

Due Date: April 30, 2013

COMPUTER PROJECT # 3

ME/AE 408 Advanced Finite Element Analysis

Consider a pressure vessel as shown in the figure. The cylinder has a longitudinal axis of rotational symmetry and is also symmetric with respect to a plane passing through it at mid-height. Due to symmetry, use a quarter of the solid model as shown in the figure for the analysis. Use 8-node 3D element in ABAQUS.

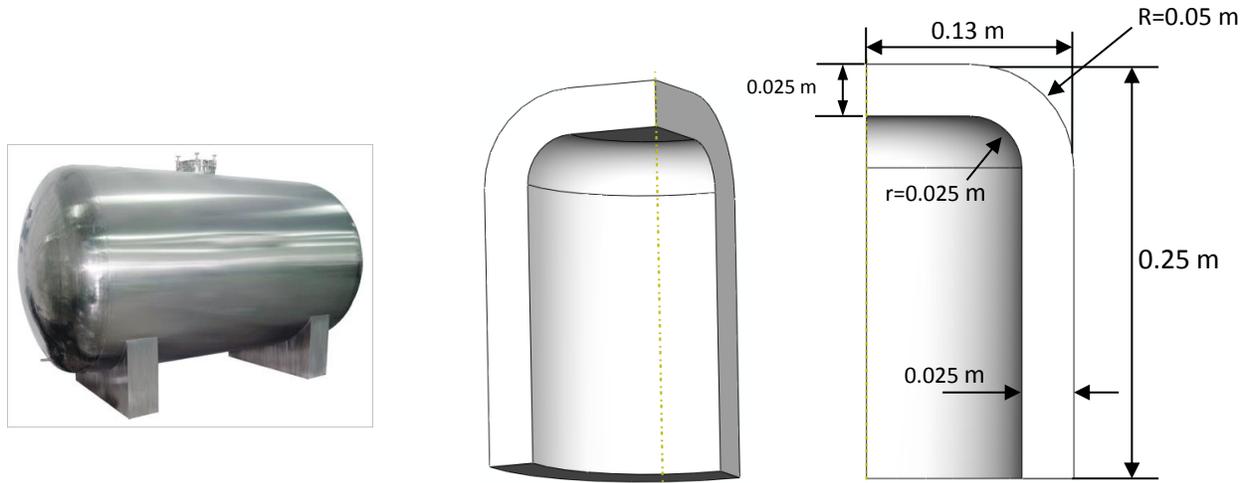


Figure 1. Pressure vessel

Take $E = 207 \text{ GPa}$, $\nu = 0.3$, $\rho = 7.8 \times 10^3 \text{ kg/m}^3$; Coefficient of thermal expansion $= 1.2 \times 10^{-5} \text{ K}^{-1}$; Thermal conductivity $= 60 \text{ W/m/K}$.

1. The cylinder is subjected to an internal pressure of 34 MPa. Use fine mesh at the fillet and perform the convergence study. Plot the stress and strain distribution, and find the maximum von-Mises stress and its location.
2. The inner surface of the cylinder is kept at 373.15 K, and the heat is lost on the exterior by convection to the ambient. The convection coefficient is $179 \text{ W/m}^2/\text{K}$ and the sink temperature is 293.15 K. Plot the temperature distribution, von-Mises stress and strain distributions.
3. Consider both mechanical and thermal loadings (cases 1 and 2). Plot the von-Mises stress and strain distributions, and find out the maximum von-Mises stress and location.

Hint:

(1) How to create the 90 degree section of the cylinder geometry?

Module->3D->Deformable->Solid->Revolution

(2) Use "Coupled temp-displacement (Steady- state)" in Step module.

(3) How to add convection boundary condition?

Module->Interaction->Create Interaction->Surface film condition->click the outside surface of the tank->done->input values

(4) How to mesh the cylinder?

Module->Mesh->Tools->Partition-> partition the cylinder

Set seeds to the edges->assign element type->mesh

(5) Use C3D8RT element

(6) For Abaqus Student Edition (node limit:1000), try to use as many elements as possible

The report should include the following:

1. Cover page (Title, name, etc.)
2. Statement of the problem
3. Procedure/Related equations
4. Summary of results with units and discussion of results
5. Sample output

The report should not exceed 20 pages.