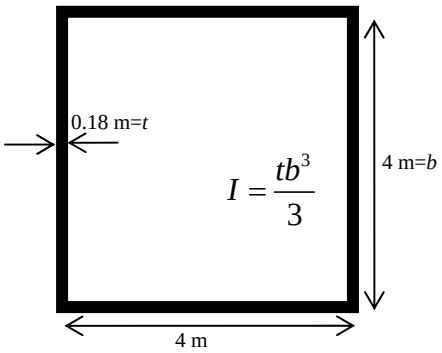
ENGN1300: Structural Analysis

Homework 8
Due Wednesday April 16, 2010

Division of Engineering
Brown University|

1. To compare the performance of a three- and a two-hinged bridge, suppose the Salginotabel Bridge (d=90m, h=13m) had been built without the central hinge. The material is concrete (E=30GPa) and the cross section is shown below. Use the Excel Arch solver to find the deflections and moments due to the 7500kN dead load (assume it to be uniformly distributed across the span). Which has the higher maximum moment?



2. Next we calculate the deflections and moment distribution for this same bridge (if it were a two-hinged circular arch) under the action of the dead load plus partial live loads. As in the previous problem set, we represent the distributed live load by 3 equal concentrated loads, each separated by a distance equal to the quarter span. The magnitude P of these loads is equal to the load over a quarter span, multiplied by a reduction factor of 0.9, due to the more severe effects of a concentrated load. Thus,

$$P=0.9\times(12\text{kN/m})\times(90\text{m}/4)=244\text{ kN}$$

   a. Use the excel solver to calculate and plot the internal moments due to the live load when the bridge is partially loaded with a single load P at quarter span

   b. Use the excel solver to calculate and plot the internal moments due to the live load when the bridge is partially loaded with a single load P at midspan.

   c. Use the excel solver to calculate and plot the internal moments due to the live load when the bridge is partially loaded with a loads P at midspan and at center span.

d. Which of these thee situations gives the highest moment? Largest maximum deflection?

3. One more design to consider for this same bridge (d=90m, h=13m): a parabolic thee-hinged arch. Calculate the internal moment for:
    a. The 7500kN dead load (assume it to be uniformly distributed across the span).
    b. The 7500kN dead load (assume it to be uniformly distributed across the span) plus a point load P=244 kN at midspan.
    c. Compare these results with the results of problem 2 and 1c from the previous homework. Which design gives rise to a smaller maximum moment?