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A STUDY ON VIBRATION CONTROLLER AND SEISMIC RESISTANT CABLE STAYED BRIDGE WITH MODEL

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ABSTRACT

This work leads the review about the seismic behaviour and different mode of vibration of cable stayed bridge. The system of bridge is more vulnerable toward the seismic resistant which was estimate in San Fernando (1971), Loma Prieta (1989), Northridge (1994), Kobe (1995), and Taiwan (1999) earthquake . With the help of wooden logs, eventually stone and cross beam the first bridge was maked by human in India. After some year with the help of trees and bamboos poles another bridge constructed by "American". Stronger bridges were constructed by "Mughal" administration in India with using iron and plaited bamboo in the 4th century. A cable stayed bridge can use for long span with different types of pylons like A type, H type, inverted Y type, Single pylon, Diamond or Pyramid shapes & Double diamond or Spread pylon shapes. In our work we have inserted a mechanical device as well as vibration indicator and seismic controller in model. With the help of this model and work we are able to get the information about vibration of bridge and their components when exceeding from their permissible limits of vibration or at the time seismic effects when the forces acting in horizontal direction. For seismic resistant we have maked a mechanical shock absorber in the foundation of bridge, which help in showing good performance under the different intensity of vibration.

Key Word: Base (foundation), Cable stayed bridge, Deck girder, Pylons, Steel Cable

I. INTRODUCTION

The concept of Cable Styed Bridge with girder which is supported by cable was first introduced in 17th century**.** A lot of cable stayed bridge has been successfully constructed with different shape of pylon across the India in the last decay of 20th and 21th century. After the Second World War a new concept of cable stayed bridge was developed with including deck which is rested on piers of bridge. In a hydraulic structure if the deck is supported by a multiple cable that runs from main girder to the tower of bridge is called "Cable Stayed Bridge". The compressive force on bridge in the form of dead load and live load is transferred to the tower, tower is responsible to absorb and transfer these load to the ground effectively and efficiently. In the second half 20th century cable of cable stayed bridge was designed in such way that it offers more stiffness, strength and stability property. Due to addition of this property a computer aided program added to reduce the calculation as well as

to measure the vibration of cable in the bridge. Cable stayed bridge having a strong beam for full span of bridge with more pillar (tower) in the middle or at end. The advantage of cable stayed bridge is that it most suitable for the span varies from 200 m to 900 m with free cantilever which provide more stiffness and stability. A cable stayed bridge constructed by prestressed concrete which is most suitable for high span with long life period .The demolition of prestressed structure is more hazards, A professional and experience industry feed required for demolition of cable stayed bridge. If the span of cable stayed bridge will increase then internal force and displacement along the girder will huge. Both lateral and vertical stability of cable stayed bridge is the important factor when the span of bridge increases from 400 m (Tang, 1976 and Ermopoulos, 1992).Now the construction of cable stayed bridge is going to increase day by day due to rapid development and modernization with availability of different types of construction material .Today following types of cable stayed bridges is going to use:

(1) A Cable Stayed Bridge

(2) Cantilever Cable Stayed Bridge

(3) Multi Span Cable Stayed Bridge

(4) Extradose Bridge

(5) Cable stayed Cradle- System Bridge

1.1 Component of Cable Stayed Bridge

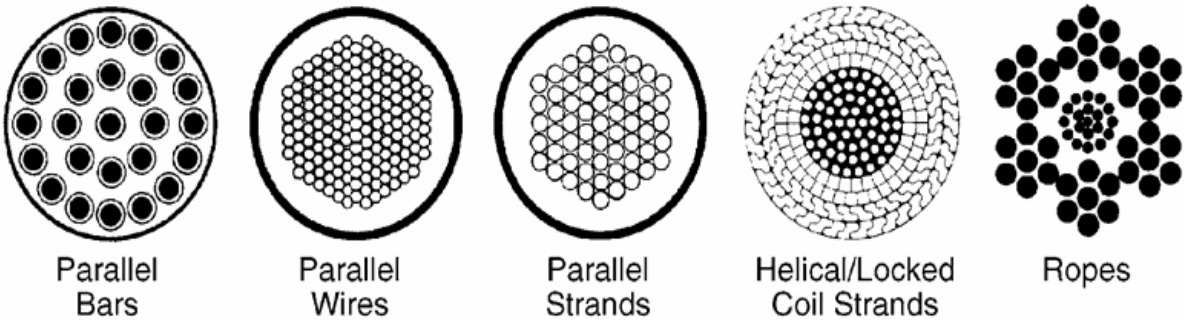

Figure 1. Types of Cable used in Cable Stayed Bridge

1.1.1Cable

It is composed of one or more than one wire with strand wire system. The cables used in stayed bridge was maked by thousands of parallel high-strength steel wires with diameter is about 5 mm and the core of the cable consists of closely-packed galvanized steel wires.

1.1.2 Pylons

It is tower like structure which transfer the load from girder to cable then pylons then ground .In the model we have used harp types of pylons which giving supported the deck girder of the bridge at the both end near the approach.

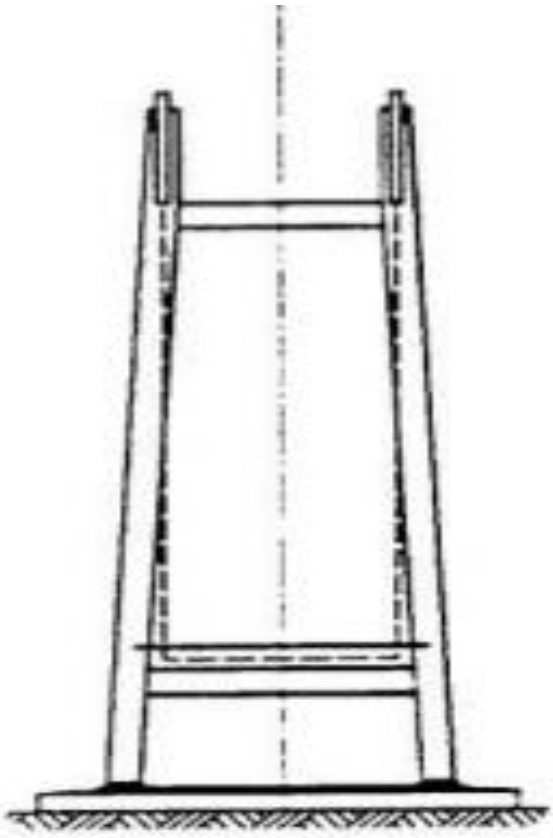

Figure 2 Harp type Pylon

1.1.3 Deck

The deck of the bridge maked by ply wood in our model which is able to take the load due to vibration as well as dead load.

II EXPERIMENTAL PROGRAM

To analyse the behaviour and stability of cable stayed bridge we have prepared a model with the help of different shock absorber material which are able to bear the vibration force due to effects of earthquake and a special take care was taken as per seismic code like IS 4326, IS13920 etc. during the making of foundation so that vertical and horizontal movement can possible in superstructure and substructure of the bridge which is providing more stability to bridge during the earthquake. In the foundation we have added a setup of electrical device by the help of this device we are able take the indication during the vibration of structure when their mode of vibration is more than the permissible limit of vibration of bridge. The following material was used

2.1 Base with Flexible bearing

In cable stayed bridge model we have inserted a mechanical shock absorber in the form of spring. The lower end of the pylon is fixed with base and flexible shock absorber acted as intermediate material between base and pylons of bridge. Due to the flexibility of spring pylons are able to move in horizontal direction as well as vertical direction.

Figure 3 Flexible Base with Electrical Setup

2.2 A setup of Electrical Device: In the base (foundation) we have fixed a setup of electrical device which was used to control the intensity of vibration as well as indicator fitted above the pylons. The intensity of vibration can control by speed controller with the help of this assembly we are able to safe the thousand human life and loss of economy.

2.3 Seismic and Vibration Indicator: By the help of this device we are getting three type of indication first at moderate vibration with "Green light" second at medium vibration with "Yellow light" and third at high vibration with "Red light" .

2.4 Assembly of cable with Pylon: In case of field assembly first cable stretched then welded together with bridge and lifted in position**.** The strands of wire collectively stressed with the help of hydraulic jack. These cables are fixed with pylons with the help of anchorage and cup cone system.

III RESULTS AND DISCUSSION

The impact of earthquake on human life and structure like bridge, multistorey building, liquid storing container, bunker etc . is very poor which was seen in last few years. The main aim of this work to protect structural damages and reduce the losses in the form of human, money. Throughout the world a large number of bridges have been collapsed due to seismic effects, use of poor quality of material, improper layout, vibration effects, use of less tensile strength of cable etc. The following data showing that the number of bridge collapse due many reason in India. But these data is based on probabilistic basis this number can increase or decrease.

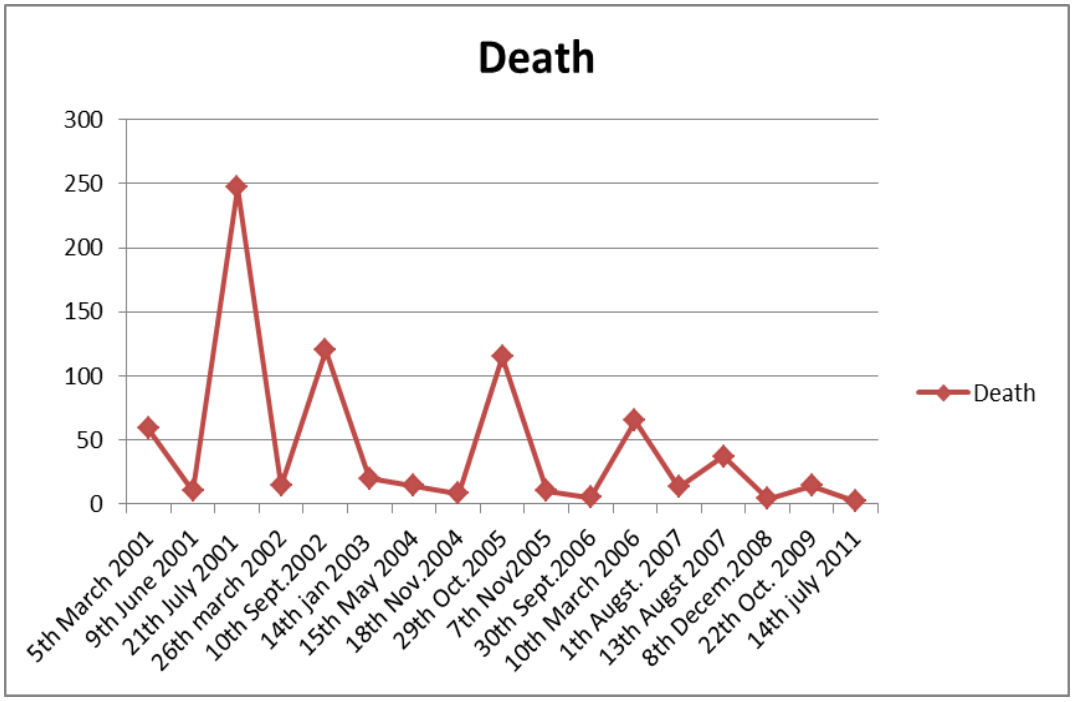

Figure 4 Number of collapsed bridge (X- axis) and number of death (Y-axis)

The above data showing that the number of collapsed bridge as well as death is decreases when the years increase because development of technology and good quality of material used.

IV. CONCLUSION

A lot of investigation contributed toward this work to control the vibration and get their indication when bridge vibrates more than their permissible limit. This works provides an analysis of the aesthetic and structural and vibrational properties of the cable stayed section .The increase in span increases the axial tensile force in the cable. By this work we are able to get the information about vibration of bridge as well as their components when exceeding from their permissible limits of vibration or at the time seismic wave, force acting in horizontal direction. In future if it is possible to make the Cable stayed bridge on this concept then we can save a lot of life, money, time period and utilization of materials in the form of cement , sand , steel ,aggregate etc.

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