STRUCTURAL BEHAVIOUR OF BOX GIRDER BRIDGE USING "Csi Bridge 2015"

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Abstract - *Post tensioned bridges are well known for their better stability and performance, now a days various software's are using for the design and analysis of bridges. Using of software's for the design of bridges is much better than the manual procedure.*

So through this project, we are analyzed the structural behavior of post tensioned box girder bridge using the recently developed software called "CSI Bridge" version 2015.

i.e we analyzed the post tensioned box girder bridges of single cell and four cell type for both IRC and AASHTO loading using the software for the specific design, to know its structural behavior and to decide which code of practice is better by comparing the results, also to know about the modeling pattern of the software,and to know about the structural behavior of single cell and four cell box girders under IRC and AASHTO loading.

Key Words: Box girder, Response, IRC, AASHTO, Four Cells, Single Cell

1.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 systems owing to their structural potency, higher stability, usableness, economy of construction and pleasing aesthetics. In U S, Bridge Engineers use the code of AASHTO "American Association of route|expressway|freeway|motorway|pike|superhighway|throughway|thruway|highway|main road} 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) commonplace to try to the planning. But The AASHTO commonplace Specification is adopted by several countries because the typically accepted code for bridge styles.

Box girder bridges ar terribly unremarkably used. It's a bridge that has its main beams comprising of girders within the form of hollow boxes. The box beam ordinarily includes of pre-stressed concrete, steel or steel concrete. A box-girder cross section could take the shape of single cell (one box), multiple spines (separate boxes), or multi-cell with a standard bottom rim (continuous cells) the box beam bridge achieves its stability in the main thanks to 2 key features: form and pre-stressed tendons.

Box girders are used extensively within the construction of associate elevated underground rail bridge and therefore the use of horizontally recurved in set up box beam bridges in fashionable underground rail systems is kind of appropriate in resisting torsional and distortion effects elicited by curvatures. The torsional and distortion rigidity of box beam is thanks to the closed section of box beam. The box section conjointly possesses high bending stiffness associated there's an economical use of the entire cross section.

Segmental box girders (segments) square measure used for building structure for bridges / different structure in replacement of standard construction via pre-cast beams and cast-in-situ decks. The segments system reduces the environmental disturbance compare to the traditional technique by ending the concreting works more removed from the development web site wherever is typically settled at town centres. Segmental box girders square measure primarily engineered as single span structures to avoid coupling of post tensioning cables. What is more in single spans the larger shear force isn't settled within the same section because the greatest bending moment, though' the joint between the segments is usually closed. a typical span includes a length of roughly 45m. It consists of twelve to fourteen segments as per the planning. No continuous reinforcement is provided across the match forged joints between the segments. A main advantage of the segmental bridge style is that it will facilitate builder's additional simply construct bridges over areas wherever it's tough to move giant sections of concrete. Segmental bridge construction is additionally redaction the essential thinking of style engineers.

For style of main road and Railway Bridge superstructures there are several codes used round the world and most of the countries have their own code reckoning on the natural conditions and therefore the close environmental factors, like the unstable effects, significant downfall, significant snow, mountainous parcel, differing kinds of auto employed in country etc. Indian bridge engineers refer IRC (Indian Road Congress) normal for the structural style. during this study 2 box-girder cross-sections were designed with totally different cross section- i) Pre stressed concrete box beam with four cells, ii) Pre-stressed concrete box beam with single cell. The look parameters were unbroken same for each of the cross-sections. Moving load as per IRC-6: 2000 were thought of for each the crosswise and normal moving load IRC category AA was applied. Comparison was done between the results of each the box-girder cross sections. During this study 2 box-girder cross-sections were designed with totally different cross section- i) Pre stressed concrete box beam with four cells, ii) Pre-stressed concrete box beam with single cell. The look parameters were unbroken same for each of the cross-sections. Moving load as per IRC-6: 2000 were thought of for each the crosswise and normal moving load IRC category AA was applied. Comparison was done between the results of each the box-girder cross sections.

1.1 Problem statement

box girder for 2 lane national highway bridge, with the data below:-

- Type of support:- simply supported
- length:- 30 m
- Carriageway width:- 7.5m
- foot path width:- 1.25m
- segmental width :- 10m
- load type :- IRC class AA loading
- concrete grade: M60 for both the cell types

FOUR CELLS PRE-STRESSED CONCRETE BOX GIRDER:

Tendon Properties:

- Pre-stressing Strand: ϕ15.2 mm (0.6"strand)
- Yield Strength: fpy = 1.56906 X 106kN/m^2
- Ultimate Strength: fpu = 1.86326 X 106 kN/m^2
- Cross Sectional area of each tendon = 0.0037449 m ^{2}
- Elastic modulus: Eps = 2 X 108 kN/m^2
- Jacking Stress: fpj = 0.7fpu = 1330 N/mm^2
- Curvature friction factor: μ = 0.3 /rad
- Wobble friction factor: k = 0.0066 /m
- Slip of anchorage: s = 6 mm

Cross Section Specification:

- 4 Cells Concrete Box-Girder with two traffic lanes and Vertical side walls

Top slab thickness = 300 mm
Bottom Slab thickness = 300 mm
External wall thickness = 300 mm
Internal Wall thickness = 300 mm
Span = 30m
Total width = 10m Road
Width of Carriage way = 7.5m
Wearing coat = 80mm
Cross-sectional Area = 8.31 m^2

SINGLE CELL PRE-STRESSED CONCRETE BOX GIRDER:

Tendon Properties:

Pre-stressing Strand: ϕ15.2 mm (0.6"strand)

Yield Strength: fpy = 1.56906 X 10^6kN/m^2

Ultimate Strength: fpu = 1.86326 X 10^6 kN/m^2

Cross Sectional area of each tendon = 0.0037449 m ^{2}

Elastic modulus: Eps = 2 X 108 kN/m ^{2}

Jacking Stress: fpj = 0.7fpu = 1330 N/mm^2

Curvature friction factor: μ = 0.3 /rad

Wobble friction factor: k = 0.0066 /m

Slip of anchorage: s = 6 mm (At the Beginning and at the End)

Cross Section Specification:

Trapezoidal Shape

Top slab thickness (Tapered) = at the center 300 mm & at corner 200 mm

Bottom Slab thickness = 200 mm

External wall thickness = 300 mm

Span = 30m

Total width = 10m Road

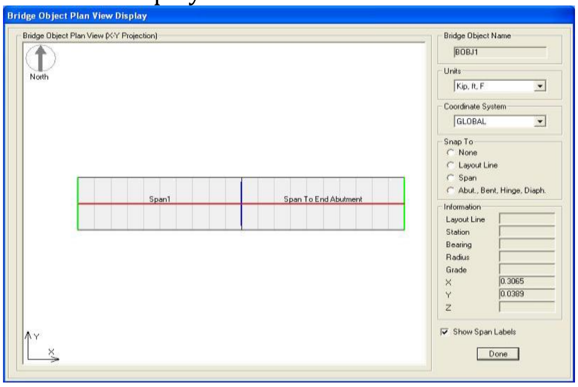
Carriage way width = 7.5m

Wearing coat = 80mm

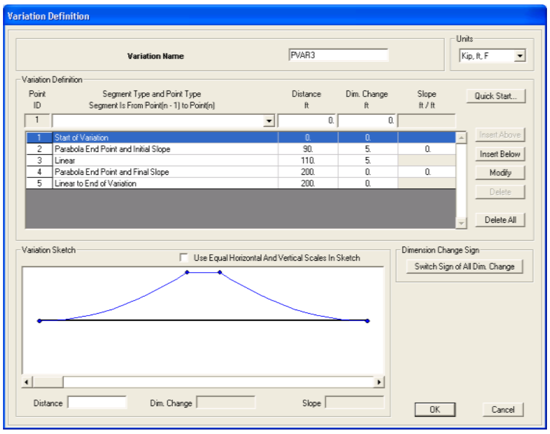
Cross-sectional Area = 4.620 m^2

1.2 Modeling in Csi Bridge

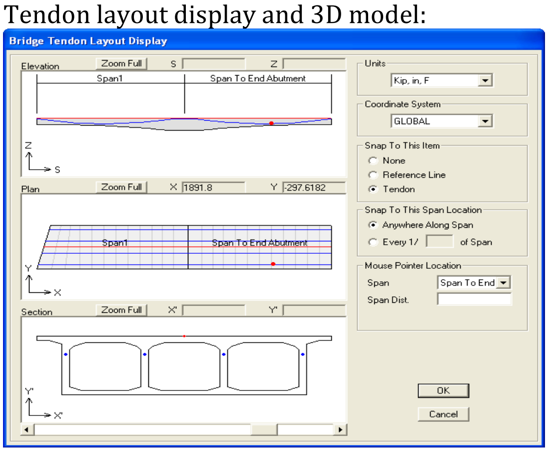
Plan view display:

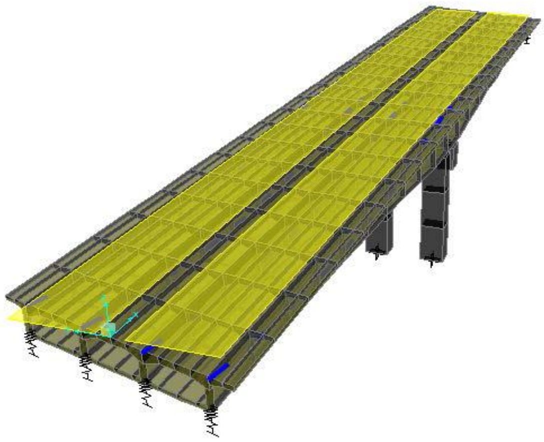


Parametric variation:



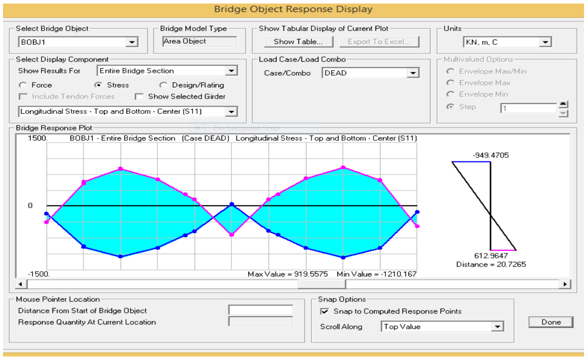
Tendon layout display and 3D model:

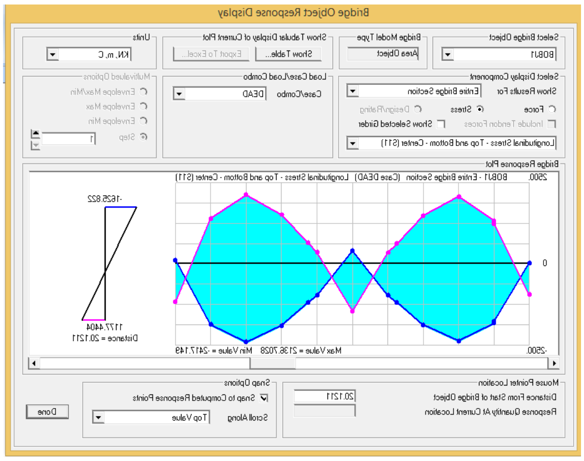




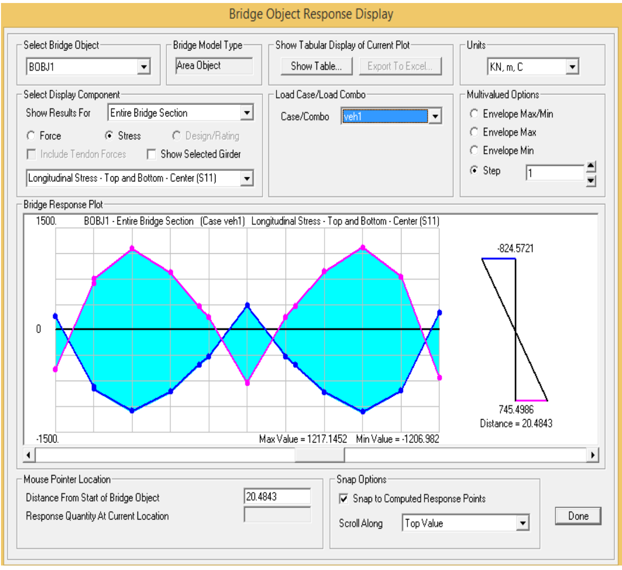
2. RESULTS OF ANALYSIS

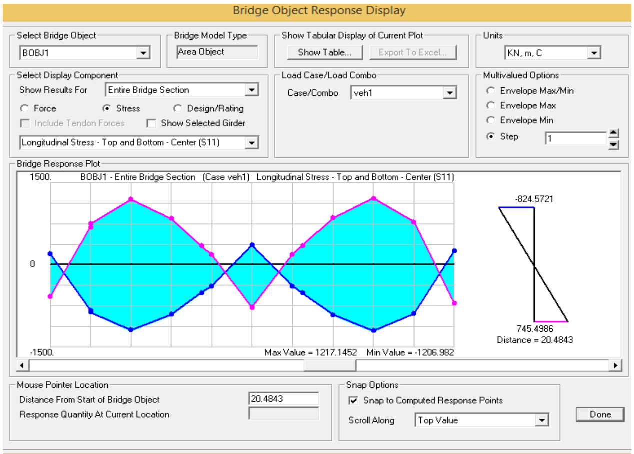
Response display to dead load (AASHTO & IRC):



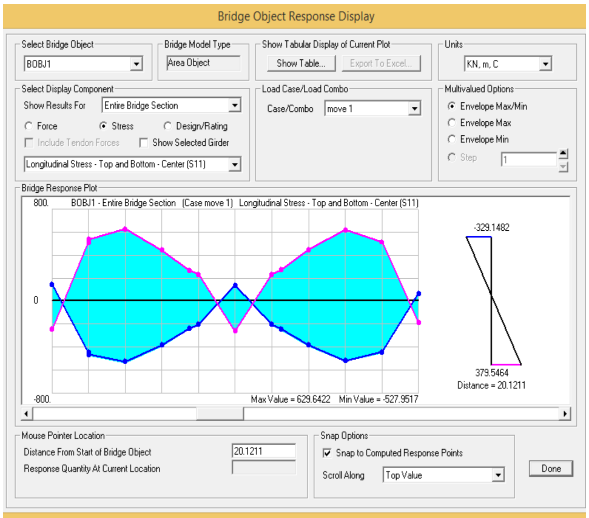


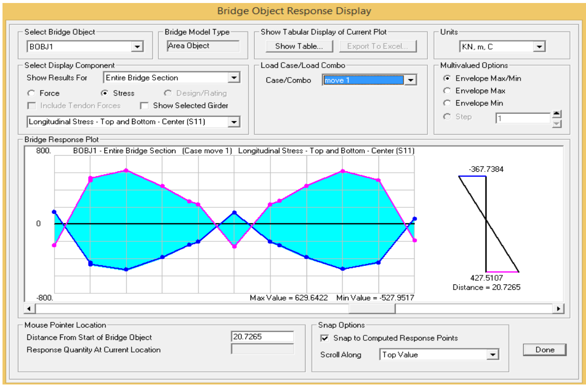
Response to vehicular load (AASHTO & IRC):



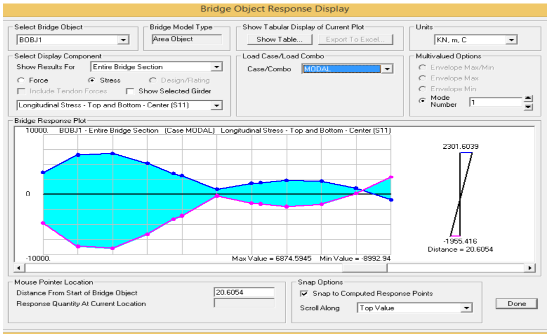


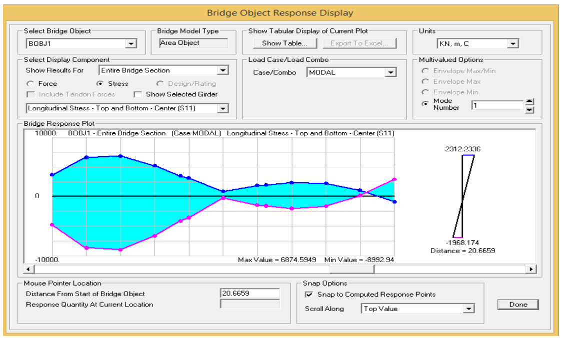
Response to moving load (AASHTO & IRC):



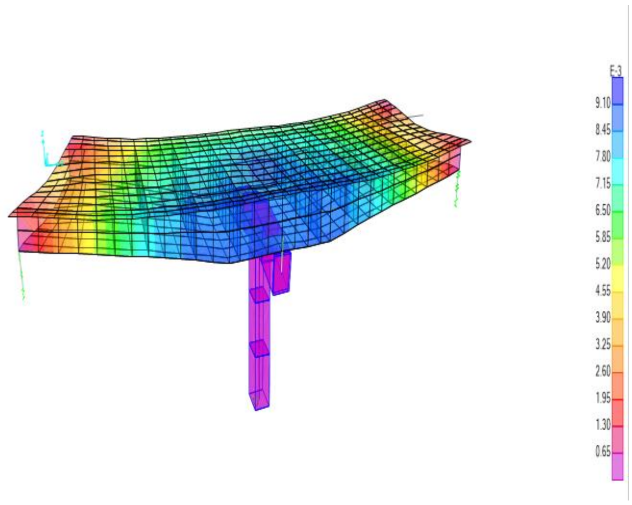


Modal response for AASHTO and IRC loading:





Deformation of 3D model:



Shear force , moments , torsion obtained during analysis (respectively for AASHTO and IRC loading):

Generated by Software :

Distance	P	V2	V3	T	M2	M3
M	KN	KN	KN	KN-m	KN-m	KN-m
0	-449.687	-969.313	-3.185	-132.9484	23.6428	0
3	-456.712	-773.941	31.887	-469.0729	-0.6931	961.6809
3	-453.692	-691.872	-33.589	-516.4071	8.1946	984.8629
6	-455.093	-453.796	-12.457	-380.4677	85.5651	2723.1021
6	-455.574	-375.937	-37.106	-241.3712	88.2007	2695.083
9	-458.391	-126.888	-9.889	-96.9527	170.3104	3412.3876
9	-461.444	-55.633	-29.9	67.5011	183.8511	3340.2189
11.25	-465.494	139.166	-38.143	-8.469	278.4244	3228.0567
11.25	-468.882	142.647	-64.277	145.9204	293.5159	3146.2111
12	-468.882	206.033	-64.277	54.0368	341.7238	3015.4561
12	-471.212	271.177	-183.417	116.323	350.7928	2941.6054

3. CONCLUSIONS

- The varied span to depth quantitative relation are taken for the analysis of beam bridges, and for all the cases, deflection and stresses are at intervals the permissible limits.
- As the depth of beam decreases, the pre stressing force decreases and no of cables decreases. attributable to prestressing, additional strength of concrete is used and additionally well governs usefulness.
- A comparative study between four cell and single cell pre-stressed concrete beam Cross sections has been done. This study shows that the one cell pre-stressed concrete beam is most fitted and economical crosswise for two lane Indian national road bridges.
- It is found that the deflection obtained thanks to varied loading conditions and at service condition is well at intervals permissible limits as per IRC. the utmost vertical deflection is found to occur close to mid-span location of the beam.
- For the optimisation of section, differing kinds of check ought to be performed; those ar applied during this paper. Results of bending moment and stress for self-weight and superimposed weight are same, however those are totally different for the moving load thought, as a result of IRC codes offers style for the significant loading compared to the AASHTO codes. In load combination,

AASHTO codes have taken additional issue of safety than IRC. space of prestressing steel needed for AASHTO is a smaller amount compared to IRC.

- Finally supported this comparative study it's clear that AASHTO code is additional economical than IRC.

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