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ANALYSIS AND DESIGN OF A COMPOSITE BRIDGE

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ABSTRACT

We need to change our trend for the construction of roads and bridges by reducing the pollution to the environment and using eco-friendly materials as much as possible in the construction. Obviously we cannot reduce the construction practice due to modernisation and urbanisation. The analysis and modelling of the composite bridge using steel I girder and concrete deck slab has been done in previous phase and in this phase the comparative study of the bridge is to be done. The study involves the variations obtained in the bending moment, shear force, deflection and stresses over the bridge. The stress variation is due to change in section of I girder, differential shrinkage and temperature variations. The section of I girder is altered by width and thickness of flanges based on market available sections and the overall depth of the girder remains the same in all the trials. In each trial section moment of inertia and section modulus are calculated for steel sections and the composite sections. The composite section values are the values calculated after curing process of the deck slab constructed over I girders. For the results obtained in every section graphs are plotted individually with the allowable stresses and allowable deflections at each stage and comparison is done.

1. INTRODUCTION

1.1 General

The definition of composite bridge, types of bridge, principle of composite bridge design and the construction methods of composite bridge are explained in the previous phase of the project. Hence in this the factors such as stress, deflection, camber, differential shrinkage, temperature variation, section modulus and modular ratio which are used in the project are to be explained.

1.2 Stress

Stress is defined as the average force per unit area that some particle of a body exerts on an adjacent particle, across an imaginary surface that separates them.

1.3 Section modulus

Section modulus is a geometric property for a given cross-section used in the design of beams or flexural members.

1.4 Moment of inertia

Moment of inertia *I* is defined as the ratio of the angular momentum *L* of a system to its angular velocity ω around a principal axis. Moment of inertia is the mass property of rigid body that determines the torque needed for a desired angular acceleration about an axis of rotation.

1.5 Deflection

Deflection is the degree to which a structural element is displaced under a load. It may refer to an angle or a distance.

1.6 Modular ratio

Modular Ratio is defined as the Ratio between Modulus of Elasticity of Steel and Modulus of Elasticity of Concrete.

1.7 Differential shrinkage

Plastic shrinkage is caused by a rapid loss of water on the concrete surface before the concrete hardens. Autogenous shrinkage happens when the concrete begins to hydrate.

2. LITERATURE REVIEW

A paper by Trevor Haas has explained about comparative analysis. The analysis was conducted for both non-composite and composite action between the steel girders and the reinforced concrete bridge deck. Based on the design calculations, a cost comparison was performed.

Sundara Raja Iyengar K.T., Prakash Desayi, and Nagi Reddy (1970) reported on stress-strain characteristics of concrete confined by steel binder. In this investigation, the authors reported that the ductility of concrete can be increased by confinement.

Mander J.B..Priestley M.J.N and Park R (1988) developed a theoretical stress-strain model for confined concrete. Tests have shown that strength enhancement from confinement and the slope of the descending branch of the concrete stress strain curve have a considerable influence on the flexural strength and ductility of reinforced concrete columns.

Puckett (1992) outlined a comparative study of the live load distribution factors for interior beams from a program that employed the finite strip method. The results were compared with those obtained by the NCHRP project 12-26 (141) using the finite element method and those using the AASHTO LRFD (6) formula-based factors.

3. METHODOLOGY

3.1 Introduction

In this section we need to allot different sections which are to be compared with the original section for the comparative study of deflection and stress factors.

3.2 Section I

Design of Composite steel girder with concrete deck slab (Limit State Method of Design)

3.2.1 Design Parameters

3.2.2 Properties of Main girder

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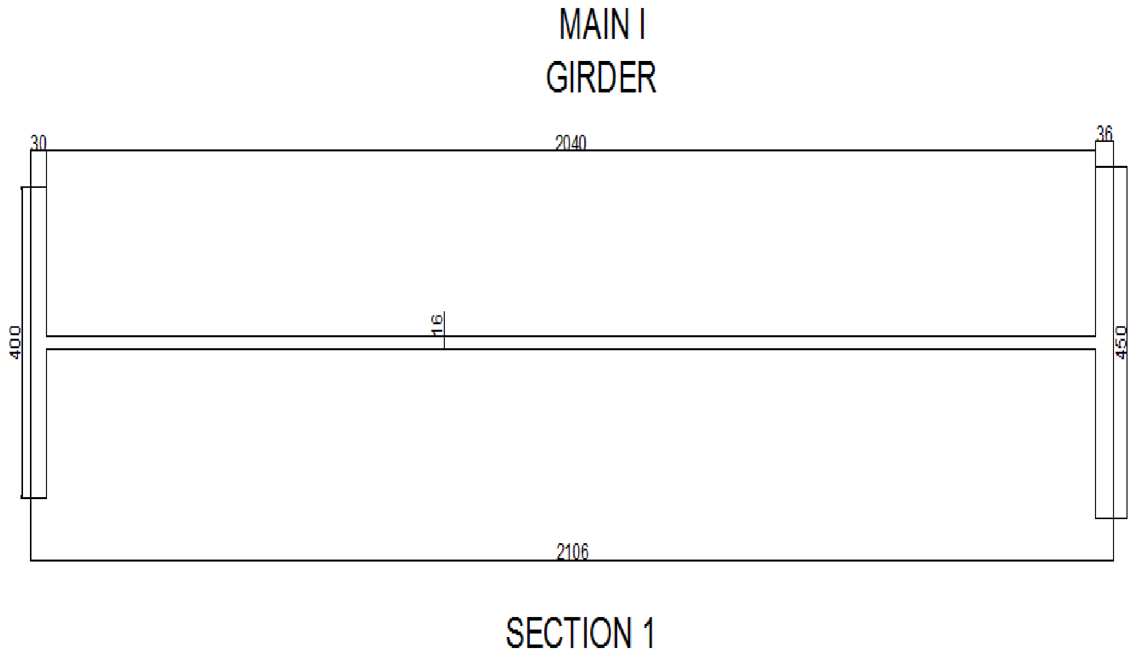

Figure 1 Section I of I gir

3.2.6 Flange Plate (Refer Clause 503.7.2 Table-2 of IRC-24-2010)

Outstanding element Compression flange - Welded section

b/t_f $< 8.4\xi$ ξ $= (250/fy)^{1/2}$

For top flange, b/t_f $< 8.4\xi$

3.2.7 Effective Flange Width

3.2.7.1 Effective Flange width for Interior beams

(As per IRC 22-2008 Clause 603.3)

b_{eff} $= [(L_0/4) <= B]$ (whichever is less)

b_{eff} $= l_0/4$ (or) b_{eff} $= B$

3.2.7.2 Effective Flange width for Exterior beams

(As per IRC 22-2008 Clause 603.3)

b_{eff} $= L_0/8 + X$

Where $L_0/8<=B/2$ and $X<=B/2$ (whichever is less)

$b_{\ eff}$ $= L_0/8$ (or) $B/2$; $= X$ (or) $B/2$

4. RESULTS AND DISCUSSION

4.1 General

The modelling for different trial sections are done by using STAAD pro which is a structural software and the shear force and bending moment values are obtained separately for each and every trial sections. **4.2 Deflection graphs**

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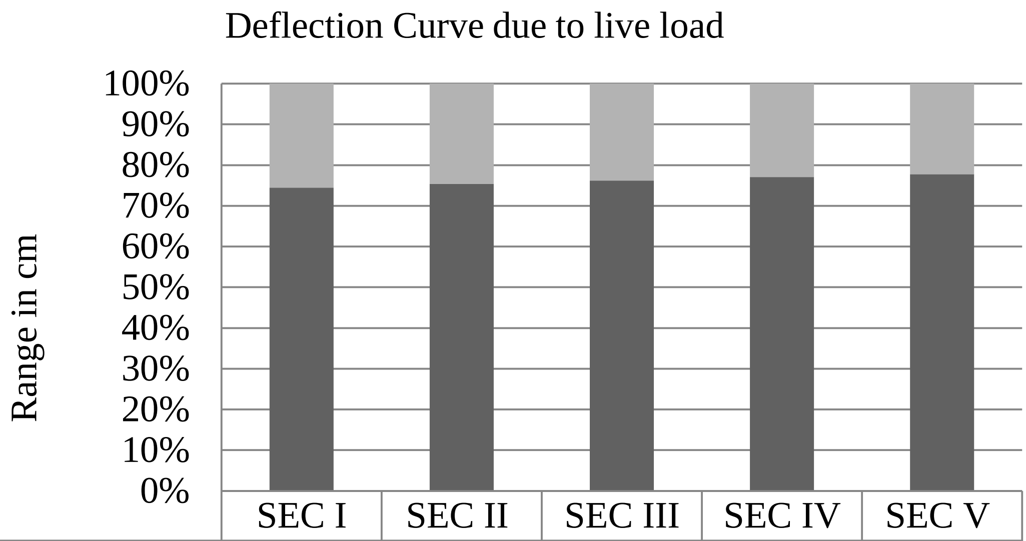
4.2.1 Deflection curve due to live load



	SEC I	SEC II	SEC III	SEC IV	SEC V
OBTAINED	1.677	1.6	1.529	1.461	1.4
ALLOWABLE	4.9	4.9	4.9	4.9	4.9

Figure 6 Deflection curve for live load

The above deflection curve proves that the curve is of decreasing manner which is based on moment of inertia of the trial sections which are considered. The allowable curve is based on the stipulation given for live load deflection in IRC 24, where deflection <L/800. The section V is better since the deflection is lesser.

CONCLUSIONS

In the analysis of the composite bridge the load calculations have done and with those results the bending moments and shear forces are calculated for various stages such as initial condition of main girder, connecting cross girders to the main girder, casting of deck slab, casting of super imposed dead loads, consideration of construction loads, footpath live load and live load analysis in both the direction of longitudinal and transverse analysis.The bending moment and shear force for section I is 930.62 kNm and 93.53 kN respectively. For section II, the BM and SF is 990 kNm and 99.5 kN. For the original section the BM and SF is 1089.027 kNm and 109.45kN. for section IV the BM and SF is 1108.83 kNm and 111.44kN and for the final section the BM and SF is 1148.43 kNm and 115.42kN..Thus the modelling, analysis and comparative study of deflection and stress of the composite bridge with steel girder and concrete deck slab is done with the help of structural software STAAD pro.

REFERENCES

1. Ajay Goyal, CE/C/N/CR,' Regarding Deflection/Camber In Various National And International Codes For Rail And Road Bridges
2. Barr.P.J, M.ASCE, Stanton.J.F, M. O. Eberhard in 'Effects of Temperature Variations on Precast, Prestressed Concrete Bridge Girders' Journal Of Bridge Engineering, March 2005.
3. Giussani.F and Mola.F, Politecnico di Milano, Italy ,29th Conference on OUR WORLD IN CONCRETE & STRUCTURES ,August 2004, Singapore by a paper 'Creep, Shrinkage And Temperature Effects In Composite Steel - Concrete Bridge Beams'.
4. Heins, C.P., "Influence of Bracing on Load Distribution of Bridges," International Conference on Short and Medium Span Bridges, Toronto (1982), pp. 3-15.
5. Inge-Lyse, 'The new method of design of modular ration in reinforced concrete'.
6. IRC 6: 2010 Standard Specifications and Code of Practice for Road Bridges, Section II – Loads and Stresses (Fifth Revision) .
7. IRC:22-2008 Standard Specifications and Code of Practice for Road Bridges, Section VI – Composite Construction (Limit States Design) (Second Revision).
8. IRC:24-2010 Standard Specifications and Code of Practice for Road Bridges, Steel Road Bridges (Limit State Method)Third Revision)
9. Kim, S.J., and Nowak, A.S., "Load Distribution and Impact Factors for I-Girder Bridges," Journal of Bridge Engineering, Vol. 2, No. 3 (August 1997), pp. 97-104.