ASEN 5007 Introduction to Finite Element Methods Fall 2009

Homework Assignment #9 (Chapters 20 and 21 of Notes)

Due Thursday November 19, 2009 (December 3 for CAETE students)

Please do not forget to attach this cover sheet to your returned homework and write your name(s) on it

Chapter 20: 20.6

Chapter 21: 21.2 (descriptive), 21.5 (transmission tower)

Exercise 20.6 is analytical. You need to use some results from linear algebra. In particular, what is the relation between the eigenvalues of $\mathbf{K}^e$ and those of $\mathbf{T}^T\bar{\mathbf{K}}^e\mathbf{T}$, if $\mathbf{T}$ is *orthogonal* so that $\mathbf{T}^T = \mathbf{T}^{-1}$ whence $\mathbf{K}^e = \mathbf{T}^{-1}\bar{\mathbf{K}}^e\mathbf{T}$? You may assume that displacement transformation matrices between different global Cartesian frames are orthogonal.†

To do 21.5 download the Notebook `SpaceTruss.nb` from index of Chapter 21, and follow instructions given in the top cell. Material in returned homework should include:

1. A listing of the problem driver script cell you wrote. *To keep output manageable, please don't include any material in cells 1–8; also don't touch the code there.* .
2. Printed output of node coordinates, element data and DOF activity.
3. Printed results showing computed displacements, node forces, element internal forces and stresses.
4. Plots of mesh and element stress levels are useful. Plots of deformed shapes are optional.

Note: Chapter 21 contains enough explanatory material to do 21.5. Mimicking the logic of Cell 8 (the bridge truss example) is a good idea to start although the plots might not be displayed in the best 3D perpective view. For the latter you may try experimenting with the `view` argument. Also the `box` argument (the "enclosing display box" for deformed shapes and stress level plots) may need some adjustments.

The obvious place to place your driver script for 21.5 is Cell 9, which is empty space in the posted `SpaceTruss.nb`. Cell 10 in that notebook contains a module that may be used to compute the total weight of the transmission tower, using a call such as shown in the bottom of that cell. The weight should come out to be 555.18 lbs. This is a valuable check for the geometry and element data structures prepared in the driver cell.

Short Term Schedule

Chapter 22 will not be covered, pending rewrite. We move directly to Chapters 23 through 25. Homework 10, on Chapters 23-24, will be due Th Dec 3 for on-campus students.

Final Exam Information

The final take-home exam will be posted on the course web site on or before Wed Dec 9, 2009.

On-campus students will have six days to return it to instructor.

For CAETE students, instructions for deadline on returning the final exam will be sent directly by e-mail. Since it is take-home, it does not to go through the EO: exam can be downloaded directly from the Web.

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† If you are rusty on eigenvalue properties, read http://mathworld.wolfram.com/SimilarityTransformation.html