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A REVIEW ON BEHAVIOUR ANALYSIS OF STAYED BRIDGE WITH DIFFERENT CABLE ARRANGEMENT USING STAAD PRO

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ABSTRACT

This work will deal with the crtical review of work done by various authors on design and analysis for different cables arrangement with the different shapes of pylon using STAAD Pro. Various authors made comparison considering shear force, bending moment, displacements for all the cases. The review work will make in respect to the efficiency of one of the arrangements. This can be useful in the modifying the drawbacks of others.

Keywords: Cable stayed bridges, Radial arrangement, Star arrangement and harp arrangement, Tower.

I. INTRODUCTION

Cable-stayed bridge is a bridge similar to suspended bridge in that it has towers and a deck that is held by cables, but its cables hold the deck by connecting it directly to the towers instead via suspender cables. It usually carries pedestrians, bicycles, automobiles, trucks, and light rail. It is used in places where spans need to be longer than cantilever bridge can achieve (because of its weight), but the span is short enough so a suspension bridge is not practical there economically.

A cable-stayed bridge has one or more towers (or pylons), from which cables support the bridge deck. A distinctive feature is the cables which run directly from the tower to the deck, normally forming a fan-like pattern or a series of parallel lines. This is in contrast to the modern suspension bridge, where the cables supporting the deck are suspended vertically from the main cable, anchored at both ends of the bridge and running between the towers. The cable-stayed bridge is optimal for spans longer than cantilever bridges and shorter than suspension bridges. This is the range where cantilever bridges would rapidly grow heavier if the span were lengthened, while suspension bridge cabling would not be more economical if the span were shortened.

II. LITERATURE REVIEW

Mycherla Chaitanya (2018) determined internal forces, stresses and deformation of structure under various load effects. In the present study, Girder Bridge and Cable stayed bridge are modelled and comparative analysis is carried out for dynamically loading conditions. A comparison is made between the bridges for dead load, live load and combined load.

Krunali Mavani (2017) performed the modelling of Cable Stayed Bridges with different pylon configuration. The cable stayed bridge is one of the modern bridges which were built for the longer spans. There is a need of study on the effect of shape of pylon on the dynamic response of cable stayed bridge, for this, the bridge span dimension and other parameters are kept constant, and only the pylon shape is varied i.e. A type, H type, inverted Y type, Single pylon, Diamond or Pyramid shapes & Double Diamond or Spread Pylon shapes. The height of the pylon is also change for all the shapes for comparison purpose. The modelling of bridge is prepared on SAP 2000 software.

Pravin Malwiya (2017) did linear static and nonlinear static analysis using this software SAP2000. Results of cable tension, deck deflection, and base shear are compared for the study of behaviour of cable-stayed bridge.
Pawan Patidar and Sunil Harne (2017) checked the economic status of Plate Girder Bridge (Railway) on various spans keeping one parameter constant and other parameters varying.

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Praveen kumar M et al (2017) evaluated the displacements of the cable stayed bridge deck and pylon under the action of traffic loads and seismic loads. Cable-stayed bridge is an aesthetic icon in the field of Engineering. These long run bridges support the movement of maximum traffic. The Pylons are the load bearing compression members of the bridge. The cables are the diagonal members that channelize the load from deck towards the pylon. Later this load is transferred to the foundation below the pylons. The shape of the pylons and arrangement of cables is chosen in such a way that they should withstand all the various types of loads.

G. Lakshmi Poornima and R. Bharath (2017) studied on optimization of cable stayed bridge with different cable configuration based on connection to the deck and the tower; and the different shapes of pylon (i.e. one axial layer of stays and two laterals of stays) up to failure and evaluates the most suitable configuration of the cable and the tower by using FEM software. The pylons are of two laterals of stays i.e. "A" shape, "Y" shape, "H" shape and one axial layer of stays i.e. circular shape pylon .All the considered shapes of pylon has cross sectional area but is of different shape. The cable configurations are mainly of four types which are based on the connection of cables to the deck and the tower i.e. HARP configuration, FAN configuration, RADIAL configuration, STAR configuration.

Guru prasad D (2016) made comparison of these two bridges are made to find of the most economical bridge for the six traffic lanes. He conclude that three plane cable configuration of cable stayed bridge is economical for the bridges having more width as compared to that of two plane cable configuration.

Shivanshi and Pinaki (2016) considered fan type, semi fan type and harp type cable arrangements. The bridge is designed and analysed for these cables arrangement by STAAD Pro software. The most efficient arrangement is proposed after analysis among three. The comparison is made for Shear force, bending moment, displacements for the cases. The results indicated that the fan arrangement is more efficient then two other arrangement.
G. M. Savaliya (2015) performed the analysis of cable-stayed suspension Hybrid Bridge. Modeling of cable-stayed suspension Hybrid Bridge in SAP2000 software and its validation is carried out. The nonlinear static analysis and modal time history analysis of cable-stayed suspension hybrid bridge is carried out in SAP2000 software. The time period of bridge for different mode shape is presented to compare the result of research paper with Sap 2000 software.

Deep Gupta et al (2016) design and build a bridge at the intersection of NH-58 and Kaliyar road in front of COER. This will eliminate traffic congestion and delay at the highway as well as eliminate conflicts between pedestrians and motor vehicles. In recent years, the interest in solar energy has risen due to environmental concern and also to support green building initiative of College, a solar power generation system also incorporates in the design.

Mohammed Yakub Ali & Gugulothu Swarna (2016) design Bridge where the traffic exceeds more than 2500 vehicles, for the elimination of conflicts between pedestrians and motor vehicles. As an average hourly traffic of more than 2500 vehicles in front of aurora's engineering college where students and other people cross the road. With this high average hourly traffic value, crossing by foot can not only be challenging, but can be dangerous. With this in mind, this project aims to design and build a bridge at the intersection of roads in front of college building. This will eliminate traffic congestion and delay at the highway as well as eliminate conflicts between pedestrians and motor vehicles. We are designing the pedestrian bridge by using staad.pro.

Nikhil R (2017) provided a comparative study on the effects of structural configuration (i.e., shape of pylon and cable arrangement) on seismic analysis of cable stayed bridges. The modelling of bridge is prepared on SAP 2000 software and was analysed as FEM model using non-linear time history analysis. The parameters considered in the study are Base shear, Mid-Span displacement and Tower Head displacement. The study revealed that the fan type cable arrangement and H-shape pylon is found to be effective in earthquake prone areas.

Hussain Hararwala (2016) deals with the modelling of Cable Stayed Bridges with different shapes of pylons. The cable stayed bridge is one of the modern bridges which were built for the longer spans. There is a need of study on the effect of shape of pylon on the dynamic response of cable stayed bridge, for this, the bridge span dimension and other parameters are kept constant, and only the pylon shape is varied i.e. A type, H type, inverted Y type, Single pylon, Diamond or Pyramid shapes & Double Diamond or Spread Pylon shapes. The height of the pylon is kept constant for all the shapes for comparison purpose. The modelling of bridge is

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prepared on SAP 2000 software. For this, the arrangement of cable stay has been taken as semi fan type as well as fan type for the purpose of comparison. The study reveals the following points such as the spacing of cables, the inclination of pylon legs & spacing of intermediate supports which needs to be considered for the modelling of bridge.

T. Pramod Kumar and G. Phani Ram (2015) design of super structure of road cum Railway Bridge across Krishna River proposed on downstream side of existing bridge between Mahanadu road of Sithanagaram and P.N.Bus station, Vijayawada. The bridge is made of through type steel truss which carries two railway tracks at lower level and a roadway of three lane carriage way in the upper level. The span length matches with that of existing nearby Railway Bridge. Analyses of top floor members, truss members and bottom floor members are done using STAAD Pro. The design of structural members of the truss, top floor and bottom floor members is done as per Indian railway standard code and Indian roads congress code.

Aye Nyein Thu (2014) described the structural behaviours of long span cable-stayed bridge with H-shaped tower. 2400 ft main span superstructure of long span cable-stayed bridge with H-shaped tower is analyzed and designed by using SAP 2000 software in this study. This study provides the results of cable tension forces, axial forces, vertical shear and horizontal shear, vertical moment and horizontal moment, torsion, truss girder displacement, support reactions and so on. Necessary design and checking are done according to the specifications of AASHTO

Atul K. Desai (2013) increase the maximum span of cable-stayed bridges has developed a modified static system. The basic idea of this new concept is the use of pairs of inclined pylon legs that spread out longitudinally from the foundation base or from the girder level. Spread-pylon cable-stayed bridge has distinct advantage like reduction of sag of cables and oscillation of cable during earthquake over traditional cable-stayed bridges.

Ghanshyam M. Savaliya (2013) studied the behaviour of the1400m central span cable-stayed bridge and 1400m central span suspension bridge is studied in this paper. The analyses of the differently configured bridges are carried out in SAP2000. The results are presented and validated is carried out by comparing the time period of the analysed bridges with the available data in literature.

III. PROBLEM STATEMENT

Because of their large size and nonlinear structural behaviour, the analysis of these types of bridges is more complicated than conventional bridges. In these bridges, the cables are the main source of nonlinearity. An optimum design of a cable-stayed bridge with minimum cost while achieving strength and serviceability requirements is a challenging task.

In our work, cable stayed bridge is analysed by changing the cables arrangement each time, to obtain the results for bending moment, forces, deflection. The bridge is analysed by the commercial finite element based software STAAD Pro.

IV. CONCLUSION

A typical cable stayed bridge is a deck with one or two pylons erected above the piers in the middle of the span. The cables are attached diagonally to the girder to provide additional supports. The pylons form the primary load-bearing structure in these types of bridges. Large amounts of compression forces are transferred from the deck to the cables to the pylons and into the foundation. The design of the bridge is conducted such that the static horizontal forces resulting from dead load are almost balanced to minimize the height of the pylon. Cable stayed-bridges have a low center of gravity, which makes them efficient in resisting earthquakes. Cable stayed bridges provide outstanding architectural appearance due to their small diameter cables and unique overhead structure.

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