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CAPACITY SURFACE OF PLATED I-SECTION FOR STEEL BRIDGE PIERS

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ABSTRACT

Steel built up sections are often used in piers of steel bridge. However, published literature is not available for every built up section that would give the interaction of axial compression and bending moments on the section. This paper presents a methodology developed for generation of interaction diagrams for plated I-section, thereby enabling a more accurate description of the capacity of plated I-section under the effect of axial compression and lateral bending.

Keywords: Steel Plated Bridge Piers, Column, Built-up section, Interaction curve, Capacity surface.

I. INTRODUCTION

RCColumn is software which helps structural engineers analyse and design columns under a combination of axial compression and bending as per IS456:2000[1].RCColumn provides an aid to practising engineers and researchers in their endeavour of designing columns having complex cross-section shapes. In absence of design charts for columns having arbitrary shapes,RCColum provides a reliable solution, based on IS:456.Design of RCC columns having rectangular or circular shape is simple due to the fact that well established design tables and charts are available for description of interaction of axial compression with the bending actions. However, for built up steel sections[2], such charts are not available. Further, it may not be practical to develop such charts as the shape and size of column are most likely to change from structure to structure. Hence, the objective of this paper is to develop a method for computation of the interaction curves for built up piers used in steel bridges.

The Interaction curves[3] depend upon the direction about which the bending action is considered. This is primarily due to the fact that the moment capacity depends on the moment of inertia about any given axis. Hence, the section has different moment resisting capacity in both x and y directions. Further, for unsymmetrical sections the moment resistance also varies based on the sign of the applied moment. Hence, we would ideally get four different interaction diagrams for any unsymmetrical section. Interaction curves along all four axes (positive x, negative x, positive y and negative y) have been generated and reported. It is clear from the plot that there are four interaction curves for the section. Of course, the curve to be considered depends upon the design problem at hand. Since these interaction curves have been generated for the particular section, the values are not normalized for section parameters, but are reported in force and moment units. Further, capacity surfaces[4] have been generated and reproducedhere.

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II. ANALYSIS OF A PLATED I SECTION OF THE STEEL BRIDGEPIER

Steelbuilt up section of bridgepiershave been taken into consideration for analysis here. Three cases are considered and the schematic diagram of the plated section is shown below in figure 3.1. The dimensions have been shown below in table 3.1.

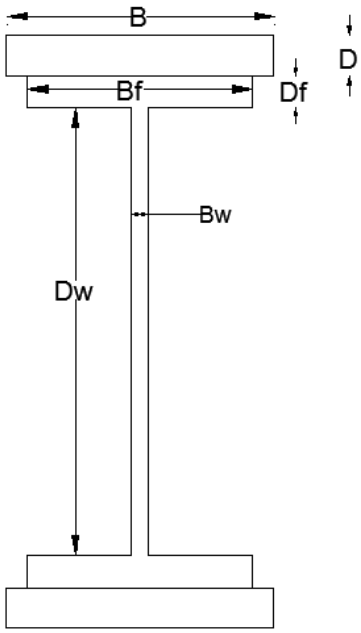

Fig 3.1.Schematic of Plated I-section of a Steel Bridge Pier.

Case No.	Width of Plate (B)	Depth of plate (D)	Width of flange (Bf)	Depth of flange (Df)	Width of web (Bw)	Depth of web (Dw)
1	400	60	335	48	26.4	573
2	500	70	385	58	26.4	593
3	600	80	435	68	28.4	613

Table 3.1.Dimensions of the Plated I-section.

The model of the pier made using RCColumn. The interaction curve obtained from RCColumnwas imported into matlab and a graph depicting the curve has been plotted. Under the combined effect of axial compression and bending, the capacity of the section is a 3D surface. Strength envelopes are the plot of section capacity for varying value of bending moments at different angles for a constant value of axial compression "Pu".

III. RESULTS

Interaction curves of the columns[5] weregenerated to determine the maximum axial load and moment carrying capacity of the column.Under the combined effect of axial compression and bending, the capacity of the section is a 3D surface. Strength envelopes are the plot of section capacity for varying value of bending moments at different angles for a constant value of axial compression "Pu". The interaction curves and capacity surfaces generated for the sections are shown inFigures below.

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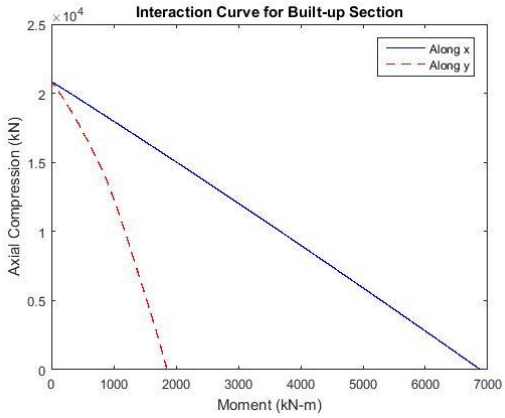

Fig. 4.1 Interaction curve for case-1

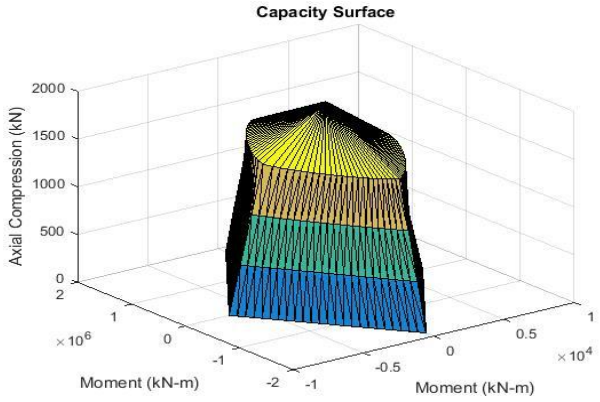

Fig. 4.2 Capacity Surface for case-1

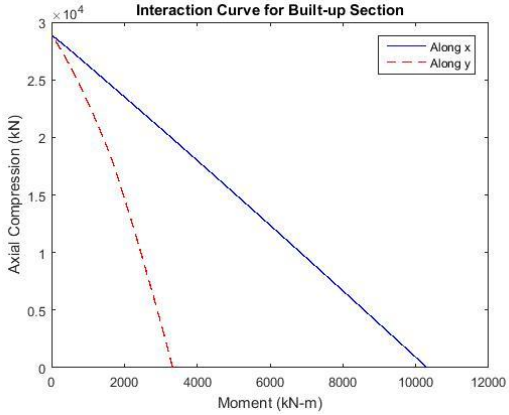

Fig. 4.3 Interaction curve for case-2

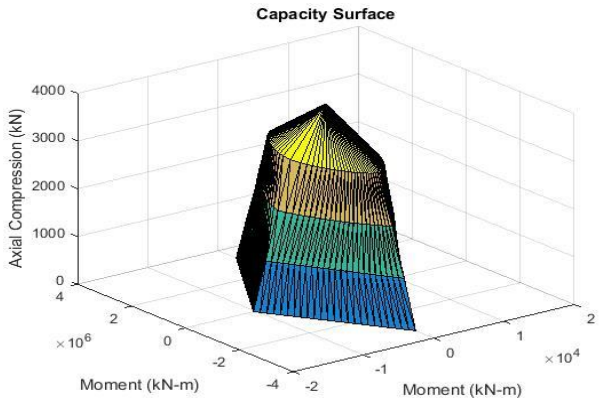

Fig. 4.4 Capacity Surface for case-2

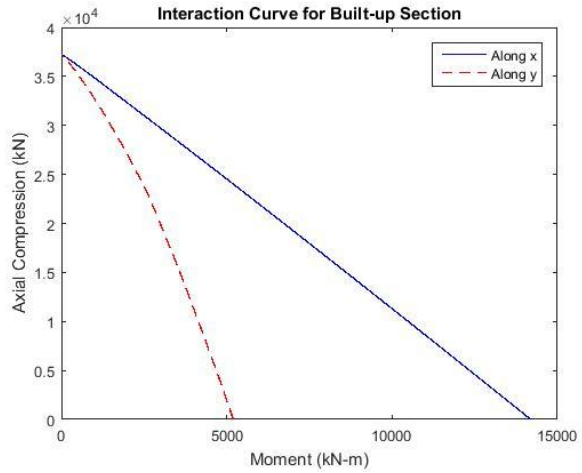

Fig. 4.5 Interaction curve for case-3

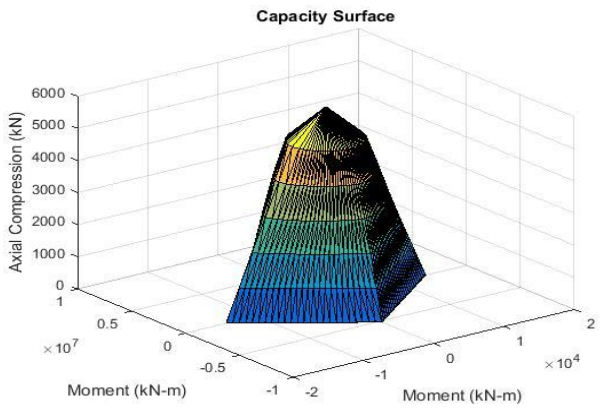

Fig. 4.6 Interaction curve for case-3

IV. CONCLUSION

Methodology developed for generation of Interaction curvesof built-up section of bridge pier has been presented here. 3-D capacity surfaces have been reproduced, which indicate the strength of the section in each direction. From the three cases it has been observed that the strength capacity is increasing with increase in section dimension thereby making pier design process more definitive. The methodology appears to be promising and tries to give a more robust technique for design of Piers.

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