UNIVERSITY OF TORONTO

FACULTY OF APPLIED SCIENCE AND ENGINEERING

FINAL EXAMINATION – DECEMBER 2001

Fourth Year Civil Engineering

CIV519F – Structural Analysis II

Exam Type: C

Examiners – E.C. Bentz

Ensure that you have all the pages.
There are blank pages at the end if you need extra space
Stiffness matrices will be handed out during the exam.

NAME: ______________________

ID Number: ____________________

1	
2	
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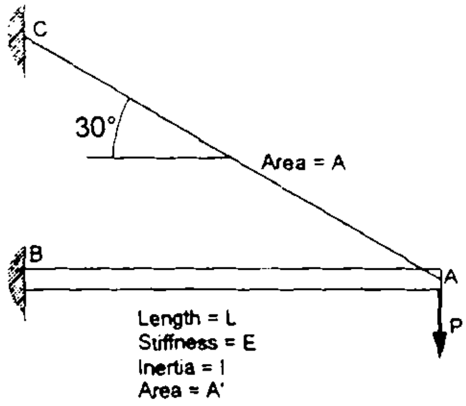
5	
Total	

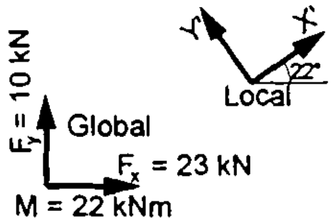
1: Beam AB shown below is fixed to the wall at end B and supported by a cable at end A. If the applied load at A is P, determine an equation for the vertical displacement at end B in terms of P, E, I, L, and A (Hint: you can ignore the axial resistance of the beam AB. (15 marks)



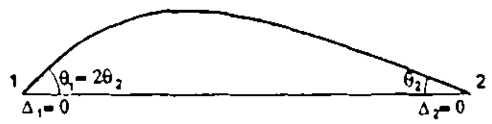
2: Short Answers (6 marks each)

a) List 6 important spreadsheet commands, tricks, and techniques you used in this course.

b) Convert the shown global forces to the listed local coordinates.

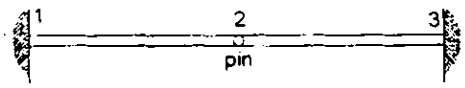


c) Calculate the location of maximum deflection within the following beam

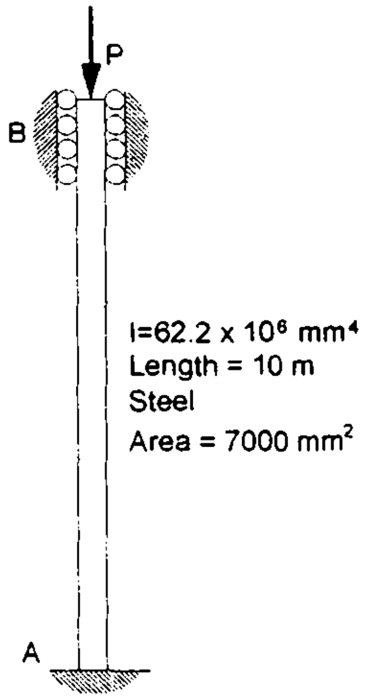


d) What are the three fundamental principals used in this course? (Give an example of each one)

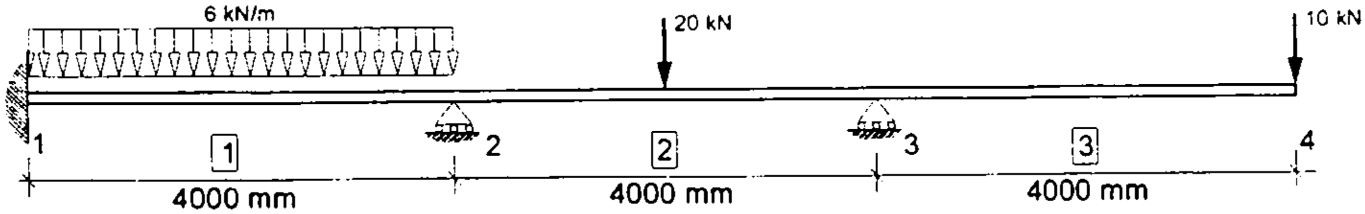
e) Write out the full 6x6 assembled stiffness matrix for the shown problem in terms of E, I, and L. (only include Δ_{y1}, θ_1, Δ_{y2}, θ_2, Δy_3, θ_3 degrees of freedom)



3: For the column shown, determine the critical elastic buckling load. Divide up the 10 metre column (fixed against rotation top and bottom) into two 5 metre long elements. (Ignore the degree of freedom that acts in the vertical (axial) direction). Comment on the quality of the answer. (20 Marks)

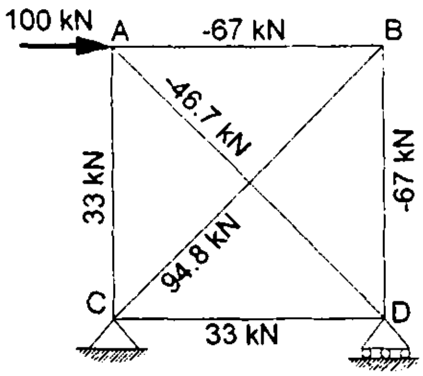


4: An analysis on the steel structure shown ($A=4900\ mm^2$, $I=31.3\times10^6\ mm^4$) has produced the indicated displacements. Sketch the displaced shape, calculate and draw the bending moment diagram, shear force diagram and determine the reactions. (20 marks)



θ_2	0.00119 rad
θ_3	-0.00539 rad
Δ_{Y4}	-55.6 mm
θ_4	-0.01817 rad

5: The methods we have learned for nonlinear material behaviour apply to trusses as well as frames. Use the method from class to determine the collapse load for this steel truss against a point load at location A. (All the same steps apply. Where moments were used before, use axial forces. You don't need to use the stiffness method here.) The truss is shown solved in its initial indeterminate configuration with a reference load of 100 kN applied at A. (15 marks)



Plastic Capacity
AB, BD, AC, CD = +/- 200 kN
AD, BC = +/- 150 kN