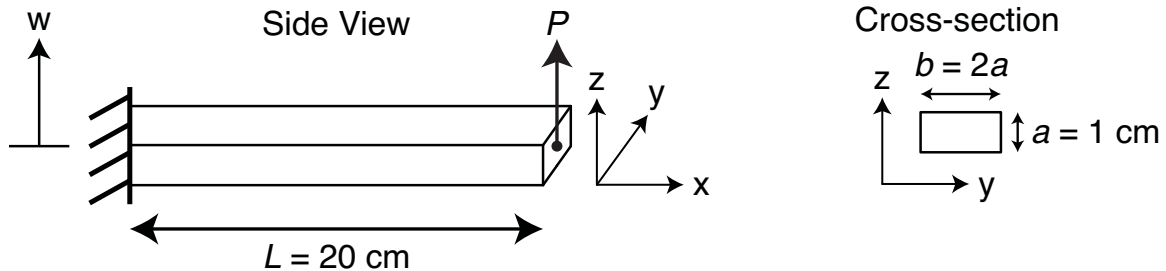


Department of Aeronautics & Astronautics
MIT
Field Exam, Jan. 2018
Question – Materials & Structures



A slender member shown above is a basic structural element in aerospace mechanics, and is characterized by length L and a constant cross-sectional area $a \times b$, where $b = 2a$. The member is fixed on one side, and is undergoing deformation due to a load P acting at $x = L$. Investigate the following while carefully stating all assumptions. Please answer all questions noting that (2) – (4) are largely qualitative.

- (1) Assuming that the member is an isotropic aluminum alloy, derive and sketch the displacement field as a function of x . Discuss the mechanical response, including failure, for different magnitudes of P .
- (2) Qualitatively discuss how your answer to (1) changes if the member is now comprised of a non-isotropic carbon fiber reinforced plastic (CFRP) material, where the carbon fibers (CFs) are aligned parallel to x .
- (3) Qualitatively discuss how your answer to (1) changes if the member is now comprised of two layers of CFRP, each of height $a/2$: one where the fibers are aligned parallel to x , and the other where the fibers are aligned parallel to y , *i.e.*, a two-ply laminate.
- (4) What are some pros and cons of the three member compositions above?