

T&AM 202 Synthesis HW question

due Tuesday Dec 10, 2002

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Structure and geometry description:

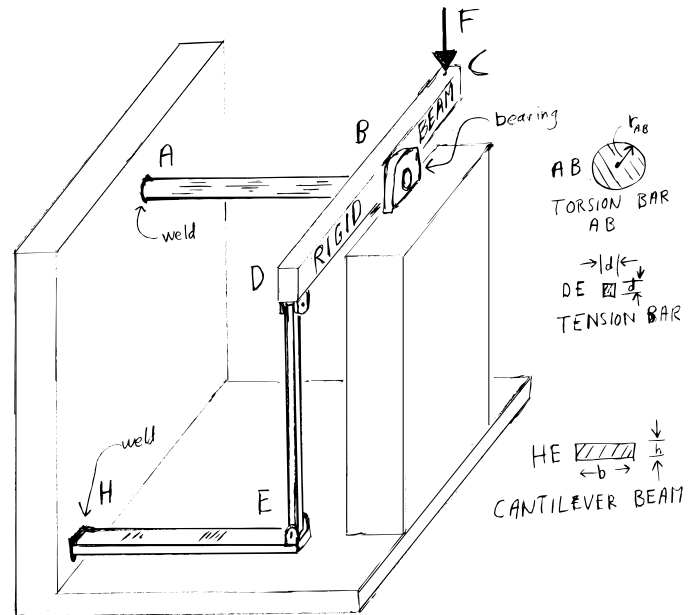
Torsion bar AB is welded to a rigid support at its left end at A and is supported by a bearing at B. Rigid beam DBC is welded to, and rotates with, the right end of the bar AB. The load F is applied to point C on DBC. The width of this beam can be neglected when considering the length of AB. Tension rod DE hangs from a pin joint at D and pulls up on a pin joint at E. Cantilever beam HE is welded to the wall at H and has its end pulled up by the pin at E.

The load F tries to rotate the beam DBC clockwise (as viewed from the right). This motion is resisted by the torsional stiffness of rod AB and would also be resisted by the bending stiffness of HE but for the compliance of tension rod DE which diminishes this resistance.

Assume linear elastic behavior throughout. The structure is stress-free when there is no load ($F = 0$).

Given:

$L_{AB} = L_{HE} = L_{DB} = L_{BC} = L_{DE} = 0.5 \text{ m}$
 $r_{AB} = 2 \text{ cm}$, $G_{AB} = 80 \text{ GPa}$,
 $d = 2 \text{ mm}$, $E_{DE} = 200 \text{ GPa}$,
 $b = 2 \text{ cm}$, $h = .5 \text{ cm}$, $E_{HE} = 200 \text{ GPa}$
 $F = 1000 \text{ N}$.



- What is the deflection of point C?
- What is the maximum shear stress on any surface in bar DE?
- What is the maximum tension stress in bar HE?
- What is the maximum tension stress on any surface in bar AB?