SOUTH CENTRAL RAILWAY

SPECIAL CONDITIONS-TECHNICAL FOR OPEN WEB GIRDERS

GENERAL FEATURES:

Supplying, Fabrication, Transportation, Assembling & Erection of Super-structure OWG steel Girders.

- Supply, fabrication & fixing of ‘H’ Beam sleepers.
- Supply & fixing of Spherical bearings.
- Provision of Side path way conforming to RDSO Drg. No. CBS-0045.
  Other Connected Misc. Works.

i. Any temporary arrangement, strengthening of member(s) if required in connection with launching of girders shall be at Contractor’s cost including restoring it back as per original standard drawing.

ii. On completion of work, the contractor shall clear all temporary staging/other arrangement and other obstructions to the natural waterway if any at his own cost.

iii. Contractor has to ensure proper camber as per drawing irrespective of launching scheme.

iv. End brackets at both ends are to be provided on one end span & the remaining span have brackets at one end only.

v. Automatic submerged arc weld should be employed for butt & fillet welds wherever shown.

vi. All welds are to be made by approved welders using approved welding procedures.

vii. The welders intended to be deployed for fabrication of steel bridge girders should be qualified in addition to the provisions of IS:7310 Part-I and the following: (a.) Welders to be engaged should at least be High school pass and preferably trained from ITI or a reputed welder training institute. This provision of educational qualification shall not be applicable for the welders already qualified & working satisfactorily. (b) Oral andwritten test to be made mandatory for qualifying new welders. (c) No welding by the fresh welders to be allowed till they get the welder qualification test (WQT) certificate issued. If feasible, WQT certificate to be issued at site only. (d) In case of renewal of WQT certificate for the existing welders, the test procedure to be clearly specified. Besides the existing provisions, oral test and evaluation of records of welding be insisted upon.

viii. Fabrication shall be done as per IRS– B1 – 2001 & IRS welded bridge code - 2001. QAP (Quality assurance plan) shall be submitted by the agency and is to be approved by RDSO before commencement of work. All butt welds are to be examined preferably by using Phased Array Ultrasonic Testing (PAUT) in NDT testing in fabrication of steel bridge girders. All other welds may be examined by radio graphic or any other non-destructive method which are equally effective. All the welds shall also be examined by liquid penetrant detection method or by magnetic particle flaw deflection method as per IS: 3658 AND IS: 3703.

ix. The girder fabrication and welding shall be inspected and certified by Research, Design and Standards Organization, Manak Nagar, Lucknow in accordance with IRS welded bridge code – 2001 with latest correction slips. The inspection charges will be borne by the Railways.

x. The girder components/girders shall also be inspected and passed by Railway's authorized representative as per BI – 2001.

xi. Inspection: For fabricated component and trial assembly inspection of the layout, jigs, templates, fabricated component as well as trial assembly shall be done by RDSO as per IRS/B1-2001 and inspection of erection of girder shall be done by Railway's Representative/Engineer-in-charge.

xii. It will be the responsibility of the supplier to get material inspected timely. Railway shall not entertain any correspondence regarding late inspection of the material by the inspecting authority.

xiii. Railway administration shall not provide any assistance for the procurement of raw material for manufacturing the girders tendered for. Tenderer should quote rate of steel with all taxes inclusive of lead lift and expenses thereon.

xiv. In case of any deviation from standard RDSO drawing, contractor will have to prepare detailed drawing and submit the same for approval before commencement of work.

xv. Contractor will arrange accommodation for inspecting official of Railways/RDSO official and conveyance from Railway station to their Workshop as well as erection site and back to Railway station free of cost. He will also ensure to offer sufficient quantity of material for inspection to the inspecting officials on their visit to workshops, failing which expenses incurred on such inspection will be deducted from the running bills of the contractor.

xvi. The quantities are approximate. The Railway reserves the right to increase/decrease the same.

xvii. Contractor shall hand over free of cost following measuring equipment along with calibration certificate to engineer in charge before the start of the work for calibration & cross checking of contractor's work. These measuring equipment shall be retained by Railway after the completion of work. Measuring equipment to be supplied are (i)standard gauge cum level of PIE or similar make, (ii)Weld fillet gauge, (iii)Bridge CAM type weld gauge, (iv)automatic weld gauge, (v) leaf type weld fillet gauge, (vi)Rivet profile gauge, (vii) Vernier Calipers, (viii) Digital paint thickness gauge of make Elcometer or similar with extended probe attachment along with calibration test certificate capable of measuring galvanization & subsequent painting up to 1000- micron thickness over steel. Preparation of QAP (Quality assurance plan), WPSS (Welding procedure specification sheets), shop drawings etc for fabrication of steel work based on RDSO's relevant drawings and preparation of necessary jigs, templates etc for all components of the girder including bearings and get them approved/passed by RDSO.

xviii. Trial erection of first span of the girder and getting it passed by RDSO.

xix. As per Rly. Bd. Lr.dt:24.10.2016 , For the steel girders of important bridges (as defined in IRS Sub Structure Code),besides RDSO approved firms, the tendering firm can also be other than RDSO approved firm for Steel Bridge Girders subject to the firm fulfilling technical and financial eligibility criteria as prescribed by the Railway in the tender and the site fabrication work shop of the firm shall be set up at site of work which meet with the Schedule of Technical Requirement (STR) for Steel Bridge Girders issued by RDSO time to time. The approval of the site fabrication workshop meeting with the STR to be done by RDSO only and not by any other organization. The existing system of approval by Railway officer not below JA Grade is discontinued.

Any other particulars required in connection with the above work can be perused in the office of the Chief Administrative Officer/ Construction /S.C.Railway /Secunderabad - 500025 or Deputy Chief Engineer/ Construction /S.C. Railway during working hours on any working day.

SPECIFICATIONS:

The execution of all works under this Tender/Contract shall conform to the specifications and codes of practice mentioned below and as mentioned in other part of this document as amended from time to time.

i) Indian Railways Unified Standard Specifications for works and materials – 2019 Vol. I and II.

ii) For Earth work in embankment: RDSO guide lines issued vide GE: IRS-0004 (Sept, 2020),

iii) Indian Railways Standard Concrete Bridge Code (Revised) 2014 read in conjunction with Indian Standard Specifications mentioned therein.

iv) Notes in South Central Railway Unified Standard Schedule of Rates, 2021

v) IS Code No. IS/2062 - Supply of steel for fabrication purposes.

vi) I.S.456/2000 Code of practice for plain and reinforced concrete.

vii) Indian Railway Permanent-Way, Bridges and Works Manual.
viii) Indian Railway Standard Schedule of dimensions.

ix) The works shall be carried out to the relevant I.S. Codes of practice and other specifications mentioned in plans.

Note: -

1) Latest edition including correction slips up to date of submission of price bid /revised bids, shall govern.

2) The list given above is by no means exhaustive. All I.S. and I.R.S. codes pertaining to Work shall be applicable.

3) Copies of plans and additional information required may be had by tenderers from office of the Chief Administrative officer, Construction, S.C. Railway, Secunderabad or office of Deputy Chief Engineer/Construction/ S.C.Railway on any working day during office hours.

The Railway reserves the right to reject or alter any part of the work executed by the contractor which in the judgment of Railway does not comply with the requirements of the above specifications. The decision of the Railway shall be final and conclusive for all purpose.

SPECIFICATIONS AND SPECIAL CONDITIONS FOR CONCRETING, READY MIXED CONCRETE & STEEL REINFORCEMENT

1.0. MATERIAL & IS CODES.

i) Concrete: 1S 456, IS 4926(Ready Mixed Concrete)

ii) Cement: IS 12269 (53 grade OPC).

iii) Aggregates: IS 383-1970.

iv) Steel Reinforcement: IS 1786

2.0 CEMENT:

Supply and usage of cement shall be as per the IRU standard specifications 2019.

2.1. The cement shall confirm to the specifications of ordinary port land cement as per the site requirement and as approved by the Engineer-in-charge.

2.2 In addition to confirming to IS specifications as detailed above, the contractor(s) Shall procure Cement from the reputed cement companies/ brands but not cement manufactured by minor cement plants. The make should be approved by the Railways.

2.3. The contractor should submit the bill of purchase of cement to the Railways for Verification and record. Contractor shall also submit a test certificate issued by the manufacturer for standard properties of cement for verification & record.

2.4 Occasionally Cement has to be got tested at reputed private/Govt. laboratories (or) Engineering colleges as per the directions of Engineer-in-charge and submit the report. Charges for such tests shall be borne by the contractor.

2.5. Storage of cement:

2.5.1. The contractor shall make his own arrangements for storage of cement and other materials and see that no damage takes place during storage. The storage of cement should confirm to standard height in a column to avoid damage during storage.

2.5.2. The Railway reserves the right to inspect the storage accommodation of the contractor and to reject in the event of any clotted cement is noticed or any other cement which is not suitable for usage of work and not confirming to the specifications and no compensation will be made for the loss if any sustained by contractor on this account. A ledger shall be maintained at site showing the quantities of cement procured, date wise consumption and balance available at site. These Ledgers are to be jointly signed by the JE/ SE/Works at site and contractor/his representative.

2.6. CONSUMPTION/USAGE OF CEMENT:

2.6.1 The contractor shall take all precaution for effective usage of cement between the period of procurement and period of usage without losing any strength of cement.

2.6.2 The contractor shall ensure the consumption of cement specified under each item of work correctly. No sub-standard work on this account shall be permitted. If for any item of work at any stage, the Railway finds that less consumption was effected, such item of work will be rejected and cost of removal of such items of work and re- doing the same shall be borne by the contractor. The decision of the Engineer in charge in this regard is final & binding on the contractor. No claims will be entertained on this account.

2.6.3 Cement when brought to work site shall not be more than 6 weeks old from the date of manufacture.

2.6.4 Cement should be consumed within 3months from the date of manufacture, if due to any reasons it is not possible to use the cement within 3 months then it should be tested and if found fit then it may be permitted to use in the lean concrete or other unimportant items of work. However, cement older than 6months should not be allowed to use in any type of works

2.7 PAYMENT FOR CONTRACTORS CEMENT:

Payment for the supply of cement will be paid under relevant item of supply of cement under relevant schedule. Payment for above item will be made on the basis of actual consumption in the item/as per approved design mix and no advance payment will be made on procurement of cement. No extra payment will be made for wastage.

3.0 **AGGREGATES** shall be as per the IRU standard specifications 2019:

3.1. Aggregate shall consist of naturally occurring stones, gravel & sand. They shall be hard, strong, dense, durable, clear and free from injurious amounts of disintegrated pieces, alkali, vegetable matter and other deleterious substances.

3.2. Materials for concrete such as granite stone metal, sand, etc., should also be collected from outside Railway's land and the Contractor shall pay all seigniorage charges.

3.3. Aggregate shall not contain any harmful material such as pyrites, coal, lignite, mica, shale or similar laminated material.

4.0 **COARSE AGGREGATE** shall be as per the IRU standard specifications 2019.

5.0 **FINE AGGREGATE** shall be as per the IRU standard specifications 2019.

5.1 Fine aggregate shall be of approved quality and grading to IS 383, IS 456 & IS 1343 standards. It shall be clean, sharp, angular, and gritty to touch and composed of hard siliceous material. It should also free from impurities & deleterious substances.

5.2 FA grading shall fall within the limits of grading Zone I; II & III as per IS 383. The decision of Engineer in charge shall be final and binding on the contractor regarding the approval of the coarse and fine aggregate for concreting works. 5.3 The contractor shall be required to carry out weighing and sieving aggregates, if directed by Engineer in charge and all costs shall be borne by the Contractor.

6.0 **CONCRETE WORKS:** shall be as per IRU Standard Specification-2019.

6.1 Supply of RMC

i. In case the total quantity of RCC/PSC/CC/MCC involved is significant (say 15,000 Cum or more) the Contractor shall preferably set up his own RMC plant at site or shall make suitable exclusive arrangement close to the site to ensure high quality RMC supply.

ii. Use of RMC shall also be mandatory in the work where substantial quantity (say 500 Cum or more) of RCC/PSC/CC/MCC is involved and work site is located in Urban areas and RMC plants are readily available nearby.

iii. The specification for RMC shall confirm to IS 4926-2003 as well as IRU Standard Specifications, 2010.

iv. The RMC plant shall be inspected and approved by concerned Dy.CE/C/BZA. The accepted rates of items of RCC/PSC/CC/MCC shall be deemed to be for RMC. Nothing extra will be payable for RMC in the Contract of work. However, if RMC is not feasible in certain isolated portion of work, then conventional concreting can be allowed by Engineer-in charge in such isolated locations/portions with the same rates.

6.2 Concrete required for all works shall be machine mixed using weigh batches. Hand mixing will not be permitted. The Contractor should keep vibrators of 25mm needle for jacketing work and 40mm needle for concrete work. Standby needles and vibrators should be kept. During the course of concrete work if vibrator is not working the work shall be stopped. The materials proposed to be used for the work should pass tests/analysis as prescribed in relevant IS/ IRS codes & manuals. An approval given by the Railway in consequences of such tests or analysis shall limit or interfere with the absolute Right of the Railway to reject the whole or portions of such materials supplied which, in the judgment of the Railway do not comply with the specifications. The decision of the Railway in this regard shall be final and conclusive for all purposes.

6.3 The contractor shall prepare at his own cost, standard cubes of concrete at specified intervals during concreting operations under the supervision of the Engineer or his authorized representatives and submit the same to the Railway for testing and approval. Contractor should arrange equipment for testing of concrete cubes at site. Based on the discretion of Engineer –in –charge certain cubes shall be got tested reputed private/Govt. laboratories (or) Engineering colleges as per the directions of Engineer- in – charge. Charges for such tests shall be borne by the agency.

6.4 While executing all concrete works below sub-soil water level the foundation pit must be kept free of all seepage water by bailing or pumping or in any other manner. The rates adopted for concrete items below bed/ground level are inclusive of the charges.

6.5 As this work is located in “Severe/Moderate” category of environment the minimum cementitious material content in concrete structures shall be as given below and the actual consumption of cement depends upon the requirement as per design mix. Plain concrete -- 300/250 Kgs. Cement/Cum R.C.C. -- 350/300 Kgs. Cement/Cum. NOTE: For under water concrete 10% extra cement should be added over and above the normal cement content of the concrete mix specified above. For SSR items the cement consumption shall be as specified in the USSR, 2019.

6.6 **DESIGN MIX:** Nominal mix concrete shall be permitted for concretes of M-20 and lower. For all other grades design mix concrete shall be used. All the concrete mixes richer than M-20 specified in the schedule of items for various works shall be designed by conducting tests on raw materials such as aggregate, sand and cement on strength criteria only. The contractor has to submit the design for design mix concrete from a recognized /approved laboratory/ reputed engineering colleges. Designing of concrete mix shall confirm to IS 10262.These design mixes will be approved by Engineer-in-charge before commencement of concrete works, only after conducting tests and sample test cubes cast as per design mix with the ingredients available at work spot and intended to be used in the works. Minimum and maximum cement content in the design must be as per Indian Railway concrete Bridge code, read along with all relevant correction slips issued up to date.

6.7 All the concrete works shall be done only in the presence of the SSE/JE/Work. The programme/ planning of the concrete works shall be submitted to XEN/AXEN well in advance so as to direct SSE/JE/Works for witnessing the same.

7.0 Curing shall be executed as per IRU Standard specification-2019 for IRUSSR-2019 items.

7.1 All concrete work in cement, mortar/plaster pointing etc., shall be continuously cured for the prescribed period as per direction of the Engineer. Curing shall be done by covering the newly laid concrete with gunny bags and keeping them wet constantly. If it is found that the contractor is not properly observing these instructions, the Engineer may undertake the curing through another Agency/labour without any notice to the Contractor at the cost of the contractor. The cost incurred along with incidental charges @ 2% and along with supervision charges 12.5% of the cost will be debited to the Contractor. Intimation of the employment of another agency, for curing will be given to the Contractor as soon as possible. This intimation in writing to the Contractor under the head of the Engineer-in-charge of the work shall be conclusive evidence of the employment of another agency.

8.0 **USE OF SAND COLLECTED FROM THE WATER COURSES WITHIN THE RAILWAY LAND:** If the sand available in the river bed water course with in the Railway land, and if it is found suitable for the works, the contractor can collect the sand from the area within the Railway boundary and utilize the same for the works.

The Railway will not levy any charges for sand so collected for the work within the Railway boundary. However, seigniorages charges if any payable to state or local authorities shall be borne by the Contractor. The tenderer shall take these aspects in to account while quoting the rates. The location of the borrow pits for collection of sand within the Railway area should be approved by Engineer-in-charge.

09.0 **SHUTTERING ARRANGMENTS** shall be executed as per IRU Standard specification-2019 for IRUSSR-2019 items.

10.0 **SUPPLY, FABRICATION AND ERECTION OF STEEL WORK** shall be executed as per IRU Standard specification-2019.

10.1 For works the contractor is required to use own steel for reinforcement. Payment for supply of reinforcement steel in MCC / RCC/PSC items will be made under respective Schedule.

10.2 The Contractor is required to safeguard the steel and use the same on the work in accordance with the actual requirement as approved by the Engineer and as may be indicated in the relevant drawings or specifications.

10.3 The Railway reserves the right to inspect the storage yard of the contractor, where the steel materials are stored and take samples wherever considered necessary, got them tested by agency for Physical & Mechanical properties, chemical composition as directed by the Engineer-in-charge at reputed private/Govt. laboratories (or) Engineering colleges as per the directions of Engineer- in – charge and submit the report. Charges for such tests shall be borne by the contractor. If the steel is found to be not confirming to relevant IS 1786 and IS: 2062 provisions, the entire steel lot represented by the tested sample will be rejected. The contractor shall not use any such reinforcement & will lift them from site at his own expenses. The contractor cannot claim in such an event any losses, damages, expenditure incurred by him and Railway shall not entertain any claim on this account.

10.4 The payment for the steel reinforcement will be made on bar bending schedule and the quantity shall be arrived by converting the lengths into weight based on sectional weight. While working out the quantity consumed, the overlaps, hooks, bends, chairs will be taken into account. If there is any wastage, it shall be to the contractor’s account. The item for placement of reinforcement steel is provided with cost of binding wire.

a) Supply and placement of reinforcement steel and supply, fabrication and erection of structural steel shall be as per IRU Standard speicifications-2019.

b) All Reinforcement Steel (TMT Bars) and Structural Steel shall be procured as per specifications mentioned in BIS's documents – IS: 1786 and IS: 2062 respectively. Independent tests shall be conducted for physical & mechanical properties, chemical composition at reputed private/Govt. laboratories (or) Engineering colleges to ensure that the materials procured conform to the specifications. If the steel is found to be not confirming to relevant provisions, the entire steel lot represented by the tested sample shall be rejected. It shall be ensured that a bill copy along with manufacturer's test certificate is submitted at the time of supply of material.

c) The reinforcement steel and structural steel shall be procured from the following firms, circulated as per sl.no.4 & 39 vide PCE/SC's office letter No.SCR-HQ0ENGG(SOR)/1/2020-Dy.CE/WORKS/SCR dt.06.03.2020, which are Established, Reliable, Indigenous & Primary Producers of Steel, having Integrated Steel Plants (ISP), using iron ore as the basic raw material and having in-house iron rolling facilities, followed by production of liquid steel and crude steel, as per Ministry of Steel guidelines.

S.No.	**Brand**	**Make**
1	SAIL	Steel Authority of India Ltd
2	VIZAG	Rastriya Ispat Nigam Ltd
3	TISCO	TATA Steel Ltd
4	JSW	JSW Steel Ltd

The same has been re-iterated vide PCE/SC's letter No. No.SCR-HQ0ENGG (SOR)/ 22/2019-Dy.CE/WORKS/SCR dt.15.03.2022, wherein, it was stated that there is already an approved list of vendors.

d) However, only certain isolated sections of structural steel, not being rolled by ISPs, can be procured from the authorized re-rollers of ISPs or authorized licensee of BIS having traceability system and who use billets produced by ISPs. The traceability of the material shall be ensured by an officer authorized by the concerned CE/C on case to case basis for this purpose.

ANNEXURE

LIST OF EQUIPMENTS FOR TESTING LABORATORY TO BE ESTABLISHED BY THE SUCCESSFULTENDERER AT THE SITE OF WORK

Contractor should provide a testing lab at site/nearest stations /or nominated /specified location as instructed by the Engineer-in-charge in Railway premises with following facilities:

S.No.	Description of equipment	Unit
1.	IS set of sieves with base & top lid 65mm, 40mm,20mm, 16mm, 10mm, 4.75mm, **2mm, 600 mic, 425 mic, 212 mic, 75 mic.**Equipment for checking moisture content , maximum dry density etc., (core cutters with cap, hammer, stove, Electronic weigh balance, kerosene stove/ oven, pan etc and other tools/plant/materials required for doing soil compaction test), Plastic limits apparatus, Liquid limit apparatus, Moisture meter with accessories, Standard modified proctors test apparatus, etc.	2 Sets
2.	**Hand/motor operated sieve shaker for above sieves**	2 Nos.
3.	Balance	
	a) Pan balance - 10 Kg capacity (with 1.0 gm least count)	2 Nos.
	b) Electronic/digital balance – 10 kg capacity (with 1 gm Least Count)	2 Nos.
4.	Sieve brush - Wire brush	As required
5.	Concrete Cube testing Machine -200Tonne capacity - Electrical-cum-hand operated with single pressure gauge	1 No.
6.	Slump cone test apparatus with tamping rod	2 Nos.
7.	Cube moulds 150x150x150mm	24 Nos.
8.	Vikat's needle test apparatus with dashpot	1 No.
9.	Flakiness Index Test apparatus	1 No.
10.	Elongation Test Apparatus	1 No.
11.	Aggregate impact value test apparatus	1 No.
12.	Auto Level with accessories	2 Nos.
13.	Thermometer for concrete	2 Nos.
14.	Digital camera off 10.0megapixel or above of reputed brand like Sony, Canon, etc with still/video shooting and SD card	1 No.
15.	Desktop PC, with LCD monitor minimum 20 " wide or Note book with WIN- 7 OS, MS office & MS Project	1 No.
16.	All in one A3 size ink jet printer & mobile /portable colour Printer	1 No. each
17.	Screw gauge	1 No.
18.	Vernier caliper	1 No.
19.	Total Station	1 No.

Date: Name and Signature of Authorized Signatory

NOTE: 1. No payment will be made to the contractor on this account. Land/ open space required for the laboratory will be provided by the Railway free of cost. After completion of the work, contractor can take back all machinery and establishments etc., Contractor is deemed to have taken this into consideration while quoting his rates.

2. The above list is only tentative and the actual requirement will be given by the Engineer in charge before commencement of work. The above equipment can be taken back by the contractor after completion of work as is where basis is.

SPECIFICATIONS FOR H-BEAM SLEEPERS & FITTINGS FABRICATION OF H-BEAM SLEEPERS:

1. Fabrication of H-Beam Sleepers shall be done at bidder's own workshop with his own tools, plants, machines and consumables as per RDSO's Drawing Nos. RDSO/B-17001, B-1363/4,5,6& RH-1122, RH983 and other drawings mentioned therein and as per RDSO's specification No. BS:45. H-Beam Sleeper should be made of standard rolled section IS HB-200 @37.3 kg/m conforming to IS:2062Gr.B. Beams and MS Plates to IS:2062 Gr.B fully killed and normalized steel. The H-Beam Sleepers and all the required MS fittings shall be galvanized as per IS:4759.

2. The test on sleepers should be done as per RDSO's guidelines. The Agency will arrange to conduct test as per RDSO's guidelines on completed H-Beam Sleepers.

3. The fittings of H-Beam Sleepers shall be inspected by RDSO/RITES and used only after RDSO/RITES certification. The charges for this inspection will be borne by the Agency. The required fittings like elastomeric pads of steel sleepers shall be procured from RDSO approved sources and their inspection shall be conducted by RDSO. The testing and test on the sleepers should be done as per those with Beams as mentioned above.

TRACK LINKING WITH H-BEAM SLEEPERS:

1. For linking of track on girders the provisions in the IRPWM-2004, IRICEN Pune's publications on quality control in the track linking, track circulars issued by Railway shall be followed.

2. Design and provision of Guard rail shall be as per para 275(2) of IRPWM,2004. The end of the guard rails should be bent vertically and buried and a piece of timber fixed on the end of prevent entanglement of hanging loose couplings.

3. The linking of track on girders with H-Beam Sleeper shall be done as per RDSO's drg. No. B-1634/4, 5 & 6 and instruction/notes laid therein. Track fitting of H-Beam sleeper should be as per drawing no. RH983 & RH-1122 developed by M/s. Rahee Industries Ltd., Kolkata or as per guidelines issued by RDSO and or as directed by the Engineer. H-Beam sleeper shall be laid at a maximum spacing of 740mm centre to centre for BG.

4. The rails and guard rails shall be fastened to sleeper as per RDSO's Drawing No. B-1636/5 and as per Drg. No. T-5155 to 5164. The gangway shall be provided as per RDSO's Drg. No. B-1635/5. TEST CERTIFICATES.

1. All materials for the work shall pass tests and / or analysis prescribed by the relevant IS specifications or such other equivalent specifications.

2. All raw materials shall be obtained from recognized producers or their authorized representatives and the contractor shall furnish copies of test certificates from the manufacturers including proof sheets, mill sheets etc. showing that the materials have been tested in accordance with the requirements of various specifications and codal provisions and to the satisfaction of the Railway.

3. Any approval given by the Railway in consequence of such tests or analysis shall in no way limit or interfere with the absolute right of the Railway to reject the whole or part of such materials supplied, which in the judgment of the inspecting authority/Engineer does not comply with the conditions of the contract. The decision of the Engineer in this regard shall be final, binding and conclusive for all purpose.

A. GALVANIZED STEEL H-BEAM SLEEPER

i) Fabrication & Supply of Steel H-Beam Sleepers to suit RDSO's 61.0m 25T Loading Welded span (RDSO's Drg. No. B-17182 to B-17182/17) with all riveted/Welded components as per RDSO's drawing No. B-1636/4, B-1636/5 & RH-1122 (with latest alteration) and other drawings mentioned therein or approved drawing supplied by Railway and specification thereto complete in all respect including supply ad riveting of canted bearing plates. Relevant specification & schedule of H-Beam sleeper enclosed herewith.

ii) H-Beam Sleeper should be made of rolled section IS: HB 200 confirming to IS:2062 Gr.B (withlatest revision and after fabrication shall be galvanized as per IS:4759)

B. FITTINGS & FIXTURES (GALVANIZED EXCEPT NON-METAL)

i) Supply of Fittings for steel H-Beam sleepers to suit (RDSO Drg. No. BA-11481) shall be done as perDrawing No. RDSO/B-1636/4, 5 & 6 and other drawings mentioned instruction / note laid therein. Track fitting for H-Beam sleeper should be as per drawing no. RH-983 & RH-1122 developed byM/s. Rahee Industries Ltd. Kolkata or as per guidelines issued by RDSO or as directed by theEngineer. Relevant specification & schedule of H-Beam sleeper fittings enclosed herewith.

ii) H-Beam Sleeper MS fittings shall be galvanized as per IS:4759.
iii) Material List & DODL List per Sleeper for Steel H-Beam and Fittings should be prepared bymanufacturer and get the approval from our design department before execution of the work.

2. INSPECTION /TESTING / TEST CERTIFICATES:

• The finished steel H-Beams and all riveted/welded components are subject to inspection byDy.CE/C/BZA, South Central Railway or their nominated representative.
• All expenses involved for Inspection /Testing shall be borne by the H- Beam sleeper manufacturer.
• The H-Beam Sleeper manufacturer have to provide assistance, instruments, machine, labour and anymaterial which are required for examining , measuring and testing of any materials and workmanshipas may be selected and required by Dy.CE/C/BZA, South Central Railway or their AuthorizedRepresentative without any extra cost.
• INSPECTION CALL LETTER should be sent by the H-Beam Manufacturer minimum 5 (five) days in advance at our Office Dy.CE/C/BZA

PER SET STEEL H-BEAM SLEEPER FITTINGS.

Sl. No.	Description	Drawing No.	QuantityrequiredPer Sleeper (in No.)
1	28mm dia x 350mm long hook bolts with double nut.	B-1636/5	4
2	Single coil spring washer for 28mm dia Hook bolts	B-1636/5	12
3	Elastomeric Pad (320 x 25/30 x 305)	B-1636/5	2
4	Rail Pad with Embedded Steel Pad Plate	RH-1154	2
5	Tapered Washer	T-5161	4
6	Tapered Washe r	T-5162	4
7	G. R. Pad 6mm thick	T-5163	4
8	Bolt & Nut	T-5164	4
9	Single Coil Spring Washer	T-10773	4
10	Tapered Split Pin	Suitable	8
11	Elastic Rail Clip	RH-1122	4
12	Special Liner	RH-1122	4

Note :-Above no. of fittings per sleeper are approximate. However, fittingsshould be as per drawing No. RDSO/B-1636/4, RDSO/T -5200, RH -983 & RH-1122 along with all specifications as mentioned on drawings and or as directed by the Engineer.

BEARINGS – SPECIFICATIONS

Bearings as per RDSO/B-17184/3

Section 1.0: Bridge Bearings- Rocker and Roller Bearing

1. **General:** The railway track on this Section shall be electrified. The superstructure should be isolated from the bed block by suitable insulating material. TheRocker and RollerBearings shall be provided as per specifications and requirements.

1.2 Work Included Furnish all labour, materials and equipment required for the design, manufacture, supply and installation of Rocker and Roller Bearingsshown on the Drawings and/or in the Specifications and include but not limited to the following:

Related Work

i). Examine work done by other agencies:

Before commencing fabrication of the work of this item, the Contractor installing the bearings is required to inspect and take field measurements of work done by other Agencies which may affect the work. Before commencement of the work, the contractor shall notify the Engineer in writing, of his acceptance of work done by other Agencies. If any conditions exist which are likely to affect a proper installation of the work, the Engineer shall be notified in writing, and installation shall not proceed until such conditions are addressed and the Engineer has received the letter of acceptance from all agencies.

ii). Co-operation:

Where items of other Agencies are to be built into the work of this item, e.g., anchorage to be inserted / affixed into the pedestal / superstructure steel, etc., such items shall be procured and provided in ample time to avoid delay. The Contractor shall attend upon and cooperate with other agencies in respect of the work of this item and do everything necessary to enable the work of other agencies to be completed without delay.

1.3 Technical requirements:

Approvals: Prior to manufacturing the bearings and prior to the construction ofthe bearing pedestals/seats, the Contractor shall submit the following Information to the Engineer for consideration and approval:

The Design standards, materials, manufacture & technical data and QAP for Fabrication, Testing/Inspection & Installation Plan of bearings.

ii) The Contractor shall submit the manufacturer’s TechnicalApproval Document as approved by RDSO for the Rocker and Roller Bearingsproposed which will ensure the working life of the bearings to be not less than 50 years.

iii) Shop drawings detailing all the works of items related to the Rocker and Roller Bearings.

iv) Design calculations clearly indicating how the bearing satisfies the design criteria indicated on the Drawings and the specifications by RDSO.

v) Detailed procedures to be followed during the testing and installations of bearings.

vi) A certificate from the Bearing Manufacturer stating the work to be done complying to this section.

vii) EC - Certificate of Conformity by Notified Testing Supervising and Certification Body for the product and the production place ensuring that the product with CE certification/marking shall only be used.

viii) Certification of the manufacturer as per latest ISO 9001-2008, ISO 3834-2 and EN-1090

The Contractor shall submit from the Bearings Manufacturer, Technical Approval document by RDSO for Rocker and Roller Bearings.

Manufacturer of the Bearings shall have designed, manufactured, supplied and installed for operation in service in India or abroad for at least 2/3rd the loads/displacements combinations involved in the bridge bearings as per the bearings loading schedule. The Contractor shall submit precedence of adoption of similar bearings in India or evidence of the successful installation and operation of comparable proprietary bearings in projects outside India by the manufacturer demonstrating the suitability of the system and materials proposed, in particular, for loads, traffic and environment conditions comparable to the project to the satisfaction of the Engineer.

The approval of the Engineer shall not relieve the Contractor of any responsibility under the Contract for the successful completion of the work. The manufacturer of bearings shall offer his full co-operation and assistance for one or more visits by the Engineer or his representative to his workshop for the purpose of quality control/assurance.

1.3.2 Shop Drawings

The Contractor shall submit shop drawings to the Engineer for approval which shall include, but not limited to, the following information:

i) Shop drawings showing plan, elevations and complete details and sections including all materials used in the bearings.
ii) Bearing preset details, as applicable.
iii) Protective coating requirements.
iv) Loads and forces: a) The maximum vertical loads and co-existing horizontal loads b) Minimum vertical loads and co-existing horizontal loads c) Maximum horizontal load and co-existing vertical load.
v) Bearing pedestal/seat, all bearing connections and anchorage details.
vi) The bearing orientation (uni and multi-directional bearings) with respect to the direction of Bridge / traffic movement. The drawings and design calculations shall be

duly signed & stamped by manufacturer's company seal duly proof-checked by reputed international consultancy Firm/Institute.

1.4 Provisions for Bearing Types

The design and the manufacture of the bearings shall comply with the following requirements:

Mandatory Standard: As per RDSO/B-17184/3

Other standards and / or approval documents which should be used in special conditions to accommodate design constraints.

All the above and any other documents and specifications referred to in this document shall be the latest edition (or superseding document and specification).

In case of any conflict between the standards stipulated above and this specification, the provision of the standards shall govern.

1.5 Materials

Material certificate shall be furnished in accordance to EN 10204 as per stipulations laid down in EN 1337-7 and ETA. Materials shall conform to the following standards:

1.5.1 Steel: All main structural steel parts of the Bearings shall be made from structural steel conforming to the requirements of S355J2+N of EN 10025 or EN 10137-1 or Cast Steel in accordance with 340- 550W of ISO 3755 or equivalent.

1.6 DESIGN REQUIREMENTS

Asper RDSO/B-17184/3

1.6.1 General:

i) Serviceability Limit State: The design should be such that bearings will not suffer damage which would affect their correct functioning or incur excessive maintenance costs during their intended life.

ii) Ultimate Limit State: The strength and stability of bearings should be adequate to withstand the ultimate design loads and movement of the structure as stated in Bridge Bearings schedule.

iii) Design Life: Bearings and their installations should be designed to be compatible with the design life of the bridge; taking into account the consequences of maintenance and/or replacement.

iv) Durability: Bearings should be detailed to exclude crevices and the like which allow moisture and dirt to be trapped. The materials used in their manufacture and the protective and maintenance measures adopted against corrosion and deterioration due to

environmental effects should be such as to ensure that bearings continue to function correctly throughout their design life.

v) Replacement of bearings: The substructure and superstructure design shall permit the bearings to be removed for inspection or rehabilitation with minimal jacking of the structure. Sufficient space shall be made available on top of bridge supports (at abutments and piers) and on the soffit of bridge superstructures within the width of deck diaphragms to enable the location of jacks during bearing replacement. Bearings shall be designed so that they can be replaced by lifting the deck no more than 15 mm or the distance specified.

1.6.2 Sliding Materials Methods of attachment:

i) Horizontally installed sliding material shall only be recessed and shall not be bonded into its steel substrate.

ii) Vertically installed sliding material sheet shall be bonded and recessed into or bonded to and mechanically fastened to its steel substrate.

iii) The recess into the steel substrate shall be designed in accordance to the technical approval of the bearing for the sliding material sheet thickness but shall be at least one half of the thickness of the sliding material. The shoulders of the recesses shall be sharp and square.

1.6.5 Anchor Bolt Assemblies:

• The anchor studs/dowels welded to the underside of the bottom anchor plates shall be as per RDSO/B-17184/3

• The dowels shall be located in their sockets using an approved high strength • shrinkage compensated cementitious grout applied strictly in accordance with the material recommendations and specifications. The grout shall be subject to the approval of the Engineer.

• The anchor bolts shall be limited in length by the need to remove the anchor bolts during future bearing replacement. There shall be no obstruction which will impede the unfastening of the anchor bolts during bearing replacement.

• The anchor bolts shall be designed to resist the full horizontal design loads from the bridge superstructure without any reliance on the frictional forces developed from steel to steel contact between the bearing elements and the adapter plates.

• Tension anchors, if required in consideration of the effect of eccentricity in design over the stabilising gravity load, should be provided separately and should be designed to ensure proper force transfer in the concrete substructure.

1.7 EXECUTION

1.7.3 Identification: All bearings must be clearly coded by the manufacturer. The coding must prevent mix-up and remain clearly visible on the bearings. Each bearing shall be stamped with the number, bearing number, direction of installation and the installed

location which must correspond with the information contained on the approved drawings for the bearings. The stamp shall be on a surface visible after installation.

1.7.4 Handling, Transport and Storage:

• Bearings shall be protected from damage or distortion during handling, transport, storage and installation and kept clean and free of all deleterious matter and contaminants including moisture and dust.

• Suitable handling arrangements shall be provided on the Bearings as required. Temporary clamping devices shall be used to maintain correct orientation of the parts during handling, transport, storage and installation. However, the same shall not be used for slinging or suspending bearings unless specifically designed for this purpose.

• All bearings, whether in the fabrication shop or an independent warehouse or at the bridge site shall be stored on a platform above ground surface, in a clean, dry, well ventilated and covered roofed facility, away from sunlight, heat, oils and chemicals deleterious to the bearings.

• The bearings shall not be stacked in a manner or on a surface which will cause distortion of the bearings.

• When in storage the bearings will be kept banded, wrapped and secured in a condi tion suitable for shipment.

1.8 Installation & Seating of Bearings in general:

1.8.1 Installation

(i) Care shall be taken during installation of the bearings to permit their correct functioning in accordance with the design scheme.
(ii) To prevent contaminations, dismantling of the bearings at the site shall not be done.
(iii) The load shall be transferred onto the bearings only when the bedding material has developed sufficient strength. The props for the framework shall only be removed after lapse of appropriate time. In special cases, this can be ensured by suitable devices like jacks, etc.
(iv) Temporary clamps and shims (introduced to maintain working clearance) shall be removed at an appropriate time, before the bearing is required to permit movement.
(v) Permitted installation tolerance of the bearing from plane of sliding shall be maintained.
(vi) Cement based non-shrinking grout with air releasing additive and epoxy based grout, whichever is specified shall be first tried at the site. For the proprietary grout mixes, appropriate instructions from the manufacture shall be followed specially with regard to the following: (a) Preparation ->concrete cleaning, roughening, pre soaking, etc. (b) Forms ->sturdiness, leak proofing shape, header funnel vents, etc. (c) Bearing Base ->cleaning, etc. (d) Placement -

>mixing, consistency, time period, finishing, etc. (e) Protection ->curing, ambient temperature, etc.

(vii) Bearings shall be installed in the structure as specified and shown on the drawings and directed by the bearing supplier. Installation procedure shall be subject to review and approval by the engineer. The manufacturer will have its technical representative present for the placement of the all the bearings.

(viii) Bearings shall be set to the dimensions and offsets prescribed by the manufacturer and the drawings. When placed, bearings shall be dry, clean, and free from dirt, oil, grease, or other foreign substances.

(ix) Bearings shall be adjusted as necessary to take into account the temperature at time of installation and future movements of the bridge due to temperature changes, release of false-work and shortening due to pre-stressing.

(x) Under no circumstances shall bearings be taken apart and reassembled on the site, except where it is an unavoidable feature of the installation procedure, in which case the dismantling, installation and reassembly shall be under the supervision of the Manufacturer's technical representative and at the risk and responsibility of the Contractor.

(xi) No rehabilitation, modification or repair work to the bearings shall be carried out on the bearings.

(xii) Bearings shall be located true to line and levels such that:

a) their centre lines are within ± 3 mm of their correct positions and

b) Bearings are set to their correct inclination to the horizontal within a tolerance of ± 0.1° in any direction.

xiii) Threaded fixings shall be uniformly tightened over their entire area to avoid overstressing any part of the bearing.

xiv) Voids or hard spots after installation are not acceptable. Care shall be taken to ensure that no air pockets exist below the bearing bottom plate after installation.

xv) The bedding material shall be capable of transmitting the applied load to the structure without damage. The bedding mortar thickness shall not be less than 20 mm. The bedding mortar shall extend beyond the bearing perimeter by at least 50 mm or twice the thickness of the bedding mortar; whichever is greater. Fall away (slope) the top surface of this mortar extension from the bearing to prevent the collection of water around the bearing.

xvi) Bearings and their surrounding area shall be left clean after installation. All temporary transit clamps shall be removed at a time to be agreed upon by the manufacturer and the Engineer.

xvii) Contractor/manufacturer shall notify/certify, in writing to the Engineer upon completion of the installation, that the bearings have been correctly installed.

1.8.2 Seating: Seating shall be as per manufacturer's recommendations and inaccordance with RDSO/B-17184/3

1.9 DOCUMENTATION TO BE SUPPLIED WITH THE BEARING

The Contractor shall provide all necessary documentation for the long term inspection, maintenance, and replacement of the bearings. This shall include full documentation of the design, working drawings, a certificate of compliance from the supplier, third party testing agency (MPA or equivalent) certificates, welding certificates, quality records and as

installed details, procedures for the inspection of the bearing, procedures for maintenance and a fully detailed method statement for the replacement of the bearings.

1.10 ACCEPTANCE CRITERIA

1.10.1 Acceptance Tests:

Acceptance of the bearings shall be done on the basis of thefollowing:

- Material certificates

- Dimension control

- Control for tolerances of fit

- Surface roughness control

- Corrosion protection

- Assembly control

Railway may appoint RDSO/any other agency for inspection of the bearings as per the above, based on the Quality Assurance Plan and Drawings approved by Railways, at manufacturer's workshop prior to the dispatch of the bearing and confirm acceptance.

1.10.2 Lot Size Minimum one bearing of each type from each lot shall be tested. A lot shall be defined as those bearings presented for inspection at a specified time and date. A lot shall not exceed 24 bearing. It shall consist of those bearings of the same type.

The test and number of samples to perform tests shall be in accordance with the following table:

Test	**Samples Required**
Proof load and compression strain	One production bearing per lot
Rotation	One production bearing per lot
Coefficient of friction	One production bearing per lot (test must be Completed using two identical bearings)
Physical properties of sliding material	Six samples of 250 by 400 mm piece of sliding material for the project

1.10.3 Proof Load Test

Bearings shall be simultaneously subjected to a vertical load of 125% SLS design load and rotation of 0.02 radian or design rotation, whichever is greater, for a period of one (1) hour. Note any deformations, cracks, or separations (lift off) of plates from each other or from the sliding material.

1.10.4 Test for Coefficient of Friction (applies to movable bearings only)

• The aim of this test is to verify the sliding capability of the bearing. The bearing shall be loaded in compression with 100% of the SLS design load for a minimum period of ½ hours, while simultaneously placing them in a rotated condition of 0.02 radians, or design rotation, whichever is greater.

• Determine for the first movement the average static and dynamic coefficient of friction for the two sliding surfaces at a sliding speed of less than 25 mm / min.

• Subject the bearing to 1000 sliding cycles of 25 mm minimum movement at a speed not exceeding 300 mm / min.

• Determine for the 1001st movement the average static and dynamic coefficient of friction for the two sliding surfaces as described for the first movement. Note any deformation or cold flow of the sliding material.

• The sliding coefficient of friction shall be calculated as the horizontal load required to maintain continuous sliding of one bearing, divided by the bearing`s vertical design capacity.

1.10.6 Acceptance Criteria for Inspection after Testing

• If all tests performed on the selected bearing in a given load range and lot meet the specified requirements, all bearings within that load range will be acceptable. In the event that any test on a bearing in a given load range and lot does not meet the specified requirements, the tested bearings and all other bearings in that same load range and lot will be rejected unless each individual bearing is satisfactorily tested and approved by the Engineer. There shall be no liftoff or separation between plates during rotation.

• Properties of materials shall be within the limits of the specifications.

1.11 GUARANTEE

i) The contractor shall Guarantee satisfactory performance of spherical bearings for a period of 05 (Five) years. During the Guarantee period,the bearings should perform within the design range of movement and under the design loads. The Guarantee period will commence from the certified date of completion of the whole work as covered by the contract.

ii) In this regard, 50% of the Security Deposit amount of contract will be retained as Caution Deposit during the Guarantee period.

iii) The Contractor shall be responsible during the guarantee period, for the replacement (including supply and installation) of the bearing components or the bearing as a whole at no cost to Railways in the event that the bearings do not perform satisfactorily within the design range of movement and under the design loads.

Note: Caution Deposit for the Guarantee period to be submitted by contractor is also acceptable to Railway in the form of Term Deposit Receipt/irrevocable Bank Guarantee for equivalent amount from Scheduled Bank.

SPECIFICATION & GUIDE LINES FOR FABRICATION AND ERECTION OF STEEL GIRDER BRIDGES

1. Specification & Interpretation

1.1 This specification is intended mainly to cover technical provisions relating to fabrication and erection of steel girder bridges including supply of the materials through contract.

1.2 This specification makes reference to the Indian Standard (IS), Indian Railway Standard (IRS), RDSO's Specifications (M&C) & RDSO Guidelines (BS).

1.3 Wherever reference to the standards mentioned in clause i,e IS, IRS & RDSO Specification, it shall be taken as a reference to the latest version of the standards. 1.4 Any revision or addition or deletion of the provisions of this Specification shall be issued only through correction slip. No cognizance shall be given to any policy directives issued through other means.

2. Responsibility for Completeness

2.1 The Contractor shall be entirely responsible for the execution of the contract in all respects in accordance with the terms of this Specification and the conditions of contract, notwithstanding any approval which the Engineer/Inspecting Officer may have given to the detailed drawings prepared by the Contractor or Sub-Contractor for materials or other parts of the work involved in the contract or for tests carried out, either by the Contractor or by the Engineer/Inspecting Officer.

2.2 Any fitting, accessory or apparatus which may not have been mentioned in this Specification, but which are usual or necessary in the execution of such work, are to be provided by the Contractor without extra charge. The whole work must be completed in all details, whether mentioned in this Specification or not, with the exception of such work as has been specified in the Schedule of Requirements to be separately provided for by the Purchaser.

3. Sub-letting of Work: Refer Special Conditions – General.

4. Stacking Materials

4.1.1 On receipt of materials at the bridge yard they shall be carefully unloaded examined for defects, checked, sorted and stacked securely on a level bed out of danger from flood or tide and out of contact with water or ground moisture. All material shall be available for inspection by the Engineer or Inspecting Officer.

4.1.2 Materials shall be verified with the markings shown on the marking plan of part list, which shall be supplied by the manufacturers or the Engineer.

4.1.3 Any material found damaged during transit or while unloading should be stacked separately and damaged portions shall be indicated by paint with distinctive colour. All such materials shall be dealt with under the orders of the Engineer without delay. If any component after receipt at site, has in the opinion of the Engineer or Purchaser, been

damaged in transit, such component shall be replaced or repaired to the satisfaction of the Engineer or Purchaser free of cost.

4.1.4 All such damaged material shall be dealt with as per the orders of the Engineer. Badly damaged portions may require replacement. Slightly distorted parts may be straightened by gradual pressure without heat or annealing. Badly distorted or broken parts must be dealt with as the case demands and as directed by the Engineer.

4.1.5 Where the work has been passed in the manufacturer's works as strictly interchangeable, all members bearing the same marks can be stacked together without reference to any particular span.

4.1.6 The Contractor shall unload the material promptly on delivery; otherwise he/she shall be responsible for demurrage charges.

4.1.7 On receipt of rolled steel at workshop or fabrication yard they shall be carefully unloaded and stacked properly to avoid bending, twisting, corrosion etc.

5. Imported Material

5.1 In case of work fabricated in India, where any material or component is imported, such material or component will be inspected, if desired by the Contractor, Purchaser or Inspecting Officer, and passed in the country of origin before despatch to India. In such cases the Contractor shall submit to the Inspecting Officer details on prescribed form in quadruplicate of the materials or components to be inspected together with the requisite number of copies of all necessary documents, to enable inspection to be carried out prior to dispatch. The cost of such inspection and supervision of tests in connection therewith will be borne by the Purchaser, the Sub-Contractor providing free of charge all material, labour and appliances for carrying out tests made in his/her works and any material which may be required for independent tests and analysis.

6. Leading to Site

6.1 Care must be taken by the Contractor to see that the parts at site are available in proper sequence.

7. Lines and Levels

7.1 All lines and levels should be given by the Engineer and all stakes and marks so given shall be carefully preserved by the Contractor who shall give all necessary assistance and facilities to establish or check the lines and levels and to measure the work.

8. Steel

8.1 IS:2062, Quality "A" Grade Designation E250 as rolled semi-killed or killed shall be used for footover bridges and other structures subjected to non-critical loading.

8.2 IS:2062, Quality "B0" Grade Designation E250 fully killed and with normalizing/ normalizing rolling/ controlled rolling where service temperature does not fall below 0°C, shall be used for welded/riveted girders subjected to Railway loading. Plates less than 12mm thick need not be with normalizing/ normalizing rolling/ controlled rolling.

8.3 IS:2062, Quality “C” Grade Designation E250 fully killed and with normalizing/ normalizing rolling/ controlled rolling ensuring impact properties at (-) 20° C shall be used for sub-zero temperature areas for welded/riveted girders subjected to Railway loading. Plates less than 12mm thick need not be with normalizing/ normalizing rolling/ controlled rolling.

NOTE:

1. In case Rolled Steel Section confirming to IS:2062 Quality “B0” or “C” are notavailable in market, CAO(C)/CBE may permit use of steel confirming to IS:2062 Quality “BR” on case-to-case basis by satisfying himself about non availability of quality “B0” or “C”.

2. In case Rolled Steel Section confirming to IS:2062 Quality “BR” is also not available in market, CAO(C)/CBE may permit use of steel confirming to IS:2062 Quality “A” on case-to-case basis, by satisfying himself about non availability of quality “BR”.

8.4 High tensile steel shall comply in all respects with the requirement of IS:2062 Grade Designation E 410 Quality B0 or C (copper bearing quality) for the welded work.

8.5 For superior and enhanced corrosion resistance for sections, plates and bars for welded, riveted or bolted construction, the material shall comply with the requirement of IRS:M-42, Gr I or Gr.II for riveted/bolted or welded work respectively.

8.6 Steel, which is to be cold pressed, shall comply with the requirements of IS:2002.

8.7 Steel for bolts shall conform to property class 4.6 or 6.6 as specified in IS:1367 accordingly, as the structural steel specification is for mild steel or high tensile steel.

8.8 Steel for drifts shall be in accordance with IS:1875 for forged quality steel or IS:7283 for hot rolled bars.

8.9 Steel for rivets shall comply with the requirement of IS:1148 for hot rolled rivet bars for general structural purposes and IS:1149 for high tensile steel rivet bars for high strength structural purposes. For high strength low alloy structural steel rivet bars with enhanced corrosion resistance for use in bridges, steel shall comply with the requirement of IRS:M-43.

8.10 The dimensions of all rolled sections must agree with the contract drawings or as agreed to between the Purchaser and the Contractor.

8.11 The rolling and cutting tolerances shall be in accordance with IS:1852 or as agreed to between the Purchaser and the Contractor if closer tolerances are desired they shall be shown in the drawing.

8.12 All the steel sections used in the fabrication must have mill test certificate clearly indicating the specification to which the steel conforms and whether steel is killed and normalized. All the cast mark numbers/ heat mark numbers, shall be recorded along-with the number of plates in a register as soon as the plates are received in the workshop. Whenever the steel is received without any test certificate, a sample test piece from plate

of each cast mark number is to be cut and sent for testing. Only when it is established that the plates are of required specification, these shall be processed for cutting.

8.13 Use of steel of any quality other than those mentioned above would require the prior approval of the Engineer.

9. Pins and Expansion Rollers

9.1 Pins and Expansion Rollers shall be made from steel conforming to IS:2004 (Class 3steel).

9.2 Expansion rollers may, alternatively be turned from approved carriage and wagon axles.Only axles manufactured after 1931 shall be used for the manufacture of rollers. USFD test shall be conducted to ensure freeness from internal flaw. Test pieces shall be left as an integral part of the roller with the stamp of the supplier on it so that the Accepting Authority can cut-off the test pieces and check if required.

10. Steel Castings

10.1 Steel casting shall comply with IS:1030 for normal temperature zone and to IS:4899for use at low temperature zone.

11. Maintenance of Records by Fabricators

11.1 The records of fabrication shall be maintained in the registers as per the formats given in the Appendix I.

12. Manufacture

12.1 The whole work shall be representative of the highest class of workmanship. The greatest accuracy shall be observed in the design, manufacture and erection of every part of the work to ensure that all parts will fit accurately together on erection. For manufacture of the components of all spans to be made strictly interchangeable as specified in clause 33, approved set of same jigs and assembly fixtures shall be used. The tolerances in manufacture shall be in accordance with as shown in Appendix II of IRS Specification for Bridge Fabrication and Erection of steel girders serial No. B1-2001. The Contractor shall state which of the following alternative methods of manufacture he/she intends to adopt. i) The whole of work to be erected complete and pieces marked to place. ii) All spans to be made strictly interchangeable as specified in clause 33.

12.2 The Contractor shall maintain a master steel tape of approved make for which he/she has obtained a certificate of accuracy from any National Test House or Government recognised institutions competent to do so.

13. Templates

14.1 The templates throughout the work shall be of steel. The template shall be used for marking of cutting material and as well as profile machining for girders of railway loading. Templates shall be used for marking of drilling holes in steel structures other than girder of

Railway loadings. In case where actual materials from a bridge have been used as templates for drilling similar pieces the Inspecting Officer will decide whether they are fit to be used as part of the finished structure.

14. Flattening and Straightening

14.1 All steel materials, plates, bars and structural's 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 are required to be of 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.

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

15. Planning and Shearing

15.1 Except where otherwise indicated, cutting of all plates and sections shall be affected by shearing or sawing. All edges shall be clean, reasonably square and true. Wherever possible the edges shall be cut in a shearing machine, which will take the whole length of the plate in one cut.

15.2 Should the inspection find it necessary, the cut edges shall be ground afterwards.

15.3 Planning or machining of the edges or surface shall be carried out when so specified in the contract drawings or where specifically ordered by the Engineer. Where machining is specified, the plates or all sections shall be cut in the first instance to such a size so as to permit not less than 3mm of metal being removed from each sheared edge or end, in the case of plates or sections of 12mm or less in thickness and not less than 6mm of metal being removed in the case of plates and sections exceeding 12mm in thickness.

15.4 The butting ends of all booms and struts where spliced shall be faced in an end milling machine after members have been completely fabricated. In the case of compression members the face shall be machined so that the faces are at right angle to the axis of the members and the joint when made, will be in close contact throughout. At the discretion of the Inspecting Officer, a tolerance of 0.4mm may be permitted at isolated places on the butting line.

16. Flame Cutting

16.1 Flame cutting by mechanically controlled torch/torches shall be accepted both in the case of mild steel and high tensile steelwork. 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.

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

16.3 Unless machining has been specifically provided for, special care is to be taken to ensure that ends of all plates and members are reasonably in close contact and the faces are at right angles to the axis of the members and joints, when made, are also reasonably in close contact.

16.4 Use of multi-head flame cutting machine having multiple oxy acetylene torches is desirable for higher productivity and reducing the distortion due to cutting operation. Plasma-arc cutting method can also be employed. This process offers less heat input causing less distortion.

17. Drilling and Sub-punching

17.1 All holes shall be drilled but the Contractor may, if he/she so prefers sub-punch them toa diameter 6mm less than that of finished holes, e.g. a punched hole which is to be drilled out to 25mm in diameter shall not exceed 19mm in diameter at the die end. When the rivet holes are to be sub-punched, they shall be marked with a centre punch and made with a nipple punch or preferably, shall be punched in a machine in which the position of the hole is automatically regulated. The punching shall be so accurate that when the work has been put together before drilling, a gauge 1.5mm less in diameter than the size of the punched holes can be passed easily through all the holes. Holes for countersunk heads of rivets, bolts or screws shall be drilled to the correct profile so as to keep the heads flush with the surface Holes for countersunk heads of rivets, bolts or screws shall be drilled to the correct profile so as to keep the heads flush with the surface.

17.2 No sub-punching shall be allowed in the main truss members of open-web girders.

17.3 Holes for turned bolts, should be 1mm under drilled in shop and should be reamed at site to suit the diameter of turned bolt.

17.4 Where the number of thicknesses to be rivetted exceeds three or the total thickness is 90mm or more, the rivet holes, unless they have been drilled through steel-bushed jigs, shall be drilled out in place 3mm all round, after assembling. In such cases the work shall be thoroughly bolted together.

17.5 The steel bushes shall be case hardened by an approved process and checked for diameter after the heat-treatment. The bores of bushes shall initially have a tolerance of -0mm, 0.1mm. The tolerance shall be checked from time to time and when the bores exceed a tolerance of, -0mm, +0.4mm, the bushes shall be rejected. For this purpose, go and no-go gauges are to be used. Tolerances for checking jigs from master plates shall be +0mm-0.13mm. 18.6 The work shall be taken apart after drilling and all burrs left by the drill and the sharp edges of all the rivet holes completely removed.

18. Parts in Contact

18.1 All steel work intended to be rivetted or bolted together shall be in contact over the whole surface.

18.2 Drifts as shown in Fig. 2 of IRS Specification for Bridge Fabrication and Erection of steel girders serial No.B1-2001 may be used for drawing light members into position but

their use on heavy members should be restricted to securing them in their correct positions. In no case, shall drifting be allowed to such an extent that holes are distorted.

18.3 Drifting to enlarge unfaired holes is prohibited. The holes that will have to be enlarged to admit rivets should be reamed provided the Engineer permits such reaming after satisfying himself about the extent of inaccuracy and the effect of reaming on the soundness of the structure. The Purchaser retains the right to reject all steel work if the holes are not properly matched.

19. Making of Joints

19.1 Cleaning of permanent contact surfaces:- Surfaces which will have permanent contact shall be removed of paints and mill scale down to bare metal, clean and dried and immediately a coating of zinc chrome red oxide priming to IS:2074 shall be applied. Care shall be taken to see that all burrs are removed and no surface defects exist before the parts are assembled.

19.2 Bolting and Drifting:- Only barrel drifts as per Fig. 2 of IRS Specification for Bridge Fabrication and Erection of steel girders serial No.B1-2001 shall be used in erection. They may be used for drawing light members into position; but their use on heavy members shall be restricted to securing them in their correct position. Any apparent error in shop work, which prevents the assembling and fitting up of the parts by the proper use of these drifts, shall be investigated immediately. As all work is rigidly inspected in the manufacturers work before despatch, these difficulties should not arise and the cause should be first be sought in the use of incorrect components or the transposition of a correct part. It is usually important that parts should be correctly handled. Should error still persist, the matter shall be immediately reported to the Engineer who will decide what action is to be taken. No reaming shall be undertaken without the written authority of the Engineer, except for the under drilled holes meant for turned bolts. If approved, the Contractor shall supply, at his/her own expense, any special rivets that maybe required. Copies of all correspondence relative to the recourse to reaming and the use of over-size rivets shall invariably be sent by the Engineer for information to the inspectorate concerned.

19.3 Joints shall normally be made by filling not less than 50% of the holes with service bolts and barrel drifts in the ratio of four to one. The service bolts are to be fully tightened up as soon as the joint is assembled.

19.4 Special methods of erection other than described in Appendix III of IRS Specification for Bridge Fabrication and Erection of steel girders serial No.B1-2001.In cases where the joints have to withstand stresses arising from special method of erection, provision is to be made to take the whole stress that will or may occur. Cylindrical drifts and turned bolts shall be used to withstand such stresses and no reliance is to be placed on the service bolts for this purpose. Upto maximum of 40% of the holes of each member of the joint are to be filled with drifts and balance of strength required is to be attained with turn bolts. The position and number of the drifts and bolts will be intimated by the Engineer. The condition of clause 20.1 must be observed and the bolt fully tightened up as soon as the joint is made.

19.5 Where the manufacturing of girders has been done in accordance with clause 33 relating to steel girder bridges, the erection shall be done in accordance with Appendix III of IRS Specification for Bridge Fabrication and Erection of steel girders serial No.B1-2001. However, if the Contractor desires to adopt any other method of erection, he/she shall submit the scheme and obtain the approval of the Engineer. It shall be ensured that when in position, the girder has the camber as per drawing.

19.6 Emergency Jointing: - In the event of an emergency arising such as the staging is in danger of being carried away by floods before the rivetting can be completed, the joints shall be made secure by filling 40% of the holes with cylindrical drifts and equal number with service bolts fully tightened.

20. Erection and Equipment

20.1 The Contractor shall provide at his/her own cost all tools, machinery, equipment and erection material necessary for the expeditious execution of the work and shall erect the structural steel and iron work, in every respect as covered by the contract and in accordance with the drawings and specifications.

20.2 If any labour, material, plant staging haulage and storage facilities are to be provided by the Purchaser, details of such items and the conditions under which these are to be supplied shall be clearly specified in the contract agreements. In the absence of any such provisions in the agreement, the Contractor shall make his/her own arrangement for such items.

20.3 Before starting the work, the Contractor shall advise the Engineer fully as to the method he/she proposes to follow and the amount and character of equipment he/she proposes to use, which shall be subjected to the approval of the Engineer. The approval of the Engineer shall not be considered as relieving the Contractor of the responsibility for the safety of his/her method or equipment or from carrying the work in full accordance with the drawings and specifications.

20.4 All temporary work shall be properly designed and substantially constructed for the loads, which it will be called upon to support. Adequate allowance and provision of a lateral forces and wind loads shall be made according to local conditions and ensure that support shall not settle during erection.

20.5 Careful and periodical inspection of plants shall be made by the Contractor to ensure that all tackle, ropes, chains and other important lifting gear and machinery are in good order and fit for service and well upto the capacity for which they are required.

20.6 When chains are used for lashing, care must be taken to protect the edges of members to avoid the marking and distortion otherwise caused.

20.7 Span erected upon staging shall be supported upon suitable blocks, which shall ensure that the girders shall be at the correct elevation and alignment when completed. If other methods of erection be adopted where staging in situ is not employed, special means shall be used to ensure this.

20.8 The method used for lifting and slinging flexible members shall be brought to the notice of the Engineer and shall be subject to his/her approval.

20.9 Temporary bracing shall be provided to take care of stresses from erection equipment or other loads carried during erection.

21. Bearings and Anchorages

21.1 Bed plates shall be set to required level and fixed accurately in position by giving full and even bearing by setting them on a layer of cement sand and cast-iron chips as approved and directed by the Engineer.

21.2 The Contractor shall drill the holes where necessary and set the anchor bolts. The bolts shall be set accurately and fixed with cement grout or any other grouting material as approved by the Engineer completely filling the holes.

22. Rivets and Riveting

22.1 The dimensions on the drawings referred to the diameters of the rivet holes and their finished rivets. The rivet holes shall be 1.5 mm greater than the diameter of the rivet bars used. The rivets shall be made to IS:1929. The shanks of the undriven 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 sections rivetted are in close contact throughout. Rivets shall completely fill the holes and shall be machine driven by means of pressure or percussion rivetters of approved design.

22.2 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 and in no case shall the point be heated, more than the head. Sparking or burnt rivets shall not be used. Where 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.

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

22.4 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 on the head with the 110-gm. rivet testing hammer, shall be free from movement or vibration.

22.5 While rivetting built-up members great care should be exercised to ensure that the set of holes for field rivets in each flange of the built-up member, is aligned dead-square in relation to that in the other flange and not ‘aborrated’. Use of assembly fixtures shall be made to ensure this.

22.6 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 Appendix IV of IRS Specification for Bridge Fabrication and Erection of steel girders serial

No. B1- 2001. 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. Recupping and caulking shall in no circumstances be resorted to.

22.7 Riveting shall not be started until such time as the Engineer has personally satisfied himself that the alignment of the girders is correct, the verticals plumb laterally, the camber according to that shown on the camber diagram with camber jacks screwed tight, all the joints and cover plates well up, service bolts tight and field rivet holes coinciding. Special care should be taken that service bolts are frequently retightened as the rivetting proceeds.

22.8 All field rivets shall be tested as directed by the Engineer.

22.9 Where practicable all riveting shall be done by pneumatic or hydraulic rivetting machine. The working pressure to be employed when using pneumatic or hydraulic tools shall be approved by the Engineer. Hand rivetting shall only be done when sanctioned by the Engineer. In such cases, means shall be adopted to ensure the rivets being used in their entire length so as to fill the rivet holes completely, the snap being used only to give the correct form of head.

22.10 When all the rivets of joints have been finally passed, they shall be painted as under.
a) one coat of ready mixed zinc chrome primer to IS:104 followed by one coat of ready mixed paint red oxide zinc chrome primer to IS:2074 b) Finishing coat as per clause 39

23. Field Rivets, Bolts, HSFG Bolts, Nuts and Service Accessories

23.1 The work is to include supply of all units, bolts, HSFG Bolts, nuts, washers etc. required to complete erection at site with an allowance for wastage etc. of 12.5% of the net number of field rivets, bolts and washers required subject to a minimum number of five in each item.

23.2 The Contractor shall be responsible for supplying site rivets/ HSFG Bolts of approved length. The length of such rivets/HSFG bolts shall be verified by snapping a few rivets/ HSFG bolts of each length in the presence of the Inspecting Officer. In the case of rivets with long grips (with grip exceeding 6 times the diameter) specimen rivets on the test piece shall be cut to see if the holes are totally filled even though the rivets are tight under the usual hammer tests.

23.3 Black hexagonal bolts (Service bolts) with nuts and ordinary platter's washers and drifts for use in the erection of the work shall also be supplied at 60% (45% bolts and 15% drifts) of the number of field rivets per span in each size (this includes wastage). The Purchaser may however, specify a reduction in the quantities of service bolts etc. if more than one span of each type is ordered.

24. Smithed Work

24.1 All joggles shall be performed by pressure. Craned sections or knees can be formed by forging or by gas cutting and welding by any approved electric arc process. Any

bending, forging, cutting or welding shall be carried out in such a manner as not to impair the strength in the metal. Forging shall be annealed as indicated in the drawing.

24.2 If drop forging through dies is resorted to, excessive forging in one operation shall be avoided. Where necessary, a series of intermediate stage dies shall be manufactured and used.

25. Welding

25.1 Welded construction work shall be carried out generally in accordance with the provisions of Indian Railway Standard Welded Bridge Code and subject to further specifications given in the following paragraphs.

25.2 All welds should be done by submerged-arc welding process either fully automatic or semiautomatic. Carbon dioxide welding or manual metal-arc welding may be done only for welds of very short runs or of minor importance or where access of the locations of weld do not permit automatic or semi-automatic welding.

25.3 Except for special types of edge preparation, such as single and double 'U' single and double 'J' the fusion edges of all the plates which are to be joined by welding may be prepared by using mechanically controlled automatic flame cutting equipment and then ground to a smooth finish. Special edge preparation should be made by machining or gouging.

25.4 Welding procedures: - The welding procedure shall be such as to avoid distortion and minimise residual shrinkage stresses. Properly designed jigs should be used for assembly. The welding techniques and sequence, quality, size of electrodes, voltage and current required shall be as prescribed by manufacturers of the material and welding equipment. The Contractor should submit full details of welding procedure in proforma given at Apppendix V of IRS Specification for Bridge Fabrication and Erection of steel girders serial No. B1-2001.

25.5 Site welding should not be undertaken except in special circumstances with the approval of the Chief Bridge Engineer. Site welding should be confined to connections having low stresses, secondary members, bracings etc.

25.6 Manual metal arc welding may be done taking adequate precautions as per IS:9595 and under strict supervision.

26. Sequence of Welding and Weld Pass

26.1 For fabrication of welded composite girders, channel shear connectors shall be welded on top flange plate prior to assembly of I-section. This facilitates correction of any distortion of flange plate developed during the welding of channel shear connectors.

26.2 In making a typical I-section four fillet welds are to be made. The welding sequence to be followed is indicated by number 1 to 4 as shown in the Fig. 3 of IRS Specification for Bridge Fabrication and Erection of steel girders serial No. B1-2001.

26.3 Whenever a square butt weld in a 10 or 12mm thick plate is required to be made, the sequence to be adopted is shown in Fig. 3 of IRS Specification for Bridge Fabrication and Erection of steel girders serial No.B1-2001.

27. Bolts, Nuts and Washers

27.1 Bolts, Nuts and Washers shall be in accordance with the following specifications: - (i) Black hexagonal bolts to IS:6639 and Nuts to IS:1363. (ii) Precision and turned bolts with nuts and hexagonal screws to IS:1364. (iii) Plain washers to IS:2016 and IS:5369. (iv) Spring washers - IS:3063. (v) Taper washers - IS:5372 and IS:5374.

27.2 Manufacture, workmanship, Marking, packing etc. for Bolts and Nuts shall comply with the requirements of IS:1367.

27.3 Where the head and nuts bear on timber, square washers having the length of each side not less than three diameters of the bolt and the thickness not less than one quarter of the diameter shall be provided. Steel, wrought iron or malleable cast iron taper washers shall also be provided for al heads and nuts bearing on bevelled surfaces.

27.4 For black bolts a clearance (difference in diameter) of 1.5mm for all sizes of bolts shall be allowed.

27.5 Where turned bolts are required they shall be carefully turned and shall be parallel throughout the barrel. Holes for turned bolts should be 1mm under drilled in shop and should be reamed at site to suit the diameter of the turned bolts.

27.6 The following limits of tolerances, shall be permitted upon the diameter of the shank of turned bolts and of the holes which they are to fit:

Limit of tolerance	Shank of bolt(mm)	Hole(mm)
High	0.000	+0.125
Low	- 0.125	0.000

27.7 The shank of each turned bolt shall be of such a length that it is in full contact with the work, throughout, the screwed portion being made at least 1.5mm less in diameter than the shank or to suit the next smaller size of screw thread. The shank portion shall be joined to the threaded portion by a 450 chamfer within the thickness of the washer. Washers with perfectly flat faces should be provided with all turned bolts.

27.8 The washers under the nut shall have a hole of 1.5mm larger in diameter than the shank of the bolt and shall have a thickness of not less than 6mm so that the nut, when screwed up, shall not bear on the shoulder of the bolt.

27.9 Supply of High Strength Friction Grip (HSFG) Bolts

28. Reference Codes:

(i) IS 1367 (Part 6) – 1994 (reaffirmed 2004) – Mechanical Properties and test methods for nuts with specified proof loads

(ii) IS 1367 (Part 8): 2002 – Prevailing Torque type Steel Hexagon Nuts – Mechanical and Performance Properties.

(iii) IS 1367 (Part XII):1983(reaffirmed 2001) – Phosphate Coatings for Threaded Fasteners.

(iv) IS 3757 – 1985 (reaffirmed 2003) – Specifications for High Strength Structural Bolts.

(v) IS 4000: 1992 – High Strength Bolts in Steel Structures – Code of Practice.

(vi) IS 6623:2004 - High Strength Structural Nuts - Specifications (

vii) IS 6649:1985 - Specification for Hardened and Tempered Washers for High Strength Structural Bolts and Nuts.

28.9.2 Hierarchy of Codes: The hierarchy of codes shall be as follows: (i) Provisions of IRS codes. (ii) Where IRS codes are silent, relevant IS codes. (iii) Where both IRS and IS codes are silent, relevant EN codes.

28.9.3 Definition: HSFG bolts are high strength structural bolts which have been tightened such as to induce predefined tension in the bolt shank. Provisions in this code apply to non – galvanized Bolts of dia. M12 to M36 only.

28.9.4 Types of Bolts: For the purpose of HSFG connections, only high strength structural bolts of two property classes: 8.8 and 10.9 can be used. Bolts shall conform to IS 3757. The bolts shall have the following characteristics

(i) Identification: The property class of bolts (8.8 or 10.9) shall be embossed or indented as 8S or 10S respectively on the top of head along with the manufacturer's identification symbol. Alternately, marking '8.8 S' or '10.9 S' are also acceptable. The suffix 'S' here denotes that the bolt is high strength structural bolt with a large series hexagon.

(ii) Length: The length of bolt shall be chosen such as to hold the steel members in position, with provision for the nut, washer(s) and some projection beyond the bolt. Along with the overall length of the bolt, the thread length has to be specified. At least 4 full threads shall remain clear between the bearing surface of the nut and unthreaded part of the shank Further, minimum one full thread pitch must protrude from the nut after tightening.

(iii) The minimum length of bolt shall be worked out on the basis of maximum grip length (covering ply thicknesses and all washers) plus an additional allowance as per table 1 of IS:4000.

(iv) Maximum grip length of all plies, including packings and packing washers, shall not exceed 10 times the nominal diameter of the bolt.

(v) Surface Finish: All bolts shall be supplied with coating consisting of zinc phosphate that is used in conjunction with suitable oil of rust preventive type as per IS 1367 (Part XII).
28.9.5 Nut: Each bolt shall be tightened using a high strength nut, conforming to IS 6623. The nut has to be strong enough to be able to impart the necessary torque to the bolt and also withstand the force during the life of the structure.

Further, the threads in nut shall be matching with the threads in the HSFG bolt and the nut shall be free running on the threads of the HSFG bolts. Nuts shall have following characteristics:

(i) Property Class: For HSFG bolts, the property classes to be used are 8 and 10 as specified in IS 1367 (Part 6), suitable for bolts of property class 8.8 and 10.9 respectively. Normal height of nut shall be more than 0.8 times the nominal bolt diameter.

(ii) (ii)Identification of Nut: The nuts have the following markings: (a) Manufacturer's identification symbol. (b) Property class, marked as '8S' or '10S'. (The suffix 'S' denotes a high strength structural nut with a large series hexagon.) Alternately, '8.8 S' or '10.9 S' are also acceptable. The marking shall be either on the top or the bottom face of double chamfered nuts and shall be either indented or embossed on nonbearing surface of washer faced nuts.

(iii) Surface of Nut: All nuts shall be supplied with coating consisting of zinc phosphate that is used in conjunction with suitable oil of rust preventive type as per IS:1367 (Part XII).

(iv) Position of nut in bolt: Nuts shall be provided in bolts preferably as follows:
(a) In girder web: Towards outside of the girder.
(b) In flanges: Towards bottom (Except when in composite construction).
(c) In composite construction: Towards inside of concrete.
(d) In bracing: Towards the rolled section side so that the space for rotation of the nut is not readily available.
(e) Where Tapered washer is used, the nut shall preferably be on the other side.

28.9.6 Washer: Annular rings which are provided between the bolt head/ nut and the members being joined are called washers. Washers for HSFG bolts shall conform to IS 6649. The washers have the following characteristics:

(i) Types: Three types of washers have been specified in IS 6649, clause 2:
a) Type A: Plain hole circular washers.
b) Type B: Square taper washers for use with channels (60 taper)
c) Type C: Square taper washers for use with I-beams (80 taper)

Identification: Type A washers shall be identified by provision of two nibs (small projections) and manufacturer's identification symbol in indented character. The type B and C washers shall be identified by the type identification symbol, B or C and the manufacturer's identification symbol.

(ii) Categories of washers: a) Plain washer: Plain washers are used as per provisions of clause

28.10.2 where other types of washers are not suitable. HSFG bolts shall be provided with minimum one washer.
b) Packing washers: If the bolt is longer than required, plain washers may be used as packing washers also. However, the maximum number of packing washers shall be limited to 3, with maximum total combined thickness of 12 mm.
c) Tapered Washer: Where the angle between the axis of bolt and the joint surface is more than 3 degree off normal, a tapered washer shall be used against the tapered surface. Non rotating surface shall preferably be placed against tapered washer.
d) Direct Tension Indicators (DTI): The Direct Tension Indicators are special type of washers with projections which get pressed when tension is applied. The

pressing of projections to required level indicates that the required tension has been applied in the bolts. DTIs have multiple projections, between which the feeler gauge is to be inserted to check if the bolt has been sufficiently tightened or not. The projections shall be kept in the direction of nut/head of bolt and not towards member.

(iii) Calibration of Direct Tension Indicator: Before the DTI are brought to site, the sameshall be tested in the presence of engineer. Three nos. bolts of similar diameter and property class as to be used in the work shall be taken and installed with DTI. The installation procedure to be followed shall be similar to the one given for plain washers. On full tightening, the projections on DTI washers shall meet the requirements of checks specified after second stage tightening using DTIs. Alternately, calibrated load cells may be used to check the calibration of DTI washer. Only the DTIs which satisfy the calibration shall be brought to site for work.

(v) Surface Finish: All washers (except Direct Tension Indicators i.e. DTIs which may have any surface finish, as specified by manufacturer, with condition that the surface finish shall be compatible with the metallurgy of the steel structure and the HSFG bolt/ nut) shall be supplied with coating consisting of zinc phosphate that is used in conjunction with suitable oil of rust preventive type as per IS 1367 (Part XII).

28.10 Fabrication and Assembly of High Strength Friction Grip (HSFG) Bolts

28.10.1 Holes for HSFG Bolts: Normal holes in the steel members being connected by the rivets shall be used for HSFG bolts also, subject to the following: (a) Making of holes: The holes shall be made by drilling only.
(b) Nominal Diameter of Hole: The nominal diameter of hole shall be 1.5 mm more than the bolt diameter for less than 25mm bolt and 2mm more than the nominal diameter of the HSFG bolt for larger diameters. (c)Oversize Holes: In case the bolts are to be provided in existing structure, the maximum size of hole shall not exceed 1.25 d or d + 4 mm whichever is less.

28.10.2 Number of washers and their fixing: (i) DTIs are very good method of ensuring that the bolts are tightened properly, and this method of tightening shall be preferred over the method with plain washers. Hence DTI washers shall be preferably used. If there is some problem with availability of DTIs, plain washers may be used for installation of HSFG bolts after approval of SAG officer in-charge of the work.

(ii)The DTIs used shall be the ones which are compatible metallurgically and also suitable for the bolts of property class 8.8 and 10.9. Suitable markings identifying the bolt manufacturer, property class of DTI and its diameter shall be engraved suitably on the DTI. (iii) Number of washers to be provided: (a)Two washers shall be provided, one against head and one against the nut. (b)One DTI shall be used in one bolt. In case DTI is being provided, the same will count as one washer i.e., one DTI and one plain washer shall be provided.

DTIs shall normally be provided below the head of the bolt (with projections towards bolt head) in case nut is rotated. In case the bolt is to be rotated, DTI shall normally be provided under nut (with projections towards nut). In case other side is not accessible for measuring projection gap in DTI, the DTI may be provided under nut which is being rotated. In this case, an additional washer shall be provided on the

DTI side to protect the projections from damage due to the abrasion during bolt tightening.

28.10.3 Surface preparation for steel interface before providing HSFG bolts: The steel interface between the plies which form a joint having HSFG bolts shall have special surface preparation so that sufficient slip factor is available. The surface preparation shall be as assumed by designer in design, based on slip factor specified in Table XIII of Steel Bridge Code. The following surface preparation is recommended: (i). New construction: The interface between the plies which are connected together by the HSFG bolts shall be "Aluminiummetallised without any over coating". The aluminiummetallising shall be as per para 39.2.1

(ii). Existing structures: The interface of plies which are to be included in the HSFG bolts shall be cleaned by wire brushing/ flame cleaning equivalent to the surface specified in IRBM para 217, 1 (b), (i) to (iv). The surfaces shall be cleaned to remove all loose rust and paint layers (Only isolated patches of coatings/ rust can remain). If, however, in existing structures, rivets are to be replaced by bolts but no surface preparation is possible, the slip factor shall be suitably reduced as per Table XIII of Steel Bridge Code.

28.10.4 Personnel for Tightening: The tightening of HSFG bolts is a technical procedure. Only trained personnel who understand the procedure shall carry out the installation of HSFG bolts. Before any person is deployed for installation, his knowledge of the procedure for tightening shall be checked and if found satisfactory, a competency certificate shall be issued by an engineer not below the rank of ADEN or equivalent. The competency certificate once issued shall be valid for six months. Any person deployed for installation of HSFG bolts must possess a valid competency certificate.

28.10.5 Procedure for tightening: Bolts shall be tightened so as to impart bolt tension as specified in para 7.12.6 of IRS Code of Practice For The Design Of Steel Or Wrought Iron Bridges carrying Rail, Road Or Pedestrian Traffic. The following steps shall be followed for tightening of bolts:

(i) The holes shall be brought in alignment by using drifts etc. such that the bolt threads are not damaged during insertion of bolts. Drifting shall not distort the metal or enlarge the holes.

(ii) The members being joined shall be held in position by insertion of few HSFG bolts (tightened to first stage (as defined in para 28.10.5) only). These bolts shall not be tightened to second stage as defined in para 28.10.5 till all the bolts in a joint are inserted and tightened to first stage.

(iii) After the alignment/ geometry of members is verified to be correct as per drawings, balance bolts shall be inserted and tightened upto first stage of tightening. The drifts inserted as above shall also be replaced by HSFG bolts one by one.

(iv) Clearance between plies: The final tightening shall not proceed until the gap between the plates has been closed. Residual gap, if any, shall be less than 2 mm at edges. There shall, however, be no gap in the central portion. In case the central portion is not in close contact or gap at edges is more than 2 mm, straightening of members may be done after opening out the bolts inserted and the entire procedure i) to iii) above shall be repeated.

(v) Sequence of tightening: During tightening of bolts also, the steel members can continue to deform and hence the tightening of subsequent bolts can lead to

loosening of already tightened bolts. In order to minimize the loosening of already tight bolts, tightening in the two stages shall be done starting from the stiffest part to the free edges. Stiffest parts of joint are generally towards the center of the joint.

28.10.6 Procedure for Installation of HSFG Bolts Using Direct Tension Indicator: The tightening is done in two stages so that the bolts already tightened do not get loose when the subsequent bolts are tightened. The procedure shall be as follows:

(a) First Stage of Tightening: As a first stage, all bolts in the joint shall be tightened to 'snug tight' condition in proper sequence for tightening. Snug tight condition means the nut is tightened using an ordinary wrench by an average worker, applying maximum force on the wrench. This stage is required to bring the plies in close contact.

(b) Checks after First stage tightening: After first stage of tightening, the joint shall be checked to see if the plies are in close contact and the clearances are not exceeded.

(c) Second Stage of Tightening: During the second stage of tightening, torque wrench is used to tighten the bolts until the indentations on the DTI indicate full tightening. The bolts shall be tightened in proper sequence of tightening.

(d) Checks after Second stage tightening: 0.40 mm thick feeler gauge shall be used to check 100% of the bolts for proper tightening. If 0.40 mm thick feeler gauge cannot be inserted in the space between indicator positions on a DTI, it is called a 'refusal'. If a 0.10 mm thick feeler gauge cannot be inserted in the space between indicator positions on a DTI, it is called 'full compression of the indicator'. The joint/bolts shall be said to be properly tightened if the following condition is met with:

Number of indicator positions in DTI washer	Minimum number of feeler gauge refusals*
4	3
5	3
6	4
7	4
8	5
9	5

*No more than 10% of the indicators in a connection bolt group shall exhibit full compression of the indicator.

28.10.7 Procedure for Installation of HSFG Bolts without DTI washers:

The tightening shall be done in two stages so that the bolts already tightened do not get loose when the subsequent bolts are tightened.

i. First Stage Tightening: In the first stage, a calibrated wrench with an accuracy of ±10%shall be set to 75% of the torque computed for the complete tightening of the bolt. The torque computed shall be as per manufacturer recommendation, duly certified to impart the bolt tension specified in para 7.12.6 of IRS Steel Bridge Code. All the bolts in the joint shall be tightened to this torque in proper sequence for tightening. After checking all bolts after the first stage, permanent marks shall be made with suitable marker on the bolt as well as nut steel member to indicate the relative position of the two. The mark shall

be such that the same shall be visible for inspection upto 1 year after the date of installation.

ii. Checks after first stage: After the first stage of tightening, following shall be checked:

a) The steel members that make up the plies of the joint with HSFG bolts shall be checked for proper contact as specified in para 28.10.4

b) 10% bolts, subject to minimum 2 per joint shall be tried to be rotated with a separate calibrated torque wrench set at 75% of the proof load for the bolt. Any bolt turning by more than 150 during the check shall be rejected. If the improperly tightened bolts thus found are more than 5 but less than 1% of the total, another 10% of the bolts shall be checked. If the total improperly tightened bolts thus found exceed 1% of the total, the tightening procedure and personnel involved shall be reviewed, the torque wrench used for tightening shall be calibrated afresh and the entire lot shall be checked for tightness.

iii. **Second Stage Tightening:** The bolts tightened to first stage shall be turned by afurtheramount inproper sequence of tightening as specified below:

Total nominal thickness "t" of parts to be connected (including all packing and washers), d = dia of bolt	Further rotation to be applied, during the second stage of tightening	
	Degrees	Part turns
$t < 2d$	60	1/6
$2d \leq t < 6d$	90	1/4
$6d \leq t \leq 10d$	120	1/3

iv. **Checks after second stage tightening:** After the second stage of tightening, following shall bechecked:

a) 100% bolts shall be checked and certified to have been turned through the requisite amount byverifying the permanent marks on the bolt and the nut/steel member.

b) 1% of the bolts, subject to minimum of 10 per size of bolts shall be checked for gross under-tighteningas per procedure given in Annexure D of IS 4000.

28.10.8(i) Painting during initial installation:

In case of HSFG bolts with "Direct Tension Indicating"device, the final coat in field applied on complete structure may be applied on HSFG bolts also. In casepart turn method of tensioning is used without "Direct Tension Indicating" device, the HSFG bolts shallnot be painted and the permanent location marks made onthe bolts shall be visible after 1 year ofinstallation.

28.10.8(ii) Painting in service: HSFG bolts shall be painted as per normal painting schedules andpainting methodologies as specified in the Indian Railways Bridge Manual for the girder as a whole.

28.10.9 Re-tensioning of bolts'.The HSFG bolts are tightened beyond yield stress level and undergo plastic deformation once tightenedfully. If the bolt is opened out aftercomplete

tightening, its length gets increased permanently ascompared with the initial length. The initial few threads which transfer the load from the nut to the bolt suffer the maximum damage.

Therefore, a bolt completely tightened shall not bereused under any circumstances.
ii.A bolt which has been snug tightened or partially tightened (tightened to first stage of tightening) andthen opened out will not be considered to have been fully tensioned and reuse of such bolt will bepermissible in the same or different hole, as required.

28.10.10 Specifications of torque wrench: Except for works of minor nature where numberof HSFGbolts to be installed in very less, only mechanical torque wrenches (pneumatic, hydraulic, electronic etc.)shall be used for tightening of bolts. For small quantum of work, manual torque wrenches may be usedwith permission of site-in-charge.

28.10.11 Calibration of torque wrench: Calibrated torque wrenches, accompanied with a certificate tothe effect, shall be brought to site. Torque wrenches shall be calibratedperiodically at least once in a yearto an accuracy of ±10%. These shall be recalibrated incase of any incidence involving the wrench duringuse resulting in heavy impact (such asfall, mishandling etc.,) or if the joint is found to have beenimproperly tightened using thesame. The procedure for calibration of torque wrench shall be as specifiedby the manufacturer.

29. Connecting Pins

29.1 All connecting pins shall be finished accurately to gauge and parallel throughout, straight and with smooth surface entirely free from flaws and of sufficient length to ensure that all parts connected thereby shall have a full bearing on the pin. They shall be turned to a smaller diameter at the end for the thread and driven to place with a pilot nut, where necessary to preserve the thread.

30. Pin Holes

30.1 Pinholes shall be bored smooth straight and true to gauge and at right angles to the axis of the member. Boring shall only be done after the member has been rivetted up and the diameter of the pin shall not be less than that of the hole by more than 0.5mm.

31. Bearing and Expansion Gear

31.1 All steel bed and bearing plates or plates over saddle castings, shall be made perfectly level and all rivet heads on their bearing surfaces shall countersunk and dressed flush.

31.2 The saddles, knuckle-bearers and roller bed-plates shall be planed on all bearing surfaces and elsewhere as indicated on the Contract Drawings and all bolt-holes shall be drilled. The bottom edge of ribs should be machined and welded to the bottom slabs after which the top edges of the ribs should be machined as a whole and the top plate welded. Subsequently the top and bottom surfaces should be machined to the specified tolerances as given in Appendix VI of IRS Specification for Bridge Fabrication and Erection of steel girders serial No.B1-2001. Generally in connection with the bearing gear all meeting

surfaces including the sides of the roller frames, shall be machined, all bolts except anchor bolts turned and fitted, all washers faced, the rollers knuckles and pins polished to smooth surface and the whole finished in the style of first class machined work.

31.3 Tolerances shall be as specified in Appendix VI of IRS Specification for Bridge Fabrication and Erection of steel girders serial No.B1-2001 and shall be shown on the drawings.

32. Erection in Contractor's Works

32.1 The work shall be temporarily erected complete at the Contractor's Works for inspection by the Inspecting Officer, with the exception of such rivetting as has to be done at site, so that accuracy of fit and perfection of workmanship may be assured. The work shall be put together with sufficient numbers of parallel drifts or turned bolts or both to bring the pieces into place. When so erected all holes left to be filled at site shall be so fair that a parallel gauge turned to a diameter 0.8mm less than that of the hole, of a length equal to the depth of the hole, can be passed through them without difficulty. No drift shall be used anywhere in the work larger in any part than the hole in which it is to be driven. Holes for turned bolts, which have been 1 mm under drilled in shop, should be reamed at site by the erecting agency.

33. Interchangeability

33.1 Every span is to be temporarily erected complete in Contractor's works adopting the method of giving camber as explained in clause 34 and all parts as marked to their place, unless the whole of the work is made completely interchangeable by the use of steel jigs and hard steel bushes controlled by master gauges, in which case the first span must be completely erected to test the accuracy of the templates. Further spans or part span assemblies built from parts selected at random by the Inspecting Officer shall be erected from time to time to check the accuracy of the work as the Inspecting Officer may require.

33.2 If the work is considered interchangeable by the Inspecting Officer a simplified scheme of marking will be permitted, i.e. all pieces which are identical shall bear one distinguishing mark irrespective of the span to which they belong. Should the interchangeability not to the satisfaction of the Inspecting Officer, the whole of the spans must be erected complete and all parts marked to their place without additional charge. The tenderers must state in their tenders whether they intend to adopt complete interchangeability or not.

33.3 Under special arrangement with the Purchaser, it shall be permissible for approved portions of the work to be despatched before complete erection of the first span, provided the Contractor satisfies the Inspecting Officer that such portions of the work are strictly interchangeable and will assemble correctly and accurately in the complete structure.

34. Camber

34.1 In order to ensure that the fabrication and erection of main girders shall be such as to eliminate secondary stresses in the loaded span, the nominal length (i.e. the lengths which

will give no camber) of member shall be increased or decreased by the amount shown on the camber diagram supplied by the Purchaser.

34.2 For setting of the angles of intersection of the chords and web members and also for templating the gusset, full size of panels with nominal lengths of the members, shall be used. Similarly, the machining of all chords butts shall be to suit the nominal outline as defined in clause No. 34.1.

34.3 The procedure for erecting the span at Contractor's work shall be as specified. The site riveting holes shall be riveted or bolted and drifted as specified in Appendix III of IRSSpecification for Bridge Fabrication and Erection of steel girders serial No.B1-2001

34.4 When supported on blocks or staging's, the girders shall be erected to the camber specified in the fabrication drawings according to which the girders have been manufactured. A camber diagram indicating the relevant height of each panel point when erected on blocks at the manufacturing works shall be supplied by the Engineer.

34.5 The cambering of the main girders along with pre–stressing, when all panel points are supported on the blocks or stagings, shall be carried out in accordance with Appendix 'A' of Steel Bridge Code.

34.6 Special methods of erection will require special erection drawings approved by the Engineer, which must not be deviated from.

34.7 In the case where the girders are erected on yielding supports such as a service span, due allowance shall be made for the anticipated yield when the camber blocks are set out. 34.8 Frequent checks shall be made of the camber of girders during erection and care taken to see that the camber as per drawing is obtained when the girder is completely assembled. When span is supported on ends and intermediate supports are removed the dead load camber shall be recorded and entered in bridge register. This will provide the reference to compare the camber checked during technical inspection to ascertain the loss of camber.

35. Testing

35.1 The Inspecting Officer shall be empowered, at his/her discretion to make or have made under the supervision, any of the tests specified in the specifications mentioned herein in addition to such other tests as he/she may consider necessary, at any time upto the completion of the contract and to such an extent as he/she may think necessary to determine the quality of all materials used therein. In doing so, he/she shall be at liberty under any reasonable procedure, he/she may think fit to select, identify, have cut-off and take possession of test pieces from the material either before, during or after its being worked up into the finished product.

35.2 He shall also be empowered to call for a duly authenticated series of mechanical tests to be obtained from the maker for these materials used in the work and to accept the same in lieu of other tests to the extent he/she deems fit. The Contractor shall supply the material required for the test pieces and shall also prepare the test pieces necessary.

35.3 The test shall be carried out by the Contractor, for which Contractor shall provide all facilities including supply of labour and plant. Inspecting officer may at his/her discretion direct the Contractor to despatch such tests pieces as he/she may require to the National Test House or elsewhere as he/she may think fit for such testing purposes.

36. Check on Tests Made at Contractor's Work

36.1 The Inspecting Officer may at his/her discretion, check test results obtained at Contractor's work by independent tests at National Test House.

36.2 The Inspecting Officer shall at all times be empowered to examine and check theworking of the Contractor's plant before and after using it. Should the Contractor's plant be found, in the Inspecting Officer's opinion, unreliable, he/she is empowered to cancel any tests already carried out in this contract and have these tests carried out at any National Test House or elsewhere, as he/she may think fit.

37. Analysis

37.1 The Contractor shall supply authenticated copies of analysis of any materials used in the contract when required to do so by the Inspecting Officer who shall be empowered to accept them to the extent he/she thinks fit. In addition to the above samples may, at theInspecting Officer's discretion be subjected to complete analysis at the National Test House or elsewhere as the Inspecting Officer may determine, the cost of the same to be borne by the Purchaser.

38. Inspection - General

38.1 The Inspecting Officer shall have free access to the works of the Contractor at all reasonable times and shall be at liberty to inspect the process of manufacture at any such time and to reject in whole or part, any work or material that does not conform to the provisions of this Specification and may order the same to be removed, replaced or altered at the expense of the Contractor. All gauges and templates necessary to satisfy the Inspecting Officer of the complete interchangeability of parts must be supplied by the Contractor free of cost.

39. Oiling, Painting and Metalizing

39.1 No part of the work shall be painted or coated, packed or dispatched, until it has been finally inspected and approved by the Inspecting Officer. Dry Film Thickness shall be measured by elcometer or any other approved method.

39.2 When so specified by the Purchaser, the whole of the work except machined surfaces shall be given protective coating using one of the systems of painting or metallising given in clauses 39.2.1 to 39.2.4. Prior to the application of protective coating, the surface of work shall be carefully prepared removing mill-scale, rust, etc. using wire brushes, sand or grit blasting as stipulated and approved by the Purchaser.

39.2.1 For locations where the girders are subjected to salt spray such as in close vicinity of the sea and/or over creeks etc. the protective coating by metalizing with sprayed aluminium as given in the Appendix VII of IRS Specification for Bridge Fabrication and

Erection of steel girders serial No.B1-2001 followed by painting as per painting schedule given below may be applied: (i) One coat of etch primer to IS:5666. (ii) One coat of zinc chrome primer to IS:104 with the additional provision that zinc chrome to be used in the manufacture of primer shall conform to type 2 of IS:51. iii) Two coats of aluminum paint to IS:2339 brushing or spraying as required. One coat shall be applied before the fabricated steel work leaves the shop. After the steel work is erected at site, the second finishing coat shall be applied after touching up the primer and the finishing coat if damaged in transit.

39.2.2 For locations where girders are exposed to corrosive environment i.e. flooring system of open web girders in all cases, girders in industrial, suburban or coastal areas etc., protective coating by metalizing followed by painting as mentioned in clause 39.2.1 or by painting using epoxy based paints as per the following painting schedule may be applied: i) Surface Preparation a) Remove oil/grease from the metal surface by using petroleum hydrocarbon solvent to IS:1745. b) Prepare the surface by sand or grit blasting to Sa 2-1/2 to IS:9954 i.e. near white metallic surface. (ii) Painting (a) Primer Coat Apply by brush/airless spray two coats of Epoxy Zinc Phosphate primer to RDSO Specification No. M&C/PCN/102/86 to 60 microns min, dry film thickness(DFT) giving sufficient time gap between two coats to enable the first coat of primer to hard dry. (b) Intermediate Coat Apply by brush/ airless spray one coat of Epoxy Micaceous Iron Oxide paint to RDSO Specification No. M&C/PCN/ 103/86 to 100 microns minimum DFT of 100 and allow it to hard dry. (c) Finishing Coat Apply by brush/airless spray two coats of polyurethane aluminium finishing to RDSO Specification No. M&C/PCN-110/88 for coastal locations or polyurethane red oxide (red oxide to ISO 446 as per IS:5) to RDSO Specification M&C/PCN-109/88 for other locations to 40 microns minimum DFT giving sufficient time gap between two coats to enable the first coat to hard dry. The finishing coats to be applied in shop and touched after erection if necessary.

39.2.3 For other locations, protective coating by painting as per painting schedule given below may be applied: a) Primer coat One coat of ready mixed paint zinc chrome priming to IS:104 followed by one coat of ready mixed paint red oxide zinc chrome priming to IS:2074. or Two coats of zinc chromate red oxide primer to IRS:P-31 b) Finishing Coat Two finishing coats of red oxide paint to IS:13607 with colour / shade to be specified by Zonal Railway or of any other approved paint shall be applied over the primer coats. One coat shall be applied before the fabricated steel work leaves the shop. After the steel work is erected at site the second finishing coat shall be applied after touching up the primer and the finishing coat if damaged in transit. Note: (i) The colour / shade of finishing coat should be generally matching with the Smoke Grey colour / shade No. ISC 692 mentioned in IS:5- 2004. (ii) The colour/shade can be changed by CBE as per the local requirements.

39.2.4 Where the life of protective coating is required to be longer to avoid frequent paintings, the problem of accessibility of locations and for other locations where metallising or epoxy based painting is recommended vide Clause 39.2.2 but there are no facilities available for the same, protective coating by painting as per following painting schedule may be applied with the approval of the Purchaser: a) Primer coat One coat of ready mixed zinc chrome priming to IS:104 followed by one coat of zinc chrome red oxide priming to IS:2074. b) Finishing Coat Two coats of aluminium paint to IS:2339 shall be applied over the primer coats. One coat shall be applied before the fabricated steel work

leaves the shop. After the steel work is erected at site, the second coat shall be applied after touching up the primer and the finishing coat if damaged in transit.

39.3 Surfaces which are inaccessible for cleaning and painting after fabrication shall be applied one heavy coat of zinc chrome red oxide priming to IS:2074 before being assembled for riveting / welding.

39.4 All rivets, bolts, nuts, washers etc. are to be thoroughly cleaned and dipped into boiled linseed oil to IS:77

39.5 All machined surfaces are to be well coated with a mixture of white lead to IS:34 and Mutton tallow to IS:887.

39.6 For site painting the whole of the steel work shall be given the second finishing coat after finally passing and after touching up the primer and finishing coats if damaged in transit.

40. Name Plate

40.1 A neat casting bearing the name of the Contractor, the place and year of manufacture, drawing number, the contract number and the standard of loading to be specified by the Purchaser shall be bolted conspicuously on each span. The drawing of the name plate shall be approved by the Engineer.

41. Erection Mark

41.1 Every portion of the work shall be distinctly stencilled with paint with letter size not less than 10 mm for guidance in the erection in the field, and stamped with the letters specified in the drawings. In the case of non-interchangeable work, the system of marking shall be in accordance with the drawings prepared by the tenderer and approved by the Purchaser.

42. Packing

42.1 All projecting plates or bars shall be kept in shape by timber or angle bars spiked or bolted to them, and the ends of the chord lengths, end posts and plate girders at their shipping joints shall be protected and stiffened so as to prevent damage or distortion in transit as the Inspecting Officer may direct.

42.2 All threaded ends and machined surfaces are to be efficiently protected against damage in transit. The parts shall be sent out in lengths convenient for transport.

42.3 All straight bars and plates except small pieces are to be sent out in convenient bundles temporarily rivetted or bolted together or bound with wrought iron or suitable wire as the Inspecting Officer may direct. All rivets, bolts, nuts, washers, plates under 300 mm square and small articles generally are to be packed separately for each span in cases each weighing, when full, not more than 350 kg, or in strong petroleum casks, or in barrels approved by the Inspecting Officer. If not entirely filled by the contents the space left shall be closely packed with wood shaving or other suitable material. Bolts and rivets of different

sizes shall be separately packed in bags, each bag having a label indicating its contents. A list of the contents shall be placed in the top of each case or cask.

42.4 In the case of imported material all cases shall be made of 32mm boards with ends nailed with 90mm wire nails strengthened by battens and 38mmx 1.6mm (No. 16 BG) hoop - iron and made thoroughly secure for transit to India. All casks shall be in sound condition, and if not entirely filled by the contents the space left shall be closely packed with wood-wool or other suitable material. The heads shall be firmly secured by means of hoops in the usual way, and in addition each head shall be further secured by a strong wooden batten and not less than two strips of 1.6mm(No.16 BG) hoop-iron passing over the head and nailed to the staves on both sides. The hop-iron shall be long enough to pass over two hoops on each side of the cask and be nailed in such a manner that the hoops cannot slack back. Bolts and rivets of different sizes shall be packed in a separate canvas bags, each bag having a label in dictating its contents. End field holes to be bolted in case of members having split in plate and channels

43. Dispatch or Shipping Marks

43.1 Each package, case or bundle is to have clearly stencilled on it in good oil paint the address as stated in the order of contract, gross and net weight description of contents and such marks as may be required by the Purchaser must be shown against each item in the invoice. The Contractor is to provide necessary stencil plates for marking. Every piece of bundle shall be marked and in the case of material (shipped to India) all cases or casks shall be clearly cut or branded, not merely painted, with their net and gross weights and with such shipping marks and other particulars as the Inspecting Officer may direct and each bundle shall also have a metal label securely attached with wire stamped with similar marks. The marking shall be done with thick oil paint and in such a manner that it cannot be washed off or obliterated.

44. Loading

44.1 All trucks or wagons are to be loaded to as near their full capacity as is consistent with safe transport. While loading the material in wagon, truck or trailor, care should be taken that heavier material is loaded first and lighter material is kept on top so that lighter material is not damaged due to heavy weight. While transporting the material by road, adequate safety precautions shall be taken as per extant instructions.

44.2 The Contractor shall apply all dunnage and lashing required to hold the material securely in position free of charge.

44.3 While handling any girder or girder component it shall be ensured no damage to material takes place in the form of dent/cut mark etc. Wooden blocks, rubber pads shall be used to avoid direct contact between materials to be handled and handling equipment.

45. Weight of Steel Work for Payment

45.1 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 to rejection.

45.2 Payment shall be made on the tendered weight to be calculated in accordance with the nominal weight of the sections as specified on the contract drawings. An addition in weight for welds/HSFG Bolts and rivet heads should either be specified in the schedule or be made as follows: a) 3% in case of rivetted and b) Nil % in case of purely welded work.

45.3 Should the actual weight fall short of the calculated weight by 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.

45.4 No separate payment shall be made for the items mentioned in clause 24.

45.5 In the event of a dispute arising as to the weight of a portion of steelwork, a weighment shall be made in the presence of the Inspecting Officer.

46. Quantities

46.1 In case where the estimated quantities are given with the schedule, it must be understood that the Purchaser will not be responsible for their accuracy and if the Contractor makes use of them in preparing his/her tender, he/she does so at his/her own risk, as he/she will not be entitled to make any claim or demand nor to raise any question whatsoever, on account of any error or miscalculations in or misunderstanding of the said quantities, as these are given for the convenience of the Purchaser.

47. Tracings and Printings

47.1 Excepting in the case of standard spans fabricated without any modifications to the standard drawings the Contractor shall supply free of charge, one set of neatly executed tracing on linen. They shall be fully dimensioned and contain all erection marks, notifications as to the colour the work has been printed, the name of the Contractor and any alterations from the contract drawings, which may have been made in executing the work. The drawings shall conform to standard sizes as given in IS:962 and shall not exceed AO size. The drawings shall not be folded but rolled outwards on a roller, in addition to three sets of full size copies on strong paper made by an approved process.

48. Rivets and Bolts Lists

48.1 The Contractor shall also supply, without charge, three complete lists of the rivets, bolts, HSFG bolts, service bolts, washers and drifts required for erecting the work at site, showing the parts of the work to which the various rivets and bolts belong and having each item marked so as to indicate the particular case in which it will be found. 49. Photographs
49.1 If required by the Purchaser the Contractor shall also supply without charge, two sets of large wellexecuted, unmounted photographs of the first span of each description of plate girder or truss bridge when erected, taken from two points of view and showing the erection marking as clearly as possible Photographs of rolled beam, trough girder or trough plate girder bridges will not be required.

50. Attestation of Tracings etc.

50.1 The tracings, photographs and lists shall be examined and signed by the Inspecting Officer. They shall be supplied with the first instalment of the work delivered.

51. Deviations from this Specification

51.1 Should a tenderer desire to depart in any respect from the provisions of this Specifications either on account of manufacturing practice or for any other reasons, he/she must do so in an alternative tender which may not be considered, with a covering letter explaining in detail each and every departure he/she proposes to make from the Specification.

51.2 Manufacturer's standard specification may be submitted but all discrepancies must be carefully drawn attention to, both in covering letter and in appendices to be annexed to the specification. 51.3 The intention is to adopt manufacturer's standard equipment as far as possible but these standards must in all respects comply with the conditions of this Specification regarding safety from break-down, output, capacity, performance etc.

52. Alterations in Work

52.1 The Contractor shall not in any case or in any circumstances have authority to make any alterations in, modifications of, substitution for, addition to, or omission of work or any method or system of construction, unless an alteration order in writing directing such alteration, modification, substitution, addition, omission or change shall have been given by the Purchaser prior to the commencement of the work or part of work nor shall the Contractor be entitled to any payment for or in respect of any such alteration, modification, substitution, addition, omission or change may have been actually made and executed and no course of conduct shall be taken to be a waiver of the obligation and conditions hereby imposed.

52.2 All altered, modified, substituted, additional and changed work, labour and materials and all omitted work shall be valued by the Purchaser on the basis of the rates specified in the schedule. Supplying, Acceptance inspection & Testing, and Installation of Elastomeric Bearings will be also governing by para 22.3 of Indian Railways Unified Standard Specifications (Works and Materials) 2010.

GUIDELINES ON FABRICATION OF STEEL GIRDERS

The fabrication of steel girder bridges is being done by various Railway through trade. The fabrication is governed by the provisions of;

i) Indian Railway Standard specification for fabrication and erection of steel girder bridges and locomotive turn-tables. (B1-2001).

ii) Indian Railway Standard Code of Practices for metal arc welding for structural steel bridges carrying rail cum road or pedestrian traffic (Adopted 1972 Revised 2001). All Rly engineers associated with fabrication are advised to understand the provision of IRS B1-2001 and Welded Bridge Code and take help from these guidelines. Engineer of contractors should also have good understanding of various provisions of above Railway codes other related codes and Guide lines on Fabrication RDSO-BS-110.

ITEM REQUIRING ATTENTION BY RAILWAY FIELD ENGINEERS AND CONTRACTORS & ENGINEERS DURING FABRICATION OF STEEL GIRDERS

A. Approved Drawing to be used for fabrication:
Field/Workshop Engineer associated with fabrication should have all the relevant drawings, Codes & Specifications with latest Correction Slips prior to the start of work. On the basis of structural drawings, fabrication drawings should be prepared by fabricator. Plate Girder Drawings to be checked for intermediate stiffeners whether riveted or welded.

B. Quality Assurance Programme (QAP) of Steel Girder Fabrication:
To ensure the proper quality of fabrication Quality Assurance Plan (QAP) is prepared. QAP must indicate stage wise manufacturing process covering various steps, tests, checks & their frequency, sampling plan, authority for grant of clearance etc. for all activities from inspection and testing of raw material to trial assembly and erection. The QAP must cover following aspects.

Brief Details of project
- Contract Agreement No.
- Loading Standard
- Governing Specification
- Drawing references
- Roles and responsibilities of various agencies involved in fabrication erection & inspection.

A sample QAP for 30.5m welded open web girder is given at Annexure-I of Guidelines on Fabrication of Steel Girder BS-110 issued by RDSO B&S Directorate.

QAP is to be scrutinized and approved by the inspection agency. In case of welded girder it is to be done by RDSO, as per prevailing orders.
Field Engineer should ensure that work is carried out strictly as per the approved QAP and no deviation takes place from QAP. All the stages should be studied in detail, prior to start of work.

C. Scrutiny & Approval of Welding Procedure Spec. Sheet (WPSS) (final approval to be done by RDSO):

WPSS is process sheet indicating plate/section used, welding process, type of joint, welding consumables quality, welding parameters, acceptance standard, tests applicable etc. Field Engineer should ensure that welding is carried out as per approved WPSS. It is to be ensured that welding consumables to be used are from approved source and a proper record of their consumption is maintained. A sample Performa for record keeping of consumables is enclosed as Annexure–II of Guidelines on Fabrication of Steel Girder BS-110 issued by RDSO B&S Directorate.

D. Welding Procedure Qualification Records (WPQR) (final approval to be done by RDSO):

WPQR is the document indicating approval of various welders who are to be deployed for carrying out welding work for fabrication. It contains Name of the welder with photograph, qualification, experience, qualification tests and records for each welding process and joint, welding parameter. Tests are conducted by RDSO Official from M&C Directorate before qualifying the welders and then approval is granted through WPQR. Field engineer should ensure that welding is done only by approved welders and no deviation takes place.

E. Raw Material and Gauge Certification Inspection of Raw Materials: -

Passing of raw material is done on the basis of visual inspection and lab test for mechanical properties, chemical composition, ultrasonic examination, Charpy Impact Test, lab test report etc. Rivets and other consumables like paint etc. should also be got tested from NABL Lab as per relevant codes/specification. All the required test should be got done through independent NABL Labs and compared with the mill test results given by the supplier before passing the material for use. Material test certificate register must be maintained by fabricator as per Annexure available in IRS:B1- 2001(appendix-I,Performa-7)and signed by railway representative as well as fabricator. All angle/channel, rolled section to be used for open web girder fabrication shall be checked for rolling tolerance as stipulated in IS:1852. In addition to above visual inspection shall be done to ensure that steel is free from surface defects like pitting, laminations, imperfect edges, twist, other harmful defects etc. and recorded in the register.

F. Item requiring attention before Fabrication of Girder.

F1. Inspection of Layout on template floor–Field engineer has to ensure that the Template floor is level. Nominal and camber layout are drawn with the calibrated steel tape. The certificate of calibration from a authorized agency should be kept in record. For squareness, diagonal measurement are also checked. It should be remembered that tape should not be changed during the various stages of measurement. Running measurement should be recorded with a long tested tape having minimum length suitable for half span/full span measurement as per the case.4 lbs pull is to be applied for stretching the tape. Suitable device should be used for this purpose.

F2. Inspection of Jigs, Fixtures and Master Plates-Master Gussets should be checked on nominal layout and transfer of all inter section line/points to be done with great care and accuracy. If gussets are symmetrical then 1/4thor half hole marking is to be done and same will be transferred to complete the gusset marking. Dimensional Inspection of Jigs, Fixtures, Master Plates used in manufacture of girder should be done very carefully to ensure accuracy. It should be remembered that jigs of main members of the open web girders are fabricated on the camber length with the adoption of the field holes at nominal length layout through master gussets.

F3. Layout of joints is drawn as per drawing on 1:1 scale on a level ground to check for ;i)Any infringement of rivets, adjoining edges etc. iii) Position of holes in master plates for jigs as per layout.

iii) The bore of bushes shall initially have tolerances of - 0mm to + 1mm. Fairing of bushes with holes of master plate shall conform to tolerances of – 0.13mm using a 'GO' gauge of 0.13mm less than hole diameter. Bushes of jigs during service should be maintained within acceptable limit (D+0.4mm) which shall be checked at regular intervals.

F4. Certification of Jigs, Fixtures and Master Plates-Stamping of Master Plates by the inspection official should be ensured prior to their use. The jigs should be checked by fabricator and field engineer from time to time for their wear and tear for maintaining accuracy during work.

G. Item requiring attention during fabrication of girder:

Field/Workshop engineer should keep a watch and maintain proper record for-(i)Ensuring Use of Approved Raw Material-Only raw material cleared originally to be used during fabrication. (ii)Ensuring use of Approved Welding Consumables-Type of consumables, source, quality, approval status, grade, suitability for fabrication as per WPSS etc. to be frequently checked and recorded. (iii)Ensuring use of Approved Welders-Checking of welders certificate, records, skill and procedure adopted for welding as per WPSS (iv)Ensuring use of Approved WPSS & Welding Parameters-Checking welding parameters and equipment used for correctness of joint preparation etc.

Important Checks for Tack Welding:

i) Check that top & bottom flange plate are perfectly perpendicular with reference to web throughout the length of I Section.

ii) Check the squareness i.e. 90° angle between flange & web of top and bottom flange plate to avoid out of squares flanges.

iii) Check with filler gauge throughout the length of top & bottom flange connection for uniform contact throughout the web plate.

Points requiring attention during full welding:

i) Thorough cleaning of tack welded member should be done with appropriate tool like wire brush, before shifting for full welding. Minimum width of 75mm throughout the length shall be cleaned to ensure that the surface is free from dust, mill scale, grease, oil and paint to ensure sound quality of weld.

ii) Full welding shall be carried out in flat position with SAW process as per sequence mentioned in WPSS/WPQR using manipulator/special welding fixture.

iii) The sequence of welding shall be shown in WPSS/WPQR marked as 1, 2, 3 & 4 in the order of welding.

iv) The welding should be done in proper sequence. v) Minor welds/ Inaccessible location welds shall be made by CO2weldingor other type of welding as per approved WPSS.

v)

Good Working practice for prevention of distortion in welded girders:

i) By prebending of flange plate of welded girder using appropriate fixture.

ii) By clamping the flange plate to fixture. (Fixture developed by MMR Workshop is given at Annexure of Guidelines on Fabrication of Steel Girder BS-110 issued by RDSO B&S Directorate.) Radiographic Exam.of Butt Weld Joints-Any butt welding provided as per approved WPSS should be subjected to radiographic testing by authorized agency only. The film should be preserved for examination, sensitivity, defect interpretation and acceptance decision based on prescribed criteria. Ensuring use of Approved set of Jigs & Fixtures-To permit the inter changeability of the components and ensure pre-stressing in open web girders and to avoid distortion, it should be ensured that only approved Jigs & fixture are used and proper clamping arrangement are provided in jigs/fixtures.

H. Item requiring attention after fabrication of girder: stacking of component should be proper and shipping mark is properly stencilled on component for identification.

Field/Workshop engineer should ensure that: -
While cutting the plates or other section the heat/cast mark should be transferred to all cut members while using these members for fabrication. Proper record of heat mark should be maintained/ correlating it with the components of girder. Visual Exam of Welds-Quality of weld, uniformity of weld bead, size of the weld, weld defects e.g. under cut, blow hole, porosity, spatter, crack etc. should satisfy para 31 and Appendix C of welded bridge code. Metallographic and NDT Exam of Fillet Welds-Macro etching on girder, run-on, run-off tabs for ensuring proper weld quality, Dye penetrant examination etc. should be arranged by fabricator, for independent inspection. Structural and dimensional inspection-Dimensional check should be carried out by field engineer to ensure conformance to drawing dimensions including diagonal checks for squareness etc. before offering girders for final inspection.

I. Trial Assembly: for open web girder. First span is always trial assembled to check whether fabrication process is proper or require any correction in jigs, workmanship or procedures to ensure regular quality output. Following important parameters are checked during trial assembly:-

(i) Camber: Camber shall be checked while the girder is supported on the nodal points on camber jacks and after releasing jacks i.e. for residual camber with girder resting on bearing ends. The camber measurements should be done with appropriate levelling instrument:

(ii) Dimensional check: i) Overall length ii) Bearing centers iii) Height iv) Truss center v) Center to center distance of rail bearers vi) Center to center distance of panel points vii) Squarenessviii)Alignment of the girder ix) Fairing of holes x) Verticality xi) Infringement, if any xii) Butting of compression flange.

(iii) (3) Component Inspection of first span- Detailed inspection of dismantled components of trial erected span is carried out to see the integrity of components. There should not be any elongation of holes, tearing of edges or other defects after dismantling of trial assembly.

(iv) (4) Component inspection of 2nd span onwards:- Once fabrication process is found satisfactory i.e all steps from A to J are proved during trial assembly and its component inspection, then only components of 2nd span and onwards should be fabricated with the approved sets of jigs and fixture, the

tested WPSS and WPQR as laid out in steps earlier. Field engineer should do the components inspection and ensure all record are available before giving final inspection call inspecting authority.

Plate girder check.

i) Overall length ii) Bearing centers iii) Height iv) Girder center v) Squareness vi) Fairing of holes vii) Verticality viii) Infringement, if any ix) Butting of compression flange.

L. Anti-Corrosive Treatment- Surface preparation, metalizing and or painting as perapplicable painting schedule. Should be done as per provision given in para 39 of IRS: B1-2001. It should be ensured that paint are procured only through RDSO approved sources. The list of approved vendors by M&C Directorate of RDSO is available on web site.

M. Some important DOs & DON'TS are given here for guidance:-

DOs-

Use proper fixtures and clamps to hold the members firmly at desired location while welding. The clamps and fixtures must be strong enough to prevent any distortion of the member while cooling of the welding joint. The clamps and fixtures are only to be removed when the joint is cooled to ambient temperature. ¬ Do the welding work in a warm and dry place so that rain water or other atmospheric elements may not come in contact while welding is in progress. ¬ While welding in very cold weather pre-heat the material before welding and apply post heating to prevent the weld joint from rapid cooling and develop stress raiser due to sudden contraction. ¬ Cross level of bearing plates in the welded plate girders should be checked properly for proper sitting over bed plate. ¬ To co-relate use of steel and welders in different members proper records should be maintained. ¬ Drilling of holes through approved set of jig particularly long members should be ensured. No fabrication should be done with unapproved jig. ¬ Drain hole in the portal girders at proper locations should be ensured. ¬ Fairing of holes and removal of drill burrs through initial assembly should be ensured. ¬ Proper edge finishing with grinding/ special attention in top chord compression members butting by end milling should be carried out. ¬ At site during the erection of girders particularly open web girders due and adequate care should be taken to achieve the required camber values. ¬ Camber Jacks should be provided at all the nodal points during trial assembly. ¬ Butting of compression members, X-levels of stringers and alignment of stringers to be checked properly in the trial erection. ¬ Application of paint on permanent contact surface should be ensured after proper surface preparation visual inspection is very important tool. ¬ The plates should be perfectly horizontal while drilling the holes to ensure horizontal verticality of holes. ¬ Steel with proper test certificate/ reports should be used. Commercially available steel in the market should not be used. Steel received from the rolling mills has generally punch heat mark numbers. These numbers should be legibly marked again with paint for easy identification. Heat mark numbers should be transferred to cut members with paints Members of the open web girders should be fabricated on the camber length with the adoption of the field holes of nominal length. Consistency of weld quality is higher in Submerged Arc Welding

Process and chances of human errors are also eliminated. Therefore, welding of the girders should be done by SAW process. Whenever not possible then only CO2 welding or MMAW may be adopted if provided in app. WPSS. ¬ Stage inspection during fabrication should be properly ensured to avoid rejection at later stage. ¬ Skilled and qualified welders, drillers, fitter should be deployed for welding drilling and marking works. The welder should be individually approved by authorized agency i.e. M&C Directorate of RDSO. ¬ Selection of Angles in fabrication of cross girders and stringers of open web girders requires special attention, drooping in angles either acute or obtuse should not be permitted. It will cause improper sitting of sleepers on the stringers.

DON'T's-

Use of pitted/ corroded material should not be done because it gives rise to concentration of stresses and results in poor fatigue strength. Tack welds in fabrication of riveted open web girders should be avoided. Do not hammer the distorted joints for rectification. It may lead to the development of cracks and failure of the joints. Do not do the welding in chilled weather, as due to sudden cooling of welded joints they are liable to be brittle and develop cracks. The joints may also suddenly fail under dynamic loading without any prior warning. Do not weld with un-controlled welding parameters, these will affect the quality of welding and make the joints weak and may yield in dynamic loading on the structure. Do not weld the joint haphazardly without following the proper welding sequence. This will lead to uncontrolled and irreparable distortion, of the proper geometry of the joint. Sharp notches in the member should be avoided.

RESEARCH DESIGNS AND STANDARD ORGANISATION (RDSO) MANAK NAGAR, LUCKNOW-226011

Document No. : **BS-S-4.2.3–2**

Document Title:**SCHEDULE OF TECHNICAL REQUIREMENTS FORFABRICATION OF STEEL GIRDERS.**

AMENDMENT HISTORY:

S.No.	Amendment Date	Version	Reasons for Amendments
1.	14-09-2010	1.0	STR approved by Railway Board.
2.	22-06-2012	1.1	Minor change in procedure for ONLINE facility only (Facility of Hard Copy with drawn).
3.	23-10-2012	2.0	Modification in Para 2.2, 2.4, 2.5, 4.3 & 7.8 and addition of Para 4.14 & 4.15
4.	27-06-2014	3.0	Modification in para 2.2.1, 2.2.2, 4.1 to 4.12, 6.2, 7.1, 7.4, 7.5 & 7.8, deletion of para 2.2.2 to 2.6 and addition of para 4.16
5.	21-09-2015	3.1	Minor Modification in Para 2.2 & 2.2.1.

SCHEDULE OF TECHNICAL REQUIREMENTS FOR FABRICATION OF STEEL GIRDERS

1. Scope

This schedule covers the norms for evaluation of both the capability and the capacity of any firm to manufacture and supply Steel Bridge Girders. Intended fabricators will be required to fabricate riveted/welded plate girders and riveted/welded open web girders.

2. Procedure for registration of firms for fabrication of girders.

2.0 The firm will ensure availability of

a. The required infrastructure, machinery & Plant.

b. Testing and measuring equipments duly calibrated.

c. Trained technical manpower and Quality Assurance Programme

d. Equipments meeting the requirements of relevant specifications.

e. Space required for manufacturing, testing and storage viz. manufacturing floor, godown, store, office and test lab etc.

2.1 In case fabricator is satisfied that the infrastructure available commensurate with the above stated requirements then firm shall apply for registration ON-LINE on the RDSO website. All relevant documents like Guidelines for Registration and Quality Audit of Vendors in Bridge & Structure Directorate, Application Form, Schedule of Technical Requirement (STR), latest version of relevant specifications (if applicable), RDSO Vendor Approval Process Guidelines, etc. are available on the RDSO website. The requisite charges as specified on website are to be deposited through the means as specified on the RDSO website.

2.2.1 The firm has to submit ONLINE complete application form, self compliance of STR and all necessary documents in support of self compliance of STR and documents in support of other important aspects of application. The firm has also to submit the Undertakings and Documents as mentioned in Doc No. BS-G-4.2.3-1 (latest version) titled “Guidelines for Registration and Quality Auditof Vendors in Bridge & Structure Directorate.”

2.2.2 For detail procedure for Registration and other related aspects, refer to Doc No. BS-G4.2.3-1 (latest version) titled “Guidelines for Registration andQuality Audit of Vendors in Bridge & Structure Directorate.”

3. Norms for Acceptance

3.1 To qualify for riveted steel bridge girders production, the firm must satisfy the infrastructural requirement as laid down in para 4 to 6.

3.2 To qualify for welded steel girders production, firm must satisfy the requirement laid down in para 7 in addition to requirement of other para 4 to 6.

3.3 Fabricators who do not have established the workshop for fabrication but do have required facilities at site as given in para 3.1 & 3.2 above as applicable will also be considered.

4. General and Infrastructural Requirements for Steel Girders:-ProvideDetail Information on items given below and enclose necessary documents in support as applicable ONLINE:-

4.1 The fabricator must have adequate organization including supervisors, skilled workers and adequate manpower to execute the fabrication work in competent manner. (Enclose list of staff along with Qualification & experience of employees.)

4.2 A proper organization must exist to perform the functions of purchasing of various raw materials and consumables etc. and maintaining related inspection certificates, test certificates etc. (Enclose list of staff along with Qualification & experience of employees).

4.3 Previous experience of fabricating steel structures capable of with-standing dynamic loads such as bridge girders, microwave towers, heavy industrial steel structures etc. is essential.

Note:-

(i) Bridge Girders:- Firm should have fabricated not less than 1 span of 30m or above Open Web Girder or not less than 3 spans of Plate Girder for Railway Bridge or ROB’s (Foot Over Bridges, Pipe Line crossings etc. will not be considered for similar experience purpose).

(ii) Towers:- Fabrication of only those Microwave Tower/Power Transmission Tower/Chimneys will be considered for which height above ground level is not less than 30 meters.

(iii) Gantry Girders:- Fabrication of Gantry Girders and/ or columns designed to cater for EOT crane of capacity not less than 50 tone.

(iv) Heavy Industrial Structure is defined as the work in which firm has fabricated more than 1000 MT involving built up section like I-girder of depth not less than 700 mm or Box section with X-sectional area of Box not less than 90000 mm 2 .

(v) Previous experience will be considered only for the works completed during the last five financial years &upto the date of application in the current financial year.

(vi) For items (i) to (iv), the applicant has to submit the concerned fabrication details along with performance certificate from client, explicitly as supporting documents for this and in absence of these, experience will not be considered. Certificate issued by Govt./ Semi Govt./PSU's will be accepted for this purpose.

(vii) Performance certificate from Private individuals will not be accepted except those which are reputed Pvt. Ltd. firm whose turnover is more than 100 croresper annum and the applicant has to submit necessary certificate from CA and Audit Reports of CA or Income Tax returns to prove his point.

(viii) Necessary documents in support of above to be enclosed. If above conditions are not satisfied, it will be deemed that firm is not having the desired experience, which in turn is essential & his application will be closed as per procedure mentioned in Guidelines for Registration/Renewal of Vendors in Bridge & Structure Directorate.

4.4 A proper procedure for maintenance of records for receipt and consumption of raw material should be in vogue or developed so as to permit verification by railway's representative.

4.5 Adequate power supply should be available through distribution agencies and adequate backup shall be available through captive generation. (Necessary documents in support to be enclosed).

4.6 Covered bay area served by EOT cranes or by mechanically operated machines should be provided to handle day today fabrication of girder components. (Necessary documents in support to be enclosed).

4.7 Enough area to store raw material, sub-assemblies and finished product should be available. The area provided should be enough to store raw material to execute the work order for requirement of steel. Suitable material handling facilities in form of EOT/mobile cranes should be available.

4.8 A separate line for inspection and testing of girders should be provided for final inspection and testing of bridge girders by railway's inspecting engineers.

4.9 Covered shed area protected from rain, dust etc. should be provided for surface preparation/painting/metallising of steel girders. As no part of the work shall be painted unless it has been finally passed and cleared by inspecting officer, adequate space for storing fabricated component awaiting painting shall be available.

4.10 For full scale layout of drawings to which girders are to be manufactured, template shop with steel/concrete floor should be available. For symmetrical girders, central half of the layout may be done and for non-symmetrical girders full-length layout shall be required. Further, for development of jigs and fixtures this shop should have in-house jigs manufacturing facilities.

Note: For para 4.6 to 4.10 Applicant has to submit ONLINE neat copy of planof works premises & show detail of items given below:- (a) Covered bay area with proper handling facilities available to handle dayto-day fabrication of Steel Bridge Girder. (b) Area for storing raw material, sub-assemblies & finished products etc. (c) Area for separate line for inspection and testing of Girder. (d) Covered shed area protected from rain, dust etc, available for surface preparation/painting/metallizing. (e) Availability of Template floor.

4.11 Sufficient space for trial erection of the girder after manufacture shall be available. For this purpose, proper handling equipment, stacking space and other facility shall be available and same should be marked clearly in the factory plan to be submitted.

4.12 An adequately equipped and staffed drawing office is required for preparation of fabrication drawings. (Enclose list of staff along with Qualification & experience of employees).

4.13. Digital Signatures: It is mandatory for all the vendors to obtain Digital Signature Certificate & get registered with IREPS at http://www.ireps.gov.in.

4.14 It should be mandatory to inform the RDSO through FAX (followed by confirmation copy through courier/speed post) as soon as any machinery is removed from the firm's premise (even for repair etc.). RDSO should be informed again, when brought back and made operational.

4.15 Firm should be required to give an undertaking at the time of seeking approval that if at any time after approval is accorded, some machinery is found deficient without intimation to RDSO, then it will be presumed that machinery was not there since beginning and firm's approval will be withdrawn immediately.

4.16 Firm should submit the detail of Equipments/Machinery i.e. covering Quantity, Make, Model Number, Capacity, Year of manufacture/commissioning, Machine number etc. preferably in a chart form for the machineries and plants as mentioned under para-5 and 7.1 to 7.2 given below (Machinery owned by sister concern will not be accepted).

5. Machinery & Plants: Following machinery and plants shall be available with the fabricator:

5.1 EOT/Portal/mobile crane of min. 10t capacity or suitable material handling facility to serve the handling of material for fabrication of girders, unloading of raw material and loading of finished product.

5.2 Compressors of adequate capacity suitable for riveting and for other simultaneous applications.

5.3 Oxy-Acetylene gas cutting equipment a) Profile cutting equipment of adequate size. b) Self propelled straight cutting equipment preferably consisting of multiple torches.

5.4 Radial drilling machines of adequate capacity to drill holes of 12 to 50 mm diameter.

5.5 End milling machine.

5.6 Plate & structural sections straightening machine.

5.7 Pneumatic/hydraulic yoke riveting machine.

5.8 Adequate number of portable pneumatic tools such as grinders, drilling machines, chipping machines, wrenches etc.

5.9 Dumpy level or theodolite instrument for recording of camber/deflection of trial erected girder. 5.10 Facilities for surface preparation/painting/metallising as per IRS B-1 specification.

5.11 A) To test the raw material and girders to conform it for relevant specification, testing facilities for the following must be provided:- (b) Elcometer for measuring thickness of paint. (c) Steel measuring tape duly calibrated

5.11 B) Following facilities for testing of material can be in house or may be arranged from external agencies:

(a) Equipments required for testing of mechanical properties, chemical composition and microstructure etc. Note: - If facility is in house provide details of Equipment like, Make, Model Number, Capacity, Year of manufacture/ commissioning and copy of test certificates issued earlier. If outsourced, submit copy of MOU with NABL Lab and copy of some previous Test Certificate issued by NABL Lab. The MOU should have validity of minimum 30 months.

(b) Ultrasonic flaw detection testing facilities for checking internal flaws and thickness of section.

Note:- If facility is in house provide details of Equipment like, Make, Model Number, Year of manufacture/ commissioning, Proficiency Certificate of minimum levelII of personal conducting UT Test and copy of some test certificates issued earlier. If outsourced, submit copy of MOU with NABL Lab /approved agency, Proficiency Certificate of minimum level-II of personal conducting UT Test and copy of some previous Test Certificate issued by NABL Lab/approved agency. The MOU should have validity of minimum 30 months.

5.12 System of periodical maintenance of M&P must be in vogue and proper records maintained.

6. Quality Infrastructure:

6.1 Fabricator shall have proper quality infrastructure to ensure the quality product as required under latest issue of IRS B1 Specification and IRS Welded Bridge Code as applicable. ISO certified firms would be preferred.

6.2 A system should be in force for analysis of defects noticed during internal and external inspections of the final product and sub-assemblies. A dynamic arrangement for a

feed back to the source of defects and for rectification should be in vogue. Necessary perform as followed to be enclosed.

6.3 The fabricator should have adequate infrastructure and facilities like checking gauges, templates etc. during fabrication required from time to time so as to ensure that the finished product is as per requirement of IRS: B1 and Welded Bridge Code

6.4 Following specifications/codes commonly referred in connection with fabrication of riveted steel girders must be available with fabricator

IRS B-1	Fabrication and erection of steel Girder Bridges
IRS	Steel Bridge Code
IS: 1148	Hot rolled steel rivet bars (upto 40mm dia) for structural purpose.
IS: 1149	High tensile steel rivet bars for structural purpose
IS: 1852	Rolling and cutting tolerance for Hot Rolled Steel Products.
IS: 2062	Hot rolled low, medium and high tensile structural steel.

The latest version of BIS Code/Specifications referred herein including their amendments issued from time to time are to be followed.

6.5 All equipments must meet the requirements of corresponding BIS or other international Specifications.

7. Additional general and infrastructural requirements for fabrication of welded girders.

7.1 The following facilities should be available for fabrication of welded girders.

a) Welding transformers/rectifier for Manual Metal Arc Welding (MMAW)

b) Inert gas (Carbon Dioxide) welding equipment sets.

c) Automatic sub-merged arc welding equipment.

d) Suitable welding manipulators.

e) Macroetching /Dye Penetrant or Magnetic Particle testing facilities.

f) Arrangement for radiographic test either in house or from external agency.

Note:- If facility is in house provide details of Equipment like, Make, Model Number and Year of manufacture/commissioning and provide copy of proficiency Certificate of minimum level-II of personal conducting RT Test and copy of Test Certificates issued earlier. If outsourced, submit copy of MOU with approved Agency by BARC/Atomic Energy Regulatory Board and copy of Proficiency Certificate (preferable which should be minimum level-II) of person trained for Radiography Testing and copy of previous Test Certificates issued earlier by approved agency. The MOU should have validity of minimum 30 months.
g) Tongue tester for measuring current and voltage. h) Gauges for checking weld size, throat thickness and edge preparation etc.

7.2 Machine for edge preparation before welding.

7.3 Fabricators must ensure that welding and gas cutting equipment/accessories meet BIS or other international standard requirements. It will be fabricators responsibility to satisfy the inspecting engineer that all the welding equipment/accessories conform to the BIS standard or any other standard in the absence of proper marking on such equipment/accessories.

7.4 Only trained and qualified Welders shall be deployed for welding. The welders must be trained in accordance with the provisions of IS: 817. They must be trained either from recognized welding institutes or by in-house training, if proper facilities exist. The welders must be tested as per requirements of IS: 7310 and proper records maintained. Applicant to submit copy of some welding procedures and Welders Qualification followed at their works.

7.5 All welding shall be carried out under the overall supervision of a qualified welding supervisor who has been trained in Welding Technology from any recognized welding institute. Submit details of staff & their Qualification and experience.

7.6 Welding instructions shall be prominently displayed on the shop floor. Requirement of the job in hand must be clearly explained to the welder before he is permitted to work.

7.7 Following specifications/codes commonly referred in connection with fabrication of welded steel girders must be available with fabricator.

IRS WBC	IRS Welded Bridge Code
IS:817	Code of practice for training and testing of metal arc welders.
IS:818	Code of Practice for Safety and health requirements in electric and gas welding operations
IS: 822	Code of Procedure for inspection of welds.
IS: 4353	Recommendations for sub-merged arc welding of mild steel and low alloy steels.
IS:7307 (Pt1)	Approval tests for welding procedure
IS:7310(Pt.1)	Approval tests for welders working to approved welding procedure-fusion welding of steel.
IS:9595	Recommendations for metal arc welding of carbon and carbon manganese steel.

The latest version of BIS Code/Specifications referred herein including their amendments issued from time to time are to be followed. Wherever to the standards mentioned above appears in the specification it shall be taken as a reference to the latest version of the standard.

7.8 Quality Audit of the Registered Vendors will be done every three years for which following are the requirements:

(a) The firm should continue to maintain the facilities as required at the time of initial approval.

(b) The firm should have participated in at least one of the tender of Railway Bridge Girder Fabrication. OR The firm should have carried out any one work satisfying criteria 4.3 of this

STR during the last five financial years &upto validity of current financial year at the time of Quality Audit.

(c) The firm should not have any adverse report from any of the Railways.

7.8.1 For Quality Audit, firm will be inspected for facilities provided under para 5 to 7 of this STR, which in turn will be verified after inspection by the RDSO team. Regarding para 4 of STR, the firm should give undertaking that organizational and infrastructural requirement mentioned in para 4 of STR have been maintained as existing at the time of initial approval.

7.8.2 If the firm does not satisfy either of the criteria given in para 7.8(b), its name will be removed from list and firm shall have to apply afresh.

8.0 RESPONSIBILITY AND AUTHORITY:

The following table indicates responsibility related to this document: -

Activity	Responsible	Approver	Supporting	Consulted	Informed
Creation, maintenance of this document	DBS/T&I	ED/B&S	DD Insp., AE/Insp. and Staff of DD/Insp.	-	Through intranet/ soft copy.
Compliance of Directive contained in this document	DD/B&S/Insp.	DBS/T&I	Directorate staff	-	-
Requirement of Deviation from Directive	DBS/T&I	ED/B&S	DD/Insp., AE/Insp.	-	Through intranet/ soft copy

8.0 **ABBREVIATION:**

9.0 ED = Executive Director/B&S
10.0 DBS = Director/Joint Director(B&S)/Insp.
11.0 DD/Insp. = Deputy Director/Inspection
12.0 AE = Assistant Engineer/Insp.
13.0 SE = Section Engineer/Inspection