Max marks: 40

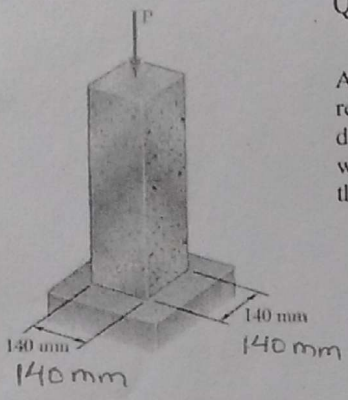
29/08/2016

MECHANICS OF SOLIDS (APL108)

DEPARTMENT OF APPLIED MECHANICS, IITD

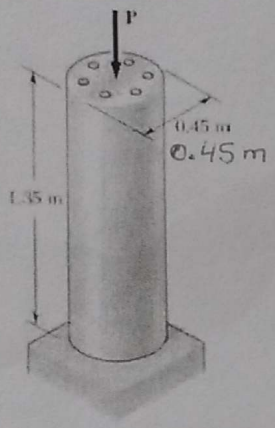
P. Goutham.

Question 1: [10 marks]



A centric load **P** is applied to the granite block shown. Knowing that the resulting maximum value of the shearing stress in the block is 18 MPa, determine (*a*) the magnitude of **P**, (*b*) the orientation of the surface on which the maximum shearing stress occurs, (*c*) the normal stress exerted on that surface, (*d*) the maximum value of the normal stress in the block.

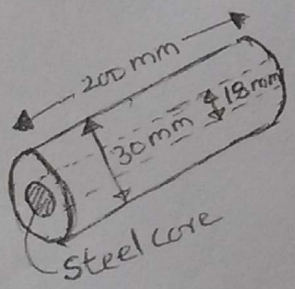
Question 2: [10 marks]



The 1.35 m concrete post is reinforced with six steel bars, each with a 28 mm diameter. Knowing that $E_s = 200$ GPa and $E_c = 29$ GPa, determine the normal stresses in the steel and in the concrete when a 1560 kN axial centric force **P** is applied to the post.

L = 1.35 m

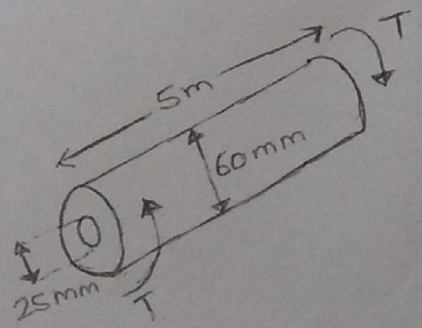
Question 3: [10 marks]



The assembly shown consists of an aluminum shell ($E_a = 73$ GPa, $\alpha_a = 23.2\times10^{-6}$/°C) fully bonded to a steel core ($E_s = 200$ GPa, $\alpha_s = 11.7\times10^{-6}$/°C) and is unstressed. Determine (*a*) the largest allowable change in temperature if the stress in the aluminum shell is not to exceed 41 MPa, (*b*) the corresponding change in length of the assembly.

$d_{outer} = 30$ mm $d_{inner} = 18$ mm

Question 4: [10 marks]



The hollow steel shaft shown ($G = 77.2$ GPa, $\tau_{all} = 50$ MPa) rotates at 240 rpm. Determine (*a*) the maximum power that can be transmitted, (*b*) the corresponding angle of twist of the shaft.

$d_{outer} = 60$ mm $d_{inner} = 25$ mm