Structural Analysis of C Section Steel Columns With Different Web Sections Subjected To Axial Compressive Eccentric Loading

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Abstract-*The buckling behavior of C section steel column is examined in this paper under the axial compressive eccentric loading. Lateral buckling is an important factor in designing the stable steel structure. The web sections are also considered in both the column to understand the effect of different web on buckling.*

Different parameters are considered in study and results are presented in graphical form with simple curves. Finite element analysis is used to analyze the proposed design and CATIA is used to create the actual performing models with material properties.

Structural analysis is done to examine the influence of the section dimension of not only columns but also are of web, due to axial compressive eccentric loading. Using the study it is observed that not only the cross section of steel column but also the web section of column influences the resistance to buckling of steel column.

Keywords*-*Buckling, steel column, cross section, web sections, axial compression, eccentric loading.

I. INTRODUCTION

Column is the structural element which is subjected to axial compressive forces[3]. Structural steel columns may experience either global or local buckling depending on their dimensions[3]. Normally in structural construction I-sections, C-hannels or angles etc are used. which are called open sections, or rectangular or circular tubes which are called closed sections [5]. These are the combination of individual plate elements and connected together to form the required constructed shape. The strength of compression members made of such sections depends on their slenderness ratio [4]. By reducing the slenderness ration, higher strengths can be obtained *i.e.* by increasing the moment of inertia of the cross-section. By increasing the moment of inertia of the cross-section, the strengths of beams can be increased,. For a given cross-sectional area, higher moment of inertia can be obtained by making the sections thin-walled[6].

Thin-walled structures generally refer to structural components which consist of one or more thin plates or shells connected together at one or more common edges [1].

Elements of columns are flanges and webs, and both flanges and webs local buckling depends on width-thickness ratios. Buckling is occurs with the entire length of column [2].

The governing criteria for the local buckling of compression member is width to thickness ratio[4]. To avoid the local buckling need to provide proper width to thickness ratio for the cross section. General modes of failure in steel member are (a) flexural buckling, (b) torsional buckling and (c) flexural torsional buckling [5].

II. METHODOLOGY

After reviewing the various literatures and papers in order to understand the mechanism behind bending & lateral-torsional buckling and failure analysis of regular column subjected to eccentric loading, herewith provide some steps to analyze the column for different cross section and taper ratio with variation in thickness. The analysis is done with the help of CAE software.

- Analysis of regular C section steel column with triangular web.
- Analysis of regular C section steel column with cross web
- Finalize the best possible solution for the concern problem.

Parameter selection

1. Shape of sections : C shape, I shape
2. Taper ratio: 1:1, 1:1.25, 1:1.5
3. Thickness: 10mm, 12mm,
4. Length: 2mtr, 3mtr
5. For web cross section
   a. Web type: Cross, triangular
   b. Web thickness: 5mm, 8mm
   c. Corrugation angle (θ): 30^0, 45^0, 60^0

III. FINITE ELEMENT METHOD

Finite element method (FEM) has a powerful tool for the numerical solution of a wide range of engineering problems. In this method of analysis, a complex region defining a continuum is discredited into simple geometric shapes called finite element. The material properties and the governing relationship are considered over these elements and expressed in terms of unknown values at element corners. An assembly process duly considering the loading and constraints result in a set of equations. Solution of these equations gives us the approximate behavior of the continuum.

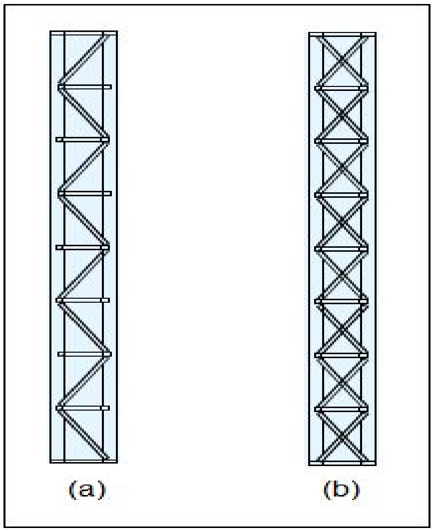

Fig 1: Proposed design for steel column with (a) triangular web and (b) cross web

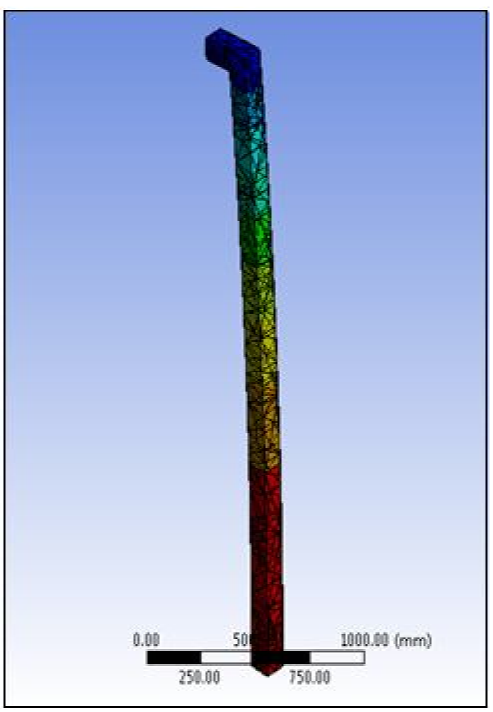

Fig 2: C section with triangular web

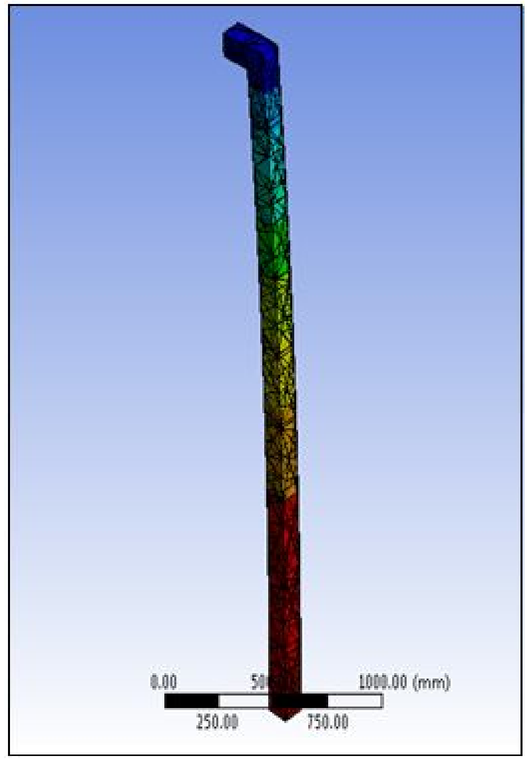

Fig 3: C section with cross web

IV. RESULTS AND DISCUSSIONS

The effect of some geometric parameters on the performance of steel column loaded with eccentric axial compressive load, such as effect of thickness, cross section of column and taper ratio were investigated. In the following table, the results of these parameters are presented in detail.

Table 1: FEA results for triangular & cross web

Sr. No	Sections	Web Shape	Web Angle	Bending in X Axis
1	C Section	Triangular	15	29.43
2	C Section	Triangular	45	25.37
3	C Section	Triangular	75	28.89
4	C Section	Cross	15	26.11
5	C Section	Cross	45	21.48
6	C Section	Cross	75	23.75

V. GRAPHS

The effect of some geometric properties on the performance of steel column loaded with eccentric axial compressive load, such as effect of column cross section, web thickness, web cross section, web angles, etc were investigated and the other geometric parameters such as length and thicknessare kept constant for column parameter where thickness is vary for web parameter. Followings are the graph shows results in curve type.

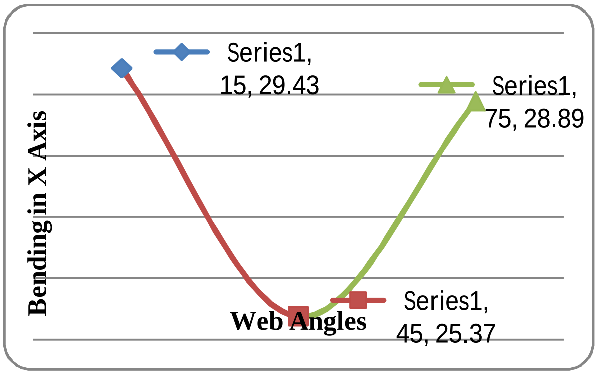

Fig 4: Effect of web angles on buckling of column (Triangular Web)

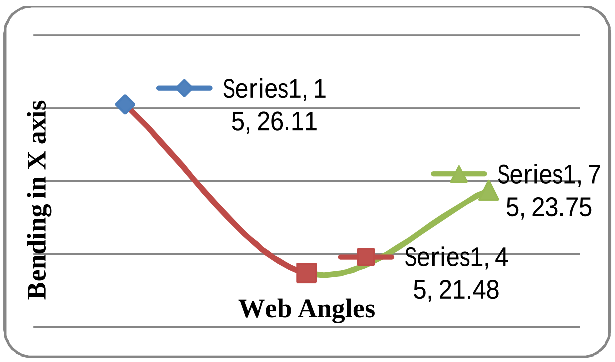

Fig 5: Effect of web angles on buckling of column (Cross Web)

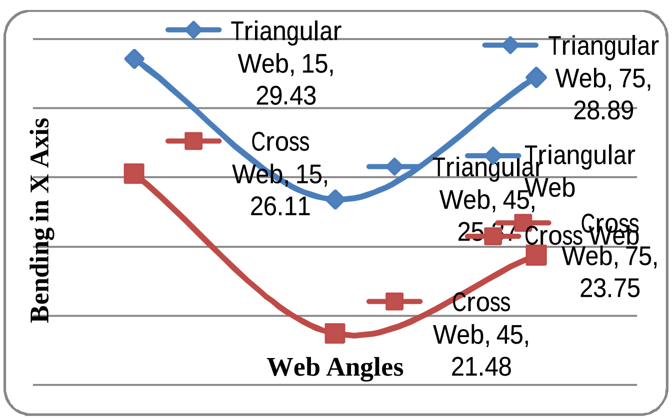

Fig 6: Effect of web angles on buckling of column (Triangular & Cross Web)

VI. CONCLUSION

A finite element analysis is done on the behavior of C-section steel column with different web sections when applied an eccentric axial compressive load, and the following points are concluded:

- C section gives better resistance to lateral buckling compared with I section.
- Cross web section gives better resistance to lateral buckling compared with triangular web section.
- Increasing thickness of web increase the resistance capacity of column.

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