COMPRESSION MEMBERS: STRUT & COLUMN

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Abstract - Steel structure has always been top choice of designers for construction over other construction methods. Various development and improvement has taken place over the period of time in steel construction. Design of compression members is one such development which can be used effectively in designing of column, struts, truss, frames.

1. INTRODUCTION

Strut and column are the members or components of a structure.The structure can be a building, bridge, power pylon, cell base station tower, or any civil engineering or mechanical engineering construction. In the designing of compression members (column and strut) main design issue is buckling unlike for tension members main design issue is shear lag.

2. STRUT

It is structural member subjected to compression only. Bending moment is zero in this member. The word strut is used for compression members of trusses.

2.2 Analysis of Struts

If strut is spanning between 2 gusset plate only, then it is called a discontinued strut. If it is spanning over more than two gusset plate, then it is called a continuous strut.

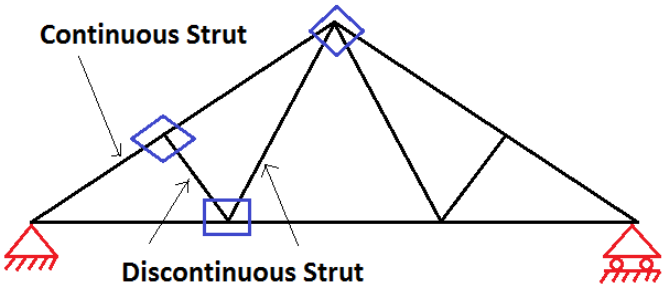

Fig 1

If a single angle discontinuous strut is connected by only one bolts at each end, then L=l

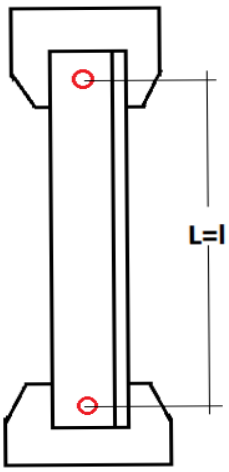

Fig 2

If a single angle discontinuous strut is connected by two or more bolts or welds , then L=0.85l

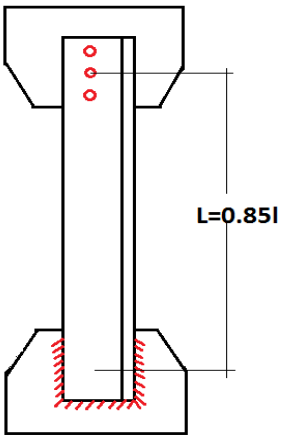

Fig 3

If there is possibility of buckling of the strut perpendicular to the plane of struts (i.e. out of plane buckling)

Then L=l

Depending on the orientation of strut, it can buckle in the plane of truss or perpendicular to plane of truss.
When structural steel sections like angles, channels are used as compression members maximum pitch of tack bolts= 600mm.

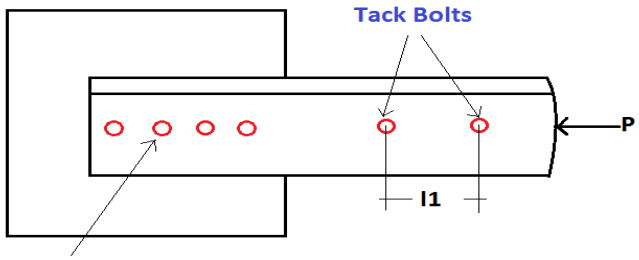

Fig 4

In Fig. 4 the maximum pitch of tack bolts i.e. l_1 is 600mm

To prevent buckling of strut component between the tack bolt the following condition must be satisfied.

$(\lambda)_{Comp}$ not greater than 40

not greater than 0.6 (λ) whole strut

$(\lambda)_{Comp} = \frac{l_1}{(r_{min})_{comp}}$

l_1= Distance between tack bolts

r_{min}= Min radius of gyration of strut component

Maximum slenderness ratio for compression member is 180 (less value due to bucking)

3. COLUMN

It is structural member mainly subjected to compression. Bending moment can also exist in this member. The word column is used for compression members of frames (i.e. RCC or steel frames).

Column always tend to buckle about their weak axis. Weak axis is the axis about which moment of inertia and radius of gyration are minimum. So in Euler's column formula 'I' is always 'I_{min}'

For a given cross sectional area thin hollow circular section is the most efficient cross section in resisting compression.

(Because for a given cross sectional area I is maximum for thin hollow circular section)

Euler's critical stress = fcc

$$= \frac{P_{cr}}{A} = \frac{\frac{\pi^2 AE}{(\frac{L}{r})^2}}{A}$$

$$= \frac{\frac{\pi^2 E}{(\frac{L}{r})^2}}{} = \frac{\pi^2 E}{(\frac{KL}{r})^2}$$

KL = Effective Length

Because of the assumptions involved in the derivation of Euler's critical stress, we get a higher value of stress. But columns actually buckle at less value of fcc. So IS 800-2007 modified Euler's critical stress and given design compressive stress fcd.

As per IS: 800-2007, the load carrying capacity of compression member is given by
Pc = fcd x Ag
Where fcd = design compressive stress of column (its value is formed from either linear interpolation or from the formula)
Ag= gross cross-sectional area

Basic difference between Strut and column:

Both the Strut and Column are compression structural members. Struts fail due to buckling, but columns fail in compression. Slenderness ratio of struts is high, whereas it is low for columns.

4. CONCLUSIONS

Both of these structural elements are essential to the structural engineer in his design process, and the appropriate one must be used according to the particular situation. When the member is to be design for taking axial load/ gravitational load, column is used. When the member is to design as supporting member such as to support roof top etc. Strut is used.