jambs, soffits etc. of these openings:

(a) When both the faces or walls are provided with finish, deduction shall be made for one face only.

(b) When each fasce of wall is provided with different finish deduction shall be made for that side of frame for door, windows etc. on which width of reveals is less than that of the other side, where width of reveals on both faces of wall are equal, deduction of 50% of area of opening on each face shall be made from total area of finish.

(c) When only one face of wall is treated and the other face is not treated, full deduction shall be made if the width of reveal on the treated side is less than that on the untreated side, but if the width of the reveal is equal or more than on the untreated side neither deductions nor additions be made for reveals, jambs, soffits, sills etc.

3.4. In case of area of opening exceeding 3 sq. mt. each, deduction shall be made for openings but jambs, soffits, shall be measured.

3.5. No deduction shall be made for attachment such as casing, conducts, pipe, electric wiring and the like.

3.6. Corrugated surfaces shall be measured flat as fixed and not girth. The quantities so measured shall be increased by the following percentage and the resultant shall be included with the general areas.

(a) Corrugated steel sheets 14%

(b) Corrugated A. C. Sheets20%

(c) semi corrugated A. C. Sheets 10%

(d) Nainital pattern roof (Plain sheeting with rolls) 10%
(e) Nainital pattern roof (with corrugated sheets) 25%

3.7. Cornices and other wall features, when they are not picked out in a different finish/colour shall be girthed and included in the general area

3.8. The rate shall include the cost of all materials, labour, scaffolding, protective measures etc. involved in all the operations described above.

3.9. The rate shall be for a unit of one sq. metre.

Item No. 52

Providing & Laying Pre Cast Concrete Box Drain 2500mm X 2500mm. As per Drawing, laying in gradient/ Slop, laying on Road Site completed As per Site. The product shall be made by using advanced precast technology using high performance self compacting concrete of C40 / M50 grade and Fe 500 D grade TMT steel reinforcement bar. The product shall have a load carrying capacity of 5 Tonnes Wheel load for heavy vehicle movement at road crossing including loading, Unloading, Transportation and Installation.

The work shall consist of laying laying pre cast concrete box drain 2500mm x2500mm as per drawing. For concrete It.No.33 and for steel It.No.44 shall be followed.

Payment shall be made on Running Meters.

The rate shall include cost of material, labour, and tools to complete the job.

Item No. 53

Providing and laying Rubble with loading and unloading at site including packing & Filling as directed engineer in charge.

And

Item No. 54

Providing and laying rubble for appron (each stone weighting not less than 40Kg.) including and packing and filing in the interestices with quarry-spalls.

1.The work shall consist of laying boulders directly on the prepared surface for protections against scour.

2. The stone used apron shall be sound, hard, durable and fairly regularly in shape. Stone subjected to marked deterioration by water or weather shall not be used the thickness and shape of apron shall be as indicated on the drawings or as directed by the engineer-in-charge. The4 surface on which the apron is to be laid shall be leveled and prepared for the length and width as shown on the drawing. The size of stones shall as large as possible and weights shall be as specified in the item but in no case any fragment shall weight less than 40 kg. The specific gravity of the stone shall be as high as possible and it shall not be less than 2.50. to ensure regular and orderly deposition of the full intended quantity of stone in the apron, template cross walls in dry masonry shall built about a meter wide and two the full height of the specified thickness of the apron at interval of 30 meters and all along the length and width of the apron. Within the walls, the stone then shall be hand packed.

3. Payment shall be made on Cubic. Meters. Bases of stack the material shall have to be stacked at site before laying. Preparation of base for laying bedding shall be deemed incidental to the work. Nothing shall deduct for voids.

4. The rate shall include cost of material, labour, and tools to complete the job.

Item No. 55

Providing and fixing hectometer as per I.R.C. type design including painting,lettering etc. complete. (ii) Fixing in C.C. 1:5:10

The work shall be carried out as per the item of hectometer stone as per I.R.C. 26 (Type design for 200 metre stones) and fixing shall be in C.C. 1:5:10 which will consist of one part of cement, five part of good sand and ten parts of good brick bats. The measurement for payment as well as the operations included in the unit rate shall be as per ordinary kilometers stone. Rate includes all labour and curing etc. necessary for concrete.

The Payment shall be made on No. basis for complete item.

Item No. 56

Providing and fixing guard stone as per I.R.C. type design including white washing etc. complete.(ii) Fixing in C.C. 1:5:10

The work shall be carried out as per the item of guard stone as per I.R.C. 26 and fixing shall be in C.C. 1:5:10 which will consist of one part of cement, five part of good sand and ten parts of good brick bats. The measurement for payment as well as the operations included in the unit rate shall be as per ordinary kilometers stone. Rate includes all labour and curing etc. necessary for concrete.

The Payment shall be made on No. basis for complete item.

No. 57

Providing and fixing 5th Kilometer stone of precast C.C. 1:2:4 including necessary reinforcement as per I.R.C. type design in C.C. 1:4:8 including painting,lettering etc. complete (For N.H., S.H. and M.D.R.)

1. 5^{th} Kilometer stone shall be of approved quality and shall be of precast 1:2:4 R.C.C. as specified in the item.

2. The size, manner of fixing, painting and lettering of 5^{th} K.M. stone shall conform specification as per I.R.C. - 8 (Type design for Highway kilometer stones). The fixing of 5^{th} K.M. store shall be carried cut in ordinary concrete of grade specified in the item using hand broken metal field metal or grave. The measurement for payment shall be made per No. of 5^{th} K.M. stone fixed in position.

3. Unit rate for 5^{th} kilometer stone includes the cost of all materials, labour, tools, fixing, finishing curing, lettering and painting as directed by the Engineer-in-charge.

The Payment shall be made on No. basis for complete item.

No. 58

Providing and fixing ordinary Kilometer stone of precast C.C. 1:2:4 including necessary reinforcement as per I.R.C. type design in C.C. 1:4:8 including painting,lettering etc. complete (For O.D. road V.R.)

And

No. 59

Providing and fixing ordinary Kilometer stone of precast C.C. 1:2:4 including necessary reinforcement as per I.R.C. type design in C.C. 1:4:8 including letter and paints etc. complete (For N.H., S.H. and M.D.R.)

1. Ordinary Kilometer stone shall be of approved quality and shall be of precast 1:2:4 R.C.C. as specified in the item.

2. The size, manner of fixing, painting and lettering of Ordinary Kilometer stone shall conform specification as per I.R.C. - 8 (Type design for Highway kilometer stones). The fixing of Ordinary Kilometer store shall be carried cut in ordinary concrete of grade specified in the item using hand broken metal field metal or grave. The measurement for payment shall be made per No. of Ordinary Kilometer stone fixed in position.

3. Unit rate for Ordinary Kilometer stone includes the cost of all materials, labour, tools, fixing, finishing curing, lettering and painting as directed by the Engineer-in-charge.

The Payment shall be made on No. basis for complete item.

Item No. 60

Cautionary Warning Sign :-Providing and fixing sing boards made out of 2mm aluminium sheet; size 90 x 90 x 90 cms. equilateral triangle as per design of IRC-67-1977. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ;reflectorised with retro refiectivesheeting as per latest M.O.S.T.Specifications; 3.1m long stand postand frame fabricated from suitable sizeiron angle of 35 x 35 x 3mm, 75 x 75 x 6mm as required; painted with bestquality epoxy coatings in black andwhite bends. The details of symbol foreach board shall be as per theinstruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc.complete under the supervision of engineer in charge.(A) Engineer Grade(VR)

And

Item No. 61

Cautionary Warning Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 90 x 90 x 90 cms. equilateral triangle as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro refiectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.6mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting

And

Item No. 62

Village name/ Bump Ahed sign :-Providing and fixing sing boards made out of 2mm aluminium sheet; size 90 x 60cms. rectangle as as per the design of IRC-67-1977 pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro refiective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968, 3.1m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50 x 50 x 5mm painted with best quality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)...

And

Item No. 63

Village name Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 90x60 cms. rectangular as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro refiectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.3mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting

And

Item No. 64

Providing and fixing Junction board of M.S. plates and angles as per standard I.R.C. design including fixing in C.C. 1:4:8 with necessary excavation painting figuring and lettering on board etc. complete.

And

Item No. 65

Citizen's information Board Providing and fixing of typical MMGSY information board as per instruction.Two MS plates of 1.6 mm thick,of 900 mm x 750 mm size fixed at top and bottom duly welded with MS angles of 25 x25 x 5 mm thick M.S. plate shall be welded by welded bt two vertical M.S.flats & four horizontal M.S. flates 5 mm thick to 75 mm x 75 mm of 12 SWG square tubes posts duly embedded in cement conctrete M-15 grade block of 600 mm x 600 mm x 75 mm,below ground level.Painting New letters & figure of any shade with ready mixed synthetic enample paint of superior quality in required shade and colour,All sections of framed posts and steel tube will be painted with primer and two coars of epoxy paints as per drawings clause 1701 and Annexure 17001 (10.16)

And

Item No. 66

Hazard Marker Sign :-Providing and fixing sing boards made out of 2mm aluminium sheet; size 90 x 30cms. rectangle as as per the design/drawing attached (IRC) pretreated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro refiective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm & 50 x 50 x 5mm painted with best quality epoxy coatings The fixing at site shall be in 1:2:4 CC block of size 45x45x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)...

And

Item No. 67

Hazard Marker Sign :-Providing and fixing sign boards made out of 2.0 mm aluminium sheet / 4 mm ACP (Aluminum composite Panel); size 90x30 cms. rectangular as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro refiectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 1.8mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting

And

Item No. 68

Chevron Board on Curve Providing and fixing sign boards made out of 3 mm aluminium sheet, size 60x45cms. rectangle pre treated with phospheting process & acid etching. coated with one coat of epoxy primer and two coats of best quality epoxy paint reflectorised with retro sheeting as per latest M.O.S.T. Specifications ; 2.1m long stand post of 50 mm dia. M.S.Pipe and frame may fabricated either from iron angle of 35 x 35 x 3mm as required, painted with best quality epoxy coating in black and white bends. The fixing at site shall be in 1:2:4 CC block of size 45 x 45x 60cms. for each leg, including excavation curing etc. complete under the supervision of engineer in charge.(A)Engineer Grade.

And

Item No. 69

Supply & fixing logo board of MMGSY diamond size (600mm x 600mm) 16 Gauge & board plate size (900mm x 250mm) 16 Gauge thick M.S plate and 2.40 mt. deep length single angle 75 x 75 x 6 mm size including fitting and painting lettering with luminous color as per drawing etc.

And

Item No. 70

Diversion sing board :-Providing & Fixing sign boards made out of 2mm aluminium sheet, size 180 x 60 cms. rectangle as per the attached drawing pre treated with phospheting process & acid etching. coated with one coat of epoxy priemr and two coats of best quality epoxy paint reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968,3.1m long (2nos) stand post and frame fabricated from iron angle of 35x35x3mm, 50x50x5mm painted with best quality epoxy coatings in blak and white bends. The fixing at site shall be in 1:2:4 CC block of size 45 x 45x 60cms for each leg, including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade.

And

Item No. 71

Men at work (2' x 2') sign :-Providing and fixing sing boards made out of 2mm aluminium sheet; size 60 x 60cms. equare as as per the attached drawing. pretreated with phospheting process &acid etching coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro refiective sheeting as per latest M.O.S.T. Specifications; 3.10m long stand post and frame febricated from iron angele of 35 x 35 x3mm and 50 x50x5mm as required . Painted with best quality epoxy coatings in black and white bends. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade...

And

Item No. 72

Danger Plate Sign :-Providing & fixing sign board made out of 2mm aluminium sheet, size 30cms diameter circle, pretreated with phospheting process and acid etching, painted with one coat of epoxy primer and two coats of best quality epoxy paint reflectorised with retro reflective sheeting as per latest M.O.S.T. specifications (As per attached draiwng)(A) Engineer Grade.

And

Item No. 73

Providing & Fixing " FLOOD GUAGE POST" on Causeway / dip having (Channel size 100 x 50 mm) i.e. C.C. 1:2:4 in headwall, i.e. Painting & lettering with ordinary paint colour as per instruction of engineer in charge.

801.3.1. General requirements:

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

801.3.2. High intensity grade sheeting: This sheeting shall be of encapsulated lens type consisting of spherical glass lens, elements adhered to a synthetic resin and encapsulated by a flexible, transparent water-proof plastic having a smooth surface. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM Standard E: 810) as indicated in Table 800-1

TABLE 800-1 ACCEPTABLE MINIMUM COEFFICIENT OF RETRO REFLECTION FOR HIGH INTENSITY GRADE SHEETING (CANDELAS PER LUX PER SQUARE METRE)

Observation angle (in degrees)	Entrance angle (in degrees)	White	Yellow	Orange	Green / Red	Blue
0.2	-4	250	170	100	45	20
0.2	+30	150	100	60	25	11
0.5	-4	95	62	30	15	7.5

0.5	+30	65	45	25	10	5.0

When totally wet, the sheeting shall not show less than 90 per cent of the values of retro-reflectance indicated in Table 800-1. At the end of 7 years, the sheeting shall retain at least 75% of its original retro-reflectance.

801.3.3. Engineering grade sheeting: This sheeting shall be of enclosed lens type consisting of microscopic lens elements embedded beneath the surface of a smooth, flexible, transparent, water-proof plastic, resulting in a non-exposed lens optical reflecting system. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined in accordance with ASTM Standard: E-810) as indicated in Table 800-2.

TABLE 800-2 ACCEPTABLE MINIMUM COEFFICIENT OF RETRO-REFLECTION FOR HIGH INTENSITY GRADE SHEETING (CANDELAS / LUX PER SQUARE METRE)

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

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

801.3.4. Messages/borders:

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

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

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

801.3.7. Colour:

Unless otherwise specified, the general colour schbm6 shall be as stipulated in IS 5 "Colour for Ready Mixed Paints", viz.

Blue - is Colour No. 166: French Blue

Red - is Colour No. 537: Signal Red

Green - is Colour No. 284: India Green

Orange - IS Colour No. 591: Deep Orange.

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

801.3.8. Adhesives:

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

801.3.9. Refurbishment:

Where existing signs are specified for refurbishment, the sheeting shall have a semi-rigid aluminium backing pre-coated with aggressive tack type pressure sensitive adhesive. The adhesive shall be suitable f6r the type of material used for the sign and should thoroughly bond with that material.

801.3.10. Fabrication:

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

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

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

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

801.4. Installation:

801.4.1. Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind loads or displacement by vandalism. Normally, signs with an area up to 0.9 Smt shall be mounted on a single post, and for greater area two or more supports shall be provided. Sign supports may be of mad steel, reinforced concrete or galvanised iron (G.1). Post-end

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

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

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

801.5: Measurements for Payment:

The measurement of standard cautionary, mandatory and information signs shall be in numbers of different types of signs supplied and fixed.

801.6. Rate

The Contract unit rate shall be payment in full for the cost of making the informatory cum logo sign board as per item description, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications.

Item No.:74

Providing Crash Barrier including ISMB 15x75x5 mm Size 2.0 meter C/C in Length and W Shape GI 3 mm plate in Single Row including providing Foundation block of Size 0.45 x 0.45 x 0.06 in 1:2:4 for CC Work etc… as per detailed drawing providing and fixing with nuts and bolts welding as required and one coat of redoxide and two coat of approved oil Paint & sticking reflective sticker Red/ Yellow radium etc. complete.

811 CRASH BARRIERS

Scope

The work shall consist of construction, provision and installation of crash barriers at locations as shown in the drawing or as directed by the Engineer. The type of the crash barrier shall be as specified in the Contract.

Metal Beam Crash Barrier
Materials

Metal beam rail shall be corrugated sheet steel beams of the class, type, section and thickness indicated on the drawings. Railing posts shall be made of steel of the section, weight and length as shown on the drawings. All complete steel rail elements,

terminal sections, posts, bolts, nuts, hardware and other steel fittings shall be galvanized. All elements of the railing shall be free from abrasions, rough or sharp edges and shall not be kinked, twisted or bent.

The "W' beam type safety barrier shall consist of a steel post and a 3 mm thick "W" beam rail element. The steel post and the blocking out spacer shall both be channel section of 75 mm x150 mm & size 5 mm thick. The rail shall be 70 em above the ground level and posts shall be spaced 2 m center-to-center. Double "W' beam barrier shall be as indicated in IRC:5-1998.

The thrie beam safety barrier shall have posts and spacers similar to the ones mentioned above for "W" beam type. The rail shall be placed at 85 em above the ground level.

The "W" beam, the thrie beam, the posts, spacers and fasteners for steel barriers shall be galvanized by hot dip process (zinc coated, 0.55 kg per square metre; minimum single spot) unless otherwise specified. The galvanizing on all other steel parts shall conform to the relevant IS Specifications. All fittings (bolts, nuts, washers) shall conform to the IS:1367 and IS:1364. All galvanizing shall be done after fabrication.

Concrete for bedding and anchor assembly shall conform to Section 1700 of these

Specifications.

Construction Operations

The line and grade of railing shall be true to that shown on the plans. The railing shall be carefully adjusted prior to fixing in place, to ensure proper matching at abutting joints and correct alignment and camber throughout their length. Holes for field connections shall be drilled with the railing in place in the structure at proper grade and alignment.

Unless otherwise specified on the drawing, railing steel posts shall be given one shop coat of paint (primer) and three coats of paint on structural steel after erection, if the sections are not galvanized. Any part of assembly below ground shall be painted with three coats of red lead paint.

Splices and end connections shall be of the type and designs specified or shown on the plans and shall be of such strength as to develop full design strength of the rail elements.

Installation of Posts

Holes shall be dug or drilled to the depth indicated on the plans or posts may be driven by approved methods and equipment, provided these are erected in proper position and are free from distortion and burring or any other damage.

All post holes that are dug or drilled shall of such size as will permit proper setting of the posts and allow sufficient room for backfilling and tapping.

Holes shall be backfilled with selected earth or stable materials in layers not exceeding 100 mm thickness and each layer shall be thoroughly tamped and rammed. When backfilling and tamping are completed, the posts or anchors shall be held securely in place.

811.3.3.5 Posts for metal beam guardrail on bridges shall be bolted to the structure as detailed on the plans. The anchor bolts shall be set to proper location and elevation with templates and carefully checked.

Erection

All guard rail anchors shall be set and attachments made and placed as indicated on the plans or as directed by the Engineer.

All bolts or clips used for fastening the guardrail or fittings to the posts shall be drawn up tightly. Each bolt shall have sufficient length to extend at least 6 mm through and beyond the full nut, except where such extensions might interfere with or endanger traffic in which case the bolts shall be cut off flush with the nut.

All railings shall be erected, drawn and adjusted so that the longitudinal tension will be uniform throughout the entire length of the rail.

End Treatment for Steel Barrier

End treatments shall from an integral part of safety barriers which should not spear, vault or roll a vehicle for head-on or angled impacts. The two end treatments recommended for steel barriers are ''Turned-down-guardrail" and "Anchored in back slope", as shown on the drawings or as directed by the Engineer.

Tolerance

The posts shall be vertical with a tolerance not exceeding 6 mm in a length of 3m. The railing barrier shall be erected true to line and grade.

Measurements for Payment

Metal beam railing barriers will be measured by Running metre of completed length as per plans and accepted in place. Terminals/anchors of various types shall be paid for by numbers.

Furnishing and placing anchor bolts and/or devices for guard rail posts on bridges shall be considered incidental to the construction and the costs thereof shall be included in the price for other items of construction.

No measurement for payment will be made for excavation or backfilling performed in connection with this construction.

811.3.8 Rate

The Contract unit rate shall include full compensation for furnishing of labour, materials, tools, equipments and incidental costs necessary for doing all the work involved in constructing the metal beam railing barrier complete in place in all respects as per these Specifications

Item No.:75

Road Marking with Hot Applied Thermoplastic paints with Reflectorising Glass Beads on Bituminous Surface:- Providing and laying hot applied thermoplastic compound 2.5 mm thick including reflectorising glass beads @ 250 gms Per sqmt.area,thickness of 2.5 mm exclusive of surface applied glass beads as per IRC:35-2015.The finished surface to be level,uniform and free from streaks and holes.Zebra patta/Bump patta lane/center line/edge line/ cut patta. The White colour marking shoud provide liminance coefficient on cement road shall be min 130 mcd/m2/lux and asphalt road shall be mim 100 mcd/m2/lux during the service life during the day time. The marking should meet the perfomance criteria for night time reflectivity,wet reflectivity and skid resistance as mentoined in the section-15 of IRC 35-2015.Warranty for retro reflectivity shall be two years.

The specification for this item separately attached.

801.5: Measurements for Payment:

The measurement of Road Marking with hot applied Thermoplastic paints shall be in Square Metre.

801.6. Rate

The Contract unit rate shall be payment in full for the cost of making the per item description, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications attached.

Item No.:76

Cat eyes / road stud / RPM Supplying of molded twin shanks raised payment markers made of polycrbonet and ABS molded body and reflective pannels with micro prismetic lans (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 catgory A of MORTH circuler no. RW / NH/ 33023/ 10-97/ do/III Dt. l 1.06.1997 the height width and length shall not exist 20mm, 130mm and with minimum reflective area of 13 Sq. mt. on each side and the slope to the base shal be 35 + / -5 degree the strength of detachment of the intergrated cylirdical shanks.(of diameter not less than 19 +/-2 mm and height not less than 30 + / -2mm from the body is to be a minimum value of 500 Kgf. fixing will be by drilling holes on the roads for the shanks to go inside, without nails and using epoxy resin based adhesive as per manifactures recommandation and the color of the marker should be as per the IRC-35-20 15 and as directed by engineer in charge.

The specification for this item separately attached.

801.5: Measurements for Payment:

The measurement of cat eyes/Road/RPM shall be in numbers supplied and fixed.

801.6. Rate

The Contract unit rate shall be payment in full for the cost of making the cat eyes per item description, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications attached.

Signature of contractor	**Deputy Executive Engineer Panchayat R. & B. Sub Division Bhuj-Kachchh**	**Executive Engineer Panchayat R. & B. Division Bhuj-Kachchh**