

Third Party Audit of ROB's and FOB's of SCR



INSPECTION OF FOB AT REPALLE RAILWAY STATION

Final Report
SEPTEMBER | 2020

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1. VISUAL INSPECTION

Name of the Project	:	VISUAL INSPECTION OF FOB AT REPALLE RAILWAY STATION
Location	:	REPALLE RAILWAY STATION
Location Co-ordinates	:	16°01'08.4"N 80°49'44.2"E
Date of Inspection	:	09 th NOVEMBER, 2019



Visual inspection Summary:

- a) Corrosion is observed at Stringer beams of Staircase.
- b) Corrosion is Observed at bracings of Staircase Flight
- c) Corrosion is observed at Floor beams of FOB.
- d) Corrosion is also observed at Cleat angles connecting Stanchion and Staircase and Gusset plates.
- e) All the Corroded parts of the FOB are painted but the Element size is reduced at corroded locations.

1.1 GENERAL INFORMATION AND OBSERVATION		
a.	Name of the Bridge	FOB/ PF-1 – Circulating area
b.	Location of Bridge	Repalle Railway Station 16°01'08.4"N 80°49'44.2"E
c.	Type of truss Structure	Plate Girder Bridge
d.	Year of Construction	-
e.	Description of the main use of the bridge	Pedestrians Crossing
f.	Major Materials used in different parts of bridge	a. Structural Steel (Frame), b. RCC Cast-In-situ Slab (Floor slab)
g.	Width of the pathway (m)	1.95 m
h.	Length of the pathway (m)	13.45 m
i.	No of Railway Lines Crossings	2 tracks
j.	Span arrangement (no x Span in meters)	12.611 m (clear span)
k.	Vertical Clearance (from rail top to girder bottom)	5.673 m
l.	Head Room	2.51 m
m.	Damages due to accidental hitting, Grazing Marks	-
n.	History of Repair/ maintenance	Painting has been done.
o.	Existing structural drawings	-

Key Plan

1.2 IDENTIFICATION OF LOADS ON BRIDGE			
		Yes/No	Photo ID
a.	Dead Loads at Roof level		
	a) Pipeline - Utilities	Yes	a. 1-inch, 2-inch GI pipes and 1-inch HDPE pipe of 3 No's are supported along the length of girder and 1.5-inch GI pipe is supported on Stanchions and Mid landing. (Refer fig :1.3) b. King post Truss is used as Roof truss (Refer fig :1.9) c. Insulated Electrical Lines are Supported on Roof Truss. (Refer fig :1.9) d. Steel Metal Sheet is used for Roof (Refer fig: 1.1)
	b) Cables	Yes	
	c) Roof Truss	Yes	
	d) Roof Sheet	Yes	
	e) load of advertising hoarding	No	
	f) load of train/coach display boards	No	No train coach display boards are provided
	g) Electrical equipment (OHE), signal	No	No electrical equipment and signal are provided
b.	Dead Loads at Floor level		
	a) Additional wearing coat on Floor	No	Only Chequered tiles used for Flooring
	b) Provision of protective screen for passengers	Yes	Steel Railing is provided with 65 x 50 x 8 angle section and 45 x 10mm MS flat, supported on Composite Girder

1.3 STRUCTURAL SYSTEM OF THE BRIDGE			
			Photo ID
a.	Foundation Details		Not visible at site
b.	Trestles details		Not visible at site
	Trestles Connection Details		Concrete Encasement is provided
	No. of Bolts and size		
	Thickness of Base Plate	Not visible at site	
c.	Roof Truss		
	Element of roof truss section	Angle section	King post Truss of 75 x 75 x 8 mm Angles are used as Roof truss supported with bracings of 65 x 65 x 8 mm Angle section (Refer fig : 1.9)
	Size of roof truss	2.00 x 0.60 m	
	Connection of Roof elements	Welded	
d.	Steel Truss		
	Shape of Truss Section	Plate Girder	a) Built-up Composite girder of 850 x 350mm (Height x Flange) I- section with 16mm thick plate supported by 75 x 75 x 10mm Angle stiffeners
	Height of Truss (H)	0.85 m	
	Girder/Truss Support Condition	Ridged connection	

	Type/Shape of Secondary Girder /Bracings	Channel section	with Riveted joint. (Refer fig : 5)
	No of Secondary Girders/bracings for span	6	b) ISMC 150 mm Channel sections are used as Floor beams.
	Arrangement of Bracings	Zig-Zag bracing	c) Bottom Lateral Bracings 75 x 75 x 8 Angle section in Zig-zag pattern are used to support Floor beams.
	Type of Beam-Column Joint (shape of gusset plate if any)	Gusset	
e.	COLUMN		
	Type/Shape of Column section	Build up section with Channel	a) FOB is supported on vertical column of Built up channel section 300x200, with bracings of 50x65x8 mm angle section.
	No of Columns/support	2	b) Stanchion 1 & 2 columns has built up section of 2 channels of ISMC 300 mm with single lacing systems of 65x14 mm MS Flat.
	Dimensions of Column	300x200 mm	c) Staircase mid landing is supported by rail section of 65x130x65mm, with bracings of 50x65x10mm angle section and 64x14mm MS Flat.
	BEAM-Column joint (bolted, welded, riveted)	Riveted connection	
f.	FLOOR SLAB OF THE PATHWAY		
	Material of Slab	RCC	a. Cast in-situ Reinforced concrete slab is used for floor slab of 200 mm thick, RCC slab covered by Sacrificial Plate is resting on Composite Girder, which is supported by Floor beams and Bottom Lateral Bracings.
	Thickness of Slab	200 mm	b. CC flooring is laid on the top of the Floor slab. (Refer fig : 1.2)
	Condition of Slab from Bottom	RCC slab is not visible, Covered with Sacrificial plate	
	Condition of Slab from Top	RCC slab is not visible, Covered with CC flooring	
g.	Staircase Details		
	Number of Staircase	2 No's	Staircase is observed as Cast in situ RCC Slab supported on Stringer beam of ISMC 200 mm Channel section and cross bracings of 75 x 75 x 8mm angle section. (Refer fig : 1.6)
	Number of Steps from Circulating area 1	36 no's	
	Number of Steps from Circulating area 1	40 no's	
	Material used for steps	Cast Insitu RCC Slab	
h.	Staircase Railing		
	Type of Parapet Railing	Steel railing	Staircase is provided with railing on both sides using 65 x 50 x 10 angle section and 45 x 10 mm M.S flats are used. (Refer fig : 1.6)
	Height of Railing	1.35	

1.4 SIGNS OF DISTRESS, DEFORMATION IN BRIDGES

1.

✓ Corrosion observed at Staircase 1st & 2nd



a) Corrosion observed at Staircase 1 Stringer beam

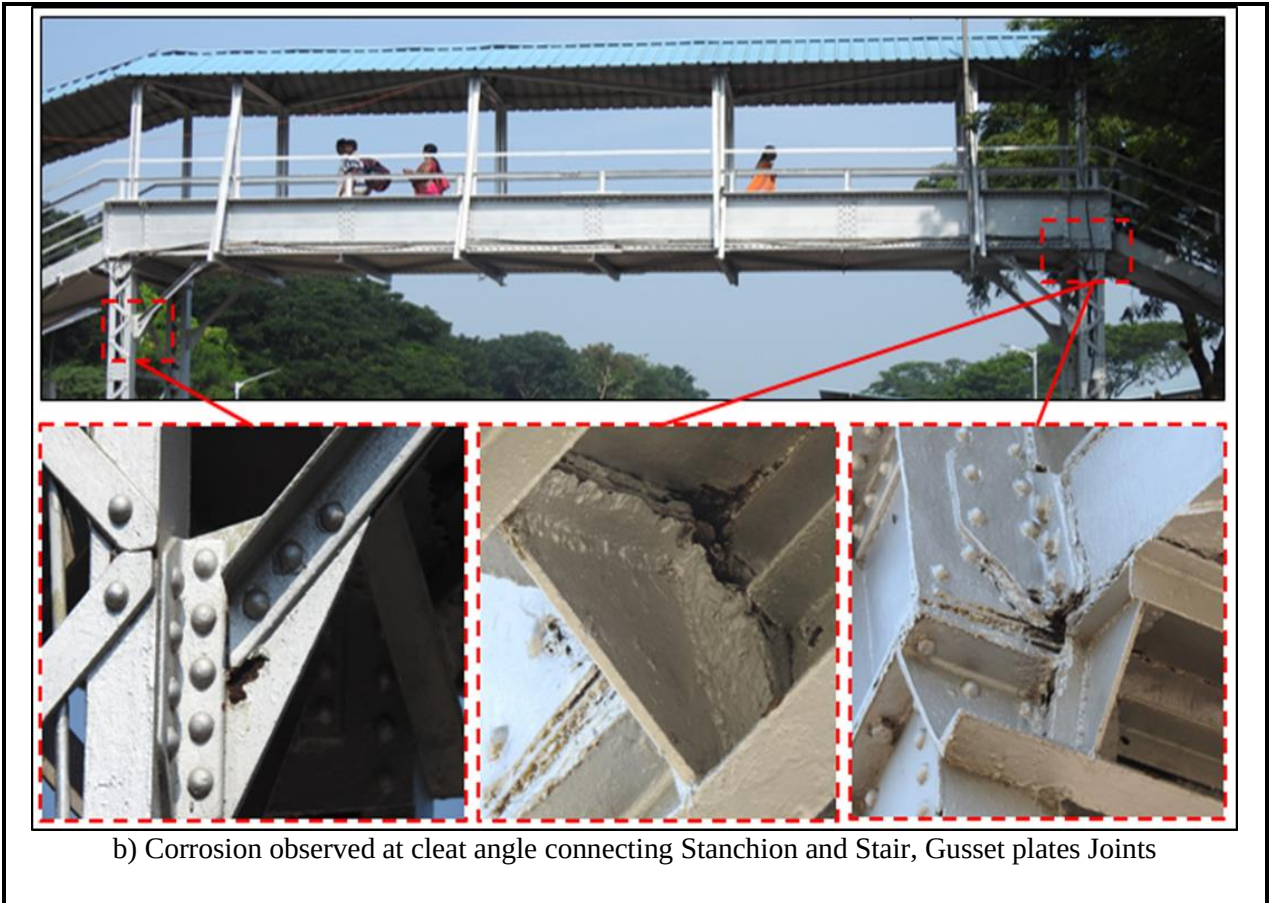


b) Corrosion observed at Staircase 2 Stringer beam and Corrosion of cross bracing

2. ✓ Corrosion observed at floor beams of FOB



a) Corrosion observed at floor beams of FOB



SIGNS OF DISTRESS, DEFORMATION IN BRIDGES			
	Defects	Location	Notes
	Cracking in Steel Members		No cracks are observed in Steel during visual inspection
	Cracking in RCC components		No Cracks observed
	Water seepage		No visual signs appear.
	Spalling		No spalling is observed.
	Rust straining		Corrosion is observed at Cross bracing Supporting Staircase Flight. (Refer Part 1.4(a))
	Corrosion	Floor level	Corrosion is observed the Floor Beams of FOB. (Refer Part 1.4(b))
	Corrosion at steel-Concrete joint		Corrosion is observed at Stringer beams of Stair case and at cleat angles connecting Stanchion and Stair case (Refer Part 1.4(a) & Part 1.4(b))
	Condition of Painting of steel structure		Painting is affected only at distressed places.



Fig 1.1(a): Front view of FOB



Fig 1.1(b) Bottom view of FOB



Fig 1.2: Pathway, Steel Railing of FOB



Fig 1.3: Additional loads of HDPE, GI pipes



Fig 1.4: Stanchions column section details and additional GI pipe Connected.



Fig 1.5: Composite Girder



Fig 1.6: Railing Details



Fig 1.7: Staircase Mid landing Rail Section Details



Fig1.8: Staircase Bottom view



Fig 1.9: Insulated Electrical lines on Roof truss

2. Repair and Retrofitting Recommendations

2.1 Repairs/Maintenance

a. Cleaning

- **Methodology for cleaning:** Generally foreign material are deposited or accumulated on bridge deck and in several bridge components which can deteriorate the bridge if proper action is not taken, so we support cleaning.
- **Debris removal:** The surface areas of a FOB should be cleaned and washed by brushing with fresh water or using high-pressure water blasting, including Deck slab top, sides along steel concrete joint on either side of deck, Supporting Railing and connecting staircase.

b. Corrosion:

Based on Steel Surface area effected by corrosion on steel member are classified into three grades as follows

- i. **Grade 1-** Mild Corrosion: 10 – 20 % of Surface area is affected with and peeled-off coating film is partially visible.
- ii. **Grade 2-** Moderate Corrosion: 20 – 30 % of Surface area is affected with corrosion and coating film is almost visible but partially deteriorated due to corrosion.
- iii. **Grade 3-** Severe Corrosion: 30% and more of Surface, area is affected by Corrosion and coating film is almost gone.

Methodology for Corrosion:

- If the paint condition is identified as Grade-1, aluminum paint shall be applied with a similar shade.
- Where condition of paint is evaluated as Grade-2 special anticorrosion paint shall be applied to restrict corrosion from progressing further.
- When the condition of the member is observed to be in Grade – 3, which might have occurred due to environmental conditions or age of the structure. In such cases section loss is calculated by using caliper where it is accessible and UPV at one accessible location. The first step in dealing with corrosion is to measure the section loss in the member. The member may be measured using calipers or other appropriate methods for totally exposed sections.
 - a. Section Loss < 15% - Clean the Surface and Apply the anticorrosion protective coat.
 - b. Section Loss 15% - 40% Repair the member as per design.
 - c. Section Loss > 40% - Replace the member.

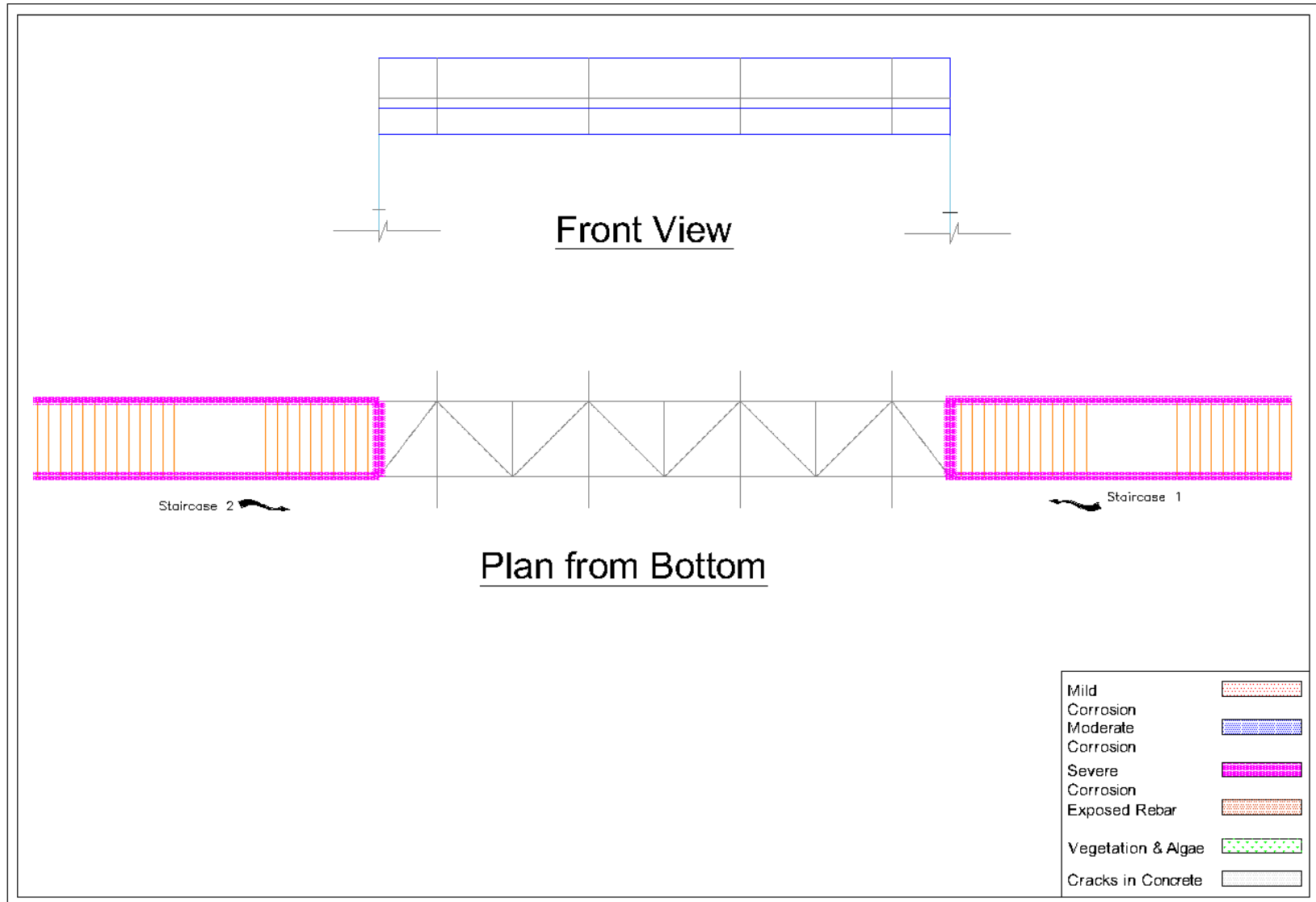


Fig: 2.1 locations of deteriorations and bottom view of FOB

Span recommendations

- Structural members are in fair condition, displaying mild corrosion for top chord members, verticals, diagonals, and bottom chord members and **severe corrosion** for staircase stringer beam along steel concrete joint in staircase-1 and staircase-2 (locations are marked in figures).
(Photographs of the same can be see in **fig 2.2-2.4**)

Table 2.1: Grading of corrosion in span 1

Span 1	Mild Corrosion	Moderate Corrosion	Sever Corrosion	Remark
Floor Beams/ Cross Girders	✓			
Bottom Chord	✓			
Top Chord	✓			
Bottom Lateral Bracings	✓			
Diagonals	✓			
Vertical	✓			
Gusset Plates	✓			
Sacrificial plate	✓			
Bolts	✓			

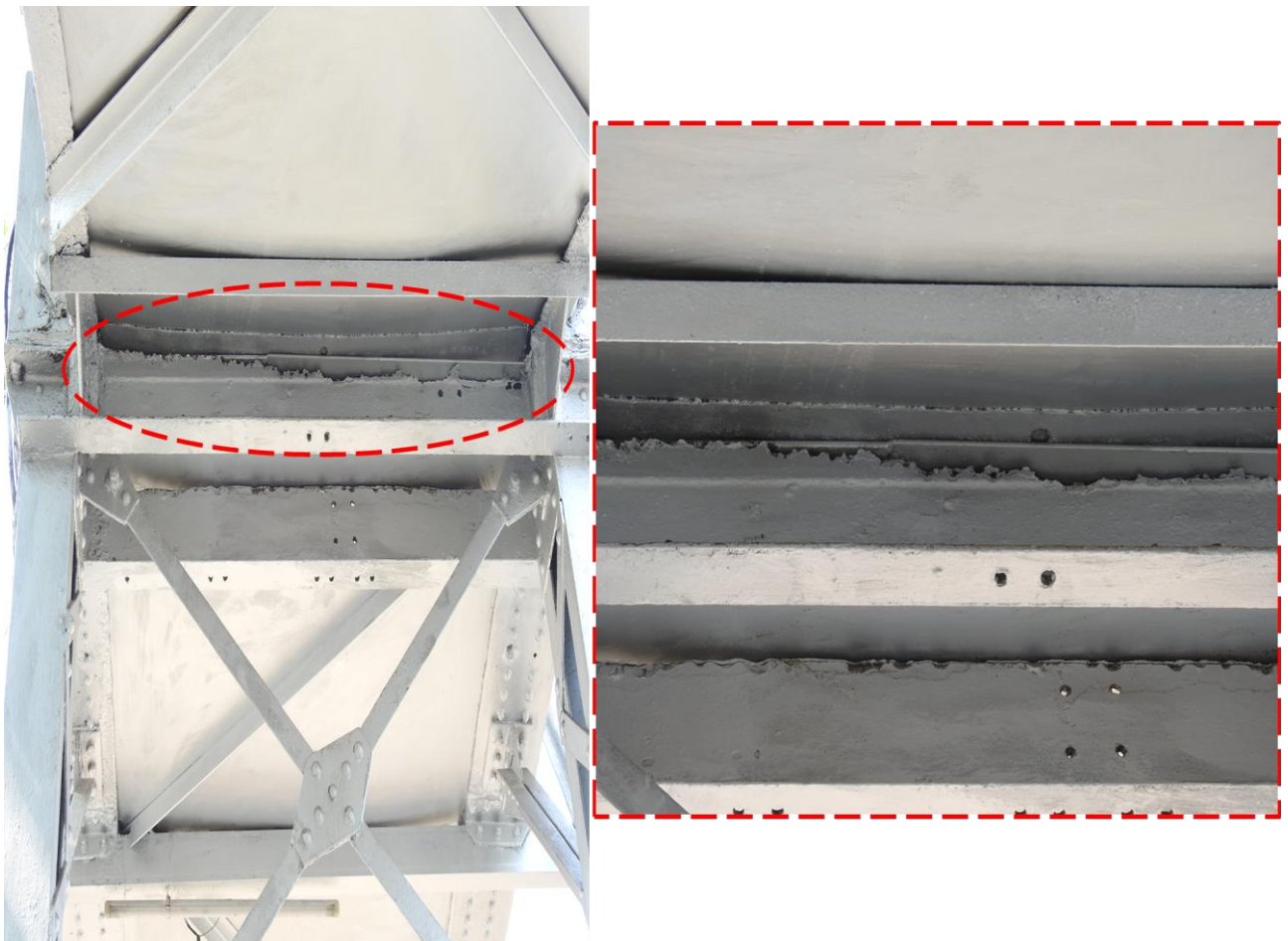


Fig: 2.2 Corrosion of Floor beam

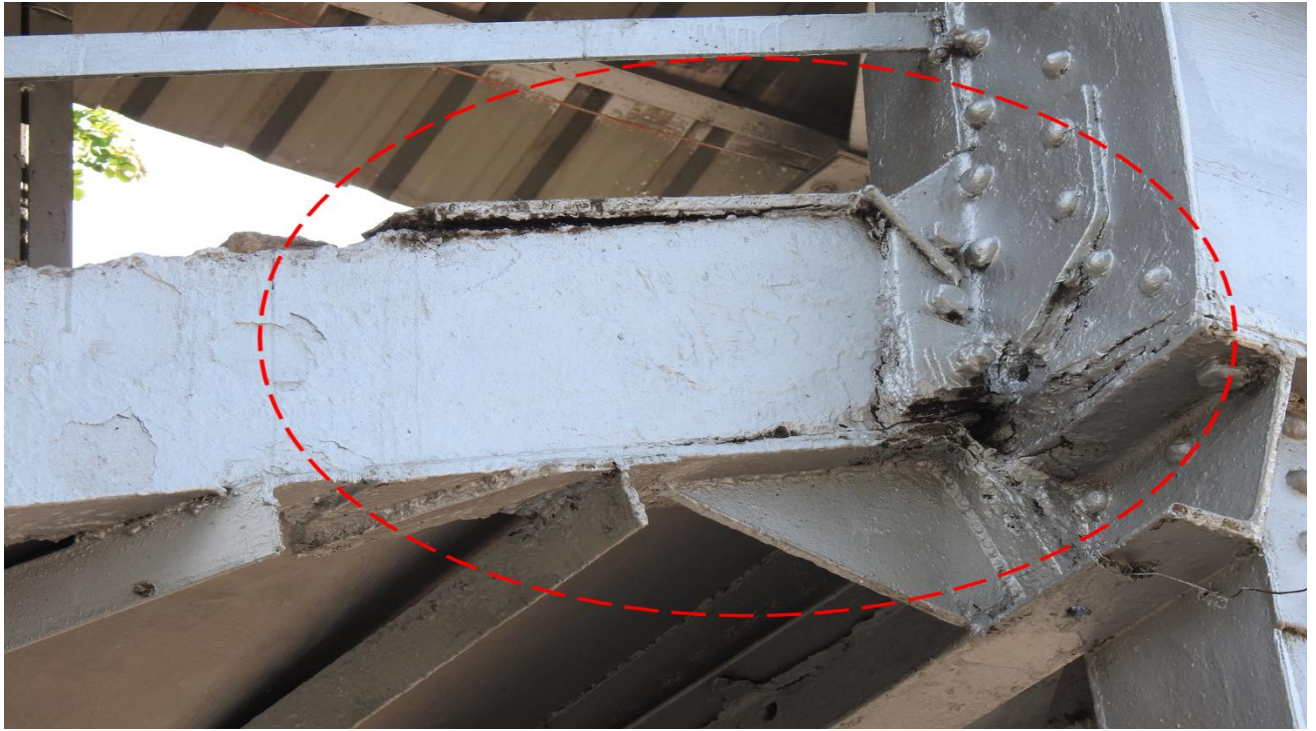


Fig: 2.3 Corrosion of joints

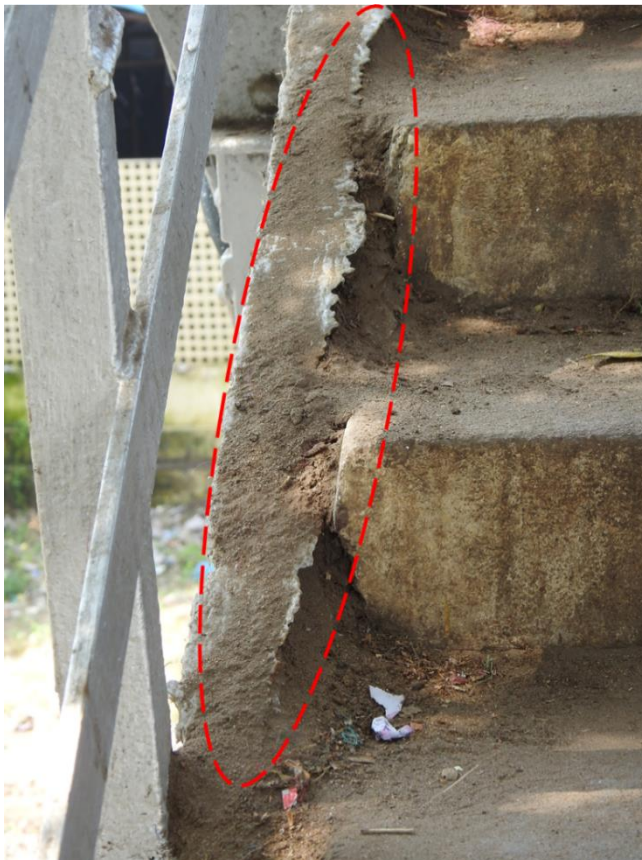


Fig: 2.4 Corrosion of Stringer beams

ANNEXURE

Annexure-1c: Repair methods

Defects/Deficiency	Minor corrosion of steel element
Remedial Measures	Touchup painting

Due to thin paint coverage on steel surfaces or formation of pin-holes in paint, the steel surface may get exposed to atmosphere resulting in initiation of corrosion. Touch up painting at the early stages prevents progress of corrosion. Work included in this section comprises field touchup painting on steel members at localized areas including surface preparation and other associated works. This section covers only painting on relatively small affected areas which can be carried out with the use of small power tools / hand tools. Painting of larger areas requiring sand blast cleaning should be carried out in accordance with the specifications covered under major repairs.

Work Sequence

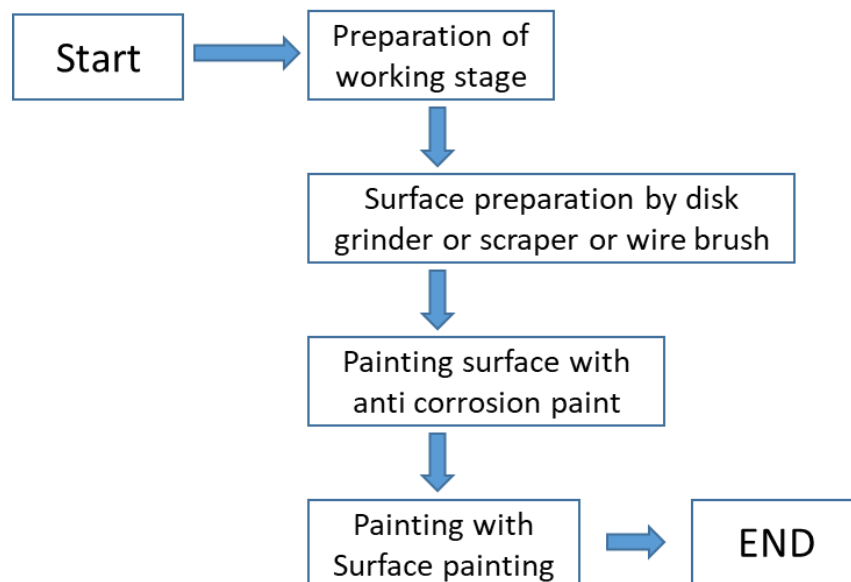


Figure: 1.2 Work sequence of Painting with anti-corrosion paint

Required Equipment / Tool and Material

i. Materials

- Aluminum paint / special anticorrosion paint as required
- Thinner
- Epoxy resin filler

ii. Tools/Equipment

- Scaffolding, inspection vehicle
- Portable generator (3 kVA)
- High pressure water blaster (8.0Mpa, 10.0 liters/min.)
- Sandpaper, portable power disk grinder
- Paint brush, roller

Requirement and Specifications

i. Material

Aluminum paint material shall be in accordance with the manufacturer's specifications and as approved by the Engineer.

For special anticorrosion paint, the materials shall satisfy the test requirements indicated in the relevant ASTM specifications as follows:

Table 1.4 Specification of Aluminum paint

Test	Test reference	Specification
Adhesive test	ASTM D7234	7days 1.0 N/mm ² , 28days 1.5 N/mm ²
Elongation	ASTM C190	7days 0.40 % , 28days 0.40 %
Saltwater test	ASTM D6943	No defection

ii. Work requirement

1) Scaffolding

Scaffolding shall be installed for close access to the corrosion-affected surfaces of the steel members to be repaired. Standard scaffoldings may be used however mobile scaffolding/inspection vehicle may be found suitable as it allows for free movement in most cases and provides access with convenience to various parts of a bridge.

2) Preparation of Steel Surface

Surface preparation shall conform to the paint manufacturer's specifications. Hand or power tools shall be applied for cleaning the surface. Groves and ridges formed on the affected surface shall be removed with power grinder. Where appropriate, as an alternative, epoxy resin filler may be used to fill the surface to a smooth and even finish. Where depth of roughness is within 0.5 mm, paint adequacy and durability can be achieved without application of multiple coats of surface leveling paints. Thickness of each coat shall not exceed the limiting value recommended in the paint manufacturer's specifications. Application of aluminum paint material shall be in accordance with the manufacturer's specifications and as approved by the Engineer.

3) **Application of Touchup Paint**

Paint shall be applied with brush or roller. The paint shall be applied in such a way that a uniform and smooth surface is formed without wrinkles, runs, streaks, sags, or any other defects. Components of the paint shall be mixed in accordance with the manufacturer's instructions and the application shall also conform to such instructions and specifications. Paint shall be applied immediately after the surface preparation, preferably within 4 hours. Total dry film thickness for special anticorrosive paint shall be 500 μm (equivalent 1.5kg/m²) consisting of two layers of coating as follows: -

Layer-1: 250 μm and Layer-2: 250 μm

Anticorrosion paint shall be applied in accordance with the stipulations of paint manufacturer's specifications. Minimum total film thickness for aluminum paint shall be not less than 125 μm . Roval paint is recommended for galvanized member touchup painting. Total dry film thickness for Roval paint shall be 80 μm (equivalent 0.5kg/m²) consisting of two layers of coating as follows: -

Layer-1: 40 μm and Layer-2: 40 μm

Roval paint shall be applied in accordance with the stipulations of paint manufacturer's specifications.

Summary

- **Visual inspection of Repalle railway station fob has been conducted on 09th Nov 2019, following observations were made**
 - i. Corrosion is observed at Stringer beams of Staircase.
 - ii. Corrosion is Observed at bracings of Staircase Flight
 - iii. Corrosion is observed at Floor beams of FOB.
 - iv. Corrosion is also observed at Cleat angles connecting Stanchion and Staircase and Gusset plates.
 - v. All the Corroded parts of the FOB are painted but the Element size is reduced at corroded locations.
- **Based on visual inspections and its interpretations following recommendations were made:**
 - a) Cleaning of debris immediately to avoid deterioration of concrete and steel members.
 - b) Anti-corrosion treatment for Grade-1 and Grade-2 highlighted corrosive members for floor beams.
 - c) Replacement of damaged members or severely corroded members, staircase stinger beam at staircase-1 and staircase-2. Cleat angles connecting Stanchion and Staircase and Gusset plate.

Note: Provided step wise procedure for each recommendation are detailed out in annexure based on requirements