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कार्यस्थल पर सुरक्षा - केस स्टडी सहित

SAFETY AT WORKSITE - WITH CASE STUDY



केमटेक/2019/सि/कार्यस्थल पर सुरक्षा/1.0

CAMTECH/2019/C/SAFETY AT WORKSITE/1.0

अक्टूबर – 2019

October – 2019

अआमा संRDS
रेल अग्रदूत Transforming Railways

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कार्यस्थल पर सुरक्षा - केस स्टडी सहित

SAFETY AT WORKSITE - WITH CASE STUDY

प्राक्कथन

सार्वजनिक सुरक्षा रेलवे संगठनों की प्रमुख चिंता है। भारतीय रेलवे में आरओबी के निर्माण और रखरखाव जैसे कार्य प्रत्यक्ष / अप्रत्यक्ष रूप से सार्वजनिक सुरक्षा से संबंधित हैं।

CAMTECH के सिविल निदेशालय द्वारा "कार्यस्थल पर सुरक्षा केस स्टडी सहित" विषय पर हस्तपुस्तिका लाने का प्रयास सराहनीय है, जिसमें मुख्य रूप से कार्यकर्त्ताओं, सामग्री और मशीनरी की सुरक्षा के लिए कार्यस्थल पर सामान्य सुरक्षा उपायों के बारे में एवं गर्डर ब्रिज के निर्माण में विभिन्न चरणों से संबंधित जानकारी तस्वीरों के माध्यम से प्रदान की गई है।

मुझे उम्मीद है, भारतीय रेलवे में विभिन्न निर्माण और रखरखाव गतिविधियों में शामिल इंजीनियरिंग कर्मियों के लिए यह पुस्तिका काफी उपयोगी होगी।

केमटेक, ग्वालियर@अअमासं ***(जितेंद्र सिंह)***

31 अक्टूबर, 2019 ***प्रधान कार्यकारी निदेशक***

FOREWORD

The public safety is the prime concern of Railway Organisations. Works like construction and maintenance of ROBs in Indian Railways are directly/indirectly related to Public Safety.

It is appreciable to the efforts made by Civil Directorate of CAMTECH to bring out a handbook on "Safety at Worksite with Case Study", in which the information regarding general safety measures to be followed at worksite mainly to safeguard Men, Material & Machinery during various stages in construction of Girder Bridge has been provided along with photographs relevant to the construction stages of ROB.

I hope, this handbook shall be quite useful to the engineering personnel involved in various construction and maintenance activities in Indian Railways.

CAMTECH/Gwalior@RDSO ***(Jitendra Singh)***
31 October, 2019 ***Principal Executive Director***

भूमिका

हाल ही में, JHS-GWL सेक्शन में OHE MAST NO. 1224/16-1224/22 के बीच एक रेल ओवर ब्रिज का निर्माण रेलवे स्टेशन , ग्वालियर के पास पडाव, ग्वालियर में रेलवे ट्रैक पर Deposit Work के रूप में किया गया है , जिसमें रेलवे स्पान Bow String Steel Girder का है। इसका एक सिरा सिंधिया कन्या विद्यालय की ओर और दूसरा गांधी रोड की ओर, के बीच की सड़क को जोड़ने के लिए सफलतापूर्वक लॉन्च किया गया है।

सुरक्षा सर्वोपरि है और किसी भी परिस्थिति में सुरक्षा से समझौता नहीं किया जाना चाहिए। कर्मचारियों को निरीक्षण, मरम्मत, निर्माण और रखरखाव के दौरान सुरक्षा-संबंधी कार्यों को करने के शॉर्टकट का पालन नहीं करना चाहिए।

इस हस्तपुस्तिका **"कार्यस्थल पर सुरक्षा - केस स्टडी सहित"** में इस ROB पर अनुसरित सामान्य सुरक्षा उपायों को शामिल किया गया है, जिसमें गर्डर ब्रिज के निर्माण के विभिन्न चरणों के दौरान श्रमिकों, सामग्री और मशीनरी की सुरक्षा के लिए कार्यस्थल पर सुरक्षा उपायों को अपनाया गया है।

इस केस स्टडी में सामग्री की आपूर्ति, निर्माण, असेंबली, Bow String Steel Girder की लॉन्चिंग तथा अस्थाई प्रबंधों को हटाने तक के दौरान अपनाए गए सुरक्षा उपायों को शामिल किया गया है। सुविधा के लिए , यह केस स्टडी कार्यस्थलों पर अपनाए जाने वाले निम्नलिखित सुरक्षा उपायों पर आधारित है -

1. श्रमिकों की सुरक्षा
2. परिवहन तथा सामग्री की हैंडलिंग में सुरक्षा
3. कार्य शुरू करने से पहले कार्यस्थल पर सुरक्षा
4. कार्य की प्रगति के दौरान कार्यस्थल पर सुरक्षा
5. अस्थाई प्रबंधों को हटाने के दौरान सुरक्षा

इस केस स्टडी का उद्देश्य रनिंग ट्रैक के ऊपर गर्डर ब्रिज (ROB) के निर्माण में विभिन्न चरणों के दौरान सुरक्षित कार्य के बारे में, भारतीय रेलवे के SSE/JEs और अधिकारियों के मध्य ज्ञान का प्रसार करना है।

हम इस केस स्टडी के और सुधार के लिए अपने पाठकों के किसी भी सुझाव का स्वागत करते हैं।

केमटेक, ग्वालियर *(डी. के. गुप्ता)*

28 अक्टूबर, 2019 *संयुक्त निदेशक / सिविल*

PREFACE

Recently, a Rail Over Bridge between OHE Mast No. 1224/16-1224/22 in JHS-GWL Section is constructed as a Deposit Work over the Railway Track at Padav, Gwalior near Railway Station, Gwalior, in which railway span is Bow String Steel Girder. The span is launched successfully to connect the road between two ends i.e. towards Scindia Kanya Vidhyalay and opposite of it towards Gandhi Road.

Safety is sacrosanct and should not be compromised under any circumstances. Staff should not follow shortcuts while undertaking safety-related works during inspection, repair, construction and maintenance.

This Handbook on **"Safety at Worksite – With Case Study"** involves the general safety measures followed at this ROB to safeguard the Men, Material & Machinery during various stages in construction of Girder Bridge.

This case study covers the safety measures adopted during supply of material, fabrication, assembly, launching of Bow String Steel Girders till removal of temporary arrangements. For the sake of convenience, this case study is based on the safety measures to be taken at the worksites to ensure the following –

1. Safety of Workers
2. Safety in Transportation and Handling of Materials
3. Safety at Worksite prior to Start of Work
4. Safety at Worksite during Progress of Work
5. Safety during Removal of Temporary Arrangement

The object of this case study is to disseminate the knowledge among SSEs/JEs and Officers of Indian Railways about safe working during various stages in construction of Girder Bridge (ROB) over the running track.

We welcome any suggestions from our readers for further improvement of this handbook.

CAMTECH/Gwalior ***(D.K. Gupta)***
28th October, 2019 ***Joint Director/Civil***

विषय-सूची / CONTENT

सं. क्र. / S. No.	विवरण / DESCRIPTION	पृष्ठ क्र. / PAGE NO.
	प्राक्कथन / FOREWORD	*(i)*
	भूमिका / PREFACE	*(ii)*
	विषय-सूची / CONTENT	*(iii)*
	संशोधन पर्चियाँ / CORRECTION SLIPS	*(iv)*
A	**INTRODUCTION**	**01**
B	**BRIEF ON BOW STRING STEEL GIRDER (ROAD OVER BRIDGE)**	**01**
C	**DESIGN ASPECTS OF BOW STRING STEEL GIRDER**	**02-04**
	Detailed Cross-Section of Bow String Steel Girder	
1.0	**SAFETY OF WORKERS**	**05-08**
1.1	Use of Personal Protective Equipments (PPE)	
1.2	Use of Safety Belt or Harness	
1.3	Safety Harness and its Lanyard Must	
1.4	References to Railway Board's Letters Regarding Safety at Worksite	
2.0	**SAFETY IN TRANSPORTATION AND HANDLING OF MATERIALS**	**08-12**
2.1	During Transportation	
2.2	Depending upon their distance from IR Tracks works to be executed in vicinity of Running Lines	
2.3	During Handling	
3.0	**SAFETY AT WORKSITE PRIOR TO START OF WORK**	**13-15**
3.1	Checklist	
3.2	Safety aspects to be observed while working in OHE area	
3.3	Technical Organisation/Tools, Equipments and Plants	
4.0	**SAFETY AT WORKSITE DURING PROGRESS OF WORK**	**16-35**
4.1	Stacking Materials	
4.2	Safety Measures during Fabrication	
4.3	Safety Measures during Welding	
4.4	Alterations in the Work	
4.5	Safety Measures during Painting	
4.6	Assembly and Erection	
4.7	Inspection and Rectification	
4.8	Launching of Girders	
5.0	**REMOVAL OF UNUSED MATERIALS ETC.**	**36**
Annex - I	**Records to be maintained during Fabrication**	**37-38**
Annex – II	**Manufacturing Tolerances**	**39-41**
Annex - III	**Performa for Welding Procedure**	**42-44**
	संदर्भ / REFERENCES	**45**
	टिप्पणी / NOTES	**46**
	गुणवत्ता नीति एवं डिस्क्लेमर / QUALITY POLICY AND DISCLAIMER	**47**

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संशोधन पर्चियों का प्रकाशन
ISSUE OF CORRECTION SLIPS

इस हस्तपुस्तिका के लिए भविष्य में प्रकाशित होने वाली संशोधन पर्चियों को निम्नानुसार संख्यांकित किया जाएगा :

The correction slips to be issued in future for this handbook will be numbered as follows:

केमटेक/2019/सि/कार्यस्थल पर सुरक्षा/1.0/सीएस# XX दिनांक_____

CAMTECH/2019/C/SAFETY AT WORKSITE/1.0/CS # XX date_____

जहाँ XX संबन्धित संशोधन पर्ची की क्रम संख्या है (01 से प्रारम्भ होकर आगे की ओर)

Where "XX" is the serial number of the concerned correction slip (starting from 01 onwards).

प्रकाशित संशोधन पर्चियाँ
CORRECTION SLIPS ISSUED

क्र.सं./ Sr. No.	प्रकाशन दिनांक/ Date of issue	संशोधित पृष्ठ संख्या तथा मद संख्या/ Page no. and Item No. modified	टिप्पणी/ Remarks

A. INTRODUCTION

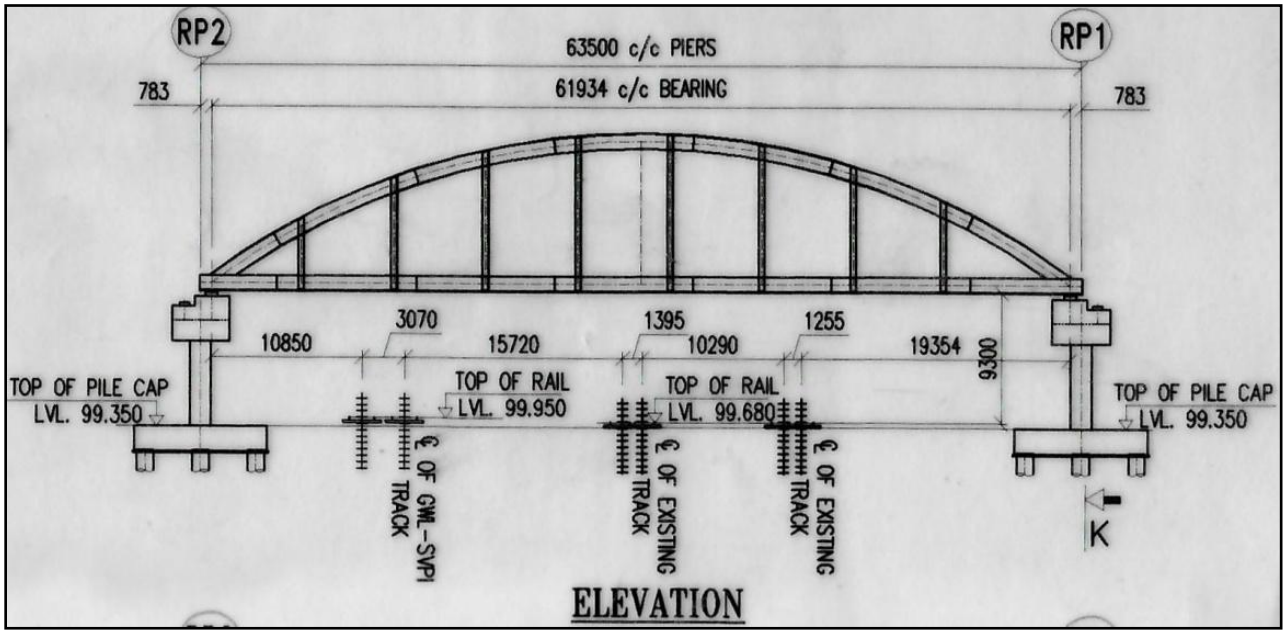
For a structure to operate with maximum safety certain fundamental requirements must be recognized and made effective. The scope of this case study is only limited to the safety procedures being followed in the field at different stages of construction of ROB.

This case study covers the safety measures adopted during supply of material, fabrication, assembly, launching of Bow String Steel Girders till removal of temporary arrangements. For the sake of convenience, this case study is based on the safety measures to be taken at the worksites to ensure the following –

1. Safety of Workers
2. Safety in Transportation and Handling of Materials
3. Safety at Worksite prior to Start of Work
4. Safety at Worksite during Progress of Work
5. Safety during Removal of Temporary Arrangement

B. BRIEF ON BOW STRING STEEL GIRDER (ROAD OVER BRIDGE)

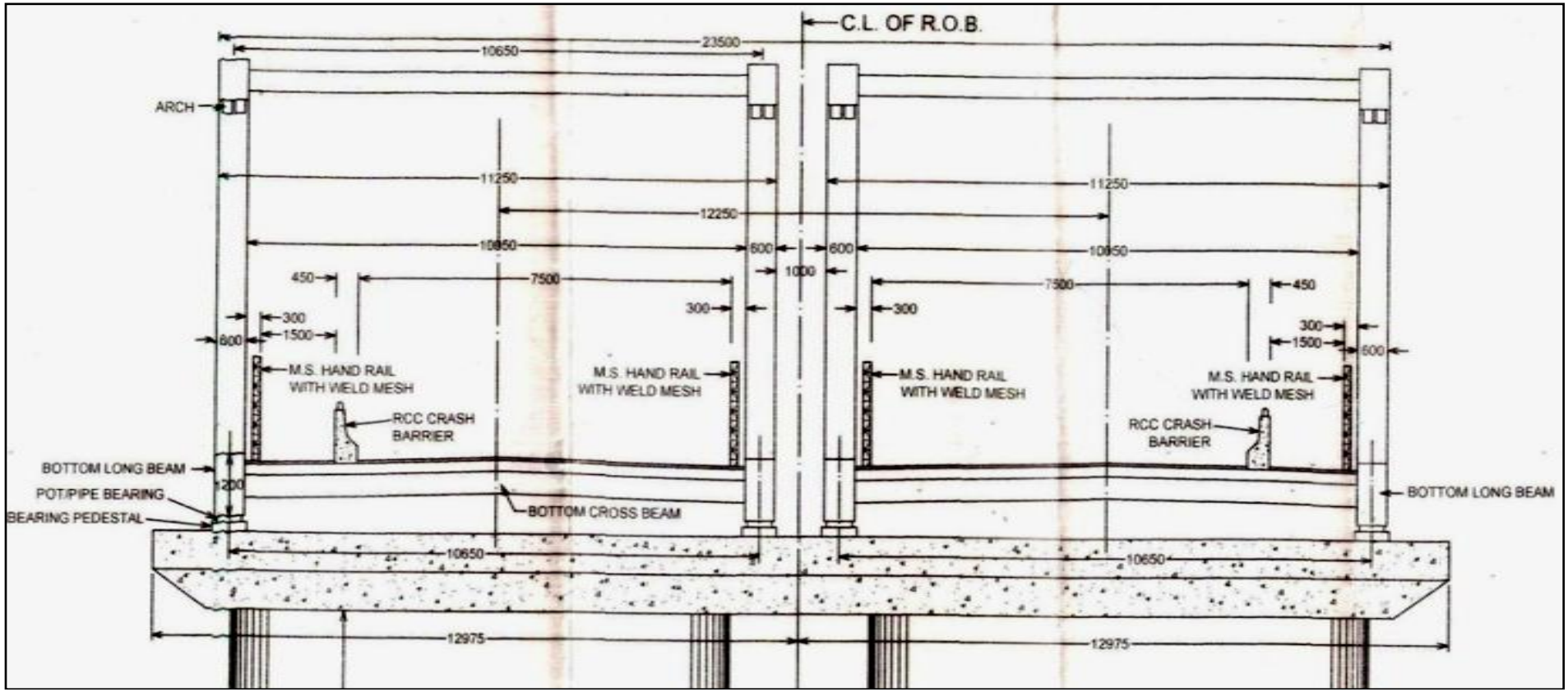
The present Bow String Steel Girder (Road Over Bridge) is constructed as a deposit work over the Railway Track at the Padav, Gwalior near Gwalior Railway Station between OHE MAST No. 1224/16-1224/22 in JHS-GWL Section to connect the road between two ends i.e. towards Scindia Kanya Vidhyalay and opposite of it towards Gandhi Road.

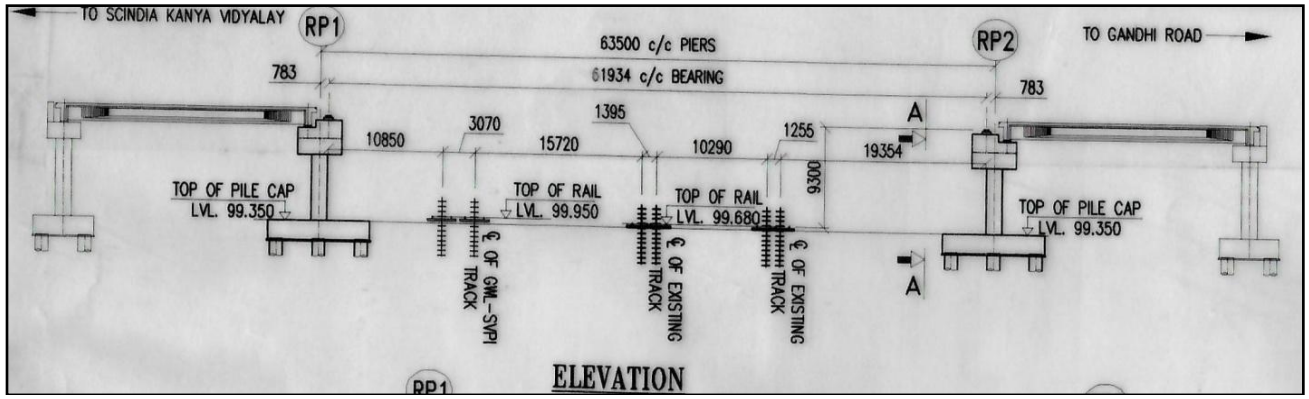


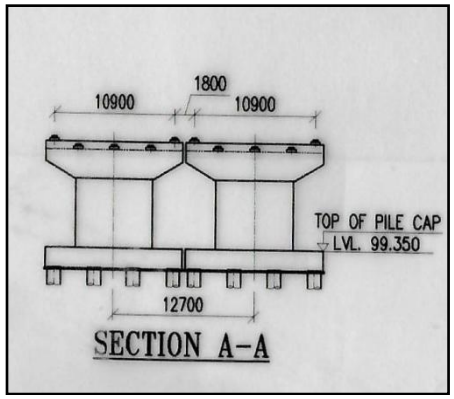
C. DESIGN ASPECTS OF BOW STRING STEEL GIRDER

- The Bow String Steel Girder is Bridge having deck slab with a length of 61.935 m c/c of Bearings and a total carriage way width of 10.45 m including footpath 1.5 m wide. Both girders are two lane ROBs, which involve the use of shear connector.
- The superstructure includes RCC crash barrier after carriageway and steel railing beyond footpath to safeguard pedestrian.
- The RCC deck slab including crash barrier has been designed with design Mix Concrete with grade of Concrete M40.
- The grade of reinforcement shall be Fe500.
- The minimum cover to any reinforcement shall be 40 mm.
- The sacrificial shuttering of 4 mm thick plate with 75x75x8 mm stiffeners @ 475 c/c shall be provided.
- The cement concrete wearing coat shall be laid separately over the bridge deck. The concrete shall be of minimum M30 grade.
- The thickness of wearing coat shall be 75 mm thick.
- Steel reinforcement of 8 mm dia. at 150 mm spacing in both directions shall be provided at the mid depth of the wearing coat. In a length of 1000 mm near the expansion joint, additional reinforcement of 8 mm dia. bars shall be provided in both directions to make the spacing as 75 mm.
- The bearings used in these girders are POT and POT cum PTFE (Poly Tetra Floro Ethylene).
- The cross-drainage slope in the deck slab to drain the water shall be provided as per approved drawing. 100 mm dia. drain pipe shall be used as drainage spouts.
- Bow string girders are to be fabricated as per Indian Railway Specification for Fabrication and Erection of Steel Girder Bridges and Locomotive Turn-Tables (Serial No B1-2001).
- High Strength Friction Grip Bolts (HSFGB) shall be used as per drawings of RDSO. Notes for use of HSFGB are given in drawing no. RDSO/B-11760/R.
- For Structural Details of ROB, approved drawings shall be referred.
- Protection screen is to be provided as per RDSO Drawing No RDSO/ETI/C/0068 in each ROB.
- The protective coating is to be given to the bow string girder by metalizing with sprayed aluminium as recommended in RDSO drawings.
- All workshop fabrication shall be done using SAW **(Submerged Arc Welding**) process only.
- All welding, other than workshop welding, shall be done through Gas Shielded FCAW (**Flux Core Arc Welding**) process only.
- FCAW wire to be used shall be Flux Core Tubular consumable electrode to generate flux gas in addition to gas cover of CO_2, Argon or /CO_2-Argon mixture only. In FCAW process, wind screen and /or enclosures shall be providing around the welding location to prevent shielding gas from blown out.
- SMAW (**Shielded Metal Arc Welding**) also known as **Manual Metal Arc Welding, shall NOT be permitted** anywhere in the structure.

Detailed Cross-Section of Bow String Steel Girder




TO SCINDIA KANYA VIDYALAY
RP1
63500 c/c PIERS
61934 c/c BEARING
RP2
TO GANDHI ROAD
783
783
10850
3070
15720
1395
10290
1255
19354
9300
A
A
TOP OF PILE CAP
LVL. 99.350
TOP OF RAIL
LVL. 99.950
TOP OF RAIL
LVL. 99.680
TOP OF PILE CAP
LVL. 99.350
℄ OF GWL-SVPI TRACK
℄ OF EXISTING TRACK
℄ OF EXISTING TRACK
RP1
ELEVATION


1800
10900
10900
TOP OF PILE CAP
LVL. 99.350
12700
SECTION A-A



1.0 SAFETY OF WORKERS

1.1 Use of Personal Protective Equipments (PPE)

- Despite of all preventive measures in planning and supervision, some personal protective equipment such as helmet, hearing and eye protection, boots and gloves, is needed.
- Proper work clothes should be provided for protection of the skin.
- Where harmful dust, mist or gases may be present respiratory protection equipment should be used.
- Those engaged in welding works shall be provided with welder's protective eyesight lids.
- All safety equipments should be in accordance with their related IS codes like IS-5983 for Goggle Shield, IS-3521 for Industrial Safety Belt and IS-2925 for Safety Helmet.





1.2 Use of Safety Belt or Harness

- The majority of fatal accidents in construction field are due to falls from heights.
- Where work cannot be done from a scaffold or ladder, or from a mobile access platform, the wearing of a safety harness may be the only way to prevent serious injury or casualty.
- There are many types of safety belt and safety harness available.
- The manufacturer or supplier should be asked for advice on suitable types for the intended purpose and for instructions on use and maintenance.
- Full safety harness should always be used in preference to a safety belt.

1.3 Safety Harness and its Lanyard

- Must limit your fall to a drop of not more than 2m by means of an inertia device.
- Must be strong enough to support your weight.
- Must be attached to a strong structure through a firm anchorage point above the place at which you are working.

1.4 References to Railway Board's Letters Regarding Safety at Worksite

1.4.1 Safety at Worksites where Railway Staff is working on Track

[Ref.: Railway Board's Letter No. 2015/CE-II/TK/14, dated 06.11.2018]

The following instruction should be ensured at worksites where railway staff while working on track got run over –

1. Maintenance work on track to be done only after ensuring proper protection of track/worksite as per laid down instructions. Wherever required a staff should be posted for lookout duty.
2. No supervisor or staff should be forced to do maintenance work without protection of track/worksite.
3. No harassment of staff or supervisor for putting banner flag for safety reasons.
4. Violations, if any, should be monitored and severe action should be taken against defaulters.

1.4.2 Safety at Worksites where Work is carried out in the proximity of Running Track

[Ref.: Railway Board's Letter No. 2015/CE-II/TK/14, dated 30.12.2015]

1. It is stipulated vide Para No. 826 of IRPWM that any work in the proximity of running of track shall be started by contractor only in the presence of Railway supervisor or his representative and contractor's supervisor at site along with other procedures and rules to ensure safety.
2. The instructions have been issued by Board vide letter no. 2000/CE-II/PRA/12, dated 26.11.2012 to provide sturdy fencing to forewarn the road vehicle drivers working in vicinity of railway track.

1.4.3 Works to be carried out by Railway Engineer or his nominated Supervisor

[Ref.: Railway Board's Letter No. 97/CE-I/BRO/158(Policy)Pt.II, dated 16.07.2009]

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

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

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

1. Excavation of foundation/ground level near to Railway Track.
2. Concrete Casting and/or masonry very close to Railway Track.
3. Erection of temporary structures near to running lines.
4. Casting of structures like girder/slab over Railway Track.
5. Stage-Prestressing of girders when placed across Railway Tracks properly supported.

6. Launching of precast/pre-assembled girders across Railway Tracks.
7. Any work of lifting, side shifting and slewing of girders over the Railway Track.
8. Dismantling of temporary structures, shutters, scaffolding, etc. adjacent to and above Railway Track.

For carrying out the activities of casting, erection, launching, handling and dismantling as listed above, the Contractor's Engineer shall furnish the Construction Programme in advance to Supervising Railway Engineer. No such work should be taken up in absence of the Supervising Railway Engineer.

For the activities which are to be done in presence of the Railway Engineer, prior intimation shall be given in writing and acknowledgement obtained from Railway's representative. Such activities of work shall not be carried out without the presence of Railway Engineer.

1.4.4 Safety at Worksites

- [Ref.: Railway Board's Letter No. 2003/CE-II/Safety Misc./3, dated 21.06.2007]

  It is seen that contractors are allowed to start the work without ensuring provisioning of barricading etc. In this regard, it has been decided by Board that Engineer in-charge of the work sites will henceforth submit a certificate in writing along with the request for issuing green notice, that all the prescribed methods and arrangements for protecting the running line have been put in place, without which commencement of the work should not be allowed by Control. Open line staff and engineers will also keep a watch on the safety precautions being taken at the worksite and have the work stopped, if any unsafe working is noticed.

- [Ref.: Railway Board's Letter No. 2003/CE-II/PRA/20 (CRS), dated 20.10.2004]

  1. Instructions have been issued by the Board for ensuring safety at work sites and for training of Supervisors of Contractors who work in close proximity to track.
  2. The type of barricading to be adopted at worksites and for making it as an item in tender schedule and its payments as the work progresses. It is expected that Railways would have taken action to incorporate the item in their tender schedule.
  3. Railway's attention is also drawn to the Para 15, Para 24 and Para 34(4) of the General Conditions of Contract (GCC).

1.4.5 Safe Working of Road Cranes for Launching of girders/LHS

[Ref.: Railway Board's Letter No. 2015/CE-IV/RUB/206, dated 11.08.2016]

- As per Railway Board's Letter No. 2015/CE-IV/RUB/206, dated 15.02.2016, the following special conditions for safe working of road cranes should be incorporated in tender conditions –

  a) No machine shall be selected to do any lifting on a specific job until its size and characteristics are considered against the weights, dimensions and lift radii of the heaviest and largest loads.

b) The contractor shall ensure that a valid Certificate of Fitness is available before use of Road Cranes.
c) Contractors can utilise the services of any competent person as defined in Factories Act, 1948 and approved by Chief Inspector of Factories.
d) The laminated photocopies of fitness certificate issued by competent person, the operators' photo, manufacturer's load chart and competency certificate shall always be either kept in the operator cabin or pasted on the visible surface of the lifting appliances.
e) All lifting appliances including all parts and gears thereof, whether fixed or movable shall be thoroughly tested and examined by a competent person once at least in every six months or after it has undergone any alterations or repairs liable to affect its strength or stability.

- Besides above, following items shall also be ensured and properly incorporated in modus operandi –

a) Based on site conditions i.e. maximum boom length and operating radius, safe working load of crane shall be assessed which should be more than 1.5 times of load to be handled.
b) Before actually commencing the work near track, trial at site shall be done by actually lifting the heaviest segment to be tackled with required boom length and required operating radius. Once, the trial is successful, then only crane shall be brought to site of actual work.
c) The stability of slope under imposed load of crane prop under loading conditions and point nearest to edge of slope shall be checked. The location of prop, locations of working of crane and other relevant factor shall be clearly indicated on plan.
d) At locations near crane propping, the strengthening of slope by driving the rails/Sal Balli Piling shall be done to prevent any chance of slope failure. Also, the proper compaction/strengthening of soil at prop location shall be done to prevent any settlement of prop.
e) Stone/quarry dust may be filled by side of precast units with hand compaction before restoring train.

2.0 SAFETY IN TRANSPORTATION AND HANDLING OF MATERIALS

2.1 During Transportation

Means of Transportation of material may be by trucks, tipper Lorries, tractors, and trailers etc. For this:-

- Each driver must have a valid Driving license.
- Route of transport should be levelled, marked and planed to avoid potential hazards such as over head power line and steeply sloping ground.
- If necessary, warning boards / barriers may be erected to prevent over head structure or over head power line.
- Unattended vehicles should have the engine switched off.

- The strength and capacity of ramps for trucks used in delivering the equipment, supplies or the steel, should be checked to prevent their failure.
- If a level trestle is being used instead of ramp for truck or cranes to operate, this should be carefully checked.
- Shipments on barges, or any other form of carrier, should be inspected for safe loading and unloading.
- Steel members should be so placed that they will not shift, slide or over turn during transit.
- The loading should be such that no pieces are liable to move and trap a man when part of the load is removed.
- When a number of trusses or deep girders are loaded in one truck, all but one being lifted should be tied back unless they have been tied or braced to prevent their falling over and endangering men unloading.
- Load should be within the capacity of vehicles and should be evenly distributed and properly secured and should not projected beyond the plan area of vehicles. If it is unavoidable, it should be clearly shown by the attachment of flags.

2.2 Depending upon their distance from IR Tracks works to be executed in vicinity of Running Lines are :-

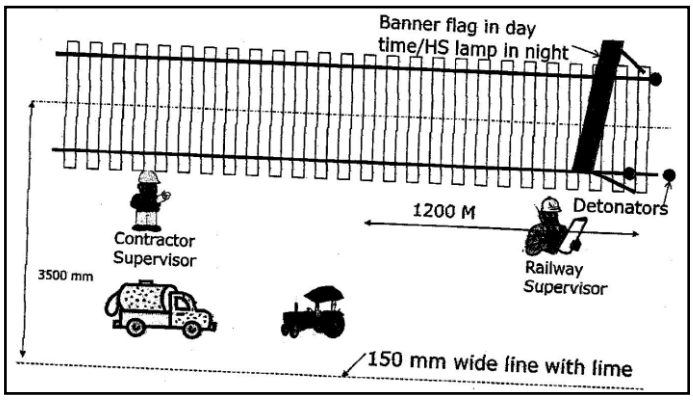
a) Works within 3.5 meters from centre of track.

b) Works between 3.5 meters and 6 meters from centre of track.

c) Works beyond 6 meters from centre of track.

2.2.1 Works within 3.5 meters from centre of track

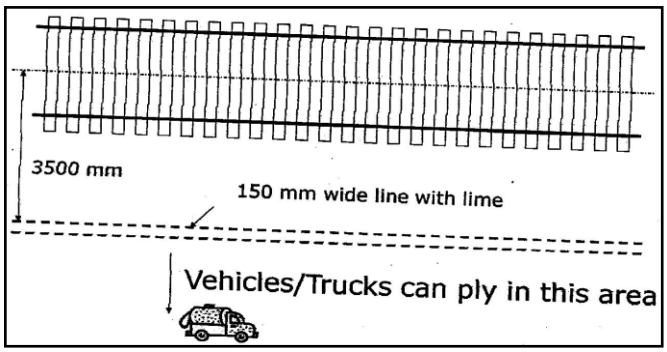
All works planned within 3.5 meters from centre of running line or which involve working of machineries and vehicles within this zone, are to be done essentially under block protection and necessary safety precautions for protection of track as per Para 806 and 807 of IRPWM be taken. This includes even occasional plying of vehicles/machineries for short durations.



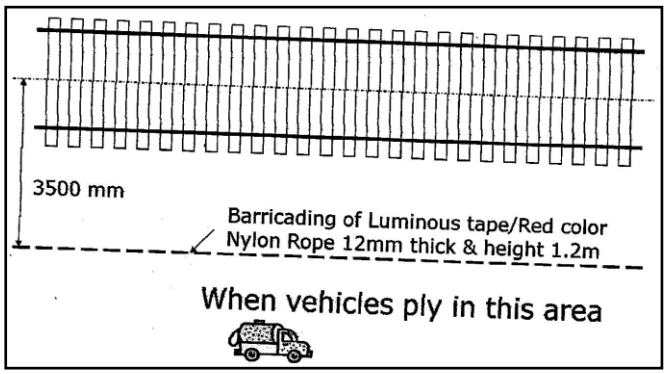
2.2.2 Works between 3.5 meters and 6 meters from centre of track

Following precautions be taken when works are required to be done between 3.5 meters to 6 meters from track centre or machines/vehicles are required to work/ply within this zone.

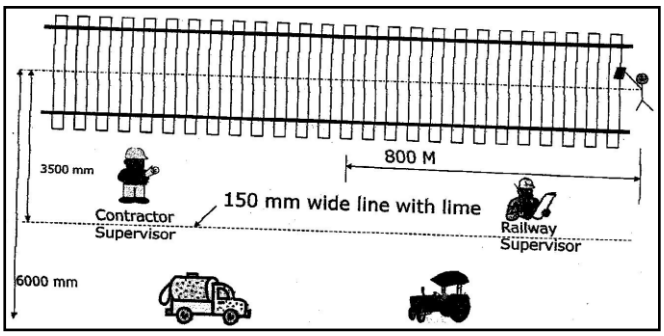
(i) Before start of work demarcation should be done parallel to running track at a distance of 3.5 meters from centre of track in advance, as shown in fig., by 150 mm wide white line of lime. Any work or movement of machinery infringing this line will need block protection.



(ii) Rail barricading should be put up at such locations, as shown in fig., to ensure that even by carelessness or over sight, vehicles do not infringe fixed dimensions. Barricading design shall be approved by the Engineer.



(iii) In case vehicles have to ply or machineries have to work within this zone, railway's and contractor's supervisors be positioned as shown in fig.



(iv) Instead of a Railway supervisor it would be a responsible and trained staff of the Contractor.

(v) Additional trained staff of the Contractor shall be posted where turning of vehicles is required during working.

Also:-

i) Location for reversing vehicles should be nominated and it should be selected in such a way that there is no danger to running trains at such location. Such trained staff of the Contractor should be available with hand flags so that vehicles do not come closer to track by 3.5 meters. Wherever vehicles have to take turn, it should be done in such a way that the driver is invariably facing the running track at all times.

(ii) Look out men should be posted along the track at a distance of 800 meters from location of work with red flag and to whistle in face of road vehicles and approaching trains. Look out men shall also be suitably trained staff of Contractor.

(iii) In additional to look out men, caution order needs to be issued to trains and speed restrictions imposed wherever considered necessary through Employer.

(iv) Arrangements should be made to protect the track in case of emergency at work site.
(v) All temporary arrangements required during execution should be done in a manner that moving dimension is not fringed.
(vi) Individual vehicle/machinery shall not be left unattended at site of work. If it is unavoidable and essential to stable it near running track, it shall be properly secured and manned even during non working hours with all arrangements to protect the track from infringement.
(vii) Any material unloaded or shifted along the track should be kept clear of moving dimensions and stacked at a specified distance from running track.
(viii) Movement of vehicle/working of machineries should be prohibited at night. However, in case of emergency when night working unavoidable, adequate lighting shall be provided with all protection measured as mentioned above in full force. All night working near IR track shall require Engineer's prior approval.
(ix) The work site should be suitably demarcated to keep public and passengers away. Necessary signage, boards, such as "work in progress" etc should be provided at appropriate location to warn public/passengers.
(x) Contractor's drivers/operators handling vehicles/machineries shall be issued a fitness certificate by the safety officer of the Contractor after educating them about safety norms and after taking assurance in writing for working within vicinity of railway's track.
(xi) While working on cuttings with machineries or when there is movement of vehicles above cutting, if there is possibility of any of the following circumstances, work has to be done under block protection:
  (a) Any possibility exists for machinery/vehicle after toppling/due to loss of control come over track of infringe it.
  (b) Chance of machineries/vehicles to come within 3.5 meters from track centre though working beyond it.

2.2.3 Works beyond 6 meters from centre of IR track

No precautions are needed except in cuttings or where the work can affect train running in any way.

2.2.4 The look out and whistle caution orders shall be issued to the trains and speed restrictions imposed where considered necessary. Suitable flagmen/detonators shall be provided where necessary for protection of trains.

2.2.5 The supervisor/workmen should be counselled about safety measures. A competency certificate to the contractor's supervisor as per Performa shall be issued by AEN, which will be valid only for the work for which it has been issued.

COMPETENCY CERTIFICATE

Certified that Shri _____P.Way supervisor of M/s_____ has been examined regarding P.Way working on _____work. His knowledge has been found satisfactory and he is capable of supervising the work safely.

Assistant Engineer

2.3 During Handling

For Handling of material, when crane is used at site, then:-

- Consider all the factors that could affect the safe use such as, the weight, size and type of the load, maximum reach or radius required and any restrictions like over head power line and ground conditions.
- Operator of cranes and other lifting appliances and the workmen engaged in slinging should be well trained in the safe use of cranes, hoists etc.
- Proper signalling system should be developed for the use of workmen and it should be strictly followed. Hand signal should be adopted and no oral signals should be given. Only one man at a time, who is allotted this specific task, should give the signals.
- Before slinging and before lifting load, it should be ensured that the load does not exceed the safe lifting capacity of the cranes.
- Cranes should always be on a level and firm ground.
- The movement of mobile cranes should be carefully watched so that the boom of the cranes does not come into contact of with any electric wires and other objects in the vicinity of work being carried out.
- Only properly tested and marked lifting tackles of adequate strength should be used. The safe working load of the tackles should never be exceeded.
- Every Crane Driver or hoisting appliances operator shall be properly qualified and no person under the age of 21 years shall be in-charge of any hoisting machine including any scaffolding.





3.0 SAFETY AT WORKSITE PRIOR TO START OF WORK

3.1 Checklist :–

Checklist Regarding Eligibility and Competency of Staff

Name of Work : _____ **Location : _____**
Duration of work : From _____ To _____ **Date of Inspection : _____**

S. No.	CHECK POINTS	Yes	No
1.	Does the Contractor's supervisor who is going to be site in-charge have the competency certificate?		
	Does the knowledge of contractor's supervisor on safety of track & worksite is up to the mark.		
	Is Railway's supervisor of Const. Organisation/Other department's available at site?		
	Is knowledge of Railway's supervisor O.K?		
	Is the Training imparted to contractor's supervisor & Certificate issued?		
	Is the worksite inspected by Construction's Supervisor, other department's supervisors along with contractor's supervisor?		
2.	Is whole worksite safe for working of men/vehicles & trains?		
	Are the precautions to be taken at worksite identified and listed and implemented accordingly?		
3.	Is the plan of work drawn out by contractor's supervisor in consultation with Railway's Supervisor?		
	Is the plan of work brought to the knowledge of Engineers/ Supervisors/In-charge of section AEN/ IOW & PWI?		
4.	Is the proper line marking/barricading done at worksite before start of work?		
5.	Are the men deputed for protection of track along with safety equipments?		
	Are adequate protection equipments available at site?		
6.	Is the Caution Order issued for the train drivers in case work is being done within 6 m of centre of running track?		
	Are train drivers following the enforced temporary speed restriction?		
7.	Are the Drivers of vehicles/ machinery being used identified?		
	Is the Driver of vehicles/ machinery briefed about the safe working?		
	Is it ensured that only identified drivers are driving the vehicles/ machinery?		
8.	Has work-permit been taken for working in night?		
	Is the sufficient lighting provided at worksite for night working?		
9.	Are the infringements checked?		
10.	Have the Sectional (open line) Engineers & Supervisors satisfied themselves regarding safety arrangements?		
11.	Is the availability of Walkie-Talkie sets for communications checked?		
12.	Is the approved cable route plan available?		
13.	Has work-permit been taken for working in Electrified territory/station yards (Points & Crossing areas)?		

3.2 Safety aspects to be observed while working in OHE area

- No electrical work close to running track shall be carried out without permission of railway representative.
- **A minimum distance of 2m has to be maintained between live OHE wire and body part of worker or tools or metallic supports etc.**
- No electric connection etc. can be tapped from OHE.
- Authorized OHE staff should invariably be present when the relaying work or any major work is carried out.
- Power block is correctly taken and **'permit to work'** is issued.
- The structure bonds, track bonds, cross bonds, longitudinal rail bonds are not disturbed and if disconnected for the work, they are reconnected properly when the work is completed.
- The track level is not raised beyond the permissible limit during the work.



3.3 Technical Organisation/Tools, Equipments and Plants

(A) Contractor should have qualified and trained manpower suitable to do the work in terms of technical specifications and contract conditions.

(B) Contractor should have suitable and adequate plants, machinery and equipments required to execute the work like:

(i) Cutting machine
(ii) Radial drilling machine
(iii) Edge milling machine, end milling machines
(iv) Plate/structural steel straightening machine
(v) Pneumatic grinding machine, drilling machines, chipping machines and wrenches etc.
(vi) Sand blasting equipment and metalizing equipments.

(vii) Welding machines
   a. SAW (Submerged Arc Welding)
   b. MIG (Metal Inert Gas) / MAG (Metal Active Gas)

(viii) Welding transformers

(ix) Cranes of adequate capacity

(x) Suitable Jigs and fixtures

(xi) To test the raw material and girders to conform to relevant specification, testing facilities, for the following should be available either in house or through outsourcing.
   a. ELCOMETER for measurement of thickness of paints.
   b. Steel measuring taps duly calibrated.
   c. Ultrasonic flow detection testing facilities for checking internal flaws.

(xii) Suitable Welding manipulator.

(xiii) Macro etching/DP or MP testing facilities.

(xiv) Tongue tester for measuring current and voltage.

(xv) Gauges for checking weld size throat thickness and edge preparation etc..

(xvi) All equipments must meet the requirements of corresponding IS, IRS or other international specifications.



(C) **Manpower:** Adequate nos. of trained qualified welders shall be available with the contractor. The welder must be trained in accordance with the provision of IS: 817. They must be trained either from recognized welding institutes or by in house training, where proper training facilities exist. The welder must be tested as per requirements of IS: 7310 and proper records maintained.

List of equipments mentioned above is only indicated and not exhaustive. The firm shall be required to deploy all other machineries, tools & plants etc. required for successful completion of the work of fabrication, assembly and launching of the girders.

4.0 SAFETY AT WORKSITE DURING PROGRESS OF WORK

4.1 Stacking Materials



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

(b) The materials, on receipt at site, shall be carefully examined for defects, checked, sorted and stacked securely on a level bed out of danger from flood and out of contact with water or ground moisture.

(c) All materials shall be available for inspection by the Engineer as per the Performa in Table -1.

Table-1
MATERIAL OFFERING AND INSPECTION REGISTER
[APPENDIX – I (Ref. Clause 12) of IRS B1 2001]

This register shall be maintained separately for each work order for keeping record of material offered for inspection, inspection remarks and passing details. One page should be allotted for individual members or fittings. Performa shall be as under:-

1. Description of component/fitting:
2. Shipping mark:
3. Quantity required per span:

Span No.	Initial of Supervisor offering material for inspection.	Inspecting officials Remarks	Compliance action	Seal & initial of Inspecting official	Despatch & consignee details.
1	2	3	4	5	6

(d) The materials shall be verified with the marking shown on the marking plan of part list, which shall be supplied by the manufacturers or the Engineer.

(e) Any materials found damaged during transit or while unloading should be stacked separately and damaged portions shall be indicated by paint with distinctive colour. If any component after receipt at site, has in the opinion of the Engineer or Purchaser, been damaged in transit, such component shall be replaced or repaired to the satisfaction of the Engineer or Purchaser free of cost.

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

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

4.2 Safety Measures during Fabrication

- The fabrication shall be carried out in a workshop which is in the approved vendor list of RDSO for 'Steel Bridge Girder' or in a site workshop duly approved by RDSO.
- The workshop staff shall have requisite experience, proven skill and experience in the technique of fabricating large components.
- The fabrication shall be preceded by **Quality Assurance Plan (QAP).**
- Quality Assurance Plan (QAP) should be prepared in accordance with sample quality assurance plan given in Annexure – I of RDSO's Guidelines BS – 110 (R).
- Quality assurance plan (QAP) submitted by contractor must be approved from competent authority before start of fabrication work.
- Detailed Shop Drawings including Drawing Office Dispatch Lists (DODL's) shall be prepared on the basis of design drawings supplied by Engineer in such size and in such details as may be specified by Engineer.
- Records of fabrication shall be maintained by the fabricator. Registers to be maintained are given in **Appendix – I of IRS B1 – 2001** and as given in Annexure - I**.**
- Fabrication tolerances shall be in accordance with **Appendix – II of IRS B1 – 2001** and as given in Annexure - II.
- Master steel tape of approved make with certificate of accuracy from any National Test House or Government recognised institutions competent to do so shall be maintained at site for proper measurements.
- Only approved and stamped Jigs shall be used for fabrication.
- For tack assembly, the components shall be kept on a firm hard bed and shall be held in position using suitable fixtures so that once the measurements are taken to set a component at proper location, these shall not move till the final tack assembly is done.
- Quality of Tack Welds shall be as per clause 24 of Welded Bridge Code.
- Tack welding may be permitted only at ends or locations, which will eventually be cut and removed. No active part of the component shall be tack welded as this would initiate crack formation in service.
- Templates shall be of steel of similar category.
- The templates shall be used for:
  - marking of cutting materials
  - profile machining for girders
  - marking of drilling holes in steel structure
- Template Shop should be fully covered consisting of uninterrupted steel or concrete floor having true and correct level covering adequate area.
- Drilling and Sub punching shall be in accordance with Clause 18 of IRS B1-2001.
- **Temporary Bolts, Nuts & Washers should be provided in accordance with** Clause 28.1 to Clause 28.8 of IRS B1-2001 issued by RDSO.
- Anchor bolts shall be provided in holes (max. dia 40 MM) made in pier top/pedestals.
- Anchor bolts and nuts shall be hot dip galvanized 100 micron thick, as per IS: 4759.
- The erection gang should have adequate supply of bolts, washers, rivets, pins etc of the correct size.
- Enough number of bolts should be used in connecting each piece using a minimum two bolts in a pattern to ensure that the joint will not fail due to dead load and erection load.

- All splice connections in column, wave girder etc. should be completely bolted or riveted or welded before erection.
- Slings for erecting steel work should be light and flexible enough to grip the pieces but strong enough to bear the loads.
- The slings should not slide while erecting diagonal members.
- The Contractor shall be responsible for supplying site rivets/bolts of approved length. The length of such bolts shall be verified by snapping a few bolts of each length in the presence of the Engineer.

4.2.1 Quality Assurance Plan

Quality Assurance Plan for "Fabrication of Bow String Girder Bridge (ROB)" under case study is as follows :-

Quality Assurance Plan for Fabrication of Bow String Girder Bridge

[As per Drawing Series No. PPC/RLY/1224/22/ROB/ST-05, prepared by M/s Galvano India Pvt. Ltd., Greater Noida and approved by Dy. CE (C), NC Railway, Gwalior for construction of Bow String Girder (ROB) 62.0 m c/c of Bridge for 40^0 Skew Angle]

SN.	Components/Operation	Characteristic Check	Frequency & type of check	Reference document	Fabricators quality control	Inspection detail		Type of record	Acceptance criteria	Remarks
1	2	3	4	5	6	7	8	9	10	11
1.0	**Raw Material**									
1.1	Steel Plates, Structural Section	Identification and correlation with Mill Test Certificate from approved Supplier e.g. SAIL, TISCO, IISCO, etc.	As per Mill T.C. and tests required by Inspection Authority from Govt/NABL approved lab.	Challan, Mill T.C.	Verification of reference document	North Central Railway	100%	Fabricator's record as per IRS B1-2001	Plates: IS 2062-2011, Gr. E350 B0, above 12 mm thick. Plates are fully killed & normalised or control cooled. Sections IS 2062-2011, Gr. E250 A	-
		Physical condition i.e. Pitting, rusting, straightness, rolling defect, etc.	Visual	-	Complete visual inspection	North Central Railway	100%	Fabricator's record as per IRS B1-2001	IS 2062-2011	-
		Mechanical test as per IS 2062-2011 UTS, Ys, %EI, Bend Test.	Lab Test at NABL approved Laboratory	-	Lab Test Report	North Central Railway	-	-	IS 2062-2011, Gr. E350 B0, fully killed & normalised or control	Raw material clearance shall be by Authorized in-charge of

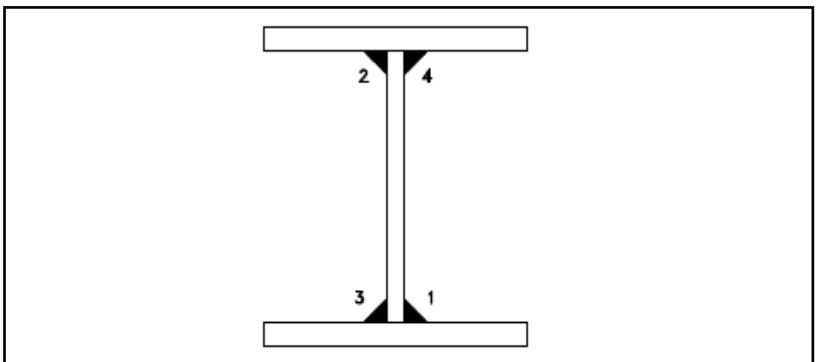
									cooled.	Inspection Authority decided by Dy. CE, NCR
		Charpy Test at 0^0C for plates of above 12 mm thick	-Do-	-	-Do-	North Central Railway	Heat/ Cast no. section wise as per IS 2062-2011	-	-	-
		Chemical Analysis as per IS 2062-2011	-Do-	-	-Do-	North Central Railway	-Do-	-	Table -1 along with note no. 2 of IS 2062 -2011, Gr. E350 B0	-
		Ultrasonic test for above 12 mm thick plates, as per IS 4225 or ASTM-SA 435/435M	By ASN level II operator	-	Lab test report	North Central Railway	100% Review by Inspecting official	-	IS 4225 or ASTM-SA 435/435M	USFD at random will be done on each plates of each thickness @10% by NCR
		Dimension	Measurement	Challan	Measurement of dimension	North Central Railway	100% Review by Inspecting official	Fabricator's Record & Zonal Railway Records	-	-
1.2	HSFG Bolts & Nuts & Washers	a) Dimension	Visual/ Measurement	Challan	Verification of reference document	North Central Railway	As per requirement	-	For Bolt: IS 1367 (Part II) IS 3757 IS 6623 IS 6649 BS-111 with Latest Revision & property classes as per relevant Drgs.	-
		b) As per specn. Mechanical & Chemical	Manufacturer's test certificate	Manufacturer's test certificate	-Do-	North Central Railway	-Do-	-Do-	-Do-	-
1.3	Paints	Verification of Manufacture's test	Visual	Challan, Manufacturer's test certificate	Verification reference document	North Central Railway	Each batch	Manufacturer's test certificate	As per contract agreement	Paints will be procured from

		certificate, inspection certificate, challan								vendors approved by RDSO
1.4	Welding Consumables	As per specification and as approved by Inspection Authority	Manufacturer's test certificate	Challan, Manufacturer's test certificate	Verification reference document	North Central Railway	As per requirement	Fabricator's record as per IRS B1-2001	-	Consumables will be of RDSO approved brand
2.0	**Manufacturing Process**									
2.1	Layout of Components & Joints a) Normal	Dimensions	Measurement with calibrated steel tape & gauges	Approved Drawing	Measurement of Dimension	North Central Railway	100% Review by Inspecting official	Inspection Report of Inspection Official	Relevant IS/IRS Codes & Approved Drawings	Clearance by Inspection agency as decided by Dy. Chief Engineer, NC Railway
	b) Jigs & Templates	Dimension, Intersection lines, pitch, gauge, dia. of holes & no. of holes	Measurement with calibrated steel tape & gauges	Approved Drawing	Measurement of Dimension	North Central Railway	100% Review by Inspecting official	Record of Jigs & fixtures as per Performa	IRS B1-2001	-
	c) Cutting, Straightening, Edge preparation	Dimension, Freedom from defect	Visual/ Measurement	Inspection Report of Inspection Official & Fabricator's Record	Visual & Measurement of dimension	North Central Railway	100% Review by Inspecting official	Inspection Report of Inspection Official & Fabricator's Record	IRS B1-2001	-
3.0	**Welding**									
	a) Submission of WPSS	Review of WPSS	Verification	IRS B1-2001, IS 9595-96, WBC-2001	Verification of Reference Document	North Central Railway	100%	Fabricator's Record	IRS B1-2001, IS 9595-96, WBC-2001	Only RDSO certified welders to be engaged in the job
	b) WPQR	Witnessing of established WPSS witnessing of welder qualification test	Visual, DT & NDT at approved lab	As per code requirement	Verification of Reference Document	North Central Railway	100% Review by Inspecting official	WPQR Sheet to be recorded in presence of representative of inspection agency	IS 7310(I)-74	-

								as decided by Consignee		
	c) Preheating	Measurement of Temperature	Visual with thermal Chalk	As per approved WPSS	Verification of Reference Document	North Central Railway	Random	Inspection Report of Inspection Official & Fabricator's Record	IRS B1-2001	-
	d) Baking of Electrode Flux	To have moisture free Electrode & Flux	Visual Check of Electrodes & beating	As per Manufacture's recommendations	Verification of Reference Document	North Central Railway	% Review by Inspecting official	Inspection Report of Inspection Official & Fabricator's Record	IRS B1-2001	-
	e) Selection of correct Electrode & Flux	Reference to WPSS, IRS Class, etc.	Visual	As per approved WPSS	Verification of Reference Document	North Central Railway	% Review by Inspecting official	Inspection Report of Inspection Official & Fabricator's Record	As per list of vendors approved by RDSO	-
	f) Current Condition	Measurement of Amp. & Voltage	Visual with Ammeter & Voltmeter	As per approved WPSS	Verification of Reference Document	North Central Railway	Random	Inspection Report of Inspection Official & Fabricator's Record	IRS B1-2001	
	g) Sequence of welding	To control distortion	Visual	As per approved WPSS	Verification of Reference Document	North Central Railway	Random	Inspection Report of Inspection Official & Fabricator's Record	IRS B1-2001	
	h) Provision of Run on & Run off Plates	To avoid crater defects	Visual	As per IRS B1-2001	Verification of Reference Document	North Central Railway	% Review by Inspecting official	Inspection Report of Inspection Official & Fabricator's Record		

4.0	**Inspection of Welding**	For Fillet Welds: Visual, D.P. Test Fillet Size, Penetration, Leg Length, Throat thickness, etc.	VISUAL, Gauge, D.P. Test & macro Etching	Approved Drg. & WPSS	Visual Inspection & Verification of dimension by gauges	North Central Railway	100%	Fabricator's record	Relevant IS/IRS Code, Approved Drg. & WBC-2001	Clearance by Inspection agency as decided by Dy. Chief Engineer, NC Railway
5.0	**Trial Assembly**	a) Level Measurement by calibrated Instrument b) Dimension c) Fairness of holes	Visual & Dimensional	Approved Drg.	Complete dimensional check of Control Assembly	North Central Railway	One complete span or as per guidelines of inspecting agency	Inspection Report of Inspection Official & Fabricator's record	IRS B1-2001	Clearance by Inspection agency as decided by Dy. Chief Engineer, NC Railway
6.0	**Final Clearance**	Component completeness	Visual Dimensional & Structural	Stage clearance Record	Verification of Stage clearance Record	North Central Railway	Girder fabrication with approved Jigs-100%	Inspection Report of Inspection Official & Fabricator's record	IRS B1-2001	Clearance by Inspection agency as decided by Dy. Chief Engineer, NC Railway

4.3 Safety Measures during Welding



Sketch showing the sequence of fillet welding for fabricating the I–section

FIG.–3
(REF. CLAUSE 27)

- **All welds should be done by submerged-arc welding process either fully automatic or semiautomatic.**
- **Site welding should not be undertaken except in special circumstances with the approval of the Chief Bridge Engineer.**

- Site welding should be confined to connections having low stresses, secondary members, bracings etc.
- Welding procedure shall be such as to avoid distortion and minimize residual shrinkage stresses.
- Properly designed jigs should be used for assembly.
- Welding procedure should be in accordance with the Performa given in Appendix-V of IRS B1-2001 and should be approved by Engineer.
- Channel shear connectors shall be welded on top flange plate prior to assembly of I-section. This will facilitate correction of any distortion of flange plate developed during the welding of channel shear connectors. **The welding sequence to be followed is indicated by number 1 to 4 as shown in the Fig. 3 of IR Fabrication specification Serial No. IRS B1-2001 issued by RDSO.**
- **Shop welded joints shall be 100 % radio-graphically examined.**
- Tests to be performed on welds are:

  (a) Non Destructive Tests (NDT):
  - Visual inspection/profile gauge for dimensional check of size and throat thickness of weld.
  - Etching test for penetration of joint.
  - Magnetic particle or Ultra Sonic Pulse Velocity (USPV)
  - Gamma Radiography & x-ray (only for butt welds)
  - Dye penetration of all welds joints.

  (b) Destructive Test:
  - Tensile test
  - Bend test
  - Impact test
  - Load test
- **Welding Procedure Qualification Records (WPQR'S)** shall include joint details, welding consumables (i.e. electrode/wire & flux combination), weld parameters (i.e. welding current, wire feed speed), welding position, welding equipment carriage speed (for SAW process), are Length, arc voltage etc.
- **Parts to be welded shall be assembled such that the joints to be welded are accessible and visible to the operator.**
- **Fabrication of components subject to dynamic loading in the structure needs careful inspection during fabrication by qualified, experienced and certified Engineer from contractor's side and final approval by Inspecting Officer.**
- **This inspection shall be carried out as stipulated in Indian Railway Welded Bridge Code before, during and after welding.**

4.3.1 Precautions during welding

- The Contractor shall submit list of weld joints of different combined thickness for approval of welding procedure for all members.
- The welding of built up component shall be carried out only by approved welding operators and in accordance with Welding Procedure Qualification Records. WPQR's shall be prepared in advance and approved by the Engineer. Proper welding sequence shall be

followed to avoid distortion and minimize residual shrinkage stress, and surface defects, within acceptable tolerance limits.

- To ensure sound and defect free welding of built up members, record of welding adopted as per approved qualifying procedure shall be maintained in Performa prescribed in guidelines for welded fabrication. The Performa are given in Annexure – III.
- Any change during welding for fabrication of built up member, such as welding sequence, welding process, positioning, wire and flux combination joint details, increase or decrease in combined thickness of joint by 5 mm etc. shall be carried out only after representative samples test and procedure qualification, is accepted. **In no case deviation from WPQR's without approval of Engineer shall be adopted.**

4.3.2 Additional Precautions during Welding

Following precautions shall further be observed during fabrication:

(i) All equipments shall be provided with calibrated gauges to observe limits of variation for parameters prescribed in WPQR'S for welding current, arc voltage, speed of travel of equipment etc.
(ii) Covered shed for environmental control (particularly against dust, moisture and water) shall be provided to avoid entrapment of hydrogen which is likely to cause crack initiation in weld or under bed of weld (i.e. Heat Affected Zone HAZ). Also baking of flux use for submerged arc welding in oven for an hour at 200 degree C shall be carried out o ensure that no moisture is contained in flux during welding.
(iii) All tack weld shall be carried out by qualified and approved welder only. As tack weld will become part of the final weld, it shall be free from all cracks and other welding defects.
(iv) If multiple runs are used for fabrication of built up member, inter run cleaning shall be carried out and subsequent weld bed made only after approval of inspecting officer or his authorized representative. This is to check free defects in the weld. Also visible defects such as cracks, cavities, if any, shall be removed by grinding. It shall be ensure during welding that craters are avoided.
(v) Stray arcing of components, which cause local hard spots or cracking of parent metal, shall be avoided.
(vi) Flux of approved quality will be permitted for use.
(vii) The Auto melt grade wire spools of wires for Submerged Arc Welding and Carbon Dioxide (CO2) consumables of only the approved quality will be permitted.
(viii) Pre Heat Treatment will be given to the consumables to remove the moisture if any.
(ix) No violation of welding procedure will be permitted on any account.

4.4 Alterations in the Work

The Contractor shall not in any case or in any circumstances have authority to make any alterations in, modifications of, substitution for, addition to, or omission of work or any method or system of construction, unless an alteration order in writing directing such alteration, modification, substitution, addition, omission or change shall have been given by the competent authority prior to the commencement of the work or part of work.

4.5 Safety Measures during Painting

- Paints manufacturing firms shall be in the approved list of RDSO.
- Paints used at the site shall be finally approved by the Engineer.
- Paints shall have
  a) Date of Manufacture as certified by the manufacturers
  b) Test certificate for paint conforming to relevant IS code
- On paints, following tests are required to be carried out in the field:
  - Weight per litre
  - Consistency Test
  - Scratch Test
  - Flexibility and Adhesive Test
- Metalizing and painting shall be carried out as per Clause no 39.2.1 of IRS B1-2001.
- Painting shall not be commenced till the surface preparation has been approved by the Engineer or his representative.
- Sealed containers of paint of approved brand shall be used. The paint drums must be rolled, turned upside down and shaken before opening. The paint must be stirred well before use.
- Over stirring which results in invisible air bubbles etc, shall be avoided.
- Where brush painting is accepted, the paint must be applied by means of flat brushes not more than 75 mm in width having soft flexible bristles conforming to IS: 384.
- Round and oval brushes of approved quality conforming IS: 487 may also be used as per the instructions of the Engineer or his representative or inspecting officer.
- All new brushes should be soaked in raw linseed oil conforming to IS: 77 for at least 24 hours before use.
- The date of painting shall be marked with paint on the member.
- Paint should be mixed in small quantities sufficient to be consumed within one hour in the case of red lead paint.
- The applied coat of paint shall be uniform, and free from brush marks, sack marks, blemishes, scratching, non-uniform thickness, holes, log marks, fuel staining, cracking, scaling, and other defects.
- Paint shall be applied only on dry and clean surface free from moisture or dust (including scrapping dust).
- Paint should be used within the prescribed life from the date of manufacture.
- Each coat of paint shall be left dry till it sufficiently hardens before the subsequent coat is applied. Each coat of paint shall be inspected by the Engineer and certified as satisfactory before applying subsequent coat.
- The metal spraying shall be carried out as soon as possible after surface preparation under the following conditions:

  a) The chemical composition of aluminium to be sprayed shall be 99.5% aluminium conforming to IS: 2590.
  b) The surface of the sprayed coating shall be of uniform texture and free from lumps, coarse areas and loosely adherent particles.
  c) The nominal thickness of the **coating shall be 150 µ(microns)**. The minimum local thickness shall be **not less than 110 µ(microns).**

4.6 Assembly and Erection

- Before starting the work the contractor shall seek the Engineer's approval as to the method he proposes to follow and the type and suitability of equipment he proposes to use for assembly of girder components and launching of girder.
- All temporary work shall be properly designed and substantially constructed for the loads, which it will be called upon to support.
- Adequate allowance and provision of a lateral forces and wind loads shall be made according to local conditions and ensure that support shall not settle during erection.
- When chains are used for lashing care must be taken to protect the edges of members from twisting and distortion, damage to paint and similar effects.
- Temporary bracing shall be provided to take care of stresses caused by erection equipment or other incidental loads during erection.
- The method used for lifting and slinging flexible members shall be brought to the notice of the Engineer and shall be subject to his approval.
- The contractor shall observe sufficient accuracy in the assembly of every part of the work to ensure that all parts fit accurately together.
- If the fabrication workshop is set up by the contractor at bridge site itself the test assembly may be done at assembly platform and after testing of accuracy of jigs, fixtures & templates and the same assembly can be launched after bolting. The test assembly shall be certified by Inspecting agency of the Engineer.
- Drifting of joints shall be avoided as far as possible, and when necessary should be done with greater care and under close expert supervision.
- It is essential that the camber is accurately maintained throughout the process of erection and it should be constantly checked.
- All panel points, except the centre, shall be lowered by the amount to produce the correct camber in the main girders as shown on the camber diagram.
- All components shall be offered for inspection prior to painting. All approved components shall be stamped defect free, painted as per specifications.
- The appearance test and test to check the fixing of shear studs shall be as per approved/RDSO drawings.
- After assembly, all blank holes shall be checked with plug gauge of diameter 0.8mm less than hole diameter, to check fair matching of holes before riveting / bolting.
- No reaming shall be undertaken without the written authority of Engineer or his authorized representative except for under drilled holes meant for turned bolts.
- Special bolts shall be supplied to fill reamed hole, where reaming is approved.
- The position and number of the drifts and bolts will be decided by Engineer.

4.7 Inspection and Rectification

- During erection of girders, the contractor shall provide all facilities and permit the Engineer to inspect the field assembly, site bolting and erection of spans.





- After inspection by the Engineer, the contractor shall identify cause of any defect, imperfection and/or fault noticed during such inspection and initiate corrective action as per the direction of the Engineer.
- **A neat casting bearing the name of the contractor, the place and date of manufacture, the contact number and the standard of loading to be specified by the Engineer shall be bolted conspicuously on all girders. The drawing of the name plate shall be approved by the Engineer.**

4.8 Launching of Girders

Once girders are assembled and the sub structure has been certified to be ready, launching of girders shall be taken up. The scheme for launching shall be approved before hand by competent authority and any statutory clearances such as CRS sanction must be obtained.

- The launching of girders shall be done as per approved drawings.
- In order to ensure perfect fit of the temporary components, holes may be carefully drilled for the connecting members in between the girders in situ and T & F High Tension Grip Bolts used.
- The launching system shall be test tried if directed by the Engineer.
- All temporary members shall be removed after launching and may be taken back by the contractor.
- Erection gussets provided for connecting the members may be cut and edges ground as required by the Engineer.

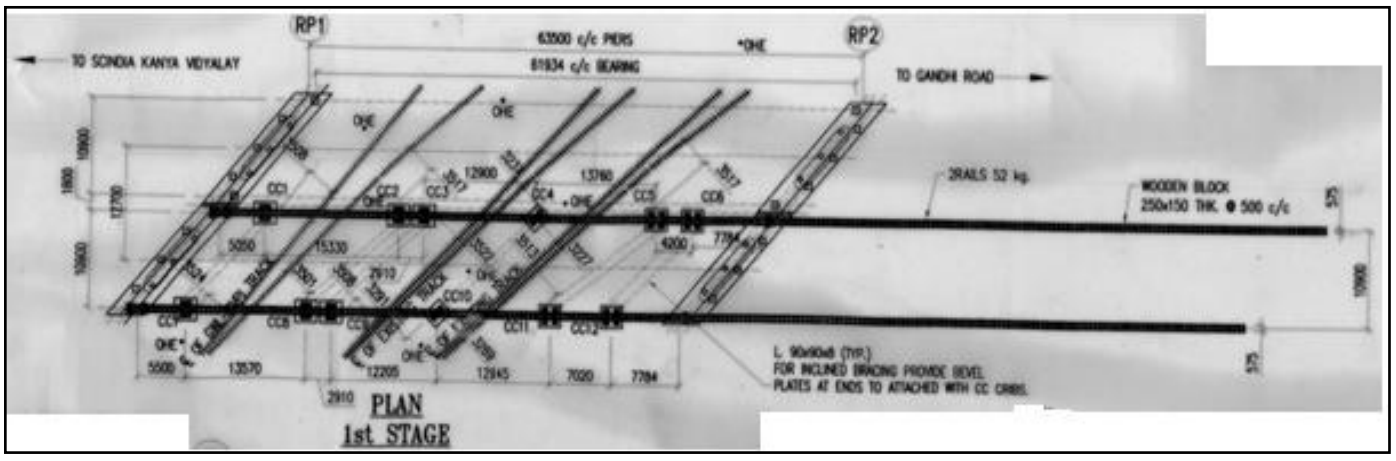
Following are the important stages during launching :-

1st STAGE

(i) Without Traffic and Power Block



1. Mark the centre lines of Girder on Piers, Pedestals & Ground.
2. Mark the position of CC Cribs on the Ground.
3. Cast foundation pads at appropriate place as per plan.
4. Erect CC Crib Trestles on foundation pads as shown in plan except CC1 to CC5 & CC7 to CC11.
5. Place steel stools on CC Cribs/Trestles CC6 & brace the CC Cribs/Trestles.
6. Erect CC Cribs/Trestles CC1 to CC7 to CC11 & place stool on them.
7. Brace these trestles as shown.



(ii) With Traffic & Power Block of Two Hours

1. Place beams over Railway Track on CC Crib/Trestles along the direction of Bridge & brace them.
2. Connect the beams with RP1 & RP2 to avoid any movement in longitudinal or traverse directions.
3. Provide rails & wooden blocks over temporary beams and check their alignment & level in case the alignment & levels are not proper, provide hard wood blocks at minimum spacing of 500mm for adequate alignment & level.



2nd STAGE –

(i) Without Traffic & Power Block

1. Assemble steel girder on CC Crib over camber jacks with X-Girders.
2. Keep the Girders in correct plumb & alignment with the help of guys avoiding infringement to SOD of BG.
3. Complete the welding work in all respect to assemble the Bow String Steel Girder.

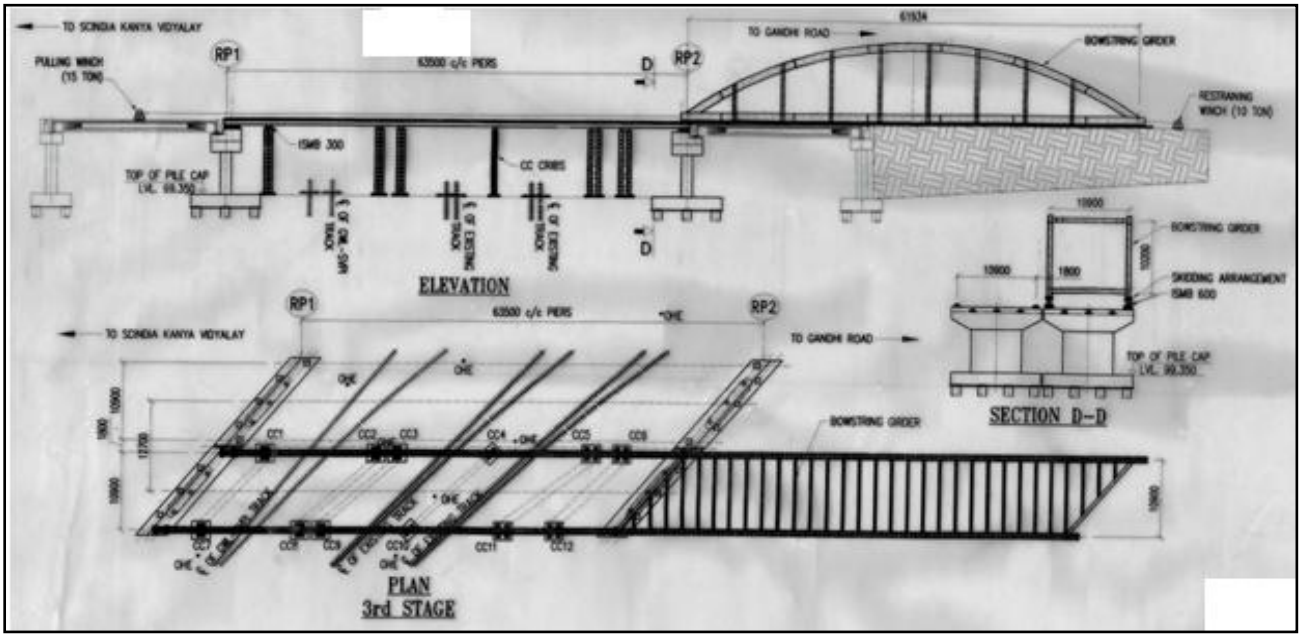




3rd STAGE –

(i) Without Traffic and Power block

1. Lift the Girder, remove the camber jacks & attach skidding arrangement with suitable thickness of wooden blocks under the cross girders so that skidding should properly rest on rails.
2. Provide rail over temporary girder for skidding.
3. Provide hard wood packs & skid arrangement on nodal points at the location of vertical as per approved plan.



4. Fix two pulling winches of 15 ton capacity each on Scindia Kanya Viddhyalaya side & restraining winches of 10 ton capacity each on Gandhi Road side as shown in the drawing.
5. Test check the temporary arrangement for its proper functioning & stability.



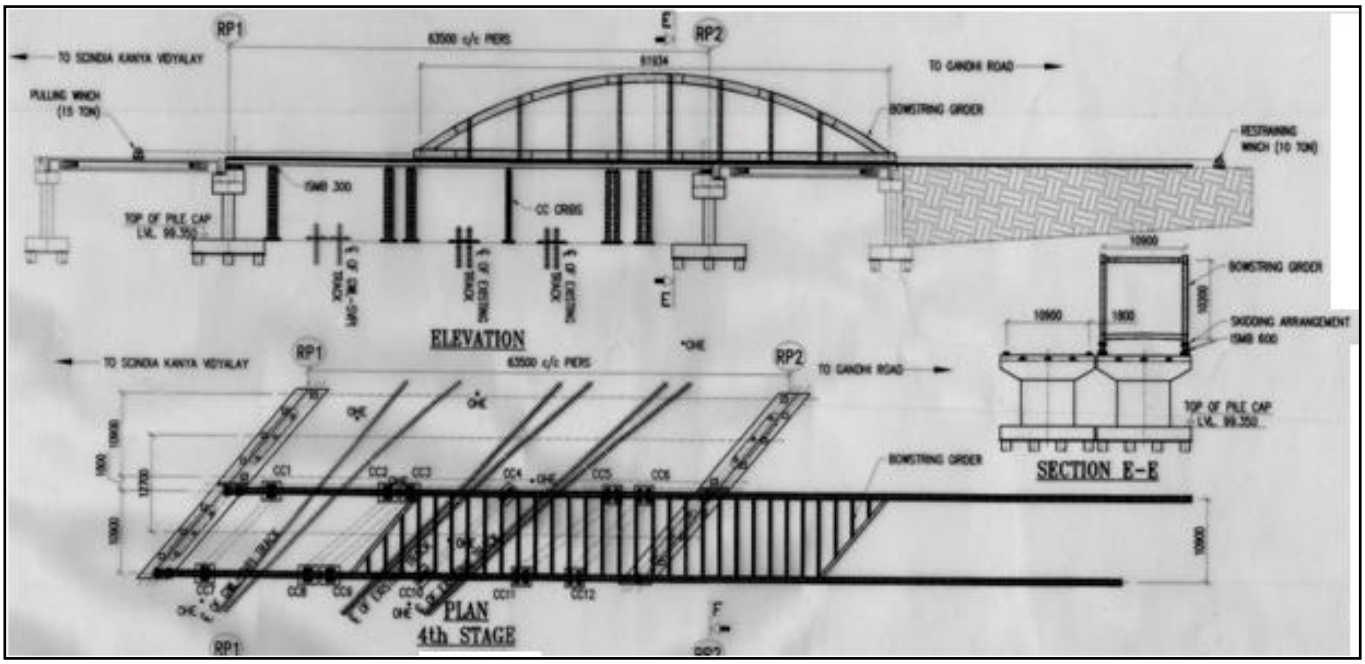


4th STAGE –

(i) With Traffic and Power Block

1. After ensuring the skidding & stability of the arrangement pull the bow string girder up to trestle CC3 & CC9 with the help of pulling wenches & releasing the restraining winches.

2. Pull the girders with the help of pulling winches to required position.

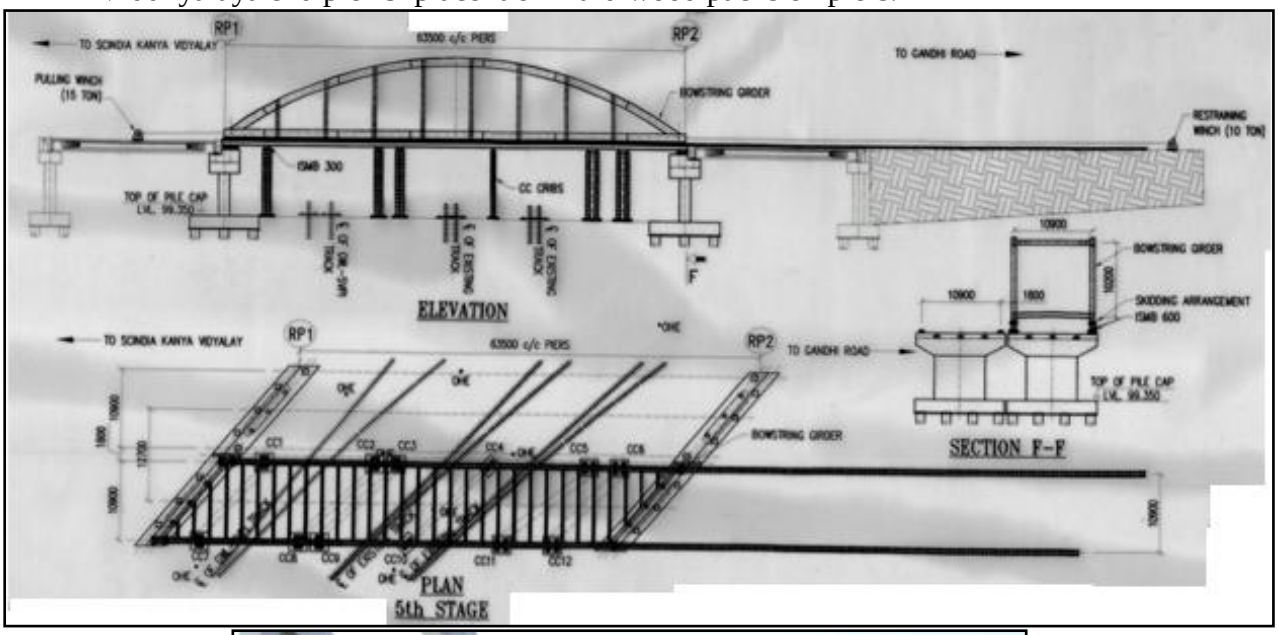






5th STAGE – (i) With Traffic and Power Block of Two Hours

1. Continue pulling the girders with the help of pulling winches up to Scindia Kanya Viddhyalaya end pier & place it on Hard wood packs on piers.

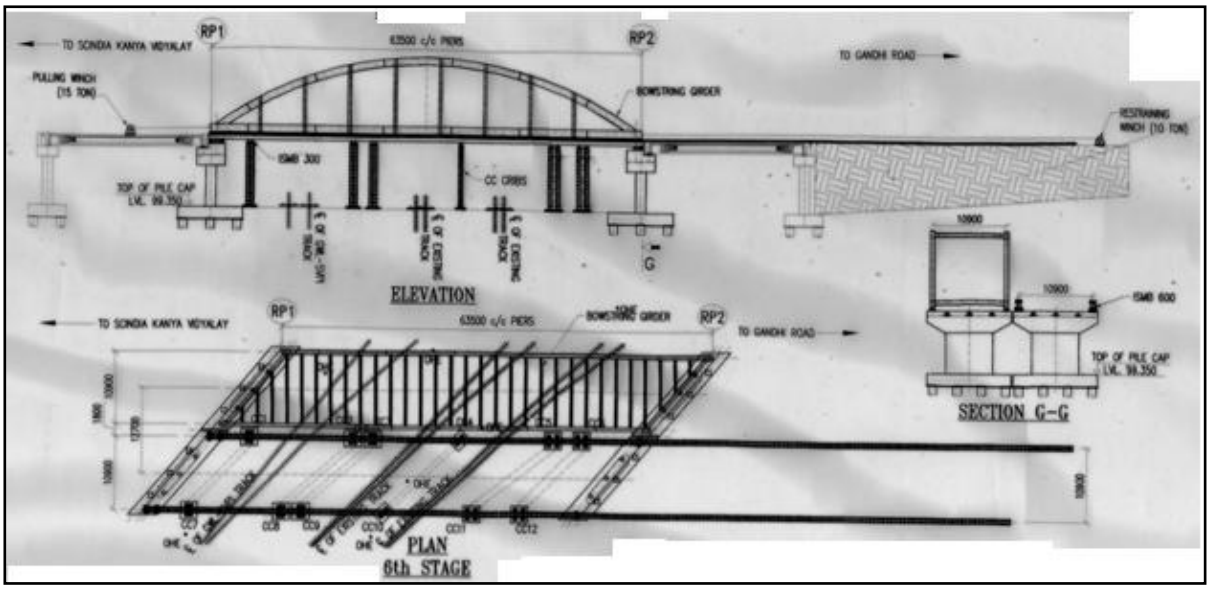






6th STAGE – (i) Two Nos. Traffic and Power Block of Two Hours Each

1. Provide side slewing arrangement below main girder at end X-Girder location.





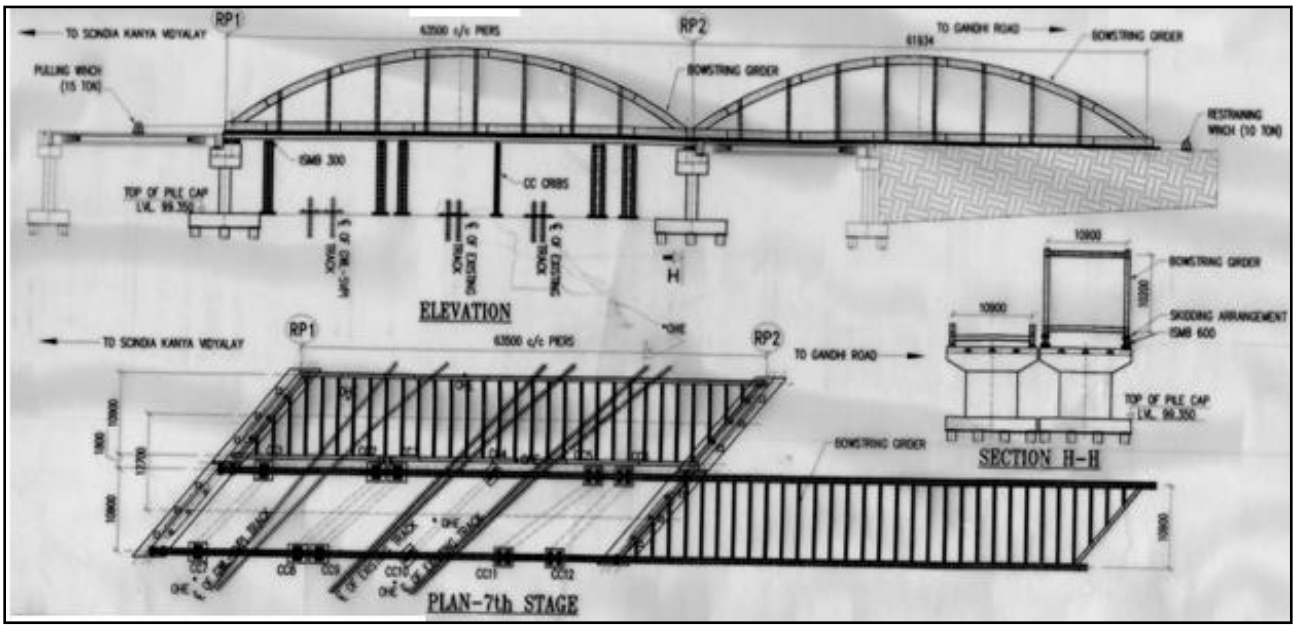


2. Side slew the girder to the new position.
3. Provide jack & wooden block under the girder and remove temporary arrangement side slewing arrangement.
4. Lower the girder & remove jacking support.



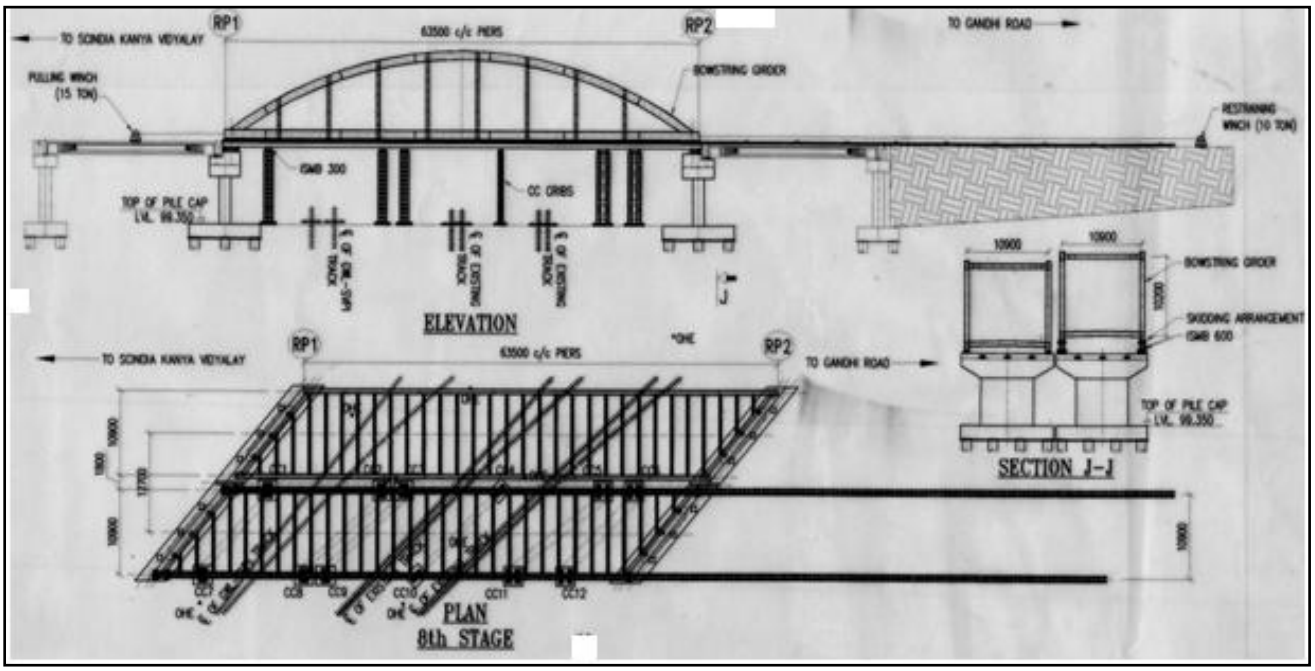
7th STAGE – (i) Without Traffic and Power Block

1. Assemble 60m span bow string girder (2nd span).
2. Provide temporary arrangement on CC Cribs.
3. Assemble 60m span bow string girder & provide skidding arrangement under main girder at verticals.



8th STAGE - (i) With Two Nos. Traffic and Power Block of Two Hours Each

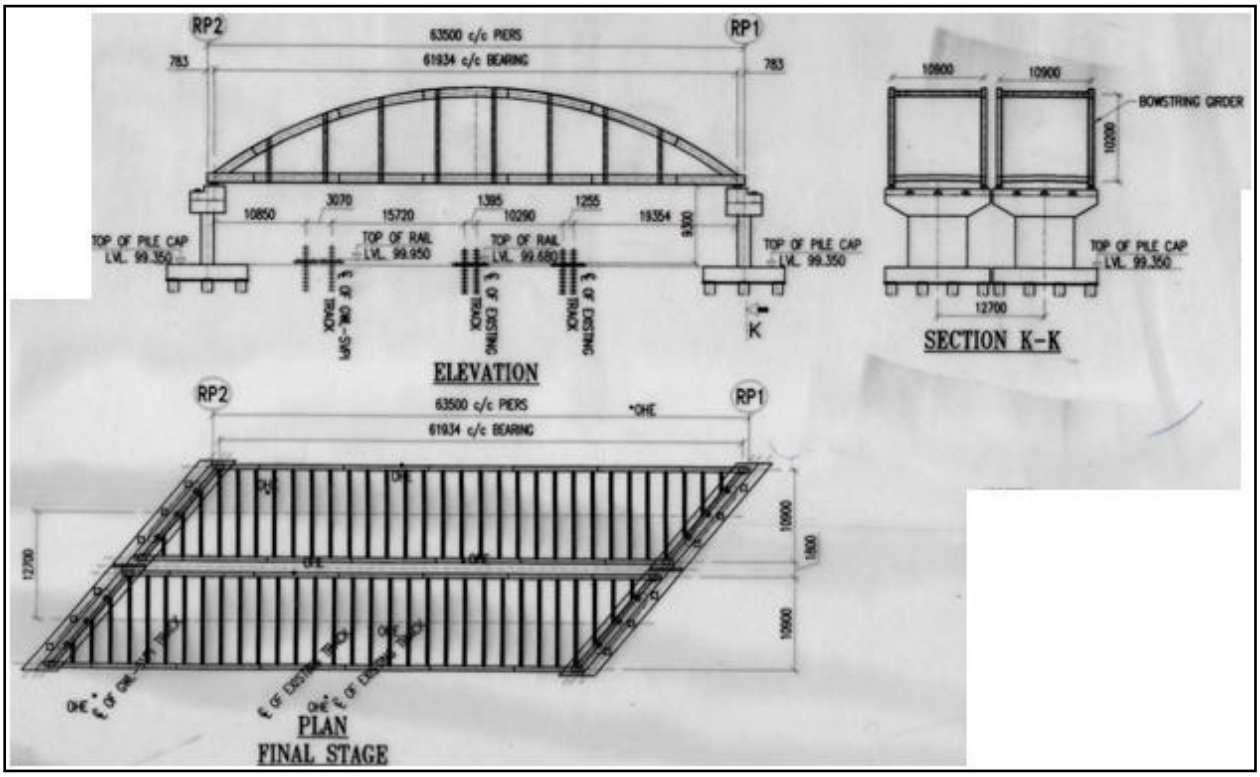
1. Pull the girders with pulling winches to the provided position.





<u>FINAL STAGE</u> - With Traffic and Power Block of Three Hours Each

1. Remove CC Cribs & rolling arrangement.
2. Lower the girders on bearings & check the levels & alignment.
3. Remove all the material provided for launching of girder and clear the site.



5.0 REMOVAL OF UNUSED MATERIALS ETC.

On the completion of the work, all unused and surplus materials, plant, staging and refuse, or other materials produced by operations shall be removed.



***

(Annexure – I)

APPENDIX - I
(Ref. Clause 12)

Records to be Maintained

1) JIGS REGISTER

This register shall be maintained for keeping record of details of jigs, their approval and modification/rectification to the jigs. One page should be allotted for each jig and details mentioned in the following proforma:-

1. Description of jig:
2. Jig No.:
3. Shipping mark of the component for which jig is made:
4. Drawing No. for the component:

Date of inspection	Observation/inspection notes	Compliance action	Initial of Supervisor Incharge
1	2	3	4

In the beginning of Register, a statement of jigs shall also be placed in the following proforma:

Jig No.	Description of Jig.	Shipping mark of the component.	Drg.No. as per which jig is made/modified	Inspecting official's approval details
1	2	3	4	5

2) RIVET CHECKING REGISTER

This register shall be maintained for keeping record of rivet quality checking and replacement of defective rivets. Register shall be maintained in the following proforma:-

Component description	Date of rivetting	Rivetting party	Number and nature of defective rivets	Number of defective rivets replaced	Initial of Supervisor Incharge.
1	2	3	4	5	6

After rivetting, component has been inspected and defective rivets have been replaced, the Supervisor Incharge of rivetting should put a stencil mark on the component to this effect.

3) MATERIAL OFFERING AND INSPECTION REGISTER

This register shall be maintained separately for each work order for keeping record of material offered for inspection, inspection remarks and passing details. One page should be allotted for individual members or fittings. Proforma shall be as under:-

1. Description of component/fitting:
2. Shipping mark:
3. Quantity required per span:

Span No.	Initial of Supervisor offering material for inspection.	Inspecting officials Remarks	Compliance action	Seal & initial of Inspecting official	Despatch & consignee details.
1	2	3	4	5	6

4) RDSO INSPECTION NOTES AND COMPLIANCE REGISTER

This register shall be maintained for record of compliance action taken on RDSO Inspection notes. In this register one copy of the inspection note received from RDSO shall be pasted and compliance action recorded against each item.

5) WELDING PROCEDURE DATA REGISTER

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

Name of work:_____

Contract/Work Order No. _____

Span No._____

Date of welding	Girder component and its Sl.No.	Weld joint description	Name of welder/Ticket No.	WPSS No. followed
1	2	3	4	5

Welding consumable used		Welding parameters			Weld repair details	Run on/Run off tabs. No. if any	Radiograph no. if any	Initial of Supervi-sor Incharge.
Electrode / wire	Flux	Current (amp.)	Arc Voltage (volt)	Travel Speed (m/min)	11	12	13	14
6	7	8	9	10				

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

6) RADIOGRAPHIC INSPECTION REGISTER

Record of radiographic inspection of welded girders shall be maintained in the register in the proforma given below:

Name of work	Span No.	Girder Part	Weld joint description	Date of radiographic inspection.	Radio-graph No.	Obser-vation	Result	Initial of Supervisor Incharge.
1	2	3	4	5	6	7	8	9

7) STATEMENT OF MATERIAL TEST CERTIFICATES

Name of Work_____

Contract/Order No.._____

Span No.._____

Girder Component description and identification No.	Type and Size of rolled section	Material Test Certificate No.	Cast No.	Steel quantity as per the test certificate	Steel Manufacturer/ Supplier	Initial of Super-visor Incharge .
1	2	3	4	5	6	7

One page should be allotted for each span.

(Annexure – II)

APPENDIX - II
(Ref. Clause 13)

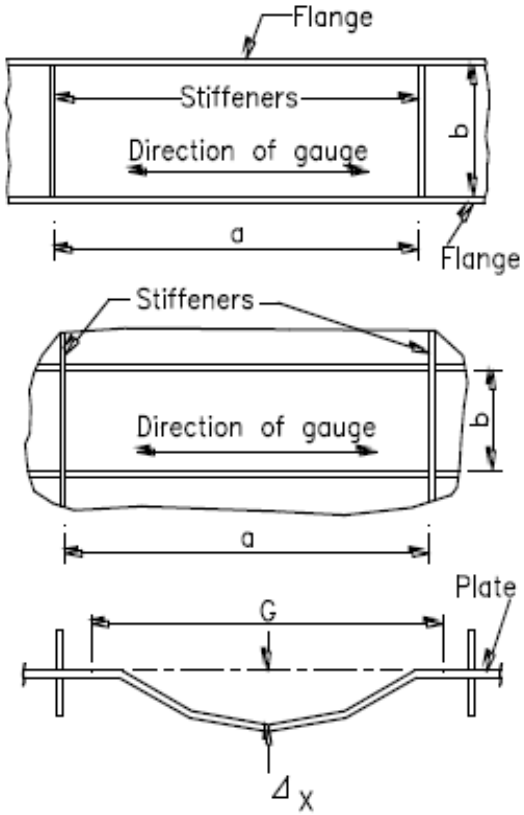
Manufacturing Tolerances

			Tolerances in mm		Notation in the Figure No.1
			(plus)	(minus)	
1.	Plate girders				
	(a)	Overall length of the girder	6	3	a
	(b)	Distance between centres of bearings	1	1	b
	(c)	Depth over angles	3	1	c
	(d)	Corner of flange angle to edge of web at any place	0	2	d
	(e)	Diagonal at either end of the assembled span	3	3	e
	(f)	Centres of intersection of diagonals with girder flange measured along the girder flange	3	3	f
	(g)	Butting of compression ends			
		i) throughout	0	0.15	g
		ii) locally	0	0.25	g
	(h)	Butting edge at web splices	0	1	h
	(i)	Straightness of girder bottom laid on the ground and checked with piano wire:			
		(i) vertical plane			
		Convexity	0	3	j
		Concavity	0	0	j
		(ii)Horizontal plane	2	2	j
2.	Open web girders				
	(a)	Over-all length of girders	1	1	k
	(b)	Distance between centre to centre of bearings	1	1	l
	(c)	Cross diagonals of assembled bays	1	1	m
	(d)	Centre to centre of cross girders	1	1	n
	(e)	Centre to centre of rail bearer	1	1	p
	(f)	Panel length in lateral bracing system	1	1	q

	(g)	Distance between inter section line of chords vertical and horizontal	1	1	r
	(h)	Butting edges of compression members:			
	.	(i) throughout	0	0.15	s
		(ii) locally	0	0.25	s
	(i)	Twist in members	0	0	t
	(j)	Lateral distortion between points of lateral supports	.001 L	.001 L	u
3.	Holes-				
	(a)	Between any two holes in group	0.5	0.5	v
	(b)	Between holes of one group and another	1	1	w
	(c)	Edge distance	0.5	0.5	x
	(d)	Distance of 'GO' gauge open holes in two or more thicknesses	0	0.8	y
				(On nominal diameter of hole)	

4 Special Fabrication Tolerances as applicable to Welded Plate Girder.

	Description.	Tolerances in mm
1.	Depth at the centre of web	+2 to -1
2.	Flange out of square for compression member and beams	1/200 or 3 max From edge whichever is less.
3.	Displacement of vertical axis of the web with reference to flange.	2
4.	Box width of member	0 to +3
5.	Verticality of stiffener or diaphragm out of plumb.	2
6	Overall length of girder	+ 6 to -3
7	Depth of the girder at the ends	+ 3 to -1
8	Depth of the girder at the centre of span	+ 2 to -1
9	Distance between centre of bearings	+ 1 to -1
10	Diagonal at either end of assembled span	+ 3 to -3

11	An allowable limit for web buckling or undulation shall be flatness at right angles to plate surface measured parallel to longer side in either direction calculated from the formulae $\Delta_x = \frac{G}{165}\sqrt{\frac{\sigma_y}{355}}$ or 4mm which ever is the lesser. Where Δ_x = Maximum deviation from straightness within a specific gauge length other values are constant σ_y = Yield stress of steel in N/mm^2 G = length of measuring gauge in meter (G= a where a<2b and G=2b where a>2b) 

Annexure - III

APPENDIX - V
(Ref. Clause 26)

1. Proforma for Welding Procedure Specification Sheet

Name and address of Fabricator:
Welding procedure specification No

1. Weld joint description:
2. Base Metal :
3. Welding Process :
4. Welding position :
5. Welding consumables :

5.1 Electrode/Wire — Class :
Dia :
Drying method:

5.2 Flux — Class :
Type:
Drying method:

5.3.1 Shielding gas:
6.0 Base Metal preparation:
6.1 Joint design details:
(Give sketch showing arrangement of parts, welding groove details, weld passes & their sequence etc.)
6.2 Joint preparation:
7. Welding current: Type:
Polarity:
8. Welder qualification:
9 Welding parameters and technique:
9.1 Welding Parameters:

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

9.2 Welding sequence and technique:
(Give sketch showing sequence and direction of welding).
10. Provision of run in and run-off tabs:
11. Cleaning of weld bead before laying next weld bead:
12. Root preparation before welding other side of groove weld:
13 Preheating and inter pass temperature:
14 Peening
15 Post weld treatment:
16 Rectification of weld defects:
17 Inspection of weld.
18. Any other relevant details

Prepared by
Signature _____
Designation _____
Date _____
(for & on behalf of Fabricator).

2. Proforma for Welding Procedure Qualification Record

NAME AND ADDRESS OF FABRICATOR

1. Description of weld joint:
2. Welding procedure specification no.:
3. Name of welder:
4. Date of preparation of test piece:
5. Dimensions of test piece:
6. Base Metal:
7. Welding Process:
8. Welding position:
9. Welding Current: Type:
   Polarity:
10 Weld joint design details:
11 Welding consumables:
11.1 Electrode/Wire Class:
   Dia:
   Brand:
11.2 Flux Class:
   Type:
   Brand:
11.3 Shielding gas:
12. Welding parameters:

Weld pass No.	Electrode wire dia (mm)	Current (amp)	Arc voltage (volt)	Wire feed speed (mm/min)	Travel speed (mm/min)	Electrical stick out (mm)	Shielding gas flow rate (l/min)
1	2	3	4	5	6	7	8

13. Preheating and interpass temperature:
14. Results of Qualification Tests:

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

Signature _____
Designation _____
Date _____
(for & on behalf of Fabricator).

Performa for maintaining Register for consumable:

Date	Detail of Item with manufacturer name	Weather item is approved by RDSO (Yes/No)	Manufacturer test certificate detail.	Quantity received	Quantity consumed	Quantity balance	Sign of site supervisor

***

संदर्भ / REFERANCE

1.	General Arrangement Drawing for ROB between OHE Mast No. 1224/16-1224/22 in JHS-GWL SEC. (Near Gwalior Station)
2.	Approved Execution Drawings issued by North Central Railway
3.	Construction Videos and Photographs of Site
4.	Railway Board's Letters, RDSO Guidelines, IRICEN Reports, PCE's Circulars, IRPWM, IRBM

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टिप्पणी / NOTES

गुणवत्ता नीति

आर. डी. एस. ओ. लखनऊ में हम सतत सुधार और ग्राहक मूल्यांकन प्राप्त करने हेतु गुणवत्ता प्रबंध प्रणालियों की आवधिक समीक्षा के माध्यम से रेलों में यात्री और माल यातायात की बढ़ती आवश्यकताओं, माँग और अपेक्षाओं को पूरा करने के लिए गुणवत्ता प्रबंध प्रणाली की व्यवहारिक आवश्यकताओं और अनवरत सुधारों को पूरा करने के समर्पण गुणवत्ता उद्देश्यों को निर्धारित करके अनुसंधान, अभिकल्पों और मानकों में उत्कृष्टता के माध्यम से वैधानिक और नियामक अपेक्षाओं का अनुपालन करते हुए सुरक्षित, आधुनिक और किफ़ायती रेल प्रौद्योगिकी विकसित करने हेतु सेवाओं को बनाए रखने और अद्यतन पारदर्शी मानकों हेतु प्रतिबद्ध हैं। इसे संगठन के अंदर संसूचित एवं लागू किया गया है तथा सभी संबंधित पक्षकारों को भी उपलब्ध कराया गया है।

QUALITY POLICY

"We at RDSO Lucknow are committed to maintain and update transparent standards of services to develop safe, modern and cost effective railway technology complying with statutory and regulatory requirements, through excellence in research, designs and standards by setting quality objectives, commitment to satisfy applicable requirements and continual improvements of the quality management system to cater to growing needs, demand and expectations of passenger and freight traffic on the railways through periodic review of quality management systems to achieve continual improvement and customer appreciation. It is communicated and applied within the organization and making it available to all the relevant interested parties."

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हमारा उद्देश्य

अनुरक्षण प्रौद्योगिकी और कार्यप्रणाली को उन्नयन करना तथा उत्पादकता और रेल्वे की परिसंपत्ति एवं जनशक्ति के निष्पादन में सुधार करना जिससे अन्तर्विषयों में विश्वसनीयता, उपयोगिता और दक्षता प्राप्त की जा सके।

यदि आप इस संदर्भ में कोई विचार और सुझाव देना चाहते हों तो कृपया हमें इस पते पर लिखें।

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Our Objective

To upgrade Maintenance Technologies and Methodologies and achieve improvement in productivity and performance of all Railway assets and manpower which inter-alia would cover Reliability, Availability, and Utilisation.

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