Question 1:

The axial load on building column resulting from the code specified service loads have been calculated as:

P_D = 530 kN
P_L = 360 kN
P_{Lr} = 178 kN
P_W = 270 kN (compression)
= 310 kN (tension)

Determine the required strength for this column

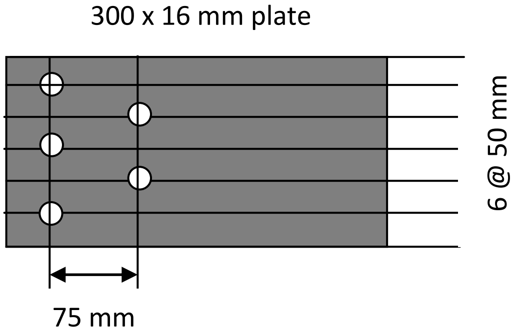
Combination	P_u (kN)
Comb.1 ➔ 1.4 D ➔ 1.4 (530)	742
Comb.2 ➔ 1.2 D + 1.6 L + 0.5 L_r ➔ 1.2 (530) + 1.6 (360) + 0.5 (178)	1301
Comb.3(a) ➔ 1.2 D + 1.6 L_r + f_1 L ➔ 1.2 (530) + 1.6 (178) + 0.5 (360)	1100.8
Comb.3(b) ➔ 1.2 D + 1.6 L_r + 0.8 W ➔ 1.2 (530) + 1.6 (178) + 0.8 (270)	1136.8
Comb.4 ➔ 1.2 D + 1.6 W + f_1 L + 0.5 L_r ➔ 1.2 (530) + 1.6 (270) + 0.5 (360) + 0.5 (178)	**1337**
Comb.5 ➔ 1.2 D +1.0 E + f_1 L ➔ 1.2 (530) + 1.0 (0) + 0.5 (360)	816
Comb.6(a) ➔ 0.9 D + 1.6 W ➔ 0.9 (530) + 1.6 (270)	909
Comb.6(b) ➔ 0.9 D – 1.6 W ➔ 0.9 (530) – 1.6 (310)	**-19**
Comb.7 ➔ 0.9 D + 1.0 E ➔ 0.9 (530) + 1.0 (0)	477

Based on combination results, the required strength of the column is **1337 kN in compression** and **19 kN in tension**.

Question 2:

Compute the net area for each of given member .assume 22-mm bolts.

(a)



$d_b = 22\ mm$
$t = 16\ mm$
$A_g = 300 \times 16 = 4800\ mm^2$

Path 1-1:

$$A_n = A_g - \sum (d_b + 3\ mm)\ t$$
$$A_n = 4800 - 3\ (25)(16) = \mathbf{3600\ mm^2}$$

Path 2-2:

$$A_n = A_g - \sum (d_b +\ 3\ mm)t + \sum \frac{s^2}{4g}\ t$$
$$A_n = 4800 - 4\ (25)(16) + 2\frac{(75)^2}{4(50)}(16)$$
$$A_n = 4800 - 1600 + 900 = \mathbf{4100\ mm^2}$$

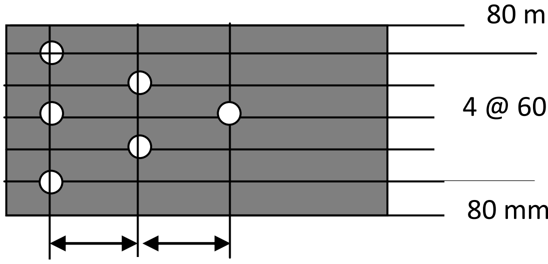
Path 3-3:

$$A_n = A_g - \sum (d_b +\ 3\ mm)t + \sum \frac{s^2}{4g}\ t$$
$$A_n = 4800 - 5\ (25)(16) + 4\frac{(75)^2}{4(50)}(16)$$
$$A_n = 4800 - 2000 + 1800 = \mathbf{4600\ mm^2}$$

$$\therefore \boldsymbol{Critical\ \ A_n} = \mathbf{3600\ mm^2}$$

(b)

$d_b = 22\ mm$
$t = 16\ mm$
$A_g = 400 \times 16 = 6400\ mm^2$



Path 1-1:

$$A_n = A_g - \sum (d_b + 3\ mm)\ t$$
$$A_n = 6400 - 3\ (25)(16) = \mathbf{5200mm^2}$$

Path 2-2:

$$A_n = A_g - \sum (d_b + \ 3\ mm)t + \sum \frac{s^2}{4g}\ t$$
$$A_n = 6400 - 4\ (25)(16) + 2\frac{(75)^2}{4(60)}(16)$$
$$A_n = 6400 - 1600 + 750 = \mathbf{5550\ mm^2}$$

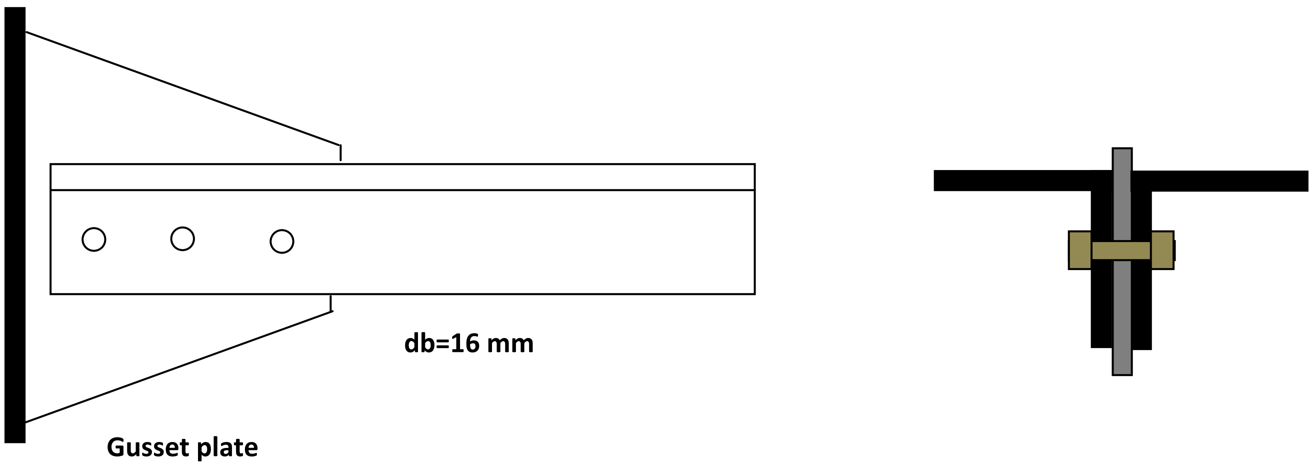
Path 3-3:

$$A_n = A_g - \sum (d_b + \ 3\ mm)t + \sum \frac{s^2}{4g}\ t$$
$$A_n = 6400 - 5\ (25)(16) + 4\frac{(75)^2}{4(60)}(16)$$
$$A_n = 6400 - 2000 + 1500 = \mathbf{5900\ mm^2}$$

$$\therefore \boldsymbol{Critical}\quad \boldsymbol{A_n} = \mathbf{5200\ mm^2}$$

Question 3:

Two A36 L102x102x9.5 are connected to gusset plate with 16mm diameter bolts, as shown in figure below. Compute the tensile strength of the member.
Assume that the A_e=85% of A_n.



Gross area of angle = $A_g = 3700\ mm^2$ (Table on page 1-86 of AISC Manual)
$t = 9.5\ mm$
A36M steel: F_y=250 MPa
F_u=400 MPa
Net section area:
d_b=16mm
$A_n = 3700 - 2(16+3) \times 9.5 = 3339\ \ mm^2$
Effective net area:
$A_e = 0.85 \times 3339 = 2838.15\ mm^2$
Gross yielding design strength = $\emptyset_t A_g F_y = 0.9 \times 3700 \times 250 \times 10^{-3} = \mathbf{832.5\ kN}$
Net section fracture = $\emptyset_t A_e F_u = 0.75 \times 2838.15 \times 400 \times 10^{-3} = 851.445\ kN$

Design strength $\boldsymbol{\emptyset_t P_n = 832.5\ kN}$ (gross yielding governs)