

227

230

1676

Page 146

**GANGA BRIDGE ALLAHABAD (Revised)**  
**Annexure A to A&C 3**

Annexure-3

**Specifications For  
Fabrication & Erection of Steel Super Structure**

**1. Site Inspection**

Tenderers are requested to inspect the site and carry out careful examination to satisfy themselves as to the nature of work involved and facilities available at the site. They should note carefully all the existing structures and those under construction through other agencies. They should also study the suitability of utilizing the different equipments and the machinery that they intended to use for the execution of the work. The tenderer should also inspect sites for the purpose of locating their workshop, store, yard, laboratory, staff quarters etc. satisfy themselves with regard to the feasibility of transporting the trusses from the yard to the final site of placement etc.

**2. Drawings:**

- 2.1. General Arrangement Drawings and the structural drawing will be issued by RVNL to the Contractor. The detailed working shop fabrication drawing shall be prepared by the contractor and proof checked by a nominated consultant at his own cost and submitted for approval. The cost for detailed working fabrication drawings will be borne by the contractor.
- 2.2. Detail launching/erection scheme arrangement for the steel girders/structural members shall be prepared by the contractor and proof checked by nominated consultant and submitted to RVNL for approval. Cost of preparation and proof checking etc. of launching/erection scheme shall be borne by the contractor.
- 2.3. The cost of all materials, fabrication, temporary erection and testing at the contractor's site workshop packing and delivery at the site of work as specified in the schedule is to be included in the price quoted on the tender. Any fittings accessories for apparatus which may not have been mentioned in the specification but which are considered necessary for the execution of this work, are to be provided by the contractor without any extra payment for completion of work in all respects.

**3. Materials /Fabrication/Workmanship**

Material and Fabrication workmanship shall comply with Indian Railways Standards "Specifications for Fabrication and Erection of Steel Girders and Locomotives Turn Tables" Serial No B1-2001 with latest correction slips.

**3.1. Material Specifications**

**3.1.1. High tensile structural steel**

High tensile structural steel should conform to IS 2062:2011 E410 BO Cu as depicted in the tender schedule/drawings/contract conditions etc. It shall be fully killed and Normalized/controlled cooled. Material should conform to Charpy V-Notch Impact Test at the Room temperature and at 0 C (Zero-degree centigrade temperature) in accordance With IS 2062: 2011 or as directed approved by the Engineer. Material should conform to Chemical composition test bend test and tensile test in accordance with IS2062: 2011 or as directed /

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approved by the Engineer. Material shall be ultrasonically tested in terms of provisions of relevant codes.

**3.1.2. Mild structural steel**

Mild structural steel should conform to IS 2062:2011 E 250 B), as depicted in the tender schedule/drawings/contract conditions etc. It shall be fully killed and Normalized/controlled cooled. Material should conform to Charpy V-Notch Impact Test at the Room temperature and at 0-degree C (Zero-degree centigrade temperature) in accordance with IS 2062:2011 or as directed /approved by the Engineer. Material should conform to Chemical composition test, bend test and tensile test in a accordance with IS 2062:2011 or as directed /approved by the Engineer. Material shall be ultrasonically tested in terms of provisions of relevant codes.

**3.2. Fabrication and Manufacturing**

**3.2.1.** The whole work shall be representative of the highest class of Workmanship. The greatest accuracy shall be observed in the design, manufacture and creation of every parts of the work to ensure that all part will fit accurately together on creation and parts similar shall be strictly interchangeable.

**3.2.2.** The contractor shall maintain steel tapes of approved make for which he must have obtained a certificate of accuracy from any National Test House or Govt. recognized institution competent to do so.

**3.2.3.** Rolled material before being laid off or worked must straight. If straightening or flattening is necessary it shall be done by method that will not damage the material. Material having sharp kinks and bends will be rejected.

**3.2.4.** The tolerance in fabrication shall be in accordance with as mentioned in Appendix-II of RDSO's booklet IRS B-1-2001.

**3.2.5.** The records of fabrication shall be maintained in the register as per Format given in Appendix-I of RDSO's Booklet IRS: B -1-2001 or as specified by the Engineer.

**3.2.6.** All steel materials, plates bars and structures 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 surface or edges shall be in close contact or at uniform distance throughout.

**3.2.7.** Flattening or straightening under hot condition shall not be carried out unless and until authorized and approved by inspecting officer /agency and RVNL.

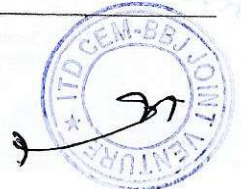
**3.2.8.** The contractor may fabricate the steel work at his workshop at the site of the work or at any of his other workshops. The tenderer must inspect the approach roads right up to/from site of the workshop and should ensure that it would be possible for him to transport the materials by Road. The site, layout and details/composition of the workshop (s) for fabrication works must be passed/approved by Engineer/RDSO/Inspection agency as authorized by RVNL, before commenting fabrication work.

**3.2.9.** The responsibility of custody of the materials in Contractor's site workshop will remain with

Section-5: Works Requirement  
(Based on SBD updated upto 26.12.2018)

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RVNL/BSB



1674

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229

~~232~~

**GANGA BRIDGE ALLAHABAD (Revised)**  
**Annexure A to A&C 3**

contractor till the completion of work and then handed over of the Railway, after completion of the work.

**3.2.10. Templates:**

The templates, throughout the work shall only be of steel. The template must be used for cutting of materials, profile machining of girder members and used for making of drilled holes.

**3.2.11. Camber:**

Camber shall be as per approved drawing and /or as contained in Clause 34 of IRS Fabrication Specification Serial No. IRS-BI-2001 issued by RDSO.

**3.2.12. HSFG Bolts, Nuts & Washers:**

High Strength Friction Grip Bolts used in fabrication and erection of Steel Girders and its components shall conform to RDSO Report No BS 111 with latest corrections. The bolts shall of class 8.8 or as mentioned in the approved drawing. The Bolts shall conform to IS 3757.

**3.2.13. Welding:**

As per Indian Railways Standard "Specification for Fabrication and Erection of Steel Girder Bridges and Locomotive Turn Tables Serial No. IRS-BI-2001" issued by RDSO, clause 26 & clause 27 & Appendix V.

**3.2.14. Alterations in the Work:**

As per Indian Railways Standard "Specification for Fabrication and Erection of Steel Girder Bridges and Locomotive Turn Tables Serial No. IRS-BI-2001" issued by RDSO, clause 53.

**4. Handling & Storage of Material:**

- 4.1. The material, on receipt at site shall be carefully unloaded, examined for defects and checked. Sorted and stacked securely on a level bed out of danger from flood or tide and out of contact with water or ground moist.
- 4.2. Any material found damaged or defective shall be stacked separately and the damage or defective portion be painted in distinctive colour. Such material is to be dealt with under the orders of Engineer without delay.
- 4.3. Care must be taken to see that parts at site are available in proper section.

**5. Erection & Equipment**

As per "Specification for Fabrication and Erection of Steel Girder Bridges and Locomotive Turn Tables. IRS-BI-2001" issued by RDSO, clause 21 and clause 32.

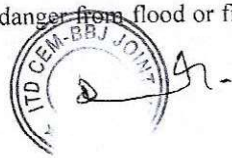
**6. Erection of Open Web Girder Span**

As per "Specification for Fabrication and Erection of Steel Girder Bridges and Locomotive Turn Tables IRS-BI-2001" issued by RDSO, clause 20 & clause 34 and Appendix III.

**7. Handling & Storage of Material**

- 7.1. The material, on receipt at site shall be carefully unloaded, examined for defects and checked. Sorted and stacked securely on a level bed out of danger from flood or tide and out of contact

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with water or ground moist.

- 7.2. Any material found damaged or defective shall be stacked separately and the damage or defective portion be painted in distinctive colour. Such material is to be dealt with under the orders of Engineer without delay.
- 7.3. Care must be taken to see that parts at site are available in proper section.

**8. Bearing & Anchorage:**

- 8.1. Bed plates and shoes shall be set level in exact position. They shall be given full and even bearing by setting them on a layer of cement/epoxy mortar or any other suitable material as approved/ directed by Engineer (cement/epoxy mortar etc. to be supplied by the contractor) after placing them accurately as directed by the Engineer. No extra payment will be made for that.
- 8.2. The tenderer shall drill the holes and set the anchor bolts except where the bolts are already built in to the concrete or masonry. The bolt shall be set accurately and fixed with Portland cement /epoxy grout completely filling the holes. No extra payment will be made for that.
- 8.3. Before grouting, the holes should be cleaned very carefully as such there should not be any deposit of rubbish etc. No extra payment will be made for that

**9. Testing:**

As per Clause 35 & Clause 36 of "Specification for Fabrication and Erection of Steel Girder Bridges and Locomotive Turn Tables, IRS-BI-2001" issued by RDSO.

**10. Check on Test Made at Contractor's Work:**

As per Clause 36 and Appendix IV of "Specification for Fabrication and Erection of Steel Girder Bridges and Locomotive Turn Tables, IRS-BI-2001" issued by RDSO.

**11. Removal of Unused Materials Etc.:**

- 11.1. The contractor shall take step as desired by the Inspecting officer to ensure that rejected work is not resubmitted for inspection.
- 11.2. On the completion of the work the contractor shall remove all his unused and surplus materials. The cost of all the surplus material, cut pieces, wastages etc. is inclusive in the rate and for this no extra payment will be made. After the fabrication and erection work is over the site should be made clean and tidy.

**12. Contractor to Study Drawing & Specifications etc.**

The tenderer shall be responsible for close scrutiny of the approved drawings supplied by the Railway. For any discrepancies, error or omissions in the drawing or in other particulars indicated therein, the contractor shall approach the RVNL immediately for rectification of such discrepancies, error and omission. If any dimension/figure /features etc. on approved drawing or plans differ from those drawing or plans issued to the tenderers at the time of calling of the tender the dimensions as figured upon the approved drawing or plans shall be taken as correct. No claim shall be entertained on this account and decision of Railway shall be final, binding and conclusive on the contractor.

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 Section: Works Requirement  
 (Based on SBD updated upto 26.12.2018)



**GANGA BRIDGE ALLAHABAD (Revised)**  
**Annexure A to A&C 3**

**13. Transportation and Handling of Materials & Plants:**

The contractor shall be responsible to arrange at his own cost wagon/Rakes (if required) for transportation of materials and store. The contractor shall be solely responsible for all handling and timely loading and unloading as per Railway commercial rules for public.

**13.1. Further Drawings and Instructions:**

RVNL shall have full powers to make and issue further drawing or instructions from time to time as may appear necessary and proper for efficient construction completion and maintenance of the work. The contractor shall be not be entitled to any claim/extra payment in respect to any work or materials shown or directed to be done supplied, due to such further drawing or instructions required for completion unless the RVNL has given order for extra payment for the same in writing.

**13.2.** The Tenderer's quoted rate should also provide for cutting M.S plates for making out M.S Flats from plates in case M.S Flats are not available. No extra payment for such cuts and grinding that may be necessary for converting M.S. Plates to Flats be admissible.

**13.3.** If the works are required to be done in by railway yard and railway tracks are to be crossed the work shall have to be done in such a manner that the normal working of the Railway within the railway yard and road traffic of roads does not get disturbed. Proper protection is to be ensured by the contractor for allowing their labours to cross the Railway line and roads with head-leads. No material/temporary structures should be kept adjacent to the running track and roads within 3 M from the center line of track/road which may infringe rail/road traffic. The contractor shall take necessary precaution to prevent/cause damage to the Railway property & staff during the execution of the work.

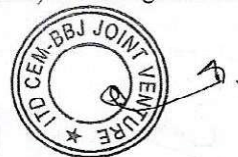
**13.4.** The tenderer shall inspect the site and make him thoroughly acquainted with site condition and quote proper rate including provision for making suitable facilities at site for the work.

**14. Manpower**

Adequate number of trained qualified welders shall be available with the tenderer. The welder must be trained in accordance with the provision of IS:817. They must be trained either from recognized welding institutes or by in house training where proper training facilities exist. The welder must be tested as per requirement of IS:7310 and proper records maintained.

**15.** It is mandatory that the successful tenderer should establish (at his own cost) the fabrication workshop near the site only for close monitoring of all the quality aspects of this contract work. Contractor's request for establishing workshop/using workshop proposed/located away from the bridge site shall require prior approval.

**16.** Contractor shall establish fully equipped laboratory for all the tests required on materials/processes/products as per provisions of the contract, specification and the direction/approval of the Engineer Costs of these are deemed to be included in the quoted rates. Prior approval of engineer shall be obtained for non-installation of such testing equipment's which cannot be installed in normal course due to any reason. However engineer's decision (for installation non- installation) in this regard shall be final bindery and conclusive.



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**Sr. DGM/Fin**  
**RVNL/BSB**

235

1671

Page 151

**GANGA BRIDGE ALLAHABAD (Revised)**  
**Annexure A to A&C 3**

## 17. FABRICATION

### 17.1. General

- 17.1.1. The fabrication of the girders and its accessories shall be carried out by the contractor in his factory premises or in a well-established fabrication workshop to be set up by the contractor at bridge site.
- 17.1.2. The workshop staff shall have requisite experience proven skill and experience in the technique of fabricating large components. Accuracy of fabrication shall be realized and ensured through controlled high precision jigs, fixtures and templates which shall be inspected and passed by RDSO /Engineer/Any other inspection agency/officer (herein after called I.O) as nominated by the Railway.
- 17.1.3. The fabrication shall be preceded by following:

#### (a) Process Document Verification

Sr. No.	Process Document	Details
1	Approval of Quality Assurance Plans (QAP)	Stage-wise manufacturing process from raw material indicating various steps, tests, checks & their frequency test equipment used their calibration status, sampling plan authority for grant of clearance
2	Scrutiny & Approval of welding procedure specification sheet (WPSS)	Process sheet indicating plate/section used, welding process type of joint welding consumables quality, welding parameters to be employed acceptance standards and test applicable etc.
3	Welders certification and Qualification records (WPQR)	Name of the welder, qualification, experience, qualification tests and records for each welding process and joint welding parameter etc.

Above mentioned Quality Assurance Plans etc are to be submitted by the contractor. The officials responsible for monitoring these identified quality parameters shall also be specified in these Quality Assurance Plans etc. The contractor shall get above Documents, quality assurance plans etc. approved from RDSO/Engineer/I.O before start of fabrication work.

#### (b) Raw Material and Gauge Certification

Sr. No.	Item	Details
1	Inspection of Raw Material	Source of purchase, Material TCs

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RVNL/BSB

Section-5: Works Requirement  
(Based on SBD updated upto 26.12.2018)



1670

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**GANGA BRIDGE ALLAHABAD (Revised)**  
**Annexure A to A&C 3**

		Quantity, Size Visual examination, mechanical properties, chemical composition ultrasonic examination, Charpy Impact Test, Lab test report etc.
2	Certification, of raw material	Verification of mill test certificates with test results obtained, cast wise identification of raw materials and ensuring their traceability clearance etc.
3	Inspection of Layout on template floor	Layout plan for manufacture of girders detailed planning of components, sequence of fabrication etc.
4	Inspection of jigs, Fixtures and Master Plates	Dimensional inspection of Jigs, fixtures, master plates used in manufacture of girder to ensure accuracy
5	Certification of Jigs, Fixtures and Master Plates	Stamping of Jigs, fixtures. master plates to certify their use during fabrication by the inspection officials.

Above mentioned Inspection tests and certification etc shall be done by RDSO/ Engineer/I.O before start of and/or during fabrication works.

- 17.1.4. The RDSO/Engineer/I.O shall be empowered to check the manufacturing process from time to time to ensure that the work is being executed as per approved quality assurance plans etc. The quality record shall be submitted to Engineer for record after completion of fabrication work.
- 17.1.5. The work of fabrication in contractor's fabrication shop will at all times be open for inspection by RDSO/Engineer/I.O. Before dispatch of fabricated steel work from the shops, the same will be inspected in the contractor's fabrication workshop by RDSO/Engineer/I.O who will thereafter issue inspection certificate.
- 17.1.6. The details of inspection items during and after fabrication are as under

(a) Inspections during fabrication

SI. No.	Item of Inspection	Details
1	Ensuring use of approved Raw Materials	Raw materials originally cleared only to be used during fabrication.
2	Ensuring use of approved Welding consumables	Types of consumables source quality approval status grade suitability for fabrication as per WPSS
3	Ensuring use of approved Welders	Checking of welder certificates, records skill and procedure adopted for welding as per

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Section-5: Works Requirement  
(Based on SBD updated upto 26.12.2018)



237

1669

Page 153

**GANGA BRIDGE ALLAHABAD (Revised)**  
**Annexure A to A&C 3**

		WPSS etc.
4	Ensuring use of approved WPSS and Welding parameters	Checking welding parameters employed equipments used correctness of joint preparation etc
5	Radiographic examination of butt weld joints	Radiographic examination method type of film employed sensitivity defect interpretation and acceptance decision based on criteria
6	Ensuring use of approved sets of jigs, Fixtures and Master Plates	To ensure inter changeability of components and pre-stressing (camber) in open web girders and to avoid distortion.

**(b) Inspection after fabrication**

Sl. No.	Item of Inspection	Details
1	Visual examination of welds	Quality of welds uniformity of weld bead size of the weld, weld defect e.g. under cut blow hole porosity spatter cracks etc.
2	Metallographic and NDT examination of Fillet welds	For ensuring proper weld quality Dye penetration examinations.
3	Structural and dimensional inspection	Dimensional checks to ensure conformance to drawing dimensions.
4	Trial Assembly	Camber of Jacks, Dead Load Camber, Dimension fairness of holes, Temporary Fasteners, Infringements if any Butting of compression flanges
5	Anti-corrosive treatment	Surface preparation metallising and or painting as per applicable painting schedule.
6	Components Inspection	Detailed inspection of dismantled components of trail erected span and inspection of different components of second span onwards.

17.1.7. Any defect noticed during inspection in the execution of work shall be rectified or replaced by the contractor at his own cost. The decision of RDSO/Engineer/I.O as to the existence of the defect and the manner in which the defective work has to be rectified or replaced shall be final, binding and conclusive.

17.1.8. During fabrication of the girder, necessary arrangement and provision shall be kept for inspection facilities underneath the girder and also for carriage of service cables pipe lines etc as per approved plans.

**17.2. Fabrication Drawings.**

17.2.1. The contractor shall prepare detailed shop drawings including drawing office dispatch lists (DODL's) on the basis of design drawings supplied by Engineer in such details as

Section-5: Works Requirement  
 (Based on SBD updated upto 26.12.2018)

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**RVNL/BSE**





237

235

238

1668

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**GANGA BRIDGE ALLAHABAD (Revised)**  
**Annexure A to A&C 3**

may be specified/ approved by Engineer. The shop drawings shall be submitted to Engineer in triplicate one copy of which will be returned after scrutiny and approval. The fabrication drawings shall indicate member sizes prior to and after flame cutting and or machining to obtain correct length and shape, tolerance provisions, welding sequence type and size of welding. No work of fabrication will be started without such approval being obtained preparation & Proof checking of fabricating drawing should be done by reputed national/ international consultants. Before finalization, contractor will submit detail credentials of proposed proof checking consultant to Railways for approval. If any interaction of Railway representative with proof consultant/designer at their design office/premises for facilitating expeditious finalization and better technical interaction will be required the RVNL/Railway representative may visit their design office/ premises on the request of contractor and the complete cost of such visit of RVNL/Railway representative shall be borne by the contractor as per their entitlement in the RVNL/Railway.

17.2.2. Engineer will make all efforts to approve the drawings submitted by the contractor within reasonable time but no claim for any delay on this account shall be entertained by Engineer.

17.2.3. For Engineer's use and record, the contractor shall supply free of charge four sets of prints on strong paper and one set of neatly executed tracings of all approved detailed drawings and fabrication drawings soon after communication of approval for use at site.

**17.3. Maintenance of records by Fabricators**

The records of fabrication shall be maintained in the registers as per the formats given Appendix 1 of IRS BI-2001.

17.4. **Brief Design Data:** The through type steel girders have been designed for double track 25T loading as per Indian Railway Bridge Rules and Standard Specification and three lane road loading as per IRC class "A" or one lane of IRC class 70R as per IRC- 06-2000. All panel joints are designed for vertical and transverse forces including secondary moments.

17.4.1. The structure shall be fabricated to camber as per IRS steel bridge code and or as provide in the approved drawings. The deflection of girder is expected not to exceed the value as given the approved drawing.

17.4.2. All members of the girder and joints are to be either bolted or welded as shown in the approved structural drawings No field welding will be permitted, only bolting will be permitted in the field. All welding and bolting are to be carried out as per relevant IRS Specification and as approved by the RVNL.

**18. Materials**

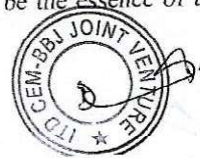
**18.1. Structural Steel, Bolts and Welding Materials Etc.**

18.1.1. Structural steel shall conform to specifications contained in clause 5.1 of Annexure -3 of these documents.

18.1.2. The steel shall comply in all respects with the requirements of approved drawings and relevant codes and specification and shall be procured from approved manufacturers only. It may be noted that quality of steel use for fabrication shall be the essence of the contract & shall be

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Section-5: Works Requirement  
(Based on SBD updated upto 26.12.2018)



239

1667

Page 155

**GANGA BRIDGE ALLAHABAD (Revised)**  
**Annexure A to A&C 3**

rigidly followed. Entire Steel sections (100%) to be supplied by the manufactures shall be ultrasonically tested as per codal provisions at the manufacturer's premises before dispatch. Only tested steel shall be used for fabrication .In rare cases that too only for case of sections other than plates ultrasonic testing may be dispensed with after prior approval of RVNL this approval may be given only on production certificate to the effect of non-requirement of testing of such section by producers like SAIL/TISCO/RINL.

Further the contractor has to arrange Charpy V-notch impact test of the structural steel supplied by the Contractor in terms of relevant IS Code stipulations.

All rolled sections shall bear case mark and shall be of such length as to avoid butt welded joints in components of truss. Such rolled sections shall be within rolling tolerances stipulated as per IS:1852 and shall be detects free.

- 18.1.3. The usage of type and grade of steel may vary during the execution of the work depending upon the design requirement and market availability. No claim shall be entertained from the contractor on this account and payment shall be as per relevant items of BOQ.
- 18.1.4. Wedding consumables for manual Metal Arc Welding (MMAW) shall confirm to IRS-M- 28 or IS:9595-1996/IS:816-1969 as stipulated/approved by Engineer.
- 18.1.5. Wire and flux combination for Submerged Arc Welding shall confirm to IRS M-39 (or as stipulated /approved by Engineer).
- 18.1.6. Filler wires for CO2 welding shall conform to RDSO/M&C/Specification (or as stipulated, approved by Engineer).
- 18.1.7. All welding consumables (electrodes, wire, flux etc.) shall be procured only from the manufactures approved by RDSO subject to final approval by Engineer. The electrodes shall conform to IRSM-28/IS:814-1974.
- 18.1.8. In an extreme eventuality of steel of particular section not being made available locally by Indian steel manufacturers the tenderers may have to import steel. The imported steel shall be of equivalent specification. Use of built up sections in place of rolled section can be permitted. Working out the weight of steel for payment in such cases will be based on the actual sections used. Engineer will not take any responsibility of delays in importing the steel and no cognizance of the same will be given in the completion period.
- 18.2. **Test Certificates**
- 18.2.1. All materials for the wok shall pass test and/or analysis prescribed by the relevant IS specifications or such other equivalent specification.
- 18.2.2. For all materials including bolts, the contractor shall furnish copies of test certificates from the manufactures including proof sheets, mill sheets etc. showing that the material have been tested in accordance with the requirements of various specification and codal provisions.
- 18.2.3. If any further testing of materials is required by the Engineer in respect of these and other items the same shall be arranged by the contractor at a reputed laboratory/ National Test House/Workshop Laboratory as directed/approved by Engineer. For this nothing extra shall be

Vetted

Section-5: Works Requirement  
 (Based on SBD updated upto 26.12.2018)

Sr. DGM/Fin  
 RVNL/BSB



239

237

240

1666

**GANGA BRIDGE ALLAHABAD (Revised)**  
**Annexure A to A&C 3**

payable and accepted rates in the schedule of items, quantities and rates shall be deemed to include this.

**18.2.4.** Even satisfactory outcome of such test or analysis in no way limit dilute or interfere with absolute right of the Engineer 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 purposes.

**18.3. Handing and Storing of Steel Sections.**

**18.3.1.** All projecting plates or bars shall be kept in shape by timber or angle bars spiked or bolted to them and the ends of chord lengths. End posts etc at their shipping joints shall be protected and stiffened so as to prevent damage or distortion in transit as the Engineer may direct/approve.

**18.3.2.** All threaded ends and machined surfaces are to be efficiently protected against damage in transit. The parts shall be transported in convenient lengths.

**18.3.3.** All straight bars and plates, except small pieces are to be transported in covenant bundles temporarily bolted together or bound with wrought iron or suitable wire as the Engineer may direct/approve. All bolts, nuts, washers, flats under 300mm square and small articles are to be packed separately for each span in cases each weighing when full not more than 350kg in strong petroleum casks or barrels as approved by Engineer. If not entirely filled by the contents the space left shall be closely packed with wood shaving or other suitable material. Bolts of different sizes shall be separately packed in bags each bag having a label indicating its contents. A list of contents shall be place on top of each case or cask.

**18.3.4.** All rolled steel received from supplier shall be carefully unloaded to avoid twisting bending and damage to mill scale. Stacking area shall be covered and the materials placed on a raised platform above ground level. Every care shall be taken to avoid contact with water moisture or any other harmful substances in order to prevent rusting and pitting.

**18.3.5.** All sections damaged during transit or handling shall be stacked separately and damaged portions shall be indicated by paint of distinct colour. Such materials shall be dealt with as per instruction of the Engineer. Badly damaged portions may require replacement slightly distorted parts or broken parts must be dealt with as the case demands and as directed, approved by Engineer. The rectified sections shall be used for fabrication only after approval of Engineer.

**18.3.6.** Where the work has been passed in the manufacture's factory premises as strictly to any particular position. Care must be taken by the contractor that the parts at site are available in proper sequence. Every portion of work shall be distinctly stenciled with paint and marked with punch not less than 15mm dia for guidance in the field and stamped with the letter specified in the drawings. In the case of no-inter changeable work the system of marking shall be as shown in drawing.

**18.3.7.** All HSFGB bolts, service bolts and drift for assembly of girder shall be stored under cover.

**18.3.8.** The contractor shall supply without any charge, six complete lists of the HSFGB bolts, service

Vetted

Sr. DGM/Fin  
RVNL/BS



241

2  
3

1665

**GANGA BRIDGE ALLAHABAD (Revised)**  
**Annexure A to A&C 3**

bolts, washers and drifts required for erecting the work at site showing the part of the work to which the various HSFG bolts belongs and having each items marked so as to indicate the particular case in which it will be found. List of total HSFG bolts required of one girder/stating length, numbers and wastage allowance of 12.5% shall be prepared and supplied along with span components. The requirements for service bolts is @ 45% and that of drifts @ 15% covering 60% of filed holes in one span plus wastage allowance of 12.5% Engineer reserves the right to increase the above proportion of service bolts and drifts without any extra cost. Actual requirement for the work shall be assessed by the contractor who shall arrange accordingly.

**18.3.9. Steel Tape:** Contractor shall use steel tape conforming to IS: 1270 duly tested and issued with certificate of accuracy by an accredited National Testing House Tempting. The tape shall be calibrated under tension of 1.8kg at 16.7C.

**18.3.10.** All marking and checking of gussets, camber layout etc shall preferably be at the mean temperature of fabrication zone.

**18.4. Straightening**

**18.4.1.** All rolled sections and plates shall be straight and free from defects like twists and bends before they are used for marking and cutting.

**18.4.2.** If any rolled section of plate has minor defects, it shall with the approval of the Engineer, be cold straightened by pressure with the help of palate and section straightening machine. Pressure applied for straightening shall be such as not to damage the surface or microstructure of grains in steel member.

**18.4.3.** Flattening straightening and bending in hot condition shall not be carried out unless specified on drawings and or approved by Engineer.

**18.5. Cutting of Material**

**18.5.1.** All edges shall be machined mechanically (by a sawing machine) or controlled torch oxy-acetylene flame cut. All flame cut edges shall be ground to secure clean and square edges. No shearing of section or plates is permitted.

**18.5.2.** When flame cutting is deployed on a plate of long length, flame cutting shall be done be multi torch mechanically controlled equipment to ensure a straight clean cut and prevent lateral distortion due to heat application. All flame cut edge shall be ground or machined to obtain reasonable clean square and true edge. Drag lines formed during flame cutting shall be removed.

**18.5.3.** While chalk marking for flame cutting following cutting allowance shall be added to prescribed dimensions.

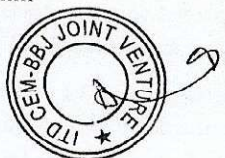
**Thickness**

**Cutting allowance**

Up to 12mm	+3mm
Above 12 and up to 25mm	+5mm
Above 25mm	+7mm

**Vetted**  
Section-5: Works Requirement  
(Based on SPP updated upto 26.12.2018)

**Sr. DGM/Fin**  
**RVNL/BSB**



241

239

242

1604

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**GANGA BRIDGE ALLAHABAD (Revised)**  
**Annexure A to A&C 3**

- 18.5.4. Templates made from 3 to 4 mm thick steel plate shall be used for cutting Gussets. Long length cutting by marking with white chalk and string may be followed.
- 18.5.5. Minimum edge distance while preparing profile for gussets, cleats and edges of components from center of hole to a flame cut edge shall be 1.75 times the diameter of hole and for machined edge or rolled edge shall be 1.5 times the diameter of bolt holes ( machined edge means first edge distance kept 1.75times diameter of hole for flame cutting reduced to 1.5 times diameter of hole by removal of material by machining.)

**19. Method of Fabrication**

- 19.1.1. Considering the length and height of span jigs and fixtures shall be suited to guide and support drilling of holds and fixtures during centre fabrication work assembly of components before riveting/ welding of components.
- 19.1.2. Drilling jigs shall be fabricated with the help of Master gussets fabricated as templates for all panel joints of truss. Jigs after manufacture shall be checked and approved by Engineer or any other Inspecting Official. Only approved and stamped jigs shall be used for fabrication. First components after drilling of holes through approved jig for each specific components of truss. Shall be checked with the help of Master gusset by the Inspecting Office before further fabrication.

**19.2. Tack Assembly**

- 19.2.1. For fabrication of bolted construction top and bottom chords of members shall be tack assembled for drilling of holes through jig. Tack assembly of members shall be done by stitch bolts after positioning the drilling jig in true position.
- 19.2.2. Drilling jig and tacked members shall be clamped to a fixture to avoid shifting of jig during handling and drilling.
- 19.2.3. Tack welding may have permitted only at the ends and the locations which will eventually be cut and removed. No active part of the component shall be tack welded as this would initiate crack formation in service.

**19.3. Template**

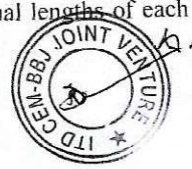
- 19.3.1. The contractor shall supply and provide require templates at his own cost. No separate payment shall be made for this and accepted rates shall have deemed to include this aspect. The templates used for the work shall be of steel and of tested quality.

**19.3.2. Template Shop**

- (i) Fully covered template shop consisting of uninterrupted steel or concrete floor as approved having true and correct level covering adequate arca shall be provided by the contractor.
- (ii) Camber layout shall be drawn to full scale from end of girder to half span. This camber layout once approved shall be used for fabrication of master gusset profiles and end profile of each member. It shall be used for working out the actual lengths of each member and checked to

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**RVNL/BSB**

Section-5: Works Requirement  
(Based on SBD updated upto 26.12.2018)



243

conform the calculated length.

- (iii) Master gussets at every panel joint of top chord bottom chord and middle web panel shall be marked accurately on camber layout drawn on template floor.
- (iv) All precautions shall be taken while drawing camber layout correct setting of angle of intersection of chord and web member and great accuracy shall be ensured while transferring the same on mater gusset. If there is symmetry of holes on vertical axis marking shall be made only on half the master gusset across vertical axis an holed drilled by inscribing each hole. Subsequently remaining half portion shall be drilled through gusset using the same half portion master gusset.
- (v) Camber layout and fabrication of Master gusset at every panel joint requires highly skilled and trained staff experienced in accurate fabrication of large girder, drilling jigs and fixtures. At least one jig shall be required for each component. Each jig shall be numbered and a record kept in register of identification.

#### 19.4. Drilling of Holes

- (i) Holes for bolts in members shall be carried out by drilling through jig only. No punching or hand drilling of holes is permitted. Sub-punching to a diameter 6mm less than that of finished holes may permitted by Inspecting Officer/Engineer except in the main truss members of open web girders.
- (ii) When the holes are to be sub-punched they shall be marked off with a center punch and made with a nipple punch or preferably shall be punched in 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.
- (iii) Drilling jig should be provided with an internal turned an case hardened bush at all holes in jig for retaining accuracy of all similar units fabricated Bushes will have tolerance of -0.0/+0.1mm for bolting. The tolerance shall be periodically checked & replaced when the tolerance exceeds -0.0/+0.4mm (for hardening). Before fixing to jig bushes shall be checked with a approved plug gauge to ensure these tolerances.
- (iv) Drilling of all holes though jig by radial drilling machine for fabrication of top and bottom chords of all members will be allowed. Web members and floor system having welded construction field holes for bolting shall be drilled through jig.
- (v) 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.
- (vi) Holes for bolts shall be 2.0 mm greater than the diameter of bolts used upto 20mm dia HSFG bolts. Holes for turned bolts for field connection where specified on drawing shall be drilled in the shop 1mm less than diameter of holes shown on the drawing and should be reamed at site to suit diameter of turned bolt.
- (vii) **Drilling to enlarge unpaired holes is prohibited.** The holes required to be enlarge shall be reamed provided the Engineer permits such reaming after satisfying himself about the extent of

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Section-5: Works Requirement  
(Based on SBD updated upto 26.12.2018)

**Sr. DGM/Fin  
RVNL/BSB**



243

241

~~244~~

1662

**GANGA BRIDGE ALLAHABAD (Revised)**  
**Annexure A to A&C 3**

inaccuracy and the effect of reaming on the soundness of the structure. The Engineer reserves the right to reject all steel work if the holes are not properly matched.

- (viii) On completion of drilling of holes in each component and before shifting the jig it shall be ensured that all the holes are drilled to their correct diameter to confirm the quality of work.

**20. Welding of Components**

- (i) All welding work shall be as per IRS Standard and by such process that the workmanship is flawless. All welding shall be by automatic and semi-automatic submerged arc welding process except where inaccessible. Site welding shall be avoided but if necessary shall be carried out only to secondary members having low stresses to transmit across the joint for which approval of the Engineer shall be required.
- (ii) Welded construction shall be carried out generally in accordance with provisions of the IRS Welded Bridge Code and IS:9595 (Metal Arc Welding) and further subject to specification as under.
- (iii) Welding shall be done only by qualified and approved welding operators whose competency has been verified and certified by RDSO/Engineer/I.O. Routine re-testing of welding operators may be required every six months if deemed necessary by the Engineer who also reserves the right to retest any welding operator at any time during the contract.
- (iv) All long and continuous welds shall be carried out by automatic Submerged Arc Welding (SAW) process only in order to obtain sound and uniform shape and cross section. CO<sub>2</sub> or manual metal arc welding (MMAW) may be done for short lengths or for secondary connections where access to location of the weld does not permit Submerged Arc Welding (SAW) subject to approval of Engineer.
- (v) Except for special types of edge preparation such as single & double U and single & 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 smooth finish special edge preparation should be made by machining or gouging.
- (vi) The contractor shall appoint welding supervisors whose competence and qualification shall be subject to approval of RDSO/Engineer/I.O. All welds shall be carried out strictly under their direction & supervision.
- (vii) Welding position for fabrication of components shall be Flat or Horizontal position for SAW (flat position preferred) and Flat or Horizontal position for CO<sub>2</sub> or Manual Metal Arc Welding.
- (viii) To ensure above position for welding component shall be placed in manipulator tack assembled and rotated in manipulator to assist welding sequence and prevent distortion of member. In absence of manipulator special jig and fixtures shall be provided for positioning and careful handling by crane subject to approval of Engineer.

**20.1. Welding procedure**

Section-5: Works Requirement  
(Based on SBD updated upto 26.12.2018)

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**RVNL/BSB**



245

2/2  
A. - 1661  
Page 161  
**GANGA BRIDGE ALLAHABAD (Revised)**  
**Annexure A to A&C 3**

The welding procedure shall be such as to avoid distortion and minimize residual shrinkage stresses. Properly designed jigs should be used for assembly. The welding techniques and sequences, 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 Appendix-V of IRS BI-2001

## 20.2. Sequence of welding and welding pass

The sequence of welding pass shall be done as per IRS BI-2001.

## 20.3. Welding of stud shear connectors

The stud shear connectors shall be welded in accordance with the manufacturer's instruction including preheating. Welding shall be done using only the stud guns made for the purpose of the fixing welding.

The stud and the surface to which studs are welded shall be free from scale, moisture, rust and other foreign material. The stud base shall not be painted, galvanized or cadmium plated prior to welding.

Welding shall not be carried out when temperature is below 10°C or surface is wet or during periods of strong winds unless the work and the welder is adequately protected.

The welds shall not be visually free from cracks and shall be capable of developing at least the nominal ultimate strength of studs. The procedural trail for welding the stud shall be carried out when specified by the Engineer.

## 20.4. Weld Quality Test

### A. Procedure Trials

Welding and flame cutting as per following shall be carried out and completed before fabrication on representative samples of materials to be used in the work.

- (i) The samples of material shall be selected and marked by the Engineer when the materials for the work are inspected in contractor's fabrication/storage.
- (ii) The trials of flame cutting shall be carried out in material representative of all thicknesses to be used in the work.
- (iii) Trials on material 19mm thick may be taken to include all material under 19mm thick and on material 38mm thick to include material between 19mm and 38mm thick. Over 38mm thickness material shall be tested for every thickness increment of 6mm. The trials of flame cutting shall be carried out in material representative of all thicknesses to be used in the work.
- (iv) The welding & flame cutting trials shall be commensurate to the satisfaction of Engineer/ Inspecting officer and the procedures to be adopted in the fabrication of work which shall include.
  - a) Welding procedure in accordance with relevant specification.
  - b) Heat control technique required to ensure that the flame cut surface of steel are suitable for inclusion in welds.

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Section-5: Works Requirement  
(Based on SBD updated upto 26.12.2018)

**Sr. DGM/Fin**  
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245

243

246

1660

**GANGA BRIDGE ALLAHABAD (Revised)**  
**Annexure A to A&C 3**

- (v) The trials shall include specimen weld details from the actual construction which shall be welded in a manner simulating the most unfavourable instances of fit up and preparation. After welding the specimens shall be held as long as possible at room temperature but in any case, not less than 75 hours and shall be sectioned and examined for cracking. Six representative samples of each weld joint similar to joint used in fabrication of all components shall be prepared by qualified and certified welding operators.
- (v) Following groups of tests shall be carried out
  - a) Butt Welds: Transverse tensile test, transverse & longitudinal bend test with the root of weld in tension and compression respectively, Charpy V- notch impact test.
  - b) Fillet Weld: Fillet weld fracture test.
  - c) Track welds: Inspection for cracking.
  - d) All welds: Macro examination.

**B.** Additional tests as under shall also be carried out for approval and during contract executions stage as per requirement and instructions of RDSO/Engineer/I. O the cost of which shall be borne by the contractor. Following test are normally performed on welds:

- (a) **Non-Destructive Test (NDT)**
  - Visual inspection /profile gauge for dimensional check of size and throat thickness of weld.
  - Etching test for penetration of joint
  - Magnet. A particle or Ultra Sonic Pulse Velocity (USPV)
  - Gamma Radiography & X-ray (only for butt welds)
  - Dye penetration test of all weld joints
- (b) **Destructive Test**
  - Tensile test
  - Bend test
  - Impact test
  - Load test

Once samples representing the weld joint used in fabrication of all components are tested and test results are found satisfactory, then approval shall be taken from the Engineer/Inspecting officer for the welding of built up components by approved welding operators. **Welding Procedure Qualification Records (WPQR's)** shall be prepared which shall include joint details welding consumables (i.e. electrode/wire & flux combination) weld parameters (i.e. welding current, wire feed speed) welding position, welding equipment carriage speed (for SAW process) are Length arc voltage etc.

**C. Qualification and Testing of welders:**

(i) No welding operator shall be employed on the work until he has in the presence of the RDSO/Engineer/I.O passed the appropriate tests laid down in relevant specification

(ii) Where plates of 12mm thick and over are to be butt welded the tests set out in relevant specification is to be followed.

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Section-5: Works Requirement  
Based on SBD updated upto 26.12.2018



247

1659

- (iii) Routine re-testing of welding operators may be required every six months if deemed necessary by the RDSO/Engineer/I. O
- (iv) The RDSO/Engineer/I. O reserves the right to require any welding operator to be re- testing at any time the contract.

**20.5. Precautions during welding**

- (i) The contractor shall submit list of weld joints of different combined thickness for approval of welding procedure for all members.
- (ii) The welding of built up component shall be carried out only by approved welding operators and in accordance with welding Procedure Qualification Records. WPQR 's shall be prepared in advance and approved by the Engineer proper welding sequence shall be followed to avoid distortion and minimize residual shrinkage stress and surface defects within acceptable tolerance limits.
- (iii) To ensure sound and defect free welding of built up members record of welding adopted as per approved qualifying procedure shall be maintained in Performa prescribed in guidelines for welded fabrication issued by RDSO or as stipulated in IRS- BI-2001.
- (iv) Any change during welding for fabrication of built up member such as welding sequence welding process positioning wire and flux combination joint details increase or decrease in combined thickness of joint by 5mm etc shall be carried out only after representative samples test and procedure qualification is accepted in no case any deviation from WPQR's without approval of engineer shall be permitted.

**20.6. Preparation of Faces**

- (i) Preparation of joint face except for special types of edge preparation such s single or double 'U' & 'J' joints the fusion edges of all plates which are to be joined by welding shall be prepared by using mechanically controlled automatic flame cutting equipment with the cutting allowance as per clause 4.7 and the extra length machined to obtain connect length.
- (ii) It shall be ensured by Non-destructive test that the fusion face and adjacent surface are free from cracks notches or other irregularities that are likely to cause defects during service or interfere with deposition of the weld.
- (iii) Fusion faces and he surrounding surface upto 5.mm shall be free from mill scale moisture oil, paint dirt or any other substance which may affect the quality of the weld and same shall be removed by grinding or flame cleaning grit blasting.
- (iv) Details of joint fusion faces root face and gap shall be as per details given in fabrication drawing or as stipulated in IS:9595

**20.7. Welding Operation**

- (i) Parts to be welded shall be assembled such that the joints to be welded are accessible and visible to the operator. Assembly jig and fixture shall be used for accuracy.
- (ii) Manipulators should preferably be used to execute the sequence of welding without disturbance

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Section-5: Works Requirement  
(Based on SBD updated upto 26.12.2018)

**Sr. DGM/Fin  
RVNL/BSB**



247

245

248

1658

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**GANGA BRIDGE ALLAHABAD (Revised)**  
**Annexure A to A&C 3**

in the most suitable position. Fixture shall maintain the alignment with minimum restraint in order to reduce the possibility of locked up stress.

- (iii) Run in and run out plates shall be provide for fabrication of built up members or truss to ensure that weld will start on run in plate and weld will stop on run out plate and thus avoid crater defects on the components.
- (iv) Fabrication of components subject to dynamic loading in the structure need careful inspection during fabrication by qualified experienced and certified Engineer from contractor's side and final approval by RDSO/Engineer/I.O. This inspection shall be carried out as stipulated in Indian Railway Welded Bridge Code before, during and after welding.
- (v) During design and detailing of components length care is to be taken to avoid butt weld in built up members of truss. Therefore, it is essential to use only nearest size and length of rolled sections that has been procured to scheduled sizes and lengths by proper planning. No butt weld shall be carried out without approval of Engineer.
- (vi) Fabrication of components subject to dynamic loading in the structure need careful inspection during fabrication by qualified experienced and certified Engineer from contractor's side and final approval by RDSO/Engineer/I.O. This inspection shall be carried out as stipulated in Indian Railway Welded Bridge Code before during and after welding.

**20.8. Additional Precautions during Welding**

Following precautions shall further be observed during fabrication.

- (i) All equipment's shall be provided with calibrated gauges to observe limits of variation for parameters prescribed in WPQR's for welding current etc voltage, speed of travel of equipment etc.
- (ii) Covered shed for environmental control (particular against dust moisture and water) shall be provide to avoid entrapment of hydrogen which is likely to cause crack initiation in weld or under bed of weld etc Heat affected Zone (HAZ). Also baking of flux used for submerged arc welding in oven for an hour at 200-degree C shall be carried out to ensure that no moisture is contained in flux during welding.
- (iii) All tack welds shall be carried out by qualified and approved welder only. As tack weld will become part of the final weld it shall be free from all cracks and other welding defects.
- (iv) If multiple runs are used for fabrication of built up member inter run cleaning shall be carried out and subsequent weld bed made only after approval of inspecting officer or his authorized representative. This is to check free defects in the weld. Also visible defects such as cracks, if any shall be removed by grinding it shall be ensured during welding that craters are avoided.
- (v) Stray arcing of components which cause local hard spots or cracking of parent metal shall be avoided.
- (vi) Flux of approved quality will be permitted for use.
- (vii) The Auto melt grade wire spools of wires for submerged Arc Welding and Carbon Dioxide (CO<sub>2</sub>) consumables of only the approved quality will be permitted.

Section-5: Works Requirement  
(Based on SBI updated upto 26.12.2018)

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~~249~~

2/2  
1657  
Page 165  
**GANGA BRIDGE ALLAHABAD (Revised)**  
**Annexure A to A&C 3**

- (viii) Pre- Heat Treatment will be given to the consumables to remove the moisture if any.
- (ix) No violation of welding procedure will be permitted on any account.

#### 20.9. General: Welding

Qualified trained and experienced supervisor is essential at all times during fabrication/erection and for maintenance of records.

After riveting of riveted components or welding of welded components, they shall be finished finally by grinding or matching with the help of a profile template. All the butting ends of components shall be faced in milling machine after members have been completely fabricated in the case of compression members the face shall be machined so that the faces are of proper angle as shown in drawing and the joint when made will be in close contract throughout within a gap tolerance of less than 0.15mm. The inspecting officer may permit a tolerance of (-) 0.4mm at isolated points n butting line.

#### 20.10. Full penetration butt welding with radiography testing:

Above is not permitted in this work.

#### 21. Painting

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. The work of painting shall be done in the supervision of the paint manufacturer to ensure the proper procedure and quality of painting. To ensure the quality of work, the manufacturer shall submit the QAP for the approval of Engineer and the quality of painting should be ensured as per approved QAP.

For measurement of Dry Film Thickness (DFT) following instruments may be used by the contractor. DFT is to be measured as described in Appendix (VII) of IRS B1-2001 shall be measured by elcometer or any other approved method.

- Electronic coating thickness Gauge.
- Elcometer (Magnetic Thickness Gauge (Dial Type))
- Surface profile Gauge

#### 21.1. Surface Preparation: Surface of all components/ member of the superstructure shall be prepared as per following provisions before application of first coat of paint/primer.

- The surface should be clean dry and free from contaminants and it should be rough enough to ensure adhesion of the paint film. However, it should not be so rough that the film cannot correct the surface peaks.
- The surface of works shall be carefully prepared removing mill-scale, rust, etc. using wire brushes and oil/ grease shall be removed from the metal surface by using petroleum hydrocarbon solvent to IS:1745 and thereafter prepare the surface by sand or grit blasting to Sa2-1/2 to IS: 9954 i.e. near white metallic surface. This will be achieved by high velocity impact of abrasive material against the surface in accordance with the provision of IS:6586 which will also create a base for good adhesion. The abrasive material once used for cleaning heavily contaminated surface should not be reused even though re-screened. The material specification and other requirements shall be as provided in Indian Railways Bridge Manual.

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Section-5: Works Requirement  
(Based on SBD updated upto 26.12.2018)



~~253~~~~1653~~

Page 169

**GANGA BRIDGE ALLAHABAD (Revised)  
Annexure A to A&C 3****21.7. Payment**

The payment for complete painting of all components of girders including all accessories, painting of contact surface etc. including all labour and material is included in the accepted rates for item (BOQ) in the schedule of items, rates and quantities and nothing extra shall be paid.

**22. Assembly & Erection****22.1. General**

- (i) The contractor shall provide at his own cost all tools, machinery, equipment and erection material, including all temporary works and shall assemble all components in every respect as stipulated in the contract and in accordance with approved scheme, drawings and specification.
- (ii) Before starting the work, the contractor shall seek the Engineer's approval as to the method he proposes to follow and the type and suitability of equipment he proposes to use for assembly of girder components and launching at girder. The approval the Engineer shall however not in any way relieve the construction of his responsibility for the adequacy and safety of method and or equipment's he proposes to use for carrying out the work in accordance with drawings and specification.
- (iii) All temporary works shall be properly designed and fabricated & erected with great care for the loads which they will be called upon to support. Adequate allowance and provision for the effect of lateral forces and wind loads shall be made to meet unforeseen condition.
- (iv) When chains are used for lasing care must be taken to protect the edges of members from twisting and distortion damage to paint and similar effects.
- (v) Temporary bracing shall be provided to take care of stresses caused by erection equipment or other incidental loads during erection.
- (vi) The method used for lifting and slinging flexible members shall be brought to the notice of the engineer and shall be subject to his approval.
- (vii) The contractor shall observe sufficient accuracy in the assembly of every part of the work to ensure that all parts fit accurately together.
- (viii) Contractor shall take necessary precautions for safety of the substructure of this Bridge and substructure and superstructure of approach viaducts, during assembling erection & launching works of the girder and nothing extra will be paid on account of this. In addition, the contractor shall adopt all precautionary measures for safe plying of inland vessels, boats crafts etc and nothing extra will be paid owing to this.

**22.2. Procedure for Assembly in Workshop & Site**

The contractor is required to undertake test assembly of one girder of each type of span in his fabrication workshop to prove accuracy of templates and jigs. The assembly can be done in horizontal position. In case the fabrication workshop is set up by the contractor at bridge

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RVNL/BSB**Section-5: Works Requirement  
(Based on SBD updated upto 26.12.2018)

253

251

254

1652

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**GANGA BRIDGE ALLAHABAD (Revised)**  
**Annexure A to A&C 3**

site itself the test assembly may be done at assembly platform and after testing of accuracy of jigs fixtures & templates and the camber, the same assembly can be launched after riveting. The test assembly shall be certified by RDSO/Engineer/I.O. Following procedure may be used by contractor subject to checking of design by contractor's consultant and final approval by the RDSO/Engineer/I.O.

- (i) The joints at the end of each top & bottom chord shall be drifted, bolted and preferably stitch riveted to their Geometrical outline.
- (ii) The procedure during assembly shall consist of placing camber jacks in position to support the structure. The camber jacks shall be set such that they provide sufficient height to allow for lowering of panel points to obtain and maintain the required camber. Throughout the process of assembly, tilt, shift, twisting etc. shall be repeatedly checked. The jacks shall be spaced so that they will support the ends of the main girders and the panel points.
- (iii) The bottom chord members shall then be placed on the camber jacks, carefully leveled and checked for straightness and the joints completed by riveting.
- (iv) The vertical and diagonal web members, except the end verticals shall then be erected with gusset connection outward from center in their proper position on the bottom chords. Temporary gussets with correct hole position as on master gusset shall be fixed to connect the top end of diagonals. Strainers shall be used to realize matching of holes in the gussets at top & bottom of the diagonals & verticals, to ensure that the angles between the members at the bottom joints are as given by the nominal outline of the girders. The verticals and diagonals shall then be riveted to the lower chord.
- (v) All panel points, except the central one shall now be lowered by an amount sufficient to produce the correct camber on the main girders as shown on the camber diagram.
- (vi) The top chord shall thereafter be erected piece by piece, working symmetrically outwards from the centre without loss of camber profile.
- (vii) Temporary top gussets, if used, shall be replaced by permanent gussets outwards from the centre.
- (viii) The ends posts shall be erected last. The upper end connection should preferably be made first and if there is no splicing in the end vertical, the final closure be made at the bottom connection. If there is splicing, it shall be made at the splicing.
- (ix) Frequent checks shall be made of the camber of girders during erection and care taken that the correct camber is obtained when the girder is completely assembled.

**22.3. Care during Assembly at Workshop**

**22.3.1. Drilling & Drifting of Holes**

Drilling of joints shall be avoided as far as possible and when necessary should be done with great care and under expert supervision. Hammers not exceeding 1kg (2 lb) in weight may be

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Section-5: Works Requirement  
(Based on SBD updated upto 26.12.2018)



255

1651

Page 171

**GANGA BRIDGE ALLAHABAD (Revised)**  
**Annexure A to A&C 3**

used with turned barrel drifts and a number of holes drilled simultaneously, the effect of drifting shall be checked by observation of adjacent unfilled hole. Any apparent error in shop work which prevents the assembling and fitting of the mating parts by the proper use of drifts, shall be investigated immediately.

As all work is rigidly inspected at the fabrication shop before dispatch, these difficulties should not arise and the cause could possibly be due to the use of incorrect components. It is usually important that parts be correctly handed. Should errors still persist, the matter shall be immediately reported to the Engineer who will decide what action is to be taken.

### 22.3.2. Reaming

No reaming shall be undertaken without the written authority of Engineer or his authorized representative or Inspecting Officer except for under drilled holes meant for turned bolts. If approved by Engineer, the Contractor shall supply at his own expense, special rivets as may be required. Records of all actions relative to the recourse to reaming and the use of oversize rivets shall be reported to the Engineer.

### 22.3.3. Service Bolts & Drifts

Joints shall normally be made by filling not less than 50 to 60 percent 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 to secure full contact of the mating parts.

### 22.3.4. Inspection, Testing & Marking

All components shall be offered for inspection prior to painting. All approved components shall be stamped defect free, painted as per specifications prior to dispatch to bridge site. On final finishing of each component, it shall be marked distinctly with paint with shipping mark for guidance, during assembly of component. Stud shear connectors shall be subjected to the following tests:

- a) The fixing of studs after being welded in position shall be tested by striking the side of the head of the stud with a 2 kg hammer to the satisfaction of the Engineer.
- b) The selected stud head stroked with 6 kg hammer shall be capable of lateral displacement of approximately 0.25 times the height of the stud from its original position. The stud weld shall not show any sign of crack or lack of fusion.

The studs whose welds have failed the tests given in (a) and (b) shall be replaced. All other aspects not stated above shall comply with IRS-BI-2001 and Welded Bridge Code.

### 23. Transports from Workshop & Stacking at Site

All items fabricated in the workshop shall be marked and packaged with accompanying package list. The items after fabrication shall be transported by Contractor to site by Rail/Road in a manner as to cause no damage to the components. Contractor shall be liable for all losses and damages in transit for the materials consigned by him till materials are erected and work completed and taken over by the Engineer. Insurance against loss or damage in transit, if any, shall be the responsibility of the Contractor.

**Vetted**

**Sr. DGM/Fin**  
**RVNL/BSB**

Section-5: Works Requirement  
 (Based on SBD updated upto 26.12.2018)



~~1650~~

**GANGA BRIDGE ALLAHABAD (Revised)**  
**Annexure A to A&C 3**

After identification & correct marking, all components of each girder shall be dismantled & similar components shall be grouped together & labelled; rivets bolts and plates of each size shall be packed separately in the manner described elsewhere in this tender document, after approval by the inspecting authority. The packages shall be of such size by length & weight that they are safely transportable by Rail/Road. The components shall be provided with necessary packing to avoid damage to painting & members in transit. Dimensions for transport shall be as per standard schedules.

**24. Assembly at Site**

**24.1. Holes** After drilling holes in temporary tack assembled components, the components shall be taken apart after match marking and all burrs left by drill and sharp edges of all holes shall be removed by spot grinding to ensure full contact when assembled. Assembly fixture shall be used to build components for turned bolt connection. These connections will help realize correct position of member and matching of coaxial holes in opposite members besides true alignment and level. After assembly, all blank holes shall be checked with plug gauge of diameter 0.8mm less than hole diameter, to check fair matching of holes before riveting.

**24.2. Drifts**

Drifts as per IRS specifications 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. Drifting to enlarge unfaired holes is prohibited.

**24.3. Reaming**

The holes that will have to be enlarged to admit bolts should be reamed subject to approval of Engineer/Inspecting Officer who will satisfy himself about the extent of inaccuracy and the effect of reaming on the soundness of the structure. The Contractor shall supply special rivets to fill reamed holes, where reaming is approved. Record of all such variations shall be kept. However, these provisions should not apply for under drilled holes meant for turned bolts. Copies of all correspondence pertaining to the recourse of reaming and the use of oversize bolts shall be sent by the Contractor for information to Engineer.

**24.4. Making of joints**

Care shall be taken to see that all burrs are removed and no surface defects exist before the parts are assembled. The mating surfaces shall establish full contact when assembled. In cases where the joints have to withstand stresses arising from special methods 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 service bolts for this purpose. Up to a maximum of 40 percent 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 turned bolts. The position and number of the drifts and bolts will be decided by Engineer.

**24.5. Assembly and Launching**

Section-5: Works Requirement  
(Based on SBD updated upto 26.12.2018)

Vetted  
Sr. DGM/ITD  
RVNL/BSR

