

TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS

1.0 PREAMBLE:-

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

1.2 Site Information:-

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

2.0 GENERAL REQUIREMENTS:-

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

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

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

(2) The General Technical Specifications for Road works.

(3) The General Technical Specifications for Bridge works.

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

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

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

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

(MMGSY 2025-26 - Vanbandhu Kalyan Yojana-2)

Construction of Box Culvert on Various Road of Pardi Taluka. (3 - Box Culvert)
Pkg-17 (1.) Construction of Box Culvert on Sukhesh Vaniya Faliya to Parwasa Road. (VR-Plan) Ch. 2/0 to 2/2 Ta Pardi Dist. Valsad (2.) Construction of Box Culvert on Sukhesh Kanubhai Desai Cricket Ground to Halpatiwas to Navinagri Bhagat F. Road. (VR- Non-Plan) Ch. 0/80 to 1/0 Ta Pardi Dist. Valsad. (3.) Construction of Box Culvert on Sukhesh Kothar Khadis Causway to Bhagat Faliya School to Hanuman Temple to joining Lalu Bhikhabhai House Road.(VR- Non-Plan) Ch. 0/0 to 2/0 Ta Pardi Dist. Valsad

ITEM WISE SPECIFICATION

Item No. *Item No.1* Excavation for foundation in sand, gravel, clay soft soil & murrum etc. including shoring, strutting and dewatering as necessary and disposing of the excavated stuff as directed depth upto 3.0 mt.

1 Excavation for structures shall consist of the removal of materials 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 materials.

2 After the site has been cleared the limits of excavations 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 setting 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 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 materials 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, rain or other reasons, the contractor shall take adequate measure 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

7 The bottom of the foundation shall be levelled 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 is to be used in the construction of embankment, it shall be directly deposited at the required location within 100 metres lead

11 All useful materials not intended for use in the bank, shall be stacked neatly on Government land as directed by the Engineer-in-charge within 100 metres 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 metres 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 :-

- i) Settings out and fixing bench marks and centre line stones
- ii) Construction of necessary shoring and bracing and their subsequent removal.
- iii) Removal of all logs, stumps, Grubs, and other deleterious, matter and obstructions for placing the foundations including trimming of bottoms of excavations
- iv) Foundation sealing, dewatering including pumping

v) Backfilling, Clearing up the site and disposal of ail surplus materials With in all lifts and lead upto 100 metres

vi) All labour, materials tools equipment, safeguards and incidentals necessary to complete the work to the specific

14 Excavation shall be for ordinary soil such as vegetation or orgaruc soil, turf, sand, silt, loam, clay, mud, black cotton soil, soft shale or soft murrum, a mixture of these and similar materials which yeilds to the ordinary application of pick and shovel, or other ordinary -digging equipment. Removal of gravel or any other nodular material having in any one direction. exceeding 75 mm. occuring 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.2 Providing and filling in foundation with ordinary cement concrete M 100 mix and providing necessary vertical pin headers including formwork, vibrating ramming and curing complete.

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 “ referrers 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 bad 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 of 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	
M- 100	1:3:6	300	fine aggregate to	34
M- 150	1:2:4	20	coarse	32
M- 200	1:1 ½ :3	160	aggregate by	30
M- 250	1:1:2	100	volume but	27
			subject to a	
			upper limit 1:1 ½	
			& a lower limit of	
			1:3	

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 to 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. 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 or 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 pacing 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 pacing of concrete. Suitable comber shall be provided in horizontal members of structure, specially in long spans to counteract the effects of any fixed as to proved 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 concert 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 from 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 hues responsibility for safety of men, machinery, materials and for results obtained.

22. The Engineer in charge shall be informed in advance be 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 of 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 reuse 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 poured. 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 shown 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.3 Providing and casting in situ controlled cement concrete M.300 for R.C.C. Box, Approach slab and cutt off walls as per drawing including necessary shuttering, laying, vibrating, ramming and curing complete.

Controlled cement Concrete

1. For controlled concrete, design of the mix shall be approved after preliminary tests and all necessary precautions shall be taken in its production to ensure that the required works cube strength is attained and maintained. The controlled concrete shall be in eight grades designated as M.100, M. 150, M. 200, M. 250, -M.300, M. 350, M. 400 and M. 450 with the suffix 'controlled' added to it.

2. In the designation of a concrete mix, letter M refers to the mix and the number to the specified 28 days works cubs compressive strength of that mix on 150 mm. cubes, expressed in kg/cm² where ordinary Portland cement conforming to IS : 269 or Portland blast furnace cement Conforming to IS : 455 is used, the compressive strenght requirements for various grades of concrete shall be as given below.

Grade of Concrete Compressive works test strength in kg/cm²
on 150 mm. cubes, conducted in accordance with IS:516

	Min.at7days	Min. at 28 days
M 100	70	100
M 150	100	150
M 200	135	200
M 250	170	250
M300	200	300
M350	235	350
M400	270	400
M450	300	450

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

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

3. Concrete mix shall be designed on the basis of preliminary tests so as attain a strength at least 33 per cent higher than that required on work tests. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with the means available. Except where it can be shown to the satisfaction of the Engineer-in-charge that supply of properly graded aggregate of uniform quality can be maintained till the completion of work, grading of aggregate should be controlled by obtaining the coarse aggregates in different sizes and blending them in the right proportions as required. Aggregates of different sizes shall be stocked in separate stock piles. Required quantity of material shall be stock piled several hours, preferably a day, before use. Grading of coarse and fine aggregate shall be checked as frequently as possible, frequency for a given job being determined by the Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests.

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

5. It is most important to keep the specified water-cement ratio constant and at its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined by the Engineer-in-charge according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture cement. For the determination of moisture content in the aggregates, IS : 2386 (Part -III) shall be referred to. Suitable adjustments shall also be made in the weights of aggregates to allow for the variation in weights of aggregates due to variation in their moisture content. Minimum quantity of cement to be used in controlled concrete shall not be less than 210 Kg. per cubic meter in plain concrete and not less than 300 kg/per cubic meter in reinforced concrete structural members. The minimum quantity of cement for prestressed concrete work shall not less than 360 kg/per cubic meter of concrete nor shall it be more than 540 kg/per cubic meter of concrete.

6. 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) R.C.C. well curb, R.C.C. well steining and R.C.C. piles. 40 mm
- (ii) P.C.C. well steining 63 mm.
- (iii) Well cap or pile cap; solid type piers, abutments and wing-walls, their pier caps. 40 mm.
- (iv) R.C.C. works in cross girders, deck slab, wearing coarse, kerb, light posts, blast walls approach slab etc., and hollow type piers, abutments, wing-walls and their pier caps. 20 mm.
- (v) R.C.C. bearings 20mm
- (vi) For any other item of construction not covered by items (i) to (v) above As specified on the drawing or as desired by the Engineer-in-charge in case it is not specified on drawing.

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

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

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

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

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

11. For all work concrete shall be mixed in a mechanical mixer which 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 shows complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.

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

13. The method of transporting and placing concrete shall be approved by the Engineer-in-charge. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be 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 then shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer-unless carried in properly design agitators, operating continuously when this time shall be within 3 hours of the addition of cement to the mix 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 meter when internal vibrator are used not exceeding 0.30 meter in all other cases.

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

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

17. Immediately after compaction, concrete shall be protected against harmful effects of weather including rain, running water, shocks, vibration, traffic, rapid temperature changes, frost and drying out process. It shall be covered with wet 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. Formwork shall however be of the following two distinct categories :-

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

(2) Scaffolding i.e. formwork required for supporting shuttering.

Forms for shuttering shall be constructed only, in metal suitably lined. Forms for scaffolding shall be constructed of metal or timber. Both shuttering and scaffolding shall be substantial rigid construction and shuttering shall be true to shape and dimensions shown on the drawings. All bolts and rivets shall be countersunk 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 prescribed lines occurring during and after placing the concrete. Screw jacks or hardwood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of structure specially in long spans to counteract the effects of any deflection. The formwork shall be so fixed as to provide for such camber. Forms shall be so constructed as to be removable in sections in the desired sequence. Without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed, chamfers or fillets of sizes 25 mm x 25 mm shall be provided at all angles of formwork to avoid sharp corners.

20. The inside surface of shuttering shall, except in the case of permanent form work or where otherwise agreed to be 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 agent shall not be used in form work for concrete which will be visible in the finished works.

21. Special measures shall be taken to ensure that the form does not hinder the shrinkage of concrete because without these cracking could occur before the form work is removed. Wherever applicable arrangements must be made to ensure that the form work does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The formwork should take due account of the calculated amount of positive or negative camber so as to ensure the correct final shape of the structure having regard to the deformation due to 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 these sections as soon as possible after the concrete has set in order to avoid cracking due to shrinkage of concrete. Form work shall be tight enough to prevent any

appreciable loss of cement during vibrations. Suitable tolerance should be provided in the formwork. Immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the 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 that influence the setting of concrete and 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 of soffit forms may commence when concrete has attained strengthening 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 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 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, 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 aggregated mixed in the proportions used in the grade of concrete that is being finished and of as dry a consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been pointed shall be kept moist for a period of twenty four hours. If rock pockets/honey-combs, in the opinion of the Engineer-in-charge are of such an extent or character as to effect the strength of the structure materially or to endanger the life of the steel reinforcement, 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 regular slump tests. Following slump shall be adopted for different types of works

Type of work Slumps

Where vibrators are used Where vibrators are not used

(i) Mass concrete in R.C.C. foundations footings and retaining walls 10 mm to 25 mm.
80mm.

(ii) Beams, slabs and columns simply reinforced 25 mm. to 40mm 100 mm. to 120 mm

(iii) Thin R.C.C. section or section with congested steel 40 mm. to 50mm 125mm. to 150mm.

25. For controlled concrete preliminary tests shall consist of three sets of separate tests, and in each set, tests shall be conducted on six specimens. Not more than one set of six specimens shall be made on any particular day. Of the six specimen in each set, three shall be tested at seven days and the remaining three at 28 days. The preliminary tests at 27 days are intended only to indicate the strength likely to be attained at 28 days. Work strength tests shall be made in accordance with IS : 516. EACH test shall be conducted on ten specimens five of which shall be tested at seven days and the remaining five at 28 days. The samples of concrete shall be taken on each day of concreting and cubes shall be made at the rate of one for every 5 cubic meter of concrete or a part thereof. However, if concreting done in a day is 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 when ever the quality and grading of materials is changed irrespective of the quantity of concrete poured. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure to tests given above reveals a poor quality of concrete and in other special cases.

26. The average strength of the group of cubes cast for each day shall not be less than the specified works cube strength. 20 per cent of the cubes cast each day may have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specified strength.

27. R.C.C. work shall have exposed concrete surface. Centering design and its erection shall be approved by the Engineer-in- charge. One carpenter with helper will invariably be kept through out the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. For access to different parts, suitable mobile platforms shall be provided so that steel reinforcement in position as not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber, kapachi or metal 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 and shuttering, the executive Engineer shall inspect the work and satisfy by random checks that concrete produced is of good quality. Plastering shall not be allowed to the exposed faces of concrete.

28. In reinforced concrete the volume occupied by reinforcement shall not be deducted. The slab shall be 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 plant 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 centering and forms required for the work

Item No.4 Providing and casting in situ-controlled cement concrete M-200 for R.C.C. return as per drawings including centering shuttering, scaffolding where necessary, laying vibrating, curing and finishing complete. (A) Height from 0.0 to 5.0 M.

The work of Providing and casting in situ-controlled cement concrete M.300 for R.C.C. work in piers/ abutment and curtain wall as per drawing including centering,shuttering scaffolding where necessary laying vibrating curing and finishing complete. as per relevant specifications of **Item No. 3** of this contract. The measurement shall be in cum basis.

Item No.5 Providing and casting in situ controlled cement concrete M.300 for kerb/kerb blocks including form work, curing and finishing complete

The work of Providing and casting in situ controlled cement concrete M.300 for kerb/kerb blocks including form work, curing and finishing complete. as per relevant specifications of **Item No. 3** of this contract. The measurement shall be in cum basis.

Item No.6 Providing and casting in situ controlled cement concrete M.300 for average 75mm to 100mm thick wearing coat laid as directed including temping, vibrating, finishing, curing & filling in joints with bitumen complete.

The work of Providing and casting in situ controlled cement concrete M.300 for average 75mm thick wearing coat laid as directed including temping, vibrating, finishing, curing & filling in joints with bitumen complete..as per relevant specifications of **Item No. 3** of this contract. The measurement shall be in cum basis.

Item No.7 Providing and placing in position FE 500/500D TMT. Bar reinforcement including cutting, bending, hooking and tying complete as per detailed drawing for raft slab, pier, solid slab, kerb block, wearing coat etc.

1601. DESCRIPTION

This work shall consist of furnishing and placing high strength deformed reinforcement (TMT)bars (untensioned) of the shape and dimensions shown on the drawings and conforming to these Specifications or as approved by the Engineer.

1602. GENERAL

Steel for reinforcement shall meet with the requirements of IS 1786:2008.

1603. PROTECTION OF REINFORCEMENT

Uncoated reinforcing steel shall be protected from rusting or chloride contamination. Reinforcements shall be free from rust, mortar, loose mill scale, grease, oil or paints. This may be ensured either by using reinforcement fresh from the factory or thoroughly cleaning all reinforcement to remove rust using any suitable method such as sand blasting, mechanical wire brushing, etc. as directed by the Engineer. Reinforcements shall be stored on blocks, racks or platforms and above the ground in a clean and dry condition and shall be suitably marked to facilitate inspection and identification.

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

1604. BENDING OF REINFORCEMENT

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

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

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

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

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

1605. PLACING OF REINFORCEMENT

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

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

of concrete, or any other operation. The diameter of binding wire shall not be less than 1 mm.

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

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

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

Layers of reinforcements shall be separated by spacer bar at approximately one metre intervals. The minimum diameter of spacer bar shall be 12 mm or equal to maximum size of main reinforcement or maximum size of coarse aggregate, whichever is greater. Horizontal reinforcement shall not be allowed to sag between supports.

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

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

Bar coated with epoxy or any other approved protective coating shall be placed on supports that do not damage the coating. Supports shall be installed in manner such that point of weakness is not created in hardened concrete. The coated reinforcing Reel shall be held in place by use of plastic or plastic coated binding wires especially manufactured for the purpose. Reference shall be made to Section 1000 for other requirements.

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

1606. BAR SPLICES

1606.1. Lapping

All reinforcement shall be furnished in full lengths as indicated on the drawing. No splicing of bars, except where shown on the drawing, will be permitted without approval of the Engineer. The lengths of the splice shall be as indicated on drawing or as approved by the Engineer. Where practicable, overlapping bars shall not touch each other, and shall be kept apart by 25 mm or $1\frac{1}{4}$ times the maximum size of coarse aggregate, whichever is greater. If this is not feasible, overlapping bars shall be bound with annealed steel binding wire, not less than 1 mm diameter and twisted tight in such a manner as to maintain

minimum clear cover to the reinforcement from the concrete surface. Lapped splices shall be staggered or located at points, along the span where stresses are low.

1606.2. Welding

1606.2.1. Splicing by welding of reinforcement will be permitted only if detailed on the drawing or approved by the Engineer. Weld shall develop an ultimate strength equal to or greater than that of the bars connected.

1606.2.2. While welding may be permitted for mild steel reinforcing bars conforming to IS:432, welding of deformed bars conforming to IS:1786 shall in general be prohibited. Welding may be permitted in case of bars of other than S 240 grade including special welding grade of S 41S grade bars conforming to IS: 1786, for which necessary chemical analysis has been secured and the carbon equivalent (CE) calculated from the chemical composition using the formula :

is 0.4 or less

1606.2.3. The method of welding shall conform to IS:2751 and IS:9417 and to any supplemental specifications to the satisfaction of the Engineer.

Welding may be carried out by metal arc welding process. Oxy-acetylene welding shall not be permissible. Any other process may be used subject to the approval of the Engineer and necessary additional requirements to ensure satisfactory joint performance. Precautions on over heating, choice of electrode, selection of correct current in arc welding etc., should be strictly observed.

All bars shall be butt welded except for smaller diameter bars (diameter of less than 20 mm) which may be lap welded. Single-V or Double-V butt joints may generally be used. For vertical bars single bevel or double bevel joints may be used.

Welded joints shall be located well away from bends and not less than twice the bar diameter away from a bend.

Generally, shop welding in controlled conditions is to be preferred, where feasible. Site welding where necessary shall, however, be permitted when the facilities, equipment, process, consumables, operators, welding procedure are adequate to produce and maintain uniform quality at par with that attainable in shop welding to the satisfaction of the Engineer.

Joint welding procedures which are to be employed shall invariably be established by a procedure specification. All welders and welding operators to be employed shall have to be qualified by tests prescribed in IS:2751. Inspection of welds shall conform to IS:822 and destructive or non-destructive testing may be undertaken when deemed necessary. Joints with weld defects detected by visual inspection or dimensional check inspection shall not be accepted.

Suitable means shall be provided for holding the bars securely in position during welding. It must be ensured that no voids are left in welding. When welding is done in 2 or 3 stages, previous surface shall be cleaned properly. Bars shall be cleaned of all loose scale, rust,

grease, paint and other foreign matter before carrying out welding. Oily competent and experienced welders shall be employed on the work with the approval of the Engineer. No welding shall be done on coated bars.

M.S. electrodes used for welding shall conform to IS:814.

1606.2.4. Welded joints shall preferably be located at points where steel will not be subject to more than 75 per cent of the maximum permissible stresses and welds so staggered that at any one section, not more than 20 per cent of the bars are welded.

1606.2.5. Welded pieces of reinforcement shall be 'tested. Specimens shall be taken from the site and the number and frequency of tests shall be as directed by the Engineer.

1606.3. Mechanical Coupling of Bars

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

1607. TESTING AND ACCEPTANCE

The material shall be tested in accordance with relevant IS specifications and necessary test certificates shall be furnished. The fabrication, furnishing and placing of reinforcement shall be in accordance with these specifications and shall be checked and accepted, by the Engineer.

1608. MEASUREMENTS FOR PAYMENT

Reinforcement shall be measured in length including hooks, if any, separately for different diameters as actually used in work, excluding overlaps. From the length so measured, the weight of reinforcement shall be calculated in M.T. on the basis of IS:1732. Wastage, overlaps, couplings: welded joints, spacer bars, chairs, stays, hangers and annealed steel wire or other methods for binding and placing shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement

1609. RATE

The contract unit rate for coated/uncoated reinforcement shall cover the cost of material, fabricating, transporting* storing, bending, placing, binding and fixing in position as shown on the drawings as per these specifications and as directed by the Engineer, including all labour, equipment, supplies, incidentals, sampling, testing and supervision.

The unit rate for coated reinforcement shall be deemed to also include cost of all material, labour, tools and plant, royalty, transportation and expertise required to carry out the work. The rate shall also cover sampling, testing and supervision required for the work.

Payment shall be made on M.T. basis

Item No.09 Providing and laying filter media 600 mm thick as directed at the back of abutments, returns and wing walls as per detailed specification.

1. Stones subject to mark deterioration will not be accepted. The stone Shall be sound, hard, durable and fairly regular in shape and its thickness in any one direction shall not be less than 15 cm.

Sr. No. No. of Size Range Sieve designation Percentage by weight passing through the

1	60 to 40 mm	90 mm	100 – 00
	63 mm		85 – 100
	50 mm		35 – 70
	40 mm		00 – 15
	20 mm		00 - 05

The size shall be 40 mm. to 63 mm. where in tolerance limit for over size shall be upto 15% and that for lower size should be upto 15% and below 20 mm. it shall be allowable upto 5%. the filter Materials shall be tightly placed to a thickness of not less that 600 mm. and provided over the entire surface behind abutments, wings or return walls to the full height.

2. Materials shall be first stacked in boxed of 2 m. 1. 1/2 m. x 0.5 m. size on fairly level ground and measured

3. The measurement for payment shall be made on Square meter basis for complete execution of item.

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

Item No.10 Providing and fixing marble slab including engraving and painting complete (A) Size 75cm x 60cm x 4cm

Marble stone for year plate shall be white and of approved quality and shall be 25 mm thick It shall be of 20 cms x 15 cms x 2.5 cms size or standard size as directed by the Engineer-in-charge of the work.

Lettering on year plate shall be done by U-shape engraving and shall be filled with black paint of approved quality. Lettering shall be done as directed by the Engineer-in-charge. The marble plate shall be fixed in neat cement at a place as directed by the Engineer-in-charge. Cement shall conform to relevant I.S. specification.

Measurement shall be per number of marble plate fixed

Item No.11 Providing and fixing G.I. 100 mm diameter water spout including necessary iron gratings as per drawing

2705 DRAINAGE SPOUTS

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

2705.1 Fabrication

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

2705.2 Placement

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

2705.3 Finishing

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

2707 TESTS AND STANDARDS OF ACCEPTANCE

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

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

2708 MEASUREMENTS FOR PAYMENT

The measurement for payment drainage spout shall be measured in numbers.

2709 RATE

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

Item No.12 Wall painting (Two coats) with plastic emulsion paint of approved brand and manufacture on undecorated wall surface to give an even shade including thoroughly brushing the surface free from mortar dropping and other foreign matter and sand papered smooth.

1.0. Materials

The enamel pain shall conform to M-44 B.

2.0. Workmanship

2.1. General : The materials required for work of painting work shall be obtained directly from approved

manufactures or approved dealer and brought to the site in maker's drums; kegs. etc. with seal unbroken.

2.1.2. All materials not in actual use shall be kept properly protected, lids of containers shall be kept closed and surface of paint in open or partially open containers covered with a thin layer of turpentine to prevent formation of skin. The materials which have become state or flat due to improper and long storage shall not be used. The paint shall be stirred thoroughly in its container before pouring into small containers. While applying also, the paint shall be continuously stirred in smaller container. No left over paint shall be put back into stock tins. When not in use the containers shall be kept properly closed.

2.1.3. If for any reasons, things is necessary, the brand of thinner recommended by the manufacturer shall be used.

2.1.4. The surface to be painted shall be thoroughly cleaned and dusted. All rust, dirt and grease shall be thoroughly removed before painting is started. No painting on exterior or other exposed part o the work shall be carried out in wet, damp or otherwise unfavorable weather and all the surfaces shall be thoroughly dry before painting work is started.

2.2. Application of paint:

2.2.1. Brushing operations are to be adjusted to the spreading capacity advised by the manufacture of particular paint. The paint shall be applied evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the -laying off is finished. The full process of crossing and laying off will constitute one coat.

2.2.2. Each coat shall be allowed to dry completely and lightly rubbed with very fine grade of sand-paper and loose particles brushed off before next coat is applied. Each coat shall vary slightly in shade and shall be got approved from Engineer-in-charge before next coat is started.

2.2.3. Each coat the last shall be lightly rubbed down with sand paper of fine pumice stone and cleaned of dust before the next coat is applied. No hair marks from the brush of clogging of paint puddles in the corners of panels, angles of moldings etc. shall be left on the work.

2.2.4. Special care shall be taken while painting over bolts, nuts, rivets, overlaps etc. Approved best quality brushes shall be used.

3.0. Mode of measurements and payment

Measurements shall made on sqm. basis.

Item No.13 Diversion of water course, providing cofferdam and bund and bund or island as may be necessary for foundation and maintaining the same for the period as may be necessary (A) Diversion by channel

1. The item provides for the Design, Construction & Demolition of Temporary Cofferdam or any other suitable means as may be necessary and approved by Engineer-in-charge to facilitate construction of pile foundation, pile cap, sub structure & super structure of whole bridge. This item will not include dewatering of foundations, trenches, which will be covered in the item of open excavation.

The contractor shall take all necessary protective measures against possible erosion due to tide variations if any and maintain the coffer dams, bund or island in proper manner during construction. He shall not be entitled for any payment or compensation in the event of washing of the coffer dam, bund or island at any time, either due to tidal waters if any or floods, or any other reasons whatsoever, and the contractor shall reconstruct the same if required at his risk and cost. The size of the coffer dam, bund or island shall be such as would allow without obstruction and inconvenience, enough working free space all around the. foundation works.

2. The contractor shall plan, construct and maintain satisfactorily necessary diversion channels and protective works so as to safely pass the stream flow and also satisfactorily meet with any sudden rise of flow due to tides, flood or any other reason, without damaging the foundation works. The coffer dam or bund shall be such as to give sufficient working space for construction, inspection and installations of pumping machinery inside the enclosed area. The coffer dam or bund shall be of adequate section and properly designed, constructed to prevent ingress of water as practically as possible in the foundation pits and to protect green concrete or masonry work.

3. Adequate pumping arrangement shall be made for dewatering the inside of coffer dam, bunds etc. Pumps of adequate capacity and in required number shall be provided to ensure adequate pumping.

4. The coffer dam, bund or island shall be completely removed, and their materials shall be disposed of in the manner as directed by the Engineer-in-charge when no longer required.

5. Measurements for Payment

The rate for this item of work shall be per **Nos.** for the whole bridge structure and shall be paid at the Numbers tendered for the work on completion of the entire work.

6 Rates

The Contract unit rates 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. The unit cost includes cost of maintenance till all operations to complete the entire bridge structure as may be necessary.

Item No.14 Dismantling the existing structure including removing and stacking the dismantled materials as and where directed. (A) RCC Structure

202 DISMANTLING CULVERTS, BRIDGES AND OTHER STRUCTURES/PAVEMENTS

202.1 Scope

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

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

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

202.2 Dismantling Culverts and Bridges

The structures shall be dismantled carefully and the resulting materials so removed as not to cause any damage to the part of the structure to be retained and any other properties or structures nearby.

Unless otherwise specified, the superstructure portion of culverts/bridges shall be entirely removed and other parts removed up to at least 600 mm below the sub-grade, slope

face or original ground level whichever is the lowest or as necessary depending upon the interference they cause to the new construction. Removal of overlying or adjacent material, if required in connection with the dismantling of the structures, shall be incidental to this item. Where existing culverts/bridges are to be extended or otherwise incorporated in the new work, only such part or parts of the existing structure shall be removed as are necessary and directed by the Engineer to provide a proper connection with the new work. The connecting edges shall be cut, chipped and trimmed to the required lines and grades without weakening or damaging any part of the structure to be retained. Due care should be taken to ensure that reinforcing bars which are to be left in place so as to project into the new work as dowels or ties are not injured during removal of concrete. Pipe culverts shall be carefully removed in such a manner as to avoid damage to the pipes.

Steel structures shall, unless otherwise provided, be carefully dismantled in such a manner as to avoid damage to members thereof. If specified in the drawings or directed by the Engineer that the structure is to be removed in a condition suitable for re-erection, all members shall be match-marked by the Contractor with white lead paint before dismantling; end pins, nuts, loose plates, etc. shall be similarly marked to indicate their proper location; all pins, pin holes and machined surfaces shall be painted with a mixture of white lead and tallow and all loose parts shall be securely wired to adjacent members or packed in boxes.

Timber structures shall be removed in such a manner as to avoid damage to such timber or lumber having salvage value as is designated by the Engineer.

202.3 Dismantling Pavements and Other Structures

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

Item No.15 Providing temporary all weather diversion suitable for double lane traffic during the construction period of box culvert including providing earthwork for embankment/Cutting as per site requirement, providing RCC pipes of suitable diameter in required row to drain water, supplying, spreading and compacting 200 mm thick GSB grade I & 200 mm thick GSB grade II & 20 mm thick MSS with priming coat & tack coat in 3.75 mt. carriageway with providing all safety measures including red lamps/ signals at night for traffic and maintaining the diversion in condition till completion of work etc.complete as directed.

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.

Passage of Traffic along a Temporary Diversion :-

In stretches where it is not possible to pass the traffic on part width of the carriageway, or while construction of cross drainage works a temporary diversion shall be constructed with 5.50 Mt. carriageway and 1.0 Mt. earthen shoulders on each side (total width of road way 7.50 Mt.) with the following provision for road crust in the 5.50 Mt. width.
[i] 150mm thick compacted GSB grade I as per detailed specification Item No. 5 of this contract.

Necessary earth work for embankment or cutting as may be required for preparing diversion shall be carried out by the contractor at his own cost. The surface so prepared shall be well compacted with vibratory roller and 150 mm thick compacted coarse graded GSB grade I as directed by the Engineer in charge.

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

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 temporary diversion.

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.

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 refractory type, if so directed by the Engineer.

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 and as directed by the Engineer. The temporary traveled way shall be kept free of dust by frequent application of water, if necessary.

Measurement for Payment

The temporary road diversion constructed for cross drainage works shall be measured on **RMT basis**.

Rate

The rate for this item shall be for the complete finished work and it includes earth work, rolling and watering, providing, laying and compacting 1850 mm thick GSB, maintaining the diversion throughout period of construction, providing safety measures and traffic control devices etc. including cost of all labour, material, tools and plants, machineries etc. necessary to complete the work.

Item No.16 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 17 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.18 Earthwork for embankment including breaking clods, dressing with all lead and lift and including watering rolling, and consolidation of subgrade in layers at O.M.C. to required dry density including filling the depression which occur during the process using power roller 8T to 10T (E) From borrow area within 3.0km lead

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

2.After clearing the site, the alignment of the road shall be properly set out true to line, curves, slopes grades and sections as shown on the plan or directed by the Engineer-in-charge. The contractor shall provide all labours and materials such as lime, strings, pegs, nails, bamboos, stone, mortar, concrete etc. required for setting out, establishing. Bench Marks and giving profiles. The contractor shall be responsible for maintaining the B.Ms, profiles alignments and other marks as long as they are required for the work in the opinion of the Engineer-in-charge. If the contractor defaults in this respect they may be restored by the department at the cost of the contractor.

3.When an existing embankment is to be widened, continuous, horizontal benches, each at least 0.3 meter wide shall be cut into the existing slope for ensuring adequate bond with the fresh embankment materials to be added. The material obtained from the cutting of benches can be utilized in the widening of the embankment. Where the width of the widened portions is insufficient to permit the use of usual rollers, compaction shall be carried out with the help of tandem/sheeps foot rollers, hand rollers, mechanical tempers or other approved plant. The dumping of material from trucks for widening operations shall

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

4. The soil to be used for embankment for sub grade shall be having CBR not less than 5 % and shall be free from trees, stumps, roots, rubbish or any other objectionable materials. Only material considered suitable by the Engineer-in-charge shall be used for the construction and that considered unsuitable other disposed off as directed by him. The selection of the materials to be used in the construction of embankment shall be made after soil surveys and investigations are carried out by the Department. The embankment shall consist of earth available from road-side borrow pits on either side with lead and all lifts, and within land-width in the manner specified in Para 10 below./ The road, if any, required for the purpose of haulage of earth by men, animals or vehicles will be constructed (if not existing) and maintained by the contractor at his own cost, the material satisfying the density requirements given in the table below shall be employed for embankment construction.

Density requirement of embankment and subgrade materials

Type of Work	Maximum laboratory dry unit weight when tested as per IS:2720 (Part-8)
-Embankment up to 3 meter height, not subjected to extensive flooding.	Not less than 15.2 kN/cum.
-Embankment exceeding 3 meter height or embankments of any height subject to long periods of inundation.	Not less than 16.0 kN/cum.
-Subgrade and earthen shoulders/ verges/ backfill.	Not less than 17.5 kN/cum.

Note: (1) This table is not applicable for lightweight fill material e.g. cinder, fly ash etc.

(2) The Engineer may relax these requirements at his discretion taking into account the availability of materials for construction and other relevant factors.

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

5. When permitted, the contractor shall use the soil for embankment work available from box cutting the road. The soil shall be used after approval from Engineer-in-charge. For this purpose the contractor shall make his own arrangement for loading, transporting & unloading the cutting stuff available from box cutting to required site with all lead and lift.

6. The embankment shall be constructed in uniform layers not exceeding 250 mm in loose thickness. The soil shall be spread uniformly over the entire width of the embankment, unless otherwise directed by the Engineer-in-charge. The operation of laying the successive layer of earth shall have to be suitably synchronized with the consolidation

work. If the soil as delivered to the road bed is too wet, it shall be dried by exposure to the sun till the moisture content is acceptable for compaction. All clods of hard lumps of earth shall be broken to have maximum size of 15 cm. when being placed in the embankment and a maximum of size 5 cm when being placed in the top 45 cm of the embankment. The work of next layer shall be allowed only after the first layer below it has been thoroughly compacted to the density specified.

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

8. To avoid interference with the construction of abutment, wing walls or return walls of culverts/bridge structures, the contractor shall, at point to be determined by the Engineer-in-charge, suspend work on embankments forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of interference or damage to the bridge work. Unless directed otherwise, the filling ground culverts, bridges and other structures up to a distance of twice the height of the embankment from the back of the embankment shall be earned out independent of the work on the main embankment. The fill material shall not be placed against any abutment or wing wall unless permission has been given by the Engineer-in-charge but in any case not until the concrete or masonry has been in position for 14 days, (he embankment shall be brought up simultaneously in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer-in-charge. Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers simultaneously with the laying of fill material. The material used for the filter shall conform to the requirements for filler medium and will be paid extra in the relevant item. Where it may be impracticable to use power rollers or other heavy equipment, the compaction shall be carried out by mechanical tampers or other methods approved by the Engineer-in-charge. Care shall be taken to see that the compaction plant does not hit or come too close to any structural member so as to cause any damage to them.

9. The embankment shall be finished in conformity with the alignment, levels, cross sections and dimension shown on the plans or as directed by Engineer-in-charge. Where

the alignment of the road is in a curve, the top of the embankment shall be formed with the super elevation and the increased width shown on the drawings or as the Engineer-in-charge may direct. Finishing operations shall include the work of shaping and dressing the shoulders, road bed and the side slopes to conform the cross section. The work of laying of earth work in layers shall be synchronized with the work of compaction and consolidation of the earth work and the operations shall also be synchronized with the field and laboratory testing.

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

- (i) The borrow pits will be so excavated as to form a road side longitudinal gutter to drain the water, interrupted by such gutter.
- (ii) The width of the drain shall be restricted to 1.5 mts. only. The depth will be restricted to such grade so as to drain the water efficiently. All balance quantity of earth shall be brought from distant borrow areas only.
- (iii) If there is top layer of black cotton or other objectionable soils, the same be removed and disposed off elsewhere and usable material found at the lower level will only be used in the earthen embankment, if the contractor chooses to utilize this material.
- (iv) The drain should be aligned along the boundary of the land width of the road. No pit, other than this drain, shall be dug within 5 meters of the toe to the final section of the road embankment.
- (v) No borrow pits shall be allowed in the length in which earth obtained from cutting is specified to be used in embankments.

11 Rolling and Watering

11.1 The embankment materials shall be spread uniformly over the entire width of the embankment in layers not exceeding 250 mm in loose thickness. Successive layers of embankment shall not be placed until the layer under construction has been thoroughly compacted to the requirements set down hereunder :-

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

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

Moisture content of each layer of soil shall be checked in accordance with IST 2720 (Part-II) and unless otherwise mentioned shall be so adjusted, making due

allowance for evaporation losses, that at the time of the compaction it is in the range of 1 percent to 2 percent below the optimum moisture content determined in accordance with ISI (Part-VII). Highly expansive clays shall however be compacted at 2 to 4 percent above the optimum moisture content.

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

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

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

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

11.2 Compaction of the earthwork shall be carried out using vibratory roller of required capacity or any other equipment approved by the Engineer-in-charge shall be employed to compact the materials. The contractor shall demonstrate the efficiency of the plants he intends to use for carrying out compaction trials.

Each layer of the materials shall be thoroughly compacted to the densities specified in following table

Compaction requirements for embankment and subgrade.

Sr. No.	Type of Work/ materials	Relative compaction as percentage of maximum laboratory dry density as per IS:2720 (Part-8)
1.	Sub grade and earthen shoulders	Not less than 97.
2.	Embankment	Not less than 95.
3.	Expansive Clays	
	A) Subgrade and 500 mm portion just below the subgrade	Not allowed.
	B) Remaining portion of embankment	Not less than 90.

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

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

12. Measurements for Payment : The earthwork measurements shall be paid on cross sectional measurements and computing the volumes of earth work in cubic meters by average area method. The contractor shall sign day to day leveling work and also original cross section, longitudinal section etc. in token of his acceptance. The working sections both longitudinal and cross of the ground shall be taken by the Engineer-in-charge before the actual work is started. The contractor or his authorized representative shall attend day to day leveling work and sign with date the field book daily, in token of his acceptance. If there is any disagreement the contractor shall inform of it in writing to the officer concerned with specific reference to the sectioned before starting further work. Once the work is started, no-cognizance of any complaint will be taken. Merely not signing of level book shall not be deemed as disagreement. The Executive Engineer shall also verify leveling work to the extent of 5% before commencement of earth work and on finalization. The contractor shall maintain the embankment by filling in ruts, rain cuts, depression due to shrinkage etc. to proper formation and grade till this item is finally measured and accepted by the Department. The measurements shall be taken on compacted earth work. The quantity of cutting stuff available from cutting/ box cutting will be deducted from the net quantity of the earth work in the embankment arrived at. No deduction for shrinkage shall be made from gross measured quantity of compacted earth work. However the contractor shall have to bear loss of quantity due to all settlements as well as other types of deformations etc. if any that might have taken place at the time of taking the final measurements of this item.

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

mechanical roller and water tanker required for consolidation including all labour, equipments fuel, hire charges, tolls, and incidentals necessary.

Item No.19 Consructing of granular sub-base by providing course graded B.T. machine crushed material satisfying MOST specification of grading I 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 II.

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.20 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 subgrade sub base/ base or existing pavement as the case may be in accordance with the requirements of these specifications. The material shall be laid in one or more layers as necessary to lines, grades and cross-sections shown on the approved drawings or as directed by the Engineer.

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

406.2 MATERIALS

406.2.1 AGGREGATES

406.2.1.1 PHYSICAL REQUIREMENTS :

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

400-10 below.

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

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

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

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

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

406.2.1.2 Grading requirements :

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

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

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

Materials finer then 425 micron shall have plasticity index (P.1) 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 specifications.

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

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 care full / 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, as smooth wheel roller of 80 to 100 KN weigh 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 at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall the 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 caused 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 the material as determined by the method outlined in IS : 2720 (Part-8)

After completion, the surface of any finished layer shall be wellclose, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated or otherwise defective areas shall be made god to the full thickness of the layer and recompacted.

406.3.6 Setting and drying :

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

406.4 Opening to Traffic :

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

406.5 Surface Finish and Quality control of work

406.5.1 Surface evenness :

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

406.5.2 Quality Control :

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

406.6 Rectification of Surface Irregularity :

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

406.6.7 Arrangement for Traffic :

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

406.8 Measurements for Payment :

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

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

- i) Making arrangement for traffic to Clause 112 as above Except for initial treatment to verges, shoulders and Construction of diversions
- ii) Furnishing wet materials 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.21 Providing and applying priming coat with emulsion grade SS1 at the rate of 7.50 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-1 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 these standards. Guidance on viscosity and rate of spray is given in Table 500-1.

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

Type of Surface	Kinematic Viscosity of Primer at 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.22 Supplying, stacking & spreading Hard murrum on road side for filling in approaches of work as per specification including rolling, watering & consolidation complete.

1. Hard murrum should be of approved quality. Any material which is found inferior shall be rejected and contractor shall remove such rejected material from the site at his own cost. The material of Hard murrum shall be collected from quarries approved by the Executive Engineer.

2. The materials shall be got approved by "the Executive Engineer prior to collection on site and shall be free from all, rubbish, dust and any organic materials as well as clods of black cotton soil. Material shall not be allowed to be collected from within the road boundary. The materials to be used shall be got tested prior to its use in road construction.

For road work complete stacking of materials as per-- requirement shall be earned out in 2 KM length before spreading. The materials stacks shall be got cross checked by other Deputy Executive Engineer as per rules before spreading. The collection shall always commence at one end of K.M. and be carried continuously towards the other end.

The materials shall be stacked by filling standard boxes of size 2m x 1.5m x 0.5m on a fairly level ground. It shall be stacked on road land beyond the top of the bank and on a level ground. The rate includes supplying the hard murrum with all lead and lift on road site and stacking the same in regular phrase of the required dimensions. Materials shall be collected in required quantity only at required site of work.

The payment shall be made on cubic metre basis.

Item No.23 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.24 Providing & laying 50mm 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 asphalt 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 Viscosity grade 60/70 (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	60/70 (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 80/100 bitumen 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 bitumen of penetration grade 80/100 (VG-10) 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 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 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 14⁰ 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 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 other wise 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 a 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 fired 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 not 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 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 of 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 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 "Handbook of Quality Control for Construction of Road & Runways" [IRC Sp. 11] and the MOST specifications. Where they are contradicting the provisions in these specifications shall be followed. Where 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 Corrector'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 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 [1] Machine laid.	+ 6 mm - 6 mm + 10 mm - 10 mm - 15 mm

	[II] Manually laid.	- 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		4 mm		7 mm		4 mm		7 mm	
Length [Mt.]		300	75	300	75	300	75	300	75
National	Highways/	20	9	2	1	40	18	4	2
Expressways.									

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 of 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/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 bond 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.25 Providing & laying mix seal surfacing 20mm thick on previously laid bituminous base course surface as wearing course with specified graded machine crushed agg. Premixed with bituminous binder at 2.50 Kg/10Sq.mt. for tack coat & for mixing 51 kg/MT in a hot mix plant, transporting the mixed material by tripper and laying with pavers finisher to the road surface level and rolling with power roller of 80 to 100 KN including cost of carrying of materials.

1. DESCRIPTION : This work shall consist of laying and compacting mix seal surfacing in single course composed of suitable aggregates premixed work, a bituminous binder on a previously prepared base in accordance with the requirement of these specification.

Mix seal surfacing shall be as specified. MATERIALS :

2.1 UNDER. : The binder shall be bitumen of a suitable grade, as directed by the Engineer-in-charge and satisfying the requirement of I.S. : 73,217,454 or other approved cut back as applicable.

2.2 COARSE AGGREGATE :The aggregate shall consist of angular fragment, clean, hard, tough and durable rock of uniform quality throughout. The aggregate shall be obtained by crushing rock, gravel or river shingle and be free of clan gated and flaky pieces, soft and disintegrated materials and vegetable or other deleterious matter. They shall preferably be hydrophobic type.

The aggregate shall satisfy the quality requirement set forth in Table 5001. except that the index shall be limited to a maximum of 30.

TABLE – 500.1
PHYSICAL REQUIREMENT OF AGGREGATES

Sr. No.	Test	Test Method	Requirement
1	Los Angeles Abrasion Value.	I.S. 2386 (Part-IV)	35 % Maximum
2	Aggregate Impact Value	--do--	30% Maximum
3	Flakiness Index	I.S.238 (Part-1)	30 % Maximum
4	Stripping Value	I.S.6242	25 % Maximum
5	Water Absorption	I.S.238 (Part-III)	2 % Maximum

2.3 FINE AGGREGATE

The fine aggregate shall consist of crusher run screenings, natural sand or

a mixture of both. These shall be clean, hard, durable, uncoated, dry and free from injurious, soft or flaky pieces and organic or deleterious substances.

2.4 AGGREGATE GRADATION The coarse sand, fine aggregate shall be so graded or combined as to conform to the grading set forth in Table-500.10

TABLE - 500.10

AGGREGATE GRADATION FOR MIX SEAL SURFACING

Sieve Designation	Percent by weight passing
13.20 mm	-
11.20 mm	100
5.60 mm	52-88
2.80 mm	14-38
90.00 Micron	0-05

2.5 PROPORTIONING OF MATERIALS : The total quantity of the aggregates used for mix seal surfacing shall be 0.27p[V-0 cum. per 10 sq.mt. area. The quantity of binder used for premixing in terms of straight run bitumen shall be 5.10 % by weight of the total mix i.e. 53.80 Kgs. per tone of mix. Before starting the work, the contractor shall get the job mix formula for the mix approved by the Engineer-in-charge.

3. CONSTRUCTION OPERATIONS

3.1 WEATHER & SEASONAL LIMITATION : Mix seal surfacing shall not be laid during rainy weather or when the base course is damp or wet.

3.2 PREPARATION OF BASE :

The base on which mix seal surfacing is to be laid shall be prepared shaped and conditioned of the specified lines, grade and cross sections in accordance with M.O.S.T. specification, clause-601 as directed by the Engineer-in-charge. The surface shall be thoroughly swept and scribed, clean and free of dust and foreign matter

3.4 PREPARATION AND TRANSPORT OF MIX : Mix seal surfacing mix shall be prepared in a drum mix plant of adequate capacity and capable to yield a mix of proper and uniform quality with thoroughly coated aggregate. The plant shall be drum mix type. The plant shall have co-ordinate set of essential unit capable of producing uniform mix within the job mix formula such as laid down in appendix - A.

(a) In case of drum mix plant, the cold feed system shall have variable speed belt conveyors/ or other suitable devices for regulating the accurate proportioning of aggregate to an even flood flow automatically from a Control operation/Control Cabin.

(b) Filler System :-Capable of measuring/metering and spraying required quantity of bitumen at specified temperature with automatic synchronization of bitumen and aggregate feed.

(c) Filler System :A fine feeder system suitable to receive bagged to bulk supply of filler materials and its incorporation to the mix in the correct quantity shall be necessary auxiliary.

(d) Dust Control :A suitable built in dust control equipment "for the dryer to contain the exhaust of fine dust in to atmosphere for environmental

control, wherever so specified by the Engineer.

(e) Suitable auxiliary Bitumen Boiler of Adequate capacity with self heating arrangement and temperature control device. The boiler should be fitted with temperature indicating instruments.

The temperature of binder at the time of mixing shall be in the range of 160° - 177°C. and of aggregates in the range of 155° -163° C. provided also that at no time shall be the difference in temperature between the aggregates and the binder exceed 14°C.

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

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

3.5 SPREADING : The mix transported from the drum mix plant to the site shall be spread by means of a self propelled mechanical paver with suitable screeds capable, of spreading temping, finishing the mix, true to specified grade, lines and cross sections. The temperature of mix at the time of laying shall be in the range 121° - 163° C.

Longitudinal joints and edge shall be constructed true to the delineating lines parallel to the centre line of the road. Longitudinal joints shall be off-set by at least 150 mm. from those in the binder course. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh materials.

ROLLING :Immediately after the spreading of mix, it shall be thoroughly compacted by rolling with a set of rollers moving at a speed not exceeding 5 Km. per hours. The initial or break down rolling shall be with 8-12 tone, three wheel rollers and the surface finished by final rolling with 8-10 tone tandem rollers or suitable pneumatic rollers.

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

4. OPENING TO TRAFFIC :The traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

5. SURFACE FINISH & QULITY CONTROL FOR WORK : The surface finish of construction shall conform to the requirement of M.O.S.T. Specification Clause-901, control on the quality of material and works shall be exercised by the Engineer-in-charge in accordance with M.O.S.T. specification, Clause-902.

6. ARRANGEMENT FOR TRAFFIC : The provision of M.O.S.T. specification, clause-105 shall apply as regards that flow at traffic during construction.

7. MEASUREMENT FOR PAYMENT : The payment shall be made on the tonnage basis of the weight of mix of aggregate and bitumen. For this purpose, the contractor shall have to install a weigh bridge of suitable capacity for the purpose of regiment of dumpers at suitable place at his cost as directed. Weight of empty and weight of loaded dumper will be recorded in bound and numbered register on plant site. Department will be free to get some loaded dumpers test checked at other weigh bridge. Weigh bridge will be period call got calibrated and verified from weight and measure authorities.

For the purpose of application of tack coat, if the theoretical area as per sanctioned estimate for basis of tone differs with the actual area of work done in the field, the reduction in or addition to payment shall have to be effected to the contractor. On pro-rata basis depending upon the area deducted 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 measurement shall be recorded by the Deputy Executive Engineer or Assistant Engineer or Addl. Asst. Engineer, if so authorized, Record of each dumper will be maintained separately in bound and numbered register, which will be maintained by the departmental representative and signed by the contractor. Proper gate pass system shall be established for his vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer and meter in which individual dumper are unloaded be recorded carefully.

8. RATE The contract unit rate for mix seal surfacing shall be paid in full for carrying out the required operations including full compensation for all components listed in M.O.S.T. Specification, Clause 503.8 of M.O.S.T.

Item No.26 Road Marking with hot applied thermoplastic compound with reflectorising glass beads on bituminous surface. Providing & laying hot applied thermoplastic compound 2.5 mm thick including reflectorising glass beads @ 250 gms. per sq.mt. area thickness of 2.5 mm is exclusive of surface applied glass as per I.R.C. 35 The finished surface to be level, uniform & free from streaks & holes.

803 ROAD MARKINGS

803.1 Scope

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

803.2 Materials

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

803.3 Ordinary Road Marking Paint

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

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

803.4 Hot Applied Thermoplastic Road Marking

803.4.1 Thermoplastic Material

803.4.1.1 General

The thermoplastic material shall be homogeneously composed of aggregate, pigment, resins and glass reflectorizing beads. The colour of the compound shall be white or yellow (IS colour No. 356) as specified in the drawings or as directed by the Engineer.

803.4.1.2 Requirements :

- i) Composition: The pigment, beads, and aggregate shall be uniformly dispersed in the resin.

The material shall be free from all skins, dirt and foreign objects and shall comply with requirements indicated in Table 800-9.

Table 800-9 : Proportions of Constituents of Marking Material (Percentage by Weight)

Component	White	Yellow
Binder	18.0 min	18.0 min.
Glass Beads	30-30	30-30
Titanium Dioxide	10.0 min	--
Calcium Carbonate and Inert Fillers	42.0 max.	See Note below
Yellow Pigments	--	See Note below

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

- ii) Properties: The properties of thermoplastic material, when tested in accordance with ASTM D36/BS-3262-(Part 1), shall be as below:

- a) Luminance:

White: Daylight luminance at 45°-65 percent min. as per AASHTO M 249

Yellow: Daylight luminance at 45°-45 percent min. as per AASHTO M 249

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

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

- d) Cracking resistance at low temperature: The material shall show no cracks on application to concrete blocks.
- e) Softening point: $102.5^{\circ}\text{C} \pm 9.5^{\circ}\text{C}$ as per ASTM D 36.
- f) Yellowness index (for white thermoplastic paint): not more than 0.12 as per AASHTO M 249
- iii) Storage life : The material shall meet the requirements of these Specifications for a period of one year. The thermoplastic material must also melt uniformly with no evidence of skins or unmelted particles for the one year storage period. Any material not meeting the above requirements shall be replaced by the manufacturer/supplier/ Contractor.
- iv) Reflectorisation : Shall be achieved by incorporation of beads, the grading and other properties of the beads shall be as specified in Clause 803.4.2.
- v) Marking : Each container of the thermoplastic material shall be clearly and indelibly marked with the following information:
 - 1) The name, trade mark or other means of identification of manufacturer
 - 2) Batch number
 - 3) Date of manufacture
 - 4) Colour (white or yellow)
 - 5) Maximum application temperature and maximum safe heating temperature.
- vi) Sampling and Testing : The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM/BS method. The Contractor shall furnish to the Engineer a copy of certified test reports from the manufacturers of the thermoplastic material showing results of all tests specified herein and shall certify that the material meets all requirements of this Specification.

803.4.2 Reflectorizing Glass Beads

803.4.2.1 General

This Specification covers two types of glass beads to be used for the production of reflectorised pavement markings.

Type 1 beads are those which are a constituent of the basic thermoplastic compound vide Table 800-9 and Type 2 beads are those which are to be sprayed on the surface vide Clause 803.6.4.

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

These shall conform to the requirements spelt out in Clause 803.4.2.3.

803.4.2.3 Specific Requirements

- a) Gradation : The glass beads shall meet the gradation requirements for the two types as given in Table 800-10.

Table 800-10 : Gradation Requirements for Glass Beads

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

b) Roundness: The glass beads shall have a minimum of 70 percent true spheres.

C) Refractive index: The glass beads shall have a minimum refractive index of 1.50.

d) Free flowing properties: The glass beads shall be free of hard lumps and clusters and shall dispense readily under any conditions suitable for paint striping. They shall pass the free flow-test.

803.4.2.4 Test Methods

The specific requirements shall be tested with the following methods:

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

803.4.3 Application Properties of Thermoplastic Material

803.4.3.1 The thermoplastic material shall readily get screeded/extruded at temperatures specified by the manufacturers for respective method of application to produce a line of

specified thickness which shall be continuous and uniform in shape having clear and sharp edges.

803.4.3.2 The material upon heating to application temperatures shall not exude fumes, which are toxic, obnoxious or injurious to persons or property.

803.4.4 Preparation

- i) The material shall be melted in accordance with the manufacturer's instructions in a heater with a mechanical stirrer to give a smooth consistency to the thermoplastic material to avoid local overheating. The temperature of the mass shall be within the range specified by the manufacturer, and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material should be used as expeditiously as possible and for thermoplastic material which has natural binders or is otherwise sensitive to prolonged heating, the material shall not be maintained in a molten condition for more than 4 hours.
- ii) After transfer to the laying equipment, the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.

803.5 Reflectorised Paint

Reflectorised paint, if used, shall conform to the Specification by the manufacturers and approved by the Engineer. Reflectorising glass beads for reflectorising paints where used shall conform to the requirements of Clause 803.4.2.

803.6 Application

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

803.6.2 Where the compound is to be applied to cement concrete pavement, a sealing primer as recommended by the manufacturer, shall be applied to the pavement in advance of placing of the stripes to ensure proper bonding of the compound. On new concrete surface any laitance and/or curing compound shall be removed before the markings are applied.

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

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

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

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

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

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

- i) Width of lines and other markings shall not deviate from the specified width by more than 5 percent.
- ii) The position of lines, letters, figures, arrows and other markings shall not deviate from the position specified by more than 20 mm
- iii) The alignment of any edge of a longitudinal line shall not deviate from the specified alignment by more than 10 mm in 15 m.
- iv) The length of segment of broken longitudinal lines shall not deviate from the specified length by more than 150 mm.

In broken lines, the length of segment and the gap between segments shall be as indicated on the drawings; if these lengths are altered by the Engineer, the ratio of the lengths of the painted sections shall remain the same.

803.6.7 Properties of Finished Road Markings

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

- a) The stripe shall not be slippery when wet.
- b) The marking shall not lift from the pavement in freezing weather.
- c) After application and proper drying, the stripe shall show no appreciable deformation or discoloration under traffic and under road temperatures upto 60°C.
- d) The marking shall not deteriorate by contact with sodium chloride, calcium chloride or oil dripping from traffic.
- e) The stripe or marking shall maintain its original dimensions and position. Cold ductility of the material shall be such as to permit normal movement with the road surface without chopping or cracking.

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

803.6.8 Measurements for Payment

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

803.6.8.2 In respect of markings like directional arrows and lettering, etc., the measurement shall be by numbers.

803.6.9 Rate

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

Item No.27 Supplying and fixing cat eye (Stimsonite) made out from Acrilo beaufite sterine injuction high compressed molding with reflector made of MMC (prismatic type of size 12cm x 6cm x 2.5cm) provided with bituminous adhesive 100g. with each unit for fixing. (High Intensity grade))

1.1 General

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

1.2 Definitions

1.2.1 Description of Terms Specific to this standard

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

1.2.1.6 Upper surface – that part of the external surface of road stud which is visible when the road stud is fixed in position in the road.

1.2.1.7 Anchorage – that part of a road stud which is below the road surface above the road stud is fixed position in the road.

1.3 Material

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

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

1.4 Design

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

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

1.5 Optical Performance

1.5.1 Unidirectional and bi-directional studs

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

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

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

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

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

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

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

1.5.2 Omni – directional studs

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

1.5.3 Tests

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

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

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

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

1.6 Fixing of Reflective Markers

1.6.1 Requirements

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

1.6.1.2 The reflecting portions of the studs shall be free from crevice or ledges where dirt might accumulate.

1.6.1.3 All road studs shall be legibly marked with the name, trade mark or other means of identification of the manufacture.

1.6.1.4 Marker height shall not exceed 20 mm.

1.6.1.5 Marker width shall not exceed 130 mm.

1.6.1.6 The base of the marker shall be flat within 1.3 mm. If the bottom of the marker is configured. The outermost faces of the configurations shall not deviate more than 1.3 mm from a flat surface.

1.6.2 Placement

1.6.2.1 The reflective marker shall be fixed to the road surface using the adhesives and the produced recommended by the manufacturer. No nails shall be used to affix the marker as nails are hazardous for the roads.

1.6.2.2 Regardless of the type of adhesive used. The markers shall not be fixed if the pavement is not surface dry and on new asphalt concrete surfacing unit the surfacing has been opened to traffic for a period of not less than 14 hours.

1.6.2.3 The portions of the highway surface, to which the marker is to be bonded by the adhesive, shall be free of dirt, curing compound, grease, oil, moisture, loose or unsound layers, paint and any other material which would adversely affect the bond of the adhesive.

1.6.2.4 Use a wire brush, if necessary to loosen and remove dirt. Then brush or blow clean.

1.6.2.5 The adhesive shall be placed uniformly on the cleaned pavement surface or on the bottom to the marker in a quantity sufficient to result in complete coverage of the area of contact of the marker with no voids present and with a slight excess after the marker has been lightly pressed in place.

1.6.2.6 For epoxy installations, excess adhesive around the edge of the marker, excess adhesive on the pavement and adhesive on the exposed surfaces of the markers shall be immediately removed. Soft rags moistened with mineral spirits or kerosene may be used as necessary to remove adhesive from exposed faces of pavement marker.

1.7 Warranty and durability

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

1.8 Measurement for Payment

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

1.9 Rate

The contract unit rate for Cats eye (MMC) shall be payment in full compensation for furnishing all labour, material, tools, equipment including incidental costs necessary for carrying out the work at site conforming to the specifications complete as per approved drawings or as directed.

Item No.28 Cautionary Warning Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet; size 90 x 90 x 90 cms. equilateral triangle as per design of IRC-67-1977. Pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ;reflectorised with retro reflective sheeting as per latest M.O.S.T.Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm, 75 x 75 x 6mm as required; painted with best quality epoxy coatings in black and white bands. 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.(B) Engineer Grade

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

Table 800 – 2

ACCEPTABLE MINIMUM COEFFICIENT OF RETRO-REFLECTION FOR ENGINEERING GRADE SHEETING

(CANDELAS PERLUXPER 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 coefficient of retro-reflection shall not be less than 50 per cent of the values of corresponding colour in Tables 800-1 and 800-2, as applicable.

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

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

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

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

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

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

801.3.10 FABRICATION :

801.3.10.1 Surface to be reflectorised shall be effectively prepared to receive the retro reflective sheeting. The aluminium sheeting shall be degreased either by acid or hot alkaline etching and all scale/dust removed to obtain a smooth plain surface before the application of retro-reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable device or

clean canvas gloves, between all cleaning and preparation operation and application of reflective sheeting/primer. There shall be no opportunity for metal to come in contact with grease, oil or other contaminants prior to the application of retro-reflective sheeting.

801.3.10.2 Complete sheets of the material shall be used on the signs except where it is unavoidable; at splices, sheeting with pressure sensitive 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.29 Hazard Marker Sign :-Providing and fixing sing boards made out of 2mm aluminium sheet; size 90 x 30cms. rectangle as as per the design/drawing attached (IRC) pretreated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm & 50 x 50 x 5mm painted with best quality epoxy coatings The fixing at site shall be in 1:2:4 CC block of size 45x45x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(B) Engineer Grade

. The work of providing and fixing **Hazard Marker Sign** shall be executed as per relevant specifications of **Item No. 28** of this contract and as per approved drawing. The measurement shall be in numbers of **Hazard Marker Sign** board supplied and fixed in position

Item No.30 Providing and fixing 'W' type safety barrier using M.S. iron channel 150mm x 75mm x 5mm size erected at 2.0 Mt. center to center and providing 'W' shaped galvanised steel sheet guard rail 3mm thick for crash barrier in single row as per detailed drawing with fabrication and installation charges including providing foundation block of size 0.60 x 0.60 x 0.75 Mt. in C.C. 1:2:4 and oil painting two coats with one coat of red oxide etc complete.

1.0 The work shall consist of furnishing and erection of metal crash barrier of dimensions and at locations as shown on the drawing, 'or' as directed by the Engineer-in-charge.

2.0 Materials

2.1 Metal beam rail shall be corrugated sheet of galvanized iron of the class, type section and thickness and shall be provided in one row as indicated in the item and shown on plan. Railing post shall be of steel section 150 mm x 75 mm x 5 mm. All complete steel rail elements, terminal sections, bolts, nuts, hardware and other fittings shall be galvanized.

All elements of the railing shall be free from abrasion, rough or sharp edges and shall not be kinked twisted or bent, and shall conform to the IS 1367 and LS 1364.

2.2 Concrete for anchor assembly shall be in proportion of 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm size) which includes concrete foundation block of size 0.60 x 0.60 x 0.75 mt for each post. The concrete work shall be carried out in accordance with the relevant MORT&H specifications

3.0 Construction Operation :

3.1 Installation of posts :

3.1.0. Workmanship

3.1.1. The ground shall be roughly leveled and after making the position of post, at 2.00 mt. C/C the foundation pit shall be excavated in true line and level as shown on drawing or as directed by the Engineer in charge.

3.2 The Pit shall be back filled with R.C.C. 1:2:4 as shown on drawing or as directed.

3.3 While casting foundation concrete, steel post shall be embedded in concrete work at 2.00 mt C/C with necessary hold fast. The line and grade of railing shall be true to that shown on the plan. The railing shall be carefully adjusted to fixing in place to ensure proper matching at abutting joints and correct alignments and caber throughout their length. Holes for field connection shall be drilled with the railing in place in the structure at proper grade and alignment.

3.4 Railing steel post shall be given one coat of primer and two coats of paint on structural steel after erection if the sections are not galvanized. Any part of assembly below ground shall be painted with two coats of red lead paint.

4.0 Erection :

4.1 All ground rail anchors shall be set and attachment made and placed as indicated in the item and shown on the plan or as directed by the Engineer-in-charge.

4.2 All bolts or clips used for fastening the guard rail or fittings to the posts shall be drawn up tightly, Each bolt shall have sufficient length to extend at least 6 mm through and beyond the full nut, except where such extensions might interfere with or endanger traffic in which case the bolts shall be cut off flush with the nut.

4.3 All railings shall be erected, drawn and adjusted so that the longitudinal tension will be uniform throughout the entire length of the rail.

4.4 The post shall be vertical with a tolerance not exceeding 6 mm in a length of 3 meter. The railing barrier shall be erected true to line and grade.

5.0 Measurement for payment :

5.1 Meal beam crash barrier will be measured and paid by liner meter of completed length as per plans and accepted in place.

5.2 No measurement for payment shall be made for excavation, back filling with concrete etc. performed in connection with this construction.

5.3 The contract unit rate shall include full compensation for furnishing of labour, material, tools, equipments works involved in constructing the “W” type crash barrier complete in place in all respect as per these specification.

Item No.31 Logo Board:- Providing and fixing Logo Board made out of 2mm aluminium sheet, as per the drawing & design. Pre treated with phospheting process and acid etching coated with one coat of epoxy primer and two coat of best quality epoxy paint, refloctrorized with retro reflective sheeting as per the latest M.O.S.T. specification, 3.1 Mt. long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3 mm, 75 x 75 x 6 mm as required painted with best quality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 cms for each leg, including excavation curing etc. complete under the supervision of Engineer-In-Charge (A)Engineer grade.

. The work of providing and fixing **Logo Board** shall be executed as per relevant specifications of **Item No. 28** of this contract and as per approved drawing. The measurement shall be in numbers of **Logo Board** board supplied and fixed in position

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

Executive Engineer,
Panchayat (R&B) Division
Valsad

Signature of the
contractor

- : 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	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	

			as per IS 1206		
7]	Cement		<ul style="list-style-type: none"> - 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		<ul style="list-style-type: none"> - 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		<ul style="list-style-type: none"> - Chemical test 	Once for approval of source of supply	
10]	Steel		<ul style="list-style-type: none"> - Tensile Strength - Yield Stress - Elongation - Size 	1 test/ 40 tonnes/ per category	
11]	Bricks		<ul style="list-style-type: none"> - Water absorption - Efflorence - Size - Compressive Strength 	1 test per 50,000 bricks	
12]	Prime coat/ Tack coat		<ul style="list-style-type: none"> - 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		<ul style="list-style-type: none"> - Quality of 	Number of samples per lot	

	Seal coat mix/ B.M/ M.S.S.		<ul style="list-style-type: none"> binder - Grading - Temperature of binder - Binder content vide 45 IMD 2172 - Rate of spread of mix materials 	<p>and test as per IS:73</p> <p>1 test on individual contents and mix aggregate from the dryer for each 100 tonns of mix subject to minimum of two test per plant per day</p> <p>At regular close intervals</p> <p>One test for each 100 tonnes of mix subject to mini. of Two per day</p> <p>Regular control through checks on layer thickness</p>	
14]	Granular Sub-base	~~~~~	<ul style="list-style-type: none"> - Gradation - Atterberg limits - Moisture content prior to compaction - Density of compacted layer - Deleterious constituents - C.B.R. 	<p>As mentioned under serial number 3</p> <p>As mentioned under serial number 3</p> <p>As mentioned under serial number 3</p> <p>One test per 500 m²</p> <p>As required</p> <p>As required</p>	
15]	Wet Mix Macadam		<ul style="list-style-type: none"> - Aggregate Impact Value - Grading - Flakiness and Elongation Index - Atterberg limits of portion of aggregate passing 425 	<p>As mentioned under serial number 1</p> <p>As mentioned under serial number 1</p> <p>As mentioned under serial number 1</p> <p>As mentioned under serial number 3</p>	

			micron sieve - Density of compacted layer -	One test per 500 m ²	
16]	Water Bound Macadam		- 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		- 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.

Signature contractor	of the	Deputy Executive Engineer, Panchayat (R&B) Sub Division Pardi	Executive Engineer, Panchayat (R&B) Division Valsad
-------------------------	--------	---	---