ANALYSIS AND DESIGN OF PRESTRESSED BOX GIRDER BRIDGE BY USING CSI BRIDGE SOFTWARE

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Abstract : Pre-stressed concrete bridges are well known for their high compressive strength and high tensile strength and also for their better stability and performance, now a day's various software's are using for the design and analysis of bridges. Using of software's for the planning of bridges is far higher than the manual procedure. The structural behaviour of box girder is complicated, which is difficult to analyze in its actual conditions by conventional methods. Bridge construction these days has achieved a worldwide level of importance. Bridges are the key parts in any road network Use of box beam is gaining quality in bridge engineering fraternity as a result of its higher stability, serviceableness, economy, aesthetic look and structural efficiency.

Key words - Bridge, Box Girder, pre stressed, Deck, CSI Bridge software.

I. Introduction

In order to supply safer and larger speed of traffic, the route is made as straight as potential box girders, have gained wide acceptance in superhighway and bridge system owning to their structural potency, higher stability, unstableness, economy of construction using aesthetics. In U.S bridge engineers use the code of AASHTO American association of superhighway and transportation officials ; this code will be adopted for style of the highway bridges with special needs. Similarly Indian bridge engineers seek advice from the IRC (Indian Road Congress) common place to train the planning

• A bridge may be a structure providing passage over associate obstacle while not closing the method below. The required passage is additionally for a road, a railway, pedestrians, a canal or a pipeline. The obstacle to be crossed is also a stream, a road, railway or a natural depression.

• In earlier years, single cell and multi-cell concrete box Bridge are projected and widely used as economic for the over crossings, under crossings, grade separation structures and ducts found in modern highway system.

• just in case of long span bridges, giant dimension of deck is offered to accommodate pre stressing cables at heart rim level.

• Interiors of box beam bridges may be wont to accommodate service like gas pipes, water mains etc. For large spans, bottom rim may be used as another deck accommodates traffic also.

Fig.1.2(a) box girder block

- A box girder bridge in which the main beams comprises girders in the shape of a hallow box. The box girder normally comprises either pre-stressed concrete, structure steel, or a composite of steel and reinforced concrete. The cross-section of box is typically rectangular or trapezoidal.

- Box girder bridges are commonly used for highways flyovers and for modern elevated structures of light rail transport. Although normally the box girder bridges is a form of beam bridge, box girders may also be used on cable-stayed bridges and other forms By constructing the box girder it reduce the slab thickness and self weight of the bridge.

Fig.1.2(b) box girder bridge

- It will have greater strength per unit area of concrete. Quality assurance, as precast girder are made off-site. But the main disadvantages of providing the box girder is the structural steel girders are costly. Logistical inefficiencies and transportation cost.

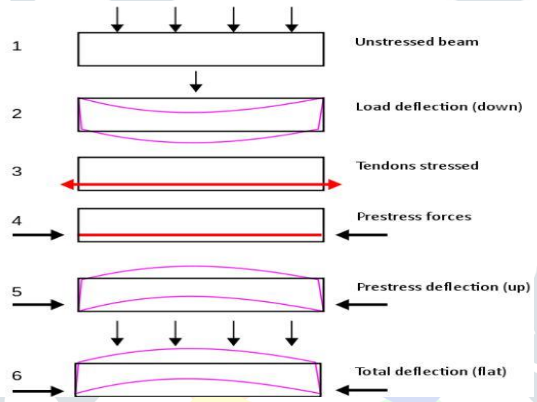


Fig.1.4 Detailing pre-stressed box girder
Components of bridge:

2.SCOPE OF STUDY

- ✓ The study aims at design and analysis of pre-stressed concrete box girder bridges.
- ✓ It is according to IRC and AASHTO codes.
- ✓ To increase the sustainability of the concrete box girder bridge by using pre-stressed concrete.
- ✓ The box section conjointly possesses high bending stiffness associated there's and economy use of the entire cross section.

3.OBJECTIVES

The current study is about the behaviour and analysis investigation of the pre-stressed box girder bridges. The objective for the study are:

- ✓ Study the behavior of pre-stressed concrete box girders and compare the analytical model results.

4. CSI BRIDGE SOFTWARE

Modeling, analysis, and style of bridge structures are integrated into CSI Bridge to form the final word in computerized tools tailored to satisfy the wants of the engineering skilled. The ease with that all of those tasks will be accomplished makes CSI Bridge the foremost versatile and productive software system program within the trade. Using CSI Bridge, engineers will simply outline complicated bridge geometries, boundary conditions and cargo cases. The constant quantity creator permits the user to create straightforward or complicated bridge models and to create changes expeditiously whereas maintaining total management over the look method. Lanes and vehicles will be outlined quickly and embrace breadth effects. Simple and sensible Gantt charts area unit accessible to simulate modeling of construction sequences and programming. The CSI Bridge includes a simple to follow Wizard that outlines the steps necessary to form a bridge model.

Fig.1.6 CSI log

4.1 LOADS

1. Dead Load: The burden is nothing however a self-weight of the bridge components. The different components of bridge arc deck block, sporting coat, railings, parapet, stiffeners and different utilities. It is the primary style load to be calculated within the style of bridge.

2. Live Load: The loading on the bridge, is moving load on the bridge throughout its length. The moving loads are vehicles, Pedestrians etc. but it's troublesome to pick one vehicle or a bunch of vehicles to style a secure bridge.

So, IRC counseled some notional vehicles as live hundreds which is able to offer safe results against the any variety of vehicle moving on the bridge. The vehicle loadings are categorized in to three types and they are The vehicle loadings are categorized in to three types and they are

- IRC class AA loading
- IRC class A loading
- IRC class B loading

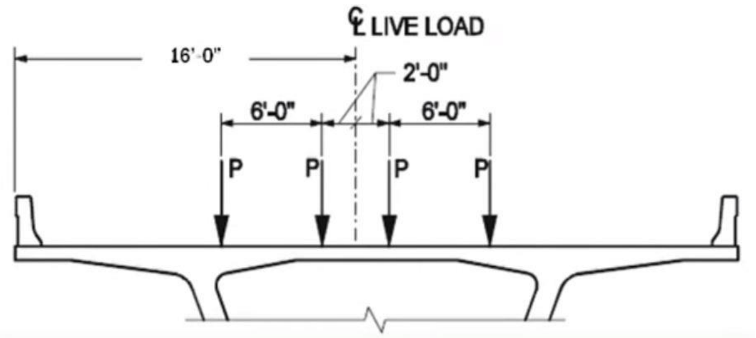


Fig.4.1(a) Live load

3. Impact Loads: The Impact load on bridge is thanks to unexpected masses that square measure caused once the vehicle is moving on the bridge. When the wheel is in movement, the live load will change periodically from one wheel to another which results the impact load on bridge.

To consider impact masses on bridges, a control issue is employed. Impact issue could be a multiplying issue that depends upon several factors like weight of car, span of bridge, velocity of vehicle etc. The impact factors for various IRC loadings square measure given below.

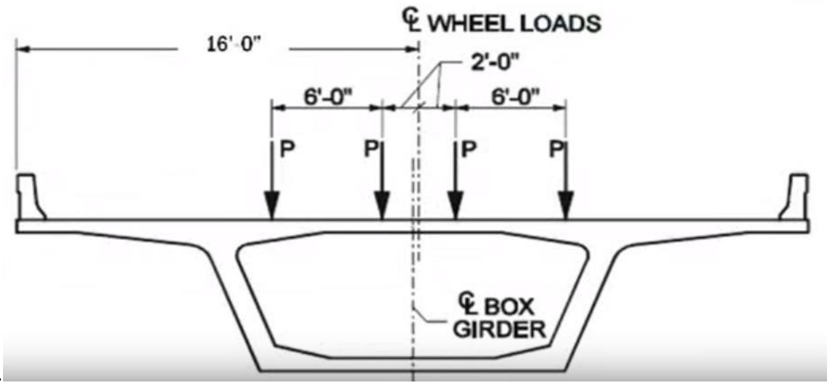


Fig.4.1.1(b) Impact load

After creating a model, analysis is carried out. The analysis will be done to understand the behaviour of bridge. The main aim of research is to urge shear force and bending moment working on the structure. The bridge model is shown in Fig:4.2 . The bridge model after analysis is shown inFig:4.2.

Modeling and analysis of bridge:

A pre-stressed concrete box girder bridge of span 100 ft was modeled using CSI BRIDGE. Analysis of the structure were carried according to IRC loading and AASHTO design specifications.

Model Geometry:

The structure of pre-stressed concrete box girder is analyzed along the trapezoidal box section.

Number of lanes : 2

Length of bridge : 220 ft

width of bridge : 42 ft

Preliminary data for pre-stressed concrete box girder bridge

S. NO.	Content	Description
1.	Type of structure	Pre-stressed concrete box girder bridge
2.	No. of lanes	2
3.	Width of bridge	42 ft
4.	Lane width	14ft
5.	Carriage way width	6 ft
6.	Top slab thickness	9"
7.	Bottom slab thickness	8"
8.	Super structure depth	7 ft
9.	Specific weight of RCC	25 KN/m3
10.	Length of bridge	220 ft
11.	Moving load	800 kips

4.2 ANALYSIS

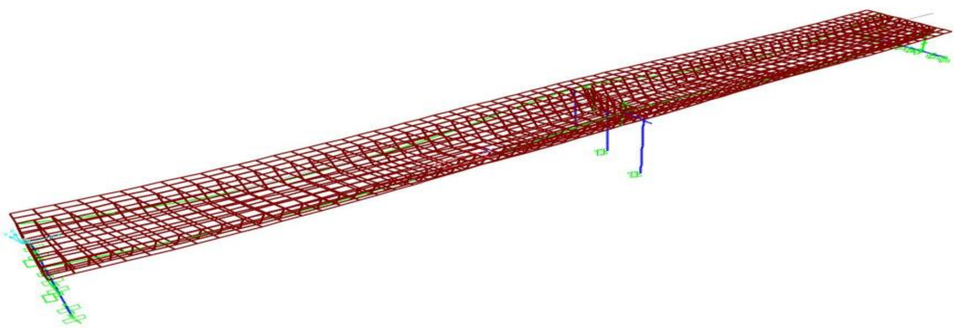


Fig:4.2

RESULTS AND DISCUSSION

4.1 Design required -1

4.1(a) Longitudinal stress without torsion and compression limits:

4.1(b) Longitudinal stress with torsion and compression limits:

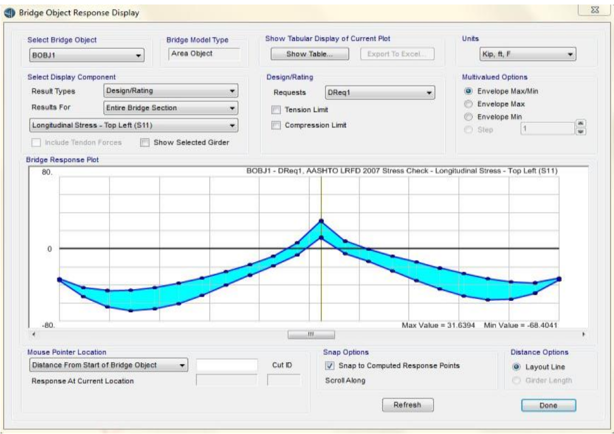


Fig .4.1(a) Longitudinal stress without torsion and compression limits

Table of Longitudinal stress without torsion and compression limits :

S .no	Longitudinal Stress	
	Maximum	Minimum
1	31.6394 KN/m2	-68.4041 KN/m2

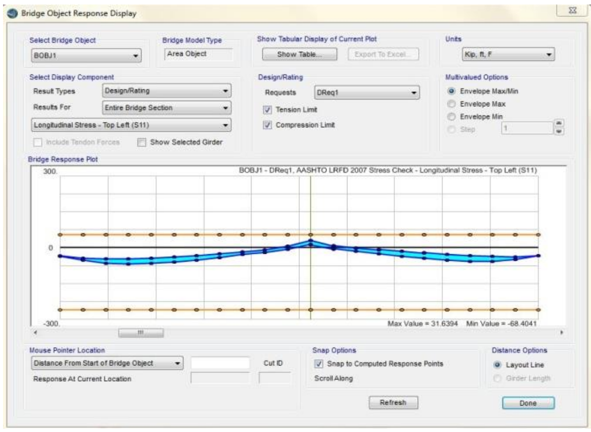
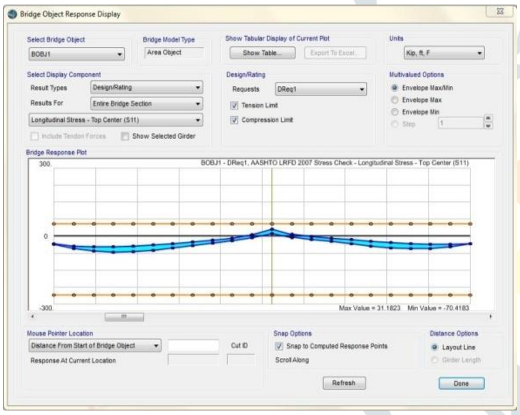


Fig .4.1.(b) Longitudinal stress at top left with torsion and compression limits

Table of Longitudinal stress without torsion and compression limits :

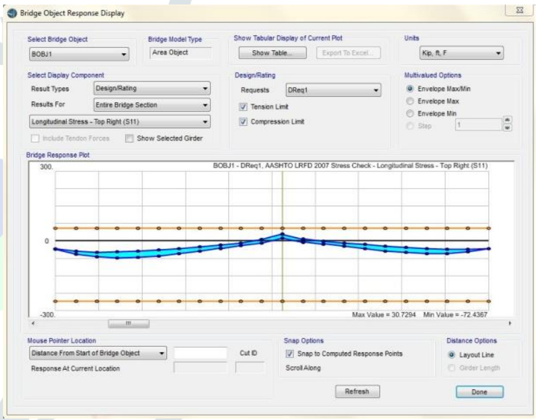
S .no	Longitudinal Stress	
	Maximum	Minimum
1	31.6394 KN/m2	-68.4041 KN/m2

Fig 4.1.(c) Longitudinal stress at top centre with torsion and compression limits



S .no	Longitudinal stress at top center	
	Maximum	Minimum
1	31.1823 KN/m2	-70.4183 KN/m2

4.1.(d) Longitudinal stress at top right with torsion and compression limits:



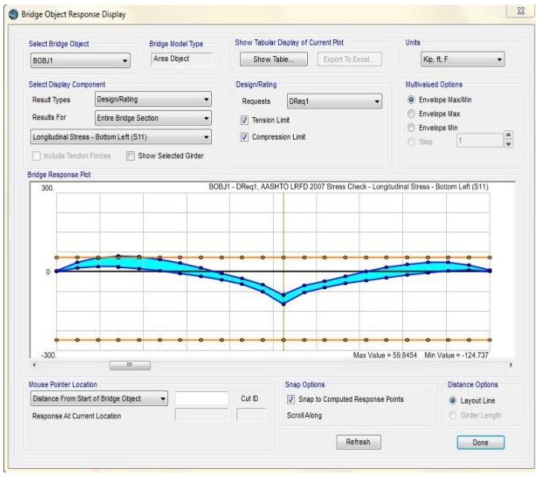
S .no	Longitudinal stress at top right	
	Maximum	Minimum
1	30.7294 KN/m2	-72.4367 KN/m2

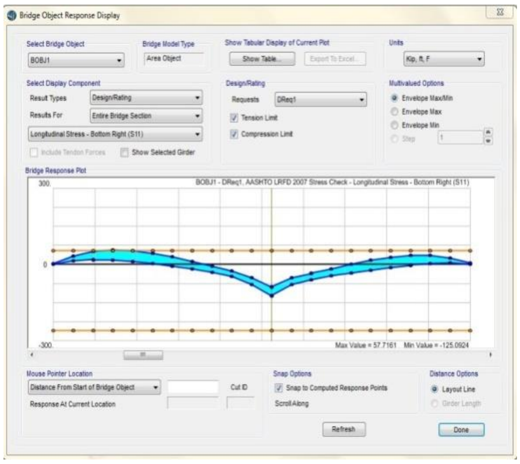
4.1(e) Longitudinal stress at bottom left with torsion compression limits:

S .no	longitudinal stress at bottom left	
	Maximum	Minimum
1	59.8454 KN/m2	-124.737 KN/m2

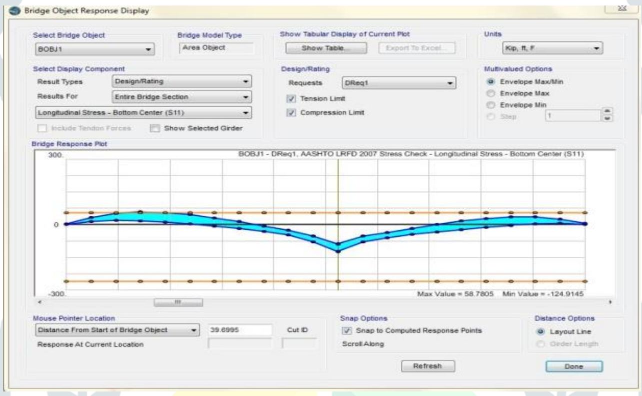
4.1(f) Longitudinal stress at bottom right torsion and compression limits:

S .no	longitudinal stress at bottom right	
	Maximum	Minimum
1	57.7161 KN/m2	-125.0924 KN/m2





4.1(g) Longitudinal stress at bottom centre with torsion and compression limits:



S .no	Longitudinal stress at bottom center	
	Maximum	Minimum
1	58.7805 KN/m2	-124.9145 KN/m2

CONCLUSION

- Comparing the manual results with those of software analysis for shear force and bending moment, it is observed that the manual result are less than those of analysis with software.
- There are a few minor differences in the result of manual design and software analysis. The results will be occurred due to effect of its boundary conditions. so, the software analysis result are higher than those with manual analysis.
- . The results pertaining to substructure are given only in the form of numerical values without any pictorial representation.

Finally, it is concluded that the bridge structure is safe for software analysis

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