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International Journal for Scientific Research in Modern Engineering and Science

International Journal for Scientific Research in Modern Engineering and Science, 1(2): 1-5 (2020)

STRUCTURE ANALYSIS OF CONCRETE BRIDGE DECK

G. A. Irfan Khan[1]*, K Divya Kotecha[2], Anisha Mire[3], Lokesh Singh[4]

[1]PG, Scholar, [23]Assistant Professor, [4]Head of Department, Department of Civil Engineering,

[1342]RSR Rungta College of Engineering & Technology, Kohka-Kurud Road, Bhilai, Chhattisgarh, India.

Abstract

Bridge decks are an integral part of the bridge structure by providing the direct riding surface for motor vehicles. For many years, design of concrete bridge structures has been based on two-dimensional frame analysis. The results from longitudinal frame analysis were assumed to be valid over the entire bridge width except for some adjustments in the support regions. Nevertheless, proper designed structures often remain un-cracked under service conditions. For the new generation of design codes, Eurocodes, the Swedish transport administration demands a new approach for analysis of bridge structures. In the new approach, the overall structural behavior shall be accounted for by, for example by a three-dimensional finite element analysis based on shell theory. The two-dimension frame analysis is no longer an acceptable method for analysis of slab bridges. However, it is not clear if the more rigorous demands are necessary for simple types of slab and slab frame bridges.

Keywords: *Bridge; Concrete; Steel; Finite Element Analysis.*

* *Corresponding author*

1. Background

During many years the established engineering practice in Sweden for analysis of concrete bridge structures, comprising slab frame bridges or superstructures of flat slabs, was based on equivalent frame analysis. Bridge structures were divided longitudinally into frames with a width of 1.0m and then analyzed as 2D structures with loads adjusted to the 1.0m width. The obtained results were then assumed to be valid over the entire bridge width with some adjustments over the edge regions. This method of analysis, though non-admitted, is based on theory of plasticity. Nevertheless structures, when proper designed, often proved to remain un-cracked under service conditions even if the design was carried out according to the abovementioned method.

Figure 1. Concrete bridge structure

2. Literature Review

Dzolev et. al., This paper presents the analysis of reinforced concrete Girder Bridge designed according to EN 1998-2, with the determination of the achieved ductility in plastic hinges at the target displacement for the designed seismic action, for confined and unconfined concrete cross sections, with and without the effects of geometric nonlinearity. In this paper, analyses were conducted for RC Girder Bridge with confined and unconfined concrete cross sections with and without the effects of geometric nonlinearity. Based on the pushover curves, it can be concluded that, for the same level of horizontal displacement, lower values of base-shear are obtained if P-Δ effects are applied.

Kulkarni, this paper carries out a seismic evaluation case study for an existing RC bridge using nonlinear static (pushover) analysis. In the present study a 4 Span RC Bridge existed in SH-12 in Karnataka, India, was selected and by defining FEMA 356 Auto hinges conducted Nonlinear Static (Pushover)Analysis using (ATC 40) Capacity Spectrum Method and software SAP2000 was used to analyze the Bridge.

Sharma, this paper deals with the evaluation studies for the existing, RC bridge using non-linear static analysis. For the seismic assessment of the bridge a 3-span bridge is selected which is located on the hindon river at Ghaziabad (Uttar Pradesh). this area is highly vulnerable to the seismic activity because it is lie in the Zone – 4. So, the high magnitude earthquake may be occurring in this region (may be greater than 7 magnitude).

Kumar et. al., this paper deals with the analysis and design of super structure of road cum railway bridge across Krishna river proposed on downstream side of existing bridge between Mahanadi road of Sithanagaram and P.N. Bus station, Vijayawada. The bridge is made of through type steel truss which carries two railway tracks at lower level and a roadway of three lane carriage way in the upper level. The span length matches with that of existing nearby railway bridge. Analyses of top floor members, truss members and bottom floor members are done using STAAD.Pro.

Kanth et. al., This paper deals with a design minor Bridge. We plan on covering every aspect of the redesign. This is going to include the design of the actual replacement bridge, the affect this bridge will have on the surrounding area through an environmental impact, and the logistics associated with the construction phase. In completing this project, we are going to have to use a number of tools. We will have to get bridge history reports in order to see the deficiencies of the current bridge, including height issues and pier quality.

Karthiga et. al., This paper presents a linear analysis of the substructure of rail over bridge by considering IRS 25t railway loading and road over bridge by considering IRC class-A loading. Road over bridges are bridges over which the roadway can be operated. On the other hand, in rail over bridges, the rail track can be operated over the bridge. The aim of this paper is to determine the various types of loads acting on the structure and analyze the substructure of road over bridge and rail over bridge using STAAD Pro. The moment is obtained from STAAD Pro for road over bridge and rail over bridge and compared for the critical pier section. The loads and load combinations are considered with respect to IRS and IRC codes.

Monteiro et. al., this paper intends to readdress that issue from the modeling type point of view. Currently, most of the structural seismic analyses are carried out considering either fiber-based or plastic hinge structural models. Depending on the choice, distinct ways of considering the non-linear behavior of the elements are regarded and different parameters and calibration procedures need to be set.

Li et. al., This paper studies the seismic responses of corrosion-damaged RC bridges under spatially varying seismic ground motions. The chloride induced corrosion damage to the bridge is considered in the analysis. Based on the time-variant chloride corrosion current density, the extent of the reinforcement corrosion in the bridge piers is estimated. The probability distributions of bridge column reinforcement diameter and yield stress at different time steps after the bridge having been in service are calculated using Monte Carlo simulation method.

Yuan et. al., This paper deals with pushover analysis of bridges with elevated pile foundation systems, the inelastic contributions of the second mode cannot be neglected. Generalized pushover analysis cannot be applied directly in this condition. A modified generalized pushover procedure is developed for estimating seismic demands of bridges with elevated pile foundation systems. Modified generalized pushover procedure, modal pushover analysis and incremental dynamic analysis of a bridge with elevated pile foundation systems are conducted.

3. Conclusion

A bridge is a construction built to span physical difficulties such as a body of water, valley, or road, for providing passage over the problem. Designs of bridges vary depending on the function of the bridge, the nature of the terrain where the bridge is constructed, the material used for construction and the funds available to build it. A bridge has three main elements. First, the foundation transfers the loaded weight of the bridge to the ground; it consists of components such as columns (also called piers) and abutments. An abutment is the connection between the end of the bridge and the road carried by the earth; it provides support for the end sections of the bridge. Second, the superstructure of the bridge is the horizontal platform that spans the space between columns. Finally, the deck of the bridge.

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