

Homework #4 (ASEN5022, Spring 2004)

Due at Start of Class on Tuesday, 16 March 2004

Problem : A beam with uncertain boundary conditions.

A group of engineers conducted vibration tests on a bridge that needs to be retrofitted with reinforced structural elements in order to improve earthquake vulnerability. After a careful modal analysis based on their measured acceleration output data sets, they discovered that the fundamental frequency is equivalent to $\beta L = 4.25$, and the peak amplitude of the corresponding mode shape occurring at the beam span $x = 0.55L$. They have concluded that there is no discernable boundary inertia effects.

- 4.1 Formulate the continuum equations of motion for this beam, complete with the uncertain boundary conditions.
- 4.2 Model this beam in terms of discrete springs and masses employing the discrete modeling approaches discussed in the class. Can you have a rough estimate of the boundary springs from your discrete model? Show your rationale as to how well your proposed discrete model can guide you to a reasonable set of model parameters.
- 4.3 Utilizing the technical insight you gained from the above two tasks, develop a strategy of how you can employ the continuum model derived in problem (4.1) to arrive at the uncertain boundary condition parameters.
- 4.3 Discuss complementary features of both the rigorous continuum modeling approach and *ruthless* discrete modeling approaches, if any. What have you learned?