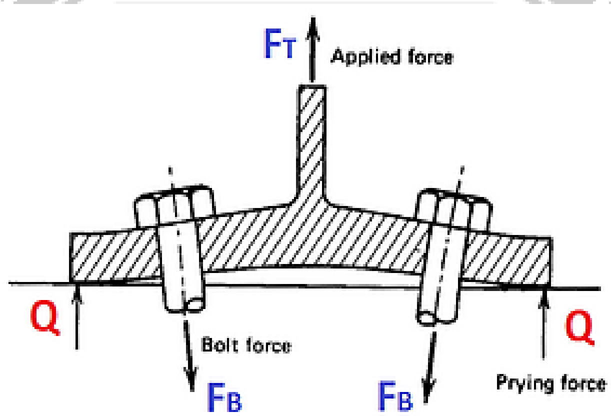
UNIT II CONNECTIONS IN STEEL STRUCTURES

PRYING FORCES:

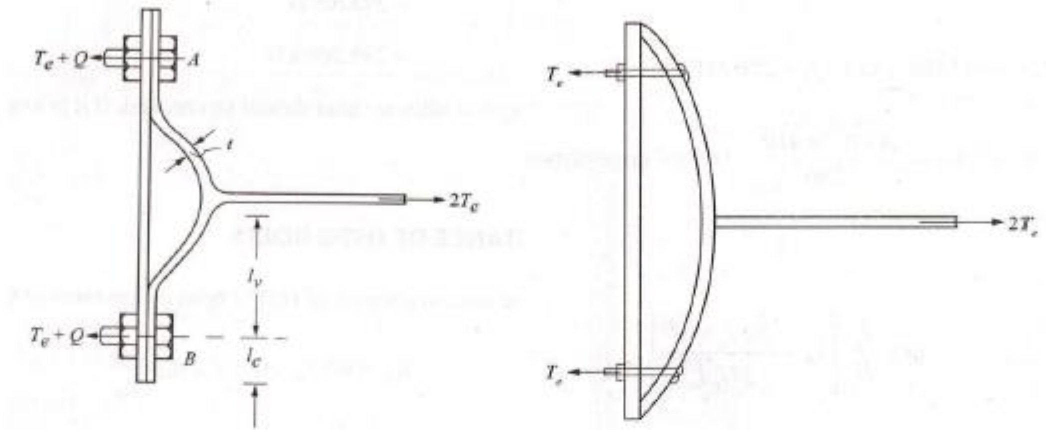
The concept of prying action can be most easily presented in terms of a T-stub loaded by a tensile force FT. The applied force is not concentric to the centre of the bolt and additional forces (Q) may be developed near the flange tip, increasing the bolt force itself. The tension induced in the bolts, from equilibrium, is thus FB= FT/2 + Q. This phenomenon is illustrated in Fig.



There are some important comments and notes regarding prying action:

• Prying action in high strength friction grip bolts is reduced only at a relatively low level of load and the behaviour of the bolts at ultimate load is not significantly affected.
• Even if prying action is low, the distortion of the connected parts results in significant bending of the bolt and local bending of the bolt nut or head.
• Prying action in Eurocode 1993-1-8:2005 is implicitly taken into account when determining the design tension resistance.
• Base plate connections usually have long anchor bolts and a thick base plate when compared to an
end plate. This results in the uplift of the T-stub from the concrete foundation and in these situations, prying of anchor bolts is not observed.

PRYING FORCE:- [cls 10.4.7 IS 800-2007]

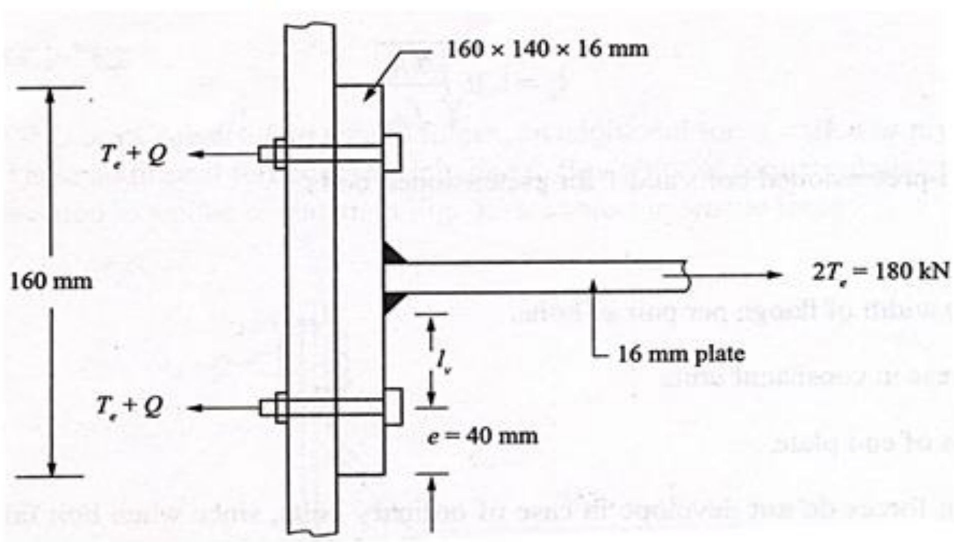


$$Q = \frac{l_v}{2l_e}\left[T_e - \frac{\beta\eta f_o b_e t^4}{27 l_e l_v^2}\right][Q\ f_o = 0.7 f_{ub}]$$

When,

$$l_e = 1.1t\sqrt{\frac{\beta f_o}{fy}} < e[Q\ f_o = 0.7 f_u]$$

1. The jt shown in fig. as to carry a factored load of 180KN. End plate used size 160x140x16mm. The bolts used are M20 HSFG bolts of grade 8.8 check whether the design is safe.



Given:-

M20 HSFG Grade 8.8

f_{ub}= 800 N/mm^2

Plate:-

f_u= 400 N/mm^2

27 = 180 KN

Assuming 8mm size weld a edge distance are of 40mm

$$l_v = \frac{160}{2} - 8 - 8 - 40$$

$$l_v = 24\text{mm}$$

l_e least of $1.1t\sqrt{\frac{\beta f_o}{fy}}$ (or)40mm

For β = 1 for pretensioned bolt

$f_o = 0.7fu$ [∵ fu for plate assumed as 410 N/mm^2 fy=250 N/mm^2]

= 0.7 x 410

f_o= 287 N/mm^2

$$\because l_e = 1.1 \times 16\sqrt{\frac{1 \times 287}{250}}$$

= 18.86mm (or) 40mm

$$\boxed{l_e = 18.86\text{mm}}$$

Prying force $Q = \frac{l_v}{2l_e}\left[T_e - \frac{\beta \eta f_o b_{et}^4}{27 l_e l_v^2}\right]$

When,

$$\beta = 1, \eta = 1.5, T_e = 90\text{KN}, f_o = 0.7 \times 800 = 560\text{N/mm}^2$$

$$b_e = 140\text{mm}, t = 16\text{mm}, l_e = 18.86, l_v = 24\text{mm}$$

$$\therefore Q = \frac{24}{2 \times 18.86}\left[90 - \frac{1 \times 1.5 \times 560 \times 140 \times (16)^4}{27 \times 18.86 \times (24)^2}\right]$$

$$\boxed{Q = 40.55 \text{ KN}}$$

Total force on bolt = T + a

= 90+40.55

= 130.5 KN

Tension capacity of bolt = $\frac{0.9 f_{ub} A_n}{\gamma_m}$

$= \frac{0.9 \times 800 \times A_n}{\gamma_m}$

$A_n = \frac{0.78 \times \pi \times 20^2}{4}$

= 245 mm^2

$= \frac{0.9 \times 800 \times 245}{1.25}$

$T_e = 141.12\text{KN}$

Hence the design is safe.