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Analysis of Different Shapes of Pylon on Extra Dosed Bridge

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***Abstract*—Bridge eases the mode of transportation by providing ways to cross the obstacles. Bridge not only helps us to commute from one place to the other but also let us create a passage through impassable objects. Extra dosed bridges are the bridges which have properties in between girder bridge and cable-stayed bridge. These bridges follow the robustness and rigidity of box girder bridge and aesthetics and modernity of cable stayed bridges. They tend to have deeper girder and lower tower height as compared to other bridges. In this paper, analysis of different shapes of pylon like A-Shape, H-Shape, and inverted Y- Shape on Extra dosed bridge is done under static and dynamic loading. The CSI BRIDGE software has been used for modeling and analysis. Analysis of static load, dead load, and moving a vehicular load on the bridge is done. Models are made keeping the structural property and dimensions same, the only change is made in the construction of shape of a pylon. This paper would be helpful for the selection of the appropriate shape of the pylon for Extra dosed bridges. The results have shown that most of the response quantities for inverted Y pylon shape are less as compared to other pylon shapes considered in this study. Hence it is concluded that inverted-Y pylon shape is statically and dynamically stronger than any other pylon shapes under the action of loads considered in this study.**

***Index Terms*—Pylon shapes, Cable-Stayed Bridge, Girder Bridge, Extra dosed Bridge**

1. INTRODUCTION

The word intrados refers to the interior curve of an arch whereas extrados refers to the upper surface of the arch. Concept of Extra dosed bridge first came into existence in 1988 by James Mathivat.

The Extra dosed bridges are the bridges which have properties intermediate between the cable-stayed bridge and girder bridge.

They impart the strength of the girder bridge and the aesthetics of the cable-stayed bridge. In Extradosed bridges, the ratio of the girder height to the span length (H/L) lies between 1/15 to 1/35, while it is 1/15 to 1/17 for box girder bridges.

1.2 Pylons

Pylons are the principal structural element in the Extra dosed bridge as they transmit the live and dead load of the bridge deck to the foundation. The pylons are also provided in the Extra dosed bridges for supporting the cable system.
The height of pylon is approximately half as that of a cable-stayed bridge, hence they are easier to construct and economical too. Pylons are subjected to axial loading hence they must provide resistance to buckling.

Due to freedom of shaping and economical viability concrete towers are preferred over steel pylons. Different shapes of pylons constructed are A shape, H shape, Inverted Yshape, etc.

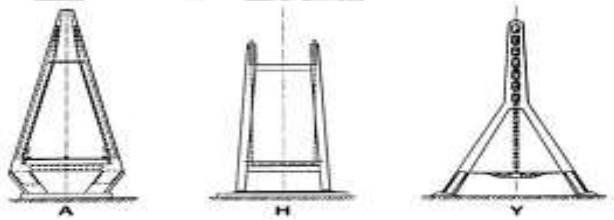

Figure 1.1 Shapes of Pylons

2. MODELING AND ANALYSIS

Three different models of the bridge have been created and analyzed with the help of CSI BRIDGE software.
The shape of the pylons has immense potential to reduce or increase the response of the bridge under certain types of loading.

According to structural analysis and design requirements of the structure, "the shape of the structural member or the whole structure which possesses more resistance to applied loading is preferred".
Hence it is necessary to conduct a study on Extra dosed bridge for different loadings with various pylon shapes in order to come up with the optimal shape of the pylon.

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2.1 Structural Details Of The Bridge

S. No.	Structural Part	Dimensions
1.	Bridge type	Extra dosed bridge
2.	Length of bridge	200m
3.	Width of carriageway	7.5m
4.	Depth of deck	400mm
5.	Height of pylon	20m
6.	Pylon type	A, H and Inverted Y
7.	Section of pylon	Rectangular cross section
8.	Number of Pylons	2
9.	Deck type	Box type deck
10.	Longitudinal girder	600mm*120mm
11.	Cross girder	500mm
12.	Spacing of cables	6m
13.	Cable arrangement	Fan type
14.	Number of cables	40
15.	Loading as per IRC 6:2017	Class 70R wheeled
16.	Concrete	Grade M45
17.	Steel reinforcement	Grade Fe500
18.	Cables	200N/mm^2
19.	River discharge	30 cum
20.	Cables diameter	0.2 m

3. BRIDGE MODELS

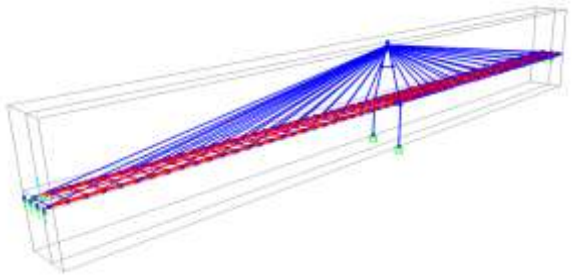

Figure 3.1a Extra dosed bridge model with A shape pylon

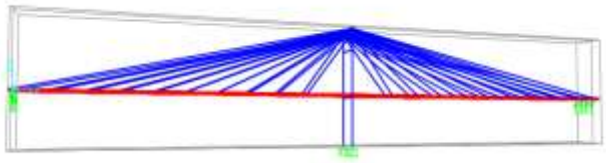

Figure 3.1b Extra dosed bridge model with H shape pylon

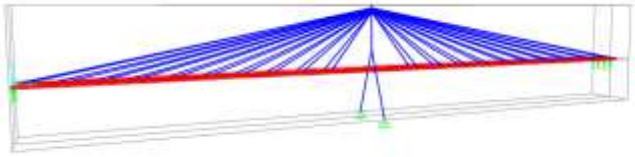

Figure 3.1c Extra dosed bridge model with inverted Y shape pylon

3.2 Analysis Of The Models

The models are generated keeping all the structural parameters same, the only change is made in the shape of pylons. All the three models of the bridge are analyzed to understand the best possible shape of the pylon for the strength and durability of the bridge. Study of different parameters like axial force, bending moment, torsion, deflection, the shear force is done. Thus the analysis of the models helps us to meet the purpose of this research.

4. RESULTS AND DISCUSSIONS

The following paper represents the results evaluated by a thorough analysis of the bridge with the help of software.

4.1 Comparison of different parameters for A, H, and inverted Y shape of Pylon

Parameters	H shape	A shape	Inverted y shape
Pylon axial force (kn)	24668.03	36116.86	4352.047
Bending moment (knm)	27357.62	24428.35	50297.45
Shear force (kn)	11992.44	11172.35	22794.41
Torsion (knm)	9885.445	7346.085	17146.27
Deflection (m)	0.0165	0.0142	0.017

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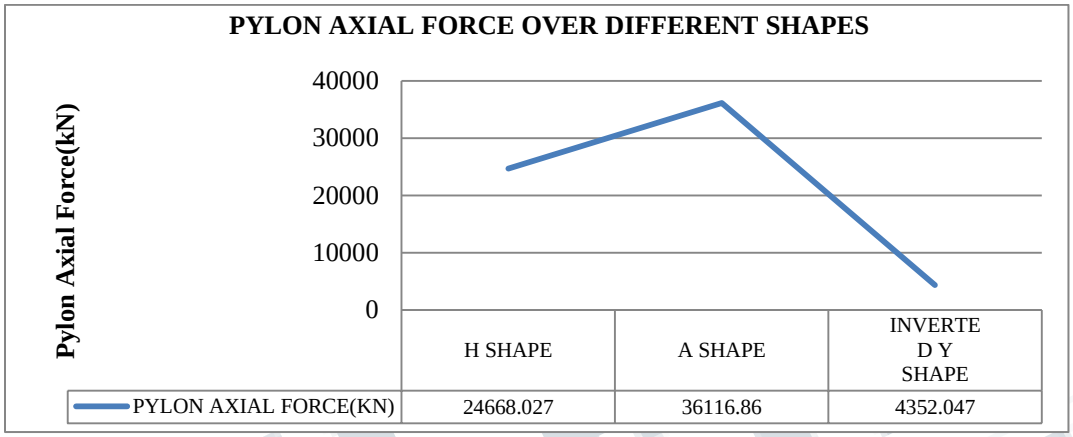
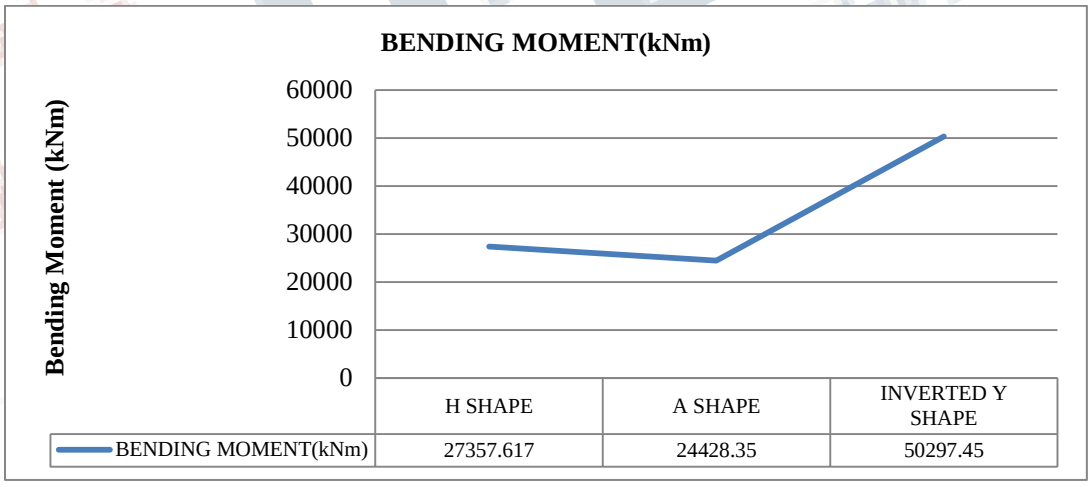
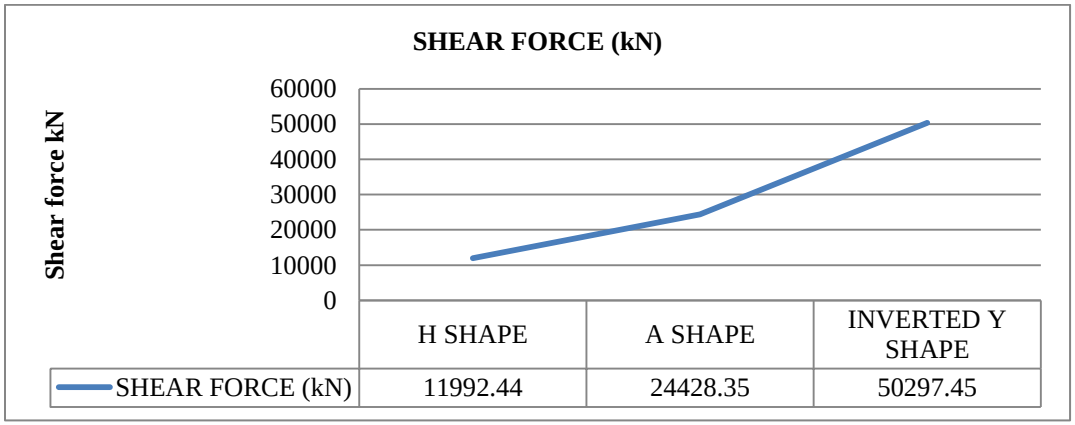
4.2 Tabular representation of Pylon Axial Force for A, H, and inverted Y shape of Pylon



4.3 Tabular representation of Bending Moment for A, H, and inverted Y shape of Pylon



4.4 Tabular representation of Shear Force for A, H, and inverted Y shape of Pylon



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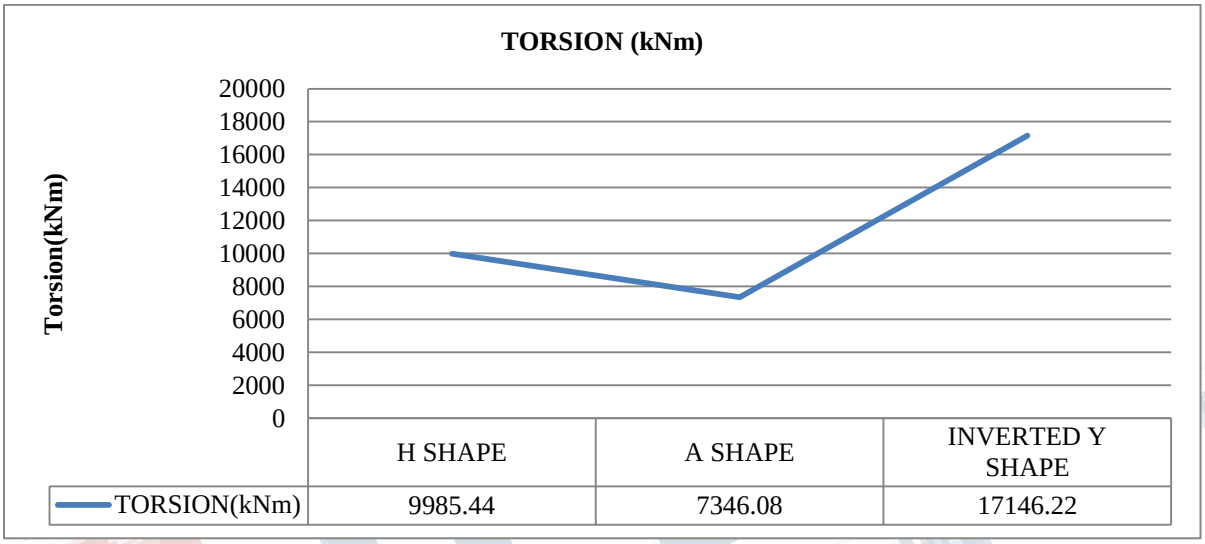
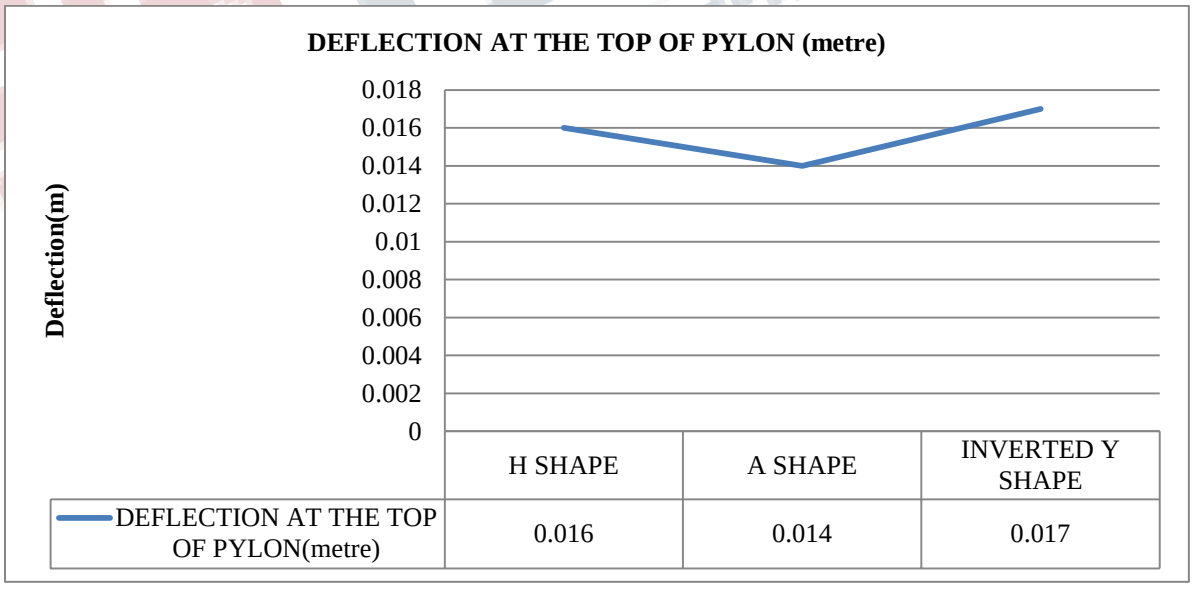
4.5 Tabular representation of Torsion for A, H, and inverted Y shape of Pylon



4.6 Tabular representation of Deflection at the top of the pylon for A, H, and inverted Y shape of Pylon



5. CONCLUSIONS

Following conclusions has been inferred from the analysis of different shapes of the pylon.

- Bending moment of A shape pylon is 51.4% less than the other shapes.
- The shear force of A shape pylon is also 50% less than the other pylons which indicate its productivity.
- Torsion of A shape pylon is also 42% less and deflection 21% less than the other pylon shapes.
- Only axial force of inverted Y shape pylon is 87% less than the other pylons.
- Under dead load, among all the structural responses, A Shape pylon's shape seems to be better because it has less magnitude of bending moment, shear force, torsion, and deflection.

6. ACKNOWLEDGEMENT

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