Literature Review on Box Girder Bridge Deck with Skew Angle

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***Abstract*— Box girder bridge deck, is the most common type of bridges in world and India, it consists of several Slab or girders. The span in the direction of the roadway and connected across their tops and bottoms by a thin continuous structural stab, the longitudinal box girders can be made of steel or concrete. The Simple supported single span concrete bridge deck is presented in present study. Skew in a bridge can result from several factors, including natural or manmade obstacles, intricate intersections, space limitations, or mountainous terrain. The skew angle can be defined as the angle between the normal to the centerline of the bridge and the centerline of the abutment or pier cap. Due to high traffic road can hardly change in order to eliminate the skew. Therefore, considerable numbers of skew bridge decks are constructed. The skew angle effects on the behaviour of the bridge. Therefore, there is need for more research to study the effect of skew angle on performance of bridges. In the present study, the effects of change in skew angles with normal bridge are carried out for IRC Loadings.**

***Keywords* — Skew angle, Box girder bridge deck, IRC loadings.**

I. INTRODUCTION

Skew bridges are common at highway, river passage and other extreme grade changes when skewed geometry is necessary due to restrictions in space. There is a growing demand for skewed RC box girder bridges as the needs for complex intersection and the troubles with space constraint in urban and metro city areas arise. When roadway alignment changes are not feasible then the Skewed bridges are useful or due to the topography of the site to maintained economic and as well at particular areas someplace environmental impact is an issue. In order to offer high speeds and more safety necessities of the traffic, modern highways are to be straight as far as possible and this has required the provision of rising number of skew bridges. If a road alignment crosses a river or other obstruction at an inclination different from 90°, a skew crossing may be essential. The inclination of the centre line of Roadway to the centre line of river in case of a river bridge or other obstruction is called the skew angle. The analysis and design of a skew bridge are much more complicated than those for a Normal bridge. The analysis and design of bridge decks complicated if skew is present. Bridges with large angle of skew can have a considerable effect on the behaviour of the bridge especially in the various ranges of spans. A significant number of research studies have examined the performance of skewed highway bridges. However, there are no detailed guidelines addressing the performance of skewed highway bridges. Several parameters affect the response of skewed bridges which make their behaviour intricate. Therefore, there is a need for additional research to work the effect of skew angle on the performance of box girder bridges.

Characteristics of skew box girder bridge decks

In normal box girder bridges, the deck slab is perpendicular to the supports and the load placed on the deck slab is transferred to the supports which are placed normal to slab. Load transfer from a skew box girder slab bridge is complicated problem because there always remain a doubt as to the direction in which the slab and the manner in which the load will be transferred to the supports. With increasing the skew angle, the stresses in the box girder bridge deck and reactions on the abutment vary significantly from those in straight slab.

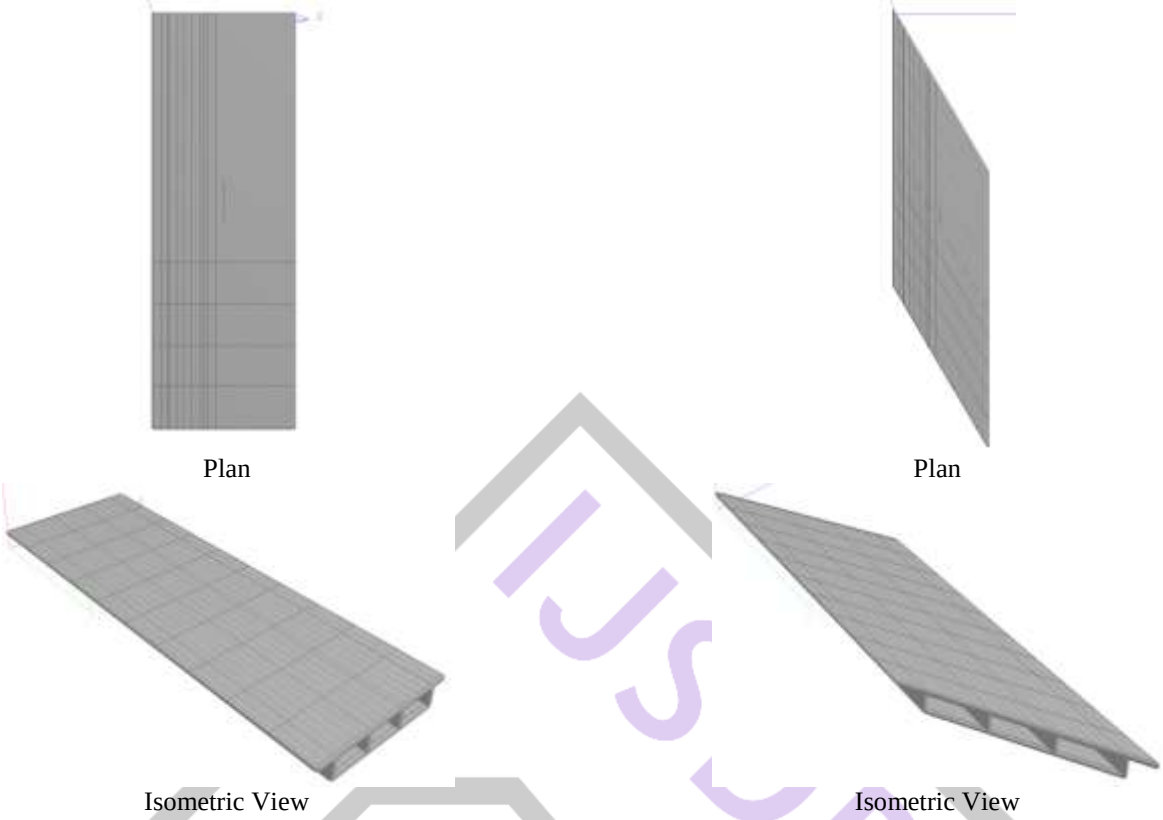
The magnitude and intensity of these effects depends on the angle of skew, aspect ratio of the slab and the type of construction of deck with supports. The shape and edge details can also influence the direction of maximum moments, the deck slab distance to abutments, the stiff edge beams acts as a line of support for the slab which effectively spans right to abutments crossways full width. The skew is so high that the deck is cantilevered off the abutments at the acute corners. The above characteristics are mostly significant in solid and cellular slab decks because their high torsional stiffness try to oppose the twisting of deck. In contrast, the skew is less significant in beam and slab decks, particularly with spaced beams.

Effects of increase in the skew angle

With increasing the skew angle, the stresses in the slab differ significantly from straight slab. Loads applied on the slab are travels to the support in proportion to the rigidity of the various possible paths. Hence a major and important part of load tends to reach the support in a direction normal to the faces of piers and abutments. As a result, the planes of maximum stress are perpendicular to the centre line of the roadway and slab tends to twisted. The reactions at the obtuse angled corner of slab support are larger than other end, the increase in value common value ranging from 0 to 50% for skew angle of 15 to 55°.The reaction are

negative for the skew angle more than 50°.The reaction on the obtuse angle end corner becomes twice the average reaction, thus creation the acute angle corner a zero pressure point when skew angle reaches about 60°.

Normal Skew Angle box Girder Bridge ***60^0 Skew Angle Box Girder Bridge***



Plan Plan

Isometric View Isometric View

II. Objective And Scope

- Analysis the behaviour of Box Girder Bridge for various skew angles by dynamic analysis.
- To compare normal and skew box girder bridge with parameter such as the Deflection, Support Reaction, Transverse Moment and Bending Moment by considering IRC Loading and Load Combination.

III. Literature Review

1) Ibrahim S. I. Harba[1](2011):- This project study deals with the effect of skew angle on behavior of simply supported R. C. T-beam bridge decks. an analytical study using three dimensional finite element methods was performed to investigate the skew angle effect on behavior of simply supported reinforced concrete T-beam bridge decks. This study discrepancy with the AASHTO standard specifications and the LRFD in mentioning that bridges with skew angle less than or equal 20° be considered as straight (non-skewed) bridges also it suggested that to perform three dimensional finite element analysis for skewed T-beam bridge decks.

2) VikashKhatri, P. R. Maiti[2](2012) done Analysis of skew bridge using computational method. In their study they considered a bridge deck contains of beam and slab is defined and modeled using grillage and finite element method. The effect of grid arrangement on different skew angles on equal span of reinforced concrete bridges using the finite-element method and grillage analogy method are compared. Maximum deflection, bending, reactions force and torsional moments is calculated and compared for both analysis methods. The appropriate grid size is estimated for this narrow and long bridge is seven partitions whose ratio of transverse to longitudinal grid.

3) Ansumankar, VikashKhatri[3](2012)carried out study is to investigate the effect of skew angle in skew bridge. They analyzed the effect of change in skew angles with right bridge is studied by two well established analysis methods finite element method & grillage analogy method. Longitudinal moment, transverse moment, reaction at support and deflection are computed by FEM and as well as grillage analogy method and results are compared for different skew angles. Simple supported single span bridges are adopted in this study. The analysis results shows that as skew angle increases, torsion and transverse moment increases but reaction increases, bending moment decreases up to a certain angle, after which it decreases.

4) Sindhu B.V, AshwinK.N[4](2013):- In this study, they analyzed the effect of a skew angle on single-span reinforced concrete bridges are analyzed by using the finite-element method. Investigations are carried out on RC slab bridge decks with and without edge beams to study the stimulation of aspect ratio, skew angle and type of load. The finite-element analysis results for

skew angle bridges are compared with straight bridges for dead load, IRC 70R loading and IRC Class A loading for without and with edge beam. A total of 90 bridge models are examined. The variation of maximum deflection, maximum torsional moment, maximum longitudinal sagging bending moment, and maximum support reaction with skew angle is studied for all 90 numbers bridge deck models. The FEA results of Dead load and Live load bending moments and deflections decreases with increase in skew angle, whereas maximum support reactions increases with increase in skew angle and the maximum torsional moment rises with skew angle up to 45 degrees and there after decreases. The benefit of providing edge beam is reflected in decrease in deflection, longitudinal bending moment and torsional moment.

5) L.A. Abozaid, Ahmed Hassan [5](2014):-This paper presents a comparison between certain results of previous experimental revisions and the non-linear finite element analysis of a reinforced concrete skew slab. The primary parameters studied were the skew angle with the steel arrangements. The slabs were designed using an elastic stress field under an ultimate design load are input for the direct design method. A good agreement between the experimental and theoretical results was found. Furthermore, a theoretical study was performed on an actual ribbed bridge consisting of two lanes under the traffic loads based on Egyptian code of practice recommendations. The parameter investigated in this analytical studies was the skew angle, which was varies from 0° to 45°. Skew angles of 0° and 30° were used to study the effect of concrete grade on bridge decks. Compressive strength values of 400 to 900 kg/cm are adopted for each skew angle. the skew angle and concrete grade had a influence on the overall behaviour of the slab.

6) Kamal Kumar Pandey, SavitaMaru[6](2015):- This paper presents they made assumption for changing the bridge deck into grillage is very important. Bridge deck slab is converted into grillage modeled for different skew angles. For finding the most correct values of bending moments, reactions, torsion, shear force and deflections. The spans are used carriageway width 7.5m and length is 10m for the grillage model.

IV. CONCLUSIONS

Many of the studies have been carried for various Skew angles on bridge using Staad Pro the results are compare for various skew angle for various span length. Whenever a bridge structure exhibits different skew angle, it is necessary to analyse the bridge for various type of IRC loading and for the load Combination. From many past studies it can be concluded that the deflection, Bending moment, Shear force, Torsional Moment and Support Reaction are varying with respect to angle of skew

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REFERENCES

[1] Ibrahim S. I. Harba, (2011) “Effect of Skew Angle on Behavior of Simply Supported R. C. T-Beam Bridge Decks”,ARPN Journal of Engineering and Applied Sciences, ISSN 1819-6608, VOL. 6, NO. 8, AUGUST 2011, Iraq.
[2] Vikash Khatri, P. R. Maiti (2012). “Analysis of Skew Bridges Using Computational Methods”,/International Journal Of Computational Engineering Research / ISSN: 2250–3005, IJCER | May-June 2012 | Vol. 2 | Issue No.3 |628-636, India.
[3] Ansumankar, Vikash Khatri(2012) “Study on Effect of Skew Angle in Skew Bridges”, International Journal of Engineering Research and Development e-ISSN: 2278-067X, p-ISSN: 2278-800X Volume 2, Issue 12 (August 2012), PP. 13-18,India.
[4] Sindhu B.V, Ashwin K.N (2013) “Effect of Skew Angle on Static Behaviour of Reinforced Concrete Slab Bridge”, IJRET: International Journal of Research in Engineering and Technology, eISSN: 2319-1163 | pISSN: 2321-7308, pg no. 50-58, Nov-2013, India.
[5] L.A. Abozaid, Ahmed Hassan (2014) “Nonlinear Behaviour of a Skew Slab Bridge under Traffic Loads”, World Applied Sciences Journal 30 (11): 1479-1493, 2014, ISSN 1818-4952, 2014, Egypt.
[6] Kamal Kumar Pandey, Savita Maru (2015), “Modelling of Skew Bridge Deck Slab by Grillage”, International Journal of Engineering Research and General Science Volume 3, Issue 4, July-August, 2015, ISSN 2091-2730, pg no. 617-623, India.
[7] IRC:6-2014, “Standard Specifications and Code of Practice for Road Bridges Section : II Loads and Stresses”.
[8] IRC:21-2000, “Standard Specifications and Code of Practice for Road Bridges Section : III Cement Concrete (Plain and Reinforced)”.