

Department of Aeronautics & Astronautics
MIT
Field Exam, January, 2011
Question -- Materials & Structures

A structure is basically a truss configuration in that it is composed of long and slender individual components joined only at the ends of each component. Each of the components is made of the same, isotropic material. The structure is in the x - z plane and can be subjected to mechanical loads at the joints of the structure. In addition, the structure is subjected to a thermal profile that varies in x and z , as referenced to an initial uniform temperature of the structure. There are no considerations in the y -direction except that each structural part of the overall configuration has finite dimensions in that direction.

Your primary task is to devise models of various levels of complexity in order to determine the stresses in the individual components (but not in the joints themselves). In so doing, indicate the base assumptions, applicability, and limitations of these models. In developing these models, please consider and discuss the following:

- a) The role of boundary conditions on the overall structural configuration.
- b) The role of the specifics of the joints utilized in the structural configuration.

The primary work should be conducted assuming that the material maintains a linear behavior and without concern for failure. Upon completion of these models, progress to:

- c) consider and discuss how material nonlinearity and failure play a role in these models.

DO NOT WORK TO SOLVE AN ACTUAL PROBLEM, although an actual problem can be used as a means to consider the various models.