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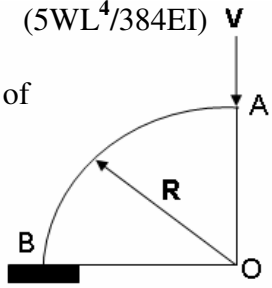
Mechanics of Materials-II

6th Semester---- (Session 2007)

Problem Sheet #3

Pb.1 Find the deflection of a simply-supported beam of length L and flexural rigidity EI carrying a load W uniformly distributed over the whole beam using virtual work principle or Castigliano's theorem. ($5WL^4/384EI$)

Pb. 2 A structure is in the form of one quadrant of the thin circular ring of radius 'R' with one end is clamped while other end is loaded by a vertical load as shown in Fig. Determine the horizontal & vertical displacement under the application of vertical load.
($\delta_V = \Pi VR^3/4EI$; $\delta_H = VR^3/2EI$)

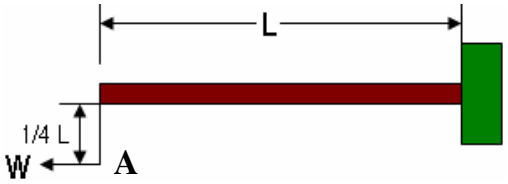


Pb.3 For a cantilever beam of length L and flexural rigidity EI with load
(a) uniformly distributed over the whole beam,(b) concentrated at mid span
Using Castigliano's theorem or virtual work principle determine:

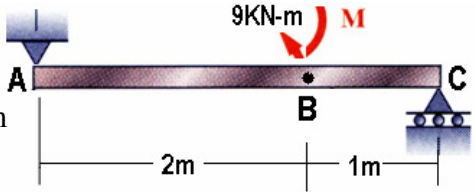
(i) slope at the free end ($WL^2/6EI$, $WL^2/8EI$)
(ii) deflection at the free end ($WL^3/8EI$, $5WL^3/48EI$)
(iii) deflection at the mid-span ($17WL^3/384EI$, $WL^3/24EI$)

Pb.4 A simply supported beam of length 'L' and flexural rigidity EI carries a concentrated load 'w' at a distance of 'd' from the left hand support. Determine the deflection of the beam underneath the load using Castigliano's theorem.
($wd^2 (L-d)^2/3EIL$)

Pb.5 Using Castigliano's theorem or virtual work principle determine the horizontal and vertical deflection of point A of the member shown in Fig. ($13WL^3/192EI$, $WL^3/8EI$)



Pb. 6 A beam of 3 m length is simply-supported at each end and is subjected to a couple of 9KN-m at a point B,2 m from the left end as shown in Fig. Determine the slope at B. Take $EI=30KN\text{-}m^2$. (0.1 rad)

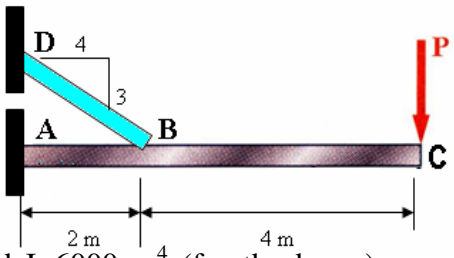


Pb. 7 Two identical rectangular section steel members are loaded in the following way: (a) one is subjected to an axial tensile force W, (b) the other is supported as a cantilever and subjected to a load W at its free end. If each member is required to absorb the same strain energy, compare the maximum stress which this would cause in each case. ($\sigma_b = 3\sigma_t$)

Pb. 8 A hollow shaft, subjected to a pure torque, attains a maximum shear stress of τ. Given that the strain energy per volume is $\tau^2/3G$, calculate the ratio of shaft diameters. Determine the actual diameter of such a shaft to transmit 4 MW at 110 rpm when the energy stored per unit volume is 20,000Nm/m^3. G=80,000N/mm^2.
(1.732, 306 mm, 177 mm)

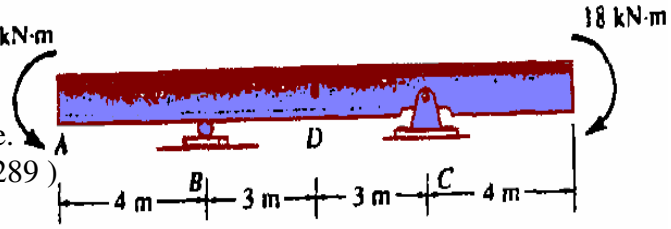
Pb. 9 Using Castigliano's theorem or virtual work principle find the deflection and rotation at the middle of a cantilever beam of length L and flexural stiffness EI carrying a uniformly varying load from zero at the free end to W_o at the fixed end.
($49W_oL^4/3840EI$, $15W_oL^3/384EI$)

Pb.10 An aluminium beam is supported by a pin at one end at point A and an inclined aluminium bar at end point D, as shown in Fig. Using Castigliano' theorem find the deflection at C caused by the application of the downward force P of 2 KN at that point. The cross section of the beam is 0.5cm^2, and that of the bar, 0.05cm^2.E=70Gpa and I=6000cm^4 (for the beam). Neglect deflection caused by shear. (19 mm)



Pb. 11 A beam, fixed at its ends, span 3m, carries a load of 60 KN at 1m from one end. Using Castigliano's theorem find the fixing moments at the ends & the deflection of the load. E = 205 KN/mm^2 & I = 8000 cm^4 (26.67 KN, 13.33 KNm, 0.362 mm)

Pb.12 For the steel beam shown in Fig. determine the displacement at 'D' & slope at' A' using Castigliano's theorem or Virtual work principle. I = 125 * 10^6 mm^4 & E= 200 GPa(3.24 mm, 0.289)



Pb. 13 Determine the horizontal & vertical displacements of point 'C'. There is fixed support at 'A' & EI is constant. (4000 / EI Nm ^{3}, 76800 / EI Nm^3)