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Volume 06, Issue 12, Pages: 39–42.

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COMPARATIVE STUDY OF COMPARATIVE STUDY OF PRECAST I PRECAST I PRECAST I-GIRDER BRIDGE BY GIRDER BRIDGE BY GIRDER BRIDGE BY USING THE IRC THE IRC AND AASHTO CODES

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ABSTRACT The main objective of paper is the comparison for axial force, shear force, torsion, longitudinal stress and bending moment at various positions in I-Girder section. We considered the three span bridge model with lane width is 14.8m. Each span length is having 40m and total length of the bridge is 120m. The live loads assigned for the bridge model is class AA and class A from IRC code and HL -93K and HL-93M from AASHTO code. The Codes considered for bridge design like Indian code (IRC-2000) and American code (AASHTO LRFD-2007). The design of the bridge and structural analysis is done by using the computer software CSi Bridge v17.0. The obtained results shows the maximum difference in longitudinal stress for IRC is 7.6% more than the AASHTO results. The torsion moments are minimum difference for both codes. The max bending moment for IRC value is 2.2% high compare to AASHTO. The IRC results are obtained max in all forces and AASHTO results are less. Hence the pre-cast I-Girder bridge is more stable in IRC code when compared with AASHTO code values.

Keywords: IRC-21, IRC-06, AASHTO LFRD-2007, axial force, torsion, shear force, influence line, bending moment, CSi Bridge v17.0

1. INTRODUCTION The suitability of a particular type of bridge depends on different aspects, including topography, geotechnical conditions, height, clearance, and method of construction. Girder bridges that are built non-segmentally should have constant depth over their entire length to reduce false work and formwork costs. This type of bridge is economical for spans of up to roughly 80m in length. An efficient use of materials and a simple layout of pre stressing steel result from choosing span lengths to minimize the difference between the moment diagrams of any two adjacent spans. Girder depth is determined by economic and aesthetic considerations and may also be influence by clearance requirements. The principal advantage of precast components is ease of erection. Their use can substantially Reduce construction time and elimination of false work often result in low construction cost. The design of various components of bridges is now done in most countries almost invariably with the use of computers. Designers are going in for longer and longer spans and adopt different forms and geometry in alignment. Designs have to be competitive and during conceptual and design stage, this calls for an iterative approach to arrive at the optimal span, type and structural arrangements. Design by hand calculations for such cases is very difficult and time consuming, if not impossible, naturally, this calls for use of computers and custom made programs. Here we considered the CSi Bridge software for analysis of pre-cast I-Girder bridge.

2. COMPONENTS OF R.C.C BRIDGE

A girder bridge, in general, is a bridge that utilizes girders as the means of supporting the deck Bridges having mainly three components, i.e Super structure, Sub structure and Foundation

2.1 Super Structure Components: The superstructure is everything from the bearing pads, up - it is what supports the loads and is the most visible part of the bridge. Girders are main load carrying components.

• Steel or concrete girders

• Segmental boxes

• Suspension or cable stayed

• Trusses -Deck -Wearing surface-bituminous or concrete

2.2 Substructure: The Substructure is the foundation, which transfers the loads from the superstructure to the ground. Both parts must work together to create a strong, long-lasting bridge.

• Piers

• Abutments In a beam or girder bridge, the beams themselves are the primary support for the deck, and are responsible for transferring the load down to the foundation. Material type, shape, and weight all affect how much weight a beam can hold. Due to the properties of inertia, the height of a girder is the most significant factor to affect its load capacity. Longer spans, more traffic, or wider spacing of the beams will all directly result in a deeper beam.

3. LOADING STANDARDS IN BRIDGE DESIGN:

Loading standards for design of bridges are specified by various countries through either their standardization organization or recognized professional bodies. They may vary considerably country to country, depending on the type of vehicles in use or proposed for use in their country. The wide variation in Highway Bridge loading adopted by different countries, as they were some time back in different countries in the world. The concept of design has also undergone changes. Earlier practice was to use working stress or allowable stress concept for design of bridge structures. Most countries now follow limit state design concept in design of bridge structures also. The load factors assumed may vary from standard to standard.

4. LOADING ON I-GIRDER BRIDGE:

Any bridge structure has to support moving loads, i.e. laden vehicles, and transmit their effects, through its various components, to the soil on which it is constructed. It has also to support and convey in a similar manner the self-weight of its various components. In addition, the structure is subjected to other external forces, such as those caused by the wind, velocity of water and earthquake, to which the area may be subjected to and stresses caused due to temperature variation. **4.1 DEAD LOAD:** It consists of the portion of the weight of superstructure and fixed loads coming thereon, wholly or partly supported by the member or girder considered and self- weight. 4.2 Live load: Live load covers a range of forces produced by vehicles moving on the bridge. It includes the static and dynamic components. The effect of live load depends on many parameters including the span length, truck weight, axle loads, position of the vehicle on the bridge, girder spacing, and stiffness of structural members. In this case we considered two codes of vehicles loads in bridge analysis. According to IRC – Class AA and Class A According to AASHTO – HL-93K and HL-93M 4.3 Wind load: WS – horizontal and vertical pressure on superstructure or substructure due to wind. WL – horizontal pressure on vehicles due to wind. 5. Specifications Considered In Bridge Design: Span length - 40.00 m c/c No. of Spans - 3 Total length of bridge - 120m Length of the slab - 39.96 m Expansion joint width - 40 mm Width of the slab - 14.80 m Slab thickness - 0.22 m Grade of concrete - M45 Carriage way width - 10.50 m Foot path (on both sides) width - 1.50 m No. of Girders on each slab - 5 no. Crash barrier width (on both sides) - 0.45 m Hand rails width (on both sides) - 0.20 m Drainage spouts (on both sides) - 2 x 7 no.s 5.1 Precast girders: Concrete strength at transfer fci = 0.75fck = 0.75×45 = 33.75 = 40 MPAConcrete strength at 28 days fc = 45 MPA Concrete unit weight = 24 KN/M Overall girder length = 39960 mm = 40040mm Design of span = 40m 5.2 Pre-Stressing Strands: 12.7 dia , seven wire low relaxation strands Area of strands = 98.71 mm2 No of strands in one cable = 15 No of cable = 5 Ultimate strength fpu = 1860 Mpa Yield strength =0.9 fpu =0.9×1860 =1674 Mpa

CONCLUSIONS AND RECOMMENDATIONS

General

The following conclusions and recommendations result from the comparison of the design provisions of the investigated design codes. General design and analysis of a typical Box- Girder RCC bridge has been carried out with Evaluation of response and design philosophies according to three international codes namely IRC, AASHTO and Eurocode.

Major Conclusions

The following major conclusions are drawn from the current research.

1) Amongst of all, the Euro code gave most conservative design. It may be due to the use of characteristics load used without any factor.

2) Euro codes are made for wide range of applicability and coverage so it can be referred for the design of bridges in India also. Nationally determined parameters can be developed for suit of India.

Future Scope

This type of a study is very useful in the context that each type of code is good at some and and not that effective in other areas. For example, the maximum nominal force on the pier is much greater as per IRC than the other two codes. Further, area steel of box girders is much higher in eurocode than in the IRC. This shows that the codes developed by different countries can be more rationalized and standardized for a much greater congruence in design practices as well as making bridge design much simpler. The main characteristics of the bridge worked out in the following chapters are presented here. The dimensions of the deck and the substructure, the constituent materials, the construction process and the relevant design assumptions are summarized in this chapter. There is a main example which is analyzed from the point of view of each Eurocode all along this Report. However, where an author has considered of interest to highlight some specific aspect, a partial alternative example has been developed to explainthe relevant issue. These alternative examples, like different cross-sections of the deck, different pier heights or bearing configurations are presented here as well.

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