

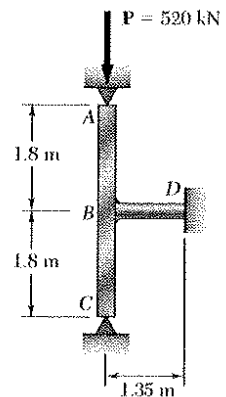
## MIDTERM ME 208-2

| Q1 | Q2 | Q3 | Q4 | TOTAL |
|----|----|----|----|-------|
|    |    |    |    |       |

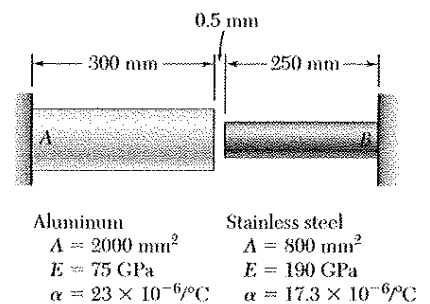
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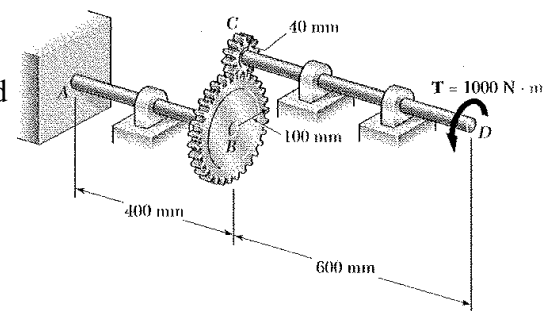
- 1) Rod BD is made of steel ( $E = 200 \text{ GPa}$ ) and is used to brace the axially compressed member ABC. The maximum force that can be developed in member BD is  $0,02P$ . If the stress must not exceed  $126 \text{ MPa}$  and the maximum change in length ( $\delta$ ) of BD must not exceed  $3,6 \text{ mm}$ . Determine the smallest diameter rod that can be used for member BD.



- 2) At room temperature ( $20^\circ\text{C}$ ) a  $0,5 \text{ mm}$  gap exists between the ends of the rods shown. At a later time when temperature has reached  $140^\circ\text{C}$ , determine a) the normal stress in the aluminum rod, b) the change in length of aluminum rod.



- 3) The design of the gear and shaft system shown requires that steel shafts of the same diameter be used for both AB and CD. It is further required that  $\tau_{\max} \leq 60 \text{ MPa}$  and that the angle  $\Phi_D$  through which end D of shaft CD rotates not exceed  $1,5^\circ$ . Knowing that  $G = 77 \text{ GPa}$ , determine the required diameter of the shafts.



- 4) The beam shown is made of a nylon for which the allowable stress is  $24 \text{ MPa}$  in tension and  $30 \text{ MPa}$  in compression. Determine the largest couple  $M$  that can be applied to the beam.

