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15/ENG06/035

MECHANICAL ENGINEERING

1 $Q = 200 m^3/h = 33.3 m^3/hr$

$P = 1.2 N/mm^2$

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

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

inside diameter of a pipe

$D = 1.13 \sqrt{\frac{Q}{V}}$ subsituting Q&V into the equation

$= 0.159 m = 160 mm$

Wall thickness of a pipe

from table C = 3 mm

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

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

$\sim 6 mm$

$D = 200 mm$

$P = 0.7 N/mm^2$

From table $\sigma_t = 1.4 N/mm^2$

$C = 9 mm$

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

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

$t = 14 mm$

Normal diameter of bolts!

$d = 0.75t + 10$

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

Number of bolts

$n = 0.0275D + 1.6$

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

Thickness of flanges

$t_f = 1.5b + 3$

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

Width of the flange

$b = 2.3d$

$= 2.3 \times 2 = 48.3 \simeq 50$mm

Outside diameter of bolts

$D_o = D + 2t + 2B$

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

Pitch circle diameter of bolt

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

$= 200 + 2(14) + 2(50) = 32\ 8$ mm

Circumferential pitch of bolts

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

$$= \frac{\pi \times 282}{8} = 110.7\text{mm}$$

$d_1 = d + 3$

$21 + 3 = 24$mm

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

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

Since the circumferential pitch is above $20\sqrt{d_1}$ and $30\sqrt{d_1}$ the design is satisfactory

3 Given $D = 50$ mm therefore $R = 25$mm

$P = 7\text{N/mm}^2$

$\sigma_t = 21\text{NPa} = 21\text{N/mm}^2$

$\sigma_{tb} = 28\text{NPa} = 28\text{N/mm}$

$t =$

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

$= 10.35$ say 11mm

Lets, Assume width of Packaging is 10mm

outer diameter of packaging

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

force trying to seperates the flanges F

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

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 bolt

load on each bolt (F_b)

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

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

$$(d_c)^2 = \frac{1347.5}{2199} = 612.6$$

$d_c = 24.7 \approx 25mm$

Norminal diameter of bolt

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

$= 29.4 = 30mm$

outer diameter of flange

$D_o = D + 2t + 4.bd$

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

$= 210$ mm

pitch circle diameter of bolts

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

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

$= 157 mm$

from the diagram

$b = 111.40 mm$

$e = 48 mm$

bending moment of section X-X

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

$= 646632 \, N\text{-}mm$

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

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

$= 389.76 (t_f)^2$

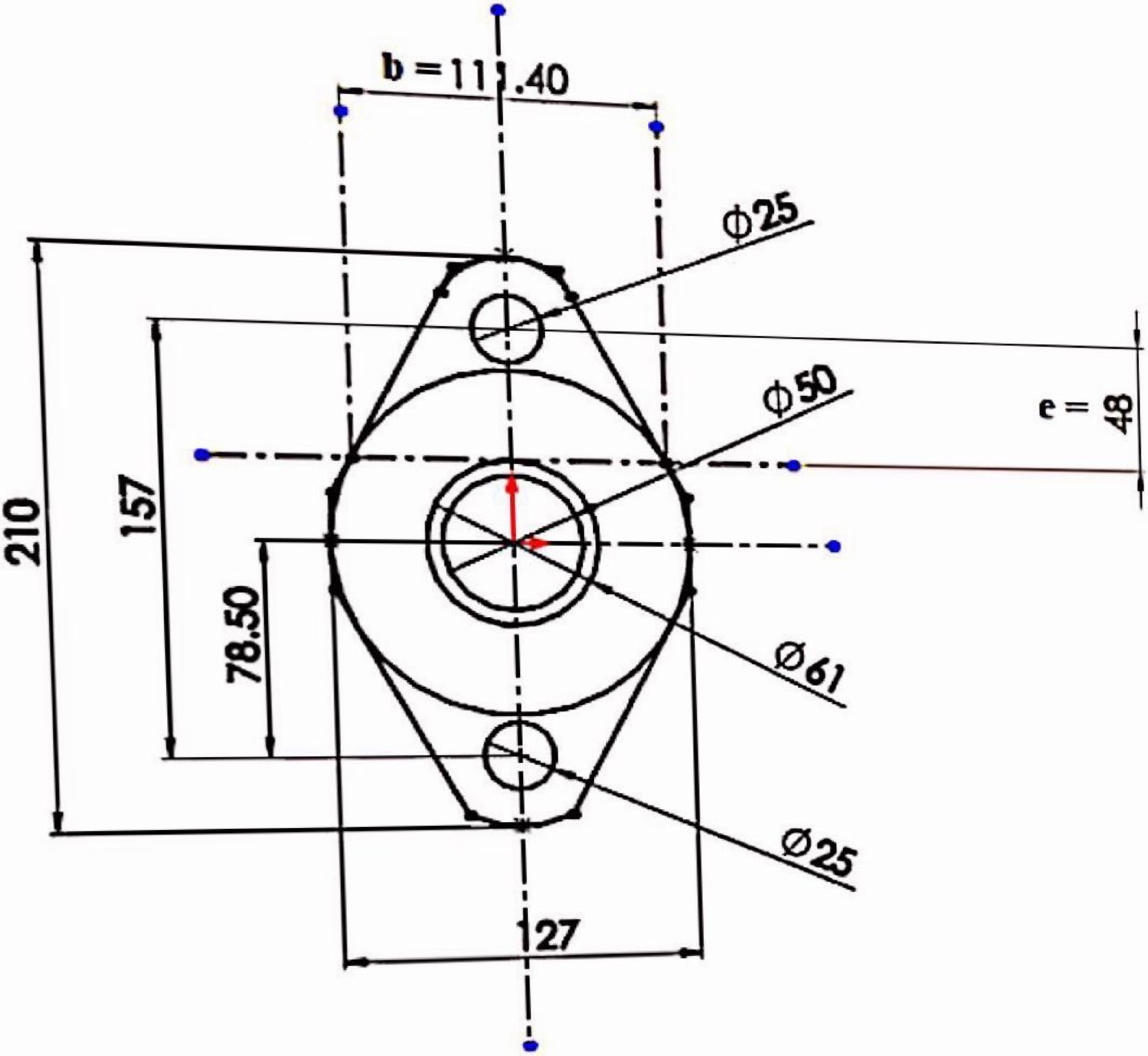
$t_f = \frac{646632}{389.76}$

$t_f = \sqrt{1659.05}$

$t_f = 40.7 = 41 mm$

$t_f = 41 mm$

Scanned with CamScanner


Φ25
Φ50
e = 48
210
157
78.50
Ø61
Ø25
127