"STUDY OF THE BRIDGE PARAMETERS OF THE DOUBLE BOX UNIT BY CHANGING THE CONFIGURATION OF THE BOX UNIT"

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Abstract - Bridges are very important symbols of the nation. It is difficult for a structural engineer to determine the best section for a subway bridge (bridge with a longer span), such as single cell, double cell or rectangular trapezoidal shapes. Bridges are used to overcome obstacles without obstacles. Bridge design and analysis should be optimized regarding their weight and economy. The wide-span bridge box is cheaper than flat girder bridges. Double box bridges of different geometries are used for economic reasons and require less time for construction. Choosing the best shape geometry for a bridge box, reducing costs and stabilizing the structural section is a challenge for today's structural engineers. In light of the foregoing, it was decided to select different cell type geometry between two boxes of bridge cells and to develop the geometry by automatic CAD. It is observed that the economy of two-box bridges is based on various parameters such as the length of the bridge, the width, the angle of the double-box cone and the height of the double-box cone bridge. Selecting the best shape geometry of a bridge box and reduce cost and make section structural stable is challenging in front of structural engineer now a days. It is observed that the economy of two box cell bridges are based on different parameters such as length of bridge, width, angle of double Box taper and height of double box taper bridge. In this study, the form and shapes of two Boxes Cell Bridge are modified to study for economy and better structural stability.

Key point: - Box cell, bridge box, dead load, IRC, Class A load, 70R load.

I. INTRODUCTION

Box bridges in prestressed concrete with one or more cells are widely used today because they offer economic and aesthetic solutions and overcome the constraints, distances, structures and dividing lines that are found today in modern and metropolitan road systems.

The main advantage of this bridge box is the high torsional rigidity, available thanks to the closed box section. The torsional rigidity offers stability and load distribution properties and makes this form particularly suitable for level separation.

II. DOUBLE BOX CELL TYPE

Double-cell box bridges have been used worldwide because they withstand high seismic loads and high payloads. Deflection is an important criterion of the double box system and therefore geometry or configuration is important. A double box beam is a bridge where the main beams contain beams in the form of an empty double box.

In the current scenario, the construction of double-box cell bridges is of global importance. The region behind is the efficient spread of traffic jams, economics and aesthetics. A double box bridge or pipe stand is a stand that forms a closed pipe with multiple cells. Double box beams are generally used for subway, highway, overflight and light rail transport, etc.

III. DESIGN OF PROPOSED WORK

The box-shaped bridge is formed of prestressed concrete, steel or a mix of steel and RC materials. The box-cell bridge can have a rectangular, trapezoidal and circular cross section. Boxcell tapered bridges are often used for highway, subway overpasses and modern buildings such as rail transport. The very high torsional rigidity is provided by the transaxle cones to resist the torsional forces caused by the load.

Analysis & design of box cell bridges are very complex due to its 3-Dbehaviors consisting of torsion, bending in longitudinal & transverse directions.

Analysis & design of the box cell type bridge can be divided into 2 parts i.e.

1) Longitudinal analysis
2) Transverse analysis

This section provides model geometry information, including items such as joint coordinates, joint restraints, and element connectivity.

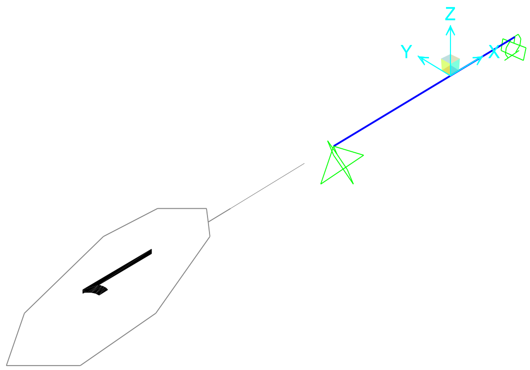

Fig 1 Linear Beam as Per SAP 2000 Origin & Axes Directions

IV. LOAD DEFINITIONS

As we neglected wind load and seismic load and considered only dead load and live load for this study

1. DeadLoad:

It is first load to be calculated in the design of bridge. Dead load is computed directly by software SAP 2000. Dead load is the self-weight of the bridge box elements. The main elements of bridge are box slab, wearing coat, railings, parapet, stiffeners etc. we assign only weight of concrete box.

2. Live Load:

It is the moving load on the bridge throughout its span. The moving loads are truck, car, motor, cycle, bus, vehicles, Pedestrians etc. but it is complicated to select one vehicle or a combo of vehicles to safely analysis and design of a bridge.

As per IRC recommendations some important vehicles as live loads are considered in design of bridges as per their use on different highway category.

According to IRC

A. IRC Class 70RLoading (Considered in study)
B. IRC Class AA Loading
C. IRC Class ALoading (Considered in study)
D. IRC Class BLoading

In this study only two loading for analysis are selected mainly class A and 70 R to observed the effect of configuration on bending moment, shear force and deflection.

A. Class70R Loading:

It is generally occurs on all roads of permanent bridges and culverts. Bridges designed for sophistication Class 70R loading should be checked for sophistication Class-A loading also as under certain conditions reactions may occur because of class-A Loading.

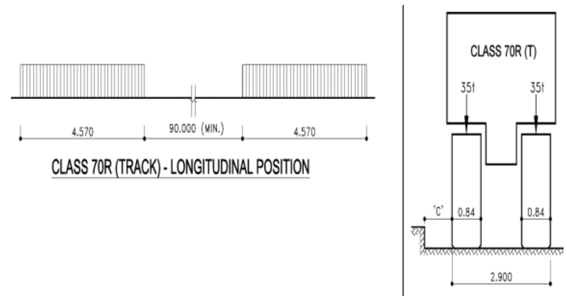

Fig 2 Wheel Arrangement for 70R (Wheeled) Vehicle

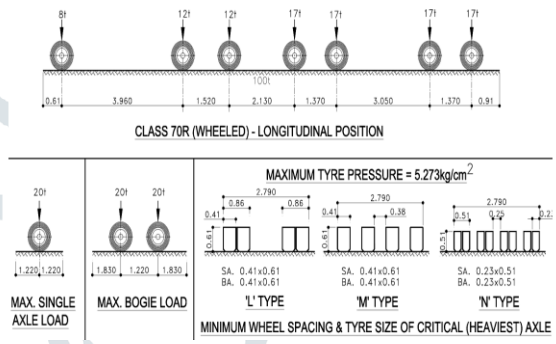

Fig 3 Load Define In SAP 2000

B. IRC Class A Loading:

Generally bridge should be checked and designed for this loading due to possibility of severe stresses.

Table: 1 Carriage Way Width Data

Clear Carriageway Width	g	f
5.3m to 6.1m	Varying between 0.4m to 1.2m	150 mm for all Carriageway Width
Above 6.1m	1.2m	

Table: 2 Ground Contact Area Data

Axle load (tone)	Ground Contact Area	
	B (mm)	W (mm)
11.4	250	500
6.8	200	380
2.7	50	200

V. GEOMETRY PARAMETER DEFINED FOR DIFFERENT CASE

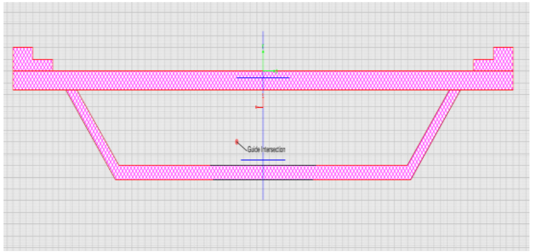

Fig 4 Case of Double Box Modify To Single Box

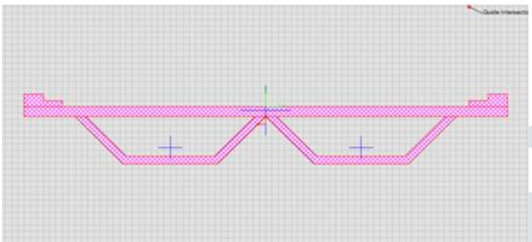

Fig 5 Case of Double Box Cell of 45 Degree

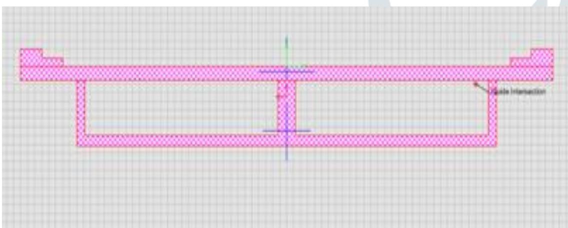

Fig 6 Case of Double BoxCell of 90 Degree

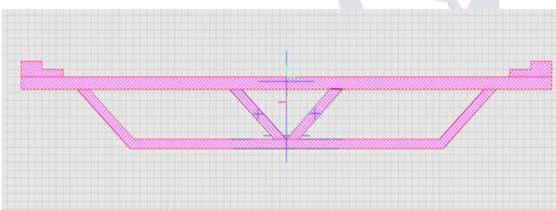

Fig 7 Case of Double BoxCell of (Inverted) Triangle

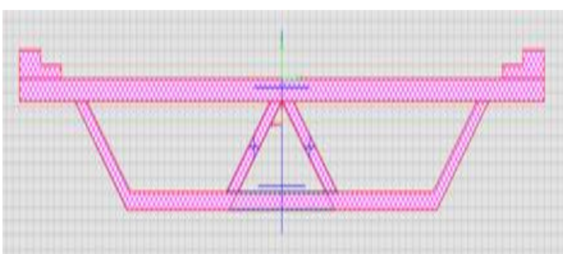

Fig 8 Case of Double BoxCell of Strap Type

VI. RESULTAND DISCUSSION

In this study a complete Box of 30 meter long span is taken for analysis. In this study efforts are made to find best section which will give minimum bending moment and shear force and deflection.

Torsion is taken into account when vehicle is moving with an eccentricity of 6.7 and 5.65 m respectively.

1. Deflection Results

Deflection value is obtained by graph and graph of alldata is shown in graphical figures. Deflection is Maximum for double boxcell of 45 degree and maximum value of deflection is found at center and minimum zero value is found at support. In comparison of sections minimum deflection is found for box cell of 90 degree.

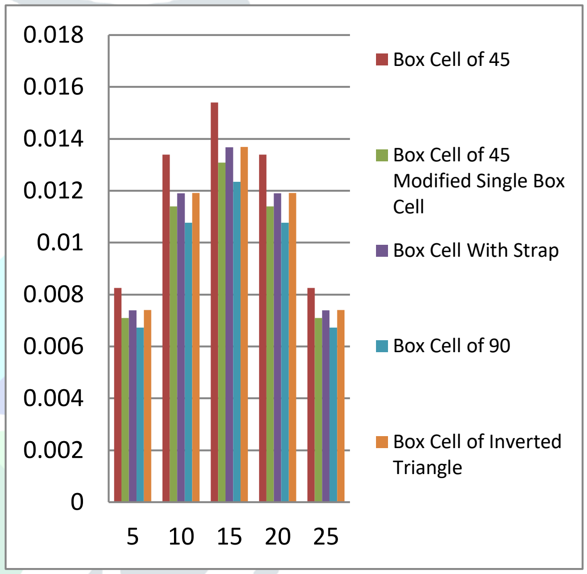

Fig 9 Common Deflection Curve for All Cases of Box Cells

2. Bending Moment Results Due to Dead Load

Bending moment result computed in tables is shown in graph and it can be noticed that bending moment is zero at support as expected and maximum at center. Bending moment is maximum for a case of boxcell of 90 degree. Bending moment is minimum for boxcell modified to single Box.

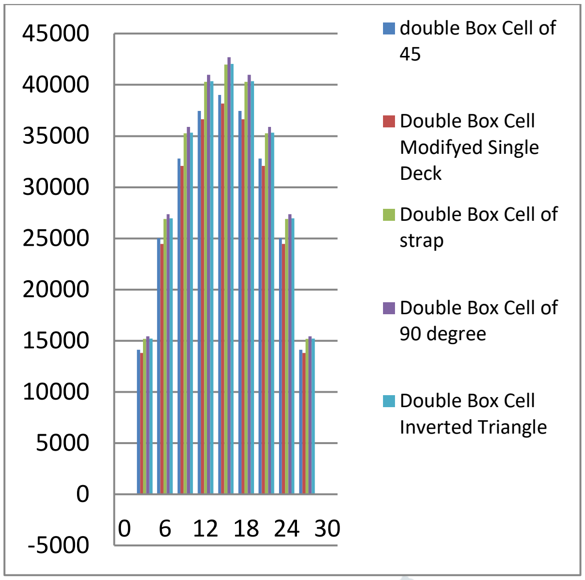

Fig 10 Common Bending Moment for All Case of Double Box Cell

3. Shear Force Results Due to Dead Load

The Results obtained by SAP 2000 are shown in graphical form and if we can be noticed that shear force is to minimum for 45 degree box cell. Shear force is minimum at mid span and its maximum at support with positive value and negative value as the span is considered simply supported.

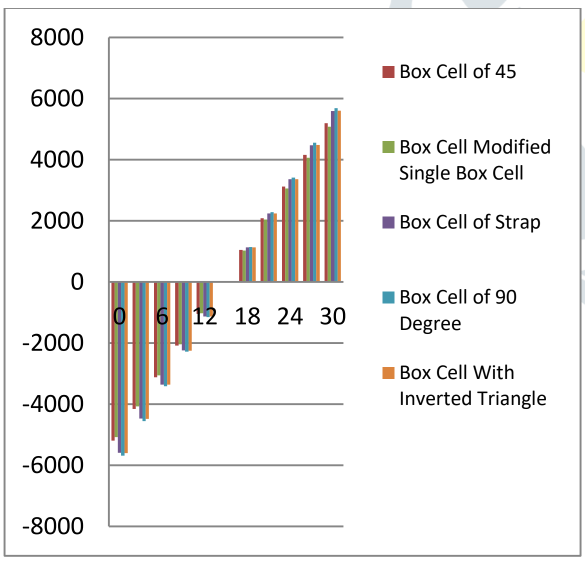

Fig 11 Common Shear Force Diagram For All Cases of Box Cells

4. Bending Moment Results Due To Live Load of Different Loading

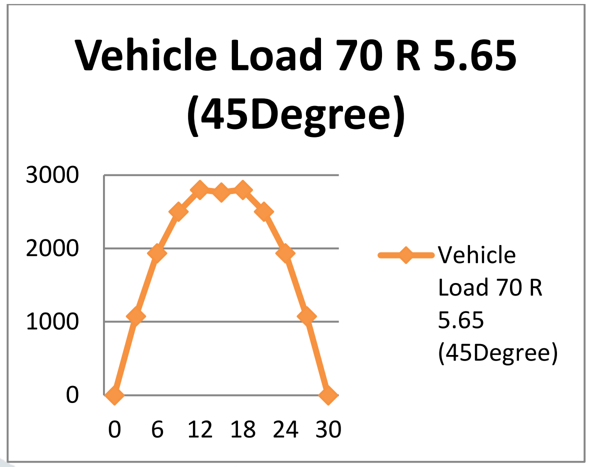

Fig 12 Bending Moments Results For Vehicle Load 70 R 5.65 (45 Degree)

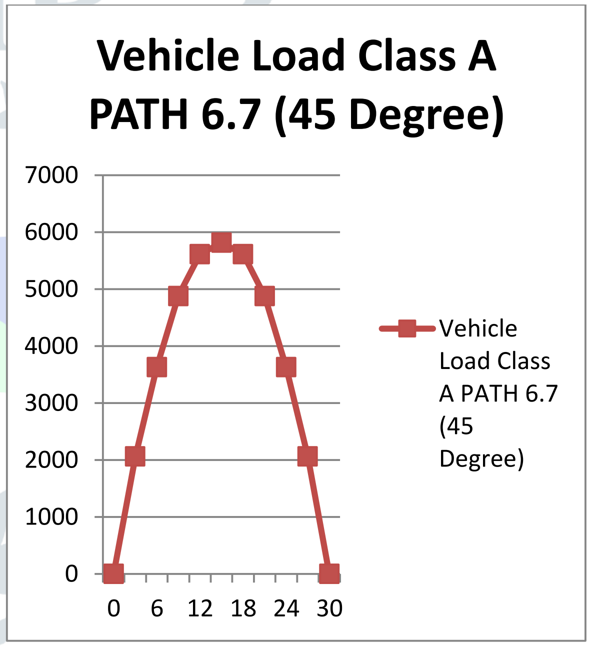

Fig 13 Bending Moments Results forVehicle Load Class-A Path 6.7 at (45 Degree)

5. Shear Force Results Due To Live Load of Different Loading

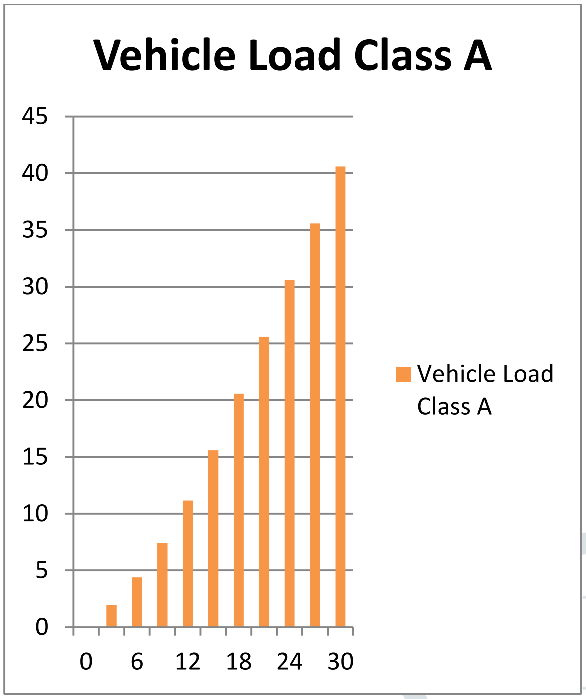

Fig 14 Shear Force Results for Vehicle class Apath 6.7

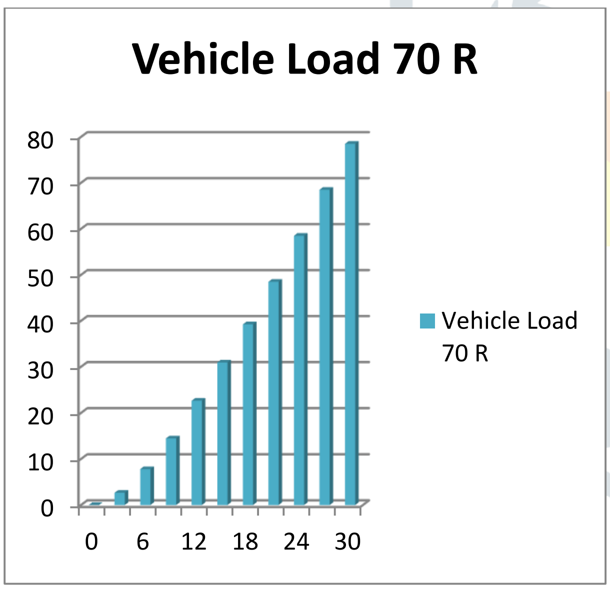

Fig 15 Shear Force Results for Vehicle Load 70 R paths 5.65

6. Torsion Results

Torsion results of all case are found same because of live load as dead load (change in cross section not depend) does not have any effect on torsion

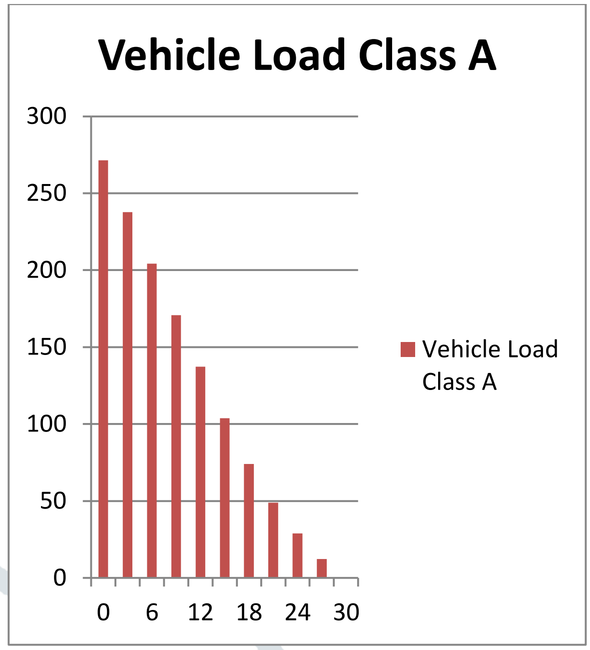

Fig 16 Torsion Due To Load Class-A

Maximum torsion is obtained for class 70R loading with an eccentricity of 5.65 from center line of cross section.

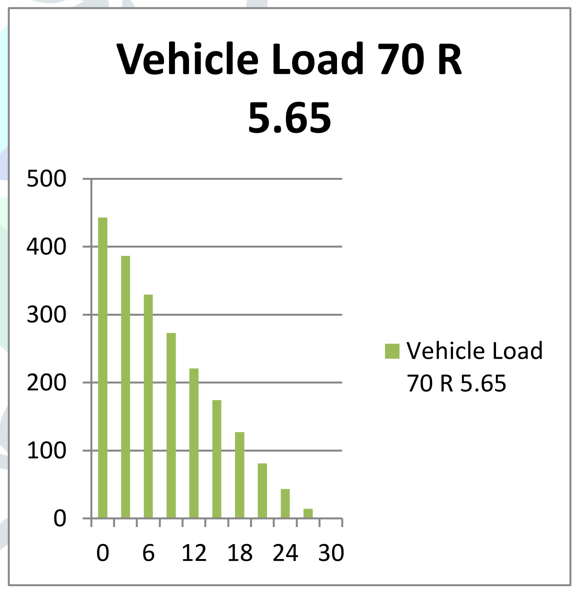

Fig 17 Torsion Due To Load Class 70R

VII. CONCLUSION

- The bending moment is minimum for single box cell and maximum for 90 degree box.
- Result of the bending moment calculated in the tables and presented in graphic form. We can see that the bending moment is zero at the support as expected and its maximum in the center.
- The bending moment value is a maximum of 42593.7344 KN-m for the dead load double box cell.
- The bending moment value is a maximum of 2799.9 KN-m for the live load of vehicle class A 5.65.

- The bending moment value is 5815.15 KN-M maximum for a moving load of the vehicle 70R path 6.7.
- The shear force is also minimum to the modified box cell up to the maximum single box cell for 90 degree double box cell.
- The shear force is minimum (ZERO) at mid stroke and maximum at support with a positive value and a negative value at left support.
- The shear force value is 5688.698KN maximum for a dead load double box cell.
- The shear force value is 78.472KN maximum for a live load of the class-A vehicle load 5.65.
- The shear force value is 40.587KN maximum for the live load of the vehicle 70R path 6.7.
- The minimum deflection is found for 90 degree box cells.
- The maximum deflection is for 45 degree type cell.
- The maximum deflection value is in the center and the minimum zero value is located on the support.
- When the vehicle load moves with Class A and Class 70R offsets, torsion is generated in the box cell.
- The torsion value is at most 271.3091 KN-M for a live load of the vehicle load class A 5.65.
- The torsion value is 442.8507 KN-M maximum for the live load of the vehicle 70R path 6.7.
- The results of all cases are the same because of the live load and not because of the dead load (the modification of the section does not depend)

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