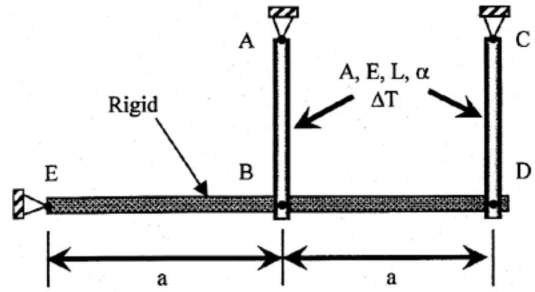
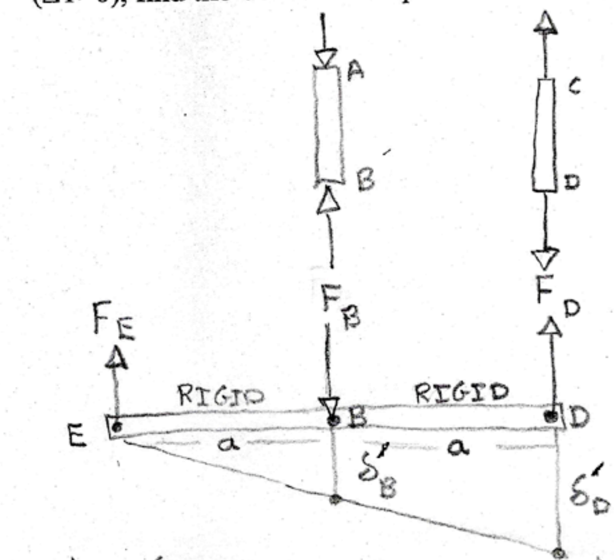
PART II: WORK OUT PROBLEMS (23 Points Each)

The rigid beam ED of length 2a is supported by the two identical rods AB and CD as shown below. The rods are made from a material with a modulus of elasticity E, a coefficient of thermal expansion α, cross-sectional area A, and length L. If the rods AB and CD are subjected to a temperature difference ΔT (ΔT>0), find the deflection of point D in terms of E, α, A, L, a, and ΔT.





Kinetic: (Force-Moment Equilibrium)

$\circlearrowleft + \sum M_{@E} = 0 = -aF_B + 2aF_D$

$F_B = 2F_D \quad (1)$

Kinematic (Geometry Only) (no Forces)

$\frac{\delta'_B}{a} = \frac{\delta'_D}{2a} \qquad 2\delta'_B = \delta'_D \quad (2)$

Subst (1), (3), & (4) →

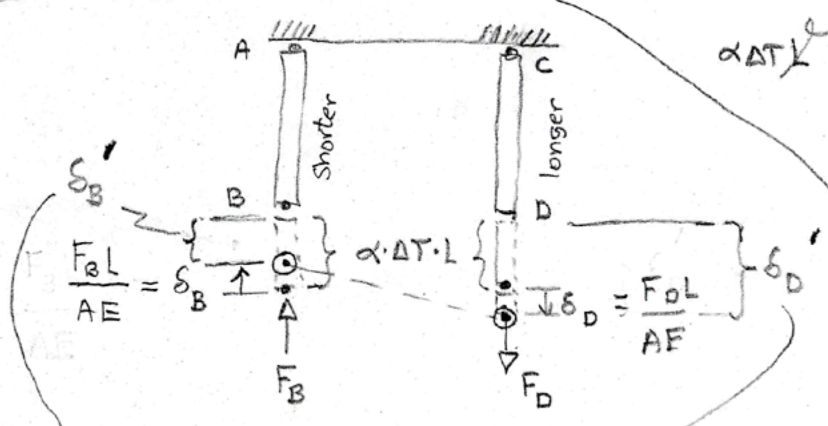
$2\alpha\Delta TL - \frac{2(2F_D)L}{AE} = \alpha\Delta TL - \frac{F_DL}{AE}$

$\alpha\Delta TL = +\frac{3F_DL}{AE} \qquad F_D = \alpha\Delta TAE/3$

Subst into (4)

$\delta'_D = \alpha\Delta TL + \frac{\alpha\Delta TAE}{3AE}L$

$\delta'_D = \frac{4}{3}\alpha\Delta TL$



$\delta'_B = \alpha\cdot\Delta T\cdot L - \frac{F_BL}{AE} \quad (3)\ ; \quad \delta'_D = \alpha\cdot\Delta T\cdot L + \frac{F_DL}{AE} \quad (4)$