PERFORMANCE OF DOUBLE PYLON CABLE STAYED BRIDGE WITH DIFFERENT CABLE PROFILES

Dr. Bhushan H. Shinde [1] Chetan Prakash Patil[2]

[1]*Asst. Professor, Department of Civil Engineering, G.H. Raisoni Univrsity, Amravati.(M.S.)*

[2]*Post Graduate Student, Department of Civil Engineering, G.H. Raisoni University, Amravati.(M.S.)*

ABSTRACT: *Cable stayed bridge is widely used in modern says of construction works due to its good structural appearance as well as uniqueness .This works deals with comparative analysis of double pylon cable stayed bridge for long span with different cable profiles. Pylon profiles „Harp type", „Fan type" and „Semi fan" are considered. For analysing MIDAS CIVIL is used. Parameters like axial force in cable and pylon as well as bending moment, shear force and deformation in pylon are analysed and determined at critical nodes.*

Keywords: Cable profile, MIDAS CIVIL, IRC-6-2016, Cable stayed bridge , Pylon ,Bending moment ,Shear force, Deformation..

1. INTRODUCTION

Bridges are defined as structures, which provide a connection or passage over a gap without blocking the opening or passageway beneath. conveyors. Type of bridge which has one or more towers (or pylons), it has cable support to the bridge deck, cables hold the deck by connecting it towers, these bridge is called as cable stayed bridge .These bridge are very economical for long spans. A distinctive feature are the cables or stays. Which run directly from the tower to the deck, it normally forming fan like pattern. Cables are made of high strength steel and it covers in a plastic or steel. Steel covering that is filled with grout and fine grained form of concrete for protection against corrosion. A strand can be used as an individual load carrying member, where the radius or curvature is not major requirement.it is component in the manufacture of the structural rope.

Types of Cable Patterns

I. Harp arrangement: The cables are made nearly parallel by attaching them to different points on pylon.

II. Fan arrangement:

In this pattern all the stay cables are attached to a single point at top of each pylon.

III. Semi fan arrangement:

It is a combination of radial & harp type.

Effect of spatially variable ground motions on the towers of cable-stayed bridges with 200, 400 and 600 m main spans was considered. Seismic analysis of the bridges was performed, taking account of different sources of the spatial variability, namely; incoherence and wave passage effects. This paper examined the effect of the SVGM on the towers of cable-stayed bridges with 200, 400 and 600 m main spans. Different wave propagation velocities in the range 250-2000 m/s are considered, to account for the propagation.[1]. While some author considered a single-tower double-cable-plane bridge, and the gulf nearby the bridge is in a typical typhoon-affected zone. Therefore, modal analysis of the cable-stayed bridge should be carried out.Therefore, the finite element model needs to be validated and corrected in the future[2].Also discussion the results relative to the dynamic load tests on the new cable-stayed bridge in Bari (Italy) is done. The results obtained for the damping factor show relatively low values, equal to 0.294% for the predominant mode and 2.43 % for the lowest mode. These values are close to the values considered to be normal in the scientific literature, between 0.5% and 2 %[3]. Programs of tensioning cables were introduced and test results during tensioning showed in this research paper. The study on the application of the first cable-stayed bridge with CFRP cables in China was carried out[4]. Analysis at construction stage of Nagpur stayed bridge was done. It is actual three lane cable stayed bridge in Nagpur known as ‘Ram Jhula’ .they present simple technique cantilever arm of CFT during the construction of deck. Cable stayed bridge is highly indeterminate structure .initial pretension cable forces are found out using load factor method. They also studied considering time dependent material property like creep and shrinkage is also carried out using MIDAS civil software. Various parameter like cable forces, deflection, axial force, bending moment etc. are studied for various construction stages [5].Consideration on advancement of cable stayed connect with various cable setup dependent on association with the deck and the towers and the various states of arch was done. The arches are of two laterals of stays for example "A" shape, "Y" shape, "H" shape . H shape with harp and the fan shape setup is the best design[6]. Dynamic analysis was done on coupled road vehicle and long span cable- stayed bridge system under cross winds. The vertical and lateral ride comfort of the concerned road vehicle running on the bridge subjected to cross winds can meet the specified comfort criteria when the vehicle speed and mean wind are 80km/h and 15.0m/s, respectively[7].Time-History Analysis of a Cable Stayed Bridge for Various Spans and Pylon Height was studied. Seismic Protection is a fundamental issue when it comes to high seismic risk areas design. This article provides information on time history analysis of a cable stayed bridge for various spans of the bridge and pylon height[8]. After effects of nonlinear static investigation and modular examination completed utilizing SAP2000 [9]. Analysis of static and dynamic load for cable stayed bridge of fan type arrangement eas carried out.The analysis were done with all the cables under normal condition, different percentage of corrosion of one cable and the failure of one cable due to excessive corrosion[10]. Furthermore, the response of the structural model is discussed for multiple types of cable loss cases. Two different progressive collapse patterns are identified for nonlinear static and dynamic procedures as the dynamic unloading function is considered in the dynamic analysis procedure[11]. Asynchronous and stochastic dynamic analyses of a cable-stayed bridge are carried out using the finite element method[12]. Incorporated structure for seismic examination of long-range link stayed spans was studied[13]. The effects of random road surface roughness on the impact effects on cable-stayed bridge due to moving vehicles are investigated[14]. The concept and design of bridges has been evolved over the past years, having numerous amounts of different geometrical models and methods to construct bridges[15]. structural monitoring of cable stayed bridge during rehabilitation was done [16].In the part of seismic analysis, the time history analysis done and took data of 1940 El Centro earthquake so the nonlinear dynamic behaviour of four bridges investigated[17].

2. RESEARCH SIGNIFICANCE

To know the performance of pylon cable stayed bridge it is required to evaluate its strength and deformation. For that the cable stayed bridge is analysed for bending moment, shear force, axial force and deformation .To minimize the structural instability for long span (>200m) bridge is to be design with double pylon. In this analysis cable forces and pylon forces at critical nodes are to be determined using MIDAS Civil. Also bending moment, deformations and shear force is to be found for critical node using MIDAS Civil. After getting results for all parameters , comparative study for different shape of pylon cable will be done. Thus, conclusion can be drawn regarding which type of pylon cable profile is most efficient and least efficient from structure point of view.

3.METHODOLOGY

Models of cable stayed bridge are generated with different type of pylons in MIDAS CIVIL 2019. Firstly, materials and section properties of cable stayed bridge are defined. Then Assign load in the model. Assigning vehicle definition by selecting vehicle data base, provide IRC Class 70 R wheel loading. As per IRC6: 2016 & IS 1893:2016 Part 1 all load combination & response spectrum factors are applied. After generating load click on ok & go to modelling, expand all load case details. Then corresponding parameters like axial force in cable and pylon as well as bending moment, shear force and deformation in pylon are determined at critical nodes.

4.MODELLING AND RESULTS

4.1 TYPE OF CABLE PROFILES.

Depending on shape of pylon cable , there profiles are defined. Keeping all sectional and material properties of bridge same , there shapes are varied and analysed..

Following three profiles of cables are considered.

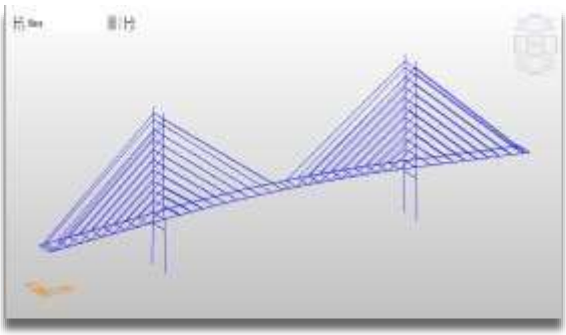


Figure 1: Cable profile-Harp type

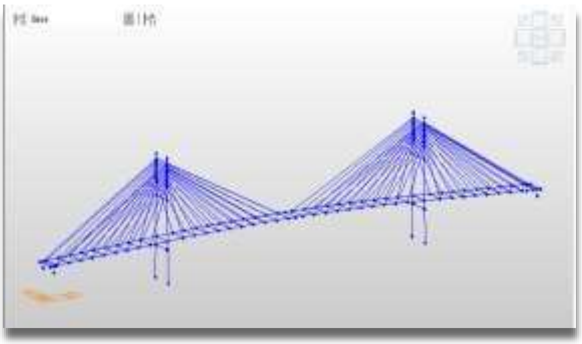


Figure 2 : Cable profile-fan Type

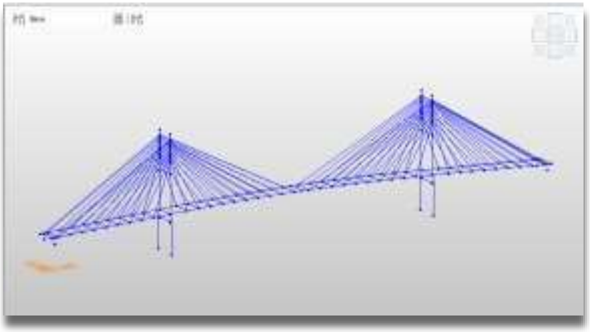


Figure 3 : Cable profile-semi fan Type

4.2 SPECIFICATION

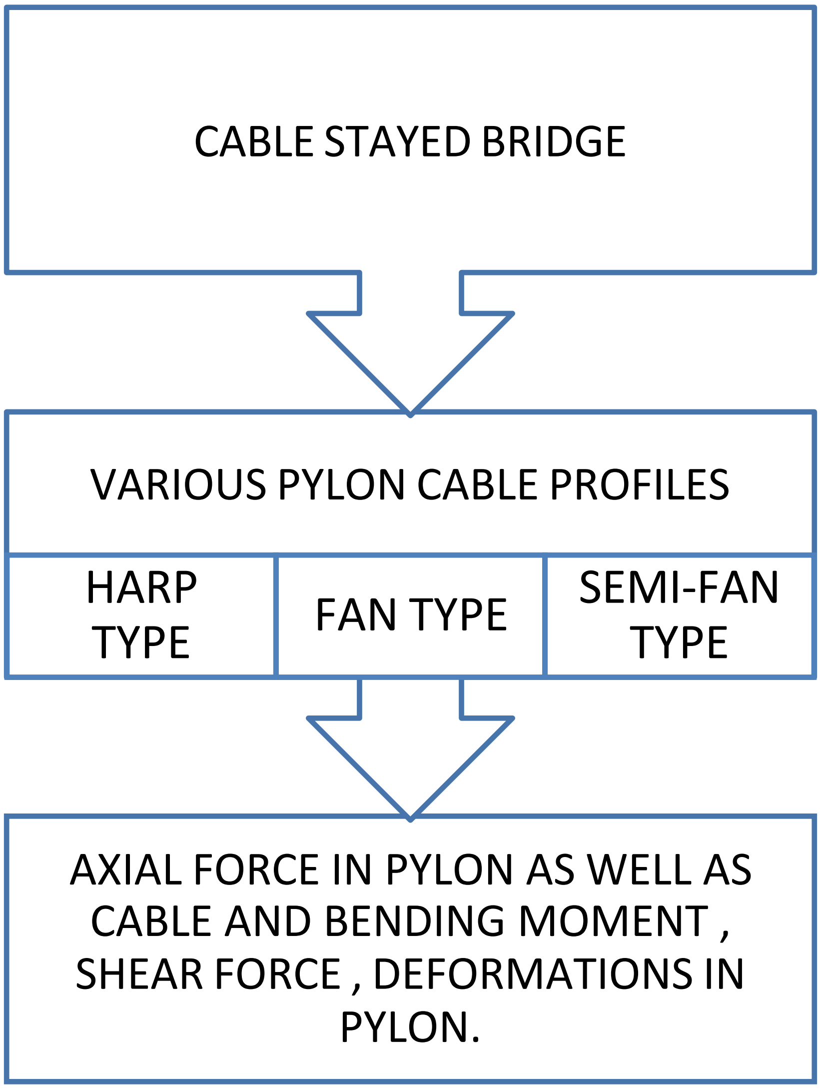
Total Span of Cable Stayed Bridge is taken as 420 m with carriage way width = 14 m and height of pylon above and below deck slab level is 65m and 25m respectively. Center to center distance between cross girder is 5.72 m . Diameter of pylon is taken as 1m .Cross section of longitudinal and cross girder 0.40x0.60m , 0.40x0.6m .Thickness of deck slab is 0.3 m and diameter of Cable is 0.3 m

4.3 SECTION DETAILING

TABLE 1: Section detailing of various components of bridge

Section ID	Name	Area (m^2)	Ixx (m^4)	Iyy (m^4)	Izz (m^4)
1	Cable	0.0052	0.0	0.0	0.0
2	Girder	0.3092	0.007	0.1577	4.7620
3	Pylon	9.2000	19.51	25.5670	8.1230
4	CBeam_Girder	0.0499	0.0031	0.0447	0.1331
5	CBeam_Pylon	7.2000	15.79	14.4720	7.9920

4.4 FLOW CHART



4.5 RESULTS

Using Midas civil , various parameters are determined at critical node .Axial force in pylon and cable as well as bending moment , shear force and deformation are determined for harp type, fan type and semi fan type. Accordingly table is drawn as shown table 2 . From obtained results, graphical representation of axial force in pylon and cable as well as bending moment , shear force and deformation are shown in for harp type, fan type and semi fan type are plotted.

TABLE 2: AXIAL FORCES , MOMENT AND DEFORMATIONS IN VARIOUS PYLON CABLE

SR. NO.	PARAMETERS	HARP TYPE	FAN TYPE	SEMI FAN TYPE
1	MAX. FORCE IN CABLE (kN)	1030.20	915.48	882.30
2	MAX. FORCE IN PYLON (kN)	32553.00	32625.00	29402.00
3	MAX. BENDING MOMENT(kN.m)	6650.25	5234.30	4795.34
4	MAX. SHEAR FORCE (kN)	1714.84	10802.52	669.95
5	MAX. DEFORMATION (mm)	23.60	20.77	5.60

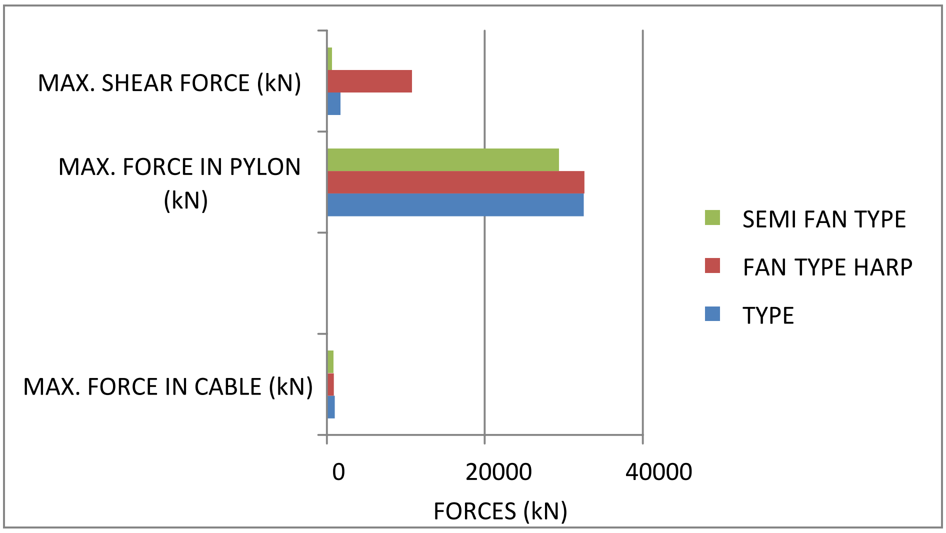


Figure 4 : Graphical variation of forces

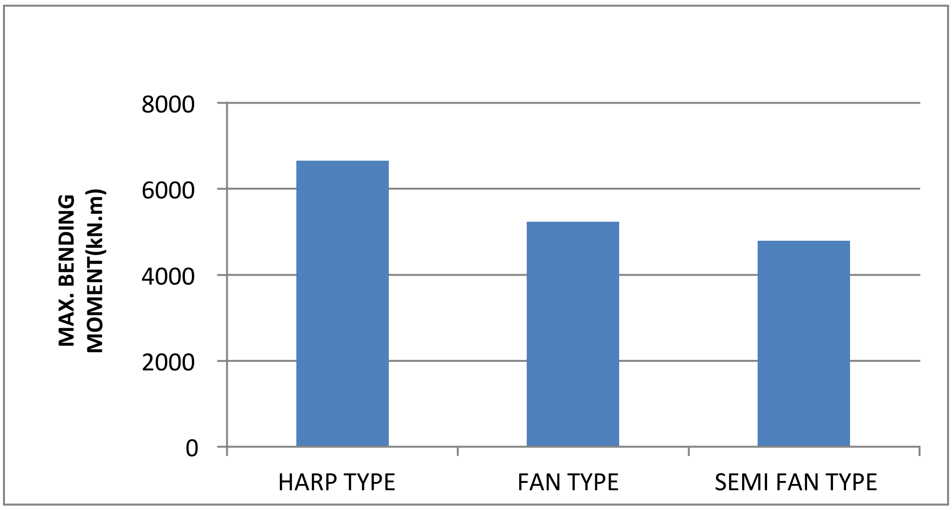


Figure 5 : Graphical variation of bending moment

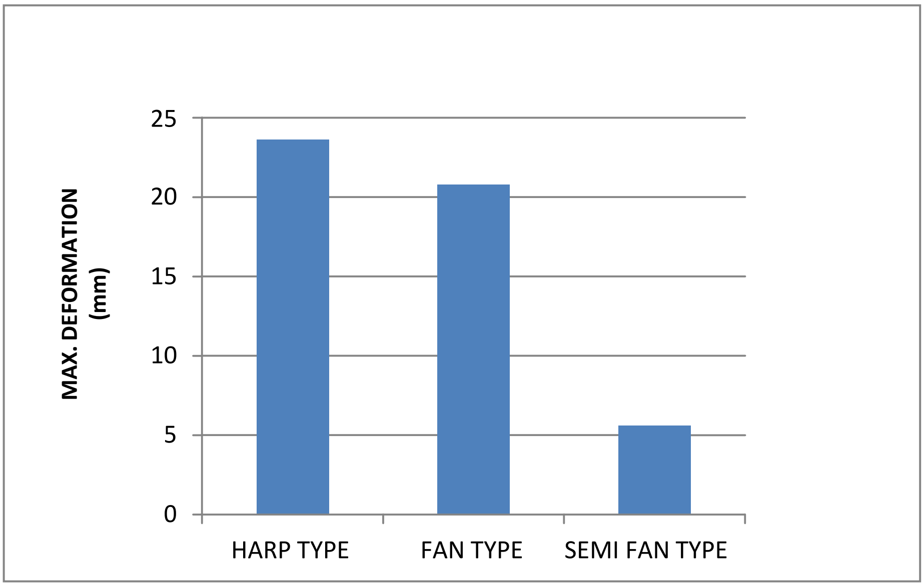


Figure 6 : Graphical variation of deformation

DISCUSSION

In fig 4, graphical variation of axial force in pylon and cable as well as shear force for harp type, fan type and semi fan type is shown. It can be noticed fan type is subjected to more shear force than other and it is least in semi fan type. Also it is found that force in pylon is nearly same for harp and fan type . Force in pylon is least in semi fan type .Thus force in pylon for harp type and fan type are more as compared to semi fan type. It can be noted that forces in cable for semi fan type and fan type is same . While for harp fan type it is slightly greater than fan type and semi fan type. In fig 5 , graphical variation of bending moment for for harp type, fan type and semi fan type is shown. It is observed that harp type is subjected to more bending moment and least in case of semi fan type . In fig 6, graphical variation of deformation for harp type, fan type and semi fan type is shown. Least deformation occurs in semi fan type. Also it can be noted that harp type has more deformation than fan type and semi fan type. Harp type deformation is considerably more as compared to semi fan type.

3. CONCLUSION

Axial tension force of Cables in Harp type exposed to 14% and 11% more tension than fan type and semi fan type respectively. Also axial force of pylon in fan type is nearly 10% less than harp less than harp and semi fan type.Harp type maximum Bending moment is 27% and 21% more than Semi fan and Fan type respectively. Semi fan type has 60.93% and 93.79% less value of maximum Shear force than Harp and fan type respectively. Semi fan type has 76.27% and 73.03% less deformations than fan type and harp type respectively.Thus overall, Semi fan shape appears to be most efficient among all profiles.

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