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15/ENG 06/067
MECHANICAL ENGINEERING.

Pipe Line Engineering – Assignment.

1.) $Q = 2000\ m^3/h = 33.3 m^3/h$

$P = 1.2 N/mm^2$.

$V = 28 m/s = 1680 m/min$

$\sigma_t = 40 mPa = 40 N/mm^2$.

Inside diameter of Pipe

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

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

$= 0.159 = 160$ mm.

Wall thickness of pipe.

from table 8.2, $C = 3mm$

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

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

$= 5.4mm$ Say 6mm.

2) $D = 200$ mm.

$P = 0.7 N/mm^2$

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

from table 8.2, $c = 9mm$.

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

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

$t = 14mm.$

other dimensions of a flanged joint for a cast iron pipe are:

Nominal diameter of bolts.

$d = 0.25t + 10.$

$= 0.25 \times 14 + 10 = 20.5mm$ Say 21mm.

Number of bolts.

$n = 0.0275D + 1.5.$

$= 0.0275 \times 200 + 1.6 = 7.1$ Say 8mm.

Thickness of the flanges

$t_f = 1.5t + 3.$

$= 1.5 \times 14 + 3 = 24mm.$

width of the flanges

$B = 2.3d$

$= 2.3 \times 21 = 48.3$ Say 50mm.

Outside diameter of the bolts.

$D_o = D + 2t + 2B.$

$= 200 + 2(14) + 2(50) = 328mm.$

Pitch circle diameter of the bolts.

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

$= 200 + 2(14) + 2(21) + 12 = 282mm$

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 $20\sqrt{d_1}$ to $30\sqrt{d_1}$, where d_1 is the diameter of the 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 $20\sqrt{d_1}$, and $30\sqrt{d_1}$, the design is satisfactory.

3) Given : $D = 50mm$ or $R = 25mm.$

$P = 7 N/mm^2$

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

$\sigma_{tb} = 28 mPa = 28 N/mm^2.$

$$t = R\left[\sqrt{\frac{\sigma_t + P}{\sigma_t - P}} - 1\right] = 25\left[\sqrt{\frac{21+7}{21-7}} - 1\right] = 10.35 \text{ Say } 11mm$$

Assuming the width of the packing as 10mm ∴ Outer diameter of the packing.

$D_1 = D + 2 \times$ width of the packing.

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

∴ Force trying to seperate the flanges.

$$F = \frac{\pi}{4}(D_1)^2 P = \frac{\pi}{4}(70)^2 7 = 26943N.$$

Since the flange is secured by means of bolts,

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

Let d_c = Core diameter of bolts,

load On each bolt (F_b)

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

$$= \frac{\pi}{4}(d_c)^2 28 = 21.99(d_c)^2.$$

$$(d_c)^2 = \frac{13471.5}{21.99} = 612.6.$$

$d_c = 24.7$, or $25mm.$

Nominal diameter of bolts

$$d = \frac{d_c}{0.84} = \frac{25}{0.85}$$

$$= 29.4 = 30mm.$$

Outer diameter of the flange.

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

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

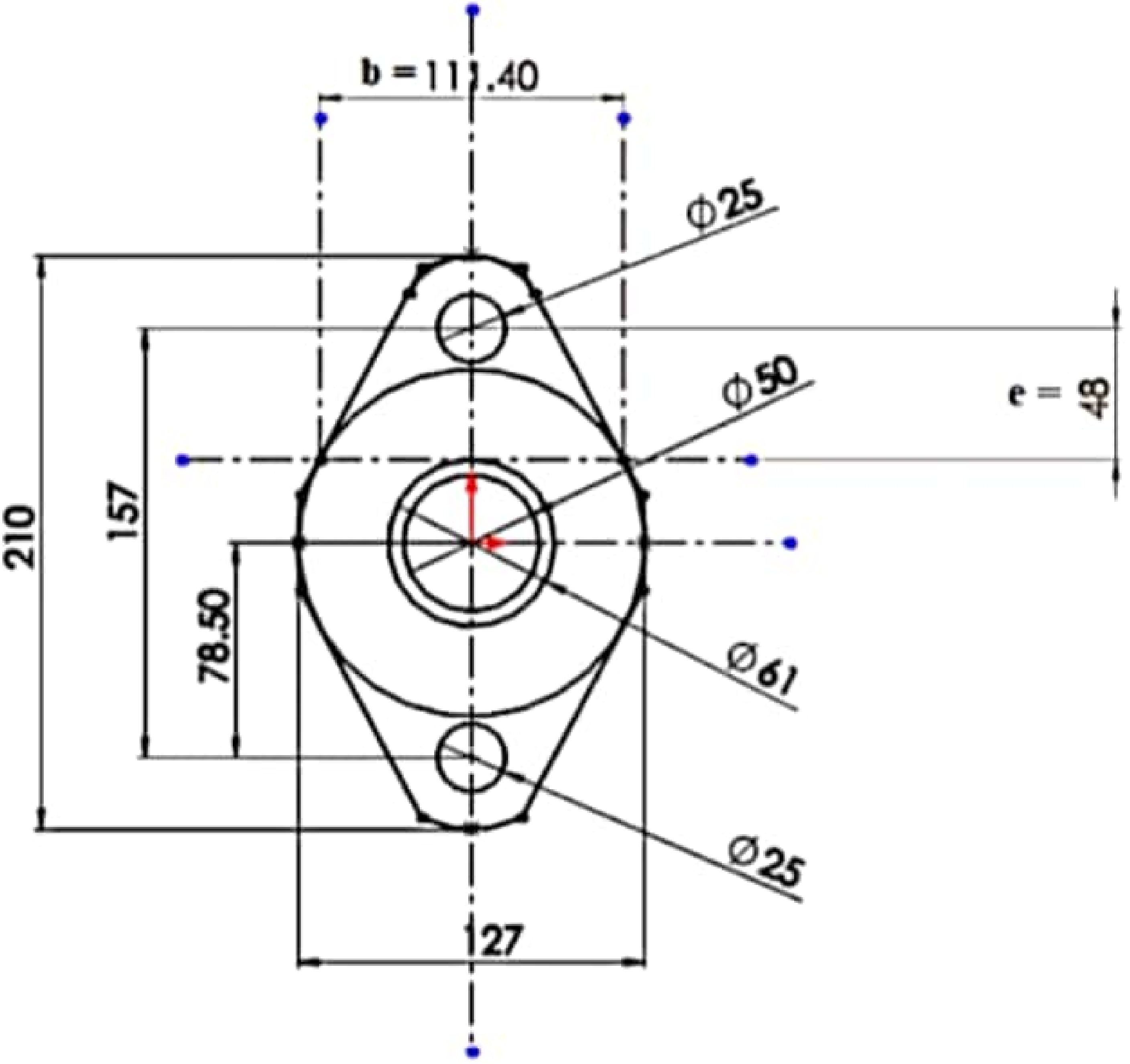
$$= 210mm.$$

Pitch circle diameter of bolts.

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

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

$$= 157mm.$$


b = 11].40
Ø25
Ø50
e = 48
210
157
78.50
Ø61
Ø25
127

From the diagram above:

$b = 111.40\,mm$.

$e = 48\,mm$.

Bending moment at section x-x.

$M_{xx} = F_b \times e = 13471.5 \times 48\,mm$

$= 646632\,N.mm$

and section modulus.

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

$= 18.56 (t_f)^2$.

We know that $M_{xx} = \sigma_b \times Z$.

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

$= 389.76 (t_f)^2$.

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

$t_f = 40.7 \approx 41\,mm$