

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



INSPECTION OF FOB AT LAKDIKAPUL RAILWAY STATION

Final Report

SEPTEMBER | 2020

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1. Visual Inspection

Name of the Project	:	VISUAL INSPECTION OF FOB/ PF-1 - PF-2 AT LAKDIKAPUL RAILWAY STATION
Location	:	LAKDIKAPUL RAILWAY STATION
Location Co-ordinates	:	17°24'22.0"N 78°27'43.6"E
Date of Inspection	:	18 th OCTOBER, 2019

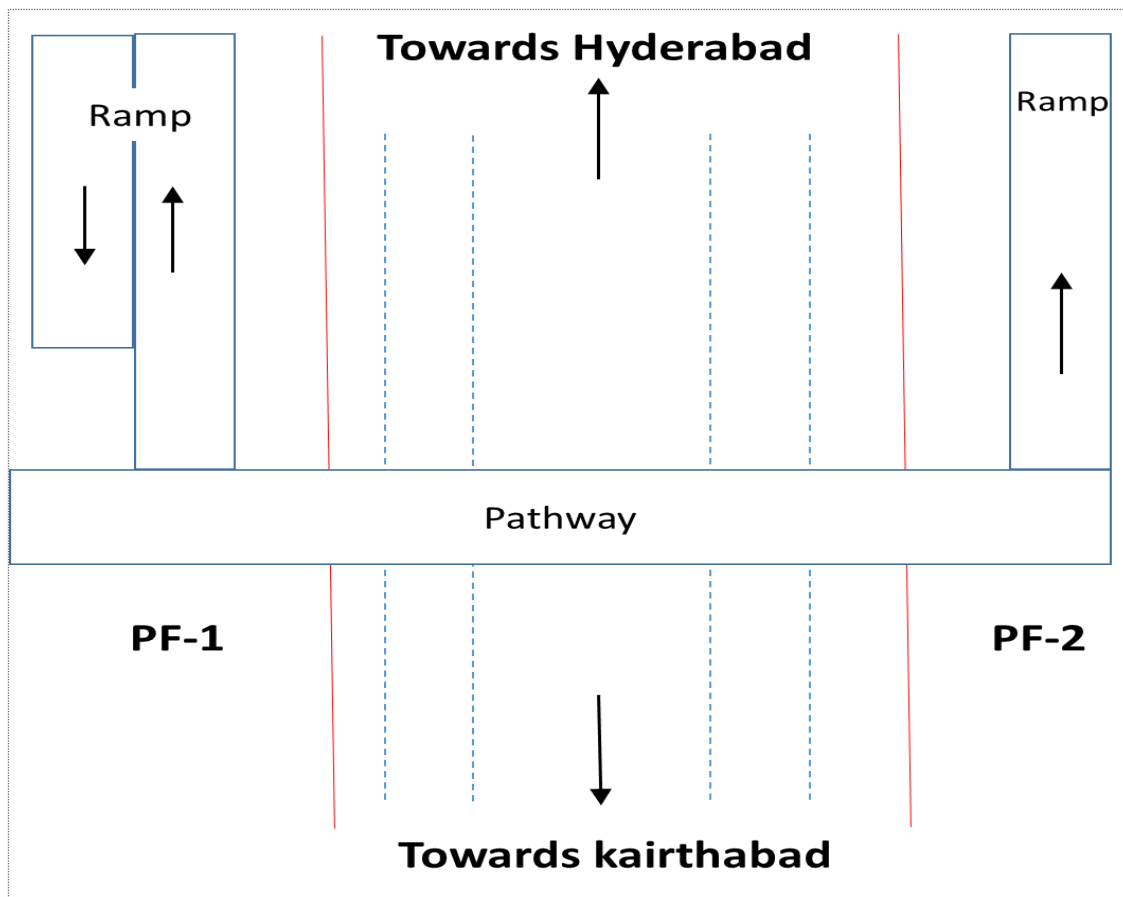


Visual inspection Summary:

- From visual inspection, slight corrosion is observed at the bottom of sacrificial plate.
- Mild Corrosion is observed at Trestles (Double channel section) at PF-2.
- Corrosion of gusset plate at bottom chord members.

1.1 GENERAL INFORMATION AND OBSERVATION		
a	Name of the Bridge	FOB/ PF-1 - PF-2
b	Location of Bridge	Lakdikapul Railway Station
c	Type of truss Structure	Pratt Truss with cross bracing at center
d	Year of Construction	Not available
e	Description of the main use of the bridge	Pedestrians Crossing
f	Major Materials used in different parts of bridge	Structural Steel (truss, frame), RCC (Slab, Staircase)
g	Width of the pathway (m)	2.5 m
h	Length of the pathway (m)	18.6 m
i	No of Railway Lines Crossings	2 tracks
j	Span arrangement (no x Span in meters)	1x 18.6 m
k	Vertical Clearance (from rail top to girder bottom)	6.7 m
l	Head Room	Not available
m	Damages due to accidental hitting, Grazing Marks	No Visible signs appear
n	History of Repair/ maintenance	Not available
o	Existing structural drawings	Not available

Key Plan



1.2 IDENTIFICATION OF LOADS ON BRIDGE			
		Yes/No	Photo ID
a	Dead Loads at Roof level		
	a) Pipeline - Utilities	No	Not observed at site
	b) Cables	Yes	1-inch Hallow circular sections are used (truss member) (Refer fig :1.1) Steel Metal Sheet is used for Roof (Refer fig :1.2)
	c) Roof Truss	Yes	
	d) Roof Sheet	Yes	
	e) load of advertising hoarding	No	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
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	Chain link 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 Protection. Mesh frame is supported with angular and MS flats. (Refer fig :1.1)
	c) Type of Material used for mesh	Galvanized wire mesh	

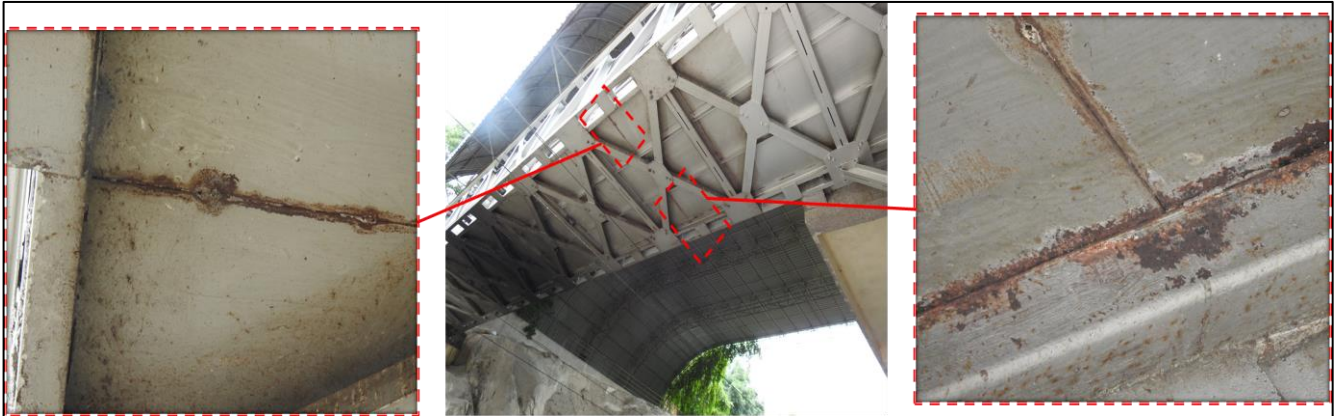
	1.3 STRUCTURAL SYSTEM OF THE BRIDGE		
			Photo ID
a	Foundation Details		Not visible at site
b	Trestles details		
	Type of Pedestal	Concrete	Concrete encasement is observed below vertical supports (Refer fig :1.3) By performing cover test, reinforcement in pedestal can be identified (Refer fig :1.3)
	Trestles Connection Details		
	a) No of Bolts and size	Not visible	
	b) Thickness of Base Plate	Not visible	
c	Roof Truss		
	Element of roof truss section	circular truss supported with hollow pipes	2-inch circular truss with plate welded to top chord members. (Refer fig :1.2)
	Size of roof truss		
	Connection of Roof elements	Welded	
d	Steel Truss		
	Shape of Truss Section	N- type truss, Double Channel sections	a. Top and bottom Chord members are ISMC 150 double channel section back to back
	Height of Truss (H)	1.85 m	

	Girder/Truss Support Condition	Ridged connection	b. Diagonal bracings and vertical bracings of ISMC 150 Double channel section.
	Type/Shape of Secondary Girder /Bracings	Double channel section	c. Floor beams are ISMC 150 Double channel section.
	No of Floor beams/bracings for span	10 no's	d. one end of fob is anchored to the stone (Refer fig :1.4)
	Arrangement of Bracings	Diagonal	
	Type of Beam-Column Joint (shape of gusset plate if any)	Cleat angles	
e	COLUMN		
	Type/Shape of Column section	Channel Section	a. Truss supported on ISMC 250 double channel section
	No of Columns/support	4	b. Supported with angular bracings of 90x 90 x 8 mm
	Dimensions of Column	ISMC 250	c. 10 mm thick gusset plate is used. (Refer fig :1.3)
	BEAM-Column joint (bolted, welded, riveted)	Bolted connection	
f	FLOOR SLAB OF THE PATHWAY		
	Material of Slab	RCC	a. RCC slab casted in site supported on sacrificial plate.
	Thickness of Slab	Not visible at site	b. Chequered tiles of 25 mm thick are observed on FOB.
	Condition of Slab from Bottom	Slabs supported with Sacrificial plate	c. RCC slab is supported by Floor beams of ISMC150 (Refer fig :1.5)
	Condition of Slab from Top	RCC slab is not visible, Covered with Chequered tiles	
	Condition of sheeting – leaky roof	Not visible on site	
g	Ramp Details		
	Width of ramp	2.3 m	Ramp is supported with RCC slab at a length of 49.54 m at PF-1 and 60 m at PF-2.
	Material used for Ramp	RCC slab with Chequered tiles	(Refer fig :1.6)
h	Ramp Railing		
	Type of Parapet Railing	Steel railing	Stair case is provided with Railing on both sides of one-meter height using Hollow Circular sections. (Refer fig :1.6)
	Height of Railing	1 m	

1.4 SURVEY OF SIGNS OF DISTRESS, DEFORMATION IN BRIDGES

a

✓ Slight corrosion is observed between two sacrificial plate joints



Corrosion observed at sacrificial plates

b

✓ Mild Corrosion is observed at Trestles (Double channel section) at PF-2



Corrosion observed in Double channel section

SIGNS OF DISTRESS, DEFORMATION IN BRIDGES			
	Defects	Location	Comments
	Cracking in Steel Members		No cracks are observed in Steel during visual inspection
	Cracking in RCC components		No cracks are observed in RCC components
	Spalling		No Spalling is observed in RCC members.
	Rust straining	Sacrificial plate	Corrosion is observed at bottom slab of FOB (Refer Part 1.4-a)
	Extent of Corrosion		No Corrosion is observed along the span of FOB
	Corrosion in Gusset plate		No Rusting is observed in Gusset plates
	Condition of Painting of steel structure		Painting is affected at corroded places.



Fig 1.1: Electrical Cables and Protective screening mesh for passengers



Fig 1.2: Roof Sheet and Roof truss



Fig 1.3: Trestles and their protection with concrete encasement



Fig 1.4: Top and bottom main chord members with vertical and diagonal bracings



Fig 1.5: Slab is supported with sacrificial plate

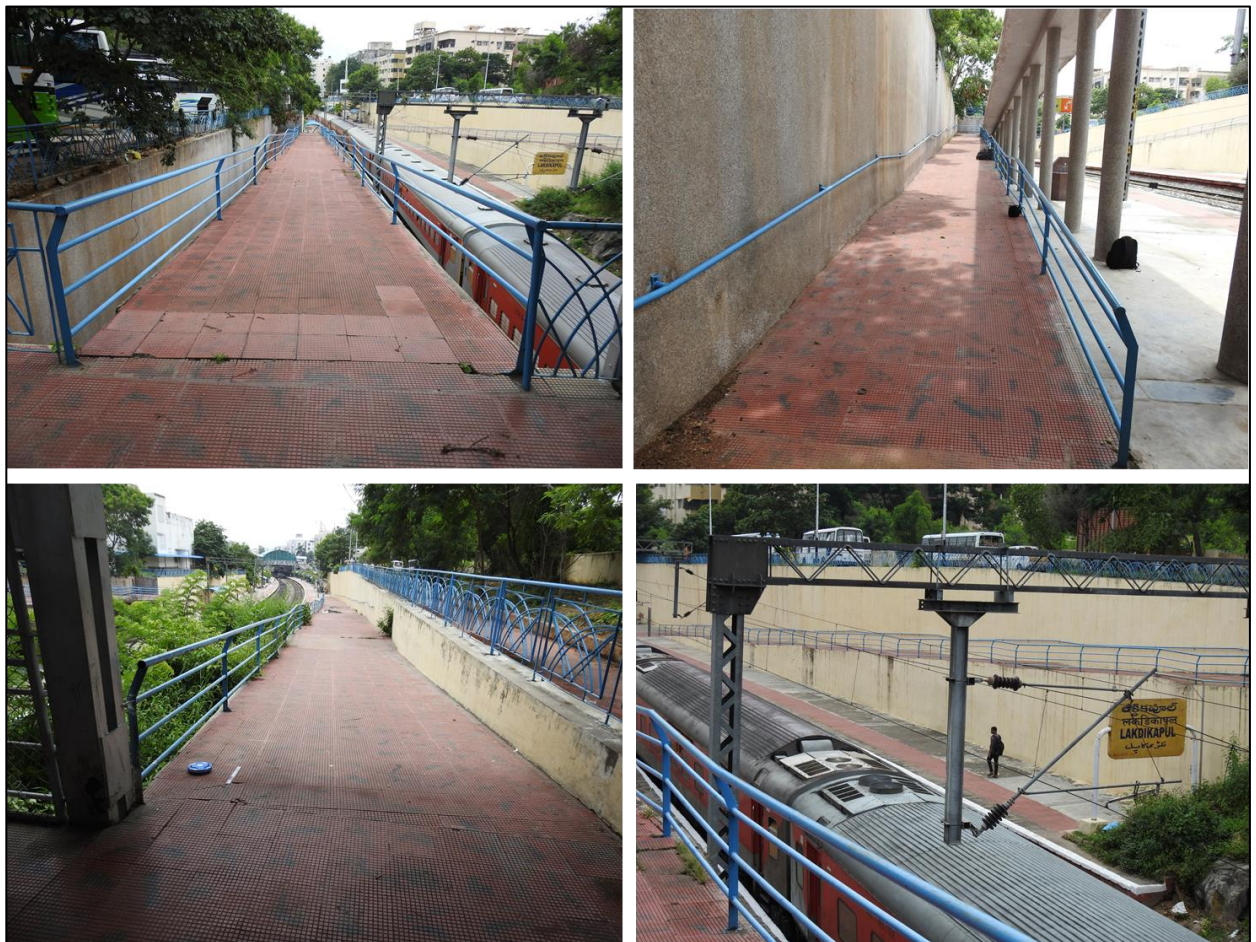
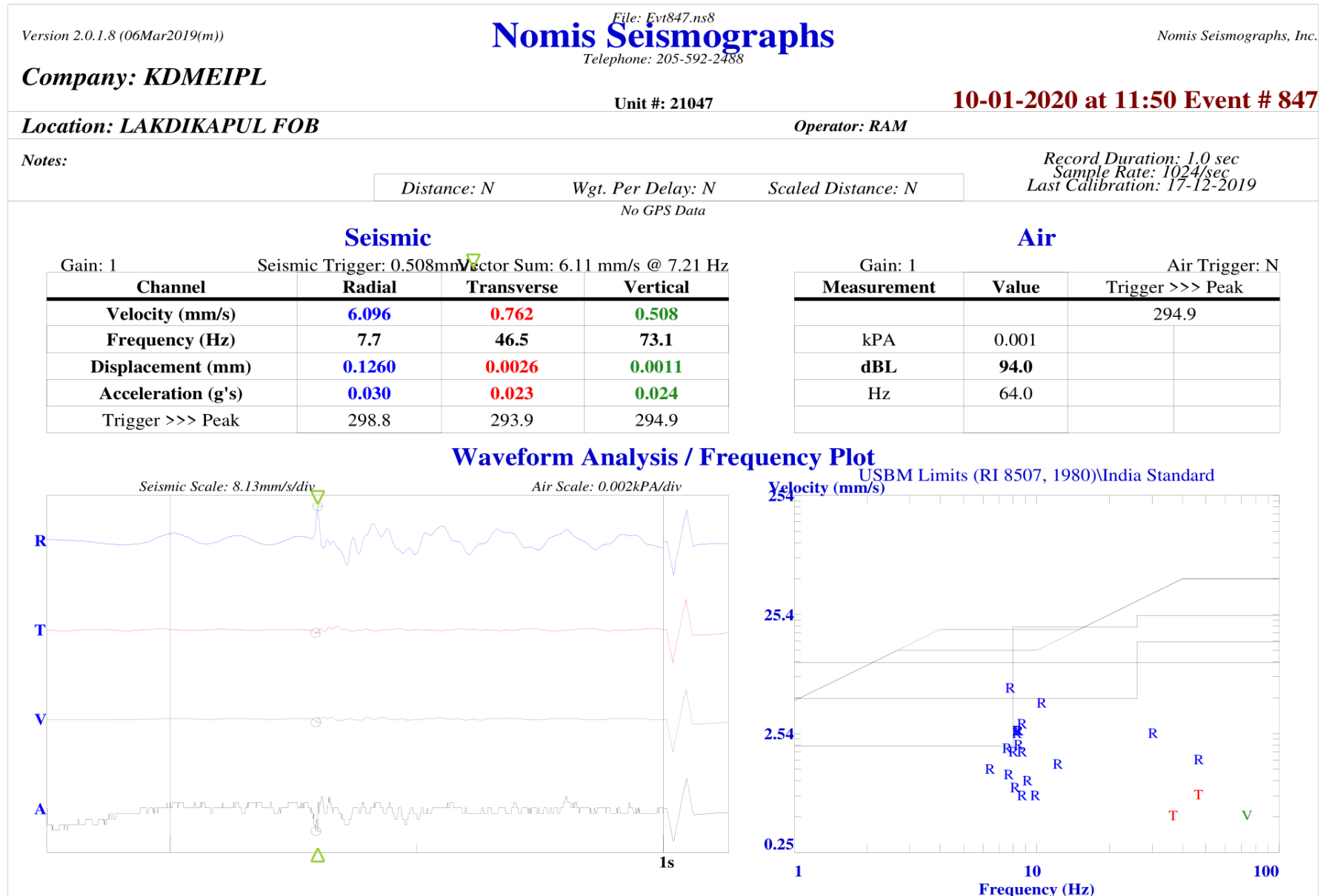


Fig 1.6: Ramp on PF-1 and PF-2

2. Vibration Analysis

2.1 Interpretation Vibration Analysis



Company: KDMEIPL**Unit #: 21047****10-01-2020 at 10:33 Event # 731****Location: LAKDIKAPUL FOB****Operator: RAM****Notes:**

Distance-Source: N

End Time: 13:25:25
 Sample Rate: 1024/sec
 Last Calibration: 17-12-2019

No GPS Data

Seismic

Gain: 1

Vector Sum: 6.11 mm/s

Channel	Radial	Transverse	Vertical
Velocity (mm/s)	6.096	0.762	1.397
Frequency (Hz)	6.9	21.8	2.0
Time	11:50:32	11:50:32	13:24:13
Displacement (mm)	0.1406	0.0056	0.1112
Acceleration (g's)	0.027	0.011	0.002

Air

Gain: 1

Measurement	Value		
kPA	0.019992		
dBL	120.0		
Hz	93.1		
Time	12:36:52		

BarGraph

Seismic Scale: 8.13mm/s/div

Air Scale: 0.03197kPA

Bar Samples total/shown: 171/171

Summary Interval (min): 15
 Bar Interval (sec) 60



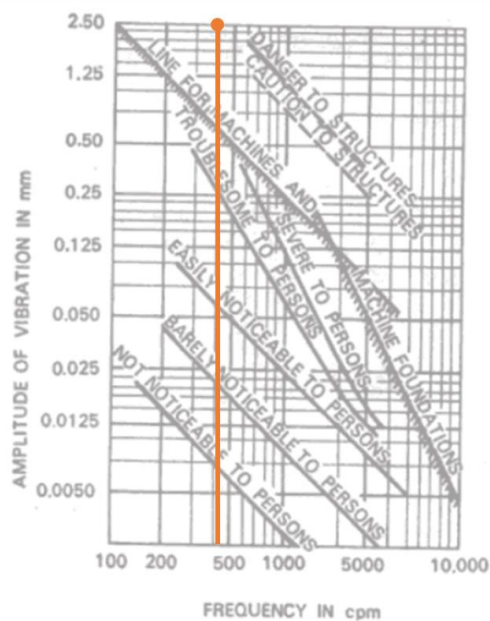
The permissible amplitudes of vibration are generally specified during analysis and design of the structure. Below fig. suggested by Richart may be adopted during design or operation of the structure. The values indicated below might have been due to sudden vehicle movement.

Lakdikapul Railway Station FOB

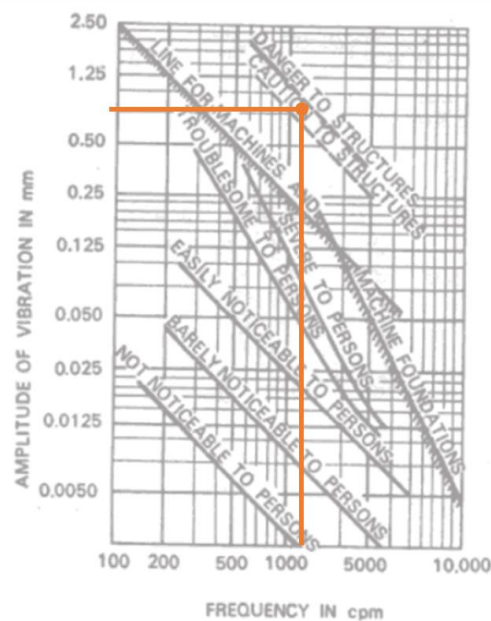
Vibrations Directions	
Radial Direction	- Along the Gangway (GW)
Transverse	- Perpendicular to Direction of GW
Vertical	- Along the Gravity

Table – Vibrations measured at site

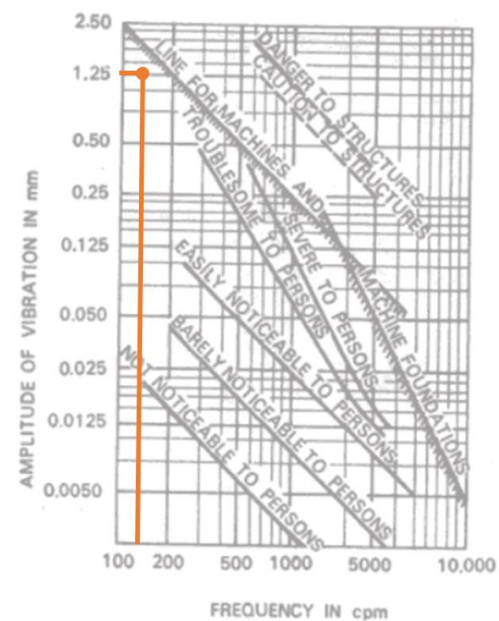
S. No	Direction	Amplitude (mm)	Frequency (Hz)	Frequency (cpm)
1	Radial	6.096	6.9	414
2	Transverse	0.762	21.8	1308
3	Vertical	1.3	2	120



(a) Radial Direction



(b) Transverse Direction



(c) Vertical Direction

3. Repair and Retrofitting Recommendations

3.1 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.

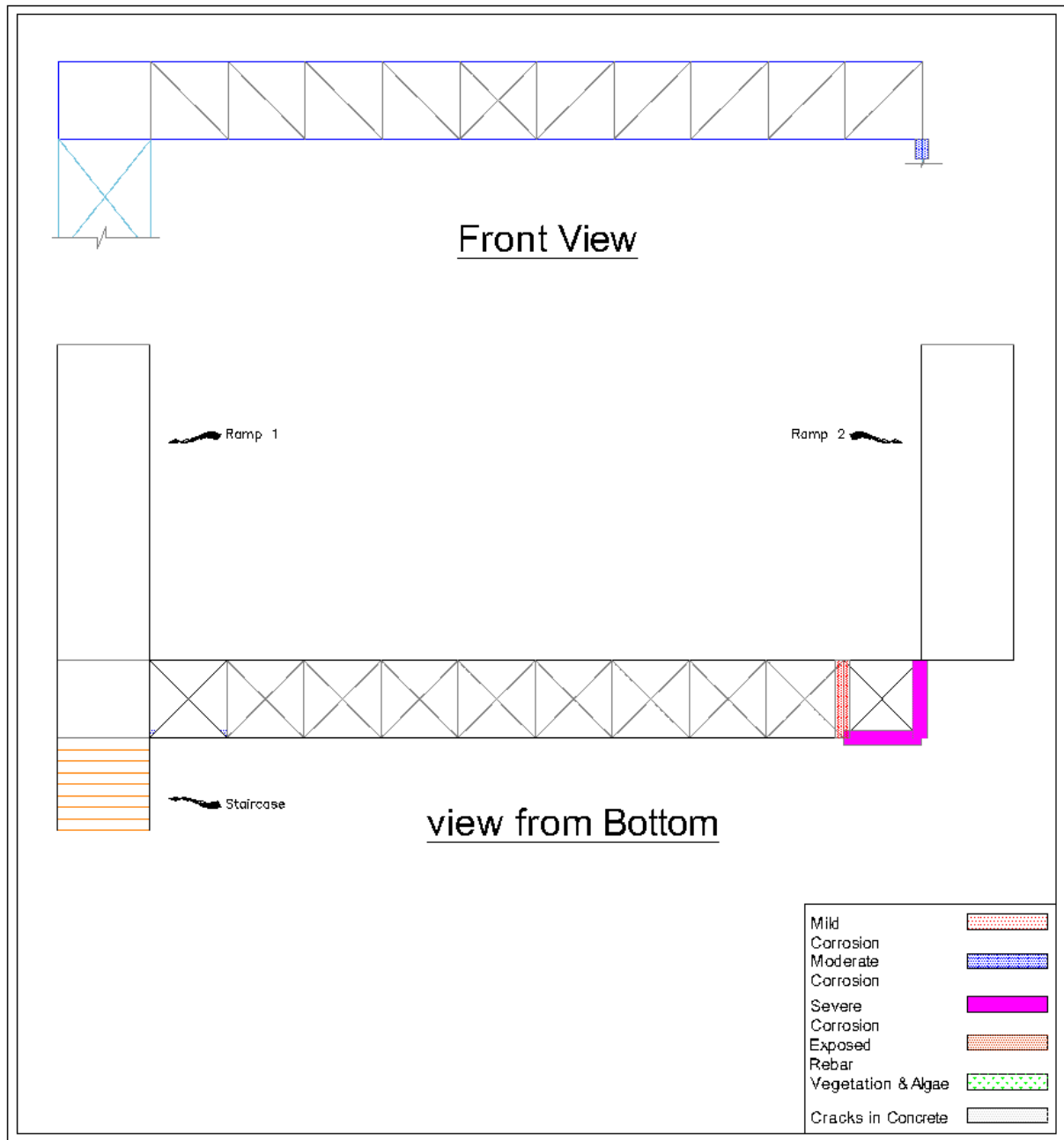


Fig 2.1: Location of corrosion and rusting of members of FOB

Span recommendations

- Structural members are in fair condition, displaying mild corrosion for top chord members, verticals, diagonals, and gusset plates, bottom chord members along steel concrete joint and on

the Sacrificial plate is also corroded in some locations. Severe corrosion at gusset plate near (Locations are marked in figures below).

- Severe corrosion is observed in bottom chord near ramp 2. Effective thickness is decreased due to corrosion. (Photographs of the same can be see in **fig 2.2-2.3**)

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		✓		



Fig 2.2: Corrosion of vertical member, gusset plate and at steel concrete joint



Fig 2.3: Corrosion of bottom chord and gusset plate

ANNEXURE

Annexure-1a: 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

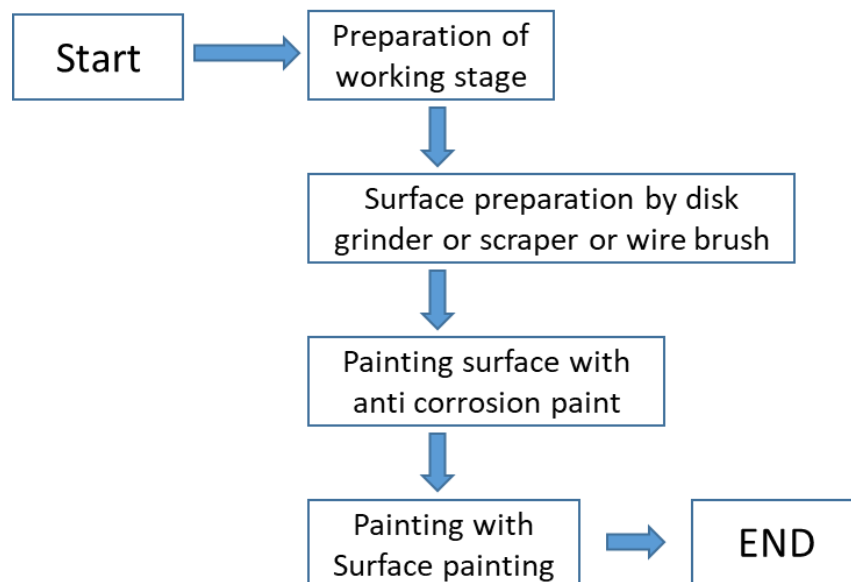


Figure: 1.2 Work sequence of Painting with anti-corrosion paint

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 Lakdikapul railway station fob has been conducted on 18th October 2019, following observations were made**
 - i. From visual inspection, slight rusting is observed at bottom of sacrificial plate.
 - ii. Mild Corrosion is observed at Trestles (Double channel section) at PF-2.
 - iii. Corrosion of gusset plate at bottom chord members.

- **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.
 - c) Replacement of gusset plate and bottom chord members or severely corroded members near ramp 2. (*See fig 2.3*)

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