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Study on The Effect of IRC Loading On Plate Girder Under City Areas

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***Abstract*— Thework presents the study on the effect of IRC Loading on Plate Girder coming under city areas. In the Indian subcontinent Plate Girders supported over piers and abutments are being used for a long time. The moment resisting capacity of Plate Girders is between rolled I section and truss girders. They are basically I beams comprising separate structural plates made up of steel which may either be welded, bolted or riveted. Most of the plate girders are normally prefabricated and the limit for the length of the plate girder is set by the mode of transportation used to move the girder from the bridge shop to the bridge site. The normal practice nowadays is to use welded plate girder because of the advancement in welding techniques. For analysis welded plate girder is considered as it is economical as compared to riveted/bolted plate girder. It is evident that the welded plate girder is far superior to the riveted or bolted girder in terms of simplicity and efficiency. Here a Plate Girder of 25 m length is considered and the effect of the IRC Loading is studied. The girder is initially designed manually using limit state method and all results are further verified on CSI BRIDGE software.**

***Index Terms*— CSI BRIDGE, IRC Loading, Plate Girder**

1. INTRODUCTION

The performance of plate girder is often compared with that of prestressed concrete girder. Though steel girders need periodic maintenance, they are far better in view of safety when compared to PSC Girders. The main advantages in steel girders viz problems like corrosion can be overcome with protective coating, possibilities of strengthening whenever or wherever or whatever required, easy replacement by steel girders if it warrants, temporary girders of similar spans available in case of emergencies etc.

The span of PSC girders mostly are not matching with the conventional steel girder span of 12.2, 18.3, 24.4, 30.5 etc. If any PSC Girder fails the alternate arrangement is not confinedbut we know failure in PSC will be a sudden. Therefore in no way Plate girder can be thought of less efficient as compared to PSC girder.

This work on study of plate girder includes the girders erected in city areas as in city portion all the possible situations could easily be adopted while construction of plate girder.

1.1Plate Girder

Plate Girders are built up flexural members. Their bending resistance can be increased by increasing the distance between the flanges. This in turn also increases the shear resistance as the web area increases. Plate girders are primarily provided in bridges but are also very common in buildings where heavy concentrated loads act on a long span beam. Riveted/bolted plate girders are economically used between 15m to 30m span, whereas the welded plate girders may be used up to 100 m span. Welded plate girder is far superior to the riveted/ bolted plate girder because of the considerable reduction in its self weight. The designer feels more free to proportion the welded plate girders with varying depths and produce tapered and haunched girders.

1.2 Plate Girder Details

Table 1

General data	Values
Total Depth	1200 mm
Total Flange Width	400 mm
Web Thickness	13 mm
Bottom Flange Width	250 mm
Bottom Flange Thickness	25 mm
Grade of Steel	Fe 410
Welded connection is to be provided	Fillet Welding
Weight of Girder per m run	10 KN/M

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2. METHODOLOGY

Design of a plate girder basically consists in determining the most efficient and economical size of the web and flanges. Application of concentrated loads on the top flange may produce web yielding, web crippling, and side sway web buckling. This form of buckling occurs when the compression in the web causes the flange to buckle laterally. In order to prevent this, the relative movements of the flanges should be restrained by lateral bracing. Usually in the construction of steel structures it is preferred to brace the plate girders laterally to achieve economy. Generally slender webs yield economical design. A girder of high strength to weight ratio can be designed by incorporating the post buckling strength of the web in design method employed. A decision for the provision of intermediate stiffeners is made easily in the design process because it will affect the web thickness. Provisions of bearing stiffeners, torsional stiffeners, etc, are made if required. Finally the connections between the various elements are designed preferably with welds.

The results obtained from the hand calculations are verified on CSI BRIDGE software. The length of span considered is 25 m for analysis. The vehicular loading considered is class 70(R) for 2 lane and class(A) for 1 lane. All the guidelines as mentioned in IRC:24 -2010, IS:800-2007, IS:1343-2012 have been kept in mind whole designing girder. For better understanding plan of the girder has also been made on AUTO CAD.

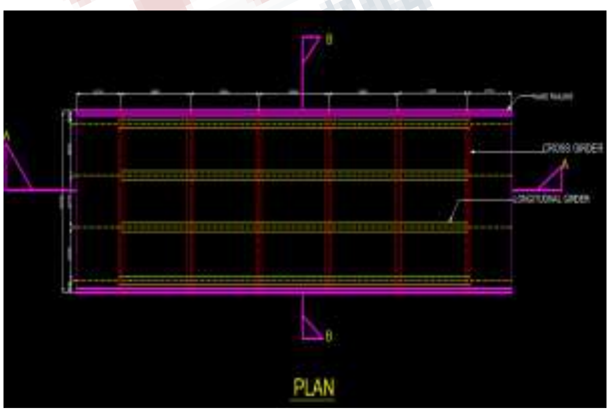

FIG 2.1 Plan of Plate Girder

Analysis

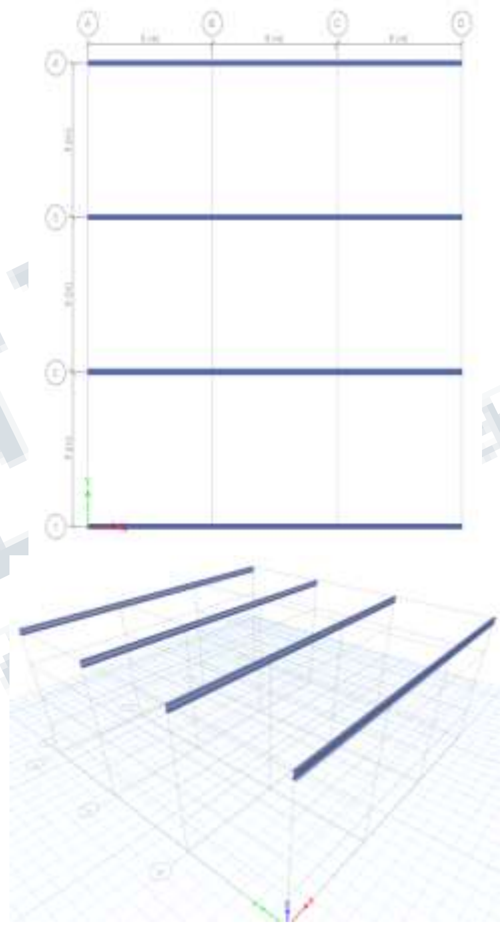

FIG 2.2-Plan (top) and 3-D view (bottom)

The analysis of girder is carried out on CSI BRIDGE software. The parameters for analysis are:-

a) Shear Force
b) Bending Moment
c) Vertical Displacement
d) Longitudinal Displacement

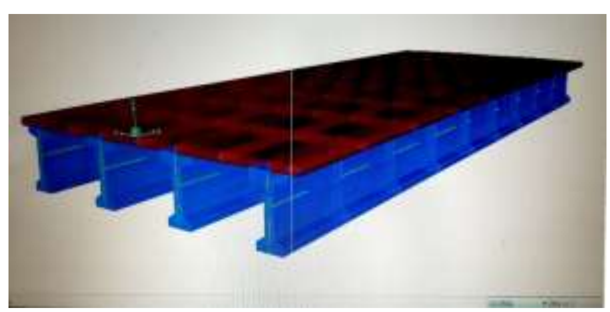

FIG 3 Model Of Plate Girder

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3.1 Shear Force

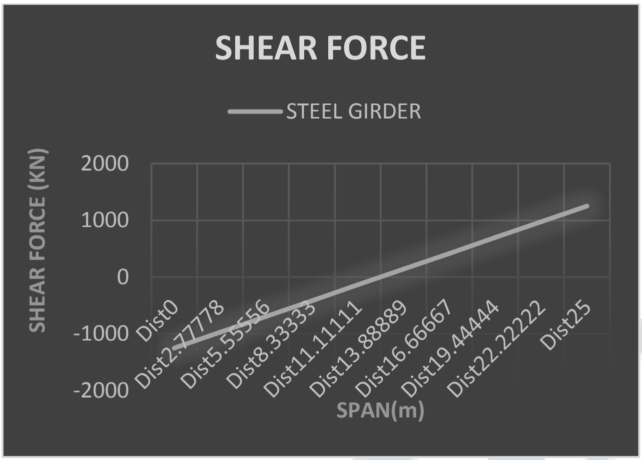


FIG 3.1 Shear Force in KN

Table 2

SPAN(m)	PLATE GIRDER
0	-1253.239
2.77778	-974.742
5.55556	-696.244
8.33333	-417.746
11.11111	-139.249
13.88889	139.249
16.66667	417.746
19.44444	696.244
22.22222	974.742
25	1253.239

3.2 Bending Moment

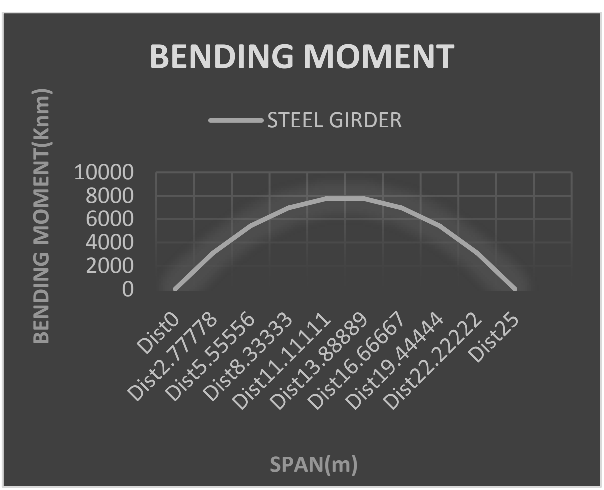
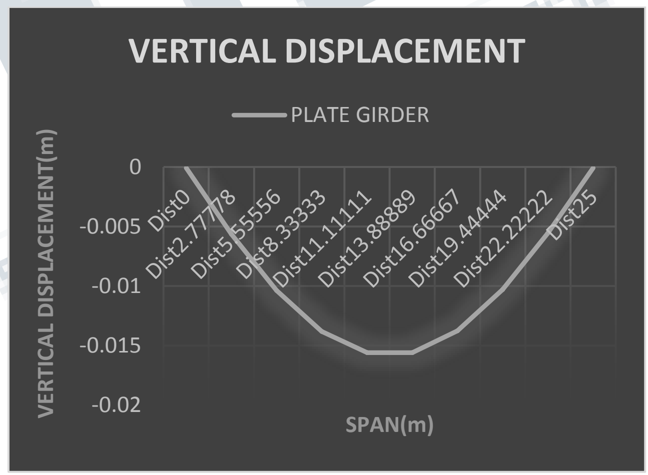


FIG 3.2 Bending Moment in Knm

SPAN(m)	PLATE GIRDER
0	0
2.77778	3094.4176
5.55556	5415.2309
8.33333	6962.4397
11.11111	7736.0441
13.88889	7736.0441
16.66667	6962.4397
19.44444	5415.2309
22.22222	3094.4176
25	0

3.3 Vertical Displacement



SPAN(m)	PLATE GIRDER
0	0
2.77778	-0.005639
5.55556	-0.010381
8.33333	-0.013805
11.11111	-0.015586
13.88889	-0.015564
16.66667	-0.013745
19.44444	-0.010298
22.22222	-0.005566
25	-0.000089

3.4 Longitudnal Displacement

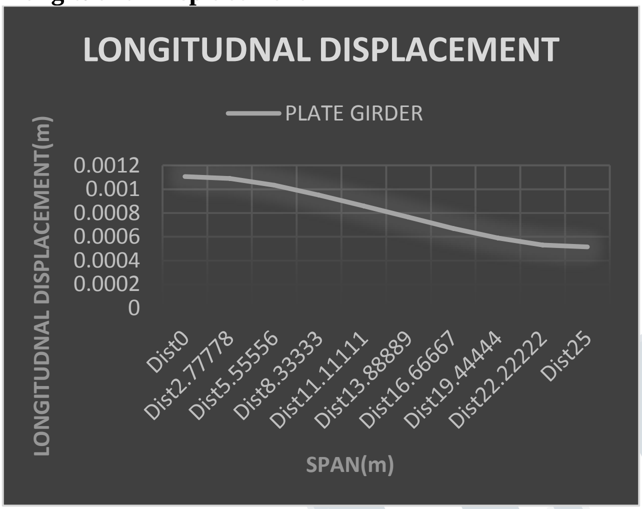


FIG 3.4 Longitudnal Displacement in m

SPAN(m)	PLATE GIRDER
0	0.002224
2.77778	0.002206
5.55556	0.002152
8.33333	0.002084
11.11111	0.00206
13.88889	0.001925
16.66667	0.001846
19.44444	0.001775
22.22222	0.001717
25	0.001699

RESULTS AND CONCLUSIONS

1. 25 m length of span is considered for the analysis of Plate Girder.
2. The maximum bending moment for Plate Girder has been found to be 7736 Knm at mid span.
3. The maximum shear force in Plate Girder is 1253KN.
4. The vertical and longitudinal displacement of Plate Girder has been found to be within the permissible limit.

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