

AST Design Project Worksheet 5

Objectives

- To demonstrate understanding of Archimedes' principle and Pascal's law.
- To understand the use of storage tanks and the associated problems.
- To use new material in conjunction with material previously learned in the classroom to answer questions regarding the stability of a storage tank.
- To use critical thinking to design a solution to an engineering problem.
- To effectively communicate and present unique ideas to an audience.

Definitions

volume

mass

density

buoyancy

pressure

weight

above-ground storage tank (AST)

Relationship Questions

What is the relationship between the volume, mass, and density?

What is the relationship between mass and weight?

Name: _____ Date: _____ Class: _____

Questions

1. How many hurricanes occurred during the year that you were born? _____
List all hurricanes with name, date and brief description including category, effects, landfall location and other interesting features.
2. What U.S. group is responsible for tracking and predicting weather systems in the tropics?
3. What types of failure do ASTs experience? What specifically causes these failures?
4. How does Archimedes' principle apply to ASTs?
5. How does Pascal's law apply to ASTs?

Design Project

1. Derive an equation for the weight of the AST.
Hint: Units should be (lb) which is lb_m . If you get units of $(ft \cdot lb/s^2)$, you found weight in lb_f .

2. Derive an equation for the weight of the liquid inside the AST.
Hint: Units should be (lb), which is lb_m . If you get units of $(ft \cdot lb/s^2)$, you found weight in lb_f .

3. Derive an equation for the weight of the water displaced (Hint: units should be (lb) which is lb_m , if you get units of $(ft \cdot lb/s^2)$ you found weight in lb_f)

4. Use the equations you derived in questions 1, 2, and 3 to derive an expression to determine whether or not the AST will displace or remain stationary in the case of a flood.

Name: _____ Date: _____ Class: _____

- c. Create a graph in Excel that illustrates the weight of the water displaced vs. surge level (S) for $0 < S < h$.
Make sure to include: 1) a data marker that indicates the point at which your AST displaces, 2) the weight of the AST + weight of liquid inside AST as a constant value somewhere on your graph, 3) axis titles, 4) axis labels, 5) a clear title and 6) a legend.
8. As a group, come up with at least one idea to prevent displacement OR buckling. Create a schematic diagram or build a miniature prototype to present to the class. (One idea for either displacement or buckling is the minimum. If you would like to come up with an idea for displacement and buckling, or more than one idea, feel free to do so.)
9. Prepare a 5- to 8-minute presentation (using PowerPoint or equivalent software) that includes:
- The dimensions of your group's AST
 - The storm conditions assigned to your group
 - Whether your group's AST displaces or not
 - The graph of weight of the water displaced vs. surge level (S) for $0 < S < h$
 - Whether your group's AST will buckle given the storm conditions
 - Your design proposal for a solution to these problems (If you build a miniature prototype, you do not need to add this to your PowerPoint, just show the model prototype.)