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REHABILITATION OF RC BRIDGE DECK BY USING PRESTRESSED CONCRETE BRIDGE

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Abstract

Deck replacement in prestressed girder bridges requires special attention because the deck forms an integral part of the load-resisting mechanism. Prestressed concrete bridge analysis is completely dependent on the standards and design criteria. Herein the study to check whether it is possible to replace the damaged deck of prestressed concrete girder bridges that maintain the superstructure span without the need of falsework. It is important to know the practical options for lane closure and traffic rerouting were incorporated into the replacement strategies, and these options included temporal longitudinal and transverse replacements. For that case study, an existing Indian bridge is considered. An analysis was carried out using STAAD.Pro V8i to find the mechanical properties similar to that existing girder and loading parameters of the bridge using IS codes.

Keywords: RCC, Prestressed, IRC loading class, IRC code.

1. Introduction

The importance of the bridge increasing day by day because of reduction in the transportation cost and time due to its direct relationship with other places. Bridge is a structure which is constructed to provide a passing over a gap which may be in the form of valley or river.

Component of the bridge are deck, abutment, bridge seat, beams and girder, barrier rail, slope protection, approach slab, roadway, wingwall, piles, columns, pile footing, cap, etc. Each and every component of the bridge are equally important. If from those one of the components got damage it's important to rehabilitate that on time.

The Bridge decks are among the basic components of the bridge that forms its surface. The bridge deck may either be cast-in-situ, precast, steel, wood, concrete, or other pavement systems which are supported on concrete or steel girders or beams (composite bridges). The bridge decks are most often defining the characteristics of the bridge. In a suspension bridge, the deck is suspended from the main structural element.

Rehabilitation is the process of achieving the original state of structure when it undergoes any sort of defects or deterioration or destruction. Restoration of structure is an ultimate aim of rehabilitation where it plays a major role by maximizing the functional utility of the structure.

Figure 1.1. Bridge

Rehabilitation is done with help of prestressed deck slab.

2. Literature Review

The possible replacement of damaged deck bridge without the use of false work to support the superstructure has been discussed in brief. Deck replacement requires special attention because the deck forms an integral part of the load-resisting mechanism and large precompression has been locked in by the posttensioning in the superstructure.

Sulav Sigdel. [1] In this study they compare only three codes IRC, AASTHO, Chinese, and compare it with each other to find which ever gives the better values among the three codes. The codes adopted from different countries may indicates variation of structural parameters for the bridge design. The bridges structural design is consisting of understanding structural members behavior subjected to forces and loads and designing them with economy and elegance to give safe, serviceable and durable bridge structure. For this study, modal the bridge in software CSI bridge. Modelling approach is adopted and IRC loading standard for bridge, AASTHO specification for bridge, Chinese loading are contemplated. From the conclusion it is depicts that the IRC loading class A approach provides the right balance between safety and severability for the design. Junming

Shubham S Hande [2] These research paper compares of two different standards that is IRC and AASTHO standards for analysis of box girder bridge. Which differs with each other in loading conditions of vehicles and many other factors. The equivalent study has been carried out by doing analysis with the help of MIDAS CIVIL software. The result of the primary structural analysis parameters was compared under loading conditions of two different i.e., IRC and AASTHO standards.

Shubham Sirse, Dr. Kuldeep R. Dabhekar, Dr. Isha P. Khedikar, M. B. Saiwala [4] In this study compare the results of performance analysis using the codes for two types of bridges i.e., T-beam and box girder bridge. Various researchers' studies are available on the design and analysis of T beam bridge and box girder bridge using IRC:112-2011 and IRC:21-2000. The purpose of this study is to determine the most economical and preferable design code for both T-beam bridges and box girder bridges.

Rajendra Soni, Komal Bedi [5] The study deals with the stress analysis of deck slabs used with integral abutment bridges due to truck loads. The considered superstructures consist of a concrete slab on several composite steel beams. The loading is composed of two side-by-side HS20 trucks, in accordance with the AASHTO's Load Factor Design provisions.

Phani Kumar and Adithya [9] has conducted analysis of box girder bridge and designed the sections as per IRC 112 specifications. The method of analysis of PSC box girder bridge was explained for a span of 30m and carriageway width of 7.5m using SAP 2000.various span to depth ratios were adopted and results showed that deflections, stresses are in safe permissible limits. Also, it was concluded that, when the depth of girder decreases, the number of prestressing strands and prestressing force was decreased. Since the prestressing force is decreased, more strength of concrete is utilized and governing the serviceability criteria.

3. Modelling

In this research paper, replacement of damaged bridge deck is done with the help of Indian specifications (IRC code). A damaged RCC bridge deck of 200m long with eight no. of span, four lane has been taken for the rehabilitation.

Figure 3.1. damage bridge deck

4. Damaged bridge deck replacement options

There are three possible options for the implementation of the longitudinal replacement sequence of Bridge. The options are as follows,

In Option 1- Deck 1 signified that the deck on the right lane was removed and replaced in both spans. The replacement was followed by Deck 2 that involved the removal and replacement of the deck on both spans. Upon completion of the operation for Deck 2, Joint 1, simulating the connection of the new and newer decks, was executed to complete the deck replacement of Option 1. This option may be viewed as an all-span replacement strategy, which would have the advantage of speed as well as lesser traffic disruption.

In Option 2- Involved a span-by-span replacement strategy, where the deck was removed and reconstructed in one span each time. With a smaller portion of the deck being replaced and rebuilt each time, changes to the state of the bridge were expected to be less severe in this option than option 1. On the other hand, the time for completion was expected to be longer because a larger number of construction stages were involved.

In Option 3- were refinements of the longitudinal replacement sequence and could be viewed as the half-span replacement strategy. In either option, only half of Span 1 or 2 was replaced at each stage in the longitudinal direction. The two options, which assumed that the replacement sequence could proceed from either or both abutments, were intended to determine whether a more balanced strategy would minimize the span deflection and whether a smaller extent of deck removal would avoid the significant stress build-up in the slab during replacement.

5. Geometry Specifications

In this research, the 8 No. of span with span length 25m. The reinforced and prestressed deck bridge were developed using STAAD.Pro V8i software.

Table 5.1. Details of Specimens

Specimens	Length (m)	Width (m)	Thickness (m)	Diameter of pier (m)	No. of span
RCC 200	200	16	0.15	1.4	08
Prestressed 200	200	16	0.15	1.4	08

5.1. Model Overview

5.1.1 Part and Element of the Model

This section geometry of the bridge used in this study as shown in the detailed in figure 5.1.1 and figure 5.1.2. It consists of carriage way of 13m and remaining consist of footpath, etc.

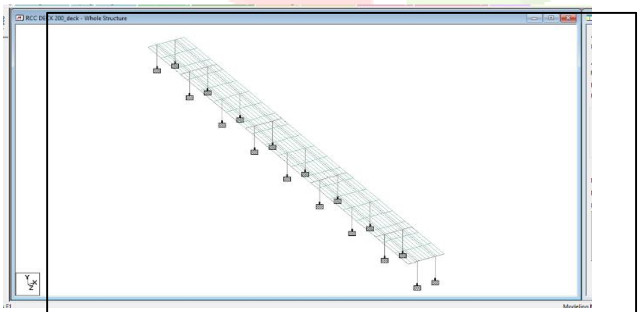

Fig.5.1.1. Model whole structure.

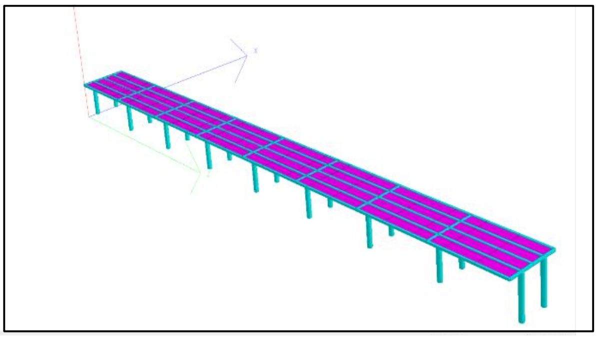

Fig.5.1.2. Model 3D model

5.1.2. Loading

The loading was taken from the IRC chapter 3 with the help of this code the different types of loading conditions IRC class AA, IRC class 70R, etc. was applied and compare.

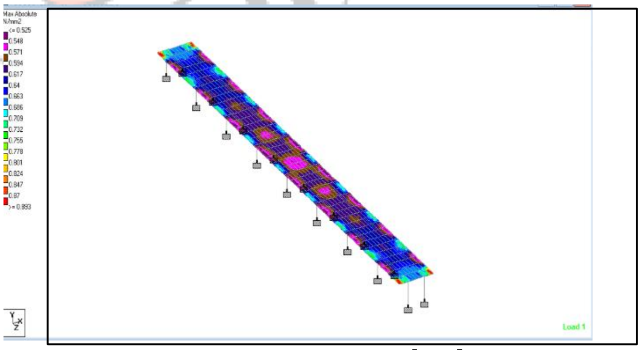

Fig.5.1.3. Maximum absolute

Table 5.2 Loading class

class	features
IRC class AA loading	It consists of either a tracked vehicle 700kN or a wheeled vehicle of 400kN.
IRC class 70R loading	It consists of either a tracked vehicle 700kN or a wheeled vehicle of 1000kN.
IRC class A loading	It consists of a wheel load train composed of a driving vehicle and trailers of specified axle spacing and culverts.
IRC class B loading	It is adopted for only temporary loading.

6. Result

Model and analysis were performed in STAAD.Pro V8i software.

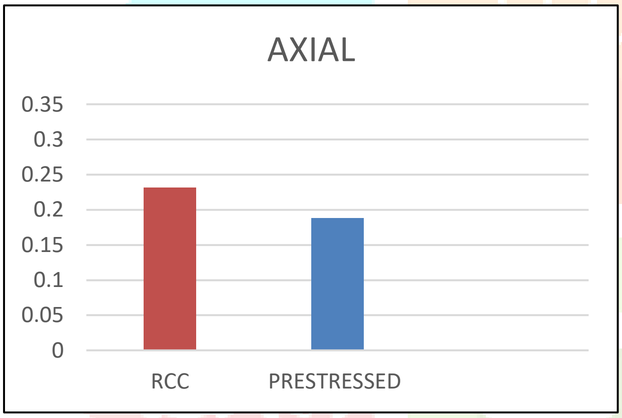

Fig.6.1. Axial of Class AA loading (kN)

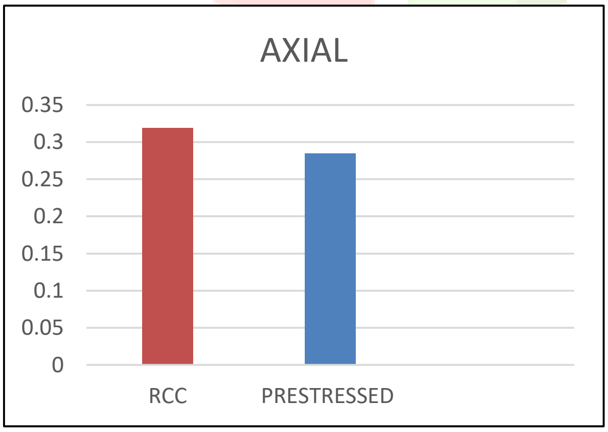

Fig.6.2 Axial of Class 70R loading (kN)

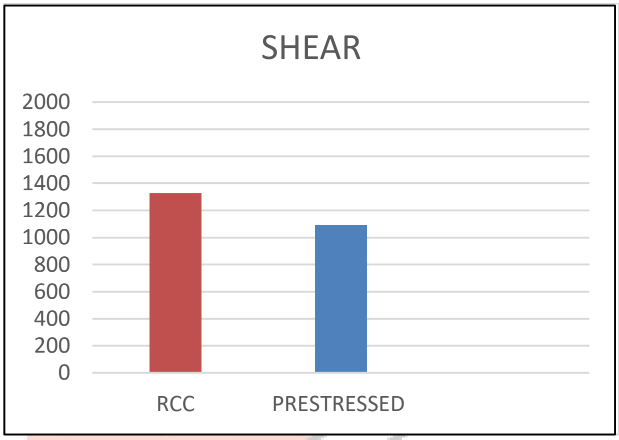

Fig.6.3. Shear of Class AA loading (kN)

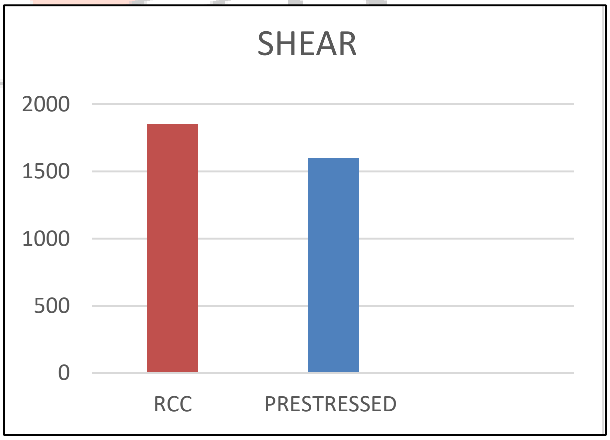

Fig.6.4. Shear of Class 70R loading (kN)

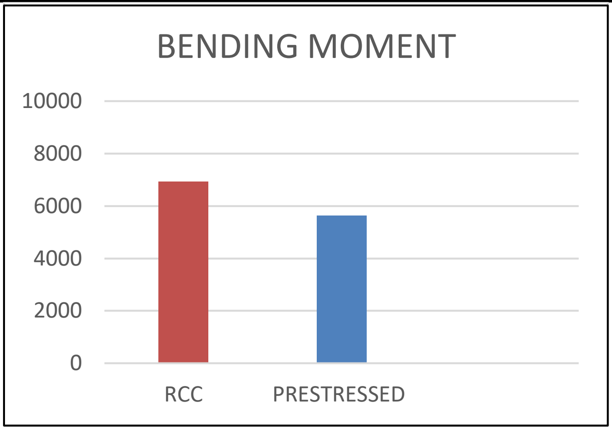

Fig.6.5. Bending Moment of Class AA loading (kNm)

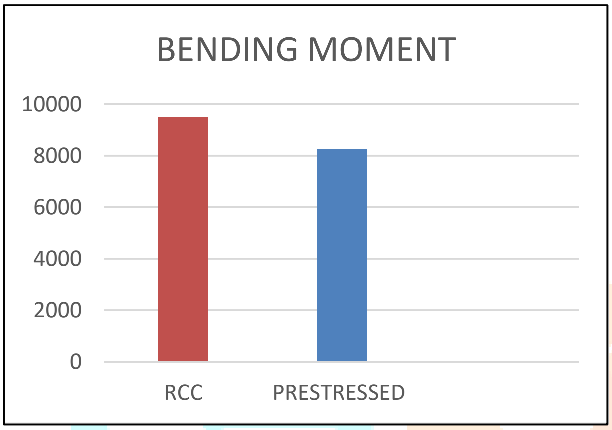

Fig.6.6. Bending Moment of Class 70R loading (kNm)

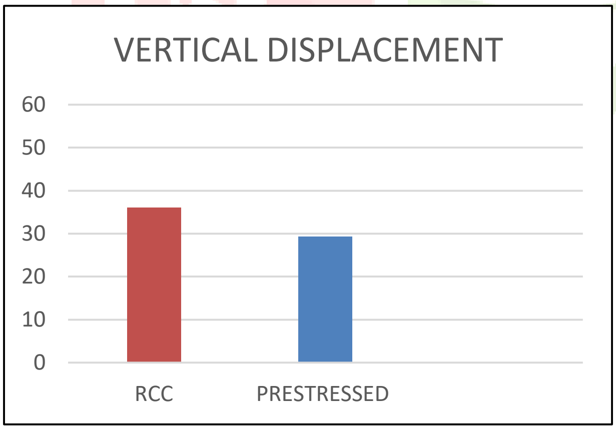

Fig.6.7. Vertical Displacement of Class AA loading (mm)

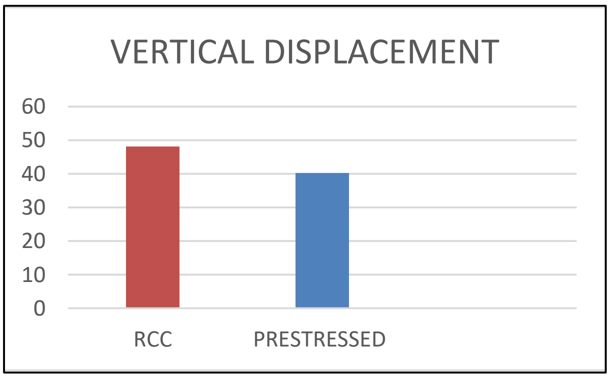

Fig.6.8. Vertical Displacement of Class 70R loading (mm)

From the above data it can be seen that class 70R provides maximum values of bending moment, axial, shear, and vertical displacement. This is due to the loading of class

7. Conclusion

Different arrangement of RCC damaged deck slab with prestressed deck slab was taken like span-by-span, half span replacement, all span replacement, different loading conditions.

a) The all-span replacement strategy which would have the advantage of speed as well as lesser traffic distribution.
b) Having analysis for RCC and prestressed is same for different loading conditions.
c) When comparing the RCC with all loading conditions like class AA, class 70R+A, etc. has more deflection which is disadvantages.
d) And the prestressed deck has less deflection when compared to all type of loading conditions.

From the above discussions, it is concluded that all span replacement and prestressed deck slab is good with all loading conditions when compared to RCC.

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