Unit ⇒ 5.

Compressive Members

* **Compressive members** :- A member in a structure which is subjected to compression is known as compressive member.

The compressive force may be axial or eccentric.

* **Classification of Compressive member** :-

1. **Strut** :- A strut is defined as structural member subject to compression in a direction parallel to its longitudinal axis. Commonly used in roof truss.
Strut generally consits single angle section or double angle section.

Single angle section used in light roof truss.

Double angle section used in Tee section or roof truss.

2. **Columns** :⇒ Vertical compression members subject to compressive force in a section parallel to its longitudinal axis is called column.

3. **Boom** :- Compression members of a crane are called boom.

* **Radius of gyration (r)** :- The radius of gyration of a section is a geometrical property of the section. Denoted by r.

Radius of gyration, $r = (I/A)^{1/2}$.

$$r = \sqrt{\frac{I}{A}}$$

where,
r = Radius of gyration.
I = Moment of inertia of section
A = Area of the section.

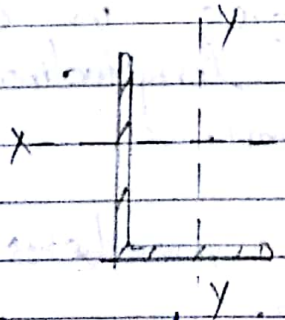
(*) Slenderness Ratio :- (λ) ⇒ Ratio of effective length (l) of a compression member to its least radius of gyration (r) is called slenderness Ratio.

$$\lambda = \frac{\text{effective length}}{\text{least radius of gyration.}}, \quad \lambda = \frac{l_{eff}}{r}$$

Single angle section :- (1) Both equal and unequal angles can be used.

(2) The single angle section are commonly used in the single plane truss.

(3) Single angle section are not suitable for compression member of long lengths.

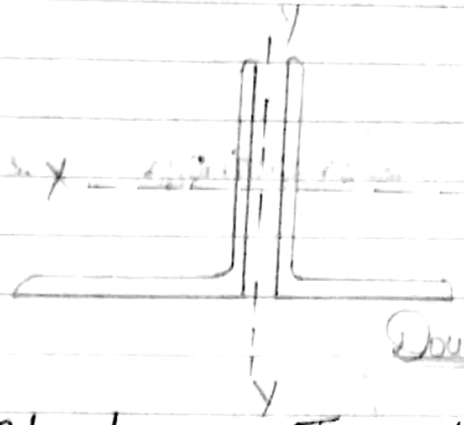


Single angle section.

Double angle section :- (1) It can be used as strut by placing them either on the same side or on the both side of the gussel plate.

(ii) Both unequal and equal angle section can be used as a strut.

(iii) Double angle should be arranged that give maximum moment of Inertia.



Double angle section

Angle Struts :- Two types

(i) Continous Member (ii) Discontinous Members.

(i) Continous Member :- The compression members which are continous over a number of joints, are known as continous member.

* may be single angle strut and double angle strut.

(a) Effective length (l) = 0.7 L to 0.85 L.

(b) Permissible (allowable) axial compressive stress $\Rightarrow \sigma_{ac}$.

(ii) Discontinous member :- The compression member which are not continous over a number of joints i.e. they extend b/w two adjacent

joints only are known as discontinous membess.

OR.

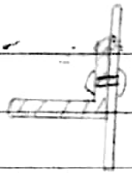
* These member in small length and extend b/w two adjacent joint are known as discontinous member.

(1.) Single angle Discontinous strut :-

A.) Connected by one rivet or bolt at each end.

(i.) Effective length (l) = L.
(ii.) Allowable axial compressive stress = $0.8\,\sigma_{ac}$.
(iii.) Maximum value of slenderness ratio (Max. λ) = $\not> 180$.

B.) Connected by two or more rivets, bolts or welded at each.



(i.) Effective length (l) = $0.85\,L$.
(ii.) Allowable axial compressive stress = σ_{ac}.

(2.) Double angle Discontinous struts :->

(A.) Placed back to back and connected to both side of the gusset plate by two or more rivets.

(i) Effective length (l) = $0.7\,L$ to $0.85\,L$.
(ii) Allowable compressive stress = σ_{ac}.

(B.) Placed back to back and connected to the same side of the gusset plate by one rivet

bolt at each end.

(i.) Effective length (l) = L.
(ii.) Allowable axial compressive stress = $0.8\ \sigma_{ac}$.
(iii.) Maximum slenderness ratio (Max. λ) $\neq 180$.

(C.) Placed back to back and connected to same side of the gusset plate by two or more rivets, bolts and welding at each end.

(i.) Effective length (l) = L.
(ii.) Allowable axial compressive stress = $0.8\ \sigma_{ac}$.

Strength of axially loaded compression member:- It defined as its safe load carrying capacity. The maximum permissible axial compressive load on compression member is given by the relation

$$P = \sigma_{ac} \times A.$$

where, P = Axial compressive load (in N).
σ_{ac} = Permissible axial " stress (N/mm^2).
A = Effective cross-sectional area of member (mm^2).

Design of Axially loaded Compression Member (Strut):-

Step → 1.) Calculation of gross section area:-

Assume permissible compressive stress = $80 N/mm^2$

∴ Gross sectional area required ⇒ $\frac{\text{Axial loaded}}{\text{Permissible compressive stress.}}$

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Step -2.) Choose a trial section :-

Area of Trial section = Approximate gross section area

Step → 3.) Calculation of slenderness ratio (λ)

$$\lambda = \frac{l}{r_{min}}$$

Step → 4.) Determine the permissible compressive stress(σ

Corresponding to the slenderness ratio (λ) calculated in step-3. find permissible Compressi normal stress (σ_{ac}) from table 5.2, to value of λ and f_y.

f_y should be taken as 250 N/mm² (if not giv

Step -5.) Calculation of safe load carrying capacity

Safe load carrying capacity = $\sigma_{ac} \times A$.

Step -6.) Check for the max. slenderness ratio :-

Check the λ ratio of the selected section for the maximum slenderness ratio. Value of λ should not exceed the max. λ ratio limit as specified in Table 5.1.

Step → 7.) Design the end connection :-

The end of the strut (if two sections placed back to back) to be connected together with not less than two rivets or bolt or their equivalent in welding.