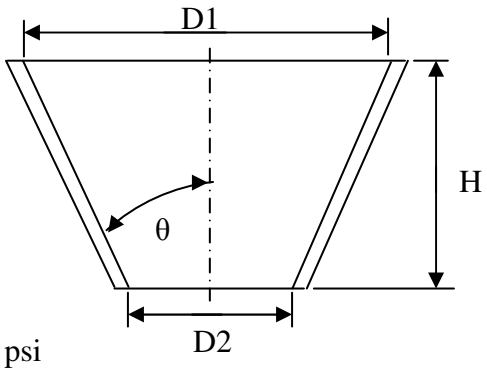
4.0 TANK DESIGN

4.1 Lower Cone Thickness

Lower Cone Design: Ref [4]

Assumptions: 1) The axial force due to the weight of the contents bearing on the laminate below the point of interest acts in a vertical direction (worst case) for the top and bottom points of the cone. The mid point sees an axial force parallel to the angle of the cone.

Knowns: Stitchmat Laminate
Upper Diameter, D_1 = 132 in
Middle Diameter, D_M = 69 in
Lower Diameter, D_2 = 6 in
Cone Height, H = 88.25 in
Fluid Head above Cone, H_h = 258 in
Cone Angle, θ = 35.5 deg
Density of Water, γ = 62.4 lbs/ft^3
Additional Pressure, P_{ADD} = 0
Maximum Stress (Hoop/Axial), σ_{max} = 2250 psi



Let the initial estimated thickness, t_{est}, be 0.605 in. for the top half of cone and 0.370 in. for the bottom half of cone.

Determine hydrostatic pressures at top, middle and bottom of cone,

- Hydrostatic Pressure at Top, $P_{top} = \frac{\gamma}{12^3} H_h SG + P_{ADD} = 16.77\,psi$
- Hydrostatic Pressure at Middle, $P_{mid} = \frac{\gamma}{12^3}\left(H_h + \frac{H}{2}\right) SG + P_{ADD} = 19.64\,psi$
- Hydrostatic Pressure at Bottom, $P_{bot} = \frac{\gamma}{12^3}(H_h + H) SG + P_{ADD} = 22.51\,psi$

Determine the hoop and axial stresses due to the hydrostatic pressure [4],

- at Top,

$$\sigma_{top,axial} = \frac{P_{top} R_1}{2 t_{est,top} \cos\theta} = 1124\,psi \qquad \sigma_{top,hoop} = \frac{P_{top} R_1}{t_{est,top} \cos\theta} = 2248\,psi$$

- at Middle,

$$\sigma_{mid,axial} = \frac{P_{mid} R_M}{2 t_{est,bot} \cos\theta} = 1125\,psi \qquad \sigma_{mid,hoop} = \frac{P_{mid} R_M}{t_{est,bot} \cos\theta} = 2250\,psi$$