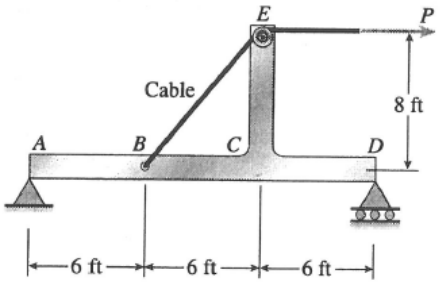
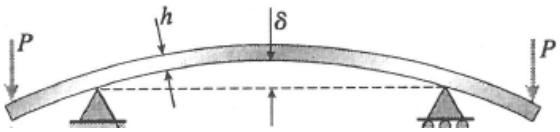
CEE212 – Structural and Solid Mechanics
Winter Semester 2014-2015
Homework #6
(Due March 20, 2015)

Beam Elements – Normal Stress

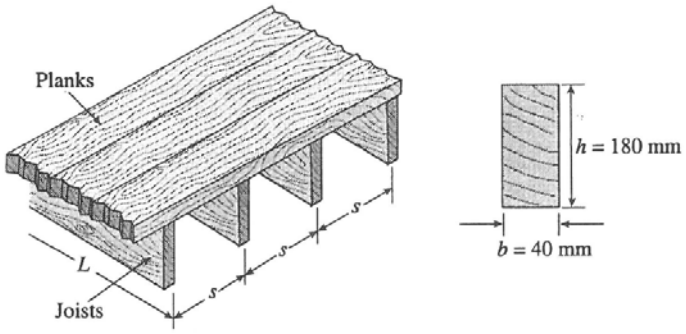
Problem 1: The "T" beam shown to the right is denoted as *ABCDE*. A steel cable is attached at *B* and rides over a pulley mounted at *E*. Load *P* is applied to the steel cable. What is the applied load, *P*, that induces a moment of 640 lb-ft to the immediate left of point *C*? You can use the centerline dimensions of the beam *ABCDE*; in otherwords you can ignore the widths of the elements.



Problem 2: A beam is "cambered" as shown in the figure to the right. The beam is of a rectangular cross section with a height of 10.0 cm. The center deflection is measured to be 3.6 mm. If the distance between supports is 1.2 m (*L*), what is the maximum normal strain in the bar?

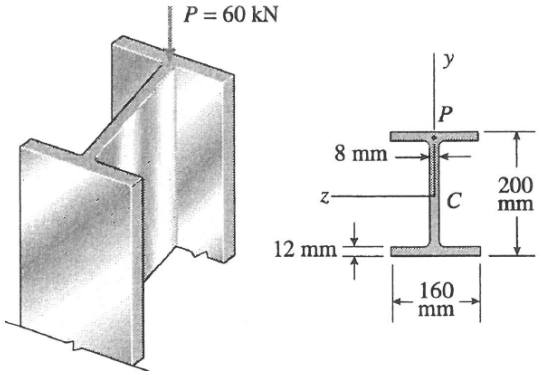


Problem 3: You are called in as a structural engineer to evaluate a floor system that a client complains is "too springy". The floor system consists of deep wood joists (40 x 180 mm^2) upon which wood planks are nailed to create the floor system. For this problem, the planks do not contribute to the flexural strength of the joists and can for all intensive purposes can be ignored. The joists have a total span (*L*) of 4.0 m. The load on the floor is 3.6 kPa which includes the self-weight of the floor system. If the maximum allowable stress permitted by code in the wood joists is 15 MPa, what is the maximum spacing between the joists, *s*?

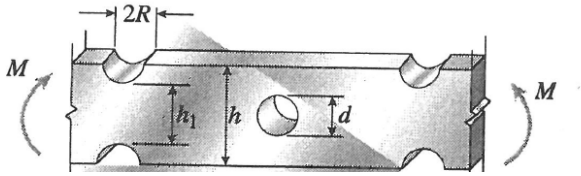


L = 4.0 m
w = floor load = 3.6 kPa σ_{allow} = 15 MPa
s = spacing of joists

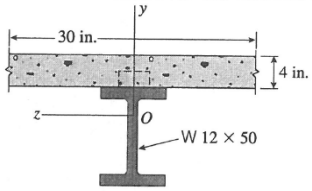
Problem 4: A column shown on the right carries a load of 60 kN concentrated at the mid-point of the column flange. The dimensions of the column are shown on the right. For this problem, please find: (a) the maximum stress of the column in compression and tension; (b) determine the location and orientation of the neutral surface in the column under the loading condition shown.



Problem 5: A rectangular steel beam, as shown, has two notched sections (with notch radius of R). The internal moment reaction inside the beam is M = 130 k-in. The beam has a depth of h = 5.5 in and width of b = 1.6 in. At the notched sections, the distance between the notches is h_1 = 5 in. If the maximum permissible (allowable) stress in the element is specified by code as 42 ksi, what is the smallest radius notch that can be allowed? Now say the contractor wants to pass an electrical conduit through the steel beam. What is the largest diameter hole (d) you will allow him/her to make?



Problem 6: In many highway bridges, the flexural response of the system is derived from a concrete deck supported by a steel girder as shown. In such systems, the steel and concrete are in complete composite action meaning they work together and are compatible in their strain response. The steel girder, as shown, is a W12x50 section (total depth of d = 12.2 in; I = 394 in^4; A = 14.7 in^2). The concrete slab is 4 in thick. For this problem, you can assume the steel is 12 times stiffer (E) than the concrete. If a moment of 95 k-ft is applied to the section, what is the maximum stress in the steel and the concrete?



Problem 7: A wood girder to be used in the construction of a house is deemed to lack sufficient capacity to carry the load of a roof. To increase its flexural capacity, the engineer calls for an aluminum C-channel to be epoxy bonded to the bottom of the wood girder as shown to the right. The aluminum channel has a uniform wall thickness of 6 mm; all other dimensions of the beam is shown. If the allowable stress in the wood is 8 MPa and the allowable stress in the aluminum is 38 MPa, what is the maximum bending that can be allowed on the beam? The moduli of the wood and aluminum is 70 GPa and that of wood is 11.67 GPa.