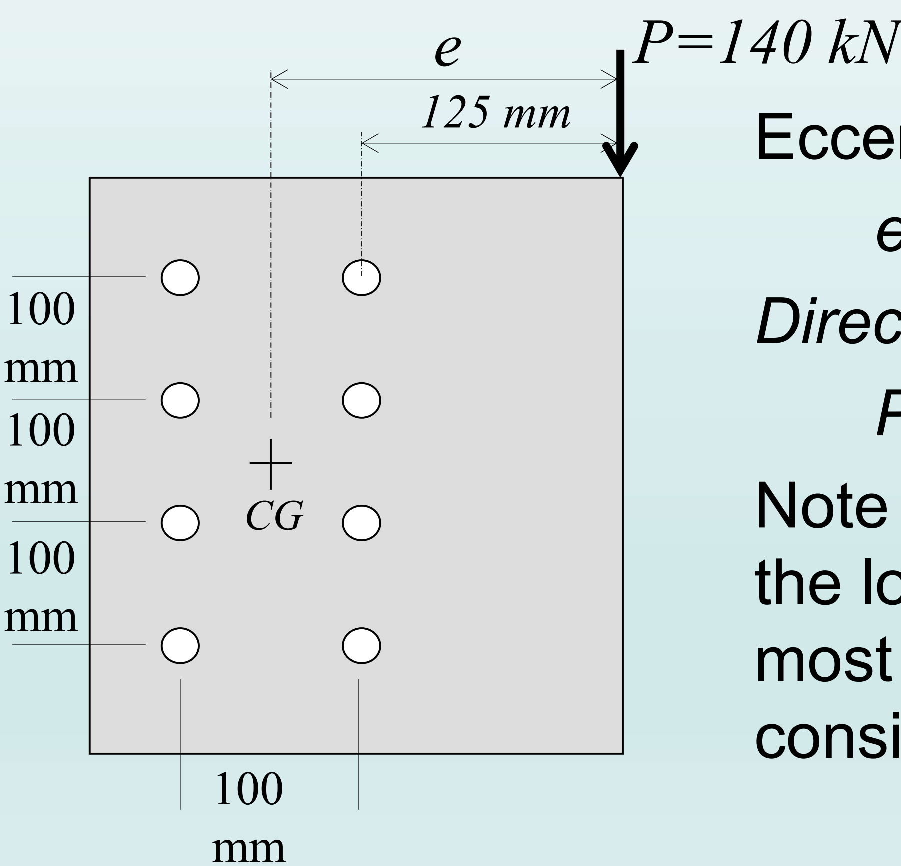
Ex. 6.3 – Eccentric Connections – Elastic Method

Determine the force in the most stressed bolt of the group using elastic method



Eccentricity wrt *CG*:

$e = 125 + 50 = 175\ mm$

Direct Shear in each bolt:

$P/n = 140/8 = 17.5\ kN$

Note that the upper right-hand and the lower right-hand bolts are the most stressed (farthest from *CG* and consider direction of forces)

Ex. 6.3 – Eccentric Connections – Elastic Method

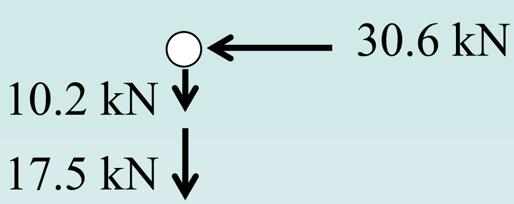
Additional Shear in the upper and lower right-hand bolts due to moment *M = Pe = 140x175 = 24500 kN.mm:*

$$\sum d^2 = \sum x^2 + \sum y^2 = (8)(50)^2 + (4)(50^2 + 150^2) = 120000$$

$$p_{mx} = \frac{My}{\sum d^2} = \frac{(22500)(150)}{120000} = 30.6 \text{ kN}$$

$$p_{my} = \frac{Mx}{\sum d^2} = \frac{(24500)(50)}{120000} = 10.2 \text{ kN}$$

The forces acting on the upper right-hand bolt are as follows:



The resultant force on this bolt is:

$$R = \sqrt{(10.2 + 17.5)^2 + (30.6)^2} = 41.3 \text{ kN}$$

Bolts Subjected to Shear and Tension

- Nominal Tension Stress F_t of a bolt subjected to combined factored shear stress ($f_v = V_u/N_b A_b$) and factored tension stress ($f_t = T_u/N_b A_b$) can be computed as functions of f_v *as:*

$$F'_{nt} = 1.3F_{nt} - \frac{F_{nt}}{\phi F_{nv}} f_v \le F_{nt}$$

  - ***ϕ = 0.75***
  - ***F'_{nt} = nominal tensile strength modified to include the effect of shear***
  - ***F_{nt} = nominal tensile strength from Table J3.2 in (AISC Spec.)***
  - ***F_{nv} = nominal shear strength from Table J3.2 in (AISC Spec.)***
  - ***f_v = the required shear stress***

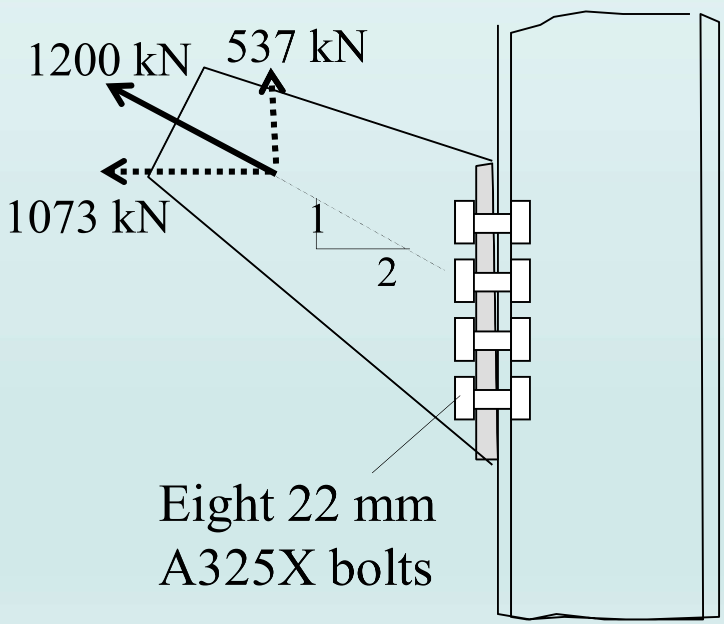
Bolt Type	F_{nt} (MPa)
A325	620
A490	780

Ex. 6.5 – Combined Tension & shear

Is the bearing-type connection below satisfactory for the combined tension and shear loads shown?

Shear stress per bolt: $f_v = V_u/N_bA_b = 537000/(8x380) = 176.6$ MPa

$\phi F_{nv} = (0.75)(413) = 310$ MPa $> f_v = 176.6$ MPa (OK)



Tension stress per bolt:

$f_t = T_u/N_bA_b = 1073000/(8x380) = 353$ MPa

Nominal Tension Strength F_t (Table J3.5)

$\phi F_t = 0.75[(1.3x620 – (620/310)x176.6) \le 620]$

$= 496$ MPa $\le 620]$

$= 496$ MPa $> f_t = 353$ MPa (OK)