16.21 - Techniques of structural analysis and design

Spring 2005

Final Exam

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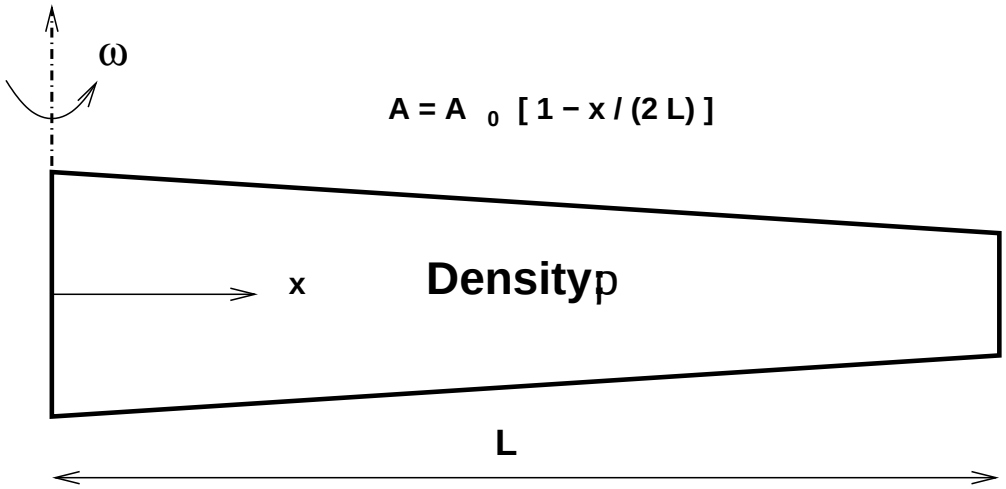
Student's name:_____

Question	Grade
1) 30 points	
2) 30 points	
3) 30 points	
4) 10 points	
Total:	



The structure of the figure is made of an elastic material with Young's Modulus E, and mass density ρ and rotates at an angular velocity ω. (Questions start on the next page)

1. (30 points) Compute an approximate value of the radial displacement at $x = L$. Use an approximate method of your choice. Discuss the reason of your choice of method and your additional assumptions, if any.

2. (30 points) Show how you can use an energy method to compute the exact value of the radial displacement at $x = L$. You do not have to (but are welcome to) evaluate the final expression, if it is too complex to do by hand.

3. (30 points) From the approximate solution compute an approximation of the stress at the rotating axis ($x = 0$) and compare with the exact solution. Why can you compute the exact solution in this case without much effort?

4. (10 points) What is the maximum angular velocity attainable before the material starts to deform plastically if the structure has a length $L = 2m$ and is made of an Aluminum with mass density $\rho = 2700\frac{Kg}{m^3}$ and yield stress $\sigma_0 = 200MPa$.