

Method Statements
For
Various Critical Activities of Bridge
Construction



August, 2026

Indian Railways Institute of Civil Engineering
Pune - 411001

PREFACE

Bridges are among the most critical components of railway infrastructure, and their construction requires a systematic execution planning. With the increasing emphasis on modernization, capacity enhancement and construction of new railway infrastructure, there is a growing need for uniformity and clarity in the execution of various bridge construction activities.

In this context, the Railway Board, vide Letter No. 2021/02/CE-III/BR/1/Bridge Policy dated 18.06.2026, has issued instructions regarding the preparation and adoption of appropriate Method Statements for various bridge construction activities. The objective is to ensure that construction activities are planned and executed in a systematic, safe and technically sound manner, with clearly defined procedures, quality-control requirements and safety precautions.

This compilation of method statement has been prepared in accordance with the above instructions with the objective of providing a practical and comprehensive reference for engineers, supervisors, contractors and other personnel involved in steel bridge construction and maintenance activities.

Each Method Statement is intended to provide a clear sequence of activities, applicable materials, plant and equipment, manpower requirements, quality-control measures, inspection requirements, safety precautions and relevant technical considerations. The procedures have been presented in a structured manner so that they can serve both as a reference during planning and execution and as a useful training document for field personnel.

The Method Statements contained in this book should be read in conjunction with the latest applicable Indian Railway codes, manuals, Railway Board instructions, approved drawings, technical specifications, Standard Specifications for Materials & Works, relevant BIS/IRC provisions, approved Quality Assurance Plans and site-specific requirements. Where any discrepancy arises, the latest applicable instructions shall prevail.

The preparation of this book is an effort towards promoting standardization, consistency, quality and safety in bridge construction practices across Indian Railways. It is hoped that this compilation will be useful to field engineers, supervisors, executing agencies and trainees in understanding and implementing systematic construction methodologies.

Although care has been taken to include details as per references, still there may be some errors/omissions. We shall be grateful to the readers, for their suggestions, which may be sent to IRICEN at mail@iricen.railnet.gov.in. This will be helpful in further refinement and rectification of errors/omissions.

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(1)
METHOD STATEMENT
FOR
FABRICATION OF STEEL GIRDER
FOR
RAILWAY BRIDGES

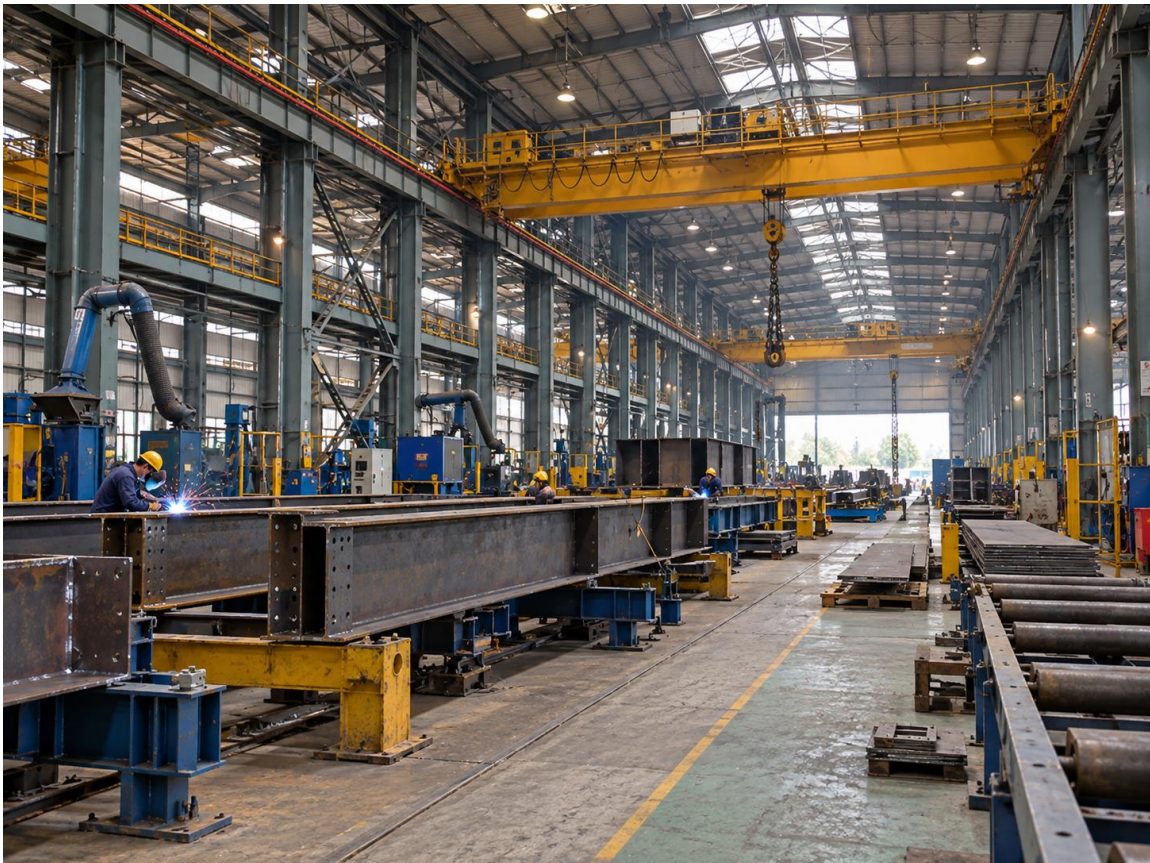


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1 Scope and References-

1.1 References

1. **IRS B1-2001**-Indian Railways Standard Specification for fabrication and erection of steel girder bridges and locomotive turn tables (Fabrication Standard).
2. **IRS WBC**- Code of Practice for metal arc welding for structural steel bridges carrying rail cum road or pedestrian traffic (Adopted 1972 Revised 2001).
3. **IRS M-28**—Indian Railways Standard Specification for Classification, Testing and Acceptance Criteria of Manual Metal Arc Welding Electrodes and Gas Welding Rods
4. **IRS M-39**-IRS Specification for Classification, Testing and Acceptance Criteria of Wire and Flux for Submerged Arc Welding of Structural Steel for Use on Indian Railways
5. **IRS M-46** -IRS Specification for Classification, Testing and Acceptance Criteria of Filler Wires for MIG/MAG Welding (With and Without Gas Shielding)
6. **IRBM**- Indian Railways Bridge Manual -2024
7. **IRCM**- Indian Railways Construction Manual -2023
8. **RDSO BS-110 R**- Guidelines on fabrication of steel girders for construction/field engineers-March 2016
9. **RDSO BS-125**- Method statement for fabrication of 45.7 m through type open web girder for 25T loading drawing no. RDSO B-17181 series- June2018
10. **RDSO BS-130**-Guidelines for fabrication inspection of RDSO standard spans-composite I-section steel girders for road over bridges (ROBs)-June 2021

1.2 Scope

This method statement is prepared to help the field engineer execute the fabrication work. These guidelines are intended to facilitate, not supersede, the codes related to the fabrication of steel bridge girders as given above. In case of any differences between this document and the above-mentioned references, the provisions in the latter shall prevail.

1.3 General Conditions

1. The purchaser, inspecting official(s), or their authorized representative shall have free access to the fabricator's works at all reasonable times. They shall be at liberty to inspect the fabrication process at any stage and to reject any material that fails to conform to the provisions of the Quality Assurance Plan (QAP) or other applicable specifications.
2. The contractor/fabricator shall follow all applicable standards, codes, and manuals relevant to the quality requirements of the girder fabrication, along with the terms and conditions mentioned in the contract agreement, and shall comply

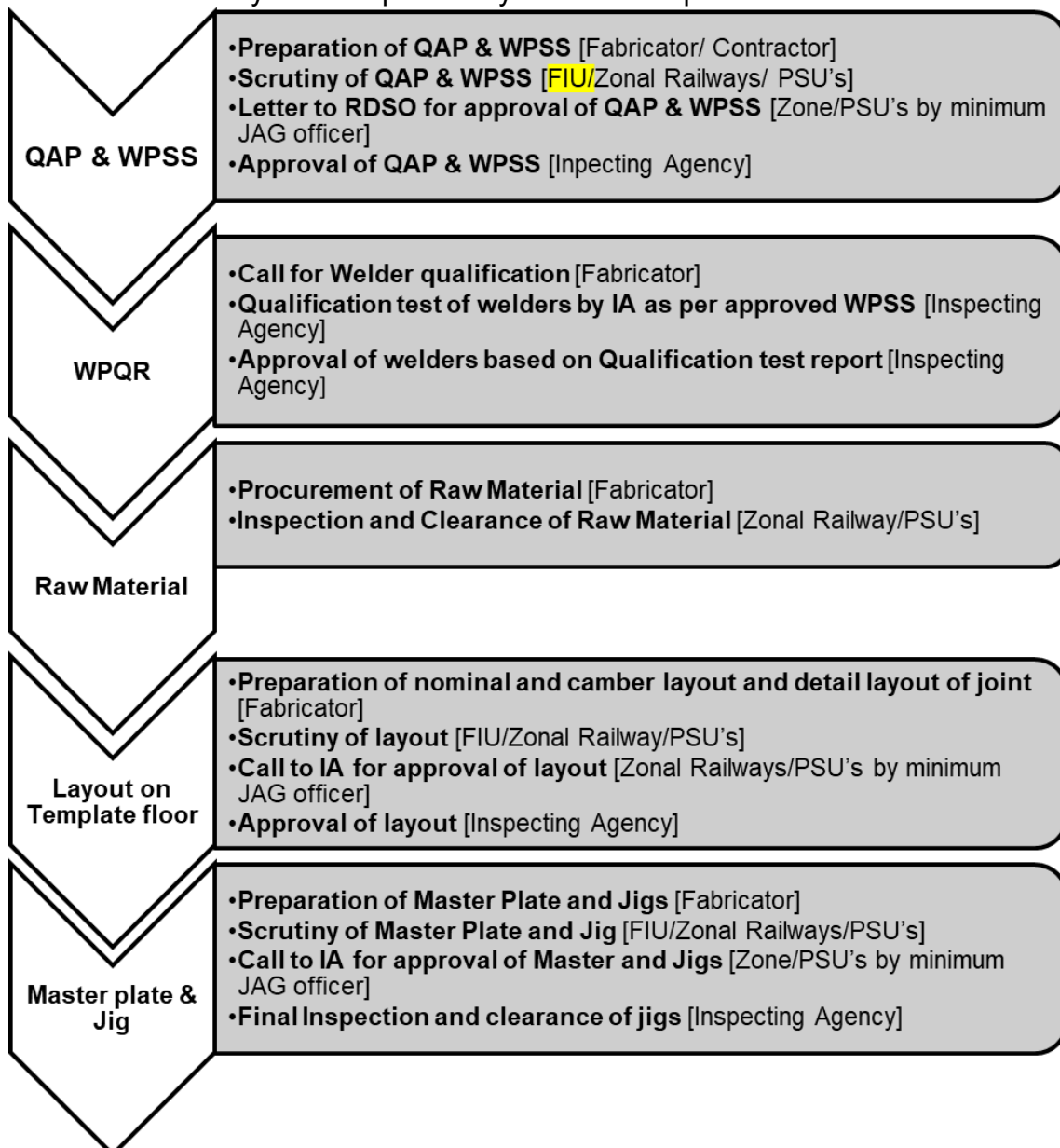
with the instructions issued by the engineer-in-charge or their representative from time to time.

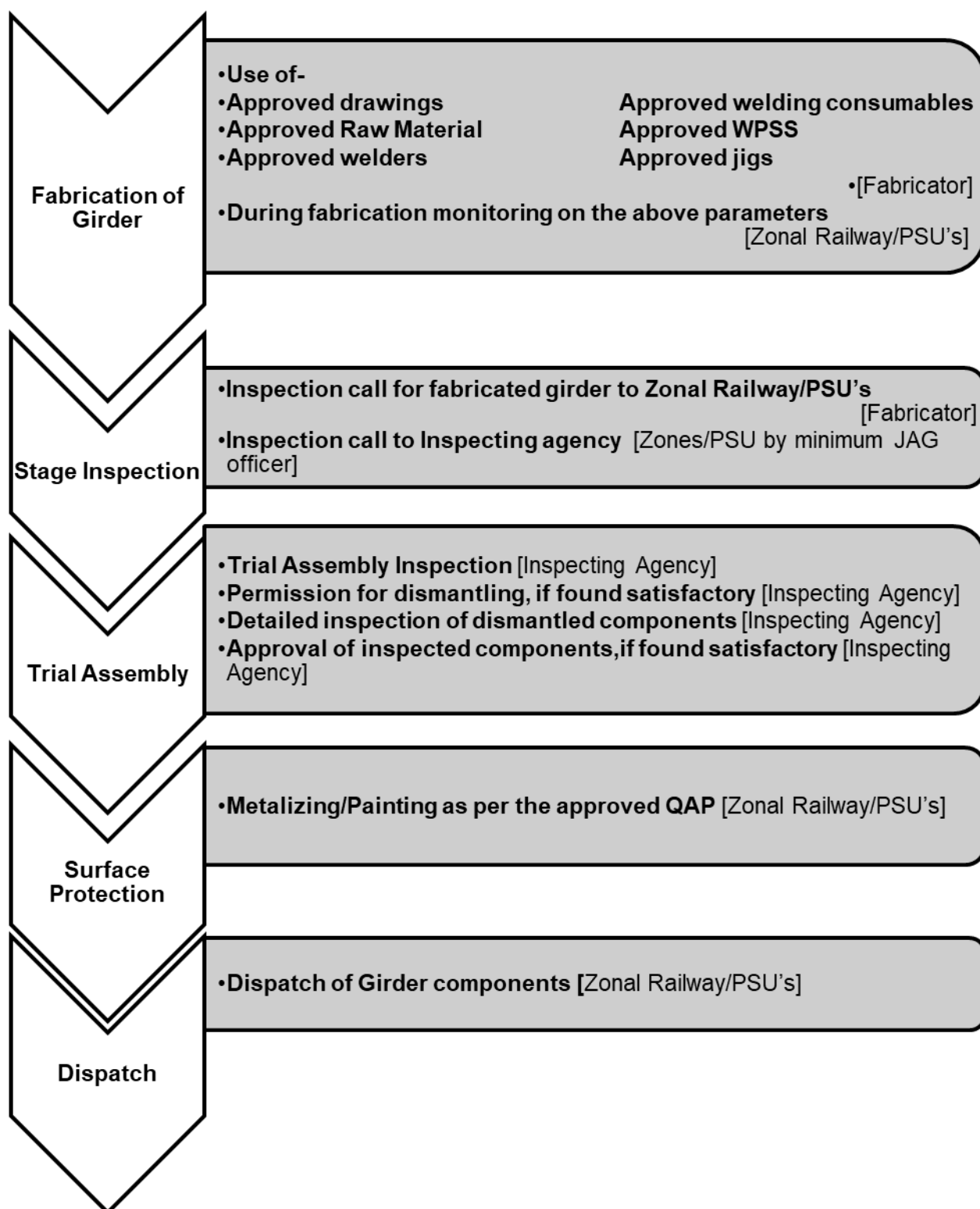
3. Any fitting, accessory or apparatus which are usual or necessary in the execution of such work, are to be provided by the Contractor without extra charge.

4. The whole work must be completed in all details, with the exception of such work as has been specified in the Schedule of Requirements to be separately provided for by the Purchaser.

1.4 Flow Chart of activities involved in fabrication

Each activity wise responsibility is listed in square bracket.





2 QAP, WPSS& WPQR

2.1 Preparation and Approvals

The Project Quality Assurance Plan (QAP) must be compiled using the standard model layout (RDSO Model QAPs), signed by both the contractor and the fabricator, and officially countersigned by an executing officer holding a minimum rank of Railway Junior Administrative Grade (JAG) or equivalent before formal submission to the designated inspecting agency for approval. Work shall commence

on the shop floor only after the approval receipt of the QAP and Welding Procedure Specification Sheets (WPSS). Which must be duly signed by all parties and approved by the inspecting agency.

2.2 Checks by Field Engineers

2.2.1 Quality Assurance Plan

The QAP must indicate the stage-wise manufacturing process, covering various steps, tests, checks, and their frequencies. It must also include applicable codes and specifications, sampling plans, acceptance criteria, clearance authorities, and the documents and registers to be maintained—such as MTCs, challans, and welding procedure data registers—along with the details of the personnel responsible for maintaining them, for all activities from the inspection and testing of raw materials to trial assembly and erection.

Field engineers should ensure that the referenced QAP correctly mentions the project details, contract agreement number, loading standard, governing specification, and drawing references for the project in hand. Subsequently, they must ensure that all tests, manufacturing processes, and records maintained comply with the approved QAP.

The details in Table 2.1 are to be filled in from the approved document by the field engineer for the record.

Table 2.1: QAP Approval Details

SN	Title	Details
1	Details of project	
2	Contract Agreement No.	
3	Loading Standard	
4	Governing Specification	
5	Drawing references	
6	Other Relevant Details	
7	Contractors Name & Address	
8	Approving Authority Details	
9	Approval Date	
10	Revision Approvals (If Any)	
(a)	Authority Details	
(b)	Revision Date	

2.2.2 Welding Procedure Specification Sheet (WPSS)

Refer to method statement for welding of steel girder for railway bridges

2.2.3 Welding Procedure Qualification Records (WPQR):

Refer to method statement for welding of steel girder for railway bridges

3 Raw Material- Inspection & Testing

3.1 Steel Plates

Raw material steel must comply with Para 8 of IRS B1:2001 (Latest revision). In the majority of cases where the service temperature does not fall below 0°C, the steel grade designation is E-250 Quality 'B0' as per Para 8.2 of IRS B1:2001.

The rolling and cutting tolerances shall be in accordance with IS: 1852, or as agreed between the purchaser and the contractor. If closer tolerances are desired, they must be shown on the drawings (IRS B-1, Para 8.10).

Before passing the material for use, all required tests must be conducted through independent Government, NABL, or NABCB accredited laboratories, and the results must be compared with the mill test certificates provided by the supplier or with the applicable standards.

Table 3.1 contains the details of test/inspections to be carried out for the acceptance of Steel plates.

Table 3.1: Testing Frequency, Acceptance Criteria and Specifications

S No	Nature of Inspection	Inspection and or test methods	Frequency	Acceptance criteria	Codes and specifications
1.	Appearance	a) Visual Inspection b) Pitting c) Rusting d) Straightness e) Rolling Defect	100% by quantity	Material should be free from any visual defect like jagged edges, bends and rusting/pitting, improper surface appearances etc. when observed with unaided eyes.	
2	Dimension and Geometry	Length, Width & Thickness	100% by quantity	Refer Table 3.8	IS-1852
3	Chemical	Chemical test (Ladle & Product) analysis	100% per heat	Refer Table 3.9	IS 2062
4	Mechanical	Tensile, Yield, Elongation, Bend, Charpy's Test	100% per heat	Refer Table 3.10	IS 2062
5	NDT	Ultrasonic testing By ASN Level II operator	100% by quantity	Refer Table 3.11	IS 4225 or ASTM SA 435/435M

The fabricators should prepare the details as given in table no. 3.2 and 3.3 for all the received material for record and further processing.

Table 3.2: Heat no Details

This Inspection Report to be Prepared for each Heat Number	
Mill	
Grade	
Heat Production Date	
PO Reference	
Description of plates as per PO	

Ordered Quantity	MT=	Nos=
Offered Quantity	MT=	Nos=
PO Balance Quantity	MT=	Nos=
PO Quantity Completed	Yes	No

Table 3.3: Plate details

Dimension						
Heat No	Plate	L	W	T	QTY Nos	Wt MT

3.1.1 General

The material must be free from any visual defects—such as jagged edges, bends, rusting, pitting, or improper surface finishes—when observed with the unaided eye.

This inspection must be carried out by the field engineer for all received steel materials, and the details shall be entered in the format provided in Table 3.4 below.

Table 3.4: General Inspection

General	
Inspection activity	Remarks (OK/Not OK/NA)
Visual Appearance	
Flatness	
Scratches	
Pitting	
Scales	
Corrosion	
Any material found unacceptable must be clearly marked with a suitable paint, and the field engineer must ensure that it is stacked separately and not used in member fabrication during subsequent activities.	

3.1.2 Rolling and Cutting Tolerances

(a) The tolerance parameters for the width of a plate depend on its length, width, and thickness:

Table 3.5: Tolerances on Width (on Length 7.1 of IS: 1852)

Length (mm)	Width (mm)	Thickness (mm)	Tolerance on Width (mm)
Up to and including 8,000	Up to and including 2,000	Up to and including 20	- 0.0, + 10
		Over 20	- 0.0, + 15
Up to and including		Up to and including 20	- 0.0, + 0.5% of

8,000	Over 2,000		width
		Over 20	- 0.0, + 20
Over 8,000	All widths	Up to and including 20	- 0.0, + 0.2% of length
		Over 20	- 0.0, + 0.3% of length

(b) The permissible variations in plate length depend on the length and thickness:

Table 3.6: Tolerances on Length (Plate No 7.2 of IS: 1852)

Length Range (Over)	Length Range (Up to & Including)	Thickness (mm)	Tolerance on Length (mm)
—	2,200 mm	Up to and including 20	- 0.0, + 10
		Over 20	- 0.0, + 15
2,200 mm	3,000 mm	Up to and including 20	- 0.0, + 0.5%
		Over 20	- 0.0, + 15
3,000 mm	6,300 mm	Up to and including 20	- 0.0, + 0.5%
		Over 20	- 0.0, + 0.5%
6,300 mm	8,000 mm	Up to and including 20	- 0.0, + 35
		Over 20	- 0.0, + 0.5%
8,000 mm	Above	Up to and including 20	- 0.0, + 35
		Over 20	- 0.0, + 40

(c) The thickness shall be measured:

1. One at each corner of the plate
2. One in the middle of the width and
3. One in the middle of the length

These measurements shall be 15 mm away from the Plate. No points randomly chosen. The thickness measured at each of these points shall satisfy the tolerances specified in the table below:

Table 3.7: Thickness Tolerances (Plate No 7.3 of IS: 1852)

Nominal Thickness Range	Plus Tolerance (%)	Minus Tolerance (%)
Less than 8 mm	+ 12.5%	- 5.0%
From 8 mm up to and including 12 mm	+ 7.5%	- 5.0%
Over 12 mm	+ 5.0%	- 5.0%

Field Engineer should prepare a list of plate thicknesses required as per drawing and then note down the required permissible values of dimensions from the table 3.5, 3.6 & 3.7 above.

An example of 20mm thick plate 12.5 m long and 2.5 m wide is shown in the table below for reference.

Table 3.8: Dimension Check

SN	Plate No/ Identification Mark	Required (mm)			Actual (mm)			Remarks
		L	W	T	L	W	T	Acceptable Yes/No
1	Abcd12	12500 to 12535	2500 to 2525	9.5 to 10.75				
2								
3								
4								

3.1.3 Chemical and Mechanical Properties

The values from lab tests reports are to be recorded in the table 3.9 given below for each heat number by the field engineer.

Table 3.9: Chemical Properties

This Report to be Prepared for each Heat Number						
Cast Mark/Heat No. :						
Grade/Quality :		e.g. E250 B0				
Test Sample No. :						
Test Report No. :						
Date of Testing :						
Lab Test Report No. :						
(Values From Table 1 of IS 2062 for Grade and Quality) (The Values are % Max)	C	Mn	S	P	Si	CE
Required Ladle Analysis (as per IS 2062)	0.22	1.50	.045	.045	0.40	0.41
Actual Ladle Analysis (From MTC)						
Acceptable	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Required Product Analysis	0.22	1.50	.045	.045	0.40	0.41
Permissible Variation (Table 3 of IS 2062)	C<0.20- 0.02 C >0.20-0.03	0.05	0.005	0.005	0.03	-
Actual Product Analysis						
Acceptable	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No

Carbon equivalent (CE) would be calculated based on ladle analysis only.

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

The values from lab tests reports are to be recorded in the table 3.10 given below for each heat number by the field engineer.

Table 3.10: Mechanical Properties

Heat No.									
	Tensile Strength Rm, Min M Pa ¹⁾	Yield Stress ReH,Min MPa ¹⁾			Percentage Elongation A, Min At Gauge Length	Internal Bend Diameter Min		Charpy's Impact Test (SeeNote3)	
								Tem p oC	Min J
		<20	20-40	>40		<25	>25		
(1)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Required	410	250	240	230	23	2t	3t	RT	27
Actual Test Piece-1									
Actual Test Piece-2									
Acceptable	Yes/No	Yes/N	Yes/No	Yes/No	Yes/No	Yes/	Yes/No	Yes/N	Yes/No

3.1.4 Acceptance of steel

- If any of the tests above do not give the specified results, two additional tests shall be carried out at random on the same lot. Both re-tests shall conform to the requirements of IS: 2062; otherwise, the lot shall be rejected (**L x W x T 17.1 of IS: 2062**).
- If any heat-treated material fails to meet the mechanical requirements specified, the supplier may re-heat the material and, in that case, all mechanical properties shall be re-evaluated. (**Para 17. 2 of IS: 2062**)

3.1.5 Ultrasonic Testing

Ultrasonic test for 12mm & above thickness Plates by an ASN level II operator (as per IS 4225 or ASTM SA 435/435M) to analyse that the plates are free from internal defect like laminations, voids etc.

The details from tests reports are to be recorded in the table 3.11 given below for each heat number by the field engineer.

Table 3.11: Ultrasonic Testing Details

Operators details :						
Testing Instrument Details :						
Test Report No. :						
Date of Testing :						
Scanning method :						
couplant used :						
Area of Testing :						
Plate No.	Size(L x W x T)			Date	Time	UT Result

3.1.6 Inspection/Measuring/Testing Equipment's

The Details of the equipment used in carrying out Inspection, Testing and measuring during the process should be kept, along with the details of certificate of

accuracy issued by an accredited National Testing House.

The fabricator's QC should ensure that only duly calibrated equipment's and devices are used in testing and measurements and should keep a record in the format as given in table 3.12 given below

Table 3.12: Details of Testing Equipment/Measuring devices

SN	Device/Equipment Name	Equipment Make, S No etc	Calibration Certificate no. & Date	Validity
1	Measuring tape			
2	Vernier			
3	UT Thickness Gauge			
4				
5				

A record of all applicable tests and results thereof should be kept for future references and should be a part of documents, supplied to the executing agency at the time of final delivery of the girder.

After the verification of the results of all the tests the inspecting officer will issue a certificate to the effect that the material has been found satisfactory and can be used in the fabrication of the girder. A practice may be adopted to stamp each of the tested plate clearly and the details of stamping may be mentioned in the material passing certificate.

3.2 Welding Consumables

Refer to method statement for welding of steel girder for railway bridges

3.3 HSFG Bolting Assembly

Refer to method statement for HSFG bolting assembly

3.4 Metalizing Consumables

3.4.1 Abrasive material for blasting

(i) The abrasive material shall be in accordance with Clause 4 of IS: 6586.

3.4.2 Aluminium wire

Table 3.30: Material Composition

Parameter	Required Values	Obtained Values	Acceptable
Cast No.		560325	
Coil No.		13	
UTS (Kg/mm ²)	10.2	10.2	Yes/No
% Elong G.L	15.8	15.8	Yes/No
Cond.	61.8	61.8	Yes/No
% Si	.06	.06	Yes/No

% Fe	.13	.13	Yes/No
% Cu	.001	.001	Yes/No
% Mn	.003	.003	Yes/No
% Mg	.001	.001	Yes/No
% Cr	.001	.001	Yes/No
% Zn	.002	.002	Yes/No
% Ti	.002	.002	Yes/No
% V	.006	.006	Yes/No
% B	.002	.002	Yes/No
% Ga	.009	.009	Yes/No
% ZR	.001	.001	Yes/No
Other Impurities	.01	.01	Yes/No
% Al	99.772	99.772	Yes/No

3.4.3 Etch/Wash Primer

Table 3.31: Wash Primer IS 5666

Sl. No.	Test Parameters	Identification of Method use	Units	Acceptance Criteria	Test Results	Acceptable
1	Viscosity	IS-101 (Part 1/section 7): 2020	s	50+/-10	44	Yes/No
2	Drying time a) Air dry b) Force dry	IS 5666 (Clause 3.5)	HRS	Shall show no sign of sagging, pin holding or any other defect.	Pass	Yes/No
3	Consistency	IS 5666	NA	Smooth and uniform with no tendency to gel or objectionable skinning	Pass	Yes/No
4	Finish	IS 101	NA	Smooth and matt	Pass	Yes/No
5	Fineness of dispersion	IS 101	mG	5 H.G.	Pass	Yes/No
6	Fitness to take a coat of primer cellulose finish	IS 5666	NA	Pass the test with excellent adhesion without lifting, wrinkling or blistering	Pass	Yes/No

3.4.4 Zinc chrome Primer

Table 3.32: Zinc chrome Primer

SN	Test Parameters	Identification of Method use	Units	Acceptance Criteria	Test Results (Acceptable)
1	Mass per Ten Litre - Determination of density Pycnometer method	IS-101 (Part 1/sec 7)	g/cc	1.4 g/cc, min	1.467 (Pass)
2	Drying Time - Hard Dry	IS 101 (Part 3/sec-1)	HRS	Within 8 hrs	Pass
3	Consistency	IS 101	—	Smooth, uniform and Suitable for application by brushing without appreciable drag on the brush	Pass
4	Finish	IS 101 (Part 3/ Sec 4)	—	Smooth and matt or egg shell flat	Pass
5	Wet opacity	IS 101	m ² /unit	Between -10 percent and +20 percent of the approved sample	Pass
6	Colour	IS 101 (Part 4/ Sec 2)	—	That of zinc chromate	Pass
7	Water content	IS 101 (Part 2/ Sec 1)	%	0.5 (Max)	0.4 (Pass)
8	Flexibility and adhesion				
	a) Scratch hardness (Load 1000 g)	IS 101 (Part 5/ Sec 2)	—	No such scratch as to show the bare metal	Pass
	b) Bend test with 6.25 mm dia mandrel and type 1 apparatus	IS 101 (Part 5/ Sec 2)	—	No visible damage or detachment after	Pass
9	Flash point	IS 101 (Part 5/ Sec 6)	°C	Not below 30°C	Above 30°C, (Pass)
10	Resistance to humidity under condensation				
	(a) Resistance to humidity	IS 101 (Part 6/ Sec 1)	Days	To pass the test for 7 days	No sign of corrosion and blistering (Pass)
	(b) Resistance to salt spray	IS 101 (Part 6/ Sec 1)	Days	To pass the test for 7 days	

3.4.5 Aluminium Paint- conforming to IS: 2339

Table 3.33: Aluminium Paint

Sl. No.	Test parameters	Identification of Method used	Units	Required	Results	Acceptable
1	Mass per Ten Litre- Determination of density Pycnometer method	IS-101 (Part 1/sec 7)	g/cc	0.9 min	0.923 For ready mix paint/ Combined	Yes/No
2	Hard Dry	IS 101 (Part 3/sec-1)	hr	8 hrs max	< 8 hrs	Yes/No
3	Consistency	IS 101		Smooth, uniform and Suitable for application by brushing or spraying	Pass	Yes/No
4	Finish	IS 101 (Part 3/ Sec4)		Bright, lustrous and smooth	Pass	Yes/No
5	Flash point	IS 101 (Part 5/ Sec 6)	°C	Not below 30°C	Pass	Yes/No

3.5 Shear Studs

Refer to Method Statement for Shear Studs for composite girders.

4 Manufacturing Processes

4.1 Fabrication Drawings

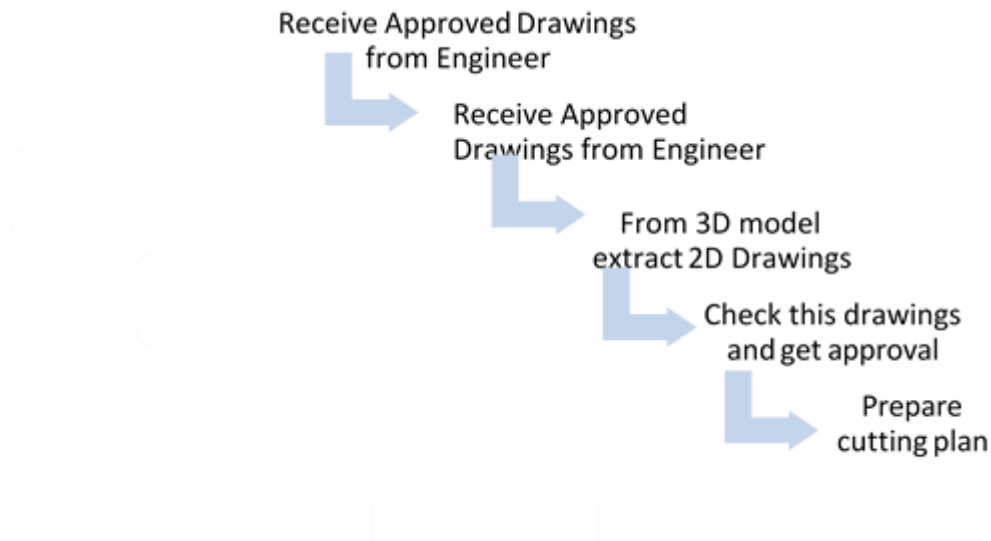
4.1.1 Conventional Approach

The field or workshop engineer associated with fabrication must have all relevant drawings, codes, and specifications—complete with the latest correction slips—prior to starting the work.

Based on the structural drawings, the fabricator must prepare detailed fabrication drawings for each component. These drawings must clearly mark all dimensions, holes, pitch, gauges, edge distances, and profiles. Furthermore, all drawings must be approved by the Engineer-in-Charge before use in the actual fabrication process, and a record of any alterations or corrections must be maintained in a dedicated register. Finally, the fabricated components must fully conform to the drawings regarding all specified measurements

4.1.2 For CNC Machines

The Procedure followed for Fabrication drawings preparation is as per the flowchart depicted below-



4.1.3 Procedure

- Receipt of approved drawings from Engineer
- 3D model will be prepared from the approved drawings received from Engineer using appropriate software.
- 2D Drawings will be extracted from the prepared 3D model.
- Shop drawings prepared will be submitted for approval to Engineer in the approved Contract Drawing format.

4.2 Layout of Components & Joints

4.2.1 Calibration Certificates of Measuring Instruments

Table 4.1: Measuring Instruments Details

S N	Instrument	Calibration Certificate No	Validity
1	Tape		
2	Feeler Gauge		
3	Digital Vernier Calliper		
4	Coating Thickness gauge		
5	Weld Fillet gauge		
6	Micrometer		
7	Auto level		
8	Torque wrench		
9	Step gauge for measuring distortion		

4.2.2 General Precaution

- a) Layout on template floor is to be checked for following:
 - i) Field engineer has to ensure that the template floor is level.
 - ii) The nominal lengths and camber lengths shall be rounded off to the nearest half a millimeters (1/64 in.).
 - iii) Nominal and camber layout are drawn with the calibrated steel tape. The certificate of calibration from an authorized agency should be kept in record.
 - iv) Squareness, diagonal measurement of layouts is also checked.
 - v) It should be remembered that tape should not be changed during the various stages of measurement.
 - vi) Running measurement should be recorded with a long tested tape having minimum length suitable for half span/full span measurement as per the case.
 - vii) 4 lbs. pull is to be applied for stretching the tape. Suitable device/Arrangement should be used for this purpose.



Figure 4-1: Arrangement for applying pull to measuring tape

- b) Detailed Layout of joints is drawn as per drawing on 1:1 scale on a level ground to be checked for:
 - i) Any infringement of rivets/ HSFG bolts, adjoining edges etc.
 - ii) Position of holes in master plates for jigs as per layout.
 - iii) The bore of bushes shall initially have tolerances of - 0mm to + 0.1mm.
 - iv) 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.
 - v) Bushes of jigs during service should be maintained within acceptable limit (D+0.4mm) which shall be checked at regular intervals.

4.2.3 Layout Inspection

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.
- ii) Position of holes in master plates for jigs as per layout.
- iii) The positions and angular setting out lines of all connection holes in the main gussets and also the positions of the connection holes in the chord joints and the machining of the ends shall be exactly as shown on the contract drawings. This will permit the butts in the chord segments to be exactly as shown on the contract drawings.
- iv) The groups of connection holes at the ends of all the members are to be as shown on the contract drawings, i.e. in nominal dimensions.

4.2.4 Nominal

Field engineers should have a checklist Prepared as per the approved reference drawing containing the details of the component wise dimensions, and no. of holes (shop & field), pitches, gauges, edge distances & any other relevant details considered necessary for ensuring proper quality based on the above drawings. This dimensions and joints parameters should be verified from the templating/layout and recorded in the format given below:

4.2.5 General Parameters:

Reference Drawing No.-RDSO/B-17182/2

- i) Overall Length = 63700 mm.
- ii) Bearing Centre. = 63000 mm.
- iii) Half of OAL = 31500 mm.
- iv) Half Diagonal = 32760.5 mm.
- v) Height = 9000 mm

Table 4.2: Nominal Dimensions Table

Panel Point	Standard Dimensions	Observed Dimensions
L0 - L1	7875	7875.0
L1 - L2	7875	7875.5
L2 - L3	7875	7875.0
L3 - L4	7875	7875.0
U1 - U2	7875	7875.0
U2 - U3	7875	7875.0
U3 - U4	7875	7875.0
L0 - U1	11959	11959.0
L2 - U1	11959	11959.0
L2 - U3	11959	11959.0
L4 - U3	11959	11959.0
L1 - U1	9000	9000.0
L2 - U2	9000	9000.0
L3 - U3	9000	9000.5
L4 - U4	9000	9000.0

From the Nominal layout the lines and relations of the following members are transferred on the master plates as precisely as possible for making master-

- i) Bottom Chords
- ii) All Gussets
- iii) Holes in members at gusset locations

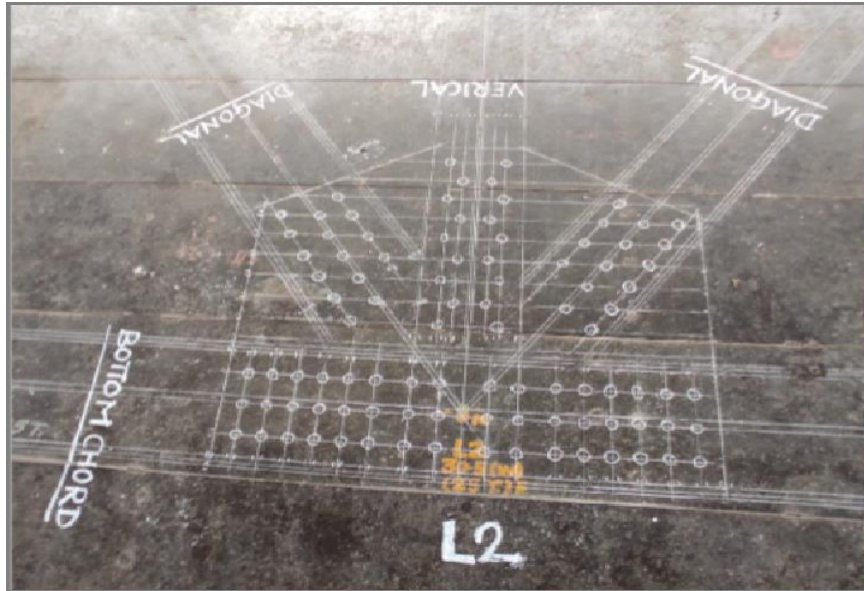


Figure 4-2: Nominal Layout of Gusset

4.2.6 Camber Lengths of members

The distance between the groups of holes at the ends of each member shall be altered by the amount of the camber allowance in the member. The camber length of members are then transferred to the master plate as precisely as possible.

Table 4.3: Camber Dimensions

Panel Point	Standard Dimensions	Observed Dimensions
L0 - L1	7875	7875
L1 - L2	7875	7875.5
L2 - L3	7875	7875
L3 - L4	7875	7875
U1 - U2	7882	7882
U2 - U3	7882	7882.5
U3 - U4	7882	7882
L0 - U1	11967.5	11968
L2 - U1	11957.5	11957
L2 - U3	11968	11968.5
L4 - U3	11962	11962
L1 - U1	9001	9001
L2 - U2	9003	9002.5
L3 - U3	9001	9001
L4 - U4	9003	9002.5

The Dimensions required as per drawing and as observed on the layout are then tabulated as given in table 4.3 below and are sent for approval or correction in drawing to the engineer in charge.

Table 4.3: Camber Lengths of members

SN	Component	Shipping Mark	Required Camber Dimension/Qty (in mm)	Observed Camber Dimension (in mm)	Satisfactory Yes/No	Remark
1	End Raker	1-1x	9630			
2	Top Chord	2-2x	5909+5909			

4.3 Master & Jigs

- Master Gussets should be checked on nominal layout and transfer of all intersection line/ points to be done with great care and accuracy.
- If gussets are symmetrical then 1/4th or half hole marking is to be done and same will be transferred to complete the gusset marking.
- Dimensional Inspection of Jigs and Master Plates used in manufacture of girder should be done very carefully as per drawing 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 Nos. Of holes the field holes at nominal length layout through master gussets.

Table 4.4: Details of Jigs and Masters

Sr. No.	SM No.	Description of Jigs	Joint	Page No	Remarks
01	—	Layout	Elevation	04	
02	SM-32	Side gusset plate at L0, L8	L0, L8	06	
03	SM-42	Side gusset plate at L1, L7	L1, L7	08	
04	SM-49	Side gusset plate at L2, L6	L2, L6	10	
05	SM-59	Side gusset plate at L3, L5	L3, L5	12	
06	SM-67	Side gusset plate at L4	L4	14	
07	SM-25	Side gusset plate at U1, U7	U1, U7	16	
08	SM-30	Side gusset plate at U2, U6	U2, U6	18	
09	SM-31	Side gusset plate at U3, U5	U3, U5	20	
10	SM-30A	Side gusset plate at U4	U4	22	
11	—	Bottom Lateral Plan	—	24	
12	SM-33-33X	Bottom Lateral Gusset	L0, L8	26	
13	SM-46	Bottom Lateral Gusset	L1, L7	28	
14	SM-53	Bottom Lateral Gusset	L2, L6	30	
15	SM-64	Bottom Lateral Gusset	L3, L5	32	
16	SM-72	Bottom Lateral Gusset	L4	34	

17	SM-LB3	Bottom Lateral Central Gusset	L0-L1, ...	36	
18	SM-LB6	Bottom Lateral Central Gusset	L1-L2, ...	38	
19	SM-LB10	Bottom Lateral Central Gusset	L2-L3, ...	40	
20	SM-LB1	Bottom Lateral Bracings (Long)	L0-L1', ...	42	
21	SM-LB2	Bottom Lateral Bracings (Short)	L'0... L0...	44	
22	SM-LB4	Bottom Lateral Bracings (Long)	L1-L2', ...	46	
23	SM-LB5	Bottom Lateral Bracings (Short)	L'1-L2, ...	48	
24	SM-LB7	Bottom Lateral Bracings (Long)	L2-L3, L3-L4	50	
25	SM-LB8	Bottom Lateral Bracings (Short)	L2'...L3, L3'...L4	52	
26	SM-23-23X	Top Bent Gusset	U1, U9	54	
27	SM-16	Top Lateral Gusset	U2 to U8	56	
28	SM-L73	Top Lateral Bracings Center Gusset	—	58	

4.3.1 Approval of Master & Jigs

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.

Table 4.5: Inspection layout and master (gusset) plate

Girder Type:		Span:	Drawing No.:
Inspecting Agency:		Inspecting Official:	Date of Inspection:
SN	Particulars	Requirement	Acceptable
1	Checking nominal layout	As per drawing	Yes/No
2	Checking camber layout	As per drawing	Yes/No
3	Checking of master plates using nominal layout		
a	Intersection line	As per drawing	Yes/No
b	Distance between intersection points	As per drawing	Yes/No
c	Verification of intersection point	As per drawing	Yes/No
d	Verification of pitch and gauge	As per drawing	Yes/No

Details of inspected and passed master plates. (Each master gusset plate of the applicable drawing is to be listed in the table below)

Table 4.6: Master Plate Details

SN	Description of Master(gusset) plate	Size	Shipping Mark	Dia. (mm)	Nos. of holes	Qty.	Acceptable Y/N/NA
1	Bottom Lat Gusset (L1, L7)		SM 27	23.5			
2	Bottom Lat Gusset (L0, L8)		SM 30	23.5			

4.3.2 Templates

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. The templates are developed in the layout stages and are to be approved by the inspecting agency along with the layout approval.

4.3.3 Profiles

The end profiles of irregular shape members and gussets are also developed carefully from the layout for or from the masters and should be approved by the internal Quality control of the fabricator.

4.3.4 Gauges

Gauges to ensure proper edge distances shall be at the time of finishing shall be prepared and approved by the internal QC for ease of inspection.

4.4 Cutting Straightening, Edge Preparation

4.4.1 Traceability of Material

The materials received and issued for fabrication should follow the traceability procedure throughout and Fabrication process as follows-

- a) The material available in the stores will be marked with the following details as relevant.
 - i) Plate Number & Grade
 - ii) Heat Number
 - iii) Accepted (Ok) /Non-Conforming (Hold) status
- b) The material available during Fabrication process will be marked with the following details and Fabrication.
 - i) GAD Number
 - ii) Plate No. Grade & Heat No.
 - iii) Part Number: (GAD XXXX/Assembly Number/Part Number)
- c) The details to be transferred on the material available during Fabrication process shall be and Fabrication round nose machine tool.
- d) The details marked in the materials will be noted in the records prepared at each stage and Fabrication procedure.
- e) The Responsibility of traceability lies with the designated staff for store management and Fabrication in charge respectively.
- f) Traceability register shall be maintained in physical form duly verified by inspecting agencies

Table 4.7: Traceability of heat no.

SL No.	Date	Description of Material	Heat No.	Plate No.	Grade	Supplier	Qty (In MT)	Cutting Plan No (Nested)	GAD / Assembly Mark			Off cut Dimension (Left Over sizes)	Remarks	Signature of Shop In-Charge	Signature of IEB	Signature of Engineer
									Part No	Quantity (NOS)	Quantity (In MT)					
1																

4.4.2 Cutting

- Material Specification and Grade shall be confirmed based on the fabrication drawing of the components.
- All rolled sections and plates shall be straight and free from defects like twists and bends before they are used for marking and cutting.
- In case of any defects observed, then the plate should go through the plate straightening procedure.
- Nesting Plan to be prepared from the approved Shop drawings considering extra margin for shrinkage/distortion and tolerances using CNC Compatible software.
- Ensure stress direction in preparation of nesting plan and submit before proceeding to cutting.
- Then the nesting plan should be fed to the CNC machine for cutting the steel plates.
- Identified plate shall be placed in the CNC cutting bed.
- Cutting shall be carried out either mechanically or by controlled oxy-acetylene flame torch or plasma process.
- Grounding of all flame cutting edges to secure clean and square edges.
- The individual part number shall identify on the component in a standardized font by permanent mark number after cutting and before taking out from the CNC bed.

4.4.3 Straightening

- It is ensured that Steel plates and rolled structural have straight edges, flat surfaces, free from any twist.
- Flattening / straightening under hot condition/cold condition with approved repair procedure.
- Hammering is not allowed for straightening.
- It should be ensured that all rolled sections and plates are straight and free from defects like twists and bends before they are used for marking and cutting.
- Any deviation from geometrical shape during cutting or sweep i.e., distortion to

be corrected as per Engineer approved procedure.

4.4.4 Edge Preparation

The cut parts of components from cutting bed are shifted to the edge preparation bed for preparation of edges as per approved drawings.

- a) The edge preparation will be done by Edge Milling Machine/ Gas Cutting machine & grinding as per the approved fabrication drawing.
- b) Edge Prepared, will be inspected for required bevel angle using gauge for each bevel angle as per approved drawing.
- c) Straightness of Bevelled Edge shall be ensured.
- d) After edge preparation inspection clearance, the plate will be moved to the fit-up work preparation.

Table 4.8: Cut Material Inspection

SN	Inspection stage/Item	Record verification (Available/ Not available/Not applicable)	Remarks(Satisfactory/ Unsatisfactory)
Preparatory Works-to be checked as per frequency & format agreed between executing agency and inspecting agency			
(i)	Cut Edge Quality (No cracks, notches or excessive hardness)		
(ii)	Straightening No local overheating or distortion)		
(iii)	Edge Preparation (Bevel Inspection stage as per approved WPSS)		

4.5 Drilling

4.5.1 General Precautions

Drilling should be done either using CNC Drilling machine with approved drilling plan or with the approved set of Jigs when done on a manual Radial Drilling Machine.

- a) The plates should be perfectly horizontal while drilling the holes to ensure horizontal verticality of holes.
- b) Jigs should be firmly fixed on members, using approved fixture, so as to allow no relative movement during drilling operation.
- c) No tacking of the jig with member should be allowed as far as possible.
- d) The holes of different diameter should be marked with distinct colour code for ease of identification by the driller.
- e) Jigs should be removed from the components only after the drilling of all holes has been done and checked by the drilling supervisor

- f) Over /under drilling of holes is not permitted without the approval of Engineer in charge.
- g) No sub punching is allowed in main members of OWG.

4.5.2 Drilling stage inspection Format

Table 4.9: Drilled Material Inspection

S N	Inspection stage/Item	Record verification (Available/ Not available/Not applicable)	Remarks(Satisfactory / Unsatisfactory)
1	Drilling(Hole diameter pitch & edge distance)		
2	Burr Removal(All burrs removed after drilling)		
3	Fit-up(Alignment & gaps within tolerance)		

4.5.3 Tolerances for holes

4.6 Fit-up and Tack Welding

Parts required for making an I-section or box as per drawing shall be edge prepared and drilled suitably as with approved jigs and brought to the fit-up assembly section. The plates viz flange plates (top/bottom) and web for I-section and side plates. Top plate and diaphragm plate etc for box are held in place as per the drawing using clamps or bolting on the fixtures prepared for the same.

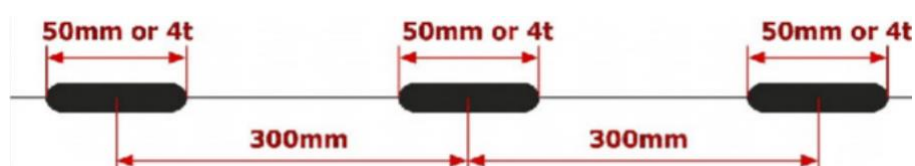
- a) Freedom from harmful defects such as cracks, surface flaws, laminations, and rough, jagged or imperfect edges shall be verified by visual examination of the material prior to welding.
- b) Dimensions of parts shall be checked by measurement.
- c) Edge preparation shall conform to the relevant drawings and meet the requirements of this code.
- d) After the parts are assembled in position for welding, the Inspector shall check for incorrect root gap, improper edge preparation and other features that might affect the quality of the welded joint.
- e) Check that top & bottom flange plate are perfectly perpendicular with reference to web throughout the length of I Section.
- f) Check the squareness i.e. 90° angle between flange & web of top and bottom flange plate to avoid out of squares flanges.
- g) Check with filler gauge throughout the length of top & bottom flange connection for uniform contact throughout the web plate.
- h) For manual welding, the tolerances on limits of gap and root face should be ± 1 mm on the specified dimensions for material record. The and including 12 mm thick and ± 2 mm for material over 12 mm thick.

Table 4.10: Checklist for Fit-up Inspection

SN	Inspection stage Item	Observation	Record verification (Available/ Not available/Not applicable)	Remarks (Satisfactory/ Unsatisfactory)
1	Fabrication Drawing No			
2	Dimensions Verified			
3	Visual Examination for-			
(i)	surface flaws			
(ii)	laminations			
(iii)	rough, jagged or imperfect edges			
(iv)	cracks			
4	Gap at Root Face (Check using feeler Gauge)			
5	Joint surface free from rust, moisture, oil, grease, mill scale etc.			
6	Any other observation			

After careful examination of the assembly for the dimensions viz length, width, diagonal, centreline etc. as per the drawing the component is taken-up for tack welding. Following precautions shall be observed during tack welding-

- Tack welds shall be not less than the throat thickness or leg length of the root run to be used in the joint.
- The length of the tack weld shall not be less than four times the thickness of the thicker part or 50 mm whichever is the smaller.
- The Tacking should be done as per the figure given below



Where a tack weld is incorporated in a welded joint, the shape, size and quality shall be suitable for incorporation in the finished weld and it shall be free from all cracks and other welding defects.

- Tack welds, which are prone to cracking, shall be cut out and re-welded.
- Tack welds shall not be made at extreme ends of joints.
- Tack welds shall be done by qualified welders only.

Table 4.11: Checking of Tack weld in Fit-up

SN	Inspection stage Item	Observation	Record verification (Available/ Not available/Not applicable)	Remarks (Satisfactory/ Unsatisfactory)
1	WPSS No.			
2	Welder Name & WPQR No.			
3	Any distortion observed after the fit-up			
4	Distance of tack weld from end			
5	Size of tack weld (=50mm or 4t)			
6	Gap between the tack welds			
7	Crack or other defects			
8	Good for inclusion in welded joint?			

Once the fit-up is complete and checked then only it should be sent for final welding. The welding should be carried out as per the approved WPSS by the qualified welders using approved consumables. The record of the same is to be maintained in WPDS register by the fabricator for all the components, which shall be handed over to the purchaser at the time of final delivery for the record. The Method Statement for welding should be followed.

Table 4.42: Fit-up inspection and Clearance for welding

Date	Component description	Dimension	Hole relation	Height	Length	Straightness	Sign. of internal QC	Sign. of Project executive agency
		Actual						
		Observed						

4.7 Initial Assembly

- (1) The surfaces of hole should be ground by 'pencil grinding machine' to remove burrs formed during drilling, especially at mating surface to ensure dead contact. Care shall be taken not to reduce mating surface contact area by excessive grinding.
- (2) Entire mating portion which are to be in contact permanently shall be cleaned of rust, mill scale and one coat of red oxide zinc chrome primer to IS: 2074 shall be applied when initial assembly is done by welding/ riveting. This is very important activity and will ensure sealing of mating parts and will prevent entry of water or moisture and help to prevent corrosion in hidden parts during entire life of the girder.
- (3) When initial assembly is done with HSFG bolts, the metalized surface with Aluminium shall not be applied with any overcoat paint. As overcoat paint film will change the Friction factor to unknown value contrary to design value. It is

good practice to protect joint area suitably while applying coating over adjoining areas.

- (4) With the help of assembly fixtures, members are formed to final shape. Provide 50% of bolts and drifts at alternate hole (in 4:1 ratio) to ensure the provision of clause 19 of IRS B1. Clamping force exerted by service bolts and alignment provided by drifts will ensure proper fabrication.

5 Structural and Dimensional Inspection

5.1 Trial Assembly

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:-

5.1.1 Dimensional check:

Parameters to verify from the Trial Assembly are as follows:

Table 5.1: Trial Assembly Parameters

Overall length	Squareness
Bearing centers	Alignment of the girder
Height	Fairing of holes
Truss centre	Verticality
Centre to centre distance of rail bearers	Infringement, if any
Centre to centre distance of panel points	Butting of compression flange
Skew angle	Straightness
Drift plan showing Drift & Temporary fasteners	Edge Distances
Diagonal at either end of the assembled span	Match marking of joint components for non-interchangeable fabrication

Table 5.2: Trial Assembly Inspection Format

SN	Description	Required Dimension (mm)	Observed Dimensions	Remarks
1	Overall length	47850		
2	C / C bearing	47240		
3	Truss centre	5400		
4	Height of girder at centre	8117.5		
5	C/C of panel point	5905		
6	C/C rail bearer	1900		
7	Alignment of girder	—		
8	Fairing of holes	—		
9	Verticality	—		
10	Infringement If any	—		

Checklist for trial assembly of first girder of 45.7 m span, 25t Loading as per RDSO drawing no. B-17181 Series.

The dimension given are based on the drawing and the tolerance in the dimension should be as per the Appendix 'B' of IRS- B1.

5.1.2 Camber

5.1.2.1 Camber on Jack

Table 5.3: Measurement of Camber on Jack

SN	Panel Point	Required (mm)	Observed LHS (mm)	Observed RHS (mm)
1	L0	0.00		
2	L1	16.5		
3	L2	29.5		
4	L3	40.0		
5	L4	42.0		
6	L5	40.0		
7	L6	29.5		
8	L7	16.5		
9	L8	0.00		

5.1.2.2 Dead Load Camber

Table 5.4: Camber without Jack (Residual Camber)

SN	Panel Point	Required (mm)	Observed LHS (mm)	Observed RHS (mm)
1	L0	0.00		
2	L1	13.33		
3	L2	23.82		
4	L3	32.32		
5	L4	33.54		
6	L5	32.32		
7	L6	23.82		
8	L7	13.33		
9	L8	0.00		

5.1.3 Component Inspection of first span

1. Detailed Inspection of dismantled components of trial assembly shall be carried out to see the integrity of components. (Ref. Para 13 of BS: 125)
2. Components are checked for handling damage, oval holes, bulging of plates at drifting location etc.
3. Any corrective action suggested based on trial assembly to be completed. Before final assembly inspection. If such corrections are required to be done in Jigs, then the same shall be reflected in the Jig register and the corrected Jigs shall be used henceforth.
4. Dimension Inspection (FDI) of components including end finishing is done.
5. In case of interchangeable component, second span onwards inspection is to be done using stage clearance record and other visual and dimensional measurements by inspecting agency. For second and subsequent spans, each girder to be offered in leaf assembled condition for inspection. Part spans shall not be offered for inspection of inspecting agency.

5.1.4 Final Inspection

In order to ensure the quality of steel Bridge Girders while offering the girder to Inspecting Agency for final inspection a four-point certificate mentioning following shall be submitted by the executing agency (minimum Railway JA Grade Officer or equivalent) vide RDSO No. CBS/INSP/WBG Dt. 10.04.2015 (Ref. 12.12).

1. Steel used for welded Bridge Girders components is of weldable quality of IS:2062 Gr B0/C as the case may be fully killed and fully normalized, which has been inspected and approved by the Railways/ executing agency.
2. Fabrication has been done with the help of approved Jigs/CNC machines, as per approved QAP.
3. Entire welding is done by approved welders using approved welding procedures and welding consumables (as per WPSS).
4. Fabrication work is inspected by internal quality control/inspection organization including the welding and riveting. All significant defects are rectified and final dimensions are within tolerances.

5.2 Interchangeability

1. Every span is to be temporarily erected complete in Contractor's works adopting the method of giving camber as approved 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.
2. 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.(from April 2026, all OWG spans are to be trial assembled at fabricators premises)
3. 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.
4. 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.
5. The tenderer must state in their tenders whether they intend to adopt complete interchangeability or not.
6. Under special arrangement with the Purchaser, it shall be permissible for approved portions of the work to be dispatched 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 completely and accurately in the complete structure.

The tables below are based on the RDSO Drawing No. B-17181 series for a 45.7m OWG as specified in BS-125. For detailed information regarding other members, Annexure-IX of this BS report may be referenced.

Table 5.5: End Raker

Product Name: End Raker			Shipping Mark: 1-1x		Qty Required: 4 Nos.	
S.N.	Description	Dimension				
	A-SECTION					
1	Side Plate	542x16x9451				
2	Bott. Flange Plate	150x20x				
3	Top Flange Plate	642x20x9026				
4	Batten Plate	480x10x518				
5	Lacing Plates	65x10x542				
6	Diaph. Plate (4 nos)	450x10x572				
	B-DIMENSIONS					
1	Intersection	9630				
2	Top Plate Length	9026				
3	Overall Length	9451				
4	Box width	610				
5	Web 1st Row	7582				
6	Web 5th Row	7862				
7	Top flange inner	8361				
8	Bracket hole inner side @ U1	1313				
-	Relation at L0	42				
-	Relation at U1	39				
	C-FIELD HOLES					
1	Web @ L0	40+40				
2	Web @ U1 (Inner)	40+40				
3	Portal connection hole @ U1 (Inner)	06 (21.5 ø)				
4	Top flange @ L0	14				
5	Top flange @ U1	36				
	D-GAUGE APPLY					
1	Web @ L0	Profile				
2	Web @ U1	Profile				
3	Top flange @ U1	65				
4	Top flange @ L0	40				

5	Slop Gauge	1				
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Table 5.6: TOP CHORD U1-U3 (END)

Product Name: TOP CHORD U1-U3(END) Shipping Mark: 2-2x Qty Required: 4 Nos.						
S.N.	Description	Dimension				
	A-SECTION					
1	Top flange Plate	642x12x11928				
2	Side Plate	542x12x11928				
3	Bottom Flange Plate	150x10x11928				
4	End Batten Plate	516x10x605				
5	Int. Batten Plate	516x10x395				
6	Lacing Angle	75x50x8x576				
7	Diaph. Plate (2 Nos.)	450x10x580				
	B-DIMENSIONS					
1	Intersection	5909+5909 = 11818				
2	Overall Length	11928				
3	Box Width	610				
4	Top flange Plate U1-U2	4913.5 / 5113.5				
5	Top Flange Plate U2-U3	5009.5 / 5409.5				
6	Web U1-U2	4993.5				
7	Web U2-U3	5139.5 / 5781.5				
-	Relation Top Flange Plate @ U1	22				
-	Relation Top Flange Plate @ U3	14				
-	Relation Bottom Flange Plate @ U3	14				
	C-FIELD HOLES					
1	Top flange Plate @ U1 / U2 / U3	42 / 46 / 23				
2	Web @ U1 / U2 / U3	46+46/30+30/40+40				
3	Bottom flange Plate @ U3	4+4				
	D-GAUGE APPLY					
1	Top flange Plate @ U1 / U3	56 / 50				
2	Web @ U1 / U3	Profile / 64				
3	Bottom Flange @ U3	50				

6 Surface Protection (Ref. aluminum 39 of IRS B1)

In order to ensure flawless shipping/ erection marking, durable tags (mentioning the erection mark/ shipping mark/ ID etc. of particular component/member) shall be inserted/tied in the (planned) bolt holes in members using metal wire before transporting the members/components for blasting, metalizing and painting. These tags should be sturdy enough to withstand the handling during above processes.

6.1 General

1. All painting to be carried out in covered shed. Humidity, curing time & temperature to be maintained as per paint specification. 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.
2. The protective coating by metalizing with sprayed aluminum shall be applied for all types of New Steel Girder Bridges (including all components), for all locations, as given in the Metallising
3. Dry Film Thickness shall be measured by 'Metallising' or any other approved method.
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 in QAP.
5. 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.
6. During fabrication, only one layer of the top coat shall be applied in workshop. The second layer of the top coat shall be applied at site after the portions of paint affected by the wear/ abrasion during assembly/ launching of girders have been touched and repaired.

6.2 Metallising

6.2.1 Surface preparation-

1. Surface preparation shall be started only after final clearance of girder. Blasting shall be done in covered sheds and surface roughness shall be ensured by visually comparing with roughness comparator of Sa 2½ (Ref IRS B1 Appendix-VII, IS: 5905).
2. Metalizing shall be started within 4 hours and completed within 8 hours after blasting.
3. Dry Film Thickness (DFT) shall be checked by taking minimum one reading per square meter of painted surface. Adhesion test shall be done as per IRS B1 Appendix-VII. Format for DFT records of Metalizing may be as given below

Table 6.1: Dry Film Thickness Checking

Date	Component description	Blasting	Metalizing DFT @ 1readingperSq. inch	Etch primer	Zinc chrome Sign. Of internal	1 st coat of aluminum(at fabricators premises)	2 nd coat of aluminum (Sign. Of internal after launching)	Sign. Of internal QC	Sign. of Project Unloading and Stacking at Site

1. After metalizing is completed, apply:
 - (i) One coat of etch primer conforming 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 aluminium paint to IS: 2339 brushing or spraying as required. One coat shall be applied before the fabricated steel work leaves the shop.
 - (iv) 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.

7 Dispatch

While dispatching a girder/ component it shall be marked as per the approved shipping and erection drawing. Hard Punching for marking shall not be used. The shipping list shall indicate the parts, numbers and the identification markings on the members for the guidance of the field engineers during assembly. The following shall be ensured during dispatch:

- (i) Shipping mark on all Components as per erection drawings & shipping list.-. After painting and re-assembling of components, the standard practice of marking stenciled erection marks/ shipping marks on the member shall be followed.
- (ii) Fixing of Inscription Plate-
- (iii) Packing
- (iv) Loading

8 Assembly at Site

8.1 Unloading and Stacking at Site

Care shall be taken to ensure that no damage is done to the finished component during unloading and stacking. Interchangeable components shall be stacked together. All

damaged components shall be suggested and listed out for recoupment.

- (1) Check List for fabrication –inspection of dispatch activities given in table below

Table 7.1: Checklist-Inspection of Assembled Structure at Site

SN	Description	Yes/No/NA	If NO, Action Needed	Details of Record or Ref Doc No
(1)	Verification of received material and components with shipping list and erection drawing.	YES		
(2)	Assembly at site before launching(By fabricator or their authorized agency)	YES		
(a)	HSFG Bolts fitment	YES		Records available in HSFG bolt fitment register Page No.
(b)	Camber measurement (On End support and intermediate supports)	YES		Records available in camber measurement register Page No.
(c)	Camber measurement (On End support only)	YES		Records available in camber measurement register Page No.

1. Competency Certificate of the personnel employed for torqueing of HSFG bolts shall be issued by an engineer not below the rank of ADEN or equivalent (Ref.BS-111 para 11(iii)).
2. Assembly of girder parts shall be done on level surface.
3. Proper drifting and service bolting shall be done.
4. Only after ensuring camber values are as required, HSFG bolt shall be fixed.
5. Onsite Inspection details/measurements for following shall be recorded for:
 - (a) Inspection of HSFG bolt fitment. For assembly at site, HSFG bolt fitment record shall be maintained as per format given in table below

Table 7.2: HSFG Bolt Fitment Register

Date	Component description	Joint details	Location	Applied torque	DTI location	DTI feeler gauge inspection	Torqueing done by	Sign. of internal QC	Sign. of Project executive agency
1									
2									

(b) Camber measurement details for girder supported on end support and intermediate support shall be maintained depending upon the type of girder.

(c) Camber measurement details for girder supported on end support only in dead load condition shall be maintained depending upon the type of girder. The method statement for erection of girder should be followed to carry out the activity.

(2)
METHOD STATEMENT
FOR
WELDING OF STEEL GIRDER
FOR
RAILWAY BRIDGES

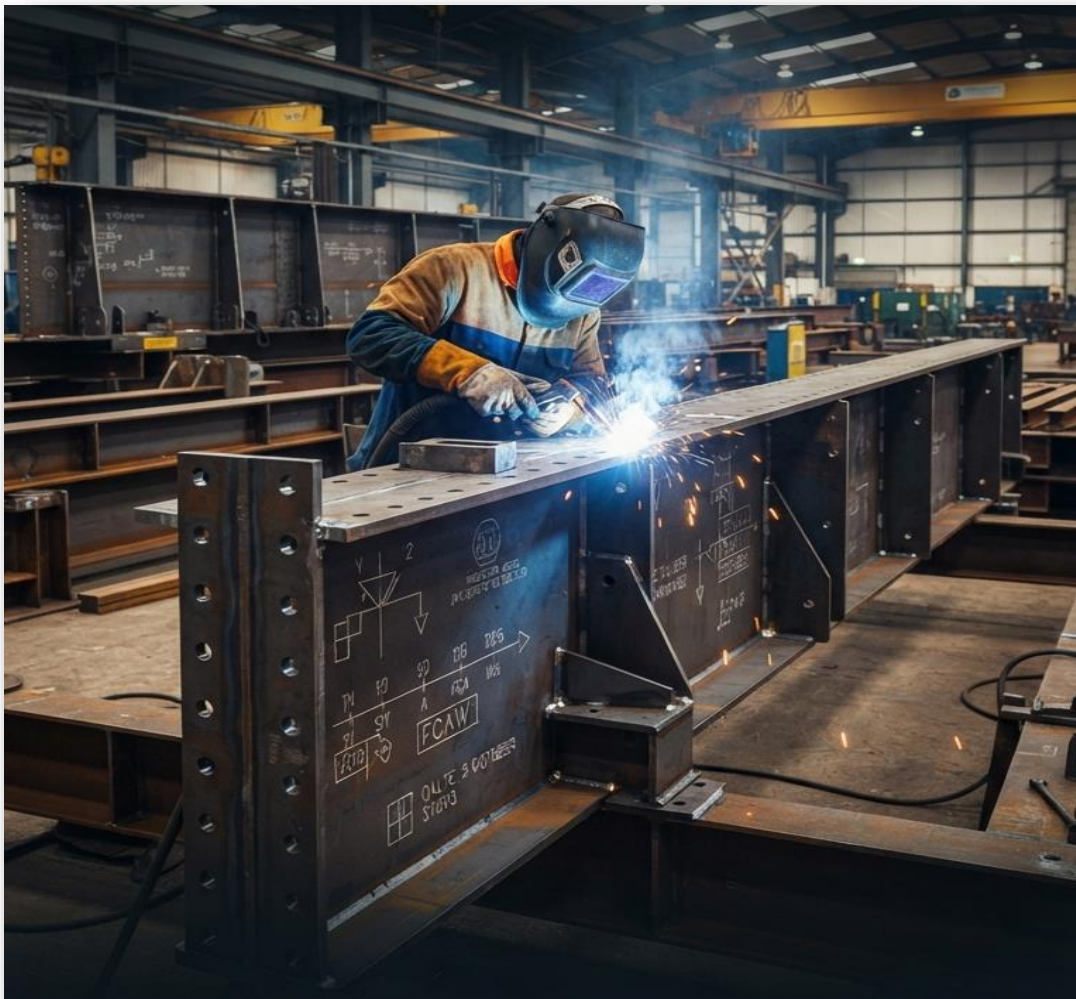


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1 Introduction

Welding is a fundamental fabrication process that permanently join metal by fusing them under high heat, pressure, or a combination of both. In railway structural fabrication, arc welding process is predominantly utilized due to its proven cost-effectiveness and low incidence of process-induced defects. This methodology relies on an electric current to generate the precise thermal energy required to melt and fuse the structural components.

The implementation of welded construction delivers highly efficient structures characterized by a low dead-weight-to-live-load ratio, which directly minimizes the seismic forces acting upon the superstructure. Furthermore, this design flexibility enables shallow construction depths, slender aesthetic profiles, and reduced embankment heights—making it ideal for space-constrained urban infrastructure.

However, because welded joints in railway bridge girders are continuously subjected to severe impact and cyclic loading, they are highly vulnerable to fatigue failure. This method statement may be referred to ensure that the produced weld are defect free and in line with structural integrity requirement.

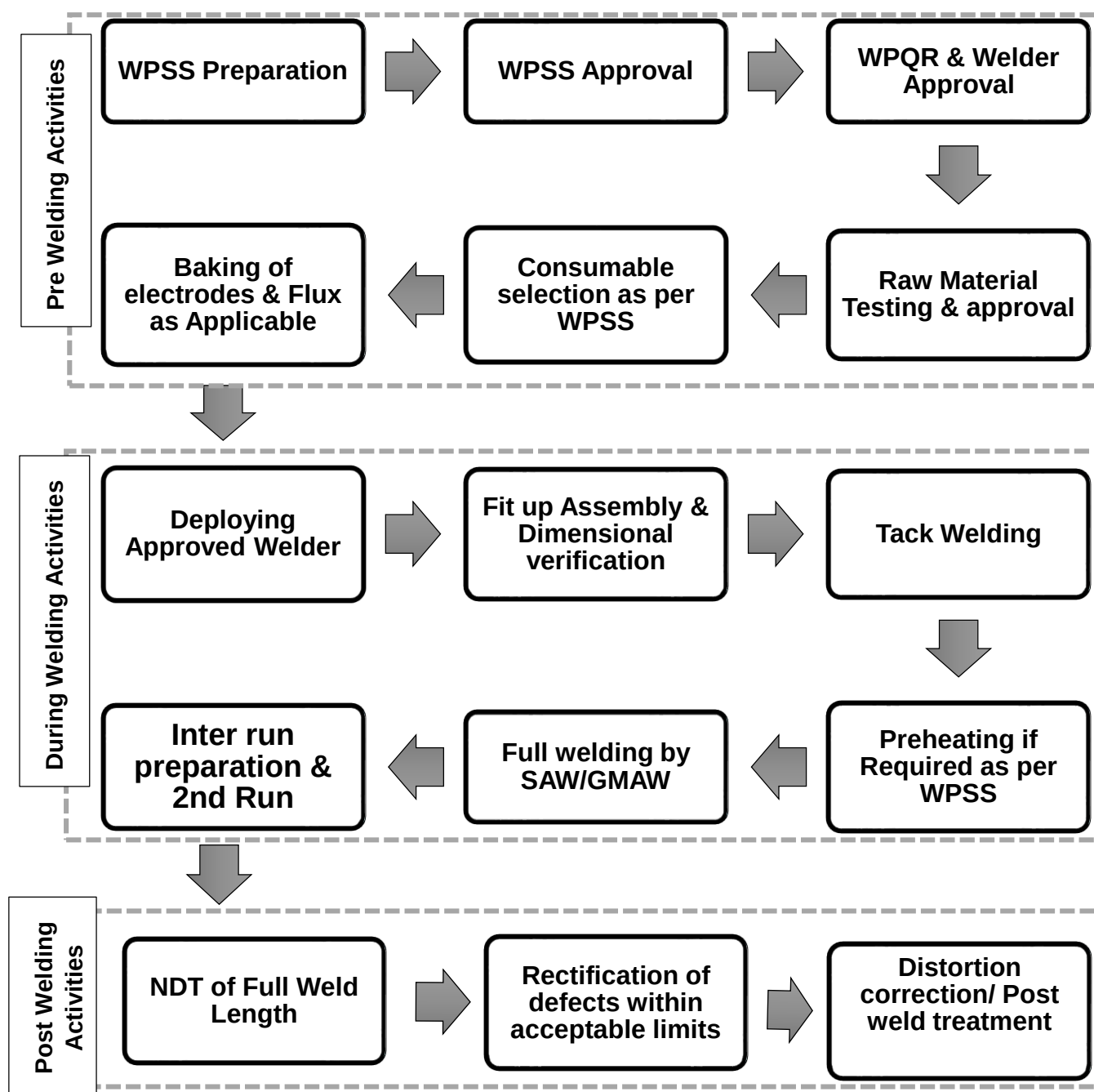
2 Scope

This Method Statement is prepared to help field engineers in inspection of welding operations during fabrication work executed within RDSO-approved workshops, in approved premises and having requires machinery as per scale mentioned in STR. These guidelines are intended to facilitate, rather than supersede, the official codes related to the welding and fabrication of steel bridge girders listed below. In the event of any discrepancies between this document and the referenced codes, the provisions of the latter shall prevail.

3 References

1. **IRS B1-2001**-Indian Railways Standard Specification for fabrication and erection of steel girder bridges and locomotive turn tables (Fabrication Standard)
2. **IRS WBC**- Code of Practice for metal arc welding for structural steel bridges carrying rail cum road or pedestrian traffic (Adopted 1972 Revised 2001)
3. **IRS M-28**– IRS Specification for Classification, Testing and Acceptance Criteria of Manual Metal Arc Welding Electrodes and Gas Welding Rods
4. **IRS M-39**-IRS Specification for Classification, Testing and Acceptance Criteria of Wire and Flux for Submerged Arc Welding of Structural Steel for Use on Indian Railways
5. **IRS M-46** -IRS Specification for Classification, Testing and Acceptance Criteria of Filler Wires for MIG/MAG Welding (With and Without Gas Shielding)
6. **IRBM**- Indian Railways Bridge Manual -2024
7. **IRCM**- Indian Railways Construction Manual -2023
8. **RDSO BS-110 R**- Guidelines on fabrication of steel girders for construction/field engineers-March 2016
9. **RDSO BS-125**- Method statement for fabrication of 45.7 m through type open web girder for 25T loading drawing no. RDSO B-17181 series- June 2018
10. **RDSO BS-130**- Guidelines for fabrication inspection of RDSO standard spans-composite I-section steel girders for road over bridges (ROBs)-June 2021.

4 Flow Chart of Activities



5 Welding Procedure Specification Sheet (WPSS)

The first step in fabrication of girders by welding is to establish the parameters to be used for welding different type of joints involved in fabrication of girder and ascertaining if the welders are competent to make the welds of proper quality and strength. For this it is preferable to group the joints based on type, position, size, thickness of base plate etc. so that number of WPSS can be kept minimum (as given in Table-1 below). WPSS for tack welding shall also to be prepared. For approval and testing of welding procedures para 19 of IR Welded Bridge Code & para 26 of IRS B1 may be referred.

(As per RDSO Drawing no. B-17181 Series)

Table 1: Details of Joints & Details of WPSS Approval

Name of the Project:					
Ref Drawing No:					
Inspecting Agency details:					
Name of the fabricator:					
Name and designation of approving official:					
SN	Component		Description(Plate Thickness in mm)	Weld Size	Approved WPSS No
1.	A.	End Raker (L0 - U1)	Web Plate (16) to Flange Plate (20)	6 mm	
2.			Top Plate (20) to Web Plate (16)	6 mm	
3.			Flange Plate (20) to Batten & Lacing Plate (10)	6 mm	
4.	B.	Top Chord (U1-U2& U2-U3)	Web Plate (12) to Flange Plate (10)	6 mm	
5.			Top Plate (12) to Web Plate (12)	6 mm	
6.			Flange Plate (10) to Batten & Lacing Plate (10)	6 mm	
7.	C.	Top Chord (U3-U4)	Web Plate (16) to Flange Plate (20)	6 mm	
8.			Top Plate (16) to Web Plate (16)	6 mm	
9.			Flange Plate (20) to Batten & Lacing Plate (10)	6 mm	
10.	D.	Bottom Chord (L0 - L1 & L1-L2)	Web Plate (12) to Flange Plate (16)	6 mm	
11.			Flange Plate (16) to Batten Plate (10)	6 mm	
12.	E.	Bottom Chord (L2 - L3 & L3-L4)	Web Plate (20) to Flange Plate (25)	6 mm	
13.			Flange Plate (25) to Batten Plate (10)	6 mm	
14.	F.	Verticals	Web Plate (10) to Flange Plate (12)	6 mm	
15.	G.	Diagonal (U1 - L2)	Web Plate (16) to Flange Plate (12)	6 mm	
16.			Flange Plate (12) to Batten Plate (10)	6 mm	
17.	H.	Diagonal (U3 - L2 & (U3 - L4)	Web Plate (12) to Flange Plate (10)	6 mm	
18.			Flange Plate (10) to Batten & Lacing Plate (10)	6 mm	
19.	I.	Cross Girder	Web Plate (20) to Flange Plate (25)	12 mm	
20.			Web Plate (20) to End Plate (16)	10 mm	
21.	J.	Corner Bracket	Web Plate (10) to Flange Plate (10)	12mm / 5 mm	
22.	K.	Stringer	Web Plate (10) to Flange Plate (20)	10 mm	
23.	L.	Portal Girder	Web Plate (10) to Flange Plate (10)	6 mm	
24.	M.	Sway Girder	Web Plate (10) to Flange Plate (16)	6 mm	
25.	N.	Top Lateral Bracing	Web Plate (10) to Flange Plate (10)	6 mm	
26.	O.	End Diaphragm	Web Plate (10) to Flange Plate (10)	10 mm	

5.1 Preparation of WPSS

The latest version of IS: 7307 Part-I shall be referred for preparation of WPSS and testing. Welding procedure test shall be carried out to demonstrate by means of a specimen weld of adequate length on a steel representative of that to be used, so as to conform that satisfactory weld is achievable with the welding procedure to be used for fabrication.

Following are the important point regarding WPSS:

- a) Each page of WPSS shall be signed by fabricator, contractor, and an officer of project executing organization being minimum Railway JAG or equivalent rank.
- b) The welding procedure shall be such as to avoid distortion and minimize residual shrinkage stresses.
- c) Properly designed fixtures should be used for assembly.
- d) The welding techniques, quality, size of electrodes, required voltage and current shall be as prescribed by manufacturers of the material and welding equipment.
- e) The Contractor should submit full details of welding procedure in Proforma as per IRS B1 para 26.4.

5.2 Approval of WPSS:

The Inspecting Agency shall give approval of WPSS based upon scrutiny of submitted sheets with respect to the approved structural drawings of the girder.

Following procedure may be adopted for preparation and approval of WPSS by the Inspecting Agency:

- a) A statement of the results of assessing each test piece, including repeat tests for each welding procedure stating that no rejectable features or test results are found, and the test piece made according to the particular welding procedure satisfied the requirements of IS: 7307 in respect of that type of test piece from the approved lab will be the basis for approval of a particular WPSS (Ref. Para 8 of IS: 7307).

OR

- b) The welding procedure tests carried out in accordance with IS:7307 and witnessed by an independent inspecting authority may be accepted by other inspecting authorities provided that all the provisions have been fulfilled subject to undertaking by fabricator and project executing agency that same welding machines will be used based on which earlier approval of WPSS was granted.

The WPSS signed by the parties mentioned in para 5.01 (a) above will become the approved WPSS once signed by the Inspecting Agency representative. This person will clearly state whether all test results are satisfactory, or if any retests were conducted. They will also specify if any process or parameter modifications are required to achieve the necessary quality, along with any special precautions or observations needed to comply with applicable standards.

The particulars of the welding equipment used to prepare the WPSS and perform the actual welding play an important role in achieving a high-quality weld. Therefore, their calibration and proper functioning must be ensured. To achieve this, the field engineer should record the equipment details in Table-2 below.

Table 2: Details of Welding Equipment's

SN	Equipment	Make	Serial No	Year of Mfg	Calibration certificate No	Validity of certificate	Remark
1							
2							
3							

6 Welding Procedure Qualification Records (WPQR)

The WPQR is the document indicating the approval of the various welders who are to be deployed for the fabrication work. It contains the name, photograph, qualifications, experience, welding parameters, qualification tests, and validity details of each welder for each welding process and joint.

6.1 Tests Related to WPQR

Welding Procedure Qualification Record is maintained for each welder by the executing agency and approved by Inspecting Authority. As per IS: 7310 (part-I) visual, NDT

and destructive test shall be carried out at premises of fabricator and it shall be the part of WPQR prepared by the executing agency as per Appendix V & para 26 of IRS B1 for each welder.

Approval test results shall clearly state whether the results are satisfactory, unsatisfactory, or not applicable, and clearly indicate any results of re-tests against each of the tests listed in the document. The non-destructive tests include visual, magnetic particle, liquid penetrant, and radiography/ultrasonic, while destructive tests include macro-examination, root bend, face bend, side bend, and fillet weld fracture tests.

Necessary arrangements of machines/ equipment to carry out these tests shall be made by the fabricator during WQT or these tests may be arranged by fabricator in approved Govt. labs/ NABL labs.

6.2 Approval of WPQR:

Inspecting Agency shall consider the WQT report while approving the WPQR. The WPQR shall be renewed every six months. The WQT shall be conducted based on the WPSS as approved in para 5.2 above.

The details of approved welders is to be maintained in the table 2.4 by the field engineer.

Table 3: WPQR Approval Details

Fabricator's Name:					
Inspecting Agency:					
WPQR Issuing official Name & designation:					
Total No. of Approved Welders:					
SN	Name of Welder	WPQR Approval No	Approval Validity		Renewal Details
			From	To	Valid up to
Reference WPSS No.:-					
1					
2					
3					
Reference WPSS No.:-					
1					
2					
3					

6.3 WPQR Renewal

For each welder listed in Table 3, the WPQR shall be renewed every six months. This renewal requires a declaration by the fabricator regarding the welder's satisfactory performance over the preceding six months. A welder's approval to weld to a particular procedure shall remain valid provided that it can be shown, as certified at intervals of six months by a senior responsible person in the firm that employs the welder, that the welder has, subsequent to the test, been employed with reasonable continuity on that procedure and has continued to produce satisfactory welds as verified by non-destructive examination.

Records of these renewals must be maintained in the format specified in Table 4.

Table 4: WPQR Renewal details

SN	Name of welder	WPQR approval No	Welder has done welding in last 6 months	Quality of welding was satisfactory (NDT)	Remarks
			Yes/No	Yes/No	

7 Testing of Welding Consumables

7.1 Sampling for Testing

The sampling of consumables at fabricators premises and witnessing of testing in approved laboratory shall be ensured by representative of the project executing agency.

7.2 Consumable testing

All consumables to be used must have manufacturer's test certificates, the results of which must be correlated with a NABL-approved laboratory's test report. The material shall only be used after approval by the official in accordance with the Quality Assurance Plan (QAP). Records must be maintained by the fabricator's stores department and also recorded in the welding process data register, as specified in SN 5 of Appendix-I of IRS-B1. Tests results may be recorded in the formats as applicable in the paras given below-

7.2.1 MMAW

Table 5: Chemical Composition of Electrode (Table 8 of IRS M-28)

Particulars			Details							
Name of manufacturer			XYZ							
Size/ dia (mm)			3.15 mm							
Batch No.			T-1157							
Date of Manufacture			14.06.2026							
Expiry Date			14.10.2027							
IS Code/IRS Class			A3							
Test Report No.										
Witness Test Report Date			31.03.2025							
Chemical Composition (%)										
Criteria	C	Mn	Si	Ni	Cr	Mo	S	P	Cu*	V
Values Obtained										
Specified Value	0.12	1.6	0.75	0.30	0.20	0.30	0.035	0.035		0.08
Acceptable	Yes/ No	Yes/No o	Yes/No	Yes/N o	Yes/N o	Yes/N o	Yes/N o	Yes/N o	Yes/N o	Yes/No

Table 6: Mechanical Properties of Electrode (Table 5 of IRS M28)

Criteria	UTS (N/mm ²)	YS (N/mm ²)	Elongation (% age, GL=5d)	R.A. (%)	Charpy's Impact Individual (Joules)	Charpy's Impact Avg. (Joules)	Test Temp (°C)	Transverse bend test with 3T mandrel dia at 180°
Value Obtained	643.24	536.28	29.60	68.64	145, 148, 129, 100, 144, 122	135	-20°C	
Specified Value	5610	350	26.00	50.00	47	47.0	-20°C	Satisfactory
Acceptable	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No		Yes/No

7.2.2 SAW

Submerged Arc Welding wire is to be tested for chemical and mechanical properties by sampling from each batch received. The results of tests are then validated for acceptance as per IRS M-39. Similar process is to be followed for the flux also.

Weld samples made for a particular wire-flux combination to be used as per approved WPSS are also tested for chemical and mechanical properties as per IRS M-39.

7.2.2.1 SAW Wire

(i) Chemical Composition

Table 7: Chemical Composition (Table 3 of IRS M-39)

Particulars				Details		
Name of manufacturer				XYZ		
Size/Wire dia (mm)				3.15 mm		
Batch No.				T-1157		
Date of Manufacture				14.10.2024		
Expiry Date				F1		
IS Code/IRS Grade						
Test Report No.						
Witness Test Report Date				31.03.2025		
Chemical Composition (Table-3 of IRS M-39)						
Criteria	C (%)	Mn (%)	Si (%)	S (%)	P (%)	Cu*(%)
Values Obtained						
Specified Value	0.10	0.4-0.6	0.03	0.030	0.030	0.40
Acceptable	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No

Single values in the above table are max values.

*The Wt% of copper includes copper coating also.

ii) Mechanical Properties

Table 8: Mechanical Properties (Table 5 of IRS M-39)

Criteria	UTS (N/mm ²)	YS (N/mm ²)	Elongation (% age, GL=5d)	R.A. (%)	Charpy's Impact Individual (Joules)	Charpy's Impact Avg. (Joules)	Test Temp (°C)
Value Obtained	643.24	536.28	29.60	68.64	145, 148, 129, 100, 144, 122	135	-20°C
Specified Value	410	330	26.00	50.00	27	47.0	-20°C
Acceptable	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	

- **Radiography Results: Satisfactory (as per IRS-M39)**

7.2.2.2 Flux

The flux shall be of agglomerated type and be granular in nature. The consignment of flux shall be homogenous and free from any foreign matter. It shall be flow freely through the flux feeding system. Basicity index of flux for all the grades shall be minimum 1.6. The Moisture Content of flux when heated at 150°C for 2 hours shall not exceed 0.3%.

Table 9: Flux Properties (Para 5 of IRS M-39)

Particulars			Details	
Brand Name			XYZ	
Name of manufacturer			SAW Flux IRSM-39	
Batch No.			T-1157	
Date of Manufacture			14.10.2024	
IS Code/IRS Grade			F1	
Grain Size distribution				
Test Report No.			abc	
Test Report Date			31.03.2025	
Tap Density				
Parameter	Min	Max	Test Result	Acceptable
Density (g/cc)	1.00	1.70	1.2	Yes/No
Moisture Content				
Result (%)	-	.300	.067	Yes/No

Grain Size Analysis						
Size	BS5	BS10	BS30	BS44	BS100	Pan
Required Weight retained Value (%)	Nil	90% minimum			2% Max	
Weight retained value result (%)						
Acceptable	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No

7.2.2.3 Weld Metal Test for Wire Flux Combination

The flux when used in conjunction with the wire of corresponding IRS grade/grades as recommended by the manufacturer shall produce satisfactory crack free weld deposit meeting the acceptance criteria of that particular class of wire-flux combination (weldment). When welded with normal parameter, slag shall be self-peeling or easily detachable by light tapping. The weld bead shall be sound and free from porosities and any other welding defect. Bead shape shall be flat to convex and blend evenly with the parent metal.

i). Consumable Details (Table 4 of IRS M-39)

Table 10: General Details of Consumable

Field	Value	
Serial No.	123456	
Item Code	WCF.BS.710.BA01	
Product Description	Automelt B-71 Automelt EM12K WIRE 4.00mm IRS M 39-20: CLASS III;W3/F3	
Date	20 JUL 2026	
Test Report No	Xyz123	
Consumable	Batch No	Month of Manufacture
Wire	123456	JUL-2026
Flux	654321	APR-2026

ii). Chemical Analysis (Table 7 of IRS M-39)

Table 11: Chemical composition

Particulars	C%	Mn%	Si%	S%	P%	Ni%	Cu%
Required Values							
Wire	0.096	0.980	0.230	0.005	0.015		—
Weld Metal	0.12	1.6	0.80	0.030	0.030	2.0-2.90	0.40
Obtained Values							
Wire	0.096	0.980	0.230	0.005	0.015		—
Weld Metal	0.087	1.420	0.390	0.015	0.023		0.048
Acceptable	Yes/ No	Yes/ No	Yes/ No	Yes/ No	Yes/ No	Yes/ No	Yes/ No

Note- Single values in the above table are max values

iii). Mechanical Properties (Table 5 of IRS M-39)

Table 12: Mechanical Properties of Multirun Weld

Property Test	Specification / Unit	Required	Result	Acceptable
Ultimate Tensile Strength	N/mm ²	540	546	Yes/No
Yield Strength (0.2% Offset)	N/mm ²	390	454	Yes/No
Elongation on 5xd G.L.	%	24	26.9	Yes/No
% Reduction in Area	%	45		Yes/No
Charpy's V-Notch Impact	Joules at -20 °C	25	58, 64, 50, 54, 60	Yes/No
Radiography	—		Acceptable	Yes/No

7.2.2.4 Retest

Where any test specimen fails to satisfy the requirement of a particular test, twice no. of test specimens for that test shall be prepared using filler wire and/or flux from the same batch wherever possible and subjected to the test in which failure occurred. The wire or the flux shall not be accepted as having passed that test unless all the test results on the additional specimens are satisfactory.

7.2.2.5 Shelf Life

Wire: - The shelf life of wire shall be minimum 9 months from the date of receipt in Stores or 12 months from the date of manufacture, whichever is more.

Flux: The shelf life of flux shall be minimum 12 months from the date of receipt in Stores or 18 months from the date of manufacture, whichever is more.

7.2.2.6 Storage

The spools of wire/container of flux shall be stored in some dry area to minimize ingress of moisture. The roof, floor and walls shall be made of damp proof concrete/brick. The storeroom shall not be used as storage place for grease, oil or other chemicals, which may affect the performance of wire or flux adversely. Preferably a separate room shall be allotted. The storing system shall be First In First Out (FIFO) to prevent undue storage.

The Field engineer should ensure that the used consumable are within the shelf life guidelines given in Para 3.2.2.5 above and are properly stored as per para 3.2.2.6 above. Random inspection to this effect must be carried out with a clear remark about the fulfilments of conditions mentioned above in his report.

7.2.3 GMAW

7.2.3.1 General Information (para 5.1.2 of IRS M-46)

Table 13: General details of Wire

Particulars	Details
Brand Name	MIG WS-6
Wire Size/Dia (mm)	1.20 mm
IRS Class with IS and/or AWS Code	IRS M-46 Class-I
Batch No.	T-112
Date of Manufacture.	11-02-2026
Date of Expiry	
Test Report No.	123456
Date of Issue	
Issued to	M/S xyz
Test Conducted as per	IRS M 46 : CLASS-I

7.2.3.2 Chemical Composition of Wire (%) (Table 5 of IRS M-46)

Table 14: Chemical composition

Element	C	Mn	Si	S	P	Cu
Required Values	.07-0.15	1.0-1.5	0.65-0.85	0.025	0.025	0.2-0.4
Obtained Value (%)	0.083	1.442	0.831	0.019	0.019	0.279*
Acceptable	Yes /No	Yes /No	Yes /No	Y /N	Yes /No	Yes /No

Note- Single values are maximum except otherwise stated.

The Cu% includes copper coating also.

7.2.3.3 Mechanical Properties (Table 4 of IRS M-46)

Table 15: Mechanical Properties of wire

Property Test	Unit / Condition	Required	Result	Acceptable
Yield Strength (Y.S. 0.2% Offset)	N/mm ²	350	476.26	Yes/No
Ultimate Tensile Strength (U.T.S.)	N/mm ²	510	580.46	Yes/No
% Elongation on 5xd G.L.	%	26	27.31	Yes/No
% Reduction of Area	%	50	62.46	Yes/No
Impact Energy	Joules (at - 20°C)	47	62, 66, 72, 64, 70	Yes/No

Tolerances in limiting values as given in respective IS/AWS are not applicable.

7.2.3.4 Weld Metal Test (Table 6 of IRS M-46)

Table 16: Chemical Composition with shield Gas

Element	C	Mn	Si	S	P	Cu	Mo	Ni	Cr	V
Required Values	0.15	1.6	0.90	0.03	0.04	0.2-0.4	0.30	0.50	0.20	0.08
Obtained Value (%)	0.087	1.442	0.831	0.019	0.019	0.279	0.013	0.019	0.023	0.007
Acceptable	Yes /No	Yes /No	Yes /No	Y /N	Yes /No	Yes /No	Yes /No	Yes /No	Yes /No	Yes /No

7.2.3.5 Additional Operational & Performance Tests

Table 17: Additional tests applicable as per class of wire

Test / Parameter		Required Value	Result / Value	Acceptable
Diffusible Hydrogen			2.76 ml / per 100 gms of weld metal	Yes/No
Moisture Content (%)			—	Yes/No
Fillet Weld Test			—	Yes/No
Copper Coating			0.27	Yes/No
Bend Test			—	Yes/No
Cast			612-910 mm	Yes/No
Helix		0 - 4 mm		
Code	Test Parameter	Observation / Result		
A	Ease of Arc Striking	Wire produce arc easily		
B	Arc stability	The wire having stable arc & not break during arcing.		
C	Spatter Quality and Quantity	The spatter found less & soft		
D	Ripple of weld bead	The weld bead is smooth & evenly rippled		
E	Convexity / concavity of weld bead	Weld bead is flat to convex		
F	Tendency to undercut	No undercut found		
G	Crack, porosity etc	Wire is Free from crack , porosity & any other defects		
H	Smoke quality & quantity	The smoke is normal & visible arc		
A1.3	Positional welding	Wire operated in all welding positions, and appearance & quality of weld found satisfactory		
A1.4	Adversity	No any adversity found		

8 Check Point One

Further welding activities shall only be carried out after completing the activities outlined in paragraphs 5 to 7 above and obtaining a signed checkpoint clearance certificate from the executing or inspecting agency official, as per the QAP. The clearance certificate for material testing and acceptance as given in table below shall be issued by minimum Junior

scale officer or equivalent and above of the project executing agency. Details shall be entered in Table-18 below and the certificate shall be signed by the authorised person before the actual welding work is taken up.

Table 18: CP-01 Pre-Welding Activity and Consumable Testing

PROJECT NAME: _____			REF DRAWING NO: _____		
FABRICATOR NAME: _____			DATE OF INSPECTION: _____		
Compliance Checklist					
SN	Activity / Parameter	Acceptance Check	Record / Document	Objective	Status (Pass/Fail)
1	WPSS Review & Approval	Verification of signatures on all sheets by fabricator, contractor, Railway JAG, and Inspecting Agency.	Approved WPSS / Para 5.2	To establish valid welding parameters	
2	Equipment Calibration	Verification of machine performance, electrical parameters, and valid calibration certificates.	Table 2 / Para 5.2	To ensure machines operate within the precise voltage and current ranges required.	
3	Welder Qualification & Tracking	Verification of active WPQR documents and verify valid performance renewals practices are in place.	Table 3 & 4 / Para 6.2 & 6.3	To ensure only competent, approved welders execute the welding work.	
4	Consumable Testing	Correlation of manufacturer certificates with NABL test reports against IRS chemical/mechanical standards.	Tables 5 to 17 / Para 7.1	To ensure use of approved welding consumables in welding.	
5	Storage & Baking Compliance	Verification of separate damp-proof storage rooms, FIFO logistics, and oven baking	Stores Log / Para 7.1.2.5 & 7.1.2.6	To strictly eliminate hydrogen/moisture ingress that causes process defects.	
Certificate of Compliance for Stage-I					
It is hereby certified that all pre-welding and consumable testing activities at the site have been inspected sequentially as per the sequence depicted above, and all checklists/tables are endorsed by the authorized personnel with their signatures, confirming compliance with the specified requirements. The workshop fabrication setup and materials are accepted for further structural girder welding activities under the Quality Assurance Plan (QAP). Name of the In-charge Executing Official: _____ Signature of the In-charge Executing Official with Date: _____ Name of the Inspecting Agency Official: _____ Signature of the Inspecting Agency Official with Date: _____					

9 Welding Procedure Data Register (WPDR)

In this register complete details of welding of welded girders shall be maintained in the proforma as under:

Table 19: Welding Procedure Data Register

Date of welding		Weld joint description		WPSS No. followed	Welding consumable used
-----------------	--	------------------------	--	-------------------	-------------------------

	Girder component and its Sl.No.		Name of welder /Ticket No.		Electrode / wire	Flux
1	2	3	4	5	6	7
Welding parameters			Weld repair details	Run on/ Run off tabs. No. if any	Radiograph no. if any	Initial of Supervisor Incharge.
Current (amp.)	Arc Voltage (volt)	Travel Speed (m/min)				
8	9	10	11	12	13	

The welding data record to be submitted to Inspecting Agency while offering the welded girders for inspection, shall be prepared based on the details recorded in this register.

10 Distortion Control Measures

10.1 General Requirements

- The welding sequence and pass progression shall be explicitly documented in the WPSS to mitigate structural distortion.
- All operations shall strictly comply with Paragraph 27 of IRS B1 and Paragraphs 21 and 22 of the IRS Welded Bridge Code.
- Approved fabrication methodologies or distortion control measures that are specified in Paragraph 1214(6) of the Indian Railways Construction Manual-2023 shall be implemented during component assembly to minimize thermal distortion.

10.2 Thermal Management

- The specified minimum preheating temperature and maximum interpass temperature shall be maintained throughout the welding operations to ensure structural integrity.
- Thermal chucks or approved pyrometric devices shall be utilized to continuously monitor and control work temperatures during heating.

10.3 Documentation and Quality Assurance

- All applied distortion control measures shall be systematically logged in Table 20.
- The contractor shall demonstrate the efficacy of these distortion control measures as per instruction by the Engineer-in-Charge.
- The undue mechanical restraining of members for distortion control is strictly prohibited.
- Thermal straightening or rectification heating shall not be executed without prior written approval from the Engineer-in-Charge.

Table 20: Distortion control measures

SN	Checklist Item / Control Measure	Status (Y/N/NA)	Remarks / Sign-off
1	Is the welding sequence and pass progression explicitly detailed in the WPSS?		
2	Is any of the following distortion minimization method(s) implemented? IRCM-2023, Para 1214(6)		
(i)	Method of balanced (double-sided) joint welding		
(ii)	Suitable welding process selected to reduce heat input		
(iii)	Reduced number of weld passes utilized		
(iv)	Pre-set of the parts to be welded at a suitable distance by clamping		
(v)	Controlled heating applied opposite to the welding zone		
(vi)	Preheating of the weld location via LPG flame thrower gun		
(vii)	Back-to-back tack welding of components for 'C-built up' and 'L-built up' sections		

(viii)	Drooping plate used to control flange bending		
3	Any Other Method used*		
4	Are clamping and jiggling setups checked to ensure there is no undue restraining of members?		
5	Has the minimum preheating temperature been achieved before initiating welding?		
6	Is the maximum interpass temperature being actively monitored and maintained?		
7	Are thermal chinks or calibrated pyrometric devices available at the active workstation?		
8	Has any required rectification heating received prior written approval from the Engineer-in-Charge?		
9	Was the joint, subjected to any external forces or shocks during the entire welding & cooling cycle,		
*	Description:-		

11 Defects & Quality Control

Welding defects are mostly induced by incorrect joint preparation, excessive deviation from the approved parameter range, improper storage conditions for consumables, inadequate drying of flux, or improper fixtures and handling of the member. All of these factors result in defects that are either very difficult to rectify during initial fabrication or may result in the premature failure of the member during its service life.

Additionally, run-on and run-off pieces play an important role in ensuring a defect-free weld during fabrication, serving as representative test pieces for weld quality tests at a later stage. Therefore, the provision of run-on and run-off pieces of sufficient length is crucial for girder fabrication. All defect control measures shall be ensured before the commencement of actual welding, and a record shall be maintained in Table 21 below for the reference of inspecting officials.

Table 21: Defect control Measures.

SN	Checklist Item / Prevention Parameter	Status (Y/N/NA)	Remarks / Sign
1	Are the following checked using master gauges?		
(i)	Root gap		
(ii)	Groove angle		
(iii)	Edge alignment		
2	Is the joint zone free of rust, scale, moisture, paint, and slag before strike-off?(75mm on either side of joint on web & flange)		
3	Are electrodes and filler wires stored in heating ovens as per parameters?		
4	Has the Submerged Arc Welding (SAW) flux undergone the mandatory baking cycle?		
5	Are the welding machine digital parameter meters calibrated within validation dates?		
6	Are current ($\pm 10\%$), voltage ($\pm 7\%$), and speed ($\pm 15\%$) locked inside WPSS limits?		
7	Are extension pieces fabricated using identical steel grades and joint geometry?		
8	Are the extensions long enough to guarantee start/stop craters fall entirely outside the girder?(40-200mm)		
9	Are extension pieces marked and preserved as future representative test pieces?		
10	Any other observation		

12 Check Point Two

The welding activities detailed from Paragraph 9 to 11 reflect the standard quality control practices implemented at the fabrication workshop, demonstrating the fabricator's capability to deliver structurally sound, high-quality welds. Prior to the commencement of actual

fabrication, these steps shall be verified by the Inspecting Agency or the Project Executing Agency, as mutually agreed upon. Upon satisfactory verification, a certificate confirming the sufficiency and effectiveness of the employed measures shall be issued by the respective agency. Furthermore, the contractor shall execute a written undertaking committing to strict adherence to the standard processes certified by the Inspecting or Executing Agency.

Table 22: Stage-II Compliance Certificate & Undertaking

<u>Certificate of Compliance for Stage-II</u>
This certifies that all site welding activities have been inspected, and both distortion/defect control measures and WPDR logging are satisfactory. All relevant checklists, tables, and registers have been signed by authorized personnel to confirm compliance. The workshop welding processes and control measures detailed above are approved for ongoing operations, provided quality standards are maintained and fabricators submit a written undertaking to adhere to these approved processes.
Name of the In-charge Executing Official: _____
Signature of the In-charge Executing Official with Date: _____
Name of the Inspecting Agency Official: _____
Signature of the Inspecting Agency Official with Date: _____

<u>Undertaking</u>
We, M/s _____, hereby undertake to strictly adhere to the standard welding processes, sequences, and parameters as certified by the Inspecting/Executing Agency in the certificate of compliance for stage-II dated ___/___/20__.
We guarantee that all workshop quality control, distortion management, and defect prevention measures will be rigidly maintained to ensure structurally sound, high-quality welds. No deviations from these certified procedures shall be permitted without prior written approval, and we accept full contractual liability for any non-compliance, which may result in the immediate rejection of the affected structural components.
Authorized Signatory: _____
Date: _____
Seal: _____

13 Testing of Welds

13.1 Post Weld Inspection

The welding carried out using the precautions and parameters mentioned in the paras above shall produce good quality weld and to confirm the same the various visual and Non-destructive test are carried out on actual members and other destructive tests shall be done on the test specimen prepared from the Run-on & run-off pieces. The records of inspection & testing shall be documented in a format as given in Table 23 below for future reference and quality records.

Table 23: Post Weld Inspection

SN	Checklist Item / Inspection Parameter	Status (Y/N/NA)	Remarks / Sign
----	---------------------------------------	-----------------	----------------

1	Has the weld surface been thoroughly cleaned of oxide layers and adherent slag?		
2	If chipping hammers were used, are the surfaces free of deep marks that could hide fine cracks?		
3	Has the weld zone been finished with a stiff wire brush or grit blasting?		
4	After completion of weld, welding is stopped at Run-off piece.		
5	Do the finished weld sizes and contours conform to the approved drawings?		
6	Flux is removed by suction after allowing 10 to 15 minutes cooling.		
7	Does the weldment meet all dimensional accuracy and warpage tolerances?		
8	Run-on and run-off pieces are removed by abrasive cut or hacksaw blade to avoid thermal stress.		
9	Variation observed in shape of member after welding (if any)		
10	Are defective welds marked clearly and positively using methods understood by shop personnel?		
11	Is the defect marking permanent enough to remain visible until the repair is executed?		
12	Have repaired weld zones been re-inspected and re-marked as satisfactory?		

13.2 Visual Examination

All welds shall be visually examined to ensure that the welds meet the specifications. The results of visual inspection shall be recorded in the format as given in table 24 below.

Table 24 : Visual Examination of Welds

SN	Checklist Item / Inspection Parameter	Status (Y/N/NA)	Remarks / Sign
1	Surface defects visible at surface		
2	Cracks have opening at surface		
3	Damage to parent metal		
4	Profile defects		
5	Incorrect Finish		
6	Spatter		
7	Under cut		
8	Stray arc		
9	Any Other Observation(s)		

13.3 Non-destructive testing

Liquid/Dye penetrant testing (LPT/DPT), magnetic particle testing (MPT), radiographic testing (RT), ultrasonic testing (UT), and eddy current testing (ECT) are the most frequently used non-destructive testing (NDT) methods in steel fabrication. Among these, DPT is the most popular due to its simplicity and effectiveness. The entire length of welds produced by submerged arc welding (SAW) must be tested using the DPT method. Any requirements for radiographic or ultrasonic testing must be clearly specified in the contract beforehand.

13.4 Marking of Defective Welds

- The marking shall be positive and clear and in accordance with the method of marking followed and understood by the Inspector and shop personnel involved in making the repairs.
- Marking shall be permanent enough to be evident until the repair is carried out and the inspection completed.
- After the repair has been done, it shall be inspected again and properly marked to indicate whether the repair is satisfactory or not.

The observations/results of the DPT and rectification shall be recorded in the DPT register format as given in Table 25 below.

Table 25: DPT Register

Date	Component description	Weld line No.	Porosity	Undercut	Crack	Grinding	Rectification date	Sign. of internal QC	Sign of Project executing agency
1	2	3	4	5	6	7	8	9	10

13.5 Macro Etching Register

This weld inspection is carried out on the run on/off pieces for determining throat thickness and root penetration, format given in Table 26 below may be used.

Table 26: Macro Etching Register

Date	Component description	Weld line No.	Vertical leg length	Horizontal leg length	Throat Thickness	Penetration	Sign. of internal QC	Sign. of Project executive agency
1	2	3	4	5	6	7	8	9

13.6 Destructive testing (DT)

The destructive tests shall be done on test pieces prepared from run-on/run-off piece of a welds as prescribed in QAP and recorded in destructive weld testing register as per Table 27. Balance run-off/ run-on pieces are to be preserved till girder is passed.

Table 27: Destructive weld testing register

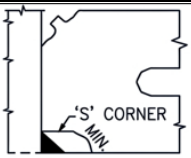
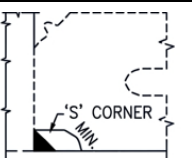
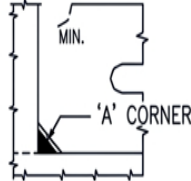
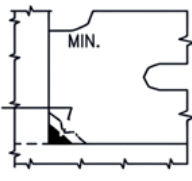
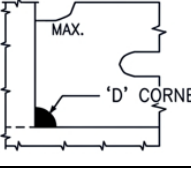
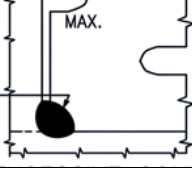
Date	Component description	Weld line No.	Tensile test	Bend test	Impact test	Sign. of internal QC	Sign. of Project executive agency
1	2	3	4	5	6	7	8

14 Acceptance Levels for Welds

All the welds shall meet the acceptance level for the defects permitted and shall be free from the defects not permitted in IRS Welded Bridge Code for the welding done and tested. The details on inspection shall be recorded in Table 28 below for the record.

Table 28: Acceptance level for welds as per IRS-WBC Para 30 & 31

SN	Defect Type / Check Parameter	Acceptable Limits / Criteria	Status (Pass/Fail/NA)	Measured Value / Remarks
	Planar Defects			
1	Cracks & Lamellar Tears	Not Permitted		
2	Lack of Root Fusion	Not Permitted		
3	Lack of Side Fusion	Not Permitted		
4	Lack of Inter-run Fusion	Not Permitted		
5	Lack of Root Penetration	Not Permitted		
6	Root Concavity	0.1t or 1.2mm whichever is less		
	Cavities			
7	Isolated Pores (Individual or in a group)	$\varnothing \leq t/4$ and also less than (i) 1.5 mm for $t \leq 25$ mm; or		

		(ii) 3.0 mm for $25 < t \leq 50$ mm; or		
		(iii) 4.5 mm for $50 < t \leq 75$ mm; or		
		(iv) 6.0 mm for $t > 75$ mm		
8	Uniformly distributed or localized porosity	one percent by area (as seen in radiograph) for $t \leq 25$ mm and pro-rata for greater thickness		
9	Linear Porosity (Parallel to weld axis)	Not Permitted (as, if parallel to the axis of the weld may indicate lack of fusion or lack of penetration)		
10	Worm Holes (Isolated)	Length $l \leq 6$ mm Width $w \leq 1.5$ mm		
11	Worm Holes (Aligned)	Not Permitted (treated as linear porosity)		
12	Crater Pipes	Length $l \leq 6$ mm Width $w \leq 1.5$ mm		
	Solid Inclusions (Slag & Metallic)			
13	Slag Inclusions (Individual & parallel to axis)	Within dimensional limits specified based on plate thickness (t)		
	t	l	w	
(i)	≤ 18 mm	$\leq t/2$ & ≤ 6 mm	≤ 1.5 mm	
(ii)	> 18 mm and ≤ 75 mm	$\leq t/3$	≤ 1.5 mm	
(iii)	> 75 mm	≤ 25 mm	≤ 1.5 mm	
14	Slag Inclusions (Linear group)	Aggregate length should not exceed 8% of group length (group length should not exceed $12t$)		
15	Individual and Randomly oriented (Not parallel to weld axis)	Maximum dimension in any direction 6 mm		
16	Copper Inclusions	Not Permitted		
	Profile Defects			
17	Undercut	Slight/intermittent allowed; no sharp notch; depth should not exceed 0.4 mm		
18	Shrinkage Grooves & Root Concavity	Same as undercut: depth should not exceed 1.2 mm		
19	Excess Penetration	Height ≤ 3 mm (occasional local slight excess allowed)		
20	Reinforcement Shape	shall bend smoothly with the parent metal and dressing shall be as specified in drawing or required for NDT		
21	Overlap	Not Permitted		
22	Linear Misalignment	$h \leq t/10$ and ≤ 3 mm		
	As per Clause 30.2 of IRS WBC			
		Correct	Incorrect	
23	Profile defect- Leg Size			
24	Profile defect-Throat Size			
25	Profile defect- Convexity			
Note: t represents the thickness of the parent metal (thinner component if thicknesses are dissimilar).				

*** End of the Document ***

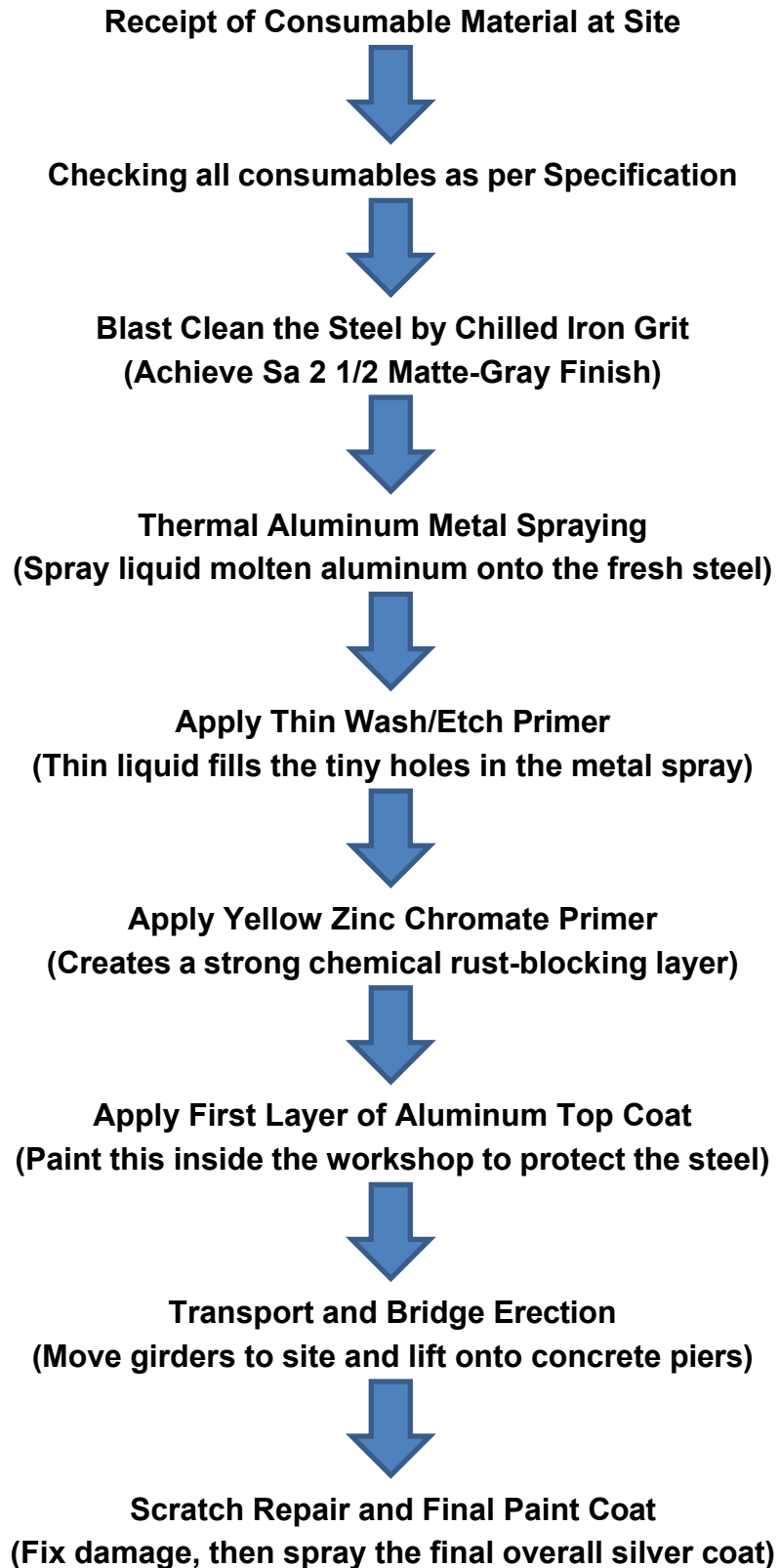
(3)
METHOD STATEMENT
FOR
PAINTING & PROTECTIVE COATING



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Flow Chart



1. Preamble

1.1 Scope

This document defines the mandatory procedures for the surface preparation, metallizing, and painting of new steel bridge girders. Work must strictly comply with approved construction drawings, applicable Railway/IRC specifications, the approved painting schedule, and explicit instructions from the Engineer-in-Charge.

2. Pre-Requisites & Site Preparation

- **Certificates:** Verify paint material receipts, manufacturer batch test certificates, and NABL/NABCB lab test reports before commencing work.
- **Calibration:** Calibrate electronic coating thickness gauges, dial-type magnetic Elcometers, and replica tapes.
- **Workforce PPE:** Ensure all blasters, painters, and workmen wear the correct Personal Protective Equipment (PPE).
- **Equipment Capacity:** Confirm the air compressor capacity is at least 300 CFM with a pressure range above 5 kg/cm².
- **Structural Inspection:** Inspect fabricated steel components for physical defects like dents, weld spatters, cracks, or undercuts.
- **Defect Rectification:** Grind down weld profile defects in the direction of the weld and round free edges to a minimum radius of 2.0 mm.

3. Storage, Handling, and Issue of Consumables

3.1 Material Receipt & Verification

- **Approved Procurement:** Procure all paints, thinners, and blasting media exclusively from client-approved manufacturers.
- **Container Labeling:** Verify every incoming container has a secure outer label detailing the manufacturer's name, material description, color, item number, batch number, production date, and expiration date.
- **Batch Verification:** Cross-check incoming manufacturer batch certificates against the physical containers to confirm acceptable laboratory test results.
- **Wire Inspection:** Inspect incoming aluminium metallizing wire to verify a minimum chemical composition of 99.5% pure aluminium conforming to IS: 2590 / BS 1475 (Material 1-B).

- **Abrasive Logging:** Record visual and dimensional inspection details of all incoming blasting abrasives in the designated Material Inspection Register.

3.2 Controlled Storage Environment

- **Designated Segregation:** Store all paint containers and thinners in an enclosed, separately designated area away from miscellaneous construction materials.
- **Climate Control:** Monitor the storage environment to ensure surrounding temperatures and relative humidity levels do not exceed the manufacturer's specified thresholds.
- **Stock Arrangement:** Segregate all paint stocks cleanly by their specific material type code and color. Install clear, legible display boards in front of earmarked rows.
- **Pallet Stacking:** Stack paint cans and drums systematically on wooden or plastic pallets arranged neatly in defined rows and columns.
- **Airtight Seals:** Prevent any potential leakage hazards by keeping all container seals completely airtight during storage.

3.3 Handling & Maintenance

- **Damage Prevention:** Handle all consumable containers carefully during unloading and positioning to prevent puncture, denting, or structural damage to the seals. Prohibit the use of sharp hooks or rough machinery.
- **Contamination Control:** Avoid handling loose abrasives or open paint containers in areas exposed to dirt, moisture, or airborne dust.
- **Brush Conditioning:** Soak new application brushes (at least 5 cm wide with flexible bristles) in raw linseed oil for at least 24 hours prior to their first operational use. Clean application brushes thoroughly in linseed oil at the conclusion of every single working day.

3.4 Controlled Material Issuance

- **Stock Indent:** Require the application supervisor to submit a formal, written stock indent to the stores prior to getting paints or thinners.
- **Multi-Component Release:** Release two-component paint systems (Base and Hardener / Components A and B) simultaneously in the exact mixing ratio recommended by the manufacturer.

- **Enforced Shelf-Life Limits (From Date of Manufacture):**
- Ready-Mixed Zinc Chrome Primer (IS: 104) / Red Oxide Zinc Chrome (IS: 2074 / IRS-P-31): **1 Year**
- Aluminium Paint (IS: 2339) - Unmixed Paste and Oil: **1 Year**
- Aluminium Paint (IS: 2339) - Pre-Mixed Paste and Oil: **4 Months**
- Boiled Linseed Oil: **2 Years**

4. Surface Preparation (Blast Cleaning)

- **Environmental Limits:** Measure the environmental relative humidity at the working location; it must not exceed 80% during blast cleaning.
- **Initial Cleaning:** Remove all traces of oil, grease, or bituminous contaminants by scrubbing the affected areas with a petroleum hydrocarbon solvent conforming to IS: 1745, or water and acetone, using a stiff-bristled brush.
- **Final Blasting location:** Execute grit or sand blasting inside covered sheds after obtaining final structural clearance for the girder.
- **Abrasive Specifications:** Use chilled iron grit (G.24 as per BS: 2451/ conforming to IS: 4683) or clean, washed, salt-free angular silica sand (mesh size 12 to 30, with a minimum of 40% retained on a 20-mesh screen). Do not reuse heavily contaminated abrasives.
- **Blasting Parameters:** Maintain an air pressure of not less than 2.109 kg/cm². Hold the nozzle at right angles to the steel surface at a distance of approximately 22.5 cm. The nozzle diameter must not exceed 12 mm.
- **Surface Finish & Profile:** Blast the surface to achieve a near-white metallic finish (Sa 2½ profile conforming to IS: 9954 / IS: 5905). Verify that the resulting surface roughness is uniform and falls between 50 µm and 80 µm using a comparator chart and replica tape. Ensure peaks do not pierce the ultimate dry film thickness.
- **Dust Removal:** Clean away all fine dust, residual abrasives, and contaminants from the prepared surface using a dry compressed air jet.
- **Temporary Protection:** Apply a temporary uniform coating of boiled linseed oil if painting cannot follow blasting immediately, ensuring a coverage rate of 1/3 litre per 10 m².

5. Aluminium Metallizing Process

- **Time Windows:** Initiate the sprayed metallic coating process as soon as possible, strictly within 4 hours of completing surface blasting. Complete the full specified metallizing thickness layer within 8 hours of the initial blasting operation.
- **Application Method:** Use the electric wire spray method, feeding an aluminium wire with a diameter of 3 mm or 5 mm.
- **Operating Air Pressure:** Supply clean, dry compressed air to the thermal spray gun at a stable pressure of not less than 4.218 kg/cm².
- **Coating Thickness:** Apply the aluminium coating in no fewer than two distinct sequence layers. Ensure a minimum thickness of 115 microns at any given single spot and a structural average thickness of 150 microns.
- **Workmanship Quality:** The final metallised finish must be uniform and completely free from uncoated patches, blistering, scaling, or lumps of loosely spattered metal.
- **Testing Restriction:** Ban the use of testing hammers on the metallised surface to prevent chipping or fracturing the protective layer.

6. Protective Painting System Application

The component must be inspected and approved by the designated Inspecting Officer before painting begins.

- **Step 1: First Coat (Etch Primer):** Apply one uniform coat of wash/etch primer conforming strictly to IS: 5666. Allow the primer coat to completely dry and harden before proceeding.
- **Step 2: Second Coat (Zinc Chromate Primer):** Apply one coat of ready-mixed zinc chromate priming paint conforming to IS: 104. Ensure the zinc chrome pigment used in manufacturing conforms strictly to Type 2 of IS:51. Allow the layer to hard-dry completely according to the manufacturer's specified drying time window.
- **Step 3: Third Coat (1st Finishing Coat - In Workshop):** Mix the entire contents of the paint drum thoroughly by mechanical agitation. Prohibit the addition of unauthorized thinners, driers, spirit, turpentine, or kerosene oil. Add a small, controlled quantity of blue paint to this first coat to visually differentiate it from the final topcoat. Apply this coat of aluminium paint (IS: 2339) via brush or spray in the fabrication workshop before the steelwork leaves the premises.

- **Step 4: Fourth Coat (2nd Finishing Coat - At Site after Erection):** Erect and launch the steel bridge girder at the construction site according to the approved engineering scheme. Conduct a meticulous inspection to locate any transit damage, wear, or abrasions. Touch up and repair all damaged primer patches and first-coat finishes using fresh matching materials. Apply the second and final finishing coat of aluminium paint (IS: 2339) across the entire structure. Ensure the completed paint layer is uniform and free from brush marks, sags, runs, or peeling. Never use rags or cotton waste to apply paint.

7. Technical Constraints & Quality Assurance

7.1 Environmental Restrictions

- Conduct painting under dry, warm ambient conditions where the relative humidity does not exceed 90%.
- Do not paint at night, during early morning hours (due to dew condensation), during the rainy season, or during dust storms, mist, and fog.
- Confirm specific environmental factors such as severity zones (coastal vs. arid) and required DFT target ranges with the project's executive agency before finalization.

7.2 Structural Constraints

- **Composite Girder Restriction:** If executing a composite girder design, do not apply any zinc paint or metallised coating over the shear connector studs. Coated studs degrade the structural weld metallurgy and reduce concrete bonding strength. Aluminium metallizing can protect the surrounding steel plate flange only after stud welding and inspection are complete.

7.3 Application Rules

- Hold the brush at a 45° angle to the surface, applying light vertical and lateral strokes, followed by crosswise strokes to ensure an even film thickness free of brush marks, sags, or run-offs.

7.4 Maximum Allowed Time Lag Limits

From Activity	To Activity	Maximum Allowed Time Lag
Surface Preparation	Primer Application (Normal Painting)	24 Hours
Primer Application (Normal Painting)	First Finishing Coat (Patch Painting)	48 Hours
Primer Coat	1st Finishing Coat	7 Days
1st Finishing Coat	2nd Finishing Coat	7 Days

7.5 Quality Control & DFT Monitoring

- **DFT Gauging:** Check and record thickness parameters systematically across the structure using an electronic coating thickness gauge or a dial-type magnetic Elcometer (Elcometer). Take surface base readings right after blast cleaning and again after final painting to calculate the true net dry film thickness.
- **Measurement Frequency:** Take at least one independent reading per square metre of the treated area. Maintain a structured QA record sheet matching Table 12.29 of the Construction Manual to document Component Descriptions, Blasting Dates, Metallizing DFT, and individual primer/paint coat completions.
- **Adhesion Tests:** Execute mandatory paint adhesion tests in strict Compliance with IRS B1 Appendix-VII guidelines.

8. Safety & Compliance Notice

- **MSDS Consultation:** Consult the specific Material Safety Data Sheets (MSDS) provided by the coating manufacturer for detailed information on ventilation, fire prevention, and hazardous waste disposal.

(4)
METHOD STATEMENT
FOR
ERECTION OF STEEL OPEN WEB
BRIDGE GIRDERS
BY
CANTILEVER END LAUNCHING METHOD



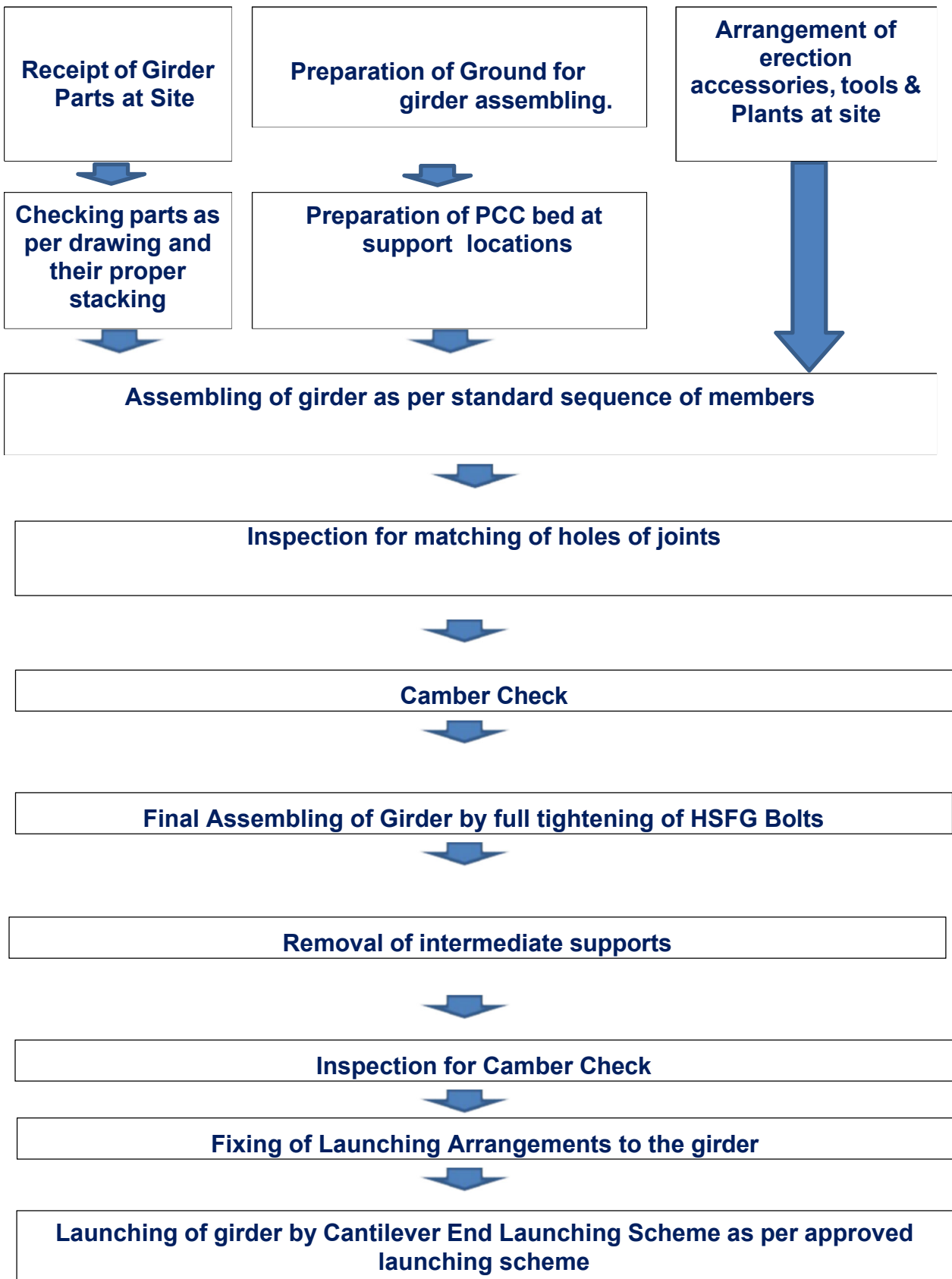
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Attachments:

- a) Annexure I Checklist
- b) RDSO's Drawing No. 17181R General Arrangement Drawing
- c) RDSO's Drawing No. 17181-2(1) Camber
- d) RDSO's Drawing No. 17181-3(3) Bearing
- e) RDSO's Drawing No. 17181-18 Erection_page-0001 (1)
- f) RDSO's Drawing No. 17181-19 Shipping List.

Flow Chart



1. Introduction

1.1 Scope

This Method Statement describes the procedure for assembling and launching of steel open web through type girder by cantilever end launching method. This involved receipt of girder material at work site their assembling on either end of bridge approach and launching on a bridge sub structure.

All activities to be carried out in accordance with the approved construction drawings, applicable Railway/IRC specifications, relevant standards, and the instructions of the Engineer-in-Charge.

1.2 Brief Description:

a) Back Ground:

For this method statement we considering site condition as below:

- (i) A new line bridge site of 3 x 45.7m span
- (ii) Sub structure having approx. 20m pier height. With high banks and flowing water in a river bed.
- (iii) Formation work, approaches & bridge sub-structure is ready.

New construction of Open web through type steel girders, when staging is not feasible on river bed due to high pier height or the river bed cannot support the temporary staging or the water is flowing with high current.

As per site condition Cantilever End Launching Method is found suitable and hence, adopted for this worksite.

b) Theory:

In this method, the girder is assembled on the approach bank and it is longitudinally pulled/pushed from the bridge approach towards bridge proper over the opening and lowered on a sub structure i.e. pier and abutment in proper position.

This method is based on the principle of equilibrium of propped cantilever i.e., overturning moment is maintained less than the restoration moment by suitable counter weight. In this method, minimum three girders are tied together. The front girder itself acts as a launching nose and two rear girders itself acts as counter weight. Therefore, Overturning Moment is occurred by One Girder and restoration moment occurred by two rear girders which is double than overturning moment.

Launching will be carried out by pushing this entire assembly from bridge approach with the help of push/pull arrangements of power/manual winch and rollers for movement of girders.

If number of spans are less than three. Then, for maintaining overturning moment less than the restoration moment. Separate arrangement of attachment of launching nose and attachment of counter weight is necessary.

1.3 Documents required to carry out erection

1.3.1 Applicable Codes and Standards

- i. Indian Railway Standards (IRS)-B1.
- ii. Report No. BS-111 (Revision 7).
- iii. Indian Railways Bridge Manual (IRBM).
- iv. Indian Railways Construction Manual (IRCM).

1.3.2 Applicable Drawings

- v. Approved General Arrangement (GAD) Drawings.
- vi. Approved Launching Scheme.
- vii. 45.7m 25t loading (welded through type) Girder Drawing No. RDSO/B-17181/R to 17181/19

1.3.3 Other Documents

- i. Method Statement.
- ii. Design details & Proof check for the launching scheme.
- iii. Standard Technical Requirements.

1.4 Documents generated during erection

- i. Camber Details.
- ii. HSFG Bolt Test Register.
- iii. Bridge Inspection Report.

These documents need to be handover to open line officials/Bridge maintaining officials.

2. Roles

<u>Railway Authority</u>	<u>Responsibility</u>
	1. Day-to-day supervision, execution monitoring and quality control at site. 2. Administrative and technical control, review of quality, progress and contractual compliance.

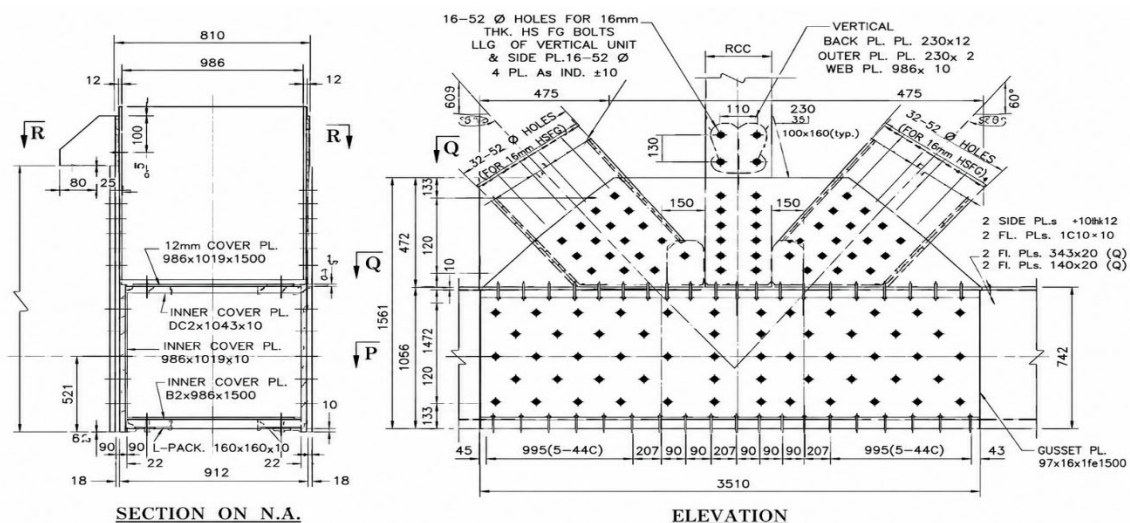
<u>Contractor's Authority</u>	<u>Responsibility</u>
	1. Planning, manpower, plant & machinery, materials and execution of the work. 2. Day-to-day execution and coordination of bearing installation activities. 3. Inspection, testing, documentation and maintenance of quality records. 4. Implementation of approved safety procedures and statutory requirements.

3. Receipt and Acceptance of Girder Parts at Site

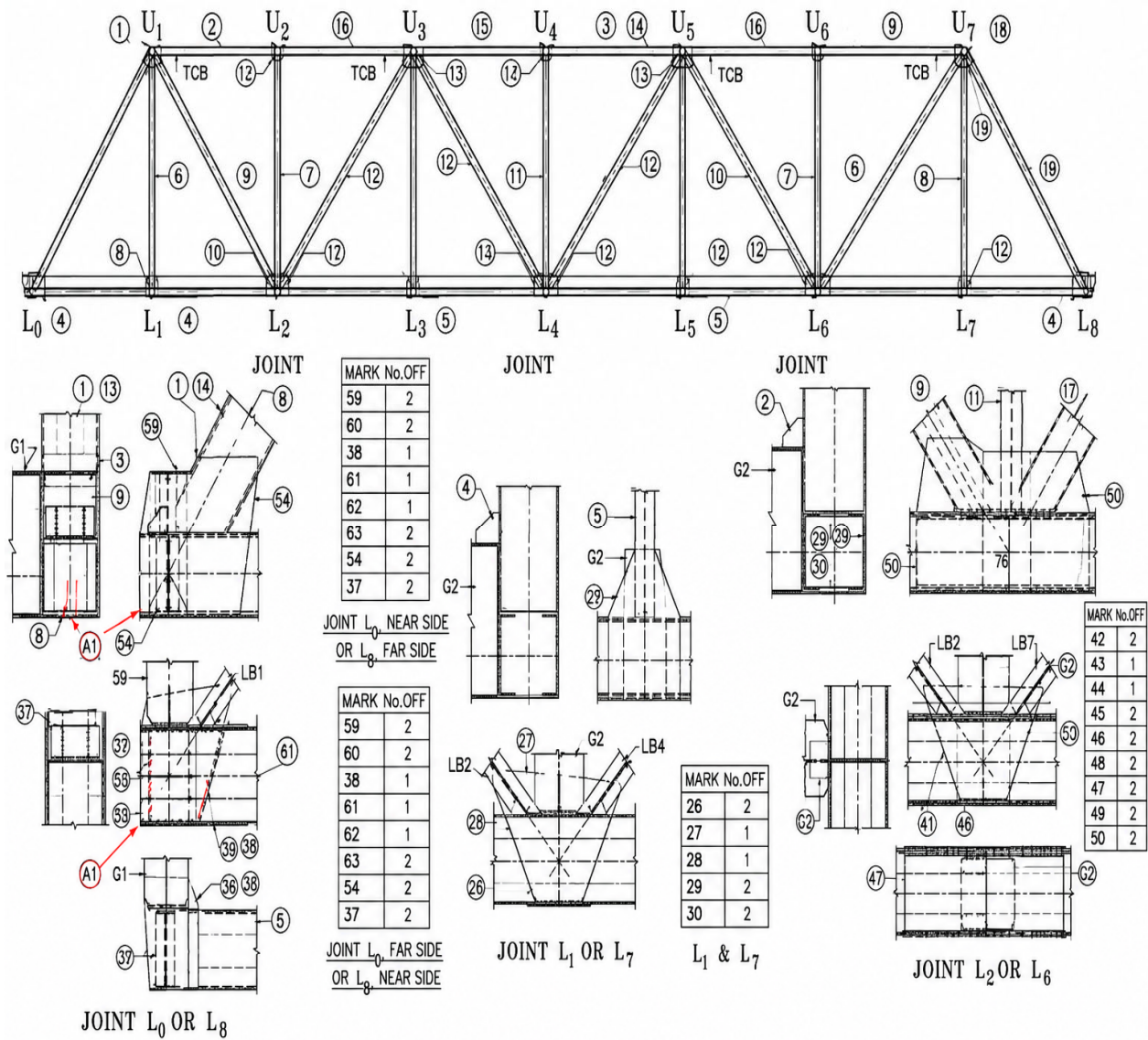
3.1 Girder Parts Details

- ☐ List of Girder parts will be available in **RDSO's Drawing No.**

RDSO/B-17181-19 "Shipping list"



Snapshot of RDSO's Drawing No. 17181-10(ALT-2) Bottom Chord Joints



Snapshot of RDSO's Drawing No. 17181-18 Erection

SHIPPING MARK	DESCRIPTION	No. REQD.
①	END RAKERS	2
①X	END RAKERS (O.H.)	2
②	TOP CHORDS (END)	2
②X	TOP CHORDS (END) (O.H.)	2
③	TOP CHORDS (MIDDLE)	2
④	BOTTOM CHORDS (END)	2
④X	BOTTOM CHORDS (END) (O.H.)	2
⑤	BOTTOM CHORDS (INTERMEDIATE)	4
⑥	VERTICALS	2
⑥X	VERTICALS (O.H.)	2
⑦	VERTICALS (INTERMEDIATE)	6
⑧	VERTICALS (INTERMEDIATE)	4
⑨	DIAGONALS (END)	4
⑩	DIAGONALS (INTERMEDIATE) L_2-U_3 & U_5-L_6	4
⑩A	DIAGONALS (INTERMEDIATE) U_3-L_4 & L_4-U_5	4

Snapshot of RDSO's Drawing No. 17181-19 Shipping List

- ☐ Prepare details of as per following table while receiving and accepting Girder Parts at worksite. Quantity of each and every girder parts is ensured and any surplus/shortfall reported to the fabricator immediately.

Table: 3.1

SN	Shipping Mark	Description of Item	Nos. per Span	Total Nos. of parts Required for Three Nos. of Spans	Nos. Received	Remark/ Shortage/ Surplus

3.2 Storage and Handling.

- ☐ All the girders parts including gussets shall be stored in a covered area, protected from moisture, dust, chemicals, and mechanical damage.
- ☐ While handling extra care should be taken for maintaining straightness of the members it should not be bend/damaged by hit, drop etc.
- ☐ Holes should not be oblong /damaged during handling.

4. Requirements of Tools, Plants, Accessories & Manpower for girder assembling & launching work

4.1 Requirement of Tools, Plants, Accessories:

Sr. No.	Tools, Plants & Launching Accessories
1	Mechanical Jacks (Camber Jacks) as per site requirement i.e. one jack per panel point of required capacity.
2	Crane for handling of Members of Girder
3	Rope
4	Sling
5	Chain Pulley Blocks
6	Rope Pulley & Winch
7	Rollers
8	Auto Level/Levelling Instrument
9	Drifts
10	Service Bolts
11	Wooden Planks
12	Wooden Blocks
13	HSFG Bolts for final assembly
14	Gas Cutting Set
15	MMAW Welding setup
16	1.5 kg Hammer for Drifting
17	Torque Wrench Etc.
18	Spanners
19	HSFG Bolts
20	Diesel
21	Raw Oil
22	Grease
23	Cotton Waste
24	First Aid Box
25	Wooden Blocks
26	Wooden Planks
27	M. S. Packing Plates

4.2 Requirement of Manpower:

Sr. No.	Type of Worker	Numbers
1	Skilled Worker For Jacking Operation, Chain Pulley Operation, Winch Arrangement, Insertion & Observation of Rollers while launching, HSFG Bolt Tightening etc.	15
2	Unskilled Worker/Helper	20
3	Additional Unskilled Worker in case of Manual Winch	20

5. Assembling Work

5.1 Preliminaries

The following arrangements made before actual girder assembling work is started:

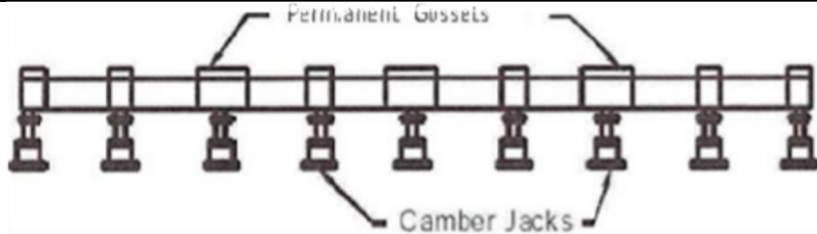
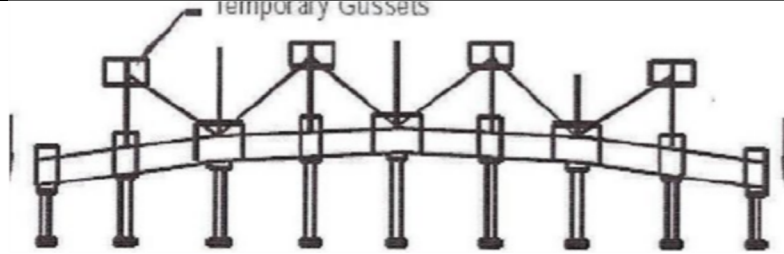
- Move the girder materials to the site by rail or road check of all inventory as per 3.1 above. Ensure no shortfall of girder parts be there, if any shortfall then it should be recouped by procurement/arrangement of new part/member. Otherwise Assembling work get delayed on this account
- Make arrangement of the plant and equipment necessary to carry out the work along with spares.
- Make yard arrangements on one approach of the bridge for assembling of girder
- Test all the equipment to be used in the erection work.
- Ensure communication arrangement at site.
- Make arrangement of Skilled and Unskilled Staff along with their supervisor

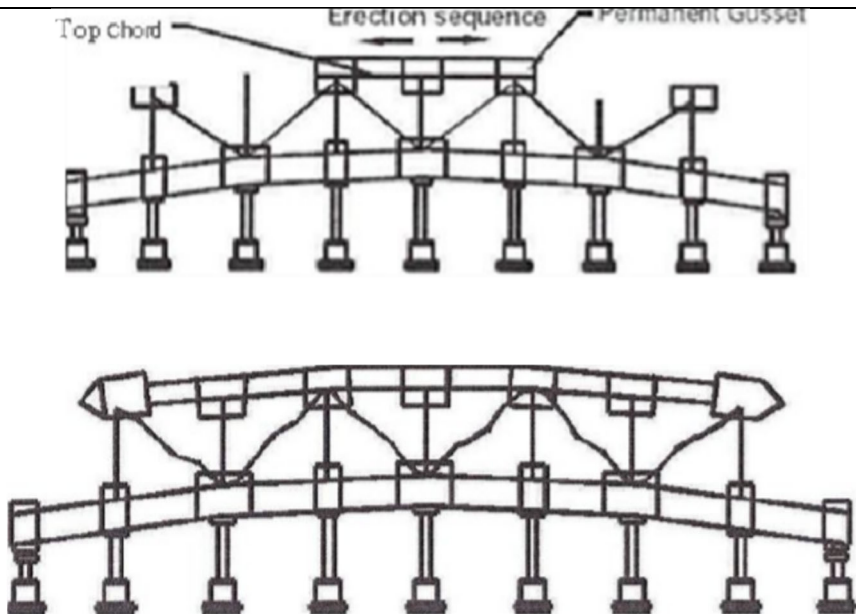
5.2 Sequence of activities

- A uniform unyielding levelled platform to be prepared.
- All the locations on ground under the Nodal points of girder should be in a proper line and level. Ensure that ground shall provide firm support to the girder.
- Check and ensure levels at all panel point locations with the help of levelling instrument.

- d. At all the panel points, wooden packing's are placed over which camber jacks are placed.
- e. Jacks are all run up almost upto full height and their tops are levelled.

f. Assembling sequence as per following stages:

Stages	Activity
Stage 1	Erection of Bottom Chord Members L0-L1, L1-L2, L2-L3, L3-L4, L4-L5, L5-L6, L6-L7, L7-L8
	Erection of Bottom Chord Members L0'-L1', L1'-L2', L2'-L3', L3'-L4', L4'-L5', L5'-L6', L6'-L7', L7'-L8'
Stage 2	Erection of Bottom Lateral Bracings
Stage 3	Erection of Bottom Cross Girder L0-L0', L1-L1', L2-L2', L3-L3', L4-L4', L5-L5', L6-L6', L7-L7', L8-L8'
Stage 4	Erection of Stringer Members L0-L1, L1-L2, L2-L3, L3-L4, L4-L5, L5-L6, L6-L7, L7-L8
Stage 5	Erection of Stringer Bracings
	
Stage 6	Erection of Vertical Members L1-U1, L2-U2, L3-U3, L4-U4, L5-U5, L6-U6, L7-U7
	Erection of Vertical Members L1'-U1', L2'-U2', L3'-U3', L4'-U4', L5'-U5', L6'-U6', L7'-U7'
Stage 7	Erection of Diagonal Members U1-L2, L2-U3, U3-L4, L4-U5, U5-L6, L6-U7
	Erection of Diagonal Members U1'-L2', L2'-U3', U3'-L4', L4'-U5', U5'-L6', L6'-U7'
	
Stage 8	Erection of Top Chord Members U1-U2, U2-U3, U3-U4, U4-U5, U5-U6, U6-U7
	Erection of Top Chord Members U1'-U2', U2'-U3', U3'-U4', U4'-U5', U5'-U6', U6'-U7'

	
Stage 9	Erection of End Raker L0-U1, L8-U7
	Erection of End Raker L0'-U1', L8'-U7'
Stage 10	Erection of Portal Girder & Portal Bracing U1-U1', U7-U7'
Stage 11	Erection of Sway Girder & Sway Bracing U2-U2', U3-U3', U4-U4', U5-U5', U6-U6'
Stage 12	Erection of Top Lateral Bracings

Note: While assembling the girder, the vertical & horizontal member is used to finalise the upper chord notes whereas diagonal members are used to verify.

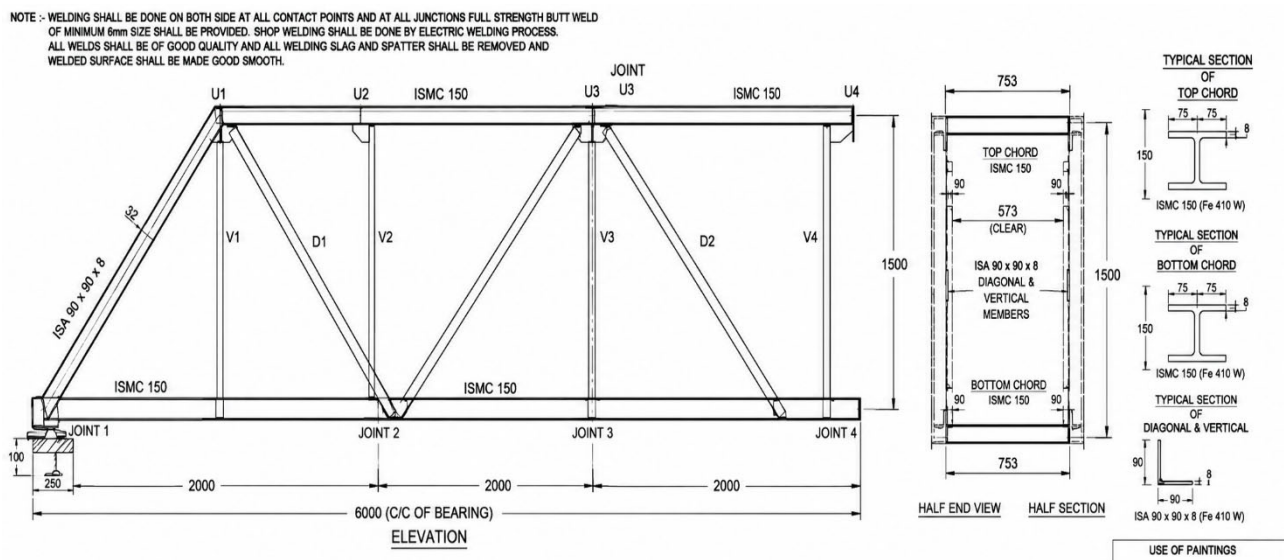
- g. While erection check the straightness, line & level of member with the help of piano wire.
- h. Joints shall normally be made by filling not less than 50% of the holes with service bolts and barrel drifts in the ratio of four to one. The service bolts are to be fully tightened up as soon as the joint is assembled.
- i. It is very important to frequently check that all bolts are tight and entire chord is in one level.
- j. The camber jacks are then lowered by necessary amounts as per **RDSO's Drawing No. RDSO/B-17181-2 "Camber Diagram"**, keeping the central jack in the original position, so that the resultant bottom profile of girder takes the shape conforming to the theoretical camber.
- k. Vertical members are erected and then the diagonals are erected using derricks or crane

- l. The top boom members are erected, starting from the center. Drifting will have to be done by using Hammer not exceeding 1 kg weight. Care should be exercised while lifting and slinging the members during erection so as to cause no permanent set in them.
- m. After all the joints are thus properly connected, service bolts should be replaced one by one with HSFG Bolts and then the drifts replaced by HSFG Bolts.
- n. After full tightening of all the HSFG Bolts jacks under the intermediate support shall be removed and the camber shall be checked and confirmed as per drawing.
- o. As per same sequence Second and Third girder should also be assembled

6. Launching Work by Cantilever End Launching Method

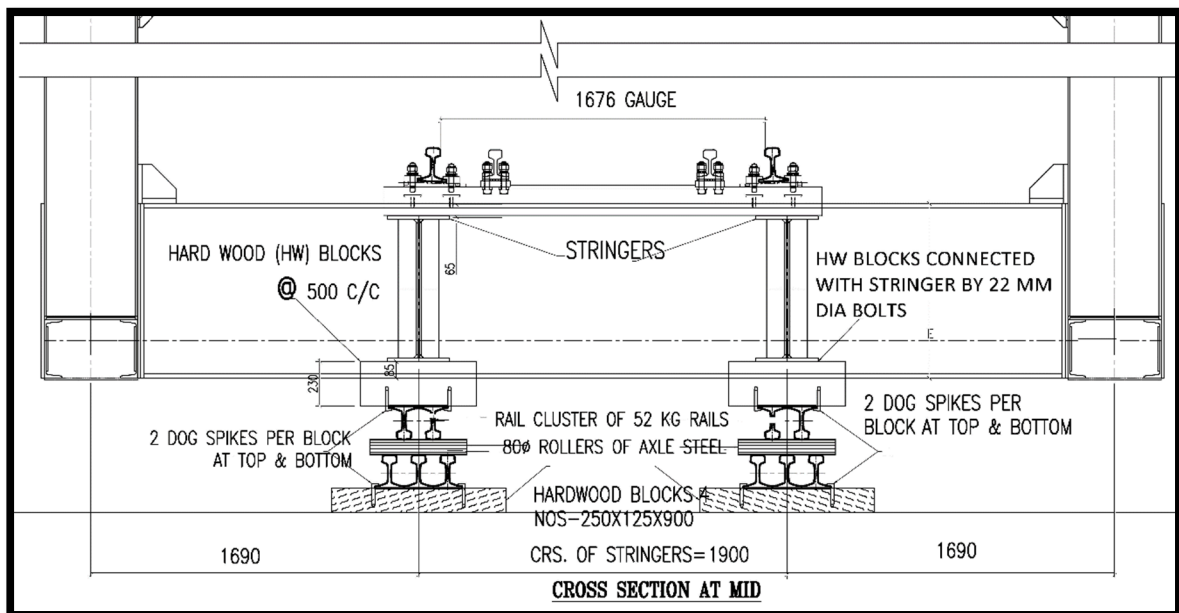
6.1 Sequence of Activities

- a. Permanent & temp members is a part of initial design & launching scheme. It should be designed & proof checked for the structural behavior and loading during Cantilever End Launching Activity.
- b. Positioned first three girders one after other on one end of Bridge approach with the help of sliding/rolling in a lateral and/or longitudinal direction.
- c. Tie First and Second girders together as per approved launching scheme by fixing of specially designed temporary members i.e. top chord, Vertical & Top Lateral Bracings between the First and Second girders. Similarly fixed Pinned connections (Act as an internal hinge) between second and third spans.





- d. Fix rolling arrangement for movement of girder in a longitudinal direction as per approved launching scheme. It consists fixing of inverted Rail Panel throughout the length of the girder. It carries a weight of girder span and rolls over the rollers as shown in drawing below:





- e. Fix pulling arrangement, it consists of well anchored Manual/Power Winch and Wire Rope Pulley



- f. Now, launching work to be started by pulling of set of three girders by power/manual winch from approach towards bridge proper
- g. Pulling activity continued till girder will reach up to pier. While pulling, extreme cantilever end of girder keep continuously under observation for to immediately notice any unusual sag.

6.2 Precautions (Ref: IRCM Para 1097 (3))

- a. Jack, Wire ropes/cables/winch machines etc. to be tested before starting the launching operations and keep record.
- b. Foundations of the trestles/winch machines, their fixing arrangements etc. should be well designed and approved.
- c. General arrangement and Structural drawings of trestles/ temporary arrangement should be made and approved by the competent authority.

- d. Skidding Arrangement to be designed suitably as per the case and its anchoring with the longitudinal beams, should be ensured in all respect.
- e. Secure the girder safely on rolling points
- f. Closely monitor the alignment of girder & deflection of extreme cantilever while launching in progress
- g. Check & ensure proper functioning of:
 - Pulling equipment like manual/ power winch.
 - Jacking arrangement for lifting & lowering operations.
- h. Ensure smooth, rust-free contact surfaces of fish plates, rollers & rails whichever applicable for free movement of girder.
- i. Maintain alignment of rollers during rolling operation to prevent deviation in girder movement.
- j. Ensure the girder moving path is clear of any obstacles.
- k. The rear end of girder shall be tied with a rope and gradually released as it moves in the desired direction to control unusual movement of the girder. The support to which rope is tied should be well anchored into the ground.
- l. While lowering girders to their final positions, Lowering should be done at a slow pace and in steps. To avoid any sudden jerk.

Annexure I

Check List:

Ref: IRCM Para 1097 (4) Table 10.31

Sr. No.	Checks	Yes/No/NA	Action Taken	Remarks
1	Approved launching scheme is in place.			
2	Necessary checks to ensure of proper functioning of rope, pulley, cables, jacks, winch machine, etc. are ensured.			
3	The fabrication and placement of all the temporary arrangements like trestles, stools, connection elements etc. is done as per approved structural drawing/scheme.			
4	Arrangement for securing the girder from uncontrolled movement is in place.			
5	All the sliding surfaces are smooth and free from rust.			
6	Arrangement to monitor roller alignment during launching is in place.			
7	Exact scheme for lowering of girder at slow pace and in steps is in place and a system to monitor the same is there.			

(5)
METHOD STATEMENT
FOR
LAUNCHING OF RAILWAYS STEEL BRIDGE
GIRDER
BY
USING SIDE-SLEWING METHOD



Table of contents

1.	Objective & Scope
2.	References & Codes
3.	Suitability Criteria
4.	Resources & Equipment Requirements
5.	Step-by-Step Erection & Slewing Procedure
6.	General Precautions & Safety Controls
7.	Quality Control & Work Completion Checklist

1. Objective & Scope

This method statement defines the safe procedure for launching a railway's steel bridge girder using the side-slewing method. It covers assembling, lateral shifting (slew-in & slew out), and final lowering onto bearings during a scheduled traffic block in case of Re-girding/Replacement of girder.

2. References & Codes

- Indian Railways Construction Manual (**IRCM**)
- Indian Railways Bridge Manual (**IRBM**)
- Fabrication and Erection Specifications (**IRS-B1**)
- IRS Steel Bridge Code (**SBC**)

3. Suitability Criteria

As mandated by Indian Railways regulations, the side slewing method is highly specific to the following site situations:

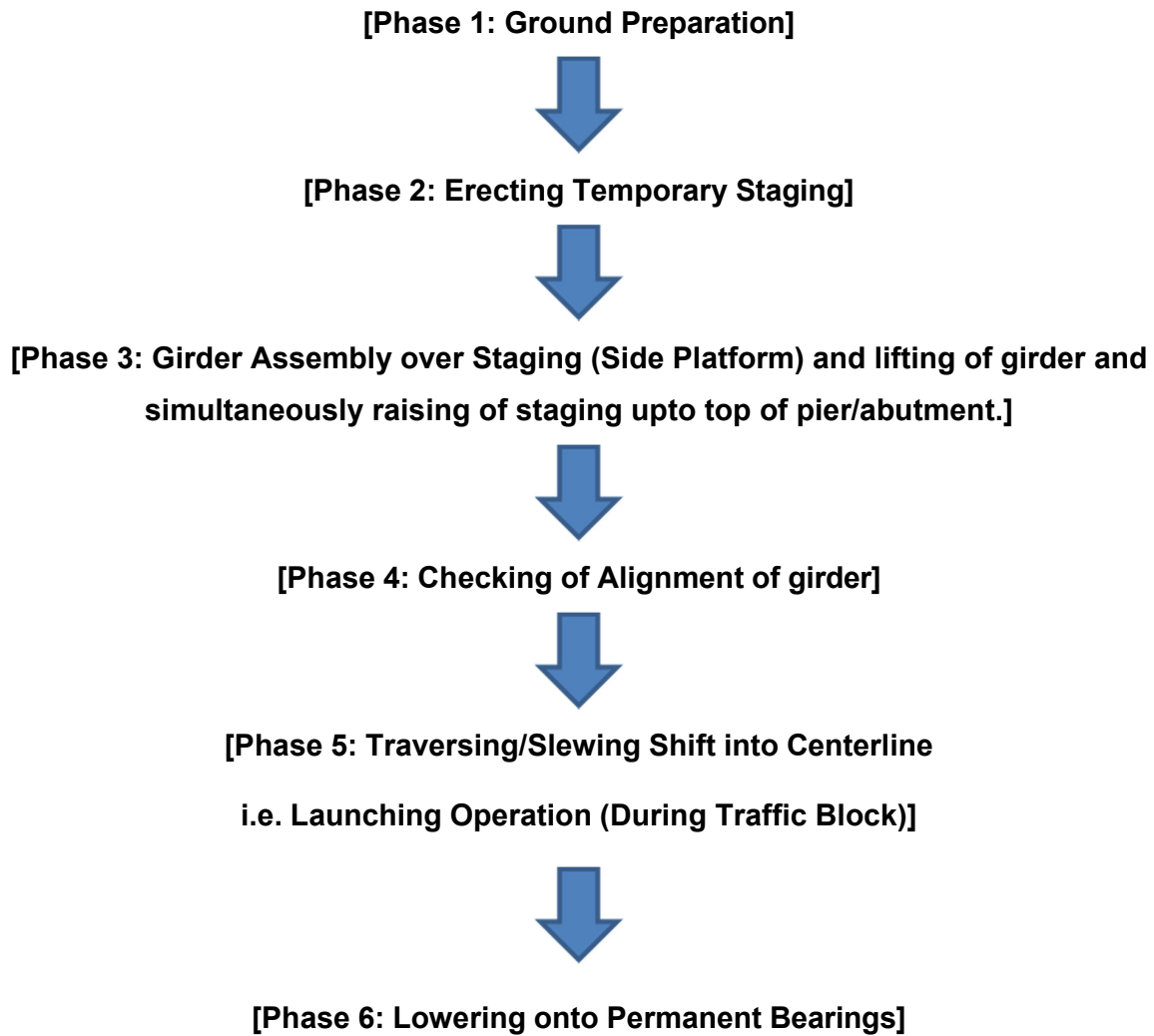
- **Bridge Height:** Maximum suitable height of the substructure is up to 4–5 meters.
- **Ground:** Firm, stable ground support, capable to support staging without settlement.
- **Clearances:** Adequate clearance/gap must exist between adjacent railway lines or bridge approaches to accommodate released girder.
- **Span & Type:** This method is more suitable for steel plate girder spans up to 24.4m spans. For higher span lengths, Open web girders & PSC girders this method can be made feasible by providing well designed temporary staging and subjected to availability of required bearing capacity of ground.

4. Resources & Equipment Requirements

- **Temporary Staging Support:** C.C. Cribbs, steel trestles, and timber packing blocks.
- **Pulling/Shifting Gear:** High-capacity wire ropes, chain pulley blocks or Tirfor machines.
- **Sliding/Slewing Assembly:** Smooth, rust-free, well-greased steel track rails and fish plates or PTFE

Sr. No.	Tools, Plants & Launching Accessories
1	Three Hydraulic Jacks of required capacity for lifting of girder
2	Rope
3	Sling
4	Chain Pulley Blocks or Turfer or Winch for Slew-In & Slew Out of girder
5	Rollers
6	Drifts
7	Service Bolts
8	Wooden Planks
9	Wooden Blocks
10	HSFG Bolts for final assembly
11	Gas Cutting Set
12	MMAW Welding setup
13	1.5 kg Hammer for Drifting
14	Torque Wrench Etc.
15	Spanners of required sizes
16	Diesel
17	Raw Oil
18	Grease
19	Cotton Waste
20	First Aid Box
21	M. S. Packing Plates

5. Step-by-Step Erection & Slewing Procedure



Phase 1: Foundations & Staging Setup



- Validate the soil bearing capacity under temporary setups. Ensure no water-logging or ponding near the foundations exists. If required, Soil bearing capacity can be improved through a variety of targeted ground modification techniques.

E.g. Mechanical Compaction, Widening the Support, Lateral Confinement.

- Erect un-corroded steel staging columns adjacent to the piers. Never place the first layer of C.C. Cribbs directly on raw ground to prevent uneven settlement or tilting.
- Anchor and secure a level platform using parallel timber/wooden supports.
- **Temporary Staging:** Prepare temporary staging for keeping new girder parallel and adjacent to the old girder and another temporary staging is also required for keeping old girder after slew out.

Phase 2: Track Layout & Girder Erection

- **Placement of Girder:** Place new girder over temporary side staging platform. Keep girder ready with all respect including track structure. Strictly Avoid loose service bolts during handling of girder on temporary staging. Keep girder parallel and adjacent to the final alignment.



- **Lifting of Assembled Girder:** Lift assembled girder up to top of pier/abutment on temporary staging and keep parallel and adjacent to the old girder.

- **Pulling Arrangements:** Well Anchored of Chain Pulley block or turfer or winch for pulling operation i.e. slew-in of new girder & slew out of old girder. Kept connected with the old girder before commencement of traffic block.
- **Rolling/Sliding Arrangement:** Attach specialized rolling or sliding shoes to the bottom flanges of the girder.
- **Trial:** Test all Pulling & sliding arrangements, jacks, and communication systems One day before the actual traffic block.
- **Preparatory Work on Old Girder under the speed Restriction of 20 Kmph:** Removal of Guard rails, Pathway Chequered Plate and anchor/holding down bolts of bearings. Loosening and re-tightening of all track fittings for easy removal during traffic block. Provide open cut and fish-plated joint to the main rails at girder ends.

Phase 3: Alignment, Control Setup, & slewing i.e. Launching Operation (During Traffic Block)

- **Track Clearance:** After allowing of traffic block by railway authorities, Disconnect the running rails by opening of fish-plated joint at girder ends. Make old girder free to move laterally.
- **Slew-Out Old girder:** Lift the old girder and insert sliding rails, rollers of PTFE arrangements below the girder. Slew out the old girder with the help of pulling and sliding/rolling arrangements and after clearing space for new girder, old girder will be safely lowered on temporary staging.
- **Slew-In New girder:** Extend sliding rails on a space created after slewing out of old girder. Slew in new girder up to final location with the help of pulling and sliding/rolling arrangements and then girder will be safely lowered on pier/abutment with proper level and alignment.
- **Side Slewing:** Use turfer or chain pulley block of required capacity to push or pull the girder laterally along the slewing tracks. It can also be carried out with the help of hydraulic jacks of required capacity to push or pull the girder laterally along the slewing tracks.
- **Alignment Checks:** Monitor the movement continuously to prevent skewing.
- **Final Positioning:** Stop slewing once the girder centre line aligns perfectly with alignment of track.
- **Jacking:** Position appropriate capacity hydraulic jacks under the girder lifting points.

- **Removal of Sliding Arrangements:** Remove the sliding arrangements and remove the temporary slewing tracks.
- **Final Lowering:** Lower the girder slowly and synchronously onto the permanent bearings.
- **Fix Bearings:** Anchor the bearings and grout holding bolt by epoxy.
- **Track Linking:** Track structure of the new bridge girder link with the existing track with proper level and alignment.
- **Handover:** Check the track parameters i.e. gauge, level, alignment and twist then restore train traffic at a speed as per site condition.

Phase 4: Final Position Placement



- Position high-capacity, pre-tested hydraulic jacks below the structural nodes.
- Lift the girder slightly to remove temporary travel rollers or sliding plates. Avoid direct steel-to-metal seating contact without friction pads during this transition to prevent slippage.
- Lower the span uniformly onto its permanent bridge bearings in strict accordance with the approved General Arrangement Drawings (GAD).

6. Safety and Quality Control

- **Safety Zone:** Barricade the entire operational area to prevent unauthorized entry.
- **PPE Mandate:** Enforce the use of helmets, safety harness, high-visibility jackets, and steel-toe boots.
- **Load Test:** Ensure all lifting tools and tackles have valid third-party test certificates.
- **Line Obstruction Safety:** Maintain an unobstructed, clear travel pathway along the girder's line of motion. Discard slings or ropes exhibiting any kinks, wear patterns, or distortion.
- **Personnel Protection:** Conduct mandatory mock drill for safety. Enforce 100% field compliance for safety norms, including high-visibility clothing, safety helmets, waist slings, and industrial footwear.

7. Quality Control & Work Completion Checklist

SN	Quality / Verification Description	Status (Yes/No /NA)	Field Action Taken / Remarks	Reference Status
1	Approved launching scheme is in place.			
2	Has the design scheme and Temporary Arrangement Drawing (TAD) has checked?			
3	Are the staging foundations placed on firm, dry ground with no first-layer crib-to-soil contact?			
4	Is top layer of CC Cribs of staging covered with Wooden Sleepers?			
5	Are all structural joint connections of girder are fixed as per drawing.			
6	Necessary testing of cables, ropes, pulleys, tirfor, jacks etc. done.			
7	Proper measurements of rail level taken for assessment of track lifting requirement if any after replacement of superstructure			
8	Rolling/sliding arrangements checked and found satisfactory. Are all sliding track surfaces smooth throughout the length, heavily greased, and free of rust or pitting?			
9	Fixing of rope to arrest uncontrolled movement of girder during sliding is in place.			
10	Arrangement to monitor roller alignment during launching is in progress.			
11	Markings of final position of girder on bed block			

(6)
METHOD STATEMENT
FOR
INSTALLATION OF ELASTOMERIC BEARING



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1. Introduction

1.1 Scope

This method statement establishes the procedure for the safe handling, positioning, installation, inspection, and acceptance of elastomeric bearings to ensure compliance with the approved drawings, relevant specifications, and applicable codes, thereby achieving the intended structural performance, durability, and service life of the bridge.

1.2 Applicable Codes, Standards and Specifications

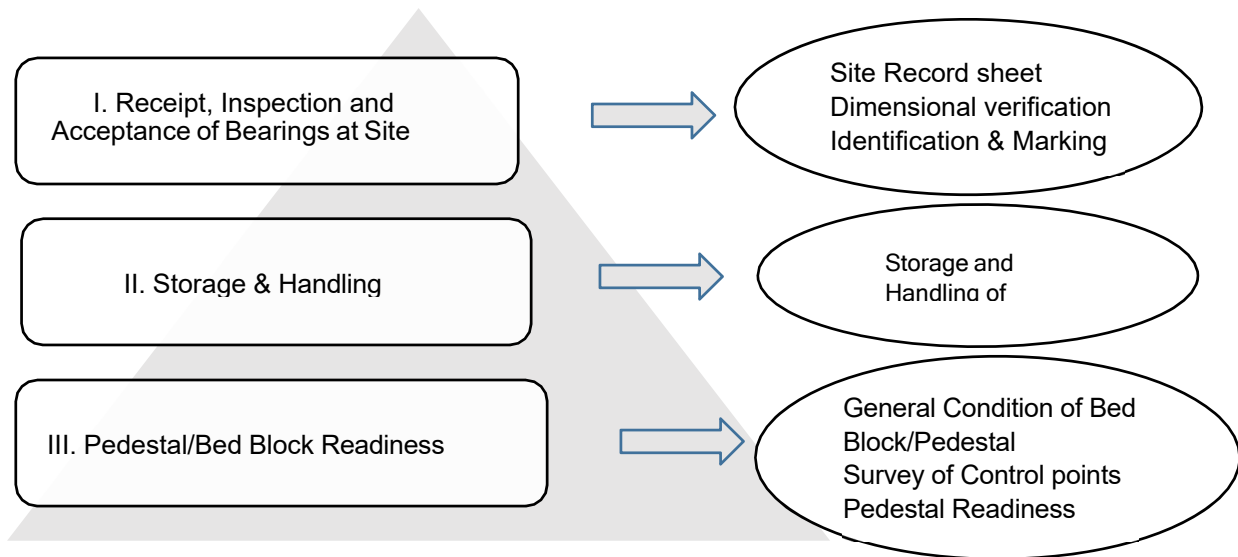
- i. Approved General Arrangement (GAD) Drawings
- ii. Manufacturer's Approved Drawings and Installation Manual for the supplied Elastomeric Bearings.
- iii. Report No.BS-102R
- iv. IRBM 2024
- v. IRCM
- vi. IRC 83 Part II

1.3 Inspection and Measurement Equipment

All survey instruments, measuring devices, and equipment used for inspection, compliance verification, and measurements shall be duly calibrated.

Part I- Pre Installation Activities

▪ Sequence of Activities



2. Receipt, Inspection and Acceptance of Bearings at Site

2.1 Bearing Receipt schedule/record

- Because rubber and neoprene are flexible, elastomeric bearings easily suffer structural damage and require careful inspection before acceptance at site.
- A Bearing schedule/Site record sheet should be prepared and kept in record while receiving and accepting the bearings at site.
- A Site Record Sheet (**Table-1**) for Elastomeric Bearings is attached herewith for recording details of all incoming bearings.

Bearing Record Sheet: Table no -1

INCOMING ELASTOMERIC BEARINGS – RECORD SHEET								
PROJECT / WORK :			DATE OF RECEIPT :					
BRIDGE NO. :			SUPPLIER / MANUFACTURER :					
SPAN / PIER / ABUTMENT NO. :			INSPECTED BY :					
SL. NO.	BEARING UNIQUE ID / NUMBER	MFG. NAME	MFG. YEAR	IDENTIFICATION MARK (AS EMBOSSED)	SCRATCH / CUT / BULGING ETC.	QTY. (NOS.)	DOCS.: PRE DISPATCH INSPECTION REPORT (YES / NO)	REMARKS
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
INCOMING ELASTOMERIC BEARINGS – CHECKLIST								
SL. NO.	CHECK ITEMS				YES	NO	REMARKS	
1	DELIVERY CHALLAN / DOCUMENTS AVAILABLE							
2	NO VISIBLE CUT, BULGING OR ANY SIGN OF TRANSPORTATION DAMAGE							
3	ALL BEARINGS RECEIVED AND STACKED WITH DUE CARE							
4	VISIBLE MARK OF ANY JOINT OR TEAR OFF IN BEARINGS							
RECEIVING OFFICIAL (NAME) : _____ SIGNATURE : _____ DESIGNATION : _____ DATE : _____								

2.2 Traceability, Identification and Marking on Bearings

2.2.1 Marking on Bearings

- I. Permanent, non-editable engravings/embossing shall be provided on each bearing to ensure unambiguous identification and complete traceability throughout its service life. It shall be verified that the manufacturer's name, unique bearing identification number, bridge number, and manufacturing month/year (MM/YYYY) are clearly and permanently embossed on every elastomeric bearing. All elastomeric bearings shall conform to the standard marking scheme prescribed by the Railways. The details of the required markings are given in **Table 2.1** below.
- II. The marking details as specified in **Table-2.1** and **Fig-1** shall be verified for each bearing received at site. Any deviation from the approved marking scheme shall

be recorded, and the bearing shall not be accepted until compliance is ensured.

Reference Table 2.1: Standard Marking Requirements for Bearings	
Requirement	Details / Compliance Requirements
Mandatory Engraving / Embossing	Each bearing shall be permanently engraved/embossed with the following information, which shall remain legible throughout its service life under normal wear conditions:• Manufacturer's Name / Registered Trademark• Unique Identification Number (UIN)• Manufacturing Month & Year (MM/YYYY)• Bridge Number where the bearing is to be installed
Quality of Engraving / Embossing	Engraving/embossing shall be neat, permanent and shall not adversely affect the functionality, structural integrity, strength or durability of the bearing.
Location of Markings	Markings shall be provided on the cross-sectional faces of the bottom metallic plate (i.e., faces of the bottom plate resting on the pedestal). Railway Bridges: Across the track. ROBs: Parallel to the roadway.
Font Size, Spacing & Movement Graduations	Font size and spacing shall be appropriate to the plate dimensions so that markings are clearly readable with the naked eye from a minimum distance of 2 m. Movement graduations shall be marked using indelible ink/paint with suitable line width and symbols.
Top Surface Markings	The top surface of the bearing shall be provided with:• Centre-line markings• Direction of movement/installation• Movement graduations for monitoring displacement
Information on Stainless Steel / Aluminum Label	A suitably sized stainless steel or aluminum label securely fixed to the bearing shall indicate:• Bearing designation• Bearing type• Load capacity• Movement capacity• Centre-line markings• Direction of
	major & minor movement• Pre-set value (where applicable)• Other installation details, as required
Additional Information	Any additional information required under IRC: 83 (Part II) or specifically stipulated by Indian Railways shall be supplied separately with the approved supply documentation.

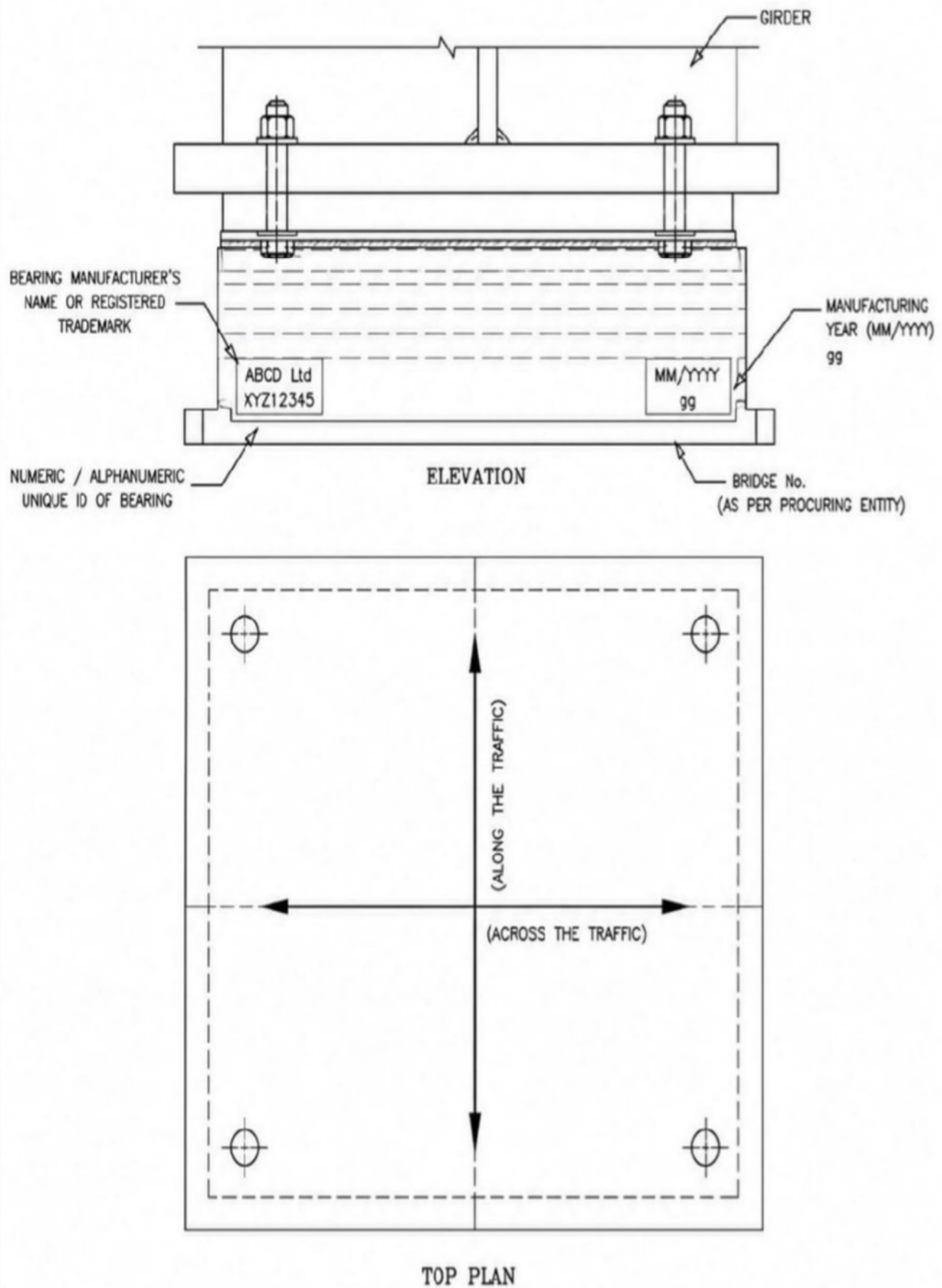


Figure 1

2.3 Dimensional verification

a) All bearings received at site shall be inspected and verified for dimensional tolerances in accordance with the manufacturer's specification and relevant drawings/standards. A detailed inspection record shall be maintained for each bearing, and the observations shall be duly recorded in Table 2.2.

Checklist Table No-2.2				
Sl. No.	Inspection Item	Site Verification Method	Acceptance Tolerance	Ok/Not Ok
1	Overall plan dimensions (Length & Width)	Verification at site	-2 mm / +4 mm	
2	Total bearing thickness	Verification at site	i) ≤ 100 mm : ± 2 mm ii) 100–150 mm : ± 3 mm iii) > 150 mm : ± 4 mm	
3	Parallelism of top surface with bottom surface	Straight edge/parallelism check or verify manufacturer's report	1 in 300	
4	Shore Hardness	Verify manufacturer's report	60 $\pm$ 5 or as per approved design.	
5	Shear Modulus	Verify manufacturer's report	0.8N/mm ² or as per approved design	
6	Steel laminate parallelism (<i>where applicable</i>)	Verify from manufacturer's inspection report	1 in 100	
7	General condition	Visual inspection at site	No cuts, cracks, blisters, delamination, exposed steel, deformation or other defects	

2.4 Undertaking by the manufacturer

The manufacturer of Bearing shall furnish an undertaking on non-judicial stamp paper of the requisite amount which shall be reviewed at site for correctness of manufacturer's name and location of use.

Undertaking by manufacturer
We M/s. (Name of Manufacturer) hereby guarantee against defective materials manufacture workmanship and certify quality assurance at every stage of manufacturing of bearings. Elastomeric bearings supplied by us and installed at (Name/No./Location of the Bridge) on (Date of Installation of Bearing) shall have a warranty of 15 years under traffic."

2.5 Acceptance of Bearing for installation

All bearings received at site shall initially be entered in the receipt register/record sheet as tabled in **Table-1**, individually inspected to verify dimensional correctness as per tolerances tabled in **Table 2.2**, identification markings, traceability details as per **Table 2.1** and compliance with the approved drawings and manufacturer's documentation. The inspection findings shall be recorded in **Checklist Table 2.3**, and the completed inspection records shall be maintained for future reference and traceability.

Elastomeric Bearings Inspection Checklist at site

Checklist Table No-2.3				
Sl. No.	Inspection Item	Requirement to be Verified	Check (✓/X)	Remarks
<u>A</u>	<u>Documentation</u>			
1	Manufacturer's Test Certificate (MTC)	MTC Available		
2	Inspection & Dispatch Report	Bearing transported to bridge site only after final acceptance by the inspector/inspection agency and is accompanied by an authenticated copy of the certificate to that effect.		
3	Bearing Identification	Matches standard bearing identification marking scheme. Each bearing is uniquely and individually numbered for identification on its external faces.		

4	Undertaking by the manufacturer	Undertaking on Non Judicial Stamp paper Available		
<u>B</u>	<u>Supply and Packing</u>			
5	Packing Condition	No damage during transportation		
6	Handling Damage	No cuts, dents or impact damage		
<u>C</u>	<u>Visual Examination</u>			
6	Overall Surface Finish	Smooth and free from blemishes		
7	Rubber Surface	No cracks, cuts, blisters or tears		
8	Exposed Steel Plates	Free from rust, pitting and corrosion		
9	Edge Cover	Uniform without voids or holes		
10	Bonding of Steel & Rubber	No signs of de-bonding or separation		
11	Steel Laminate Exposure	No unintended exposure of internal laminates		
12	Sharp Edges	No sharp steel edges visible		
<u>D</u>	<u>Dimensional Verification</u>			
13	Length	As per approved drawing		
14	Width	As per approved drawing		
15	Overall Thickness	As per approved drawing		
16	Plan Shape	Rectangular/Square/ Circular as specified		
17	Identification Marking	Legible and complete		
<u>E</u>	<u>Manufacturing Quality</u>			

18	Bearing Manufactured as Single Unit	No evidence of joints or assembled pieces		
19	Laminates of mild steel conforming to IS: 2062/ IS: 1079 or equivalent grade is used. The yield stress of the material is not lesser than 250 MPa	Certificate of confirmation available for the lot.		
20	Load Test on Bearings: i. Axial Load Test ii. Shear Modulus Test iii. Compressive Stiffness Test iv. Shear Bond Test	Acceptance Certificates Available for the lot.		
21	Rubber Homogeneity	Uniform appearance throughout		
22	Mould Finish	Smooth and uniform		
23	Surface Voids	No honeycombing, cavities or depressions		
E	<u>Acceptance</u>			
24	<u>Table 1 and Table 2.2</u> duly filled and signed by the authorized personnel.	All items checked and found Ok.		
Signature of Contractor's Representative:				
Signature of Railway Representative:				

3. Storage, Handling and Transportation

- I. Bearings shall be stored in a covered area, protected from direct sunlight, moisture, dust, chemicals, and mechanical damage. Protective packing if any and transit locking devices shall remain intact until the time of installation.
- II. Bearings shall be Packed in Heavy Duty Polythene Sheets and firmly clamped on the Wooden crates for safe Transportation.
- III. Elastomeric bearings are highly vulnerable to structural damage before installation due to the flexible nature of rubber and neoprene. Proper handling is critical to preserve their structural integrity.

- IV. Bearings shall be transported and handled using suitable lifting equipment and designated lifting points without imposing impact, shock, dragging, or lifting.
- V. Transport Brackets are not to be relied for the Lifting of the Bearings.
- VI. Any damaged bearing shall be segregated and shall not be installed until accepted by the Engineer in charge.

4. Pedestal/Bed Block Readiness

4.1 Drawings and Documents

- All latest approved drawings, bearing schedules, and installation drawings shall be compiled, maintained as controlled records, and referred to throughout the installation process to ensure correct bearing identification, location, orientation, and installation sequence.

Checklist Table: 4.1			
Document No	Name of the Document	Revision if any	Approval Confirmation
BR/GAD/No	GAD of the Bridge		Yes/No
BR/DD/No	Dimensional Detail of Bed Block/Pedestal		Yes/No
Bearing Installation Schedule/No	Bearing Installation Schedule		Yes/No

All approved drawings with latest revisions are in place: To be confirmed before installation procedure.

4.2 Inspection of Bed Block/Pedestal

- i. Bearing installation shall ensure accurate geometric control of location, level, alignment and seating to maintain the designed load path between the girder and substructure.
- ii. Incorrect installation may result in eccentric loading, reaction redistribution, restrained movements, increased friction and secondary stresses affecting the structural performance and service life of the bridge.

4.2.1 Control Point survey and general inspection of Pedestal/Bed Block

a) Incorrect Practice and consequences

<u>Reference Table: 4.2</u>		
<u>Incorrect Practice</u>	<u>Engineering Failure</u>	<u>Consequences</u>
Bearing not concentric with pedestal	Eccentric reaction	Unequal load distribution
Pedestal dimensions outside tolerance	Inadequate bearing seating area	Edge loading, overstressing of concrete and improper load distribution
Cracked or honeycombed pedestal	Reduced bearing support	Local crushing, crack propagation and loss of bearing stability
Uneven bedding	Stress concentration	Cracked grout, rocking bearing

b) Acceptance Criteria for Finished Pedestals/Bed Blocks

As specified in BS 102R, the following parameters shall be inspected and shall comply with the prescribed tolerance limits.

<u>Reference Table: 4.3</u>	
<u>Inspection Parameter</u>	<u>Acceptance Tolerance</u>
Bearing Centerline Location	±3 mm from the design position
Bearing Horizontality	1 in 200 in any direction (unless otherwise specified)
Survey Verification	Compliance with approved drawings
Corrective Action	Any deviation beyond specified tolerance shall be rectified before girder loading.

4.2.2 Pedestal/Bed Block Readiness Inspection

- I. Pedestal/Bed Block Location:** Bearing center lines shall be established with approved survey control. Minimum pedestal edge distance shall be 150 mm (or as per approved drawing).
- II. Pedestal/Bed Block Level:** Finished level shall be within ± 1.5 mm of the theoretical design level.
- III. Bearing Seating Slope:** Bearing seating shall conform to design slope. Permissible deviation shall not exceed 1 in 1000. Bearing top and bottom surface variation shall remain within 1 in 500.
- IV. Surface Flatness:** General slope shall be verified using a 500 mm straight

edge. Local undulations exceeding ± 1 mm over a 200 mm straight edge shall be rectified.

- V. Surface Condition:** Bearing seating shall be free from laitance, honeycombing, loose particles, oil, standing water and other contaminants before installation.
- VI.** Any deviation beyond specified location, level, slope or flatness tolerances shall be rectified before bearing placement.
- VII.** The location, elevation and slope of each pedestal/bed block shall be verified against the approved construction drawings prior to bearing installation. No assumptions or field modifications shall be made without approval of the Design Engineer.
- VIII.** A checklist Table No 4.4 is provided for reference which should be filled and verified before proceeding ahead.

<u>Checklist Table No 4.4</u>			
<u>Sl. No.</u>	<u>Inspection Item</u>	<u>Field Requirement / Acceptance Criteria</u>	<u>Yes/ No</u>
1	Marking of Centre Lines	Marking of centre lines on the pedestal.	
2	Surface Condition	Pedestal is free from laitance, honeycombing, loose particles, oil, standing water and other contaminants.	
3	Surface Flatness	General slope is verified using a 500 mm straight edge. Local undulations exceeding ± 1 mm over a 200 mm straight edge is rectified.	
4	Verification	Checked level using a Total Station or Theodolite, and recorded all observations before and after rectification if done.	

4.3 Preparation of Bearing Seat

4.3.1 Underside of the Girder Interface

- Surface Flatness: Check the underside of the girder at the bearing location using a 200 mm long straight edge. Mark any undulation variation exceeding ± 1 mm for immediate rectification.
- Girder Type Specifics: Verify steel girders for any bottom flange or chord distortion for steel girders and inspect concrete girders to ensure a smooth, uniform surface finish.

- Precast Inspection Support: Inspect finally assembled precast girders before launching by supporting them at jacking points or adjacent locations to keep the actual bearing zone completely free for checking.

4.4 Pre installation checks

3 pre installation inspection checks (A, B& C) should be verified for compliance and readiness prior to bearing installation.

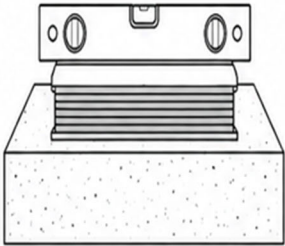
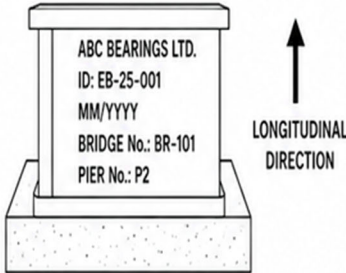
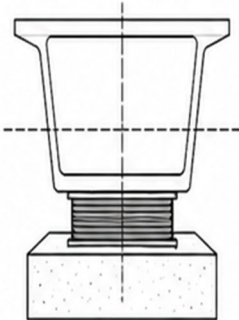
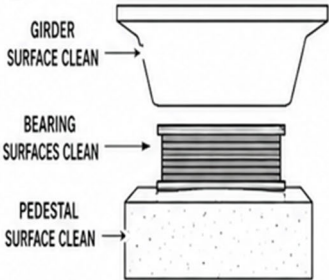
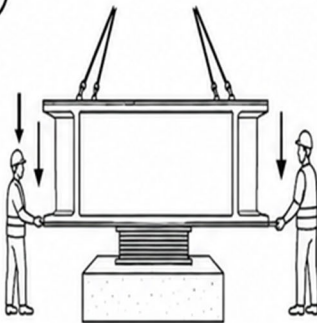
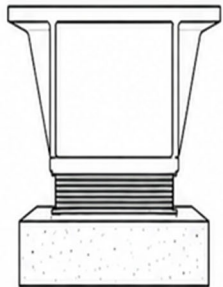
- A) General Structural condition of Bed Block/Pedestal
- B) Survey of hold points
- C) Marking on Pedestal/Bed Block

All pedestal/bed block concreting records, including concrete strength test reports and quality assurance documents, shall be verified and found satisfactory before commencement of bearing installation

Part II- Installation of Elastomeric Bearings

5) Sequence of Activities

The following six (6) essential requirements shall be complied with, during the installation of elastomeric bearings.

KEY POINTS TO BE FOLLOWED DURING INSTALLATION OF ELASTOMERIC BEARINGS		
1 BEARING SEAT LEVEL AND FLATNESS  • PEDESTAL TOP SURFACE SHALL BE TRUE, LEVEL AND FREE FROM UNDULATIONS. • HONEYCOMBING, LOOSE MATERIAL OR PROJECTIONS SHALL BE REMOVED. • BEARING SHALL ACHIEVE FULL, UNIFORM CONTACT OVER ENTIRE SEATING AREA.	2 CORRECT BEARING IDENTIFICATION AND ORIENTATION  • VERIFY BEARING TYPE, DIMENSIONS AND IDENTIFICATION MARKS AS PER APPROVED SCHEDULE AND LOCATION. • IF BEARING HAS A DESIGNATED LONGITUDINAL DIRECTION, INSTALL IN CORRECT ORIENTATION.	3 ACCURATE POSITIONING  • PLACE BEARING AT SPECIFIED CENTRE LINES ON PEDESTAL. • ECCENTRIC PLACEMENT MAY CAUSE UNEVEN STRESS, EXCESSIVE SHEAR AND UNDESIRABLE ROTATION.
4 CLEAN CONTACT SURFACES  • ALL CONTACT SURFACES OF GIRDER, BEARING AND PEDESTAL SHALL BE CLEAN. • REMOVE DUST, GREASE, LOOSE PARTICLES AND FOREIGN MATERIAL. • NO PACKING PIECES, SHIMS OR DEBRIS SHALL REMAIN BENEATH THE BEARING.	5 CONTROLLED GIRDER LOWERING  • LOWER GIRDER SLOWLY, UNIFORMLY AND VERTICALLY ONTO THE BEARING. • AVOID IMPACT, DRAGGING OR HORIZONTAL MOVEMENT. • PREVENT DAMAGE TO ELASTOMER AND INDUCE NO SHEAR STRAIN.	6 FINAL SEATING AND INITIAL LOAD VERIFICATION  • AFTER LOAD TRANSFER, CONFIRM UNIFORM SEATING WITHOUT TILTING, BULGING, EDGE LIFTING OR VISIBLE DISTORTION. • VERIFY THAT BEARING IS FULLY SUPPORTED AND PROPERLY ALIGNED. • ENSURE NO DISPLACEMENT FROM MARKED POSITION.

Installation Procedure Activities

5.1 Positioning of Bearing

- I. The center line of the top portion of bearing and center line of the Pedestal is clearly marked with paint. This shall serve as reference for inspections.
- II. **Shimming & Levelling:** Place steel shims or wedges at the four corners under the bottom plate to adjust the bearing to the exact design elevation.
- III. **Alignment tolerances:** Ensure the bearing is completely level.
- IV. Details about location/ levels/ slope of pedestals/ bed blocks shall be taken from drawings and the designer may be consulted if anything is not clear.

5.2 Level and Alignment Verification

- I. Verify that each bearing is properly seated on the bed block and girder without tilt, distortion, or uneven contact.
- II. Check that all component clearances and gaps conform to the approved drawings and manufacturer's specifications.
- III. Inspect for any signs of distress, misalignment, uneven load transfer, or damage resulting from installation or cumulative tolerances.
- IV. Rectify all non-conformities and obtain final acceptance before releasing the bearing for service or commissioning.
- V. Verify the bearing number and line/level/alignment/orientation after final seating and before grouting.

5.3 Placement of Bearing

- I. Lift the superstructure using calibrated hydraulic jacks at the designated lifting points. In multi-girder spans, all girders shall be jacked simultaneously to avoid differential loading.
- II. Remove the temporary wooden packings, clean the bearing seat, and position the elastomeric bearing accurately with the surveyed centre lines on the pedestal.
- III. Temporary hardwood packings may be used during launching/erection but shall be completely removed before installing the elastomeric bearing.
- IV. Lower the superstructure slowly and uniformly to transfer the load simultaneously onto all bearings. Sudden impact, dragging, or eccentric loading shall be avoided.

V. Ensure the bearing is fully seated with uniform contact between the pedestal and girder soffit, without tilting, edge lifting, bulging, or displacement.

VI. A checklist table no 5.1 is attached below for final verification.

Checklist Table: 5.1		
Pier No/Abutment No: Bearing unique Id: Date:		
Sl. No.	Compliance Check	✓
1	Bearing seat level, flatness and surface condition verified.	☐
2	Bearing identification, type and orientation verified.	☐
3	Bearing positioned correctly with respect to centre lines.	☐
4	Contact surfaces cleaned and free from debris or contaminants.	☐
5	Girder lowered uniformly without impact or lateral movement.	☐
6	Bearing seating, alignment and initial load transfer verified.	☐
Signature of Contractor's Representative:		
Signature of Railway Representative:		

6. Final Inspection and Acceptance

Final installed elastomeric bearing should be inspected as per the protocol shown below in Fig-2 and a checklist is also attached in the same figure which should be filled/completed after inspection.

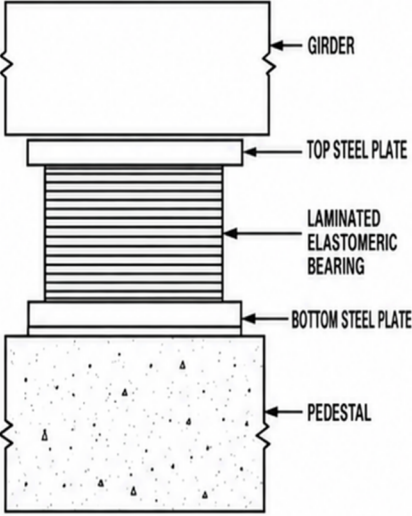
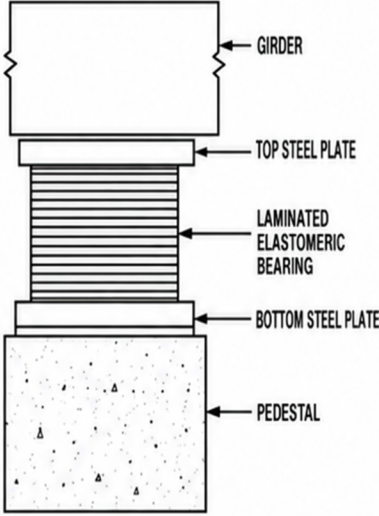
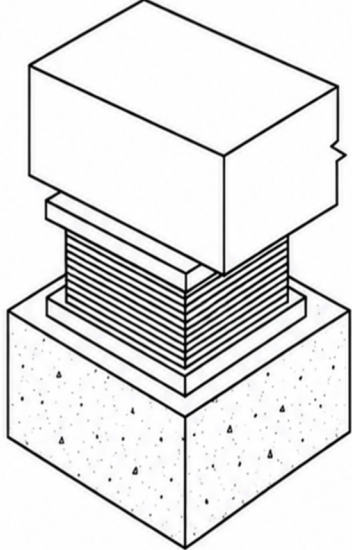
FINAL INSPECTION OF POST-INSTALLATION ELASTOMERIC BEARINGS TYPICAL VIEWS AND SITE CHECKLIST						
1. FRONT VIEW	2. SIDE VIEW		3. ISOMETRIC VIEW			
						
POST-INSTALLATION SITE CHECKLIST						
SL. NO.	CHECK ITEM	YES	NO	REMARKS	SIGNATURE OF INSPECTING OFFICIAL	DATE
1	BEARING TYPE, SIZE AND ORIENTATION AS PER APPROVED DRAWING					
2	BEARING LOCATION MATCHES APPROVED SETTING OUT					
3	BEARING SURFACES CLEAN, LEVEL AND FREE FROM DEBRIS					
4	TOP AND BOTTOM STEEL PLATES PROPERLY BONDED					
5	FULL CONTACT ACHIEVED BETWEEN BEARING AND SEATING SURFACES					
6	BEARING INSTALLED PLUMB AND IN CORRECT POSITION					
7	EDGE DISTANCES AND CLEARANCES VERIFIED					
8	ALL REFERENCE MARKINGS PROVIDED AND CLEARLY VISIBLE					
9	ALL MARKINGS ON BEARING INTACT AND CLEAR					
10	NO VISIBLE DAMAGE, CUTS, BULGING OR DELAMINATION					
11	FINAL POSITION VERIFIED AGAINST APPROVED DRAWING					
12	PHOTOGRAPHIC RECORD TAKEN AND FILED					

Figure 2

Record of Final Inspection:

- i. Final inspection should verify that the bearing has been installed in accordance with the design intent and is capable of performing its intended functions.
- ii. A tabulated inspection **checklist No-6** for record is provided below:

<u>Final Inspection Checklist Table: 6</u>		
<u>Pier/Abutment no:</u>		
<u>Bearing location and Unique Id:</u>		
<u>Date of Inspection:</u>		
<u>SN</u>	<u>Critical Items</u>	<u>Yes/No</u>
i.	Bearing type and identification matches approved GAD.	
ii.	Bearing center line matches setting-out marks.	
iii.	Bed block level and horizontality within permissible tolerance.	
iv.	The final plan position of the bearing does not deviate by more than ±3 mm from the specified location in any direction.	
v.	Full bearing seating achieved without rocking.	
vi.	Required clearance available.	
vii.	Bearing area cleaned and ready for service.	

7. Documentation and Quality Records

- i. **Bearing Identification and Traceability Records:** Bearing identification register indicating bearing number, type, serial number, manufacturer, location, GAD reference, and installation date for future inspection and maintenance.
- ii. **Survey and Dimensional Control Records:** Survey reports confirming bearing center coordinates, centerline alignment, Reduced Levels (RL), orientation, and as-installed geometry within the specified tolerances.
- iii. **Grouting Quality Records:** Records of grout batch identification, water dosage, mixing time, ambient temperature, placement time, curing details, and laboratory test reports confirming compliance with the specified performance requirements.
- iv. **Material Compliance Records:** Manufacturer's Test Certificates (MTC), Technical Data Sheets (TDS), warranty certificates, and approved material submittals for Elastomeric bearings.

- v. **Calibration and Equipment Records:** Valid calibration certificates for survey instruments, torque wrenches, hydraulic jacks, pressure gauges, load cells, and other measuring and testing equipment used during installation.
- vi. **Non-Conformance and Corrective Action Records:** Records of non-conformities observed during installation, corrective measures implemented, re-inspection reports, and final closure of observations.
- vii. **Final Installation and Acceptance Records:** As-built drawings, final survey reports, inspection and test records, commissioning checklist, and Final Acceptance Report duly certified by the Engineer, confirming that the bearing installation complies with the approved specifications and is fit for service.

8. Safety Precautions

- All lifting, jacking and bearing installation activities shall be carried out only after approval of the lifting methodology, and verification of the readiness of all personnel, equipment and work area.
- Hydraulic jacks, lifting appliances, cranes, slings, shackles, spreader beams and other lifting accessories shall possess valid inspection and proof load certificates and shall have adequate Safe Working Load (SWL) for the intended operation.
- The bridge girder shall remain adequately supported on temporary supports/jacks throughout the installation process. Removal or release of any support shall be carried out only in the approved sequence to prevent differential load transfer or instability.
- During lifting, positioning and load transfer operations, no personnel shall remain beneath suspended loads or within the designated danger zone. The work area shall be effectively barricaded and access restricted to authorized personnel only.
- Hydraulic pressure shall be applied and released gradually and uniformly to avoid impact loading, excessive differential deflection or unintended displacement of the girder and bearing.

(7)
METHOD STATEMENT
FOR
INSTALLATION OF POT-PTFE BEARING



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1. Introduction

1.1 Scope

This Method Statement describes the procedure for the receipt, inspection, storage, handling, installation, grouting, alignment, and final inspection of POT-PTFE bearings for bridge superstructures. The procedure covers activities necessary to ensure the correct positioning and installation of bearings in accordance with the approved drawings, specifications, and relevant codes and standards.

This Method Statement comprises three parts (Part I, Part II, and Part III). Part I covers the pre installation activities, Part II details the bearing installation procedure, and Part III contains the tables, checklists, and reference figures.

All activities shall be carried out in accordance with the approved construction drawings, manufacturer's installation manual, applicable Railway/IRC specifications, relevant standards, and the instructions of the Engineer-in-Charge.

1.2 Applicable Codes and Standards

- i. Approved General Arrangement (GAD) Drawings
- ii. Manufacturer's Approved Drawings and Installation Manual for the supplied POT-PTFE Bearings.
- iii. Report No.BS-80
- iv. Report No.BS-102R
- v. Indian Railway Standards (IRS)-B1
- vi. IRC 83 Part III

1.3 Inspection and Measurement Equipment

All survey instruments, measuring devices, and equipment used for inspection, compliance verification, and measurements shall be duly calibrated and conform to the applicable standards.

2. Receipt, Inspection and Acceptance of Bearings at Site

2.1 Bearing Identification Schedule

A Bearing identification schedule comprising relevant details as per (**Table 2.1**) has to be prepared and kept in record while receiving and inspecting the bearings at site.

2.2 Dimensional verification

a) POT PTFE Bearings intended for use in Railway Bridge works shall comply with the dimensional tolerance limits specified in IRS BS 80 & IRC 83 part III. **Table 2.2** provides the dimensional tolerance requirements for verification and compliance.

b) The permissible fit tolerances for various bearing components, together with their functional implications, as specified in Clause 6.1.4 of IRC:83 (Part III), are presented in **Table 2.3** for verification and compliance.

2.3 Traceability, Identification and Marking on Bearings

2.3.1 Marking on Bearings

- I. Permanent, non-editable identification markings shall be engraved/embossed on every POT–PTFE bearing to ensure traceability, unambiguous field identification, correct orientation, direction of movement, and fixity during installation, inspection, and throughout its service life.
- II. The recommended marking requirements and a typical identification layout are provided in Marking Scheme-01 and Figure 1, respectively.
- III. It shall be ensured that the markings on all incoming bearings conform to the standard marking scheme.

2.3.2 Symbols & Notations

The symbolic representation of the bearing function (Fixed/Guided/Free), movement direction and other installation references shall be permanently and legibly marked using indelible ink, durable paint, stamping or other approved permanent marking method.

2.3.3 Inspection Checklist for marking and identification

All bearings received at site shall be individually inspected to verify identification markings, traceability records, and compliance with approved documentation. The inspection shall be carried out with reference to the (Table 2.4) & checklist (Table 2.5) and record of inspection should be maintained for future reference.

3. Storage, Handling and Transportation

- i. Bearings shall be stored in a covered area, protected from direct sunlight, moisture, dust, chemicals, and mechanical damage. Protective packing if any and transit locking devices shall remain intact until the time of installation.
- ii. Bearings shall be Packed in Heavy Duty Polythene Sheets and firmly clamped on the Wooden crates for safe Transportation.
- iii. Bearings shall be provided with temporary transportation clamps to avoid separation of parts during transportation and erection.
- iv. Bearings shall be transported and handled using suitable lifting equipment and designated lifting points without imposing impact, shock, dragging, or lifting through anchorage bolts or PTFE/stainless steel sliding surfaces. All machined surfaces shall be adequately protected during transit.
- v. Transport Brackets are not to be relied for the Lifting of the Bearings.
- vi. Any damaged bearing shall be segregated and shall not be installed until accepted by the Engineer in charge.

4. Pre-Installation Activities

List of Activities Prior to Bearing Installation

- Drawing & Document Verification (Approval)
- Pedestal/Bed Block Inspection & Preparation (Specified Tolerances)
- Grouting Readiness Inspection (Execution Readiness)

4.1 Drawings and Documents

- I. All latest approved drawings, bearing schedules, and installation drawings shall be compiled, maintained as controlled records, and referred to throughout the installation process to ensure correct bearing identification, location, orientation, and installation sequence.
- II. Table 4.1 shall be filled, verified, and retained for all activities and reference.
- III. All approved drawings with latest revisions are in place: To be confirmed before installation procedure.

4.2 Inspection of Bed Block/Pedestal

- i. Bearing installation shall ensure accurate geometric control of location, level, alignment and seating to maintain the designed load path between the girder and substructure.

- ii. General structural Condition, Concrete strength and anchor holes position should be verified and confirmed.

4.2.1 Control Point survey and general inspection of Pedestal/Bed Block

a) Incorrect Practice and consequences

The performance of POT-PTFE bearings is highly dependent on proper installation. A tabulated list of common incorrect practices and their associated consequences is provided in Table 4.2 for guidance during field installation.

b) Acceptance Criteria for Finished Pedestals/Bed Blocks

The acceptance criteria for finished pedestals/bed blocks, in accordance with BS 102-R and IRC: 83 (Part III), are summarized in Table 4.3.

4.3 Preparation of Bearing Seat

4.3.1 Underside of the Girder Interface

- **Surface Flatness:** Check the underside of the girder at the bearing location using a 200 mm long straight edge. Mark any undulation variation exceeding ± 1 mm for immediate rectification.
- **Girder Type Specifics:** Verify steel girders for any bottom flange or chord distortion for steel girders and inspect concrete girders to ensure a smooth, uniform surface finish.
- **Precast Inspection Support:** Inspect finally assembled precast girders before launching by supporting them at jacking points or adjacent locations to keep the actual bearing zone completely free for checking.

4.3.2 Top/Bottom plate installation protocol

a) Top Plate

- The clearance between the top stainless steel (SS) sliding plate and adjacent components shall be verified as per the approved installation details.
- Ensure that the specified gap at the top stainless steel (SS) plate is maintained in accordance with the approved bearing installation drawing.

A reference layout plan indicating the critical areas requiring verification is provided as Figure-2

b) Bottom Plate

A reference layout plan indicating the critical areas requiring verification is provided as Figure-3

4.3.3 Formwork and Scaffold Geometry (For Cast In-Situ)

- **Shuttering and Profile:** Inspect the shuttering plates carefully to ensure the final cast girder profile perfectly matches the geometry and level of the bearings.
- **Support and Stripping Plan:** Verify the scaffolds for rigid structural support, and establish a precise, approved methodology for the removal of scaffolds and shuttering to prevent uneven loading.

4.3.4 POT Component and Material Integrity

- **Pot and Elastomer Check:** Inspect the cast steel pot to ensure it is defect-free and that the internal, non-reinforced rubber pad is completely sealed and uncompromised to guarantee proper rotational capability.
- **Slide Guides:** Confirm that the mechanical slide guides are properly aligned and free of obstructions to provide the required structural restraint in the designated direction.

4.3.5 Sliding Surfaces and Friction Protection

PTFE and Stainless Steel Interface: Verify that the PTFE surface and the matching stainless steel sliding plate are completely clean, unscratched, and free of dust. This ensures the bearing achieves its highly efficient, low coefficient of friction

5. Stages of Installation**Stages: POT PTFE Bearing Installation****Stage 1: Receipt, Acceptance & Storage of Bearings**

- Marking to be Checked & verified
- Dimensional verification of each bearing against approved drawings and confirmation with the dispatch inspection report
- Protected Storage: Dust Free/Dry

Stage 2: Pedestal/Bed Block Preparation and Inspection

- General condition of Bed block/pedestal inspection
- Alignment, Centerline & Level verification
- Marking on Pedestal/Bed block
- Preparation of Bearing Seat

Stage 3: Installation of Bearing

- Level & Alignment on Bed Block/Pedestal re-verified
- Orientation and line/level/markings of Bearings checked
- Formwork & anchor sleeves position verified
- Grouting: Approval is in place

Stage 4: Removal of Temporary**Restraints Stage 5: Final Inspection****Stage 6: Documentation & Handover****Note:**

- Documents recorded in earlier stages shall be re-verified at every subsequent stage.

Stage 1	Receipt, Acceptance & Storage of Bearings
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SN	Activity	Key Requirements	Reference (Table / Checklist / Figure)
1)	a) Receipt of Bearing at site.	I. Record the details of all incoming bearings in the Bearing Identification Schedule. A table is attached for reference.	I. <u>Table 2.1</u>
		II. Dimensional verification of each individual bearing received at site shall be carried out to ensure compliance with the approved drawings and specified tolerances. The permissible dimensional tolerances for inspection are provided in Table 2.2.	II. <u>Table 2.2</u>
		III. Review and verify the fit tolerances of all bearing components in accordance with the specified limits.	III. <u>Table 2.3</u>
		IV. Identification, designation, and manufacturer's markings on all bearings shall be verified for compliance. Any deviation from the prescribed marking scheme shall be treated as a cause for rejection.	IV. <u>Marking Scheme-01 and Figure 1</u>
2)	b) Acceptance of incoming POT PTFE bearings at site	I. Only bearings complying with all the requirements specified in Tables 2.1, 2.2, 2.3, and Figure 1 shall be accepted for further activities. The inspection record in the format provided shall be completed before proceeding further.	I. <u>Table 2.4</u>
3)	c) Handling and Storage	I. Bearings shall be stored in a clean, dry, dust-free covered area and handled strictly in accordance with the procedures specified in Para-3 of this document.	I. <u>Para 3</u>

Stage 2	Pedestal/Bed Block Preparation and Inspection
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SN	Activity	Key Requirements	Reference (Table / Checklist / Figure)
1	a) General condition of Bed Block/pedestal ▪ Approved Drawings/Scheme verification ▪ Alignment, Centerline & Level verification	Drawings and Documents should be compiled and verified for approval and correctness. A table comprising list of all approved drawings/documents to be filled and referred for all further activities.	Table 4.1
		Table 4.2 provides a summary of incorrect installation practices and their consequences. Compliance with these recommendations shall be ensured during installation activities.	Table 4.2
		Prepare and finish the pedestal to obtain a true, level horizontal surface for bearing seating.	Table 4.3
2	b) Alignment, Centerline & Level verification	Verify and confirm the center-line and reference markings on the pedestal/bed block.	
3	c) Preparation of Bearing Seat	Inspect and verify the underside bearing interface of the girder for level, flatness, surface condition, and compliance with the approved drawings.	Para 4.3.1
4	d) Top/Bottom plate installation	Ensure that all installation clearances conform to the approved bearing installation scheme/GAD before proceeding with bearing installation.	Fig 2 & Fig 3
5	e) Grouting readiness	All items to be checked and confirmed before proceeding for final grouting	i. Checklist Table 6.1(a) ii. Checklist Table 6.1(b)

Stage 3	Installation of POT-PTFE Bearing
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Step 1	Setting Out and Orientation
Step 2	Installation of Dowel Positioning Template
Step 3	Positioning of Bearing
Step 4	Placement and Temporary Fixing of Bearing
Step 5	Level and Alignment Verification
Step 6	Grouting

5.1 Setting Out and Orientation

- I. Sliding direction and guide orientation, conform to the approved GAD.
- II. The bearings shall be provided in proper orientation, taking extra care that the sliding direction is proper as per drawing.
- III. Fixed, guided, and free bearings installed at their designated locations only.
- IV. As orientation is especially important for POT PTFE type bearings, it may be jointly verified by Site Engineer and representative of the manufacturer for correctness before grouting operation.

5.2 Installation of Dowel Positioning Template

- i. Template with required rigidity and matching holes corresponding to the base and top plates of the bearing shall be used.
- ii. All the dowels shall be fitted to the lower face of the template using temporary anchor bolts and steel washers.
- iii. The template assembly shall be located with regard to level and alignment. It shall be ensured that the top of the dowel lie in a horizontal plane at the require elevation. The dowels (if required) shall be tied/welded to reinforcements to avoid displacement during concreting.
- iv. The template and steel washers shall be removed prior to placement of the bearing assembly with temporary clamps. The bearing assembly shall be fitted to the dowels with the help of anchor bolts.

5.3 Positioning of Bearing

- I. Orientation: Verify the bearing type (fixed, guided, or free) and check that its layout perfectly matches the superstructure's anticipated movement

direction.

- II. The center line of the top portion of bearing and center line of the sub-structure is clearly marked with paint or suitably engraved.
- III. Shimming & Levelling: Place steel shims or wedges at the four corners under the bottom plate to adjust the bearing to the exact design elevation.
- IV. Alignment tolerances: Ensure the bearing is completely level.
- V. Details about location/ levels/ slope of pedestals/ bed blocks shall be taken from drawings and the designer may be consulted if anything is not clear

5.4 Placement and Temporary Fixing of Bearing

- I. Lift one end of the girder at a time using calibrated hydraulic jacks at designated lifting points. In multi-girder spans, all girder leaves shall be jacked simultaneously to avoid differential loading.
- II. After removal of temporary wooden packings, align the bearing with the surveyed center lines on the bed block. Ensure the final bearing position is within tolerance in both directions, avoiding parallax errors during alignment.
- III. **Shifting/Jacking:** Lower the superstructure gradually using hydraulic jacks so all bearings make simultaneous, even contact. Avoid eccentric force.
- IV. **Top plate engagement:** Ensure the top plate is level and accurately matches the slope/camber of the superstructure soffit.

5.5 Level and Alignment Verification

- I. Verify that each bearing is properly seated on the bed block and girder without tilt, distortion, or uneven contact.
- II. Check that all component clearances and gaps conform to the approved drawings and manufacturer's specifications.
- III. Inspect for any signs of distress, misalignment, uneven load transfer, or damage resulting from installation or cumulative tolerances.
- IV. Rectify all non-conformities and obtain final acceptance before releasing the bearing for service or commissioning.
- V. Verify the bearing number and line/level/alignment/orientation after final seating and before grouting.
- VI. Grouting readiness inspection should be completed and the particulars in table 6.1 should be verified and recorded before proceeding to grout the bearings.
- VII. Grouting Readiness Inspection and Pedestal preparedness checklist no - 5.1(a) & 5.1(b) is required to be filled before proceeding further.

6. Grouting of Bearings:

6.1. Formwork, Grout Preparation & Grout Placement

- i. Grout readiness inspection of the bearings has been completed, pre-installation activities verified, and any required rectifications duly complied with prior to grouting.
- ii. Approved non-shrink grout, either cementitious or epoxy-based as specified, shall be used for bearing installation in accordance with the approved specifications and manufacturer's recommendations. Following particulars to be verified. All relevant particulars pertaining to the non-shrink grout shall be recorded in Checklist No-6.1, which shall be completed and verified at site, prior to use.
- iii. "Non-shrink grout" shall be defined as a high-strength grout which does not shrink in the plastic state, is dimensionally stable in the hardened state, and bonds permanently to clean metal surfaces and concrete substrate.
- iv. The grout shall achieve the specified compressive strength as per the approved specification before the bearing is subjected to service loads.
- v. The tests as prescribed in Table 6.2 shall be carried out in an approved NABL-accredited laboratory to verify the compliance and quality of the grout prior to its use at site:
- vi. Verify that the pedestal/bed block concrete has attained the specified design strength before installation and grouting.
- vii. Mechanically roughen the concrete bearing surface after removing laitance, and ensure that the bearing seat, anchor pockets, and anchor bolts are clean and free from oil, grease, dust, curing compounds, laitance, and other contaminants to achieve proper grout bond.
- viii. Inspect the bearing base plate and anchor bolts for rust, damage or contaminants prior to grouting.
- ix. For cementitious non-shrink grout, maintain the concrete surface in Saturated Surface Dry (SSD) condition before grout placement.
- x. For epoxy grout (if specified), ensure all contact surfaces are completely dry before grouting.
- xi. Provide rigid, leak-proof formwork capable of containing grout without leakage or deformation.
- xii. Ensure complete grout filling beneath the bearing base plate without voids or air pockets to achieve full bearing support.
- xiii. A checklist table no 6.3 (A and B) is attached for reference.

6.2 Special Precautions

- i. Anchor bolt pockets shall be grouted in a single continuous operation using approved non-shrink grout to eliminate cold joints or layer separation within the grout mass.
- ii. After completion of grouting, inspect the bearing perimeter for any grout leakage or voids. Any leakage paths shall be sealed immediately with suitable mortar.
- iii. Ensure that the entire underside of the bearing base plate is fully supported. Any gaps or unfilled areas between the bearing base plate and the grout bed shall be pressure-filled or re-grouted to achieve complete bearing contact and uniform load transfer.

Stage 4	Removal of Transportation Clamps
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Procedure to be followed for removal of transportation clamps:

- i. Transportation clamps, locking plates, and temporary restraints provided by the manufacturer shall be removed only after complete load transfer onto the bearing and after ensuring that the grout has attained the specified strength. Premature removal may result in bearing displacement or misalignment.
- ii. Prior to removal, verify that the bearing is correctly seated, anchor bolts are fully secured, and no external restraint exists that may impede the designed translation or rotation of the bearing.
- iii. After removal, manually inspect the bearing to ensure that the sliding element, guide arrangement (for guided bearings), and rotational mechanism are free from obstruction and that all temporary restraint components have been completely removed from the bearing assembly.

7. Final Inspection and Acceptance

7.1 Record of Final Inspection:

- I. Final inspection should verify that the bearing has been installed in accordance with the design intent and is capable of performing its intended functions.
- II. A tabulated inspection checklist No 8.1 for final verification is provided for reference.

8. Documentation and Quality Records

- I. **Bearing Identification and Traceability Records:** Bearing identification register indicating bearing number, type, serial number, manufacturer, location, GAD reference, and installation date for future inspection and maintenance.
- II. **Survey and Dimensional Control Records:** Survey reports confirming bearing center coordinates, centerline alignment, Reduced Levels (RL), orientation, and as-installed geometry within the specified tolerances.
- III. **Grouting Quality Records:** Records of grout batch identification, water dosage, mixing time, ambient temperature, placement time, curing details, and laboratory test reports confirming compliance with the specified performance requirements.
- IV. **Material Compliance Records:** Manufacturer's Test Certificates (MTC), Technical Data Sheets (TDS), warranty certificates, and approved material submittals for POT-PTFE bearings, non-shrink grout, anchor bolts, HSFG fasteners, and associated accessories.
- V. **Calibration and Equipment Records:** Valid calibration certificates for survey instruments, torque wrenches, hydraulic jacks, pressure gauges, load cells, and other measuring and testing equipment used during installation.
- VI. **Non-Conformance and Corrective Action Records:** Records of non-conformities observed during installation, corrective measures implemented, re-inspection reports, and final closure of observations.
- VII. **Final Installation and Acceptance Records:** As-built drawings, final survey reports, inspection and test records and Final Acceptance Report duly certified by the Engineer, confirming that the bearing installation complies with the approved specifications and is fit for service.

9. Safety Precautions

- All lifting, jacking and bearing installation activities shall be carried out only after approval of the lifting methodology, and verification of the readiness of all personnel, equipment and work area.
- Hydraulic jacks, lifting appliances, cranes, slings, shackles, spreader beams and other lifting accessories shall possess valid inspection and proof load certificates and shall have adequate Safe Working Load (SWL) for the intended operation.
- The bridge girder shall remain adequately supported on temporary supports/jacks throughout the installation process. Removal or release of any support shall be carried out only in the approved sequence to prevent differential load transfer or instability.
- During lifting, positioning and load transfer operations, no personnel shall remain beneath suspended loads or within the designated danger zone. The work area shall be effectively barricaded and access restricted to authorized personnel only.
- Hydraulic pressure shall be applied and released gradually and uniformly to avoid impact loading, excessive differential deflection or unintended displacement of the girder and bearing.
- Non-shrink grout shall not be subjected to construction or service loads until it has attained the minimum specified compressive strength as specified in the approved method statement or manufacturer's recommendations.

PART III: Tables/Checklists/Figures

1) Table 2.1

Table 2.1: Incoming Bearing Schedule and Record							
SN	Bearing Type (Fixed/Guided /Free)	Bearing Mark / Bearing ID	Location (Span– Pier – Girder)	Bearin g GAD No. (if any)	Qty.	Traceability/ Dispatch Inspection Report No	Remarks
<u>Date of Receipt:</u> <u>Signature of Receiving Official:</u>							

2) Table: 2.2 (IRC 83 part III and BS 80)

Reference Table: 2.2: Tolerance	
Description	Permissible Tolerance
I. Plan dimension of assembled bearing	-0mm to +5mm or 0.5 per cent of plan dimension, whichever is higher
II. Overall height of assembled bearing	-0mm to +3mm or 1 per cent of overall height, whichever is higher.
III. Parallel-ness of top surface of assembled bearing w.r.t. the bottom surface as datum	1 in 200
IV. Height of confined elastomeric pressure pad	-0 per cent to +5 percent
V. Thickness of any machined steel component	-0mm to + 1mm
Ref:	IRS BS 80 (Table 4)
Remarks:	Approved drawings also to be referred.

3) **Table No-2.3 (Ref: IRC 83 Part III)**

<u>Table No: 2.3</u>			
<u>Parameter</u>	<u>Specified Requirement</u>	<u>If Requirement is Not Met</u>	<u>Functional Consequence</u>
Pot–Piston Diametrical Clearance	$\leq 1.0 \text{ mm}$	Clearance exceeds limit	Improper piston guidance causing non-uniform confinement of elastomer, eccentric load transfer and localized bearing pressure.
Peripheral Gap after Elastomer Installation	$\leq 0.2\%$ of pad diameter or 1.0 mm (whichever is higher)	Gap exceeds limit	Inadequate confinement of elastomer resulting in extrusion of elastomer under design compressive stress and loss of rotational performance.
Pin–Cylinder Diametrical Clearance (Pin Bearings)	+1.0 mm to +2.0 mm	Clearance below or above specified range	Insufficient clearance restricts rotation; excessive clearance induces impact, wear and stress concentration under cyclic loading.
Guide Sliding Material–Stainless Steel Clearance	+1.0 mm to +4.0 mm	Clearance outside specified range	Low clearance restrains longitudinal movement due to binding; excessive clearance causes excessive lateral play, impact and guide wear.
Surface Roughness (Rz) – Pot Inner Cylindrical Surface	$\leq 6.3 \text{ }\mu\text{m}$	Roughness exceeds limit	Increased friction and abrasion at the elastomer-pot interface leading to non-uniform stress distribution and accelerated elastomer deterioration.
Surface Roughness (Rz) – Pot/Piston Plane Surface in Contact with Elastomer	$\leq 25 \text{ }\mu\text{m}$	Roughness exceeds limit	Non-uniform contact pressure causing localized compression of elastomer, increased internal stresses and reduced bearing service life.

4) i) Standard Bearing Marking Scheme-01

ii) Figure-1 Identification Marking

Standard Bearing Marking Scheme-01	
▪ Ref: RB Letter issued on 03.07.26	
<u>Description</u>	<u>Requirement</u>
1) Details to Be Engraved/Embossed On Bearings	The following details, capable of being legible throughout the service life of bearings under normal wear conditions, shall be engraved/embossed on bearings: I. Manufacturer's name / registered trademark II. Unique identification number of bearing III. Manufacturing month and year (MM/YYYY) IV. Bridge No. at which the bearing is to be installed
2) Engraving/Embossing of the above details shall be carried out neatly without affecting the functionality, structural integrity, strength and durability of the bearings.	
3) Location of Markings	The marking shall be done on the cross-sectional faces of the bottom metallic plates (i.e. faces of bottom plate supported on pedestal), aligned across the track (on railway bridges) or as to roads (on ROB)
4) Font Size, Spacing & Graduations	The font size of letters and spacing shall be decided as per the thickness and width of plates or pads to ensure visibility and readability of the markings with naked eyes from at least 2m. Graduations to monitor movement shall be marked with indelible ink/paint with suitable line width/symbols.
5) Top of Bearing-Center Line Marking, Direction of Movement	In addition to the above, the top of the bearing shall have center-line markings and direction of movement/installations, together with movement graduations to monitor movement.
6) Other Important Information on Label	Other important information, viz. bearing designation, type of bearing, load & movement capacity, Centre-line markings to facilitate installation, direction of major and minor movement, pre-set, etc., shall be provided in the stainless steel or aluminum label of appropriate size fixed on the bearing.
7) Additional Information	Any additional information required under IRC: 83 (Part III) or as specified by Railways shall be provided separately with the supply order

5) Technical Specification Table no 2.4

Table No:2.4 -Technical Specification of POT PTFE Bearing	
1. Vertical Load:	
2. Longitudinal Force:	
3. Lateral Horizontal Force:	
4. Design Longitudinal movement:	
5. Design Transverse movement:	
6. Design Rotation:	

6) Figure-1

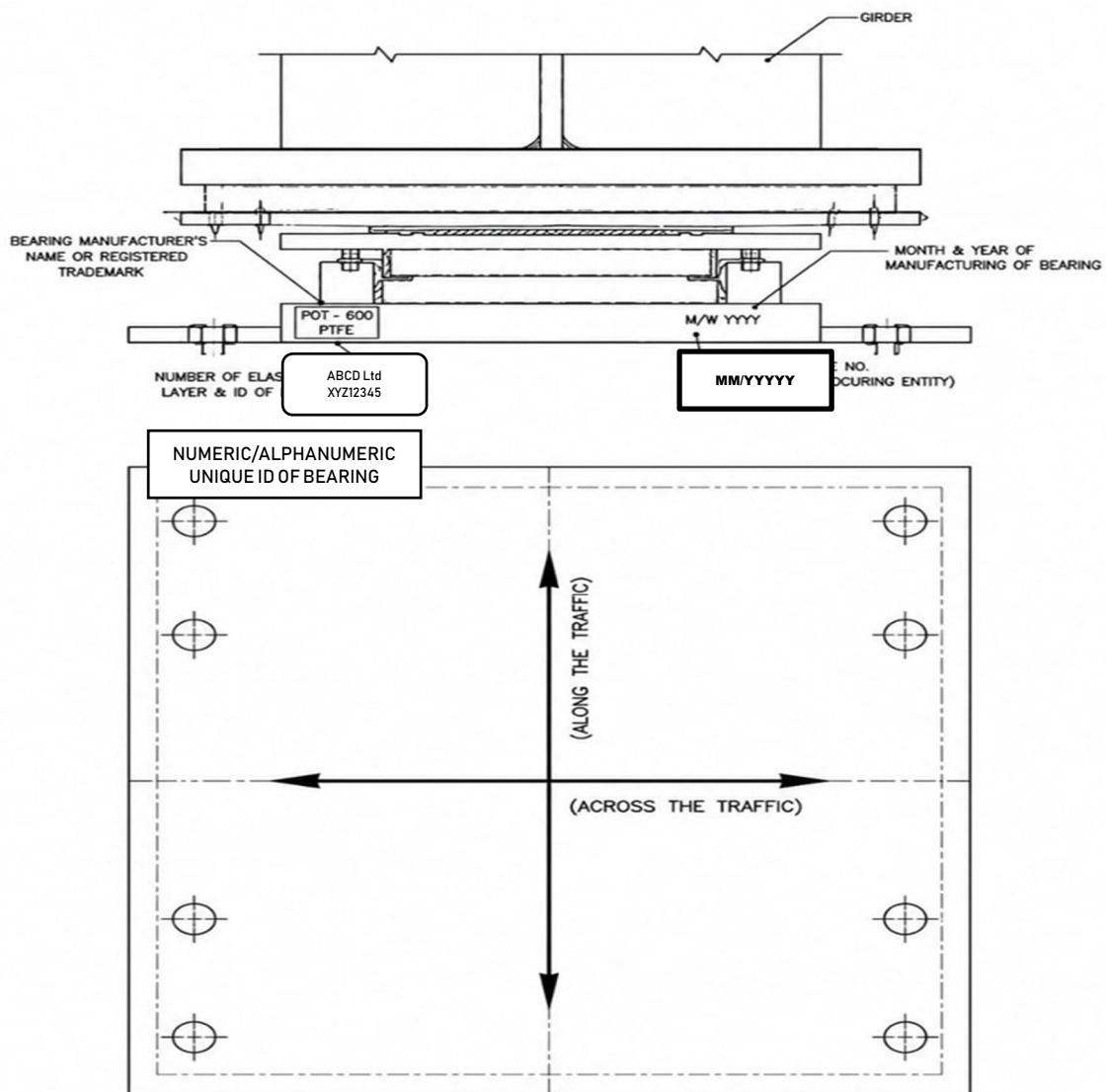


Figure 1-Identification marking

7) Checklist Table -2.5

Acceptance of Bearings for Installation- Checklist Table No: 2.5			
Verification Item	Requirement / Objective	Acceptance Criteria	Activity at site
Inspection Certification	Bearing shall have been inspected and accepted by the designated inspecting authority prior to dispatch.	Inspection/acceptance certificate available.	Verification of records (OK/NOT OK)
Traceability Documentation	Certified manufacturer's label containing bearing particulars shall accompany each bearing.	Label available and matches approved bearing schedule.	Verification of records (OK/NOT OK)
Unique Identification No	Bearing shall bear permanent and legible identification markings for complete traceability.	Markings clear, durable and verifiable. <i>As per Figure I (a/b)</i>	On Site Verification & Acceptance. (OK/NOT OK)
Manufacturer Identification	Manufacturer's name/trademark shall be permanently marked.	Verified. <i>As per Figure I (a/b)</i>	On Site Verification & Acceptance (OK/NOT OK)
Manufacturing Date	Month and year of manufacture shall be marked. (MM/YYYY)	Verified. <i>As per Figure I (a/b)</i>	On Site Verification & Acceptance (OK/NOT OK)
Bridge No	Bridge No at which Bearing is to be installed	Verified <i>As per Figure I (a/b)</i>	On Site Verification & Acceptance (OK/NOT OK)
Bearing Designation	Unique bearing identification shall correspond to approve GAD/Bearing Schedule.	Matches approved drawings.	On Site Verification & Acceptance (OK/NOT OK)
Bearing Type	Bearing type (Fixed/Guided/Free/POT-PTFE, etc.) shall be identified.	Verified prior to installation.	On Site Verification & Acceptance (OK/NOT OK)
Design Capacity marking	Vertical load and movement capacity shall be marked.	Matches design requirements.	On Site Verification & Acceptance (OK/NOT OK)

Installation Reference Marks	Permanent centerline markings shall be provided to facilitate accurate alignment.	Markings clearly visible.	On Site Verification & Acceptance (OK/NOT OK)
Movement Orientation	Major and minor movement directions shall be permanently indicated, where applicable.	Orientation verified before installation.	On Site Verification & Acceptance (OK/NOT OK)
Preset Identification (if any)	Preset value and direction, where specified, shall be clearly indicated.	Verified against approved preset requirements.	On Site Verification & Acceptance (OK/NOT OK)

8) **Table: 4.1 & Figure-A**

Table No: 4.1			
Document No	Name of the Document	Revision if any	Approval Confirmation
BR/GAD/No	GAD of the Bridge		Yes/No
BR/DD/No	Dimensional Detail of Bed Block/Pedestal		Yes/No
Bearing Installation Schedule/No	Bearing Installation Schedule		Yes/No
General Layout	Layout of Bearing on Pier Cap/Bed Block (Fig A)		Yes/No

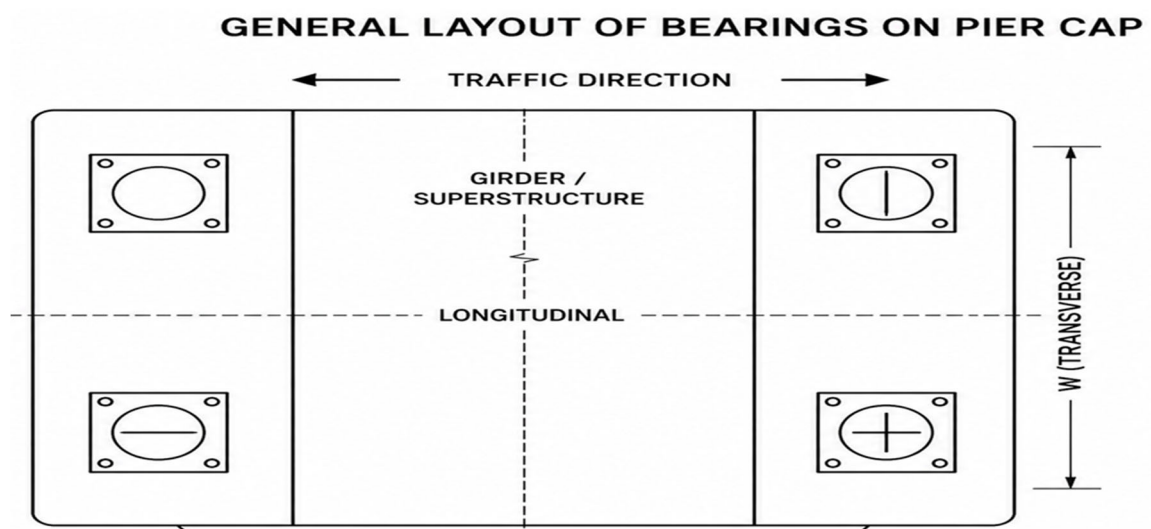


Figure A

9) Table: 4.2

Reference Table: 4.2		
Incorrect Practice	Engineering Failure	Consequences
Bearing not concentric with pedestal	Eccentric reaction	Unequal grout compression, one-sided PTFE wear
Pedestal dimensions outside tolerance	Inadequate bearing seating area	Edge loading, overstressing of concrete and improper load distribution
Cracked or honeycombed pedestal	Reduced bearing support	Local crushing, crack propagation and loss of bearing stability
Uneven bedding	Stress concentration	Cracked grout, rocking bearing
Wrong orientation of guided bearing	Movement restraint	Girder unable to expand in design direction

10) Table: 4.3 (Ref: IRC 83 Part II and BS 102 R)

Reference Table: 4.3	
Inspection Parameter	Acceptance Tolerance
Bearing Centerline Location	±3 mm from the design position
Bearing Level (Elevation) (For Continuous girders)	$\pm 0.0001 \times (\text{Sum of Adjacent Spans})$, subject to ±5 mm (maximum)
Bearing Horizontality	1 in 200 in any direction (unless otherwise specified)
Surface Condition:	Bearing seating shall be free from laitance, honeycombing, loose particles, oil, standing water and other contaminants before installation.
Survey Verification	Compliance with approved drawings
Corrective Action	Any deviation beyond specified tolerance shall be rectified.

11) Figure-2 & Figure 3

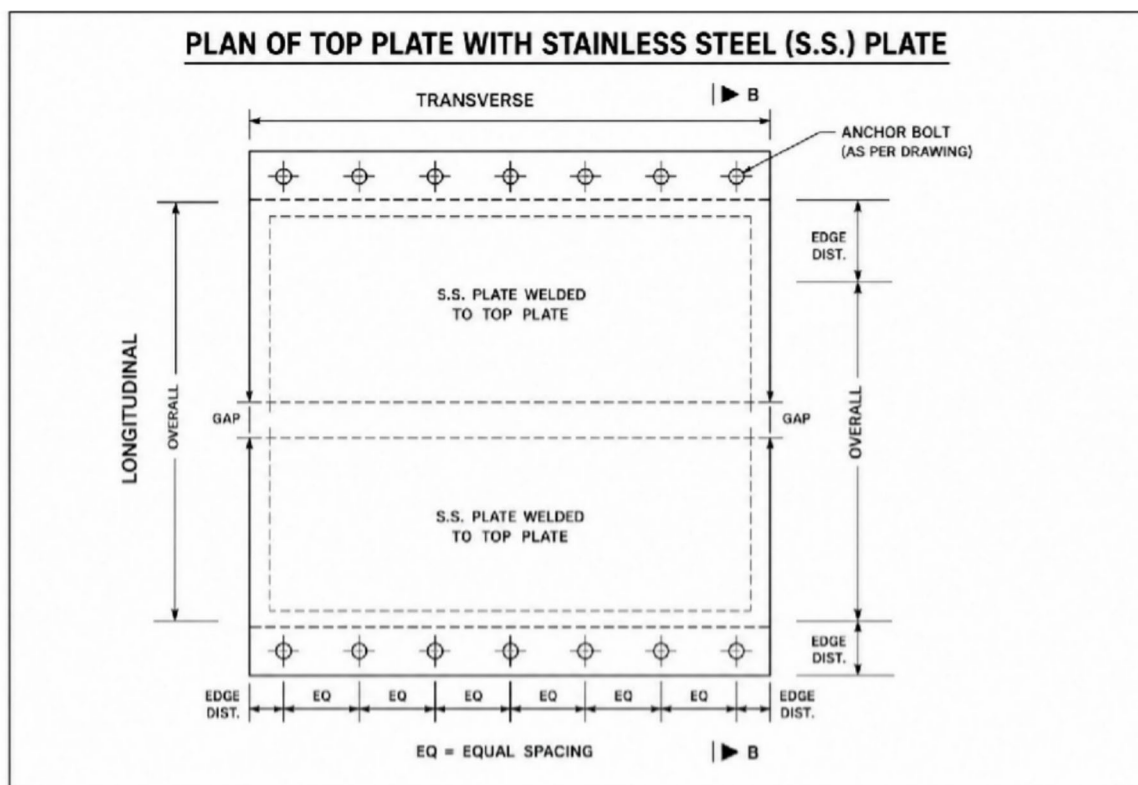


Figure 2

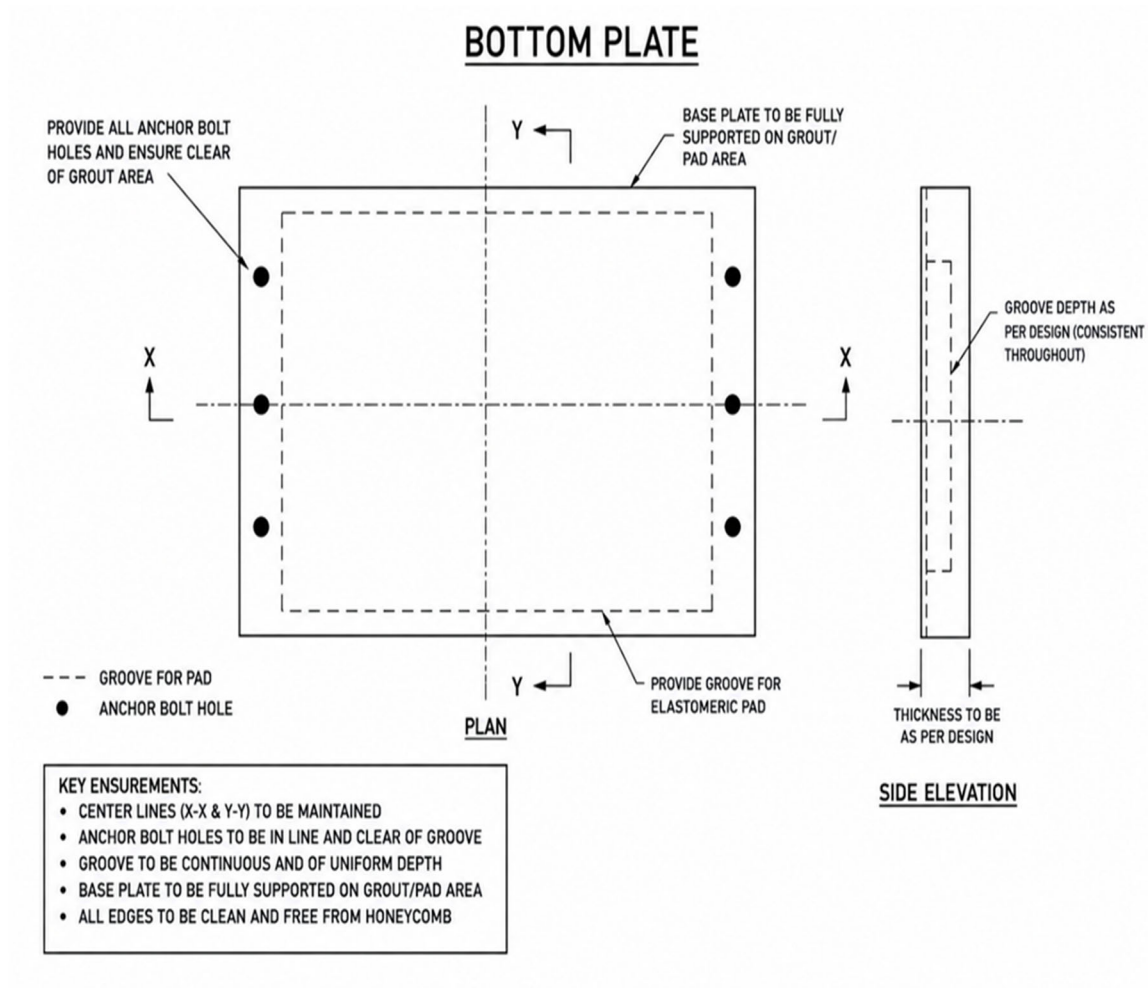


Figure 3.

12) Checklist table – 5.1(a)

Grouting Readiness Inspection Report No:							
Date of Inspection:							
Surveying Instrument Calibration Certificate no:							
Bearing Location (Pier No. / Pedestal No.):							
Details of Bearing (Type/Id/Manufacturer):							
C/L Marking on Pedestal	Identification Mark on Bearing	Level of Bed Block	Flatness of surface	Orientation of Bearing	Alignment of bearing w.r.t bed block	Any visible damage (Bearing/ Bed Block)	Remarks
✓	✓	✓	✓	✓	✓		Transportation clamps intact.
Signatures:							
Contractor's Representative				Railway Representative			

13) Checklist table – 5.1(b)

CHECKLIST AFTER PLACING BEARINGS				
SL. NO.	INSPECTION ITEM	ACCEPTANCE CRITERIA	STATUS (✓ / x / NA)	REMARKS
1	PEDESTAL DIMENSIONS	AS PER APPROVED GAD/DRAWINGS		
2	CENTRE LINE MARKING	CLEARLY MARKED AND MATCHES SURVEY COORDINATES		
3	BEARING LOCATION MARKING	BEARING OUTLINE MARKED CORRECTLY		
4	PEDESTAL LEVEL	WITHIN SPECIFIED TOLERANCE		
5	HORIZONTALITY OF TOP SURFACE	TRUE HORIZONTAL; NO NOTICEABLE UNDULATIONS		
6	SURFACE FINISH	SMOOTH, DENSE AND FREE FROM LAITANCE		
7	SURFACE SOUNDNESS	NO HONEYCOMBING, CRACKS OR LOOSE CONCRETE		
8	SURFACE CLEANLINESS	FREE FROM DUST, OIL, GREASE, CURING COMPOUND AND DEBRIS		
9	CHIPPING/ROUGHENING (WHERE SPECIFIED)	COMPLETED UNIFORMLY WITHOUT DAMAGING CONCRETE		
10	EDGE CONDITION	EDGES INTACT WITHOUT SPALLING OR BREAKAGE		
11	PEDESTAL PROJECTION BEYOND BEARING FOOTPRINT	MINIMUM 150 mm PROJECTION ON ALL SIDES OR AS PER APPROVED DRAWING		
12	REINFORCEMENT EXPOSURE	NO EXPOSED REINFORCEMENT ON BEARING SEAT		
13	DRAINAGE ARRANGEMENT	NO WATER ACCUMULATION ON PEDESTAL		
14	DRYNESS OF SURFACE	SURFACE DRY BEFORE BEARING/GROUT INSTALLATION		
15	CURING COMPLETED	REQUIRED CURING PERIOD ACHIEVED		
16	SURVEY VERIFICATION	COORDINATES, RL AND ORIENTATION VERIFIED		
17	READY FOR BEARING INSTALLATION	OVERALL ACCEPTANCE FOR NEXT ACTIVITY		
INSPECTING OFFICIAL [Name] : _____ SIGNATURE : _____ DESIGNATION : _____ DATE : _____				

14) Checklist Table No: 6.1

Grout Material Checklist Table: 6.1			
SN	Item to be Verified	Acceptance Criteria	Yes/No
i.	Product Name & Grade	Matches the approved material submittal and BOQ.	
ii.	Manufacturer	Of approved make.	
iii.	Batch/Lot Number	Clearly printed and traceable.	
iv.	Manufacturing Date	Clearly legible.	
v.	Expiry / Shelf Life	Within manufacturer's specified shelf life. Expired material shall be rejected.	
vi.	Bag Weight	Matches manufacturer declared net weight.	
vii.	Packaging Condition	Bags sealed, dry, and free from tears, punctures, or moisture damage.	
viii.	Technical Data Sheet (TDS)	Available	
ix.	Batch Test Certificate	Available for the supplied batch	
x.	Working Time / Pot Life	Adequate for the planned grouting operation under site temperature.	
xi.	Color & Appearance	Uniform dry powder, free from lumps or caking. Presence of hardened lumps indicates moisture ingress and the material should be rejected.	
xii.	Safety Information	Manufacturer's instructions	

15) Table No-6.2

NABL Test of Grout-Table No: 6.2				
SN	Test	Result	Acceptance	Remarks
i.	Compressive Strength (1, 3, 7 & 28 days)			
ii.	Flow ability (Flow Cone)			
iii.	Volume Stability / Expansion (Non-shrink Property)			
iv.	Setting Time			
v.	Drying Shrinkage			

16) Checklists: Grouting Checklist Table No 6.3

A. GROUT POCKET / BEARING SEAT READINESS CHECK					B. FORMWORK & GROUT CONTAINMENT CHECK				
SL.	CHECK ITEM	YES	NO	REMARKS	SL.	CHECK ITEM	YES	NO	REMARKS
1	BEARING LEVEL, ALIGNMENT AND CENTRE LINES VERIFIED	☐	☐		1	FORMWORK RIGID AND ADEQUATELY SUPPORTED	☐	☐	
2	GROUT POCKET DIMENSIONS CONFORM TO APPROVED DRAWING	☐	☐		2	FORMWORK JOINTS LEAK-PROOF	☐	☐	
3	SPECIFIED GROUT THICKNESS AVAILABLE BENEATH BASE PLATE	☐	☐		3	POCKET COMPLETELY ENCLOSED EXCEPT INLET AND VENT	☐	☐	
4	POCKET FREE FROM LOOSE CONCRETE, LAITANCE AND DUST	☐	☐		4	PVC / POLYVINYL FUNNEL SECURELY FIXED AT GROUT INLET	☐	☐	
5	OIL, GREASE AND OTHER CONTAMINANTS REMOVED	☐	☐		5	ADEQUATE GROUT HEAD AVAILABLE FOR GRAVITY FLOW	☐	☐	
6	STANDING WATER REMOVED AND SURFACE PREPARED AS SPECIFIED	☐	☐		6	AIR VENT PROVIDED AT OPPOSITE END	☐	☐	
7	ANCHOR BOLTS/SLEEVES CLEANED AND READY FOR GROUTING	☐	☐		7	BEARING SLIDING SURFACES PROTECTED AGAINST GROUT CONTAMINATION	☐	☐	
8	NO DEBRIS BENEATH THE BEARING BASE PLATE	☐	☐		8	ACCESS AVAILABLE FOR CONTINUOUS POURING	☐	☐	
9	ADEQUATE ACCESS AVAILABLE FOR GROUTING	☐	☐		9	BEARING REMAINS STABLE DURING FORMWORK FIXING	☐	☐	
10	GROUTING APPROVAL OBTAINED	☐	☐		10	FORMWORK INSPECTED AND READY FOR GROUTING	☐	☐	

INSPECTING OFFICIAL (Name) : _____

DESIGNATION : _____

DATE : _____

SIGNATURE : _____

17) Checklist Table No 8.1

Final Inspection Checklist Table No: 8.1		
<u>SN</u>	<u>Critical Items</u>	<u>Yes/No</u>
1	Bearing type and identification matches approved GAD.	
2	Correct fixed/free/guided location confirmed.	
3	Direction of movement verified.	
4	Bearing center line matches setting-out marks.	
5	Bed block level and horizontality within permissible tolerance.	
6	Full bearing seating achieved without rocking.	
7	Non-shrink grout fully cured and free of voids.	
8	PTFE and stainless steel surfaces clean, undamaged and free from contaminants.	
9	Required movement and rotational clearance available.	
10	Transportation clamps and temporary restraints removed after installation.	
11	Bearing area cleaned and ready for service.	
Date of inspection: Signature of Inspecting Official:		

(8)
METHOD STATEMENT
FOR
INSTALLATION OF SPHERICAL BEARINGS



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1. Introduction

1.1 Scope

This Method Statement describes the procedure for the receipt, inspection, storage, handling, installation, alignment, grouting, and final inspection of Spherical bearings for bridge superstructures. The procedure covers activities necessary to ensure the correct positioning and installation of bearings in accordance with the approved drawings, manufacturer's recommendations and relevant codes and standards.

This Method Statement comprises three parts (Part I, Part II, and Part III). Part I covers the pre installation activities, Part II details the bearing installation procedure, and Part III contains the post installation checks and final acceptance.

All activities shall be carried out in accordance with the approved construction drawings, manufacturer's installation manual, applicable Railway/IRC specifications, relevant standards, and the instructions of the Engineer-in-Charge.

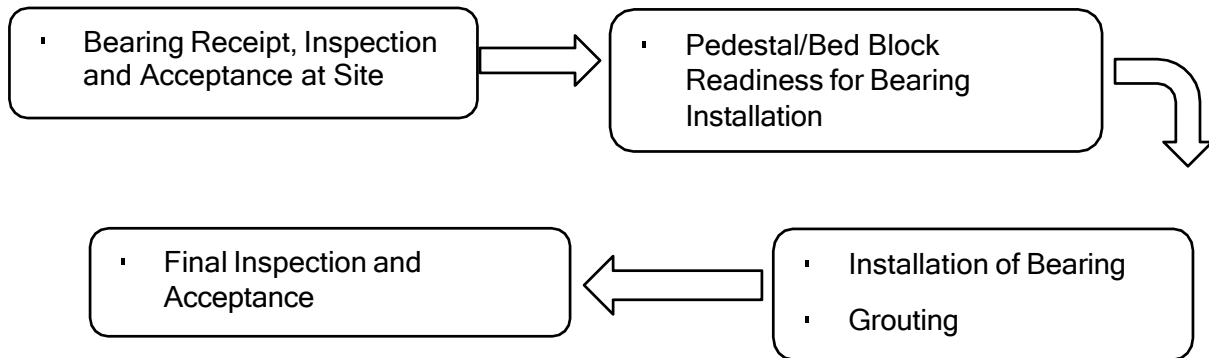
1.2 Applicable Codes and Standards

- i. Approved General Arrangement (GAD) Drawings
- ii. Manufacturer's Approved Drawings, *QAP & ITP* for the supplied Spherical Bearings.
- iii. Report No.BS-102R
- iv. Indian Railway Standards (IRS)-B1
- v. IRC 83 Part IV

1.3 Inspection and Measurement Equipment

- All survey instruments, measuring devices, and equipment used for inspection, compliance verification, and measurements shall be duly calibrated and conform to the applicable standards.
- Following tools should be available at site for verification and inspection:
 - i. Feeler gauge
 - ii. Measuring tape
 - iii. Telescopic gauge for tilt gap
 - iv. Two straight edges of length 300mm and 500mm
 - v. Thermometer
 - vi. Total station for surveying the control points
 - vii. DFT measuring elcometer
 - viii. Torque Wrench

1.4 Sequence of Activities



1.5 Activity Monitoring and Control Checkpoints

Stage-wise Activity Control Checks		
SN	Stage No. and Activity	Check Point CP
i.	Stage 01 ▪ Bearing Receipt, Inspection and Acceptance at Site	Check Point 01 CP 01
ii.	Stage 02 ▪ Pedestal/Bed Block Readiness for Bearing Installation	Check Point 02 CP 02
iii.	Stage 03 ▪ Installation Activities ▪ Grouting Readiness	Check Point 03 CP 03
iv.	Stage 04 ▪ Removal of Temporary/Transportation Clamp Stage 05 ▪ Final Inspection and Acceptance	Check Point 04 CP 04

Part I	Pre Installation Activities
Stage 01 ▪ Bearing Receipt, Inspection and Acceptance at Site ▪ Storage and Handling of Bearings Stage 02 ▪ Pedestal/Bed Block Readiness for Bearing Installation	

Stage 01

2. Bearing Receipt, Inspection and Acceptance at Site

2.1 Bearing Receipt and Identification Schedule

Upon receipt at site, all bearings shall be unloaded under supervision of an official. Each bearing shall be subjected to an incoming inspection to verify the accompanying documentation, including the pre-dispatch inspection report and transportation challan, along with the bearing identification markings, physical condition, and completeness of accessories. An Incoming Bearing Receipt Checklist and Record, incorporating all relevant particulars as specified in Table 2.1, shall be prepared, duly verified, and maintained for traceability and future reference.

2.2 Traceability, Identification and Marking on Bearings

2.2.1 Marking on Bearings

- i. Permanent, non-editable identification markings shall be engraved/embossed on every Spherical bearing to ensure traceability, unambiguous field identification, correct orientation, direction of movement, and fixity during installation, inspection, and throughout its service life.
- ii. The functional performance of each bearing is dependent on its installation at the designated location and in the correct orientation. Any incorrect identification, location, or orientation may impair the intended structural behavior of the bridge. Accordingly, all incoming bearings shall be inspected and verified for identification markings, bearing type, orientation, and designated installation location prior to acceptance and installation
- iii. The recommended marking requirements is provided in Marking Scheme-01 as a reference.
- iv. It shall be ensured that the marking on all incoming bearings conforms to the standard marking scheme.

2.2.2 Symbols & Notations

- The symbolic representation of the bearing function (Fixed/Guided/Free), movement direction and other installation references shall be permanently and legibly marked using indelible ink, durable paint, stamping or other approved permanent marking method.

2.2.3 Inspection Checklist for marking and identification

- All bearings received at site shall be individually inspected to verify identification markings, traceability records, and compliance with approved documentation. The inspection shall be carried out with reference to the (Table 2.2 (a) & (b)) & checklist (Table 2.3) and record of inspection should be maintained for future reference.

2.3 Dimensional and general verification

Spherical Bearings intended for use in Railway Bridge works shall comply with the dimensional tolerance limits specified in approved QAP of bearing manufactured or as specified in IRC 83 part IV. Table 2.4 provides a reference for assessing and confirming dimensional tolerance requirements for verification and compliance.

2.4 Movement Scale

The movement scale shall be rigidly fixed to the moving component of the spherical bearing, and the movement indicator (pointer) shall be attached to the fixed component. The arrangement shall permit clear observation and measurement of the bearing displacement in the direction of movement during inspection. A reference figure is provided as Fig. 02

3. Storage & Handling

- i. Bearings shall be stored in a covered area, protected from direct sunlight, moisture, dust, chemicals, and mechanical damage. Protective packing if any and transit locking devices shall remain intact until the time of installation.
- ii. Bearings shall be Packed in Heavy Duty Polythene Sheets and firmly clamped on the Wooden crates for safe Transportation.
- iii. Bearings shall be provided with temporary transportation clamps to avoid separation of parts during transportation and erection.
- iv. Bearings shall be transported and handled using suitable lifting equipment and designated lifting points without imposing impact, shock, dragging, or lifting through anchorage bolts or PTFE/stainless steel sliding surfaces. All machined surfaces shall be adequately protected during transit.
- v. Transport Brackets are not to be relied for the Lifting of the Bearings.

- vi. Any damaged bearing shall be segregated and shall not be installed until accepted by the Engineer in charge.

Check Point: 01 Receipt, Storage and Handling Compliance check				
Sequence of activities Performed on Receipt of Bearings at site				
Sl. No.	Activity / Parameter	Acceptance Check	Record / Document	Objective
i.	Receipt, unloading, inspection, verification, and documentation of all incoming bearings at site.	Inspection and Monitoring during Bearing Receipt.	Table No-1	To ensure safe receipt, unloading, inspection, and documentation of all incoming bearings and also maintaining complete records.
ii.	Traceability, Identification and Marking on Bearings.	Verification of the conformity of markings on all received bearings with the approved marking scheme.	Table 2.2 (a) Table 2.3	Markings on all received bearings conform to the approved marking scheme, enables correct identification, traceability, and installation at the designated location.
iii.	Dimensional and General Condition Verification.	Verification of Dimensional Compliance and Overall Condition at site for each bearings received.	Table 2.4	Verification of dimensional compliance and overall condition of each bearing received at site to ensure that the correct bearing has been delivered and that no damage has occurred during transportation.
iv.	Storage & Handling at site.	To ensure storage in a dry and covered location.		Appropriate storage conditions are maintained to protect bearings from moisture, dust, direct sunlight, and physical damage.
Certificate of Compliance: It is hereby certified that all bearings received at site have been inspected sequentially as per the sequence depicted above and all Checklists/tables are endorsed by the authorized personnel with their signatures, confirming compliance with the specified requirements. The bearings are accepted for further installation at Bridge no-XYZ. <u>Name and Signature of the In charge Official with date:</u>				

4. Pedestal/Bed Block Readiness for Bearing Installation Activities to be Completed Prior to Bearing Installation:

- i. Drawing and Document Verification (Approved GADs, bearing drawings, bearing layout plan, ITP, checklists, etc.)
- ii. Pedestal/Bed Block Inspection and Preparation (Dimensions, level, alignment, surface finish, cleanliness, and compliance with specified tolerances.)
- iii. Grouting Readiness Verification (Verification of correct bearing placement/orientation/ underside of girder etc.)

4.1 Drawings and Documents

- i. All latest approved drawings, bearing schedules, and installation drawings shall be compiled, maintained as controlled records, and referred to throughout the installation process to ensure correct bearing identification, location, orientation, and installation sequence.
- ii. Table 4.1 shall be filled, verified, and retained for all activities and reference.

4.2 Preparation of Bed Block/Pedestal

- i. Bearing installation shall ensure precise control of bearing location, level, alignment, orientation, and seating so that the design load is transferred correctly from the superstructure to the substructure.
- ii. Before installation, the general condition of the pedestal, concrete strength, dimensional accuracy, anchor hole locations, and bearing seating surface shall be inspected and confirmed to comply with the approved drawings and specified tolerances.

4.2.1 Control Point survey and general inspection of Pedestal/Bed Block

a) Incorrect Practice and consequences

The performance of Spherical bearings is highly dependent on proper installation. A list of common incorrect practices and their associated consequences is provided in Table 4.2 for guidance during field installation.

b) Acceptance Criteria for Finished Pedestals/Bed Blocks

The acceptance criteria for finished pedestals/bed blocks, in accordance with BS 102-R and IRC: 83 (Part IV), are summarized in Table 4.3.

4.3 Placement of Bearing at Pedestal

- i. The designated location of each bearing shall be positively identified before placement. Every pedestal shall be permanently marked with the corresponding unique bearing identification using durable paint or any other approved permanent marking system.
- ii. The unique identification marked on the pedestal shall be verified against the unique identification marked on the bearing and the approved Bearing Layout Drawing (BLD)/General Arrangement Drawing (GAD) to ensure that the correct bearing is placed at its designated location.
- iii. A Bearing Layout Plan, as illustrated in Layout Plan No. 4.4, shall be prepared and adhered at the site for reference. All bearings shall be placed on their respective pedestals strictly in accordance with the approved bearing layout before installation.
- iv. After placement of all bearings on their designated pedestals, a joint verification shall be carried out by the OEM representative and the Railway representative. The verification shall confirm the correctness of bearing type, unique identification, orientation, and location. The observations shall be recorded in Checklist Table No. 4.5, duly signed by both representatives, before commencement of bearing installation.

4.4 Preparation of Bearing Seat

4.4.1 Underside of the Girder Interface

- The compatibility between the underside of the girder (Steel/Concrete) and the top surface of the bearing shall be thoroughly inspected to ensure that the bearing fixing arrangement has been correctly designed and fabricated to accommodate the superstructure for secure attachment. Full and uniform contact, proper seating, and conformity with the bearing geometry shall be verified. Any mismatch, dimensional discrepancy, surface irregularity, or interference shall be rectified before final installation.
- **Surface Flatness:** Check the underside of the girder at the bearing location using a 200 mm long straight edge. Mark any undulation variation exceeding ± 1 mm for immediate rectification.
- **Girder Type Specifics:** Verify steel girders for any bottom flange or chord distortion for steel girders and inspect concrete girders to ensure a smooth, uniform surface finish.

- **Precast Inspection Support:** Inspect finally assembled precast girders before launching by supporting them at jacking points or adjacent locations to keep the actual bearing zone completely free for checking.

4.5 Anchor sleeve

- A schematic illustration of the anchor sleeve arrangement for bearing installation, including anchor bolt embedment and grouting details, is shown in Figure 04.

4.6 Pedestal Readiness checks

3 Pedestal readiness checks (A, B& C) as referred in Fig-05 are outlined for reference and to verify compliance and readiness prior to bearing installation.

Check Point 2: Pedestal Readiness Compliance Check			
Pedestal Readiness			
SN	Activity	Key Requirements	Reference (Table / Checklist / Figure)
1	General condition of Bed Block/pedestal ▪ Approved Drawings/Scheme verification ▪ Alignment, Centerline & Level verification	Drawings and Documents should be compiled and verified for approval and correctness. A table comprising list of all approved drawings/documents to be filled and referred for all further activities.	Table 4.1
		Table 4.2 provides a summary of incorrect installation practices and their consequences. Compliance with these recommendations shall be ensured during installation activities.	Table 4.2

		The acceptance criteria for finished pedestals/bed blocks	Table 4.3
2	Bearing Layout Plan,	A Bearing Layout Plan, as illustrated in Layout Plan No. 4.4, shall be prepared and adhered at the site to ensure that the correct bearing is placed at its designated location.	Layout Plan

3	a) Joint verification by OEM and Railway representative	I) Inspection to confirm the correctness of bearing type, unique identification, orientation, and location.	Checklist Table No. 4.5
	b) Underside of the Girder Interface	II) Check the underside of the girder at the bearing location	Para 4.4.1
4	Anchor Sleeve for bearing installation	Mark the anchor bolt locations in accordance with the approved installation plan, and prepare the anchor sleeves for grouting.	Fig-A
5	Overall Check	Verification of Pedestal Readiness	Figure-05

Check Point-02: Certification of Pedestal Readiness

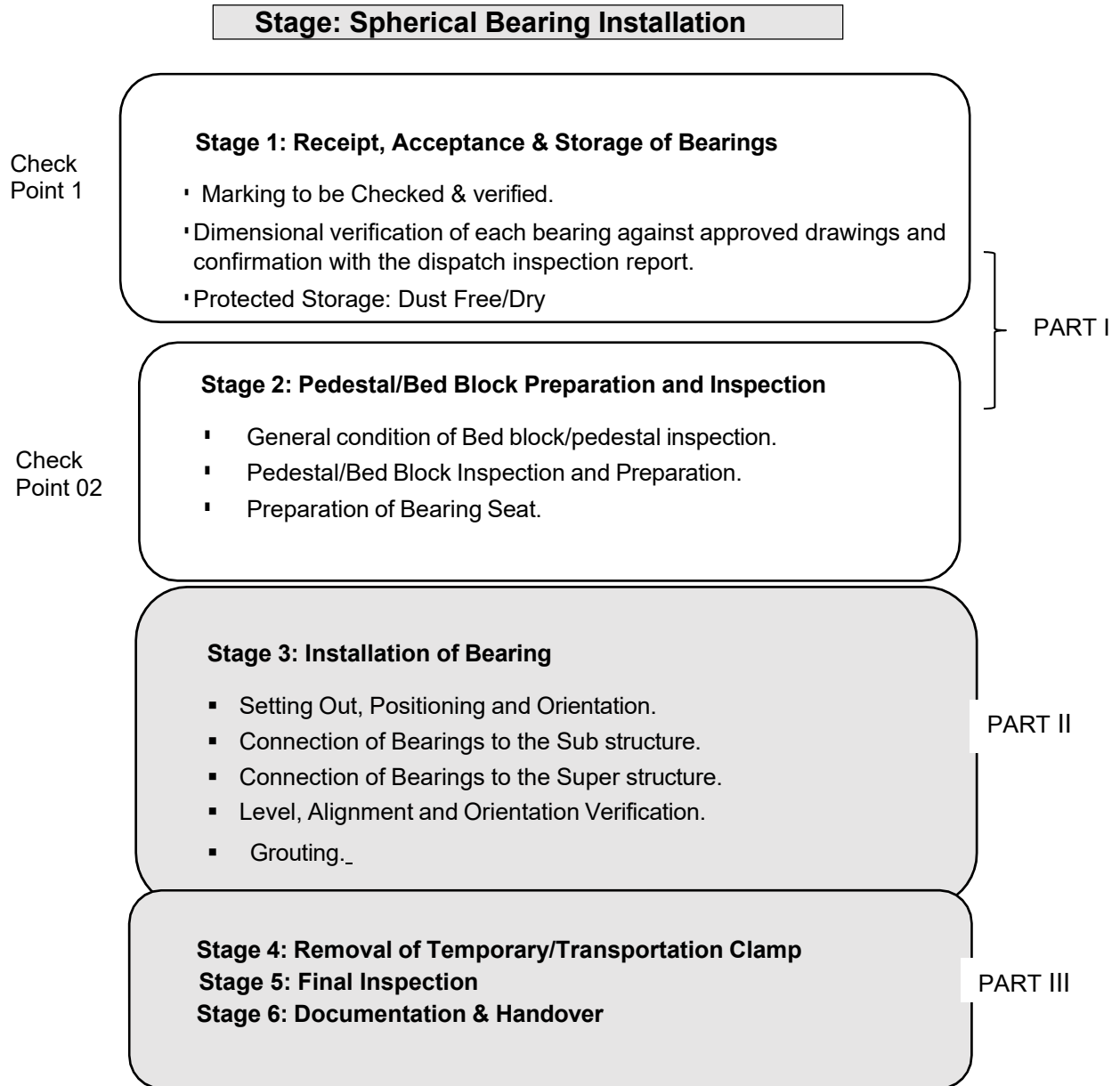
SN	Table No/Checklist No	Complied (Yes/No)
i.	Table: 4.1-List of Reference Drawings and Bearing Schedules	
ii.	Table 4.2- List of common incorrect practices and their associated consequences referred.	
iii.	Table: 4.3 Acceptance Criteria for a finished pedestal. (Ref: IRC 83 Part II and BS 102 R)	
iv.	Layout Plan 4.4-Layout Plan for Bearing Installation	
v.	Table No: 4.5 Placement of Bearings at designated location	
vi.	Checklist No: 4.6-Overall verification of pedestal and bearing after being placed	
vii.	Checklist table – 5.1(a) & Checklist table – 5.1(b)	

It is certified that all preparatory and pre-installation requirements pertaining to the preparation and readiness of Pedestal/Bed Block for the installation of spherical bearings at Bridge No. ... have been completed, verified, and documented. The site is found ready for commencement of further Bearing installation works.

Name and Signature of the In-charge Official with Date:

PART II	▪ Installation of Spherical Bearings ▪ Grouting
----------------	--

5. Stages of Installation



Note:

- Documents recorded in earlier stages shall be re-verified at every subsequent stage.
- CP-01: Check Point 01 & CP-02: Check Point 02 complied.

Stage 3	Installation of Spherical Bearing
----------------	--

Activities of Installation
Activities 1) Placement of Bearings i. Setting Out, Positioning and Orientation 2) Connection of Bearings to the Sub structure i. Fixing of Bearing to Anchor Bolts/Dowels ii. Tightening of Nuts and Temporary Securing 3) Connection of Bearings to the Super structure i. Fixing of Bearing to the Bottom of Superstructure 4) Level, Alignment and Orientation Verification
5) Pre Grouting Inspection
6) Grouting

5.1 Placement of Bearings**5.1.1 Setting Out, Positioning of Bearing and Orientation**

- i. After placing the bearing on the pedestal/Bed Block, verify that the sliding direction, guide orientation, and bearing type (fixed, guided, or free) conform to the approved GAD.
- ii. For spherical bearings, orientation and overall positioning shall be jointly verified by the Site Engineer and the manufacturer's representative for confirmation.
- iii. The center line of the top portion of bearing and center line of the sub-structure is clearly marked with paint or suitably engraved and bearing positioned correctly as per the markings.
- iv. Pedestal/bed block location, level, and slope conform to the approved drawings; any ambiguity is referred to the designer.

- v. Shimming & Levelling: Place steel shims or wedges at the four corners under the bottom plate to adjust the bearing to the exact design elevation.
- vi. Alignment tolerance: Verify that the bearing is level and within the specified installation tolerances.

5.2 Connection of Bearings to the Pedestal/Bed Block (Sub structure)

- i. Align the bearing with the surveyed center lines on the bed block. Ensure the final bearing position is within tolerance in both directions, avoiding parallax errors during alignment.
- ii. Verify that the bearing base plate is fully seated on the pedestal/bed block, correctly levelled, and oriented as specified in the approved drawings.
- iii. Ensure that the anchor bolts/studs project the required length above the pedestal and are correctly aligned to permit proper seating of the bearing and subsequent grouting.
- iv. Ensure that the anchor studs/tension anchors are embedded to the required depth as specified in the approved drawings.
- v. Do not weld the anchor studs/tension anchors to the pedestal/bed block reinforcement or any structural member to achieve temporary stability or alignment.

5.3 Connection of Bearings to the Super structure

- i. Lower the superstructure gradually using hydraulic jacks until the sole plate or embedded plate comes into contact with the bearing top plate, ensuring simultaneous and uniform contact at all bearings without transferring the superstructure load to the bearings
- ii. While the superstructure remains fully supported on hydraulic jacks or temporary stools, align the connecting holes in the bearing upper plate with the corresponding holes in the Superstructure.
- iii. Secure the bearing to the underside of the superstructure using the specified bolts, nuts, washers, and other fasteners in accordance with the approved drawings and the manufacturer's installation instructions.
- iv. Maintain the superstructure on hydraulic jacks or temporary stools until the grout has attained the specified strength. No permanent load shall be transferred to the bearings during this period.
- v. After the grout has attained the specified strength, gradually release the hydraulic jacks to ensure simultaneous and uniform transfer of the superstructure load to all bearings.

5.4 Level, Alignment and Orientation Verification

- i. Verify that each bearing is properly seated on the bed block and girder without tilt, distortion, or uneven contact.
- ii. Check that all component clearances and gaps conform to the approved drawings and manufacturer's specifications.
- iii. Verify the bearing number and line/level/alignment/orientation after final seating and before grouting.
- iv. Verify that the bearing top plate is in full and uniform contact with the girder seating surface and that it conforms to the designed slope/cross fall of the superstructure without any gap, rocking, or eccentric seating.
- v. Prior to grouting, a Grouting Readiness Inspection and Pedestal preparedness checklist no -5.1(a) & 5.1(b) shall be verified, found satisfactory, and duly recorded.

6. Grouting of Bearings:

6.1 Grouting Procedure

- i. Grouting shall commence only after acceptance of the bearing identification, location, orientation, level, alignment, anchor bolt position, and specified grout gap. Check Point 03 should mandatorily be complied and recorded before commencement of grouting.
- ii. The approved non-shrink cementitious grout shall be verified prior to use. The grout type, manufacturer's test certificate, batch number, manufacturing date, shelf life, storage condition, and compliance with the approved project specifications shall be checked. Checklist Table No. 6.1 shall be completed and verified prior to commencement of grouting.
- iii. Prior to commencement of grouting, compliance of the approved non-shrink grout with the specified performance requirements shall be verified based on valid NABL-accredited laboratory test reports, as given in Table No. 6.2.
- iv. The bearing seat shall be thoroughly cleaned to remove laitance, loose concrete, dust, oil, grease, curing compounds, and all other contaminants.
- v. The grout shall be placed within the temperature range specified by the manufacturer.
- vi. Leak-proof formwork shall be installed around the bearing with adequate grout head and discharge outlets to facilitate continuous grout flow and ensure complete filling beneath the bearing base plate.
- vii. Checklist Table No. 6.3 shall be completed and verified prior to grout placement

to confirm the readiness of the grouting pocket and formwork.

- viii. It is preferable that grouting activity be carried out in the presence of the bearing and/or grout manufacturer's technical representative.
- ix. Approved non-shrink cementitious grout shall be mixed mechanically in the proportions recommended by the manufacturer. Mixing duration, consistency, and permissible working (pot) life shall be strictly maintained.
- x. Grout shall be poured continuously from one side only, maintaining a constant grout head until grout flows uniformly from the opposite side without entrapped air, thereby confirming complete filling beneath the bearing.
- xi. During and after grout placement, the bearing assembly shall not be disturbed, re-levelled, or adjusted.
- xii. Any leakage from the formwork shall be sealed immediately to prevent grout loss. Grouting shall continue without interruption until complete and uniform filling beneath the bearing is achieved.
- xiii. Freshly placed grout shall be protected against vibration, impact, rain, direct sunlight, and rapid moisture loss. Curing shall be carried out strictly in accordance with the grout manufacturer's recommendations.
- xiv. Representative grout specimens shall be prepared and tested for compressive strength in accordance with the manufacturer's recommendations and the project specifications. All test results shall be included in the Quality Assurance records.

6.2 Special Precautions

- i. Anchor bolt pockets shall be grouted in a single continuous operation using approved non-shrink grout to eliminate cold joints or layer separation within the grout mass.
- ii. Ensure that the entire underside of the bearing base plate is fully supported by the grout. Any voids, gaps, or unfilled areas beneath the bearing shall be rectified using an approved method to achieve full bearing contact and uniform load transfer.
- iii. Use clean, dry compressed air immediately before grouting to remove dust, loose particles, moisture, and other contaminants from the bearing seat, anchor pockets, and surrounding surfaces.
- iv. Grouting of bearings shall not be carried out during rainfall or under weather conditions that may adversely affect the quality, placement, or curing of the grout. weather
- v. After completion of grouting, inspect the bearing perimeter for any grout leakage

or voids. Any leakage paths shall be sealed immediately with suitable mortar.

- vi. Although non-shrink grout is designed to compensate for shrinkage, the grout shall be inspected during and after grouting to ensure that no shrinkage, settlement, voids, or debonding have occurred.

Check Point No -03 Pre Grouting Compliance Check		
SN	Table No/Checklist No	Complied (Yes/No)
i.	Checklist No -5.1(a) & 5.1(b)	
ii.	Checklist Table No. 6.1	
iii.	Table No. 6.2.	
iv.	Checklist Table No. 6.3	
It is certified that all preparatory and pre-grouting requirements for the installation of spherical bearings at Bridge No. XYZ have been completed, verified, and documented. The site is found ready for commencement of grouting activity. <u>Name and Signature of In charge Official with Date:</u> <u>Note:</u> "Grouting shall not be commenced during rainy conditions or when rainfall is anticipated."		

Part III Final Inspection and Acceptance	
Stage 4	Removal of Transportation Clamps

7. Procedure to be followed for removal of transportation clamps

- i. Transportation clamps, locking plates, and temporary restraints provided by the manufacturer shall be removed only after complete load transfer onto the bearing and after ensuring that the grout has attained the specified strength. Premature removal may result in bearing displacement or misalignment.
- ii. Prior to removal, verify that the bearing is correctly seated, anchor bolts are fully secured, and no external restraint exists that may impede the designed translation or rotation of the bearing.
- iii. After removal, manually inspect the bearing to ensure that the sliding element, guide arrangement (for guided bearings), and rotational mechanism are free from obstruction and that all temporary restraint components have been completely removed from the bearing assembly.

8. Final Inspection and Acceptance

8.1 Record of Final Inspection:

- i. Final inspection should verify that the bearing has been installed in accordance with the design intent and is capable of performing its intended functions.
- ii. Inspect the installed bearing to confirm compliance with the specified installation tolerances for position, alignment, level, and orientation.
- iii. Verify that all bearing components, fasteners, movement indicators, and accessories are complete, properly secured, and free from cracks, deformation, damage, or any other visible defects.
- iv. Inspection checklist No 8.1 for final verification is provided for reference.

Check Point No -04 Final Acceptance Compliance Check		
SN	Table No/Checklist No	Complied (Yes/No)
1.	Inspection checklist No 8.1 complied.	
2.	Check Point 01, 02 and 03 documented.	
3.	The superstructure work has been completed and securely fixed in its final position.	
4.	Transportation Clamp/Temporary Clamp removed.	

1) It is hereby certified that all activities pertaining to receipt and handling of the bearing (CP-01), preparation and readiness of the pedestal (CP-02), pre-grouting checks (CP-03), post-grouting inspection, and curing in connection with the installation of the spherical bearing at Bridge No. XYZ have been duly completed, inspected, verified, and documented.

2) Upon completion of the above activities and satisfactory verification of the Bearings post installation, the bearing has been found to be properly installed, correctly aligned and oriented, adequately grouted, and duly cured, and is hereby certified as fit and ready for transfer of the design load.

Name and Signature of In charge Official with Date:

9. Documentation and Quality Records

- i. Bearing Identification and Traceability Records: Bearing identification register indicating bearing number, type, serial number, manufacturer, location, GAD reference, and installation date for future inspection and maintenance.
- ii. Survey and Dimensional Control Records: Survey reports confirming bearing center coordinates, centerline alignment, Reduced Levels (RL), orientation, and as-installed geometry within the specified tolerances.
- iii. Grouting Quality Records: Records of grout batch identification, water dosage, mixing time, ambient temperature, placement time, curing details, and laboratory test reports confirming compliance with the specified performance requirements.
- iv. Material Compliance Records: Manufacturer's Test Certificates (MTC), Technical Data Sheets (TDS), warranty certificates, and approved material submittals for Spherical bearings, non-shrink grout, anchor bolts, HSFG fasteners, and associated accessories.
- v. Calibration and Equipment Records: Valid calibration certificates for survey instruments, torque wrenches, hydraulic jacks, pressure gauges, load cells, and other measuring and testing equipment used during installation.
- vi. Non-Conformance and Corrective Action Records: Records of non-conformities observed during installation, corrective measures implemented, re-inspection reports, and final closure of observations.
- vii. Final Installation and Acceptance Records: As-built drawings, final survey reports, inspection and test records, commissioning checklist, and Final Acceptance Report duly certified by the Engineer, confirming that the bearing installation complies with the approved specifications and is fit for service.

10. Safety Precautions

- All lifting, jacking and bearing installation activities shall be carried out only after approval of the lifting methodology, and verification of the readiness of all personnel, equipment and work area.
- Hydraulic jacks, lifting appliances, cranes, slings, shackles, spreader beams and other lifting accessories shall possess valid inspection and proof load certificates and shall have adequate Safe Working Load (SWL) for the intended operation.
- The bridge girder shall remain adequately supported on temporary supports/jacks throughout the installation process. Removal or release of any support shall be carried out only in the approved sequence to prevent differential load transfer or instability.
- During lifting, positioning and load transfer operations, no personnel shall remain beneath suspended loads or within the designated danger zone. The work area shall be effectively barricaded and access restricted to authorized personnel only.
- Hydraulic pressure shall be applied and released gradually and uniformly to avoid impact loading, excessive differential deflection or unintended displacement of the girder and bearing.
- Non-shrink grout shall not be subjected to construction or service loads until it has attained the minimum specified compressive strength as specified in the approved method statement or manufacturer's recommendations.

Tables/Checklists/Figures

1) Incoming Bearing Receipt Checklist Table 2.1

TABLE 2.1: INCOMING BEARING RECEIPT CHECKLIST AND RECORD										
SN	BEARING UNIQUE ID	BEARING TYPE (FIXED / GUIDED / FREE)	PROPOSED LOCATION (SPAN / PIER NO. / PEDESTAL NO.)	PRE-DISPATCH INSPECTION REPORT	TRANSPORTATION CHALLAN	PHYSICAL CONDITION (NO DAMAGE)	IDENTIFICATION MARKING VERIFIED	ACCESSORIES COMPLETE (BOLTS, CLAMPS, ETC.)	ACCEPTED (✓ / x)	REMARKS
1				☐	☐	☐	☐	☐	☐	
2				☐	☐	☐	☐	☐	☐	
3				☐	☐	☐	☐	☐	☐	
4				☐	☐	☐	☐	☐	☐	
5				☐	☐	☐	☐	☐	☐	

DATE OF RECEIPT: _____

STORAGE LOCATION: _____

RECEIVED BY (NAME & SIGNATURE): _____

VERIFIED BY (INSPECTING OFFICIAL): _____

2) Standard Bearing Marking Scheme-01

Reference: Standard Bearing Marking Scheme-01	
Description	Requirement
1) Details to Be Engraved/Embossed On Bearings	The following details, capable of being legible throughout the service life of bearings under normal wear conditions, shall be engraved/embossed on bearings: I. Manufacturer's name / registered trademark II. Unique identification number of bearing III. Manufacturing month and year (MM/YYYY) IV. Bridge No. at which the bearing is to be installed
2) Engraving/Embossing of the above details shall be carried out neatly without affecting the functionality, structural integrity, strength and durability of the bearings.	

3) Location of Markings	The marking shall be done on the cross-sectional faces of the bottom metallic plates (i.e. faces of bottom plate supported on pedestal), aligned across the track (on railway bridges) or as to roads (on ROB)
4) Font Size, Spacing & Graduations	The font size of letters and spacing shall be decided as per the thickness and width of plates or pads to ensure visibility and readability of the markings with naked eyes from at least 2m. Gradations to monitor movement shall be marked with indelible ink/paint with suitable line width/symbols.
5) Top of Bearing-Center Line Marking, Direction of Movement	In addition to the above, the top of the bearing shall have center-line markings and direction of movement/installations, together with movement graduations to monitor movement.
6) Other Important Information on Label	Other important information, viz. bearing designation, type of bearing, load & movement capacity, Centre-line markings to facilitate installation, direction of major and minor movement, pre-set, etc., shall be provided in the stainless steel or aluminum label of appropriate size fixed on the bearing.
7) Additional Information	Any additional information required under IRC: 83 (Part III) or as specified by Railways shall be provided separately with the supply order

3) Table No: 2.2 (a) Technical Specification of Spherical Bearing

Table No: 2.2 (a) – Technical Specification of Spherical Bearing Unique Id/Type of Bearing: Approved GAD No:	
i.) Vertical Load:	
ii.) Longitudinal Force:	
iii.) Lateral Horizontal Force:	
iv.) Design Longitudinal movement:	
v.) Design Transverse movement:	
vi.) Design Rotation:	

4) Table No: 2.2 (b): Symbol/Legend used for identifying Spherical Bearing types

Table No: 2.2 (b)		
Symbol	Legend	Keyword
	Fixed Spherical Bearing	FX
	Free Sliding Spherical Bearing (Multi-Directional)	FE

	Longitudinal Guided Sliding Spherical Bearing	LGS
	Transverse Guided Sliding Spherical Bearing	TGS

5) Checklist Table No: 2.3- Bearing Identification Marking Compliance Check

Checklist Table No: 2.3- Bearing Identification Marking Compliance Check			
Verification Item	Requirement / Objective	Acceptance Criteria	Activity at site
Traceability Documentation	Certified manufacturer's label containing bearing particulars shall accompany each bearing.	Label available	Verification of records (OK/NOT OK)
Unique Identification No	Bearing shall bear permanent and legible identification markings for complete traceability.	Markings clear, durable and verifiable.	On Site Verification & Acceptance. (OK/NOT OK)
Manufacturer Identification	Manufacturer's name/trademark shall be permanently marked.	Verified.	On Site Verification & Acceptance (OK/NOT OK)
Manufacturing Date	Month and year of manufacture shall be marked. (MM/YYYY)	Verified.	On Site Verification & Acceptance (OK/NOT OK)
Bridge No	Bridge No at which Bearing is to be installed	Verified	On Site Verification & Acceptance (OK/NOT OK)
Bearing Designation	Unique bearing identification shall correspond to approved GAD/Bearing Schedule.	Matches approved drawings.	On Site Verification & Acceptance (OK/NOT OK)
Bearing Type	Bearing type (Fixed/Guided/Free/POT-PTFE, etc.) shall be identified.	Verified.	On Site Verification & Acceptance (OK/NOT OK)
Design Capacity Marking	Vertical load and movement capacity shall be marked.	Matches design requirements.	On Site Verification & Acceptance (OK/NOT OK)
Installation Reference Marks	Permanent centerline markings shall be provided to facilitate accurate alignment.	Markings clearly visible.	On Site Verification & Acceptance (OK/NOT OK)
Preset Identification (if any)	Preset value and direction, where specified, shall be clearly indicated.	Verified against approved preset requirements.	On Site Verification & Acceptance (OK/NOT OK)

Referred Drawing No/Document: Remarks: Date of inspection: <i>It is certified that all bearings inspected by me bear standard & in-editable identification mark/symbol/notations.</i> <u>Name & Signature of Inspecting Official:</u>

6) Table: 2.4 (IRC 83 part IV) Dimensional Tolerance

Reference Table: 2.4: Dimensional Tolerance		
<u>Description</u>	<u>Permissible Tolerance</u>	<u>Verification at Site</u>
i) Plan dimension of assembled bearing	0 to + 5 mm or 0.5 percent of the drawing dimension whichever is higher or as per approved GAD	Site Verification
ii) Overall height of assembled bearing	0 to + 5 mm or 1 .0 percent of the drawing dimension, which is higher or as per approved GAD	Site Verification
iii) Parallel-ness of top surface of assembled bearing w.r.t. the bottom surface as datum	1 in 200 or as per approved GAD	Verification of Record
iv) Height of individual machined steel component	± 1 mm or as per approved GAD	Verification of Record
v) Radius of Curvature for the concave machined steel component	0 to + 0.25 mm or as per approved GAD	Verification of Record
Vi) Radius of Curvature for the convex machined steel component	-0.25 to 0 mm or as per approved GAD	Verification of Record
vii) Tilting Gap	As per approved GAD	Verification of Record & measurement at site
Viii) Guide bar gap	As per approved GAD	Verification of Record & measurement at site
Ref:	IRC 83 Part IV/ Approved drawings as per the case.	
Remarks:	It is to be verified that no evidence of transportation/handling damage is visible.	
Name & Signature of the Inspecting Official:		
Date:		

7) Table: 4.1 List of Reference Drawings and Bearing Schedules

List of Reference Drawings and Bearing Schedules-Table No: 4.1			
Document No	Name of the Document	Revision if any	Approval Confirmation
i) BR/GAD/No	GAD of the Bridge		Yes/No
ii. BR/DD/No	Dimensional Detail of Bed Block/Pedestal		Yes/No
iii. Bearing Installation Schedule/No	Bearing Installation Schedule		Yes/No
iv. QAP of Spherical Bearing	Quality Assurance Plan		Yes/No
v. ITP of Spherical Bearing	Inspection and Test plan		Yes/No
vi. Bearing Layout Plan	Layout of Bearing on Pier Cap/Bed Block		Yes/No
i. Name and Signature of official (Railway):			

8) Table: 4.2 Common incorrect practices and their consequences

Reference Table: 4.2		
Incorrect Practice	Engineering Failure	Consequences
Bearing not concentric with pedestal	Eccentric reaction	Unequal grout compression, one-sided PTFE wear
Pedestal dimensions outside tolerance	Inadequate bearing seating area	Edge loading, overstressing of concrete and improper load distribution
Cracked or honeycombed pedestal	Reduced bearing support	Local crushing, crack propagation and loss of bearing stability
Uneven bedding	Stress concentration	Cracked grout, rocking bearing
Wrong orientation of guided bearing	Movement restraint	Girder unable to expand in design direction

9) Table: 4.3 Pedestal Preparedness (Ref: IRC 83 Part II and BS 102 R)

Pedestal Preparedness Reference Table: 4.3	
Inspection Parameter	Acceptance Tolerance
Bearing Centerline Location	±3 mm from the design position
Bearing Level (Elevation) (For Continuous girders)	±0.0001 × (Sum of Adjacent Spans), subject to ±5 mm (maximum)
Bearing Horizontality	1 in 200 in any direction (unless otherwise specified)

Surface Condition:	Bearing seating shall be free from laitance, honeycombing, loose particles, oil, standing water and other contaminants before installation.
Survey Verification	Compliance with approved drawings
Corrective Action	Any deviation beyond specified tolerance shall be rectified before girder loading.

10) Sample Layout Plan for Bearing Installation: Layout Plan 4.4

BEARING LAYOUT PLAN														
SPAN 1 (A1 - P1)			SPAN 2 (P1 - P2)			SPAN 3 (P2 - P3)			SPAN 4 (P3 - P4)			SPAN 5 (P4 - A2)		
A1		P1		P2		P3		P4		A2				
 	①		 	③	⑤	 	⑦	⑧	 	⑪	⑫	 	⑮	⑯
 	②		 	④	⑥	 	⑨	⑩	 	⑬	⑭	 	⑰	⑱
LEGEND: = BEARING LOCATION ① = BEARING NUMBER NOTES: - ALL BEARINGS SHALL BE INSTALLED AT THE DESIGNATED LOCATIONS AS PER THIS LAYOUT. - VERIFY BEARING TYPE, DESIGNATION AND ORIENTATION BEFORE INSTALLATION. - ALL BEARINGS SHALL BE MARKED WITH UNIQUE IDENTIFICATION AS PER THIS NUMBERING.														
BEARING IDENTIFICATION AND KEY DETAILS														
SPAN 1 (A1 - P1)			SPAN 2 (P1 - P2)			SPAN 3 (P2 - P3)			SPAN 4 (P3 - P4)			SPAN 5 (P4 - A2)		
BEARING NO.	TYPE / DESIGNATION	BEARING LOCATION	BEARING NO.	TYPE / DESIGNATION	BEARING LOCATION	BEARING NO.	TYPE / DESIGNATION	BEARING LOCATION	BEARING NO.	TYPE / DESIGNATION	BEARING LOCATION	BEARING NO.	TYPE / DESIGNATION	BEARING LOCATION
1			5			9			13			17		
2			6			10			14			18		
3			7			11			15			19		
4			8			12			16			20		
REMARKS:														
PREPARED BY: _____ CHECKED BY: _____ DATE: _____														

11) Table No: 4.5 Verification of Placement of Bearings at designated location

Table No:4.5 Verification of Bearings Placed at Pedestal						
Bridge No- Span Arrangement:						
SN.	Marking embossed on Bearing (Yes/No)	Pier No/Pedestal No.	Bearing Unique ID & Type	Bearing Identification Code (Color/Symbol)	Pedestal/Bed Block Identification Code (Color/Symbol)	Reference GAD No.
1	Yes	P1/PD-02- US-CSMT END	KE- 14.4/FREE	RED/06K14	RED/06K14	GAD No: XYZ

i. Date of Inspection:

ii. Name and Signature of Manufacturer/OEM Representative:

iii. Name and Signature of Inspecting official (Railway):

12) Checklist No: 4.3

PROJECT : _____ BRIDGE NO. : _____ SPAN NO. : _____ PIER / ABUTMENT NO. : _____ PEDESTAL NO. : _____	DRAWING NO. : _____ DATE : _____ BEARING DESIGNATION AS PER DRAWING : _____
--	--

SR. NO.	VERIFICATION ITEM	REQUIREMENT / CRITERIA	VERIFIED (✓ / x)	REMARKS
1.	SPAN NUMBER AND PIER / ABUTMENT NUMBER CONFIRMED WITH APPROVED BEARING LAYOUT DRAWING.	BEARING LOCATION (SPAN AND PIER / ABUTMENT) MATCHES THE APPROVED DRAWINGS.	☐	
2.	PEDESTAL IDENTIFICATION MATCHES THE DESIGNATED BEARING LOCATION AS PER THE APPROVED BEARING LAYOUT DRAWING.	BEARING IS TO BE PLACED ON THE CORRECT PEDESTAL AS PER DRAWING.	☐	
3.	BEARING UNIQUE IDENTIFICATION NUMBER (UID) MATCHES THE APPROVED BEARING SCHEDULE.	UID ON BEARING MATCHES WITH THE APPROVED BEARING SCHEDULE.	☐	
4.	BEARING TYPE (FIXED / FREE / GUIDED) MATCHES THE DESIGNATED PEDESTAL.	TYPE OF BEARING ON SITE MATCHES THE TYPE SPECIFIED FOR THAT LOCATION.	☐	
5.	DESIGN VERTICAL LOAD CAPACITY EMBOSSED ON THE BEARING MATCHES THE APPROVED BEARING SCHEDULE.	VERTICAL LOAD CAPACITY MARKED ON BEARING MATCHES THE SCHEDULE.	☐	
6.	DESIGN HORIZONTAL LOAD CAPACITY EMBOSSED ON THE BEARING MATCHES THE APPROVED BEARING SCHEDULE.	HORIZONTAL LOAD CAPACITY MARKED ON BEARING MATCHES THE SCHEDULE.	☐	
7.	MOVEMENT DIRECTION / GUIDE DIRECTION AND DIRECTIONAL ARROW (WHERE APPLICABLE) CORRESPOND TO THE BRIDGE LONGITUDINAL AXIS AS PER DRAWING.	MOVEMENT / GUIDE DIRECTION MARKED ON BEARING MATCHES THE DIRECTION SHOWN IN THE APPROVED DRAWING.	☐	
8.	COLOUR CODE (IF SPECIFIED) MATCHES THE APPROVED BEARING IDENTIFICATION PLAN.	COLOUR CODE ON BEARING MATCHES THE APPROVED IDENTIFICATION PLAN.	☐	
9.	ALL PERMANENT MARKINGS (UID, TYPE, LOAD CAPACITY, MOVEMENT, MANUFACTURER, ETC.) ARE CLEARLY LEGIBLE AND VERIFIED.	ALL MARKINGS ARE CLEAR, COMPLETE AND AS PER BEARING SCHEDULE.	☐	
10.	CROSS-VERIFICATION CARRIED OUT WITH APPROVED GAD, BEARING LAYOUT DRAWING AND BEARING SCHEDULE BEFORE LOWERING OF GIRDER.	VERIFIED FROM GAD, LAYOUT DRAWING AND BEARING SCHEDULE.	☐	

13) Checklist table – 5.1(a) Grouting Readiness Inspection Report

Grouting Readiness Inspection Report No:							
Date of Inspection:							
Surveying Instrument Calibration Certificate no:							
Bearing Location (Pier No. / Pedestal No.):							
Details of Bearing (Type/Id/Manufacturer):							
C/L Marking on Pedestal	Identification Mark on Bearing	Level of Bed Block	Flatness of surface	Orientation of Bearing	Alignment of bearing w.r.t bed block	Any visible damage (Bearing/ Bed Block)	Remarks
✓	✓	✓	✓	✓	✓		Transportation clamps intact.
<u>Signatures:</u>							
Contractor's Representative				Railway Representative			

14) Checklist table – 5.1(b) Grouting Readiness Inspection Checklist

SL. NO.	INSPECTION ITEM	ACCEPTANCE CRITERIA	STATUS (√ / X / NA)	REMARKS
1	PEDESTAL DIMENSIONS	AS PER APPROVED GAD/DRAWINGS		
2	CENTRE LINE MARKING	CLEARLY MARKED AND MATCHES SURVEY COORDINATES		
3	BEARING LOCATION MARKING	BEARING OUTLINE MARKED CORRECTLY		
4	PEDESTAL LEVEL	WITHIN SPECIFIED TOLERANCE		
5	HORIZONTALITY OF TOP SURFACE	TRUE HORIZONTAL; NO NOTICEABLE UNDULATIONS		
6	SURFACE FINISH	SMOOTH, DENSE AND FREE FROM LAITANCE		
7	SURFACE SOUNDNESS	NO HONEYCOMBING, CRACKS OR LOOSE CONCRETE		
8	SURFACE CLEANLINESS	FREE FROM DUST, OIL, GREASE, CURING COMPOUND AND DEBRIS		
9	CHIPPING/ROUGHENING (WHERE SPECIFIED)	COMPLETED UNIFORMLY WITHOUT DAMAGING CONCRETE		
10	EDGE CONDITION	EDGES INTACT WITHOUT SPALLING OR BREAKAGE		
11	PEDESTAL PROJECTION BEYOND BEARING FOOTPRINT	MINIMUM 150 mm PROJECTION ON ALL SIDES OR AS PER APPROVED DRAWING		
12	REINFORCEMENT EXPOSURE	NO EXPOSED REINFORCEMENT ON BEARING SEAT		
13	DRAINAGE ARRANGEMENT	NO WATER ACCUMULATION ON PEDESTAL		
14	DRYNESS OF SURFACE	SURFACE DRY BEFORE BEARING/GROUT INSTALLATION		
15	CURING COMPLETED	REQUIRED CURING PERIOD ACHIEVED		
16	SURVEY VERIFICATION	COORDINATES, RL AND ORIENTATION VERIFIED		
17	READY FOR BEARING INSTALLATION	OVERALL ACCEPTANCE FOR NEXT ACTIVITY		

INSPECTING OFFICIAL (Name) : _____ SIGNATURE : _____

DESIGNATION : _____

DATE : _____

15) Checklist Table No: 6.1: Grout Material Checklist

Grout Material Checklist Table: 6.1			
SN	Item to be Verified	Acceptance Criteria	Yes/No
xiii.	Product Name & Grade	Matches the approved material submittal and BOQ.	
xiv.	Manufacturer	Of approved make.	
xv.	Batch/Lot Number	Clearly printed and traceable.	
xvi.	Manufacturing Date	Clearly legible.	
xvii.	Expiry / Shelf Life	Within manufacturer's specified shelf life. Expired material shall be rejected.	
xviii.	Bag Weight	Matches manufacturer declared net weight.	
xix.	Packaging Condition	Bags sealed, dry, and free from tears, punctures, or moisture damage.	
xx.	Technical Data Sheet (TDS)	Available	
xxi.	Batch Test Certificate	Available for the supplied batch	
xxii.	Working Time / Pot Life	Adequate for the planned grouting operation under site temperature.	
xxiii.	Color & Appearance	Uniform dry powder, free from lumps or caking. Presence of hardened lumps indicates moisture ingress and the material should be rejected.	
xxiv.	Safety Information	Manufacturer's instructions	
xxv.	Temperature recommended for Grouting	Ambient temperature for grouting provided by supplier.	
Date of inspection:			
Name and Signature of Inspecting Official:			

16) Table No-6.2 NABL Test of Grout (Compliance with the specified performance requirements.)

NABL Test of Grout-Table No: 6.2				
<u>SN</u>	<u>Test</u>	<u>Result</u>	<u>Acceptance (Value/Reference)</u>	<u>Remarks</u>
vi.	Compressive Strength (1, 3, 7 & 28 days)			
vii.	Flow ability (Flow Cone)			
viii.	Volume Stability / Expansion (Non-shrink Property)			
ix.	Setting Time			
x.	Drying Shrinkage			
xi.	Any other Test			
<u>Name of NABL Lab and location:</u> <u>Test Witnessed</u> <u>(Railway Side): Reports</u> <u>Accepting Authority: Date:</u>				

17) **Grouting Pocket and Form Work**

A. GROUT POCKET / BEARING SEAT READINESS CHECK					B. FORMWORK & GROUT CONTAINMENT CHECK				
SL.	CHECK ITEM	YES	NO	REMARKS	SL.	CHECK ITEM	YES	NO	REMARKS
1	BEARING LEVEL, ALIGNMENT AND CENTRE LINES VERIFIED	☐	☐		1	FORMWORK RIGID AND ADEQUATELY SUPPORTED	☐	☐	
2	GROUT POCKET DIMENSIONS CONFORM TO APPROVED DRAWING	☐	☐		2	FORMWORK JOINTS LEAK-PROOF	☐	☐	
3	SPECIFIED GROUT THICKNESS AVAILABLE BENEATH BASE PLATE	☐	☐		3	POCKET COMPLETELY ENCLOSED EXCEPT INLET AND VENT	☐	☐	
4	POCKET FREE FROM LOOSE CONCRETE, LAITANCE AND DUST	☐	☐		4	PVC / POLYVINYL FUNNEL SECURELY FIXED AT GROUT INLET	☐	☐	
5	OIL, GREASE AND OTHER CONTAMINANTS REMOVED	☐	☐		5	ADEQUATE GROUT HEAD AVAILABLE FOR GRAVITY FLOW	☐	☐	
6	STANDING WATER REMOVED AND SURFACE PREPARED AS SPECIFIED	☐	☐		6	AIR VENT PROVIDED AT OPPOSITE END	☐	☐	
7	ANCHOR BOLTS/SLEEVES CLEANED AND READY FOR GROUTING	☐	☐		7	BEARING SLIDING SURFACES PROTECTED AGAINST GROUT CONTAMINATION	☐	☐	
8	NO DEBRIS BENEATH THE BEARING BASE PLATE	☐	☐		8	ACCESS AVAILABLE FOR CONTINUOUS POURING	☐	☐	
9	ADEQUATE ACCESS AVAILABLE FOR GROUTING	☐	☐		9	BEARING REMAINS STABLE DURING FORMWORK FIXING	☐	☐	
10	GROUTING APPROVAL OBTAINED	☐	☐		10	FORMWORK INSPECTED AND READY FOR GROUTING	☐	☐	

INSPECTING OFFICIAL (Name) : _____

DESIGNATION : _____

DATE : _____

SIGNATURE : _____

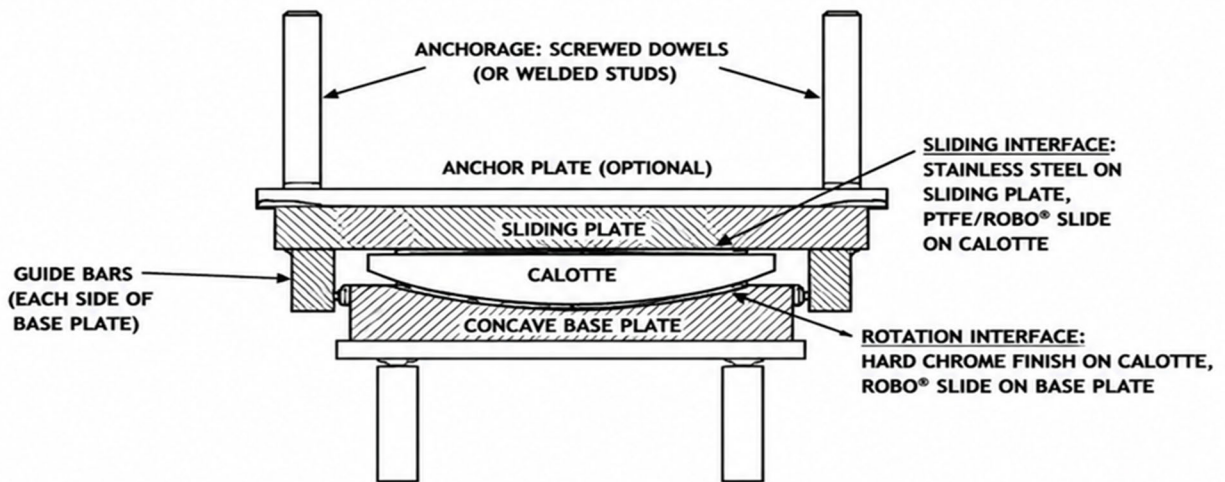
18) Checklist Table No 8.1: Final Inspection

Final Inspection Checklist Table No: 8.1		
SN	Critical Items	Yes/No
i.	Bearing type and identification matches approved GAD.	
ii.	Correct fixed/free/guided location confirmed.	
iii.	Direction of movement verified.	
iv.	Bearing center line matches setting-out marks.	
v.	Bed block level and horizontality within permissible tolerance.	
vi.	All lock nuts, hexagonal nuts, and associated fasteners are securely tightened and confirmed to be intact.	
vii.	Height of Bearing verified from GAD	
viii.	Tilting gap verified	
ix.	Guide bar gap verified (for sliding bearing)	
x.	Parallelism and location of rotating disc verified	
xi.	Full bearing seating achieved without rocking.	
xii.	Non-shrink grout fully cured and free of voids.	
xiii.	Required movement and rotational clearance available.	
xiv.	Transportation clamps and temporary restraints removed after installation.	
xv.	Bearing area cleaned and ready for service.	
xvi.	Any other item to be recorded.	
Date of inspection: Name and Signature of Inspecting Official:		

Table of Contents(Tables/ Checklists/Plans/Scheme)			
SN	Description of Table/Checklist	Table/Check list No	Part of Installation
1.	Incoming Bearing Receipt Checklist	Table 2.1	Part I
2.	Standard Bearing Marking Scheme-01		Part I
3.	Technical Specification of Spherical Bearing	Table No: 2.2 (a)	Part I
4.	Symbol/Legend used for identifying Spherical Bearing types	Table No: 2.2 (b)	Part I
5.	Bearing Identification Marking Compliance Check	Checklist Table No: 2.3	Part I
6.	Dimensional Tolerance (IRC 83 part IV)	Table: 2.4	Part I
7.	List of Reference Drawings and Bearing Schedules	Table: 4.1	Part I
8.	Common incorrect practices and their consequences	Table: 4.2	Part I
9.	Pedestal Preparedness (Ref: IRC 83 Part II and BS 102 R)	Table: 4.3	Part I
10	Sample Layout Plan for Bearing Installation: Layout Plan 4.4	Layout Plan-4.4	Part I
11	Inspection Protocol- Placement of Bearings at designated location	Table No: 4.5	Part I
12	Checklist-Placement of Bearings	Checklist No: 4.3	Part I
13	Pre Grouting Readiness Inspection Checklist	Checklist table: 5.1(a)	Part II
14	Pre Grouting Readiness Inspection Checklist	Checklist table: 5.1(b)	Part II
15	Grout Material Checklist	Checklist Table No: 6.1:	Part II
16	NABL Test of Grout (Compliance with the Specified performance requirements.)	Table No-6.2	Part II
17	Grouting Pocket and Formwork Checklist	Checklists Table No: 6.3	Part II
18	Final Inspection	Checklist Table No: 8.1	Part III

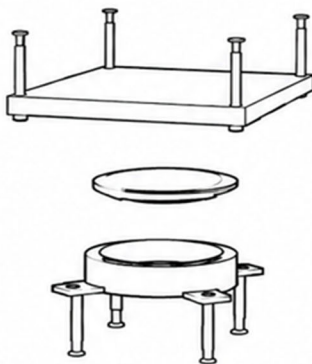
Figures

1) Figure 1: Spherical Bearing Sketch

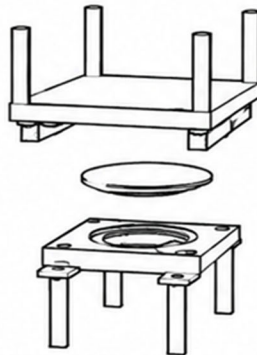


THE BUILD-UP OF THE VARIOUS TYPES OF SPHERICAL BEARING IS ILLUSTRATED BY THE FOLLOWING EXPLODED VIEWS.

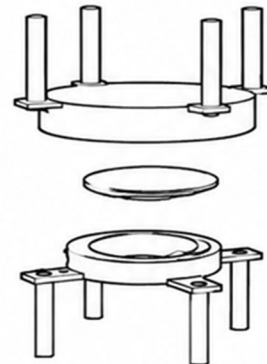
FREE SLIDING (TYPE KA):



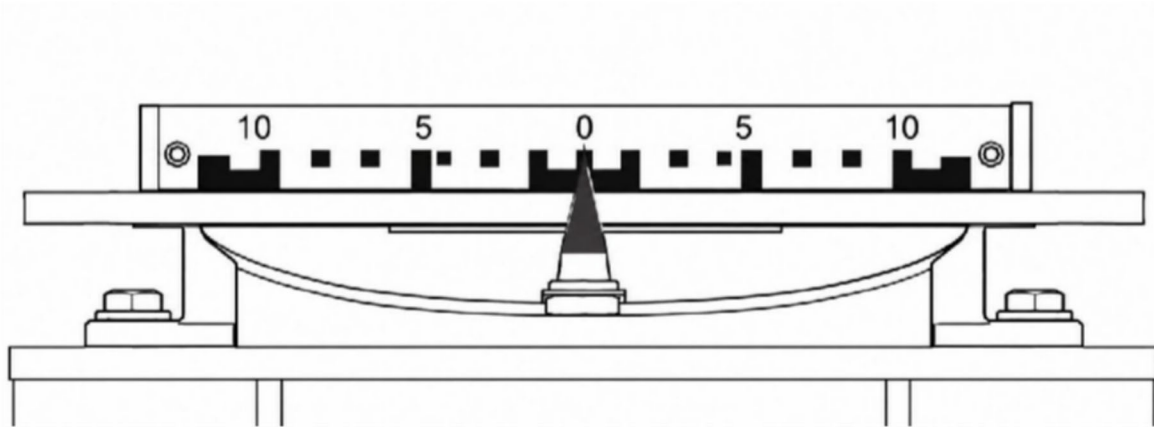
GUIDED SLIDING (TYPE KE):



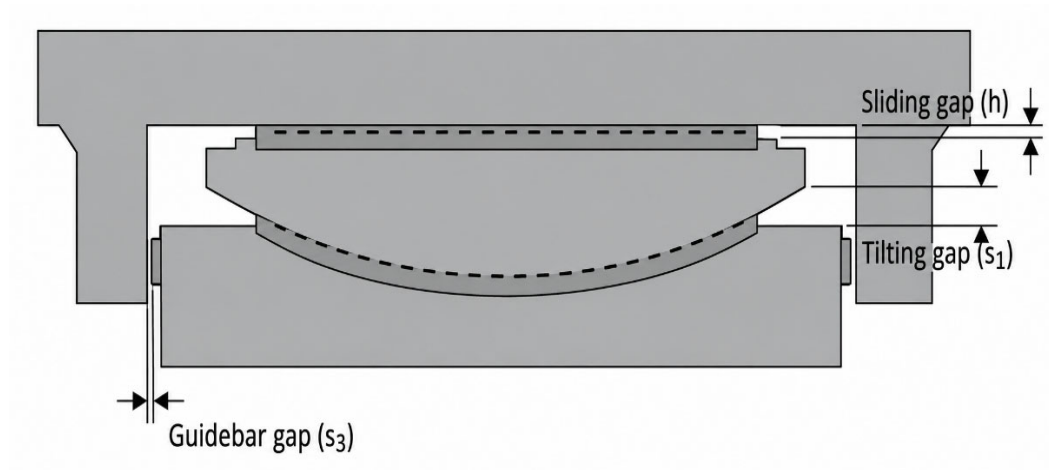
FIXED (TYPE KF):



2) Figure 2: Movement Scale



3) Figure 3: Tilt gap (s_1) and Sliding gap (h)



(09)

METHOD STATEMENT

FOR USE OF HSFG BOLT



<u>Method Statement for use of HSFG Bolt</u>
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1. Introduction
1.1 Scope
1.2 Applicable Codes and Standards
1.3 Inspection and Measurement Equipment
1.4 Sequence of Activities
1.5 Activity Control and Monitoring
2. Receipt, Review, Acceptance and Storage of HSFG Bolt Assemblies
2.1 Receipt of HSFG Bolts at site
2.2 Review, Testing and Acceptance
2.3 Storage of HSFG Bolt Assemblies
2.4 Receipt, Traceability and Acceptance of Supplied Lot: Check Point 01
3. Pre-Tightening Field Activities
3.1 Surface preparation for steel interface
3.2 Calibration of torque wrench
3.3 Personnel for Tightening
3.4 Pre-Tightening Field Activities: Check Point 02
4. Installation and Tightening of Bolt Assembly
4.1 Bolt/nut/washer(s)/DTI placement: Method of Assembly
4.2 First Stage of Tightening
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4.4 Installation and Tightening of HSFG Bolts: Check Point 03
5. Post-Tightening Inspection and Final Acceptance of Joints
6. Anti-sabotage precautionary measures
7. Health, Safety & Hazard Control – HSFG Bolt Tightening

1. Introduction

1.1 Scope

This Method Statement describes the procedure for the receipt, inspection, storage, handling, installation, tightening, inspection, and final acceptance of High Strength Friction Grip (HSFG) bolts used in structural steel bridge works. The procedure covers activities necessary to ensure that HSFG bolts are properly assembled, installed, and tightened to achieve the specified bolt tension and required frictional resistance at the faying surfaces, in accordance with the approved drawings, manufacturer's recommendations, project specifications, and relevant codes and standards.

This Method Statement comprises three parts (**Part I, Part II, and Part III**). **Part I** covers the Receipt and pre-installation/tightening activities, **Part II** details the HSFG bolt installation and tightening procedure including DTI verification, and **Part III** contains the post-installation checks, inspection and final acceptance.

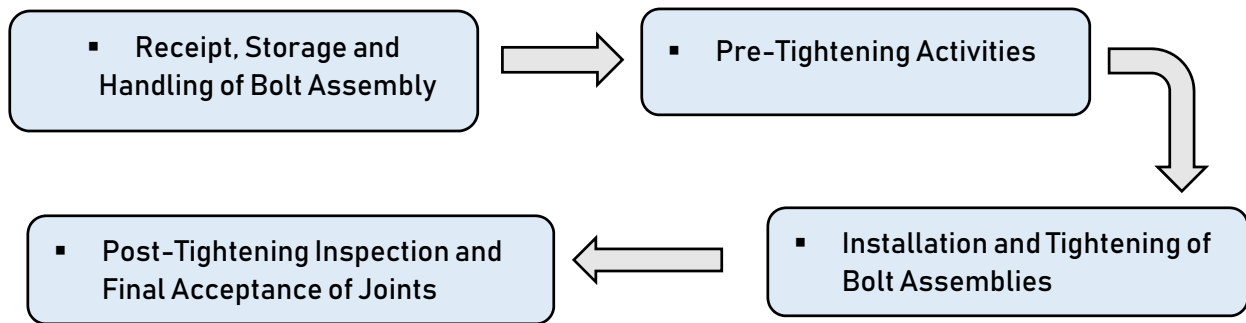
1.2 Applicable Codes and Standards

- i. Indian Railway Standards (IRS)-B1
- ii. IRS Steel Bridge Code
- iii. Report No.BS-111 R-7 (Latest Revision)
- iv. EN 14399 Series (for manufacturing tolerance)
- v. EN-1090-2: 2008
- vi. IS 4000: 1992

1.3 Inspection and Measurement Equipment

- i. Feeler gauge (0.4 mm 0.25 mm and 0.1 mm)
- ii. Torque Wrench

1.4 Sequence of Activities



1.5 Activity Monitoring and Control Checkpoints

<u>Stage-wise Activity Control Checks</u>		
<u>Method Statement Parts</u>	<u>Stage No. and Activity</u>	<u>Check Point No.</u>
I	<u>Stage 01</u> Receipt, Storage and Handling of Bolt Assembly - Review of Traceability Record - Review of Manufacturing Process Control Records - Acceptance of Lot - Storage	Check Point, Stage 01 <u>Table 04</u>
	<u>Stage 02</u> Pre-Tightening Activities - Surface Preparation and Check - Torque Wrench Calibration - Certification of Tightening Personnel	Check Point, Stage 02 <u>Table 06</u>
II	<u>Stage 03</u> Installation and Tightening of Bolt Assemblies - First Stage Tightening - Second Stage Tightening	Check Point, Stage 03 <u>Table 10</u>
III	<u>Stage 04</u> Post-Tightening Inspection and Final Acceptance of Joints - Checks after tightening - Acceptance of Joint	<u>Table 11</u>

Part I
Stage 01: Receipt, Review, Acceptance and Storage of HSFG Bolt Assemblies
Stage 02: Pre Installation Field Activities

2. Receipt, Review, Acceptance and Storage of HSFG Bolt Assemblies

2.1 Receipt of HSFG Bolting Assembly at site

2.1.1 Documents to accompany each consignment

Each consignment shall be accompanied by the requisite documents as provided in Checklist in Table No. 01.

Table No. 01

Checklist			
Checklist: Lot Receipt Verification			
Sl. No.	Inspection / Verification Item	Requirement	Compliance
1	Delivery challan	Available and matching to the consignment	☐ Yes ☐ No
2	Manufacturer's Test Certificate (MTC)	Available and applicable to the consignment	☐ Yes ☐ No
3	Packaging condition.	Packages are sealed and shows no evidence of opening or tampering.	☐ Yes ☐ No
4	Heat and batch numbers	Available and traceable to the consignment	☐ Yes ☐ No
6	Bolt Diameter, Length & DTI Grade Specified for the supplied Lot.	Required bolt diameter, length & DTI grade match the supplied lot.	☐ Yes ☐ No
7	Certificate of Tightening Torque	Torque chart applicable for the lot available.	☐ Yes ☐ No
8	HSFG Bolt, nut, DTI grade and property class verification.	Correct grade as specified	☐ Yes ☐ No
Name and signature of Receiving Official: Date: Place:			

2.1.2 Physical Inspection

Upon receipt, all bolts, nuts, DTI and washers shall be visually and physically inspected to verify their conformity with the specified requirements. The inspection shall be carried out with reference to Checklist in Table No. 02,

Table No. 02

Checklist				
Checklist: Physical Inspection of Received Lot at Site				
Sl. No.	Inspection Item	Acceptance Requirement	Compliance	Remarks
1.	Is the complete HSFG bolting assembly, including bolt, nut, DTI washer and other specified washers, supplied by a single approved manufacturer?	HSFG bolting assembly including Direct Tension Indicator (DTI) washer, shall be supplied by single manufacturer.	☐ Yes ☐ No	
2.	Are the HSFG bolts supplied with the manufacturer's specified light coating of rust-preventing oil, as required?	Supplied by the manufacturer with a light coating of rust-preventing oil.	☐ Yes ☐ No	
3.	Bolt diameter, length and grade conform to the requisition requirements.	Bolt diameter, length and grade as specified.	☐ Yes ☐ No	
4.	Manufacturer's identification and grade marking on bolts, nuts, washers and DTI	Clearly identifiable and legible	☐ Yes ☐ No	
5.	Thread condition	Threads clean, undamaged and free-running	☐ Yes ☐ No	
6.	Surface condition	Free from rust, pitting, cracks, burrs or deformation	☐ Yes ☐ No	
7.	Thread cleanliness	Free from oil, mud, paint or foreign material	☐ Yes ☐ No	
8.	Quantity	Correct quantity of bolts, nuts and washers received	☐ Yes ☐ No	
Name and signature of Reviewing Official: <u>Date:</u> <u>Place:</u>				

2.1.3 Acceptance for use

HSFG Bolting Assembly with all prerequisite checks as per Checkpoint no 01 shall be accepted for use. Each accepted lot shall be recorded in the Record sheet – Receipt & Release Record as per Table No. - 03 to ensure traceability of the incoming bolt assembly lot, its release for use and the identification.

Table No. 03

Record sheet no. 01						
HSFG Bolt Receipt & Release Sheet						
Sl. No	Receipt Date	Manufacturer Name	Lot No/Lot Id	Bolt size (Dia. ×Length)	Property class	Signature of Official
Release to Joint						
Sl. No	Issued for Joint/Span	Issued from Lot ID/Lot No	Quantity Issued	Property Class of Bolt	Issue Slip No and Date	Signature of Issuing official

2.3 Storage of HSFG Bolt Assemblies

Accepted HSFG bolts, nuts, DTI and washers shall be stored in a clean, dry and covered area, protected from moisture, dust, dirt, corrosion, mechanical damage and contamination. Bolt assemblies shall be kept in their original/identified packaging and segregated batch-wise, with clear identification to prevent mixing of different manufacturers or batches. Assemblies shall be handled carefully and only accepted assemblies in serviceable condition shall be issued for installation.

2.4 Check Point of Satge 01

Table No. 04

Check Point				
Check Point: Receipt and Acceptance				
Sl. No.	Activity / Parameter	Acceptance Check	Record / Document	Yes/No/NA
1	Packaging condition and verification of supplied lot	Verification of the packaging condition of the supplied lot done.	Check list No-01	
2	Physical Inspection	Physical Inspection of few randomly selected bolts from the supplied lot.	Check list No-2	
It is certified that the HSFG bolts received at site have been checked for conformity with the requisite standards <u>Name and Signature of the official:</u> <u>Date:</u> <u>Place:</u>				

Stage No 02

3. Pre-Tightening Field Activities

3.1 Surface preparation for steel interface before providing HSFG bolts

The steel interface between the plies which form a joint having HSFG bolts shall have surface preparation as per Para 28.10.3 of IRS B1 details the specification.

a) New construction: Interfaces shall be aluminum metallized without over coating, as per Para 39.2.1 of IRS B1.

b) 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. Checklist in Table No. 05 shall be complied with before proceeding further.

Table No. 05

<u>Checklist</u>			
<u>Checklist: Surface preparation for steel interface</u>			
Sl. No.	Activity / Parameter	Compliance	Remarks
1.	No joint is assembled for bolting until the contact surfaces have been inspected and approved by the competent authority.	☐ Yes ☐ No	
2.	New Construction: The interface between the plies which are connected together by the HSFG bolts is "Aluminum metallized without any over coating"	☐ Yes ☐ No	
3.	Existing structure: All oil, dirt, loose scale, loose rust, burrs and any other defects on the surfaces of contact is removed.	☐ Yes ☐ No	

3.2 Calibration of torque wrench

- Only calibrated mechanical torque wrenches, preferably electronic, shall be used for HSFG bolt tightening, with a valid certificate confirming $\pm 10\%$ accuracy.

3.3 Personnel for Tightening

- Deployment of trained and competent personnel is the most critical requirement in achieving the specified preload in HSFG bolted connections.
- 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. Which is valid for six months.

3.4 Check Point Stage 02

Table No. 06

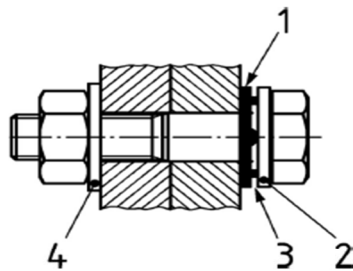
Check Point: Pre-tightening Field Activities				
Sl. No.	Activity / Parameter	Acceptance Check	Record / Document	Yes/No/NA
1.	Surface preparation for steel interface.	Steel interfaces prepared as per the requirements of IRS B1.	Checklist table No-03	☐ Yes ☐ No
2.	Calibration of torque wrench.	Only calibrated torque wrenches.	-	☐ Yes ☐ No
3.	Personnel for Tightening	Competency Certificate of Tightening Personnel.	-	☐ Yes ☐ No
It is certified that all mandatory prerequisite checks for the pre tightening field activities have been carried out and found satisfactory. <u>Name and Signature of the Reviewing Official:</u> <u>Date:</u> <u>Place:</u>				

4. Installation and Tightening of Bolt Assemblies

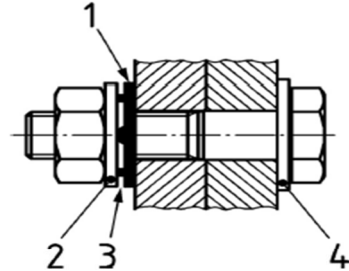
4.1 Bolt/nut/washer(s)/DTI placement: Method of Assembly

The DTI and applicable washers shall be installed in accordance with the arrangements shown in the figures below for 8.8 and 10.9 property-class bolting assemblies, ensuring the DTI protrusions are correctly oriented.

a) Normal method of assembly: Tightening of the assembly by rotation of the nut.



(a) Under Bolt head fitting



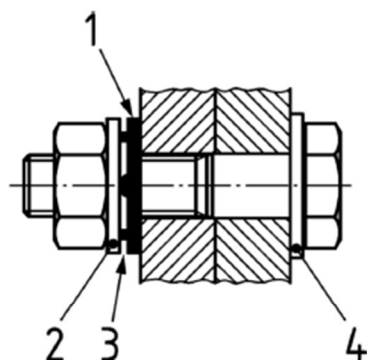
(b) Under Nut fitting

Key

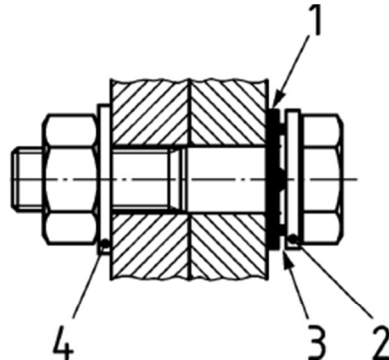
1. Direct Tension Indicator
2. Bolt face washer (not required for property class 8.8)
3. Gap
4. washer according to EN 14399-5 or -6

1. Direct Tension Indicator
2. Nut face washer
3. Gap
4. washer according to EN 14399-6 (not required for property class 8.8)

b) Alternative method of assembly: Tightening of the assembly by rotation of the bolt head.



(a) Under Nut fitting



(b) Under Bolt head fitting

Key

1. Direct Tension Indicator
2. Nut face washer
3. Gap
4. washer according to EN 14399-6

1. Direct Tension Indicator
2. Bolt face washer
3. Gap
4. washer according to EN 14399-5 or -6 (not required for property class 8.8)

4.2 First Stage of Tightening

a) As a first stage, all bolts in the joint shall be tightened to ‘snug tight’ condition. Snug tight condition means the nut is tightened using an ordinary wrench by an average worker, applying maximum force on the wrench.

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. Checklist in Table No. 07 should be filled and complied before proceeding to next stage of tightening.

Table No. - 07

Site Checklist: First Stage Tightening			
Sl. No.	Inspection Item	Qualitative Requirement	Status
1.	Bolt Assembly Arrangement	Bolt head, nut, hardened washers and DTI are correctly positioned as per BS 111 Rev 7 Fig 2 and Fig 3.	☐ Yes ☐ No
2.	Tightening Sequence	Tightening commences from the stiffest/central part of the joint and proceed systematically towards the free edges.	☐ Yes ☐ No
3.	Joint Closure & Gap Check	There is no gap at the central portion and edge gap is less than 2 mm .	☐ Yes ☐ No
4.	Post-Snug Inspection	Ply contact, washer/DTI seating, nut engagement, bolt projection checked.	☐ Yes ☐ No
<u>Name and Signature of the Official:</u> <u>Date:</u> <u>Place:</u>			

4.3 Second Stage of Tightening

In second stage of bolt tightening, bolts shall be tightened using a calibrated torque wrench to achieve the required preload. The bolts shall be tightened in the second stage until the DTI indicates full compression.

4.3.1 Checks after Second Stage of Tightening

- 100% of bolts shall be checked using a 0.40 mm or 0.25 mm feeler gauge, as applicable to the DTI position;
- Full Compression Check: If the 0.10 mm feeler gauge cannot be inserted between the DTI indicator positions, the DTI is considered to have achieved full compression. Not more than 10% of the indicators in a connection bolt group shall exhibit full compression.
- Table No. 08 shall be duly filled, compiled, and referred to for verification and record.

- Required compression of DTI washers should be verified as per para 11 of BS-111 as detailed in Table No. 09

Table No. - 08

Site Record Sheet: Second Stage Tightening						
Joint ID/Joint Name	No of bolts in the Joint	DTI position	Feeler Gauge Used (0.40 / 0.25 mm)	No of bolts passing requisite Refusals as per Table 3 of this document.	No. of Indicators Showing Full Compression (0.10 mm feeler Gauge Check)	% Full Compression

Name and Signature of Reviewing Official:

Date:

Place:

Table No. - 09

Reference: Para 11 of BS 111 Revision 7 –Acceptance criteria for bolt testing			
Number of indicator positions	Minimum number of feeler gauge refusals	Acceptance by feeler gauge check (BS 111 Revision 7)	Full-compression check
4	3	i. 100% bolts to be checked with 0.40/0.25 mm gauge. Feeler gauge: ii. 0.40 mm: If DTI is on non-rotating side and iii. 0.25 mm: If DTI is on rotating side. iv. Gauge cannot enter = “Refusal”	i. 0.10 mm refusal = full compression of the indicator ii. No more than 10% of the indicators in a connection bolt group shall exhibit full compression of the indicator.
5	3		
6	4		
7	4		
8	5		
9	5		

4.4 Check Point, Stage - 03

Table No. - 10

<u>Sl. No.</u>	<u>Activity / Parameter</u>	<u>Acceptance Check</u>	<u>Record/ Document</u>	<u>Yes/No/NA</u>
1.	Bolt/nut/washer(s)/DTI placement.	Method of Assembly as per the figure in Para 4.1 of this document.	-	
2.	First Stage of Tightening	Snug tightening of the HSFG bolt and checks after first stage tightening.	<u>Table No. 01</u> <u>Check list No</u> <u>05</u>	
3.	Second Stage of Tightening	Final Tightening to Specified Torque and Post-Tightening Checks.	<u>Table No. 02</u> <u>Check list No</u> <u>06</u>	
<u>It is certified that the HSFG bolts have been tightened in the stages as specified in BS-111 Revision 7, with the required checks carried out at each stage and duly recorded.</u> <u>Name and Signature of the official In-charge :</u> <u>Date:</u> <u>Place:</u>				

Part III**Stage 04: Post-Tightening Inspection and Final Acceptance of Joints****5. Post-Tightening Inspection and Final Acceptance of Joints**

After completion of second stage tightening following checks should be done to verify the tightness:

- 0.40 mm/0.25 mm thick feeler gauge shall be used to check 100% of the bolts for tightening.
- If the DTI is provided on the part (nut/bolt head) not being rotated, then 0.40 mm thick feeler gauge shall be used and if the DTI is being provided under the part (nut/bolt head) being rotated, 0.25 mm feeler gauge shall be used.
- 0.10 mm thick feeler gauge shall be used for checking full compression of the indicator. Refusal of 0.10 mm feeler gauge means full compression of the indicator.
- No more than 10% of the indicators in a connection bolt group shall exhibit full compression of the indicator.
- The feeler gauge shall be inserted between the DTI protrusions, with the gauge directed towards the bolt center.
- Table 09 of this document shall be referred for acceptance norms.
- Checklist as per Table No. 11 shall be completed and recorded after the final check has been satisfactorily completed.

Table No. - 11

Site Checklist: Final Tightening Check			
Sl. No	Acceptance Requirement	Compliance	Checked by
1.	Every bolt inspected 100% of second-stage-tightened bolts are checked with the applicable 0.40 mm or 0.25 mm feeler gauge; visual judgement alone not accepted.		
2.	Required refusals achieved Bolt satisfies the minimum number of refusals as per Table No 3. Actual indicator count and refusals are recorded.		
3.	Full compression assessed 0.10 mm gauge check identifies fully compressed indicators. Connection-group total is counted and percentage calculated.		
4.	Full-compression limit met Not more than 10% of indicators in the connection bolt group exhibit full compression.		
5.	Assembly condition accepted No damaged nut/bolt, split washer, displaced DTI, torn protrusion, stripped thread, local plate distress or coating damage affecting performance.		

6.	Numerical value of applied Torque noted down for each Joint.		
7.	Record of bolts sheared/snapped/broken during tightening process maintained.		
8.	The bolt protrusion is at least one full thread pitch, measured from the outer face of the nut to the end of the bolt.		
9.	Rejected Bolts stacked separately in a box for future reference.		
Name and Signature of Official: Date: Place:			

6. Anti-sabotage precautionary measures

- Bonding Agent: Where theft/sabotage is apprehended, a suitable bonding agent (functionally similar product) may be applied to the threads projecting beyond the nut to lock the bolt in position.
- Tack Welding Prohibited: Tack welding of HSFG bolts shall not be used as an anti-theft measure, as improper welding may adversely affect the metallurgical properties and functioning of the bolting assembly.

7. Health, Safety & Hazard Control – HSFG Bolt Tightening

- Safety helmet, safety shoes, gloves and safety harness shall be worn as applicable.
- Work at Height: Provide approved scaffolding, platforms, guardrails and lifelines; use a full-body safety harness where required.
- Tool Safety: Use only calibrated and properly maintained torque wrenches and tightening equipment; inspect tools before use.
- Falling Objects: Secure tools, bolts, nuts and washers against falling; barricade the area below elevated work.
- Electrical / Power Tools: Ensure electrical and powered tightening equipment has proper earthing, insulation and protected connections.
- Work Area: Keep platforms and access ways clean and free from loose bolts, packing materials, oil and other slip/trip hazards.
- Lifting & Handling: Use proper lifting arrangements for heavy tightening equipment and bolt containers; avoid unsafe manual handling.

(10)
METHOD STATEMENT
FOR
WELDING OF SHEAR STUDS



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Method Statement for Welding of Shear Studs

1. Purpose

This method statement describes the procedure for welding of shear studs to the top flange of steel girders used in steel-concrete composite construction. The purpose of shear studs is to develop effective composite action between the steel girder and RCC deck slab by transferring horizontal shear at the steel-concrete interface and restricting relative slip between the two components.

The work shall include inspection of studs and ceramic ferrules, preparation of the girder surface, qualification and setting of the stud-welding equipment, automatic drawn-arc stud welding, inspection and testing of completed welds, and treatment of defective studs.

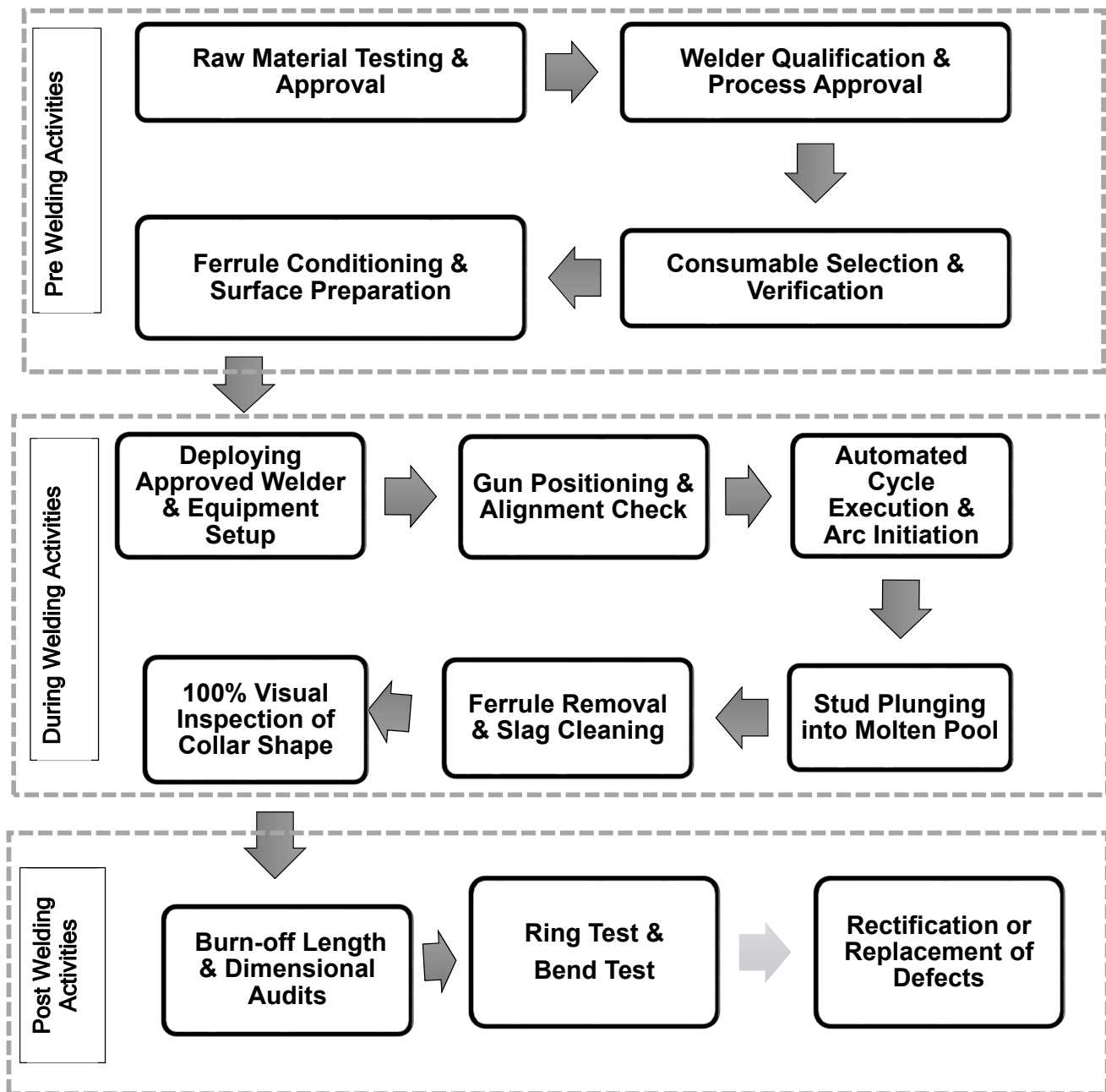
Scope

This method is applicable to shear studs welded on composite steel girders using the automatic drawn-arc stud-welding process with ceramic ferrules as per RDSO BS-115 R1. The location, number, diameter, length and spacing of studs shall conform to the approved drawings.

References

1. **IRS B1-2001**-Indian Railways Standard Specification for fabrication and erection of steel girder bridges and locomotive turn tables (Fabrication Standard)
2. **IRS WBC**- Code of Practice for metal arc welding for structural steel bridges carrying rail cum road or pedestrian traffic (Adopted 1972 Revised 2001)
3. **IRBM**- Indian Railways Bridge Manual -2024
4. **IRCM**- Indian Railways Construction Manual -2023
5. **RDSO BS-115 R1**- Guidelines for Composite construction including Stud Shear Connector - April 2016
6. **ISO 13918**- Welding — Studs and ceramic ferrules for arc stud welding- February 2008

Flow Chart of Activities



5. Materials and Material Quality Assurance

5.1 Shear Studs

- 25 mm diameter x 200 mm welded-length studs are used as per BS-115.
- Designation of Shear Stud: ISO 13918:2018 = SD1 - 25 . 200 - A/B (as per Table 1 of ISO 13918-2018)

Stud manufacturing shall be as per ISO 13918-2018.

25 mm diameter;.

Length is 205.5 +/- 1.5 mm before welding and 200 +/- 1 mm length after welding.

The additional length is consumed during the welding/burn-off process.

A/B indicates stud tip shape. A-type stud is used, which has an aluminium rounded tip at the bottom.

Chemical and Mechanical characteristics of finished stud material are as given in the table below-

Table 1: Properties of studs

Name of the Project:					
Ref Drawing No:					
Mill Test Certificate No & date:					
Name of the Supplier:					
Quantity Supplied					
No. of samples (para 5.1.1.1 above)					
SN	Particulars	Standard	Material/Material Group/Property Class/ Values	Values Obtained	Remark/ Acceptable (Yes/No/NA)
1	Symbol	ISO-13918	SD1		Material Group 1
Chemical Properties		Values from ladle analysis			
2	Carbon (C)	ISO/TR 15608	≤ 0.2 %		
3	Carbon Equivalent (Ceq)		≤ 0.35 %		
4	Aluminium (Al)		≥ 0.02 %		
Mechanical Properties					
5	Tensile Strength (Rm)	ISO 6892-1/ISO 13918	≥ 450 N/mm ²		
6	Upper YS of material (ReH)		≥ 350 N/mm ²		
7	% Elongation at fracture (A ₅)		≥ 15%		
8	specific weight		7.85 kg/dm ³		
Other					
9	Stud tip and Flux	Press fitted aluminium ball or Al spray coating			
10	Ferrule	para 10.3 of ISO 13918			

5.2 Testing of Shear Studs:

The stud supplier shall submit a mill test certificate. Additional tests to confirm the metallurgical and physical properties of the stud material from NABL/NABCB laboratories shall be done if the number of studs is more than 10,000, at one test per 20,000 studs or part thereof.

The number of samples to be sent for each test are as under-

Table 2: No of Samples for testing

Properties	Number of samples
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Tensile Strength (≥ 450 MPa),	2 Per Heat
Yield Strength (≥ 350 MPa),	
Elongation ($\geq 15\%$)	
Chemical Composition ($C \leq 0.2\%$, $CEV \leq 0.38\%$, $Al \geq 0.02\%$)	1 Per Heat
Dimension Tolerance	5 Per Heat

5.3 Ceramic Ferrules

The ceramic ferrule contains the molten weld metal, shapes the weld collar, protects the weld pool from atmospheric contamination and helps control the welding arc and spatter.

Compatible ceramic ferrules shall be used with the studs. Ferrules shall be dry, free from cracks or damage and shall be of the correct size for the stud.

Studs and ferrules form a properly coordinated welding system and should be supplied from a single manufacturer.

Designation of Ferrule: ISO 13918:2018 = UF-19 (as per Table 1 of ISO 13918-2018)

6. Equipment

- automatic stud-welding gun with suitable chuck and ferrule holder;
- approved stud-welding power source/control unit;
- suitable welding cables and connectors;
- proper earthing clamps;
- grinder/wire brush/light abrasive blasting equipment for surface preparation;
- measuring scale, vernier/calipers and templates as required;
- 2 kg hammer for ring testing;
- suitable pipe, hammer (6 kg), bending tool or other arrangement for bend testing;
- PPE including welding helmet/face shield, gloves, safety shoes, protective clothing and eye protection.

7. Pre-Welding Checks and Process Qualification

7.1 Verification of Drawings and Geometry

Before commencing welding, verify:

1. Stud diameter and finished length;
2. Stud locations, spacing and number;
3. Edge distances; the typical edge-distance requirement is approximately 25-38 mm for the commonly used 25 mm studs
4. Thickness of the flange plate. For distortion control during stud welding, plate thickness should be at least more than the half of the stud dia.
5. Welding position;
6. Any restrictions shown in the approved drawing.

7.2 Welder and Process Qualification – WPQR and WPSS and

Before production welding, the welding machine and welding parameters shall be qualified for the stud type, base material and welding position to be used.

Test studs shall be welded on sample plates having properties similar to the actual girder flange and in the same welding position. If the test welds are unsatisfactory, parameters shall be adjusted.

WPQR is prepared on the basis of approved WPSS. Minimum 2 studs shall be welded as per the approved welding parameters to approve the welder. Qualification certificate issued to welder by Assistant Engineer which is valid for two years, subject to the conditions stated therein.

7.3 Welding Machine Qualification and Parameter Setting

It is the responsibility of the welding machine supplier to recommend the welding process/parameters to be adopted. Stud welding requires very high current; hence the machine and accessories shall be capable of withstanding this requirement.

Typical requirement of current for down hand welding for 25 mm diameter studs used in RDSO designs is given below. These values are indicative only for a particular machine; actual production settings shall be based on the machine/stud manufacturer recommendation and the qualified welding procedure.

Table 2: Machine parameters

SN	Particulars	Stud Diameter (in mm)	Current (in A)	Time		Lift (in mm)	Plunge (in mm)
				Sec	Cycles		
1	By supplier	25	1900	1.4	85	0.125	0.250
2	On Field						
3	Weld Quality	Acceptable (Yes/No)					

7.4 Surface Preparation

The top flange surface at every stud location shall be inspected and cleaned before welding. Where the girder surface is already painted, paint shall be completely removed for a distance of at least 50 mm from the centre of the stud location.

Cleaning may be carried out by light sand blasting, wire brushing, scraping or grinding.

The prepared surface shall be checked and certified by the site engineer before welding starts.

7.5 Pre-Welding Visual Inspection of Studs

- Dimension check of 2-4% of studs before welding (Annexure-I, Para 7 of BS-115).
- Studs shall be free from corrosion, coating, grease, paint, galvanising and moisture.

- No galvanized/coated studs shall be used, as the coating may contaminate the weld metallurgy and/or reduce bond strength.
- Studs shall have proper and intact flux at the tip (press-fitted aluminium ball or spray coating).
- Length of loose stud shall be 205.5 +/- 1.5 mm for the commonly used 25 mm diameter x 200 mm welded-length stud.

7.6 Pre-Welding Quality-Control Checklist

Condition of the surface, studs and ferrules at the time of welding, together with correct machine parameters, plays a crucial role in ensuring a good-quality weld. The following checklist shall be completed by the quality supervisor of the fabricator before commencement of stud welding on the component and retained for record.

Table 4: Checklist for Stud Welding

SN	Particulars	Acceptable (Y/N/NA)	Remark
1	Position of Welding Downhand / Vertical/Overhead		
	Surface Preparation		
2	Is plate surface free from moisture/rust/mill scale/oil/grease /paint/galvanizing.		
3	Is the stud Galvanized/coated?		
4	Is the surface Ok for stud welding?		
	Inspection of Studs		
5	Dimension Check of studs Done		
6	Stud have proper flux at tip		
7	Studs is not corroded or having any coating.		
8	Is there any head crack in stud?		
9	If Yes, is it within permissible limits? ($c_d \leq 0.25(d_5 - d_1)$)		
	Inspection of ferrules		
10	Ferrules are not broken /damaged.		
11	Ferrules are dry.		
12	If No, required drying done.		
13	Parameter setting is as per the manufacturer specification.		Note the values.
14	Clamping surface for earthing is free from rust/paint.		
15	Arrangement required to prevent arc blow (if any) are available or not?		Box shield/ Bolted Plate

8. Welding Procedure

8.1 Welding Position, Marking of Locations and Welding Sequence

Stud welding to be carried out in the downhand position. Stud locations shall be marked on the cleaned flange in accordance with the approved drawing. A

suitable staggered/zig-zag welding sequence should be followed to minimize localized heating, shrinkage and distortion of the top flange.

8.2 Setting the Stud in the Gun

- (i) Insert the stud in the correct chuck of the stud-welding gun.
- (ii) Place the compatible ceramic ferrule in the ferrule holder.
- (iii) Ensure that the stud is properly centred inside the ferrule. Proper centring is essential because contact between the stud and ferrule during lift or plunge can restrict movement and result in insufficient penetration and a weak weld.
- (iv) Set the specified lift and plunge.
- (v) Confirm correct earthing and welding-machine settings.
- (vi) Hold the gun so that the stud is normal to the flange surface.
- (vii) Gun removal: Withdraw the gun vertically from the welded stud.
- (viii) Ferrule removal: After adequate cooling, break and remove the ceramic ferrule.
- (ix) Cleaning: Remove all loose ferrule pieces and weld debris.
- (x) Inspection: Visually inspect the completed stud and weld collar.

8.3 Control of Arc Blow

Magnetic arc blow may result in an uneven or incomplete weld collar, particularly close to flange edges. In asymmetric section, arc deflects toward larger mass and results in poor weld on edge side. To prevent this, edge side heavy iron plate may be added. Edge side should be earthed to prevent arc deflect opposite to the earth terminal.

9. Post-Welding Inspection and Testing

9.1 Visual Inspection of weld

Completed welds shall be visually examined for complete fusion around the stud, uniform weld collar and proper stud position and verticality. The weld collar shall be free from defects such as Hot Weld, Cold Weld and Hang-up.

9.2 Verticality

Studs shall generally be vertical. Slight inclination may be accepted where the weld itself is otherwise satisfactory, but repeated inclined studs indicate a problem with machine setup or welding technique and the cause shall be corrected.

9.3 Burn-Off Length

For the commonly used 25 mm diameter x 200 mm finished-length stud, the nominal burn-off is about 5.5 mm. This may be checked by placing a loose stud beside the welded stud and comparing their heights. Abnormal burn-off together with an irregular weld profile indicates that the welding parameters require investigation.

9.4 Dimensional Check of Weld Collar

- Dimensions of 5% of completed welds shall be checked against the specified requirements. The weld size around the stud should be of 3 mm thickness and 7 mm height.
- Defective weld length around the circumference shall be assessed as follows:

Less than 10% - acceptable.

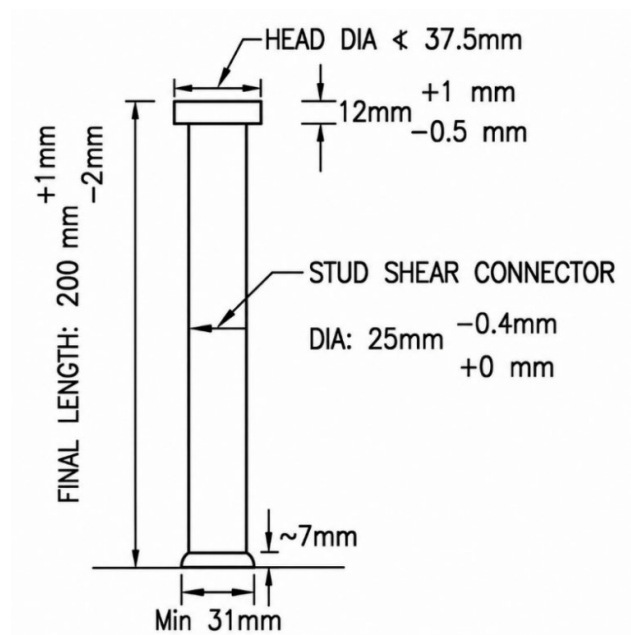
10% to 20% - repairable, subject to the permitted clustering limits.

More than 20% - defective and non-repairable.

- For repairable studs, clustering shall not exceed:

1 in 6 studs in the end quarter span;

1 in 3 studs in the middle half span.



9.5 Ring Test

5% of the welded studs (1 in 20) shall be checked by the ring test.

The side of the stud head shall be struck using a 2 kg hammer. A clear ringing sound indicates satisfactory fusion. A dull sound indicates possible lack of fusion and the stud shall be subjected to bend testing.

9.6 Bend Test

1% of welded studs (1 in 100) shall be subjected to a bend test after cooling.

The stud shall be bent approximately 60 degrees from its original axis, either by striking its free end or by placing a suitable pipe/hollow bending tool over the stud and applying the bending force. The bending direction shall preferably be opposite to any observed arc blow or visible weld imperfection.

The weld shall remain sound without failure at the stud-to-base-metal interface.

9.7 Post-Welding Inspection Checklist

The inspection results and rectification carried out, if any, shall be recorded in the following table.

Table 5: Inspection after Welding

SN	Particulars	Value/ Acceptable (Y/N/NA)	Remark
1	Total No. of studs provided		
2	Is any Hot weld/Cold weld/ Hang up noticed?		
3	Number of studs checked for weld length? (5% shall be checked.)		
4	Final length of welded studs		value in mm
5	Weld height		in mm
6	Weld Diameter (min value as per ISO)		
7	No. of Stud with weld defect length < 10 %.		Acceptable
8	No. of Stud with weld defect length 10 < n < 20 %.		Repairable
9	No. of defective studs in end quarter span		< 1 in 6
10	No. of defective studs in middle half of span		< 1 in 3
11	No. of Stud with weld defect length > 20 %.		Defective
12	Are the studs vertical or inclined?		If inclined,
13	No. of studs tested for Ring Test		1 in 20 (5%)
14	No. of studs tested for Bend Test		1 in 100 (1%)
15	No. of new studs provided		≥ that at SN 11

10. Treatment of Defective Studs

10.1 Repairable Studs

Where the cumulative defective weld length is between 10% and 20% of the circumference, and the permissible clustering limit is satisfied, the stud shall be repaired by a 6 mm size fillet weld by MMAW method as per Para 26.6 of IRS B1-2001.

10.2 Non-Repairable Studs

Where a stud is classified as non-repairable:

- The defective stud may be retained and an equal number of additional studs of the same quality and size provided as close as practicable.
- A minimum clear gap of approximately 50 mm shall be maintained between studs to allow reinforcement placement and proper concreting;

- Where additional studs cannot be accommodated, selected defective studs may be cut by gas cutting/sawing at about 20 mm above the base, taking care not to damage the parent flange.

10.3 Rejection of Member

If the concentration of defective welded studs is excessively high, and neither the addition nor the removal of studs is viable from a quality-assurance standpoint, or satisfactory rectification cannot be achieved without compromising quality, the entire structural member shall be rejected.

11. Protection after Welding

The stud surface shall not be painted, since paint can reduce bond with the subsequently cast concrete. For corrosion protection, aluminium metallizing of the steel surface and studs can be done after welding and inspection.

12. Final Inspection and Records

12.1 Stud Welding Register

Visual inspection of 100% of welded studs shall be carried out for weld quality. Defective weld length, if any, shall be measured and recorded in the Stud Welding Register along with details of rectification done and the final inspection remarks of the inspecting agency. The format below may be used.

Table 6: Stud Welding Register

SN	Date 1 in 50	Component description	Nos. of stud welded	Visual	Ring test @ 5%	Bend test @ 1 %	Welded stud Height	Details of rectification	Sign. of internal QC	Sign. of Project executing agency
1	2	3	4	5	6	7	8	9	10	11

12.2 Quality Assurance Proforma

The Quality Assurance Proforma for Inspection of Automatic Stud Welding, containing general details of the project, inspection results and remarks regarding changes required in the welding process in light of defects observed, shall be filled and kept for future record.

Table 7: Quality Assurance Proforma

	General Data			
SN	Particulars	Details		
1	Name of the Inspector		Date of Inspection	
2	Fabricating Agency		Workshop	
3	Approved Drawing No		Approved QAP No.	

4	Span No		No. of studs per Span	
5	Dia of stud		Length of Stud	
	Inspection Results		Satisfactory (Y/N/NA)	Remarks
6	Studs Material Inspection Report Nos			
7	Ferrules Material Inspection Report Nos			
8	Name of machine operator:			
9	Certificate No			
10	Date of qualification (Not more than 2 years Old)			
11	Name of Issuing Authority			
12	Welding Machine Make & SNo			
13	Machine Setting as per Approved QAP or Approved Qualification Record			
	Current	Duration	Cycles	Lift
14	Surface preparation (100%)			
a)	Is surface free from rust/mill scale etc?			
b)	Is surface free from grease/paints etc?			
c)	Is the surface being cleaned of weld splatter/ broken ferrules during welding:			
15	Visual Inspection of raw material. (on random samples, ~2-4%)(Only summary to be given here, Separate register may be made for detailed record)			
a)	Studs			
(i)	Is surface free from paint, galvanizing, grease and moisture			
(ii)	Is the flux intact at the tip of the stud:			
(iii)	Is the length of stud as per requirement			
b)	Ferrules			
(i)	Are ferrules broken			
(ii)	Are the ferrules properly dry			
c)	General Remarks on storage/ handling of materials			
16	Ring test (@5%) (Only summary to be given here, Separate register may be made for detailed record)			
	No. of tests done	Results Nos OK	Nos Not Ok	
17	Bend Test (@1%) (Only Summary)			
	No. of tests done	Results Nos OK	Nos Not Ok	
18	Visual Inspection of completed weld (@100%) Only Summary			
a)	Is the surface of flash having a shiny bluish hue?			
b)	No of studs with good weld shape?			
c)	No of studs with defects within acceptable limits?			
d)	No of studs with repairable defects?			
e)	No of studs defective/with not repairable defects?			
19	Measurement of Welded Stud Height (@5%)			
a)	Height of welded stud		Burn Off Length	
b)	Is the burn-off length proper			
20	Is the member with studs acceptable?			
21	Changes required in welding process in light of defects observed, if any			

22	Repairs to defect (If Possible)		
a)	Total Repairable Studs		
b)	Date of repair		
c)	Quality of Repairs- OK/Not OK		
23	Replacement of Non-Repairable studs If Possible		
a)	No. of Non-repairable studs		
b)	No. of additional studs Provided		
c)	No. of studs cut		
d)	No. Additional studs provided (with 50 mm gap)		
e)	Quality of New Studs Provided- OK/Not OK		
	Sign of Inspector	Date	
	Name:		
	Designation:		

13. Safety Precautions

The following precautions shall be observed during welding:

- (i) Welding equipment, cables and connections shall be properly maintained;
- (ii) The work piece shall be reliably earthed;
- (iii) Only trained and qualified operators shall perform stud welding;
- (iv) Welding areas shall be kept dry;
- (v) Wet or damp ferrules shall not be used. Wet ferrules can produce steam during the welding cycle, causing molten metal to be expelled and creating both a safety hazard and porous, weak welds.
- (vi) Flammable material shall be removed from the working area;
- (vii) Operators shall use suitable welding shields, gloves, protective clothing and safety footwear;
- (viii) Adequate precautions shall be taken against molten-metal spatter and broken ceramic ferrule particles;
- (ix) Personnel not involved in welding shall be kept away from the immediate work area.

14. Field Inspection Checklist

Following checklist to be used by the field/quality supervisor during shear-stud welding to check and ensure the quality control at every stage of work execution:

Table 8: Field Inspection Checklist

Checkpoint	Stage	Acceptance Criteria	Frequency	Required Record
Approved drawings and QAP	Before start of work	Approved drawing/QAP available; stud size, number, spacing, edge distance, flange thickness, girder identification and welding position verified.	Once for each girder/component and whenever drawing changes.	Approved drawing/QAP; pre-welding checklist.
Stud material	Before issue for welding	Studs conform to specified designation/material; correct dimensions and flux; free from corrosion, paint, galvanizing, grease and moisture; MTC accepted.	MTC: each lot/heat. Visual/dimensional sample: about 2-4% before welding.	MTC/material inspection report; stud inspection register.
Ceramic ferrules	Before issue for welding	Compatible size; dry, intact and undamaged. Wet ferrules shall not be used unless properly dried.	Random check before and during welding.	Ferrule inspection/material record.
Welder Qualification (WPQR)	Before welding	Operator and welding parameters qualified for stud type, base material and welding position; qualification certificate valid (not more than 2 years). Trial studs satisfactory.	Before first production welding; repeat for new position/quality/size as applicable.	Welder/operator qualification certificate; WPSS/WPQR/process qualification record.
Welding machine and settings	Before production welding	Machine capacity, welding gun calibration, setting of welding parameters, adequate power source.	At setup/start of shift and after any setting/equipment change.	Machine setting sheet; equipment calibration/maintenance record where applicable.
Girder surface and earthing	Before welding each area	Surface dry and free from heavy mill scale, flaky rust, oil, grease, paint, galvanizing, moisture, weld spatter and debris. Paint removed at least 50 mm from stud centre; earthing point cleaned to bare metal.	100% of stud-welding areas and earthing locations.	Surface-preparation/pre-welding checklist.
Stud location and gun alignment	Witness during welding	Stud locations as per drawing; spacing/edge distance correct; gun held normal to surface; stud centred in ferrule; correct earthing and zig-zag/staggered sequence followed.	Continuous/process check during welding.	Stud welding register / supervisor checklist.

Checkpoint	Stage	Acceptance Criteria	Frequency	Required Record
Completed weld – visual check	Before further work/concreting	Complete fusion and generally uniform collar; no unacceptable undercut, porosity, incomplete fusion, off-centre collar, excessive/insufficient flash or abnormal burn-off; stud generally vertical.	100% of welded studs.	Stud welding register; visual inspection record.
Weld dimensions / burn-off	Post-Welding Inspection	Weld dimensions comply with requirement. Defect length <10% circumference: acceptable; 10-20%: repairable subject to clustering limits; >20%: non-repairable. For 25 x 200 mm stud, burn-off about 5.5 mm.	Dimensions/welded stud height: 5% of completed welds.	Dimensional inspection record / QA proforma.
Repair of Repairable defects	Acceptance of repairs	Defective weld length 10-20% may be repaired by 6 mm fillet weld under strict supervision; clustering not more than 1 in 6 in end-quarter span and 1 in 3 in middle-half span.	Each repairable defective stud.	Repair record showing stud number/location, repair date, method and reinspection result.
Non-repairable defects	Post-Replacement Inspection	Equal number of additional studs of same quality/size provided near defective studs with minimum 50 mm gap; where necessary defective studs may be cut about 20 mm above base without damaging flange. Excessive defective population may require member rejection.	Each non-repairable defective stud.	Non-repairable stud/replacement record; revised stud location sketch if applicable; final acceptance/rejection note.
Ring test	Post-Welding Testing	Clear ringing tone indicates satisfactory fusion. Dull tone requires further examination/bend test.	5% (1 in 20) welded studs, using 2 kg hammer.	Ring-test register / stud welding register.
Bend test	Post-Welding Testing	Stud bent approximately 60 degrees after cooling without failure at stud-to-base-metal interface; bend opposite visible imperfection/arc blow where applicable.	1% (1 in 100) welded studs.	Bend-test record / stud welding register.

Checkpoint	Stage	Acceptance Criteria	Frequency	Required Record
Final acceptance and protection	Before deck reinforcement/concreting	All inspection/test results acceptable; ferrule pieces and debris removed; studs left unpainted. Aluminium metallizing, if specified, only after welding and inspection.	Each girder/span/component.	Completed stud welding register; QA proforma; inspection reports; repair/replacement records; final release/acceptance