AMOO, EMMANUEL

15/ENG06/011

PIPELINE ENGINEERING.

$Q = 2000 m^3/h = 33.3 m^3/h$.

$P = 1.2 N/mm^2$

$v = 28 ms^{-1} = 1680 m/min$.

$\sigma_t = 40 Mpa = 40 N/mm^2$

inside diameter of pipe

$$D = 1.13 \sqrt{\frac{Q}{V}}$$

$$= 1.13 \sqrt{\frac{33.3}{1680}}$$

$$= 0.159 = 160mm.$$

wall thickness of pipe

$C = 3mm$ from table 8.2.

$$\therefore t = \frac{PD}{2} + C$$

$$= \frac{1.2 \times 160}{2 \times 40} + 3$$

$$= 5.4mm \simeq 6mm.$$

2. $D = 200mm$

$P = 0.7 N/mm^2$

$\sigma_t = 14 N/mm^2$ from table 8.1

$C = 9mm$ from table 8.2.

thickness $t = \frac{PD}{2\sigma_t} + C$

$$t = \frac{0.7 \times 200}{2 \times 14} + 9$$

$$t = 14mm$$

Other dimensions of flanged joint for a cast iron pipe are,

i. Nominal diameter of bolts

$d = 0.75t + 10$

$= (0.75 \times 14) + 10$

$= 20.5mm \approx 21mm$

ii. number of bolts

$n = 0.0275 D + 1.6$

$= 0.0275 \times 200 + 1.6$

$= 7.1$

≈ 7 bolts.

iii. Thickness of flanges

$t_1 = 1.5t + 3$

$= 1.5 \times 14 + 3$

$= 24mm.$

iv. width of the flange.

$B = 2.3d$

$= 2.3 \times 21$

$= 48.3$

$\approx 50mm$

v. Outside diameter of the bolts.

$D_o = D + 2t + 2B$

$= 200 + 2(14) + 2(50)$

$= 328mm.$

vi. pitch circle diameter of the bolts.

$D_p = D + 2t + 2d + 12.$

$= 200 + 2(14) + 2(21) + 12$

$= 282mm$

vii. Circumferential pitch of the bolts

$$P_c = \frac{\pi \times D_p}{n}$$

$$= \frac{\pi \times 282}{8}$$

$= 110.7mm.$

In order to make the joint leak proof, the value of P_c should be between $20\sqrt{d_1}$ & $30\sqrt{d}$ where d is diameter of bolt hole

$d_1 = d + 3$

$= 21 + 3 = 24mm$

$20\sqrt{d_1} = 20\sqrt{24} = 97.9$

$30\sqrt{d_1} = 30\sqrt{24} = 146.9.$

Since the circumferential pitch is above $20\sqrt{d}$ and $30\sqrt{d}$, the design is satisfactory.

5. Given; $D = 50mm$ or $R = 25mm$

$P = 7N/mm^2$

$\sigma_t = 21MPa = 21N/mm^2$

$\sigma_{ts} = 28MPa = 28N/mm^2.$

$$t = R\left[\sqrt{\frac{\sigma_t + P}{\sigma_t - P}} - 1\right] = 25\left[\sqrt{\frac{21+7}{21-7}} - 1\right]$$

$= 10.35$ say $11mm$

Assuming the width of packing as 10mm;

outer diameter of the packing

$D_1F = D + 2 \times$ width of packing.

$= 50 + 2 \times 10 = 70mm.$

∴ Force trying to separate the flanges

$F = \frac{\pi}{4} (D_1)^2$

$P = \frac{\pi}{4} (70^2) 7$

$= 26943 N.$

Since the flange is secured by a means of bolts:

$F_b = \frac{F}{2} = \frac{26943}{2} = 13471.5 N$

Let d_c = core diameter of bolt

Load on each bolt (F_b)

$13471.5 = \frac{\pi}{4} (d_c)^2 \sigma_{tb}.$

$= \frac{\pi}{4} (d_c^2) 28$

$13471.5 = 21.99 (d_c)^2$

$d_c^2 = \frac{13471.5}{21.99}$

$d_c^2 = 612.6$

$d_c = 24.7 mm$

$d_c \approx 25 mm$ //

Nominal diameter of bolts

$d = \frac{d_c}{0.84} \approx \frac{25}{0.84}$

$d = 29.4 \approx 30 mm.$

Outer diameter of the flange

$D_o = D + 2t + 4.6d.$

$= 50 + 2(11) + 4.6(30).$

$= 210 mm.$

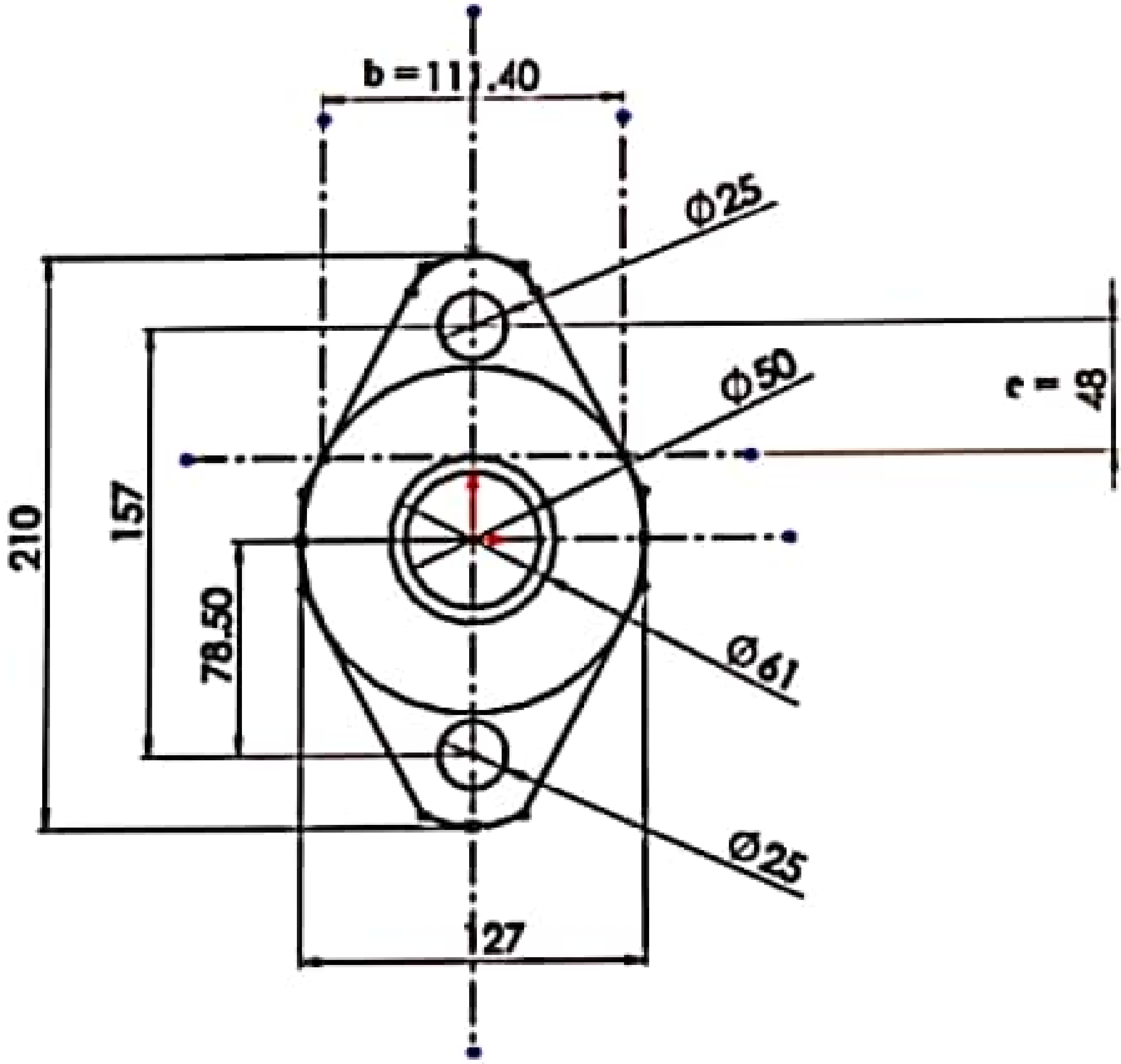
Scanned with CamScanner

pitch circle diameter of bolts

$D_p = D_o - (3t + 20mm)$

$= 210 - (3(11) + 20)$.

$= 157mm$.



b = 111.40
Ø25
Ø50
e = 48
210
157
78.50
Ø61
Ø25
127

From the diagram:

$b = 111.40mm$

$e = 48mm$

∴ Bending moment at section x-x

$M_{xx} = f_b \times e = 13471.5 \times 48 mm.$

$= 646632 N.mm.$

and section modulus

$$Z = \frac{1}{6} b (t_f)^2$$

$$= \frac{1}{6} \times 111.40 (t_f)^2$$

$$= 18.56 (t_f)^2$$

we know that

$M_{xx} = \sigma_b \times Z.$

$646632 = 21 \times 18.56 (t_f)^2$

$= 389.76 (t_f)^2$

$$t_f^2 = \frac{646632}{389.76}$$

$t_f^2 = 1659.05$

$t_f = \sqrt{1659.05}$

$t_f = 40.7$

$t_f \approx 41mm$ //.