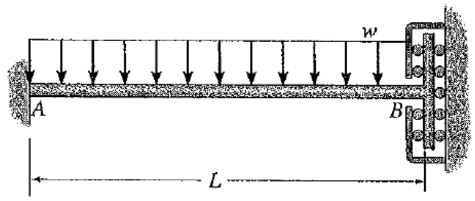
Mech417 HW assigned 2/26/08, hardcopy due at "In Box"

Part 1 due March 13, 2009, 5pm

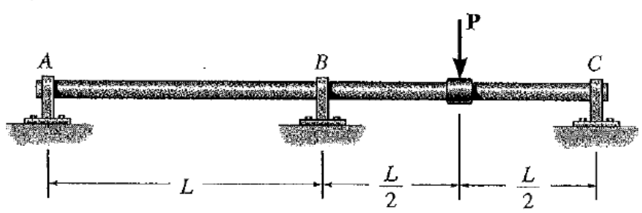
1. For each of the following four problems, state the essential boundary conditions at each support. Give the packed binary flag that would indicate the presence of each. (Do not solve any of the four.)

12–102. The rod is fixed at A, and the connection at B consists of a roller constraint which allows vertical displacement but resists axial load and moment. Determine the moment reactions at these supports. EI is constant.



Prob. 12–102

12–103. Determine the reactions at the supports, then draw the shear and moment diagrams. EI is constant. Support B is a thrust bearing.



Prob. 12–103

7.55 The two cantilever beams have the same flexural rigidity EI. When unloaded, the beams just make contact at B. Find the contact force between the beams at B when the uniformly distributed load is applied.

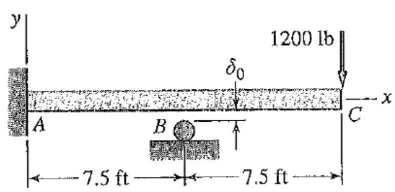


FIG. P7.17

7.18 The properties of the propped cantilever beam are $E = 72$ GPa and $I = 126 \times 10^6$ mm^4. The built-in support at B has a loose fit that allows the end of the beam to rotate through the angle $\theta_0 = 0.75°$ when the load is applied, as shown in the detail. Determine all the support reactions.

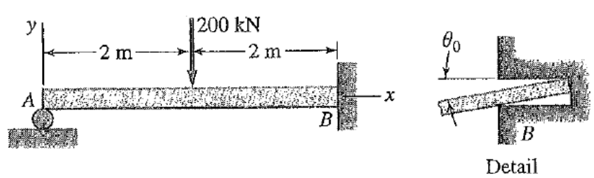


FIG. P7.18

2. The Matlab 5-th degree beam analysis script (L3_C1_Quintic_BoEF.m) has data and output for the Buchanan Example 4-8 on the class download page. Cut and paste the text file data to represent the new boundary conditions in problem 4-9 below. (That is, modify the BC flags in file msh_bc_xyz.tmp and the BC values in msh_ebc.tmp.) Execute the script with a single argument of zero (no points sources supplied). Compare the shear and moments to the exact values below. The plots produced have png extensions and can be copied and pasted into a MS Word report.

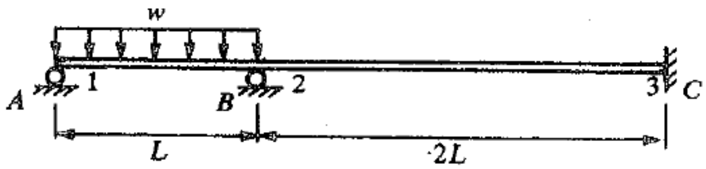
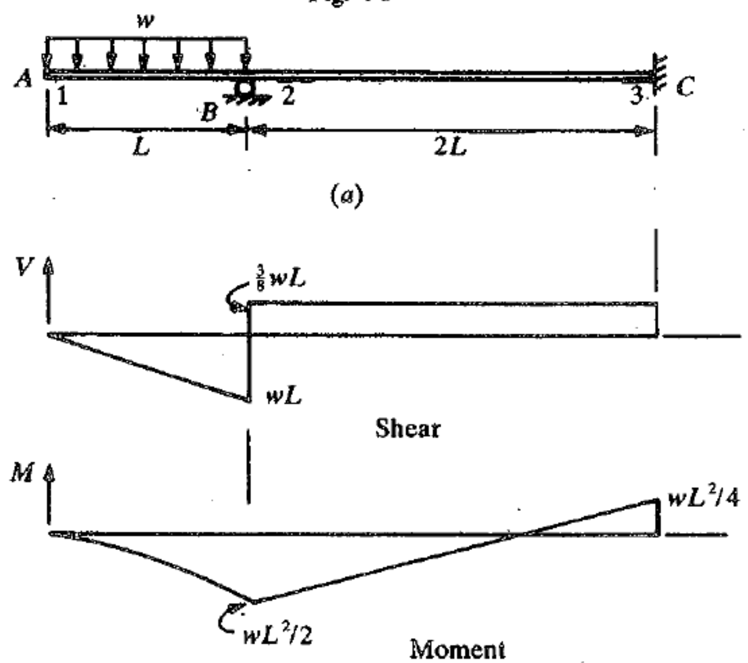


Fig. 4-8



(b)

Fig. 4-9

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3. Use the above script to solve the fixed-roller-fixed beam below (EI=1).

9–38. For the beam shown in Fig. 9–38 find (a) the bending moments at the fixed ends and at the middle support, (b) the maximum positive bending moments, and (c) the shearing forces at the fixed ends, and the reaction R_b.

Ans. (a) – 22,500 lb-ft, – 31,500 lb-ft, – 27,000 lb-ft; (b) 11,300 lb-ft, 30,750 lb-ft; (c) 6975 lb, 6225 lb, 13,200 lb

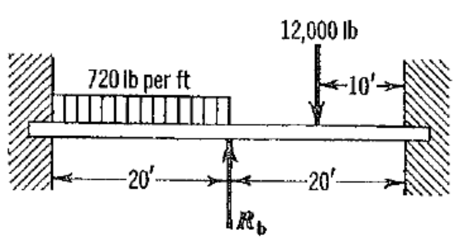

Fig. 9–38

4. Many problems involve constraints between degrees of freedom at different nodes. The two problems below each have the same constraint equation between v_{B_top} and v_{B_bottom}. What is that constraint equation? (Do not solve)

7.53 The end of the cantilever beam *BD* rests on the simply supported beam *ABC*. The two beams have identical cross sections and are made of the same material. Find the maximum bending moment in each beam when the 1400-lb load is applied.

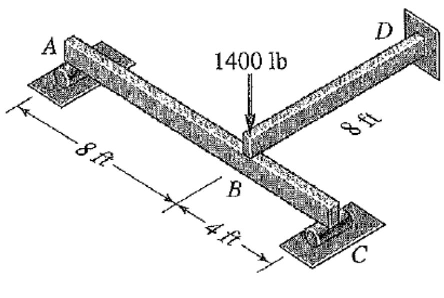

FIG. P7.53

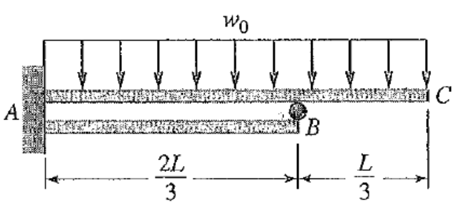

FIG. P7.55

7.55 The two cantilever beams have the same flexural rigidity *EI*. When unloaded, the beams just make contact at *B*. Find the contact force between the beams at *B* when the uniformly distributed load is applied.

Part 2 due March 17, 2009, 5pm

1. A triangle in physical space is defined by three coordinate pairs, (x_k, y_k), (in counter-clockwise order). It has a physical area of *A*. The *x* any *y* positions are interpolated parametrically over $0 \leq r, s \leq 1$ using $x(r,s) = \sum_1^3 N(r,s)_k x_k^e$, etc. for *y(r,s)*, where $N_1 = 1 - r - s,\ N_2 = r,\ N_3 = s$.
   a) Evaluate the *x* position at *r=s=0* in terms of the data x_k^e.
   b) Evaluate the *x*- and *y*- coordinates along *s=0* (as a function of *r*) in terms of x_k^e and y_k^e
   c) Find the x-centroid, $\bar{x}$, where $\bar{x}\,A = \iint x\,dA$ using a three point quadrature rule tabulated below. It can be shown that the determinant of the Jacobian of the geometric transformation is the constant |*J*| = *2A* (*dx dy* = |*J*| *dr ds*).

Table 10.3 *Symmetric quadrature for the unit triangle:*

$$\int_0^1 \int_0^{1-r} f(r,s)\,dr\,ds = \sum_{i=1}^{n} f(r_i, s_i) W_i$$

n	$p^\dagger$	i	r_i	s_i	W_i
1	1	1	1/3	1/3	1/2
3	2	1	1/6	1/6	1/6
		2	2/3	1/6	1/6
		3	1/6	2/3	1/6

Mech 517 2. Find the parametric derivative $\partial x / \partial r$ at point $r = s = 1/3$.