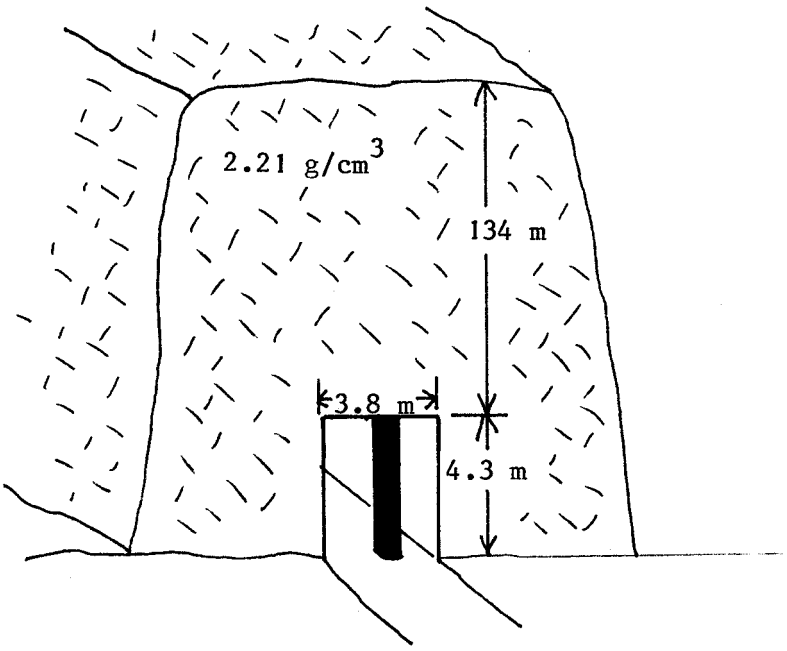
Homework Assignment: Due Thursday February 20, 2019

(Problems taken from *Computational Engineering Geology*, by E. Derringh, 1998)

1. Minnesota quartzite has an unconfined compressive strength of 629 MPa, but the unconfined compressive strength of Utah quartzite is only 148 MPa. The diameter of the thinnest cylinder of Minnesota quartzite that supports a certain weight is 3.85 cm. Find the diameter of the thinnest cylinder of Utah quartzite that supports the same weight.

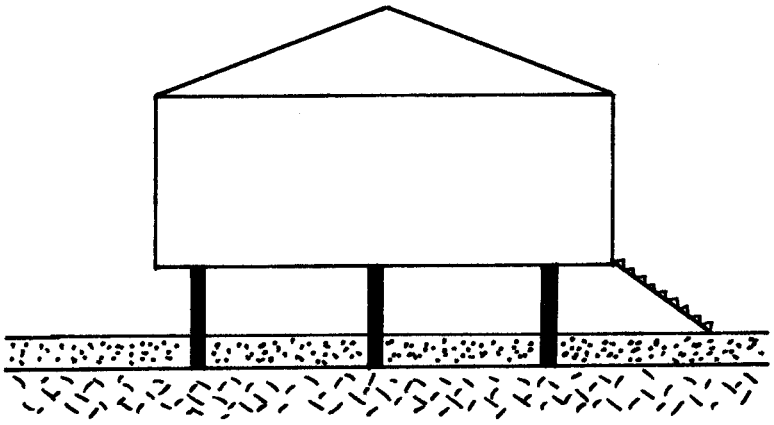
2. A tunnel 240 m long is built through a small mountain composed of rocks with density 2.21 g/cm^3. The tunnel is 3.80 m wide and 4.30 m high with a flat roof 134 m beneath the top of the mountain (see figure below). The roof is supported by a single row of posts, each with a diameter of 26.4 cm and made of material with an unconfined compressive strength of 412 MPa. Find the adjacent post spacing, center to center, in the tunnel to give a factor of safety against collapse of 1.25. There is a post at each end.



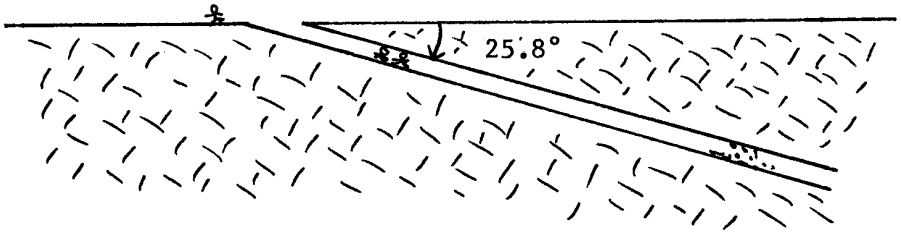
3. A house of weight W is built on a barrier island, where frequent ocean surges are expected (see figure below). The house is raised on n piles, which penetrate the sand and transfer the load of the house to underlying bedrock. Assume that each pile has the same cross-sectional area A, and that each pile supports the same load. Show that, for a factor of safety SF against collapse of the piles, the number of piles needed is given by

$$n = \frac{(SF)W}{\sigma_u A}$$

where σ_u is the compressive strength of the pile material.



4. Explorers seeking a hidden underground tomb walk slowly along a secret tunnel that slopes downward at 25.8°, as shown in the figure below. The surrounding rock has a unit weight of 24.6 kN/m^3 and unconfined compressive strength 33.7 MPa. The explorers have been warned not to go past the point where the vertical stress equals 25 % of the unconfined compressive strength of the rocks. How far along the tunnel can the explorers walk before reaching this point?



5. Determine the principal stresses and their orientation for the following σ_{ij} matrices

$$\begin{bmatrix} 1 & 2 & 3 \\ 2 & 5 & 6 \\ 3 & 6 & 9 \end{bmatrix} \text{ MPa} \quad \text{and} \quad \begin{bmatrix} 2 & 1 & 1 \\ 1 & 2 & 1 \\ 1 & 1 & 2 \end{bmatrix} \text{ MPa}$$

6. A strain matrix ε_{ij} has the following components

$$\begin{bmatrix} 1 & 1 & 3 \\ 1 & 2 & 2 \\ 3 & 2 & 3 \end{bmatrix} \times 10^{-6} \text{ strain}$$

Determine the principal strains and their orientation.