IMPACT: International Journal of Research in Engineering & Technology (IMPACT: IJRET)
ISSN (E): 2321-8843; ISSN (P): 2347-4599
Vol. 4, Issue 3, Mar. 2016, 35-42

THE CASE STUDY OF CONDITIONAL STATUS OF EXISTING MAJOR BRIDGE AND ITS REHABILITATION

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ABSTRACT

The topic entitled the 'case study of conditional status of existing Major Bridge and its Rehabilitation' about issues involved during processes of investigation of existing major bridge and its conditional status, and finalizing appropriate rehabilitation of techniques for its restoration. It also explains about the procedure adopted arriving its conidtional status of existing bridge and methodology adopted for rehabilitating existing Major Bridge. This topic primarily gives attention towards existig conditional status of existing Major Bridge, the reasons for distreess and appropirate measures required towards its restoration

KEYWORDS: Conditional Status, Bridge Strengthening, Repair & Rehabilitation

INTRODUCTION

Rapid deterioration of exiting bridge structures in the recent years which has become a serious technical and economical problem in many countries, including highly developed ones. Therefore, bridge rehabilitation is one of the most important tasks in civil engineering. Bridge rehabilitation process should be preceded by assessment and evaluation of the structure to determine its actual technical condition and to select the proper rehabilitation techniques and materials. The reasons leading to deterioration of the existing bridge are more or less same in every country.

- Increase in traffic flows and weight of vehicles, especially their axle loads, compared to the period when the bridges have been designed and constructed.
- Harmful influence of environmental pollution, especially atmospheric ones, on the performance of structural materials
- Low quality structural material as well as bridge equipment elements, such as expansion joint, waterproofing etc
- Regular Bridge maintenance being unattended which leads deterioration

SCOPE OF WORK

The focus of this present work is to study the conditional status of existing Major Bridge and recommending appropriate restoration measurese, and study of rehabiliation techniqures adopted for its restoration. The project contains one case study, which is as follows.

(A) Strengthening of existing Maneru Bridge at Karimnagar town, Telangana.

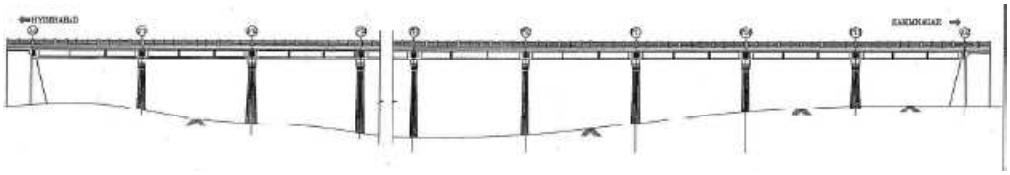


Figure 1: Elevation of Manair Existing Major Bridge

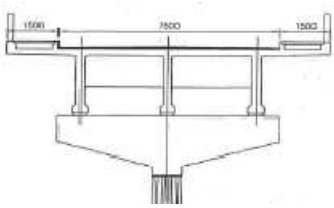


Figure 2: Cross Section

BACKGROUND

The representative bridge which was part of HKR (Hyderbad Karimnagar Ramagundam) project was done by Prasad & company Ltd on behalf of Gayathri Project Ltd, Hyderabad.The author represented for the project on behalf of Louis Berger Group USA as Independent Engineer during execution.

The existing Bridge across river Manair at Karimnagar, Telengana is an RCC T beam slab bridge, constructed about 22 years back near about 1994. The Major Bridge consists of 16 spans, each span approximately 20Mts. The sub structure comprises Piers on open foundation with cantilever Pier caps.The super structure is a typical beam slab deck with 3 beams as per MOST drawings. The general arrnagemnet of the bridge is shown as below The arch bridge with stone masonery is existing adjacent to this bridge and the age of this bridge is reported to be an 80 years with the width of 4Mts approximately.

In the month of June, 2012 the concerned authorities including author observed severe vibrations in the bridge and at the same time distress in bearing regions of pier P11 and Pier P14.The following phsyical conditions were observed from the inventory:

- Except in span 7 and span 8 every span was observed to be having distress features in the bearing pads either on one side or both sides
- In all the spans patch wok and spalling of cover concrete & exposure of reinforcement was observed in the bearing locations
- Severe perceivable vibrations were observed in the superstructure, more so in the span over Pier P11 and Pier P14
- On pier P11 & Pier P14 difference in top levels of railings was observed
- On PierP14 & Pier P11 crushing of bearing region concrete and crushing of bearing pads were observed
- When observed from the old arch bridge at some locations on the other piers similar crushing of concrete in bearing regions was observed to different degree.
- No distress features were observed in the substructue

- All expansion joints in the deck portion were observed to be clogged and were in distressed condtion
- The existing bearing pad size 265x265x99 was observed to be different from the dimensions of bearing pad recommended in MOST drawingI.e500x360x99

INVESTIGATION TESTS OF DISTRESS

In view of the honeycombs and segregation of concrete observed in main girders at bearing regions and diaphram beams (cross girders), Ultra pulse velocity test was conducted to asses the quality of in-situ concrete and also to assess the extent of distress in them.Ultra pulse velocity test is being extensively used to asses the quality of concrete in general. This test is generally used to check uniformity of concrete, determination of cracks in the inferior concrete, honeycombing and asessment of concrete deterioration.the ultra sonic pulse velocity test was conducted on accessible locations of mian girders at bearing regions and diaphrams (cross girder) beams. Direct method of scanning ws adopted at site.

INFERENCE FROM THE INVESTIGATION TEST

- From the ultra pulse velocity test the quality of concrete in tested locations of the longitudinal girder at bearing on Pier P14, Pier P11, and Pier P5 was observed to be poor at the soffit region and improvement of quality was observed in upper regions.
- From the UPV test on diaphram beams(cross girders) on piers P5, P11 & P14 it is inferred that the quality of concrete was observed to be poor at the bottom regions of the beams and require necessary restoration measures before lifting the structure
- Bearing pads were observed to be in distressed condition at many locations
- All the expansion joints were clogged and to be removed & replaced with new

Figure 3: Level Difference Observed in Hand Rail at Pier P-11 & Pier P14

Figure 4: Reinforcement Bars Exposed At the Bearing Region of Main Girder

RECOMMENDED REHABILITATION MEASURES

The following are the recommended rehabilitaion measures made based on the physical observations and inferences drawn

- In view of the poor quality of concrete and low pulse velocities observed in diaphram beams(cross girder) at bearing regions it was recommended to grout the bottom region of the beam with micro fine cement
- In view of the crushed, segregated and poor quality of concrete observed in longitudinal girders at bearing regions, it was recommended to remove this concrete portion and replace with free flow micro concrete by lifting the super structure using hydraulic jack system
- In view of the crushed & deformed bearing pads observed, it was recommened to remove thease bearing pads and replace with new ones
- The bulged concrete portion in wearing coat at the expansion joint region shall be removed upto a minimum of 500mm on the both sides of joints and filled with micro concrete. New compression seal joint shall be fixed in the expansion joint region as per standard practice.

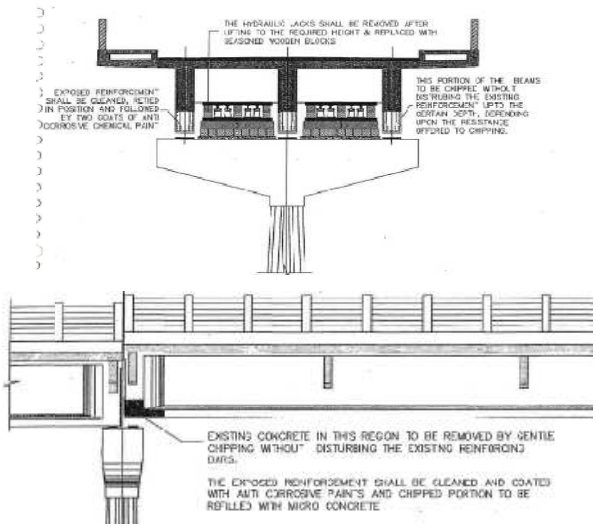
REPAIR METHODOLOGY

- The pressure grouting shall be done to diaphrams beams(cross girders) and main girders for strengthening
- Hydraulic jacks & mechanical jacks shall be placed below the end of diaphram beams as explained sketch for lifting of main girders
- The hydraulic jacks shal be connected to a single power pack to facilitate uniform lifting
- The span shall be lifted with hydraulic jack system with single power pack upon the required height and supported on mechanical jacks and wooden sleepers
- The existing loose concrete in the bearing region of main girder shall be removed using concrete chippers
- Exposed reinforcing bars shall be cleaned thoroughly to remove the rust and scales if any
- Two coats of anti-corrosive chemical paint shall be applied to exposed reinforcing bars
- Free flow micro concrete(pre packed) shall be filled in this region by using slurry tight shuttering as detailed in sketch and cured as per standard practice
- The existing bearing pads shall be removed and surface to be roughened, cleaned and liquid epoxy shall be poured to achieve required levelled surface if required
- The new bearing pad as per MOST dimensions & specificaitons shall be placed in position followed by applying coat of free flow grout on top surface of bearing pad
- The main girder lowered on new bearing pad with support of jacks
- The repacement of expansion joint shall be taken up as shown in sketch.

Figure 5: Cross Girder Lifting in Progress

Figure 6: Micro Concreting at the Bearing Region of Main Girder

Figure 7: Bridge Inspection under Progress



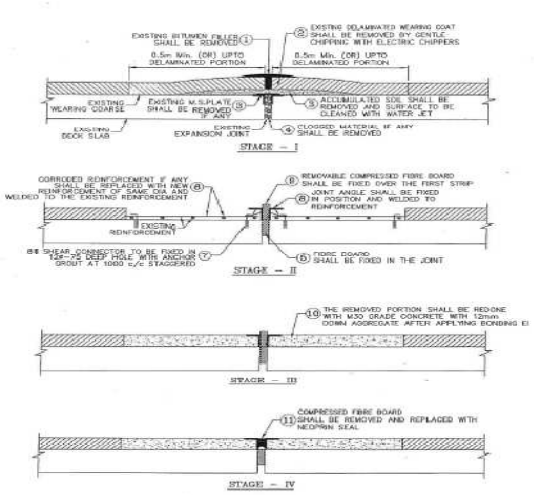


Figure 8: Replacement of Expansion Joint

SPECIFICATIONS FOR FREE FLOW MICRO CONCRETE

- Type of grout: chloride free, ready to use non-shrink, expensive cementitious group with inert particles of maximum size 1.8mm pregraded fillers (free flow grout)
- Required compressive strength: Not less than 45N/mm2@168 hours
- Setting time: not less than 20Mintues
- Shuttering stripping time: 48 hours minimum

SPECIFICATIONS FOR PRESSURE GROUTING

- Type of grout: flowable grout made out of micro fine cement with plasticizer & non shrink admixture which can penetrate into micro cavities
- Initial setting time: 60 to 120 mintues final setting time 120 to 150 minutes
- Strength: 1 day not less than 30Mpa 28 days – not less than 45 Mpa
- Grouting pressure: 3 to 4.5 Kg/sqcm injection time wihtin 30 mintues after mixing

CONCLUSIONS

- The honey combing that found at the bearing regions of Main girders is because of dense reinforcement and uncompacted concrete
- The bearing pads bulged and failed because of using substandard bearing sizes
- Expansion joints are clogged and not functioning because of not attending maintenance at regular interval.
- The existingh Manair Bridge distressed because of non attenance of maintenance at regular interval.
- The existing bridge should have to inspect its conditional status at regular interval as per Bridge maintenance manual to check it’s functioning but that not happened in this case.

- The repairs such as micro concreting at affected regions of main girders and pressure grouting for cross girders & main girders carried out for all requisite spans.
- Bearing pads replaced with new ones.
- Expansion jonts replaced with new compression seal joint.
- The above mentioned exisitng Manair Major Bridge at Karimnagar town, Telangana is brought back to normalcy after carrying out all the repairs.

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