

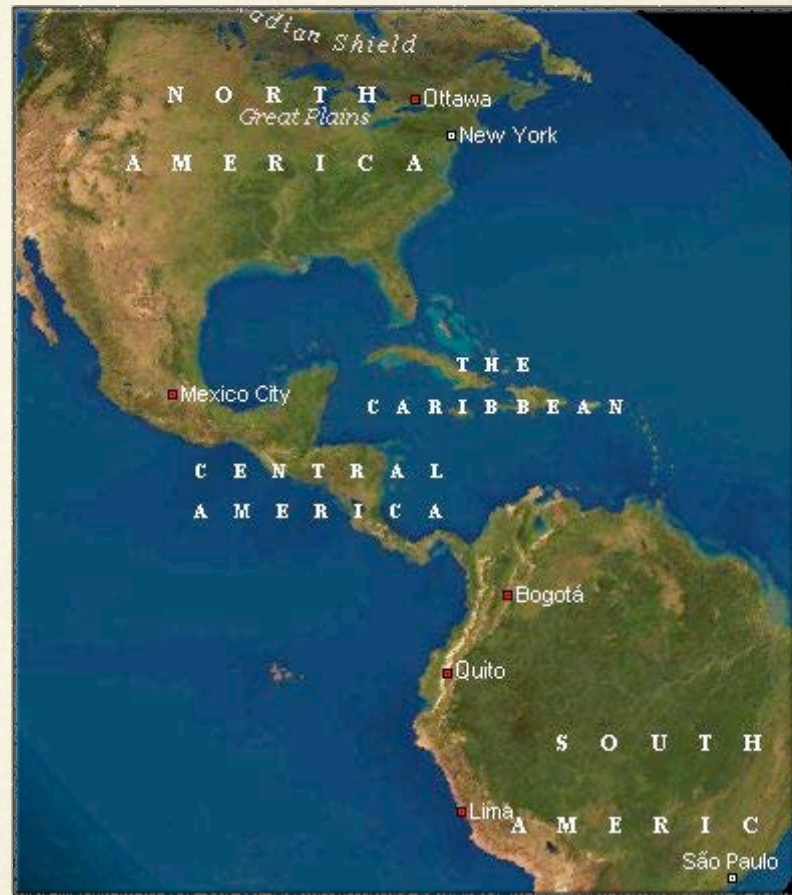
Panama Canal



*One of the Greatest Engineering Feats of the
20th Century*

Panama Problem

- ❖ So, what's the Panama Problem?
- ❖ Treacherous trip around Cape Horn, the southernmost tip of South America
- ❖ Countless number of sailors died during passage.
- ❖ 14,000 mile route trimmed to 6,000 miles.



ENGINEERS SOLVE PROBLEMS!

History - The French Attempt

- ❖ February 1, 1881 - France begins work on Panama Canal
- ❖ French Plan: dig a river between the Pacific Ocean and Caribbean Sea
- ❖ Plan prone to accidents and setbacks: mud slides, river flooding, disease from lengthy periods of time in thick jungle
- ❖ Over 14,000 people died during French period.
- ❖ Total cost = \$287 Million (1893) or \$6.8 Billion (2007)

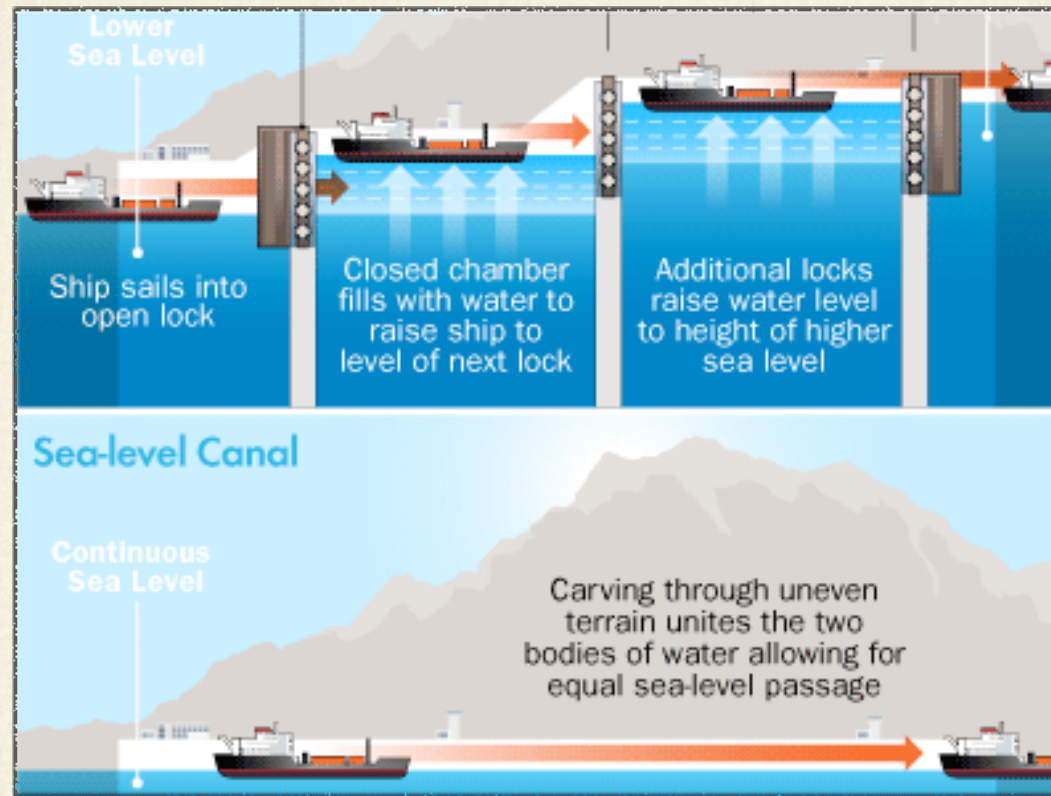


French bankrupted before completion.

History - The United States

- ❖ The United States decides, with the strenuous urging of Theodore Roosevelt, to make an attempt.
- ❖ The U.S. initially has a very difficult time because of the same conditions that plagued the French.
- ❖ The breakthrough came with the idea to create a large lake in the middle of the land mass, then raise ships up to the lake.
- ❖ The lake covers 20 miles of the 30 mile canal passage.





French Plan vs. U.S. Plan

How do you raise a ship?

- ❖ LOCKS: a device used to raise and lower ships between different levels of bodies of water. The chambers allow the water level to increase or decrease - raising or lowering the ship.

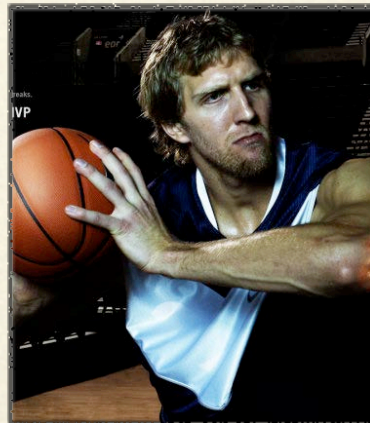


Panama Canal Locks

- ❖ Gate flaps: 65 feet wide & 7 feet thick
- ❖ The flaps have to withstand significant amounts of water pressure
- ❖ Gate height: ranges from 47 feet to 82 feet
- ❖ Large motors built into the brick walls open and close gates.
- ❖ Each chamber is 1,000 feet long, 110 feet wide, and 41 feet deep



Eiffel Tower = 986 Feet Tall



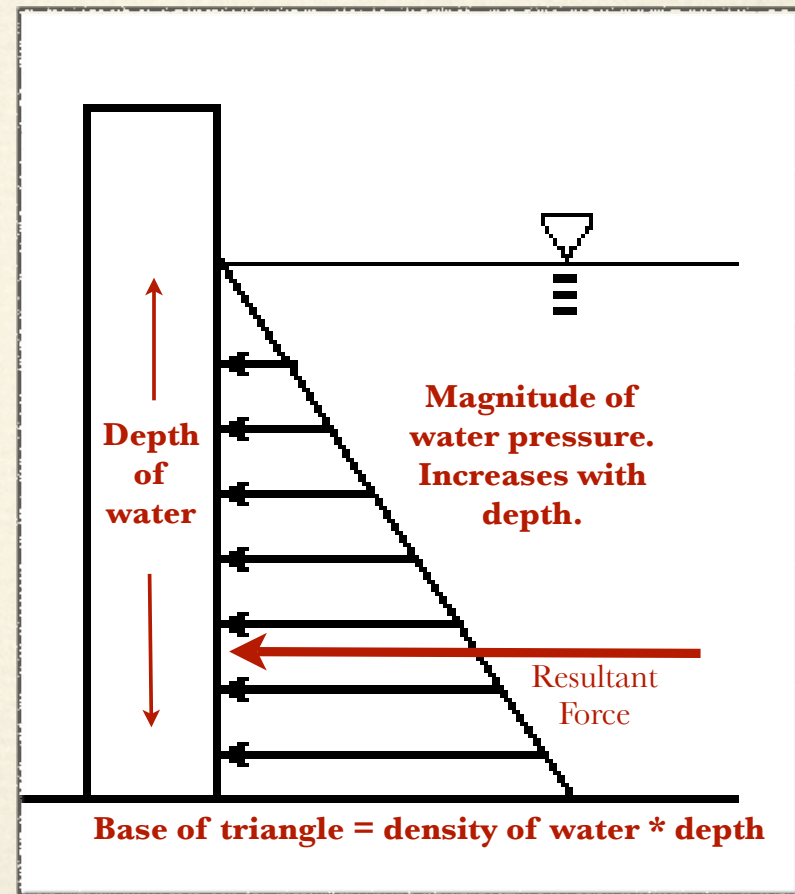
Nowitzki = 7 Feet Tall



Wicked Tower = 110 Feet Tall

Calculating Pressure on Gate

- ❖ Density of water = 62.4 lb/ft^3
- ❖ Magnitude of pressure at bottom of gate = $62.4 \text{ lb/ft}^3 * 41 \text{ feet} = 2,558 \text{ lb/ft}^2$
- ❖ Triangle load force (**resultant force**) is calculated like the area of a triangle:
 $(1/2) * (41 \text{ feet}) * (2,558 \text{ lb/ft}^2) = 52,439 \text{ lb/ft}$
- ❖ Total force on gate = $52,439 \text{ lb/ft} * 110 \text{ feet} = 5,768,290 \text{ lb}$ or 2884 tons
- ❖ The average car is about 2 tons.



Second case study: Columbia River Locks

- ❖ Columbia River originates in British Columbia, Canada
- ❖ River winds down through Washington State
- ❖ Snake River connects to Columbia River near borders of Washington, Oregon, and Idaho.
- ❖ After Snake River enters Columbia River, the river is large and calm. It is navigable by large ships.



Many dams sit on the Columbia River because the river is large and powerful. The dams produce electricity.



Portland: Large port city. Wheat is loaded onto even larger shipping barges and carried to various locations throughout west and parts of Asia.

Tri-cities area: one of the largest wheat producing areas in North America.

Columbia River Locks

