ME 478 Final Project

Spring 2024
Assigned: May 8, Due: June 5
Team members: 2
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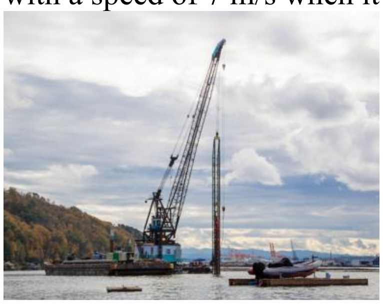
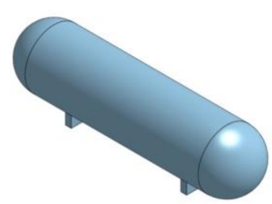
1. Investigate the stresses in an aluminum bike frame of your choice subjected to a load corresponding to a 60 kg rider (you can also download a bike frame file from a site like grabcad.com). Consider vertical loading at the top of the saddle tube. For simplicity, exclude the fork and the wheels in your analysis. What safety factor would you use? Do you trust this model? Explain. It may be good to consider stress levels, buckling, vibration resonances but you can exclude fatigue consideration.

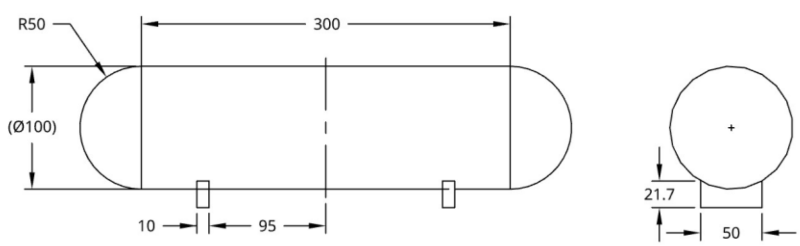
2. Using explicit dynamics in ANSYS, investigate the wave propagation in a 75-cm diameter, 18 m long steel pile with a wall thickness of 2 cm after it has been struck with pile driving hammer. Determine the axial stress as a function of time at 1 m and 17 m from the top of the pile. The weight of the hammer is 6,000 kg and is traveling downward with a speed of 7 m/s when it hits the pile.



3. Determine the maximum safe water depth for the shown underwater vessel with a safety of 1.8 (to avoid buckling). Also determine how thick the wall thickness would need to be to withstand a depth of 4,000m with a safety factor of 1.25.

Material: Al 7075-T6511
Wall Thickness: 2 cm
Dimensions are in cm





4. Do problem 15.26 in the Logan Textbook. Follow it by estimating the force required to pull out the tube after it has expanded due to the specified increase in temperature. Assume a friction coefficient of 0.4.

5. Applying a twist on a thin beverage can introduce a tensile stress in a principal direction and compressive stress in another principal direction. Excess comprehensive stress may cause the skin to buckle. Assume that the can is made of AA3004, which has a Young's modulus of 69 MPa and a Poisson's ration of 0.34.
a) Predict the torque that causes the skin to buckle using a linear buckling analysis. Determine the buckling modes.
b) Compare the buckling torque that you got in part a) with the buckling torque you would get by performing a nonlinear buckling analysis.