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CONDITIONAL ASSESSMENT OF BRIDGES
CASE STUDY: KUND-MALA BRIDGE

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Abstract- *Bridges are exposed to several environmental conditions, which deteriorate the bridges and decreases the serviceability of bridges. This deterioration may lead to the failure of bridges. To avoid such failures, timely inspection and assessment is necessary of the bridges. For any inspection of the structure, the most basic step is the conditional assessment i.e. visual inspection of the structure. The visual inspection states whether to conduct further tests or to declare the structure as safe. This paper deals with the complete visual inspection of Kund-Mala Bridge and the aspects related to it. The focus of the paper is the visual inspection of concrete bridge and steel truss bridge. It includes the history of bridge, overall inspection and how the inspection is taken place. The results of the conditional assessment a.k.a. visual inspection is used for further testing of the structure.*

Keywords- *Conditional assessment, inspection, serviceability, concrete bridge, steel truss bridge*

1. INTRODUCTION

Bridges have become a very important infrastructure and a huge investment. In last 50-55 years, there has been a great development in the construction of bridges. Many types of bridges has been constructed across India in the past few years. Bridges serve as a crossing from a river or high intensity traffic area or any other type of obstacle. These bridges include high investment in its construction and therefore, it is vital for a bridge to be serviceable and durable for maximum period of life.

However, due to some unavoidable conditions there is drastic decrease in the life span of bridge. The bridge starts to fail in various factors, which reduces the serviceability of the bridge. These may be due to environmental changes or poor quality of materials used or some another factor involved. To study these factors involved and to assess the bridge visually is known as the visual inspection of bridge.

2. NEED OF VISUAL INSPECTION

Visual Inspection i.e. is required to know if further destructive and non-destructive tests are required for the bridge. It gives a clear idea whether the bridge will sustain the applied load or is on the verge of failure. It is also helpful in repair works and to know the probable causes of damages and reduction in the life span.

3. GENERAL PROCEDURE OF VISUAL INSPECTION OF BRIDGES

Before going to the site, the engineer must gather all the relevant information related to existing structure. He must have the complete specifications along with the drawings of the structure. He should study all the details of the drawing and specifications carefully before going to the location. Method of construction as well as the year of construction is also helpful in further study of the bridge.

The inspection must be carried out carefully covering all the defects present in the bridge, the use of the bridge in the past and now. The condition of adjacent structures as well as the environmental conditions must be studied in depth. All the defects that are seen must be identified with proper justification. The engineer should record the data in the book. For example, if an engineer suspects a crack in the pier, then he must identify if the crack is a structural crack or a non-structural crack along with the probable cause of it. In visual inspection, two similar members are also compared to have better idea of distresses and the probable cause.

The visual inspection is not limited to the surface but also includes the inspection of drainage channels, bearings, corrosion, covers of reinforcement, joints, parapet walls, etc. Any kind of misuse of the structure can be found by comparing it with the original drawings. While conducting he inspection, engineer also has to look for bleeding or segregation that shows the poor quality of material used. Honeycombing in the member would be a cause of low workmanship. Deterioration of

material is also caused by the surface cracking and spalling. During inspection, observation of texture of member and colour of member could be a useful guide to ensure uniformity of materials. The frequent wetting and drying of piers and the temperati7ure variations could have adverse effects on the life of the bridge. Settlement of the surrounding soil is also to be noted.

Following observation points are to be recorded-

- Identifying the visible damages such as cracks, scouring and corrosion, etc. and quality of construction.
- Preparing report of existing condition with photographic evidences at main spots.
- Checking the soil conditions and settlement of foundation.
- Comparing the original plan and elevation from drawings and in case if no drawing is available, and then preparing the drawings.
- Identification of non-structural but falling hazards including parapets, partition walls, fixtures, bolts and other elements.

4. CASE STUDY: KUND-MALA BRIDGE

4.1 Introduction to site

The Indrayani River cascading into rocky gorges forms the spectacular Kund-Mala falls. There is a small temple perched on one of the huge boulders overlooking the waterfall. There is a bridge built over the river. The name of the bridge falls after the Kund-Mala region. The bridge is a foot-over bridge as shown in fig.1. It is located near Bhegdewadi railway station, Talegaon, Maval. The bridge was constructed in 1997 for the convenience of people to cross the river.

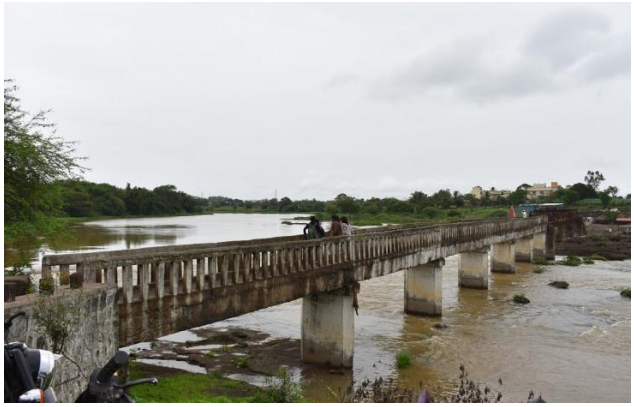

Fig.1 Kund-Mala Bridge near Talegaon over Indrayani River

4.2 General Information of Bridge

Sr. no.	Description	Details
1	Name of bridge.	Kund-mala bridge
2	Location	Near Bhegdewadi railway station, constructed over Indrayani river.
3	Mode of construction	It was constructed in two segments.
4	Year of construction	1997
5	Total years of Serviceability	21 years
6	Type of bridge	Foot over bridge
7 7.1	Classification- According to material: 1st segment 2nd segment	 Concrete Steel truss with Stone masonry
7.2	According to shape: 1st segment 2nd segment	 Slab bridge deck Pratt truss
8 8.1	Geometry- 1st segment: Components Total span Thickness of slab	 Wing walls, Footing, pear, slab, parapet wall 65 m (avg.) 0.45 m (avg.)
8.2	2nd segment: Components	 Approach, sleepers,

	Total span Thickness of slab layer Type of connections	struts 45 m (avg.) 0.24 m (avg.) Bolted, rivets and welds.
9	Type of rock Type of soil Direction of river Flow of river Density of vegetation	Asphalt Deep, Moderately Well drained, fine soil Perpendicular to the span 0.5m/sec Moderate

4.3 Observations Made During Visual Inspection-

a) Formation of cracks in slab and column in all direction. These were observed in concrete bridge. The cracks detected are both structural and non-structural type.

b) Growth of vegetation across wing wall and piers of concrete bridge has taken place. This has led to reduction in strength of piers.

c) Steel reinforcement from slab and parapet wall surfaces has been exposed. Adverse effects of moisture and temperature is taking place on the reinforcement.

d) Efflorescence effect has taken place due to moist conditions and uneven rainfall.

e) Due to flow of river base of piers has been eroded in concrete bridge.

f) Steel surface in truss segment has completely corroded due to environmental conditions and lack of painting and plastering.

g) Members of trusses have deformed and breakdown.

h) Connection of trusses having rivet and bolts has created rupture along gusset plates.

i) There is no safety provided across truss bridge, which results in severe accidents.

j) The parapet walls has been broken and damaged.

k) Loading conditions have changed over the bridge as movement of vehicular traffic (2-wheeler) has increased on it. This has led to increase in the vibrations of the bridge.

l) Scouring effect has taken place due to uneven flow of the river. This has exposed the foundation base completely.

4.4 Photographic Evidences

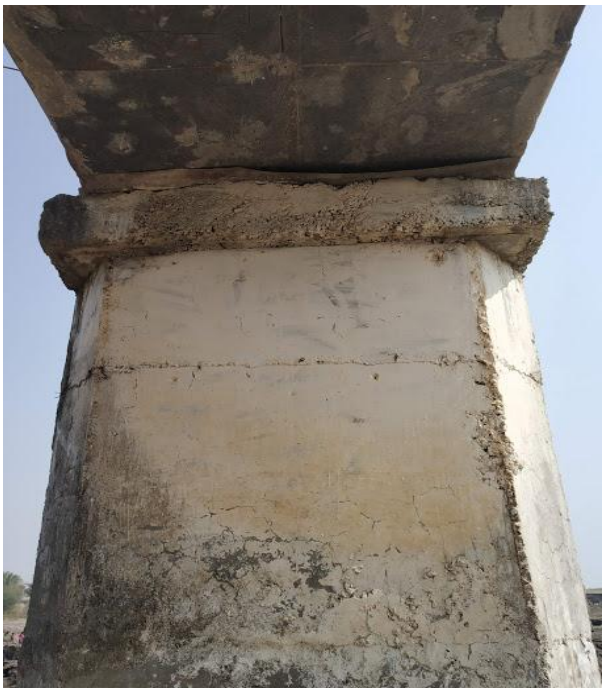

Fig.2 Development of structural crack perpendicular to the axis of pier

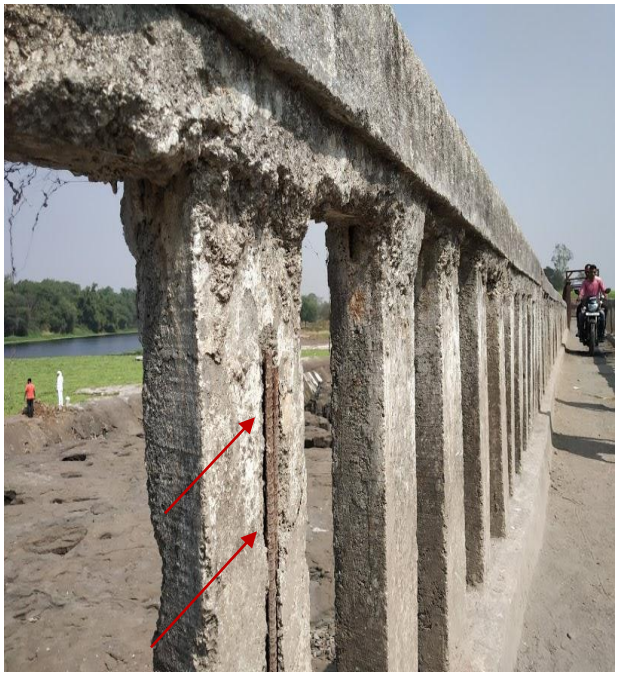

Fig.3 Reinforcement exposed in parapet wall causing decrease in strength in member

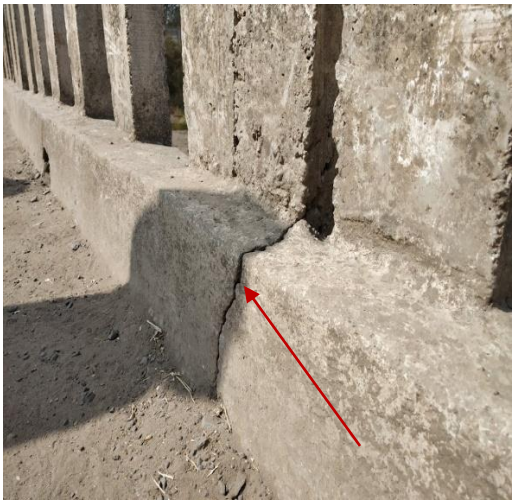

Fig.4 Non-structural crack developed in parapet wall

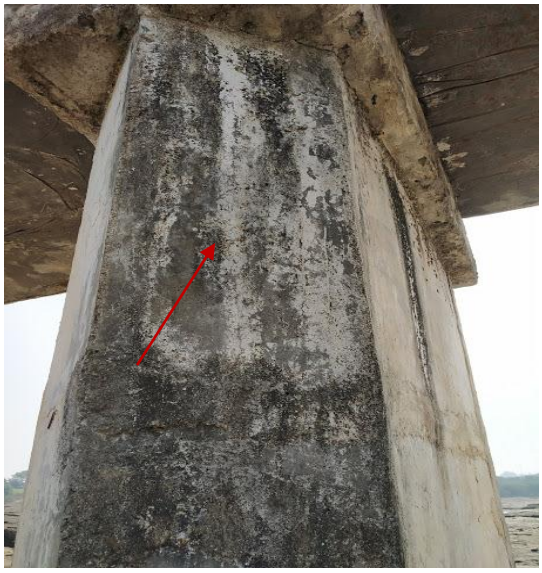

Fig.5 Efflorescence effect over the surface of pier

Fig.6 Growth of vegetation over surface of stone masonry pier

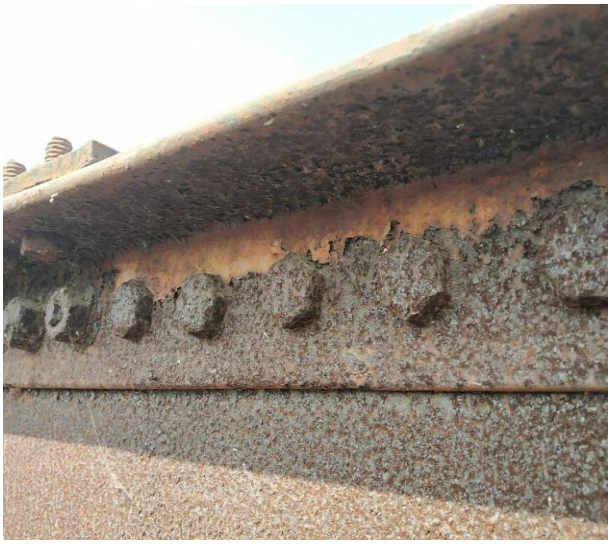

Fig.7 Rusting of the joints of steel truss bridge

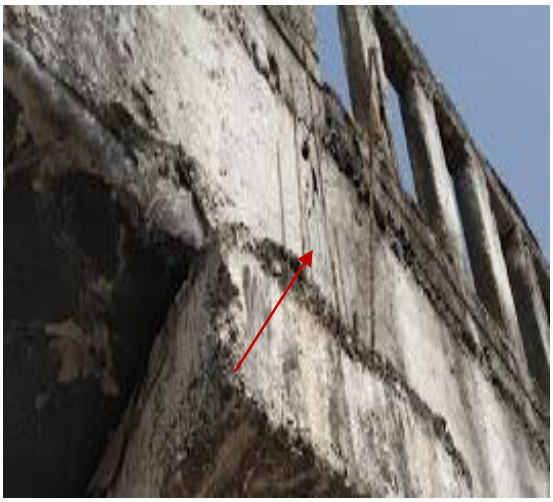

Fig.8 Exposed reinforcement covers of the slab member

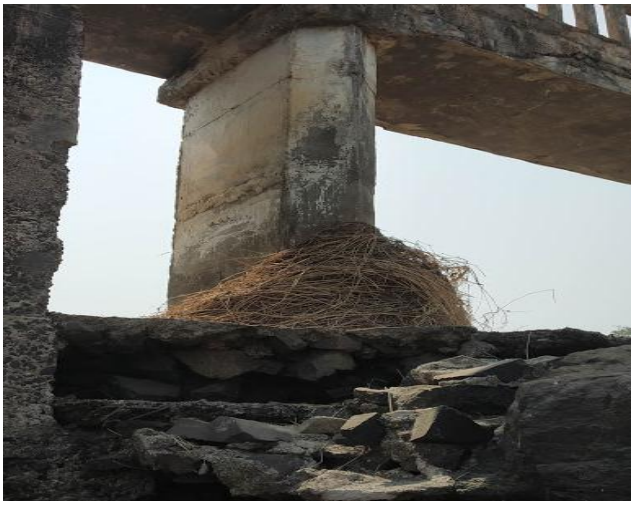

Fig.9 Scouring effect on foundation as well as growth of vegetation

5. LIMITATIONS OF STUDY

The papers deals with only the visual observations made by a civil engineer. It does not contains the results of the destructive and non-destructive tests. It is a very primitive and basic step in conducting the structural audit. The visual inspection is only a qualitative assessment, which provides only an initial information of the bridge helping in preparation of tests needed for inspection of bridge in detail. Visual inspection only provides data related to condition of structure so that we can suggest some temporary repairs based on the reports and photographic evidences.

6. CONCLUSION

Based on the information gathered from the conditional assessment a.k.a. visual inspection, we can say that the structure is not in a healthy condition. Too much damage has caused to the Kund-Mala Bridge due to temperature changes, flow of water, weather conditions and changes in loading conditions. Growth of vegetation has also effected the strength of the piers. The repair work of the bridge should start at the earliest to avoid further deterioration. The minor cracks should be filled with grouting technique. The old plaster must be removed and fresh plaster must be applied on piers. Also further tests should be conducted to check the strength, quality and durability of the bridge.

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