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Section - 1

Ans-1 Boundary conditions:
At $r = d/2 = 120/2 = 60$ mm (on the inner face), radial pressure = P MPa (assume)

Similarly at $r = d/2 = 180/2 = 90$ mm (on the outer face), radial pressure = 9 MPa

So,

$$P = \frac{b}{60^2} - a \quad \text{---------- (1)}$$

and

$$9 = \frac{b}{90^2} - a \quad \text{---------- (2)}$$

Eq. (1) - Eq. (2) gives

$$b = \frac{(P-9)}{8100-3600}(8100 \times 3600)$$

$$b = (P-9)(180 \times 36) \quad \text{---------- (A)}$$

Puting value of b in eq (2)

$$a = \frac{(P-9)(180 \times 36)}{3600_{100}} - P$$

$$a = \frac{180P - 1620 - 100P}{100}$$

$$a = \frac{80P - 1620}{100} \quad \text{---------- (B)}$$

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Lames eq for hoops stress

$$\sigma_e = \frac{b}{r^2} + a$$

For maximum value of σ_e (stress) the value of r should be minimum.
So, taking r as inner radius that is $r = 60$ mm

$$30 = \frac{(6480P - 58320)}{r^2} + \frac{80P - 1620}{100}$$

$$30 = \frac{6480P - 58320}{3600} + \frac{80P - 1620}{100}$$

$$30 = \frac{(6480P + 2880P) - 116640}{3600}$$

$$108000 = 9360P - 116640$$

$$9360P = 116640 + 108000$$

$$P = 24 \text{ MPa}$$

For radial stress

$$P_r = \frac{b}{r^2} - a$$

$$b = 6480 \times 24 - 58320$$

$$b = 97200$$

$$a = \frac{80 \times 24 - 1620}{100} = 3$$

$$P_r = \frac{97200}{3600} - 3$$

$$P_r = 24$$

Now for curve b/t hoops stress & radial stress

At $r = 70\,mm$

For

$$\sigma_e = \frac{97200}{(70)^2} + 3$$

$$\sigma_e = 22.837\ MPa$$

$$P_r = \frac{97200}{(70)^2} - 3$$

$$P_r = 16.837\ MPa$$

At $r = 80\,mm$

$$\sigma_e = \frac{97200}{(80)^2} + 3$$

$$\sigma_e = 18.875\ MPa$$

$$P_r = \frac{97200}{(80)^2} - 3$$

$$P_r = 12.875\ MPa$$

At $r = 90\,mm$

$$\sigma_e = \frac{97200}{(90)^2} + 3$$

$$\sigma_e = 15\ MPa$$

$$P_r = \frac{97200}{(90)^2} - 3$$

$$P_r = 9\ MPa$$

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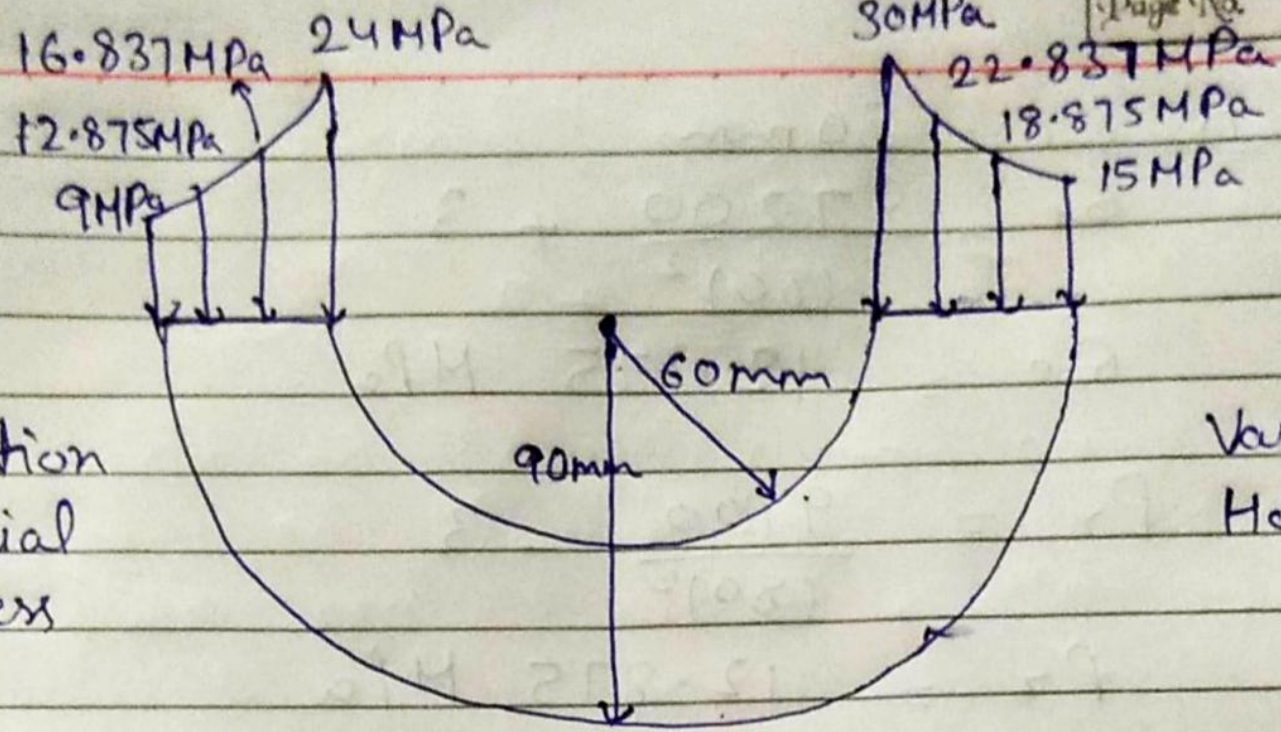

Variation of radial stress

Variation of Hoops stress