Landscape Arch Example:
Modeling and Analysis of a Natural Arch

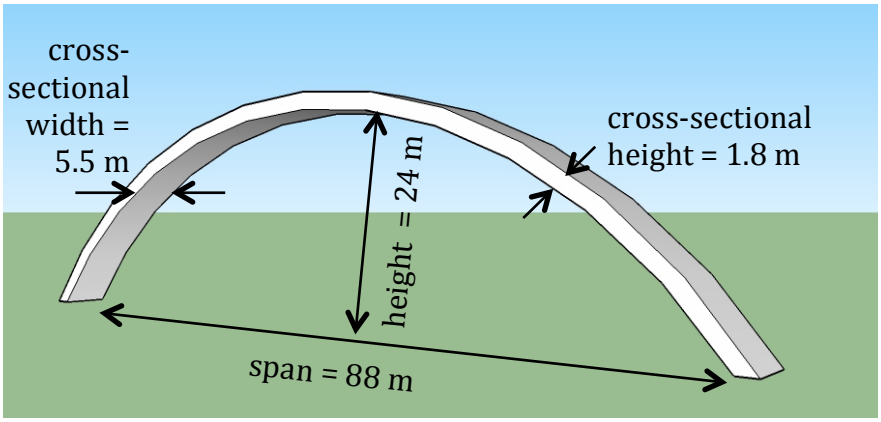
THAYER SCHOOL OF ENGINEERING AT DARTMOUTH

The Landscape Arch is one of the longest natural stone arch bridges in the world. It is located in Arches National Park in Utah.

Source: https://flic.kr/p/qzoTTr (James St. John)

The Natural Bridge and Arch Society (NABS) reports the following measurements for the Landscape Arch:

- span = 88m,
- height = 24m,
- cross-sectional width = 5.5m and
- cross-sectional height =1.8m.



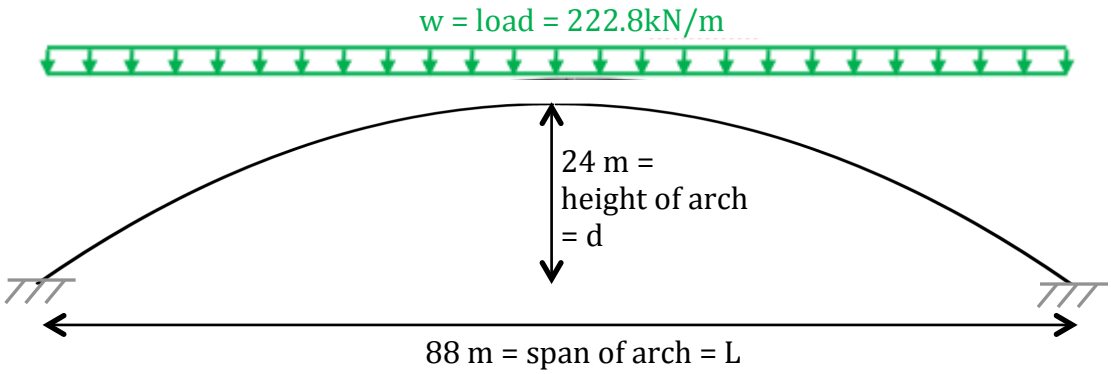
Using these measurements we can calculate the compressive force and stress in the Landscape Arch.

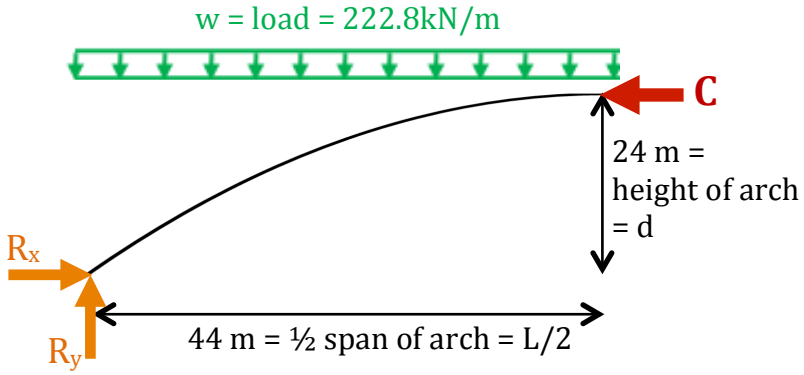
First I will look up a few values for sandstone since the Landscape Arch is composed of sandstone (http://www.engineeringtoolbox.com/):

- Allowable stress (the stress at which sandstone will crush) = 1034 kPa = 1034 kN/m^2
- Density = 22.5 kN/m^3

To calculate the weight of the arch, I'm going to assume that the cross-section is constant, which it is not, but this analysis is approximate. Using a density of 22.5kN/m^3 I can calculate the weight of the Landscape Arch as: 22.5 kN/m^3 * 5.5 m * 1.8 m = 222.8 kN/m.

Using the equation we learned for arches, we can calculate the compressive force, **C**, in the Landscape Arch.





$$C = \frac{wL^2}{8d} = \frac{\frac{222.8kN}{m} * (88m)^2}{8 * 24m} = 8986\ kN$$

The compressive stress in the arch may then be calculated by dividing the compressive force, 8986 kN, by the cross-sectional area of the arch = 5.5m*1.8m = 9.9m^2. Thus, the compressive stress in the Landscape Arch is 8986kN/9.9m^2 = **908kN/m^2**. This is actually fairly close to the allowable compressive stress for sandstone, even without a factor of safety. So my recommendation is: don't try to walk across the Landscape Arch!