CIV102F Assignment # 8 – November 4, 2020

Due Wednesday November 18, 2020 at 23:59 Toronto time

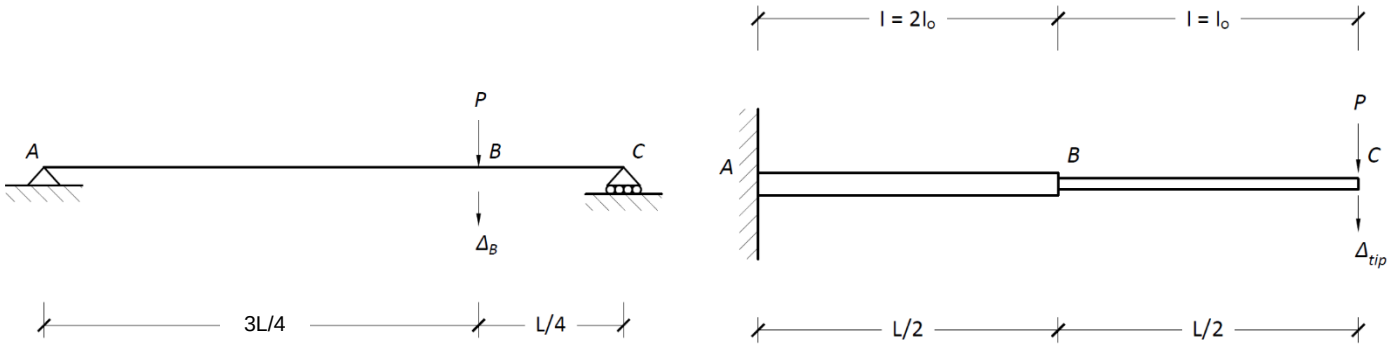
General Instructions

- There are four questions on this assignment. All questions must be attempted; however, only one question will be graded.
- Submissions which are incomplete and do not contain a serious attempt to solve each question will receive a grade of 0.
- Intermediate steps must be provided to explain how you arrived at your final answer. Receiving full marks requires both the correct process and answer.
- All final answers must be reported using slide-rule precision (ie, four significant figures if the first digit is a "1", three otherwise), and engineering notation for very large or very small quantities.
- Submissions must be prepared neatly and be formatted using the requirements discussed in the course syllabus. Marks will be deducted for poor presentation of work.

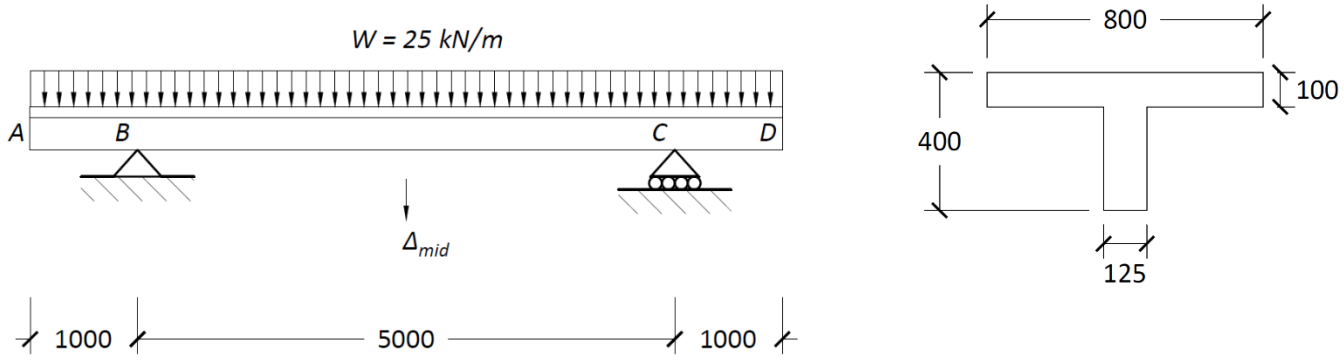
Assignment-Specific Instructions

- For each question, the bending moment diagram and shear force diagram must be provided. Label key values (i.e. local minima/maxima)
- In the second question in Q1, the change in I at point B will cause the curvature to abruptly change there as well. Don't forget that $\phi = M/EI$.

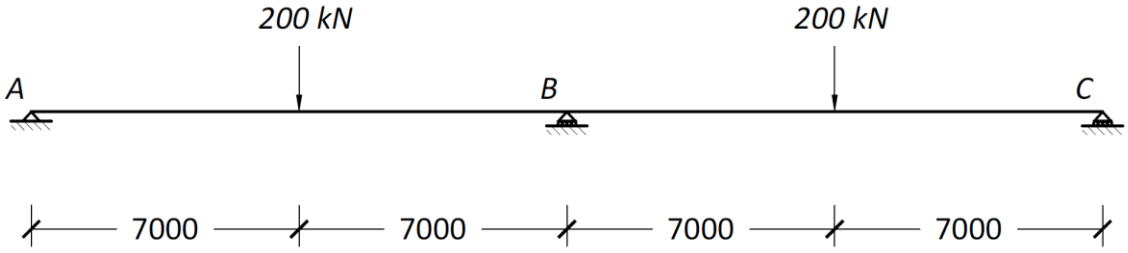
1. For the two beams shown below, draw the shear force diagrams, bending moment diagrams and curvature diagrams. Calculate the unknown displacements shown on each figure. Express your results in terms of P, L, E and I (I_o for the cantilever on the right).



2. For the following beam, draw the shear force diagram, bending moment diagram and curvature diagram. Calculate the midspan displacement and the slope of the beam at points B and C. Sketch out the displaced shape and indicate the points of inflection. Assume E = 30,000 MPa when performing your calculations. All dimensions are in mm.

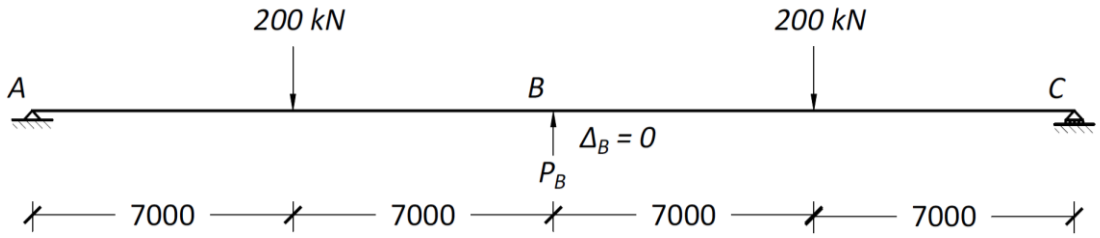


3. Shown below in System 1 is a statically indeterminate beam – there are four unknown reaction forces, which cannot be solved by the three equilibrium equations alone. All dimensions are in mm.



System 1: Statically indeterminate beam

The statically indeterminate beam in System 1 is equivalent to System 2 shown below, which is a simply supported beam where the upwards force P_B causes the downwards displacement at point B to be zero.



System 2: Statically determinate beam with displacement constraint

Solve for the following:

a. Find Δ_B in System 2 due to the two downwards point loads only. Neglect the upwards force P_B.
b. In System 2, remove the two 200 kN point loads and solve for P_B which would cause an upwards displacement Δ_B equal to the downwards displacement found in part (a).
c. From your results in parts (a) and (b), draw the shear force and bending moment diagrams for system 1.

Perform your calculations assuming the E = 200,000 MPa and I = 1.00×10^9 mm^4.

4. A timber beam is simply supported and loaded as shown below. Determine the maximum shear stress due to a uniformly distributed load of 5.5 kN/m. At the location of maximum shear stress, draw a profile of the shear stress distribution along the height of the member. Label key points.