Study of R.C Post tension Skewed Bridge Girder with Different Radius

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Abstract— *Horizontally curved girder bridges are used in mordan infrastructural system. The curve in the bridges permission for a smooth traffic flow, which generate better road travel. However, some of the disadvantages of horizontally curved bridges are that they are more difficult to analyze, design, and sometimes construct in comparison to conventional straight bridges. Behavior of the bridge Different from the straight bridges as several parameters such like skew angle Different radius of curvature and cross section of the I Girder etc, are included in the analysis of bridge. In this paper, the numerous models for curved I girders are analyzed using CSI Bridge software for different parameters such as span length, radius of curvature. Consideration of the IRC class A loading and IRC 70 R loading and dead load is primary forces. The resultant Shear force, Moment about horizontal axis and the Tensional moments of the various curved I girders are compared.*

Key words — *Curved I Girder, Radius of curvature, Deflection angle*

I. INTRODUCTION

In recent years the complexity of the highway system has increased. As, such the number of horizontally curved bridges has grown in order to accommodate higher volumes of traffic within geographical constraints. The horizontally curved alignments for the highway bridges are becoming more common and it is necessary to construct the structures curved in plan.

Skewed and curved I girder bridges plays important role play in highway intersection and interchanges, and population is high in urban area where lack of space and required the use of curve geometries. The behavior of the bridge is different and it is depend upon such parameters like as skew angle and radius of curvature.

Review of skewed bridges

Several research efforts using analytical as well as experimental approaches to understand the actual behavior of skewed bridges when subjected to static and dynamic loads. Ansuman [16] in the skew bridge makes analysis and design of bridges decks intricate.With increase in the skew angle, the stresses in the girder different considerably from those ina straight girder bridge. The increase in value over average value raging from 0 to 50 % for skew angle of 20 to 50˚. The reaction are negative for the skew angle is greater than 50˚.Critical value for the vertical deflection and bending moment with in service skewed bridge. Skew angle are increase the torsional moment, shear force and bending moment are increases. Huo and Zhang [17] studied the distribution factors of reactions at the piers are higher than those for near the same piers. The increase in reaction distribution factor at the piers in the interior beam lines is more significant than that in shear distribution factor when the skew angle is greater than 30°.

Review of curved bridges

Gupta P.K. [19] conducted parametric study on behavior of box girder using finite element method with SAP2000 .It is found that the rectangular section is superior to other section. Yong-Lin Pi[15]The behavior differs markedly from the inelastic flexural-torsional buckling behavior of a straight beam. Brett A. McElwain[]The purpose of the present study was to gather field response data from three in-service, curved, steel I-girder bridges to determine behavior when subjected to a test truck and normal truck traffic. Barr P.J [12] the different boundary conditions provided the researches a unique opportunity to evaluate the impact that these changes had on the bridges behavior.

Review of skew and curved bridge

Thomas Wilson[14] the results of this study indicate that excluding the vertical ground motion component from analyses may impose a larger margin of risk than previously perceived. This is particularly the case for moderate to high seismic regions where shorter bridges may resonate with predominant frequencies of vertical ground motion.
Deng *et.al*[13] studied thermal behavior, it carried parametric study to investigate the influence of curvature and skew angle on the stresses induced in the girders and found the impact of having two fixed piers on the design of these curved and skewed bridges.

This paper presents simple 3-D finite-element analysis on a series of two-span skewed and curved RCC I girder bridges. The bridges had different skew angle varies (30°, 60°)along with radius 60m. The purpose of this study intended to scrutinize the effect of skew angle and radius of curvature on the performance of skewed and curved rectangular box girder bridges.

II. FINITE ELEMENT MODELING AND ANALYSIS

Structural component

The bridges examine in this study in skew angle 30°and60° and radius of curvature (60 m,80m), however each bridge is constructed with the same structural components. The bridge superstructure consist of RCC I girder having width of top and bottom flange is 1.68m and total depth of I girder is 2.8 m. The thickness of flanges and webs are 0.560 m and 0.840m respectively. The modulus of elasticity of concrete for deck and girder concrete were taken as 27.38 MPa and 33.54 MPa respectively. Fig. 1 shows typical cross section of rectangular box Girder Bridge.

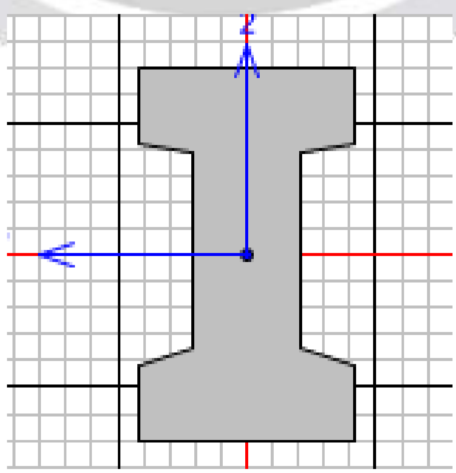

Figure 1 Typical cross section of I girder bridges

Loading condition

The live load used in the parametric study as per IRC: 6-2014 standards truck load IRC-70Rand IRC class A. For partially loaded lane, nose to tail spacing between two successive vehicles considered as 30 m for IRC-70R loading. The wheel load applied closed to the curbs at a distance of 1.2 m from inside edge of the curb. The results are obtained in this study for load combination such as dead load+ IRC-70R and Dead load + IRC Class A. Fig. 2 a typical finite element modeling of a skewed and curved RCC I girder bridges.

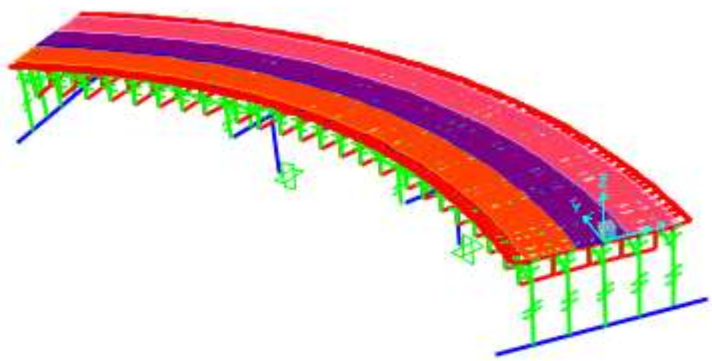

Figure 2 Modeling of Skewed and curved I Girder Bridge

III. RESULTS AND DISCUSSION

In this parametric study bridges were analyse with various configuration for radius of curvature and skew angle, keeping constant span length. In each run, the maximum Shear Forced , torsional moment and moment about horizontal axis. These obtained results of bridges for various skew angles i.e. 30° ,and 60° for different radius of curvature.

Combine the effect of skew angle and Different radius of curvature on Shear force of bridges

After the conducting the parametric study the Shear forced of bridges were recorded. Fig 3 ,4 shows the effect of skew angle and radius of curvature on the shear force of these bridges.

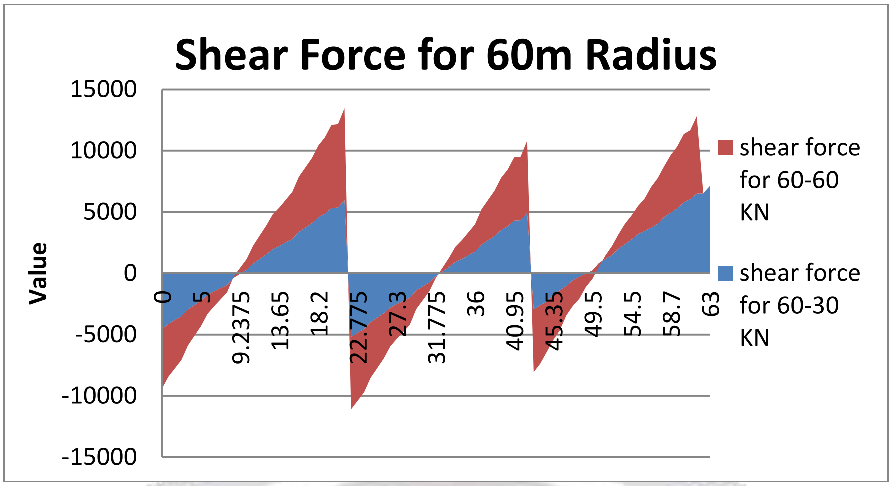

Figure 3.shear forced diagram for 60m radius

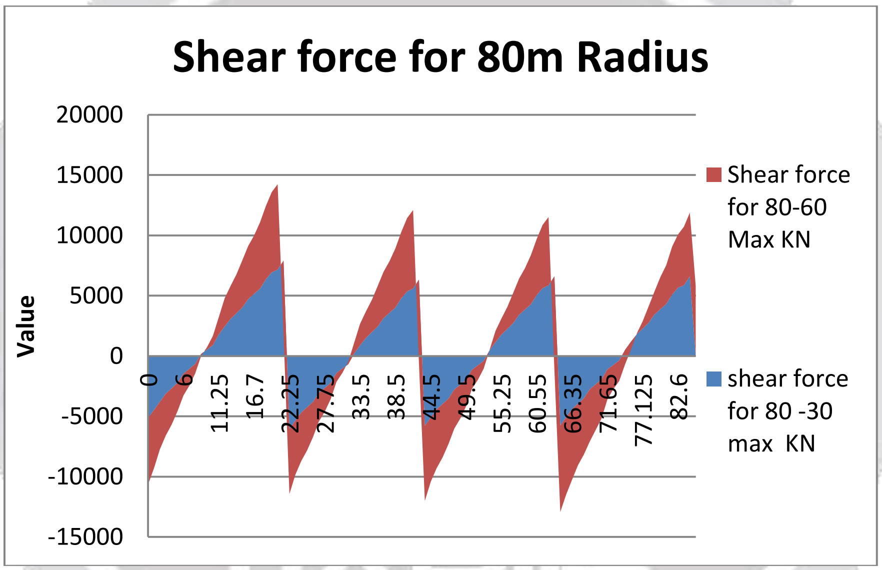

Figure 4.shear forced diagram for 80m radius

Combine the effect of skew angle and different radius of curvature torsional moment of bridges.

During this sensitive parametric study, positive and negative Torsional moment were recorded various skew angle andradius of curvature for this bridges.

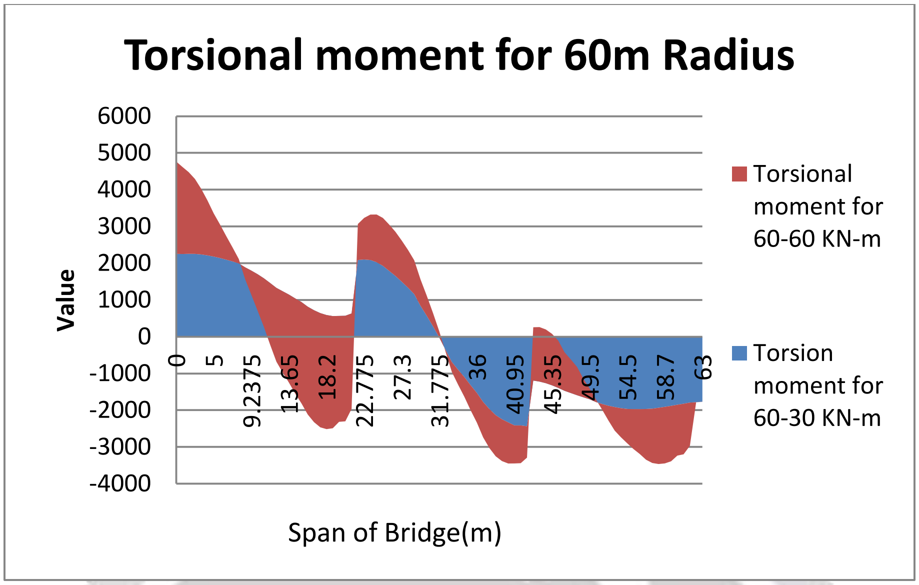

Figure5. Torsional moment for 60m radius

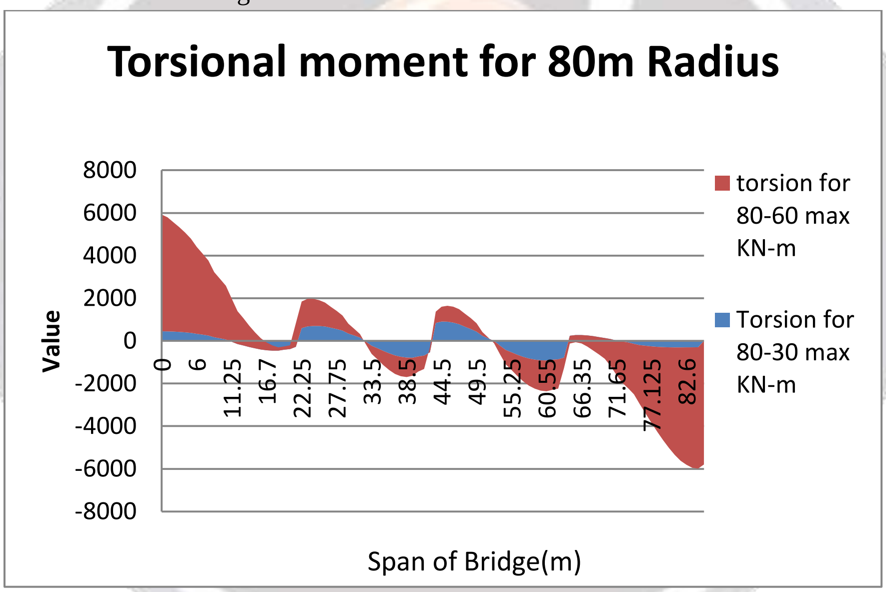

Figure 6.Torsional moment for 80m Radius

Combine the effect of skew angle and different radius of curvature Moment about Horizontal axis of bridges.

During this sensitive parametric study, positive and negative Moment about horizontal axis were recorded various skew angle and radius of curvature for this bridges.

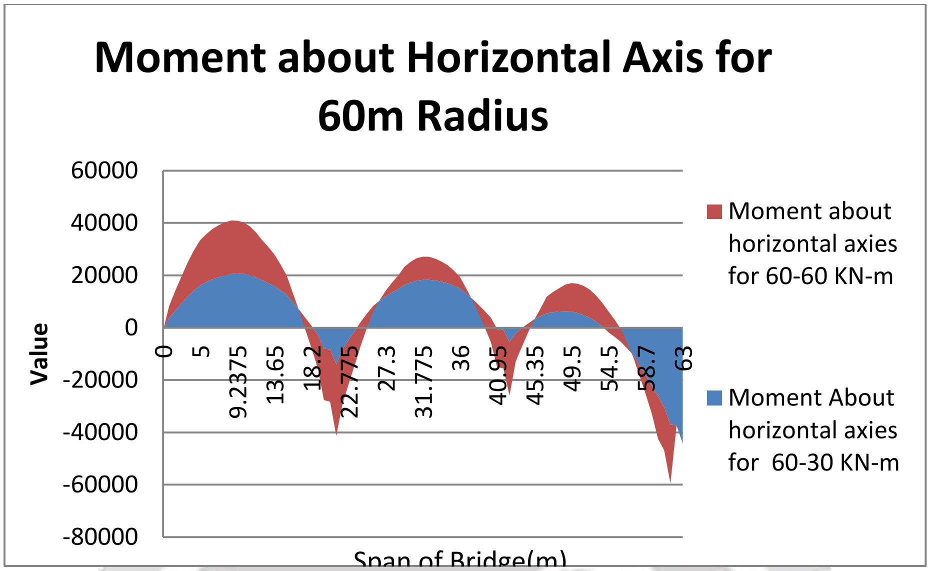

Figure 7.Moment about horizontal axis for 60m radius

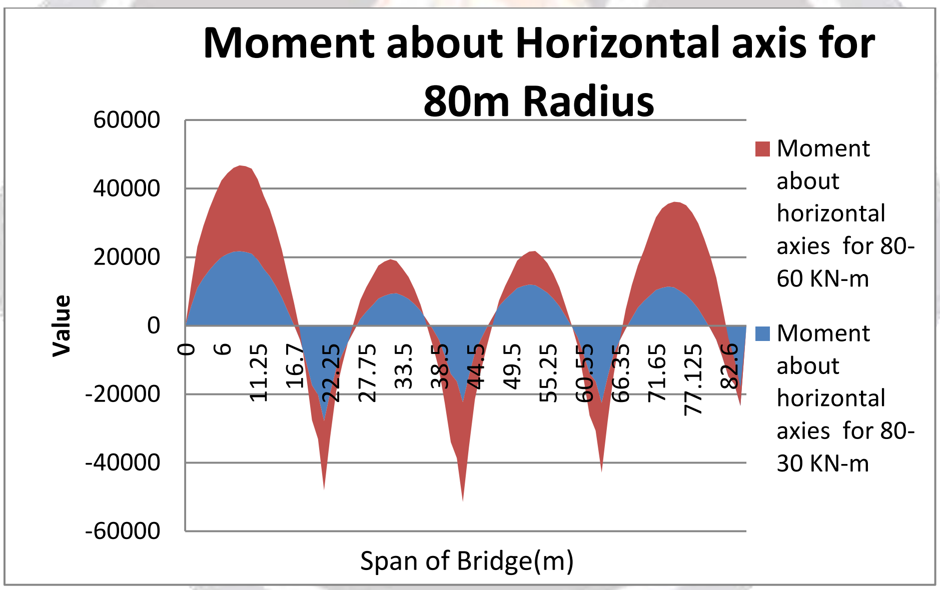

Figure 8. moment about horizontal axis for 80m Radius

IV. CONCLUSION

The analysis of skewed and curved I girder models is carried out in CSI BRIDGE software by varying skew angle and radius of curvature for constant span length. The analysis performed for I Girder Bridge using simple finite-element models subjected to IRC Class A loading and IRC 70 R truckload and dead load as primary forces. During this parametric study, the shear forced, bending moment, torsion moment were computed. After the examinations of these results, the following conclusions are made

For 60m Radius Maximum Shear force of M 60-30 is decrease by the 77.95% then the Maximum Shear force M 60-60. For 60m Radius Maximum Torsional Moment of M 60-30 is increase by 32.76% then the Maximum Torsional Moment of M 60-60. For 60m Radius Maximum Moment about horizontal about axis of M 60-30 is increase by 51.12% then the Maximum Moment About horizontal about axis of M 60-60.For 80m Radius Maximum Shear force of M 80-30 is decrease by the 2.99% then the Maximum Shear force M 80-60. For 80m

Radius Maximum Torsional Moment of M 80-30 is increase by 33.29% then the Maximum Torsional Moment of M 80-60. For 80m Radius Maximum Moment about horizontal about axis of M 80-30 is increase by 30.4% then the Maximum Moment About horizontal about axis of M 80-60.

REFERENCES

[1] American Association of State Highway and Transportation Officials (AASHTO) "Guide specifications for horizontally curved highway bridges" AASHTO, Washington, D.C, 1993.
[2] Ahmed Abdel-Mohti and Gokhan Pekcan "Assessment of seismic performance of skew reinforced concrete box girder bridges*" InternationalJournal of Advanced Structural Engineering*, Springer journal, 5:1, 2013.
[3] Choi B H. and Chai H. Y., "Strength of Stiffened Flanges in Horizontally Curved Box Girders" *Journal of Bridge Engineering*, Vol.131, No. 2, ASCE, pp. 167–176, 2005.
[4] Computers and Structures Inc. CSI analysis reference manual. Berkeley, California, USA; 2011.
[5] DeSantiagoE., MohammadiJ. and Hamadallah M. O., "Analysis of Horizontally Curved Bridges Using SimpleFinite-Element Models"*Practice Periodical on Structural Design and Construction*, Vol.10, No. 1, ASCE, pp. 18–21, 2005.
[6] Gholamreza N. and AhmadiZ. "Influence of Skew Angle on Continuous Composite Girder Bridge*"Journal of Bridge Engineering*, Vol. 17, pp.617–623, 2012.
[7] Gokhan P. and Ahmed A., "Seismic Response of Skewed RC Box-Girder Bridges" the 14th World Conference on Earthquake Engineering,Beijing, China, 2008.
[8] Hailing Z., Dongzhou H., and Ton-Lo W."Lateral Load Distribution in Curved Steel Girder Bridges"*Journal of Bridge Engineering*, Vol. 10,No. 3, ASCE, pp. 281–290, 2005.
[9] MohseniI. and Rashid K."Transverse load distribution of skew cast-in-place concrete multicell box - girder bridges subjected to traffic condition" *Latin American Journal of Solids and Structures*, vol-10, pp. 247 – 262, 2013.
[10] IRC 6-2014; Standard Specifications and Code of Practice for Road Bridges.
[11] IRC 112-2011; Code of Practice for Concrete Road Bridges
[12] P. J. Barr, N. Yanadori, M. W. Halling, K. C. Womack" Live-Load Analysis of a Curved I-Girder Bridge" J. Bridge Eng. 2007.12:477-484.
[13] Yaohua D. Brent M. P. Lowell G. Gus L. S. and Jerad J. H. "Behavior of curved and skewed bridges with integral abutments" Science direct,*engineering structure*, Vol-109, pp. 115–136, 2015.
[14] Thomas Wilson,suren chen, hussam mahmoud"Analystical case study on the seiemic performance of a curved and skewed reinforced concrete bridge under vertical ground motion." Engineeering structure 100(2015)128-136
[15] Yong-Lin Pi, Mark A. Bradford, Nicholas S. Trahair" INELASTIC ANALYSIS AND BEHAVIOR OF STEEL I-BEAMS CURVED IN PLAN" *Journal of Structural Engineering*,Vol. 126, No. 7, July, 2000.
[16]
[17] HuoX. S., and Zhang Q."Effect of Skewness on the Distribution of Live Load Reaction at Piers of Skewed Continuous Bridges" *Journal of Bridge Engineering*, Vol. 13, No. 1, ASCE, pp. 110–114, 2008
[18] WilsonT., MahmoudH. and ChenS."Seismic performance of skewed and curved reinforced concrete bridgesin mountainous states" Science direct, *engineering structure*, Vol-70, pp. 158–167, 2014.
[19] Brett A. McElwain, Jeffrey A. Laman" EXPERIMENTAL VERIFICATION OF HORIZONTALLY CURVED I-GIRDER BRIDGE BEHAVIOR" *Journal of Bridge Engineering*, Vol. 5, No. 4, November, 2000
[20] Yaohua D. Brent M. P. Lowell G. Gus L. S. and Jerad J. H. "Behavior of curved and skewed bridges with integral abutments" Science direct,*engineering structure*, Vol-109, pp. 115–136, 2015.
[21] Zahed A. and Gholamreza N."Influence of Skew Angle on Continuous Composite Girder Bridge" Journal of Bridge Engineering, Vol. 17, No.4, ASCE, pp. 617–623, 2012
[22] Kulkarni D. B, Ingawale N. S "Dynamic Analysis of a Reinforced Concrete Horizontal Curved Beam Using Software " *International Journal of Research in Engineering and Technology* Vol. 04, pp. 557-560, 2015.