Comparative Study of PSC Box Girder Multi Cell (3-Cell) Bridge of Different Shapes

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Abstract—The present thesis work involves the modeling and analysis of different shapes of Multi Cell (3-Cell) Box Girder of post-tensioned type. “When tension flanges of longitudinal girders are connected together, the resulting structure is called a box girder bridge”. Five different shapes of Multi Cell Box Girders (1) Exterior girder with maximum slopped, (2) Exterior girder with radius, (3) Exterior girder vertical, (4) Exterior girder slopped, and (5) Exterior girder clipped, are modeled and analyzed using CSI Bridge Software (v-2017). The vehicle loading of IRC Class A is applied on all different models.

Key words: PSC Multi Cell Box Girder, Post-tensioned, IRC Class A loading, CSI Bridge (V-2017)

I. INTRODUCTION

A box girder is formed when two web plates are joined by a common flange at both the top and the bottom. The closed cell which is formed has a much greater torsional stiffness and strength than an open section and it is this feature which is the usual reason for choosing a box girder configuration. Bridge construction constitutes an importance element in communication and is an important factor in progress of civilization. In the present work, Multi Cell Box Girder of different shapes are analyzed for a two-lane bridge. The design parameters were kept same for all of the cross-sections. The general parameters are as follows,

- Lane width (carriage way) - 7.5 m
- Total width of deck slab - 11 m
- Span length - 35 m
- Grade of Concrete - M40
- Tendon profile - Perabolic
- Moving load - IRC Class A loading

II. MODELING OF DIFFERENT SHAPES OF BOX GIRDER

In the present thesis work, 5 different shapes of Multi Cell Box Girder are considered. Modeling is done using CSI Bridge Software (v-2017). This software is basically finite element method software and Finite element method is the most versatile method, which can easily handle structures of complicated shapes, and boundary conditions. It involves subdivision of the whole structure into number of small elements.

III. MATERIAL SPECIFICATION

For Post tensioning work minimum grade of concrete as specified in IS-1343 is M35, while for Pre-tension prestressed work grade of concrete specified in IS-1343 is M40 (Clause 5.1 Table 1 IS-1343). In this work, concrete of grade M40 is used in post-tensioning and steel of grade Fe415.
A. Tendon Properties

- Prestress type - Post-tension
- Material - A722Gr150 TypeII
- Prestressing strand - 13mm (0.5” strand)
- Nominal diameter - ASTM 0.5mm
- Area of single strand - 98.7 mm^2
- Torsional constant - 6.625 KN/m^2
- Modulus of Elasticity: Eps = 2 X 108 KN/m2
- Shear area - 5.806 KN-m
- Tendon load (force) - 444.82 KN
- Jack from - Both ends
- Poisson μ - 0.3

IV. Loading

IRC : 6-2000 (Standard Specifications And Code Of Practice For Road Bridges, Section - II Loads and Stresses) describes different types of loadings. IRC standard live loading are as follows

- IRC Class AA Tracked Vehicle
- IRC Class AA Wheeled Vehicle
- IRC Class 70R Tracked Vehicle
- IRC Class 70R Wheeled Vehicle
- IRC Class A Loading
- IRC Class B Loading

In the present work, vehicle loading of IRC Class A is considered for analysis of bridge deck.

V. RESULTS

A. Dead Load

Dead load on girder = Dead weight of deck slab + Dead weight of wearing coat + Self weight of girder. All different models of Multi Cell Box Girders are analyzed, and the results obtained are compared as in terms of force (KN) due to dead load, Longitudinal stress (KN-m) induced in girder and displacement (mm) due to dead load.

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C. Load Combination

1.25 Dead Load (DL) + 1.75 Moving Load (ML) + 1.0 prestress, and 0.9 Dead Load (DL) + 1.3 Moving Load (ML) + 1.0 prestress

![Load Combination Force](image1)

Fig. 12: Load Combination Force

![Load Combination Stress](image2)

Fig. 13: Load Combination Stress

![Load Combination Displacement](image3)

Fig. 14: Load Combination Displacement

VI. CONCLUSION

After analyzing all different shapes of PSC Multi Cell Box Girder, it is shown that Multi Cell Box Girder of exterior girder with slopped sides is showing better results among all the other shapes. Multi Cell Box Girder of exterior girder with slopped sides has less induced longitudinal stresses as compared with all others, it is also showing less displacement with respect to all other shapes.

REFERENCES


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