Since available column width is only 200 mm, provide two brackets of length 100 mm on each side as shown in fig. Then total length of weld provided on each side is

$$= 200 + (2 \times 100) + (2 \times 100)$$
$$= 600 \text{ mm}$$

Design of flexural members:

(Beams, built up beams, purlins, girts, gantry, plate gird

- purlins → Beams supporting roof covering material
- girts → Beams supporting wall covering materials
- gantry → Beams supporting crane load!

Beams:

(i) It is a structural member subjected to transverse load. (any load that does not act along the longitudinal axis of the member is called transverse load)

(ii) Flexure formula:

$$\frac{M}{I} = \frac{f}{y} = \frac{E}{R}$$

$$M = \frac{f}{y} \cdot I$$
$$= \sigma_{bc} \cdot Z$$

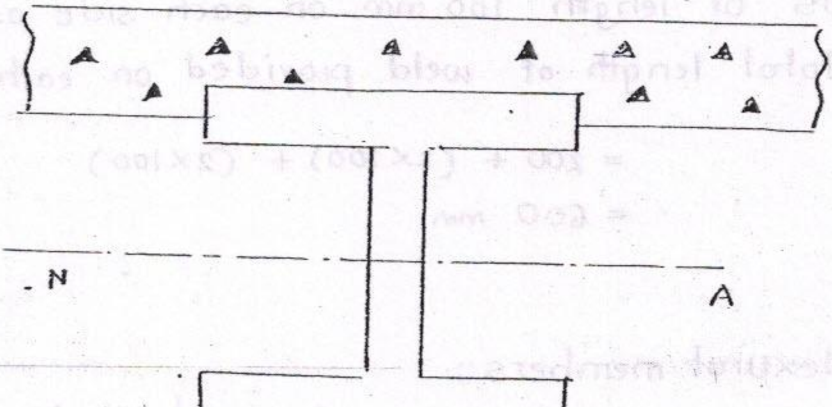
$$Z_{reqd} = \frac{M}{\sigma_{bc}}$$

σ_{bc} - permissible bending compressive stress

$= 0.66\ f_y$ (in WSM)

$= \frac{f_y}{1.1}$ (in LSM)

(iii) Laterally supported beam :

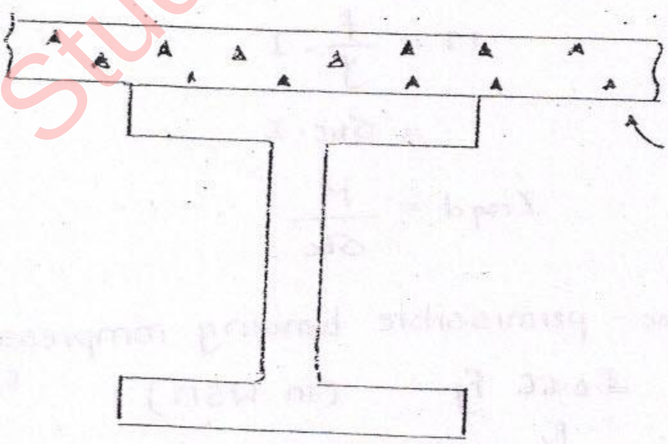


If the compression flange of the beam is completely restrained against lateral movement, then it is called laterally supported or laterally restrained beam. (since there is no possibility of buckling of compression flange due to bending compressive stress, maximum permissible compressive stress is taken as.

$$\sigma_{bc} = 0.66\, f_y \quad \text{(in WSM)}$$

$$= \frac{f_y}{1.1} \quad \text{(in LSM)}$$

(iv) Laterally unsupported beam :



If compression flange of beam is not restrained against lateral movement, then it is called laterally unsupported or laterally unrestrained beam. Since there is possibility of buckling of compression flange, σ_{bc} is

$$\sigma_{bc} = 0.66\, f_y$$

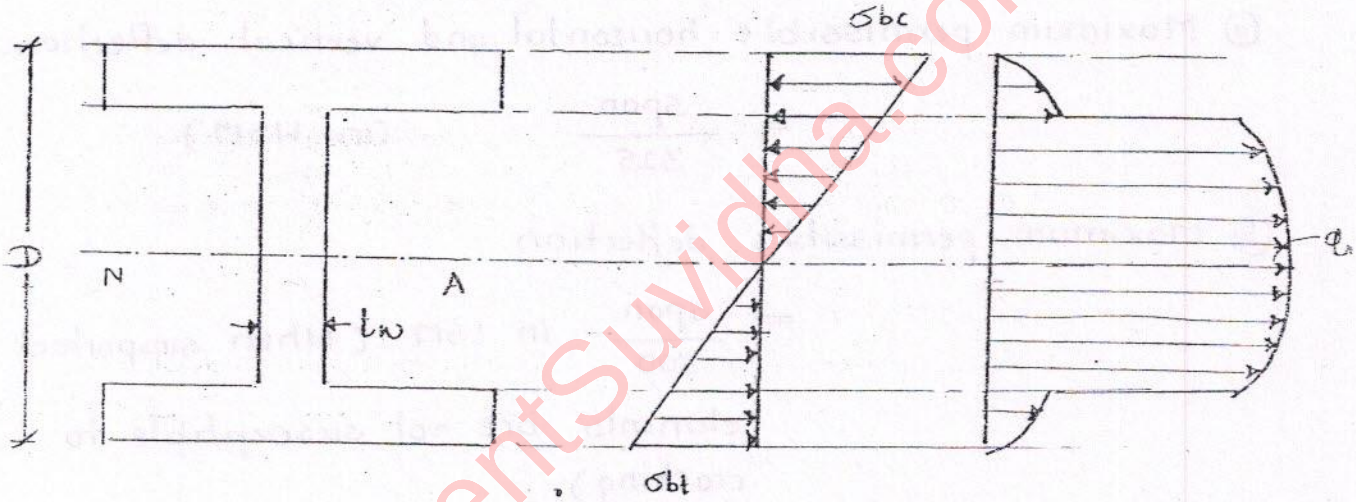
$$= \frac{0.66\, f_{cb} \cdot f_y}{\left[(f_{cb})^n + (f_y)^n \right]^{1/n}}$$

} whichever is less

where, n - imperfection factor = 1.4

f_{cb} - Euler's elastic critical stress in bending (it takes care of effect of buckling in the compression flange)

(v)



Bending stress distribution due to B.M.

Shear stress distribution due to S.F.

$$q = \frac{F(A\bar{y})}{I \cdot b}$$

In the design of beams it is assumed that flanges take entire bending moment and web takes entire shear force based on the above stress distribution diagram.

(vi) In the design of beams, it is assumed that the depth of web in resisting shear is taken as overall depth of the beam.

So, $\tau_{va,cal}$ - calculated shear stress in web

$$= \frac{S.F}{\text{shear area}} = \frac{V}{D \times t_w}$$

$\tau_{va,cal} \leq$ permissible shear stress (τ_{va})

$$\tau_{va} = 0.4 f_y \quad \text{(in WSM)}$$

$$= \frac{f_y}{\sqrt{3} \times 1.1} \quad \text{(in LSM)}$$

(But for connections like weld,

$$\tau_{va} = \frac{f_u}{\sqrt{3} \times 1.25} \quad \text{(in LSM)}$$)

(vii) Maximum permissible deflections
(stiffness criteria)

ⓐ Maximum permissible horizontal and vertical deflection.

$$= \frac{\text{span}}{325} \quad \text{(in WSM)}$$

ⓑ Maximum permissible deflection

$$= \frac{\text{span}}{300}$$ in LSM (When supported elements are not susceptible to cracking)

$$= \frac{\text{span}}{360}$$ in LSM (When supported elements are susceptible to cracking)
e.g. beams are supporting glass panels.

(viii) The primary criteria in the design of beams is that it should be strong enough to resist bending, shearing and deflection.

Strength criteria – bending and shearing } (primary criteria)
Stiffness criteria – Deflection }
Stability criteria – Buckling – (secondary criteria)