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## SPECIAL CONDITIONS FOR EARTHWORK AND BLANKET

### 1. SPECIAL CONDITIONS FOR EARTHWORK AND BLANKETING (HEAVY AXLE LOADING):

1.1 The earthwork for railway formation in cutting and embankment is to be carried out as per relevant and latest RDSO specifications and guidelines and BIS specifications (wherever applicable) with latest correction slips and as per Indian Railway's Unified Standard specifications for (works & materials) 2010 and as per the specifications herein and as per the Special Conditions for Earthwork and Blanket. In case of any contradiction amongst the above, the provision will prevail in order of following priority:

- a) Technical Specifications attached to tender document.
- b) Special Conditions attached to tender document.
- c) RDSO specifications and guidelines.
- d) BIS specifications.

All standard specifications are available on payment with the Railway/RDSO/BIS and the contractor shall procure the same for his own purpose.

1.2 Important guidelines for Earth work & Blanketing are available on RDSO Guideline and specifications for design of formation for Heavy axle Load -Report no.RDSO.2007/GE:0014 and RDSO ED(GE) Lr. No. RS/G/108/Heavy axle load dt. 26.10.2016.

### 2. SETTING UP OF FIELD LABORATORY:

2.1 The contractor, on his own, has to establish a well equipped GE field laboratory at site with appropriate and sufficient equipments etc., as required under BIS and RDSO Guidelines and arrange to conduct following laboratory tests all at his cost. One laboratory for a project length 15 to 20 Km is normally necessary and shall be provided, maintained and operated by the contractor at his cost unless otherwise specified in the schedule till the completion of earth work/ blanketing in the stretch. The laboratory can be removed only with specific approval of the Engineer-in-charge after all testing in the stretch are over. For not maintaining such items, Railway reserves the right to impose heavy penalties proportionate to the rental rates in the market for such machinery at the discretion of the Engineer-in-charge.

#### **Tests to be done as per GE14**

- a. Gradation Analysis - Sieve and Hydrometer
- b. Atterberg's limits - liquid limit and plastic limit
- c. Optimum Moisture Content (OMC), Maximum Dry Density (MDD) & Relative Density.
- d.) Placement Moisture Content and In-situ Density.
- e). California Bearing Ratio test (CBR)

f). Any other as specified.

2.2 The contractor shall set up a field laboratory of his own at his cost at work site, which should be open for use and inspection by the Railway at any time. All gauges, machines, equipments and other measuring and testing equipments of the laboratory shall be got checked /calibrated regularly. The contractor shall arrange to take samples as required/directed and transport as required at his cost.

2.3 Minimum equipments for soil/blanket testing are as under :-

Sl. Description of equipments

No

1. IS set of sieves with base & top lid 20mm, 19mm, 10mm, 4.75mm, 2mm, 600 mic, 425 mic, 212mic, 75mic.
2. Hand operated sieve shaker for above sieves
3. Balance
  - a) Pan balance - 10 Kg capacity (with 1.0 gm least count)
  - b) Electronic balance - 500 gm capacity (with 0.1 gm Least Count)
4. Field density apparatus complete
  - a) Sand replacement
  - b) Core cutter with dolly
5. Modified heavy Proctor density apparatus full unit.
6. Liquid Limit apparatus hand operated with counter & grooving tools
7. Grain size analyzer of fines
  - a) Hydrometer
  - b) Thermometer 0 to 50o C
  - c) Glass cylinder 1000 cc capacity with 60mm dia.
8. Desiccators as per IS - 6128
9. Can of 10 litre capacity for distilled water wooden mortar & pestle
10. Specific gravity test apparatus
11. Density bottle - 50 ml capacity
12. Glass cylinder 100 cc capacity (for 1 free Swell index test)

13. Oven - thermostatically controlled to maintain a temperature  
105-1100C
14. Sieve brush - Wire brush
15. California Bearing Ratio test (CBR) equipments.
16. Other necessary tools and plant as required.

Note: Normally, all the testing of any items mentioned above should be done in the laboratories at site only. In case of failure of equipments, testing outside at the nearby reputed institutes may be permitted at the cost of the contractor by the Dy.Chief Engineer in charge of the project, subject to the condition that, more than 50% of the frequency of such tests are not permissible

3.1 The contractor should fix (i) alignment pegs at every 100m or as specified (ii) pillars with temporary bench marks at every 500m by the side of the bank/cutting suitably for referring the alignment in future. Additional pegs at every 25m shall also be provided for indicating chainage/centre line of track at the time of finishing the formation.

3.2 Contractor shall arrange for making and fixing of toe line with wooden pegs for earthworks (both embankments and cuttings) and for bridges.

3.3 After completion of work up to final finish level, level pegs will be provided by contractor at every 25m interval.

3.4 The Contractor shall arrange the setting out of the alignment as directed, with his own survey equipments of good quality and of such accuracy as required by Engineer-in-charge. The Contractor shall also arrange for setting out of curves, if any, as per the directions of the Engineer-in-charge.

3.5 No earthwork in cutting/embankment shall be carried out without taking initial levels jointly by railway supervisor and contractor and cross sections drawn at every 25m, levels checked by Engineer-in-charge and test checked by concerned officials. The initial levels should be recorded in level books at an interval of 25m longitudinally and at every 3m (or even less when there is abrupt change in levels within these 3 m) transversely and at bridge approaches.

4 The contractor has to construct atleast one temporary office at site of work with reasonably good and required quantity of furniture in the same office for the use of railway officials. After completion of work, the same may be taken away by the contractor to clear the site.

5 The contractor has to engage only well experienced engineers having good knowledge of surveying. The contractor's engineers have to support and coordinate with the railway engineers in taking levels, conducting laboratory tests, selecting outside quarries etc., while executing of the work.

6 (i). The land will be provided in stages as per the progress of acquisition/work. A joint programme will be prepared as per the availability of land. No additional payment/extra rate will be permitted on this account. Contractor should engage machinery/labour/equipment etc., as required

for the programmed work. No additional payment/damages/idling charges will be paid by Railway on the account of non-availability of land at any stage. It is the responsibility of the contractor to see the availability of land etc. before works are mobilized.

(ii). The earth work /blanketing contractor should note that in various works like new line, gauge conversion and doubling type of work and similar other works, minor bridges available in the section may not exist or may not be fit for movement of materials. The contractor should make his own arrangements to pass over the small water way or roads in the area for movement of his machinery etc. and materials and shall have no claim whatsoever in this regard.

7 Immediately after getting letter of acceptance for the work, the contractor shall submit his programme and requirements to the Executive in charge in connection with execution of work as per the mile stone statement of the work/project. The contractor should not bring out problems which are causing obstruction to work at a later date or after the currency has lapsed. All efforts will be made by the Railway to clear the obstructions, however, this shall not be a cause for any claim whatsoever from the contractor.

8 The contractor shall make his own arrangements for all earth moving vehicles and any other tools and plants as may be required for the efficient execution of the work, with necessary personnel and consumable stores at his own cost. On a written requisition from the Contractor, the Railway may give permission to those suitable places of land for the stabling of the earth moving vehicles and for putting up temporary sheds for crew and labour. The land so allotted shall be used solely for the purpose connected with the execution of this contract work and shall not be used otherwise. The area shall be vacated and restored to the original condition and handed over to the Railway immediately after the completion of work. However, Railway reserves the right to permit or deny any or all locations for such purposes at the discretion of the Engineer-in-charge. Railway also reserves the right to permit only for specific periods at the discretion of the Engineer-in-charge and for further period beyond that approval, the contractor is liable to pay the Railway's standard rents for land. Contractor shall make no claims in this regard.

9 Contractor shall arrange all lab tests as required before starting earthwork to assess the type of soil and other soil parameters required to judge suitability of soil to be used for constructing bank by Railway cut spoil/contractor's own earth/blanket etc.

10 Kilometers/Chainages referred are approximate and likely to vary marginally. Local chainages may, however, be fixed by the Engineer-in-charge. The chainage references are purely intended for Railway purpose only.

11 The detailed measurements of the embankment executed with cut spoils are to be taken before starting earthwork in embankment by contractor's own earth (COE) or vice-versa.

12 Whenever earthwork is done in forming embankment, partly by leading cut spoils and partly by contractor's own earth, payment for the work done in leading cut spoils will be made by cross-section measurements of cutting quantity and quantity of own earth done will be assessed by deducting the cut spoil from the cutting.

13 Soil group, sub soil group, description with respect to percentage of fines (Soil < 75 micron) equivalent soil group as per IS classification to be referred vide RDSO ED (GE) Lr.No. RS/G/108/Heavy axle load dt. 26.10.2016 as per para 55.

14 The excavated soil in cutting, which is not suitable for filling in bank or not required by the Railway, as certified by the Engineer-in-charge, is to be disposed off as directed by the Engineer in charge. The excavated earth from cuttings which is useful and required for embankment has to be dumped by the contractor in the reach with optimum leads at the least cost to the Railway and as per agreed terms. No cut spoils are to be kept at the edge of cutting within 5m from the edge of the cutting. The area between edge of cutting and up to railway boundary shall be free from any dumped material for making catch water drains, movement of vehicles, collection of ballast etc.

15 The excavated earth, which is useful for filling but cannot be used immediately is to be stacked as directed by the Engineer in charge for which no extra payment will be made.

16 In case of hard rock requiring blasting, the excavated hard rock should be dumped at the toe of embankment or on the top of the cutting beyond the required clearance within the railway land available, unless otherwise specified in the schedule regarding disposal of cut spoil. No excavated rock should be kept at the edge of cutting. In case sufficient land is not available to dump excavated hard rock and approved for disposal by the Engineer in charge, the contractor should take it out beyond railway boundary at his own cost. Railway will not be responsible for identified railway land to stack excavated material. The railway will charge for the cut spoil materials such as soil, rock spoils and hard rock materials taken away by the contractor beyond the railway limits at rates agreed already or to be mutually arrived at the railway & shall recover the same from the running bill.

17 The contractor has to take photographs/video film for the important activities/portions carried out as directed by Engineer-in-charge. The same should be submitted in 3 copies along with a soft copy for Railway's record.

18 In case of embankments, the earthwork should not be carried out up to proposed formation level without deciding depth of blanketing material. In case of cuttings, earthwork will be carried out up to required blanketing level below the proposed formation level wherever found necessary.

19 Earthwork/blanketing shall be done with approved materials and methods only. Specifications of RDSO/Railway will strictly govern in this regard. Blanket materials, as they may not be available readily to suit RDSO specifications, may require blending of different components such as graded soil and sand etc., shall be carefully selected, tested adequately and blended by proper mechanical means, preferably in a plant and if not possible on the earthwork formation and laid after confirmation of RDSO specifications. The source of material (contractor's own earth and blanketing) to be brought/ blended will be verified in advance by railway officials and proposed material will be tested in laboratory at the cost of the contractor before taking up actual execution. Any quality failed blanket shall be summarily rejected. If the contract provides for pre-blending at the plant/depot, the same shall be strictly ensured.

20 Contractor is required to progress with all activities simultaneously so that continuous stretches of reasonable length are finished to final formation level/profile and such continuous

stretches are handed over progressively when works in remaining length are progressing. Specific milestones for handing over completed formation are to be furnished by the contractor. A register in this regard will be opened duly indicating details of handing over/taking over.

21 Wherever required, the different type of utility services such as telegraph lines, electrical lines, sewage lines, water supply lines, any other cable etc., available in the alignment which are likely to obstruct formation works will be got shifted at the cost of Railway either by the concerned departments or through the contractor. However, the contractor shall advise the details in advance to enable clearance by Railway. Normally all such obstructions should be cleared by the contractor in his normal scope of work in project works as he is required to study the grounds in advance before applying his tender.

22 The contractor shall take adequate precaution to ensure that no interference is caused to various utility services, particularly to safety related items like signaling cables, power lines etc., and any breakage of such utilities will be penalized. For each cable cut causing more than 1 hour of signal /block failures, a penalty of Rs. 100,000/- will be imposed. The contractor shall also take safety measures for the life and property of workmen or nearby habitants/ houses/property etc., and any loss to the same will be the responsibility of the contractor.

23 While working close to or alongside the existing railway track, the contractor shall be responsible for ensuring that no obstruction is caused to safe running of trains either directly or due to interference with the existing installations. He shall also make adequate arrangement to keep sharp lookout men for trains approaching to work spot and warn the workmen well in advance.

24 The contractor shall provide strong barricade by the side of existing running lines wherever he is required to work within 10 m of the existing track centre duly providing steel or wooden logs both vertically and horizontally along with red/yellow reflective tapes to warn the road vehicle/machinery user and maintain the same till the track is linked in the stretch. No work is to be carried out alongside the existing running railway tracks without providing barricading. Special care is required in cuttings, road junctions, busy areas etc. However, such barricading will be paid for separately in doubling, yard and ROB works.

25 The contractor shall obtain permission from the State Government/Local authorities for using existing roads whichever required. The contractor can use existing railway roads, if available, without any charges. However, no road will be made by the Railway and no cost will be accepted by the Railway to facilitate contractor for movement of his vehicles.

26 No borrow pits shall be dug in close proximity to railway limits, towns, villages etc., except with the prior permission of the respective authorities concerned so that public health/future development etc., are not affected.

27 The contractor shall execute earthwork in coordination with other contractors working for bridges, ballast, track etc., without interfering their work.

28 The contractor shall make his own arrangements for obtaining the license for any explosive materials as may be necessary including its procurement, transportation, storage, use, disposal etc, and pay all taxes, levies, royalties, seignorages etc as applicable under the laws of the land at his own cost.

29 For using explosives for blasting, the contractor shall abide by all the Acts / Rules in force by the Central/State Governments and observe all the provisions, rules, regulations etc as ordered from time to time.

30 The contractor shall be held responsible for any loss, damage, injury etc., to public, workmen, property etc., caused during the course of his work. Railway will not be responsible for the damage or for paying any compensation.

31 While clearing obstructions from the alignment, the trees having girth more than 300mm as well as any building, should be removed with the permission of Engineer-in-charge only and this will be paid separately. All released and useful materials shall be brought to the stores of the Engineer-in-charge and deposited by the contractor at his cost.

32 The classification of the earthwork shall be carried out as the work proceeds. The classification of the soils met within cuttings shall be done by Asst Executive Engineer/Executive engineer/Deputy Chief Engineer of the work and shall be final and binding on the contractor. No claims or representations shall be entertained by the Railway in this connection.

33 No extra allowance shall be allowed to cover any settlement or subsidence of the natural ground under weight of the embankment. The Contractor's rate shall be deemed to cover any eventuality taking into account the local conditions. The payment for the embankment shall be based on the profile measurements computed with reference to initial levels recorded before the works are commenced.

34 Payment in all cases of earthwork shall, unless otherwise specified, be based on cross section measurements. The existing ground levels and completed formation levels as recorded and signed by the contractor before the commencement of work and after the completion of work respectively shall be the basis for computation of the final quantity. Payment shall be made on the basis of final/compacted cross section, subject to a maximum of the standard profile width of 7.85 m in embankments and 9.25m in cuttings at top of formation/blanket level. Earthwork shall be done 500mm extra on either side beyond the above standard profile in embankment initially, and the same shall be cut and removed after due compaction. This extra width shall not be paid for. Any extra width beyond the standard profile of cutting or embankment shall also not be paid for. Any settlement noticed during the maintenance period shall be made good by the contractor at his own cost. However, in case of formation on curved alignment, additional cess width of 400mm shall be provided on outer side of the curve only. The top width of the formation in curved portion will be 8.25m. (7.85m + 400 mm for additional cess) in embankment and 11.25m (10.85m+400mm for additional cess) in cutting."

35 All tests on soil (cut spoil /Contractor's own earth/blanket materials) for the earthwork/blanketing done in the field should be carried out in the contractor's own laboratory under the supervision of railway officials or in the departmental soil testing lab of the Railway for every 5000 cum for earth work, and every 500 cum for blanket materials. Initial test including blending of blanketing materials as required has to be done at Railway Geo tech laboratory /approved institutions as per the relevant Annexure. The field tests results shall be periodically got verified through special tests at Railway Geo tech laboratory / approved institutions at the discretion of the Engineer-in-charge. In case contractor/Railway facility is not available for any particular test,

the same may be got done from approved technical laboratory with specific approval of the Engineer-in-charge. All tests shall be done at the cost of the contractor and specified charges for testing by Railway lab will apply.

36 The decision of the Engineer-in-charge about the lumpsum payment in CC bills is final in this regard.

37 While carrying out earthwork in embankment, the soil/blanket testing reports as per the requirement shall be submitted to railways for technical check with every bill.

38 The mechanical compaction of earthwork specified in the schedule should be done with vibratory rollers along with other heavy capacity equipments/machinery, vibrating roller shall be available at a rate of one No. of 10-12 t capacity for every 5 Km of earthwork/blanketing area and Railway reserves the right to impose penalties on the contractors for not maintaining/operating vibrating rollers in the earthwork/blanket sites.

39 The contractor shall engage earthwork equipments in proportion to quantum of work to be executed as per the program chart made by the contractor and signed jointly by him and the Engineer-in-charge with a margin of (additional) 20% for breakdown, holidays etc. The contractor shall submit list of such equipments also along with programme chart. The approximate list of such machinery and equipments to be maintained by the contractor at site is indicated below. For not maintaining such items, Railway reserves the right to impose heavy penalties proportionate to the rental rates in the market for such machinery at the discretion of the Engineer-in-charge.

**List of machinery and equipments to be maintained at site:-**

For every 5 Km of earthwork/blanket in cutting/embankment in New lines, Gauge conversion and Doubling works and for other major works involving large quantity of earth work ,the contractor shall arrange the following machinery, till the completion of Earthwork and Blanketing in the stretch.

a)	Poclain or JCBs of adequate capacity (Excavator)	-	2 Nos
b)	Tipper or Lorry of adequate capacity (Dumper)	-	10 Nos
c)	Spreading Motor Grader of adequate capacity	-	1 No.
d)	Hydraulic excavator of adequate capacity	-	1 No.
e)	Rock breaker/ chiseling equipment of adequate capacity-		1 No.
f)	Vibrating Roller capacity (10 - 12 t)	-	1 No.
g)	Bull dozer	-	1 No.
h)	Drilling/blasting equipments	-	As required
i)	Any other equipment such as total station, Auto level, other equipment as directed by		

the Engineer-in-charge

- As required

40 Full formation width at ground level plus additional extra width of 2m on both sides should be cleared of all obstructions viz., vegetation, trees, bushes, building, fences, abandoned structures etc., and thereafter it should be dressed and leveled. Depressions if any should be filled with suitable soil duly compacted. Finally, leveled surface should be properly compacted by mechanical means to get leveled and uniform ground surface. Any infringing structures, track etc. shall be removed totally.

41 When bank is constructed on ground having steep slope, then the ground surface should be suitably benched so that new material of bank gets well bonded with the existing ground surface.

42 Density of compacted soil shall be as per laid down specifications. Where the moisture content of the earth in any layer is above OMC, it shall be left for drying for a suitable period to bring down the moisture content very near to OMC before rolling is commenced. If the soil is dry, water shall be sprinkled over the spread layer in order to attain moisture content near to OMC, before rolling is commenced. Use of hose pipe for sprinkling water should be avoided. Each layer shall be compacted to the required density over its entire width commencing from both sides with minimum overlap of 200mm between each run of the roller. Further layer of soil should be done only after the compaction of the particular layer has been found satisfactory.

43 Care shall be taken during the compaction operation, to slope the surface of the bank to facilitate the shedding and to minimize the absorption of rain water, particular attention being given to prevention of ponding.

44 The quality of work shall be determined by considering the mean density of the samples in each layer. The mean dry density shall be equal to or shall exceed the minimum specified density. In no individual case shall the density be less than the minimum value specified by more than 5%; otherwise further rolling shall be done at all the appropriate locations.

45 The filling over arches and pipe culverts shall be made up simultaneously from both sides. Water proofing treatment done over these culverts must be kept undamaged and intact during the filling operations.

46 Earthwork in cuttings/embankments of more than 6m height should be carried out after ascertaining stability of slopes. The design of slope/slope stability shall be carried out as per RDSO guidelines. Contractor shall make and get the design approved before execution of such cutting/banks.

47 Soil testing in cutting or embankment formation has to be done by the contractor as directed by the Engineer-in-charge to decide the blanket thickness. Base soil testing shall also be done to decide on the capacity of the base to carry the formation.

48 Slope, width etc. shall be provided as per laid down specifications, side berms of 2m width shall be provided at every 6m height in cuttings and embankments with proper drainage arrangements.

49 The top of formation should have cross slope of 1 in 30 from centre of formation to both sides in case of single line as well as double line and from one end towards cess/drain (single slope) in multiple lines normally.

50 Following category of soils are banned for use in Railway formation

1) Category V

"Organic clays, organic silts, peat, chalk, dispersive soils, poorly graded gravel and sand with uniformity coefficient less than 2.

2)"Clays and silts of high plasticity (CH & MH).

51) The blanket material to be provided shall be strictly as per RDSO specifications vide their various guidelines issued from time to time. The specific parameters to be satisfied shall be as per the description indicated in the item in schedule for blanketing.

The depth of blanketing, type and depth of subgrade will be decided as per RDSO guide lines for earthwork in Railway projects GE: G1: July -2003, RDSO guide line and specification for design of formation for heavy axle load GE :G 0014- November – 2009 and guide line for design / Construction of formation of Indian Railway Track vide ED (GE) Lr. No RS/G/108/Heavy axle load dt. 26.10.2016. The depth of blanketing and accordingly sub – grade shall be completed upto required level and profile.

52). California bearing ratio test is to be carried out on ground soil, embankment soil, proposed sub-grade and blanket material to ensure minimum CBR value of these materials to be used in construction. The test is to be carried out on soil samples in laboratory as per procedure given in IS 2720 (part 16) - 1987 and in field as per IS 2720 (part 31) and RDSO ED (GE) Lr.No.RS/G/108/Heavy axle load dt. 26.10.2016.

### 53 EARTHWORK - CUTTING -

#### AUTHORITY FOR CLASSIFICATION OF SOILS.

53.1 The classifications of soils in excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the contractor. Merely the use of explosives in an excavation will not be considered as a reason for higher classification unless blasting is clearly necessary in the opinion of the Engineer-in-charge.

53.2 Cutting in formation, side drains, etc. shall include any wet excavation that may be met with and no extra payment will be made for this wet excavation or bailing out water with or without mechanical means or for any other precautions of work, which may be found necessary during the course of execution for the items covered under relevant annexure. The rate shall be final even if any springs of water are met with.

53.3 Excavation for foundation/foundation works, etc. shall include any wet excavation that may be met with and will be paid for under respective items of BSR/USSOR, for the wet excavation or bailing out water with or without mechanical means or for any other precautions of work which may

be found necessary during the course of execution. Even if any springs of water are met with, NO EXTRA PAYMENT will be made other than respective items mentioned in the BSR/USSOR.

53.4 Whenever excavation for catch water drain is ordered, the excavated spoils should be spread, consolidated and sectioned to the required profile to form a bund on the downhill side of the catch water drain. Payment for excavation shall be made under the relevant items of BSR/USSOR as the case may be, and no extra payment shall be made for consolidation and sectioning to profile for forming bund and catch water drain.

53.5 No separate payment will be made for site clearance or jungle clearance or shrubs clearance, brush wood, gross or other obstructions including small trees of girth not exceeding 30cm, either in connection with cuttings or banks or bridges etc. and the rates accepted in this contract are deemed to include all such costs except dismantlement of structure if any which will be paid for suitably under BSR/USSOR as per the percentage agreed under relevant Annexure.

## ANNEXURE

LIST OF APPROVED LABORATORIES FOR TESTING OF BLANKETTING:-

1. College of Engineering, Tiruvananthapuram.
2. TKM College of Engineering, Kollam.
3. RajivGandhi institute of Technology, Pampady, Kottayam.
4. Cochin University of Science and Technology, (CUSAT) Kalamassery.
5. Mar Athanasious college of Engineering, Kothamangalam.
6. Govt. Engineering college Thrissur.
7. NSS Engineering college, Palakkad.
8. National Institute of Technology (NIT), Calicut.
9. Govt Engineering College, Kannur.
10. IIT/ Chennai
11. IIT/Palakkad.

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## 1.0 TECHNICAL SPECIFICATIONS AND SPECIAL CONDITIONS FOR SUPPLY OF

### CEMENT FOR VARIOUS WORKS:

1.1. Cement to be used on the works shall be procured from the main and reputed cement manufactures or from their authorized dealers only.

1.2. Cement bags preferably in paper bags pickings should bear the following information in legible markings as per relevant specifications.

i) Manufacturer's name.

ii) Registered Trade Mark of manufacturer, if any.

iii) Type of cement.

iv) Weight of each bag in Kg.

v) Date of manufacture, generally marked as week of the year/year of manufacture, eg. 30/11 which means 30th week of 2011.

1.3. The cement supplied at site for the work shall be stored as per relevant specifications. Railway at the discretion of the Engineer in charge, reserves the rights to reject any cement on condition of storage, packing or material condition. All cement brought to site shall be kept in covered temporary shed. Any temporary structure required for storage of cement, steel etc, has to be provided by the contractor at his cost and this should be removed after completion of the work. The Railway will only provide suitable land for construction of the above temporary shed free of cost. Double lock arrangement (Contractor and Railway) for the temporary stores shed should be provided by the contractor at his cost. The security, insurance & maintenance are the responsibility of the contractor at his cost. Railway reserves the right to enter store shed and check the quality and quantity of cement available at any time. The contractor shall not use the cement rejected by engineer in charge and remove them from the railway area immediately.

1.4. Empty cement bags would be the property of the contractor and shall be disposed off by the contractor himself. However, in case the railway is in need of empty cement bags, good and usable empty cement bags are to be supplied by the contractor, at the rate of Rs.2/-per bag for empty cement gunny bags and Rs.1.40 per bag for empty cement polythene/paper bags.

### 2.0 SPECIFICATION FOR CEMENT:

2.1 .The cement used shall be any of the following, as per the approved drawing and specification and shall have the prior approval of the Engineer-in-charge.

(i) 33 Grade Ordinary Portland Cement conforming to IS:269

(ii) 43 Grade Ordinary Portland Cement conforming to IS:8112

(iii) 53 Grade Ordinary Portland Cement conforming to IS:12269

(iv) Rapid Hardening Ordinary Portland Cement conforming to IS:8041

- (v) High Strength Portland Cement conforming to IRS:T:40.
- (vi) Portland slag cement conforming to IS:455 (See Note 1 & 4 below)
- (vii) Portland Pozzolana Cement conforming to IS:1489 (See Note 2 & 4 below)
- (viii) Sulphate Resistance Cement conforming to IS:12330 (See Note 3 below)

Note 1: Normally, only Ordinary Portland cement shall be used in Prestressed concrete construction. Portland slag cement conforming to IS:455 may be used for prestressed concrete work, provided slag content in cement is not more than 50% and if approved by the Engineer-in-charge.

Note 2: Portland Pozzolana cement shall not be used for RCC & PSC works. Portland Pozzolana cement can be used only for foundation concrete and concrete works in bridge structures where reinforcement is not provided for structural strength but is provided only as nominal for temperature stresses etc. When Portland Pozzolana cement is used, supporting form work shall not be removed till concrete attains at least 75% of the design strength.

Note 3: The sulphate resisting cement conforming to IS:12330 shall be used only in such conditions where the concrete is exposed to the risk of excessive sulphate attack e.g. concrete in contact with soil or ground water containing excessive amount of sulphate. It shall not be used under such conditions where concrete is exposed to risk of excessive chlorides and sulphate attack both.

Note 4: The rate of development of strength is slow in case of blended cement i.e. Portland Pozzolana cement and Portland slag cement, as compared to ordinary Portland cement. This aspect should be taken care while planning to use blended cement. Accordingly stage of prestressing, period of removal of form work and period of curing etc. should be suitably increased. Prior approval of the Engineer-in-charge shall be available for such works based on proper design and technical report submitted by the contractor.

## 2.2 TEST CERTIFICATE REGARDING QUALITY OF CEMENT :

2.2.1. Necessary manufacturers test certificates will have to be produced by the contractor for the cement supplied at site as per relevant IS codes. The contractor shall produce the manufacturers test certificate for each lot of supply satisfying the requirements of relevant IS specifications and at the specific frequency as laid down in relevant specifications.

2.2.2. The contractor shall also arrange to carry out additional tests on physical properties of cement for every 100 metric tonne (t) of cement and for every change in lot/batch for cement at his cost at recognized /approved laboratory. In addition, the contractor shall also arrange to carry out tests on total chloride content and sulphate content in cement as per relevant IS Codes from approved/ recognized laboratory for every 100 MT of cement supply under the contract at his cost .

2.2.3. Further, Railway reserves the right to obtain specimen of the material and get tested before it is put to use at recognized /approved laboratory /National accreditation board (NABL) approved laboratories and the cost of testing shall be borne by the contractor, whenever directed by the Engineer-in-charge. The Engineer-in-charge reserves the right of selecting specimen at his own discretion.

2.2.4. Tests on Cement shall be as per IS 4031. Additional tests as required in Para 2.2.2 & 2.2.3 may be carried out for the properties as under -

i) Compressive strength.

ii) Initial and final setting time.

iii) Consistency.

iv) Soundness.

v). Fineness

vi). Total chloride content This shall in no case exceed 0.05 percent by mass of cement also, total sulphur content calculated as sulphuric anhydride ( $\text{SO}_3$ ) shall in no case exceed 2.5 percent and 3.0 percent when tri - calcium aluminates percent by mass is up to 5 or greater than 5 respectively.

vii). any additional tests as required.

## TECHNICAL SPECIFICATIONS AND SPECIAL CONDITIONS

### FOR SUPPLY OF REINFORCEMENT AND STRUCTURAL STEEL

#### 1.0 SUPPLY OF STEEL FOR VARIOUS WORKS :

1.1 Supply of steel to various specifications as required under various schedules in the contract are governed by the Technical specifications and Special conditions hereunder, and the steel supplied and used will be paid under the relevant schedule (for Supply of steel) in the contract for use under Schedule "A" (Standard Schedule Rates (SOR) items) or any other schedules involving PCC, RCC and PSC construction as specified.

1.2 All steel shall be supplied by the contractor at the site of work and stacked, stored, protected and maintained by him at his cost till they are put into use. However, Railway reserves the right to supply departmental steel to the extent available which shall be transported by the contractor from depot to the work spot. Payment towards such transportation will be made under relevant item of the Standard Schedule of Rates of the Railway, Payment for cutting, fabrication etc, done on the Railway's steel will also be made as per the SOR. Any temporary structure required for storage of steel etc. has to be provided by the contractor at his cost and should be removed after completion of the work. The Railway will only provide suitable land for construction of the above temporary shed etc. free of cost wherever available. The steel supplied for works shall be painted and stored as per Railway's specifications and guidelines at the cost of the contractor.

1.3 For supply and use of steel in various works, relevant IRS codes, BIS specifications and Railway's specifications will be applicable and wherever relevant specifications are not available, decision of the Engineer-in-charge is final and binding on the contractor.

#### 2.0 SPECIFICATIONS FOR STEEL:

2.1 The steel supplied by the contractor must satisfy any of the following material/manufacturing specifications as required for the work along with other concerned specifications.

(i) The reinforcement steel shall be high yield strength deformed steel conforming to IS 1786 (upto date) (TMT) and in case of mild steel rods it shall conform to IS 432 (Part-I upto date) and as specified. The steel to latest code and of latest manufacturing technique, as approved, shall only be made available always by the contractor.

(ii) The structural steel shall be conforming to IS 2062 (upto date) and as specified.

(iii) HTS wires/strands shall be conforming to IS 14268 (upto date) and as specified.

(iv) Relevant other IS and IRS specifications with regard to properties, testing and use of the above steel items shall also govern.

(v) Only steel of grades of 415Fe or 500Fe or 550Fe shall be used as reinforcement steel in all railway construction as specified in the approved drawings and as provided for in the schedule items in the agreement. For bridge construction, 500Fe or 550Fe is preferable and shall be as provided for in the approved drawings. In case of non availability of a particular grade of steel, alternative

available may be arranged and used by the contractor only with the approval of the Chief Engineer - in -charge of the project.

2.2 The contractor shall produce the manufacturers test certificate for each lot of supply satisfying the requirements of relevant IS specifications and at the specific frequency as laid down in relevant specifications.

2.3 The contractor shall also arrange to carryout additional tests on physical properties of steel for every 100 metric tonne (t) of each diameter of steel and for every change in lot/batch for structural steel at his cost at recognised/approved laboratory. For HTS wires and strands, contractor shall arrange to test the steel at a rate of one test per 3 metric tonne (t). The same shall be submitted to the Railways and approval taken of the Engineer-in-charge before using in work. No extra payment will be made for conducting such tests and the agreemental rate is inclusive of above testing charges.

2.4 Further, Railway reserves the right to obtain specimen of the material and get tested before it is put to use in recognised/approved laboratory and the cost of testing shall be borne by the contractor, whenever directed by the Engineer-in-charge. The Engineer-in-charge reserves the right of selecting specimen at his own discretion.

### 3.0 PROCUREMENT OF STEEL :

3.1 All reinforcement & other steel (TMT etc.,) shall be procured as per relevant BIS documents only. These steel shall be procured only from those firms which are Established, Reliable, Indigenous & Primary producers of Steel, having Integrated Steel Plants (ISP) using iron ore as the basic raw materials and having in - house rolling facilities, followed by production of liquid steel and crude steel as per Ministry of Steel's guidelines. Normally all steel for construction purpose shall be procured from the main/reputed producers such as SAIL/TISCO/RINL/and RDSO approved vendors list available in RDSO's website ([www.rdsolndianrailways.gov.in](http://www.rdsolndianrailways.gov.in)) directly or through their authorized stockists on the day of opening of the tender. Deformed bars or wires produced by re-rolling of finished products such as plates, rods, rails etc, in any form, which are not acceptable under IS 1786 (upto date) or other IS specifications, shall not be supplied and the same shall be summarily rejected. Steel supply by other producers, stockiest etc., shall also be summarily rejected.

3.2 The contractor shall have to submit the cash memo and challans along with the lot/batch of steel purchased in token of proof of purchase of steel from reputed producers/stockists. Steel shall be approved by Engineer-in-charge only after production of necessary certificates before use in works.

### 4.0 PAYMENT FOR REINFORCEMENT, HTS, STRUCTURAL STEEL:

4.1 Payment for supply of all types of steel will be made for the quantity required/used as per the specification for materials of Southern Railway and as per drawings issued from time to time and as per approved designs and as measured quantity in pre-stressed concrete/reinforced concrete/ordinary cement concrete works. No payment will be admissible for quantity supplied in excess of the required quantity as per designs/drawings. However, contractor will be permitted to take the excess quantity back by his own means, but no claim for payment for transportation so involved will be admissible. No payment will be made for more supply of steel at the site/excess

used in construction. No payment will be made for steel used in temporary or enabling works unless explicitly provided for in the schedules. Steel for enabling/temporary works shall be arranged by the contractor at his own cost.

4.2 Payment for reinforcement steel will be as per reinforcement actually utilized in the work based on approved designs/bar bending schedule. Payment for HTS will be made for the length between the bearing plates in the pre-stressed structures as used only. Structural steel will be paid for the weights of steel work calculated from final working drawings and using minimum square overall dimensions, no deductions being made for skew cuts, holes or notches. The drawing office dispatch lists (D.O.D.Ls) when prepared according to above procedure shall be the basis and shall be submitted by the contractor to the Engineer-in-charge for approval. Each gusset shall be measured as equivalent to the dimension of the smallest enclosing rectangle. The wastage of steel in the form of cut rods, wires, sections etc., shall be the property of the contractor and nothing extra will be paid for such wastage. The weight of the steel will be calculated from the nominal weight as per relevant IS specifications and weight difference between nominal weight as per BIS code and actual weight should be within the tolerance as specified in BIS specifications. GI wire or other binding material used in construction are not eligible for any payment. In case of any difference in use of steel between the approved drawing and as followed in the field due to reasons like non availability etc., the steel actually used as approved by the Chief Engineer- in-charge will be paid. No extra payment for design etc. will be made however.

4.3 Any steel work the weight of which differs by more than 2.5% from the calculated weight determined from the nominal weight of the sections shall be liable for rejection. Should the actual weight fall short of the calculated weight for more than 2.5%, the material if accepted, will be paid for the actual weight only. Should the actual weight exceed the actual calculated weight, payment will be made for calculated weight only. In the event of a dispute arising as to the weight of a portion of steel work, a weighment shall be made by the contractor at his cost in the presence of the inspecting Officer/Engineer and the decision of the Engineer-in-charge is final in this regard.

4.4 The cutting, bending and placing of reinforcement or other types of steel shall conform to relevant IS/IRS codes and instructions on detailing of reinforcement or other types of steel as directed by Engineer-in-charge. Cost of cutting, bending and placing is included in the rates as provided for in the agreement.

4.5 Payment for reinforcement steel overlaps other than in piles will be as per actual and will be limited to a maximum of 2.5% of the total consumption of steel irrespective of whatever overlap provided actually. For reinforcement in piles, payment for the steel overlap will be the minimum number of overlaps required for tying the reinforcement cage with standard length of reinforcement bars. Overlaps in critical locations shall not be permitted at all.

4.6 STAGE PAYMENTS - PROTECTION ARRANGEMENTS.

4.6.1 Stage payment as provided for in the contents for steel will be released subject to the following:

i) The steel shall be delivered at site and properly stored under covered sheds in measurable stacks and separately maintained for various sizes, sections and dates of supply.

- ii) The quantities of steel shall be brought to the site only in such installments that would facilitate smooth progress of work and consumed in reasonable time.
- iii) Proper account in the Steel Register is to be maintained in the prescribed format at the site for the receipt and use of the steel.
- iv) The stage/advance payment will be made, only when the Engineer-in-charge or his authorised representative certifies that the said quantity of steel is received at site and entered in the register and that in his opinion the steel is actually required in accordance with the contract.
- v) No stage/advance payment is permitted for steel required for temporary and enabling works.
- vi) Any stage/advance payment found to have been made against the materials brought to the site in excess over the actual materials consumed in work shall be recovered from the contractor's dues.
- vii). Steel brought to site and stage/advance payment made shall not be wasted, damaged, removed or moved by the contractor at any stage and if found out at any stage, the amount already paid will be recovered from the contractor's dues or the same shall be adjusted from his Bank Guarantees available with the Railway. Any misuse/theft/unauthorized removal from site is liable to be taken up as a criminal offence against the Railway.

#### 5.0. OTHERS :

5.1 Steel, reinforcement and other types, shall be stored in such a way so as to avoid distortion and to prevent deterioration by corrosion. All steel used should be free from loose Mill scale, loose rust, paints and oil covering/coating etc. Reinforcement steel brought to site of work should be given a coat of cement wash to prevent ingress of corrosion, at contractor's own cost as directed by the Engineer-in-charge. Storage, coating, painting, handling etc., shall be done as per Railway specifications/guide lines.

5.2 Steel material, for which stage payment has been availed by the contractor, shall be property of Railways and will be issued to contractor by Engineer-in-charge whenever required for the work. However, the contractor shall be solely responsible for guarding against theft/misuse of the consignment due to any cause whatsoever. The stage payment will be made, only when the Engineer-in-charge certifies that in his opinion that the materials are actually required in accordance with the contract. It is the responsibility of the contractor to ensure that steel as per the requirement is brought to site as per approved drawings/requirements.

5.3 The contractor shall be bound to store materials at site of work earmarked for the purpose by the Engineer-in-charge and shall not remove from the site nor use for any other purposes other than exclusively for execution of the work for which the materials are intended for. 5.4 Welding of reinforcement will not be generally permitted except in special circumstances under the written approval of the Engineer-in-charge.

5.5 Contractor shall remove from site any steel materials as rejected by the Engineer-in-charge within reasonable time as specified by him.

5.6 A register shall be maintained by the contractor with full details of reinforcement provided for account and payment of steel reinforcement. The contractor should sign a similar register maintained by Railway before undertaking concreting works, as a token of acceptance of the details of reinforcement steel provided in works, failing which the details as recorded by Railway are binding on the contractor for the purpose of payment and no dispute will be entertained by Railway on this account.

5.7 The pre-stressing steel shall be used not later than 6 months from the date of manufacture or 3 months from the date of arrival at site. Reinforcement steel and all other steel shall not be older than 12 months from the date of manufacture or 6 months from the date of arrival at site. In case casting is delayed due to reasons beyond control, Engineer in charge can order for conducting physical test on materials, and if tests are found acceptable, usage of these materials can be permitted by the Engineer in charge. Wires/strands shall be supplied / brought to site in reels or in reel-less packs having a minimum core diameter of 600mm. The coil shall be securely strapped to prevent distortion in transit and handling.

5.8 Stock piling of pre-stressing steel in the open at the work site shall not be allowed under any circumstances, special care shall be taken by the contractor to store the HT steel under suitable covered shed as approved by the Engineer. The Engineer/his representative shall always have an easy access to store yard for inspecting the HT steel for satisfying themselves regarding the condition thereof. Any modification/protection suggested by them shall be scrupulously followed by the contractor.

5.9 In addition to manufacturer's certificate, the acceptance of HT steel shall be subjected to the independent testing of steel for the following characteristics by the contractor at his cost.

- (a) Mechanical properties like diameter, mass of strand.
- (b) Ultimate tensile strength and load extension curves, yield point, proof stress and modulus of elasticity.
- (c) Elongation after fracture.
- (d) Relaxation after 1000 hour test.

5.10 Before the test pieces are selected, the contractor shall furnish copies of the mill records of the HT steel giving number of coils in each cast with sizes and identify marks to enable identification of the material with the bill produced.

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#### SPECIAL CONDITIONS FOR PRESTRESSED, REINFORCED AND PLAIN (MASS) CONCRETING

##### 1.0 General

1.1 Codes & Specifications: Concreting shall be done as per relevant latest specifications and as per the special conditions for concreting. The following codes/ specifications govern.

- i) Indian Railways Concrete Bridge Code and Bridge Rules.

- ii). (a) Indian Railways Unified Standard Specification for works and materials (2010)
  - (b) Southern Railway Specification for Works and Materials (1969) (wherever applicable.)
- iii). Relevant BIS specifications.
- iv). Technical specifications attached to tender documents.
- v). Special conditions attached to tender documents.
- vi). other important codes/ specifications given below will also apply wherever required.
  - a) IS:456 - Code of Practice for Plain and Reinforced concrete.
  - b) IS:1343 - Code of Practice for Prestressed concrete.
  - c) IS:383 - Specification for Coarse and Fine aggregate from natural sources for Concrete. (PSC)
  - d) IS:2116 - Specification for sand for Masonry Mortars.
  - e) IS: 2386 - Methods of test for Aggregates for concrete.
  - f) IS: 2430 - Methods of sampling of aggregate for concrete
  - g) IS:10262 - Code for concrete mix design.
  - h) IS: 4926 - Specification for Ready Mixed Concrete.
  - i) IS:1786 - Code for High Strength Deformed Steel Bars and Wires.
  - j) IS: 432 - Specification for Mild steel and Medium tensile steel bars and hard drawn steel wire.
  - k) IS: 1785/IS: 6006/IS: 2090/IS: 14628 for Pre-stressing steel.
  - l) IS: 269 - 33 Grade OPC
  - m) IS: 8112 - 43 Grade OPC
  - n) IS: 12269 - 53 Grade OPC
  - o) IS: 9103 – Admixtures

Railways Concrete Bridge Code shall apply strictly in case of railway bridges unless specifically asked for by the Engineer - in - charge. IS 456 normally will apply for other structures.

1.2 Only specified and approved materials of appropriate specifications shall be used in concrete. The materials/ products shall be tested as per specifications and all records maintained by the contractor. Railway reserves the right to reject the material/ product if not tested or recorded

and also further reserves the right to impose penalty/ recovery at the discretion of the Engineer-in-charge. Railway also reserves the right to reject any finished concrete product if the results of the tests prove negative at any stage.

1.3 All concrete i.e. plain/ reinforced cement concrete/ pre-stressed concrete shall be machine mixed and vibrated unless otherwise permitted by the Engineer-in-charge. Curing/Vibrating of the concrete and R.C.C. works shall be done by the contractor as specified in relevant I.S. codes. Test cubes shall be cast at regular intervals as contemplated in specifications with appropriate sampling duly following the acceptance criteria and tested to ascertain the strength of concrete in time to ensure quality of concrete at all the times. The cost of casting of cubes and their testing shall be borne by the contractor.

1.4 Curing shall be ensured by the contractor as prescribed in all cases. Adequate vibrating also shall be ensured by the contractor in all cases. No concrete shall be allowed without vibrating except under water concreting or Tremie concreting. Both internal and external vibrators as required to achieve quality shall be arranged by the contractor. In case the contractor desires to use a curing membrane instead of water curing, he may do so after submitting the necessary technical data and after the same is approved by the Engineer-in-charge. Admixtures can be used after obtaining approval of the Engineer-in-charge. It shall be noted that no additional payment would be made for curing/ placing/ vibrating/ use of admixtures unless otherwise provided in the schedule of the agreement and the contractor should make his own arrangements for the provision of necessary staging/scaffolding, power supply/ water supply, etc., and carryout curing/ placing/ vibrating/ use of admixtures at all levels as directed by the Engineer-in-charge.

1.5 If curing is not being done to satisfactory standards, the Engineer may get it done at the contractor's cost without any notice to him as the curing cannot wait for any such notice, time etc. The Engineer's decision shall be final and binding as to whether satisfactory curing is being done or not. The cost of curing will be recovered from the 'on account bills'.

1.6 Water used in concrete including washing of aggregate shall be clear from oils, acids, alkalis, salts, sugar, organic materials, etc., and shall have PH value not less than 6. It should not contain corrosion causing chemicals such as chlorides and sulphates.

1.7 Measurement of concrete work done will be based on finished concrete work as per approved plans. No measurement shall be done for green concrete and wastages.

1.8 The contractor shall make his own arrangements for the required binding wire for all RCC/ PSC works including the works under BSR items, even if it is mentioned otherwise in the BSR or other items of schedules in the contract.

1.9 Use of Portland Pozzolana cement is permitted only in CC and non critical RCC works. Use of Pozzolana cement is strictly not permitted in PSC works.

1.10) Use of Crushed Stone fine aggregate in lieu of river sand:

i) Fine aggregates obtained from crushed stone to be tested for physical properties every week during the course of work or whenever the source is changed.

ii) Materials proposed to be used as Fine aggregate shall consist of natural sand, crushed stone sand or crushed gravel sand conforming to IS: 383-1970

## 2.0 Mix design:

2.1. Mix design shall be provided by the contractor at his cost and after due testing and approval from the Dy.CE-in-charge, concrete shall be made by the contractor. No extra payment would be made for the mix design or testing. Control over adjustment of water to be added to concrete is to be necessarily exercised to achieve the required targeted strength of concrete by accounting for surface moisture present if any or lack of moisture at surface dry condition in the coarse/fine aggregates at any stage.

2.2. For M.20 or higher grade with design mix, quantity of cement will be decided based on the DESIGN MIX. For concreting under water 10 % extra quantity will be allowed. For lower grades, if required, nominal mix may be permitted if provided for in the schedules/ drawings, and if so, the cement schedule of Southern Railway will apply.

2.3. Apart from testing of Cement & Steel used in concrete, the water, fine and coarse aggregates and admixtures if any shall also be got chemically tested from time to time by the contractor at his cost for ensuring proper quality as per required standards. The results in original shall be submitted to the Engineer - in - charge and approval obtained to use these ingredients.

2.4. Workability of concrete using crushed stone fine aggregate is very low compared to that of concrete made with river sand. Hence, for use of crushed stone fine aggregate, mix design should be rigorous to see the effect of maximum water cement ratio before adoption in construction. Setting of concrete with crushed stone fine aggregate is generally faster and may cause surface crack problems. Early curing and protection of fresh concrete apart from water absorption corrections are needed.

2.5. The finalizing / approval of mix design does not absolve the contractor of the responsibility of providing required concrete and results at any stage.

## 3.0. Contractor's Batching Plant/ Mixing plant requirements:

3.1. All concreting shall be mixed with power driven concrete mixers of appropriate capacity for the work. All concreting works should be carried out by proper batching/mixing plants of approved designs. For all major concreting such as PSC girders concreting or for any major bridge (including ROBs/RUBs) involving more than 2000 cum. of PSC/ RCC/ CC or for a group of minor bridges involving more than 2000 cum. of RCC/ CC in any reach/ agreement, a computerized weigh batching/mixing plant with provision for automatic weighing and automatic print out of records with power supply is mandatory to be established at site or Batching plants established exclusively for Railway construction sites located nearer to work spot within Railway limit. In addition, in case of failure or non-availability of such batching /mixing plants, alternative stand by arrangements with weigh batching for ensuring continuous concreting, particularly for PSC/Piling works, has to be provided by the contractor at his cost. The Ready mixed concrete supplied by the Ready-Mixed concrete plants Situated outside Railway limit shall be permitted by the Dy.Chief Engineer, in charge subject to the following conditions.

(i).The facility for inspection of the Ready-Mixed plant premises, plant, mix, concrete ingredients etc by the Engineer in charge or his representatives at their discretion.

(ii)The Ready mixed plant should have full fledged lab for testing the ingredients used for concrete mix.

(iii) If demanded by the engineer in charge or his representative, the test should be conducted in the presence of Engineer In charge or his authorized representative.

Note:- Batching Plant should confirm to IS.4925

3.2.For smaller works such as small number of PSC slabs (less than 9.14m spans) or ROB/RUBs or minor bridges, smaller weigh batching/ mixing plants (RM 800 type) will be permitted by the Deputy Chief Engineer at his discretion. For CC works of smaller nature, ordinary power operated mixers with manual batching will be permitted by the Engineer in charge at his discretion.

#### 4.0 Setting up of concrete testing facilities:

4.1 The contractor shall set up at his cost for each agreement/ reach with concrete value more than Rs. 2.0 crores and/or for each work involving concreting in PCC, RCC and PSC structures exceeding 2000 cum of concrete, a fully equipped concrete testing facility with the following equipments at the project site.

- |       |   |          |
|-------|---|----------|
| i)    | Equipment for concrete mix design.                | = 1set   |
| ii)   | Cube testing machine (of adequate capacity)       | = 1set   |
| iii)  | Water testing setup to IS 456-2000 & IS 3025-1964 | = 1No    |
| iv)   | Fineness test of cement as per IS Code            | = 1set   |
| v)    | Consistency & soundness tests as per IS Codes     | = 1set   |
| vi)   | Initial and final setting time tests.             |          |
|       | a). Vicat apparatus                               | = 1set   |
|       | b). Balance to weigh 1000gms                      | = 1set   |
|       | c). Gauging trowel as per IS                      | = 1set   |
| vii)  | Workability test (slump test as per IS)           |          |
|       | a). Slump cone                                    | = 1 No   |
|       | b). Tamping rod                                   | = 1 No   |
| viii) | Sand bulkage testing apparatus                    | = 1No    |
| ix)   | Oven / stove and frying pan                       | = 1 set  |
| x)    | IS set of sieves with base top lid 20mm,          | = 2 sets |

19mm, 10mm, 4.75mm, 2mm, 600mic.,

212mic., 75mic.,

- xi) Sieves of size 80mm, 63mm, 50mm, 40mm, 31.5mm, 25mm, 16mm, 12.5mm,  
6.3mm, 3.35mm, 2.36mm, 1.18mm, 150mm, 7.5mm. = 2 sets
- xii) Hand operated sieve shaker = 1 No.
- xiii) Balance
  - a) Pan balance - 10 kg. Cap. (with 1.0gm least count) = 1 No.
  - b) Electronic balance 500gm capacity (with 0.1gm least count) = 1 No.
- xiv) Necessary consumables such as brush etc.

4.2 The contractor shall also arrange to conduct any other tests as required by the Engineer - in - charge at his cost.

4.3 For other works involving lesser volumes, the contractor is at liberty to set up the above facility or alternatively can get the tests done by reputed & approved institutions / laboratories at his cost.

4.4 For any reason, if it becomes necessary to get the tests done outside due to failure or non-availability of any test equipments at project site, the same may be accepted by the Railway. However, Railway reserves the right to impose penalties proportionate to the hire charges of the plant/machinery/tools and recover the same from the on account bills of the contractor at the discretion of Engineer - in - charge.

#### 5.0 Ready Mixed Concrete:

5.1 Ready Mixed Concrete (RMC) produced by completely mixing cement, aggregates, admixtures, if any, and water at a Central Batching and Mixing Plant and delivered in fresh condition at site of construction is permitted subject to conditions specified under relevant specifications and special conditions. Ready Mixed Concrete shall conform to the specifications of concrete, as laid down in the Indian Railways Concrete Bridge Code and for other aspects which are not covered in this code, IS 456 and IS:4926 (Specification for Ready Mixed Concrete) will apply.

5.2 Effect of Transit (Transportation) time on Ready Mixed Concrete is important. As Ready Mixed Concrete is available for placement after lapse of transit time, reduction in workability occurs, which may lead to difficulty in placement of concrete. In addition, in case of longer transit time, initial setting of concrete may also take place, which may render it unusable. Thus, while planning for using of Ready Mixed Concrete, these aspects should be reported by the contractor in advance and approval by the Engineer-in-charge should be taken.

5.3 Checking suitability of admixtures is also important. Generally admixtures, like water reducing agent, retarder etc., are used in Ready Mixed Concrete for retention of desired workability and to delay setting of concrete. In such cases where admixtures are permitted, admixtures should

be tested for their suitability as per IS:9103 at the time of finalizing mix design. Records of all the tests carried out to judge the suitability of admixture, shall be furnished by the RMC manufacturer to Railways and got approved before use. Workability test and setting time test along with compressive strength/ flexural strength tests at 7 and 28 days shall be carried out under the supervision of Railway's representative for acceptance wherever required.

5.4 Quality Control of RMC is very important. The producer of RMC shall adopt quality assurance programme duly approved by Railways. He shall have necessary tests conducted periodically to ensure quality control at each stage during production of concrete.

5.5 RMC manufacturer shall allow the Railway official to supervise operation involved in concrete production, materials proposed to be used and take samples of materials used. The contractor shall arrange for the same whenever required. RMC manufacturer shall allow Railway officials to peruse the past and present records of the concrete produced for the work if considered necessary.

5.6 The Ready Mixed Concrete shall be transported in concrete transit agitator mixers, conforming to IS:5892 (Specification for concrete transit mixers and agitators). Agitating speed of the agitators during transit shall not be less than "2" revolution per minute and not more than "6" revolution per minute.

5.7 Time Period for Delivery of Concrete is very important. The concrete shall be delivered completely to the site of work within 1.5 hours (when the atmospheric temperature is above 20 Degrees Centigrade) and within 2 hours (when the atmospheric temperature is below 20 Degree Centigrade) of adding water to the dry mix of cement and aggregate. In case, location of site of construction is such that this time period is considered inadequate, increased time period may be specified provided that properties of concrete have been tested after lapse of the proposed delivery period at the time of finalizing Mix Design and approval taken.

5.8 Concrete received after the transit time limit as specified above shall not be accepted. Concrete shall be placed in position within the designed initial setting time. At the end of initial setting time, the left over portion of concrete, if any, shall be rejected.

5.9 Under any circumstances, re-tampering (i.e. addition of water after initial mixing) and/ or vibrating already laid concrete shall not be allowed.

5.10 The concrete shall be tested for the required workability and strength at the time of placement. Concrete shall be deemed to satisfy the strength requirement when it fulfils the criteria laid down in IRS Concrete Bridge Code clause 8.7.6.

5.11 After arrival of Ready Mixed Concrete at site, additional dose of admixture, if provided for in approved mix design, can be added in the presence of Engineer-in-charge.

6.0 Pumping of concrete work will be required in cases where long lead or height at site will be involved and the contractor shall make arrangements for pumping / washing etc., at his cost unless provided for separately in the schedules.

7.0 For all pre-stressing requirements, clauses under Para 7.2 of Indian Railways Concrete Bridge Code shall apply strictly. Only approved and Railway permitted materials such as Anchorages, Sheathing, Jacks, etc., supplied by reputed suppliers will be permitted. The cost of the anchorages, sheathing and other connected materials and the cost of pre-stressing operations including that of machinery and consumables are included in the accepted rate for concreting. HTS wire/ rods above will be paid for separately as provided for in the schedule.

8.0 The contractor shall arrange adequate equipment for pre-stressing and carry out pre-stressing without delay. He shall also arrange standby arrangements for items like jacks, anchorage/ sheathing materials adequately in case of failure of the materials during casting/ tensioning.

9.0 The contractor shall provide a clear & acceptable scheme of casting/ curing/stressing/ grouting of PSC element and also special RCC elements to avoid chances of failure or rejection.

10.0 The following tables from IR concrete bridge code are appended below for ready reference:

(i) Limits for maximum WATER CEMENT RATIO for Design Mix shall be based on environmental conditions as per the table given below:-

Plain Concrete	Reinforced Concrete		Pre-stressed Concrete	
	(PCC)	(RCC)		
Moderate	0.50		0.40	0.40
Severe	0.45		0.40	0.40
Extreme	0.40		0.35	0.35

(ii) From durability consideration, depending upon the environment to which the structure is likely to be exposed during its service life, Minimum Grade of concrete shall be as given below:

Minimum Grade of Concrete		
Moderate exposure	Severe exposure	Extreme exposure

PSC & important Bridge Structures

PCC Member	M - 25	M - 30	M - 35
RCC Member	M - 30	M - 35	M - 40
PSC Member	M - 35	M - 40	M - 45
Other bridges & Structures			
PCC Member	M - 15	M - 20	M - 25
RCC Member	M - 20	M - 25	M - 30

Minimum grade of concrete shall be M - 40 for pre-tensioned pre-stressed concrete structures. However, more than M - 45 grade should not be used in any structure when cast in the field conditions and more than M - 50 should not be used when cast in factory/ specified site conditions.

(iii) Depending upon the environment to which the structure is likely to be exposed during its service life, minimum cementitious material content in concrete shall be as given below and maximum cementitious content shall be limited to 500 Kg/m<sup>3</sup>.

Environment Minimum Cementitious Material Content in Kg/m<sup>3</sup>.

Plain Concrete (PCC)	Reinforced Concrete (RCC)	Pre-stressed Concrete (PSC)	
Moderate	240	300	400
Severe	250	350	430
Extreme	300	400	440

## 12.0 Shutters, formwork and finishing:

12.1 Finished surface of concrete elements should be good on their own without any surface finishing except for minor rendering permitted by the Engineer - in - charge.

12.2 For all PSC and major RCC elements such as columns, beams & slabs of bridges, columns & beams of buildings, shutters/ formwork should be of steel type. In minor structures, closely jointed boards may be permitted by the Engineer - in - charge. In case of use of plywood shutters and badly

made steel structures affecting quality of structural elements or in case of honey-combing or out of plump noticed, Railway reserves the right to impose penalties up to 25% of the amount payable for the number at the discretion of the Engineer - in - charge, subject to the conditions that otherwise the members are safe and usable.

12.3 Tolerances of finished products are prescribed in Indian Railways Concrete Bridge Code clause No. 6.5. For violations of any of the tolerances there in, Railway reserves the right to reduce the payable rates by 25% of accepted rates, subject to the condition that otherwise the members are safe & usable at the discretion of the Engineer - in - charge.

13.0 Launching of Precast / Pre-stressed elements:

13.1 Movement, transport, launching and setting up of precast elements and also temporary girders shall be only as per approved method/ scheme. The contractor shall provide the scheme duly supported by all technical details, designs, etc., to enable the Railway to approve the same. Finalizing / approving of such scheme does not absolve the contractor of his responsibility to ensure safe and correct launching of the elements without any damages. For the damaged elements, recoveries of the already paid amount shall be effected at any stage of the contract or from any bills due to the contractor apart from the Railway's right to impose penalties on the contractor towards the damages to the project/ reputation of the Railway and the contractor shall have no claims whatsoever in this regard.

13.2 For launching of PSC girders/ slabs, the contractor shall make adequate arrangements of machinery such as cranes, jacks, power supply arrangements including standby arrangements as specified by the Railways in various circulars of the Railway and based on the need of the site conditions. The contractor normally shall arrange 100% standby in critical locations like ROB/RUBs or in sites, where the traffic in the area or life of public or progress of the project are likely to be affected seriously in case of their failure.

13.3 The cost of launching including all movement, transport, labour, fuel, consumables, designs, reports etc., shall be part of the concreting rates accepted in the contract unless otherwise specifically provide for in separate schedules or separately.

14.0 Designs and proof checking:

14.1 Normally for all structural elements used in railway systems, Railway's own design such as that of RDSO/Railway Board drawings, Zonal Railway's standard and non-standard drawings or already adopted and approved drawing only shall be used. For all other cases, specifically approved drawings by the Chief Engineer or Deputy Chief Engineer - in - charge of the project only shall be used. Wherever provided for in the schedules, the contractor shall arrange for his own designs as required by the Engineer - in - charge.

14.2 Wherever the contractor is required to produce designs and drawings for construction of structural elements, he shall produce the same from reputed and approved designers only. The designs prepared by IITs will be checked departmently and approved. In the case of designs prepared by Anna University (Guindy), National Institute of Technology Calicut, and other national institutions at the discretion of the Engineer – in – charge, shall be proof checked by any of the IIT's before submitting to Railways for approval. For designs made by any others, the contractor shall

produce a second check in the form of proof checking from the above institutions or from reputed designers such as STUP, SPAN and L & T (ROMBOLL) or any other designer of standing with the personal approval of the Chief Engineer. The cost of such proof checking shall also be borne by the contractor.

14.3 The designs/ proof checking shall be certified by any official of rank not less than Assistant Professor of the institutions/ Deputy Chief Engineer (Design)/ Senior Manager (Designs) in their personal capacity and also under the authority of the institution with authorized seal. The design/ proof checking agency shall be co-responsible with the contractor for the actions fully. It is the responsibility of the contractor to bring this condition to the knowledge of the agencies used by him.

14.4 Railway reserves the right to get the designs / proof checks rechecked at the discretion of the Engineer - in - charge in view of the public safety and reject the same if considered unsuitable for any reasons as decided by him. The contractor shall have no claims in this regard. In case of such rejections, the contractor is liable to bear the cost of such checks done by the Railway and also to penalties at the discretion of Engineer - in - charge.

#### 15.0 Elastomeric Bearings:

15.1 The contractor shall arrange and provide bearings of special designs as required as per drawings/ designs/or as directed by the Engineer - in - charge including designs for bearings wherever required. Payments for elastomeric bearings will be paid for separately if provided so in the schedules.

15.2 For elastomeric bearings, the contractor shall arrange for production of test results from the Manufacturers for acceptance by Deputy Chief Engineer for Chemical composition of raw material (Nature of Polymer, Polymer identification, Ash cement) and Hardness, Ultimate tensile strength, Elongation at break, Accelerated aging test, Compression set test of elastomer and yield stress & ultimate strength for steel laminates etc., as per relevant codes including IS codes/UIC-772-2R/ASTM/EN/IRC-83 (Part II) codes as applicable Wherever IS codes of equivalent are not available, other codes will apply.

15.3 Further, the contractor shall arrange to supply two spare bearings for every 40 bearings of the same design and source for destruction tests of Elastic Modulus, Adhesion, Ultimate compression strength and Shear modulus and these two bearings will be selected randomly by the Engineer - in - charge and the contractor shall arrange for the tests at IIT or SERC, Chennai at his cost and furnish results before the bearings are used in construction. In case of failure of any parameter of one bearing, the other bearing shall be tested. If both fail, the lot shall be rejected. If both bearings fail in not more than one parameter, one more bearing shall be arranged and tested by the Contractor. If this bearing passes in all parameters, the lot shall be accepted. The test bearings will be paid by the Railway unless any bearing fails under testing.

15.4 The elastomeric bearing shall satisfy the following criteria in destruction testing.

- (i) Elastic modulus = + or - 20% of  $1/(0.2/S^2 + 0.0005)$  where S is shape factor.
- (ii) Shear modulus = + or - 20% of 1.0 MPa

- (iii) Ultimate compression strength - Not less than 60 MPa at failure
- (iv) Adhesion strength - Not less than 7 KN/m.

15.5 For other special bearings, relevant codes/ specifications shall apply and the contractor shall arrange to carry out the tests as required as per the said specifications at his cost.

15.6 Additional tests, if required at the discretion of the Engineer - in - charge shall also be arranged by the contractor at his cost.

15.7 The contractor shall facilitate supervision of such tests by railway officials at the level of Section Engineer and above appropriately and the cost of such supervision shall be borne by the contractor.

15.8 Placement of bearings: Elastomeric Bearings shall normally be placed as part of precast concrete construction as per requirements laid down in UIC - 772 - 2R / IRC: 83 (Part II). Important requirements are:

- (i) Bearings must not be placed one behind the other along the longitudinal axis of the girder and split bearings should not be used.
- (ii) Surface contact between the bearing and the bed block and the bearing and the girder must be horizontal (tolerance less than 0.2%). In case of sloping of girders, shims or recess designed properly should be used to achieve the horizontality.
- (iii) Contact surface shall have no local irregularities of more than + or - 1mm in height and + or - 3 mm in plan size.
- (iv) Bridges with large horizontal deflections (more than 18.3 spans) shall be provided with bearings seated in a recess made on the bed block or pedestal to prevent accidental displacement. In other cases, bearings may be fixed to the underside of the girder by application of proper epoxy resin adhesives . Care should be taken to avoid the adhesive behaving like a lubricant later. The surface between the bed block and the bearing shall be of normal concrete finish to avoid slippage of bearing in service.

15.9 In case of Cast -in-situ girder, the following stages are to be followed:

- (i) Placing and adjusting the bearings on the bed block with accuracy as above.
- (ii) Preparation of a formwork side frame all around the bearing.
- (iii) Filling up the space between the bearing and the formwork frame by clean sand.
- (iv) Placement of top forms over the side frame and sand with an opening matching the size and position of the bearing.
- (v) Sealing of the gaps between the opening in top form and the bearing by adhesive tape.
- (vi) Execution of soffit formwork of the girder.
- (vii) Concreting of the girder.

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## **GENERAL BRIDGE WORKS**

### **1.0 General :**

1.1 All bridge works shall be carried out by the contractor as per the General Arrangement Drawings issued by the Railway for each bridge following all the specifications and guidelines contained in connected Railway's codes and manuals, IR Bridge manual, RDSO specifications and drawings, IRC guide lines (wherever applicable) and the specifications in IRUSS. For specifications for specific items like PSC, RCC, Steel etc. relevant specifications shall be followed as directed by the Engineer-in-charge. Special conditions for PSC, RCC, Steel and other items are separately available in this document. For bridge work, foundations and similar items, some guidelines are included herein. The Contractor shall go by sound practice supported by relevant codes and specifications with the approval of the Engineer-in-charge.

### **1.2 Reference points and bench marks :**

Permanent reference pillars established and fixed in the area shall not be removed or disturbed under any circumstances without the approval of the Engineer and wherever not available it should be fixed again. The contractor shall locate initially the centre line and level of the bridges. The contractor shall set out details of position/profile of individual foundations, piers, abutments etc. and be responsible for accuracy thereof. The contractor shall carefully maintain and protect all benchmarks and reference points and shall lay out all his work by accurate reference there to. Para 401 of Indian Railways Bridge Manual, 1998 may be referred to for details on "Setting Layout of Bridges". Before excavation and other works are commenced, approval of the Engineer-in-charge shall be taken.

1.3 In major works and as specified in other specifications like that for concreting, a field laboratory should be set up by the contractor at his cost at the work site, which should be equipped with necessary equipments to carry out the various tests on coarse and fine aggregates, cement, water and concrete. The contractor shall also arrange for SPT/Plate load tests as required by the Engineer-in-charge wherever required for reconfirming the bearing capacity of the soil at the location/level the foundations are proposed to be laid.

### **2.0 Excavation for Foundation :**

2.1 Site clearance - The contractor shall remove all vegetation, trees, structures and any foreign material existing at the site of proposed work. The area shall be stripped to remove roots of grass/trees, and other organic materials which shall be burnt and/or removed to approved disposal areas or other locations as indicated by the Engineer-in-charge. Cost of labour, tools, transport etc. required for this is deemed to be included in the overall rates unless otherwise specified.

2.2 Drainage in the vicinity of excavations - The contractor shall control the surface grade in the vicinity of all excavations so that the surface of the ground in vicinity is properly sloped or diked to prevent surface water from running into the excavated areas during the progress of the construction.

2.3 Excavations shall include the removal of all materials as per direction of the Engineer-in-charge, as may be required to execute the work properly. Excavation shall be made with sufficient clearance to permit the placing, inspection and setting of forms and completion of all works for which the excavation is made.

2.4 Sides and bottoms of excavation shall be cut sharp and true. Undercutting shall not be permitted. Earth sides of excavation shall not be used in lieu of formwork for placement of concrete unless otherwise authorised in special cases, by the Engineer-in-charge where limitations of space for larger excavation may necessitate such a decision.

2.5 When machines are used for excavation, the last 300 mm before reaching the required level shall be excavated by hand or by such equipment that will leave the soil at the required final level, in its natural condition and undisturbed.

2.6 The method of excavation, use of machinery etc. shall be decided in consultation with the Engineer-in-charge. The classification of material from the point of view of payment for excavation will be in line with that of excavation in cuttings.

2.7 The bottom of excavation shall be trimmed to the required levels and when carried below such levels by error shall be brought to level by filling with concrete M-10 (1:3:6) or as specified, at the contractor's cost. If the contractor is directed by the Engineer-in-charge to excavate to a lower level than that indicated on the drawings and the work is covered by through rates, such additional excavation shall be paid for at the applicable unit rate.

2.8 The contractor shall be responsible for assumptions and conditions regarding the nature of materials to be excavated and the difficulty of making and maintaining the required excavations and performing the work required as shown in the drawing and in accordance with the specifications. Cofferdams, sheeting, shoring, bracing, draining, dewatering, etc. shall be arranged and installed as required and the cost thereof shall be included in the unit rate quoted for the item of excavation, unless otherwise provided for in the schedule of quantities. The contractor shall be held responsible for any damage to any part of the work and property caused by collapse of sides of excavations. Material used for temporary works may be salvaged if it can be done without jeopardising safety of the work and structures and subject to approval of the Engineer-in-charge. However, no extra claim shall be entertained for material not salvaged or any other damage to contractor's property as a result of the collapse. He shall not be entitled to any claim for additional payment for having to re-do the excavation as a result of the same.

2.9 All excavation for installation or removal of underground facilities, such as piping, sewer lines, tunnels, ducts, drain lines etc. shall be open cuts and are included in the item of excavation unless provided for separately in the schedule of quantities.

2.10 Where excavation requires bracing, sheeting, or shoring etc. the contractor shall submit to the Engineer-in-charge, drawings showing arrangements and details of proposed installations and shall not proceed until he has received approval from the Engineer-in-charge.

2.11 Blasting - Blasting material required for excavation work shall be arranged by the contractor at his cost, from any authorised dealer of such approved material. Necessary assistance for obtaining approval for procurement of the material will be given by the Engineer-in-charge. The contractor shall be fully responsible for entering into agreement with any authorised magazine contractor in respect of rates, regularity of supply etc. Contractor will also obtain necessary license for transporting, stocking and use of explosives and depute only suitable qualified and licensed personnel for handling the explosives. All rules under the Explosives Act or other local rules in force shall be fully observed. All blasting works shall be done in accordance with the stipulations contained in the Indian Standard Specification No. IS:4081. Blasting shall be done by employing qualified personnel and under careful supervision. Proper precautions for safety of persons and property shall be taken, where blasting is to be carried out in the proximity of other structures. Sand bags etc. shall be used on top of the blast holes to prevent the rock fragments, from causing damage to adjacent structures and other property. The unit rate for excavation involving blasting shall be inclusive of the cost of providing all necessary materials, labour and arranging for such precautions.

2.12 Measurement for Excavation in rock - (i) As soon as level of rock is reached, the contractor shall intimate the Engineer-in-charge, who shall record the level for calculating quantities of excavation in rock.

(ii) In case, the quantity of "hard rock" alone as measured above is in excess of the theoretical total payable quantity of excavation below rock level, then payment under "hard rock" shall be restricted to the total theoretical payable quantity.

(iii) All excavated material, rock or soil, obtained as a result of over-excavation and for which payment shall not be made, shall also be carried and disposed of as directed and stacked at places shown by the Engineer-in-charge, at the cost of the contractor.

(iv) In the case of stray boulders which are classified as "hard rock", measurements of such outcrops shall be made on the basis of linear measurements of the outcrop made before excavation. Such measurements shall be signed by the contractor in token of acceptance before excavation is taken in hand.

(v) When the excavation in rock is paid for as a single item for all classes of rock, the measurement will be made based on cross-sectional area after recording rock level at commencement and finishing.

2.13 Excavation below water table:

2.13.1 Wherever water table is met with during the excavation. the contractor shall immediately report the fact to the Engineer-in-charge who shall arrange to record the exact level of the water table. The decision of the Engineer-in-charge in the matter shall be final.

2.13.2 The Contractor shall dewater and maintain the water table below the bottom of the excavation level during excavation. concreting and back-filling.

2.14 All excavated materials obtained from excavation shall be disposed off by the contractor as directed by Engineer-in-charge. The waterway of the bridge and that of the channels leading to the

bridge shall be cleared and kept clear during the monsoon periods to avoid blockage and damages to adjoining properties.

### 3.0 Seating of the foundation :

3.1 The open foundation of bridges should be taken to a depth not less than 1.75 metres below the lowest anticipated scoured bed level in ordinary soil. In rocky soil, it will be adequate if it is properly keyed into the rocks for a minimum of 0.30 metre in case of hard rock and 1.50 metres in case of soft rock. Sloping rock is to be suitably benched. Fissures and weathered rocks are to be avoided. In soft soils, raft foundations may be provided protected by means of suitable aprons and cut off walls or launching apron both on the upstream and downstream side to prevent undermining of the foundation.

3.2 The Bearing capacity of the soil at the bottom of excavation shall be determined by the Engineer-in-charge, so as to decide on the depth of foundation. The contractor shall assist him with necessary resources to arrive at the above decision.

3.3 Decision on the type of foundation shall be taken by the Engineer which shall be binding on the contractor.

### 4.0 Brick work and Stone work:

4.1 Normally brick work or stone work in bridge construction will not be used, wherever used material of pipe quality shall be used and the requirements are given below.

4.2 Sampling and Tests - Samples of bricks shall be subjected to the following tests, as per relevant specifications as directed by Engineer-in-charge.

- (a) Dimensional tolerance.
- (b) Water absorption.
- (c) Efflorescence.
- (d) Compressive strength.

IRUSS provision shall govern the above and wherever not available, relevant specifications with the approval of the Engineer-in-charge.

4.3 Dimensional tolerances: The dimensions of modular and non modular bricks when tested as per procedure described shall be within the following limits per 20 bricks. (Refer Para 6.2 of IS 1077 for details.)

### Modular Size Bricks and Tile Bricks

Length :	372 to 388 cm (380 + 8 cm)
Width :	176 to 184 cm (180 + 4 cm)
Height :	176 to 184 cm (180 + 4 cm) for 90 mm high bricks

Height : 76 to 84 cm (80 + 4 cm) for 40 mm high tile bricks

#### Non-Modular Size Bricks and Tile Bricks

Length : 452 to 468 cms (460 + 8cm)

Width : 216 to 224 cms (220 + 4cm)

Height : 136 to 144 cms (140 + 4cm) For 70mm high bricks

Height : 84 to 92 cms (88 + 4cm) For 44 mm high tile bricks

4.4 Compressive strength: The bricks, when tested in accordance with the procedure laid down in Annexure 5.2 of Unified Standard Specifications for Works & Materials shall have a minimum average compressive strength for various classes as given in Table 5.2 of Unified Standard Specifications for Works & Materials. The compressive strength of any individual brick tested shall not be fall below the min, compressive strength specified for the corresponding class of brick.

4.5 Water absorption: The average water absorption of bricks when tested in accordance with the procedure laid down in Annexure 5.3 of Unified Standard Specifications for Works & Materials shall be not more than 20% by weight upto Class 12.5 and 15% by weight for higher classes.

4.6 Efflorescence: The rating of efflorescence of bricks when tested in accordance with the procedure laid down in Annexure 5.4 of Unified Standard Specifications for Works & Materials shall be not more than moderate upto Class 12.5 and slight for higher classes.

4.7 Stone work shall follow general building construction practices.

4.8. Quality of brick or stone work in masonry and particularly in orders shall be high on the loads expected are high. For major constructions with brick or stone, load testing of the completed structure shall also be carried out by the contractor as directed by the Engineer-in-charge.

4.9 Precast CC blocks shall not be used in bridge construction except for piling/flooring where approved by the Engineer.

5.0 Rubble backing, backfill etc :

5.1.1. Rubble packing: A backing of dry rubble walling or boulder filling should be provided behind abutments, wing walls and return walls for facilitating proper drainage. It shall be provided to dimensions in accordance with the drawings. The boulder filling will be for full height and of thickness not less than 600mm with smaller size towards the back behind the boulder filling.

5.1.2 The materials used should be of broken stone of quality approved by the Engineer-in-charge. The stones used will be of least dimension of 15 cm in any direction and not friable. Materials selected from out of excavated material may be permitted to be used by the Engineer-in-charge, in which case only labour rate is payable for the work. Otherwise, the cost will include supply of all materials, labour and tools.

5.1.3 For typical arrangements of Rubble backing and Backfill behind the abutments, wing walls and return walls, Sketch 1 relating to Para 6.4.2 of RDSO's Guidelines for Earthwork in Railway Projects (GE G-1) or suitable Railway drawings may be referred to.

## 5.2. Backfill :

5.2.1 Backfill material shall consist of Granular materials of soil Groups GW,GP and SW as per IS 1498.

5.2.2 After completion of foundation, footings, abutments and wing walls and other constructions below the elevation of the final grades and prior to backfilling, all forms, temporary shoring, timber etc. shall be removed and the excavation cleaned of all trash, debris, and perishable materials. Backfilling shall begin only with the approval of the Engineer-in-charge.

5.2.3 Backfill shall be placed in horizontal layers not exceeding 20 cm in thickness. Each layer shall be compacted under proper moisture content and with such equipment as may be required to obtain a density equal to or greater than 95 % of maximum dry density as determined by the relevant Indian Standards. Trucks or heavy equipment for depositing or compacting backfill shall not be used within 1.5m of building walls, piers, or other facilities which may be damaged by their weight or operation. The methods of compaction shall be subject to the approval of the Engineer-in-charge. Pushing of earth for backfilling shall not be adopted under any circumstances.

5.2.4 Backfill adjacent to pipes shall be hand placed, free of stones, concrete, etc. compacted uniformly on both sides of the pipe and where practicable, to a depth of 300 mm over the top of pipes. While tamping around piping, care shall be taken to avoid unequal pressures.

5.2.5 On completion of structures, the earth surrounding them shall be accurately finished to line and grade as shown in the drawings. Finished surface shall be free of irregularities and depressions and shall be within 50 mm of the specified level.

## 6.0 FALSE WORK AND FORMWORK:

6.1 Reference may be made to Clauses 6.1 and 6.2 of Concrete Bridge Code respectively for False work and Formwork.

6.2 All details of formwork, placing, tying etc. shall be subject to the approval of the Engineer-in-charge and the contractor, when required, shall submit drawings, showing details of form construction. The contractor shall use prefabricated steel shutters for all bridge works and is liable for penalties for not using steel shutters. The contractor shall be responsible for the adequacy of the formwork to withstand the pressure of freshly placed concrete or other loads imposed without failure, movement or deflection of the component parts. Forms shall be true to the shape, lines and dimensions of the concrete work as shown on the drawings. Wherever vibration has to be applied externally, the design of the formwork should receive special consideration based on the disposition of vibrators.

6.3 For concrete surfaces that are exposed to view and for all other concrete surfaces that are to be finished smooth, the lining of forms shall be of smooth, nonabsorbent lining material. The type and conditions of such lining for forms shall be subject to the approval of the Engineer-in-charge. All

edges of panels shall be square and straight in both directions, and all panels shall match perfectly in length, width and alignment as required.

6.4 All forms shall be sufficiently tight to prevent the loss of liquid from the concrete. All rubbish particularly chipping, shaving and saw dust shall be removed from the interior of the forms before the concrete is placed and the formwork in contact with concrete shall be cleaned and thoroughly wetted or treated with an approved composition or release agent to prevent absorption of water from adherence of form to the concrete. Such composition or release agent shall be kept out of contact with reinforcement and shall be non-staining and non-injurious to concrete.

6.5 Form lumber may be reused, provided it is true, unwrapped, thoroughly clean and without broken or damaged edges and equal in every respect to new lumber. All reformed lumber shall have the contact surfaces re-oiled or recoated with an approved composition prior to usage.

6.6 Contractor shall keep an accurate record of the date on which the concrete is cast for each part of the work and the date on which the form work is removed. He shall also ensure engraving/markings the batch no/date on the products wherever required.

6.7 Removal of forms from structural concrete shall be in accordance with the requirements stipulated on stripping time in Clause 6.4 of Concrete Bridge Code. No supporting forms shall be removed suddenly in such a manner as to create shock-loading.

6.8 The tolerances for finished concrete bridge structures shall be as stipulated in Clause 6.5 of Concrete Bridge Code, unless otherwise specified separately.

7.0 Bending and placing reinforcement:

7.1 For specifications relating to ordinary reinforcement (other than Pre-stressing Tenders) reference may be made to Clause 7.1 of Concrete Bridge Code. Contractor shall, as per instruction of Engineer-in-charge, fabricate and place reinforcement to shapes and dimensions as indicated or required to carry out intent of drawings and specifications. The reinforcement shall conform to the provisions detailed in Para above.

7.2 The contractor shall prepare bar-bending schedule on the basis of the drawings marked "released for construction" and submit the same for approval. No work shall be commenced without the approval of the schedule.

7.3 Any adjustments in reinforcement to suit field conditions and construction joints other than those shown on drawings shall be subject to the approval of the Engineer in-charge.

7.4 The contractor shall adhere strictly to requirements for concrete cover over steel reinforcement, protection of bars for bonding with future extensions, columns ties, splices, laps, spacer bars, temperature reinforcement, mesh reinforcement and other items in connection with proper placing. Profile and verticality of reinforcement and cover shall be ensured by proper holding arrangements.

7.5 Reinforcement shall be placed accurately, conforming to tolerances not exceeding those stipulated in Clause 7.1.3.3 of Concrete Bridge Code, tied or welded securely at intersections and splices, and held in position with spacers or other approved supports during concrete placement. Tie

wire ends shall be pointed away from surface. Where bars at laps are welded, the length of weld shall be minimum butt welded on both sides of the joint and shall be in accordance with the relevant Indian Standards specially IS 2751. The contractor will not be entitled to any extra payment for welding the reinforcements.

7.6 Bending of bars will normally be done 'cold'. Engineer-in-charge's specific approval will be obtained for hot-bending of bars. Torsteel/Deformed bars will under no circumstances be hot-bent. No extra will be payable for hot-bending in lieu of cold bending.

8.0 Concrete pipe culverts:

8.1 General:

8.1.1 The pipe used shall be in accordance with IS:458-56 "Concrete Pipes" and the type will generally be to class NP-4 or as per approved RDSO drawing, unless otherwise specified in the schedule of quantities. They shall also be provided with collar unless otherwise specified or permitted by the Engineer-in-charge.

8.1.2 The laying of pipes will be in accordance with IS:783 Code of Practice for laying of concrete pipes and guidelines in Section 2300 of Ministry of Shipping and Transport Specification for Road and Bridge works.

8.2 Materials and Handling:

8.2.1 All materials used in the manufacture of pipes as well as laying in the pipe culverts shall conform to the general requirements contained in the IS Specification mentioned above and indicated in the foregoing paras.

8.2.2 Each consignment of the pipes shall be inspected, tested where considered necessary and approved by the Engineer-in-charge before their incorporation in the works. If the pipes are not being cast in the vicinity of the works, suitable facilities shall be provided for the Engineer-in-charge to inspect them during the process of manufacture at the place of manufacture. Necessary test certificates for the materials used shall be produced to the Engineer-in-charge for approval.

8.3 Excavation:

8.3.1 The foundation bed for the pipes shall be excavated true to the levels and grades shown in the drawing or as directed by the Engineer-in-charge. The pipes shall be placed in shallow excavation made in natural ground, or in trenches cut in the previously made embankments. Where the height of fill exceeds 3 times the external diameter of the pipe before excavating for pipe laying, the embankment shall first be made and properly consolidated upto a level of one pipe diameter above the proposed top of the pipe for length equal to 5 pipe diameters on either side of centre line, trenching being done thereafter. The sides of the trench shall be as nearly vertical as possible, and the clearance between sides, and pipe shall not be less than 150 mm or more than 1/3rd the pipe diameter.

8.3.2 If soft, spongy or other type of unstable soil is met with during such excavation, the unsuitable material shall be removed to depth, width and length as directed by the Engineer-in-

charge and be back filled with approved granular soil which shall be thoroughly compacted and shaped to the specified level and shape.

8.3.3 Where bed-rock-boulder, hard clay, shale or other hard material is met with, the excavation shall be taken for at least 200 mm below the bottom level of the pipe and space filled with approved soil, free of stone, fragmented material etc. and compacted for providing adequate support unless concrete bedding is specified otherwise.

8.3.4 Generally pipes for railway culverts will be laid on concrete bedding unless otherwise specified in the drawing/approved by the Engineer-in-charge.

#### 8.4 Bedding for pipe:

The concrete used for the bedding shall have mix which shall have a 28-day compressive strength of not less than M15 grade. Unless otherwise specified, bedding shall have a minimum thickness of 1/4th of the nominal diameter of the pipe and form a cradle extending for 1/4th of the diameter of the pipe above the lowest bedding level. Suitable recess will be provided in the bedding for resting the projection, collars, etc. for the pipe.

#### 8.5 Backfilling for pipes:

8.5.1 Trenches shall be back filled soon after the jointing material has hardened. Back filling shall be made of selected good soil free of stones, roots or other organic matter and the soil shall be approved by the Engineer-in-charge. The back filling shall be done carefully with selected/approved material upto 30 cm above the top of pipe and fully rammed and consolidated at optimum moisture content. It shall be laid in layers not exceeding 150 mm. Care should be taken particularly while consolidating the soil under the haunches of the pipe. Consolidation below and above haunches of the back fill shall be done by foot, light tampers or hand operated mechanical equipment approved by Engineer-in-charge.

8.5.2 Filling shall be done simultaneously on both sides of the pipe so that unequal pressures do not occur. No walking or working out the completed pipe shall be permitted till it is back-filled upto 30 cm over the pipe.

8.5.3 In case of high embankment after filling the trench upto the top of the pipe, a loose fill of a depth equal to the external diameter of the pipe shall be placed over the pipe before further layers are added and compacted. This shall be done for the full width of the trench. Only further layers placed above this level, shall be compacted.

#### 9.0 RCC Box Construction:

##### 9.1 General:

9.1.1 RCC boxes, either precast or cast-in-situ, are used for construction/rebuilding of minor bridges/limited use subways in New lines/Gauge conversion/Doubling projects regularly. The depth of foundation of RCC box i.e. from bed level to bottom of box proper is generally less than 50 cm. Settlement of boxes or alignment defects in both vertical and horizontal directions shall not occur. Sags in the middle of the box shall be avoided. Boxes are not permitted in scour able soils.

9.1.2 Cast-in-situ boxes construction is preferred as proper base and continuity can be ensured. Leakage through joints will also be eliminated.

9.2 The safe bearing capacity of soil at such shallow depths are normally not sufficient to carry the pressure coming on the soil due to live and dead loads in terms of RDSO drawings for boxes No.RDSO/B-10151/1,2,3,4,5,6,7,8,9 (for 25 t loading in the range of 12-36 t/sqm) and RDSO/B-10152/6,7,8,9 (for 32.5 t loading in the range of 13-38 t/sqm). Therefore, strengthening of foundation of RCC boxes becomes necessary to avoid differential settlement of boxes in service.

### 9.3 Strengthening of BASE SOIL depending upon existing SBC

The following strengthening measures shall be adopted based on SBC of base soil. Southern Railway's drawing No.SR/CN.23489 shall be referred to:

- |       |                               |   |   |
|-------|-------------------------------|---|---|
| 9.3.1 | Upon Hard Rock                | - | No strengthening is necessary. Only a compacted layer of sand fill of 200 mm is to be provided, which however should be empedded.   |
| 9.3.2 | SBC above 15 t/m <sup>2</sup> | - | Below the levelling course, a compacted layer of sand fill of 150 mm thick is to be provided over the compacted base soil.  |
| 9.3.3 | SBC between<br><br>of         | - | Below the levelling course, a compacted 600-1000 mm 5 & 15 t/m <sup>2</sup> . thick layer conforming to Blanket specifications RDSO or a compacted layer of 300 mm thick soling stones with 150 mm thick WBM is to be provided over the compacted base soil.  |
| 9.3.4 | SBC below or                  | - | Complete weak soil upto a depth of 1.0 m to 1.5 m equal to 5 t/m <sup>2</sup> . shall be removed in a trapezoidal shape and replaced with a compacted 1000-1500 mm thick layer conforming to Blanket specifications of RDSO, or/a specially designed Geo grid - Geo Textile layer of 900mm thickness is to be provided. |

However, the efficacy of the Geo grid - Geo textile strengthening should be tested and confirmed by Plate Load tests at one site in the area before it is adopted in any project.

- |     |                  |   |   |
|-----|------------------|---|---|
| 9.4 | Levelling course | - | Levelling course shall be laid with M15 concrete suitably adjusting the water content to suit site conditions.<br>For precast boxes, to be laid in traffic blocks, pre- |
|-----|------------------|---|---|

cast leveling course slabs of appropriate design  
in RCC shall be used.

9.5 Pre-cast boxes - There shall be of appropriate design as per approved  
Drawings and shall hence interlocking/match casting  
arrangements. Length of each unit shall be  
atleast 2.0m

and dimensions less than that shall have the approval of  
the Dy.Chief Engineer.

9.6 Lifting and handling - Pre-cast elements such as box units, slabs etc. shall have pre-determined lifting arrangements as per approved plan and shall be lifted and placed by suitable cranes. Joints of these units shall not be wider than 10-15 cm in any face and shall be filled with rich cement mortar. In case of passenger subways, shall be water sealed.

10.0 River protection works :

10.1 Pitching :

10.1.1 Pitching shall not be laid until the banks on which it is to be laid have become consolidated. Before slope pitching is commenced, unless a floor apron is also provided, a trench is to be dug at the toe of the bank, 50 cm deep, or to the depth shown on the drawings, and 15 cm layer of quarry chips or ballast must be laid in trench, on the bed of the pitching. All earth surfaces that are to be pitched and subsequently exposed to the action of running water, must be covered with a rammed layer of gravel, moorum or quarry refuse to a depth of about 15 cm or as ordered by the Engineer In charge, unless otherwise specified in the drawings specifications. This under layer prevents the finer material of the bank from being sucked out by the flowing water.

10.1.2 The stones for stone pitching shall be set in the work as received from the quarry, and without any dressing except knocking off weak corners and edges with a mason's hammer. A small proportion of chips may be allowed to show in the face work. The face stones must in general weigh at least 40 Kg and not more than 60 Kg unless otherwise specified, and be well-bedded and hand set in the earth or dry stone backing, which must be brought up at the same time as the hand set face work. If the backing is of earth, it shall be rammed in 30 cm layers. For bank protection, only rough stone pitching should be used for reasons of economy. Stone pitching in continuous lengths will be divided suitably in the form of panels by stone masonry walls 45 cm wide and equal to a depth of pitching with cement mortar 1:6 or otherwise specified in such a way that total enclosed area does not exceed 10 sq.m.

10.1.3 Precast CC block, may be permitted by the Engineer for use as pitching blocks, only in areas when pitching stones are not available as certified by the Engineer-in-charge.

10.1.4 Pitching shall be jointed with 1:6 mortar and cealed. Velocity breakers shall also be provided at suitable interval..

10.2 Flooring :

10.2.1 Base - Except where otherwise shown in the drawings, the base shall consist of dry rammed moorum or dry rammed quarry refuse of 15 cm thickness as decided by the Engineer- in-charge.

10.2.2 Flooring, Drop walls and curtain walls:

The drop walls both on the upstream and downstream shall be built in cement concrete or as specified in the drawings. On the upstream side the foundation shall be taken to a depth of 90 cm below the bed level while on the downstream side it shall be taken to a sufficient depth so as to effectively dissipate the hydraulic head due to high flood level and afflux thereby preventing seepage underneath the flooring towards the downstream side, in any case not less than 1080m. Alternatively the depth of the drop walls and the length of the flooring should be as shown in the drawings so that the minimum flow line is longer than the piping gradient line. The foundation for the drop wall shall also be laid in cement concrete and dimensions shall be in accordance with the drawings. The flooring shall be as per design based on the velocity of water flow anticipated and may be grouted/concreted as directed by the Engineer-in-charge.

10.2.3 Aprons

10.2.3.1 Aprons are provided at the toes of banks in continuation of the slope pitching for affording protection to the banks. These are provided to overcome the effects of scour that will be caused in the bed of the river at this location due to high velocities, whirls etc. Aprons are provided in such a manner that they can launch slope pitching below bed level, extending beyond scour level. Hence such aprons are provided in form of loose stones to a predetermined thickness and width.

10.2.3.2 A base consisting of smaller stones not exceeding 25 Kg in weight and not exceeding 20 cm in any direction shall be laid first over a layer of stones varying from 25 to 60 Kg in weight. The stones in the pitching shall be laid in such a way that the longest side is bedded vertically. Aprons shall be grouted by cement mortar as specified in the drawing.

10.2.3.3 Face walls, wing walls and returns shall be constructed as per approved drawings and foundation of these structures shall be taken atleast 1.75m below scour level.

11.0. Jacketing of masonry structures:

Jacketing should be under taken only when the existing structure is fairly sound and does not show signs of distress. All cracks should be thoroughly grouted before providing the jacket. For the jacketing to be effective, it has to be taken right upto the foundation and integrated at this level with the existing foundation. Jacketing to be done in stone masonry only and not in brick masonry and Cement concrete only to be used.

The foundation shall be exposed for only limited width at a time and for the shortest time necessary for strengthening so as to avoid endangering the safety of the structure. Site and soil conditions including water table shall be considered for deciding the width of foundation to be exposed at a time. The minimum thickness of jacketing should be at least 150 mm.

11.1 Procedure:

The face of the existing masonry or the concrete should be thoroughly cleaned free of all dirt. Before laying new concrete, neat cement slurry should be applied uniformly over the face of

the old masonry. Dowel bars consist of M.S rods 20 mm dia hooked at the exposed end. M.S. Tie bar flats with the ends split can also be similarly fixed into the old masonry. These dowels should be taken down to a depth of not less than 200 mm inside the masonry. For driving of dowels many times holes are required to be made. These holes must be drilled and not made by pavement breakers. The spacing of the dowels should not be more than 450 mm horizontally and vertically. The dowels should be staggered. A Mat of steel reinforcement bars spaced at minimum 200 mm horizontally and vertically may be provided as distribution reinforcement. The concrete should be cured for a minimum period of 28 days by covering with gunny bags or similar material and splashing with water.

Unless otherwise provided for, Jacketing should be done as per RDSO drg. No. EDO/B-1997.

#### 12.0 Weep holes:

Weep holes shall be provided as per IRUSS specifications, where provided for in the schedule of quantities of 100 mm dia PVC pipe of suitable length may be provided in retaining walls at regular intervals as specified in the drawings/directed by the Engineer-in-charge. Providing these holes is a part of the masonry/concrete work but no deduction would be made in the quantities for holes. In abutments, weep holes should be provided at vertical intervals of 1 metre and horizontal intervals of 1 metre in a staggered manner. In RCC boxes and retaining walls, these may be provided as directed by the Engineer-in-charge. Bottom line of weep holes shall be above the low water level. Weep holes shall be cleared of all obstruction once the work is set. No extra payment will be paid for providing PVC pipes.

#### 13.0 Bridge plaques/Board/Markers:

13.1 Every bridge shall be provided with a plaque in CC or stone with engraved and painted bridge no/direction of flow on it on both side walls appropriately. All major bridges shall be provided with a name board in steel/RCC indicating the name of the river/mullah, spans and direction of flow, duly painted on it. In case of major bridges, markers in concrete shall be laid on top of each pier/abutment showing the foundation details.

13.2 On the abutments at either end, HFL & DL marks shall be painted in each bridge.

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## SPECIAL CONDITIONS FOR PILE FOUNDATION

### 1.0 General:

1.1 Pile foundation shall be provided as per Indian Railways Substructure Code for Railway Bridges and IS: 2911 for other structures in conjunction with other specifications and special conditions of the contract.

1.2 Piles may be of 1200 mm/ 1000 mm/ 750 mm/ 600 mm diameter and may be of depth ranging from 7 - 8 m to 40 - 45 m depending upon the load, site conditions, types of soils etc. All the piles shall be of similar type and shall be built to carry the heaviest load.

1.3 The scope of the work is for the provision and testing of bored cast-in-situ RCC pile foundations for the substructure together with the pile cap connecting each or group of piles.

1.4 The schedule of quantities in this contract is based on bored cast-in-situ pile of required capacities and for approximate anticipated depth as indicated in the scope of work/schedules. The actual requirements in individual and total depth requirements may vary depending upon soil conditions and the contractor shall carryout as required without any change in rates and terms and conditions.

1.5 The piles will have to be founded on hard rock/coarse sand/other suitable soil as per the direction of Engineer-in-charge. Minimum anchorage in hard rock should be as mentioned in the drawing. Where hard rock is not met with, after reaching a depth of 30m, the Deputy Chief Engineer in charge of the project shall be notified by the contractor. Deputy Chief Engineer can decide the depth of pile in consultation with Design office. The contractor shall not dismount the machinery or stop the pile without the specific approval of Dy.Chief Engineer in charge. The top level of the pile cap will be decided by the Engineer-in-charge, depending upon the low water level and bed level.

1.6 The spoils, arising out of boring shall be disposed off as directed by the Engineer-in-charge within the accepted rates.

### 2.0 PROVIDING M.S.LINERS:

2.1 This item is for supply and fixing Contractor's permanent M.S. Liners of 6 mm thick normally for the pile from the top of the working platform up to the required depth as may be decided by the Engineer-in-Charge. The Contractor shall fabricate the M.S. Liners from his own M.S sheets to suit the diameter of the pile as directed. The required length of the M.S. Liners will be made up by welding each unit at site by the Contractor with his own equipment and plant. Welding should be of proper quality so as to withstand the forces during piling execution.

2.2 The payable depth shall however be measured only from the cut-off level though the liner might have been provided right from the level of the working platform on practical considerations, since the length above the cut-off level has to be necessarily removed by gas-cutting for facilitating peeling of the top portion of the pile and for interlacing its reinforcement bars into the capping slab. Therefore, the rate quoted shall cater for the element of cutting and removing the surplus length of the M.S. Liners. There is, however, no objection if the surplus pieces (if cut and removed carefully and then reusable) are united and are re-welded to

required length for reuse. No claim shall be entertained if the cut pieces cannot be reused by the Contractor or for the wastages in the aforesaid manner.

### 3.0 Pile Construction:

3.1 When the tube or bore has reached its final depth, it shall be free from any foreign matter before the placing of the reinforcement. The reinforcement for the pile shall be carefully placed in position and concreting started only with the approval of the Engineer - in - charge.

3.2 Use of drilling mud (Bentonite) in stabilizing the sides of the bore holes is required wherever necessary. The consistency of Bentonite suspension shall be as per IS.2911 (Part - I/Section.2)- 1985. The cost on account of the use of Bentonite for piling is included in the accepted rates and no extra payment is admissible.

3.3 Removal of obstruction if any met with during pile driving or boring shall also be done by the contractor. No extra payment shall be payable for the same.

3.4 The quantity of concrete required for the depth of the particular pile shall be calculated on the spot and checked with the actual quantity of concrete used. The quantity of concrete used in each pile should also be recorded and signed by the contractor and the representative of the Railway which will form the basis for calculating the cement actually used. The concrete will be machine mixed. For manufacture of concrete, the special conditions under 'Concreting' shall apply.

3.5 Under water, concreting shall be done as per Para 13.2 of IS 456-2000 and IS.2911.

3.6 Concrete is to be placed in the pile only by Tremie method ensuring that tip of the Tremie is at least 500 mm below the top of concrete at any time. The top of concrete in a pile shall be brought above cut-off level to permit removal of all laitance and weak concrete before capping and to ensure good concrete at the cut off level for proper embedment into pile cap. No payment will be made for providing overflow concrete or scum concrete beyond cut off level. The depth of over flow will be decided by the Engineer-in-charge. Engineer-in-charge shall permit overflow of concrete till green concrete is obtained at cut off level. The cement consumed for overflow to obtain green concrete at cut off level will be recorded and paid separately under the relevant schedules, subject to maximum of cement required for 2.0m length of pile. The pile cut off level shall be 75 mm above the bottom of pile cap. No extra payment will be made for the labour, tools etc., used in the peeling the top of concrete of the piles and for interlacing the reinforcements of the piles in to the capping slab. While inserting the reinforcement cage, care shall be taken to provide extra length so as to enable interlacing into the capping slabs.

3.7 The control of alignment of piles should be as per Para 7 of IS.2911 (Part I/Section.2) 1985 with latest amendments.

3.8 In a group of two or more piles, piles of same diameter/size and same load carrying capacity shall be installed. The distance between centre to centre of such piles shall be governed by IS.2911 (Part I/Section.2) 1985. In case the contractor offers to install the piles closer than this spacing, he shall state the reduction in the working load of the pile which will be subject to the approval of the Engineer-in-charge. The additional piles required on this account shall be provided by the contractor

without any extra cost to the department. Also cost of cement and steel reinforcement used on this score will have to be borne by the contractor. New M.S. Liners shall also be at contractor's account.

3.9 Level marks shall be put accurately on each pile immediately after it is installed. If any pile shows subsequently a tendency to heave up due to installation of other piles later or due to any other reason, the same shall be reinstalled firmly without having heaving tendency in a manner and corrective course of action shall be taken as suggested by the contractor and as approved by the Engineer-in-charge without any extra cost.

3.10 (a) If any pile during driving or boring has deviated from the designed position or from the verticality or if the same allowable load of the pile is not obtainable as per the design, all these facts shall be reported promptly by the contractor to the Engineer-in-charge in-charge shall consider the suggestions of the contractor and shall give necessary directions for the corrective measures which will be done by the contractor at his own cost and risk. The Engineer-in-charge may allow the rejected piles to be left in their places and additional piles may be installed to take up the safe working load of the rejected piles, without any extra cost, if he considers it feasible and correct. If any such changes involve additional expenditure due to increased size of pile cap etc. the same will also be borne by the contractor including the extra cost involved in the usage of the extra quantity of cement and steel used in such changes. No payment will be made for rejected piles as also the cement, steel and the M.S. Liners provided for the rejected piles.

(b) If shifting of pile is necessitated due to any obstructions existing at site, pile/pile group/pile cap are to be redesigned. Payment for piles and pile cap shall be as per the approved drawing.

3.11 In the finishing of pile heads, the clearances of the reinforcement in the pile cap and the keying of the pile head into the pile cap shall be as given in IS.2911 (Part-I/Section.2) 1985 with latest amendments.

3.12 The contractor shall indemnify the Railway Administration against any claim or obligations arising out of any damage to structure or out of any injury to any person / persons due to piling work done by him.

3.13 Durability provisions such as clear cover to reinforcements, minimum and maximum cement content, maximum water-cement ratio and permeability of concrete shall be adhered to as per relevant codes of practice. In case of harmful chemical constituents found in subsoil and in water such as chlorides and sulphides, special provisions as per relevant codes of practice shall be followed for protection against reinforcement corrosion and disintegration of concrete. For protection against corrosion and bio fouling, the pile concrete / liner below cut-off level may have to be painted, if ordered by Engineer-in-charge for which payment will be made separately. Sufficient care shall also be taken in stacking the aggregates, handling the reinforcements, mixing and placing of concrete so that sea water or sea sand shall not come in contact.

3.14 Sulphate resistant cement may be used on need based consideration after conducting the soil investigation and water investigation. As it is prohibited in acidic environment with high chloride level, chloride and sulphate contents in subsoil and water shall be tested in solid form as well as in solution form. If chlorides are present in traces only, but sulphates are present in more than permissible concentrations, requirements of concrete exposed to sulphate attack shall be as per

Table 4 of IS456-2000. If both chlorides and sulphates are higher in concentration in subsoil or water, then concrete has to be protected against sulphate attack and reinforcement steel has to be protected against chloride attack. As per Table 4 of IS 456-2000, OPC with 5 to 8% of C3A has to be used. For pH around 4, steel and concrete both have to be specially coated. If sulphate resistant cement is used which has faster setting properties, curing shall start within five hours of concreting.

3.15 Method of boring, namely, Rotary ring with suitable tools/ drill bits/ plant & machinery as appropriate to different stratas, namely all soils and soft and hard rock such as Bailer and Chisel, DMC, RMC etc shall be chosen as appropriate to strata and site conditions.

3.16 The contractor shall take all necessary precautions while piling close to existing structures and track so as to minimise vibrations and ground movement. Bores shall be cased as directed by the Engineer-in-charge and boring shall commence only after precautionary measures are taken. While working near the existing track, infringements and other safety aspects shall be specially considered.

3.17 Strata for socketing and depth of socketing shall be as decided by Engineer-in-charge. After ascertaining the quality with visual inspection like samples and penetration test for specified fall and weight of chisel, top level of socketing shall be decided and bore shall progress further in rock for requisite depth of socketing. In case of sloping bedrock profile the requisite depth of socketing shall be ensured as minimum allround piling and the payment will be made for the least depth of socketing only and no claims of differential depth of socketing are admissible. After rock-touch level, further boring should be done duly watching/ collecting/ recording/ maintaining rock samples to check consistency of the rock. The physical efforts to create the required length of socketing be studied and recorded in the first piles in terms of 'Chiselling time criteria' for a particular strata and equipment used and actual requirements shall be decided by the contractor with the approval of the Engineer - in - charge (Para 7.1.1.1 of Is: 2911 - Part 1).

3.18 Care shall be taken for free flow of concrete through splices and congested reinforcement zones with proper detailing and monitoring consumption of concrete at such locations. Mix shall be self compacting and non - segregating.

3.19 The contractor shall maintain bore log register and bored samples for each pile boring and concreting. The details shall contain various operations in pile boring with time, type of soil met with, depth of penetration with levels, liner welding and lowering details, obstruction to boring, if any, machine down time, rock touch level and final socketed level. The flushing out details before cage lowering and before concreting shall also be recorded. The concreting details such as mix proportions, sounding at various depths vis-à-vis cement / concrete consumption, unusual observations while concreting, interruption to concreting, if any and overflow concrete shall be recorded. The swelling and / or squeezing of borehole in uncased portion shall be specially monitored with recording of sounding depth, quantity concreted actually and quantity theoretically estimated corresponding to that sounding depth.

#### 4.0 Load testing:

4.1 Vertical load testing of piles (static) shall be carried out as per procedure laid down in IS code of practice for Design and Construction of pile foundation - Part IV load test on piles IS.2911

(Part IV). Dynamic testing may be permitted by the Chief Engineer if required, considering the site conditions. Lateral load testing of the pile shall also be carried as per procedure laid down in IS code no.2911- (Part-IV) if ordered by Engineer-in charge. Load testing should be done on the working piles normally. Failure tests may also be required in some cases where it should be done on Trial piles provided in the nearby area but outside the foundation layouts.

4.2 Payment for the test of the pile or group of piles shall be made to the contractor only when the test is found to be satisfactory. For tests which are found unsatisfactory or which are not completed due to any reason whatsoever no payment shall be made to the contractor. Additional tests required by the department shall be carried out at the same quoted rates.

4.3 The rates for tests include arranging of necessary Kent ledge, R.S. Joists, sand bags, etc., required for loading the platform for successful testing of the pile or group of piles and removing the same from the site of work after the test is completed and clearing the site to the satisfaction of the Engineer-in-charge and no extra payment shall be made on this account.

4.4 In case of suspected or defective piles, the contractor is liable to carryout ,at cost of contractor, non-destructive test for integrity and / or capacity assessment or static load test as confirmatory test. Railway also reserves the right to reject the pile and get the new pile done at the contractors cost in case of failure of the contractor.

5.0 Bored cast-in-Situ Piles - Special safety considerations:

5.1 While concreting uncased piles, voids in concrete shall be avoided and sufficient head of concrete shall be maintained to prevent inflow of soil or water into the concrete. It is also necessary to take precautions during concreting to minimise the softening of the soil by excess water. Uncased cast-in-situ piles shall not be permitted where mudflow conditions exist. No bored pile pit shall be kept open after digging till concreting is made. Normally concreting should be done within 24 hours of drilling. When the pit is open, the pit should be protected by keeping the bentonite slurry in circulation, top covered properly and under constant watching. For delays in concreting, Railway reserves the right to impose heavy penalty in the interest of safety at the discretion of the Engineer - in - charge.

5.2 The drilling mud such as bentonite suspension shall be maintained at a level sufficiently above the surrounding ground water level to ensure the stability of the strata which is being penetrated all through the boring operation and until the pile has been concreted.

5.3 Where bentonite suspension is used to maintain the stability of the bore-hole, it is essential that the properties of the material be carefully controlled at stages of mixing, circulating through the bore-hole and immediately before concrete is placed. It is advisable to limit:

- a) The density of bentonite suspension to 1.12 g/cc and maintain it.
- b) The marsh cone viscosity between 30 and 40 seconds.
- c) The pH value should be less than 11.5.
- d) The sand content in the bentonite powder shall be less than 7 percent and silt content should be less than 1 per cent

- e) The liquid limit of bentonite not less than 400 per cent

These aspects shall act as controlling factors for preventing contamination of bentonite slurry by clay and silt. The contractor shall make arrangements for testing these parameters at site.

5.4 The bores shall be washed by bentonite flushing to ensure clean bottom at two stages viz.

- (a) After completion of boring and
- (b) Prior to concreting after placing of reinforcement cage. Flushing of bentonite shall be done continuously with fresh bentonite slurry till the consistency of inflowing and out flowing slurry is similar.

5.5 Tremie of 150mm to 200mm diameter shall be used for concreting.

The Tremie should have uniform and smooth cross section inside, and shall be withdrawn slowly ensuring adequate height of concrete outside the tremie pipe at all stages of withdrawal. Other precautions to be taken while Tremie concreting are:

- a) The sides of the bore-hole have to be stable throughout.
- b) The tremie shall be water tight throughout its length and have a hopper attached at its head by a water tight connection.
- c) The tremie pipe shall be large enough in relation to the size of aggregates. For 20mm aggregate the tremie pipe shall be of diameter not less than 150mm and for larger is required.
- d) The tremie pipe shall always be kept full of concrete and shall penetrate well into the concrete in the bore-hole with adequate margin of safety against accidental withdrawal if the pipe is surged to discharge the concrete.
- e) For very long or large diameter piles, use of retarding plasticiser in concrete is desirable.

5.6 Bore hole has to be perfectly flushed for proper bearing on the surface of rock and ensuring good socketting. By Bailer and Chisel method, cleaning of bore hole will not be proper and slush may remain entrapped. Flushing should be ensured through bentonite rotation through tremie only.

6.0 Mode of measurements for the piles:

6.1 The payable length of the piles shall be taken up to the clear distance from the cut off level (Bottom of capping slab) to the average bottom of the bore. The length so measured shall be rounded off to the nearest first decimal of a metre (0.05 metre or more to be reckoned as 0.10m and below 0.05 metre to be reckoned as 0.00 m) for the purpose of making payment.

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1. Geo-grid shall be of consisting polypropylene polymer ribs of high density, inert to all chemicals present in soils, resistant for UV light, not solvable in aqueous solutions of acids, alkalis & salts and not bio-degradable.
2. Number of layers shall be decided by the Engineer in-charge. Normally 3 layers are adequate for base soil with SBC of 3t/sqm. This is irrespective of the thickness of the sub base layer (blanket) laid below the foundation with geo-grid.
3. Sub base layer shall be 90cm thick if SBC of base soil is 3t/sqm. It may be increased to 120cm if SBC is less than 3t/sqm. Geo-grids may be laid in layers of 30 cm thick.
4. Sub base shall be laid in layers with RDSO quality blanket material duly compacted by rollers or suitable means to get a normal dry density of not less than 95%.
5. Testing facilities exist in IIT/Chennai, IIT/Mumbai, IIT/Delhi, BRTA/Mumbai, BICS/Hyderabad, BTTG/Ahmedabad, CBRI/Roorkee, CIPET/Chennai & other central institutes. They may be preferably used. Other labs if used should have prior approval.

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1. Geo-textile shall be made of multi-filament yarn of appropriate size and woven with adequate strength in Warp and Weft directions. It shall be inert to all chemicals, unsolvable in aqueous acid, alkalis & salt solutions and not be bio-degradable. It shall satisfy industrial standards in all other parameters.
2. Geo-textile shall be laid/ wrapped around the sub-base layer by suitable mechanism so that it effectively binds and holds the sub-base layer. It shall preferably be laid and striched mechanically to develop necessary confining forces.
3. Sub-base layer conditions given for Geo-grid will also apply.
4. Test certificates conditions given for Geo-grid will also apply.
5. Laboratories of Geo-grid will also apply.

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**SPECIFICATION AND GUIDE LINES FOR ERECTION AND LAUNCHING INCLUDING TEMPORARY  
ARRANGEMENTS FOR ROB/RUBs AND WATERWAY BRIDGES.**

1. The machinery includes all field machinery for lifting, transporting, shifting, placing etc. including cranes, jacks, trucks etc. of appropriate/required capacity and numbers including operators, consumables, fuel etc., complete.
- 2). The erection system should consist of atleast 450% capacity of cranes (minimum 3 cranes) and 300% capacity of jacks(minimum 3 jacks.) However, incase of any different scheme proposed by the railway or by the contractor to suit the site condition with the approval of the railway, the request of crane etc., shall be as decided by the Engineer- in- charge. The contractor shall arrange the crane accordingly at his cost with no extra payment and no claim in this regard.
- 3).All operations shall be carried out with proper planning and adequate pre-cautions and preparations without causing any damage at any stage to the system being built etc., other Railway/Government/Private structures, houses, materials etc. available in the vicinity of the work area and for any such damages caused the contractor is solely responsible. The contractor is also responsible for the total safety of the structures and also to scheme of erection and launching including the safety of the staff engaged by him and those belonging to the Railway and other departments and also the public in the area. He shall insure his operations and safety wherever required adequately.
- 4)..The modus operandi, TAD and other requirements of the project will depend on the site conditions and approach conditions etc., and the contractor shall study and arrange the requirements fully and effectively.
- 5.The contractor shall generally follow all the requirements of such erections/ launching and particularly take care of the safety requirements etc., spelt out by the Chief Bridge Engineer of the Railway vide his circular letter No. W.246/VI/6 (Pilot) dt. 08-10-2009. Particular attention of the contractor is invited to the requirements of additional/stand by arrangements provided for the erection and launching in terms of 450% capacity of cranes, 600% capacity of jacks, working in OHE area etc., specified therein and the decision of the Engineer-in-charge is final in this required.
- 6.The actual requirements will vary from case to case. The Railway may or may not provide any scheme or details for erection and launching to the contractor initially and may also change the initially provided scheme if any at any stage etc,. Railway also may or may not accept the scheme provided by the contractor and may direct him to change. The contractor is responsible for understanding the requirements/changes/ enhancements made at any stage and provide for all the requirements at his cost. The main objective in this regard is the timely completion of the project duly keeping the train disturbances to the minimum and ensuring safety of all concerned. While the Railway is welcome to any new reliable and safety scheme made by the contractor, Railway's decision in accepting it or otherwise is final and the contractor should have no claims in this regard.
- 7.Railway may provide if available with the Railway steel and other supporting materials on hire basis as per extent instructions on the Railway and the contractor shall have no claim whatsoever in this regard. Railway does not guarantee availability of materials.

8.The Contractor shall note that the works will have to be done under traffic running conditions both on the same or adjoining tracks, roads and nearby areas. No extra rate is payable for working in such conditions. The contractor shall provide for the above in terms of mobilizing all additional requirements for working in such conditions and provide for the same in the rates quoted by him.

9) Girder launching methodology should be developed well in advance and got approved by CBE Competent authority for works being done on open lines. For construction and MTP works not involving open line, the scheme may be got approved by the Engineer-in -charge . Wherever mandatory, CRS's sanction should be obtained as per extant policy.

10).Modus operandi for execution of the work should be developed in detail and step-by-step operations should be given in the temporary arrangement drawing .

11). It should be ensured that the launching methodology adopted at site is as per approved drawings. In case of any change/modification needed in the approved scheme subsequently or during execution, fresh approval for the modified scheme should be obtained from CBE/concerned Chief Engineer as indicated in para 1 above.

12).The launching of PSC or steel girders over running tracks should be carried out under traffic and power block only unless there is a clear and safe scheme made for doing without blocks. For launching of girders involving Road Over Bridges the road and tracks on either side should be well protected by properly trained and counseled signalmen. No work on or across track should be done without railways authorised supervisor at site.

13).Competent supervisory engineers having adequate experience in girder launching works should be available to supervise the launching of PSC and steel girders. the supervisory official of the contractor should be acceptable and cleared by the engineer-in-charge

14). The erection and launching scheme /producer adopted should be in line with guide lines issued by CBE The necessary provisions of bolt holes required for fixing A frames (normal as well as skew) with the girders and the provisions of holes in diaphragms and bolts on pier cap for securing girders after launching should be marked on drawings and ensured during casting of girders and pier cap.

15).Normally, end diaphragms are not cast on the outer side for both the extreme side girders. To ensure adequate safety and stability during launching end diaphragms should be cast for a minimum width of 300 mm at the bottom on both sides for all 'I' beam girders to provide temporary supports. The top of the diaphragm may be kept flushed with the bottom edge of the top flange.

16). At any stage of erection, if any discrepancy is found in the drawings/Modus Operandi with respect to the site conditions, which can affect the safety during the erection/launching of girders or some new activity of work is required. It should be immediately brought to the notice of the Engineer in-charge by the contractor and the scheme got suitably modified.

17).All the launching, lowering, side slewing the final seating operations should be done under Line block/Power Block and Road Block only. Unless approved by the engineer concerned

18). As far as possible, all PSC/Steel girders should be erected by direct launching method by deploying two heavy duty road cranes, one on each side of the girder. Each crane should have the lifting capacity more than the entire weight of the girder. One spare road crane of equal capacity should also be kept at site in ready condition to cater for any failures of working cranes. The maximum operating radius of the crane (boom angle) should be fixed in advance to ensure adequate safety during entire launching operation.

19). In case of direct launching by cranes, crane operation should be synchronized, coordinated, smooth and jerk free. During lifting, transport, lowering or placing in position, the girder should be secured by manila ropes and trained men to control the swing and jerk during launching.

20). While adopting the method of direct launching of girders by road cranes, detailed requirement of traffic block (including Road block if needed) as per the local site conditions including the time required for lowering and putting back of OHE should be worked out in advance in consultation with Divisional Officers and necessary approval from Headquarters Office obtained.

21). When the lifting/lowering or slewing of the girders is in progress, at least one competent supervisor should be available at each girder end, so that any abnormality can be detected in time and remedial measures undertaken.

22). Before slewing operations, girder traversing line should be paint-marked on temporary supports, so that after every slewing operation, it can be checked whether the slewing is being done in synchronized manner at both ends.

23). The Channel/ Rails on which slewing is being done should be laid throughout the length of slewing to avoid unnecessary lifting of the girders for inserting Channels/ Rails.

24). The hydraulic jacks in schemes prepared with jacks for lifting and slewing, used in lifting/lowering of the girders should invariably have suitable adequate capacity as required for the work and mechanical locking devices provided with. During the lifting and lowering operations, locking device should be simultaneously adjusted along with the lowering and lifting. This will prevent extra movement during any accidental failure of the jacks like bursting of hose, leakage of sealing and nipples etc.

25). Since the hydraulic jacks are prone to bursting of hose, leakage of sealing and nipples etc., the capacity of each jack should be adequate. Apart from easing the lifting/ lowering operations, this will help in reducing the cases of bursting of hose, leakage of sealing etc., due to lower operating pressure.

The Jacks should be calibrated/ tested by approved laboratory before they are deployed on the site for launching of PSC/Steel girders. Sufficient spare jacks of equal capacity should be ensured at site.

26). The modus operandi, which includes various stages of sequential operations as approved in the temporary staging arrangement drawings, should be studied and well understood by all the supervisory staff in advance.

27).In case of end launching method, all launching operations including longitudinal traversing of the girder on the running lines, side slewing and lowering in position should be done under line and power block.

28).Temporary crib support staging shall be interlaced with clamps and angles. Adequate base width shall be maintained in proportion to the height of stage, which is very essential for avoiding the oblong effect during launching of girders.

29).During the longitudinal traversing, the movement of the PSC/Steel girders shall be controlled both front and rear with winch mechanism having simultaneous operation, so that the speed of the launching is always under control.

30).The girder should never be left on the support of hydraulic jacks only. During the lifting/lowering operations, the girder should also be simultaneously provided adequate hard wood packing. Every 50mm of the lifting/lowering should simultaneously be followed by hard wood packing so that even if the

31)jack fails, wooden packing will take the load and further stability of the girder will not be endangered. Adequate hard wood packing in variable depth should be available on each support point.

32).Lowering of girder shall always be carried out at one end only. Further, the other end should be adequately secured by wire ropes, end brackets, etc. Thereafter, the lowering on the other side shall be continued.

33). Large size supporting arrangements like CC cribs should be avoided during raising/ lowering.

34).Suitable guiding arrangement should be provided at the base to restrict the movement of girder in the slewing direction. The side slewing operation should be done slowly but steadily to avoid any possible jerks and tilt of the girder. Both ends of the girders should be slewed simultaneously to avoid mis - orientation of the girder.

35).After supporting the first girder on bearings, it should be tied firmly to the top of the trestle beam on both sides by suitable arrangement similar to what is shown in the sketch. Hard wood packing between trestle top and diaphragm should also be ensured. After the launching of second and subsequent girders, all the girders should be tied together by suitable bracings.

36).During launching of PSC /Steel girders and subsequent adjustments for placing of bearings, special attentions and precautions are required to be followed rigorously at site without resorting to short cut methods or leaving the work at site to untrained or inexperienced engineers.

37)General safety precautions as applicable for Bridges/ civil works on open lines should be adopted at site.

38).At all times non-infringement to moving trains on adjacent lines should be ensured. Road vehicles, Material trolleys, Dollies with tendency to roll off towards the running lines are to be checked and ensured by providing chains, locking arrangements, blocks etc.

39) Personal safety gears like reflective vest, helmet, leather shoes, gloves, eye-wear approved as per Construction Industry standards should be provided by the contractor to all construction workers at site. For persons working at pier top/ Girder level, temporary supports and hand railing and necessary protection with the help of ropes, slings, temporary railings etc., shall be provided.

40). If the steel girder launcher is used for launching of PSC/Steel girders, it should be pre-tested for the critical loading on the approaches (likely to be encountered during actual launching) before deployment regarding its strength as well as amount of permissible deflection using actual test PSC/Steel girder as a testing load. Connections at supports shall be inspected and certified. Prior to actual launching, it shall be adequately secured to the base support system on the pier cap.

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## **SPECIFICATIONS AND GUIDELINES FOR ERECTION AND LAUNCHING INCLUDING TEMPORARY ARRANGEMENTS.**

Detailed notes :- for description as follows :

1. Rate is for one complete span consisting of as many I or other type girders as per approved design of the bridge including erection and launching of all additional and supporting items making up the span. This also includes items like diaphragms, bracings etc., which are to be launched/ cast to make the complete span. Rate also includes all site preparation for erection, shifting and launching complete. Rate also includes the supplements required for jacking/lifting like 'A' Frames, slings, support beams etc. as approved drawings. Rate also includes providing and using of temporary girders/ launching girders including their mobilization at site with all connected works complete. Temporary girder, launching girders, steel cribs etc., if required for the work and if available with Railway, will be provided to the contractor at the Railway's depots on the request of the contractor and the cost of the same at hire or other rates fixed by the Railway shall be payable by the contractor.

2. The machinery includes all field machinery for lifting, transporting, shifting, placing etc. including cranes, jacks, trucks etc. of appropriate/required capacity and numbers including operators, consumables, fuel etc., complete.

3). The erection system should consist of atleast 450% capacity of cranes (minimum 3 cranes) and 300% capacity of jacks (minimum 3 jacks), However, incase of any different scheme proposed by the railway or by the contractor to suit the site condition with the approval of the railway, the request of crane etc., shall be as decided by the Engineer- in- charge. The contractor shall arrange the crane accordingly at his cost with no extra payment and no claim in this regard.

4. All operations shall be carried out with proper planning and adequate pre-cautions and preparations without causing any damage at any stage to the system being built etc., other Railway/Government/Private structures, houses, materials etc. available in the vicinity of the work area and for any such damages caused the contractor is solely responsible. The contractor is also responsible for the total safety of the structures and also to scheme of erection and launching including the safety of the staff engaged by him and those belonging to the Railway and other departments and also the public in the area. He shall insure his operations and safety wherever required adequately.

5. The modus operandi, TAD and other requirements of the project will depend on the site conditions and approach conditions etc., and the contractor shall study and arrange the requirements fully and effectively.

6. The contractor shall generally follow all the requirements of such erections/ launching and particularly take care of the safety requirements etc., spelt out by the Chief Bridge Engineer of the Railway vide his circular letter No. W.246/VI/6 (Pilot) dt. 08-10-2009. Particular attention of the contractor is invited to the requirements of additional/stand by arrangements provided for the erection and launching in terms of 450% capacity of cranes, 600% capacity of jacks, working in OHE area etc., specified therein and the decision of the Engineer-in-charge is final in this required.

7.The actual requirements will vary from case to case. The Railway may or may not provide any scheme or details for erection and launching to the contractor initially and may also change the initially provided scheme if any at any stage etc,. Railway also may or may not accept the scheme provided by the contractor and may direct him to change. The contractor is responsible for understanding the requirements/changes/ enhancements made at any stage and provide for all the requirements at his cost. The main objective in this regard is the timely completion of the project duly keeping the train disturbances to the minimum and ensuring safety of all concerned. While the Railway is welcome to any new reliable and safety scheme made by the contractor, Railway's decision in accepting it or otherwise is final and the contractor should have no claims in this regard.

8.Railway may provide if available with the Railway steel and other supporting materials on hire basis as per extent instructions on the Railway and the contractor shall have no claim whatsoever in this regard. Railway does not guarantee availability of materials.

9.The Contractor shall note that the works will have to be done under traffic running conditions both on the same or adjoining tracks, roads and nearby areas. No extra rate is payable for working in such conditions. The contractor shall provide for the above in terms of mobilizing all additional requirements for working in such conditions and provide for the same in the rates quoted by him.

**Specifications and Guide lines as follows.**

1. Girder launching methodology should be developed well in advance and got approved by CBE for works being done on open lines. For construction and MTP works not involving open line, the scheme may be got approved by the concerned Chief Engineer. Wherever mandatory, CRS's sanction should be obtained as per extant policy.
2. Modus operandi for execution of the work should be developed in detail and step-by-step operations should be given in the temporary arrangement drawing .
3. It should be ensured that the launching methodology adopted at site is as per approved drawings. In case of any change/modification needed in the approved scheme subsequently or during execution, fresh approval for the modified scheme should be obtained from CBE/concerned Chief Engineer as indicated in para 1 above.
4. The launching of PSC or steel girders over running tracks should be carried out under traffic and power block only unless there is a clear and safe scheme made for doing without blocks. For launching of girders involving Road Over Bridges the road on either side should be well protected by properly trained and counseled signalmen.
5. Competent Supervisory Engineers having adequate experience in girder launching works should only be posted to supervise the launching of PSC and steel girders.

**Design Aspects.**

6. The necessary provisions of bolt holes required for fixing A frames (normal as well as skew) with the girders and the provisions of holes in diaphragms and bolts on pier cap for securing girders after launching should be marked on drawings and ensured during casting of girders and pier cap.

7. Normally, end diaphragms are not cast on the outer side for both the extreme side girders. To ensure adequate safety and stability during launching end diaphragms should be cast for a minimum width of 300 mm at the bottom on both sides for all 'I' beam girders to provide temporary supports. The top of the diaphragm may be kept flushed with the bottom edge of the top flange.

8. At any stage of erection, if any discrepancy is found in the drawings/Modus Operandi with respect to the site conditions, which can affect the safety during the erection/launching of girders or some new activity of work is required. It should be immediately brought to the notice of the Engineer in-charge by the contractor and the scheme got suitably modified.

**During launching of PSC /Steel Girders:**

9. All the launching, lowering, side slewing the final seating operations should be done under Line block/Power Block and Road Block only.

10. As far as possible, all PSC/Steel girders should be erected by direct launching method by deploying two heavy duty road cranes, one on each side of the girder. Each crane should have the lifting capacity more than the entire weight of the girder. One spare road crane of equal capacity should also be kept at site in ready condition to cater for any failures of working cranes. The maximum operating radius of the crane (boom angle) should be fixed in advance to ensure adequate safety during entire launching operation. However, alternative methods can also be approved on case to case basis.

11. In case of direct launching by cranes, crane operation should be synchronized, coordinated, smooth and jerk free. During lifting, transport, lowering or placing in position, the girder should be secured by manila ropes and trained men to control the swing and jerk during launching.

12. While adopting the method of direct launching of girders by road cranes, detailed requirement of traffic block (including Road block if needed) as per the local site conditions including the time required for lowering and putting back of OHE should be worked out in advance in consultation with Divisional Officers and necessary approval from Headquarters Office obtained.

13. When the lifting/lowering or slewing of the girders is in progress, at least one competent supervisor should be available at each girder end, so that any abnormality can be detected in time and remedial measures undertaken.

14. Before slewing operations, girder traversing line should be paint-marked on temporary supports, so that after every slewing operation, it can be checked whether the slewing is being done in synchronized manner at both ends.

15. The Channel/ Rails on which slewing is being done should be laid throughout the length of slewing to avoid unnecessary lifting of the girders for inserting Channels/ Rails.

16. The hydraulic jacks used in lifting/lowering of the girders should invariably have suitable mechanical locking device. During the lifting and lowering operations, locking device should be simultaneously adjusted along with the lowering and lifting. This will prevent extra movement during any accidental failure of the jacks like bursting of hose, leakage of sealings and nipples etc.

17. Since the hydraulic jacks are prone to bursting of hose, leakage of sealings and nipples etc., the capacity of each jack should be at least minimum twice the weight of the girder to be shared by each jack. Apart from easing the lifting/ lowering operations, this will help in reducing the cases of bursting of hose, leakage of sealings etc., due to lower operating pressure.
18. The Jacks should be calibrated/ tested by approved laboratory before they are deployed on the site for launching of PSC/Steel girders. Sufficient spare jacks of equal capacity should be ensured at site.
19. The modus operandi, which includes various stages of sequential operations as approved in the Temporary staging arrangement drawings, should be studied and well understood by all the supervisory staff in advance.
20. In case of end launching method, all launching operations including longitudinal traversing of the girder on the running lines, side slewing and lowering in position should be done under line and Power block. Suitable 'A' frames similar to that shown in Sketch No. CBE/SK/576/2009, Sheet -1 should be rigidly fixed and properly secured to the girders before mounting them on dip lorry for longitudinal traversing.
21. Temporary crib support staging shall be interlaced with clamps and angles. Adequate base width shall be maintained in proportion to the height of stage, which is very essential for avoiding the oblong effect during launching of girders.
22. During the longitudinal traversing, the movement of the PSC/Steel girders shall be controlled both front and rear with winch mechanism having simultaneous operation, so that the speed of the launching is always under control.
23. The girder should never be left on the support of hydraulic jacks only. During the lifting/lowering operations, the girder should also be simultaneously provided adequate hard wood packing. Every 50mm of the lifting/lowering should simultaneously be followed by hard wood packing so that even if the jack fails, wooden packing will take the load and further stability of the girder will not be endangered. Adequate hard wood packing in variable depth should be available on each support point.
24. Lowering of girder shall always be carried out at one end only. Further, the other end should be adequately secured by wire ropes, end brackets, etc. Thereafter, the lowering on the other side shall be continued.
25. Large size supporting arrangements like CC cribs should be avoided during raising/ lowering.
26. After longitudinal traversing and lowering of the girder, the transverse 'A' frame may be removed. Before side slewing the 'I' girders (either in square or in skew spans), suitable 'A' frame similar to that shown in sketch No. CBE/SK/576/2009, sheet - 2 oriented in the direction of side slewing should be rigidly fixed and properly secured with the girder on both ends at the support points of the slewing arrangement. The 'A' frames should be oriented in the skew direction and should be supported on the entire length of bottom member to provide more lateral stability during the side slewing of the girder.

27. Suitable guiding arrangement should be provided at the base to restrict the movement of girder in the slewing direction. The side slewing operation should be done slowly but steadily to avoid any possible jerks and tilt of the girder. Both ends of the girders should be slewed simultaneously to avoid mis - orientation of the girder.
28. After supporting the first girder on bearings, it should be tied firmly to the top of the trestle beam on both sides by suitable arrangement similar to what is shown in the sketch. Hard wood packing between trestle top and diaphragm should also be ensured. After the launching of second and subsequent girders, all the girders should be tied together by suitable bracings similar to what is shown in the sketch (refer Sketch No. CBE/SK/576/2009, sheet - 3).
29. During launching of PSC /Steel girders and subsequent adjustments for placing of bearings, special attentions and precautions are required to be followed rigorously at site without resorting to short cut methods or leaving the work at site to untrained or inexperienced engineers.
30. General safety precautions as applicable for Bridges/ civil works on open lines should be adopted at site.
31. At all times non-infringement to moving trains on adjacent lines should be ensured. Road vehicles, Material trolleys, Dollies with tendency to roll off towards the running lines are to be checked and ensured by providing chains, locking arrangements, blocks etc.
32. Personal safety gears like reflective vest, helmet, leather shoes, gloves, eye-wear approved as per Construction Industry standards should be provided by the contractor to all construction workers at site. For persons working at pier top/ Girder level, temporary supports and hand railing and necessary protection with the help of ropes, slings, temporary railings etc., shall be provided.
33. If the steel girder launcher is used for launching of PSC/Steel girders, it should be pre-tested for the critical loading on the approaches (likely to be encountered during actual launching) before deployment regarding its strength as well as amount of permissible deflection using actual test PSC/Steel girder as a testing load. Connections at supports shall be inspected and certified. Prior to actual launching, it shall be adequately secured to the base support system on the pier cap.

## **GUIDELINES ON FABRICATION OF STEEL STRUCTURE**

### **1.0 Introduction:**

Composite Girder/ Foot over bridges over the Indian Railways are used by pedestrian traffic to cross the Railway track safely.

### **1.1 Specification for steel:**

(i). Steel conforming to IS: 2062-2011 Grade E-250 quality 'BR' steel for fabrication of girders except in hilly areas shall be used.

(ii). The rolling and cutting tolerances shall be in accordance with IS: 1852.

### **1.2 Flattening and straightening of steel:**

IRS BI - 2001 (Fabrication Specification) Para 15 stipulates as under:

"15.1 All steel materials plates and structural shall have straight edges, flat surfaces and be free from twist. If necessary, they shall be cold straightened or flattened by pressure before being worked or assembled unless they required to be curvilinear form. Pressure applied for straightening or flattening shall be such as it would not injure the material and adjacent surfaces or edges shall be in close contact or at uniform distance throughout"

15.2 Flattening and straightening under hot condition shall not be carried out unless authorized and approved by the Inspecting Officer"

### **1.3 Cutting of steel:**

IRS BI - 2001 (Fabrication Specification) Para 17 stipulates as under:

"17.1 Flame cutting by mechanically controlled torch/ torches shall be accepted, provided the edge as given by the torch is reasonably clean and straight, plates may be cut to shape and beams and other sections cut to length with a gas cutting torch, preferably oxyacetylene gas should be used".

17.2 All flame cut edges shall be ground to obtain reasonably clean square and true edges. Draglines produced by flame cut should be removed"

### **1.4 Approval of Quality Assurance Plan (QAP)**

Stage wise manufacturing process from raw material indicating various steps., test checks and their frequency, sampling plan, authority for grant of clearance.. stage like templating and lay out of foot over bridge. Fixture/jig manufacturing, drilling of component/ welding of component, initial assembly, final finishing, final inspection, surface preparation and painting etc. are clearly shown and signed by manufacturer, indenting Railway authority and approved by competent authority.

### **1.5 Layout:**

(i). The layout of structure on template floor is the most important operation in fabrication. It is essential that the template floor is perfectly level with adequate lighting arrangement. Steel flooring

is desirable, as it would also minimize variation in dimensions due to temperature changes. The marking tools and instruments like square divider, punches, steel scribe should be of good quality.

(ii). Calibrated tape for measurement of lay out must be used.

#### 1.6 Jigs and fixtures:

Jig is the device used in the mass production to locate the job and guide the tool for drilling etc., while a fixture is a simple a device for holding the work in true shape during processing.

The use of steel templates, jigs and fixtures is preferable to help in achieving economy, increasing production, reducing man power, reducing human errors, increasing accuracy and eliminating special match marking.

#### 1.7 Drilling of Holes:

Quality of fabrication shall be improved if jigs are used during fabrication Drilling of the component may be done through jigs. All burrs left by the drill and sharp edges of the holes shall be removed.

#### 1.8 Welding Process and Positions:

(i). Welding shall be carried out in accordance with the approved welding procedure, specifications by approved welders, processes and positions. Proforma for welding procedure specification and welding procedure qualification records are enclosed as Annexure - I and II.

(ii). All welding be preferably done in flat position (horizontal) welding should be done as per drawing ensuring proper size of weld. Over size welding may lead to excessive heat affected zone which may lead to failure of material. Welding should be carried out in a warm and dry place so that the rain water or other atmospheric elements may not come in contact while welding is in progress.

(iii). Electrodes shall conform to Class A2 of IRSM-28 and wire for CO2 welding shall conform to Class 1 of IRSM - 46.

(iv). All consumable shall be stored and handled with care and in accordance with the manufacturer's recommendations.

#### 1.9 Riveting:

(i). Before riveting is commenced, the permanent surface of components shall be painted with two coats of red oxide zinc chrome priming to IS 2074.

(ii). IRS BI - 2001 (Fabrication Specification) Para 23 stipulates as under:

"23.1 The dimension on the drawings referred to the diameters of the rivet holes and their finished rivets. The rivet holes shall be 1.5mm greater than the diameter of the rivet bars used. The rivet shall be made to IS: 1929. The shanks of the un driven rivets shall be made of a length sufficient to fill the holes thoroughly and form the head. The clearance i.e. the difference in diameter between the rivets measured under head before being heated and the rivet hole shall not be less than 0.75mm. Before riveting is commenced, all works shall be properly bolted so that, the section riveted are in close

contact throughout. Rivet Shall completely fill the holes and shall be machine driven by means of pressure or percussion riveters of approved design".

23.2 All rivets shall be properly heated to straw heat for the full length of the shank, firmly backed and closed. The head of the rivet, particularly in long rivets, shall be heated more than the point to be heated., more than the head. Sparking or burnt rivets shall not be used, whereas, it is impossible to back up by normal method of holding up 'double gunning' may be resorted to. Alternatively pneumatic holding device may be used.

23.3 Gauges for rivet dimensions and contours shall be provided by contractor for the use of Inspecting Officer.

23.4 Rivets when driven shall completely fill the holes, have the heads concentric with the shanks and shall be in full contact with the surface. Driven rivets when struck sharply of the head with the 110 gm rivet testing hammer, shall be free from movement or vibration.

23.6 All loose and burnt rivets and rivets with cracks badly formed eccentric or deficient heads shall be cut out and replaced. Permissible deviation of driven rivets shall be as per Annexure - III. Rivets shall also be cut out when required for the examination of the work. Actual method of cutting out shall be approved by the Engineer. Recouping and caulking shall in no circumstances be resorted to.

23.8 All field rivets shall be tested.

(iii). All defective rivets and loose rivets shall be marked on their heads with paint and promptly replaced. Rivets in any components should be tested 100% in shop by responsible supervision and maintain the record of the same.

#### 1.10 Final cutting and finishing of component:

Final finishing of length, profile and notches etc. is accomplished by accurate marking with the help of templates, measurement and gauge wherever necessitates and then by gas cutting (Chipping grinding) as the case may be. Excessive metal is normally chipped off or gas cut (more than 3mm) and the exact finishing or profiling is achieved by fine and accurate grinding.

#### 1.11 Inspection Stages:

- (a) Before fabrication
- (b) During fabrication
- (c) After fabrication

(a). Before fabrication:

Quality Assurance Plan shall be prepared and got approved.

Raw material such as channels and plates etc. to be inspected as per specification mentioned against each item and rolling Mark Certificates.

Lamination, piping, pitting, rolling defects and Straightness of material to be checked before fabrication.

Consumables such as rivets, welding electrodes and paints etc. are as per standard specification.

Welding procedure specifications need to be approved.

Welders approval as per Welding procedure specification.

(b). During fabrication:

Layout, jigs, fixtures and profile to be checked.

Welding by qualified welders as per approved WPSS.

Welding parameters are to be set & checked during welding.

Riveting by qualified and skilled personnel with approved work instructions.

©. After fabrication:

Verify rolling mark number of steel sections used for fabrication from certificate issued by manufacturer. Check the register maintained by him.

Surface defects shall be checked visually.

Quality of welds with respect to specified sizes, length and any visual defects.

Quality of rivets to be checked visually and with the help of riveting hammer.

Dye penetration test for welds.

Leading dimensions i.e overall length, hole dimensions, end finishing etc. shall be checked. For this purpose detail measurement sheet shall be prepared for.

#### 1.12 Connection details:

Some of the connection details commonly used in fabrication of FOB has been shown as Annexure - IV.

#### BALLAST

a). The ballast shall be collected alongside the alignment or in the station yards or at places as directed and stacked within Railway limits for measurements in convenient stacks, clear of infringements to running lines and without affecting the movement of Road vehicles for the conveyance of P.Way materials and other purposes as directed by the Engineer-in- Charge.

b). In the event of sufficient space for stacking the full supply of ballast is not available, the Contractor shall after supplying the ballast at all other locations, request for suitable extension of

time of completion, which will be considered by Railway by merit of the case. No extra rate shall however be granted on this account nor any claims for compensation etc. shall be entertained.

c). The Tenderer/Contractor at the time of tendering shall submit the Test reports of Impact value, Abrasion value and water absorption value from reputed engineering college / laboratory/ test homes.

d). Railway reserves the right to do any number of testing of the ballast of any of the tenderers before finalisation of tender at Railway's cost.

e). The rate quoted by the Tenderer shall be for supply of ballast conforming to the specifications of Track Ballast in respect of quality. The tolerances in respect of sizes, gradation and dust contents, etc. shall be as per the specifications attached.

f). The Stone ballast shall also conform to the specification for Track ballast is enclosed. To this extent Southern Railway specification shall be deemed to have been superseded.

g). The stone ballast required for the work shall be collected from outside railway limits and the Contractor shall pay all the seignorage and other incidental charges that may be involved.

h). Ballast shall be stacked sufficiently clear of the tracks without any possibility of infringing the minimum fixed structure dimensions, and shall not be stacked over signal wires, cables, or other gear of any such items to avoid interference to the existing running lines.

i). No Ballast samples are required to be submitted along with the Tender.

j). The Test reports of the Ballast for the Abrasion value, Impact value, Water absorption etc., from any Approved laboratory / Institution are to be enclosed along with the Tender.

k). The Tenderers, along with their offer should furnish an undertaking that the Ballast supply at all times will conform to specifications for track Ballast as specified by the Railways.

l). Payments shall be made for the gross measurements of stacks. No deduction will be made for voids.

(m) (i) The testing of ballast should be got done in Railway's laboratories wherever possible and when testing at other labs, the procedure /process for testing be advised in advance and if possible a representative of the railway should also be available at the time of testing.

(ii). The initial supply of 100 cum, tests are to be carried out in the Quality Control lab of Railways and further supply shall be accepted only if these results satisfy the specifications for track ballast. In the case the results are satisfactory further tests to be conducted as per the laid down frequency in any of the Railway approved colleges/laboratories and minimum every 3rd sample should be tested in Railway Laboratory to ensure quality. In case of difference in the test results between any two approved laboratories, the test results obtained at Railway testing laboratory shall only be considered for deciding the quality of ballast. If the railway tested sample fails, then the ballast already collected in the previous three tests shall be paid at 75% of the accepted rates and the

ballast pertaining to the failed sample shall be rejected. In addition to the above, Railway reserves the right to impose penalty against the contractor for such failures. Further the Railway reserves the right to review/delete the approval of the laboratories concerned.

(n). LIST OF APPROVED LABORATORIES

List of approved Laboratories:

01). Materials Testing Laboratory, Headquarters Office, Southern Railway, Chennai.

02). Soil Testing Lab , Construction, Southern Railway, Chennai- 8

03)..National Institute of Technology, Tiruchirappalli-15.

04). Indian Institute of Technology, Adyar (IIT)

05). Anna University, Guindy (AU).

06) Regional Testing Laboratory, Taramani (RTL)

07).Structural Engg. Research Center, Taramani (SERC)

(o) (1) The Tenderers has to submit INDEMNITY BOND in NON- JUDICIAL STAMP PAPER of Rs 100 / as given in the Annexure along with the tender document.

(2) For the supply of ballast , Contractor has to ensure the payment of Royalty / seignorage charges to the state government for all running bills

### INDEMNITY BOND

THIS INDEMNITY BOND executed at (Name of place).....on this the ..... day of ..... by ..... son of Sri..... aged ..... years and carrying on business at ..... (Address)

TO AND IN FAVOUR OF The President of the Union of India, represented by the (PCE/DRM/W/ CAO..... as the case may be) of Southern Railway, is as follows:

1. WHEREAS I/WE have entered into an agreement with the President of the Union of India, represented by the ..... Southern Railway on ..... bearing agreement number ..... for supply of stone ballast
2. WHEREAS seignorage/royalty charges are to be paid to the Government of Tamil Nadu KERALA/KARNADAKA/PONDICHERY for utilization of mines and minerals, which includes the stone ballast supplied by me/us, by virtue of the provisions as contained in the Mines and Minerals Act 1952
3. AND WHEREAS under the terms of the contract entered into by me/us with the Railway Administration, more particularly clause number ..... I am/we are liable to pay the seignorage/royalty charges to the Government of Tamil Nadu/ KERALA/KARNADAKA/PONDICHERY
4. I/We ..... do hereby indemnify the Railways against any claims made against the Railways or loss sustained by the Railways on account of non payment/deficit payment of seignorage/royalty charges to the Government of Tamil Nadu/ KERALA/KARNADAKA/PONDICHERY under the provisions of the Mines and Minerals Act 1952 and all subsequent amendments thereto, in relation to the stone ballast supplied under the agreement bearing number ..... dated.....
5. I/We further state that in the event of the Railways affecting payment in furtherance to a demand made by the Government of Tamil Nadu / KERALA/ KARNADAKA/ PONDICHERY of any sum due towards seignorage/royalty charges or any incidental charges, penalty, interest, damages or any other sum to the Government of Tamil Nadu/ KERALA/KARNADAKA/PONDICHERY, I/We shall reimburse the amount so paid by the Railways together with interest, as provided in the contract.

IN WITNESS WHEREOF I/WE ..... HAVE SET MY HAND AND SEAL ON THE DAY, MONTH AND YEAR FIRST ABOVE WRITTEN

IN THE PRESENCE OF

WITNESSES

1.....

2.....

EXECUTANT

(To be typed in Rs . 100/ - Non- Judicial stamp paper)



भारत सरकार  
रेल मंत्रालय

GOVERNMENT OF INDIA  
MINISTRY OF RAILWAYS

# रेलपथ गिट्टी की विशिष्टियां SPECIFICATIONS FOR TRACK BALLAST

आई आर एस-जीई-1

जून 2016

(दिनांक 06-06-2016 के क्रमांक 4 तक के समस्त शुद्धि पत्र समाहित)

**IRS-GE-1**

**JUNE 2016**

(Embodying all correction slips upto number 4 dated 06-06-2016)

भू-तकनीकी अभियांत्रिकी निदेशालय  
अनुसंधान अभिकल्प और मानक संगठन  
लखनऊ-226011

Geo-Technical Engineering Directorate  
Research Designs & Standards Organisation  
Lucknow-226011

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## SPECIFICATION FOR TRACK BALLAST

1. **SCOPE:** These specifications will be applicable for stone ballast to be used for all types of sleepers on normal track, turnouts, tunnels and deck slabs etc on all routes.

2. **DETAILED SPECIFICATIONS:**

- 2.1 **GENERAL**

- 2.1.1 **Basic Quality:** Ballast should be hard durable and as far as possible angular along edges/corners, free from weathered portions of parent rock, organic impurities and inorganic residues.
- 2.1.2 **Particle shape:** Ballast should be cubical in shape as far as possible. Individual pieces should not be flaky and should have generally flat faces with not more than two rounded/ sub rounded faces.
- 2.1.3 **Mode of manufacture:** Ballast for all BG main lines and running lines, except on 'E' routes but including 'E' special routes, shall be machine crushed. For other BG lines and MG/NG routes planned/sanctioned for conversion, the ballast shall preferably be machine crushed. Hand broken ballast can be used in exceptional cases with prior approval of Chief Track Engineer/CAO/C. Such approval shall be obtained prior to invitation of tenders.

On other MG and NG routes not planned/sanctioned for conversion hand broken ballast can be used for which no approval shall be required.

- 2.2 **PHYSICAL PROPERTIES**

- 2.2.1 Ballast sample should satisfy the following physical properties in accordance with IS: 2386 Pt.IV-1963 when tested as per the procedure given in Annexure- I & II.

	BG, MG & NG (planned/sanctioned for conversion)	NG & MG (other than those planned for conversion)
<b>Aggregate Abrasion Value</b>	30% Max.*	35% Max.
<b>Aggregate Impact Value</b>	20% Max.*	30% Max.

- \* In exceptional cases, on technical and/or economic grounds relaxable upto 35% and 25% respectively by CTE in open line and CAO/C for construction projects. The relaxation in Abrasion and Impact values shall be given prior to invitation of tender and should be incorporated in the Tender document.

2.2.2 To carry out Impact Test on ballast, a test sample of ballast pieces (about 5 kg in weight) of size 10 mm to 12.5 mm will be required. Appropriate care should be taken by the railways that ballast selected for breaking down to 10 mm to 12.5 mm size for Impact Test should be random from the ballast supply to avoid any subjectivity in selection of test sample. Alternatively, the test sample in the recommended range of size be got manufactured along with the ballast in sufficient quantity required for this test.

2.2.3 The 'Water Absorption' tested as per IS 2386 Pt.III-1963 following the procedure given in Annexure III should not be more than 1%. This test, however, *is to be prescribed at the discretion of CE/CTE in open line and CAO/Con. for construction projects.*

2.2.3.1 The power of relaxing for water absorption limit should be delegated to CTE in open line/CAO on construction for specified areas. However, maximum water absorption in any case should not be allowed more than 2.5%.

## 2.3 SIZE AND GRADATION

2.3.1 Ballast should satisfy the following size and gradation:

- |    |                                  |            |
|----|----------------------------------|------------|
| a) | Retained on 65mm Sq. mesh sieve  | 5% Maximum |
| b) | Retained on 40mm Sq. mesh sieve* | 40%-60%    |
| c) | Retained on 20mm Sq. mesh sieve  | ***        |

\*\*\* Not less than 98% for machine crushed ballast  
Not less than 95% for hand broken ballast

\* For machine crushed ballast only.

2.3.1.1 In exceptional cases, where it is considered necessary on technical considerations, to reduce the maximum size of ballast for NG lines, CTE may modify the size & gradation of the ballast as defined above. In case of such modifications, provision given in Para 2.3.2 to 2.3.4 below shall also be suitably modified. This will be finalized before invitation of tenders and should be incorporated in the tender documents.

### 2.3.2 Oversize Ballast

- i) Retention on 65mm square mesh sieve.

A maximum of 5% ballast retained on 65mm sieve shall be allowed without deduction in payment.

In case ballast retained on 65mm sieve exceeds 5% but does not exceed 10%, payment at 5% reduction in contracted rate shall be made for the full stack. Stacks having more than 10% retention of ballast on 65mm sieve shall be rejected.

- ii) In case ballast retained on 40mm square mesh sieve ( for machine crushed ballast only) exceeds 60% limit prescribed in 2.3.1 (b) above, payment at the following reduced rates shall be made for the full stack in addition to the reduction worked out at i) above.

- 5% reduction in contracted rates if retention on 40mm square mesh sieve is between 60% (excluding) and 65% (including).
- 10% reduction in contracted rates if retention on 40mm square mesh sieve is between 65% (excluding) and 70% (including).

- iii) In case retention on 40mm square mesh sieve exceeds 70%, the stack shall be rejected.

- iv) In case of hand broken ballast supply, 40mm sieve analysis may not be carried out. The executive may however ensure that the ballast is well graded between 65mm and 20mm size.

### 2.3.3 Under Size Ballast

The Ballast shall be treated as undersize and shall be rejected if-

- i) Retention on 40mm Sq. Mesh sieve is less than 40%.
- ii) Retention on 20mm square mesh sieve is less than 98% (for machine crushed) or 95% (for hand broken).

### **2.3.4 Sieve Analysis of Ballast**

- 2.3.4.1 The test sieves used for sieve analysis shall conform to the specifications given in Annexure-IV.
- 2.3.4.2 While carrying out sieve analysis, the screen shall not be kept inclined, but held horizontally and shaken vigorously. The pieces of ballast retained on the screen can be turned with hand to see if they pass through but should not be pushed through the sieve.
- 2.3.4.3 The percentage passing through or retained on the sieve shall be determined by weight. The weighing equipment used shall NOT have least count more than 100 grams.

## **3. CONDITIONS FOR SUBMISSION OF TENDER**

- 3.1 Each tenderer at the time of tendering shall submit the test report of Impact Value. Abrasion Value, Water Absorption Value from approved laboratories and the list of these laboratories shall be mentioned in the tender documents.
- 3.2 The tenderer shall also furnish an undertaking as incorporated in the tender document that the ballast supply at all times will conform to Specifications for Track Ballast as specified by Railway.

## **4. METHOD OF MEASUREMENT**

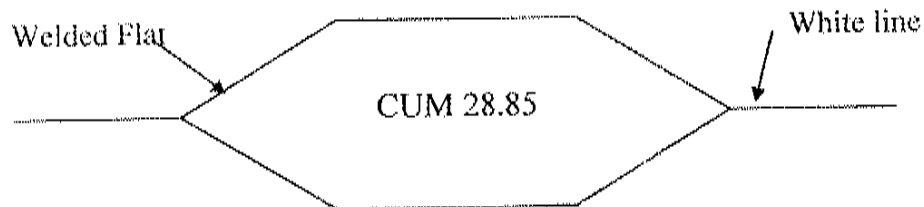
### **4.1 Stack Measurement**

Stacking shall be done on a neat, plain and firm ground with good drainage. The height of stack shall not be less than 1m except in hilly areas where it may be 0.5m. The height shall not be more than 2.0m. Top width of stack shall not be less than 1.0m. Top of stack shall be kept parallel to the ground plane. The side slopes of stack should not be flatter than 1.5:1 (Horizontal : Vertical). Cubical content of each stack shall normally be not less than 30 cum in plain areas and 15 cum in hilly areas.

### **4.2 Wagon Measurement**

- 4.2.1 In case of ballast supply taken by direct loading into wagons, a continuous white line should be painted inside the wagon to indicate the level to which the ballast should be loaded. The cubical content in cubic meter corresponding to white line should also be painted on both sides outside the wagon.

- 4.2.2 In addition to painted line, mentioned in para 4.2.1, short pieces of flats (cut pieces of tie bars or otherwise) with cubical contents punched shall be welded at the centre of all the four sides as permanent reference. In case the supply is taken in general service wagon, actual measurements will be taken.



### 4.3 Shrinkage Allowance

Payment shall be made for the gross measurements either in stacks or in wagons without any deduction for shrinkage/voids. However, when ballast supply is made in wagons, shrinkage upto 8% shall be permitted at destination while verifying the booked quantities by the consignee.

## 5. SAMPLING AND TESTING

### 5.1 General

- 5.1.1 The samples shall be drawn with due diligence and adequate precaution so that they represent the true nature and condition of the ballast.
- 5.1.2 Being a heterogeneous material, the gradation of ballast loaded in wagons and/or dumped/inserted in the track may not remain same as that initially checked in stacks, due to lifting, loading, transportation, unloading etc. Similarly in case of direct loading into wagons, the gradation of ballast at destination may not remain same as that at source, due to loading, transportation etc. Therefore, the samples from wagons and track are not representative samples as far as gradation is concerned. Even in the same stack, results of two checks may not be same.
- 5.1.3 The samples from a stack taken after lapse of a long period of stacking are not representative samples of the ballast initially supplied in the

stack, due to settling down of smaller size particles in voids underneath, dirt/dust getting accumulated in the stack, rains etc.

## 5.2 Sampling Frequency

In order to ensure supply of uniform quality of ballast, the following norms shall be followed in respect of sampling, testing and acceptance:

5.2.1 On supply of the first 100 cum, the tests for Size & Gradation, Abrasion Value, Impact Value and Water Absorption (if prescribed) shall be carried out by Railway. Further supply shall be accepted only after this ballast satisfies the specifications for these tests. Railway reserves the right to terminate the contract as per GCC at this stage itself in case the ballast supply fails to conform to any of these specifications.

5.2.2 Subsequent test shall be carried out as follows:

Type of Tests	Supply in Stacks	Supply in Wagons
(a) Size and Gradation Tests	One for each 100 cum or part thereof in any stack	One for each 100 cum or part thereof for quantity to be loaded in wagons
(b) Abrasion Value, Impact Value and Water Absorption Value (*)	One Test for every 2000 cum	

(\*) These tests shall be done for the purpose of monitoring quality during supply. In case of the test results not being as per the prescribed specifications at any stage, further supplies shall be suspended till suitable corrective action is taken and supplies ensured as per specifications.

The above tests may be carried out more frequently, at the discretion of Railway.

5.2.3 All tests for Abrasion Value, Impact Value and Water Absorption should be got done through approved laboratories or Railway's own laboratories (list of these laboratories shall be mentioned in the tender document). These tests, subsequent to award of contract, shall be done at Railway's cost.

### 5.3 Supply of ballast in Stacks

#### 5.3.1 Sampling Procedure

- (i) At the time of formation of stacks, sufficient care should be taken to ensure that there is sufficient space around the stack to facilitate movement of JCB/Power Equipments. The length and width of each stack shall be kept in such a way that every part of the stack is accessible to the JCB or Power Equipment, to be deployed for drawing "Samples".
- (ii) In case of ballast supply in stacks, three "Samples" each of 0.3-0.5 cum volume, one sample each from two sides and one sample from top after removing outer layer (150-200 mm) should be collected from stack for every 100 cum or part thereof, by JCB or other suitable Power Equipment.
- (iii) The location (in plan) and depths of sampling points shall be varied for different "Samples" and different stacks in a lot.
- (iv) "Gross Sample" should be prepared by thoroughly mixing the three "Samples" collected as in (ii) above, using JCB bucket or any other suitable Power Equipment, on a clean, flat and hard surface.

Note: In exceptional cases of site specific constraints, approval of Competent Authority (Engineer-in-charge) shall be taken prior to invitation of tender, for using manual means for collection and mixing of "Samples", and this should be incorporated in the Tender Document.

- (v) A "Test Sample" of volume 0.027 cum shall be drawn from each of the "Gross Sample", by the method described in Para 5.3.1 (vi), for carrying out Size & Gradation tests.
- (vi) Method for drawing "Test Sample": The ballast in "Gross Sample" shall be scooped into a cone shaped pile by taking care to drop each scoopful exactly over the same spot. After the cone is formed, it shall be flattened by pressing the top of cone with a smooth surface. Then it is cut into quarters by two lines which intersect at right angles at the centre of the cone. The bulk of the sample is reduced by rejecting any two diagonally opposite quarters. The remaining ballast shall be mixed and "test sample" shall be drawn for testing. After drawing "test sample", the left over ballast of "Gross Sample" shall be dumped back in the stack.

- (vii) In case clean, flat and hard surface is not available then a tarpaulin or any other suitable sheet may be used on a flat surface for mixing, drawing and sieve analysis of samples.

5.3.2 In case of stacks of volume more than 100 cum, more than one "Test Samples" will be tested for Size & Gradation. In such cases, the sieve analysis results of all the "Test Samples" shall individually conform to following gradation, for acceptance/rejection of the whole stack:

- (i) Retention on 20mm Sq. Mesh Sieve shall not be less than 98% for machine crushed ballast (not less than 95% for hand broken ballast).
- (ii) Retention on 40mm Sq. Mesh Sieve shall be between 40 to 70%.
- (iii) Retention on 65mm Sq. Mesh Sieve shall not be more than 10%.

The full payment/reduced payment for the whole stack, as given in Para 2.3, shall be decided based on the average of the sieve analysis results of all the "Test Samples" for a stack.

#### **5.4 Supply of ballast in Heaps for loading directly in Wagons**

##### **5.4.1 Sampling Procedure**

Samples of ballast shall be collected from heaps of ballast proposed to be loaded into the wagons. For this, the contractor shall inform ADEN in-charge in writing sufficiently in advance before placement of rake, about the locations of ballast heaps from where it is to be loaded into wagons. ADEN in-charge shall decide the location of heaps from which sampling is to be done, judiciously covering the entire quantity of ballast to be loaded in the rake.

5.4.2 Based on the approx. quantity of ballast to be loaded in the rake, methodology for sampling of ballast to be followed shall be the same as in Para-5.3.1 and 5.3.2 above.

**ANNEXURE-I****Aggregate Abrasion Value  
(Based on IS: 2386 Part IV-1963)****1. Apparatus**

- 1.1 The abrasion test for track ballast shall be carried out using **Los-Angles Machine** as per fig.1.
- 1.2 The **abrasive charge** shall consist of 12 nos. cast iron or steel spheres approx. 48mm dia and each weighing between 390 and 445 gm ensuring total weight of charge as  $5,000 \pm 25\text{gm}$ .
- 1.3 **IS sieves** of sizes 50mm, 40mm, 25mm and 1.70mm.
- 1.4 **Drying Oven**

**2. Test Sample**

- 2.1 The test sample of 10,000gm shall consist of clean ballast conforming to the following grading:
  - Passing 50mm and retained on 40mm square mesh sieve 5,000 gm@
  - Passing 40mm and retained on 25mm square mesh sieve 5,000 gm@

@ tolerance of  $\pm 2\%$  permitted.
- 2.2 The sample shall be dried in oven at  $100 - 110^\circ\text{C}$  to a constant weight and weighed (Weight 'A').

**3. Test Procedure**

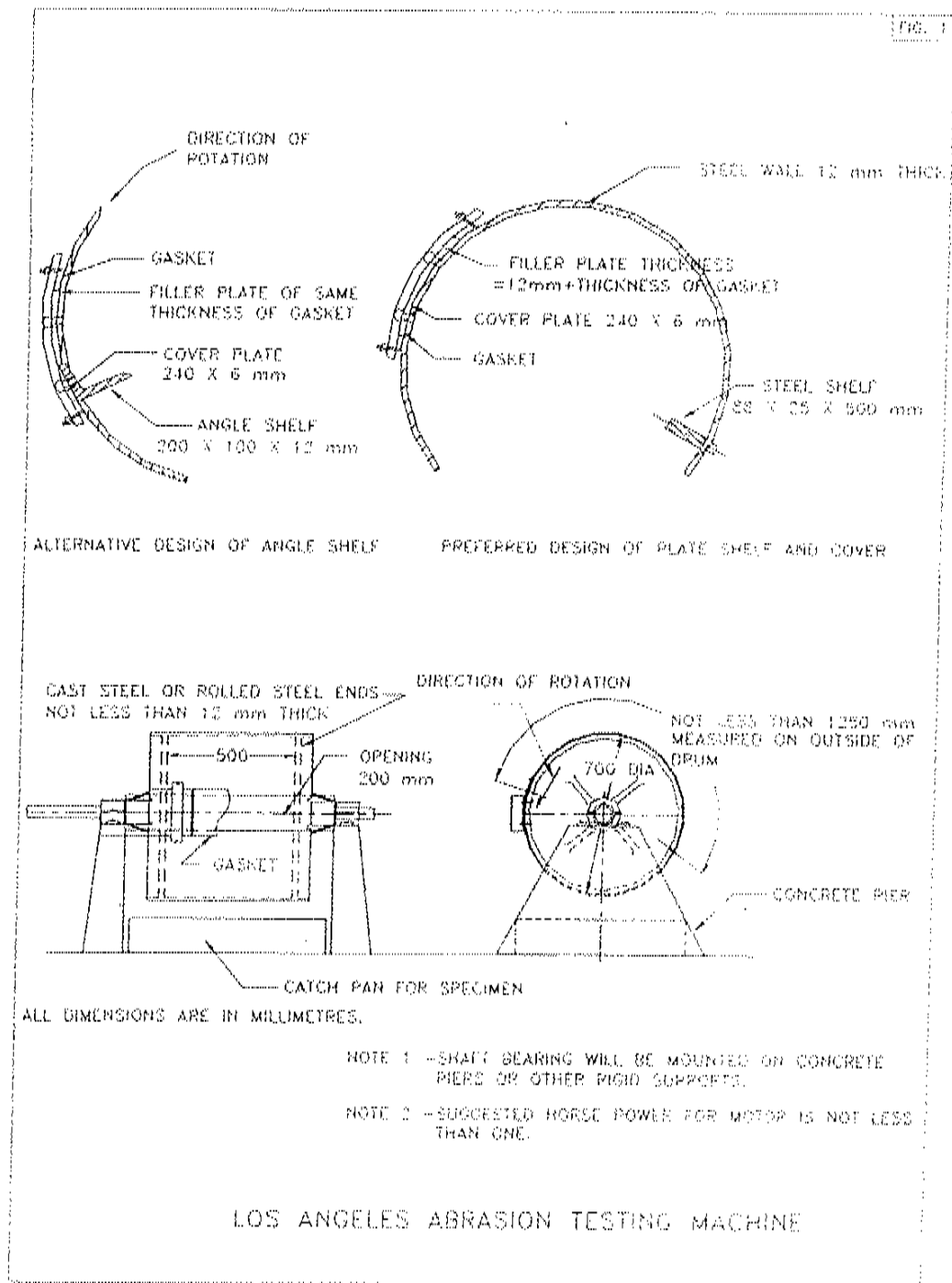
The test sample and the abrasive charge shall be placed in the Los-Angeles abrasion testing machine and the machine rotated at a speed of 20-33 revolutions/minute for 1000 revolutions. At the completion of test, the material shall be discharged and sieved through 1.70mm IS sieve.

**4. Analysis and reporting of the Result**

- 4.1 The material coarser than 1.70mm IS sieve shall be washed, dried in oven at  $100 - 110^\circ\text{C}$  to a constant weight and weighed (weight B).

- 4.2 The proportion of loss between Weight "A" and Weight "B" of the test sample shall be expressed as a percentage of the original weight of the test sample. This value shall be reported as:

$$\text{Aggregate Abrasion Value} = \frac{(A-B)}{A} \times 100$$



**ANNEXURE-II****Aggregate Impact Value  
(Based on IS: 2386 Part IV-1963)****1. Apparatus**

The apparatus shall consist of the following .....

- a) **Impact testing machine** conforming to IS: 2386 part IV-1963 as per fig.2.
- b) **IS Sieve** of sizes 12.5mm, 10mm and 2.36mm.
- c) **A cylindrical metal measure** of 75mm dia & 50mm depth.
- d) **A tamping rod** 10mm circular cross section and 230mm length, rounded at one end.
- e) **Drying Oven**

**2. Test Sample**

- 2.1 The test sample shall be prepared out of track ballast so as to conform to following grading:

- Passing 12.5mm IS sieve	100%
- Retention 10mm IS sieve	100%

- 2.2 The sample shall be oven dried for 4 hours at a temperature of 100-110°C and cooled.

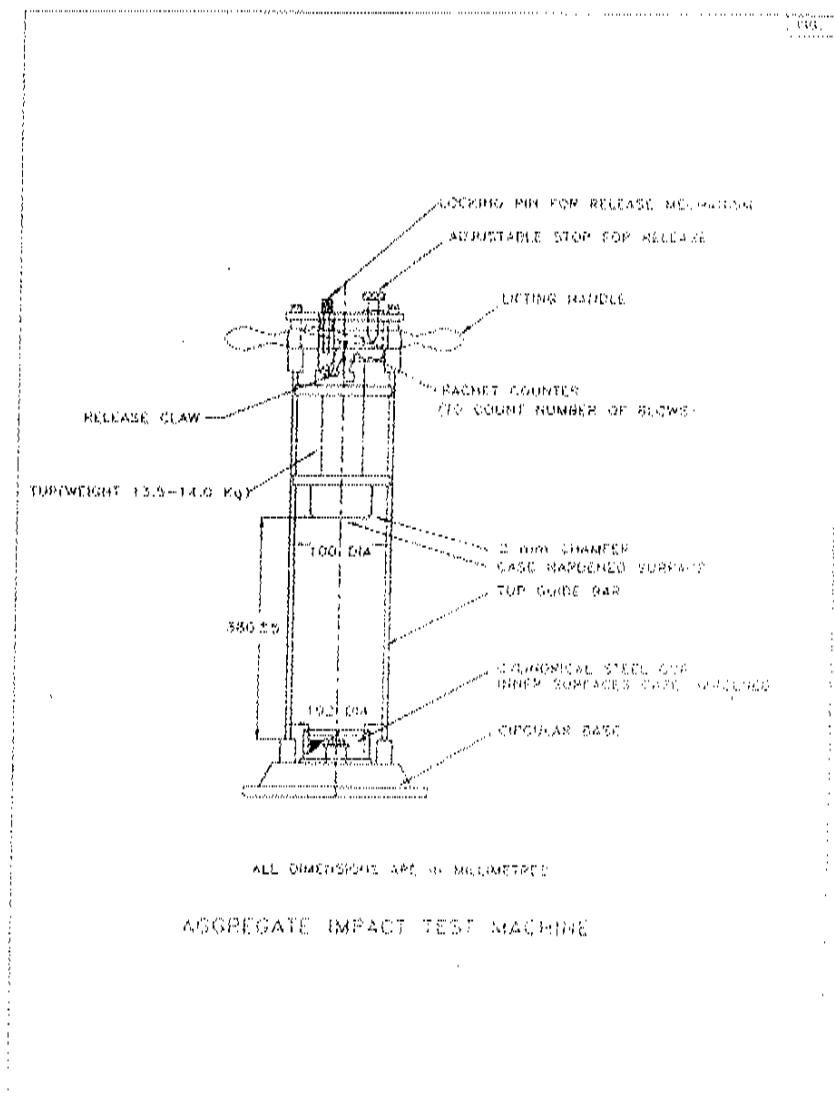
- 2.3 The measure shall be filled about one-third full with the prepared aggregate and tamped with 25 strokes of the tamping rod. A further similar quantity of aggregate shall be added and a further tamping of 25 strokes given. The measure shall finally be filled to overflowing, tamped 25 times and the surplus aggregate struck off, using and tamping rod as a straight edge. The net weight of the aggregate in the measure shall be determined to the nearest gm (weight 'A').

**3. Test Procedure**

- 3.1 The cup of impact testing machine shall be fixed firmly in the position on the base of the machine and the whole of the test sample placed in it and compacted by 25 strokes of the tamping rod.
- 3.2 The hammer shall be raised 380mm above the upper surface of the aggregate in the cup and allowed to fall freely on to the aggregate. The test sample shall be subjected to a total of 15 such blows, each being delivered at an interval of not less than one second.

#### 4. Analysis and Reporting of the result

- 4.1 The sample shall be removed and sieved through 2.36mm IS sieve. The fraction passing through shall be weighed (Weight 'B'). The fraction retained on the sieve shall also be weighed (Weight 'C') and if the total weight (B+C) is less than the initial weight (Weight 'A') by more than one gm, the result shall be discarded and a fresh test made.
- 4.2 The ratio of the weight of the fines formed to the total sample weight shall be expressed as a percentage.  
 Aggregate Impact Value =  $(B/A) \times 100$
- 4.3 Two such tests shall be carried out and the mean of the results shall be reported to the nearest whole number as the Aggregate Impact Value of the tested material.



**ANNEXURE-III****Water Absorption  
(Based on IS: 2386 Part III-1963)****1. Apparatus**

The apparatus shall consist of the following:

- a) **Wire Basket-** Perforated, electroplated or plastic coated, with wire hangers for suspending it from the balance.
- b) **Water tight** container for suspending the basket.
- c) **Dry soft Absorbent cloth** 75x45 cm size 2 nos.
- d) **Shallow Tray** of minimum 650 square cm area.
- e) **Air tight container** of capacity similar to basket.
- f) **Drying Oven.**

**2. Test Sample**

A sample of not less than 2000gm shall be used.

**3. Test Procedure**

- 3.1 The sample shall be thoroughly washed to remove finer particle and dust, drained and then placed in the wire basket and immersed in distilled water at a temperature between 22-32°C.
- 3.2 After immersion the entrapped air shall be removed by lifting the basket and allowing it to drop 25 times in 25 seconds. The basket and sample shall remain immersed for a period of  $24 \pm \frac{1}{2}$  hours afterwards.
- 3.3 The basket and aggregate shall then be removed from the water, allowed to drain for few minutes, after which the aggregate shall be gently emptied from the basket on to one of dry clothes and gently surface dried with the cloth transferring it to second dry cloth when the first will remove no further moisture. The stone aggregate shall be spread on the second cloth and exposed to atmosphere (away from direct sunlight) until it appears to be completely surface dry. The aggregate then shall be weighed (Weight 'A').
- 3.4 The aggregate shall then be placed in an oven at a temperature 100 - 110°C for 24 hours. It shall then be removed from oven, cooled and weighed (weight 'B').

**4. Analysis and Reporting of the Result**

Water Absorption =  $\{(A-B)/B\} \times 100$

- 4.1 Two such tests shall be made and individual and mean results shall be reported.

**ANNEXURE-IV****Specification of Test Sieves used for Sieve Analysis of Ballast**

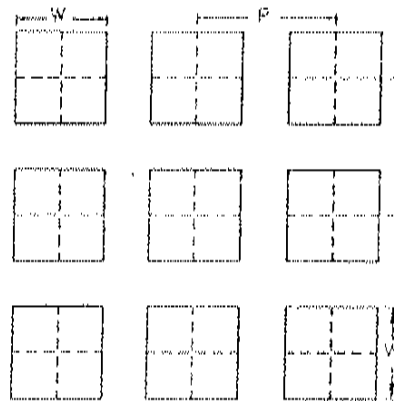
1. The test sieves shall be perforated plate sieve type with square holes/apertures, mounted on a frame. The test sieves are designated by the nominal size of holes/apertures.
2. **Material of Perforated Plate:** The perforated plate for test sieves shall be manufactured from Brass Sheet or Steel Sheet or Stainless Steel Sheet or Galvanized Steel Sheet or Electroplated Steel Sheet.
3. **Plate Thickness:** The thickness of plate used for making test sieve and the tolerance permitted for this shall be as following:

For 65mm Square Mesh Sieve - 3mm (Plus 1.0mm Minus 0.5mm)

For 40mm Square Mesh Sieve - 2mm (Plus Minus 0.5mm)

For 20mm Square Mesh Sieve - 2mm (Plus Minus 0.5mm)

4. **Arrangement of Holes/Apertures:** The square holes/apertures of size "W" in the perforated plate shall be arranged at Pitch "P" as per the sketch given below:



5. **Sieve Opening Size, Pitch of Openings and tolerances:** The nominal size of individual hole/aperture at mid-section (W), the Pitch of holes/apertures (P) and permissible tolerance for them shall be as under:

Test Sieve of Square Mesh Size	W		P	
	Nominal Size	Tolerance	Distance	Tolerance
65 mm	65 mm	( $\pm$ ) 1.5 mm	80 mm	(+) 12.0 mm (-) 8.0 mm
40 mm	40 mm	( $\pm$ ) 1.5 mm	50 mm	(+) 7.5 mm (-) 5.0 mm
20 mm	20 mm	( $\pm$ ) 1.0 mm	25 mm	(+) 4.0 mm (-) 2.5 mm

6. **Sieve Frame:** The frame of test sieves shall be manufactured from Hardwood or Steel sheet or Brass sheet. The internal size of the frame (i.e. clear size of perforated plate mounted on frame) shall not be less than 100cm in length, 70cm in breadth and 10cm in height on sides.
7. **Marking on test sieves:** A label shall be fixed to the frame of each sieve, legibly marked with following information:
  - (i) Nominal Aperture Size,
  - (ii) Material of perforated plate,
  - (iii) Material of sieve frame,
  - (iv) Maker's Name or Trademark, and
  - (v) An Identification Number for the sieve.

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#### TECHNICAL CONDITION FOR TRACK LINKING :

- a) The site of work including the availability of permanent way materials etc. shall be inspected by the contractor before quoting the rates for this tender.
- b) All items such as Rails, sleepers, cotters, pandrol clips, rubber pads, liners, fish plates, bolts, check blocks, bolts and nuts, keys, bearing plates, plate screws, other fitting etc. will be supplied at the nearest construction stores depot unless otherwise expressly specified in the respective items of Annexure. The contractor has to lead the materials to the site of linking at his cost and the RATE QUOTED FOR EACH ITEM SHALL INCLUDE THIS.
- c) Dip lorries to the extent available will be supplied by the Railway free of charge at the nearest construction DSK's stores depot and these shall be returned by the contractor at his own expenditure to the same depot as directed by the Engineer-in-charge. Loading of rails to the required tonnages and testing the track will be done by the contractor at his cost.
- d) If possible, locomotives will be supplied free by the Railway and testing will be done by the contractor with locomotive.
- e) Issue of materials to the contractor or his nominated representative will be on vouchers and the materials thus issued are to be accounted for by the contractor either in the track as fitted or as surplus materials have been returned to the Railway and he shall be held responsible for any shortages or breakages till the track is taken over by Inspector-in-charge.
- f) The permanent way tools such as :
  - i Rail Tongue/Rail hooks
  - ii Crow bar of all types
  - iii Spanners of all sorts
  - iv Jim crow
  - v Hammers of all sorts
  - vi Cotter splitters
  - vii Showels
  - viii Beaters
  - ix Track lifting jack
  - x Gauges
  - xi Level boards
  - xii Sprit level
  - xiii Cant board

xiv Expansion liners

xv Wooden square

xvi Dip lorries

xvii Wire brushes &

xviii Jack for lifting track required for the work as assessed by the Section Engineer depending on the labour strength, will be issued free for the extent available at the nearest construction DSK's Stores Depot. These also will be issued to the contractor or his representative on voucher and will have to be returned at the same depot. The damages due to wilful act or negligence or loss of tools will be deducted from contractor's bills. The cost as advised by Engineer-in-charge will be final and binding for the purpose of recoveries.

g) For drilling holes in rails and cutting rails the contractor should make his own arrangements for using drilling and cutting machines, rail cutting blades, drill bits, etc. The department will not supply any of these items. Cutting of rails and drilling of holes by JIM CROW OR GAS IS NOT PERMITTED.

h) The contractor shall employ and post at site technical supervisors who should be adequately qualified and well experienced in execution of permanent way works. The name and particulars of technical qualification and record of experience of the supervisor employed should be advised to the Engineer-in-charge. If in the opinion of the Engineer-in-charge the supervisor is not fit to be incharge of the work he should be forthwith replaced. In this matter the opinion of the Engineer-in-charge will be final and binding on the contractor.

i) No work on the track should be done unless until the contractor's technical supervisor is present at site.

j) The Tenderer should invariably furnish the Name and Biodata and details of experience in the relevant field of the Engineer/Supervisor whom he proposes to engage for this work, along with the tender while submitting the tender. Tenders received without the above details will be summarily rejected.

k) The contractor shall engage the required number of qualified and well experienced men who are well conversant with the permanent way works. A list of labourers who are engaged for the work should be got approved by the Engineer-in-charge or his representative before allowing them for work. Men who are not approved by the Engineer-in-charge or his representative will not be permitted to do the work involving safety of trains.

l) No extra payment will be made for crossing the tracks, or for lifts/descends while unloading, leading and stacking of the materials

m) Permanent way materials should be handled carefully without causing any damages. If any damage is caused, making these materials unfit for use on track, or for shortages, the cost thereof will be recovered from the contractor as per extant orders. The decision of the Engineer-in-charge regarding the damage or shortage will be final and binding on the contractor

n) The cost of permanent way materials when got broken in handling/transport, except for negligence of contractor, will not be recovered, but broken ones should be handed over to the Railway depot as nominated already or as may be directed. Whether the breakages have occurred due to negligence of the contractor or not will be decided by the Engineer-in-charge and his decision is final and binding on the contractor.

o) Materials liable to breakage, or damage by being dropped or thrown, shall be unloaded carefully by hand or other suitable means. All materials shall, after unloading, be stacked sufficiently clear of the track or the road, as the case may be and in the former case, shall remain without any possibility of infringing the minimum fixed structure dimensions when work is done near opened yards/lines

p) The entire work will be done under the strict guidance of the Engineer-in-charge or his authorised representative. The daily progress of the work will be watched and any suitable corrective measures as directed by the Engineer-in-charge or his representative should be immediately carried out wherever necessary at no extra cost.

q) After each stage of lifting, the ballast has to be properly packed and the level, gauge, alignment and other track parameters are to be attended to ensure safe passage of trains.

r) Prior to commencement of each days work, the Section Engineer-in-charge and the representative of the contractor will jointly inspect the days work and take a note of missing fittings, if any and the contractor will be responsible for any further losses till the work is completed in this length. The cost of such fittings at Railway's rates will be recovered from contractor's bills.

s) The contractor will also be held responsible for any accident or loss or damage or detention to trains, caused due to such lapses on the part of the contractor during the course of the work as observed and decided by the Section Engineer-in-charge.

All materials shall be stacked sufficiently clear of the tracks and shall remain without any possibility of infringing the minimum fixed structure dimensions. Materials shall also not be unloaded or stacked over signal wires, cables or other gear or any such items to avoid interference to the existing running lines.

### MODUS OPERANDI FOR LINKING OF P.WAY

- 1) Rails, check rails, fish bolts and nuts, PSC/ST/CST-9/Wooden sleepers, pandrol clips, rubber pads, fish plates, check blocks, bolts and nuts and all other P.Way materials shall be supplied by the Railway as mentioned in the Special Conditions of Contract. These materials will have to be lead by the contractor by head loads or any other approved means.
- 2) Rails and other permanent way materials including fittings shall be issued to the contractors progressively as the work proceeds taking care to see that the contractor shall have atleast one week's stocks in hand at any time
- 3) Consumable stores like graphite, grease, oil etc. required for the days work as assessed by the Inspector depending upon the labour strength of the Contractor, will be arranged by the contractor at his cost atleast for one week's consumption at a time.
- 4) Spreading 50 mm stone/moorum ballast to 150 mm cushion (thickness) has to be done first. Rolling of ballast with contractors rollers shall be carried out. Sleepers are to be assembled and laid over the ballast to correct spacings. The Rails shall be connected by means of a pair of fish plates using in the first instance only with two fish bolts and nuts, one in each rail. Before fishing the rail ends the fishing edges of fish plates and bolts shall be lubricated with contractor's grease, graphite and oil as directed. Correct expansion gap according to the rail temperature at the time of laying as directed by the Inspector shall be ensured between ends of rails by inserting the liners supplied by the Railways. Cut rails have to be used inside on curves and drilling of fresh bolt holes in these rails shall be done by the contractor at his cost. Drilling of holes for fixing check rails/flats shall also be done by the contractor at his cost.
- 5) The Rails shall be laid in such a way that the arrows on the web face, face the direction of traffic, where so directed.
- 6) Paint marks shall be made on the rails with Contractor's yellow paint as directed by the Inspector to indicate the spacing of sleepers to be adopted.
- 7(a) On the track with PSC sleepers, wooden sleepers with A.C. bearing platess or ST sleepers with keys and loose jaws shall be inserted under rails at every fish plated joints one on either side of the joint and the rails fastened to the A.C./M.S. bearing plates to the sleeper with plate screws/rail screws or spikes will have to be done by the contractor as per standard Railway practices, including supply and providing coal tar for the augered holes, etc. In the event of Railway deciding not to use wooden/ST sleepers at the joints, PSC sleepers at the joints also at same respective accepted rates.

#### LINKING :

- 8) In the case of PSC sleepers, the rails shall be laid on sleepers along with grooved rubber pads, fastening the rails to sleepers with pandrol clips and nylon rubber pads to neat gauge, shall be done by the contractor.

#### BALLASTING AND INITIAL PACKING

- 9) The ballast collected alongside the alignment or at specified places in the vicinity shall be lead and spread it over the formation to a thickness as specified in the Annexure and rolled with

contractor's rollers initially before laying the track and dump the remaining ballast after linking the track to have a standard ballast cushion and section and lift the track to the correct level as directed.

10) The track will be lifted with crow bars and the sleepers thoroughly packed running out of the difference in level if any at either end in one rail length. Further lifting will also be done in similar manner until the track is lifted to correct rail level as per pegs fixed before the commencement of lift by the Inspector-in-charge. At each stage the alignment, gauge and cross levels will be checked and defects rectified.

11) The ballast shall be packed under the sleepers. In the case of wooden sleepers the packing shall be to the standard cushion below each rail seat and 45 cm on either side of the rail and the middle of the sleeper shall be packed loosely.

12) In the case of CST-9 sleepers the ballast shall be worked into the bowls on either side of the keel of the plate and packed in from outside until the bowls are careful and hard packed and no ballast can be packed in.

13) The alignment of the rails shall be finally corrected, the sleepers squared, the gauge adjusted as directed, cross levels checked, lifted and repacked wherever necessary.

14) The ballast section will then be dressed to correct profile.

15) The track should be tested with a locomotive after initial packing and the track lifted and packed wherever sags have formed. The contractor shall provide his own labour for testing of track to the required number of times by locomotive, if a locomotive could be taken to the line before the contract expires. The track shall also be rolled with loaded dip lorried in advance as required. The initial packing and picking up sags after rolling by locomotive is part of assembling and linking item in the schedule. Additional packings required, if any, will be decided by the Engineer-in-charge and executed under appropriate schedule items.

(b) Any sleepers which have shifted from correct spacing or gone out of square shall be moved back and squared after loosening the fastenings. The fastenings shall be tightened again after squaring.

16) The track shall be slewed to correct alignment by sighting along the rails head of the base rail. It should be ensured that track does not get lifted in the process of slewing.

17) Any defects developed in gauge shall be rectified. Regauging of PSC sleepers shall be done under specific directions of the Inspector.

18) The track shall then be packed properly. For this sighting shall be done along the base rail and any dip or low joint lifted correctly and packed attending also to the packing of adjacent sleepers. After the base rail is thus packed for two or three rails length the cross levels shall be checked and opposite rail lifted wherever necessary and sleepers under the rail seat packed.

19) The joint and shoulder sleepers shall be repacked and cross levels adjusted.

20) After rolling of the track by engine and completing initial packing, the track shall be packed to obtain the final track conditions to permit on restricted operations of traffic.

21) Ballast section shall be dressed neatly as directed to the proper height and width with correct side slopes.

**SPECIFICATION FOR FINISHING WORK:**

22) Ballast section shall be uniform in height, width and side slopes and brought to standard section as directed by the Inspector with the quantity of ballast made available at site. No ballast shall be left on the cess, side slopes of bank or near toe of bank.

23) The following laying standards of track geometry measured in floating condition during primary renewals for Broad Gauge should be achieved.

a) Gauge - Sleeper to sleeper variation : + 2mm

b) Expansion gap - Over average gap worked out by recording 20 successive gaps : + 2 mm

c) Joints - Low joints not permitted : --

High joints not more than : + 2 mm

Squareness of joints on straight : + 10 mm

d) Spacing of sleepers - With respect to theoretical spacing. : + 20 mm

e) Cross level - To be recorded on every 4th sleeper : + 3 mm

f) Alignment - On straight on 10 m chord : + 2 mm

On curves of radius more than 600 m on 20 m chord variation over theoretical versines. : + 5 mm

On curves of radius less than 600 m on 20 m chord variation over theoretical versines. : + 10 mm

g) Longitudinal level - Variation in Longitudinal level with reference to approved longitudinal sections: 50mm

24. Gauge should be 1676 mm - Will be checked with standard gauge and on straight (for BG) On curves - The gauge on curve shall be the following standard.

(1) On new lines and on lines where complete renewal or through sleeper renewal is carried out the track should be laid to a uniform gauge to the following standards.

Broad Gauge (1676 mm) - Gauge

Radius in metres

i) Straight including curves of 400 m radius - 3 mm tight i.e. 1673 mm

ii) On curves less than 400 m radius - Upto 5 mm slack i.e. Upto 1681 mm.

(2) On existing lines as well, the above mentioned standard should be followed to the extent possible.

(3) Gauge on wooden sleepers track, however need not be disturbed if it is likely to cause spike killing of wooden sleepers. Uniformity of gauge should be stressed in all cases to get better track riding quality.

#### SPECIAL CONDITIONS FOR PROVISION OF VERTICAL SAND DRAINS FOR PRE - CONSOLIDATION GROUND IMPROVEMENT USING PRE - FABRICATED VERTICAL DRAINS, ETC.

##### 1. PRE-CONSOLIDATION MEASURES:

1.1 Pre-consolidation of existing base ground soils should generally follow IS 15284, RDSO Report No. GE-R-68 and the specifications and special conditions given below. Pre - consolidation is necessary for soils of classification MH, CH, OH particularly as these are highly compressible and liquid limit is more than 50. Soils of MI, CI & OI & sometimes SM & SC classification may also require pre-consolidation in some cases. SPT values for such soils will be less than 10 to 20 generally.

1.2 Pre-consolidation methods may be one or more of the following:

- Pre Loading
- Stage Construction
- Vertical Sand Drains
- Prefabricated Vertical Drains
- Vacuum Assisted Consolidation

1.3 Technology is available for all methods mentioned above and are to be adopted after suitable studies. Specifications for Prefabricated Vertical Drains (PVD) are discussed below.

##### 2. PRE - FABRICATED VERTICAL DRAINS

###### 2.1 General

Prefabricated vertical PVC drain can be defined as any prefabricated material or product consisting of a synthetic filter jacket surrounding a plastic core. Because of their shape, they are also known as band or wick drains. They are manufactured in rolls of 200 - 300 m and are inserted into ground to required depths using special drain stitcher rigs. Generally, installation takes place up to full depth of compressible soils. PVDs have replaced conventional sand drain for soil consolidation due to their easy & speedy installation and unlike sand drains, they act as an integral unit during the process of consolidation.

###### 2.2 Important Activities Involved:

- (i) Removal of the top soft soil/ organic clay upto 1.00m or as required. If firm ground of sand or silt is available for 1.0m depth, the same need not be disturbed.
- (ii) Provision of well compacted coarse to medium grained sand for a depth of 30 to 50 cm to act as filter media above the prepared ground surface.

- (iii) Provision of Prefabricated Vertical Sand Drains (PVSD) at an interval of 1.5 to 3m in triangular or square grid fashion for a depth of 8 to 12 m from ground level. Normally drains should extend to the depth of the poor soil or 2 times the height of the embankment. PVSD shall be appropriate specifications as specified.
- (iv) Execution of earth work above the sand layer up to formation level with extra 1.00 m preloading with earth.
- (v) The overburden soil will increase the pore water pressure in the clay and the water will escape through the PVSD drain through capillary action and by soil overburden. Once the water available between clay particles escape the reorientation of the particles will densify the clay layer.
- (vi) Removal of extra earth after 6 months or after attaining the complete consolidation. Consolidation should be checked with settlement gauges and compared with theoretical settlement obtained through studies including Tri-axial tests and settlement calculations.

### 2.3 Preparatory arrangements at site:

- (i) Base area of the embankment is divided in to fields of size 30 x 50 m or so by providing barriers if required to pump out water.
- (ii) Water, if percolates, should be pumped out fully leaving the creed bed to dry. Cofferdams if required should be provided.
- (iii) After drying, the slush/ organic material is removed up to 1.00 m by using machinery as required.
- (iv) Sand should be filled then in layers up to a depth of 30 to 50 cm and compacted with a vibratory roller of 1 to 2 tonne capacity.
- (v) Then the Prefabricated Vertical Drains can be installed by using appropriate machinery.

### 2.4 Specifications for Pre - Fabricated Vertical Drains and Installation:

2.4.1 The Contractor shall furnish all necessary plant, labour, equipment and materials and perform all operations for the installation of prefabricated vertical drains (PVDs). The drains shall consist of a band-shaped plastic core enclosed in a suitable jacket material.

2.4.2 The PV drain shall be of newly manufactured material as per specifications and shall consist of a core enclosed in or integrated with a jacket. The jacket shall allow free passage of pore water to the core without loss of soil material or piping. The core shall provide continuous vertical drainage. The drain shall be band-shaped with suitable aspect ratio (width divided by thickness).

2.4.3 The jacket shall be a synthetic non-woven geo-textile or equivalent as per specifications capable of resisting all bending, punching and tensile forces imposed during installation and during the design life of the drain. The jacket material shall not be subject to localized damage. (e.g. punching through the filter by sand/gravel particles). The jacket material shall be sufficiently rigid to withstand lateral earth pressures due to embedment and surcharge so that the vertical flow capacity through the core will not be adversely affected. The jacket material shall be sufficiently flexible to

bend smoothly during installation and induced consolidation settlement without damage. The core and the jacket shall conform to the Crab Tensile, Trapezoidal Tear, Puncture Strength and Durest Strength requirements as provided in this tender as per relevant ASTM standards and/or directed by the Engineer.

2.4.4 The core shall be a continuous plastic material fabricated to promote drainage along the axis of the vertical drain. The mechanical properties (strength and modulus) of the assembled PV drain shall equal or exceed those specified for the component jacket and core. The assembled drain shall be resistant against wet rot, mildew, bacterial action, insects, salts in solution in the groundwater, acids, alkalis, solvents, and any other significant ingredients in the site groundwater. One single type of assembled drain shall be used on the project unless otherwise specified or approved by the Engineer.

2.4.5 PV drain materials shall be labeled or tagged in such a manner that the information for sample identification and other quality control purposes can be read from the label. As a minimum, each roll shall be identified by the manufacture as to lot or control numbers, individual roll number, date of manufacture, manufacturer and product identification of the jacket and core.

2.4.6 Contractor shall:-

- i). submit to the Engineer for testing a sample of the un-spliced PV drain to be used, and 3 samples of any proposed splices, at least 28 days prior to the installation of any drains. The sample of un-spliced drain shall be at least 3m long. Samples of spliced PV drain shall be long enough to include the splice plus 60cm of un-spliced drain on both sides of the splice .
- ii) submit to the Engineer manufacturer's literature documenting the physical and mechanical properties of the drain (as a minimum those properties required by the specifications) and other similar projects where the same drain has been installed including details on prior performance on these projects, at least 14 days prior to installation No extra payment will be made in this connection.
- iii) execute the scheme for PV Drain system as approved by the Dy.Chief Engineer-in-charge of the project. The scheme should taken into account the nature of the terrain and soil condition.

2.4.7 The contractor shall indicate the proposed source of the materials prior to delivery to the site. The contractor shall also retain a supplier's purchase certificate to verify the type and physical characteristics of the drain to be used.

2.4.8 The testing of PVD components and as a drain shall be arranged by the contractor at his cost before starting the work. Railway reserves the right to ask for additional tests at the contractors cost at the description of the Engineer-in-charge.

2.4.9 During construction, individual test samples shall be cut from at least one roll selected at random to represent each shipment or 1,000 linear meters, whichever is less. Individual samples shall be not less than 3m in length and shall be full width. Samples submitted for tests shall indicate the linear meter of drain represented by the sample. The material shall not be used until the Engineer has accepted the sample (verified physical dimensions, manufacturer, drain designation and manufacturer's certification of physical and chemical properties). Should any individual sample

selected at random fail to meet any specification requirement, then that roll shall be rejected and two additional samples shall be taken at random from two other rolls representing the shipment or 2,000 linear meters, whichever is less. If either of these two additional samples fails to comply with any portion of the specification, then the entire quantity of vertical drain represented by the sample shall be rejected.

2.4.10 PV drains shall be installed with approved modern equipment of a type which will cause a minimum of disturbance of the sub-soil during the installation, operation and maintain the mandrel in a vertical position. Drains shall be installed using a mandrel or sleeve which shall be inserted by pushing into the soil. The mandrel or sleeve shall project the drain material from tears, cuts, and abrasion during installation, and shall be retracted after each drain is installed. The installed PV drain should project about the base soil and into the sand layer adequately to ensure free and effective drainage.

2.4.11 Two weeks prior to the beginning of trial PV drain installation, the contractor shall submit full details on the materials, equipment, sequence and method proposed for PV drain installation to the Engineer for review and approval. Approval by the Engineer in charge sequence and methods shall not relieve the Contractor of its responsibility to install drains in accordance with the plans and specifications.

2.4.12 Prior to the installation of production PV drains, the Contractor shall demonstrate that its equipments, methods, and materials produce a satisfactory installation in accordance with these specifications. For this purpose the contractor will be required to install 10 trial drains totaling approximately 100 linear meters at locations designated by the Engineer. No extra payment will be made for demonstration of installation of PVD above.

2.4.13 PV drains shall be located, numbered and staked out by the Contractor using a baseline and benchmark provided by the Engineer. The Contractor shall take all reasonable precautions to preserve the stakes and is responsible for any necessary re-staking. The as installed location of the PV drains shall not vary by more than 15 cm from the plan locations designated on the drawings.

2.4.14 PV drains that are installed at more than 15 cm from design plan location or are damaged or improperly installed will be rejected. The rejected drains will not be payable and the contractor can remove the materials without damaging the structure of formation at his cost. For abandoned drains, no compensation shall be paid.

2.4.15 The contractor shall supply to the Engineer at the end of each working day a summary of the PV drains installed that day. The summary shall include drain type, locations and length (to nearest 10 cm) quantity of PV drain installed at each location.

2.4.16 Equipment for installing PV drains shall be plumbed prior to installing each drain and shall not deviate from the vertical more than 5 cm in 3.0 m during installation of any drain. PV drains shall be installed using a continuous push using static weight. Installation techniques requiring driving will not be permitted Jetting techniques will be permitted only after receiving written approval from the Engineer.

2.4.17 The installation shall be performed without any damage to the drain during advancement or retraction of the mandrel. In no case will alternate raising or lowering of the mandrel during

advancement be permitted. Rising of the mandrel will only be permitted after completion of a drain installation. The mandrel penetration rate should be between 15 and 60 cm per second. The completed PV drain shall be cut off neatly 50 cm above the working grade, or as otherwise specified on the contract drawing.

2.4.18 Where obstructions are encountered below the working surface which cannot be penetrated by the drain installation equipment the Contractor shall complete the drain from the elevation of the working surface to the obstruction and notify the Engineer prior to installing any more drains. At the direction of the Engineer and under his review, the contractor shall attempt to install new drain within 60 cm horizontally from the obstructed drain. A maximum of two attempts shall be made as directed by the Engineer. If the drain still cannot be installed to the design up elevation, the drain location shall be abandoned and the installation equipment shall be moved to the next location, or other action shall be taken as directed by the Engineer. Payment will be made for the provided for extra PVD during obstruction if any.

2.4.19 If permitted by the Engineer, the contractor may use auguring, spud ding, or other methods to loosen the soil and clear obstructions, providing the auguring does not penetrate more than two feet into the underlying compressible soil.

2.4.20 The installation rig should be provided with a fully automatic drain recorder which registers the installation date, time, depth, location (within 1 m) and soil resistance of every installed vertical drain. A copy of the registration has to be provided to the engineer at the end of each shift and/or week. If the registration is stored on an electronic data storage medium, the contractor should provide the necessary software to process the data on a PC in addition.

2.4.21 Material specification:

a) Properties for core & Jacket and the complete drain are as under "-

Property	Unit	As per	Requirement
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1.Core material : Type - Continuous channel

Width	mm	Nominal	Min. 100 +/- 2
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Thickness	mm	Nominal	Min.3 to 4 +/-0.25
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Discharge Capacity	m <sup>3</sup> /s	ASTM D 4716	Min. 50 x 10 <sup>-6</sup>
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at hydraulic gradient

$i = 1.0$  @ 350 kN/m<sup>2</sup> or equivalent

Tensile strength-	KN	ASTM D 4595	Min. 1.5
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10cm width

Elongation at 0.5 KN %	ASTM D 4595	Max. 10 or equivalent.
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2. Filter Properties : Type - Non-Woven

Tensile Strength	KN/m	ASTM D 4595	Min. 2
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Permeability @ 10mm

lead or equivalent	m/s	ASTM D 4491	Min. $1 \times 10^{-4}$
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Apparent

Opening Size	micron	ASTM D 4751	Max. 80
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b) The sample test results shall prove the above categorically. Material not satisfying equal to the above shall be summarily rejected.

----- XXXXXXXXXXXX -----

## SPECIAL CONDITIONS OF CONTRACT (Technical)

### **Details of works to be done under Final location survey Field work:**

1. Final location survey should be based on a good Theodolite or Total station which should be as closely as possible to the centre line to be finally adopted.
2. The survey operation should be comprehensive to secure necessary information for the preparation of detailed plans and section to ensure that the alignment selected is most economical. The information collected should enable preparation of fairly accurate estimate of the line.
3. Investigation should be made of bunds, streams, irrigation works etc., in the vicinity of the proposed line in order to arrive at a decision on waterways and their diversions if found necessary.
4. Investigation should also include soil sampling at suitable intervals along the alignment, bridge locations etc., to required depth, conducting tests on soils to design suitable embankment, foundations of structures etc.
5. Curves: Curves should be defined both by their "Degree of curvature" in Degrees & Minutes and their radius in metres.
6. Gradients: The Ruling Gradient for this section is 1 in 200.
7. Bench Mark: The longitudinal and cross section levels taken along the centre line should bear a reference to GTS bench mark.

### **REPORT:**

The project report on conclusion of Final Location Survey shall be compiled as indicated below:

1. Introduction.
2. Characteristics of the Project area.
3. Standards of construction.
4. Route selection.
5. Project Engineering, Estimation of cost & construction schedule.
6. Conclusions and recommendations.

The report should also accompany the following statements

1. Curve Abstract.
2. Gradient Abstract.
3. Bridge Abstract.
4. Important Bridges, Major and Minor Bridges.

5. Station machinery.
6. Stations and station sites.
7. Level crossings Abstract.
8. List of power lines/ Telegraph crossings.
9. List of Over Head Crossings.
10. Index Plan, Index Section.
11. Working Plan, Working Section.

### **ESTIMATE**

The report should be accompanied by an Estimate of quantities and cost of the project survey. The methodology adopted in the computation of quantities in the earth work, bridges, buildings may be indicated.

(i) An Abstract Estimate of the cost of the line surveyed in Form E 554 accompanied by an Abstract Estimate of junction arrangements.

(ii) Detailed estimate on the prescribed form for the following :

#### Head of Allocation:

Doubling	:	1500
Gauge Conversion	:	1400
New lines	:	1100

Example for new lines

Sl.

No.	Head of Account	Particulars	From
1	Capital 1110	Preliminary Expenses	E 553
2	Capital 1120	Land	E 553
3	Capital 1131-34	Formation for Earthwork Tunnels, Walling and side drains	E 553
4	Capital 1140	Permanent way	E 553
5	Capital 1151-53	Major Bridges	E 553
6	Capital 1154-56	Minor Bridges	E 553
7	Capital 1160	Station & Buildings	E 553

8 Capital 1170 Station equipment, Plant & Machinery E 553

9 Capital 1180-90 General Charges E 553

PROFORMA FOR EXPERIENCE CERTIFICATE

Name and address of Department

Agreement No & Date

Name and address of Unit

Value of Agreement

Name and address of Contractor

Original Currency

Name and Type of work

Actual date of completion

Nature of work executed

No. of extensions granted.

Sl.No	Nature of work	Details of work	Value Agreement	Value as per actual execution	Remarks
(1)	(2)	(3)	(4)	(5)	(6)

1. PRELIMINARY ENGINEERING SURVEY

2. RECONNAISSANCE ENGINEERING SURVEY

3. FINAL LOCATION SURVEY

4. OTHERS

5. Whether any penalty is imposed

6. General Remarks about performance.

Signature of Tenderer/Contractor

Place:

Date:

**STAGE PAYMENT: RECONNAISSANCE ENGINEERING SURVEY**

Sl. No.	Description of work	Percentage
1.	Marking the alignment in 1:50,000 Topo-sheets in consultation with Engineer in Charge for plain and plateau section and site inspection for fixing station location, Power/ Telecommunication lines crossings and submission of details including Level crossing, power line crossing, station locations and Interpretation of Ground levels with the help of topo sheets for every 100m interval for preparation of estimates.	25%
2	.Submission of copies of documents such as index plan, index section, and yard diagram for departmental scrutiny along with soft copy.	10%
3.	Preparation and submission of Draft Engineering Report and Estimate for departmental scrutiny alone with soft copy.	10%
4.	Submission of required number of copies of documents such as Index plan, Index section, yard sketches etc. and their negatives in original along with soft copy (CD) having details of draft report and longitudinal section.	15%
5.	Submission of Final booklets 20 copies of the survey report along with estimate with other connected documents in full shape.	40%
Total		100%

## **DETAILS OF WORKS TO BE DONE UNDER RECONNAISSANCE ENGINEERING SURVEY**

### **FIELD WORK**

Investigations of the area with a view to determine the Technical feasibility and approximate cost of one or more routes for the projected Railway line from a general examination with the help of contoured Survey of India Maps and other available materials with instruments such as Prismatic Compass, Clinometre and similar instruments.

Particular attention should be paid to ascertain the waterway required and the best sites for stations, crossing of streams, bridge and roads. The nature of foundation required for large bridges should be investigated/ recorded.

### **REPORT**

The report submitted on conclusion of the Reconnaissance Engineering Survey as indicated below:-

#### **Engineering Report**

- i) Brief History and object of study.
- ii) Gauge, Fixed Points, Length of the lines and levels and curves.
- iii) Alignments.
- iv) Engineering features, standard of construction and probable cost.
- v) Stations and Station Sites.
- vi) General Arrangements.
- vii) Conclusion and Recommendation.

The report should be accompanied by the following tabulated details:-

- a) List of Curves and Curve Abstract.
- b) List of Gradients and Gradient Abstract.
- c) List of Bridges and Bridge Abstract.
- d) Statement of Important, Major and Minor bridges.
- e) List of Stations and Station sites.
- f) List of Tunnels and Tunnel Abstract.
- g) List of Level Crossings and Level Crossing Abstract
- h) List of Road Over Bridges and Road Under Bridges.
- i) List of power line/Telegraph line crossings.

## ESTIMATE

The report should be accompanied by an Estimate of quantities and cost of the project survey. The methodology adopted in the computation of quantities in the earth work, bridges, buildings may be indicated.

(i) An Abstract Estimate of the cost of the line surveyed in Form E 554 accompanied by an Abstract Estimate of junction arrangements.

(ii) Detailed estimate on the prescribed form for the following :

Sl. No.	Head of Account	Particulars	Form
1.	Capital 1110	Preliminary Expenses	E 553
2.	Capital 1120	Land	E 553
3.	Capital 1131-34	Formation for Earthwork Tunnels, Walling and side drains	E 553
4.	Capital 1140	Permanent way	E 553
5.	Capital 1151-53	Major Bridges	E 553
6.	Capital 1154-56	Minor Bridges	E 553
7.	Capital 1160	Station & Buildings	E 553
8.	Capital 1170	Station equipment, } Plant & Machinery}	E 553
9.	Capital 1180-90	General charges	E 553

## 1 Proforma for Welding Procedure Specification Sheet

Name and address of Fabricator:

Welding procedure specification No.

- 1.0 Weld joint description
- 2.0 Base Metal
- 3.0 Welding Process
- 4.0 Welding position
- 5.0 Welding consumables
- 5.1 Electrode/wire Class Dia  
Drying method
- 5.2 Flux Class Dia  
Drying method
- 5.3.1 Shielding gas
- 6.0 Base Metal preparation
- 6.1 Joint design details  
(Give sketch showing arrangement of parts, welding groove details, weld passes & their sequence etc.)
- 6.2 Joint preparation
- 7.0 Welding current Type Polarity
8. Welder qualification
9. Welding parameters and technique
- 9.1 Welding Parameters

Weld Pass No.	Electrodes/ wire dia. (mm)	Current (amp)	Arc Voltage (volt)	Wire feed speed (m/min)	Travel speed (m/min)	Electrical stick out (mm)	Gas flow rate (litre/min.)
1	2	3	4	5	6	7	8

- 9.2 Welding sequence and technique :  
(Give sketch showing sequence and direction of welding).
- 10.0 Provision of run in and run-off tabs:
- 11.0 Cleaning of weld bead before laying next weld bead
- 12.0 Root preparation before welding other side of groove weld
- 13.0 Preheating and inter pass temperature
- 14.0 Peening:
- 15.0 Post weld treatment:
- 16.0 Rectification of weld defects:
- 17.0 Inspection of weld:
- 18.0 Any other relevant details:

Prepared by

Signature \_\_\_\_\_

Designation \_\_\_\_\_

Date \_\_\_\_\_

(for &amp; on behalf of Fabricator)

## 1. Proforma for Welding Procedure Qualification Record

## Name and address of Fabricator

- 1.0 Description of Weld  
 2.0 Welding procedure specification no.  
 3.0 Name of welder  
 4.0 Date of preparation of test piece  
 5.0 Dimensions of test piece  
 6.0 Base Metal  
 7.0 Welding Process  
 8.0 Welding position  
 9.0 Welding Current : Type :  
 : Polarity :  
 10.0 Weld joint design details :  
 11.0 Welding consumables :  
 11.1 Electrode/wire : Class :  
 : Dia :  
 : Brand :  
 11.2 Flux : Class :  
 : Type :  
 : Brand :  
 11.3 Shielding gas  
 12.0 Welding parameters

Weld Pass No.	Electrodes/ wire dia. (mm)	Current (amp)	Arc Voltage (volt)	Wire feed speed (m/min)	Travel speed (m/min)	Electrical stick out (mm)	Shielding gas flow rate (lit/min.)
1	2	3	4	5	6	7	8

13.0 Preheating and interpass temperature:

14.1 Results of Qualification Tests:

Test	Specimen No.	Result
1	2	3
<b>Non-destructive tests</b>		
i) Visual examination:		
ii) Dye penetrant test:		
iii) Magnetic particle test:		
iv) Radiographic/Ultrasonic test:		
<b>Destructive tests:</b>		
i) Macro-examination:		
ii) Hardness survey:		
iii) Fillet weld fracture test:		
iv) Transverse tensile test:		
Tensile strength		
Yield Stress		
Location of fracture		
v) All-weld tensile test:		
Tensile strength		
Yield Stress		
Elongation %		
vi) Guided bend test:		
Root bend test		
Face bend test		
Side bend test		
vii) Any other tests		

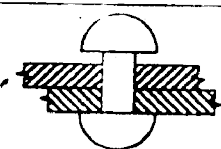
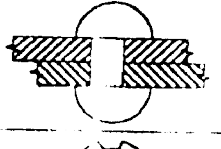
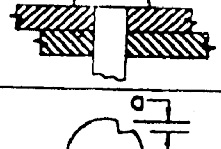
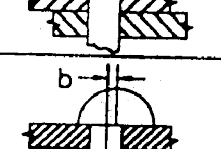
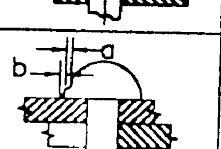
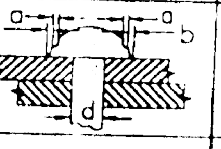
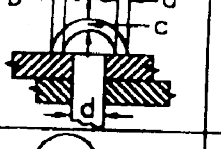
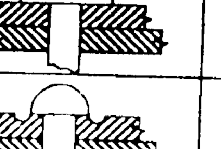
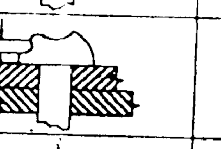


Signature

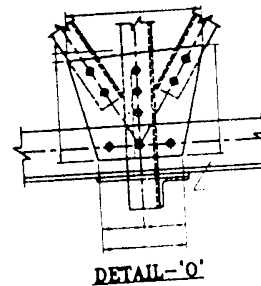
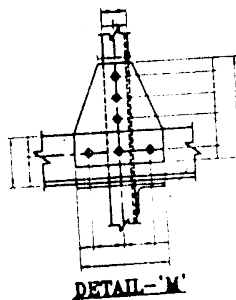
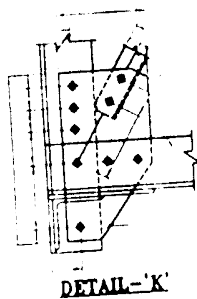
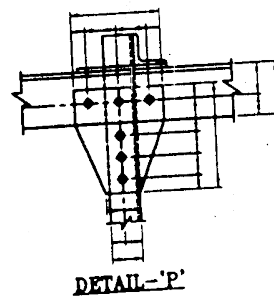
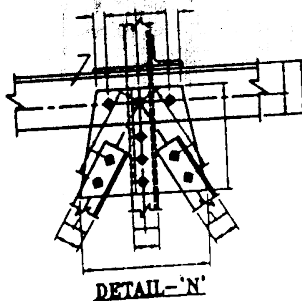
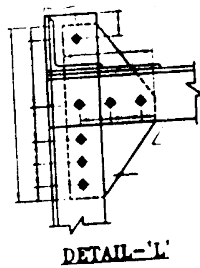
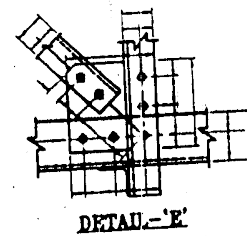
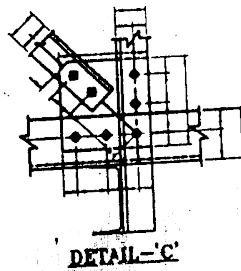
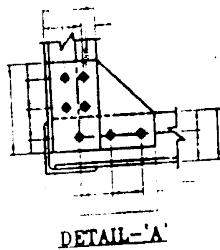
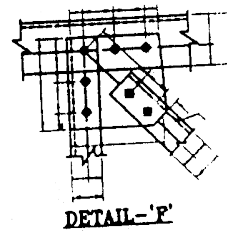
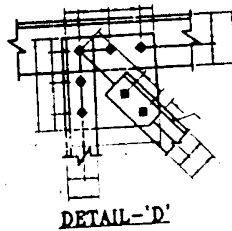
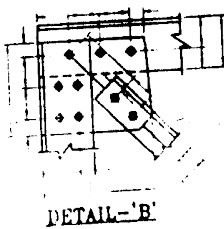
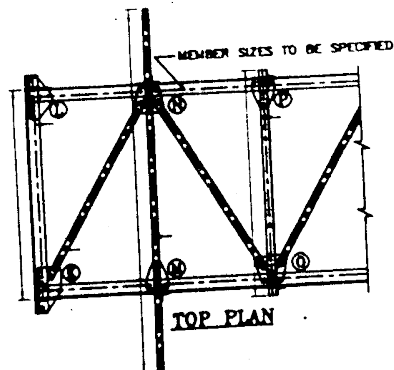
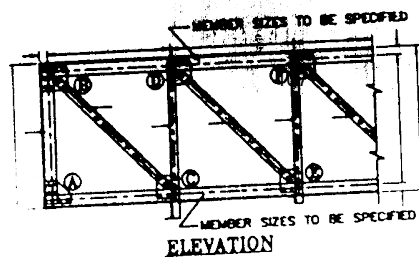
Designation

Date

(for &amp; on behalf of Fabricator)

# **PERMISSIBLE DEVIATIONS FOR DRIVEN RIVETS**

Sl. No.	DESCRIPTION OF DEVIATIONS	SKETCH	TOLERANCE
1	SHANKING OR SHIFTING OF THE HEAD UNDER THE KNOCKS OF HAMMER.		NOT ALLOWED
2	CAULKING OF THE HEAD		NOT ALLOWED
3	IMPROPER BEARING OF THE HEAD ON THE ELEMENT WHILE RIVETTING ALONG THE ENTIRE CONTOUR OF HEAD.		NOT ALLOWED
4	IMPROPER BEARING OF THE HEAD ON THE ELEMENT WHILE RIVETTING ALONG THE ENTIRE PART OF CONTOUR OR RIVET.		NOT ALLOWED
5	PRESENCE OF CRACKS IN THE HEAD.		NOT ALLOWED
6	NOTCH IN THE HEAD.		2mm
7	SHIFTING OF HEAD FROM THE AXIS OF RIVET.		$b \leq 0.1d$
8	BAD SHAPE OF HEAD ALONG THE PART OF CONTOUR OF RIVET.		$a+b \leq 0.1d$
9	BAD SHAPE OF HEAD ALONG THE ENTIRE CONTOUR OF RIVET.		$a+b \leq 0.1d$
10	HEAD OF REDUCED DIMENSION.		$a+b \leq 0.1d$ $c \leq 0.5d$
11	CROWN NEAR THE HEAD		NOT ALLOWED
12	NOTCHING OF STEEL BY SNAP.		NOT ALLOWED
13	UNEVENNESS OF THE SURFACE OF THE HEAD		$a \leq 0.3 \text{ mm}$
14	OBLIQUE RIVETTING		DEVIATION UP TO 3% OF THICKNESS THICKNESS OF JOINT ELEMENTS BUT NOT MORE THAN 3mm



- NOTE:-
1. ALL DIMENSIONS SHOWN BY ARROWS SHOULD BE SPECIFIED.
  2. MEMBER SIZES SHOULD BE SPECIFIED AS MARKED BY ARROWS.
  3. RIVET SIZES SHOULD BE SPECIFIED.

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**SAFETY PRECAUTIONS AND MEASURES TO BE OBSERVED DURING  
EXECUTION OF ROB/RUB WORKS IN RAILWAY AND ADJOINING AREAS**

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1.0 ROB/RUB work(s) in Railway area and for the approaches in adjoining area shall be got executed through experienced contractor with proven capabilities. As soon as the work of ROB/RUB is awarded, the Agency or the nominated Concessionaire shall submit the name of Contractor and the Supervision Consultant, if any, appointed to handle the Project under consideration. The Contractor shall nominate the Engineering Person-in-charge and submit the list of personnel to be available at the site along with their contact numbers and address. The contractor shall deploy/appoint only such nominated Engineer as Person-in-charge at site who has experience of execution of similar type of work(s) and should be exclusively assigned at one site at a time.

1.1 From Railways, the nominated 'Project Engineer In-Charge' and 'Engineer at-site' shall be responsible for coordinating various construction activities, and supervision control.

1.2 Personnel of the Supervision Consultant, wherever appointed for supervising ROB/RUB works, shall also be identified and their names along with contact numbers and address shall be forwarded to concerned Railway officials. The Project Management (Supervision) Consultancy Firm shall deploy only nominated 'Supervising Engineers' at site who have got supervision experience for similar type of work.

1.3 (a) Credentials of the Concessionaire/Contractor/Supervising Consultancy Firm and their Engineers/Personnel for execution of work should have been verified and issued by Railway Engineer not below the rank of Dy.Chief Engineer (JA Grade).

(b) Alternatively, the contractor's Engineer and Supervisor Engineer can get training under Railways' Training Institutes and obtain Training Certificate issued by such training organization, for the purpose of having requisite credentials and ensure safety at work site.

1.4 In addition, for Supervision of work(s) for Railways Bridge proper, Railway undertakings such as RITES, IRCON who have got expertise in supervision/execution of such type of work, can be considered and engaged by the sponsoring organization.

2.0 Construction Activities and Safety:

(a) The 'Methodology of Working' shall be incorporated in GAD and Temporary arrangement Drawings.

(b) The activities of work to be taken up during the Railway traffic block/under speed restriction etc. should be clearly mentioned in such drawings.

If at any stage of execution, any discrepancy is found in the drawing with respect to the site condition affecting safety or some new activity of work is required to be done, the same should be brought to the notice of Railway Engineer and such works should be done only after approval by Railways. In such cases, scheme may be modified and if required fresh CRS sanction shall have to be obtained.

2.1 The works required to be done under traffic block protection, are to be carried out only in the presence of Railway Engineering officials. The Railways supervisor has to certify safe conditions for passage of trains before resumption of traffic.

The works to be done under traffic shall be carried out under the provision of banner flag and protection of Engineering flagman. If considered necessary, the Railway flagman may be posted on account of the contractor.

2.2 Following important activities of works shall be carried out under supervision of Railway Engineer or his nominated Supervisor :

- a) Excavation at foundation/Ground level near to Railway track.
- b) Concrete Casting and/or masonry very close to Railway track.
- c) Erection of temporary structures near to running lines.
- d) Casting of structures like girder/slab over railway track.
- e) Stage-Prestressing of girders when placed across Railway tracks properly supported.
- f) Launching of precast/pre-assembled girders across Railway tracks.
- g) Any work of lifting, side shifting and slewing of girders over the Railway track.
- h) Dismantling of temporary structures, shutters, scaffolding, etc. adjacent to and above the Railway track.

For carrying out activities of casting, erection, launching, handling and dismantling as listed above, the Contractor's Engineer shall furnish the Construction Programme in advance to Railway Supervisor engineer. No such work should be taken up in absence of the Supervising Railway Engineer. For the activities which are to be done in presence of the Railway Engineer, prior intimation shall be given in writing and acknowledgement obtained from Railway's representative. Such activities of work shall not be carried without the presence of Railway Engineer.

2.3 To ensure 'Safety' during construction activities, Railway Engineer may direct the Contractor/Supervisor Engineer or their nominated representative for safe working procedures/instructions, notwithstanding the contractual or MoU conditions prevailing between/amongst Railways/other departments like NHAI/Contractors/ Concessionaire.

2.4 All the records of Quality Assurance/<sup>110</sup>Quality Control, testing of the materials and satisfactory completion of an activity shall be maintained at site by the Contractor's Engineer and Supervising Engineers. On the basis of these records, Railways' Engineer shall do stage-wise clearance of the works at following stages:

- i) Completion of foundation
- ii) Completion of substructure
- iii) Completion of superstructure

Without such stage clearance, the work in next stage of construction shall not be allowed by the Railway Supervisor, unless proper system of check and exercise is followed at the site.

2.5 Normally, the high beam PSC girders are designed with wider top flange and shorter bottom flange with very high beam which makes the girder unsuitable during lowering, slewing and launching time.

2.6 During launching of girders and subsequent adjustments for placement of bearings special attention and precautions are required at site to be followed rigorously without resorting to shortcut practices or leaving the work at site to untrained or inexperienced engineers. Normally, end diaphragms are not casted for the extreme both side girders. These shall to be casted min. 300 mm. on both sides for all 'I' beam girders to provide temporary supports for ensuring stability.

Or,

For side adjustments and bearing placements below 'I' section girders, end brackets made of steel angles should be provided for all 'I' beams sequentially to avoid side tilting of individual girders. End brackets shall be removed only after placing girders on bearings and casting of diaphragms.

2.7 During lowering, the jacks shall be operated duly keeping wooden packing of various thicknesses fixing the amount of lowering to the bearest minimum, so that even if the jack fails, the wooden packing will take load and further stability of girder is not endangered.

2.8 Temporary crib support staging shall be interlaced with clamps and angles. Adequate base width shall be maintained in proportionate to the height of stage, which is very essential for avoiding the ablong effect during launching of girders. During launching by RH girder method the movement of the PSC girders shall be controlled both from front and rear with wynch mechanism having simultaneous operation, so that the speed of the launching is always under the control. Spare hydraulic jacks shall always be kept at side.

Lowering of girder shall always be carried out at one end only. Further, other end should be adequately secured by wire ropes, end brackets, etc. Thereafter, the alternate process shall be continued.

2.9 As far as possible launching of girders by temporary staging shall be avoided, and launching by heavy capacity cranes, wherever feasible, shall be adopted.

2.10 Steel girder launcher if used for launching of PSC girders, should be pre-tested for the critical loading (likely to be encountered during actual launching) before deployment on the approaches regarding its strength as well as amount of permissible deflection using actual test PSC girder as a testing load. Connections at supports shall be inspected and certified. Prior to actual launching, it shall be adequately secured to the base support system on the pier cap.

### 3.0 General Construction Safety:

3.1 General Safety Precautions as applicable for bridge/civil works shall be adopted in field.

3.2 Working near running line: Safe practices at site, and at all times non-infringement to moving trains shall be ensured. Road vehicles, material trollies, dollies with any tendency to roll off towards the running lines to be checked by providing chains, locking arrangements, blocks etc. shall be ensured and the Site Incharge of the Contractor shall be primarily responsible, secondary responsibility being of Supervisor's Consultant.

3.3 Testing of cranes, lifting jacks and other equipments: All equipments like cranes, lifting jack shall be tested, duly calibrated and certified prior to use at construction site.

3.4 Construction workers at site shall be provided with personal safety gear like reflective vest, helmet, leather shoes, gloves, eye-wear – approved as per construction industry standards. For persons working at pier top/girder level, temporary supports, hand railing, protection with help of ropes, slings and temporary railings shall be provided.

3.5 Routine Safety Checks, validity of test certificates for load bearing equipments especially for cranes outsourced from third party shall be ensured prior to deployment.

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