Q2

1 Inch = 25.4 mm
12 Inch = 304.8 mm = 0.3048 m.

t = 0.02 m.

Young modulus E = 220 GPa.

Poisons ratio $V = 0.32$

Let outside press x

Internal $15 + x$

Circumferential $\sigma_H = \frac{Pd}{2t}$.

longitudinal $\sigma_L = \frac{Pd}{4t}$.

$P = \frac{F}{A}$.

$\pi r^2 t = \pi \times 0.1524^2 \times 0.02 = 1.4593 \times 10^{-3}\,m^2$.

Outside press

atm = 101325 Pa = 0.101 MPa

Internal pressure = 15 + 0.101
= 15.101 MPa

stress

$$\sigma_H = \frac{15.101 \times 0.3048}{2 \times 0.02}$$

= 115 MPa.

$$\sigma_L = \left(\frac{15.101 \times 0.3048}{4 \times 0.02}\right)$$

= 57 MPa.

strain

Young modulus.

$$E = \frac{\delta}{\varepsilon}.$$

i) Circumferential strain $= \frac{220 GPa = 115 MPa}{\varepsilon}$

$$\varepsilon = \underline{5.227 \times 10^{-4} N/m^2}$$

ii) longitudinal strain $= \frac{220 GPa = 57 MPa}{\varepsilon.}$

$$\varepsilon = 2.59 \times 10^{-4}.$$

Change in diameter

From poisons ration, $r = 0.32$.

$$\text{Poss ratio} = \frac{\text{lateral strain}}{\text{longitudinal}}$$

$$\text{latera strain} = 0.32 \times 2.59 \times 10^{-4},$$

$$= 8.288 \times 10^{-5}$$

~~Diameter~~ = lateral strain $= \frac{d}{D.}$

$$d = 8.2855 \times 10^{-5} \times 0.3048$$

$$= \underline{2.526 \times 10^{-5} m}$$

$P_{in} = 40MPa$

$P_{ex} = 0$

i) ~~Radial stress at inner~~ surface

(ii) $\delta_H = \frac{P_i D_i - P_o D_o}{2t}$ Circumferential stress

$\delta_H =$

Internal diameter = 0.13m. 0.65

$\delta_H = \frac{P_i d}{2t} = \frac{40 \times 10^6 \times 0.13}{2}$

$= 5.2MPa.$

~~Ind~~ outer diameter = 0.20m = 0.10

$P = 0$

no hoop stress at outer surface.

ii) Circumferential stress

Radial stress,

$$\delta_r = A - \frac{B}{r^2}$$

$$A = \frac{P_1 r_1^2 - P_0 r_0^2}{r_0^2 - r_1^2}$$

$$B = \frac{(P_1 - P_0)(r_0^2 r_1^2)}{(r_0^2 - r_1^2)}$$

$$A = \frac{(40 \times 0.65^2) - 0}{0.10^2 - 0.65^2}$$

$= \cancel{16.9}$ $= -40.96$

$= -\cancel{1.254}$

$$B = \frac{(40-0)(0.65^2 \times 0.1^2)}{0.10^2 - 0.65^2} \quad 0.169 \quad = -0.409$$

$$\Rightarrow \delta_r = -40.96 - \frac{0.409}{r^2}$$

Intern = -41.92 MPa
$= 41.92$ MPa Compressive stress

outer = -45.05 MPa
45.05 MPa Compressive stress