TECH-CHRONICLE
AN INTERNATIONAL E-JOURNAL ON
EMERGING TRENDS IN SCIENCE, TECHNOLOGY AND MANAGEMENT

ANALYSIS AND DESIGN OF A 24 M LONG SPAN STEEL GIRDER WITH THE LOAD OF A SPECIAL VEHICLE IN MIND

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ABSTRACT

This study examines the construction of a steel girder with a 24 m long span while taking the loading requirements of IRC 6-2014 Amendment 1. The truck is 30 metres long and has a 385-ton gross vehicle load.The only live load that will be taken into account for analysis and design purposes is the IRC class Special Vehicle defined in amendment 1 of IRC: 6-2014. The design taking into account the, Unique Vehicle The standard design from R.D.S.O. will be compared to the live load, and the viability of R.D.S.O. section for new IRC loading, i.e. Special Vehicle will be examined. In this project, a comparison will be done for the same span length (i.e., 36.0m), as R.D.S.O. supplies the design for a 36.0m span. The design criteria will be the same as those outlined in the RDSO, however

Keywords: Steel girder, RDSO, special vehicle, and vehicle load; *IRC: 6-2014*

I. INTRODUCTION

BRIDGE:- Technically speaking, a bridge is a building that allows passage over an obstruction without blocking the path below. For a water route, such as a road, railway, pedestrian path, canal, or pipeline, it may be necessary to pass over the obstruction. A river, a road, a railway, or a valley could be the thing that needs to be spanned and for which the bridge is made.

. Modern bridge and building construction frequently makes use of composite steel-concrete structures. A composite member is created when a concrete element, such as a floor slab or bridge deck, is joined to a steel element, such as an I-beam. A composite T-beam of this type balances the high-tension strength of the steel with the relatively high compression strength of the concrete.. Construction made of composite steel and concrete is particularly effective and affordable because each material is utilised to its best potential. But the main allure of such a construction is in having a strong link between the steel and the concrete, as it is this connection that permits the transfer of forces and gives composite elements their distinctive behaviour.

Due to its advantages over traditional construction, steel-concrete composite systems have recently gained a lot of popularity. Composite construction, which combines the best qualities of both concrete and steel, produces quick building. The current work consists of the analysis and design of a 36.0 m superstructure made of steel and concrete for a road overpass that is subject to IRC loading using the limit state design method. The designs that were previously made on this subject took into account Class AA Load, Class A Loading, For example, IRC:6-2000 or IRC:6-2014 mentioned Class 70R Loading, however this project Special Vehicle recommended by IRC:6-2014 will also be taken into consideration for the Besides the aforementioned burden, this analysis. India uses a fairly little amount of steel in the construction industry compared to many other emerging nations. This isn't a problem with the economy of steel as a construction material, according to the experiences of other nations. Increased use of steel in building is quite likely, especially given India's current growth needs. Exploring steel as a substitute for concrete in places where it makes economic sense would be a huge loss for the nation. Additionally, it is clear that composite sections made of steel encased in concrete are a practical, affordable, and quick solution for large-scale civil projects like bridges and skyscrapers. Steel and concrete is the most significant and often used combination of building materials, and it is used in multi- story factories, commercial buildings, and bridges. These essentially dissimilar materials are perfectly complementary to one another and compatible with one another; they exhibit nearly They have the ideal balance of strengths, with the steel being effective in tension and the concrete being effective in compression. They also have the same thermal expansion. Additionally, concrete has the ability to resist local or lateral-torsional buckling in thin steel parts. Additionally, it shields steel against corrosion. and provides thermal insulation. Steel and concrete, two essential building elements, are sadly marketed by two different companies. Since various sectors are in close rivalry with one another, it can be challenging to promote the optimum use of

I. LITERATURE REVIEW

D. R. Panchal, Ph.D., and P. M. Marathe (Dec 2011) This research compares the deflections of the members, size and material consumption of the members in composite with regard to R.C.C. and steel sections, seismic forces and behavior of the building under seismic circumstances in composite with respect to R.C.C. and steel,the foundation requirements and the type of foundation that can be chosen for composite structure with respect to R.C.C. & Steel, as well as the overall cost of the building. According to the findings, Steel is a superior option to R.C.C. The Composite option, however, is the most appropriate of the three for high rise buildings. (Sept. 2012) Vikash Khatri, P. K. Singh, and P. R. Maiti A study is conducted to contrast bridges created utilising MS and HPS. The HPS is still not in use in India, and the IS regulations do not include an HPS specification. Therefore, it is presumed that the HPS Designer Guide's comparison criteria would be used. According to Indian Standard Codes, the two steel grades to compare are mild steel (MS) Fe 410 (yield stress = 250 MPa) and high tensile steel (HPS) Fe 590 (yield stress = 450 MPa). For cost comparison purposes, HPS is assumed to be roughly 1.2 times more expensive than MS. Comparing MS to HPS and examining the economics of HPS in bridge are the main goals of this essay.

The impact of the HPS's live load deflection requirement is also highlighted in the study. The effect of HPS and greater girder spacing on weight, performance, and deflection was the main emphasis of this study. The studies looked at different HPS and MS arrangements with various girder spacings and span lengths. The designs were weight-optimized and aimed at a range of span-to-depth ratios. This study has shown comparisons between 4-girder and 5- girder composite bridge designs as well as between mild steel and HPS girder. Comparing HPS steel to MS steel, it is discovered to be more advantageous and cost-effective for bridge design. The biggest drawback of HPS, despite all of its benefits, is that the deflection exceeds the permitted deflection limit. Additional negative impacts of this include Savita Maru, Dr. Anamika Tedia (Jan 2014) In large civil projects like bridges and high-rise buildings, composite sections made of steel encased in concrete are an economical, time- and money-saving alternative. This project, which entails the research and design of a high rise structure employing steel-concrete composites, has been envisioned taking the aforementioned fact into consideration. The project also entails the analysis and design of an equivalent R.C.C. structure in order to compare the costs of a Steel-Concrete Composite Structure and an Equivalent R.C.C. Structure. From the cost comparison, it can be seen that steel-concrete composite design structures are more expensive, but their direct costs will decrease due to quicker construction, making them economically viable also under earthquake

Dr. D. R. Panchal (Jan. 2014) The analysis and design of composite structures have undergone several recent trends, which the authors' work has followed. The investigation comes to the conclusion that For spans of 12, 15, or even 20 m, composite floor construction is extremely cost-effective. Longer sections without columns are obviously in demand.

buildings with open floor plans or more freedom in workplace design. the utilization of rolled steel pieces,

profiled metal decking, and/or prefabricated composite elements speeds up execution, which is another significant factor. Continuous beams have several advantages over single-span beams, including increased load resistance due to the redistribution of bending moments, greater stiffness, and smaller steel section to handle A Wagh (April 2014) In this work, the equivalent static method was used to analyse the 3D building model. The Staad Pro programme then examines the building models. For the models, many characteristics including deflection, shear force, and bending moment are explored. Each region in the country has its own seismic codes.

The primary code that offers guidelines Indian Standard Criteria for Earthquake Resistant

Design of Structures IS 1893 (PART-) is the standard in India for calculating seismic design force.1): 2002. The codes IS-875 (PART-3) and SP64 are used to determine wind forces. The cost comparison shows that steel-concrete composite design structures are quicker to construct and more cost-effective for high-rise buildings.

II. OBJECTIVES

The main goals of this study can be summed up as follows:

1) Research on the composite steel-concrete action of roads over bridges (ROB).

. 2) The investigation of various IRC codes required for the study and design of composite steel-concrete superstructures.

Examining Composite Superstructures Under Various IRC Loads.

4) Designing Composite Superstructures in accordance with IRC 24-2010 and IRC 22-2015 Using the Limit State Design Method

III. RESULT ANALYSIS METHODS

The following is how the intended job is carried out:

- Analysis of the IRC codes 51998, 62014, 222015, and 242010.
- Investigation of the Limit State Design Method.
- Composite superstructure analysis and design

IV. PROBLEM FORMULATION

In this project, a composite superstructure model for the In STAAD-Pro, a road over the bridge will be made. using the following dimensions: 7.5 m clear roadway, 0.45 m crash barrier, 1.5 m walkway, and 0.2 m parapet walls on both sides, resulting in an 11.8 m wide superstructure. At a 2.5m centre to centre distance, 5 longitudinal girders are offered. Design shall be founded upon the Limit State Method outlined in IRC: 24-2010

for steel sections for composite, and IRC: 22-2015 sections, and loading as per IRC: 6-2014 will be taken into account. The only live load that will be taken into account for analysis and design purposes is the IRC class Special Vehicle defined in amendment 1 of IRC: 6-2014. The normal design from R.D.S.O. and the design taking into account Special Vehicle live load The design for 24.0m is provided by R.D.S.O. When building a road over bridge over a railway crossing where a single track crosses a street or a highway, a span of 24 metres is employed. Neglecting the centrifugal force is necessary because the bridge is not suggested for the curve. According to the journal of IRC 6:2014 amendment 2014, the braking force, wind, earthquake, and dynamic impact taken into account when designing the bridge for the particular vehicle load. This unique vehicle has a gross vehicle weight rating of 385 tonnes, with a trailer unit with 20 axles that are each 18 tonnes, two axles that are 9.5 tonnes, and one axle that is 6 tonnes. The complete duration of the

V. THE RESULTS OF THE ANALYSIS ON STAAD PRO

The above figure shows the Bending moment

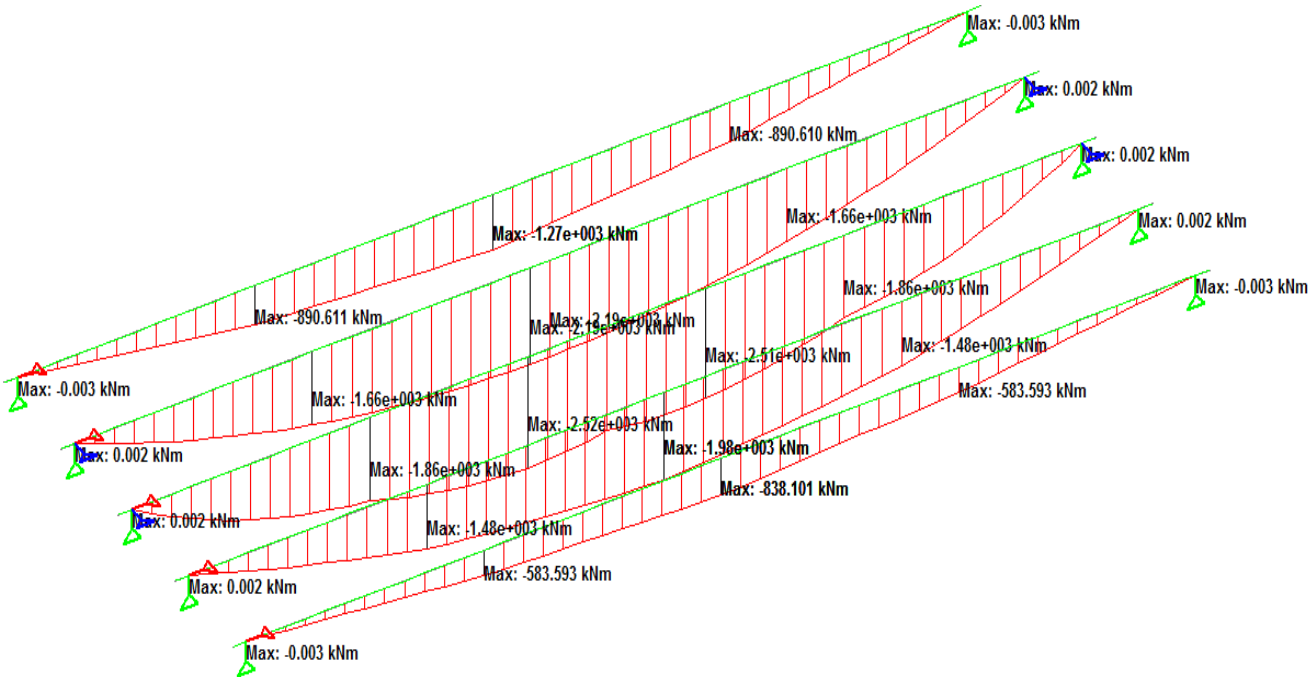
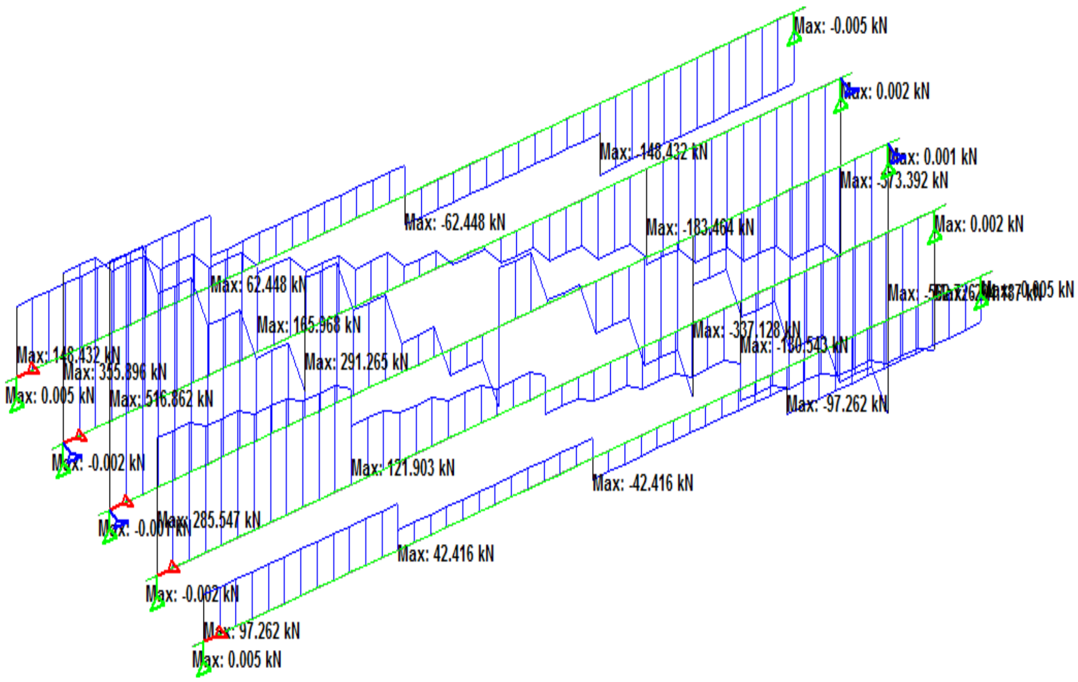


Fig: Results from Staad Pro for Shear Force



5.1 nalysis of Shear Force

The shear force diagram for the critical load combination that results in the maximum for the 24 m span of the composite superstructure comprised of the RDSO section, shear force is shown in the above figure. Shrinkage, Thermal, Special Vehicle, and Shear Force Due to Dead Load = 1006.92 KN

Average shear stresses that are legal are 91.20 Mpa. web's average shear stress is equal to 37.29 Mpa.

The allowed stress in this instance is higher than the typical shear stress that formed in the affected area on the web. The segment is hence safe from shear.

The bending moment diagram for the composite superstructure with a 24 m span and made of RDSO section
can be seen in the above figure, which was produced. the maximum value of the bending moment is produced by the critical load combination as determined by the staad input data.
Bending Moment due to Dead Load = 6258.30 KN-m Moment due to Superimposed Dead Load = 6258.30 KN-m
5685.00 KN-m is the section's moment bearing capacity.
The moment bearing capability of the section in this case is lower than the actual moment that was created on the main girder section. As a result, the bridge's girder, whose parts are in accordance with the RDSO, is unable to support the weight of the special vehicle over a span of 24 metres.

5.2 Analysis of Deflection

. Under a dead load and a live load, a girder may deflect no more than 40.00 mm. Under a live load, a girder's permissible deflection is 30.00 mm.
Girder under-deflection measurement: 13.80 mm
the girder deflected 13.51 millimeters under a dead load and a live load.
Here, the section is safe under the deflection with regard to the live load and dead load because the section's deflection is less than the girder's allowable deflection.
The part of the RDSO with a 24 m span is unsafe since the structure fails the bending criterion. Thus, this part will be updated.

VI. CONCLUSION

The bending moment estimated for Special Vehicle loading is compared to moment resistance capacity of the section according to RDSO drawings for a 24.0 m span, and the findings indicate that the moment resistance capacity of the section is less than the design bending moment. It follows from this that the portion cannot withstand special vehicle loads.loads and must therefore have its characteristics changed in order to accommodate design bending moments. However, the section is secure when subjected to shear and deflection checks.

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