OPTIMIZATION AND ANALYSIS OF CABLE STAYED BRIDGES

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Abstract: This paper deals with the study 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.

Key Words: Cable configurations, shapes of pylon (based on one axial layer of stays and two laterals of stays).

I INTRODUCTION

Cable stayed bridges date back many centuries; the system was used **by** Egyptians for their sailing ships. Early Chinese people used the cable-stayed system to construct suspension bridges out of hemp rope and iron chains**.** There are many other examples of ancient cable-stayed bridge systems found around the world.

The first modern bridge structures were a combination of a suspension and stayed system. They were constructed at the end of the eighteen-century in the United States and in England.F. Dischinger identified the need to increase the stress in the cables so as to reduce the sag effect in the stiffness. This advancement gave the impulse to modern cable based structures. In **1955** he built the Stromsund bridge, located in Sweden, which is considered the first modern cable stayed bridge**.** Another important factor in the evolution of cable-stayed bridges was the employment of superstructure sections that act as a continuous girder along the longitudinal axis. With these improvements, modern cable-stayed bridges became very popular in the last thirty years. Significant illustrated milestones are the Theodor Heuss bridge in **1958,** the Schiller-Steg footbridge which was constructed in Germany in **1961,** the Maracabio Bridge constructed in Venezuela in **1962.**

II EXPERIMENTAL STUDY

1.Harp or parallel system:The cables are parallel to each other and are connected to the tower at different heights. The aesthetics of this kind of configuration are very pleasant. However, the compression in the girder is higher than the others patterns, and the tower is subjected to bending moments (Figure 2.1) **.**

2.Fan System:This is a modification of the harp system; the cables are connected at the same distance from the top of the tower. The fan system is attractive for a bridge where the longitudinal layout is a single-plane, because the cable slope is steeper, it needs and consequently the axial force in the girder is smaller **[7]**

3.Radial System:With the radial configuration, all the cables connect to the top of the tower. This is a convenient cable configuration because all the cables have their maximum inclination; therefore the amount of material required in the girder is reduced **.** However, this configuration may cause congestion problems and
the detailing may be complex (figure **2.3).**

4.Star System:With the star configuration, all the cables connect to the two opposite end points on the deck. This is a convenient cable configuration because all the cables have their maximum inclination; therefore the amount of material required in the girder is reduced**.** However, this configuration may cause congestion problems and the detailing may be complex (figure **2.4).**

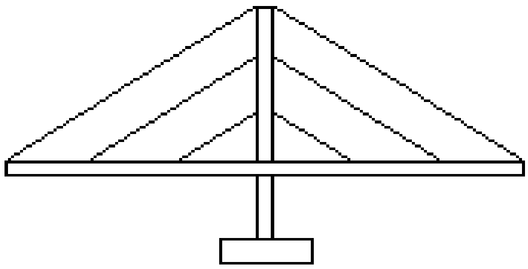

Figure 2.1: Harp System

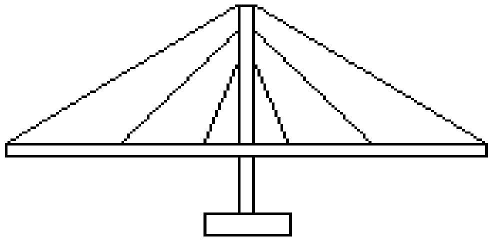

Figure 2.2: Fan System

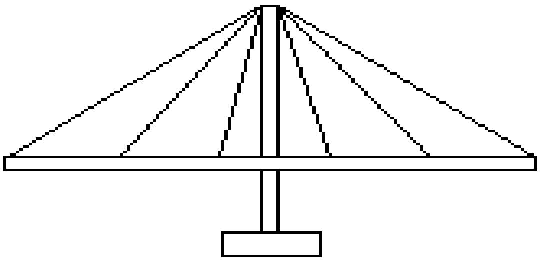

Figure **2.3:** Radial System

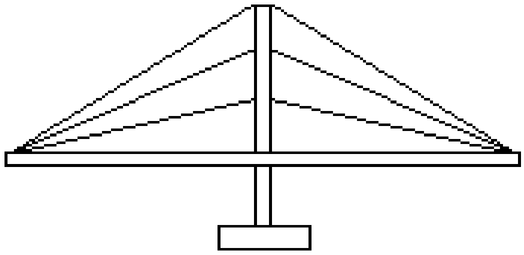

Figure **2.4:** Star System

TOWER TYPES:The tower shape is mainly selected for aesthetic reasons, and is refined based on proportions, materials, and restrictions associated with the tower design. **A** considerable variety of tower shapes exist. In general, the shape of the tower is governed **by** the required height and the environmental loading conditions, such as seismic zones and wind criteria. The towers are classified according to the basic forms shown in figure **2.5** .

The towers are subjected to axial forces. Thus they must provide resistance to buckling. **A** more sophisticated analysis of the tower includes the non-linear P-Delta effect**.** In addition, the tower strength also has to be checked under lateral loads and second-order effects (non-linearity) produced **by** tension in the cables.Box-sections are most frequently used for the towers. They can be fabricated out of steel or reinforced or prestressed concrete. Concrete towers are more common than steel towers because they allow more freedom of shaping, and are more economical**.**

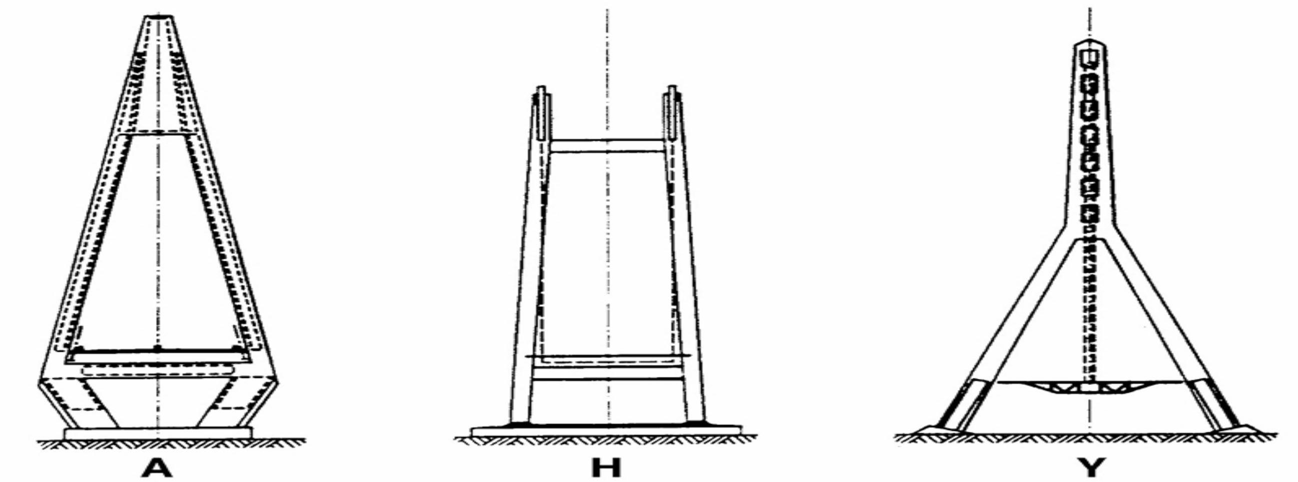

Figure2.5: Tower configuration

IV EXPERIMENTAL PROCEDURE METHODOLOGY

Analysis of the bridge: The cable stayed bridge can be analysed up to its failure by using software by different pylons is of having same cross sectional area…

- Total span=160m

- Width of the deck=10m
- Width of the road way=7.5m (two lane)
- Number of cables=34
- Spacing of cables=4.7m
- Deck slab thickness=180mm
- Wearing coat thickness=70mm
- Longitudinal girders (2no.s)= 600*800mm
- Cross girders@3mc/c= 450*800mm
- Total height of the pylon = (L/4.7)
- Height of pylon above road way= (L/7)
- Diameter of circular pylon= 1.42m
- Cross section details of rectangular pylon:
- Pylons=1.05*0.75
- Connecting beam at top=0.86*0.75
- Connecting beam at bottom=1.05*0.75

CIRCULAR, A SHAPE, H SHAPE, Y SHAPE PYLON WITH HARP CABLE CONFIGURATION MODELS IN SAP2000