RECTANGULAR PRESSURE VESSELS ACCORDING TO ASME VIII DIV 1, APPENDIX 13

DESIGN VARIABLES :

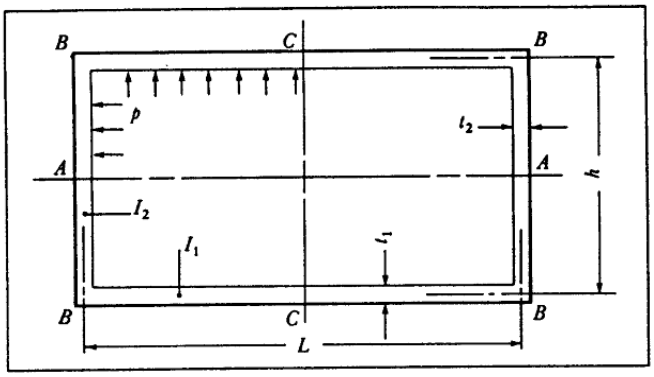
Pressure $P := 120000\ \text{Pa} = 1.2\ \text{bar}$

Long Side $L := 800\ \text{mm}$

Short Side $h := 200\ \text{mm}$

Thickness $e := 10\ \text{mm}$

Welding Factor $z := 0.8$



DESIGN CALCULATIONS :

Moment of Inertia

$$I_1 := \frac{e^3}{12} = 83.3333\ \text{mm}^3 \qquad I_2 := I_1$$

Bending moment at corner

$$M_Q := \frac{P}{12} \cdot \left(\frac{\frac{L^3}{I_2} + \frac{h^3}{I_1}}{\frac{L}{I_2} + \frac{h}{I_1}} \right) = 5200\ \text{N}$$

Bending moment at long-side midpoint M

$$M_M := M_Q - \frac{P \cdot L^2}{8} = -4400\ \text{N}$$

Bending moment at short-side midpoint N

$$M_N := M_Q - \frac{P \cdot h^2}{8} = 4600\ \text{N}$$

Bending stress at corner of long-side

$$\sigma_{bQM} := \frac{M_Q \cdot e}{2 \cdot I_1 \cdot z} = 390\ \text{MPa}$$

Bending stress at corner of short-side

$$\sigma_{bQN} := \frac{M_Q \cdot e}{2 \cdot I_1 \cdot z} = 390\ \text{MPa}$$

Bending stress at midpoint of long-side

$$\sigma_{bM} := \frac{M_M \cdot e}{2 \cdot I_1 \cdot z} = -330\ \text{MPa}$$

Bending stress at midpoint of short-side

$$\sigma_{bN} := \frac{M_N \cdot e}{2 \cdot I_1 \cdot z} = 345\ \text{MPa}$$

Membrane stress on long-side

$$\sigma_{mM} := \frac{P \cdot h}{2 \cdot e} = 1.2\ \text{MPa}$$

Membrane stress on short-side

$$\sigma_{mN} := \frac{P \cdot L}{2 \cdot e} = 4.8\ \text{MPa}$$

Total stress at corner of long-side

$$\sigma_{tQM} := \left| \sigma_{mM} + \sigma_{bQM} \right| = 391.2\ \text{MPa}$$

Total stress at corner of short-side

$$\sigma_{tQN} := \left| \sigma_{mN} + \sigma_{bQN} \right| = 394.8\ \text{MPa}$$

Total stress at midpoint of long-side

$$\sigma_{tM} := \left| \sigma_{mM} + \sigma_{bM} \right| = 328.8\ \text{MPa}$$

Total stress at midpoint of short-side

$$\sigma_{tN} := \left| \sigma_{mN} + \sigma_{bN} \right| = 349.8\ \text{MPa}$$