10:05 - 10: 55
34-101

Name ____

Unified Quiz FM3

March 18, 2009

M - PORTION

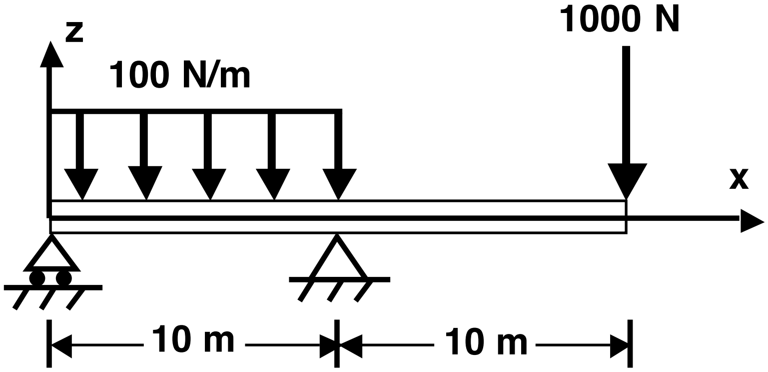
- Put your name on each page of the exam.
- Read all questions carefully.
- Do all work on that question on the page(s) provided. Use back of the page(s) if necessary.
- Show all your work, especially intermediate results. Partial credit cannot be given without intermediate results.
- Show the logical path of your work. Explain clearly your reasoning and what you are doing. *In some cases, the reasoning is worth as much (or more) than the final answers*.
- Please be neat. It will be easier to identify correct or partially correct responses when the response is neat.
- Be sure to show the appropriate units throughout. Answers are not correct without the units.
- Report significant digits only.
- Box your final answers.
- ***Calculators are allowed.***
- ***Print-outs of all M&S Handouts, particularly "HO-M-12", "HO-M-13", and "HO-M-14", along with 2 sides of pages of handwritten material are allowed.***

EXAM SCORING

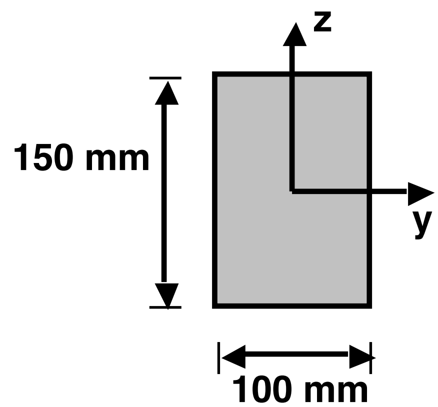
#1M (1/2)	
#2M (1/2)	
FINAL SCORE	

PROBLEM #1M (1/2)

A titanium beam (E = 100 GPa, ν = 0.3) is supported by a roller support at one end and by a pin at its mid-span point. The beam is a total of 20 meters long and has a solid rectangular cross-section with a height of 150 mm and width of 100 mm. The beam has a downward point load of 1000 Newtons at the tip, and a distributed downward load of 100 N/m between the two supports.



Cross-Section



(a) Sketch the shear force and bending moment resultant distributions as a function of position along the beam. Be sure to note the key values of each and their locations.

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PROBLEM #1M (continued)

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PROBLEM #1M (continued)

(b) Determine the x-location of the maximum shear stress (i.e. σ_{xz}).

(c) Determine the x-location of the maximum axial stress (i.e. σ_{xx}).

PROBLEM #1M (continued)

(d) How do the answers to parts (a), (b), and (c) change if steel (E = 200 GPa, ν = 0.3) is used rather than titanium? *Explain your answer **clearly**.*

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PROBLEM #1M (continued)

(e) How does the maximum deflection of the beam and its location change when the beam is made of steel rather than titanium? *Explain your answer* ***clearly***.

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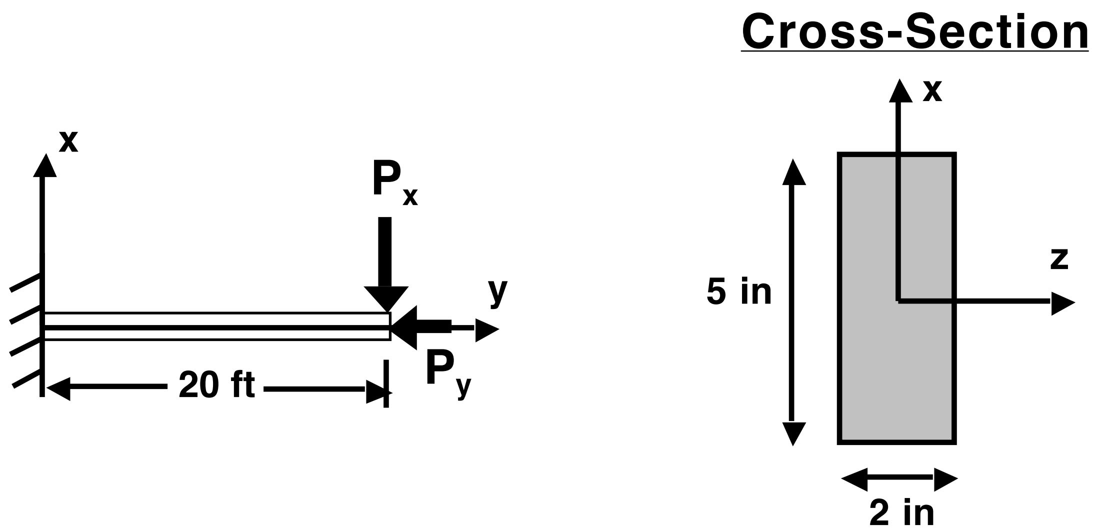
PROBLEM #1M (continued)

(f) The roller support at x=0 is replaced by a clamped support. Would the procedure for determining the answers to part (a) change? Be sure to explain ***clearly***. Use figures, ratios, etc. as appropriate. *Obtaining final values or operative quantified equations is* ***not necessary***.

PROBLEM #2M (1/2)

A 20-foot long aluminum beam (E = 10 Msi, $\nu = 0.3$) is cantilevered in the x-y plane with a clamped support at its root. The beam has a rectangular cross-section 2 inches across and 5 inches deep. The structural configuration, as illustrated in the accompanying figure, is loaded by a vertical tip load of magnitude P_x, causing bending deformation in the x-direction. This results in a maximum axial stress, σ_{yy}, of 20 ksi.



The structural configuration is *subsequently* ***also*** subjected to a horizontal tip load along its primary axis, P_y, of 100,000 pounds.

(a) Determine how the horizontal tip load affects the maximum values of the axial stress, σ_{yy}, in both tension and compression Quantify as best as you can. **Clearly** explain any modeling assumptions and associated limitations.

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PROBLEM #2M (continued)

PROBLEM #2M (continued)

(b) You can double one cross-sectional dimension, while keeping the total area constant, in order to reduce the maximum deflection. Which dimension would you change to make this the most effective? **Clearly** explain your reasoning. Also indicate how this change would affect the total axial stress, σ_{yy}, for this two-load configuration.

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PROBLEM #2M (continued)

(c) Describe how you would check results to determine whether your modeling is applicable.