

M.M.G.S.Y. 2026-27

Name of work : Resurfacing & Strengthening of Various Roads Of Valsad Taluka Dist. Valsad -Total 4 Roads 7.20 Km. (Package No. 4)

ITEM WISE SPECIFICATION

Item No.1 Clearing and grubbing road land including uprooting trunk vegetation, grass bushes, shrubs, saplings and trees girth upto 300 mm removal of stumps of trees cut earlier & disposal of unserviceable material. (C) By Mechanical means in area of light jungle.

201.1. Scope

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

201.2. Preservation of Property/Amenities

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

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

201.3. Methods, Tools and Equipments

Only such methods, tools and equipment as are approved by the Engineer and which will not affect the property to be preserved shall be adopted for the Work. If the area has thick vegetation/roots/trees, a crawler or pneumatic tyred dozer of adequate capacity may be used for clearance purposes. The dozer shall have ripper attachments for removal of tree stumps. All trees, stumps, etc., falling within excavation and fill lines shall be cut to such depth below ground level that in no case foil within 500 mm of the subgrade. Also, all vegetation such as roots, under-growth, grass and other deleterious matter unsuitable for incorporation in the embankment/subgrade shall be removed between fill lines to the satisfaction of the Engineer. On areas beyond these limits, trees and stumps required to be removed as directed by the Engineer shall be cut down to 1 m below ground level so that these do not present an unsightly appearance.

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

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

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

201.4. Disposal of Materials

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

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

All products of clearing and grubbing which, in the opinion of the Engineer, cannot be used or auctioned shall be cleared away from the roadside in a manner as directed by the Engineer. Care shall be taken to see that unsuitable

waste materials are disposed of in such a manner that there is no likelihood of these getting mixed up with the materials meant for embankment, subgrade and road construction.

201.5. Measurements for Payment

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

201.6. Rates

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

Item No.2 Earth work in cutting in all sorts of soil and soft murrum including conveying and spreading the stuff, embankment as and where directed within 200 meters from the end of the cutting with all required lead and lift.

This work shall consist of Earth work in cutting in all sorts of soil and soft murrum etc. which may be necessary for road side gutter or road formation in accordance with requirements of these specifications and the lines, grades and cross sections shown in the drawings or as indicated by the Engineer.

1. The land width .0.required for the roadway, gutter side slopes and catch water gutters shall be cleared of all trees 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 or damage to the work, property or people in the neighborhood. If the materials are to be disposed off 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 land width required for the roadway, gutter side slopes and catch water gutters shall be cleared of all trees 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 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 10m. 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 that 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 relevant 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 away 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 into 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 a way as to prevent accidents. Warning signals shall be displayed at 7mt. 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 will be responsible and liable to all the consequences including compensation.

6. All the excavated materials shall be property of Government. The useful excavated material shall be used in embankment with all lead and lift and it shall be directly deposited at the required location in specified layers. No handling or conveyance charges shall be paid if the material is temporarily deposited elsewhere and subsequently conveyed to site of deposition. The sequence of operations at convenient places shall be, without interfering with the drainage in any way. If no Government land is available but the excavated useful stuff is to be stacked temporarily before use under the same agreement, the contractor shall make his own arrangements 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.

7. If the contractor does not wish to utilize 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 utilised) 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 as above.

8. The Contract rate shall be a unit of one cubic meter for the strata mentioned in the item of excavation acceptably completed, limited to the dimensions shown on the plans or as directed by the Engineer. The measurements shall be paid on Tape measurements and computing the volumes of earth work in cubic meters by average area method. When the classification of the strata changes, the contractor shall bring this to the notice of the Engineer, who will then verify and if necessary take levels for the changed strata for purpose of measurement.

Item No.3 Scarifying gravelled macadam or bitumen macadam surface 6cm to 10 cm depth including stacking useful materials on road side and disposing off remaining stuff.

The work shall consist of scarifying & removing existing bituminous / W.B.M. surface up to full depth or up to a depth as directed by Engineer-in-charge.

1. The existing bituminous layer in the specified width and depth shall be removed with care and with out causing undue disturbance to the under laying layer by a suitable method approved by the Engineer.
- 3 The materials received from scarifying shall be screen on site of work, if order by Engineer and stone aggregates obtained from screening shall be stacked near by and reused if so desired and directed by Engineer-in-charge, while the material not required for any use shall be disposed off contractor at his own cost in manner approved by the Engineer-in-charge. The material utilized in the embankment will be deducted from the net quantity of earthwork in embankment arrived at within the chainage measured.
4. The under laying layer which may have been disturbed should be suitably compacted with vibratory roller.
5. The remaining material shall be removed from the site and disposed of as decided by Engineer-in-charge.
6. The contractor shall supply key aggregates 6 mm to 10 mm size at the rate of 0.18 cum / 10 sqm of scarified area and same shall be spreaded & compacted as directed by the Engineer-in-charge.
7. During the period of construction, arrangement of traffic shall b maintained in accordance by the Engineer-in-charge.
8. The contractor unit rate of scarifying shall be for carrying out all required operation including full compensation of all labour, tools, equipments, transportation of scarified materials from work site to the specified dumping site with all lead, safe guard necessary to complete the work.
9. The rate shall be for a unit of one Square meter.

Item No.4 Consructing of granular sub-base Gr-II by providing course graded B.T. machine crushed material satisfying MOST specification of (grading II) using materials (26.5 mm to 4.75 mm@ 75 per cent,2.36 mm below@25 per cent) including spreading in uniform layer with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC and compacting with vibratory roller to achieve the desired density etc. complete.

401.1 Scope :

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

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

TABLE 400.1 : GRADING FOR GRANULAR SUB-BASE MATERIALS

IS Sieve Designation	Per cent by Weight Passing the 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

MATERIALS.

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

401.2.2 Physical requirements:

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

401.3 Strength of sub-base.

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

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

401.4 Construction Operations:

401.4.1 Preparation of Sub grade:

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

401.4.2 Spreading and compacting:

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

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

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

Moisture content of the loose material shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface of other means approved by the Engineer so that, at the time of compaction, it is from 1 percent above to 2 percent below the optimum moisture content corresponding to IS:2720 (Part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means like disc barrows, rotavators until the layer is uniformly wet. Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 KN weight may be used. For a compacted single layer upto 225 mm the compaction shall be done with help of a vibratory roller of minimum 80 to 100 KN static weight with plain drum or pad foot drum or heavy pneumatic tyred roller of minimum 200 to 300 KN weight having a minimum tyre pressure of 0.7 MN/ M² or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional cross fall and super elevation and shall commence at the edges and progress towards the centre for portions having cross fall on both sides each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and cross fall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 Km per hour. Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS:2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

401.5. Surface Finish and Quality Control of work:

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

401.6 Arrangements for Traffic:

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

401.7 Measurements for Payment:

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

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

401.8 Rate:

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

- [i] Making arrangements for traffic to Clause 112 as above except for initial treatment to verges, shoulders and construction of diversions.
- [ii] Furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lift.
- [iii] All labour, tools, equipment and incidentals to complete the work to the specifications.
- [iv] Carrying out the work in part widths of road where directed, and
- [v] Carrying out the required tests for quality control.

Item No.5 Providing and laying wet mix macadam base course as per MORTH specification using machine crushed B.T. chips as per required gradation, mixing with required optimum quantity of water, conveying the mix to site of work, spreading in to grade and camber with paver/mechanical means and consolidation each layer with vibratory roller to achieve the desired density including cost of material labour plant and equipment etc. complete.

406.1 SCOPE

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

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

406.2 MATERIALS**406.2.1 AGGREGATES****406.2.1.1 PHYSICAL REQUIREMENTS :**

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

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

Test	Test Method	Requirements
1.*Los Angeles Abrasion value	IS : 2386 (Part-4)	40 percent (Max)
Aggregate impact value	IS : 2386 (Part-4) or IS : 5640	30 percent (Max)

2. Combined Flakiness and Elongation indices (Total)**	IS : 2386(PART-1)	30 percent (Max)
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* Aggregates may satisfy requirements of either of the two tests.

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

If the water absorption value of the coarse aggregate greater than 2 percent, the soundness test shall carried out on the material delivered to site as per 2386 (Part – 5).

406.2.1.2 Grading requirements :

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

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

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

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

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

406.3 Construction Operation :

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

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

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

406.3.2 Provision of lateral confinement of aggregates :

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

407.4 Construction Operations:

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

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

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

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

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

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

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

406.3.4 Preparation of mix :

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

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

406.3.4 Spreading of mix :

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

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

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

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

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

406.3.5 Compaction :-

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

of the road uniformly overlapping each of the preceding track by at least one-fourth width until the entire surface has been rolled.

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

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

Rolling should not be done when the sub grade is soft or yielding or when it caused a wave-like motion in the sub – base/ base course or sub grade. If irregularities develop during rolling which exceed 12mm when tested with a 3 meter straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a conforming to the desired grade and cross fall. In no case should the use of unmixed material be permitted to make up the depressions.

Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density of 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 recompact.

406.3.6 Setting and drying :

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

406.4 Opening to Traffic :

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

406.5 Surface Finish and Quality control of work

406.5.1 Surface evenness :

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

406.5.2 Quality Control :

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

406.6 Rectification of Surface Irregularity :

Where the surface irregularity of the wet mix macadam course exceeds the permissible tolerances or where the course is otherwise defective due to subgrade soil getting mixed with the aggregates, the full thickness of the layer shall be scarified over the affected area. Reshaped with

added premixed material or removed and replaced with fresh premixed material as applicable and recomputed in accordance with Clause 406.3 of this item . The area treated in the aforesaid manner shall not be less than 5m long and 2m wide. In no case shall depressions be filled up with unmixed and ungraded material or fines.

406.6.7 Arrangement for Traffic :

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

406.8 Measurements for Payment :

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

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

- i) Making arrangement for traffic to Clause 112 as above Except for initial treatment to verges, shoulders and Construction of diversions
- ii) Furnishing wet materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lifts ;
- iii) All labour, tools, equipment and incidentals to complete the work to the specifications ;
- iv) Carrying out the work in part widths of road where directed ; and
- v) Carrying out the required tests for quality control.

Item No.6 Providing and applying priming coat with emulsion (SS-2) at the rate of 2.5 kg/ 10 Sq.mt. including cost of asphalt and preparing the surface heating, and applying etc. complete.

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 or mix.

502.2 Materials

502.2.1 Primer : Primer shall be bitumen emulsion of SS-2 grade complying with IS 8887

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 three 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 60o 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 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 temperature in the shade is less than 10o C. Surfaces which are to receive emulsion primer should be damp. But no free or standing water shall be present.

502.3 Construction

502.4.1.1 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 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** .

501.8 This work shall consist of preparing an existing granular surface and shall be performed on such widths and lengths as shown on the drawing or as directed by the Engineer

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 inter locked 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 emulsion bituminous primer : The rate of application of the primer shall be at rate of 7.5 Kg / 10 Sq.m. or as directed.

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.

502.5 Quality Control of Work :

For control of the quality of materials supplied and the works carried out, the relevant provisions of Section 901 of MORT & H specifications shall apply.

502.6 Arrangements for Traffic

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

502.7 Measurement for Payment

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

502.8 Rate :-

The contract unit rate for prime coat with adjustments as described in Clause 502.7 of MORT&H specification shall be payment in full for carrying out the required operations including full compensation for all components listed below

[i] Making arrangements for traffic to Clause 112 as above except for initial treatment to verges, shoulders and construction of diversions.

[ii] Furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lift.

[iii] All labour, tools, equipment and incidentals to complete the work to the specifications.

[iv] Carrying out the work in part widths of road where directed, and

[v] Carrying out the required tests for quality control.

Payment shall be made on the basis of the provision of prime coat at an application rate of 7.5 kg per 10 square meter, 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. of MORT&H specification stated above.

Item No.7 Supplying, stacking & spreading Hard Murrum on road side for hard side shoulder of work as per specification including rolling & watering complete.

1. The Hardmurrum shall be approved by the Ex. Engineer prior to collection, Filling of boxes, shall not be allowed till the hardmurrum is broken to the specified size.

2. The Hardmurrum shall be as uniform in size as possible. The Hardmurrum shall be hard, tough, solid durable of black trap quarry of close texture, free from decay and weathering. The stone shall be angular and roughly cubical in shape and round elongated or flaky materials shall be rejected. No sound or long rubble or angular chips smaller than specified size shall be allowed.

3. All unsound, weathered or disintegrated stone obtained from the under surface layer of the quarry or other layers of boulders shall be rejected.

4. Wherever any doubt as to whether above requirement are satisfied in whole or part of the collection it shall be got screened by the Contractor if so ordered by the Executive Engineer, and for which no extra payment shall be claimed by the contractor.

5. Any collection, which does not fully satisfy the above requirements is liable to be rejected all together.

6. Stacking shall be made by the Contractor by steel pharas of 2 M x 1.5 M x 0.5 M and no deduction of voids shall be made from the gross measurements.

7. Regular stacks shall be made by the contractor on a fairly level ground. All the stack shall be marked by white wash immediately on being measured and recorded by the Engineer-in-charge,

8. The rate includes blasting the rock, if any, breaking the Hardmurrum, stacking measuring in pharas etc. complete.

9. Stacks shall as per actual requirements and any materials in excess shall have to be transported by the contractor at the places directed by the Executive Engineer at the risk and cost of the contractor.

10. White stacking materials the depositing should commence at one end of the K.M. and carried continuously towards the other end unless the Executive Engineer shall direct otherwise and as a rule measurements shall be taken after metal for half kilometer or Km. has been fully collected. Any fraction of these distance shall not be measured up. Rolling With Vibratory roller exceeding 80 KN & not exceeding 120 KN

11. The measurements shall be recorded in on Cum, basis & shall be paid accordingly.

The payment shall be made on cubic metre basis.

Item No.8 Supplying, fixing & joining reinforced concrete heavy duty non pressure pipe with colars for culverts carryig heavy traffic as per Indian Railway Standard Specifications including setting and joining the pipe in cement mortar 1:2 watering and laying (to level or slope) of I.S. class NP-3 600 mm dia.(Internal)

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

2. Reinforced concrete pipe shall be NP-3 type conforming to the requirements of IS: 458 and shall be of 600 mm internal dia. as specified in the item. Each consignment of cement concrete pipes shall be inspected, if necessary and approved by the Engineer-in-charge, either at the place of manufacture or at the site before their incorporation in the works.

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

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

FORM OF CERTIFICATE FOR NP3, NP2, NP1 PIPES

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

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

Date : _____

Place : _____ Manufacturer's Sign. _____

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

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

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

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

Item No.9 Providing & laying 50 mm thick bituminous macadam with 0.66 cum stone chips for one M.T. using the asphalt 34 kg/M.T. (i.e 3.40%) for mixing and emulsion for tack coat 2.5 kg/10sqmt heating the asphalt and agg by continues batching of hot mix plant & spreading the same by pavers finisher and consolidation with power roller of 80 to 100 KN with necessary equipment, oil, kerosene, fire, wood, labour charges etc. complete with contractor's own machinery..

Scope :-

This work shall consist of bituminous construction in a single course having 50 mm thickness course of compacted crushed aggregates premixed with a bituminous binder on a previously prepared base to the requirements of these specification.

504.2 Materials :-

504.2.1 Bitumen :-

The bitumen shall be paving bitumen of VG-30 complying with Indian Standard specification for “Paving Bitumen” IS:73.

504.2.2 Coarse aggregates :-

The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on the 2.36 mm sieve. They shall be clean, hard, durable of cubical shape, free from dust and soft or friable matter, organic or other deleterious matter. Where the contractor's selected source of aggregates have poor affinity for bitumen, as a condition for the approval of that source, the bitumen shall be treated with approved anti-stripping agents as per the manufacturer's recommendations, without additional payment. Before approval of the source the aggregate shall be tested for stripping.

The aggregates shall satisfy the physical requirements set forth in Table 500-3 as under.

**Table 500.3 Physical, Requirements for Coarse aggregates
for bituminous Macadam**

Property	Test	Specification
Cleanliness	Grain Size analysis	Max. 5% passing 0.075 mm sieve.
Particle shape	Flakiness and Elongation Index (Combined)	Max. 30%
Strength	Los Angeles Abrasion Value	Max. 40%
	Aggregate Impact Value	Max. 30%
Durability	Soundness Sodium Sulphate	Max. 12%
	Magnesium Sulphate	Max. 18%
Water Absorption	Water Absorption	Max. 2%
Stripping	Coating and stripping of Bitumen aggregate Mixtures.	Minimum retained coating 95%
Water Sensitivity	Retained Tensile Strength	Minimum 80%

Notes :-

[1] IS : 2386 Part – 1

[2] IS : 2386 Part – 1 [the elongation test to be done only on non-flaky aggregate in the sample]

[3] IS : 2386 Part – 4

[4] IS : 2386 Part – 5

[5] IS : 2386 Part – 3

[6] IS : 6241

[7] The water sensitivity test is only to be carried out if the minimum retained coating in the stripping test is less than 95 %

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

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

504.2.3 Fine aggregates :-

Fine aggregates shall consist of crushed or naturally occurring material or a combination of the two passing 2.36 mm sieve and retained on 75 micron sieve. They shall be clean hard, durable, dry and free from dust, and soft or friable matter, organic or other deleterious matter.

504.2.4 Aggregate grading and binder content :-

When tested in accordance with IS : 2386 Part-1 (wet sieving method) the combined aggregate grading for the particular mixture shall fall within the limits type and quantity of bitumen and appropriate thickness are also indicated for each mixture type.

504.2.5 Proportioning of material :-

The aggregates shall be proportioned and blended to produce a uniform mixture complying with the requirements of Table 500-4. The binder content shall be within a tolerance of ± 0.3 % by weight of total mixture when individual specimens are taken for quality control tests in accordance with the provisions of Section 900.

Table 500.4 Composition of Bituminous Macadam

Mix designation	Grading-2
Nominal aggregate size	19 mm
layer thickness	50 mm
IS : Sieve [MM]	Cumulative % by weight of total aggregate passing.
26.5	100
19	90 – 100
13.2	56 – 88
4.75	16 – 36
2.36	4 – 19
0.3	2 – 10
0.075	0 – 8
Bitumen content % by weight of total mixture	3.40
Bitumen Grade	VG-30

Note :- Appropriate bitumen contents for conditions in cooler areas of India may be upto 0.5% higher subject to the approval of the Engineer.

504.3 Construction Operations :-

504.3.1 Weather and seasonal limitations :-

Laying shall be suspended while free standing water is present on the surface to be covered or during rain, fog and dust storms. After rain the bituminous surface, prime or tack coat, shall be blow off with a high pressure air jet to remove excess moisture or the surface left to dry before laying shall start, laying of bituminous mixtures shall not be carried out when the air temperature at the surface on which it is to be laid is below 10⁰ C or when the wind speed at any temperature exceeds 40 K.M./H at 2 Mt. height unless specifically approved by the Engineer.

504.3.2 Preparation of the base :-

The base on which bituminous macadam is to be laid shall be prepared shaped and compacted to the required profile in accordance with Clauses-501.8 and 902.3 as appropriate and a prime coat, shall be applied in accordance with Clause-502 where specified or as directed by the Engineer.

501.8 Preparation of Surface :-

504.8.1 Scope :-

This work shall consist of preparing an existing granular or black topped surface bituminous course. The work shall be performed on such widths and lengths as shown on the drawings or as instructed by the Engineer. The existing surface shall be firm and clean and treated with prime or tack coat as shown on the drawings as otherwise stated in the contract.

504.3.3 Tack coat :-

A tack coat in accordance with Clause-503 shall be applied as required by the contract documents or as directed by the Engineer.

503 Tack Coat :-

503.1 Scope :-

This work shall consist of the application of a single coat of emulsion RS-1 on prepared 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 paving Emulsion RS-1 complying with Indian Standard specification for "Paving Bitumen" IS:73.

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 10⁰ C.

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 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 be applied shall be clean and free from dust, dirt and any extraneous material and otherwise prepared in accordance with the requirements of Clauses-501.8 & 513 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 :- (as per IRC - 16 - 2008)

The application of tack coat shall be at 2.5 Kg/ 10 Sq.mt. as 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 K.G. / Sq. Mt. Area.
[1] Normal bituminous surface.	0.20 to 0.25
[2] Dry and hungry bituminous surfaces.	0.25 to 0.30
[3] Granular surfaces treated with primer.	0.25 to 0.30
[4] Non Bituminous surface.	0.35 to 0.40
(a) Granular base (not primed)	
(b) Cement concrete pavement.	0.30 to 0.35

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.

504.3.4 Preparation and transportation of the mixture :-

501.3 Mixing :-

Premixed bituminous materials, including bituminous macadam dense bituminous macadam semi dense bituminous concrete and bituminous concrete, shall be prepared in a hot mix plant of adequate capacity and bituminous concrete, shall be prepared in a hot mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coating aggregates. Appropriate mixing temperatures can be found in 500.5 of these specifications, the difference in temperature between the binder and aggregate should at no time exceed 14° C. In order to ensure uniform quality of the mix and belief writing of aggregates, the hot mix plant shall be calibrated from time to time.

If a continuous mixing plant is to be used for mixing the bituminous bound macadam, the Contractor Must demonstrate by laboratory analysis that the cold feed combined grading is within the grading limits specified for the bituminous bound material. In the case of a designed job mix, the bitumen and filter content shall be derived using this combined grading. Further details are available in the Manual for Construction and Supervision of bituminous works.

501.4 Transporting :-

Bituminous materials shall be transported in clean insulated vehicles, and unless otherwise agreed by the Engineer, shall be covered while in transit or awaiting tipping, Subject to the approval of an Engineer, a thin coating of diesel or lubricating oil may be applied to the interior of the vehicle to prevent sticking and to facilitate discharge of the material.

504.3.5 Spreading :-

Except in areas where a mechanical paver cannot access, bituminous materials shall be spread, leveled and tamped by an approved self propelled paving machine. As soon as possible after arrival at site, the materials shall be supplied continuously to the paver and laid without delay.

The rate of delivery of material to the paver shall be regulated to enable the paver to operate continuously. The travel rate of the paver, and its method of operations shall be adjusted to ensure an even and uniform flow of bituminous material across the screed, free from dragging, tearing and segregation of the material. In areas with restricted space

where a mechanical paver cannot be used, the material shall be spread, raked and leveled with suitable by hand tools by experienced staff and compacted to the satisfactions of the Engineer.

The minimum thickness of material laid in each paver pass shall be in accordance with the minimum values given in the relevant parts of these specifications. When laying binder course or wearing course approaching an expansion joint of a structure, machine laying shall stop 300 mm short of the joint. The remainder of the pavement upto the joint and the corresponding area beyond it, shall be laid by hand, and the joint or joint cavity shall be kept clear of surfacing material.

Bituminous material with temperature proofing systems, unless precautions against heat damage have been approved by the Engineer.

Hand placing of pre mixed bituminous materials shall only be permitted in the following circumstances.

- [i] For laying regulating course of irregular shape and varying thickness.
- [ii] In confined spaces where it is impracticable for a paver to operate.
- [iii] For foot Ways.
- [iv] At the approaches to expansion joints at bridge viaducts or other structures.
- [v] For laying mastic asphalt in accordance with clause 515 as below.
- [vi] For filling of path holes.
- [vii] Where directed by the Engineer.

Manual spreading of pre mixed wearing course material or the addition of such material by hand spreading to the paved area, for adjustment of level shall only be permitted in the following circumstances.

- [1] At the edge of the layers of material and at gullies and manholes.
- [2] At the approaches to expansion joints at bridges, viaducts or other structures.
- [3] As directed by the Engineer.

Table 500.5 Manufacturing and Rolling Temperatures.

Penetration	Bitumen Mixing [C]	Aggregate Mixing [C]	Mixed Material [C]	Rolling [C]	Laving [C]
35	106-170	160-175	170 Maximum	100 Maximum	130 Maximum
65	150-165	150-170	165 Maximum	90 Maximum	125 Maximum
90	140-160	140-165	155 Maximum	80 Maximum	115 Maximum

504.3.6 Rolling :-

Compaction shall be carried out in accordance with the provisions of Clauses 501.6 and 501.7 as below.

501.6 Compaction :-

Bituminous materials shall be laid and compacted in layers which enable the specified thickness, surface level, regularity requirements and compaction to be achieved.

Compaction of bituminous materials shall commence as soon as possible after laying. Compaction shall be substantially completed before the temperature falls below the minimum rolling temperatures stated in the relevant part of these specifications. Rolling of the longitudinal joints shall be done immediately behind the paving operation.

After this rolling shall commence at the edges and progress towards the center longitudinally except that on super elevated and unidirectional compared portion, it shall progress from the lower to the upper edge parallel to the center line of the pavement. Rolling shall continue until all roller marks have been removed from the surface. All deficiencies in the surface after laying shall be made good by the attendants behind the paver before initial rolling is commenced. The initial or breakdown rolling shall be done with 8-10 tonnes deal weight smooth wheeled roller. The immediate rolling shall be done with 8-10 tonnes deal weight or vibratory roller or with a pneumatic tired roller of 12 to 15 tonnes weight having nine wheels, with tire pressure of at least 5.6 K.G./Sq.Mt. The finish rolling shall be done with 6 to 8 tonnes smooth wheeled tandem rollers.

Where compaction is to be determined by density of the requirements to prove the performance of rollers shall apply in order to demonstrate that the specified density can be achieved. In such cases the contractor shall nominate the plant and the method by which he intends to achieve the specified level of compaction and finish at temperatures

above the minimum specified rolling temperature. Laying trials shall then demonstrate the acceptability of the plant and method used.

Bituminous materials shall be rolled in a longitudinal direction with the driven rolls nearest the paver. The rollers shall first compact material adjacent to joints and then work from the lower to the upper side of the layer, overlapping on successive passes by at least one-third of the width of the rear roller in the case of a pneumatic-tyred roller, at least the nominal width of 300 mm.

In portions with super elevated and un-directional camber, after the edge has been roller, the roller shall progress from the lower to the upper edge.

Roller should move at a speed of not more than 5 K.M./ H. The roller shall not be permitted to stand on pavement which has not been fully compacted and necessary precautions shall be taken to prevent dropping of oil, grease, petrol or other foreign matter on the pavement either when the rollers are operating or standing. The wheels of rollers shall be kept moist with water and the spray system provided with the machine shall be in good working order, to prevent the mixture from adhering to the wheels. Only sufficient moisture to prevent adhesion between the wheels of rollers and the mixture should be used. Surplus water shall not be allowed to stand on the partially compacted pavement.

501.7 Joints :- Where longitudinal joints are made in pre-mixed bituminous materials, the materials shall be fully compacted and the joint made flush in one of the following ways, only method [iii] shall be used for transverse joints.

[1] By beating the joints with an approved joint heater when the adjacent width is being laid but without cutting back or coating with binder. The heater shall raise the temperature of the full depth of material to within the specified range of minimum rolling temperature and maximum temperature at any stage for the material for a width not less than 75 mm. The contractor shall have equipment available for use in the event of a heater break down to form joints by method [iii].

[2] By using two or more pavers operating in echelon, where this is practicable, and in sufficient proximity for adjacent widths to be fully compacted by continuous rolling.

[3] By cutting back the exposed joint for a distance equal to the specified layer thickness, to a vertical face discarding all loosened material and coating the vertical face completely with 80/100 penetration grade hot bitumen or cold applied bitumen or polymer modified adhesive bitumen tape with a minimum thickness of 2 mm before the adjacent width is laid.

All joints shall be offset at least 300 mm from parallel joints in the layer beneath or as directed and in a layout approved by the Engineer. Joints in the wearing course shall coincide with either the lane edge or the lane marking whichever is appropriate. Longitudinal joints shall not be situated in wheel track zones.

Rolling shall be continued until the specified density is achieved or where no density is specified, until there is no further movement under the roller. The required frequency of testing is defined in Clause-903.

504.4 Surface finish and Quality control of work :-

The surface finish of the completed construction shall conform to the requirements of Clause-902 as under. For control of the quality of materials supplied and the works carried out the relevant provisions of sections 900 of MORT & H shall apply.

901.1 All materials to be used all methods adopted and all performed shall be strictly in accordance with the requirements of these specifications. The contractor shall set up a field laboratory at locations approved by the Engineer and equip the same with adequate equipment and personnel in order to carry out all required tests and Quality Control work as per specifications and/or as directed by the Engineer. The internal layout of the laboratory shall be as per Clause-121 and/or as directed by the Engineer. The list of equipment and the facilities to be provided shall be got approved from the Engineer in advance.

901.2 The contractor's laboratory should be manned by a qualified materials Engineer/Civil Engineer assisted by experienced technicians and the set up should be got approved by the Engineer.

901.3 The contractor shall carry out quality control tests on the materials and work to the frequency stipulated in subsequent paragraphs. In the absence of clear indications about method and frequency of tests for any item, the instructions of the Engineer shall be followed.

901.4 For satisfying himself about the quality of the materials and work, will also be conducted by the Engineer [by himself, by his Quality Control units or by any other agencies deemed fit by him], generally to the frequency set forth hereunder. Additional tests may also be conducted where in the opinion of the Engineer, need for such test exists.

901.5 The Contractor shall provide co-operation and assistance in obtaining the samples for tests and carrying out the field tests as required by the Engineer from time to time. This may include provision of labour, attendants, assistance in packing and dispatching and any other assistance considered necessary in connection with the tests.

901.6 For work of embankment, Sub-grade and pavement construction of subsequent layer of same or other material over the finished layer shall be done after obtaining permission from the Engineer. Similar permission from the Engineer shall be obtained in respect of all other items a work prior to proceeding with the stage of construction.

901.7 The contractor shall carry out modifications in the procedure of work, if found necessary as directed by the Engineer during the inspection. Works falling short of quality shall be rectified/ redone by the contractor at his own cost and defective work shall also be removed from the site of works by the contractor at his own cost.

901.8 The cost of laboratory building including services, essential supplied like water, electricity, sanitary services and their maintenance and cost of all equipments, tools, materials, labour and incidentals to perform tests and other operations of quality control according to the Specification requirements shall be deemed to be incidental to the work and no extra payment shall be made for the same.

901.9 For testing of samples of soils/soil mixes, granular materials, mixes bituminous materials and mixes aggregates, etc. sample in the required quantity and form shall be supplied to the Engineer by the Contractor at his own cost.

901.10 For cement, bitumen, mild steel, and similar other material where essential tests are to be carried out at the manufacturer's plants or at laboratories other than the site laboratory, the cost of samples, sampling testing and furnishing of test certificates shall be borne by the contractor. He shall also furnish the test certificate to the Engineer.

901.11 For testing of cement concrete at site during construction arrangements for supply of samples, sampling, testing and supply of test results shall be made by the Contractor as per the frequency and number of tests specified in the Handbook of Quality Control for Construction of Roads and Run ways [I.R.C.: SP -11 and relevant IS codes or relevant clauses of these specifications. The cost of which shall be borne by the Contractor.

901.12 The method of sampling and testing materials shall be as required by the "Hand book of Quality Control for Construction of Road & Runways" [IRC Sp. 11] and the MOST specifications. Where they are contradicting the provisions in these modifications shall be followed. More they are silent, sound engineering practices shall be adopted. The sampling and testing procedure to be used as approved by this Engineer and his decision shall be final and binding on the Contractor.

901.13 Defective Materials :-

All materials which the Engineer/his representative has determined as not conforming to the requirements of the Contract shall be rejected whether in place or not they shall be removed immediately from the site as directed. Materials, which have been subsequently connected, shall not be used in the work unless approval is accorded in writing by the Engineer. Upon failure of the Contractor to comply with any order of the Engineer/his representative, given under this Clause, this Engineer/his representative shall have authority to cause the removal of rejected material and to deduct the removal cost there of from any payments due to the Contractor.

901.14 Imported Materials :-

At the time of submission of tender, the Contractor shall furnish a list of materials finished products manufactured, produced or fabricated outside India which he proposed to use in the work. The Contractor shall not be entitled to extension of time for acts or events occurring outside India and it shall be the Contractor's responsibility to make timely delivery to the job site of all such materials obtained from outside India.

The materials imported from outside India shall conform to the relevant specifications of the Contract. In case where materials/finished products are not covered by the Specifications in the Contract, the details of Specifications proposed to be followed at the testing procedures as well as laboratories/establishments where tests are to be carried out shall be specifically brought out and agreed to in the Contract.

The Contractor shall furnish to the Engineer a certificate of compliance of the tests carried out. In addition, certified mill test reports clearly identified to the lot of materials shall be furnished at the contractor's cost.

902 Control of alignment, level and surface regularity :-

902.1 General :-

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

902.2 Horizontal Alignment

Horizontal alignments shall be reckoned with respect to the center line of the carriage way as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of +10 mm there from. The corresponding tolerance for edges of the road way and lower layers of pavement shall be -25 mm.

902.3 Surface level :-

The levels of the sub grade and different pavement courses as constructed shall not vary from those calculated with reference to the longitudinal and cross profile of the road shown on the drawings or as directed by the Engineer beyond the tolerances mentioned in Table 900.1.

Table 900.1 Tolerances in Surface Levels

[1]	Sub grade.	+ 20 mm - 25 mm
[2]	Sub-base + 10 mm [a] Flexible pavement [b] Concrete pavement. (Dry lean concrete or rolled concreted)	- 20 mm - 10 mm
[3]	Base course for flexible pavement. [a] Bituminous course. [b] Other than bituminous [I] Machine laid. [II] Manually laid.	+ 6 mm - 6 mm + 10 mm - 10 mm - 15 mm - 15 mm
[4]	Wearing course for flexible pavement. [a] Machine laid. [II] Manually laid.	- 6 mm 6 mm - 10 mm 10 mm
[5]	Cement concrete pavement.	- 5 mm 6 mm

* This may not exceed – 8 mm at 0.30 cm from the edges.

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

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

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

902.5 Surface Regularity of Pavement Courses :-

The longitudinal profile shall be checked with a 3 Mt. Long straight edge/moving straight edge as directed by the Engineer at the middle of each traffic lane along a line parallel to the center line of the road

The maximum permitted number of surface irregularities shall be as per Table 900.2

Table 900.2 Maximum Permitted Number of Surface Irregularities.

Surface of carriage ways and paved.	Surface of lays, service areas and all bituminous base courses shoulders.							
Irregularity Length [Mt.]	4 mm		7 mm		4 mm		7 mm	
	300	75	300	75	300	75	300	75
National Highways/ Expressways.	20	9	2	1	40	18	4	2
Road of lower Category*	40	18	4	2	60	27	6	3

* Category of each section of road as described in the contract.

The maximum allowable difference between the road surfaced and under side of a 3 Mt. straight edge when placed parallel with or at right angles to the center line of the road at points decided by the Engineer shall be:

For pavement surface [bituminous and cement concrete]	= 3 mm
For bituminous base courses.	= 6 mm
For granular sub base/base course	= 8 mm
For sub base under concrete pavements.	= 10 mm

902.5 Rectification :-

Where the surface regularity of sub grade and the various pavement courses fall outside the specified tolerance the contractor shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer.

Bituminous Constructions :-

For bituminous construction other than wearing course where the surface is low the deficiency shall be corrected by adding fresh materials over a suitable tack coat if needed and recomposing to specification. Where the 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 4 Mt. in length and not less than 3.5 Mt. width.

903 Quality Control Tests During Construction

903.1 General :-

The materials supplied and the works carried out by the contractor shall conform to the specifications of MOST Clause 903.

504.5 Protection of the Layer :-

The bituminous macadam shall be covered with either the next pavement course or wearing course as the case may be within a maximum of 48 Hours. If there is to any delay the course shall be covered by MSS before opening to any traffic to the requirements of Specifications as per Item No.11 of this contract. The MSS in such cases shall be considered incidental to the work and shall not be paid for separately.

504.6 Arrangements for traffic :-

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

112. Arrangement for Traffic during construction :-

112.1 General :-

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

112.2 Passage of Traffic along a part of the Existing Carriageway under Improvement. For widening strengthening existing carriageway where part width of the existing carriageway is proposed to be used for passage of traffic, treated shoulders shall be provided on the side on which work is not in progress. The treatment to the shoulder shall consist of providing at least 150 mm thick granular base course covered with bituminous surface dressing in a width of at least 1.5 Mt. and the surface shall be maintained throughout the period during which traffic uses the same to the satisfaction of the Engineer. The continuous length in which such work shall be carried out would be limited normally to 500 m at a place. However where work is allowed by the Engineer in charge stretches passing places at least 20 Mt. long with additional paved width of 2.5 Mt. shall be provided at every 0.5 K.M. interval.

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

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

112.3 Passage of Traffic along a Temporary Diversion :-

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

- [i] 200mm [compacted] granular sub-base.
- [ii] 225mm [compacted] granular base course and
- [iii] Premix carpet with seal coat/Mix seal surfacing.

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

112.4 Traffic Safety and Control :-

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

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

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

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

On both sides, suitable regulatory/warning signs as approved by the Engineer shall be installed for the guidance of road users. On each approach, at least two signs shall be put up, one close to the point where transition of carriageway begins and the other 120 Mt. away. The sign shall be of approved design and of reflective type, if so directed by the Engineer.

112.5 Maintenance of Diversions and Traffic Control Devices :-

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

All arrangements for traffic during construction including provision of temporary cross drainage structures, if required, and treated shoulder as described in Clause 112.2 including their maintenance, dismantling and clearing debris, where necessary, shall be considered as incidental to the works and shall be the Contractor's responsibility.

504.7 Measurement for Payment :-

The payment shall be made on the tonnage basis of the weight of mix aggregates and bitumen. For this purpose, the contractor shall have to install a weigh-bridge of suitable capacity for the purpose of weighing dumpers at suitable place at his cost as directed. Weight of empty dumpers 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 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 basic 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 pro-rata basis depending upon the area reduced or exceeded respectively.

Weight of mix materials will be done in presence of responsible person, not less than the rank of Supervisor of Department and the measurements shall be recorded by the Deputy Executive Engineer or Assistant Engineer or Additional Assistant Engineer, if so authorized. Record of each dumper will be mentioned separately in bound and numbered register which will be maintained by the Department representatives and signed by the contractor. Proper gate pass system shall be established for the vehicle coming to the plant site and going from the site. The location of the K.M. hectometer and meter in which individual dumpers are unloaded shall be recorded carefully.

504.8 Rate :-

The contract unit rate for bituminous macadam shall be payment in full for carrying out the required operations as specified. The rate shall include for all components listed below.

- (i) Making arrangements for traffic to clause 112 except for initial treatment to verge, shoulders and construction of diversions.
- (ii) Preparation of the surface to revive the materials.
- (iii) Providing all materials to be incorporated in the work including arrangement for stock yards. All royalties, fees rents where necessary and all leads and lifts.
- (iv) Mixing transporting, laying and compacting the mix as specified.
- (v) All labour, tools equipment, plant including installation of hot mix plant, power supply units and all machinery incidental to complete the work to these specification.
- (vi) Carrying out the work in part widths of the road where directed.
- (vii) Carrying out all tests for control of quality, and
- (viii) The rate shall cover the provision of bitumen at the rate specified in the contract, with the provision that the variation in actual percentage of bitumen used will be assessed and the payment adjusted accordingly.
- (ix) The rate for premixed material are to include for all wastage in cutting of joints etc.
- (x) The rates are to include for all necessary testing mix design transporting and testing of samples, and cores. If there is not a project specific : laboratory, the contractor must arrange to carry out all necessary testing at an outside laboratory approved by the Engineer, and all costs incurred are deemed to be included in the rate quoted for the material.

The cost of all plant and laying trials as specified to prove the mixing and laying methods is deemed, to be included in the contractor's rates for the materials

The payment shall be made on M.T. basis..

Item No.10 Providing & laying 37.50 mm thick bituminous macadam with 0.66 cum stone chips for one M.T. using the asphalt 34 kg/M.T. (i.e 3.40%) for mixing and emulsion for tack coat 2.5 kg/10sqmt heating the asphalt and agg by continues batching of hot mix plant & spreading the same by pavers finisher and consolidation with power roller of 80 to 100 KN with necessary equipment, oil, kerosene, fire, wood, labour charges etc. complete with contractor's own machinery..

Scope :-

This work shall consist of bituminous construction in a single course having 37.50 mm thickness course of compacted crushed aggregates premixed with a bituminous binder on a previously prepared base to the requirements of these specification.

504.2 Materials :-**504.2.1 Bitumen :-**

The bitumen shall be paving bitumen of VG-30 complying with Indian Standard specification for "Paving Bitumen" IS:73.

504.2.2 Coarse aggregates :-

The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on the 2.36 mm sieve. They shall be clean, hard, durable of cubical shape, free from dust and soft or friable matter, organic or other deleterious matter. Where the contractor's selected source of aggregates have poor affinity for bitumen, as a condition for the approval of that source, the bitumen shall be treated with approved anti-stripping agents as per the manufacturer's recommendations, without additional payment. Before approval of the source the aggregate shall be tested for stripping.

The aggregates shall satisfy the physical requirements set forth in Table 500-3 as under.

**Table 500.3 Physical, Requirements for Coarse aggregates
for bituminous Macadam**

Property	Test	Specification
Cleanliness	Grain Size analysis	Max. 5% passing 0.075 mm sieve.
Particle shape	Flakiness and Elongation Index (Combined)	Max. 30%

Property	Test	Specification
Strength	Los Angeles Abrasion Value	Max. 40%
	Aggregate Impact Value	Max. 30%
Durability	Soundness Sodium Sulphate	Max. 12%
	Magnesium Sulphate	Max. 18%
Water Absorption	Water Absorption	Max. 2%
Stripping	Coating and stripping of Bitumen aggregate Mixtures.	Minimum retained coating 95%
Water Sensitivity	Retained Tensile Strength	Minimum 80%

Notes :-

[1] IS : 2386 Part – 1

[2] IS : 2386 Part – 1 [the elongation test to be done only on non-flaky aggregate in the sample]

[3] IS : 2386 Part – 4

[4] IS : 2386 Part – 5

[5] IS : 2386 Part – 3

[6] IS : 6241

[7] The water sensitivity test is only to be carried out if the minimum retained coating in the stripping test is less than 95 %

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

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

504.2.3 Fine aggregates :-

Fine aggregates shall consist of crushed or naturally occurring material or a combination of the two passing 2.36 mm sieve and retained on 75 micron sieve. They shall be clean hard, durable, dry and free from dust, and soft or friable matter, organic or other deleterious matter.

504.2.4 Aggregate grading and binder content :-

When tested in accordance with IS : 2386 Part-1 (wet sieving method) the combined aggregate grading for the particular mixture shall fall within the limits type and quantity of bitumen and appropriate thickness are also indicated for each mixture type.

504.2.5 Proportioning of material :-

The aggregates shall be proportioned and blended to produce a uniform mixture complying with the requirements of Table 500-4. The binder content shall be within a tolerance of ± 0.3 % by weight of total mixture when individual specimens are taken for quality control tests in accordance with the provisions of Section 900.

Table 500.4 Composition of Bituminous Macadam

Mix designation	Grading-2
Nominal aggregate size	19 mm
layer thickness	50 mm
IS : Sieve [MM]	Cumulative % by weight of total aggregate passing.
26.5	100
19	90 – 100
13.2	56 – 88
4.75	16 – 36
2.36	4 – 19
0.3	2 – 10
0.075	0 – 8
Bitumen content % by weight of total mixture	3.40
Bitumen Grade	VG-30

Note :- Appropriate bitumen contents for conditions in cooler areas of India may be upto 0.5% higher subject to the approval of the Engineer.

504.3 Construction Operations :-

504.3.1 Weather and seasonal limitations :-

Laying shall be suspended while free standing water is present on the surface to be covered or during rain, fog and dust storms. After rain the bituminous surface, prime or tack coat, shall be blow off with a high pressure air jet to remove excess moisture or the surface left to dry before laying shall start, laying of bituminous mixtures shall not be carried out when the air temperature at the surface on which it is to be laid is below 10° C or when the wind speed at any temperature exceeds 40 K.M./H at 2 Mt. height unless specifically approved by the Engineer.

504.3.2 Preparation of the base :-

The base on which bituminous macadam is to be laid shall be prepared shaped and compacted to the required profile in accordance with Clauses-501.8 and 902.3 as appropriate and a prime coat, shall be applied in accordance with Clause-502 where specified or as directed by the Engineer.

501.8 Preparation of Surface :-

504.8.1 Scope :-

This work shall consist of preparing an existing granular or black topped surface bituminous course. The work shall be performed on such widths and lengths as shown on the drawings or as instructed by the Engineer. The existing surface shall be firm and clean and treated with prime or tack coat as shown on the drawings as otherwise stated in the contract.

504.3.3 Tack coat :-

A tack coat in accordance with Clause-503 shall be applied as required by the contract documents or as directed by the Engineer.

503 Tack Coat :-

503.1 Scope :-

This work shall consist of the application of a single coat of emulsion RS-1 on prepared 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 paving Emulsion RS-1 complying with Indian Standard specification for "Paving Bitumen" IS:73.

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.

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 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 be applied shall be clean and free from dust, dirt and any extraneous material and other wise prepared in accordance with the requirements of Clauses-501.8 & 513 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 :- (as per IRC - 16 - 2008)

The application on tack coat shall be at 2.5 Kg/ 10 Sq.mt. as 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 K.G. / Sq. Mt. Area.
[1] Normal bituminous surface.	0.20 to 0.25
[2] Dry and hungry bituminous surfaces.	0.25 to 0.30
[3] Granular surfaces treated with primer.	0.25 to 0.30
[4] Non Bituminous surface.	0.35 to 0.40
(a) Granular base (not primed)	
(b) Cement concrete pavement.	0.30 to 0.35

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 spay, within the tolerances specified.

504.3.4 Preparation and transportation of the mixture :-

501.3 Mixing :-

Premixed bituminous materials, including bituminous macadam dense bituminous macadam semi dense bituminous concrete and bituminous concrete, shall be prepared in a hot mix plant of adequate capacity and bituminous concrete, shall be prepared in a hot mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coating aggregates. Appropriate mixing temperatures can be found in 500.5 of these specifications, the difference in temperature between the binder and aggregate should at no time exceed 14° C. In order to ensure uniform quality of the mix and belief writing of aggregates, the hot mix plan shall be calibrated from time to time.

If a continuous mixing plant is to be used for mixing the bituminous bound macadam, the Contractor Must demonstrate by laboratory analysis that the cold feed combined grading is within the grading limits specified for the bituminous bound material. In the case of a designed job mix, the bitumen and filter content shall be derived using this combined grading. Further debits she available in the Manual for Construction and Supervision of bituminous works.

501.4 Transporting :-

Bituminous materials shall be transported in clean insulated vehicles, and unless other wise agreed by the Engineer, shall be covered while in transit or awaiting tipping, Subject to the approval of am Engineer, a thin coating of diesel or lubricating oil may be applied to the interior of the vehicle to prevent sticking and to facilitate discharge of the material.

504.3.5 Spreading :-

Except in areas where a mechanical paver cannot access, bituminous materials shall be spread, leveled and tamped by an approved self propelled paving machine. As soon as possible after arrival at site, the materials shall be supplied continuously to the paver and laid without delay.

The rate of delivery of material to the paver shall be regulated to enable the paver to operate continuously. The travel rate of as paver, and its method of operations shall be adjusted to ensure an even and uniform flow of bituminous material across the screed, free from dragging, tearing and segregation of the material. In areas with restricted space where a mechanical paver cannot be used, the material shall be spread, raked and leveled with suitable by hand tools by experienced staff and compacted to the satisfactions of the Engineer.

The minimum thickness of material laid in each paver pass shall be in accordance with the minimum values given in the relevant parts of these specifications. When laying binder course or wearing course approaching an expansion joint of a structure, machine laying shall stop 300 mm short of the joint. The remainder of the pavement upto the joint and the corresponding area beyond it, shall be laid by hand, and the joint or joint cavity shall be kept clear of surfacing material.

Bituminous material with temperature proofing systems, unless precautions against heat damage have been approved by the Engineer.

Hand placing of pre mixed bituminous materials shall only be permitted in the following circumstances.

- [i] For laying regulating course of irregular shape and varying thickness.
- [ii] In confined spaces where it is impracticable for a paver to operate.
- [iii] For foot Ways.
- [iv] At the approaches to expansion joints at bridge viaducts or other structures.

[v] For laying mastic asphalt in accordance with clause 515 as below.

[vi] For filling of path holes.

[vii] Where directed by the Engineer.

Manual spreading of pre mixed wearing course material or the addition of such material by hand spreading to the paved area, for adjustment of level shall only be permitted in the following circumstances.

[1] At the edge of the layers of material and at gullies and manholes.

[2] At the approaches to expansion joints at bridges, viaducts or other structures.

[3] As directed by the Engineer.

Table 500.5 Manufacturing and Rolling Temperatures.

Penetration	Bitumen Mixing [C]	Aggregate Mixing [C]	Mixed Material [C]	Rolling [C]	Laving [C]
35	106-170	160-175	170 Maximum	100 Maximum	130 Maximum
65	150-165	150-170	165 Maximum	90 Maximum	125 Maximum
90	140-160	140-165	155 Maximum	80 Maximum	115 Maximum

504.3.6 Rolling :-

Compaction shall be carried out in accordance with the provisions of Clauses 501.6 and 501.7 as below.

501.6 Compaction :-

Bituminous materials shall be laid and compacted in layers which enable the specified thickness, surface level, regularity requirements and compaction to be achieved.

Compaction of bituminous materials shall commence as soon as possible after laying. Compaction shall be substantially completed before the temperature falls below the minimum rolling temperatures stated in the relevant part of these specifications. Rolling of the longitudinal joints shall be done immediately behind the paving operation.

After this rolling shall commence at the edges and progress towards the center longitudinally except that on super elevated and unidirectional compared portion, it shall progress from the lower to the upper edge parallel to the center line of the pavement. Rolling shall continue until all roller marks have been removed from the surface. All deficiencies in the surface after laying shall be made good by the attendants behind the paver before initial rolling is commenced. The initial or breakdown rolling shall be done with 8-10 tonnes deal weight smooth wheeled roller. The immediate rolling shall be done with 8-10 tonnes deal weight or vibratory roller or with a pneumatic tired roller of 12 to 15 tonnes weight having nine wheels, with tire pressure of at least 5.6 K.G./Sq.Mt. The finish rolling shall be done with 6 to 8 tonnes smooth wheeled tandem rollers.

Where compaction is to be determined by density of the requirements to prove the performance of rollers shall apply in order to demonstrate that the specified density can be achieved. In such cases the contractor shall nominate the plant and the method by which he intends to achieve the specified level of compaction and finish at temperatures above the minimum specified rolling temperature. Laying trials shall then demonstrate the acceptability of the plant and method used.

Bituminous materials shall be rolled in a longitudinal direction with the driven rolls nearest the paver. The rollers shall first compact material adjacent to joints and then work from the lower to the upper side of the layer, overlapping on successive passes by at least one-third of the width of the rear roller in the case of a pneumatic-tyred roller, at least the nominal width of 300 mm.

In portions with super elevated and un-directional camber, after the edge has been roller, the roller shall progress from the lower to the upper edge.

Roller should move at a speed of not more than 5 K.M./ H. The roller shall not be permitted to stand on pavement which has not been fully compacted and necessary precautions shall be taken to prevent dropping of oil, grease, petrol of other foreign matter on the pavement either when the rollers are operating or standing. The wheels of rollers shall be kept moist with water and the spray system provided with the machine shall be in good working order, to prevent the mixture from adhering to the wheels. Only sufficient moisture to prevent adhesion between the wheels of rollers and the mixture should be used. Surplus water shall not be allowed to stand on the partially compacted pavement.

501.7 Joints :- Where longitudinal joints are made in pre-mixed bituminous materials, the materials shall be fully compacted and the joint made flush in one of the following ways, only method [iii] shall be used for transverse joints.

[1] By beating the joints with an approved joint heater when the adjacent width is being laid but without cutting back or coating with binder. The heater shall raise the temperature of the full depth of material to within the specified range of minimum rolling temperature and maximum temperature at any stage for the material for a width not less than 75 mm. The contractor shall have equipment available for use in the event of a heater break down to form joints by method[iii].

[2] By using two or more pavers operating in echelon, where this is practicable, and in sufficient proximity for adjacent widths to be fully compacted by continuous rolling.

[3] By cutting back the exposed joint for a distance equal to the specified layer thickness, to a vertical face discarding all loosened material and coating the vertical face completely with 80/100 penetration grade hot bitumen or cold applied bitumen or polymer modified adhesive bitumen tape with a minimum thickness of 2 mm before the adjacent width is laid.

All joints shall be offset at least 300 mm from parallel joints in the layer beneath or as directed and in a layout approved by the Engineer. Joints in the wearing course shall coincide with either the lane edge or the lane marking which ever is appropriate. Longitudinal joints shall not be situated in wheel track zones.

Rolling shall be continued until the specified density is achieved or where no density is specified, until there is no further movement under the roller. The required frequency of testing is defined in Clause-903.

504.4 Surface finish and Quality control of work :-

The surface finish of the complicated construction shall conform to the requirements of Clause-902 as under. For control of the quality of materials supplied and the works carried out the relevant provisions of sections 900 of MORT & H shall apply.

901.1 All materials to be used all methods adopted and all performed shall be strictly in accordance with the requirements of these specifications. The contractor shall set up a field laboratory at locations approved by the Engineer and equip the same with adequate equipment and personnel in order to carry out all required tests and Quality Control work as per specifications and/or as directed by the Engineer. The internal layout of the laboratory shall be as per Clause-121 and/or as directed by the Engineer. The list of equipment and the facilities to be provided shall be got approved from the Engineer in advance.

901.2 The contractor's laboratory should be manned by a quarried materials Engineer/Civil Engineer assisted by experienced technicians and the set up should be got approved by the Engineer.

901.3 The contractor shall carry out quality control tests on the materials and work to the frequency stipulated in subsequent paragraphs. In the absence of clear indications about method and frequency of tests for any item, the instructions of the Engineer shall be followed.

901.4 For satisfying himself about the quality of the materials and work, will also be conducted by the Engineer [by himself, by his Quality Control units or by any other agencies deemed fit by him], generally to the frequency set forth hereunder. Additional tests may also be conducted where in the opinion of the Engineer, need for such test exists.

901.5 The Contractor shall provide co-operation and assistance in obtaining the samples for tests and carrying out the field tests as required by the Engineer from time to time. This may include provision of labour, attendants, assistance in packing and dispatching and any other assistance considered necessary in connection with the tests.

901.6 For work of embankment, Sub-grade and pavement construction of subsequent layer of same or other material over the finished layer shall be done after obtaining permission from the Engineer. Similar permission from the Engineer shall be obtained in respect of all other items a work prior to proceeding with the stage of construction.

901.7 The contractor shall carry out modifications in the procedure of work, if found necessary as directed by the Engineer during the inspection. Works falling short of quality shall be rectified/ redone by the contractor at his own cost and defective work shall also be removed from the site of works by the contractor at his own cost.

901.8 The cost of laboratory building including services, essential supplies like water, electricity, sanitary services and their maintenance and cost of all equipments, tools, materials, labour and incidentals to perform tests and other operations of quality control according to the Specification requirements shall be deemed to be incidental to the work and no extra payment shall be made for the same.

901.9 For testing of samples of soils/soil mixes, granular materials, mixes bituminous materials and mixes aggregates, etc. sample in the required quantity and form shall be supplied to the Engineer by the Contractor at his own cost.

901.10 For cement, bitumen, mild steel, and similar other material where essential tests are to be carried out at the manufacturer's plants or at laboratories other than the site laboratory, the cost of samples, sampling testing and furnishing of test certificates shall be borne by the contractor. He shall also furnish the test certificate to the Engineer.

901.11 For testing of cement concrete at site during construction arrangements for supply of samples, sampling, testing and supply of test results shall be made by the Contractor as per the frequency and number of tests specified in the Handbook of Quality Control for Construction of Roads and Runways [I.R.C.: SP -11 and relevant IS codes or relevant clauses of these specifications. The cost of which shall be borne by the Contractor.

901.12 The method of sampling and testing materials shall be as required by the "Hand book of Quality Control for Construction of Road & Runways" [IRC Sp. 11] and the MOST specifications. Where they are contradicting the provisions in these modifications shall be followed. More they are silent, sound engineering practices shall be adopted. The sampling and testing procedure to be used as approved by this Engineer and his decision shall be final and binding on the Contractor.

901.13 Defective Materials :-

All materials which the Engineer/his representative has determined as not conforming to the requirements of the Contract shall be rejected whether in place or not they shall be removed immediately from the site as directed. Materials, which have been subsequently connected, shall not be used in the work unless approval is accorded in writing by the Engineer. Upon failure of the Contractor to comply with any order of the Engineer/his representative, given under this Clause, this Engineer/his representative shall have authority to cause the removal of rejected material and to deduct the removal cost there of from any payments due to the Contractor.

901.14 Imported Materials :-

At the time of submission of tender, the Contractor shall furnish a list of materials finished products manufactured, produced or fabricated outside India which he proposed to use in the work. The Contractor shall not be entitled to extension of time for acts or events occurring outside India and it shall be the Contractor's responsibility to make timely delivery to the job site of all such materials obtained from outside India.

The materials imported from outside India shall conform to the relevant specifications of the Contract. In case where materials/finished products are not covered by the Specifications in the Contract, the details of Specifications proposed to be followed and the testing procedures as well as laboratories/establishments where tests are to be carried out shall be specifically brought out and agreed to in the Contract.

The Contractor shall furnish to the Engineer a certificate of compliance of the tests carried out. In addition, certified mill test reports clearly identified to the lot of materials shall be furnished at the Contractor's cost.

902 Control of alignment, level and surface regularity :-

902.1 General :-

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

902.2 Horizontal Alignment

Horizontal alignments shall be reckoned with respect to the center line of the carriage way as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of +10 mm there from. The corresponding tolerance for edges of the road way and lower layers of pavement shall be -25 mm.

902.3 Surface level :-

The levels of the sub grade and different pavement courses as constructed shall not vary from those calculated with reference to the longitudinal and cross profile of the road shown on the drawings or as directed by the Engineer beyond the tolerances mentioned in Table 900.1.

Table 900.1 Tolerances in Surface Levels

[1]	Sub grade.	+ 20 mm - 25 mm
[2]	Sub-base + 10 mm [a] Flexible pavement [b] Concrete pavement. (Dry lean concrete or rolled concrete)	- 20 mm - 10 mm
[3]	Base course for flexible pavement. [a] Bituminous course.	+ 6 mm - 6 mm

	[b] Other than bituminous [I] Machine laid. [II] Manually laid.	+ 10 mm - 10 mm - 15 mm - 15 mm
[4]	Wearing course for flexible pavement. [a] Machine laid. [II] Manually laid.	- 6 mm 6 mm - 10 mm 10 mm
[5]	Cement concrete pavement.	- 5 mm 6 mm

* This may not exceed – 8 mm at 0.30 cm from the edges.

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

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

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

902.5 Surface Regularity of Pavement Courses :-

The longitudinal profile shall be checked with a 3 Mt. Long straight edge/moving straight edge as directed by the Engineer at the middle of each traffic lane along a line parallel to the center line of the road

The maximum permitted number of surface irregularities shall be as per Table 900.2

Table 900.2 Maximum Permitted Number of Surface Irregularities.

Surface of carriage ways and paved.	Surface of lays, service areas and all bituminous base courses shoulders.							
	4 mm		7 mm		4 mm		7 mm	
Irregularity Length [Mt.]	300	75	300	75	300	75	300	75
National Highways/ Expressways.	20	9	2	1	40	18	4	2
Road of lower Category*	40	18	4	2	60	27	6	3

* Category of each section of road as described in the contract.

The maximum allowable difference between the road surfaced and under side of a 3 Mt. straight edge when placed parallel with or at right angles to the center line of the road at points decided by the Engineer shall be:

For pavement surface [bituminous and cement concrete]	= 3 mm
For bituminous base courses.	= 6 mm
For granular sub base/base course	= 8 mm
For sub base under concrete pavements.	= 10 mm

902.5 Rectification :-

Where the surface regularity of sub grade and the various pavement courses fall outside the specified tolerance the contractor shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer.

Bituminous Constructions :-

For bituminous construction other than wearing course where the surface is low the deficiency shall be corrected by adding fresh materials over a suitable tack coat if needed and recomposing to specification. Where the

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 4 Mt. in length and not less than 3.5 Mt. width.

903 Quality Control Tests During Construction

903.1 General :-

The materials supplied and the works carried out by the contractor shall conform to the specifications of MOST Clause 903.

504.5 Protection of the Layer :-

The bituminous macadam shall be covered with either the next pavement course or wearing course as the case may be within a maximum of 48 Hours. If there is to any delay the course shall be covered by MSS before opening to any traffic to the requirements of Specifications as per Item No.11 of this contract. The MSS in such cases shall be considered incidental to the work and shall not be paid for separately.

504.6 Arrangements for traffic :-

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

112. Arrangement for Traffic during construction :-

112.1 General :-

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

112.2 Passage of Traffic along a part of the Existing Carriageway under Improvement. For widening strengthening existing carriageway where part width of the existing carriageway is proposed to be used for passage of traffic, treated shoulders shall be provided on the side on which work is not in progress. The treatment to the shoulder shall consist of providing at least 150 mm thick granular base course covered with bituminous surface dressing in a width of at least 1.5 Mt. and the surface shall be maintained throughout the period during which traffic uses the same to the satisfaction of the Engineer. The continuous length in which such work shall be carried out would be limited normally to 500 m at a place. However where work is allowed by the Engineer in charge stretches passing places at least 20 Mt. long with additional paved width of 2.5 Mt. shall be provided at every 0.5 K.M. interval.

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

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

112.3 Passage of Traffic along a Temporary Diversion :-

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

- [i] 200mm [compacted] granular sub-base.
- [ii] 225mm [compacted] granular base course and
- [iii] Premix carpet with seal coat/Mix seal surfacing.

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

112.4 Traffic Safety and Control :-

The contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under

improvement, before taking up any construction, as agreed phased programme for the diversion of traffic on the highway shall be drawn up in consultation with the Engineer.

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

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

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

On both sides, suitable regulatory/warning signs as approved by the Engineer shall be installed for the guidance of road users. On each approach, at least two signs shall be put up, one close to the point where transition of carriageway begins and the other 120 Mt. away. The sign shall be of approved design and of reflective type, if so directed by the Engineer.

112.5 Maintenance of Diversions and Traffic Control Devices :-

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

All arrangements for traffic during construction including provision of temporary cross drainage structures, if required, and treated shoulder as described in Clause 112.2 including their maintenance, dismantling and clearing debris, where necessary, shall be considered as incidental to the works and shall be the Contractor's responsibility.

504.7 Measurement for Payment :-

The payment shall be made on the tonnage basis of the weight of mix aggregates and bitumen. For this purpose, the contractor shall have to install a weigh-bridge of suitable capacity for the purpose of weighing dumpers at suitable place at his cost as directed. Weight of empty dumpers 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 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 basic 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 pro-rata basis depending upon the area reduced or exceeded respectively.

Weight of mix materials will be done in presence of responsible person, not less than the rank of Supervisor of Department and the measurements shall be recorded by the Deputy Executive Engineer or Assistant Engineer or Additional Assistant Engineer, if so authorized. Record of each dumper will be mentioned separately in bound and numbered register which will be maintained by the Department representatives and signed by the contractor. Proper gate pass system shall be established for the vehicle coming to the plant site and going from the site. The location of the K.M. hectometer and meter in which individual dumpers are unloaded shall be recorded carefully.

504.8 Rate :-

The contract unit rate for bituminous macadam shall be payment in full for carrying out the required operations as specified. The rate shall include for all components listed below.

- (xi) Making arrangements for traffic to clause 112 except for initial treatment to verge, shoulders and construction of diversions.
- (xii) Preparation of the surface to revive the materials.
- (xiii) Providing all materials to be incorporated in the work including arrangement for stock yards. All royalties, fees rents where necessary and all leads and lifts.
- (xiv) Mixing transporting, laying and compacting the mix as specified.
- (xv) All labour, tools equipment, plant including installation of hot mix plant, power supply units and all machinery incidental to complete the work to these specification.
- (xvi) Carrying out the work in part widths of the road where directed.
- (xvii) Carrying out all tests for control of quality, and

- (xviii) The rate shall cover the provision of bitumen at the rate specified in the contract, with the provision that the variation in actual percentage of bitumen used will be assessed and the payment adjusted accordingly.
- (xix) The rate for premixed material are to include for all wastage in cutting of joints etc.
- (xx) The rates are to include for all necessary testing mix design transporting and testing of samples, and cores. If there is not a project specific : laboratory, the contractor must arrange to carry out all necessary testing at an outside laboratory approved by the Engineer, and all costs incurred are deemed to be included in the rate quoted for the material.
The cost of all plant and laying trials as specified to prove the mixing and laying methods is deemed, to be included in the contractor's rates for the materials
The payment shall be made on M.T. basis..

Item No.11 Providing and laying 25 mm thick compacted Semi Dense Bituminous Concrete using stone chips as per MORT&H gradation & VG-30 grade asphalt for mixing @ 5.0% by weight of total mix for binder including heating the aggregate and asphalt by drum mix plant and spreading the same by paver finisher and consolidation with vibratory roller including providing all materials, equipments, tools and plants, oil, kerosene, fire wood, labour charges etc. complete

Scope

This clause specifies the construction of Semi Dense Bituminous Concrete, for use in wearing/binder and profile corrective courses. This work shall consist of construction in a single or multiple layers of semi dense bituminous concrete on a previously prepared bituminous bound surface. A single layer shall be 25mm to 100mm in thickness.

Materials Bitumen:

The bitumen shall be paving bitumen of Penetration grade complying with Indian Standard Specification for Paving Bitumen, IS: 73 and of the penetration indicated in Table 500-15, for semi dense bituminous concrete, or this bitumen as modified by one of the methods specified in Clause 521, or as otherwise specified in the Contract. Guidance on the selection of an appropriate grade of bitumen is given in The Manual for Construction and Supervision of Bituminous Works.

Coarse aggregates: The coarse aggregates shall be generally as specified in Clause 507.2.2, except that the aggregates shall satisfy the physical requirements of Table 500-14.

Fine aggregates: The fine aggregates shall be all as specified in Clause 507.2.3.

Filler: Filler shall be generally as specified in Clause 507.2.4. Where the aggregates fail to meet the requirements of the water sensitivity test in Table 500-14 then 2 per cent by total weight of aggregate, of hydrated lime shall be added without additional cost.

Aggregate grading and binder content: When tested in accordance with IS:2386 Part 1 (Wet sieving method), the combined grading of the coarse and fine aggregates and added filler shall fall, within the limits shown in table 500-15 for gradings 1 or 2 as specified in the Contract.

Mixture Design

Requirements for the mixture: Apart from conformity with the grading and quality requirements for individual ingredients the mixture shall meet the requirements set out in Table 500-16.

TABLE 500-14. PHYSICAL REQUIREMENTS FOR COARSE AGGREGATE FOR SEMI DENSE BITUMINOUS CONCRETE PAVEMENT LAYERS

Property	Test	Specification
Cleanliness (dust)	Grain size analysis ¹	Max 5% passing 0.075mm sieve
Panicle shape	Flakiness and Elongation Index (Combined) ²	Max 30%
Strength*	Los Angeles Abrasion Value ³	Max 35%
	Aggregate Impact Value ⁴	Max 27%
Polishing	Polished Stone Value ⁵	Min 55
Durability	Soundness: ⁶	
	Sodium Sulphate	Max 12%

Water Absorption	Magnesium Sulphate	Max 18%
Stripping	Water absorption ⁷	Max 2%
Water Sensitivity**	Coating and Stripping of Bitumen Aggregate Mixtures ⁹	Minimum Retained Coating 95%
	Retained Tensile Strength ⁸	Min 80%

Notes: 1. IS: 2386 Part 1 6. IS: 2386 Part 5

2. IS: 2386 Part 1 7. IS: 2386 Part 3

(the elongation test may be done only on non-flaky aggregates in the sample)

3. IS: 2386 Part 4* 8. AASHTOT283**

4. IS: 2386 Part 4* 9. IS: 6241

5. BS: 812 Part 114

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

** The water sensitivity test is only required if the minimum retained coating in the stripping test is less than 95%.

The requirements for minimum per cent voids in mineral aggregate (VMA) are set out in Table 500-12.

Binder content: The binder content shall be optimised to achieve the requirements of the mixture set put in Table 500-16 and the traffic volume as specified in the Contract. The Marshall method for determining the optimum binder content shall be adopted as described in the Asphalt Institute Manual MS-2, replacing the aggregates retained on the 26.5mm sieve and retained on the 22.4mm sieve, where approved by the Engineer.

**TABLE 500-45. COMPOSITION OF SEMI DENSE BITUMINOUS CONCRETE
PAVEMENT LAYERS**

Grading	1	2
Nominal aggregate size	13mm	10mm
Layer Thickness	35-40 mm	25-30 mm
IS Sieve ¹ (mm)	Cumulative % by weight of total aggregate passing	
45		
37.5		
26.5		
19	100	
13.2	90-100	100
9.5	70-90	90-100
4.75	35-51	35-51
2.36	24-39	24-39
1.18	15-30	15-30
0.6	--	--
0.3	9-19	9-19
0.15	--	--
0.075	3-8	3-8
Bitumen content % by mass of total mix ³	Min 4.5	Min 5.0
Bitumen grade (pen)		60/70 VG30

Notes: 1. The combined aggregate grading shall not vary from the low limit on one sieve to the high limit on the adjacent sieve.

2. Determined by the Marshall method.

* Only in exceptional circumstances, 80/100 penetration grade may be used, as approved by the Engineer.

TABLE 500-16.
REQUIREMENTS FOR SEMI DENSE BITUMINOUS
PAVEMENT LAYERS

Minimum stability (kN at 60°C)	8.2
Minimum flow (mm)	2
Maximum flow (mm)	4
Compaction level (Number of blows)	75 blows on each of the two faces of the specimen
Per cent air voids	3-5
Per cent voids in mineral aggregate (VMA)	See Table 500-12
Per cent voids filled with bitumen (VFB)	65-78

Job mix formula: The procedure for formulating the job mix formula shall be generally as specified in Clause 507.3.3 and the results of tests enumerated in Table 500-16 as obtained by the Contractors.

Plant trials - permissible variation in job mix formula:

The requirements for plant trials shall be all as specified in Clause 507.3.4. and permissible limits for variation as shown in Table 500-13.

Laying trials: The requirements for laying trials shall be all as specified in Clause 507.3.5.

Construction Operations

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

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

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

Stress absorbing layer: Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements of Clause 522.

Tack coat: Where specified in the Contract, or otherwise required by the Engineer, a tack coat shall be applied in accordance with the requirements of Clause 503.

Mixing and transportation of the mixture: The provisions as specified in Clauses 501.3 and 501.4 shall apply.

Spreading: The general provisions of Clauses 501.5.3 and 501.5.4 shall apply.

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

Opening to Traffic

The newly laid surface shall not be open to traffic for at least 24 hours after laying and the completion of compaction, without the express approval of the Engineer in writing.

Surface Finish and Quality Control

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

Arrangements for Traffic

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

Measurement for Payment

The measurement shall be based on MT.

Rate

The contract unit rate shall be all as specified in Clause 507.9. except that the rate shall include the provision of bitumen at 4.75 per cent, by weight of total mixture. The variance in actual percentage of bitumen used will be assessed and the payment adjusted up or down, accordingly.

Item No.12 Providing and laying asphalt painting on B.T. surface with bitumen VG-30 at rate 5.00Kg / 10Sq.mt. and spreading stone dust for painting surface at rate of 0.03 cu.mt. / 10 sq.mt.

1 Scope :-

This work shall consist of the application of a single coat of bitumen VG-30 grade to an existing bituminous road surface in accordance with the following specifications.

2 Materials :-

2.1 Bitumen :-The bitumen used for asphalt painting shall be VG-30 grade complying with IS: 73 or as directed by the Engineer. :-

2.2.1. This shall be obtained from crushing hard black trap or equivalent. It shall not contain more than 8% of silt as determined by field test will measuring cylinder. The method of determining silt contents by fields test is given as under :

2.2.2. A sample of stone dust to be tested shall be placed without drying in 200 mm. measuring cylinder. The quantity of the sample shall be such that it fills the cylinder up to 100 mm. mark. The clean water shall be added up to 150 mm. mark. The mixture shall be stirred vigorously and the content allowed to settle for 3 hours.

2.2.3. The height of silt, visible as settled layer above the stone dust shall be expressed as percentage of the height of the stone dust below The stone dust containing more than 8% silt shall be washed so as to bring the content within the allowable limit.

2.2.4. The fineness modules of stone dust shall not be less than 1.80

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 then 10⁰ C.

4 Construction :-

4.1 Equipment :-

The asphalt painting shall be applied through a distributor and it 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 in narrow strips, shall be sprayed with a pressure hand sprayer or as directed by the Engineer.

4.2 Preparation of base :-

The surface on which the asphalt painting is to be applied shall be clean and free from dust, dirt and any extraneous material and other wise prepared in accordance with the requirements of Clauses-501.8 & 513 of MORT & H as appropriate. Immediately before the application of the asphalt painting the surface shall be swept clean with a mechanical broom and high-pressure air jet or by other means as directed by the Engineer.

4.3 Application of asphalt painting :-

The application of asphalt for painting shall be at 5.0 Kg/ 10 Sq.mt. as specified in the contract and shall be applied uniformly. The asphalt shall be heated in the tanker and the temperature of the asphalt at the time of spraying shall be in the range of 150⁰C -177⁰C.

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 a spraying trial that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

5.0 Spreading of Stone Dust

Soon after the spraying of asphalt, the stone dust shall be spread evenly with a twisting motion of baskets at the rate of 0.03Cum/10 Sqm. The entire surface shall be broomed to ensure uniform application of the stone dust. While the traffic is allowed on the painted surface and at later stage if additional stone dust is required, it shall be carried out by the contractor without any extra payment.

6.0 Opening to Traffic :-

Traffic may be allowed immediately after completion of flushing of stone dust on asphalt painted surface.

7.0 Arrangement of Traffic :-

The provision of MOST Specification Clause 112 shall apply as regards the flow of traffic during construction.

8.0 Mode of Measurement & Payment :

The Item shall be measured and paid as finished work in Square meters. The rates shall include the cost of all materials, labour, equipments etc. involved in all the operations described above. The rate shall be for a unit of one sq. meter.

Item No.13 Excavation for foundation upto 1.5 m. depth including sorting out and stacking of useful material and disposing off the excavated stuff as directed by Engineer in charge with all lead and lift in (a) Dense or hard soil murrum etc. complete

1. Excavation for structures shall consist of the removal of material for the construction of foundations for bridges, culverts, retaining walls, headwalls, cut off walls, pipe culverts and other similar structures, in accordance with the requirements, of these specifications and the lines and dimensions shown on the drawings or as indicated by the Engineer-in charge. The work shall include all necessary sheeting, shoring, bracing, draining and pumping and the removal of all logs, stumps, shrubs, and other deleterious matter and obstruction necessary for the foundations, trimming bottoms of excavations; back filling and clearing up the site and the disposal of all surplus material.
2. After the site has been cleared the limits of excavation shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer-in-charge. The contractor shall provide all labour, survey instruments and materials such as strings, pegs nails bamboos, stones, lime, mortar, concrete etc. required in connection with the string out of works and the establishment of bench mark, centre line 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 expense shall put up necessary shoring, strutting and planking or cut slopes to a safer angle or both with due regard to the safety of personal 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, seepage, springs, rain or other reasons, the contractor shall take adequate measures such as bailing .pumping, to keep the foundation trenches dry when so required and to protect the green concrete/ masonry against damage by erosion or sudden rising of water level. The methods to be adopted in this regard and other details thereof 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 production arrangements and for the quality and safety of the works.
6. Pumping from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of movement of water through any fresh concrete. No. pumping shall be permitted during the placing of concrete or for any period of at least 24 hours thereafter, unless it is done from a suitable sump separated from the concrete work by a water tight wall or other similar means.
7. The bottom of the foundation shall be leveled 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 on the drawings or as otherwise ordered by the Engineer-in-charge, the extra depth shall be made up with concrete or masonry of the foundation grade at the cost of the contractor. Ordinary filling shall not be used for the purpose to bring the foundation 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 foundation pits shall be securely fenced, provided with proper caution signs and marked with red lights at night to avoid accidents. The contractor shall take adequate protective measures to see that the excavation operations do not affect or damage adjoining structures.
9. Backfilling shall be done with approved materials after concrete or masonry is fully set and carried out in such a way as not to cause undue thrust on any part of the structure. All space between foundation masonry or concrete and the sides of excavation shall be refilled to the original surface, making due allowance for settlement in 250 mm. loose layers, which shall be watered and compacted.
10. All the excavated materials shall be the property of the Government. Where the excavated materials are to be used in the construction of embankment, it shall be directly deposited at the required location, with all lead as directed.
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 with all lead. Unsuitable and surplus materials not intended for use shall be disposed off as directed by the Engineer-in-charge.
12. Excavation for structures shall be measured in cubic meters for each class of materials encountered, limited to the dimensions shown on the drawing or as directed by the Engineer-in-charge. Excavation over increased width cutting of slopes, shoring, shuttering 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 structures shall be paid in full for carrying out the required operations including :-

1. Setting out and fixing bench marks and centre lines stones.
2. Construction of necessary shoring and bracing and their subsequent removal.
3. Removal of all logs, stumps, Grubs and other deleterious matter and obstructions 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 material within all lifts and lead;
6. All labour, materials, tools equipment, safeguards and incidentals necessary to complete the work to the specification.
14. Excavation shall be for dense or hard soil such as vegetation or organic soil, turf, sand, silt, loam, clay, mud, black cotton soil, soft shale or soft murrum, and similar material which yields to the ordinary application of pick and shovel, or other ordinary digging equipment. Removal of gravel or any other nodular material having diameter in any one direction not exceeding 75 mm. 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.14 Providing & filling in foundation with ordinary cement concrete M 100 mix & providing necessary vertical pin headers including formwork, vibrating ramming and curing complete.

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 table below for different grades of concrete designated as ordinary M. 100, M. 150, M.200 and M.250.
2. In the designation of a concrete mix, Letter "M" refers to the mix and the number the specified 28 days works cube compressive strength of that mix on 150 mm. cubes expressed in kg./cm².
3. The ordinary concrete mix shall generally be specified by volume. For cement which normally comes in bags and is used by weight, volume shall be worked out taking 50 kg. of cement as 0.035 cubic metre in volume. While measuring aggregate 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).
4. Ingredients required for ordinary concrete containing one 50 Kg. bag of cement of different proportions of mix shall be as given in Table below.

TABLE

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 max.	Proportion of fine aggregate to coarse aggregate	Quantity of water per 50 Kg. of cement max.
1	2	3	4	5
(1 Cubic metre = 1000 Liters)				
Ordinary	Liters			Liters.
M.100	1 :3:6	300	General 1:2 for fine aggregate to coarse aggregate by volume but subject to a upper limit of 1 : 1. 1/2 & a lower limit of 1 :3	34
M.150	1:2:4	220		32
M.200	1:1. 1/2:3	160		30
M.250	1:1:2	100		27

NOTE - The proportions 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 coarse aggregate becomes larger.

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

Note-2 A mix leaner than M.100 (1:3:6) may be used for non- structural parts, if provided in the contract. In such case grading of aggregates shall be by volume. Other requirements for mixing, placing & curing shall be the same. Following shall be the maximum nominal size of coarse aggregate for the different items of work:
coars, kerb, light posts blast walls, approach slab etc.
and hollow type piers abutments, wing-walls and their pier caps.

Sr. No.	Item of construction	Maximum nominal size of coarse aggregate
(i)	RCC well curb , R.C.C well staining and RCC piles	40 mm.
(ii)	R.C.C. well steining	63 mm.
(iii)	Well cap or pile cap; solid type piers, abutment and wing-walls, and their pier caps	40 mm.
(iv)	R.C.C. works in cross girders deck slab, wearing	20 mm.
(v)	R.C.C. bearings.	20 mm.
(vi)	For any other item of construction not covered by items (i) to (v)	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's maximum size of aggregate shall usually be restricted to 5 mm. less than the minimum lateral clear distance between the main bars or 5 mm. less than the minimum cover to the reinforcement, whichever is the smaller.

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

7. All materials shall be stored as to prevent their deterioration or intrusion 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 water tight sheds. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. The aggregate shall be stored in such a way as to prevent admixture of foreign materials. Different size of fine or coarse aggregate shall be stored in separate stock-piles sufficiently away from the each other to prevent intermixing the materials.

9. The water for mixing shall be potable water to satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce 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 the entire mass is obtained and each individual particle of the coarse aggregate show complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.

11. 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 ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material shall get mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate. Which shall also be spread in a layer of uniform thickness on the mixing platform. Dry coarse and fine aggregate and cement shall then be mixed thoroughly by turning over to get a mixture of uniform colour. Enough water shall then be added gradually through a rose can 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 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 Engineering-in charge. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes places. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.

14. If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting being given, it shall proceed continuously over the area between construction joint. 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 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to be the Engineer-in-charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 metre when internal vibrators are used and not exceeding 0.30 metre 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 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 13 mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. , Where concrete has not fully hardened, all laitance shall be removed by scrubbing the well surface with wire or 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 layer of concrete to be placed on this surface shall not exceed 150 mm. in thickness, and shall be well rammed against old work particular attention being given to corners and close spots.

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

17. Immediately after compaction, concrete shall be protected against harmful effects of weather, including rain, running water, shocks, vibration, traffic, rapid temperature changes, frost and driving out process. It shall be covered with wet sacking, 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. Masonry work over the foundation concrete may be started after 48 hours of its laying but the curing of concrete shall be continued for a minimum period of 14 days.

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

- (1) Shuttering i.e., form work required for forming the concrete.
- (2) Scaffolding i.e., form-work required for supporting shuttering.

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

19. Forms shall be mortar-tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports,. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribe lines occurring during and after placing the concrete. Screw jacks or hard wood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete. Suitable member shall be provided in horizontal members of structure, especially in long spans to

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

21. Special measures shall be taken to ensure that the form work does not hinder the shrinkage of concrete because without these cracking could occur before the form work is removed. 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 form work should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape of the structures having regard to the deformation of a false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting prestressed structures. Where there are re-entrant angles in the concrete sections the form work should be removed at those sections as soon as possible after the concrete has set in order to avoid cracking due to shrinkage of concrete. Formwork shall be tight enough to prevent any appreciable loss of cement during vibrations, suitable tolerances should be provided in the form work. 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 inspection shall not relieve the contractor of his responsibility for safety of men, machinery, materials and for results obtained.

22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of formwork, due consideration shall be given to local conditions, 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 strength tests of concrete, the removal of the load-supporting or soffit forms may 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 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 reuse the formwork, it shall be cleaned and made good to the satisfaction of the Engineer-in-charge.

23. Immediately after the removal of forms, all exposed bars or bolts passing through the Cement concrete member and used for shuttering or any other purpose shall be cut inside the cement concrete member to a depth of at least 25 mm. 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, honey comb spots, broken edges or corners and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry as consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been pointed shall be kept moist for a period of twenty four hours. If rock pockets/honeycombs, in the opinion of the Engineer-in-charge are of such an extent or character as to affect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected.

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

Type of Work	SlumpsWhere 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.	80mm.
(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. Works 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 01.18 for every 5 cubic metre of concrete or a part thereof. However, if concreting done in a day is less than 15 cubic meter the minimum number of cubes can be reduced to 6 with, the specific permission of the Engineer-in-charge. Similar works tests shall be carried out whenever the quality and grading of materials is charged irrespective of the quantity, of concrete provided. 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 at cubes cast for each day shall not be less than the specified works cube-strength, 20 per cent of the cubes cast for each day may have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specified strength.

27. R.C.C. Work shall have exposed concrete surface. Centering design and its erection shall approved by the Engineer-in-charge. One carpenter with helper will invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position for access to different parts, suitable mobile platforms shall be 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, kapchi or metal pieces shall not be used for this purpose. Concreting of important structural members shall always be done in the presence and under the supervision of a competent person not below the rank of Asst. Engineer/Addl. Asst. Engineer Overseer or as instructed by the Engineer-in-charge. After removal of form work checks that concrete produced is of good quality. Plastering shall not be allowed to the exposed faces of concrete.

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

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

30. The payment will be made on cmt. basis of the finished work.

31. The unit rate for concrete shall include the cost of all materials, labour, tools and plan required for mixing, placing in position, vibrating and compacting finishing as per directions of the Engineer-in-charge, curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as 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.15 Providing & casting in situ ordinary cement concrete M 150 mix and providing necessary pinheaders including , shuttering scaffolding laying vibrating and finishing without V-Grooves. (A) Height from 0.0 m to 5.0m for head wall of causeway

1. In case of ordinary concrete, mix is not required to be designed by preliminary tests and proportions of cement, fine aggregate and coarse aggregate are specified by column as given in tables below for different grades of concrete designated as ordinary M – 100 M – 150 M – 200 and M – 250 .

2. In the designation of a concrete mix, letter “ M “ refers to the mix and the number the specified 28 days works cube compressive strength of that mix on 150 mm cubes, expressed in Kg /cm².

3. The ordinary concrete mix shall generally be specified by volume shall be worked out taking 50 Kg of cement as 0.035 cubic meter in volume . While measuring aggregate 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 – II).

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

Grade of Concrete	Mix by volume	Total quantity of dry aggregate by volume per 50 kg of cement to be taken as sum of the individual volumes of fine and coarse aggt max	Proportion of fine aggt. to coarse aggregate	Quantity of water per 50 Kg of cement mix
1	2	3	4	5
(1 Cubic metre = 1000 Litres)				
Ordinary	Liter		General 1:2 for fine aggregate to coarse aggregate by volume but subject to a upper limit 1:1 ½ & a lower limit of 1:3	
M- 100	1:3:6	300		34
M- 150	1:2:4	20		32
M- 200	1:1 ½ :3	160		30
M- 250	1:1:2	100		27

Note :- The proportions of the aggregate shall be adjusted from upper limit to lower limit progressively as the grading of the fine aggregates becomes finer and the maximum size of coarse aggregate becomes larger.

Example :- For an average grading of line aggregate (that is zone II of IS : 383 – 1963) the proportions shall be 1:1, 1:2 and 1:3 for maximum size of aggregates 0 mm 20 mm and 40 mm respectively (after carrying out sieve analysis.

Note 2 :- A mix leaner than M – 100 (1:3:6) may be used for non structural parts, if provided in the contract. in such case grading of aggregate shall be by volume . other requirement for mixing, placing and curing shall be the same

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

Sr. No.	Item of construction	Maximum nominal size of coarse aggregate
(i)	RCC well curb, RCC well steining and RCC piles	40 mm
(ii)	RCC well seining	60 mm
(iii)	Well cap or pile cap, solid type piers, abutment and wing walls and their pier caps.	40 mm
(iv)	RCC work in cross girders deck slab, wearing coars, kerb, light ports, blast walls, approach slab etc and hollow type piers, abutment wings wall and their pier caps	20 mm
(v)	For any other item of construction not covered by item (i) to (v)	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 cover to the reinforcement, whichever is the smaller.

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

7. All materials shall be stored as to prevent their deterioration or instruction of their quality and fitness for the work. Any materials which has deteriorated or has been damaged or is other wise considered defective by the Engineer – in – charge shall not be used in the works.
8. Cement shall be stored above the ground level in perfectly dry and water tight sheds. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirement at sit and should be cleaned at least once every 3 to 4 months. The aggregate shall be stored in such a was as to prevent admixture of foreign materials. Different size of fine or coarse aggregate shall be stored in such a way as to prevent admixture of foreign materials. Different size of fine or coarse aggregate shall be stored in separate stock piles sufficiently away from the other to prevent iner mixing the materials.
9. The water for mixing shall be potable water to satisfaction of the engineer in charges. The quantity 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 through out the construction . Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate show complete coating mortar containing its proportionate amount of cement in no case shall the mixing the done for less than 2 minutes after all ingredients have been put in to the mixer
11. When hand mixing is permitted by the Engineer in charge for small jobs or for certain other reasons. It shall be on a smooth water tight platform large enough to allow efficient turning over of the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign, materials shall get mixed with concrete not does the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate. which shall also be spread in a layer of uniform thickness on the mixing platform. Dry coarse and fine aggregate and cement shall then be mixed thoroughly by turning over to get a mixture of uniform colour. Enough water shall then be added gradually through a rose can and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increase 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 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 materials takes places. All from work and reinforcement contained in it shall be cleaned and made free from standing water, dust snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer – in – charge has been obtained
14. If concreting is not started within 24 hours of the approval being given, It shall have to be obtained again from the Engineer- in – charge .Concreting being given it shall proceed continuously over the area between construction joins . 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 2 hours of the additional of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise depth of not more than 45 metre when internal vibrators are used and not exceeding 0.30 metre in all other cases.
15. Unless otherwise agreed to by the engineer in charge concrete shall not be dropped in to place from a height exceeding 2 metres. When trunking of chutes are used they shall be kept clean and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept, clean, thoroughly wetted and covered with a 13 mm thick layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the well surface with wire or bristly 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 150 mm in thickness, and shall be well rammed against old work particular attention being given to comers and close spots .
16. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless otherwise permitted by the engineer – in – charge for exceptional cases, such as concreting 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 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 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 period of 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. The water for mixing shall be potable water to satisfaction of the engineer in charges. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.

(a) Shuttering i.e., form work required for forming the concrete

(b) 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 of substantial rigid construction and shuttering shall be true to shape and dimensions shown on the drawings. All bolts and rivets shall be counter sunk and well ground to provide a smooth, plane surface.

19. Forms shall be mortar tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports,. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribe lines occurring during and after placing the concrete. Screw jacks or hard wood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of structure, specially in long spans to counteract the effects of any 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 sized 25mm x 25 mm 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 pre stressing tendons and anchorages. Different release agents shall not be used in formwork for concrete which will be visible in the finished works.

21. Special measurements shall be taken to ensure that the form work does not hinder the shrinkage or concrete because without these cracking could occur before the form work is removed. Wherever 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 of the structures having regard to the deformation of a false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting pre stressed structures. Where 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 tolerances 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 inspection shall not relieve the contractor of his responsibility for safety of men, machinery, materials and for results obtained.

22. The Engineer in charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of formwork, due consideration shall be given to local conditions, 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 strength tests of concrete, the removal of the load supporting or soffit forms may commence when concrete has attained strength equal to atleast 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 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 25mm. cover to the finished concrete surface. Where it is intended to refuse the formwork, it shall be cleaned and made good to the satisfaction of the Engineer in charge.

23. Immediately after removal of forms, all exposed bars or bolts passing through the Cement concrete member and used for shuttering or any other purpose shall be cut inside the cement concrete member to a depth of atleast 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 or corners and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry as consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been pointed shall be kept moist for a period of twenty four hours. If rock pockets/honeycombs, in the opinion of the Engineer in charge are of such an extent or character as to affect the strength to the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected.

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

Sr. No.	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. 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 less than 15 cubic metre the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer in charge.

Similar works tests shall be carried out whenever the quality and grading of materials is charged irrespective of the quantity of concrete pour. The number of specimens may be suitably increased as deemed necessary by the Engineer in charge when procedure of tests given above reveal a poor quality of concrete and in other special cases.

26. The average strength of the group of cubes cast for each day shall not be less than the specified works cube strength, 20 per cent of the cubes cast for Each day may have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specific 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 present 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 is not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber, kapchi or metal pieces shall not be used for this purpose. Concreting of important structural members shall always be done in the presence and under the supervision of departmental person not below the rank of Asstt. Engineer / Addl. Asstt. Engineer, Overseer or as instructed by the Engineer in charge. After removal of form work checks that concrete produced is of good quality. Plastering shall not be allowed to the exposed faces of concrete.

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

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

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

Item No.16 *Constructing of Granular sub-base Gr-II by providing course graded B.T. machine crushed material satisfying MOST specification of (grading II) using materials (26.5 mm to 4.75 mm@ 75 per cent, 2.36 mm below@25 per cent) including spreading in uniform layer with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC and compacting with vibratory roller to achieve the desired density etc. complete.*

The work of Constructing of Granular sub-base Gr-II by providing course graded B.T. machine crushed material satisfying MOST specification of (grading II) using materials (26.5 mm to 4.75 mm@ 75 per cent, 2.36 mm below@25 per cent) including spreading in uniform layer with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC and compacting with vibratory roller to achieve the desired density etc. complete as per relevant specifications of **Item No.4** of this contract. The measurement shall be in cum.

Item No.17 *Supplying, fixing & joining reinforced concrete heavy duty non pressure pipe for culverts carryig heavy traffic as per Indian Railway Standard Specifications including setting and joining the pipe in cement mortar 1:2 watering and laying (to level or slope) of I.S. class NP-3 900 mm dia.(Internal)*

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

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

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

FORM OF CERTIFICATE FOR NP3, NP2, NP1 PIPES

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

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

Date : _____

Place : _____ Manufacturer's Sign. _____

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

- The pipes shall be jointed either by collar joint or by flush joint. In the former case, the collars shall be of R.C.C., 150 to 200 mm wide and having the same strength as the pipes to be jointed. Caulking space shall be between 13 and 20 mm according to the diameter of the pipes. Caulking material shall be slightly wet mix of cement and sand in

the ratio of 1:2 rammed with Caulking irons. Before caulking the collar shall be so placed that its centre coincides with that of pipe and an even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self centering joint with a joining space 13 cm wide. The joining space shall be filled with cement mortar. 1 cement to 2 sand, mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care shall be taken to fill all voids and excess mortar shall be removed. All joints shall be made with care so that their interior surface is smooth and consistent with the interior surface of the pipes. After finishing, the joint shall be kept covered and damp for at least four days.

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

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

Item No.18 Wall painting two coats with plastic emulsion paint of approved brand and manufacturer on wall surfaces to give an even shade including thoroughly brushing the surface to remove all dirt, dust, mortar drops and other foreign matter.

1.0. Materials

The plastic emulsion shall conform to I.S.: 5411-1969 (part-I).

2.0. Workmanship

2.1. Preparation of surface :

2.1.1. The undecorated surface to be painted shall be thoroughly brushed from dust, dirt, grease, mortar dropping and other foreign matter and sand papered smooth. New plaster surface shall be allowed to dry for at least 2 months before applications of paint.

2.1.2. All unnecessary nails shall be removed. Pitting in plaster shall be made good with plaster again with a fine grade sand paper and made smooth. A coat of paint shall be applied over the patches. The surface shall be allowed to dry thoroughly before the regular coat of paint is allowed. The surface affected by moulds, moss, fungi, algae lichens, efflorescence etc. shall be treated in accordance with I.S; 2395 (Part 01) 1966. Before applying painting, any unevenness shall be made good by applying putty made of plaster of pairs mixed with water on entire surface including filling up the undulation and then sand papering the same after it is dry.

2.2. Preparation of Mix :

This shall be done as per manufacture's instructions. The thinning of emulsion is to be done with water and not with turpentine. The quantity of thinner to be added shall be as per manufacturer instructions.

2.3. Application :

2.3.1. Before pouring into small containers for use, the paint shall be stirred thoroughly in item container. When applying also, the paint shall be continuously stirred in the smaller container, so that its consistency is kept uniform.

2.3.2. The paint shall be laid on evenly and smoothly by means of crossing and laying off the crossing and consist of covering the area over with paint, brushing the surface hard for the first time over and then, brushing alternately in opposite direction two or three times and then finally brushing lightly in direction at right angles to the same. In this process, no brush Marks shall be left after the laying off is finished. No hair marks from the brush or clogging of paint puddles in the corners of panels, angles of moldings, etc. shall be left on the work. The full process of crossing and laying off will constitute one coat.

2.3.3. The paint shall be applied with brush or rollers. For undecorated surfaces, the surface shall be treated with minimum two coats of cement water proofing paint. The second or subsequent coat shall not be started until the proceeding coat as become sufficiently hard to resist marking by brushing being used.

2.3.4. The surface on finishing shall present a flat velvety smooth finish. It shall be even and uniform in shade without patches, brush marks, paint drops etc.

2.3.5 The shade of colour and pattern of paint to be applied on wall surface shall be got approved from the Engineer in charge before carrying out the work.

2.4. Precautions :

(a) Old brushes if they are to be used with emulsion paints, shall be completely dried of turpentine or oil paint by washing in warm soap water. Brushes shall be quickly washed in water immediately after use and kept immersed in water fusing break periods to prevent the paint from hardening on the brush.

(b) In the preparation of wall for plastic emulsion painting, no oil base petals shall be used in filling cracks, holes etc.

(c) Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.

(d) Washing or surfaces treated with emulsion paint shall not be done within 3 to 4 weeks of application

3.0. Mode of measurement & payment

3.1. Wall painting shall be measured in the decimal system as under:

- (a) Dimensions shall be measured to the nearest 0.01 m.
- (b) Area in individual item shall be worked out to the nearest 0.01 sq.m.

All the work shall be measured in sq. mt.

3.2. No deductions shall be made for ends of joists, 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 not for finish around ends of joints, beams, posts etc.

3.3. No deductions for openings exceeding 0.5 sq.mt. but not exceeding 3 sq. mt. each shall be made as follows and no addition will be made for reveals, jambs, soffits etc. of these openings :

- (a) When both the faces of walls are provided with finish, deduction shall be made for one face only.
- (b) When each face 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.

3.4. The rate shall be for a unit of One sq. meter.

Item No.19 Providing & Fixing ordinary K.M. Stone Precast C.C. 1:2:4 including necessary reinforcement as per I.R.C. type design in C.C. 1:4:8 including painting and lettering etc. complete

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

Item No.20 Providing & Fixing Hectometer stone as per I.R.C. type design including painting, lettering etc. complete (i) Fixing in C.1:5:10

1. The work shall be carried out as per the item of ordinary kilometre stone except that the size of Hectometre stone shall be smaller than that of ordinary kilometre stone as per I.R.C. 26 (Type design for 200 metre stones) and fixing shall be in earth. The measurement for payment as well as the operations included in the unit rate shall be as per ordinary kilometres stone.

Item No.21 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 phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.3mtr 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 Grade

GENERAL

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

801.1.2 The signs shall be either reflectorised or non-reflectorised as shown on the drawing or as directed by the Engineer. When they are of reflectorised type, they shall be of retro-reflectorised type and made of encapsulated lens type reflective sheeting vide Clause 801.3, fixed over aluminium sheeting as per these Specifications.

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

801.2 MATERIALS

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

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

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

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

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

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

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

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

801.3 TRAFFIC SIGNS HAVING RETRO-REFLECTIVE SHEETING

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

801.3.2 High Intensity Grade Sheetting : This sheet 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 CO-EFFICIENT 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 per cent of its original retro reflectance.

801.3.3 Engineering grade sheetting : This sheeting shall be of enclosed lens type consisting of microscopic lens elements embedded beneath the surface of a smooth, flexible, transparent, water-proof plastic, resulting in a non-

exposed lens optical reflecting system. The retro reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined In accordance with ASTM Standard :E-81 0) as indicated in Table 800-2.

Table 800 – 2

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

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

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

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

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

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

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

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

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

801.3.8 Adhesives: The sheeting shall either have a pressure sensitive adhesive of the aggressive-tack type requiring no heat, solvent or other preparation for adhesion to a smooth clean surface, or a tack free adhesive activated by heat, applied in ct, heat-vacuum applicator, in a manner recommended by the sheeting manufacturer. The adhesive shall be protected by an easily removable liner (removable by peeling without soaking in water or other solvent) and shall be suitable for the type of material of the base p1ate 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. Sheetting with adhesives requiring use of solvents or other preparation for adhesive shall be applied strictly In accordance with the manufacturer's instructions.

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

801.3.10 FABRICATION :

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

801.3.10.2 Complete sheets of the material shall be used on the signs except where it is unavoidable; at splices, sheeting with pressure sensitive 1 adhesives shall be overlapped not less than 5 mm. Sheeting with heat activated adhesives may be spliced with an overlap not less than 5 mm or butted with a gap not exceeding 0.75 mm. Where screen printing with transparent colours is proposed, only butt jointing shall be used. The material shall cover the sign surface evenly and shall be free from twists, cracks and folds. Cut-outs to produce legends and borders shall be bonded with the sheeting in the manner specified by the manufacturer.

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

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

801.4 INSTALLATION

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

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

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

801.5 MEASUREMENTS FOR PAYMENT

The measurement of standard cautionary, mandatory and information signs shall be in numbers of different types or signs supplied and fixed.

801.6 RATE

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

Item No.22 *Providing & fixing junction boards made out of 2mm aluminium sheet size 244 X 122 cms rectangle as per the design of IRC-67-1977. Pre treated with phospheting process and acid etching, coated of best quality epoxy paint reflectorised with retro reflective sheeting as per latest M.O.S.T. specification, 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 5 mm, 75 X 75 X 6 mm as required, painted with best quality epoxy coatings in black and white bend. 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 C.C. block of size 45 X 45 X 60cms for each leg. including excavation, curing etc. complete under the supervision of engineer in Charge. (A) Engineering Grade*

The work of Providing & fixing junction boards made out of 2mm aluminium sheet size 244 X 122 cms rectangle as per the design of IRC-67-1977. Pre treated with phosphating process and acid etching, coated of best quality epoxy paint reflectorised with retro reflective sheeting as per latest M.O.S.T. specification, 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 5 mm, 75 X 75 X 6 mm as required, painted with best quality epoxy coatings in black and white bend. 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 C.C. block of size 45 X 45 X 60cms for each leg. including excavation, curing etc. complete under the supervision of engineer in Charge. (A) Engineering Grade as per relevant specifications of **Item No. 21** of this contract. The measurement shall be in number of Junction Board supplied and fixed in position.

Item No.23 MMGSY Logo Board:- Providing and fixing Logo Board made out of 2mm aluminium sheet, as per the drawing & design. Pre treated with phosphating process and acid etching coated with one coat of epoxy primer and two coat of best quality epoxy paint, reflectorized with retro reflective sheeting as per the latest M.O.S.T. specification, 3.1 Mt. long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3 mm, 75 x 75 x 6 mm as required painted with best quality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 cms for each leg, including excavation curing etc. complete under the supervision of Engineer-In-Charge (A)Engineer grade.

The work of MMGSY Logo Board:- Providing and fixing Logo Board made out of 2mm aluminium sheet, as per the drawing & design. Pre treated with phosphating process and acid etching coated with one coat of epoxy primer and two coat of best quality epoxy paint, reflectorized with retro reflective sheeting as per the latest M.O.S.T. specification, 3.1 Mt. long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3 mm, 75 x 75 x 6 mm as required painted with best quality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 cms for each leg, including excavation curing etc. complete under the supervision of Engineer-In-Charge (A) Engineer grade as per relevant specifications of **Item No. 21** of this contract. The measurement shall be in number of Junction Board supplied and fixed in position.

Signature of the contractor

Deputy Executive Engineer,
Panchayat (R&B) Sub Division
Valsad

Executive Engineer,
Panchayat (R&B) Division
Valsad

- : SCHEDULE FOR TESTING OF MATERIALS :-

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

It. No. as per schedule "B"	Brief description of materials to be tested	Qty of material	Prescription of test which shall be carried out	Frequency at which test shall be carried out	Total No of test to be taken.
1]	Coarse Aggregate		- Gradation test - Impact value - Flakiness and elongation	1 to 100 cm 1 test 100 to 500 cm 3 test 500 to 1500 cm 5 test 1500 to 5000 cm 7 test Minimum 1 test/ work	
2]	Grit		- Stripping value	As above	
3]	Granular materials		- Gradation - Atterbeg limits	As above	
4]	Murum		- P I Value	One test per 50 cum.	
5]	Sand/ quarry spall		- Silt content - Gradation - CBR test	One test per work/ season One test per 200 cmt. One test per work	
6]	Asphalt		1 Penetration test as per IS 1203 2 Ductility test as per IS 1208 3 Specific gravity test as per IS 1202 4 Softening point test as per IS 1204 5 Viscosity test as per IS 1206	1 to 10 tanker 1 test 11 to 20 tanker 2 test 21 to 50 " 3 test 51 to 100 " 4 test Remaining every 50" 1 test	
7]	Cement		- Consistency - Setting time - Compressive strength - Fineness - Chemical analysis - Soundness	Up to 50 MT 1 test 100 MT 2 test 200 MT 3 test 300 MT 4 test 500 MT 5 test 800 MT 6 test 1300 MT 7 test and 8 test for larger consignment	
8]	CC Cubes		- Compressive Strength (I.S. 519 – 1959)	1 to 5 cms 1 No 6 to 15 cms 2 No 16 to 20 cms 3 No 21 to 50 cms 4 No 51 and above 4 + 1 (For each additional 50 m ³ or part thereof)	

9]	Water		- Chemical test	Once for approval of source of supply	
10]	Steel		- Tensile Strength - Yield Stress - Elongation - Size	1 test/ 40 tonnes/ per category	
11]	Bricks		- Water absorption - Efflorence - Size - Compressive Strength	1 test per 50,000 bricks	
12]	Prime coat/ Tack coat		- Quality of binder - Binder temperature for application - Rate of spread of binder	Number of samples per lot and test as per IS:73 At regular close intervals Two test per 500 m ² and not less than two test per day	
13]	Carpet and Seal coat mix/ B.M/ M.S.S.		- Quality of binder - Grading - Temperature of binder - Binder content vide 45 IMD 2172 - Rate of spread of mix materials	Number of samples per lot and test as per IS:73 1 test on individual contents and mix aggregate from the dryer for each 100 tonnes of mix subject to minimum of two test per plant per day At regular close intervals One test for each 100 tonnes of mix subject to mini. of Two per day Regular control through checks on layer thickness	
14]	Granular Sub-base	*****	- Gradation - Atterberg limits - Moisture content prior to compaction - Density of compacted layer - Deleterious constituents - C.B.R.	As mentioned under serial number 3 As mentioned under serial number 3 As mentioned under serial number 3 One test per 500 m ² As required As required	
15]	Wet Mix Macadam		- Aggregate Impact Value - Grading - Flakiness and Elongation Index - Atterberg limits of portion of aggregate passing 425 micron sieve - Density of compacted layer -	As mentioned under serial number 1 As mentioned under serial number 1 As mentioned under serial number 1 As mentioned under serial number 3 One test per 500 m ²	

16]	Water Bound Macadam		<ul style="list-style-type: none"> - Aggregate Impact Value - Grading - Flakiness Index and Elongation index - Atterberg limits of binding material - Atterberg limits of portion of aggregate passing 425 micron sieve 	As mentioned under serial number 1 As mentioned under serial No.1 As mentioned under serial number 1 As mentioned under serial number 1 As mentioned under serial number 1	
17]	Earthwork		<ul style="list-style-type: none"> - Sand Content [IS: 2720 (Part-4)] - Plasticity Test[IS:2720 (Part-5)] - Density Test [IS:2720 (Part-8)] - Moisture Content Test [IS :2720 (Part-2)] - CBR Test 	2 tests per 3000 cubic metres of soil 2 tests per 3000 cub. metres of soil. 2 tests per 3000 cubic metres of soil. One test for every 250 cubic meters of soil. One CBR test for every 3000 cum. at least or closer as and when required by the Engineer.	

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

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

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

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

Deputy Executive Engineer,
Panchayat (R&B) Sub Division
Valsad

Executive Engineer,
Panchayat (R&B) Division
Valsad

Signature of the contractor