

# Analysis and Study of Various Parameters on Skew Slab Bridges with Various Skew Angles

<sup>[1]</sup> Prashant Kumar Tripathi, <sup>[2]</sup> Rajendra Kumar Srivastava

<sup>[1]</sup> M.Tech Student, <sup>[2]</sup> Professor

<sup>[1][2]</sup> Structural Engineering, Department of Civil Engineering, Institute of Engineering & Technology, Lucknow, India

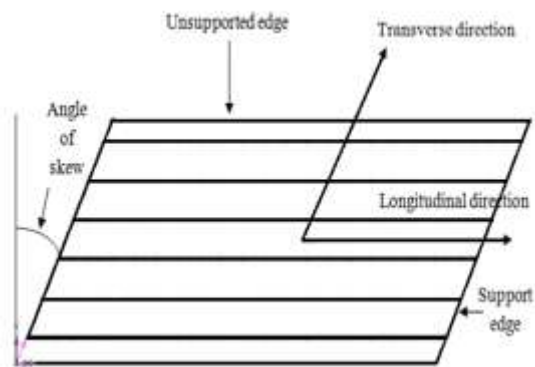
<sup>[1]</sup> ptripathi125@gmail.com, <sup>[2]</sup> dr.rajendraksrivastava@gmail.com

**Abstract**— In this paper study of the behavior of skew slab bridge with simply supported on two edge and other to edges free with various skew angles like  $0^{\circ}$ ,  $15^{\circ}$ ,  $30^{\circ}$  and  $45^{\circ}$  is done. A detailed study on variation of deflection, longitudinal moment and torsional moment on a simply supported skew slab bridges with various skew angles is analyzed by using structural analysis software CSI bridge. In this Analysis we consider the load combination to be dead load and live load (IRC class 70r tracked).

**Index Terms**— Skew bridge, skew angle, IRC, CSI Bridge

## 1. INTRODUCTION

Due to the complex intersection at various places such as highways, river crossing, railway crossing, there is a continuous growing demand of bridges to distribute the traffic without any congestion. Skew bridges are useful to cater high speed vehicle as highway alignments are kept straight as far as possible. Skew angle is the angle between the center line of carriageway and center line of a river. Skew bridge is define as the deck slab of bridge is not right angle with the abutments. Moreover, congestion of traffics also overcomes as alignment of road and bridge kept straight. These have led the provision of number of skew bridges. In small skew angle bridges say up-to  $15^{\circ}$ , bridges are considered straight and are typically designed as normal right angle bridges with no considerable modification. Up-to skew angle  $15^{\circ}$ , there is no considerable variation in values of parameters like bending moment, deflection and torsional moment. However, if the skew angle increases beyond  $15^{\circ}$ , then there could be considerable variation in terms of bending moment, deflection and torsional moment. Hence there is requirement to study the nature of skewed bridges to facilitate the various design parameters like Bending moment, deflection and torsional moment etc. In this paper graphical representation is done to show the nature of skewed angle when skew angle is increased  $0^{\circ}$  to  $45^{\circ}$  at  $15^{\circ}$  interval each.



**Figure 1: Skew slab with skew angle**

## 2. GEOMETRIC PROPERTIES OS SKEW SLAB

Width of carriageway	8.5 m
Span length of skew slab	10 m
Thickness of skew slab	500mm

Material and loading properties:

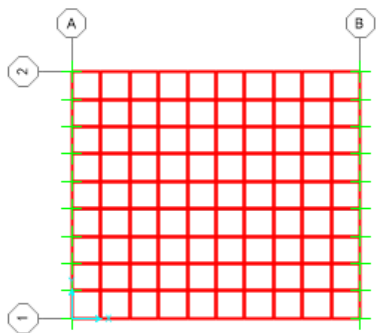
Grade of concrete	M40
Loading	IRC70r Tracked

## 3. FINITE ELEMENT ANALYSIS

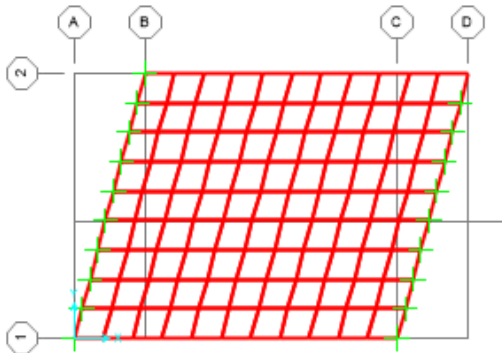
To generate the model finite element method(FEM) is used to obtain the result. It is a numerical technique for obtaining approximate solution of partial differential equation. FEM helps in producing stiffness and strength visualization, also to minimize the weight of material cost of the structure. FEM indicate the distribution of stress and strains and also it

gives detailed visualization of a body. A three dimensional model is generated using CSI bridge. The concrete slab were modelled using thin shell(SHELL) element which has six degree of freedom at each node. The slab is supported pin joint at both the end and other edge remain free. A typical square shape mesh of size 1m by 1m is generated for each and every skew angle.

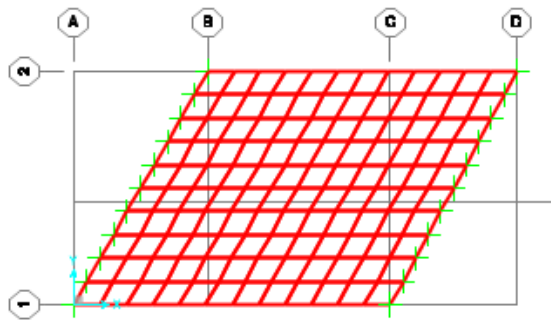
For the analysis purpose 4 model on different skew angle ( $0^{\circ}, 15^{\circ}, 30^{\circ}, 45^{\circ}$ ) is considered each having span length of 10m each. The behavior of skew slab is studied under the dead load and live load(IRC class 70r) using FEM method are analysed.



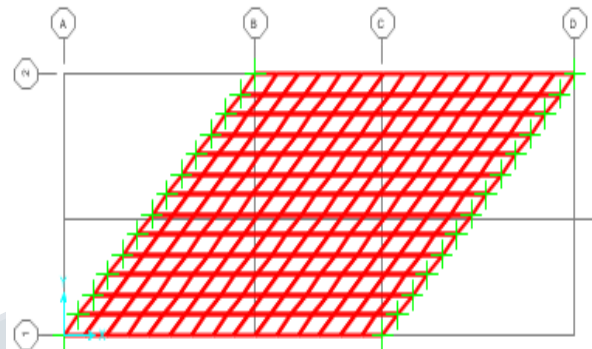
**Figure 2: FEM model with 0 degree skew angle**



**Figure 3: FEM model with 15 degree skew angle**



**Figure 4: FEM model with 30 degree skew angle**



**Figure 5: FEM model with 45 degree skew angle**

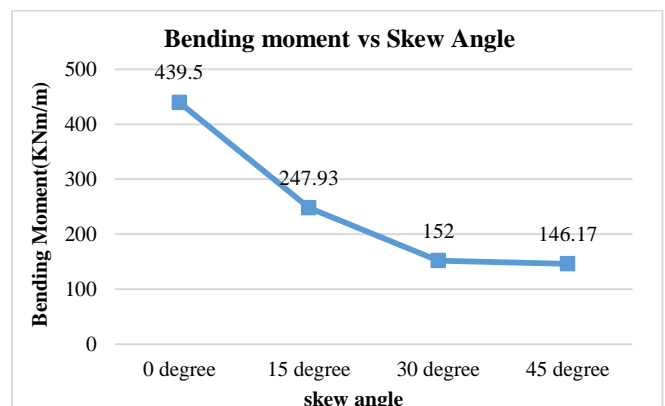
**4. RESULT AND ANALYSIS**

Analysis results of various skewed bridge are compared with various skew angle and their behavior pattern have been studied. The results are obtained based on the bending moment, torsional moment and deflection. The critical structural responses are represented by various graph. The analysis is carried out under the effect of dead load and live load (IRC 70R tracked). The vehicle will move at centre of the carriageway width and the effect of various parameter has noted down is shown in table below.

**Table 1: Analyzed value of bending moment, torsional moment and deflection with various skew angle**

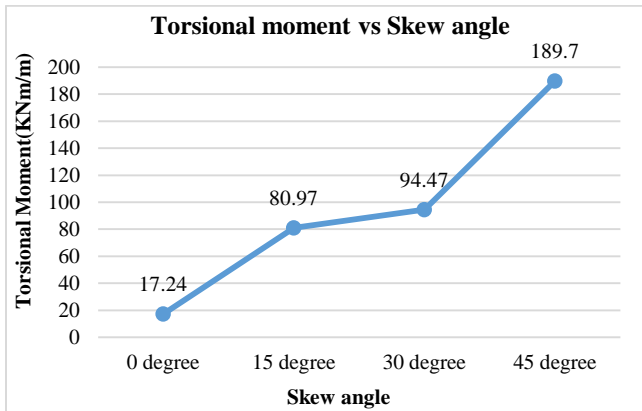
Skew Angle	Bending Moment (kNm/m)	Torsional Moment (kNm/m)	Deflection (mm)
0 Degree	439.5	17.24	12.7
15 Degree	247.93	80.97	20.56
30 Degree	152	94.47	14.88
45 Degree	146.17	189.7	7.9

i. Effect of bending moment on different skew angle



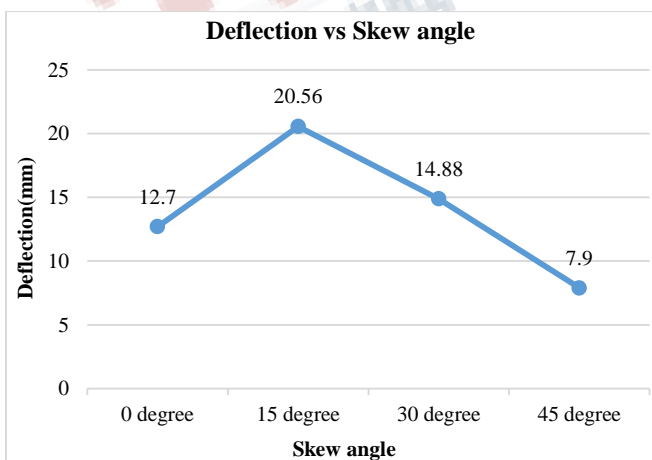
It is observed that bending moment near the free edge strip at mid span will produce maximum among all the value in each case of skew angle. The value of bending moment decrease as the skew angle increase from 0 degree to 45 degree.

ii. Effect of torsional moment on different skew angle



The variation of torsional moment at obtuse corner will produce maximum among all the value in each case of skew angle. The value of torsional moment increase as the skew angle increase from 0 to 45 degree

iii. Effect of deflection on different skew angle



Near the free edge strip at mid span will produce maximum deflection in each case of skew angle. It was noticed that deflection will increase up to 15 degree but later it will start decreasing as the skew angle further increase.

**5. CONCLUSION**

From the above analysis it can conclude that there is noticeable change in various parameter such as bending moment, deflection and torsion. Bending moment start decreasing with increase in skew angle. If we compared with right angle bridge the value of bending moment may decrease to 43% and 67%, in 15<sup>0</sup> and 45<sup>0</sup> respectively. In similar way torsional moment plays opposite role of bending moment. It start increasing its value from 0<sup>0</sup> to 45<sup>0</sup> and value may increase from 50% to 90% respectively. Deflection will increase up to 15<sup>0</sup> and then start decreasing. Maximum deflection will occurs nearer to obtuse angled corner but as aspect span is more it comes nearer to middle of the span and shifts towards obtuse angled corner as skew angle increase.

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