Comparison of Analysis of Normal Bridge and Horizontally Curved Bridge

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***Abstract*:- Bridges are the lifelines and supporters for the improvisation of the road network. Not only do the bridges help in traffic flow without any interference but also maintain the safety of roads. Due to this reason the bridges design has gained much importance.Due to the curvature in the bridge there will be large centrifugal reactions on the vehicles. Apart from the reaction a large torsional moment will be induced on the supporting girders. This paper is basically concerned about the analysis and design of normal and curved bridge by STAAD Pro which contains a span of 100m X 16m and has a 4-girder system. The objective is to check the result for particular input design, properties and parameters and the approach has been taken from AASHTO standard design. The nodal displacement, beam property, concrete design can be easily found out performing the analysis and design method.**

Keywords:- 4girder System, AASHTO, Curvature, STAAD Pro.

I. INTRODUCTION

In Past, advanced mathematical methods were used for the analysis of the large structures such as Bridges, buildings etc. Those methods are elaborated techniques. So, it takes too much time for designer to concentrate on the calculations. Nowadays, STAAD. Pro Software is being widely used for the analysis and design of buildings, towers etc. In this project, STAAD Pro. has been used for the analysis and design of a deck slab bridge in connection with STAAD . It becomes much more easier to assign the properties and other specifications in creating deck slab by the STAAD Pro. software. The various properties are to be considered in the analysis and design of the deck slab of a bridge which include section property, plate thickness, dead load, live load etc. Dead Load consists of its own weight and portion of weight of superstructure and fixed loads also.

From past few decades, the infrastructure has seen a great boom in the world. To access any inaccessible areas bridges were built. Hence building bridges became mandatory for infrastructure development. During the ancient time natural bridges were created by nature, as in, tree trunks extended to the inaccessible areas. Then humans started building their artificial bridges to travel to other side of the valley or non-transportable point. The bridges built by humans were usually made up of wood or bamboo thatch. As the population increased the need for bigger and sturdier bridge was more. This led for innovation in bridge building techniques thus many types of bridges were formed. There are many classifications of bridges. The bridge which is under study is girder bridges subjected to some radius of curvature that is also known as curved bridge. The curvature in the bridges is usually introduced to eliminate the support irregularities or presence of important structures which cannot be demolished. Due to the curvature in the bridge there will be large centrifugal reactions on the vehicles. Apart from the reaction a large torsional moment will be induced on the supporting girders. The columns location and orientation is also a major design category in bridges. When the columns are tilted from the normal angle the column is said to be skewed. Skewed column decreases the stability of structures. Skewed columns along with some degree of horizontal curvature to the bridges create a lot of instability. The design of such bridges is always governed by code books and designed very carefully. The study deals with bridges subjected to seismic loads and its behavior when the bridge is curved horizontally at deck section and skewed at column or pier section. The bridge will be subjected to many kinds of loads such as earthquake, wind and vibration loads created by the live load on the bridge.

II. LITERATUREGAP

Due to the curvature in the bridge there will be large centrifugal reactions on the vehicles. Apart from the reaction a large torsional moment will be induced on the supporting girders. Analysis is done to the Normal straight bridge and the outputs like bending moment, shear force and reactions are noted. The same analysis is done on Horizontally Curved bridge. The comparison is done between the analysis of Normal straight bridge and Curved bridge.

III. OBJECTIVE

- To determine deflection, bending moment, reaction and shear force of normal bridge.
- To determine deflection, bending moment, reaction of horizontally curved bridge.
- The comparison is to be done on the analysis between the Normal bridge and curved bridge
- This study can be used for knowing the effectiveness of the curvature of the curved bridge and to design the bridge with a clear calculation.
- By this study the additional elements needed for the stability of the bridge can be defined.

IV. SCOPE

The future scope of the project is to study the behavior of the horizontally curved bridges which can have a combination of seismic and moving loads. Also we can find the most economical acute curvature which can be introduced in the curved bridge(15,30,60 degrees)

V. MODELDETAILS

STAAD.Pro. in space is Operated with units Metre and Kilo Newton. The geometry is drawn and the section properties are assigned. Fixed Supports are taken. Quadrilateral meshing is done followed by assigning of plate thickness.3D rendering can be viewed for the geometry. Loads are defined by the loads and

Table:1 properties of bridge definitions. By Post Processing mode, Nodal displacement, Max. Absolute Stress distribution for the bridge can be viewed. transfer of load is done into STAAD Pro. For further analysis and design. All the Max. response criteria are checked Mx,My,Mz stresses
etc. for different members elements. The load positions

Specification	normal	Curved (30)
Span of bridge	100m	114m
Width of bridge	16m	16m
Radius	-	150m
curvature	-	30
Pier section	2m dia	2m dia
Beam (long)	1*1	1*1
Beam(trans)	0.5*0.5	0.5*0.5
Plate Size	300mm	300mm

and reactions, beam forces and moments,etc. are determined.The concrete is designed as per IS Code.
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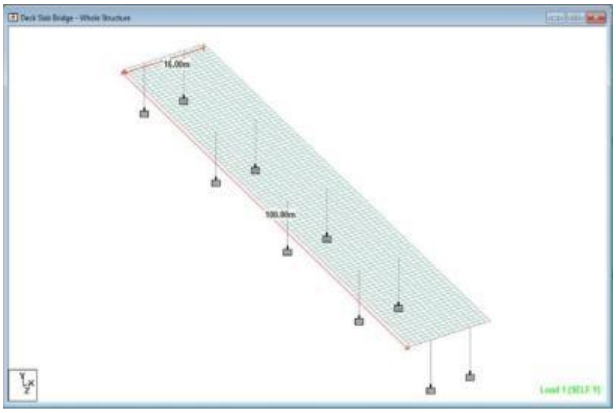

Fig:1,Geometry(normal bridge)

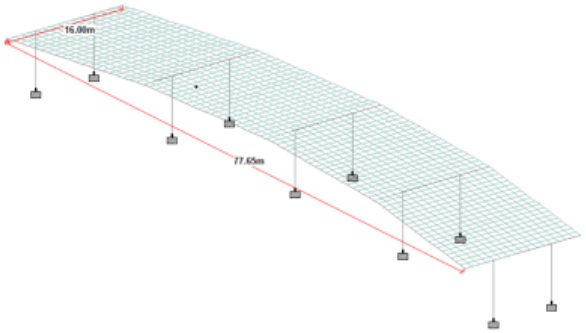

Fig:2, Geometry(30 degree curved bridge)

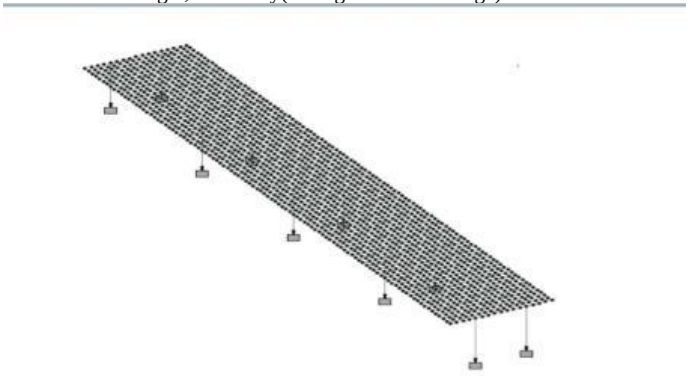
Fig:3, Quadrilateral Meshing (normal bridge)

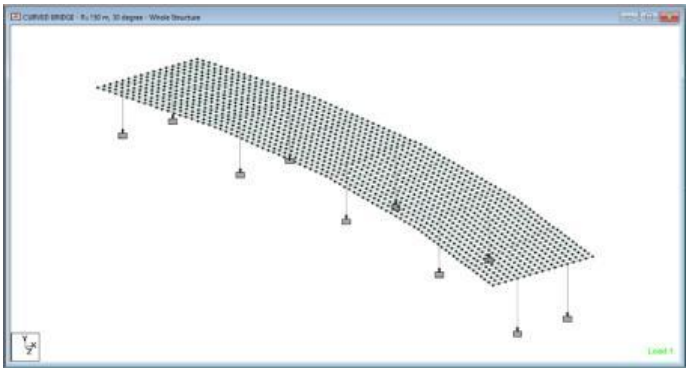
Fig:4,Quadrilateral Meshing (30 degree curved bridge)

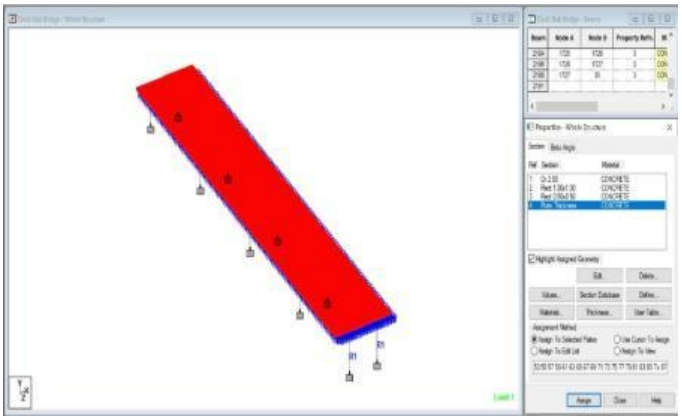
Fig:5, Plate section (normal bridge)

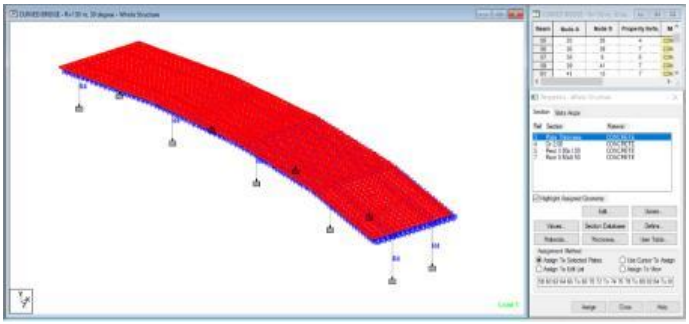

Fig:6,Plate section (30 degree curved bridge)

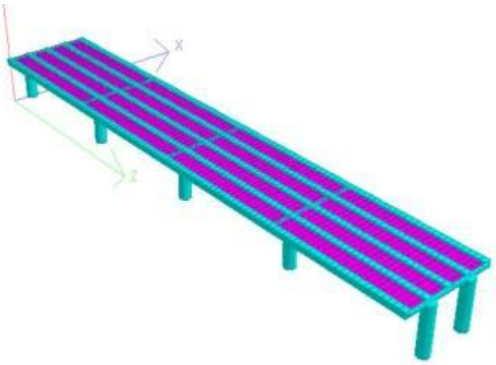

Fig:7, 3D Rendering view (normal bridge)

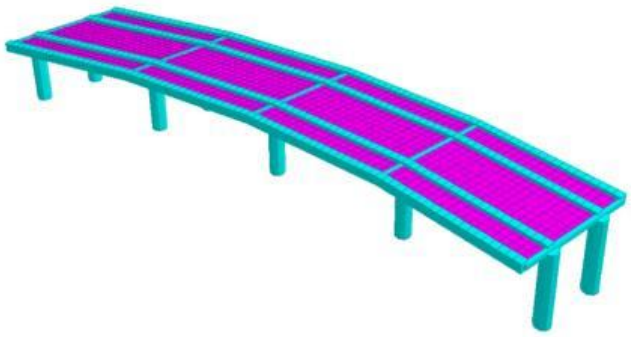

Fig:8,3D Rendering view (30 degree curved bridge)

VI. METHODOLOGY

The models of the bridge are created in the software for analysis.Self weight loads are applied to structure

- Linear static analysis is carried out on the structure and results are noted.
- Then the parameters of study are changed and model is prepared again by giving the curvature as 30 degree.
- Analysis is done and results are tabulated.
- The process is repeated for all the models.
- Comparison of the results is done

VI. RESULT

The models were analyzed separately and results were noted. The results were compared.

Analysis of Normal bridge

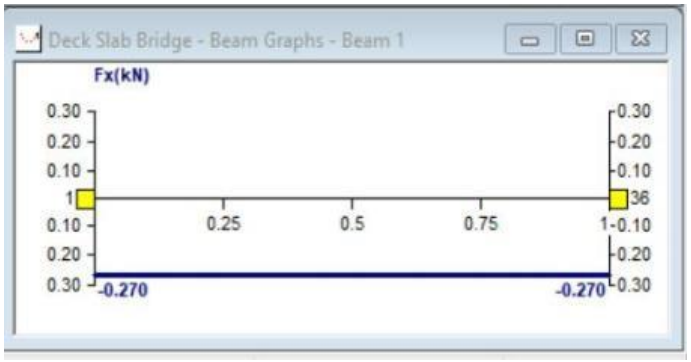

Fig:12, F_x(kN) Reaction on normal bridge

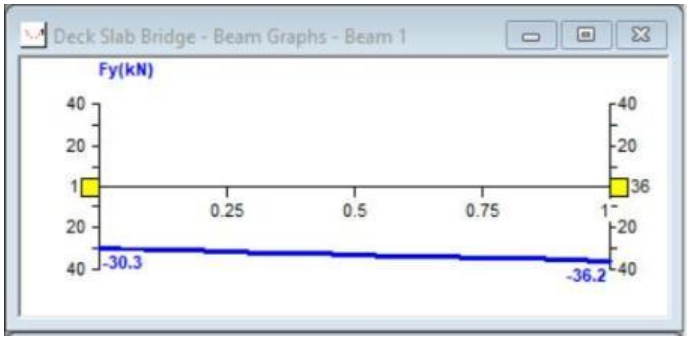

Fig:13, F_y(kN) Shear force on normal bridge

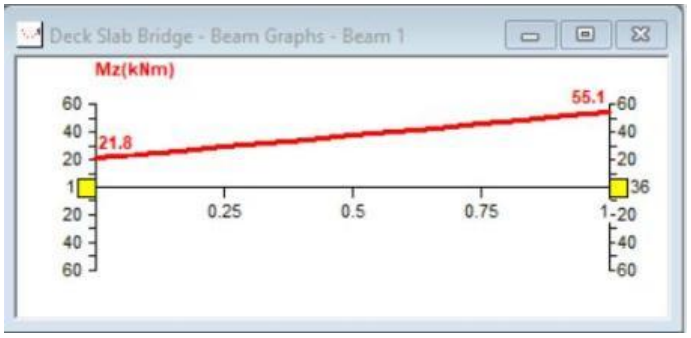

Fig:14, M_z(kNm) Bending Moment on normal bridge

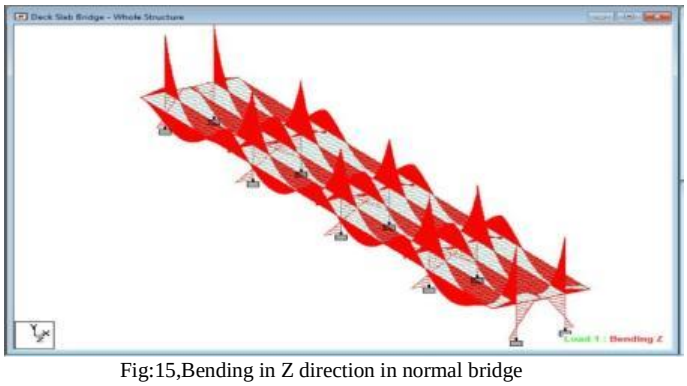

Fig:15,Bending in Z direction in normal bridge

Analysis of Horizontally CurvedBridge(30 degree)

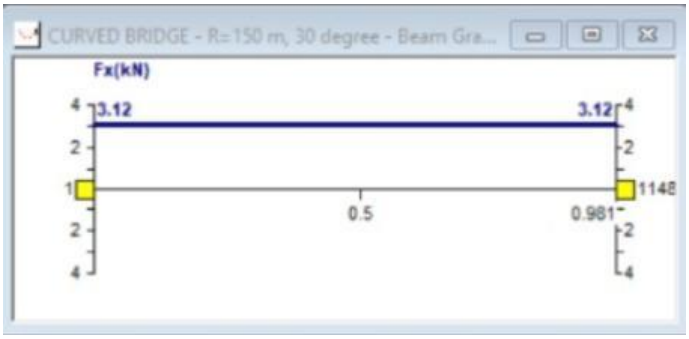

Fig:16,F_x(kN) Reaction on curved(30degree) bridge

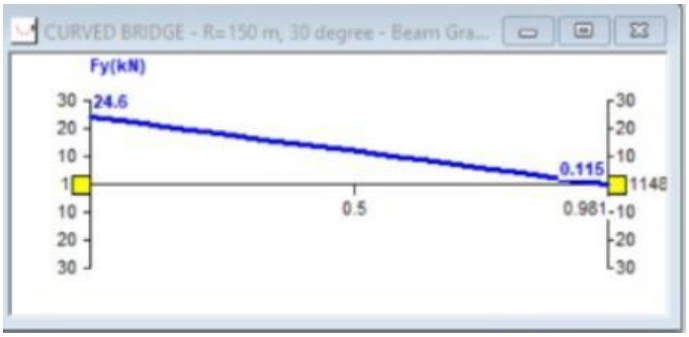

Fig:17, F_y(kN) Shear force on curved(30degree) bridge

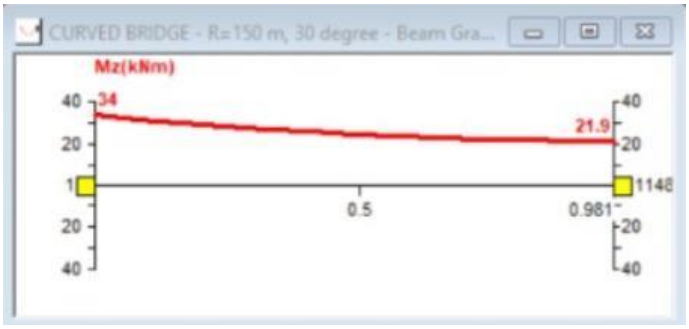

Fig:18,M_z(kNm) Bending Moment on curved(30degree) bridge

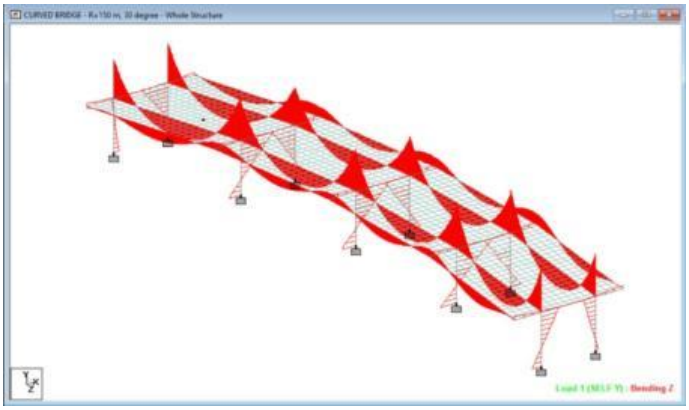

Fig:19,Bending in Z direction in curved(30degree) bridge

Table 2 shows the comparison of the results of both normal and horizontally curved(30 degree)bridge.

Parameters	Normal bridge	Curved bridge (30)
Bending Moment (M_Z)	55.1	21.9
Shear Force (F_Y)	-36.2	0.115
Fx	-0.27	3.12

The result is analysed based on the distribution of the self-weight of both the structures separately.In this the result obtained is that the bending moment and shear force

VIII. CONCLUSION

Themajorconclusionsdrawnfrompresentstudyareasfollows: -

1. The reactions will be more in the case of curved bridge than in normal bridge.
2. The shear force acted upon the normal bridge is much lesser than on curved bridge.
3. The bending moment acting on the normal straight bridge is much higher than on horizontally curved bridge.
4. For the curved bridges, the curvature is considered only when the radius is fixed.
5. For the curved bridges , as the curvature changes the span of the bridge also get varied.The curvature depends on the length of the bridge.

IX. REFERENCES

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