Vessel Height = 25m

Vessel ID = 2m

Max Op. Press = 2 MPa

∴ Design Press = 1.05 x 2 MPa = 2.1 MPa = P

Skirt height = 5m

f = 100 MPa

$C_s = \frac{0.04}{T}$

Wind Vel, = 150 km/hr

$$t = \frac{P D_i}{2fJ - P} = \frac{2.1 \times 10^6 \times 2}{2 \times 100 \times 10^6 \times 0.85 - 2.1 \times 10^6}$$

$$= 25.01 \text{ mm}$$

$t_r = t + t_c (2\text{mm})$

$= 27.01 \text{ mm}$

Next Available Thickness = 28 mm

Corroded Shell Thickness = t - C

= 28 - 2 mm

= 26 mm

Axial stress due to pressure:

$$\sigma_{zp} = \frac{p D_i^2}{4t(D_i + t)} \approx \frac{p D_o}{4t}$$

$$= \frac{2.1 \times 10^6 \times 2}{4 \times 26 \times 10^{-3}}$$

$$= 40.38 \text{ MPa}$$

Axial stress due to dead load:

W_s = Weight of shell for x m length

$$= \pi D t \times \gamma_s$$

$$= \pi \times 2 \times 26 \times 10^{-3} \times 7.7 \times 10^{-4} \times X$$

$$= 0.01257 X \text{ MN}$$

$$\sigma_{zs} = \frac{W_s}{\pi t D} = \gamma_s X \text{ N/m}^2$$

$$= 0.077 X \text{ MPa}$$

Weight of liquid supported for distance X m from top:

$$= \frac{\pi}{4} D^2 \rho g X$$

$$= \frac{\pi}{4} \times 2^2 \times 1000 \times 9.81 \times 10^{-6} \text{ MN}$$

$$= 0.0308 X \text{ MN}$$

$$\sigma_{zl} = \frac{W_l}{\pi D t} = \frac{0.0308 X}{\pi \times 2 \times 26 \times 10^{-3}} \text{ MN}$$

$$= 0.1886 X \text{ MPa}$$

$$\sigma_{zw} = \sigma_{zs} + \sigma_{zl}$$

$$= (0.077 + 0.1886) X \text{ MPa}$$

$$= 0.2656 X \text{ MPa}$$

Time Period

$$T = 6.35 \times 10^{-5} \left(\frac{H}{D}\right)^{3/2} \left(\frac{W}{t}\right)^{1/2}$$

$$= 6.35 \times 10^{-5} \left(\frac{25+5}{2}\right)^{3/2} \left(\frac{0.0434}{26 \times 10^{-3}}\right)^{1/2}$$

$$= 0.75\ s$$

$$P_w = k_1 k_2 (0.05 V_w^2) D_0$$

$$= 0.7 \times 2 \times 0.05 \times (130)^2 \times 2.056$$

$$= 3238.2\ N$$

$$M_w = P_w \frac{X}{2} J$$

$$= 1614.1\ x^2\ J$$

$$\sigma_{zwm} = \frac{4 M_w}{\pi D^2 t} = \frac{4 \times 1614.1\ x^2\ J}{\pi \times (2.056)^2 \times 26 \times 10^{-3}}$$

$$= 0.0198x^2 \text{ MPa}$$

$$M_s = \frac{C_s W x (3H - x)}{3H^2}$$

$$= \frac{0.04 \times W \times H \times 2H}{T \times 3H^2} \quad \{x = H\}$$

$$= 0.041 \times \text{MN}$$

$$\sigma_{zsm} = \frac{4 M_s}{\pi t (D_i + t) D_i}$$

$$= \frac{4 \times 1.035 \times 10^6}{\pi \times 26 \times 10^{-3} \times 2.036 \times 2}$$

$$= 0.47x \text{ MPa}$$

$$\sigma_z \text{ (tensile)} = \sigma_{zp} - \sigma_{zw} + \sigma_{zwm} + \sigma_{zsm} = fJ$$

$$= 40.38 - 0.2856x + 0.0198x^2 + 0.47x$$

$$\Rightarrow 0.0198x^2 + 0.2044x + 40.38 = 100 \times 0.85 = 85$$

$$\Rightarrow \quad 0.0198x^2 + 0.2074x - 94.62 = 0$$

$$\Rightarrow \quad x = 43$$

$$\sigma_z \text{ (Compression)} = \sigma_{zw} - \sigma_{zp} + \sigma_{zwm} + \sigma_{zsm}$$

$$= 0.125 \frac{E_t}{D_o}$$

$$\Rightarrow \quad 0.26x - 10.38 + 0.0198x^2 + 0.47x$$

$$= 0.125 \times 2 \times 10^5 \times \frac{0.026}{2.056}$$

$$= 316.76 \text{ MPa}$$

$$0.0198x^2 + 0.73x - 357.14 = 0$$

$$x = 117.13 \text{ m}$$

$\because x > H$, The design is OK.