Lab-2 & 3

1.1 Beam & Frame Analysis

Consider the 2-dimensional frame in Figure 17. It is indeterminate to the sixth degree. Assuming that the value of I is 500 in^4, the area of member AB is 15 in^2, the area of the remaining members is 10 in^2, and a Young's modulus of 29,000 ksi, the analysis is summarized below.

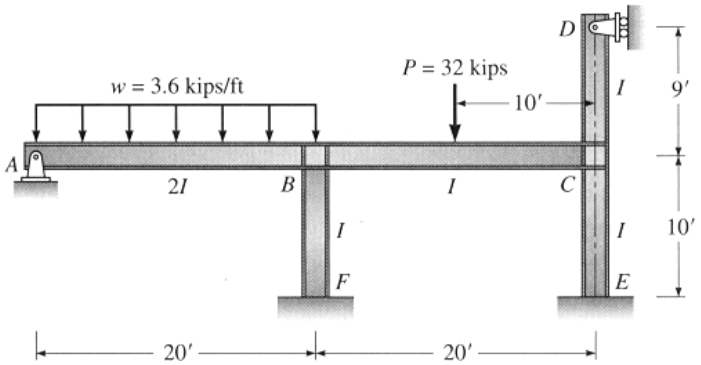


Figure **Error! No text of specified style in document.**-1: 2-D Frame Example

1. Follow Steps 1 through 4 in the previous section to provide general information. In step 3, use the default value for the **Number of Sections** so that internal forces at 5 equally spaced locations along each member will be provided. The frame is composed of 6 joints and 5 members. In step 5, change the default grid settings to 40@1 ft and 19@1 ft in the X and Y directions, respectively, such that all joints of the frame fall on the grid.
2. Follow Step 7 to enter the joint coordinates (see Figure 18). Alternatively, you can follow Step 14 to specify both joints and members graphically.

Joint Coordinates

	Label	X [ft]	Y [ft]
1	A	0	10
2	B	20	10
3	C	40	10
4	D	40	19
5	E	40	0
6	F	20	0

Figure **Error! No text of specified style in document.**-2: Joint Coordinates for Frame

3. Follow Step 8 to provide information for the **Boundary Conditions**. Since joints E and F are fix-ended, set the boundary codes for all the directions (X, Y, and rotation) as **Fixed** (see Figure 19).

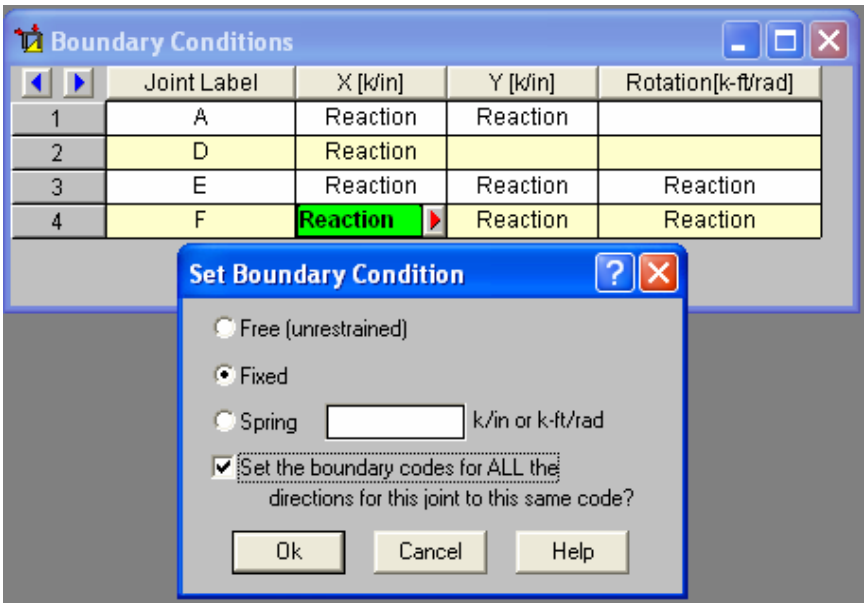


Figure **Error! No text of specified style in document.**-3: Boundary Condition

4. Click **Members** in the **Data Entry** toolbar to specify member data, which include the member labels, joint labels at both ends, area, moment of inertia, and Young's modulus (see Figure 20). Note that shearing deformation of the member is ignored in this educational version. If it is desired to ignore the axial deformation of the flexural member, you can specify a large value for the member area.

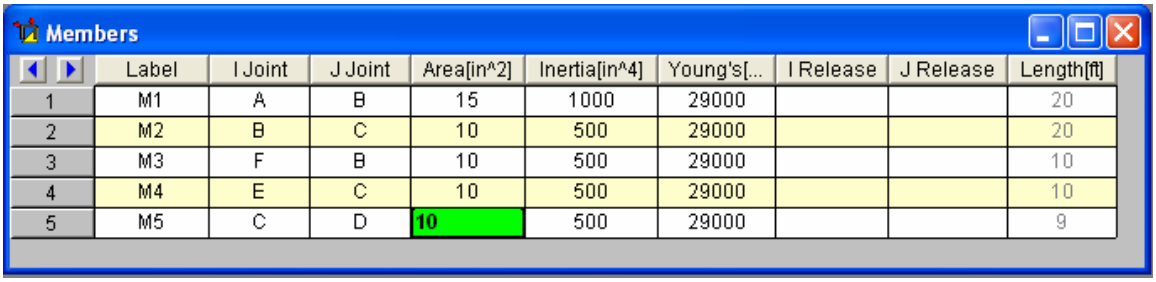


Figure **Error! No text of specified style in document.**-4: Members

5. Skip **Joint Loads** from the **Data Entry** toolbar because this example does not have joint loads. Instead, click **Point Loads** from the **Data Entry** toolbar to specify the 32-kip point load that acts on member BC (see Figure 21). Click **Distributed Loads** from the **Data Entry** toolbar to specify the uniformly distributed load that acts on member AB (see Figure 22). The data entry is now complete. Click **View** from the manual bar and select **Loads** to show graphically the applied loads (Figure 23)

Note that you can select the loading direction as **X**, **Y**, **x**, or y in the **Direction** field when specifying either the point load or the distributed load. Directions X and Y refer to the global coordinate system (see Figure 2), while directions x and y refer to the local coordinate system of a member. As can be seen from Figure 24, the local x-axis corresponds to the member centerline. The positive direction of this local x- axis is from I joint towards J joint. The local z-axis is always normal to the plane of the model with positive z being towards you. The local y-axis is then defined by the right-hand rule. When a member is inclined, it is sometimes more convenient to specify the point load or transverse load in the local coordinate system.

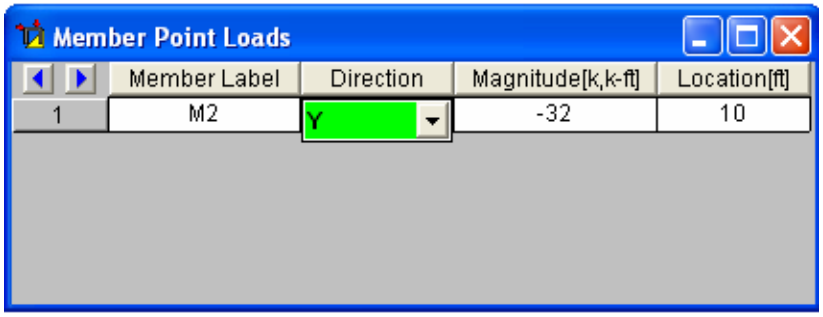


Figure **Error! No text of specified style in document.**-5: Point Loads

Member Distributed Loads

	Member Label	Direction	Start Magnitude[k/ft]	End Magnitude[k/ft]	Start Location[ft]	End Location[ft]
1	M1	Y	-3.6	-3.6	0	20

Figure **Error! No text of specified style in document.**-6: Distributed Loads

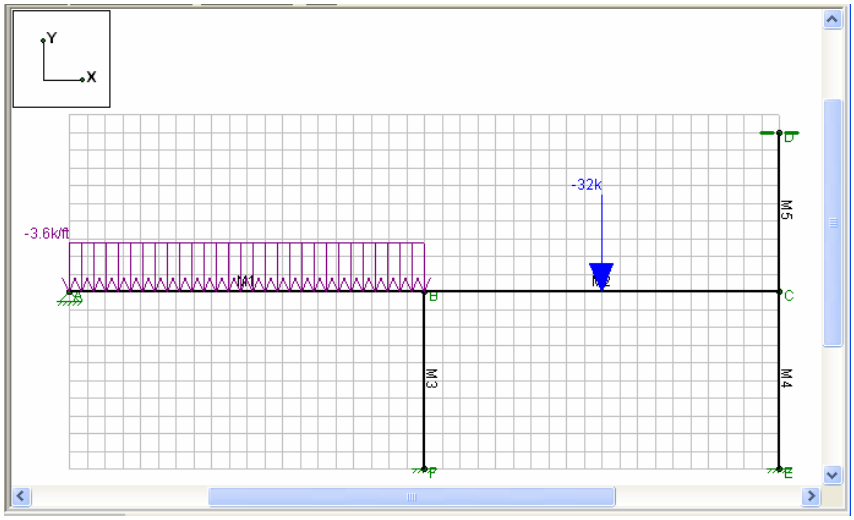


Figure **Error! No text of specified style in document.**-7: 2D Complete Model

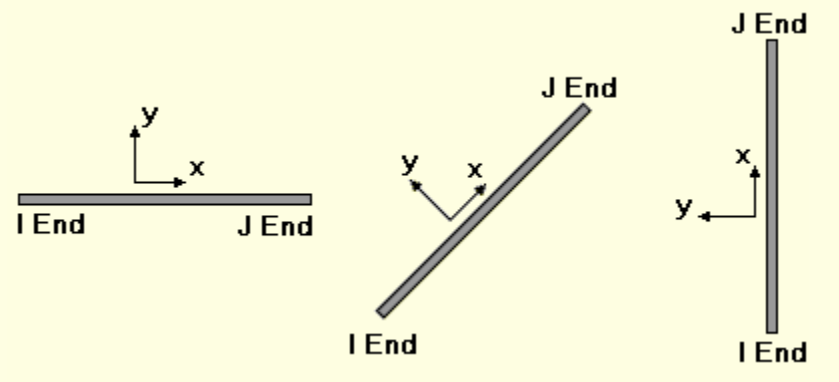


Figure **Error! No text of specified style in document.**-8: Local and Global Coordinates

6. Now click **Solve** from the manual bar to perform the structural analysis. Click **Joint Reaction**s from the **Results** toolbar to view the reaction forces (see Figure 25). Click **Joint Deflections** for the deflections and rotation at each joint (see Figure 26). Click **Member Deflections** if you are interested in the deflections of the members (see Figure 27). The member internal forces at equally spaced sections along each member can be viewed by clicking **Member Forces** (see Figure 28). The sign convention of the internal forces is defined in Figure 15.

Joint Reactions

	Joint Label	X [k]	Y [k]	MZ [k-ft]
1	A	6.987	28.718	0
2	D	3.065	0	0
3	E	-4.213	13.52	13.237
4	F	-5.839	61.762	18.817
5	Totals:	0	104	32.053

Figure **Error! No text of specified style in document.**-9: Frame Joint Recations

Joint Deflections

	Joint Label	X [in]	Y [in]	Rotation [rad]
1	A	0	0	-3.654e-3
2	B	-.004	-.026	1.031e-3
3	C	-.005	-.006	7.774e-4
4	D	0	-.006	-4.554e-4
5	E	0	0	0
6	F	0	0	0

Figure **Error! No text of specified style in document.**-10: Joint Deflection

Member Section Deflections

	Member Label	Sec	x [in]	y [in]
1	M1	1	0	0
2		2	0	-.189
3		3	-.002	-.243
4		4	-.003	-.148
5		5	-.004	-.026
6	M2	1	-.004	-.026
7		2	-.004	-.076
8		3	-.004	-.167
9		4	-.005	-.103
10		5	-.005	-.006
11	M3	1	0	0
12		2	-.006	-.005
13		3	-.013	-.014
14		4	-.019	-.014
15		5	-.026	.004
16	M4	1	0	0
17		2	-.001	-.004
18		3	-.003	-.009
19		4	-.004	-.009
20		5	-.006	.005
21	M5	1	-.006	.005
22		2	-.006	.018
23		3	-.006	.019
24		4	-.006	.012
25		5	-.006	0

Figure **Error! No text of specified style in document.**-11: Member deflections

Member Section Forces

	Member Label	Sec	Axial[k]	Shear[k]	Moment[k-ft]
1	M1	1	6.987	28.718	0
2		2	6.987	10.718	98.588
3		3	6.987	-7.282	107.177
4		4	6.987	-25.282	25.765
5		5	6.987	-43.282	-145.647
6	M2	1	1.148	18.48	-106.073
7		2	1.148	18.48	-13.674
8		3	1.148	-13.52	78.725
9		4	1.148	-13.52	11.123
10		5	1.148	-13.52	-56.478
11	M3	1	61.762	5.839	-18.817
12		2	61.762	5.839	-4.219
13		3	61.762	5.839	10.379
14		4	61.762	5.839	24.976
15		5	61.762	5.839	39.574
16	M4	1	13.52	4.213	-13.237
17		2	13.52	4.213	-2.704
18		3	13.52	4.213	7.828
19		4	13.52	4.213	18.36
20		5	13.52	4.213	28.892
21	M5	1	0	3.065	-27.586
22		2	0	3.065	-20.689
23		3	0	3.065	-13.793
24		4	0	3.065	-6.896
25		5	0	3.065	0

Figure **Error! No text of specified style in document.**-12: Member Section Forces

7. Analysis results can also be viewed graphically in the **Model View** window by clicking on the icons below the manual bar (see Figure 29). (If this window does not appear, click **View** from the manual bar and select **New View** to create one.) For example, Figure 30 shows the moment diagrams, reactions, and the deflected shape of the structure. Figure 31 depicts the reactions together with the applied loads.

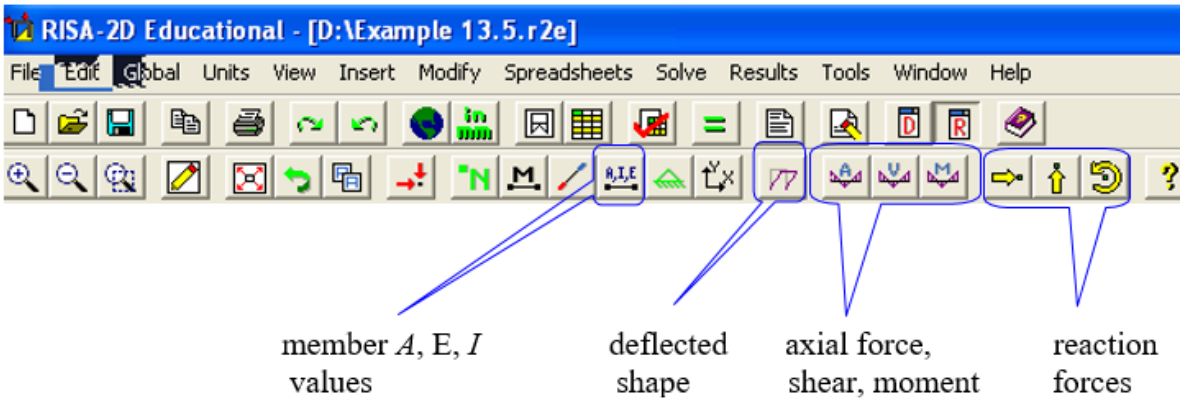


Figure **Error! No text of specified style in document.**-13: Result Shortcuts

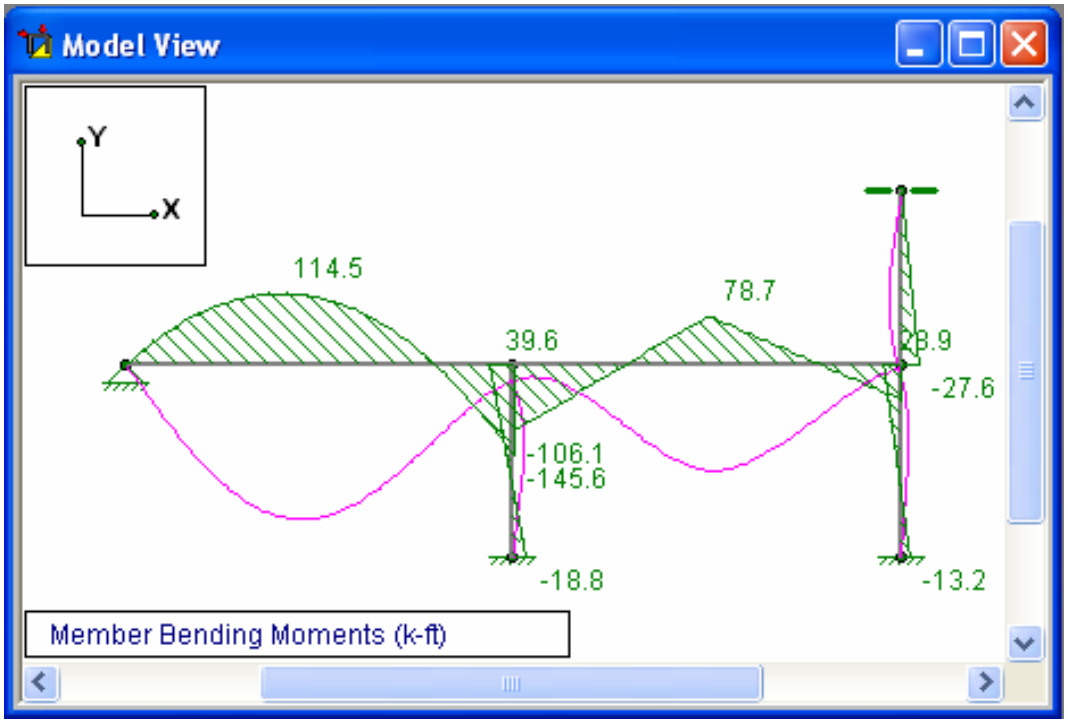


Figure **Error! No text of specified style in document.**-14: Graphical Representation of SFD and Deflection

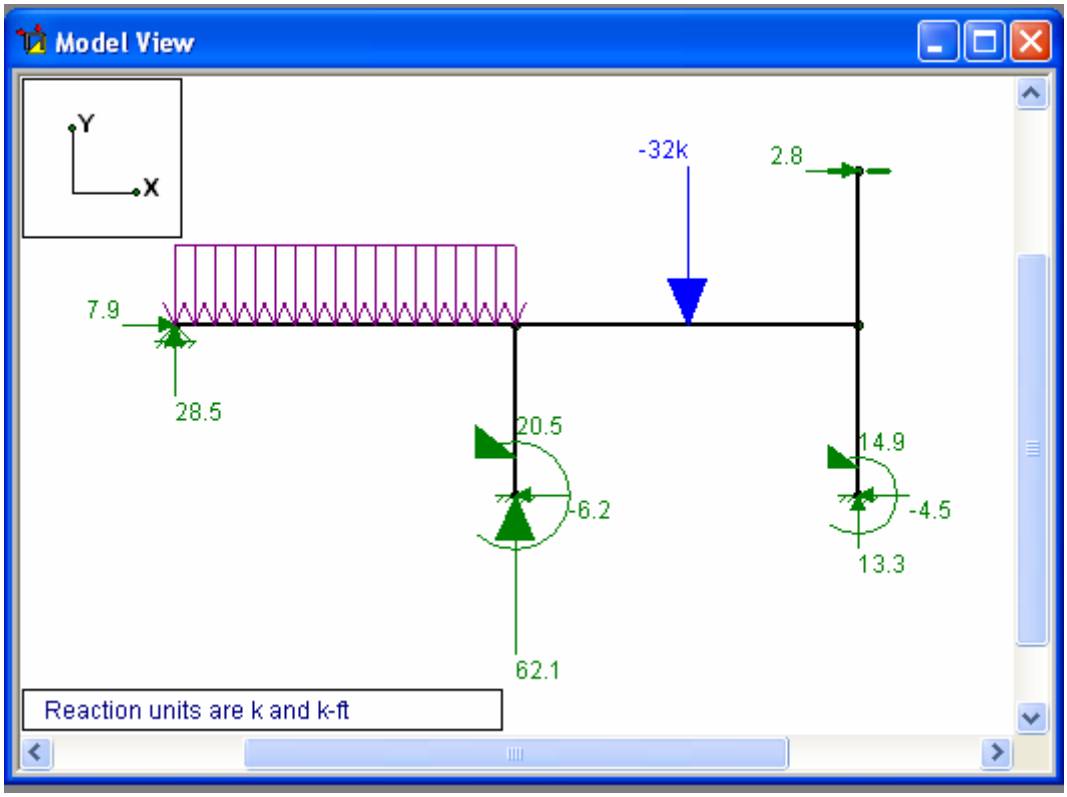
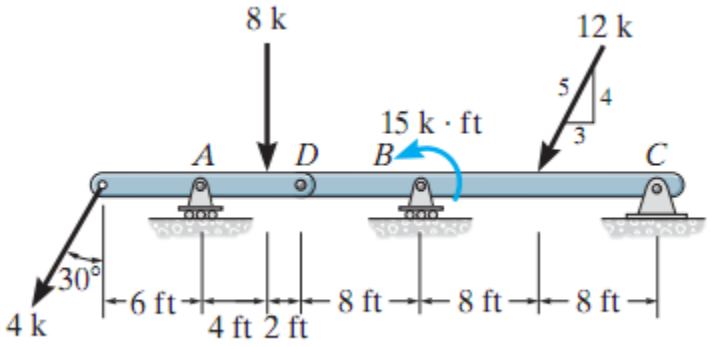


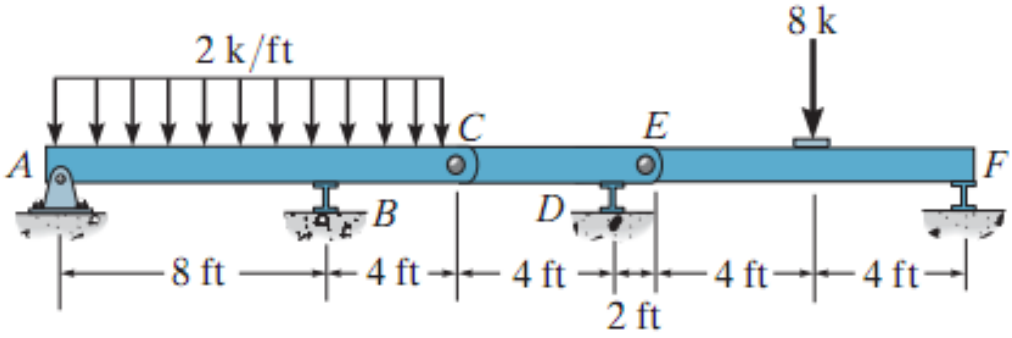
Figure **Error! No text of specified style in document.**-15: Graphical Representation of Reactions

Develop the SFD and BMD of the following beams and find the reactions using RISA-2D

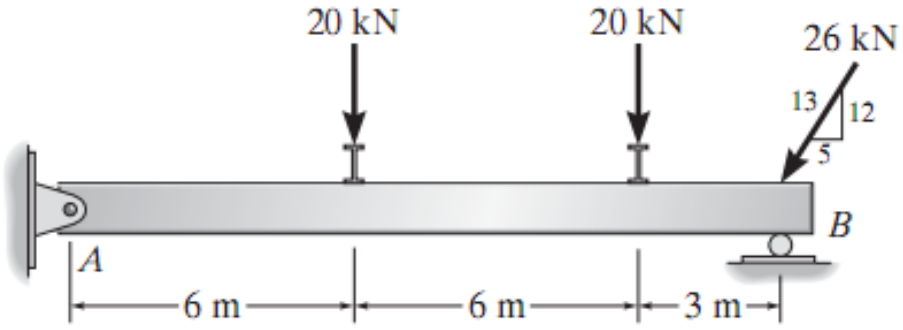
Task-1: A and B are the Roller Support and C is the Pin Support



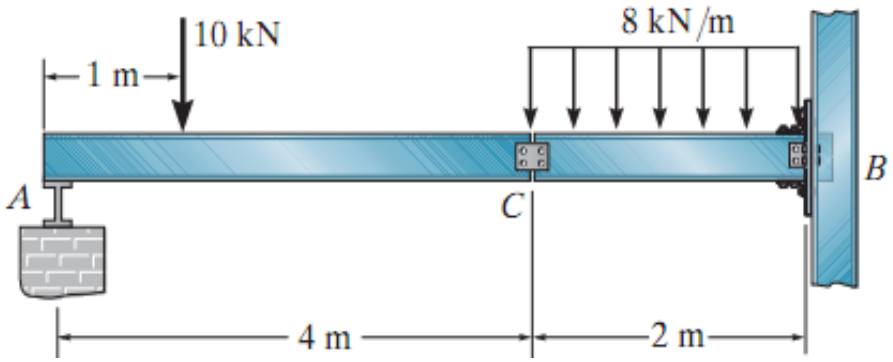
Task-2: B, D and F are the Roller Support and A is the Pin Support, whereas C and E are the pin connection



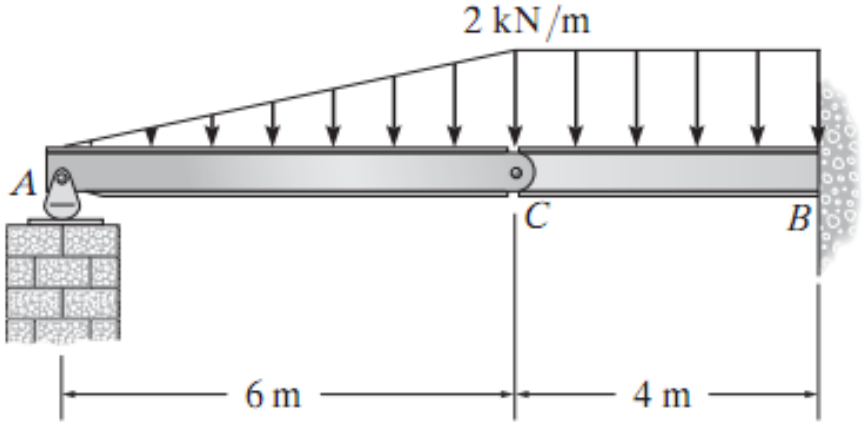
Task-3: A is the Pin Support and B is the roller support



Task-4: A is the roller support; B is the Fixed Support and C is the pin connection



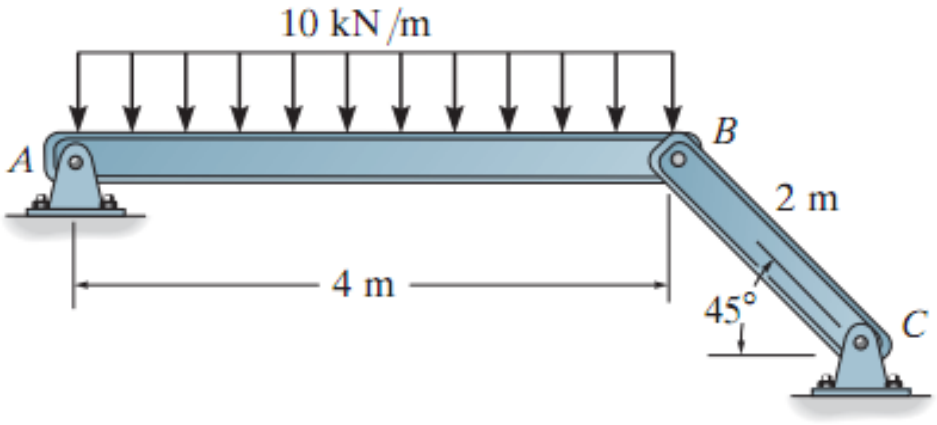
Task-5: A is the roller support; B is the Fixed Support and C is the pin connection



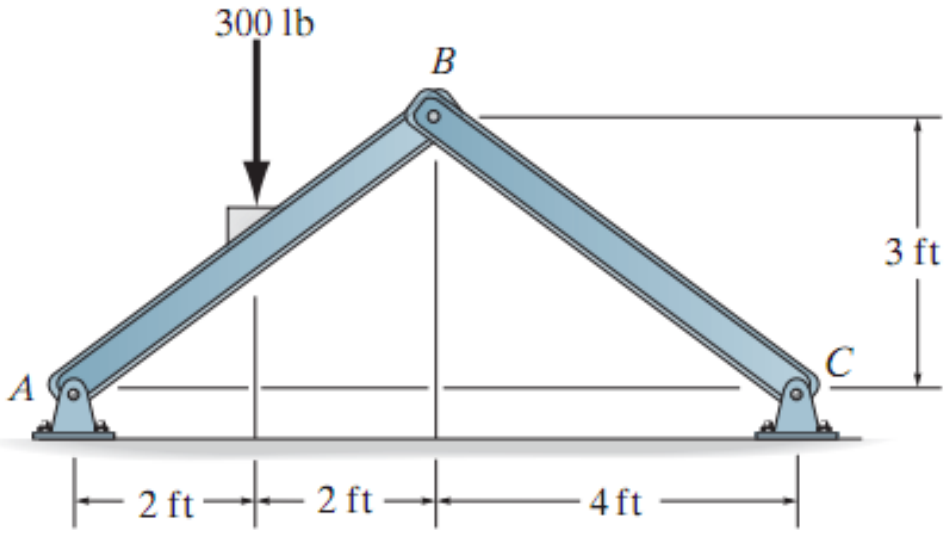
Lab-4

Develop the SFD and BMD of the following Frames and find the reactions using RISA-2D

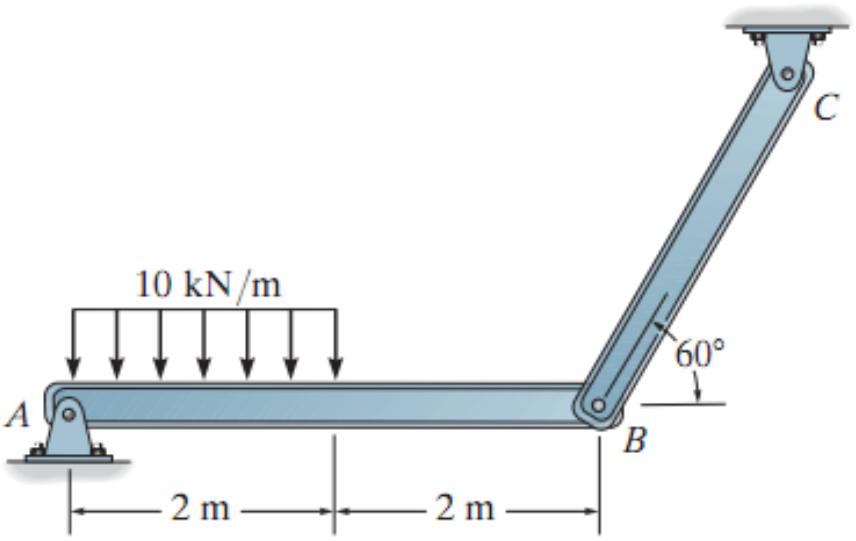
Task-1: A and B are the Pin Support and C is the Pin connection



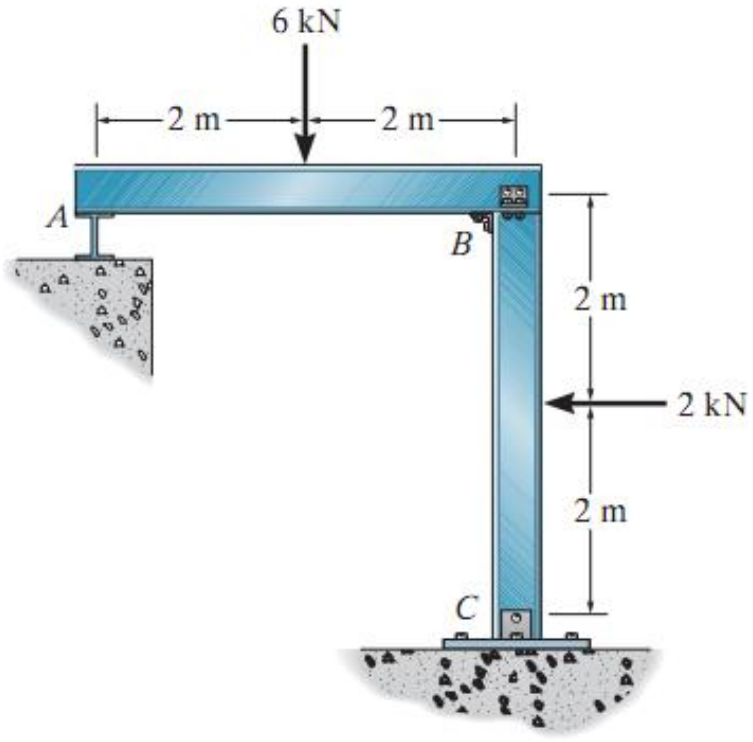
Task-2: A, C are the Pin Support, whereas B is the pin connection



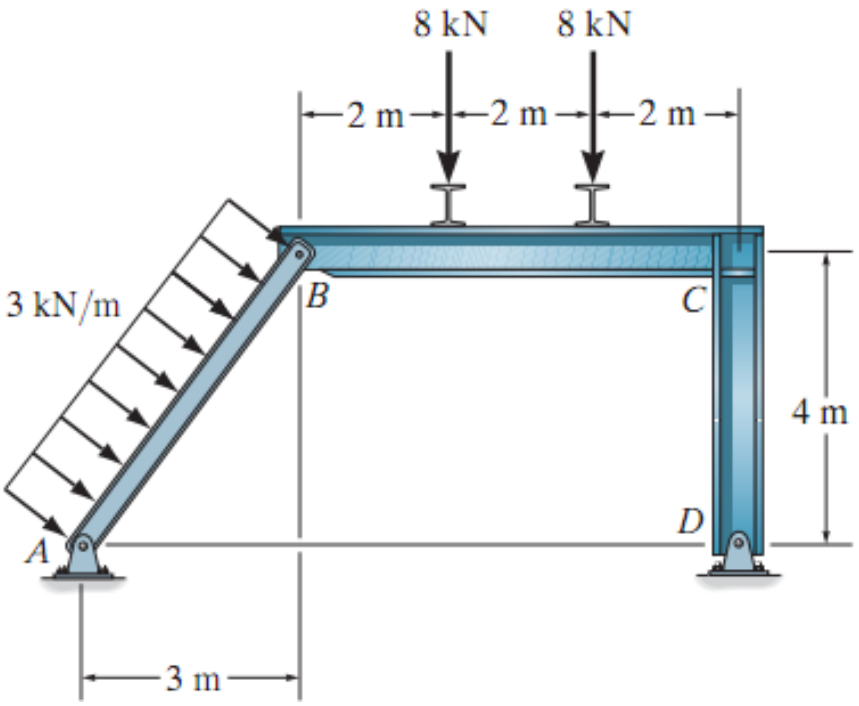
Task-3: A and C is the Pin Support and B is the Pin connection



Task-4: C is the Fix support; C is the roller support.



Task-5: A and D, are the Pin support; B is the pin connection


8 kN
8 kN
2 m
2 m
2 m
3 kN/m
B
C
4 m
D
A
3 m