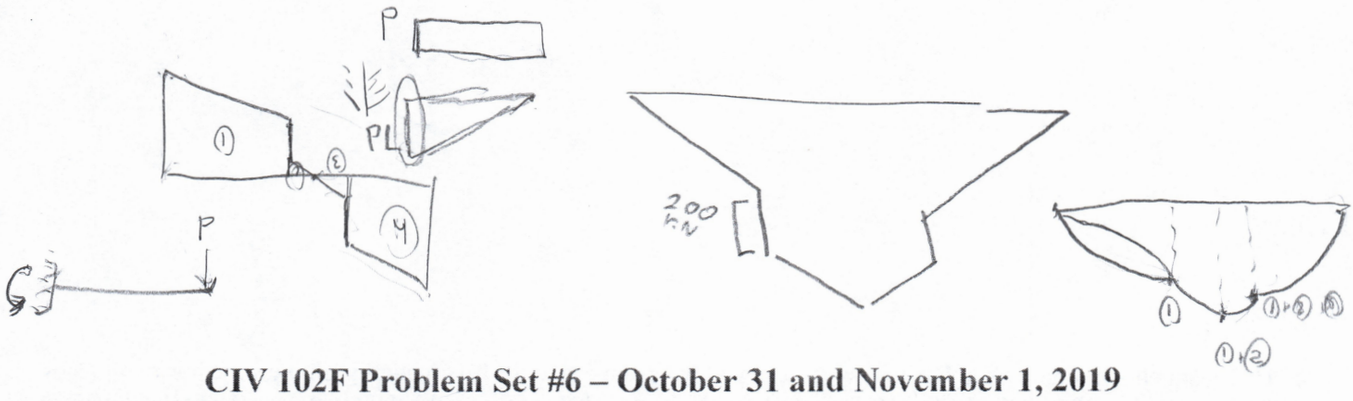
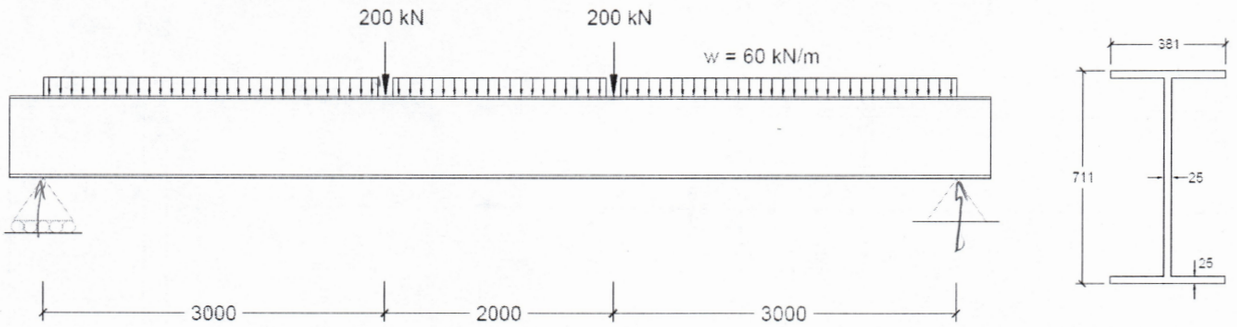


CIV 102F Problem Set #6 – October 31 and November 1, 2019

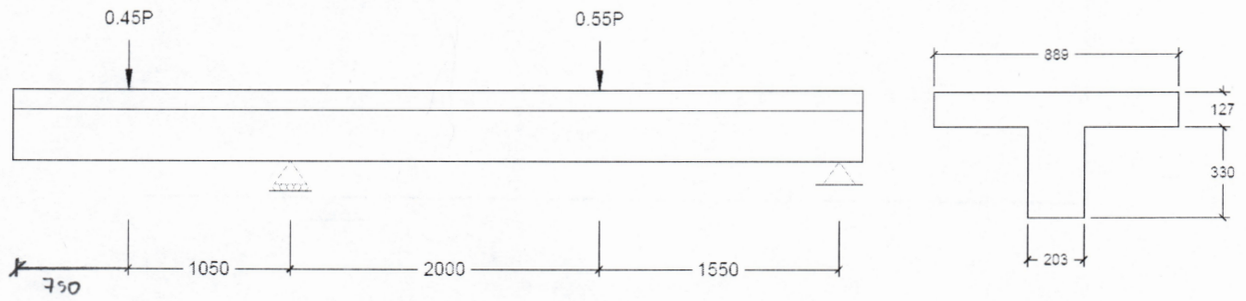
** This problem set is due in tutorial on November 14 and 15 **

1. Shown below is a steel I-beam subjected to two concentrated point loads of 200 kN each, as well as a distributed load of 60 kN/m. The details of the cross section are shown to the right. Draw the shear force and bending moment diagrams and calculate the maximum tensile and compressive stresses in the beam. Indicate where on the member these maximum stresses occur. Neglect the self-weight of the member. All dimensions are in mm.

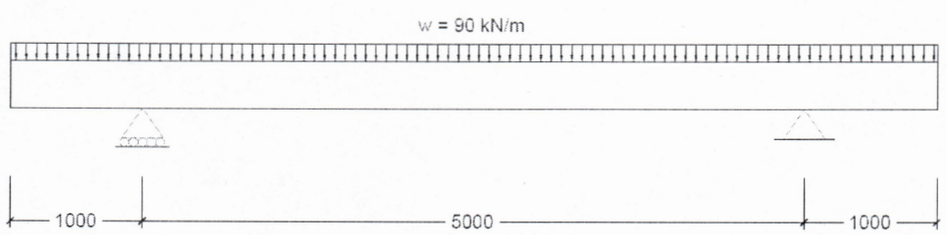


2. A reinforced concrete beam is to be tested in a laboratory under the loading conditions shown below. Details of the cross section are shown to the right. All dimensions are in mm.

a. Draw the shear force and moment diagrams corresponding to the self-weight of the T-beam. Assume a concrete density of 24 kN/m^3.
b. Draw the shear force and moment diagrams corresponding to the applied point loads in terms of the variable P.
c. What value of P will cause the concrete beam to crack, and where will this first crack appear? What value of P will cause a second crack to form, and where will that one be? Assume that cracking occurs when the tensile stress in the concrete reaches 2.5 MPa.



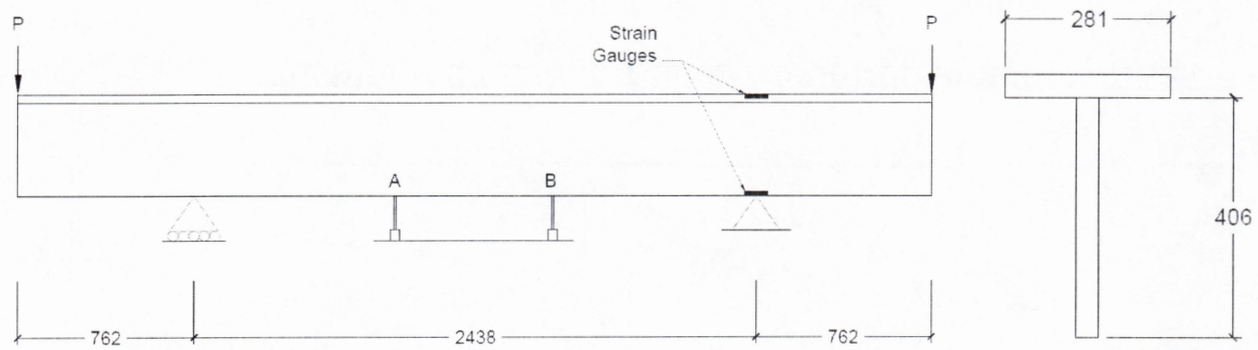
3. The wooden beam shown below is subjected to a high uniform load of 90 kN/m. It has a square cross section with dimensions 356 × 356 and is made of spruce. Calculate the factor of safety against failure for this member. When doing your factor of safety calculations, assume that failure is defined as when the flexural stress in the member equals to σ_{ult}. All dimensions are given in mm.



4. The beam shown below is a T-beam which carries two point loads, P. It is made by gluing together two pieces of spruce, each being 38 mm thick. To obtain data about the beam's behaviour, equipment which measure the downwards deflections at point A and B are provided. Strain gauges at the top and bottom of the beam at the locations shown below are also installed, which locally measure the strains in the beam where they are attached.

a. If the curvature of the member in the region AB is measured to be $\phi = 7.50 \times 10^{-6}$ rad/mm, what is the value of P?

b. For the value of P you found in part a, strains would be measured by the strain gauges?



5. For the following two structures, calculate the reaction forces and draw the shear force diagrams and bending moment diagrams.