

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



INSPECTION OF FOB AT KAZIPET RAILWAY STATION

Final Report
SEPTEMBER | 2020

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1. Visual Inspection

Name of the Project	:	VISUAL INSPECTION OF FOB/ PF-1 - PF-3 AT KAZIPET RAILWAY STATION
Location	:	KAZIPET RAILWAY STATION
Location Co-ordinates	:	17°58'27.0"N 79°30'38.6"E
Date of Inspection	:	24 th OCTOBER, 2019



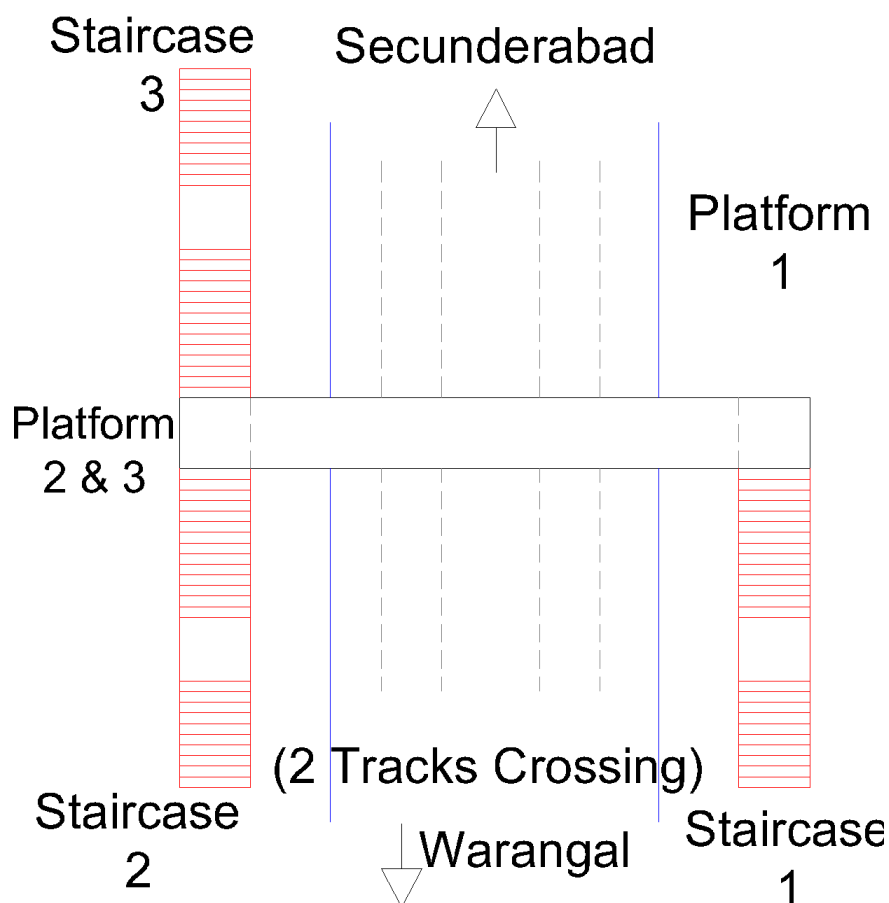
Visual inspection Summary:

- (a) Roof metal sheet is missing nearer to staircase – 2 on FOB.
- (b) Slight corrosion is observed on either sides of pathway.
- (c) Rollers are corroded at top nearer to staircase – 3
- (d) Severe corrosion and bulging is observed in pin-joints at the bottom.
- (e) Organic growth is observed on FOB pathway.

PART 1.1 GENERAL INFORMATION AND OBSERVATION

1.1	Name of the Bridge	FOB/ PF-1 - PF-3
1.2	Location	Kazipet Railway Station
	Location co-ordinates	17°58'27.0"N 79°30'38.6"E
1.3	Type of truss Structure	Pin typed truss
1.4	Year of Construction	Approx. 50+ years
1.5	Description of the main use of the bridge	Pedestrians Crossing
1.6	Major Materials used in different parts of bridge	Structural Steel (for Truss, frame), Pre-cast RCC panels(for Slab, Staircase)
1.7	Width of the Pathway (m)	2.60 m
1.8	Length of the Pathway (m)	23.35 m (overall length)
1.9	No of Railway Lines Crossings	2 tracks crossing
1.10	Span arrangement (no x Span in meters)	1 x 18.65 m
1.11	Vertical Clearance (from rail top to girder bottom)	4.950 m
1.12	Head Room	2.70 m (upto Roof truss bottom)
1.13	Damages due to accidental hitting, Grazing Marks	No Visible signs appear
1.14	History of Repair/ Maintenance	Yes Observed in site
1.15	Existing Structural Drawings	Not available

1.16 Key Plan



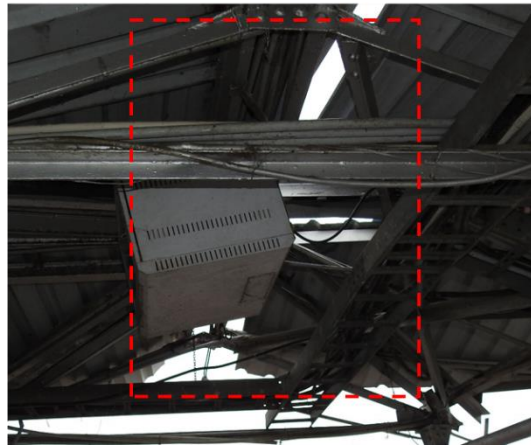
PART 1.2 IDENTIFICATION OF LOADS ON BRIDGE			
		Yes/No	Notes
	Dead Loads at Roof level		
2.1	a) Pipeline - Utilities	No	Not observed in site
	b) Cables	Yes	Set of Cables are running along the length of FOB, Approximate circumference of cables is 500 mm (Refer fig : 1.2)
	c) Roof Truss	Yes	2/65 x 65 x 8 mm Angles are used (Refer fig :1.2)
	d) Roof Sheet	Yes	Corrugated metal Sheet is used for Roof (Refer fig :1.2)
	e) load of advertising hoarding	Yes	No advertising boards are provided
	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
2.2	Dead Loads at Floor level		
	a) Additional wearing coat on Floor	No	Only Chequered tiles used for Flooring (Refer fig :1.2)
	b) Provision of protective screen for passengers	Yes	Fence made of Galvanized wire of 2 mm gauge and 2 mm Galvanized sheet is used above OHE Line on both side of Pathway is used for passengers Protection.
	c) Type of Material used for mesh	GI wire mesh	(Refer fig :2)

PART 1.3 STRUCTURAL SYSTEM OF THE BRIDGE			
			Notes
3.1	Foundation details		Not Visible
3.2	Trestles details		
	Type of Material for Bottom Encasement		Not Visible for FOB trestles, Concrete Encasement is provided for staircase 3 vertical supports.
3.3	Roof Truss		
	Element of roof truss section	King post angular section	King post angular truss with 65x65x8 mm section is used. Supported on Main tie members using welded joints (Refer fig:1.2).
	Size of roof truss	2.60 m X 0.8 m	
	Connection of Roof elements	Using Gusset plate and Bolts	
3.4	Steel Truss		
	Type /Shape of Truss Section	M.S Flats	a. Main tie members are M.S Flats 6/150x10 mm and at the joints M.S Flats 4/150x 10 mm. b. T- angles 2/110x70x10 mm with M.S Flats 1/165x 14 at mid span of FOB. M.S Flat 2/165x18 mm are used at joints at
	Height of Truss (H)	2.7 m	
	Boundary Condition	Pin jointed truss supported on rollers	

			end Support of FOB. 10 mm thick gusset plate is used for welded joint (Refer fig:1.9)
	Shape of Secondary Girder /Bracings	I-Section	ISMB 250 x 125 are used as secondary girders to transfer load from slab to roof truss. Secondary girders are connected with tie member using pin joints and bracing are connected to Secondary girder to transfer load to main tie members using bolted joint (Refer fig :1.9)
	No of Secondary Girders/bracings for span	9 no's	
	Type of Beam-Column Joint (shape of gusset plate if any)	Cleat angles	
3.5	COLUMN		
	Shape of Column section	Channel – Sections	FOB is supported on vertical Built - up channel column encased with stone masonry wall.
	No of Columns/ support	4 no's	
	Dimensions of Column		
	BEAM-Column joint (bolted, welded, riveted)	Riveted	
3.6	Floor of the Pathway		
	Material of Slab	RCC Slab	Reinforced Concrete Slab is used as floor slab of 100 mm thick supported with Sacrificial plate, RCC slab is resting on Angular chord members supported on Secondary Girders and Bracings from bottom. Chequered tile (25 mm thick) flooring is laid on the top of the Pre-cast slab panels. (Refer fig : 1.10)
	Thickness of Slab	100 mm	
	Condition of Slab from Bottom	Covered with Sacrificial plate	
	Condition of Slab from Top	Covered with Chequered tiles	
3.7	Staircase Details		
	Number of Staircase	3 No's	Staircase steps are observed as RCC slab is supported with sacrificial plate for staircase 3. Steps are supported on ISMC 250 Channel using cleat Angles. Staircase Landing of 2 m wide is supported on Vertical and Horizontal Angular Members. (Refer fig :1.4) Staircase 3 Sacrificial plate is corroded at landing from bottom. (Refer fig : 1.11)
	Number of Steps from PF – 1	29 no's (Staircase 1)	
	Number of Steps from PF – 2	29 no's (Staircase 2)	
		29 no's (Staircase 3)	
3.8	Staircase Railing		
	Type of Parapet Railing	Steel Railing	Stair case is provided with Railing on both sides of one-meter height using masonry wall (Refer fig :1.10)
	Height of Railing	1 m	

PART 1.4 SURVEY OF SIGNS OF DISTRESS, DEFORMATION IN BRIDGES

- ✓ Roof metal sheet is missing near staircase 2 on FOB



- ✓ **Condition:** Deteriorated M.S. Steel plates and pin joints are corroded in Bottom chord
- ✓ Bottom Chord members (M.S. Steel plates) are more prone to corrosion as rainwater on floor slab comes in contact with it and also due to dust/debris accumulation between the plates which retains the moisture leading to accelerated corrosion.



PART 4 SURVEY OF 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	Slab panels	Bottom of RCC slab in pathway is supported with Sacrificial plate
Water seepage		Organic growth is observed (Fig 1.9)
Rust straining		Slight corrosion is observed at all the joints of FOB at floor level and also in roof metal sheet.
Corrosion in Gusset plate	Floor level	Corrosion is observed at bottom of Main plates (Fig 1.6)
Corrosion at steel-Concrete joint		Major corrosion is observed near pin joints at bottom of FOB (Fig 1.6)
Condition of Painting of steel structure		Painting is affected only at distressed places.



Fig 1.1: Front view of FOB towards Secunderabad Junction



Fig 1.2: Set of cables running along the length of FOB



Fig 1.3: Rail Wi-Fi unit supported on roof truss

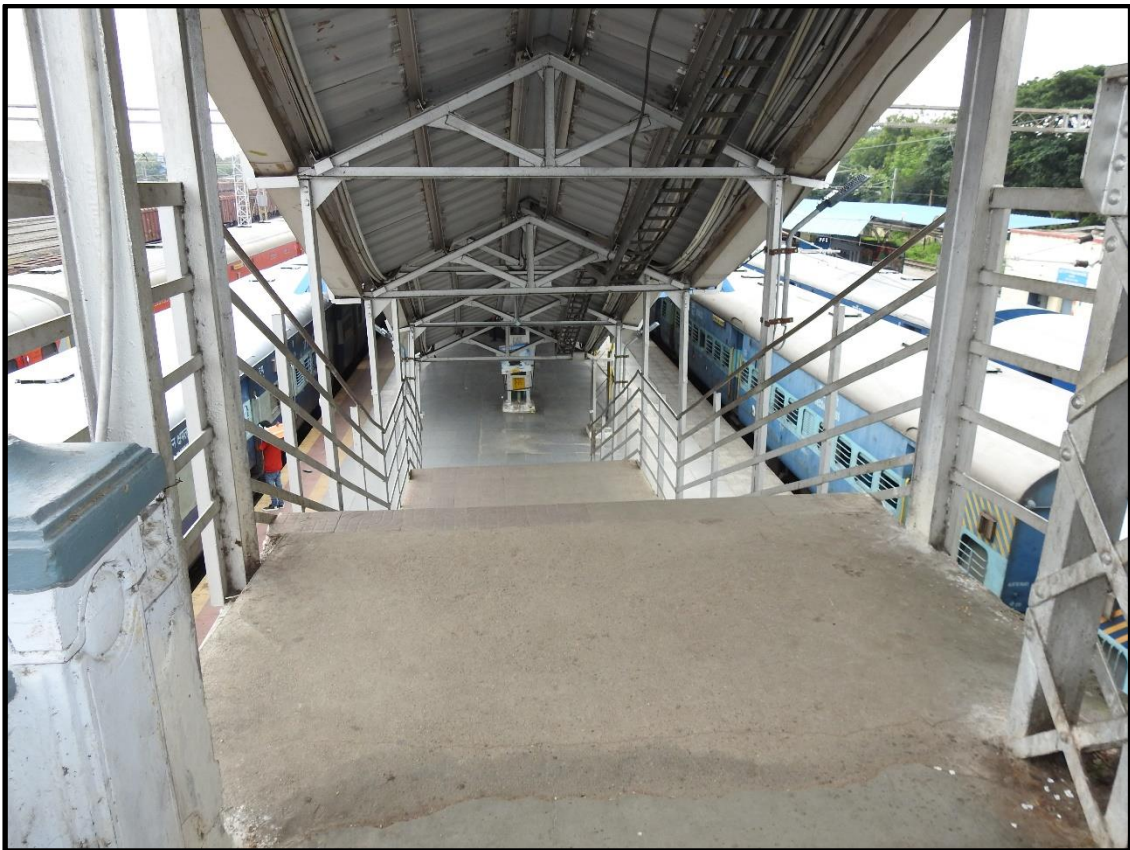


Fig 1.4: Staircase 3 view from FOB



Fig1.5: Organic growth near top cord



Fig 1.6: Severe corrosion in main plates at bottom of FOB.



Fig 1.7: Bending of bottom main plates



Fig 1.8: Corrosion of rollers near staircase 3



Fig 1.9: Vegetation on both sides of FOB at bottom



Fig 1.10: Bottom view of FOB near platform 1

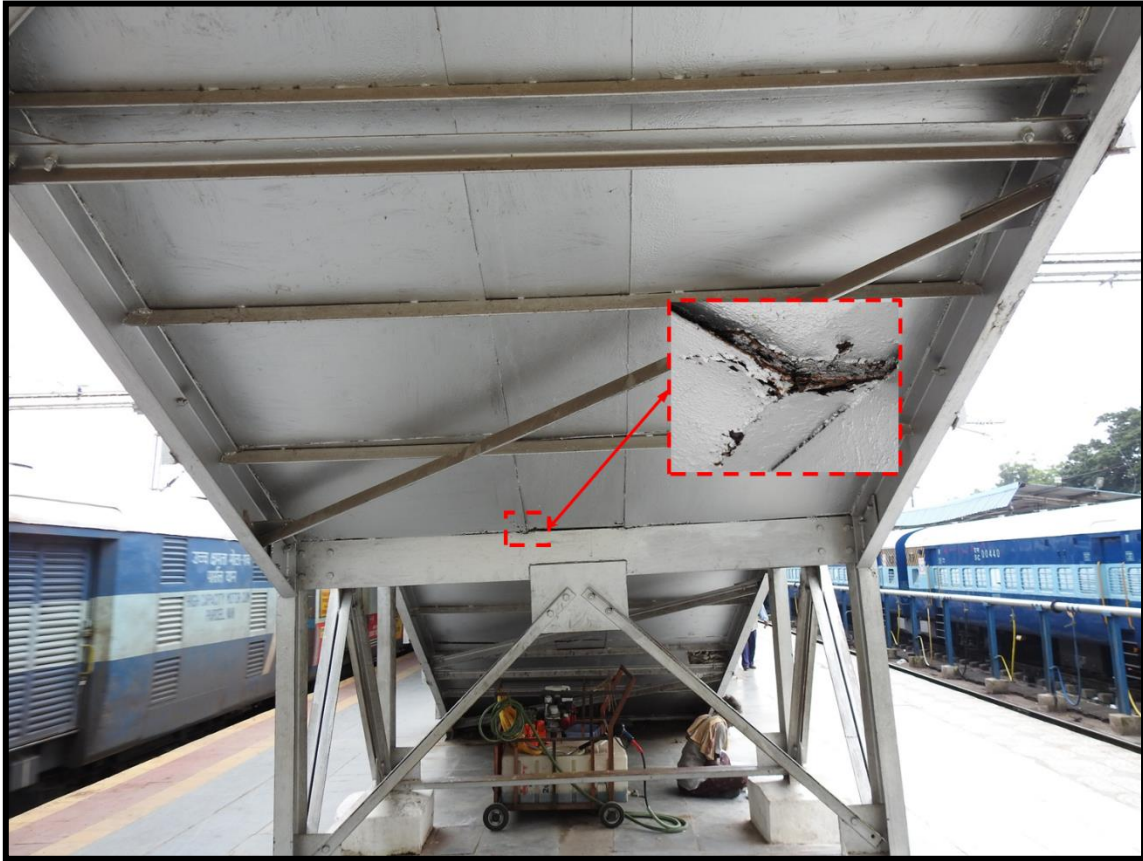


Fig 1.11: Bottom view of Staircase 3 from platform 2

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.
- **Vegetation removal:** Vegetation growth shall be removed from the components of the FOB, and near the FOB. (Photographs of the same can be see in **fig:1.9, 2.1**)



Fig 2.1: Locations of Vegetation growth and debris

b. Corrosion:

Corrosion is observed in structural members of FOB (Photographs of the same can be see in **fig:1.6, 1.8, 1.11, 2.2**)

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.
 - i. Section Loss < 15% - Clean the Surface and Apply the anticorrosion protective coat.
 - ii. Section Loss 15% - 40% Repair the member as per design.
 - iii. Section Loss > 40% - Replace the member.

SPAN - 1

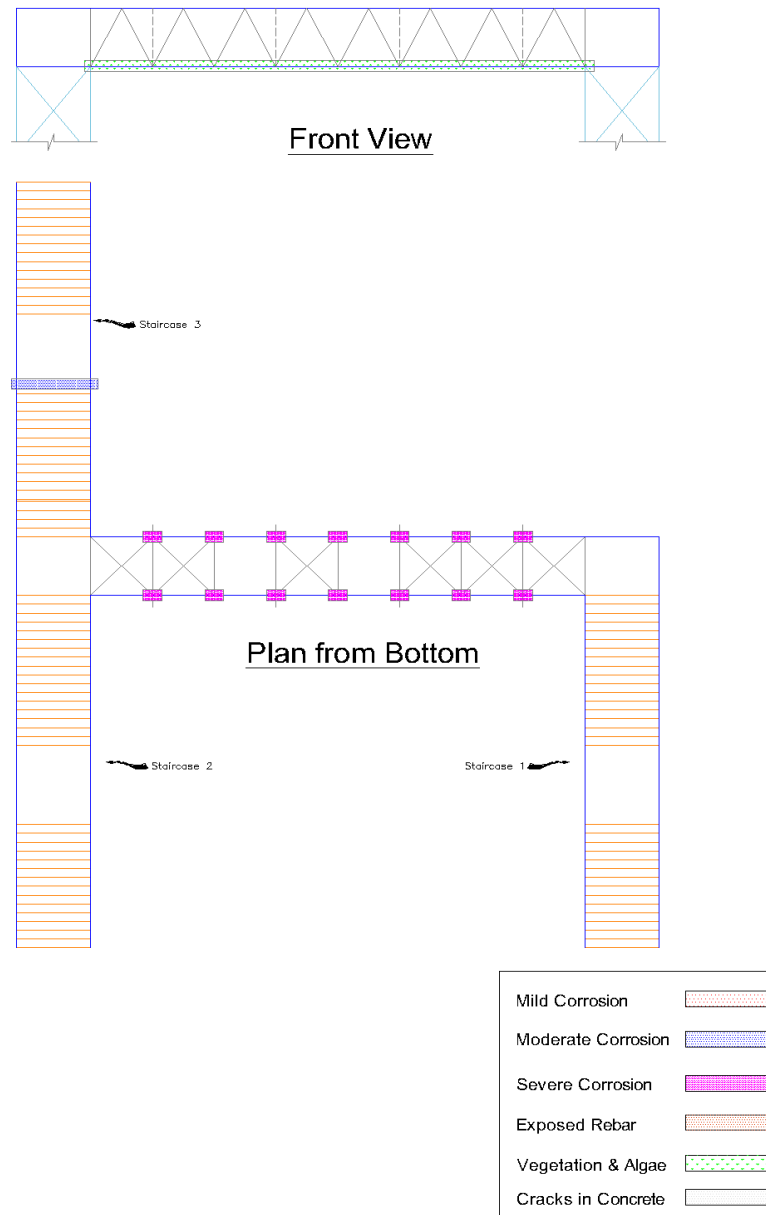
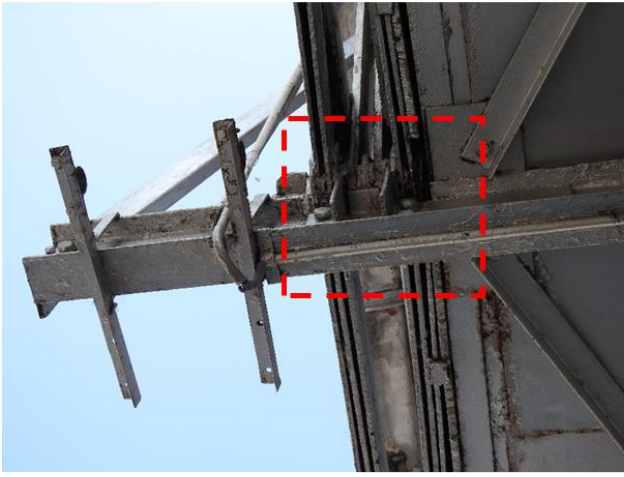


Fig 2.2: Locations of Deteriorations

Table 2.1: Grading of corrosion in span 1

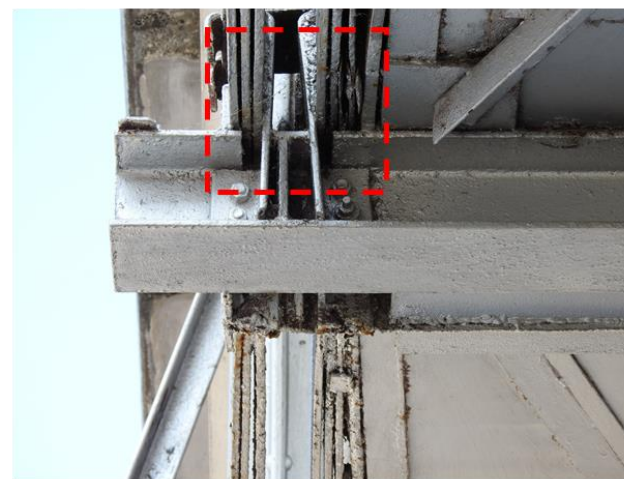
Span 1	Mild Corrosion	Moderate Corrosion	Sever Corrosion	Remark
Floor Beams/ Cross Girders	✓			
Bottom Chord (Plates)			✓	
Top Chord		✓		
Bottom Lateral Bracings	✓			
Diagonals	✓			
Vertical	✓			
Bottom Pin Joint			✓	
Top Pin Joint		✓		
Sacrificial plate		✓		



(a)

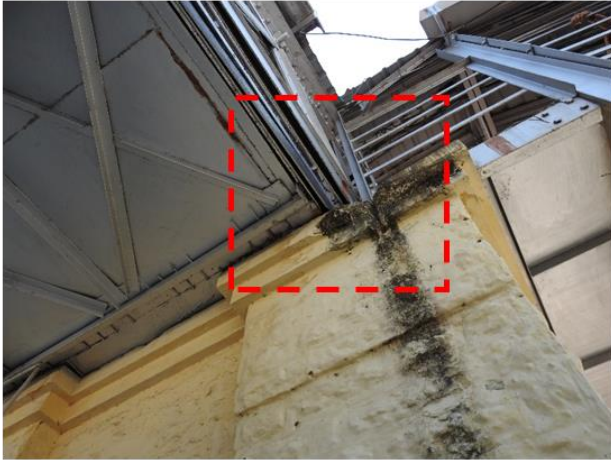


(b)

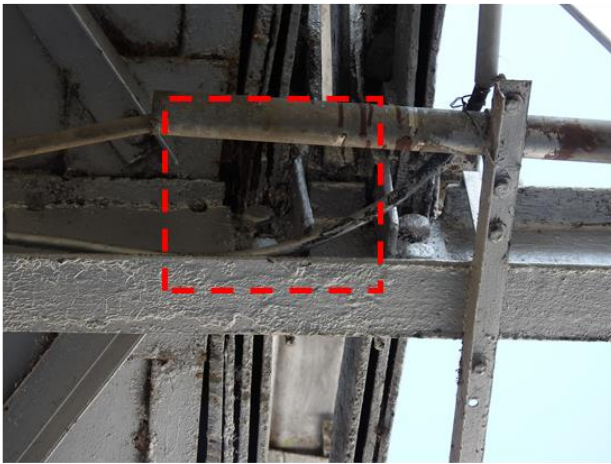


(c)

Fig 2.3: Locations of Severe corrosion and bulging of joints on deck from bottom



(d)



(e)



(f)

Fig 2.4: Locations of Severe corrosion on deck from bottom



Fig 2.5: Locations of Severe corrosion on deck from bottom

ANNEXURE

Annexure-1a: Repair methods

Defects/Deficiency	Debris accumulation
Remedial Measures	Cleaning

During the Bridge service life, several components of bridges get unclean due to deposition of foreign materials. Materials that collect on the deck surface flow with the rain water towards the drainage spouts which may choke the outlets and affect drainage. Also the materials that collect on the deck and carried by the rain water towards edges of the gangway and accumulate in the gaps or on the steel members. Such debris accumulation can cause acceleration of the corrosion in metal since debris tend to hold water. Also growth of vegetation such as grass, shrubs and other plants on the components of bridges is very common. But, they should be thoroughly cleaned of accumulated dust, debris and other foreign materials at regular intervals. This is to prevent deterioration of the bridge, which will therefore preserve the bridge components in their intended conditions resulting in increased service life of the bridge as well as provide safety and comfort to the users.

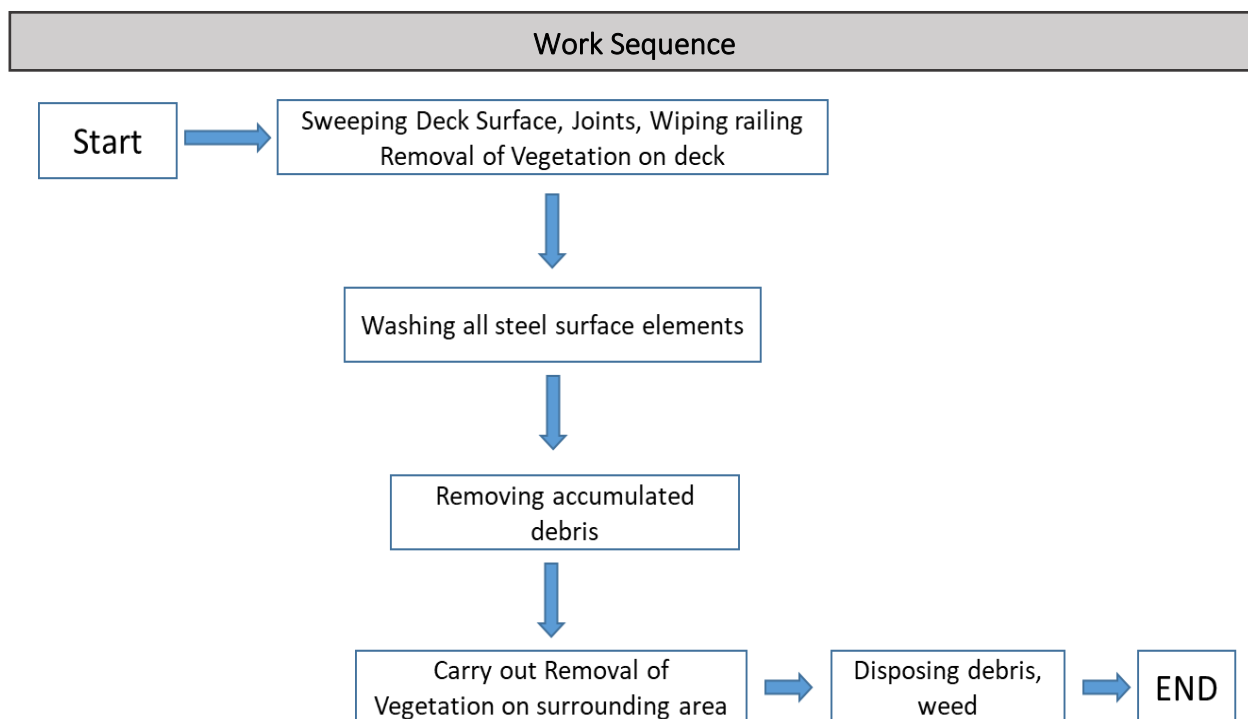


Figure:1.1 Work sequence of removal of vegetation and accumulated debris

Requirement and Specification

1. Material Requirement

Water to be used for cleaning of the bridge components shall be clean and free from unwanted foreign materials such as sediments, salt contaminants, chemicals, grease, oil, rubbish and other substances which are harmful to the bridge components.

All necessary tests shall be performed on water samples at laboratories to be specified by the Engineer, and test certificates shall be provided as required.

2. Work Requirement

1) General

All accumulated foreign materials shall be removed from gangway, its sides and check at beam flanges, gusset plates, truss joints, deck drain systems, and other locations specified and as directed by the Engineer, prior to cleaning with water pressure. Removal shall be performed using hand brooms, hand shovels, scrapers, vacuum cleaners or other methods acceptable to the Engineer. The removed materials shall be collected and disposed at an approved waste area in accordance with railway regulations. At no time shall these materials be allowed to be disposed within the vicinity of the bridge or on the tracks.

2) High pressure water

Salt contaminants, dirt, and other detrimental foreign matters shall be removed without damaging or peeling the paint from any structural steel. If high-pressure water is used, the maximum water pressure shall not be so high that any paint is damaged. The cleaning operation shall be discontinued if the foreign materials have not been easily removed or if cleaning operation is causing damage to existing paint coating. In this situation, the high-pressure water shall be adjusted to clean the surface without damaging the paint coating.

All deck drains or gangways and its accessories shall be flushed with high-pressure water after the accumulated foreign material has been properly removed. Drain systems may have to be disassembled to remove large blockages of accumulated foreign material. Should this be necessary, these shall be returned to their original configuration immediately after cleaning. Drainage systems shall drain properly after cleaning.

The Contractor shall flush out the interior surfaces of all truss members using high-pressure water. This flushing shall continue until such time that clear water is being draining out. The exterior surfaces of all truss members, miscellaneous structural steel connecting the truss members, and floor beam-ends projecting outwardly from the row of exterior stringers shall be thoroughly washed down using high-pressure water.

The Contractor shall obtain approval of the source of water used. They shall use fresh water, which is free of sediments and salt contaminants, and be responsible for all expenses involved in securing the approved water.

3) Power block

During this activity power block is mandatory and has to be carried in the presence of BRI.

Annexure-1b: 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

Work Sequence

covered under major repairs.

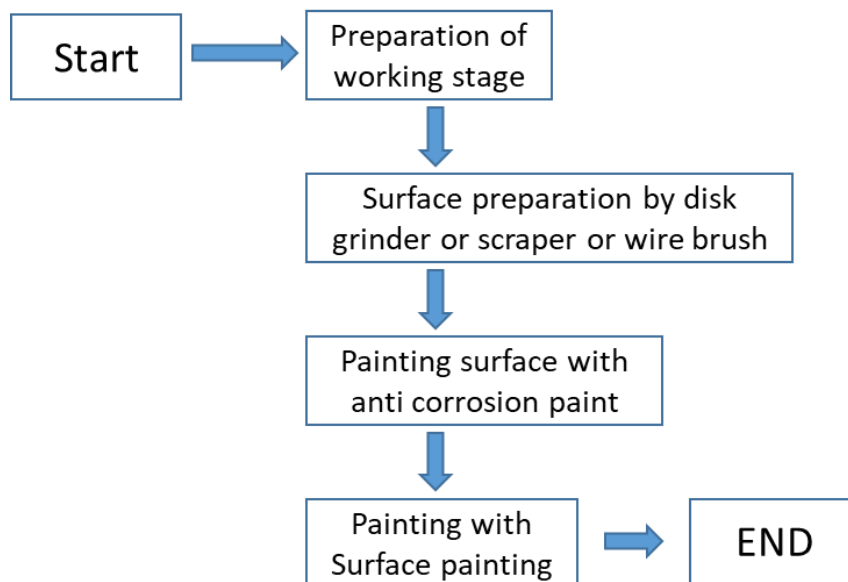


Figure: 1.2 Work sequence of Painting with anti-corrosion paint

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 the Kazipet railway station FOB has been conducted on 24th October 2019 and following major observations were made.**
 - i. Roof metal sheet is missing nearer to staircase – 2 on FOB.
 - ii. Slight corrosion is observed on either side of pathway.
 - iii. Rollers are corroded at top nearer to staircase – 3
 - iv. Severe corrosion and bulging is observed in pin-joints at the bottom.
 - v. Organic growth is observed on FOB pathway.
- **Based on visual inspections and its interpretations following recommendations can be made:**
 - i. Foreign material and Vegetation growth shall be removed from the components of the FOB. Carryout removal and cleaning as per Annexure 1a.
 - ii. Anti-corrosive treatment for Grade-1 and Grade-2 highlighted corrosive members like floor beams, top chord and bottom chord.
 - iii. Replacement of severely corroded splice joints, gusset plate and sacrificial plate.
Carryout structural repairs to all Steel members as per Annexure 1b.

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