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Comparison of Skew Bridges with Different Skew Angles

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Abstract:
In urbanized or hilly areas, the alignment issue is more critical, so as per requirements skew bridges are constructed for short distance T-beam are provides with skew angle. In this paper an attempt has been made to study the effect of skew angle in T-beam bridges. And value of the design parameters i.e. bending moment, shear force, maximum torsion in bridge. For this purpose, parametric study of bridge has been perform in STAAD pro. "IRC class AA tracked Vehicle" loading is applied and loading criteria on bridge is as per IRC 6: 2014. Skew angle varying from 0˚, 10˚, 15˚and20˚ for the constant span length of 20 m. parameters were obtained by comparing 0˚ angle with 10˚, 15˚, and 20˚skew angles. The results were obtained in the form of graphs.

Keywords — **Skew Bridge, Skew Angle, Shear Force, Bending Moment, Torsion, STAAD,**

I. INTRODUCTION

A bridge is a span with a strong support which gives a connectivity between two embankments to serve the passage for transportation. Bridge is such a structure which gives a proper flight and slop for any purpose.it is used in highly populated areas, to cross mountains, valley's and to cross river and highways.it is used for vehicles, pedestrian, railways etc.

Skew angle is the angle between the straight line and perpendicular line. skew bridge is defining as the deck slab of bridge is not right angle with the abutments. Hence the embankments are not exactly parallel to each other. Skew bridges gives a verity of ideas and solutions in alignments of roadway. It can be more needed in hilly areas and terrain. Find a way on curve roads even at low speed is very difficult.
When the normal bridges are not useful and difficult to construct for curved or long distance in such cases skew bridges are the only option in roadway and railway. Hence there is requirement to study the nature of skewed bridges to facilitate the various design parameters like Bending moment, Shear force and torsional moment, maximum moments etc. In our paper graphical representation is done to show the nature of skewed angle when skew angle is increased 0˚ to 20˚. This paper includes comparison and analysis of 0˚angle with 10°, 15°, 20° skew angles.

II. LITERATURE REVIEW

HARISH S RAKARDDI, R. SHREEDHAR: (comparative study of RCC skew T-beam Bridge using grillage analogy method.5 may 2017.)
in this paper the author's said that, the t-beam bridge having a maximum skew angle can have countable effect on the nature of the bridge in the small to medium rang of the span. Hence the

study of skew bridge is done to know the nature of T-beam bridge with respect to Bending moment, torsion, deflection, shear force under the IRC loading. They used 0˚, 15˚, 30˚, 45˚, 60˚ analysis done by using Grillage Analogy method. And results were obtained that the torsion in inner and outer girder increases when skew angle is increases. Hence torsion is very important to take while designing the skew bridges. Whereas Bending moment and deflection were decrease when skew angle increases.

SUJIT p s, JIJI ANNA VARUGHESE, TENNU SYRIAC: (Comparative study on the behavior of T-beam bridges. volume-4, issue-9, September 2015.)

In this paper they said that, the nature of T-beam skewed bridges with respect to shear force, bending moment, support reaction according to standard IRC class AA loading is presented and modelling of T- beam bridges is also compares by using finite element method and Grillage Analogy method.0˚ to 60˚ skew angle was adopted.Total 30 models of bridge were created.15 models of bridge was analyzed by using grillage analogy method and 15 models of bridge was analyzed by using Finite element method. The main moto of the project was to compare grillage method with finite element method. After study they conclude that the finite element method is give more economical structure as compare to grillage method. Results were obtained as when skew angle increases, the stresses generated in slab differentiate significantly in straight slab, reactions increase when skew angle increases, uplift or negative reaction on acute corner, maximum or high reaction on the obtuse corner.

SHEETHAL JOY, ANANYA JOHN: (Parametric study of the skew continuous T beam bridge in super structure under seismic response. Volume-6, issue-5, may2017.)

In this paper they said that, seismic responds analysis of four span bridges with skew angles varying from 0° to 60° are considered to study the seismic responds of skew T-beam bridges. 2D and 3D models were adopted. They conclude that the Shear force on longitudinal girder were increase when skew angle increases. And maximum Bending moment in girder also increases when skew angle increases. Also the maximum value torsional moment also got increased when skew angle increased. Torsional moment increases when skew angle increases the Transverse displacement for the skew bridge also get increases when skew angle increases when it compared with straight bridge. This indicates that the capacity of carring the load of skew bridges decreases when skew angle increases. When transverse seismic force acting on the continuous bridge. Considerable variations were found in the obtained results for the skew angle more than 15°.

MOHAN LAL, VEDPAL, RAVINDER KUMAR: (Study of skewness angle in Reinforced concrete girder bridges. Volume-2, issue-9, September 2016.)

In this paper they said that, the impact of skewness which comes directly on the designing parameters like Shear force, bending moment has been studied in the simply supported reinforced concrete T-beam 3 lane bridges. Study of the bridge were analyzed in staad pro software. Skew angle were 0°to 60°. they conclude that the arrangement of longitudinal girdersperpendicular to cross girders in skew bridges is more convenient in transverse load distribution as compared with the arrangement in which abutments are parallel to cross girder.Grillage Analogy Method according to stiffness matrix approach, is said to be correct method for a more range of bridge deck. This method is very convenient, and simple for the designers to prepare and visualize the analysis for Grillage. The Bending moment increases up to 40°skew angle is small. Continuous increase is observed at higher skew angle. Obtained results shows that Maximum Bending moment is occur at end girder which was placed in center of the skew span. maximum positive and negative reactions are noted in skew bridges, very close to each other.

VIKAS KUMAR SINGH, B.S. TYAGI, ALOK SINGH, HEMANT SINGH: (comparison between Etabs and staad on skew bridges with different span. volume-4, issue-12, dec-2017.)

In this study they said that the in skew

bridges the effect of skew angle according to IRC 70R loading. The comparison is done by using staad pro software and ETAB loading design software. And the only 15° skewed angle is used for span of 15, 17and 19 m lengths. Models are analyzed by FEM. And they conclude that there is considerable torsion of deck slab. At differs in load cases at different plate i.e. (45, 46, 55, 56) the longitudinal BM (Mx and My) were found Mxy the very first it decreased but when the span length increases it get increases, expect few plates like 56. In plate 56 the rate of change of torsional moment increase in STAAD but ETAB results is similar as above point 4.

SEISMIC ZONES

Indian Standard Bureau, as per past history, divides the country into 4 seismic zones i.e. II, III, IV, V.of these zones V zone is the highest seismically active region, as the zone II is the least. To calculate the earthquake, impact the Modified Mercalli (MM) intensity scale is used. The dividation of zones are as follows.

Seismic Zone Intensity on MM scale:

Seismic Zone	Intensity on MMI scale	% of total area
II (Low intensity zone)	VI (or less)	43%
III (moderate intensity zone)	VII	27%
IV (Severe intensity zone)	VIII	18%
V (very severe intensity zone)	IX(and above)	12%

METHODOLOGY:

the models are done by using the staad pro software for the skew angles 0°, 15°, 19°, 20°. Then the models were subjected to Dead load and Live loadto get the results. The self-weight of railing and kerb was ignored, the live load which was used in analysis is considered as per IRC 6:2014, and IRC class AA loading (tracked vehicle) is used with the taking impact factor as per IRC 6, and investigated design parameters were Shear force, Bending Moment, torsion.

Bending moment.

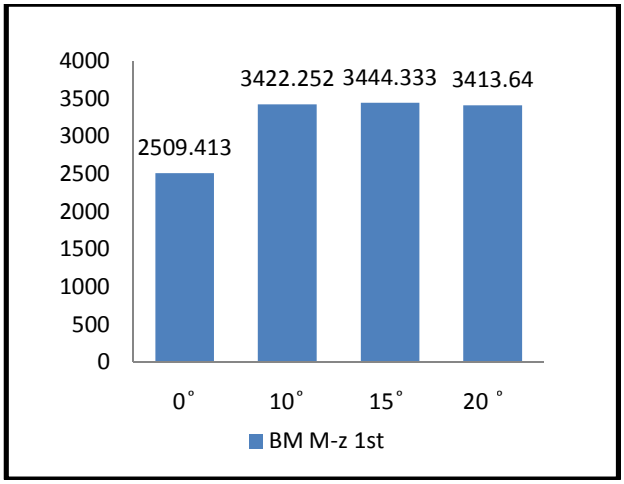

Fig.No 1 Bending moment in 1st longitudinal girder

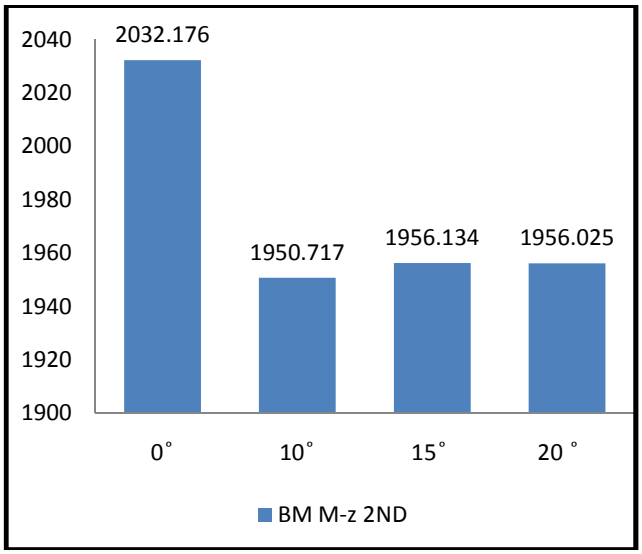

Fig No2 Bending moment in 2nd longitudinal girder.

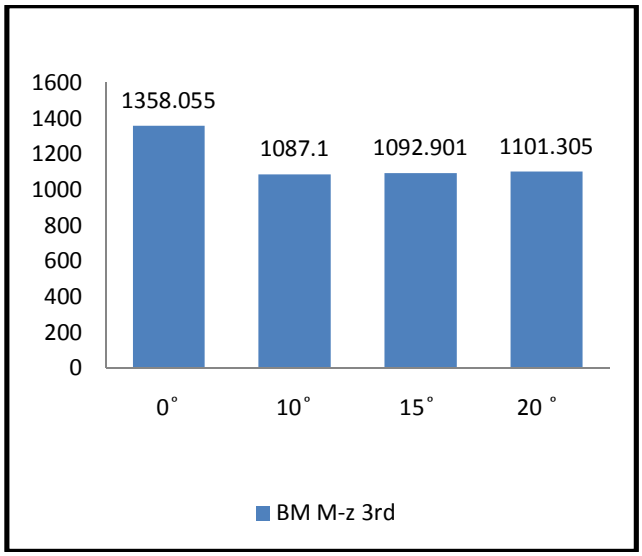

Fig No 3 Bending moment in 3rd longitudinal girder.

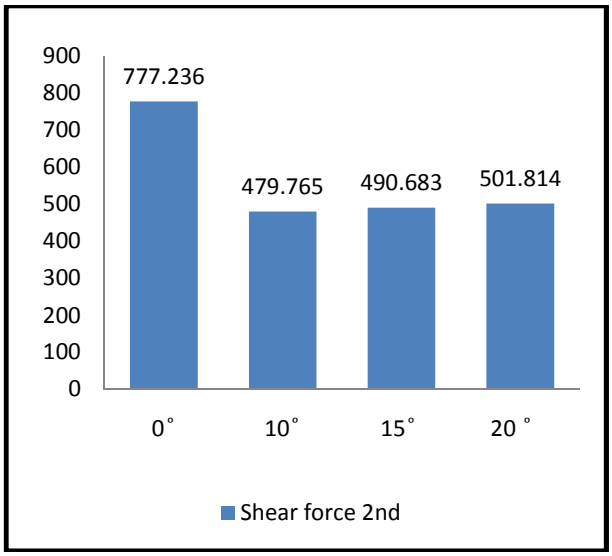

Fig No-5 Shear force in 2nd longitudinal girder.

Shear force

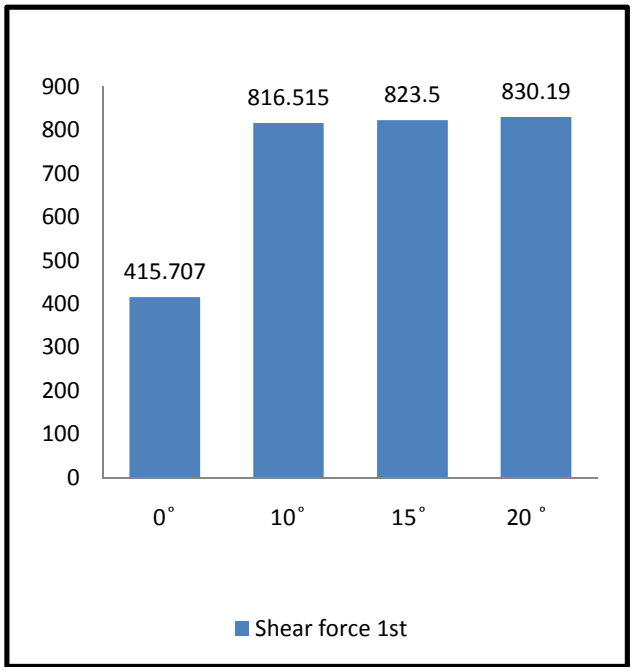

Fig No-4 Shear force in 1st longitudinal girder.

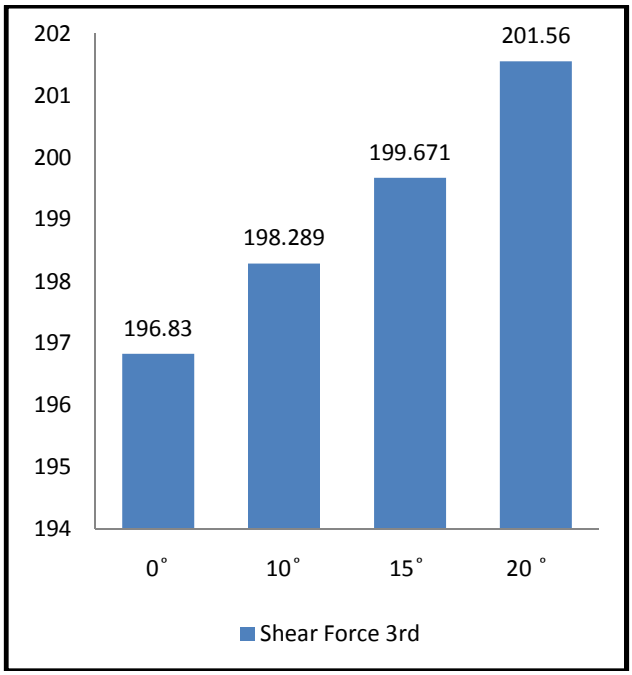

Fig No-6 Shear force in 3rd longitudinal girder.

Torsion

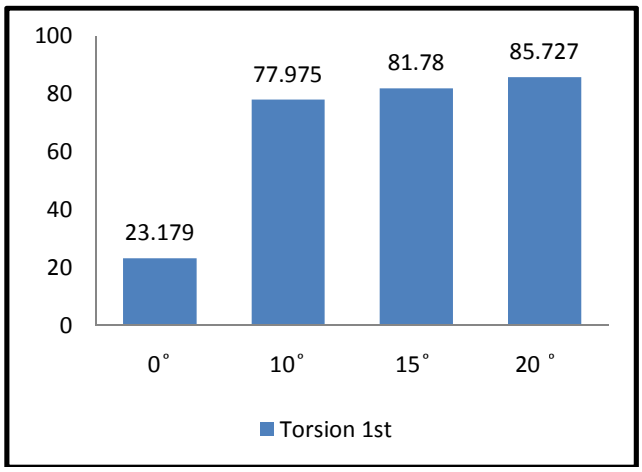

Fig No-7 Torsion in 1st longitudinal girder.

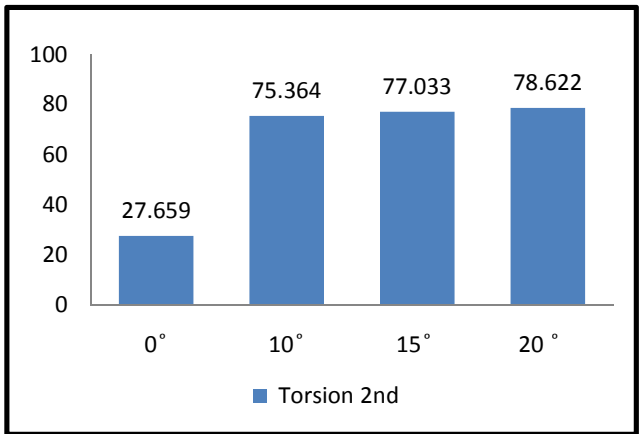

Fig No-8 Torsion in 2nd longitudinal girder.

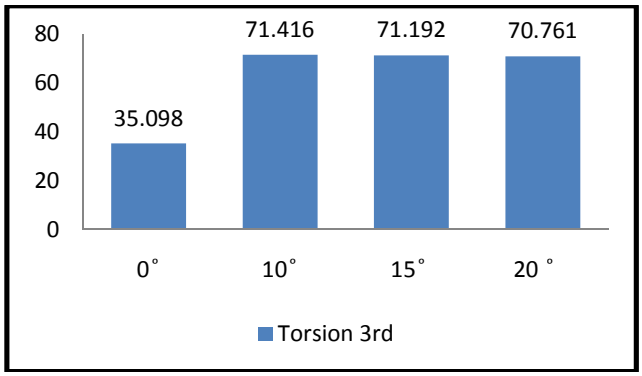

Fig No-9 Torsion in 3rd longitudinal girder.

CONCLUSION

the behaviour of a T-beam bridge of constant length of 20m is analysed and studied for different skew angles. Parameters like bending moment, shear force, torsion in longitudinal girders for same position of load are investigated. Results are as follows

BENDING MOMENT

1. In 1st longitudinal girder bending moment increases 35% to 40% with increase in skew angle

2. in 2nd longitudinal girder bending moment is decreases with increase in skew angle.
3. in 3rd longitudinal gird bending moment is decreases with increase in skew angle.

SHEAR FORCE:

1. Shear force on 1st girder is increases 96% to 100% with increase in skew angle.

2. Shear force on 2nd girder is decreases with increase in skew angle.

3. Shear force on 3rd girder is increases 1% to 2% with increase in skew angle.

TORSION:

1. Torsion on 1st girder is increases with increase in skew angle.

2. Torsion on 2nd girder is increases with increase in skew angle.

3. Torsion on 3rd girder is increases with increase in skew angle.

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