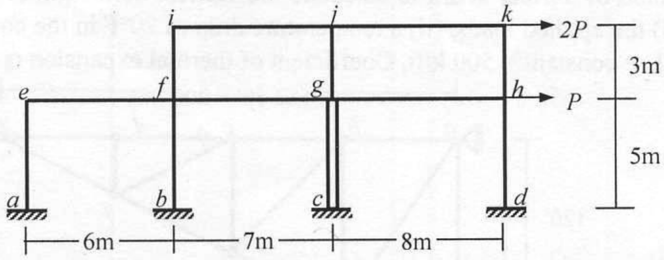
University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2012
Program: B.Sc. Engineering (Civil)

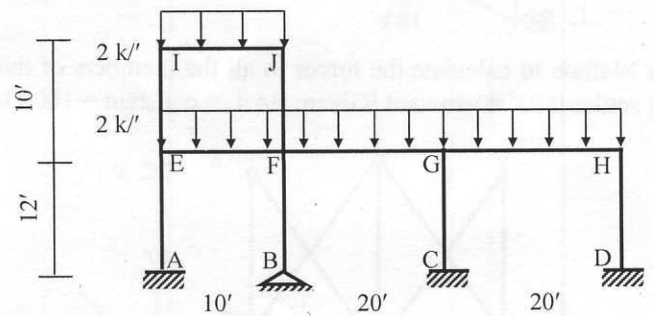
Course Title : Structural Engineering II — Course Code: CE 313
Time : 3 hour — Full Marks : 100

(There are 14 questions. Answer **any 10.** Each question carries equal marks)

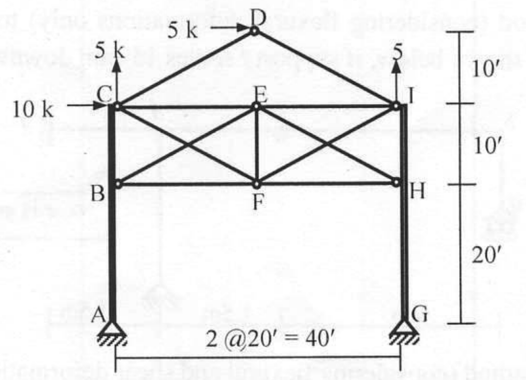
1. For the frame loaded as shown below, calculate the value of P if the
   (i) Calculate the value of P if the maximum bending moment in column cg is 75 kN-m
   (ii) Draw Bending Moment Diagram (BMD) of the beams



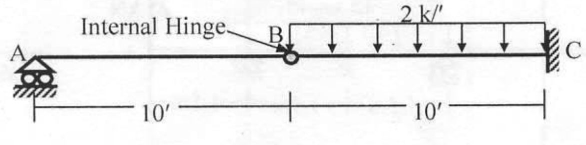
2. Analyze the two-storied frame structure loaded as shown below using the approximate location of hinges to draw the bending moment diagrams of the beams and columns.



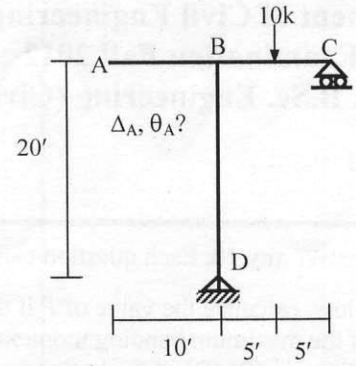
3. In the structure shown below,
   (i) Use the Portal Method to calculate the reactions at support A, G and draw the BMD of ABC.
   (ii) Calculate the forces in members CD, BE, CF, assuming diagonal members to take tension only.



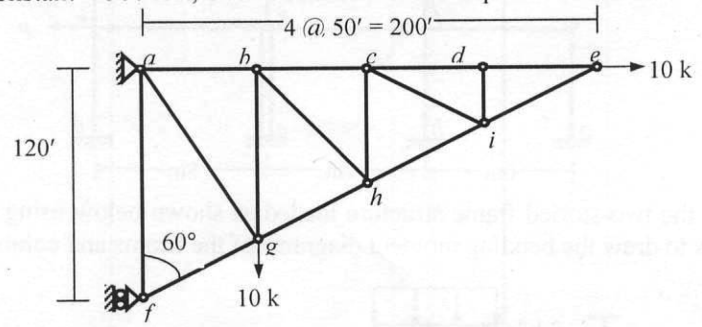
4. Use the Unit Load Method (considering flexural deformation only) to calculate the vertical deflection at B of the beam shown below [Given: EI = 40×10^3 k-ft^2, GA* = 200×10^3 k].



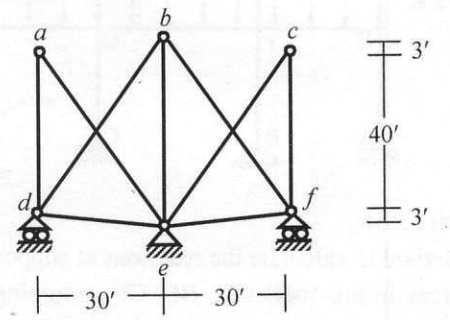
5. Use the Method of Virtual Work to calculate the vertical deflection at A ($\Delta_{A,v}$).
[Given EA = 400×10^3 k, GA* = 125×10^3 k, EI = 40×10^3 k-ft^2].



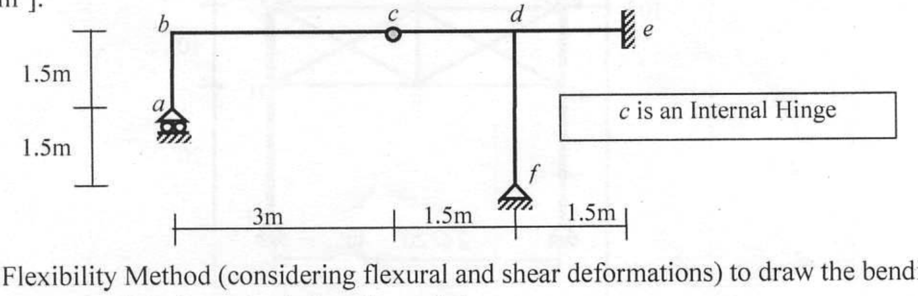
6. Use the Method of Virtual Work to calculate the vertical deflection at joint *f* in the truss shown below, for (i) the applied loads, (ii) a temperature drop of 20°F in the cord *af*
[Given: EA/L = constant = 500 k/ft, Coefficient of thermal expansion $\alpha = 5.5 \times 10^{-6}$/°F].



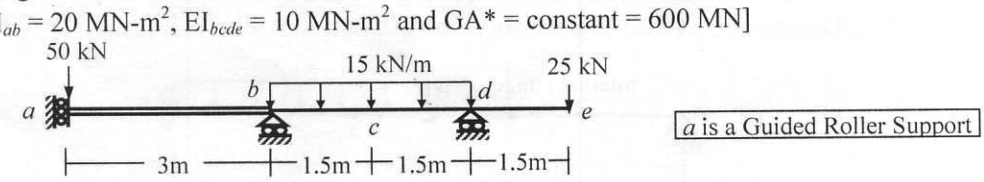
7. Use the Flexibility Method to calculate the forces in all the members of the truss *abcdef* shown below, if support *e* settles 0.05′ downward [Given: EA/L = constant = 1000 k/ft].



8. Use Flexibility Method (considering flexural deformations only) to draw the bending moment diagram of the frame shown below, if support *f* settles 15-mm downward [Given: EI = constant = 20 MN-m^2].



9. Use the Flexibility Method (considering flexural and shear deformations) to draw the bending moment diagram of the beam loaded as shown below
[Given: EI_{ab} = 20 MN-m^2, EI_{bcde} = 10 MN-m^2 and GA* = constant = 600 MN]



10. (i) Calculate the degree of statical indeterminacy (dosi) of the structures shown below.
(ii) Draw the qualitative influence line for M_A for the frame shown below.

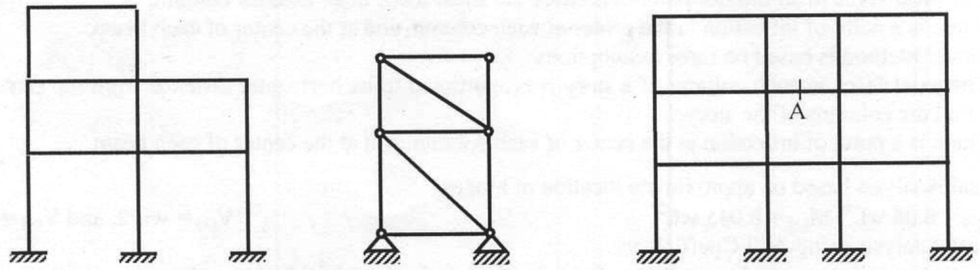
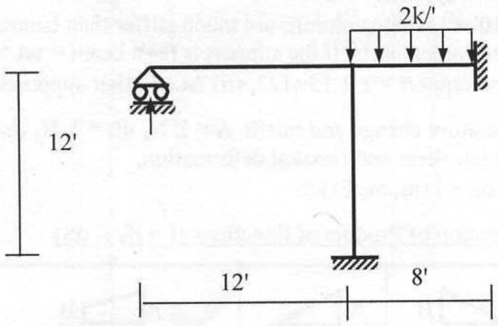


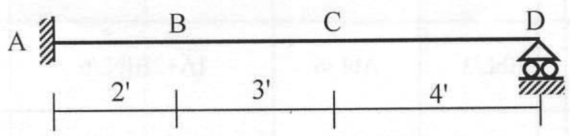
Figure for question 10. (i)

Figure for question 10. (ii)

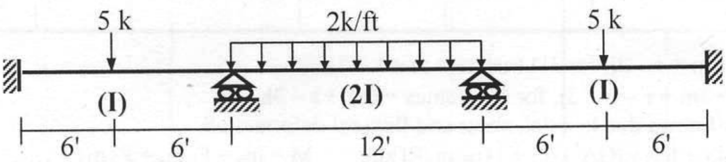
11. Draw the BMD of the following frame using moment distribution method



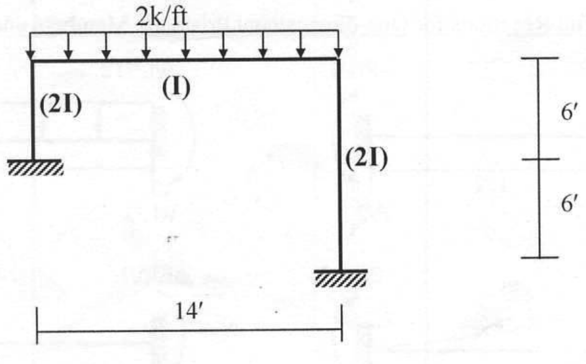
12. Draw the influence line for the vertical reaction at A and D. Also determine the quantitative value of V_A, V_B & M_C. Given: EI constant.



13. Use moment distribution method to draw the SFD and BMD of the following beam.



14. Calculate joint moments and draw BMD for the following frame using moment distribution method.



List of Useful Formulae for CE 313

* Portal Method for multi-storied frames assumes
  - The shear force in an interior column is twice the shear force in an exterior column.
  - There is a point of inflection at the center of each column, and at the center of each beam.
* Cantilever Method is based on three assumptions
  - The axial force in each column of a story is proportional to its horizontal distance from the center of gravity of all the columns of the story.
  - There is a point of inflection at the center of each column, and at the center of each beam.

* Vertical Analysis based on approximate location of hinges
  $M_{(+)} = 0.08\ wL^2$, $M_{(-)} = 0.045\ wL^2$, $V_{(+)} = wL/2$, and $V_{(-)} = -wL/2$
* Vertical Analysis using ACI Coefficients
  $M_{(+)}$ (i) For end spans, if discontinuous end is (a) unrestrained = $wL^2/11$, (b) restrained = $wL^2/14$
  (ii) For interior spans = $wL^2/16$
  $M_{(-)}$ (i) At the exterior face of first interior supports for (a) Two spans = $wL^2/9$, (b) More spans = $wL^2/10$
  (ii) At the other faces of interior supports = $wL^2/11$
  (iii) For spans not exceeding 10′, of where columns are much stiffer than beams = $wL^2/12$
  (iv) At the interior faces of exterior supports, if the support is (a) a beam = $wL^2/24$, (b) a column = $wL^2/16$
  V (i) In end members at first interior support = ± 1.15wL/2, (ii) At all other supports = ± wL/2

* Deflection of truss due to load, temperature change and misfit, $\Delta = \Sigma N_1\ dL = \Sigma N_1 (N_0 L/EA + \alpha \Delta T\ L + \Delta L)$
* Deflection of beams/frames due to axial, shear and flexural deformation,
  $\Delta = \int (x_1 x_0/EA)\ dS + \int (v_1 v_0/GA^*)\ dS + \int (m_1 m_0/EI) dS$

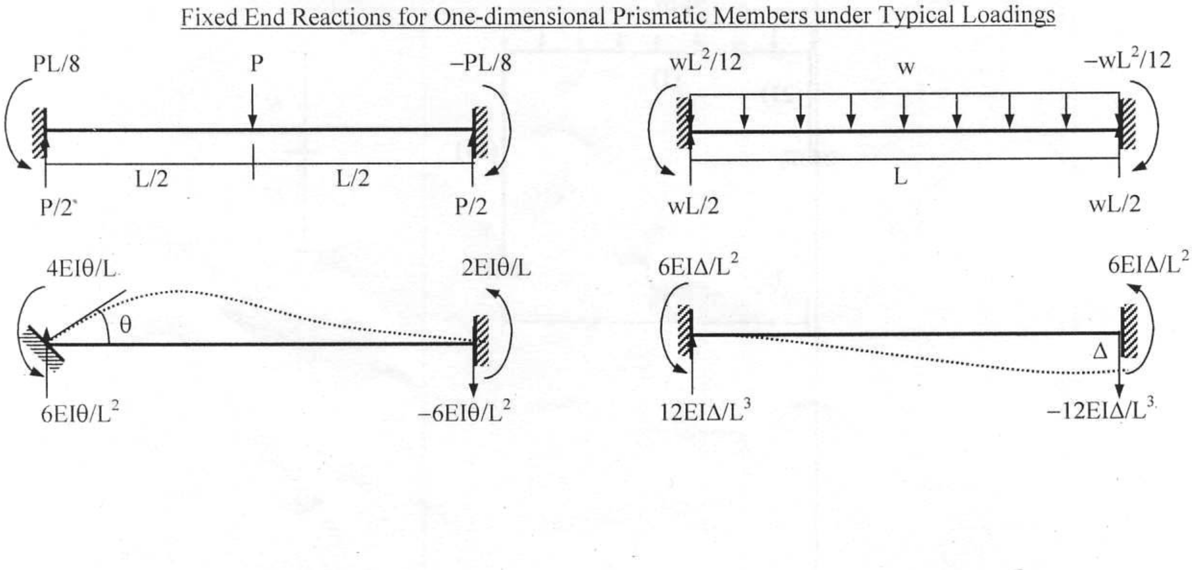
Integration of Product of Functions ($I = \int f_1\ f_2\ dS$)

f_2 \ f_1	A (rectangle), L	B (triangle, max at right), L	A (triangle, max at left), L	A, B (trapezoid), L	A, C, B (parabola), L
a (rectangle), L	AaL	BaL/2	AaL/2	(A+B)aL/2	[A+4C+B]aL/6
b (triangle, max at right), L	AbL/2	BbL/3	AbL/6	[A+2B]bL/6	[2C+B]bL/6
a (triangle, max at left), L	AaL/2	.BaL/6	AaL/3	[2A+B]aL/6	[A+2C]aL/6
a, b (trapezoid), L	A(a+b)L/2	B(a+2b)L/6	A(2a+b)L/6	[A(2a+b)+B(a+2b)]L/6	[Aa+Bb+ 2C(a+b)]L/6

* dosi for 2D trusses = $m + r - 2j$, for 3D trusses = $m + r - 3j$
* dosi for 2D frames = $3m + r - h - 3j$, for 3D frames = $6m + r - 3h - 6j$
* Deflection of beams/frames due to axial, shear and flexural deformation,
  $\Delta_{i,j} = \int (x_i x_j/EA)\ dS + \int (v_i v_j/GA^*)\ dS + \int (m_i m_j/EI) dS$; $M = m_0 + F_1 m_1 + F_2 m_2 + \ldots\ldots\ldots$, etc.
* Compatibility of deflection $\Rightarrow \Delta_{i,0} + F_1 \Delta_{i,1} + F_2 \Delta_{i,2} + \ldots\ldots\ldots F_n \Delta_{i,n} = \Delta_i$; etc

* For member with fixed far end, Rotational stiffness = 4EI/L, Carry over factor = 0.5
* For member with hinged/roller/discontinuous far end, Rotational stiffness = 3EI/L, Carry over factor = 0
* The moment distribution factors of members OA, OB,........ are $[K_{OA}/K_O]$, $[K_{OB}/K_O]$,..........respectively

Fixed End Reactions for One-dimensional Prismatic Members under Typical Loadings



SEC Z

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   (i) Calculate the value of P if the maximum bending moment in column cg is 75 kN-m
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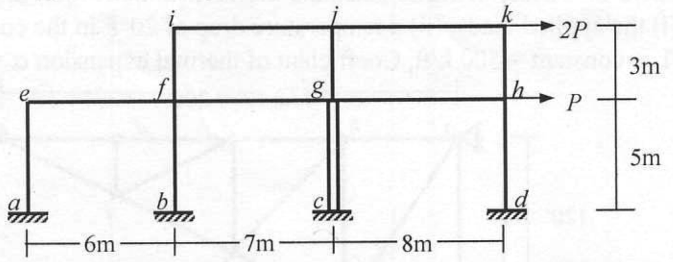

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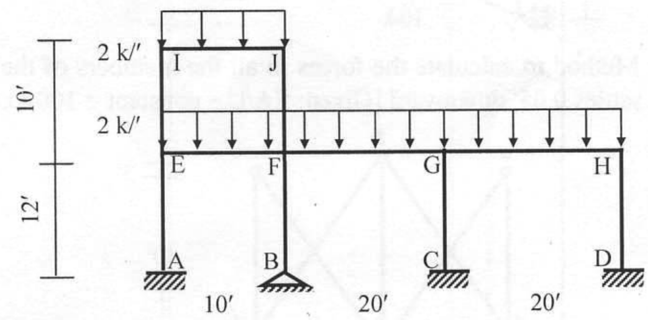

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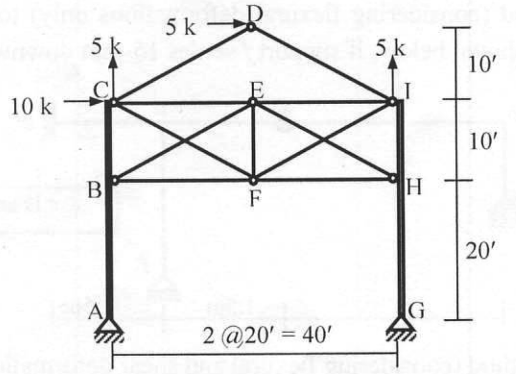

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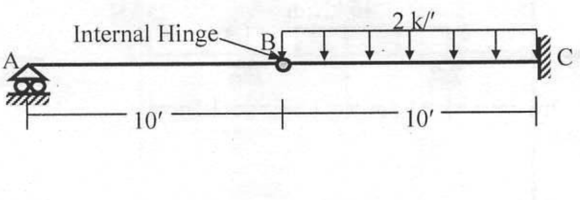

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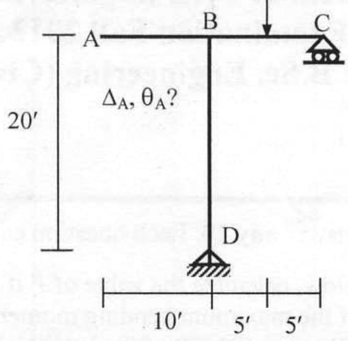

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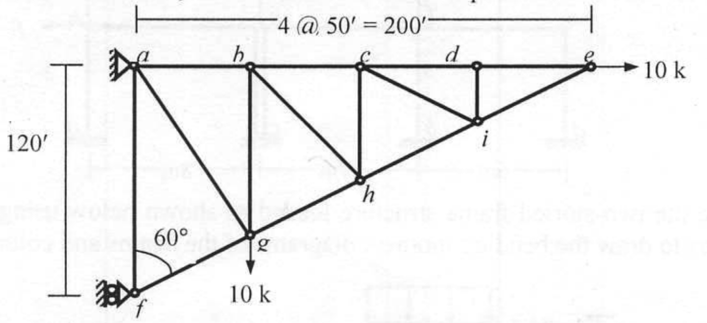

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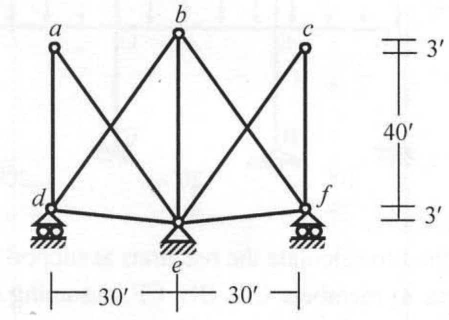

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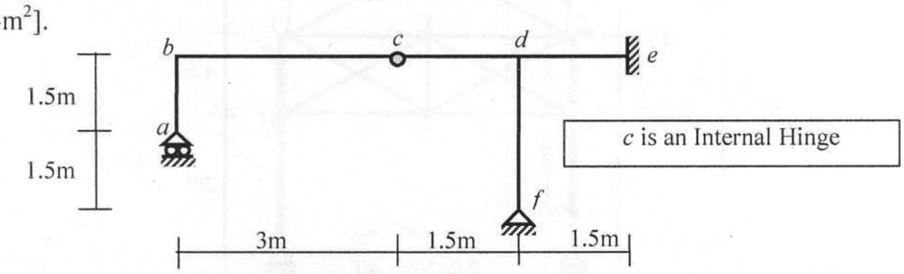

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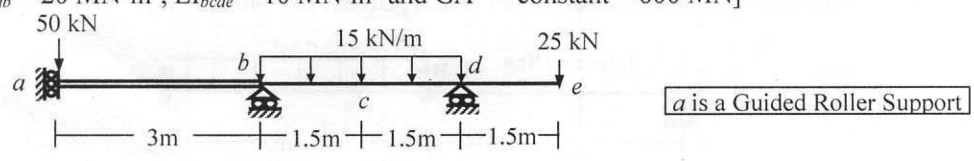

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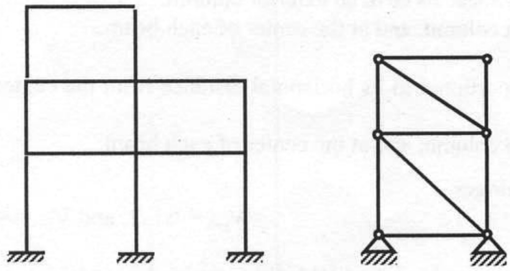

Figure for question 10. (i)

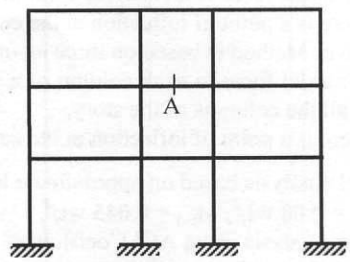

Figure for question 10. (ii)

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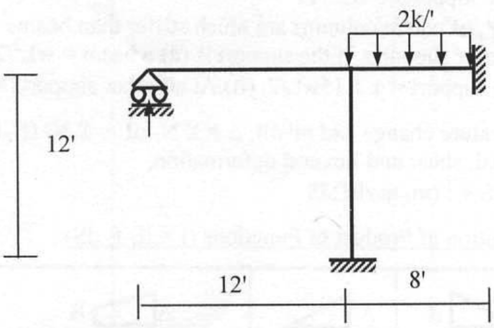

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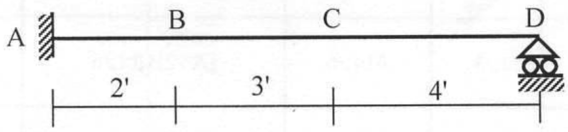

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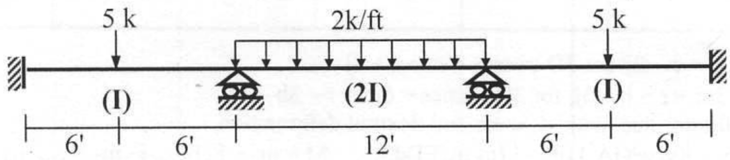

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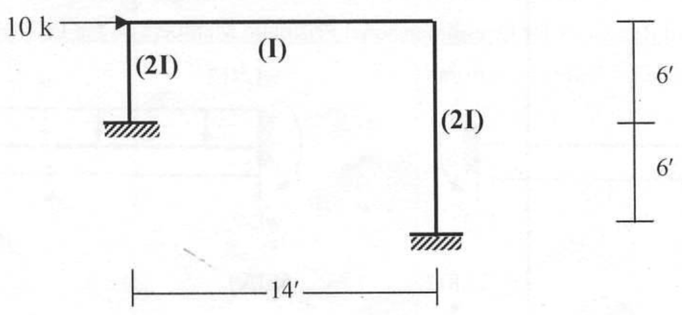

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b, L	AbL/2	BbL/3	AbL/6	[A+2B]bL/6	[2C+B]bL/6
a, L	AaL/2	BaL/6	AaL/3	[2A+B]aL/6	[A+2C]aL/6
a, b, L	A(a+b)L/2	B(a+2b)L/6	A(2a+b)L/6	[A(2a+b)+B(a+2b)]L/6	[Aa+Bb+ 2C(a+b)]L/6

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