ADEDIPE EMMANUEL SEGUN
15/ENG06/001
MECHANICAL ENGINEERING
PIPEPLINE ENGINEERING.

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

$P = 1.2 N/mm^2$

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

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

Ins

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

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

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

$= 5.4 mm$ say 6mm.

2.

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:

$d = 0.75t + 10$

$= 0.75 \times 14 + 10 = 20.5mm$ say 21mm

Number of bolts

$n = 0.0275D + 1.6$

$= 0.0275 \times 200 + 1.6 = 7.1$ say 8mm

Thickness of the flanges,

$t_f = 1.5t + 3$

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

Width of the flange

$B = 2.3d$

$= 2.3 \times 21 = 48.3$ 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 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 packing as 10 mm ∴ outer diameter of the packing:

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

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

∴ Force trying to seperate the flanges

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

Since the flange is secured by 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)

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

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

$$(d_c)^2 = \frac{13471.5}{47.2}$$

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

$d_c = 24.7$ or $25mm$

Norminal diameter of bolts,

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

$$= 29.4 \approx 30mm$$

Outer diameter of the flange.

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

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

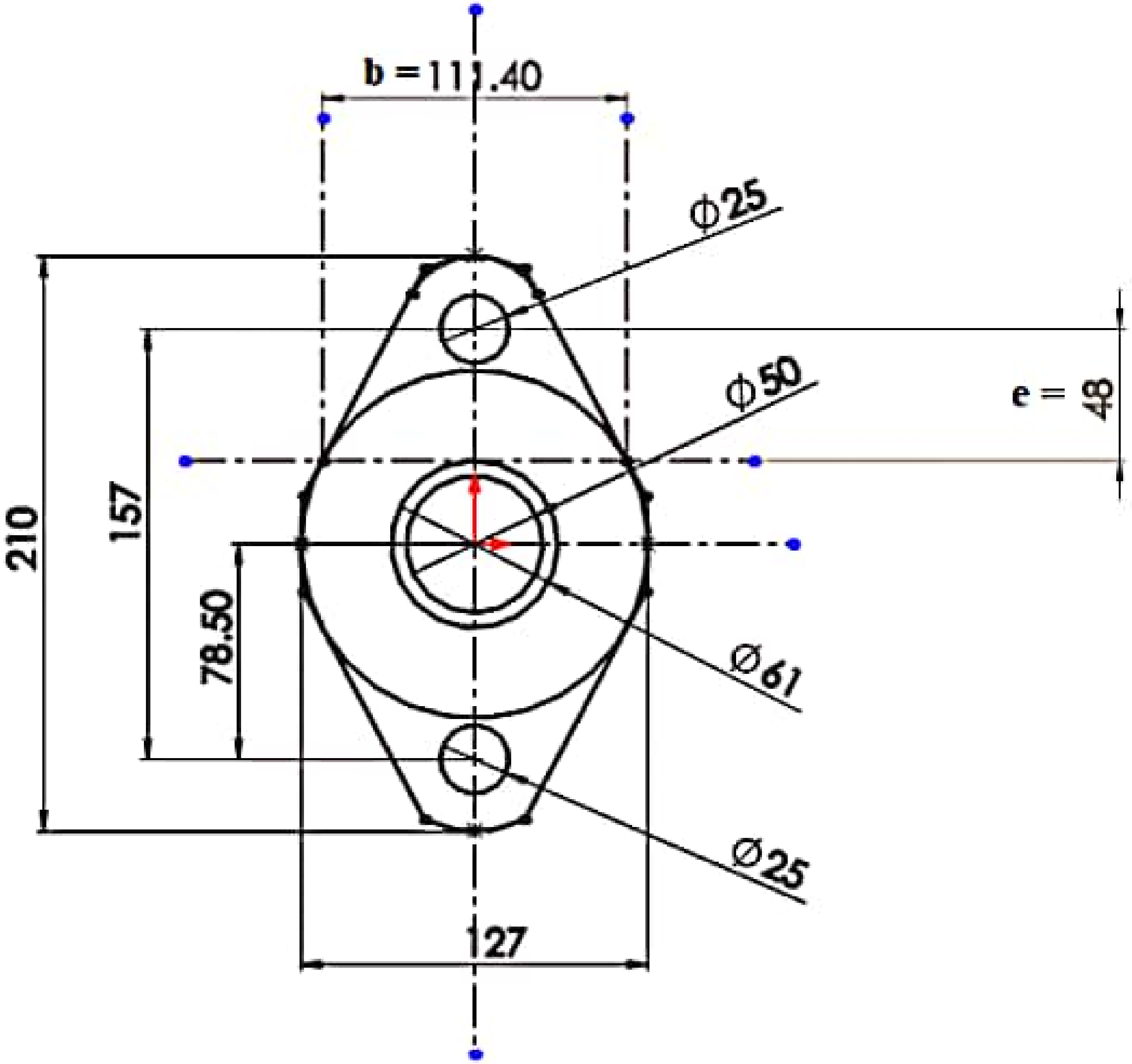
$$= 210mm$$

Pitch circle diameter of bolts.

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

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

$$= 157mm$$


b = 111.40
Φ25
Φ50
e = 48
210
157
78.50
Ø61
Ø25
127

From the diagram,

$b = 111.40$ 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.

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

$$= 18.56 (t_f)^2$$

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

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

$$= 389.76 (t_f)^2$$

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

$$t_f = \sqrt{1659.05}$$

$$t_f = 40.7 \simeq 41 \text{mm}$$