

Design of tension splice.

Splices in tension member are provided to joint two sections subjected to tensile force. Splices connection for tension member is usually bolted connection and it is designed for a force of at least 0.3 times the member design capacity in tension or the design action, whichever is more.

1. Design a splice to connect a plate of size 300x20mm with a plate of size 300x10mm. The design load is 500KN. Use 20mm block bolts fabricated in the shop. Provide a double cover butt joint with tks of cover as 10mm.

Given:-

1. Plate of size = 300x20mm
 2. Plate of size = 300x10mm
- Tks of cover plate = 6mm
 $d = 20\text{mm}$
 $d_o = 22\text{mm}$
 Design load = 500KN

Sln:-

Since plates have varying tks need to be provided packing plate is reqd to provide the two cover plates.

The bolts are under double shear.

1. Strength of bolt in double shear:- [cls 10.3.3 IS 800-2007]

$$V_{dsb} = \frac{V_{nsp}}{Y_{mb}}$$

$$V_{nsp} = \frac{f_u}{\sqrt{3}} [n_n A_{nb} + n_s A_{sb}]$$

$$n_n = n_s = 1$$

$$A_{nb} = \frac{0.78 \times \pi \times 20^2}{4} = 245 \text{ mm}^2$$

$$A_{sb} = \frac{\pi \times 20^2}{4} = 314.16 \text{ mm}^2$$

$$\beta_{pk} = [1 - 0.0125 t_{pk}]$$

$$= [1 - (0.0125 \times 10)]$$

$$\beta_{pk} = 0.875$$

$$V_{nsp} = \frac{400}{\sqrt{3}} [1 \times 245 + 1 \times 314.16] \times 0.875$$

$$= 112.99 \text{ KN}$$

$$V_{dsb} = \frac{112.99}{1.25}$$

$$V_{dsb} = 90.392 \text{ KN}$$

2. Strength of bolt in bearing:- [cls 10.3.4 IS 800-2007]

$$V_{dbp} = \frac{V_{nbp}}{Y_{mb}}$$

$$= 2.5k_b d_t f_u$$

Assume $e=1.5$ $d_o=33\text{mm}$ \angle 40mm

$p=2.5d=50\text{mm}$ \angle 60mm

$$k_b = \frac{40}{3 \times 22}, \frac{60}{3 \times 22} - 0.25, \frac{400}{410}, 1$$

$$= 0.606, 0.659, 0.975, 1$$

\therefore Take $k_b = 0.606$ [least value]

$$V_{dbp} = 2.5 \times 0.606 \times 20 \times 10 \times 410$$

$$= 124.23 \text{ KN}$$

$$V_{dbp} = 99.38 \text{ KN}$$

\therefore Design strength of bolt value = 90.39 KN

$$\therefore \text{No. of bolts} = \frac{T_u}{V}$$

$$= \frac{500}{90.39}$$

$$n = 5.5 \approx 6 \text{ Nos.}$$

\therefore Provide 6 nos. of 20mm bolts on each side

Providing the 6 bolts on each side of the connecting plate, it can be arrange along 2 vertical rows with 3 bolts on each vertical row as shown in fig.
Check for strength of section:-

1. Strength of the plate against yielding:- [cls 6.2 IS 800-2007]

$$T_{dg} = \frac{A_g f_y}{Y_{mo}}$$

$$A_g = 300 \times 10 = 3000 \text{ mm}^2 \text{ [Tks of thinner plate]}$$

$$= \frac{3000 \times 250}{1.1}$$

$$T_{dg} = 681.81 \text{ KN} > 500 \text{ KN}$$

