

PANCHAYAT (R & B) DIVISION

RAJPIPLA.



**NAME OF WORK:- Constructing C.D. Works on Palaswada
Chatuvad Road. (V.R. / Non Plan) Taluka :- Sagbara, District:
Narmada.**

DETAILED SPECIFICATIONS.

GENERAL TECHNICAL SPECIFICATION 1. General:

All measurements shall be made in the metric system. Different items of work shall be measured in accordance with the procedures set forth in the relevant specifications read **in** conjunction with Genral Conditons of Contract. The same shall not. however, apply in the case of lump-sum item. All measurements and computations, unless otherwise, indicated, shall be carried nearest to the following limites

(i)	Length and breath	10 mm
(ii)	height, depth or thickness of earthwork, sub-base, base surfacings and structural members	05 mm
(iii)	areas.	0.01 Sq.Mtrs.
(iv)	cubic contentcs	0.01 Cubic Mtr

2 MEASUREMENT OF LEAD FOR MATERIALS

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

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

3 Surface, Regularity

The surface regularity of completed wearing surfaces in the longitudinal and transverse directions shall be within the tolerances indicated in Table below. The longitudinal profile shall be checked with a 3 metre long strainght edge, at the middle of each traffic lane along a line p6ralelled to the centre of the road, The transverse profile shall be checked with a set of three cambe boards at intervals of ten metres

PERMITTED TOLERANCES OF SURFACE REGULARITY FOR PAVEMENT COURSES

Sr. No.	Type of Construction	Longitudinal Maximum Permissible in MM.	Profile with 3 meter straight edge	Cross Profile
			Maximum Nos. Of Undulations permitted length exceeding 3mm	Maxi. Permissible variation from specified camber template mm
	Bitumenous wearing coat	15	20	6

Notes.

- 1 @ These are for machine laid surfaces. If laid manually, tolerance; upto 50,-percent above these values in this column may be permitted. However this relaxation does not apply to the value of maximum undulation for longitudinal and cross profiles mentioned in columns 3 and 8 on the table
- 2 Surface evenness requirements in respect of both the longitudinal and cross profiles should be simultaneously satisfied

3.1 Rectification

Where the surface irregularity fall outside the specified tolerances, the contractor shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer-in-charge at his own cost.

3.2 Bituminous constructions

For bituminous constructions, for wearing course, where the surface is high or low, the full depth of the layer shall be removed and replaced with fresh materials and compacted to specifications, In all cases where the removal & replacement of a bituminous layer is involved, the area treated shall not be less than 5 metres long and less than 1 lane

4.0 Quality control tests during Construction

The materials supplied and the works carried out by the contractor shall conform to the enclosed relevant specifications. For ensuring the requisite quality of construction, the materials and works shall be subjected to quality control tests, as described here in after, by the Engineer-in-charge . Test procedures for the various quality control test are indicated in the respective sections of the Specifications or for certain tests within this section. Where no specific testing procedure is mentioned, the test shall be carried out as per the prevalent accepted Engineering practice to the directions of the Engineer-in-charge.

5.0 Following materials shall conform to the Indian Standards shown "Against Them".

[1]	Cement	IS: 269
	Sand of Masonary	IS : 2116
	Sand for Concrete	IS: 383,
	Coarse aggregate	IS: 383
	Mild Steel	IS: 432
	High yiled strength deformed bars-	
	(a) Hot Rolled	IS :1139
	(B) Cold Twisted	IS :1786
	Cast Steel	IS :1030
	Cast Iron	IS : 210
	Structural Steel-	
	(a) Mild Steel	IS : 226
	(b) H. T. Steel	IS : 961
	(c) Fusion welding quality steel	IS :2062
	(d) Rivet steel	IS : 1148 OR
		IS :1149 As applicable
	H.T. Steel	IS :1785
	Greese	IS :1002
	Electrodesformetalorweldingof N.J.	IS : 814

**ITEM No. Excavation for foundation upto 1.5 mt. depth including sorting out and
[1] stacking of useful materials and disposing of the excavated stuff etc.
comp. Dense or Hard Soil**

- 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 personnel 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 are 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. Setting 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 specification
- 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. Providing &Filing in foundation with ordinary Cement Concrete M- 100 [2] mix & Providing necessary Vertical Pin & headers incl form work vibrating ramming and curing etc. 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 fine aggregate to coarse aggregate by volume but subject to a upper limit 1:1 ½ & a lower limit of 1:3	
M – 100	1:3:6	300		34
M – 150	1:2:4	20		32
M – 200	1:1 ½ :3	160		30
M – 250	1:1:2	100		27

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

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

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

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

Sr. No.	Item of construction	Maximum nominal size of
(i)	RCC well curb, RCC well steining and RCC piles	40 mm
(ii)	RCC well seining	63 mm
(iii)	Well cap or pile cap, solid type	40 mm
(iv)	RCC work in cross girders deck slab, wearing coars, kerb, light	20 mm
	light ports, blast walls, approach slab etc and hollow type piers, abutment wings wall and their pier caps	
(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

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
- 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 form work and reinforcement contained in it shall be cleaned and made free from standing water, dust snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer – in – charge has been obtained
- 14 If concreting is not started within 24 hours of the approval being given, It shall have to be obtained again from the Engineer- in – charge .Concreting being given it shall proceed continuously over the area between construction 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 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 of substantial rigid construction and shuttering shall be true to shape and dimensions shown on the drawings. All bolts and rivets shall be counter sunk and well ground to provide a smooth, plane surface
- 19 Forms shall be mortar tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports,. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribe lines occurring during and after placing the concrete. Screw jacks or hard wood wedges where required shall be
- provided to make up any settlement in the formwork either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of structure, specially in long spans to counteract the effects of any fixed as to provide for such camber. Forms shall be so constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed, chambers or fillets of sized 25mm x 25 mm shall be provided at all angles of formwork to avoid sharp corners.
- 20 The inside surfaces of shuttering shall, except in the case of permanent formwork or where otherwise agreed to by the Engineer in charge, be coated with an approved material to prevent adhesion of concrete to the formwork. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not be allowed to come into contact with any reinforcement or pre stressing tendons and anchorages. Different release agents shall not be used in formwork for concrete which will be visible in the finished works
- 21 Special measurements shall be taken to ensure that the form work does not hinder the shrinkage of concrete because without these cracking could occur before the form work is removed. Wherever applicable arrangements must be made to ensure that the formwork does not restrain the shortening & 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

camber so as to ensure the correct final shape of the structures having regard to the deformation of a false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting pre stressed structures. Where there are re entrant angles in the concrete sections the formwork should be removed at those sections as soon as possible after the concrete has set in order to avoid cracking due to shrinkage of concrete. Formwork shall be tight enough to prevent any appreciable loss of cement during vibrations, suitable tolerances should be provided in the formwork. Immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer in charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength alignment and general fitness, but such inspection shall not relieve the contractor of his responsibility for safety of men, machinery, materials and for results obtained.

- 22 The Engineer in charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of formwork, due consideration shall be given to local conditions, character of the structure, the weather and other conditions that influence the setting of concrete and of the materials used in the mix. Where field operations are controlled by strength tests of concrete, the removal of the load supporting or soffit forms

may commence when concrete has attained strength equal to at least twice the stress to which the concrete will be subjected at the time of striking props including the effect of any further addition of loads. When field operations are not controlled by strength tests of concrete the vertical forms of beams, columns and walls, may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All formwork shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to

take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 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 at least 25mm.

below the surface of the concrete and the resulting holes be filled by cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honeycomb spots, broken

edges 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	Where Vibrators
(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	25 mm to 40	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 proud. The number of specimens may be suitably increased as deemed necessary by the Engineer in charge when procedure of tests given above reveal a poor quality of concrete and in other special cases

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

- 28 In reinforced concrete the volume occupied by reinforcement shall not be The slab shall be measured as running continuously through and the beam as the portion below the slab.
- 29 All necessary labour, materials, equipment, etc, for sampling, preparing test cubes curing etc. shall be provided by the Contractor. Testing of the materials and concrete may be arranged by the Engineer in charge in an approved laboratory at the cost of the contractor.
- 30 The payment will be made on cmt. basis of the finished work
- 31 The unit rate for concrete shall include the cost of all materials, labour tools and plan required for mixing, placing in position, vibrating and compacting finishing as per directions of the Engineer in charge, curing and all other incidental expenses for producing concrete of specified strength to complete structure or its components as show on the drawings and according to these specifications. The rate shall also include the cost of making / fixing and removing of all centres and forms required for the work

ITEM No. Providing and casting in situ ordinary cement concrete M.-150 mix [3] and Providing necessary pinheaders incl. Shuttering scaffolding laying vibrating curing and finishing complete. without v -Grooves (A) Ht from 0.0 M to 5.0 M.

The work shall be carried out as per relevant specification of this Tender Item No. - 2. The grade of concrete shall be **Ordinary C. C. M- 150**. The concreting shall be done as per detailed drawing. The contract unit rate includes centering, shuttering, scaffolding, wherever necessary laying, vibrating, curing and finishing comp. **Height from 0.0 to 5.00 Mt**

The contract rate shall be for a unit of **1.00 Cumt** for completed item

**ITEM No. Supplying and fixing reinforced concrete heavy duty non pressure pipe
[4] with collers for culverts carrying traffic as per Indian Railway Standard
specifications including setting the pipe in Cement mortar 1:2 watering
and laying (to level or slope) of class NP4 of 900 mm dia.**

- 1 The work shall consist to furnishing and installing reinforced cement concrete pipe of the type dia metre and length required at the location shown on the drawings or as ordered by the Engineer in charge
- 2 Reinforced concrete pipe shall be NP3 type conforming to the requirements of IS : 458 and shall be of dia as specified in the item each consignment of cement concrete pipes shall be inspected. If necessary and approved by the engineer in charge, either at the place of manufacture or at the site before their incorporation in the works

NP3 , NP3 , NP1 pipes are used for RCC 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 this responsibility of supplying pipes of required standard and will have to bear the loss or damage caused to the work in 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..... manufacture of RCC pipes produce RCC 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 carry out 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 Signature.

- 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 450mm. The laying of pipes on the prepared foundation shall start from the outlet and proceed toward 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 the 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 RCC 150 to 200 mm wide and having the same strength as the pipes to be jointed . Caulking space 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 joint space 13 cm wide, The jointing space shall be filled with cement mortar, 1 cement 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 RCC pipe shall be measured along their centre between their inlet and outlet ends in linear **metres**.
- 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 Providing and Filling Sand around the Pipe and Between Head Walls in
[5] layers as directed**

Area around pipes shall be filled with **sand** immediately after the pipes have been laid and the joining material has hardened. The material shall be clean, free from boulders large roots, excessive amount of sods or other vegetable matter, and lumps and shall be approved by the Engineer-in charge. Filling up to 0.3 metre above the top of the pipe shall be carefully done and the soil thoroughly rammed, temped or vibrated in layers of not exceeding 150 mm. particular care being taken to thoroughly consolidate the materials under the launches of the pipe. Filling shall be carried out simultaneously on both sides of the pipes in such a manner that unequal pressures do not occur.

In case of high embankments after filling up to the top in the above said manner a loose fill of a depth equal to external diameter of the pipe shall be placed over the pipe before further layer are added and compacted. Materials shall be filled in pharas 3m x 1.5. m x 0.5 m size and shall be measured in Cu.M.

Unit rate includes cost of materials and spreading including labour and tools needed for the above operations.

Payment shall be paid on **Cum** basis.

**ITEM No. Providing and fixing Guard stone as per I.R.C. Type Design including
[7] White Washing etc. complete. (I) Fixing in C.C.1:5:10 .**

- 1 The guard stone shall be of approved quality and of the size specified in the item. its length shall not be less than 75 cms . The top portion shall be rounded. The top 38 cm. shall be chisel dressed on all sides. The size, shape and dimensions of the guard stones shall be exact and shall be neatly dressed and finished.
- 2 The guard stones shall be fixed in position as directed by the Engineer- in – charge in earth only. The exposed part of the guard stones shall be given three coats of white wash. Any excavation necessary for fixing of the guard stones shall be done by the contractor at his own cost. The measurement for payment shall be per number of guard stone fixed in position
- 3 Unit rate of guard stone includes the cost of all materials , labors, tools, fixing & white washing as directed by the Engineer- in – charge .
- 4 The guard stone shall be fixed in C.C.1:5:10 as directed the Engineer- in – charge

**ITEM No. Providing and Fixing 20 cm x 15 x 2.5 cm. Thick year plate of marble
[8] stone set in cm1:4 inclu. finishing and engraving letters etc. complete.**

- 1 Providing and fixing 30 cms x 22 cms 2 2.5 cms No and year plate of marble and of standard lettering with leads or paint including finishing etc. complete.
- 2 Marble plate shall be white and of approved quality and shall be 25 mm thick and of standard size as directed by the Engineer-in-charge of the work
- 3 Lettering 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 the Engineer-in-charge. Cement shall conform to relevant I.S. specification.
- 4 Measurement shall be per **number** of marble plate fixed.
- 5 Unit rate includes cost of all material labor etc. for complete work

**ITEM No. Providing and fixing Number plate of marble stone set in cm 1:4
[9] inclu.finishing & engraving letters etc. complete.**

The work shall be carried out as per relevant specification of this Tender Item No. - 8. The contract unit rate includes the Cost of Marble Plate, Engraving Lettering etc. Complete.

Measurement shall be per **Number** of marble plate fixed.

**ITEM No. Providing and Maintaining of diversion for traffic during the work in
[10] progress till completion of work incl.providing red lamps and necessary sign board. - For Pipe Drain.**

- 1 The Item Provided for the Temporary all-weather and Fair weather diversion during the construction period of the structure like , Causeway Dip Slab Drain major & Minor Bridge for easy going traffic
- 2 The Diversion shall be made by using Material Like Earth Work , Murrum , Hard Murrum H.B. Metal , Rubble Etc. of Approved quality
- 3 The Diversion shall be made by using Material suggested by Engineer – in-Charge from above mentioned material . The Quality of material shall be brought by Contractor at required by engineer – in – Charge
- 4 The contractor shall maintain the diversion in trafficable condition. Rolling and Watering Will also carried out by Contractor whenever required.
- 5 Near Starting point and end point of the diversion the contractor shall Provide with proper caution sign & Mark with red light at night to avoid accident. The final payment of diversion will be paid to contractor when the Structure work is ready for traffic.
- 6 The Payment shall be made on **No.** Basis.

ITEM No. White washing with lime on wall surface (three coats) to give an even shade including thoroughly booming the surface to remove all dirt, dust; mortar drops and other foreign matter.
[11]

1 General :

Lime shall be hydraulic lime of approved quality.

The slaked lime, if stored, shall be kept in a weather proof and damp roof shed with impervious floor and sides to protect it against rain, moisture, weather and extraneous materials mixing with it. All lime that has been damaged in any ways shall be rejected and all rejected materials shall be removed from site of work.

2 Workanship :

The fat lime shall be slaked at site and shall be mixed and stirred with about five liters of water and 1 Kg of unslaked lime to make a thin cream.- This shall be allowed to stand for a period of 24 hours' and then shall be added to each cubic meter of lime cream. Sinai quarry of ultra marine blue shall also be added to the last two coats of white wash solution and the whole solution shall be stirred thoroughly before use.

3 Preparation of surface :

The surface shall be thoroughly cleaned of all dust mortar dropping and other foreign matter before white wash is to be applied. Oil or grease spots shall be removed by suitable chemicals and smooth, surface shall be rubbed with wire brush.

Any unsound portion of the surface plaster shall be removed to full depth of plaster in rectangular patches and plastered again after raking the masonry joints properly.

4 Application of white wash :

On the surface so prepared the white wash shall be applied with brush. The first stroke of the brush shall be from top to downwards and another from bottom to upwards over the first stroke and similarly one stroke from the right and another from the left over the first stroke before it dries.

Each coat shall be allowed to dry before next coat is applied number of coats as specified in item shall be applied

5 Mode of Measurement & Payment :

All work shall be measured in the decimal system i.e. in sq. meters. Deduction (or pipe openings shall be made fully both sides of openings. The rates shall include the cost of all materials, labour, scaffolding protective etc. involved in all the operations described. The rate shall be for a unit of **one sq. meter**.

ITEM No [12] Earthwork in Embankment inclu. breaking clods drssing with incl. Rolling and Watering of earthwork in layers with power roller including filling in depressions which occur during the process. from Borrow area With in All Lead & Lift.

- 1 The land width on which the earth work is to be done shall be cleared of all trees having a girth of 30cm and loss, 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 stack 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 brunt or other wise disposed off by the contractor at 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 cleaning the site, the alignment of the road shall be properly set out true to line, curves, slopes grade sand sections as shown on then plan or directed by the Engineer-inc-charge. The contractor shall provide all labours and materials such as lime, string, pegs, nails, bamboos, stones, mortar, concrete etc. required for setting out, establishing Bench Marks and giving profiles the contractor shall be responsive for maintaining the B.M.S. profiles alignments and other marks as long as they are required for the work in the opining of the Engineer-in-charge. If the contractor defaults in this respect they be restored by the department at the cost of the contractor.
- 3 When existing embankment is to be widened, continuous, horizontal benches, each at least 0.3 metre wide, shall be cut into existing slope for ensuring adequate bond with the fresh embankment. of the embankment. 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 to any other type hauling equipment
- 4 The soil to be used for embankment shall be free from trees, stumps, root, rubbish or any other objectionable materials. Only materials considered suitable by the Engineer-in-charge shall be used for the construction and that considered unsuitable shall be disposed off as directed by him. The selection of materials to be used in the construction of embankment shall be made after soil survey and investigations are carried out by the Department. The embankment shall consist of earth available from road-side borrow pits on either side with all lead and lifts
- 5 Location, shape and size of borrow pits shall be as indicated by the Engineer-in charge. Its shall not be dug continuously. Ridges of not less than 8 metres width should be left at interval not exceeding 300 metres. Small drain shall be cut through the ridges of facilities drainage. The other edge of borrow pits shall be so regulated that the bottom does not cut an imaginary line having a slope 1 vertical to 4 horizontal projected from the edge of final section of the bank, the maximum depth in any case being limited to 1.5 meter. Also no pits shall be dug within 5 metres of the toe of the final section of the road embankment

- 5.1 No borrow pits shall be allowed at the following sites along the road
- i Upto 30 metres on either side of C.D. works.
 - ii Upto 15 metres on either side of cart track crossing for which approaches are to be constructed.
- 5.2 If there is top layer of black cotton or there object able soils, the same shall be removed and deposited off elsewhere and usable material found at lower level will only be used in earthen embankment.
- 6 The Embankment shall be constructed in uniform layer not exceeding 250mm in loose thickness. The soil shall be spread uniformly over the entire width of the embankment Unless otherwise directed by the Engineer-in-charge the consolidation including watering and rolling of earth work shall be carried out by the Department. The operation of laying the successive layer of earth shall be broken to have maximum size 15cm. when being in the embankment and a maximum of size 5 cm. when bedding placed in the 45cm. of the embankment. The work of next layer shall be allowed only after the first layer below it has been thoroughly compacted.
- 7 Where an embankment is to be placed on sloping ground shall be balanced in the step of trenches of 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 places not be exceed 0.1 m. and may be left under the new embankment. If the existing road surface is of granulate or bituminous type and lies within 1 mt. of the new sub grade level, the same shall be scarified to a depth of minimum 50mm, so as to provide ample bond between the old and the new material
- 8 To avoid interference with construction of abutment, wing walls or return walls of culvert/bridge structures, the contractor shall at point to be determined by the Engineer-in-charge, suspend work on embankment forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of interference of damage to the bridge work, unless directed otherwise the filling around culverts, bridge and other structures up to a distance of twice the height of the embankment. The fill material shall not be placed against any abutment or wing wall unless permission has been given for 14 days, the 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 requirement for filler medium and will be paid extra in the relevant item.

9 The embankment shall be finished in conformity with the alignment, level, cross section and dimensions shown on the plans or as directed by the 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 drawing or as the Engineer-in-charge may direct. Finishing operation shall include the work of shaping and dressing the shoulder, road bed and the slopes to conform to the cross section

10 The Earthwork measurement 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 section both longitudinal and cross of the ground shall be taken by the Engineer-in-charge before the actual work is started.

The contractor or his authorized representative shall attend day to day leveling work and sign with date the field book daily, in token of the acceptance. If there is any disagreement the contractor shall inform of it in writing to the officer concerned with specific reference to the section 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 5% before commencement of earth work and on finalization. The contractor shall maintain the embankment by filling in rain cuts, depression due to shrinkage etc. to proper formation and grade till this is finally

measured and accepted by the Department. The measurements shall be taken on compacted earthworks. If the compaction as stipulated in Para above is not done by the department in that case shrinkage from such earth work quantity shall be deducted as per norms i.e 10 per cent after monsoon and 15% before monsoon. However the contractor shall have taken place at the time of taking the final measurements of this item.

11 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 area, breaking clods, conveying and spreading earth in layers with all lead and lift, finishing the entire embankment and incidental 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 the particulars item. No payment shall be made under this item for the cutting stuff used in the embankment but labor for cutting will be paid as per specification in the particulars item, and only balance quantity of earthwork brought from borrow area will be paid in this item.

- 12 For spreading materials in layers and bringing the appropriate moisture content the embankment materials successive layers of embankment shall be spread uniformly over the entire width of the embankment in layer not exceeding 250mm 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
- 13 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 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.
- 14 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 60mm when being placed in the top 0.5 meter portion of the embankment to minimize cutting of uneven compaction. Hauling equipment shall be spaced uniformly over entire surface of the previously constructed layer to minimize cutting of uneven compaction.
- 15 Where the embankment is to be constructed on low area ground that will not support the weight of truck or other hauling equipment, the lower part of the embankment should be constructed by dumping successive loads in an informally distributed layers of a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers

COMPACTION :

Only compaction equipment approved by the Engineer in charge shall be employed to compact the materials. The contractor shall demonstrate the efficiency of the equipment he intends to use for carrying out compaction trials. Each layer of the materials shall be thoroughly compacted to the densities specified in Table 1.2

Table 1.2 Compaction requirements for embankment

Sr. No.	Type of Work/ Materials	Field dry density as percentage of maximum Laboratory dry density as per IS:2720 (Part - VII)
1	2	3
(i)	Top 0.5 meter portion of	Not less than 100
(ii)	below subgrade level and	Not less than 85 to 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 inside of that 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

Measurement for Payment :

Consolidation of earth embankment construction shall be measured by taking cross section at interval in the original position before the work starts and after its completion and computing of the **volume of earthwork in cubic meters** by the method of average material brought from road way and drainage excavation. For this purpose it shall be assumed that one cubic

meter of suitable materials brought to site from roadway and drainage excavation forms one cubic meter of compacted fill and all bulking or shrinkage shall be ignored. Stripping including storing and reapplication of top soil shall be measured as volume in cubic meter.

The contract unit rate includes cost of mechanical roller required for consolidation including all labor. equipments fuel, hire chares, tolls and incidental necessary.

ITEM No [13] Providing Granular Sub base course in single layers as per gradation made of natural unscre-ened gravel 70% & sand 30% in proper propotion as directed incl.spreading, watering & rolling with vibrator roller as directed.

Scope:

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

Materials:

The material to be used for the work shall be **natural sand, murrum, gravel, crushed stone** depending upon the grading required. **Materials like crushed slag, crushed concrete brick metal & kanker may be allowed only with the specific approval of the Engineer.**

Maximum particle size of the corresponding gradings for the **natural sand, murrum, gravel, crushed stone** materials are given at Table 400-2. The grading to be adopted for a project shall be as specified in the Contract.

Physical Requirements :-

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

I.S.Sieve Designation	Percentage by Weight Passing the Sieve		
	Grading I	Grading II	Grading III
75.0 mm	100
53.0 mm	80-100	100	..
26.5 mm	55-90	70-100	100
9.5 mm	33-65	50-80	65-95
4.75 mm	25-55	40-65	50-80
2.36 mm	20-40	30-50	40-65
0.425 mm	25-Oct	15-25	20-35
0.075 mm	3-10	3-10	3-10
CBR Value	30	25	20
(Minimum)			

Note:-The 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

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

Construction Operations :

Preparation of subgrade:-

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

Spreading and compacting:

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

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

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

Moisture content of the loose material shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 per cent above to 2 per cent below the optimum moisture content corresponding to IS: 2720 (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 harrows, 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 the 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 crossfall and super elevation and shall commence at the edges and progress towards the center. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and cross fall (Camber) shall be checked and any high spots or depressions which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 Km. Per hour.

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

Surface Finish and Quality Control of Work:

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

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

Arrangements for Traffic :

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

Measurements for payment:-

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

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

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 except for initial treatment to verges, shoulders and construction of diversions;
- (ii) furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lifts;
- (iii) all labour, tools, equipment and incidentals to complete the work to the specifications
- (iv) carrying out the work in part widths of road where directed; and
- (v) carrying out the required tests for quality control

ITEM [14] Providing and laying compacted WBM of Grading-II MCBT metal of size 45 to 63mm in required layers including using 16% stone screening, 13.2mm size and 8% stone dust as filler including spreading watering & consolidation by vibratory roller etc. comp.

404.1 SCOPE

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

404.2 Materials

404.2.1 Coarse Aggregates

Coarse aggregates shall be either crushed or broken stone, crushed slag, overburnt (Jhama) brick aggregates or any other naturally occurring aggregates such as kankar and laterite of suitable quality. Materials other than crushed gravel / shingle is used, not less than 90 percent by weight of the gravel / shingle pieces retained on 4.75mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 400-8. The type and size range of the aggregate shall be specified in the contract or shall be as specified by the Engineer. If the water absorption value of the coarse aggregate is greater than 2 percent, the

TABLE 400-8. PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR WATER BOUND MACADAM FOR SUB-BASE / BASE COURSES

	TEST	TEST METHOD	REQUIREMENTS
1	*Los Angeles Abrasion Value or * Aggregate impact value	I.S. 2386 - Part -4 I.S. 2386 - Part -4 or I.S. 5640 * *	40 % (Max.) 30 % (Max.)
2	Combined Flakiness and Elongation indices (Total) * * *	I.S. 2386 - Part -1	30 % (Max.)

* Aggregate which get softened in presence of water shall be tested for impact value under wet conditions in accordance with IS:5640.

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

*** In case water bound macadam is used for sub-base, the requirements in respect of Los Angeles Value and Aggregate impact value shall be relaxed to 50 percent and 40 percent maximum respectively.

404.2.2 Crushed Broken Stone

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

404.2.3 Crushed Slag

Crushed slag shall be made from air-cooled blast furnace slag. It shall be of angular shape, reasonably uniform in quality and density and generally free from thin, elongated and soft pieces, dirt or other deleterious materials. The weight of crushed slag shall not be less than 11.2 kN per m³ and the percentage of glossy material shall not be more than 20. It should also comply with the following

- | | |
|------------------------|--|
| (i) Chemical Stability | : To comply with requirement of appendix of BS :1047 |
| (ii) Sulphur Content | : Maximum 2 Percent |
| (iii) Water Absorption | : Maximum 10 Percent |

404.2.4 Overburnt (Jhama) Brick aggregates :

Jhama brick aggregates shall be made from overburnt bricks or brick bats and be free from dust and other objectionable and deleterious materials. This shall be used only for road stretch when traffic is low.

404.2.5 Grading requirement of Coarse aggregates :

The coarse aggregates shall conform to one of the Gradings given in Table 400-9 as specified.

404.2.6 Screenings

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

TABLE 400-9 : GRADING REQUIREMENTS OF COARSE AGGREGATES

Grading No.	Size Range	I.S.Sieve	Percentage by Weight
1	63mm to 45 mm	75 mm	100
		63 mm	90 - 100
		53 mm	25 - 75
		45 mm	0 - 15
		22.4 mm	0 - 5
2	53mm to 22.4 mm	63 mm	100
		53 mm	95 - 90
		45 mm	65 - 90
		22.4 mm	0 - 10
		11.2 mm	0 - 5

Note : The compacted thickness for a layer shall be 75mm

Screenings shall conform to the grading set forth in Table 400–10. The quantity of screenings required for various grades of stone aggregates are given in Table 400–11. The table also gives the quantities of materials (loose) required for 10 m² for sub-base / base compacted thickness of 75 mm. The use of screenings shall be omitted in the case of soft aggregates such as brick metal, kankar, laterites etc. as they are likely to get crushed to a certain extent under rollers.

404.2.7 Binding Material

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

The quantity of binding material where it is to be used will depend on the type of screening. Generally, the quantity required for 75 mm compacted thickness of water bound macadam will be $0.06 - 0.09 \text{ m}^3 / 10 \text{ m}^2$.

TABLE 400 – 10. GRADING FOR SCREENINGS

Grading	Size of Screenings	I.S.Sieve	Percentage by Weight
A	13.2 mm	13.2 mm	100
		11.2 mm	90 - 100
		5.6 mm	15 - 35
		180 micron	0 - 10
B	11.2 mm	11.2 mm	100
		9.5 mm	80 - 100
		5.6 mm	50 - 70
		180 micron	May-25

TABLE 400 – 11. APPROXIMATE QUANTITIES OF COARSE AGGREGATES AND SCREENINGS REQUIRED FOR 75 MM COMPACTED THICKNESS OF WATER BOUND MACADAM (WBM) SUB-BASE / BASE COURSE FOR 10 M² AREA

Classification	Size Range	Compact Thickness	Loose Quantity	Screenings			
				Stone Screenings		Crushable type Such as murrum &	
				Grading Classification & Size	For W.B.M./ Sub Base/ Base Course (Loose Qty.)	Grading Classification & Size	Loose Quantity
Grading -1	63 mm to 45 mm	75 mm	0.91 to 1.07 Cum	Type -A 13.2 mm	0.12 to 0.15 Cum	No Uniform	0.22 to 0.24 Cum
Do	Do	Do	Do	Type - B 11.2 mm	0.20 to 0.22 Cum	Do	Do
Grading -2	53 mm to 22.4 mm	75 mm	Do	Do	0.18 to 0.21 Cum	Do.	Do.

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

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

404.3 Construction Operations

404.3.1 Preparation of base :

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

Where the WBM is to be laid on an existing metalled road, damaged area including depressions and potholes shall be repaired and made good with the suitable material. The existing surface shall be scarified and re-shaped to the required grade and camber before spreading the coarse aggregate for WBM. As far as possible, laying water bound macadam course over an existing 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.

404.3.2 Inverted Choke / Sub surface Drainage layer

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

404.3.3 Lateral Confinement of Aggregates

For construction of WBM, arrangement shall be made for the lateral confinement of aggregates. This shall be done by building adjoining shoulders along with WBM layers. The practice of constructing WBM in a trench section excavated in the finished formation must be completely avoided.

Where the WBM course is to be constructed in narrow widths for widening of an existing pavement, the existing shoulders should be excavated to their full depth and width upto the sub grade level except where widening specifications envisages laying of a stabilised sub base using in situ operations in which case the same should be removed only upto the sub base level.

404.3.4 Spreading coarse aggregates

The coarse aggregates shall be spread uniformly and evenly upon the prepared sub grade/sub-base/ in the required quantities from the stock piles to proper profile by using templates placed across the road about 6 m apart, in such quantities that the thickness of each compacted layer is not more than 75 mm. In no case shall these be dumped in heaps directly on the area where there are to be laid nor shall their hauling over a partly completed base be permitted. Wherever possible approved mechanical devices such as aggregate spreader shall be used to spread the aggregates uniformly so as to minimize the need for manual rectification afterwards.

No segregation of coarse aggregate shall be allowed and the coarse aggregates, as spread shall be of uniform gradation with no pockets of fine material.

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

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

404.3.5 Rolling:

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

Except on super elevated portions and carriageway with unidirectional cross-fall, where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inward parallel to the centre line of the road, in successive passes uniformly overlapping preceding tracks by at least one half width.

Rolling shall be carried out on courses where coarse aggregates of crushed / broken stone are used, till the road metal is partially compacted. This will be followed by application of screening and binding material where required in Clauses 404.3.6 and 404.3.7.

However, where screenings are not to be applied as in the case of aggregates like brick metal laterite and kankar for the sub base construction, the compaction shall be continued until the aggregates are thoroughly keyed. Rolling shall be continued and light sprinkling of water shall be done till the surface is well compacted. Rolling shall not be done when the sub grade is soft or yielding or when it causes a wave-like motion in the sub grade or sub base course.

The rolled surface shall be checked transversely with templates and longitudinally with 3 m. straight edge. Any irregularities exceeding 12mm shall be corrected by loosening the surface, adding or removing necessary amount of aggregates and re-rolling until the entire surface conforms to desired camber and grade. In no case shall the use of screenings be permitted to make up depressions.

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

404.3.6 Application of screenings:

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

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

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

404.3.7 Sprinkling of water and grouting :

After application of screenings, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping

and rolling operation shall be continued, with additional screenings applied as necessary until the coarse aggregate have been thoroughly keyed, well-bonded and firmly set in its full depth and a grout has been formed of screenings. Care shall be taken to see that the sub base or sub grade does not get damaged due to the addition of excessive quantities of water during construction.

In case of lime treated soil sub-base, construction of water bound macadam on top of it shall be taken up after curing as per Clause 402.3.9 and as directed by the Engineer.

Application of binding material :

After the application of screenings in accordance with Clauses 404.3.6 and 404.3.7, the binding material where it is required to be used (Clause

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

404.3.8 Setting and drying :

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

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

404.4 Surface Finish and Quality Control of Work

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

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

404.4.3 The water bound macadam work shall not be carried out when the atmospheric temperature is less than 10° C in the shade.

404.4.4 Reconstruction of defective macadam :

The finished surface of water bound macadam shall conform to the tolerance of surface regularity as prescribed in Clause 902. However, where the surface irregularity of the course exceeds the tolerances or where the course is otherwise defective due to sub grade soil mixing, with the aggregates, the course to its full thickness shall be scarified over the affected area, reshaped with added material or removed and replaced with fresh material as applicable and re-compacted. The area treated shall not be less than 10 sq.m. In no case shall depressions be filled up with screenings or binding material.

404.5 Arrangement for Traffic

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

404.6 Mode of Measurement & payment

Water bound macadam shall be measured as finished work in position in **cubic meters**

404.7 RATE

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

- (i) Making arrangements for traffic to Clause 112 except for initial treatment to verges, shoulders and construction of diversions;
- (ii) Supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts,
- (iii) All labour, tools, equipment and incidental to complete the work to the Specifications
- (iv) Carrying out the work in part widths of the road where required and
- (v) Carrying out the required tests for quality control

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