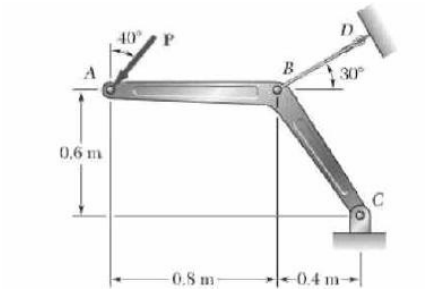
Exam 1
March 12, 2013
90 minutes

Problem 1 (20 Points)

Member *ABC* is supported by a pin at *C* and a cable *BD*. Knowing that the ultimate load for cable *BD* is *100kN,* determine:

a) The safety factor with respect to cable failure if a load ***P = 16kN*** is applied as shown.
b) The largest load ***P*** that could be applied if a factor of safety of ***3.2*** with respect to cable failure is required.



Problem 2 (30 Points)

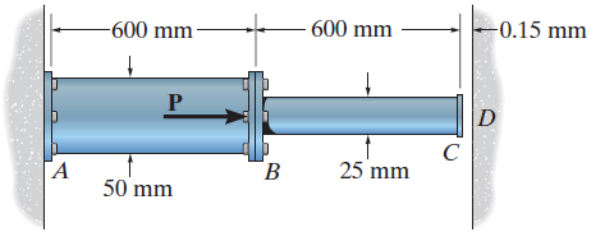
A *60mm* cube is made of a metal alloy with *E = 155GPa* and $\nu = 0.28$. The cube is subjected to a compressive load of *140kN* in the *x-direction.* Determine the changes in the cube dimensions and the volumetric strain, knowing that:

a) The cube is free to expand in the *y* and *z* directions.
b) The cube is free to expand in the *z-direction*, but is restrained from expanding in the *y-direction* by two fixed frictionless plates.

Problem 3 (30 Points)

The assembly shown is made of *A36* steel (*E = 200GPa, G = 75GPa,* $\alpha = 12 \times 10^{-6}\ /°C$). If the gap between *C* and the rigid wall at *D* is *0.15mm* when the assembly is unloaded and the temperature is $30°C$.

a) Determine the support reactions at *A* and *D* when the force **P = 180kN** is applied and the temperature is decreased to $\boldsymbol{T_f = 10°C}$.
b) Determine the displacement of point B.



Problem 4 (20 Points)

A steel reinforced concrete bar having a length of 1m and the cross-section shown below is fixed from both ends. Considering only axial deformations, determine the induced stresses in the steel and concrete when the temperature is decreased by $20°C$.

$(E_{steel} = 200GPa, \alpha_{steel} = 12 \times 10^{-6}/°C,$
$E_{concrete} = 22GPa, \alpha_{concrete} = 9 \times 10^{-6}/°C)$