ANALYSE AND DESIGN OF A PSC BOX GIRDER BRIDGE.

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ABSTRACT - Most of the bridges still under construction at this time were delayed for investigation of basic design principle. Some were abandoned and rebuilt as a different form of bridge altogether. Box girder are rarely used in the buildings, but they may be used in special circumstances, such as when loads are carried eccentrically to the beam axis. Box girders can be universally applied from the point of view of load carrying, to their indifference as to whether the bending moments are negative or positive and to their torsional Stiffness; from the point of view of economy.

- Pre-Stressed Concrete Box Girder bridges are extensively use in highway and railway construction.

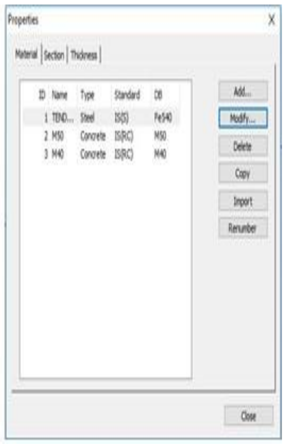
- Pre-Stressed Concrete Box Girder are used to achieve deflection control and to restore bearing capacity of bridges.

INTRODUCTION

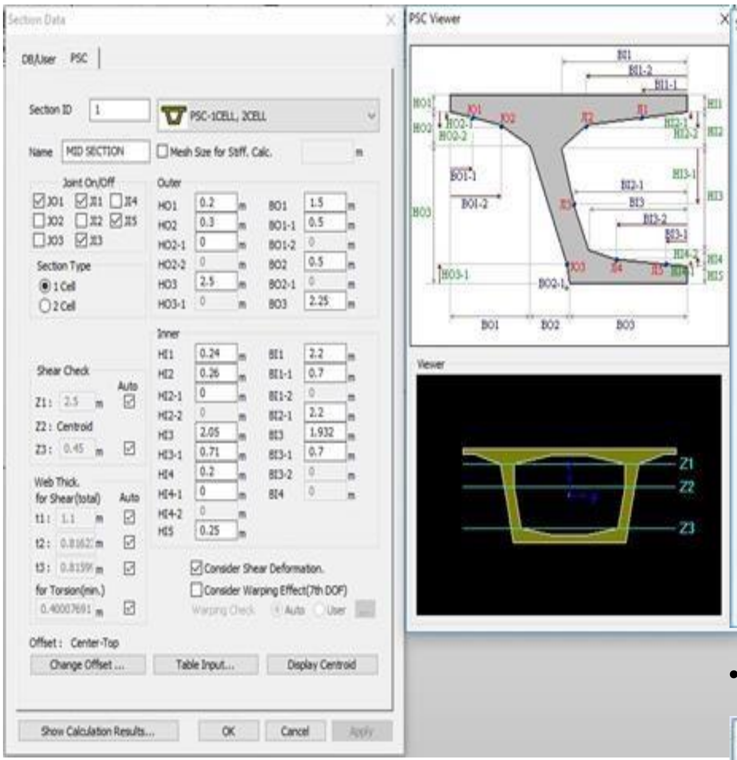
Planning and designing of bridges is part art and part compromise , the most significant aspect of structural engineering. It is the manifestation of the creative capability of designers and demonstrates their imagination, innovation , and exploration. The first question designers have to answer is what kind of structural marvel bridge design are they going to create? The importance of conceptual analysis in bridge-designing problems cannot be emphasized strongly enough. The designer must first visualize and imagine the bridge in order to determine its fundamental function and performance. Without question, the factors of safety and economy shape the bridge designer‟s thought in a very significant way. The values of technical and economic analysis and indisputable, but they do cover the whole design process Bridge is a complex engineering problem. The design process includes consideration of other important factors, such as choice of bridge system, material, dimension, foundation, aesthetics, and local landscape and environment.

METHODOLOGY

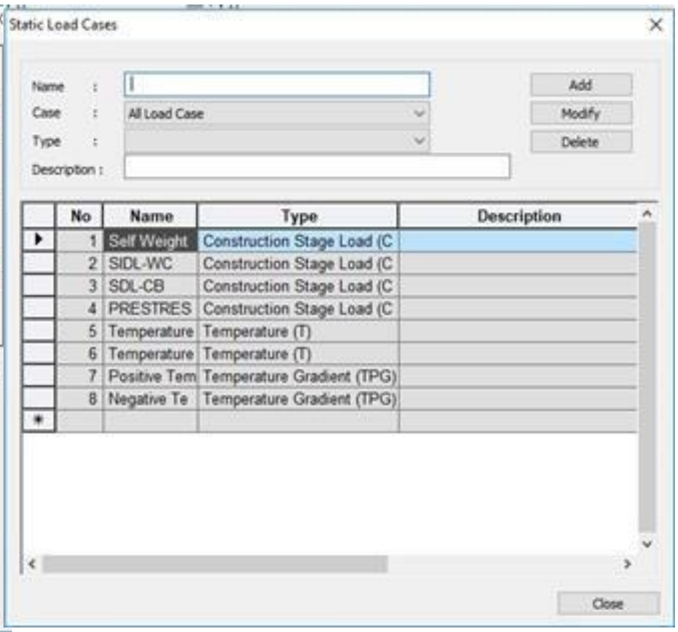
- Material definition



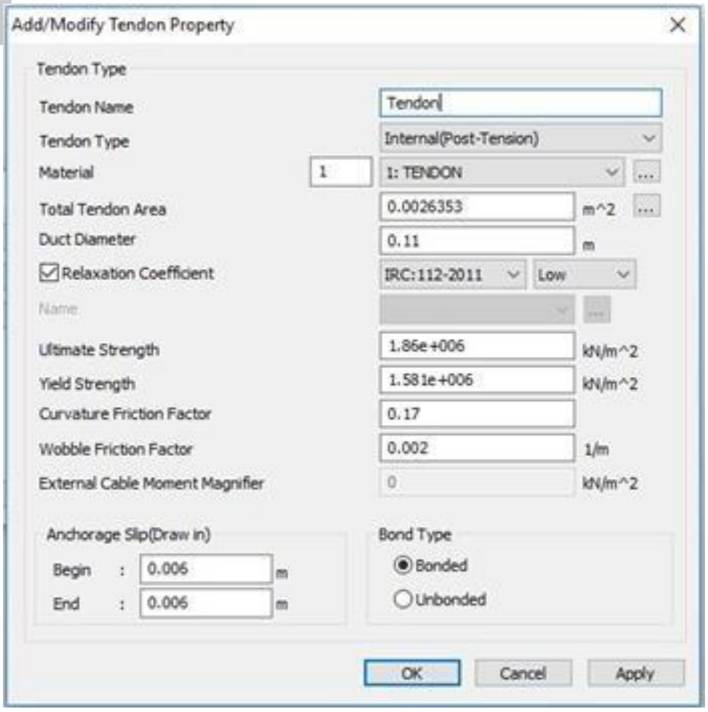
• Section definition



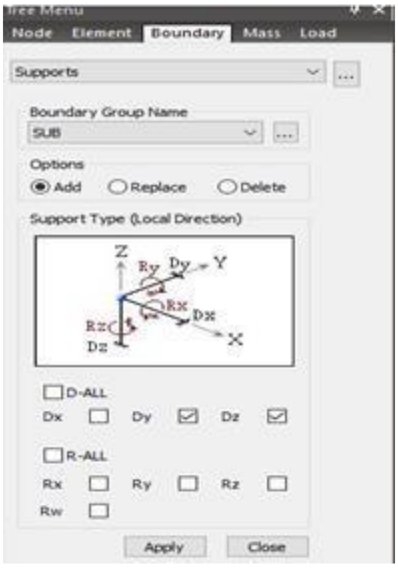
• Defining load cases



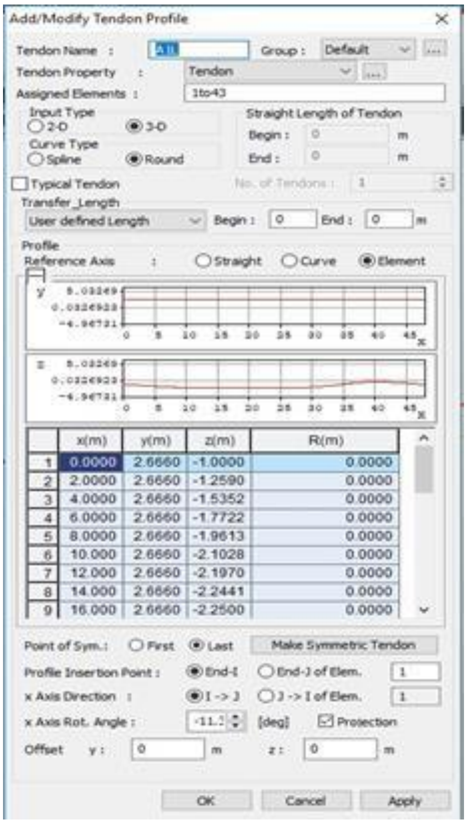
• Defining Tendons



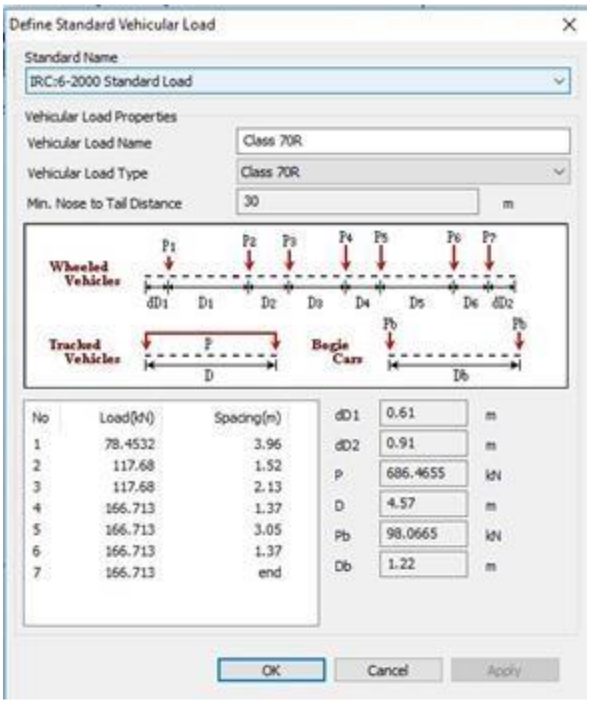
• Defining supports



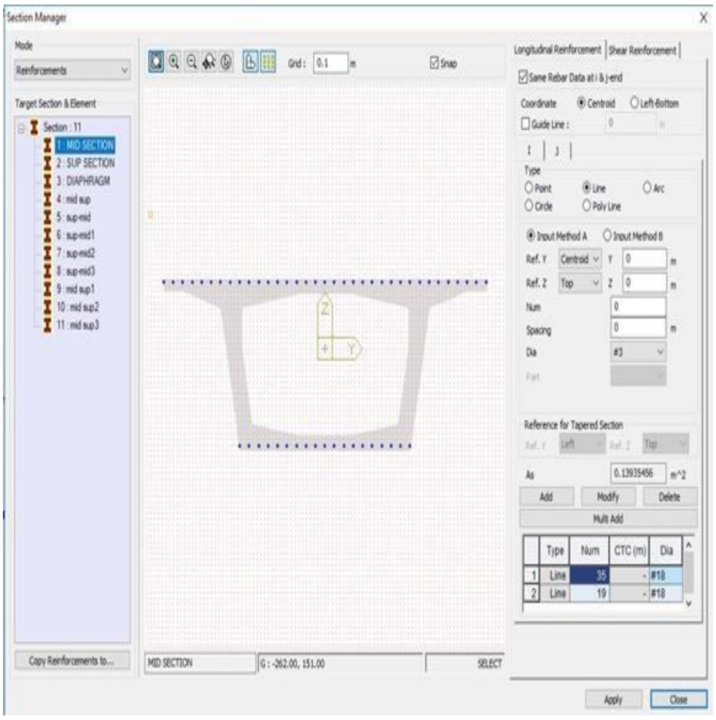
• Defining Tendon profile



• Load definition of vehicle



• Assigning reinforcement



• Assigning load combination

LIST OF LOAD COMBINATIONS

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NUM NAME ACTIVE TYPE

LOADCASE(FACTOR) + LOADCASE(FACTOR) +

LOADCASE(FACTOR)

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1. cLCB1 Strength/Stress Add

70R(1.500) + Dead Load(1.350) + SIDL-WC(1.350)

+ SIDL-CB(1.350) + Creep Secondary(1.000) + Shrinkage Secondary(1.000)

+ Tendon Secondary(1.000)

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2. cLCB2 Strength/Stress Add

Cl.A(1.500) + Dead Load(1.350) + SIDL-WC(1.350)

+ SIDL-CB(1.350) + Creep Secondary(1.000) + Shrinkage Secondary(1.000)

+ Tendon Secondary(1.000)

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3. cLCB3 Strength/Stress Add

Temperature Rise(0.900) + Temperature-fall(0.900) + Positive Temp. Grad(0.900)

+ Negative Temp. Grad(0.900) + 70R(1.500) + Dead Load(1.350)

+ SIDL-WC(1.350) + SIDL-CB(1.350) + Creep Secondary(1.000)

+ Shrinkage Secondary(1.000) + Tendon Secondary(1.000)

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4. cLCB4 Strength/Stress Add

Temperature Rise(0.900) + Temperature-fall(0.900) + Positive Temp. Grad(0.900)

+ Negative Temp. Grad(0.900) + Cl.A(1.500) + Dead Load(1.350) + SIDL-WC(

1.350) + SIDL-CB(1.350) + Creep Secondary(

1.000)

+ Shrinkage Secondary(1.000) + Tendon Secondary(1.000)

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5. cLCB5 Strength/Stress Add

Temperature Rise(-0.900) + Temperature-fall(-0.900) + Positive Temp. Grad(-0.900)

+ Negative Temp. Grad(-0.900) + 70R(1.500) + Dead Load(1.350)

+ SIDL-WC(1.350) + SIDL-CB(1.350) + Creep Secondary(1.000)

+ Shrinkage Secondary(1.000) + Tendon Secondary(1.000)

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6. cLCB6 Strength/Stress Add

Temperature Rise(0.900) + Temperature-fall(0.900) + Positive Temp. Grad(0.900)

+ Negative Temp. Grad(0.900) + 70R(1.500) + Dead Load(1.350)

+ SIDL-WC(1.350) + SIDL-CB(1.350) + Creep Secondary(1.000)

+ Shrinkage Secondary(1.000) + Tendon Secondary(1.000)

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7. cLCB7 Strength/Stress Add

Temperature Rise(0.900) + Temperature-fall(0.900) + Positive Temp. Grad(0.900)

+ Negative Temp. Grad(0.900) + Cl.A(1.500) + Dead Load(1.350)

+ SIDL-WC(1.350) + SIDL-CB(1.350) + Creep Secondary(1.000)

+ Shrinkage Secondary(1.000) + Tendon Secondary(1.000)

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8. cLCB8 Strength/Stress Add

Temperature Rise(-0.900) + Temperature-fall(-0.900) + Positive Temp. Grad(-0.900)

+ Negative Temp. Grad(-0.900) + 70R(1.500) + Dead Load(1.350)

+ SIDL-WC(1.350) + SIDL-CB(1.350) + Creep Secondary(1.000)

+ Shrinkage Secondary(1.000) + Tendon Secondary(1.000)

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9. **cLCB9 Strength/Stress Add**

70R(1.500) + Dead Load(1.350) + SIDL-WC(1.350)

+ SIDL-CB(1.350) + Creep Secondary(1.000) + Shrinkage Secondary(1.000)

+ Tendon Secondary(1.000)

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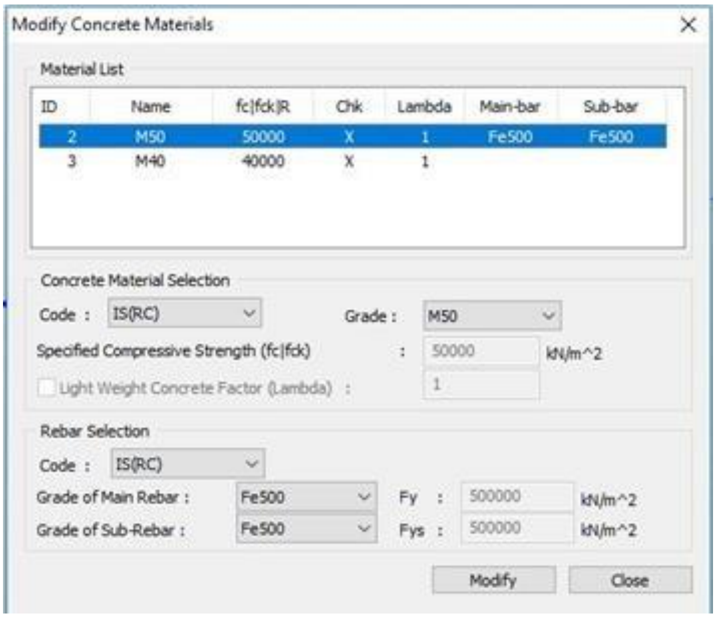
10. **cLCB10 Strength/Stress Add**

Cl.A(1.500) + Dead Load(1.350) + SIDL-WC(1.350)

+ SIDL-CB(1.350) + Creep Secondary(1.000) + Shrinkage Secondary(1.000)

+ Tendon Secondary(1.000)

• PSC design material

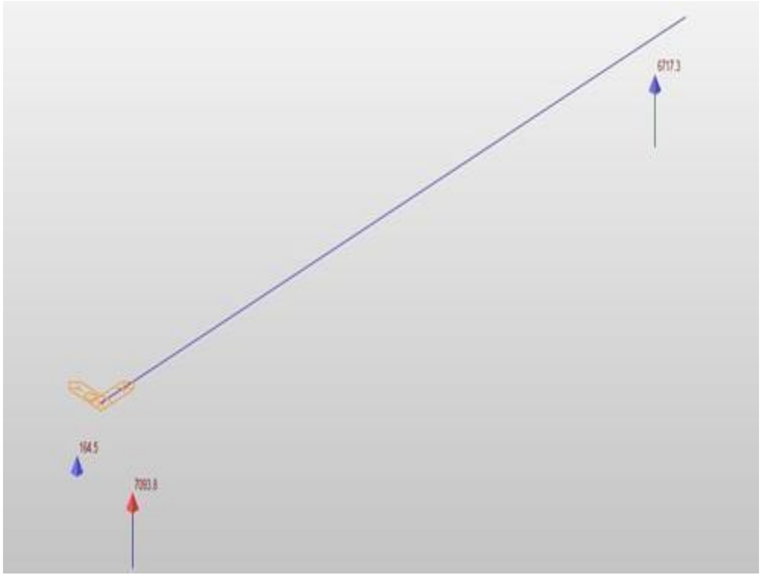


• Performing design and generating report

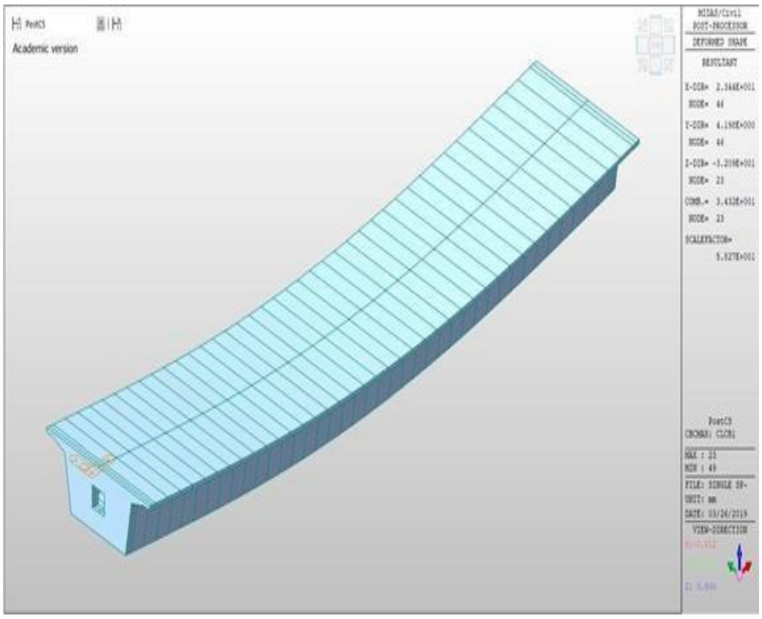
RESULTS AND DISCUSSIONS

The various analysis results for the PSC box girder such as support reactions, displacements, bending moments, torsional moments, shear forces, prestresses along with the design results have been discussed.

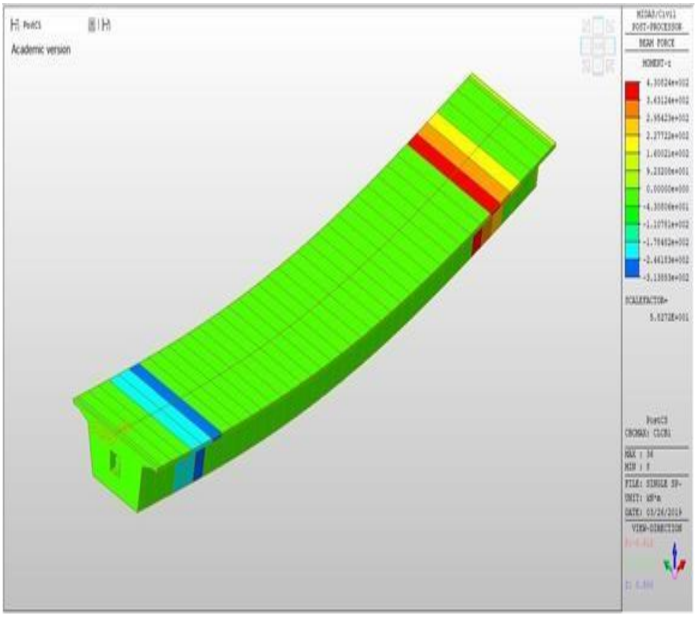
*Maximum Reaction :- Left support = 7093.8 kN Right Support = 6717.3 kN



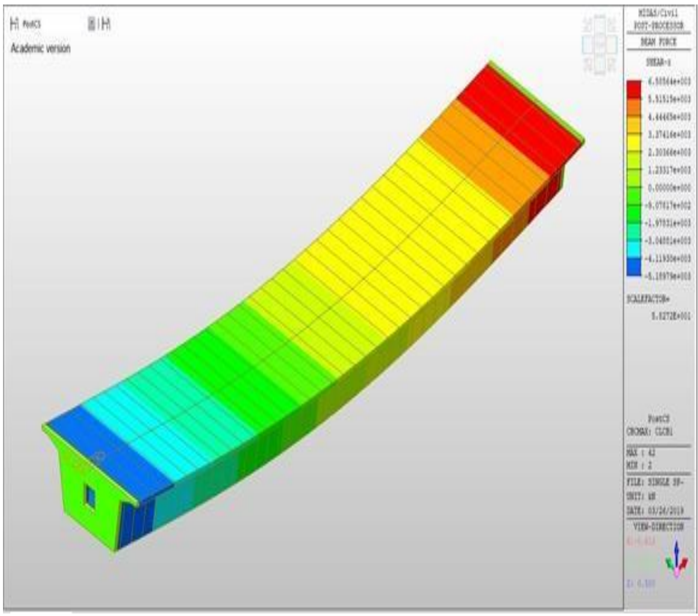
*Displacements:- Maximum Displacement 23mm.



*Bending Moment:-Maximum B.M= 36 kNm



*Shear Force Maximum S.F = 42 kN



ACKNOWLEDGEMENT

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REFRENCES

1. Khaled M.Sennah & John B.Kenndy performed elastic analysis and experimental studies on the elastic response of Box Girder Bridges. in elastic analysis they represent the orthotropic plate theory method, grillage analogy method, folded plate method, finite element method, thin-walled curved beam theory etc The curvilinear nature of box girder bridges along with their complex deformation patterns and stress fields have led designers to adopt approximate and conservative methods for their analysis and design. Recent literature on straight and curved box girder bridges has dealt with analytical formulations to better understand the behavior of these complex structural systems. Few authors have undertaken experimental studies to investigate the accuracy of existing method.

2. Kenneth W. Shushkewich performed approximate Analysis of Concrete Box Girder Bridges. The actual three-dimensional behaviour of a box girder bridges as predicted by a folded plate, finite strip or finite element analysis can be approximated by using some simple membrane equations in conjunction with plane frame analysis.

3. Y. K. Cheung et al discussed on curved Box Girder bridges based on the curvilinear coordinate system, the spline finite strip method is extended to elasto-static analysis. As the curvature effect cannot be ignored, the webs of the bridges have to be treated as thin shells and the flanges as flat curved plates. The shape functions for the description of displacement field (radial, tangential, and vertical) are given as product of B-3 spline functions in the longitudinal direction and piece-wise polynomials in the other directions. The stress-strain matrices can then be formed as in the standard finite element method. Compared to the finite element method, this method yields considerable saving in both computer time and effort, since only a small number of unknowns are generally required in the analysis.This paper represents three examples box girder bridges of different geometrical shapes to demonstrate the accuracy and versatility of the method. This method was recently devised by Cheung et al. (1982) for the analysis of right straight plates and box girders. It was then subsequently extended to cover skew plates (Tham et al. 1986) and the plates of arbitrary shape (Li et al. 1986).

4. Ricardo Gaspar & Fernando Reboucas Stucchi presented Web Design of Box Girder Concrete Bridges. An experimental investigation was undertaken with the purpose verifying the validity of the newly developed approach. The following failure modes considered: excessive plastic deformation of stirrups, crushing of the compressed struts and failure of the stirrups due to fatigue. The experimental results showed good agreement with the results of the proposed approach. Furthermore, the tests revealed new aspects of the fatigue behavior, the failure of the stirrups due to fatigue occurred in stages, one at a time in gradual manner. In all cases, failure took place near the connection between the web and the bottom flange.

5. Ayman M. Okeil & Sherif El Tawil carried out detailed investigation of warping-related stresses in 18 composite steel-concrete box girder bridges. The bridge designs were adapted from blueprints of existing bridges in the state of Florida and encompass a wide range of parameters including horizontal curvature, cross-sectional properties, and number of spans. The bridges after which the analysis prototypes are modeled were designed by different firms and constructed at different times and are considered to be representative of current design practice. Forces are evaluated from analyses that account for the construction sequence and the effect of warping. Loading is considered following the 1998 AASHTO-LRFD provisions. Differences between stresses obtained taking warping into account and those calculated by ignoring warping are used to evaluate the effect of warping. Analysis results show that warping has little effect on both shear and normal stresses in all bridges.

6. Alok Bhowmick presented Detailing Provisions of IRC: 112-2011 Compared with Previous Codes (IRC: 21 & IRC: 18) Part-2: Detailing Requirement for Structural Member & Ductile

Detailing for Seismic Resistance (Section 16 & 17 of IRC: 112). The unified concrete code (IRC: 112) published by the Indian Road Congress (IRC) in November 2011 combining the code for reinforced concrete and prestressed concrete structures. The new unified concrete code (IRC: 112) represents a significant difference from the previous Indian practice followed through IRC: 21 & IRC: 18. The code is less prescriptive and offer greater choice of design and detailing methods with scientific reasoning. This new generation code, when used with full understanding, will bring benefits to all sectors of our society as it will eventually lead to safer construction make a tangible contribution towards a sustainable society. The present situation in the industry is that most of the consulting officers are struggling to understand this code, which is not so user friendly. Since the designer is hard to pressed for time, majority of the consultants are unfortunately spending their valuable time only in fulfilling the prescribed rules of the code, acting as a technical lawyer, with very little understanding of the subject

BIOGRAPHIES

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