

REVIEW ON SKEW SLAB BRIDGES

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ABSTRACT: In developing infrastructure there is an enormous growth in the number of skew slab bridges, flyovers and culverts; especially in the urban areas, having space restrictions, places where roads cross any obstruction like river, areas having different terrains and for architectural view, in such conditions Skew slabs are constructed instead of conventional straight slabs. Due to its different behaviour under loads than conventional slabs its design, analysis and construction are complicated. Significant literature is available to emphasize load-deflection behaviour, skew angle influence, span influence, Reinforcement distribution influence and application of different finite element methods to determine stress parameters. A brief review of the available literature is presented in this paper

KEYWORDS: Skew slab; Skew angle; Finite Element; Skew span.

INTRODUCTION:

Skew slabs possesses a broad range of application in present times because of several reasons like, space restrictions in urban areas, when roads have to elevate or sometimes have to pass through irregular space, locations where there are some other forms of geographical constraints like mountains, when roads cross the obstructions like rivers, sometimes because of religious beliefs like when Mosques, Temples, Church comes in the way of roads. Skew slabs are those slabs whose sides are non-orthogonal and opposite angles are equal but other than 90 degrees. These are the types of slabs that don't transmit the load to their supports at 90 degrees. Skew slabs can be classified into two types.

- 1) Skew slabs whose short diagonal to span ration is less than unity
- 2) Skew slabs whose short diagonal to span ration is greater than unity.

SKEW SLAB BEHAVIOUR

Generally, Skew slabs with skew angles less than 20 degrees and inclination angle less than 15 degree behaves like a normal slab and are designed same as that of normal slabs but the problem arises when the skew angles are greater than 20 degree and inclination angles are greater than 15 degrees that times skew slabs behave differently because of the below mentioned points, the design and analysis of skew slabs become complicated

- Significant Torsional moments start inducing in the slab.
- Longitudinal moments start reducing along with an increase in the transverse moment.
- The high reaction at obtuse corners.
- Uplifting of acute corners, especially in case of slabs with high inclination angles.
- Sagging moments orthogonal to abutments.
- Point of maximum deflection close to obtuse angles.
- The distribution of reaction forces is not uniform on the support line.

LITERATURE REVIEW:

Significant research has been done on the behaviour and analysis of skew slabs by taking aspects like skew angle effect, span effect, reinforcement distribution effect, lateral live load distribution, shear and reaction distribution, moment distribution. Research on above mentioned parameters carried by various authors are presented under.

Sharma et al. (2019) gives an Improved theoretical formulation to predict the ultimate flexural capacity of laterally loaded reinforced concrete skew slab and concluded that the actual crack pattern and ultimate flexural capacity of slab specimens tested in the laboratory are found in a good agreement with the theoretical predictions and simulated results for all slabs having aspect ratio greater than or equal to unity and the hypothetical collapse mechanism for skew slabs was found to be in a good agreement.

Naresh & Muthu (2017) carried analysis of a simply supported reinforced concrete skew slab by using finite element software ANSYS and calculated load deflection behavior under the action of uniform distributed load and compare the results with the experimental results and it has been found that theoretical results closely concur with experimental results.

Raj & Phani (2017) study deals with the design and study on the behavior of skew slab bridges with various skew angles using STAD PRO and analysis is as per Indian codes IRC 6:2014 and concluded that load-carrying capacity increases with the increase in tilting angle, maximum deviation of inclined skew slabs decreases with the increase in the inclination angle, up to 15 degree inclined angle skew slabs behave like normal slabs and also by comparing results with the experimental results it shows load deflection same.

Lal et al. (2016) carried out the analysis of reinforced concrete girder bridges with different skew angles and find the effect of skewness on design parameters i.e. B.M, share force and Maximum Reaction and concluded that the increase in BM up to 40-degree skew angle is less. At a higher skew angle, a sharp increase is observed. Torsion, with an increase of skew angle, increases appreciably in all directions.

Anusreebai & Krishnachandran (2016) studied FEM analysis using ANSYS software on skew slabs by taking different reinforcement pattern and compared the results with the experimental results and concluded that the slab with main reinforcement parallel to the free edge and distribution reinforcement perpendicular to the free edge has more cracking load and ultimate load-carrying capacity.

Kothari & Murnal (2015) carried out the seismic analysis of skew bridges using the finite element method (SAP2000) taking different skew angles and concluded that skewness affects the seismic response of the bridge. i.e large skewness increases deck acceleration and bearing reaction of the bridge. Axial forces in the exterior girders increase more than that of interior girders.

Deepak & sabeena (2015) carried out research on finite element analysis of skew slabs by using skew angles from 0 degrees to 30 degrees and find the effect of skew angles on the uplift of acute corners and concluded that with the increase of skew angles uplift of acute corners increases but load carrying capacity also increases.

Kumar et al. (2014) studied the yield line analysis of reinforced concrete skew slabs with different boundary conditions using yield line theory. The reinforcement is assumed orthogonal. The ratio of span moments to support moments is equal to 0.75 and design tables are prepared and results are compared with IS:456-2000 for zero skew angles and it is found that the results obtained are 0.75 times the codal value.

Nouri & Ahmadi (2012) carried out three-dimensional finite -element analysis on continuous composite skew slab girder bridges with different skew angles and compared with the non-skew bridges as well as with to AASHTO standard specifications and AASTHO LRFD specifications and concluded that as the skew angle increases, the support moment in interior and exterior girders rapidly decreases.

Menessa et al. (2007) compared the effect of skew angles with reference to straight bridge and reported that the bridges with the skew angles less than 20 degree can be designed as non-skew as moments are almost same for both.

Bhatt et al. (1988) carried out the theoretical analysis and compared with the experimental results on the behavior of reinforced concrete skew slabs designed by the Direct Design Method and concluded that the method can be used for the practice.

CONCLUSIONS:

After study the research of various researchers it can be concluded that:

- Most of the researchers have used Finite element software's like STAAD PRO, ANSYS, ABACUS, SAP, ATENA 3D for the analysis and design of skew slabs but in present times it needs great skill and care to get the best results, so it can be recommended that analyze the skew slab by principal of limit analysis so it can be understood by designer easily.
- Minimal work has been done on non-symmetrical skew slabs in case of slab dimension or plan and also on unsymmetrical loading which gives us a hint for further investigation.
- Problems like maximum hogging moments and reaction at acute angles and maximum uplifting of acute angles with the increase of skew angles and loading warrants for further research.

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