

Bolted Connections

ENGR 244 Mechanics of Materials

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Winter 2016

References

1. G.L. Kulak (2005), High Strength Bolting for Canadian Engineers, CISC.
2. E.P. Popov et al., Mechanics of Materials, SI units, 2nd edition, Prentice Hall.

Types of connections

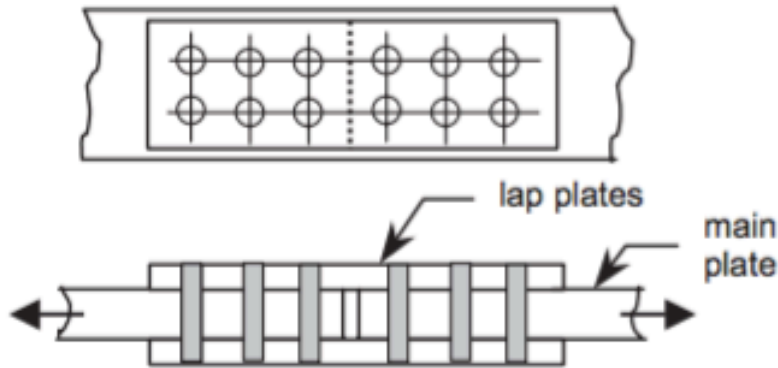


Fig.1.3(a) Lap Splice

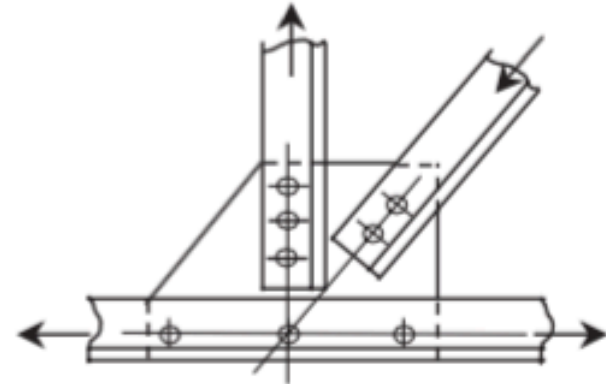


Fig. 1.3(b) Truss Joint

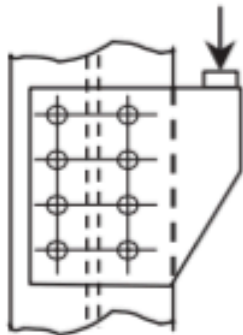


Fig. 1.3(c) Eccentric Joint

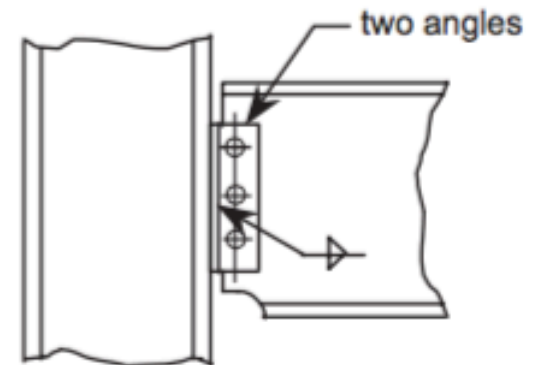


Fig. 1.3(d) Standard Beam Connection

Types of connections

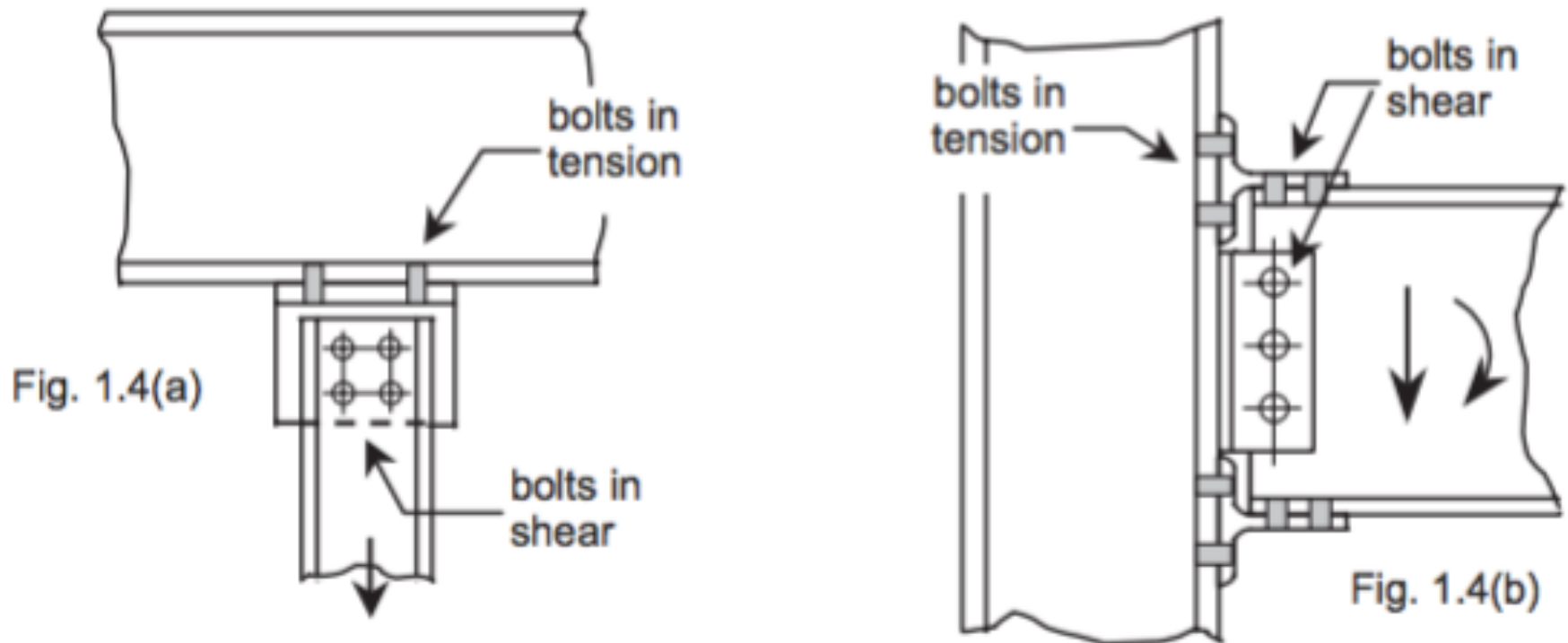


Fig. 1.4 Examples of Bolts in Tension

Types of connections

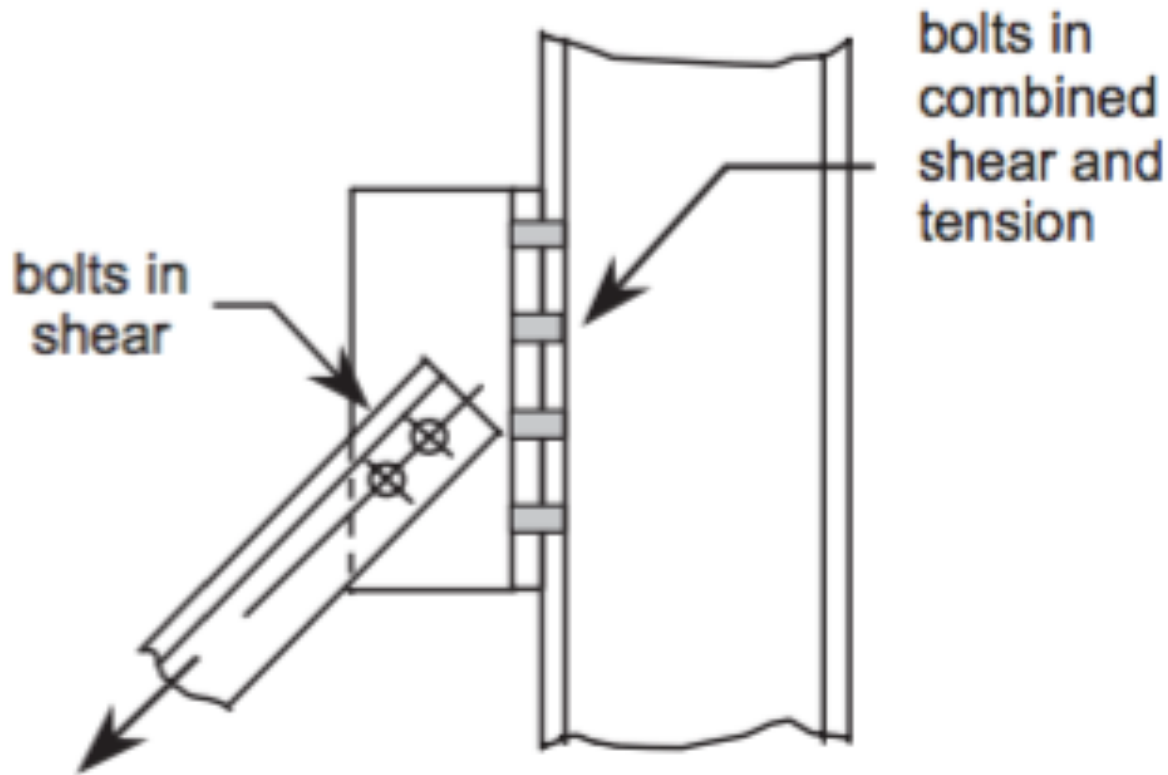


Fig. 1.5 Bolts in Combined Shear and Tension

Types of connections

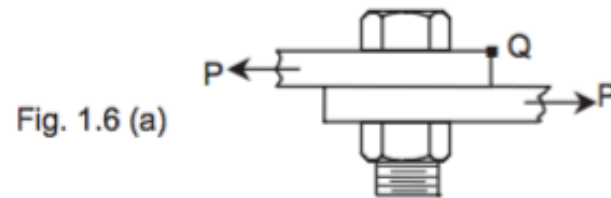


Fig. 1.6 (a)

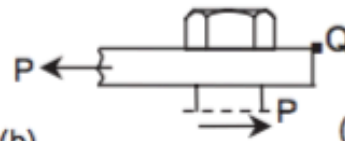


Fig. 1.6 (b)

(and associated shear stress, $\tau = P/A$)

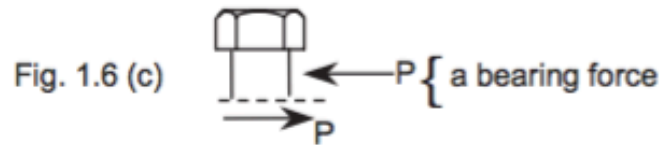


Fig. 1.6 (c)

$\left\{ \begin{array}{l} \leftarrow P \\ \rightarrow P \end{array} \right\}$ a bearing force

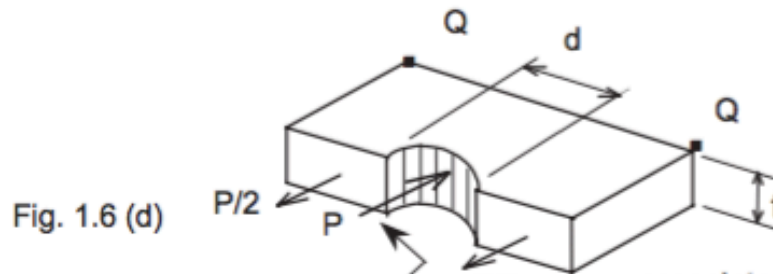


Fig. 1.6 (d)

associated average bearing stress: $\sigma = P/A = P/(td)$

note that this force is equal and opposite to the bearing force shown in (c)

Strength of mechanical fasteners

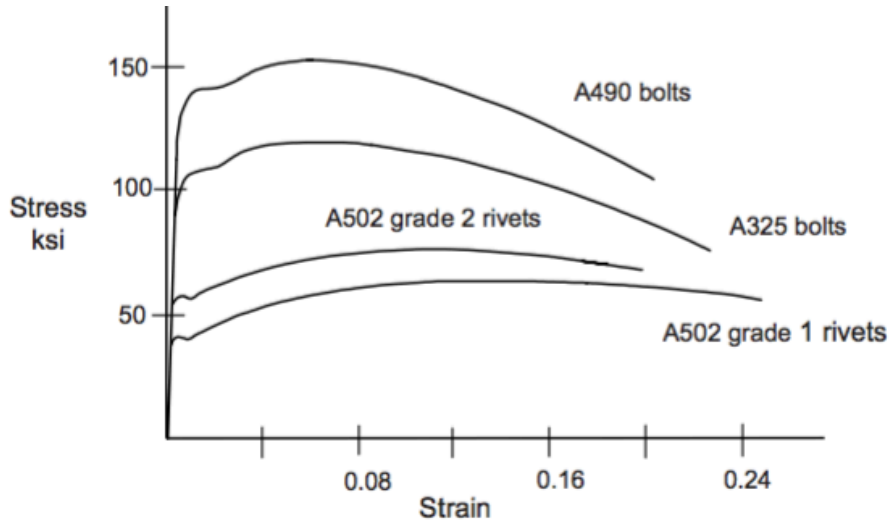


Fig. 1.1 Stress vs. Strain of Coupons taken from Bolts and Rivets

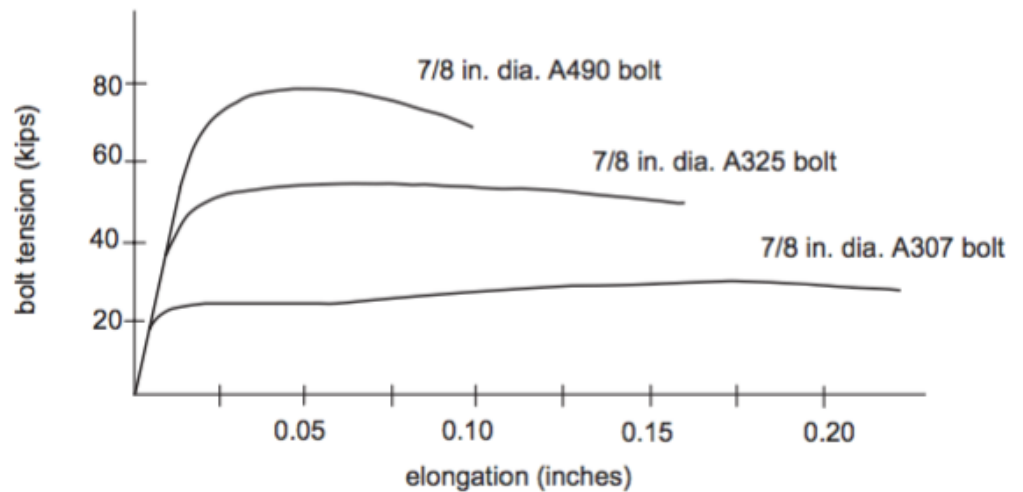


Fig. 1.2 Comparison of Bolt Types: Direct Tension

Bolts in tension

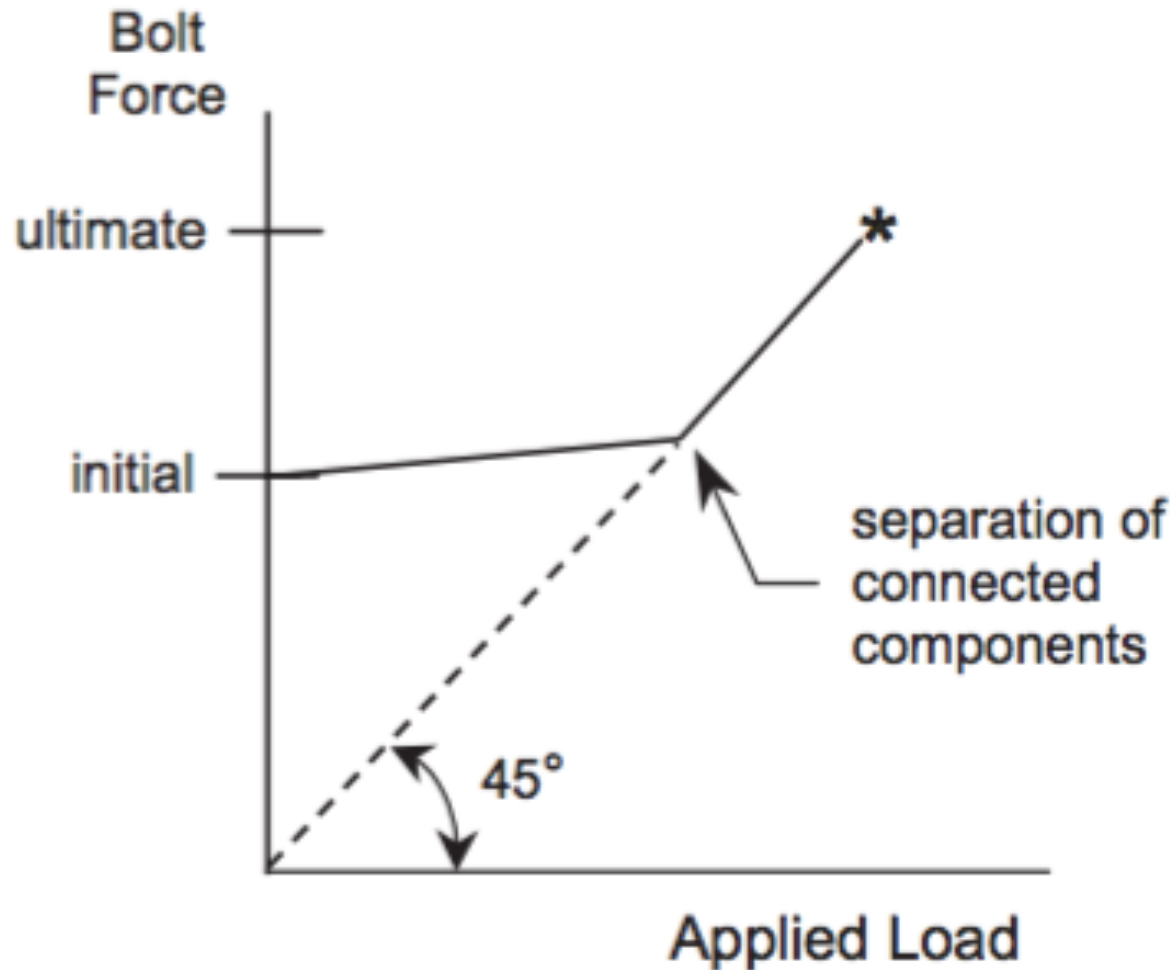


Fig. 4.1 Bolt Force vs. Applied Load
for Single Pretensioned Bolt

Bolts in shear

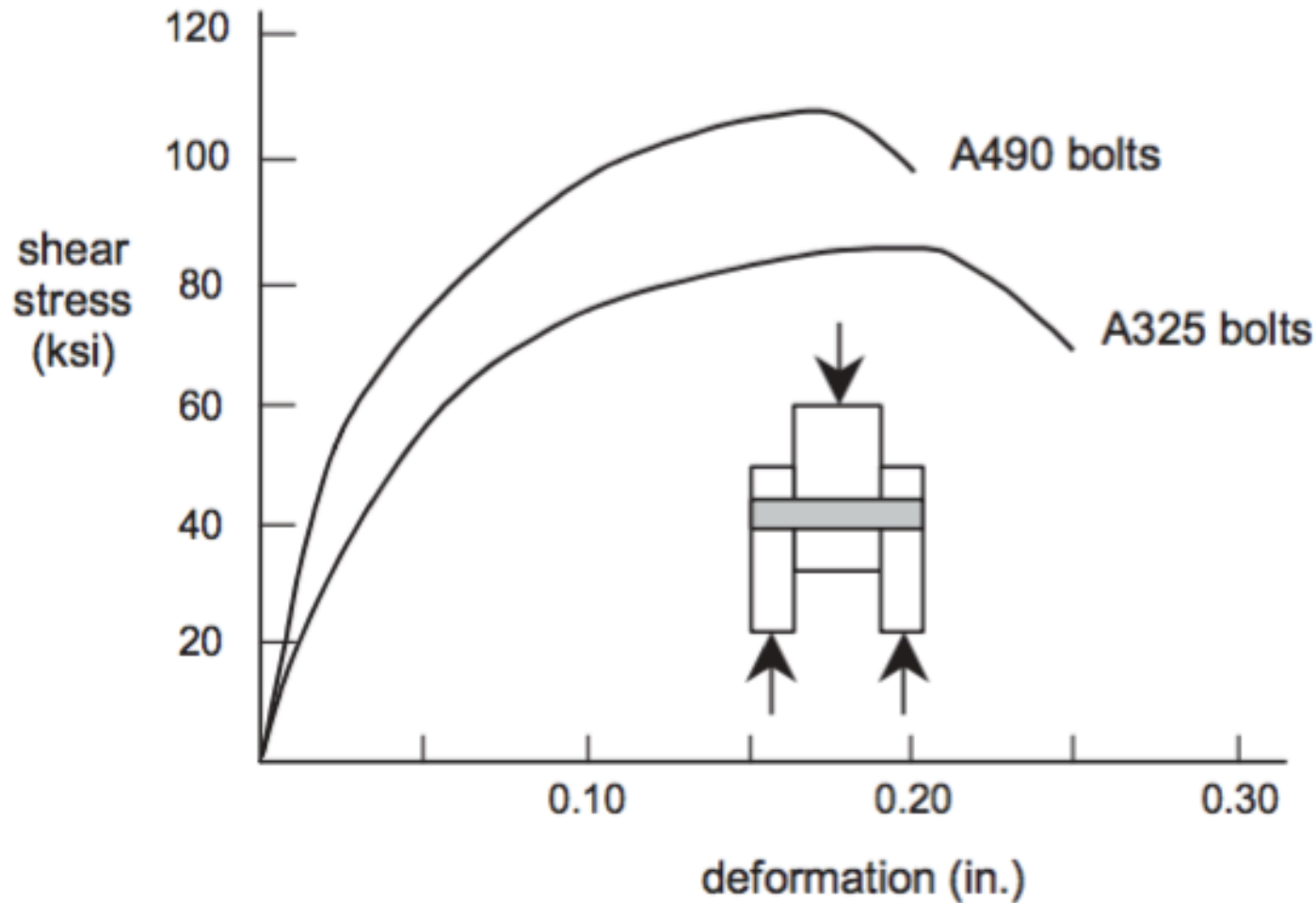


Fig. 4.2 Typical Shear Load vs. Deformation Curves for A325 and A490 Bolts

Bolts in shear splices

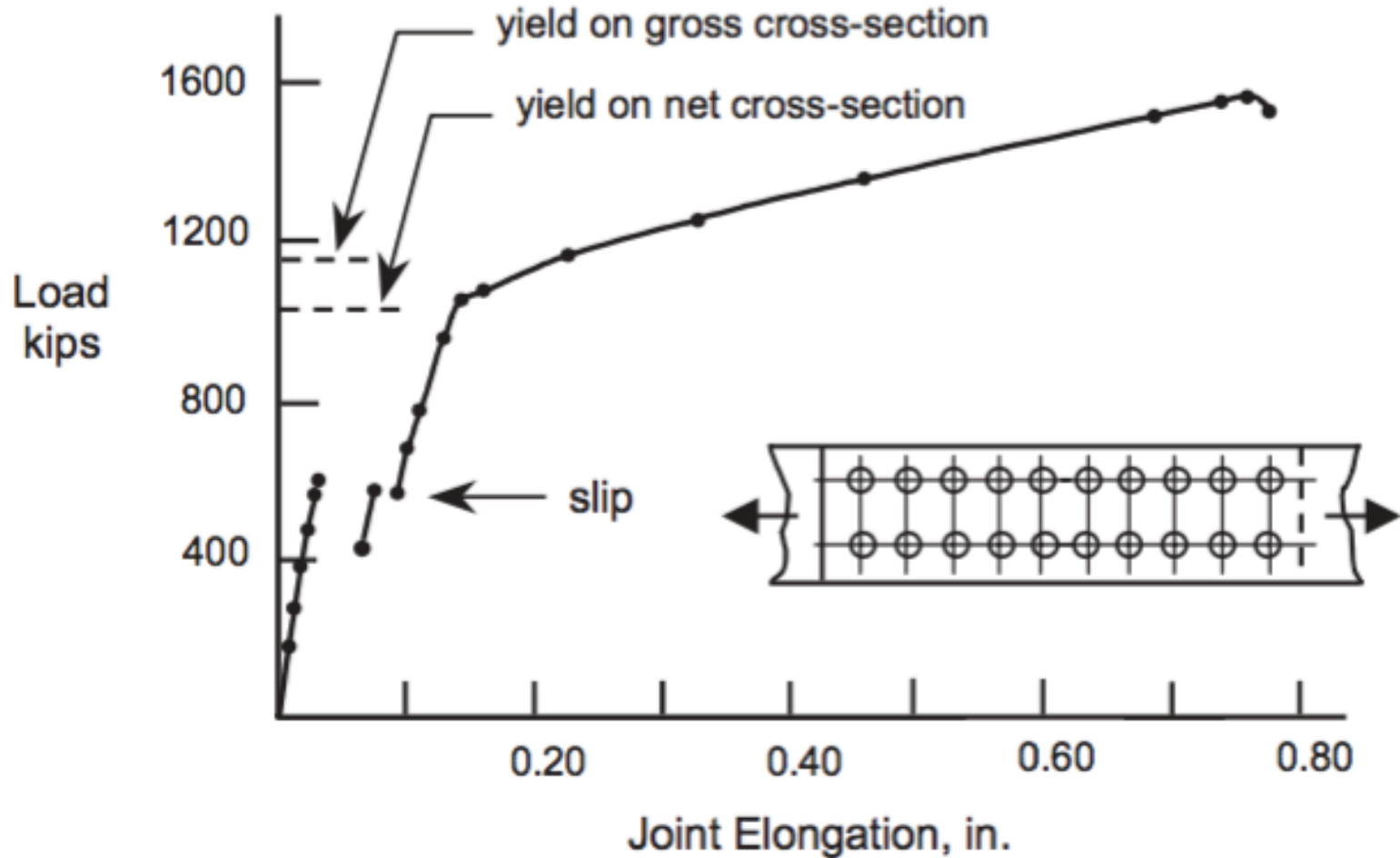
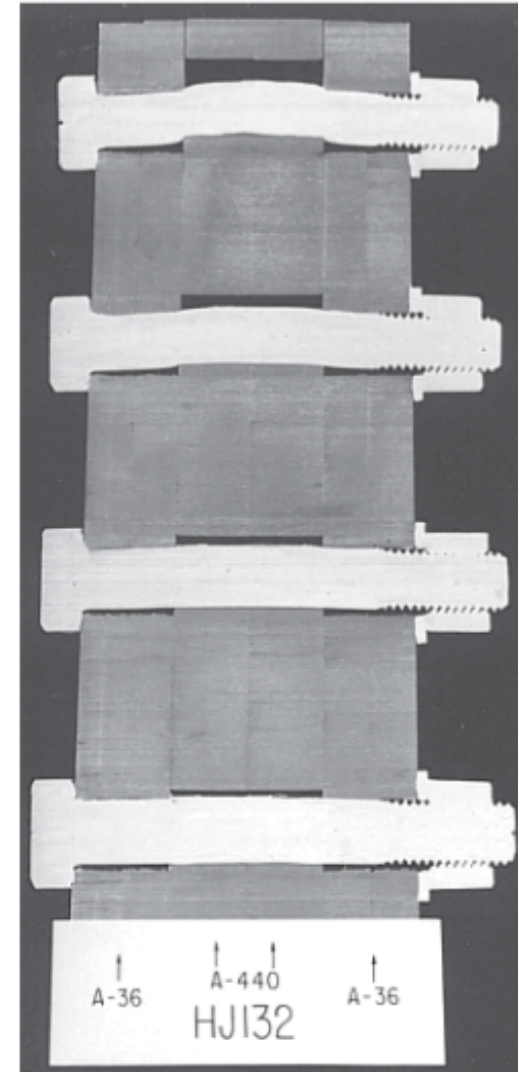
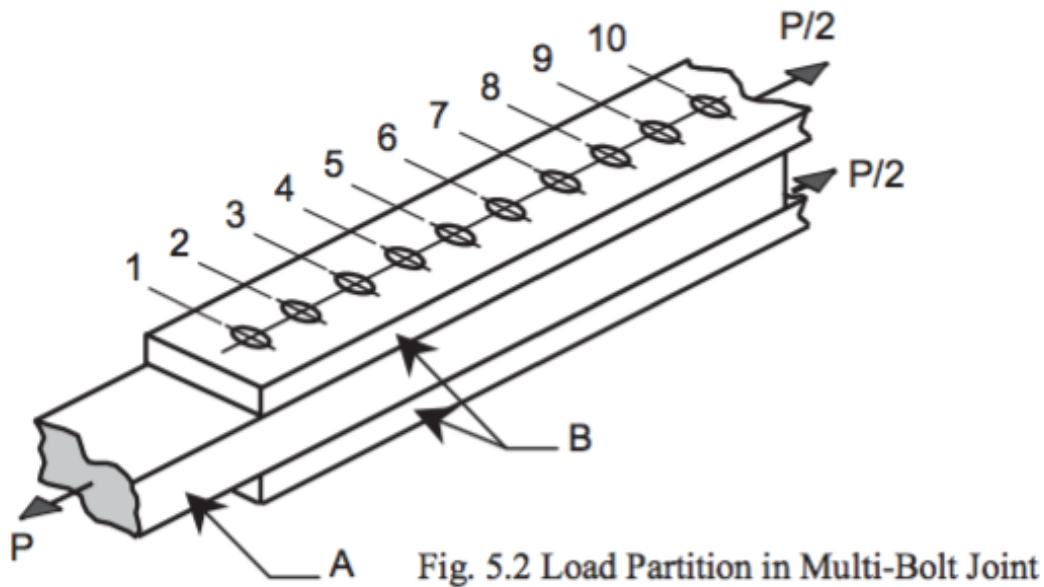


Fig. 5.1 Load vs. Elongation Behavior of a Large Joint

Bolts in shear splices



Bolts in tension

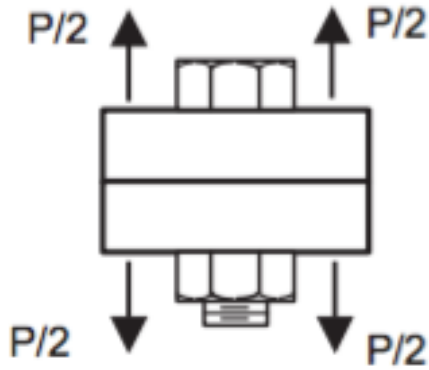


Fig. 6.1(a) Single Bolt and Tensile Force

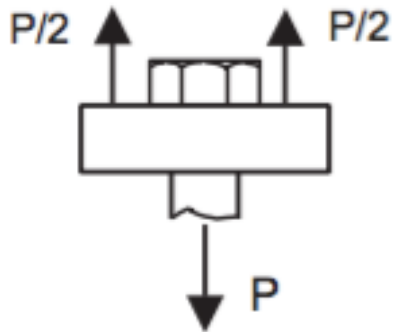


Fig. 6.1(b) Free Body Diagram

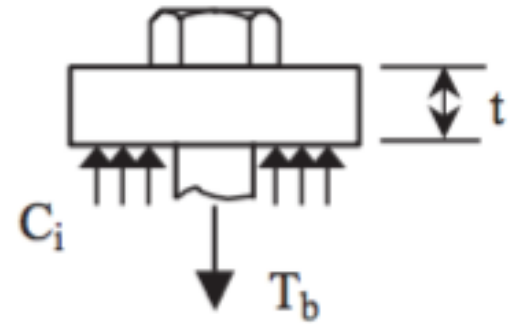


Fig. 6.2(a) Free Body: No External Load

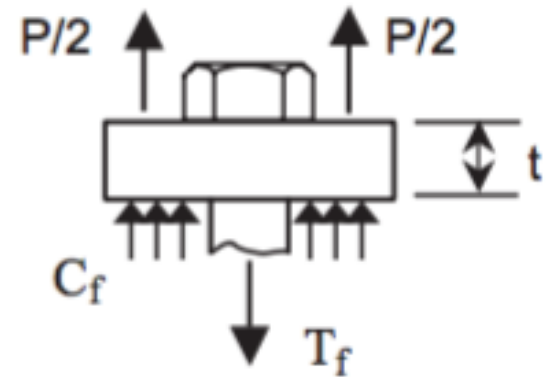


Fig. 6.2(b) Free Body: External Load Applied

Bolts in tension

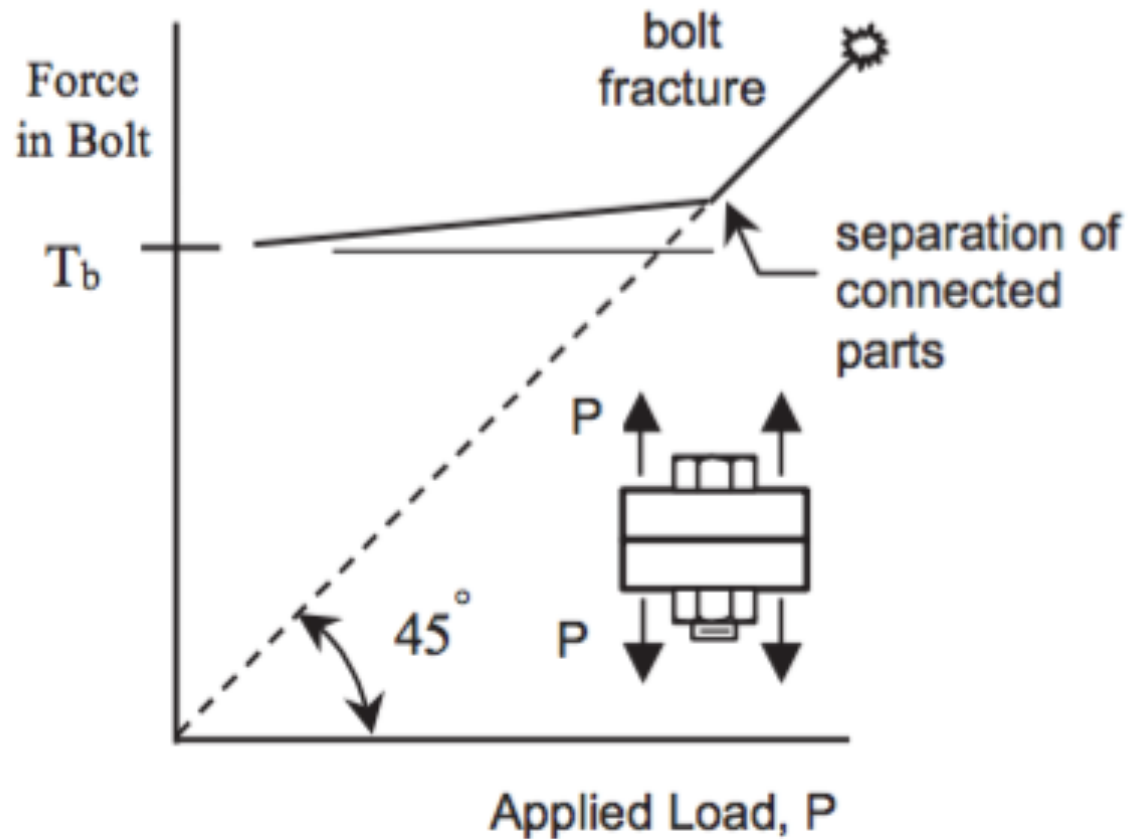
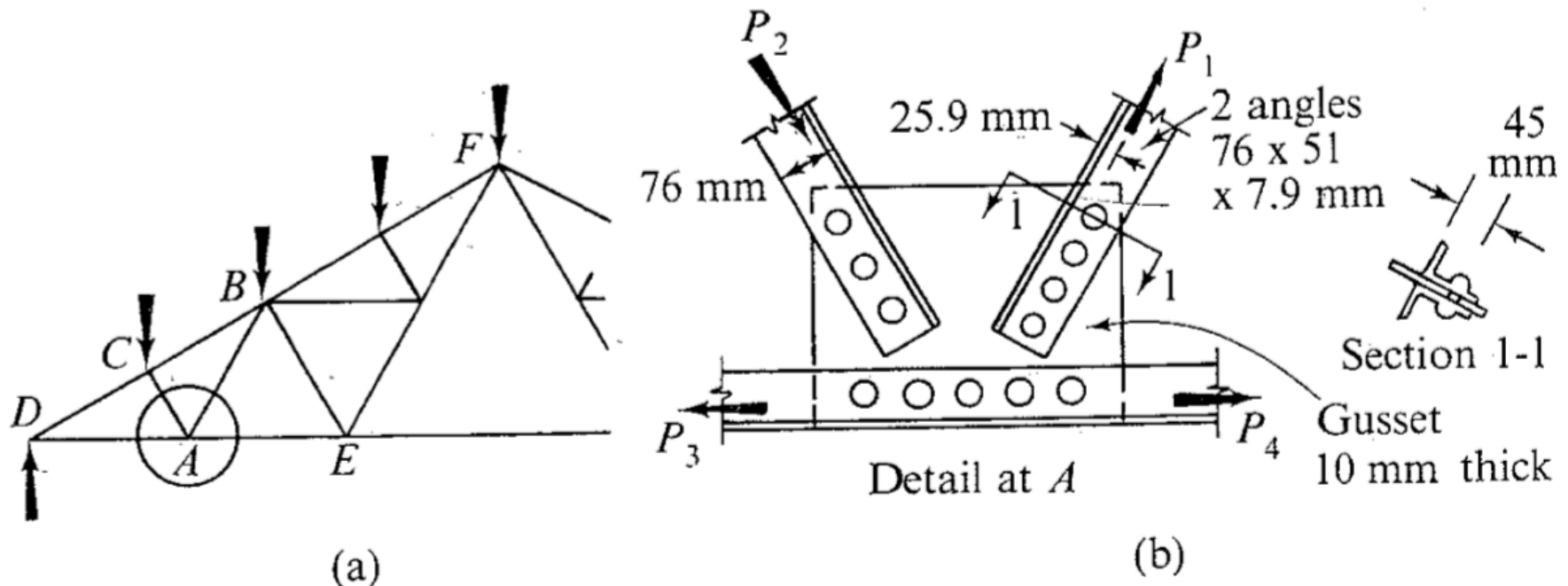


Fig. 6.3 Bolt Force vs. Applied Load

Example 14.2

Find the capacity of the tension member AB of the Fink truss shown in Fig. 14-10(a) if it is made from two 76x51x7.9 mm angles attached to a 10 mm thick gusset plate by four 19 mm ordinary bolts in 22 mm diameter holes. The allowable stresses are 150 MPa in tension, 100 MPa in shear and 335 MPa in bearing on the angles as well as the gusset.



Eccentric bolted connections

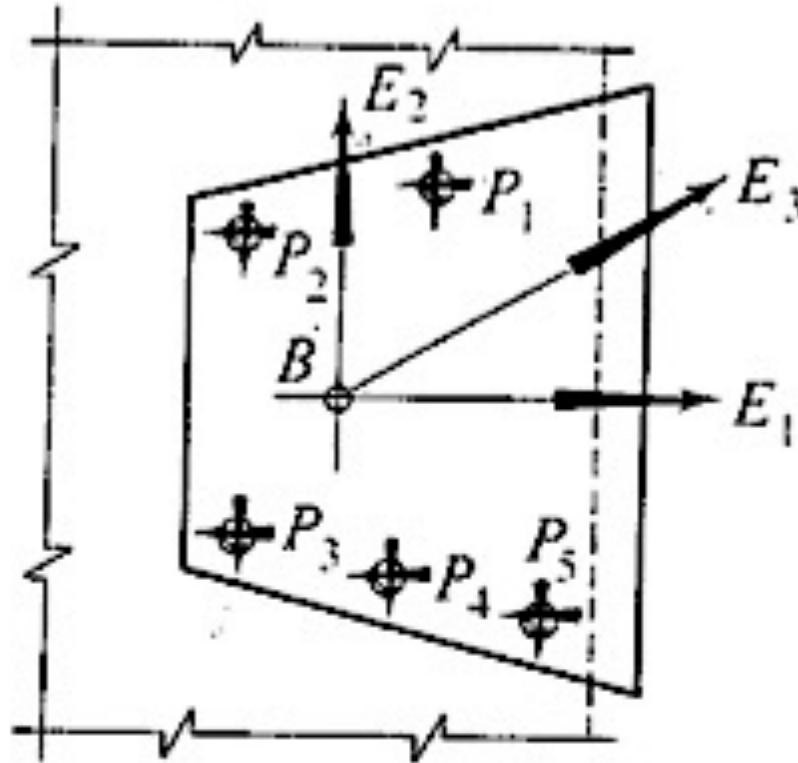


Fig. 14-13. The applied force must act through the centroid of rivet areas to prevent twisting of a connection

Eccentric bolted connections

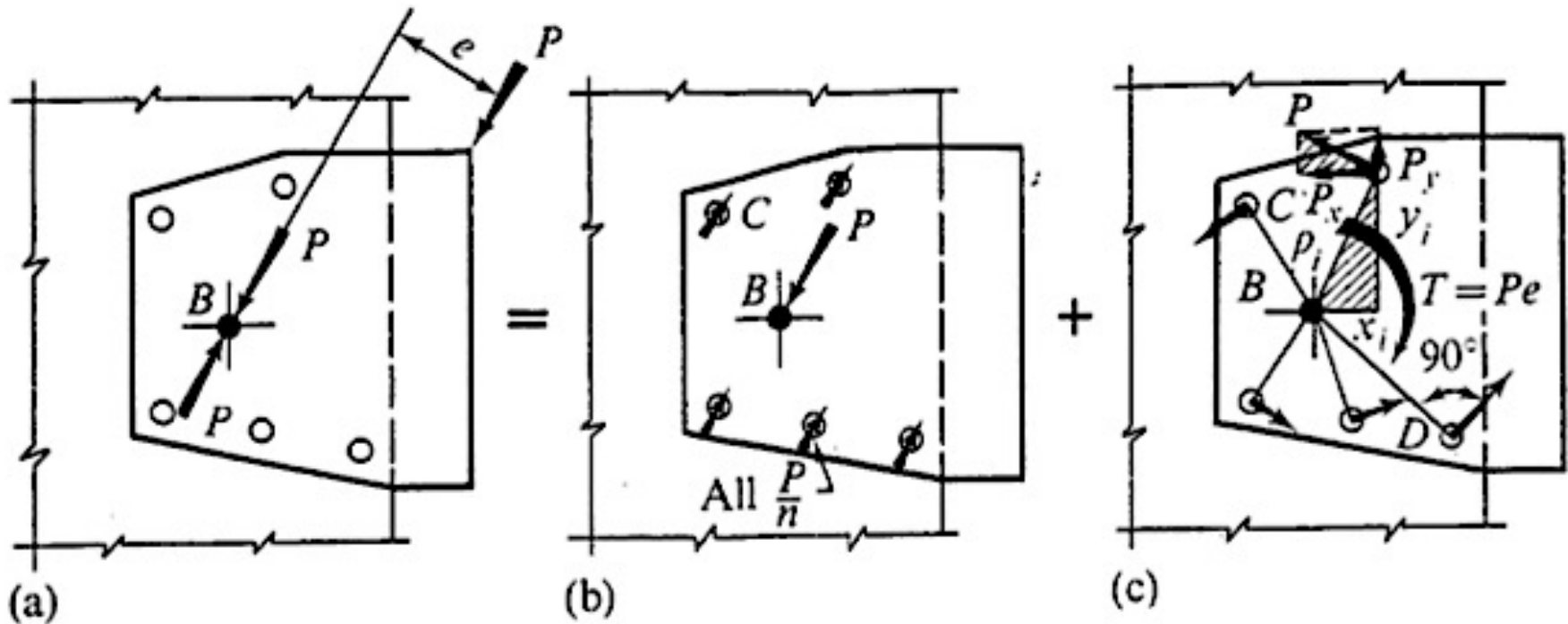


Fig. 14-14. Résolution of a problem of an eccentrically loaded riveted connection into two problems.

Example 14.6

Find the maximum shearing stress caused by an inclined force $P = 50$ kN in the bolts of the connection shown in Fig. 14.15(a). The bolts are of 25 mm diameter ($A = 491$ mm²). All dimensions are in mm.

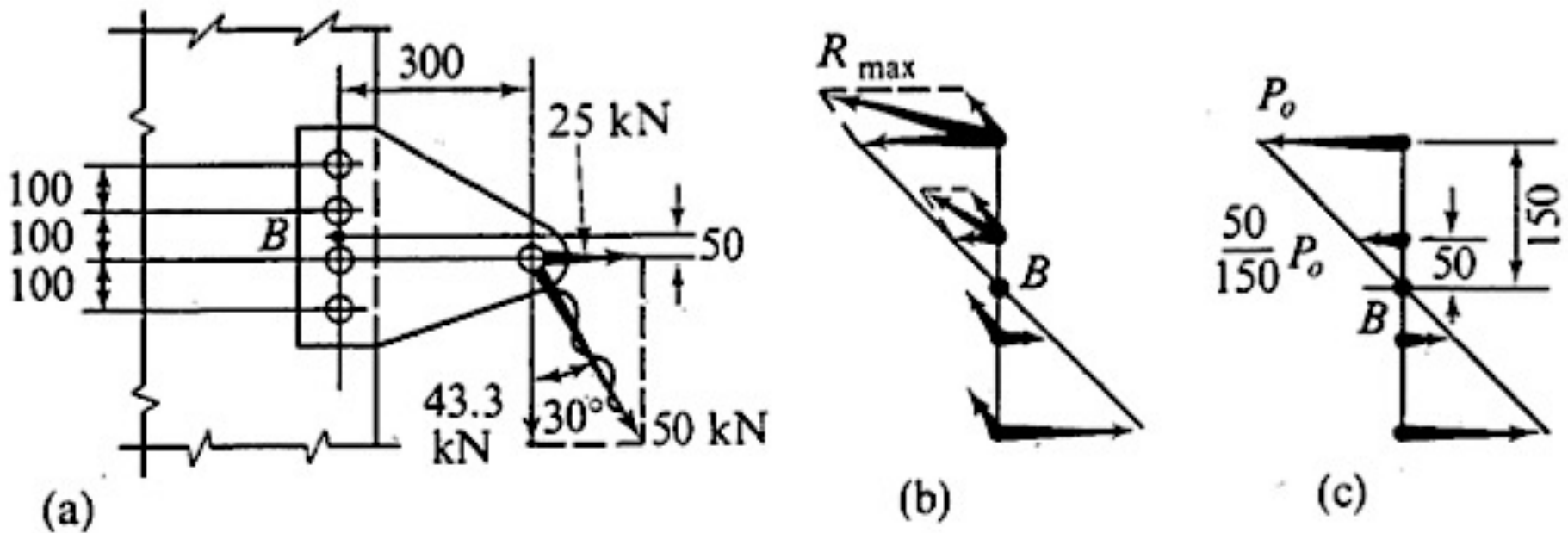


Fig. 14-15