Development Of Design Charts Of Concrete Filled Steel Tube Columns

[1]Ranpariya Trushar, [2]Kaushik Koradia,
[1]Student, M.E Structural Engineering,
[2]Assoc. Prof, M.E. Structural Engineering
[1]Structural Engineering, Civil Engineering Department,
[1]Darshan Institute of Engineering and Technology – Rajkot, India

Abstract : Concrete Filled Steel Tube (CFST) column system is the composite section formed by filling concrete into a hollow steel tube. The CFTS section resist applied load through the composite action of concrete and steel. This advantages interactive behavior between steel tubes and concrete increases the strength of CFST section. Local buckling of the steel tube is delayed by the restraint of the concrete and the strength of concrete is increased by the confining effect of the steel tube. Hence it has become more popular in recent days and is being used in the CFST sections possess highly ductility, strength and stiffness properties. This property is considered to be important especially for the multi storied buildings required to be erected in earthquake prone areas. Therefore behavior and design of CFST sections needs to be studied. The project describes about design recommendation for the design of compression members and provides a design chart of P-M diagram of CFST column with the reference use of EUROCODE-4. To eliminate a laborious calculation process of P-M Diagram.

***IndexTerms* -P-M diagram, CFST, bending moment, Axial loading, Uniaxial bending, buckling.**

I. INTRODUCTION

Concrete Filled Steel Tube section are one of the best composite section which have many advantages over conventional steel and RC sections and hence these CFST sections are becoming more popular in recent days. The CFST sections are formed by filling concrete into a hollow steel tube section and offers resistance to applied load through the composite action of steel and concrete.

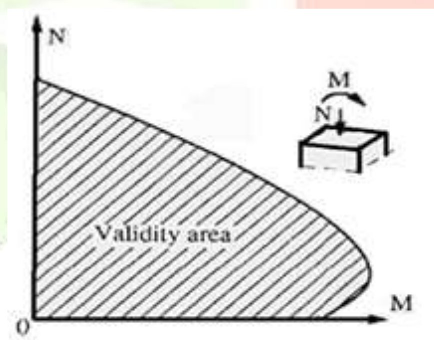


Fig.1 Typical axial compression–uniaxial Bending interaction curve for CFST Columns.

The interaction curve of a column represents the relation between the column axial section resistance to compression and the resistance to bending. In a typical interaction curve of CFST columns, there is no continuous reduction in the bending resistance of column section with increase of the applied axial load, as for virgin steel columns. Where, and as shown in Fig.1, the bending resistance of CFST column cross section may be increased with the presence of axial compression. Actually, the construction of a composite cross section interaction curve is a very time consuming. Therefore, this paper presents Practical interaction curves, by using the simplified design method of Eurocode 4, for different dimensions of CFST square columns that most common used in construction, considering different combinations of Material properties.

II. METHODOLOGY

Theoretically, the axial compression-uniaxial bending interaction curve for a column cross section can be found by considering different positions of the natural axis over the whole cross section and by determining the internal action effects from the resulting stress distributions. This approach can be carried out only by computer analysis. Whereas, in the simplified method of Eurocode 4, it is only need four to fivepoints to construct a polygonal diagram, as shown in Fig.2 that may be used instead of the exact interaction curve. But, this simplified method is applicable to the design of composite columns under several conditions. The mean two conditions are the columns cross section must be symmetrical about its principal axis and the column relative slenderness must be equal or less than two.

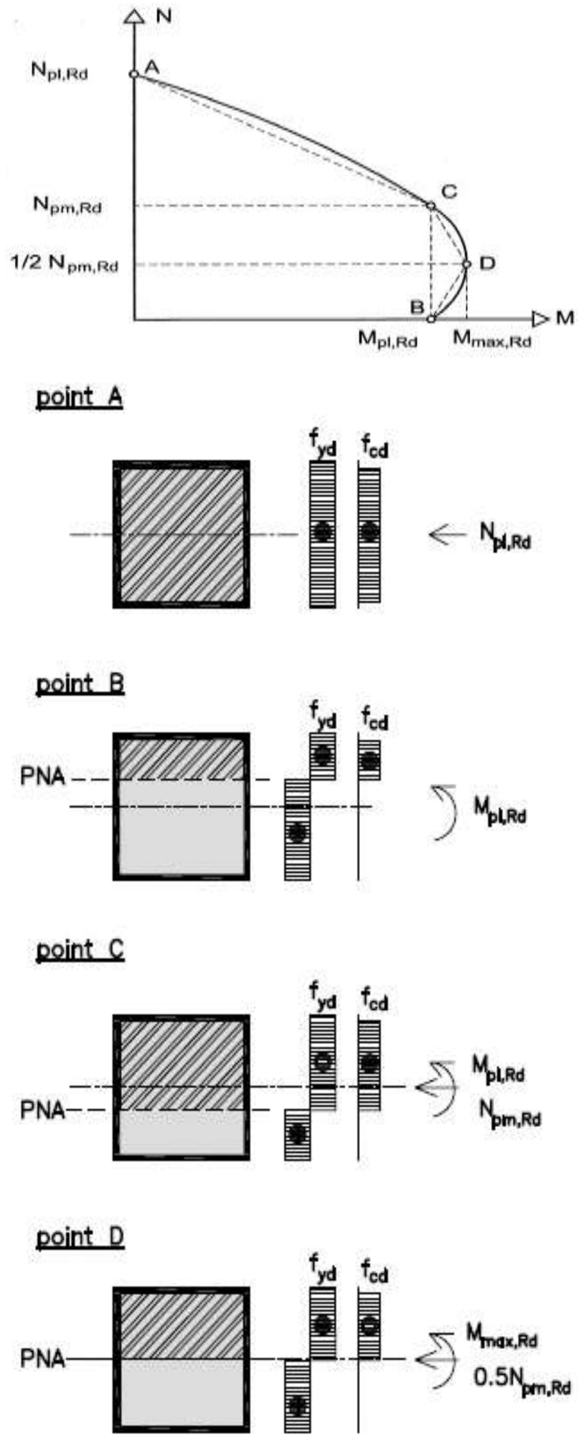


Fig.2 Simplified interaction curve and corresponding Stress distributions of the CFST rectangle column cross section

Fig.2 also shows the stress analysis of the CFST rectangular column cross section at the four points of interaction diagram, which specified by the simplified method of Eurocode 4, assuming rectangular stress blocks and concrete zones under tension as cracked. In order to determine the location of plastic neutral axis of the composite section, it was also assumed that the resulting axial compression is equal to zero, $N_{pl,Rd}$ represents the plastic resistance of column cross section to axial compression, while, $M_{pl,Rd}$ is the plastic resistance of column cross section to uniaxial bending. It must be noted that, with the neglect of the steel reinforcement effect and in the absence of bending, the plastic resistance of a composite column cross section to axial compression can be calculated as.

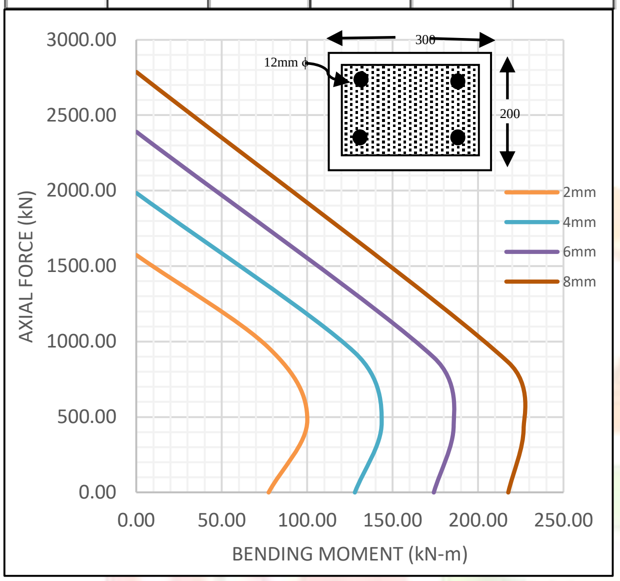
$$N_{Pl,Rd} = A_a.f_{yd} / \Upsilon_a + A_c f_{cd} / \Upsilon_c + A_s f_{sd} / \Upsilon_s$$

where A_a , A_s and A_c are areas of steel reinforcement, steel section and concrete, respectively, f_{yd} , f_{sd} and f_{cd} are the corresponding design strength of reinforced steel, structural steel and concrete.

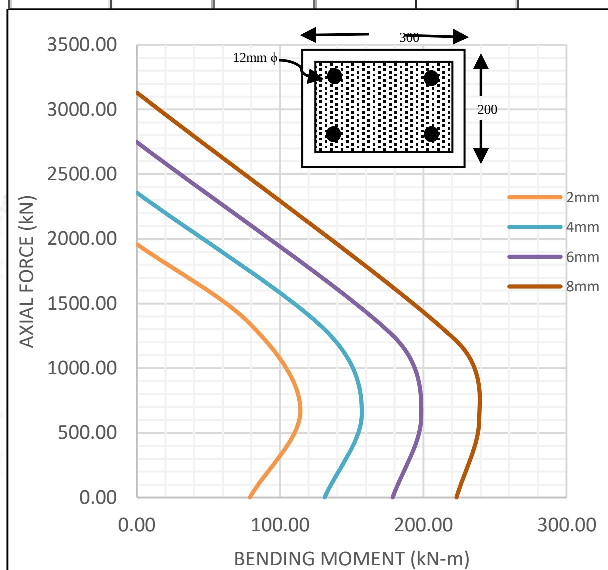
On the other hand, the plastic resistance of composite column cross section in the presence of bending moment along with axial compression is represented as a point within the interaction curve of that section. Therefore, a column cross section will have sufficient resistance if subjects to any combination of applied design axial compression and bending lies inside the area enclosed by that interaction curve. Here we present some chart to different plate thickness like 2,4,6 and 8 mm.

III. INTERACTION CHART

NO	B	D	Fc	Fy	Fs
1	200	300	25	415	250

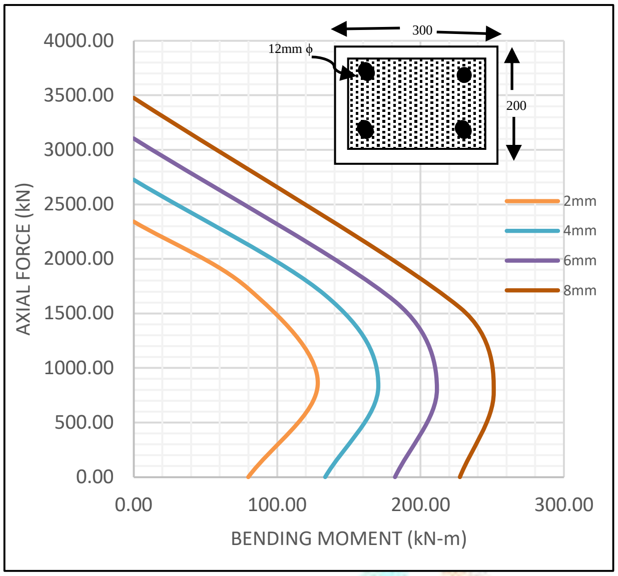


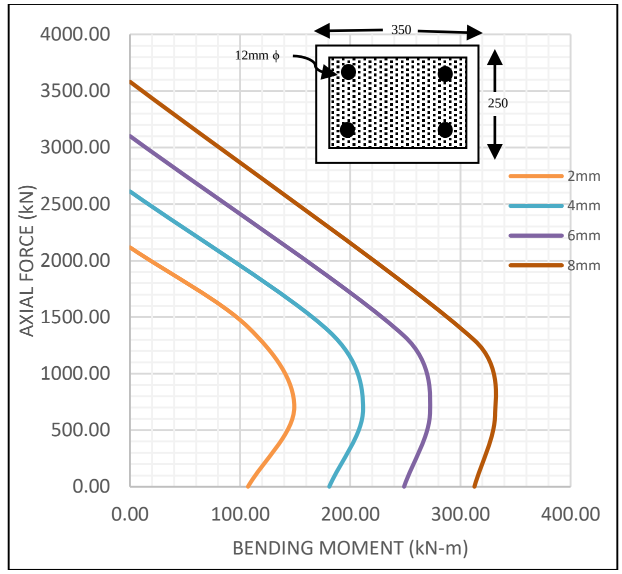
NO	B	D	Fc	Fy	Fs
2	200	300	35	415	250



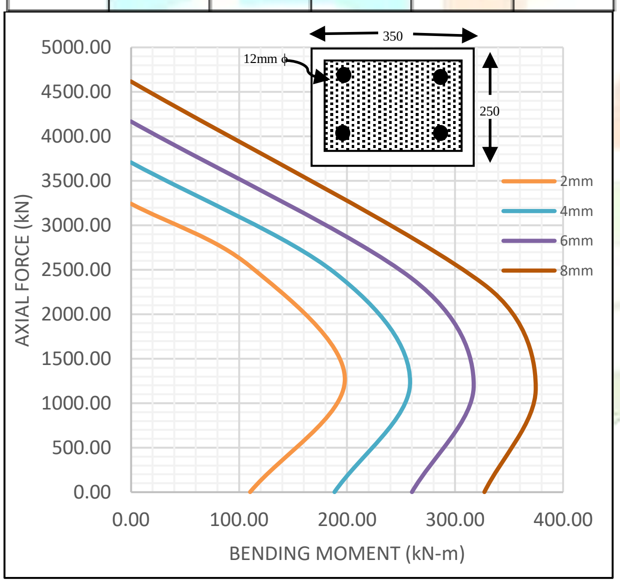
NO	B	D	Fc	Fy	Fs
3	200	300	45	415	250

NO	B	D	Fc	Fy	Fs
4	250	350	25	415	250

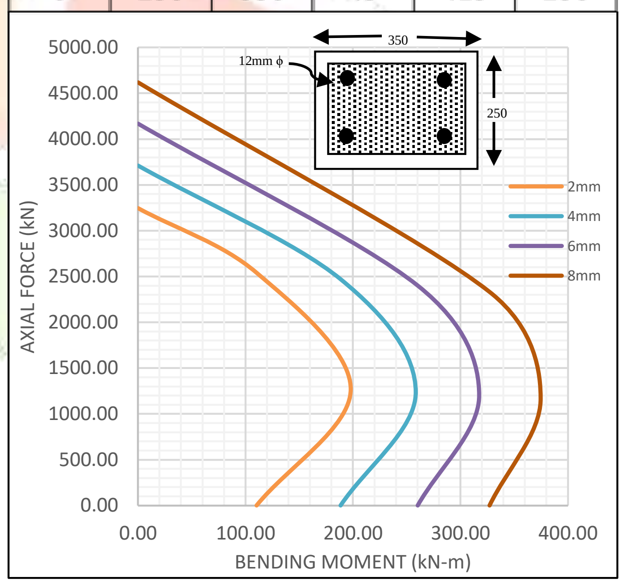




NO	B	D	Fc	Fy	Fs
5	250	350	35	415	250



NO	B	D	Fc	Fy	Fs
6	250	350	45	415	250



IV. RESULTS AND DISCUSSION

A computer application is developed in VB.net for development of P-M interaction diagrams for a concrete filled steel tube column section under axial loading and uniaxial bending. The applied compression – uniaxial bending interaction curves were constructed in the present work for most three-common used CFST rectangular column sections. Different steel section and concrete strengths were adopted here. It was observed that the CFST column section resistance for compression and bending moment can be increased significantly with the increase of concrete strength. As per our prime goal use of interaction curve are easy and quick and its eliminate the laborious process of calculation.

REFERENCES

[1] Lin-Hai-Han, Wei Li, and Reidar Bjorhovde: Developments and advanced applications of concrete filled steel tubular (CFST) structures: Members J. con. Steel research 2014;100: 211-228

[2] Francesco trentadue , giuseppe quaranta , giuseppe c. Marano Closed-form approximations of interaction diagrams for assessment and design of reinforced concrete columns and concrete-filled steel tubes with circular cross-sectionEngineering structures 127 (2016) 594–601

[3] Young-hwan choi, douglas a. Foutch, james m. Lafave New approach to aisc p–m interaction curve for square concrete filled tube (cft) beam–columns Engineering structures 28 (2006) 1586–1598