

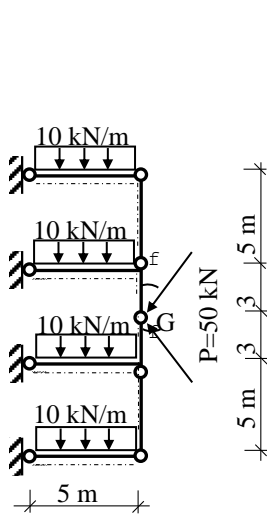
NOTE:

- This worksheet is prepared with the purpose of improving your comprehension of the course materials considering that problem solving sessions might not be sufficient. It is suggested to solve related problems after a topic is covered in lecture. It is obvious that you will be more successful if you consider this suggestion seriously.
- The force unit is **kN**, and the length unit is **m**, unless it is mentioned.

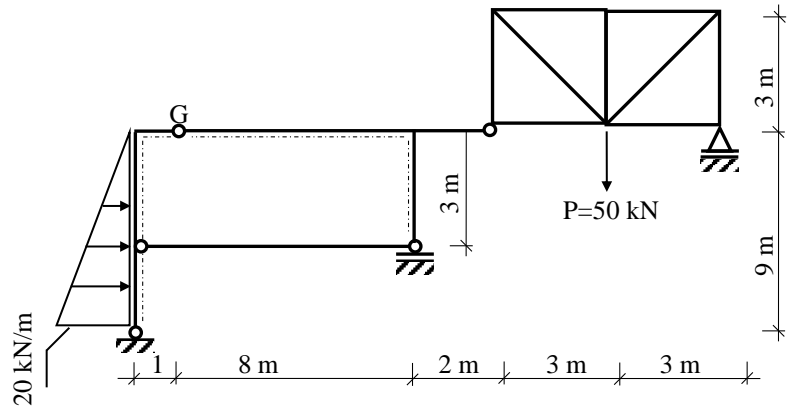
Question 1:

a) Determine the lateral displacement at point ‘G’ for system given in **Figure-1a** by using **Virtual Work Principle**. ($EI=14700 \text{ kNm}^2$, $EA=5,25 \times 10^6 \text{ kN}$, $GA'=1,69 \times 10^6 \text{ kN}$, EA , EI and GA' are constant for whole system.)

b) Determine the relative rotation at point ‘G’ ($\Delta\phi_G$) for the system given in **Figure-1b** due to given external loads and **in case of the tie-rod** is exposed to uniform temperature change to be 15°C by using **Virtual Work Principle**. External loads and temperature change will be affected separately. ($\alpha_T=1,3 \cdot 10^{-5} \text{ } 1/^\circ\text{C}$). ($t=15^\circ$)



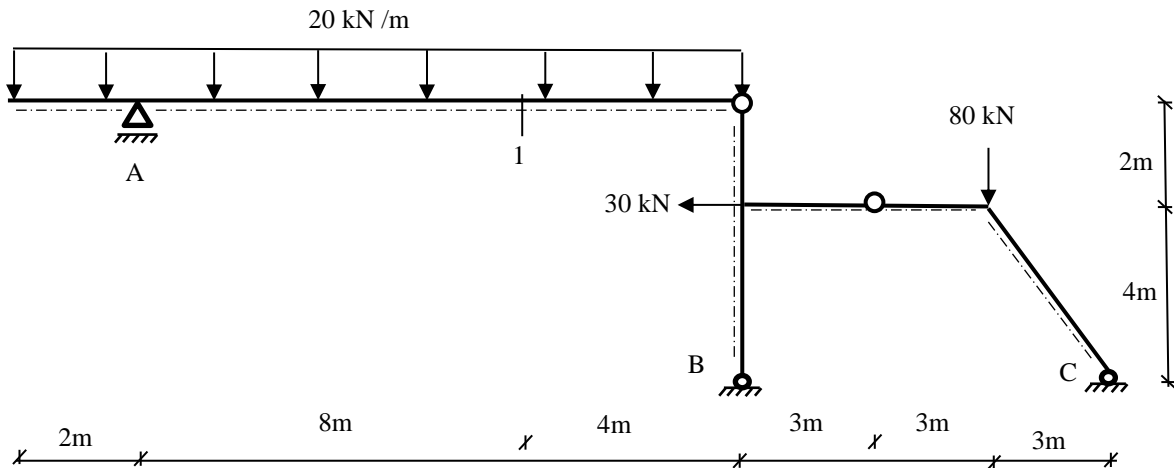
(Figure-1a)



(Figure-1b)

Question 2:

Determine the vertical displacement at section ‘1’ for the system given in **Figure-2** by using **Virtual Work Principle**. ($EI=3 \times 10^4 \text{ kNm}^2$, $EA=\infty$ ve $GA'=\infty$)



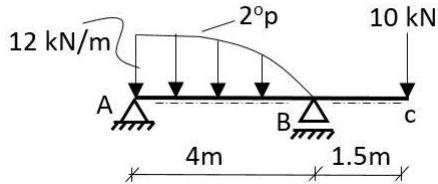
(Figure-2)

Yıldız Technical University-Faculty of Civil Engineering-Department of Civil Engineering 2024-2025 Academic Year Fall Semester Structural Analysis II Worksheet

Question 3:

- a) Determine the rotation angle at support 'A' (ϕ_B) of the system given in **Figure-3**.
- b) Draw the **bending moment (M) diagram** of the system given in Figure-3 just for a non-uniform temperature change $\Delta t=30^\circ\text{C}$. ($h=60\text{cm}$, $\alpha_t = 10^{-5} 1/^\circ\text{C}$)

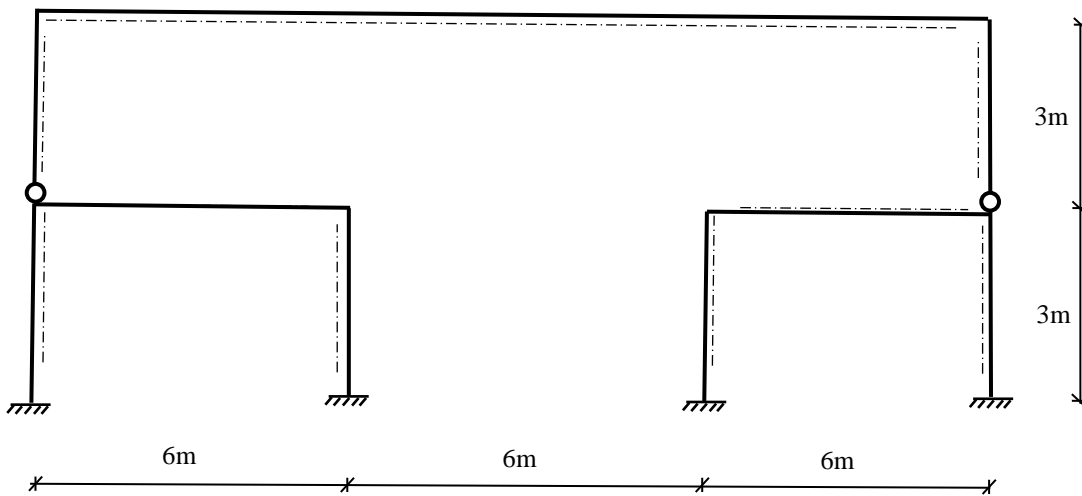
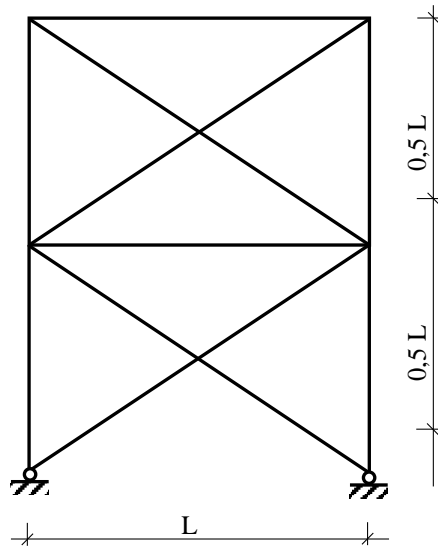
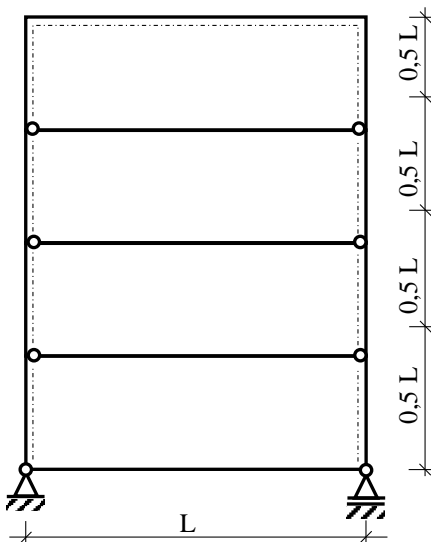
by using **Virtual Work Principle**.



(Figure-3)

Question 4:

- a) Determine the **degree of indeterminacy** of the system given in **Figure-4**.
- b) Specify at least two statically determined systems and show the redundant forces of these systems.
- c) Draw the unit force diagrams of the statically determined systems.

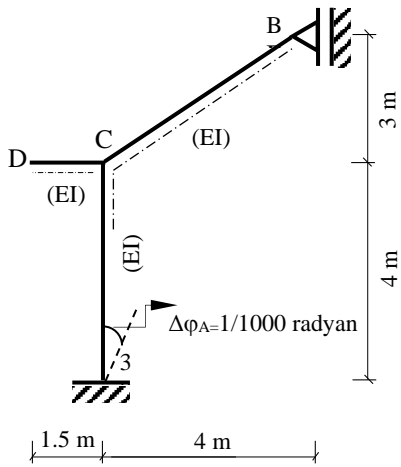


(Figure-4)

Worksheet

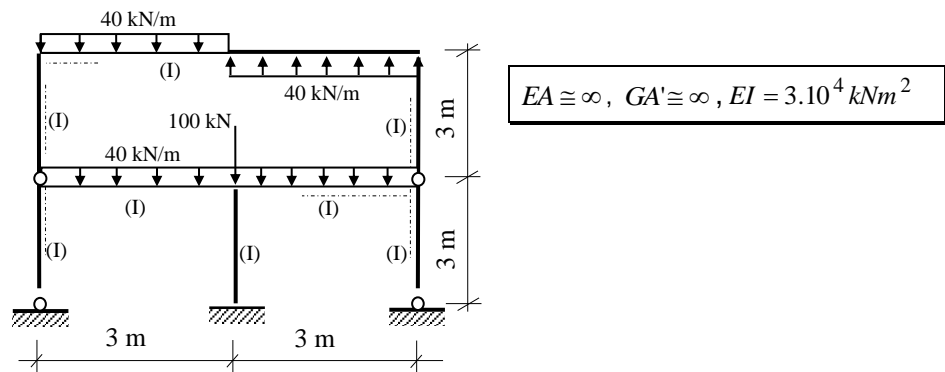
Question 8: Draw the bending moment (**M**) and shear force (**V**) diagrams of the system given in **Figure-8** due to **1/1000 rad** rotation at support **A** by using **Force Method**.

Note: ($EI= 3 \times 10^4 \text{ kNm}^2$, $EA= \infty$ ve $GA'= \infty$)



(Figure-8)

Question 9: Draw the bending moment (**M**) and shear force (**V**) diagrams of the system given in **Figure-9** due to the given external loads by using **Force Method**.

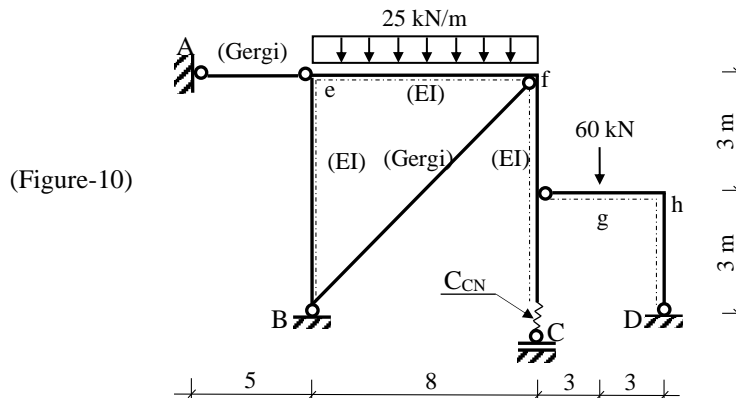


(Figure-9)

Question 10:

- a) Draw **M** and **V** diagrams of the system given in **Figure-10** due to the given external loads,
- b) Draw the bending moment (**M**), shear force (**V**) and axial force (**N**) diagrams due to Δv_A vertical settlement and Δu_A lateral displacement at the same time at point A, by using **Force Method**.

Note: ($\alpha_T=10^{-5} \text{ 1/}^\circ\text{C}$, $h=50 \text{ cm}$, $C_{CN}=3 \times 10^4 \text{ kN/m}$, $EI=3 \times 10^4 \text{ kNm}^2 \cong 2EA_g$, $\Delta u_A = 4.5 \text{ cm}$, $\Delta v_A = 5 \text{ cm}$).



(Figure-10)

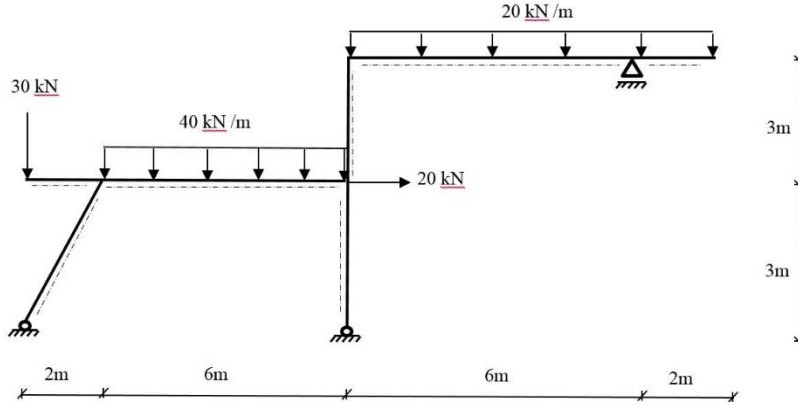
Yıldız Technical University-Faculty of Civil Engineering-Department of Civil Engineering 2024-2025 Academic Year Fall Semester Structural Analysis II Worksheet

Question 11:

- a) Draw **M, V** and **N** diagrams of the system given in **Figure-11** due to **the given external loads**,
 b) Draw the bending moment (**M**), shear force (**V**) and axial force (**N**) diagrams of the system due to a non-uniform temperature change $\Delta t = 15^\circ \text{C}$,

by using **Force Method**.

$$(\alpha_T = 10^{-5} \text{ 1/}^\circ\text{C}) \quad (EI = 3 \times 10^4 \text{ kNm}^2, EA = \infty \text{ ve } GA' = \infty)$$



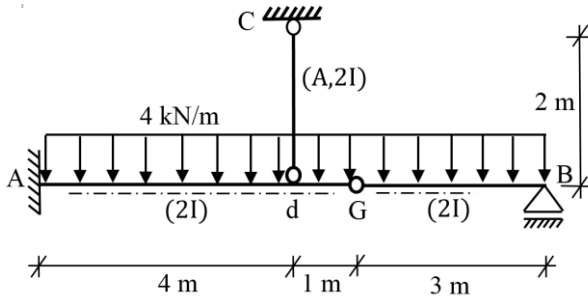
(Figure-11)

Question 12:

- a) Draw **M** and **V** diagrams of the system given in **Figure-12** due to **the given external loads**,
 b) Draw the bending moment (**M**) diagram of the system due to only a non-uniform temperature change $\Delta t = 20^\circ \text{C}$

by using **Force Method**.

$$(EI = 3 \times 10^4 \text{ kNm}^2, EA = \infty (\text{tüm çubuklarda}), GA' = \infty, h = 60 \text{ cm}, \quad \alpha t = 10^{-5} \text{ 1/}^\circ\text{C})$$



(Figure-12)

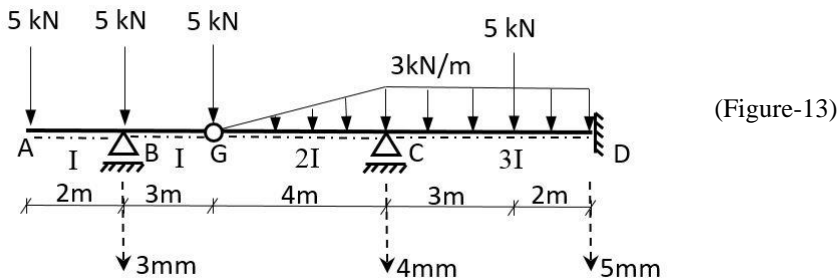
Yıldız Technical University-Faculty of Civil Engineering-Department of Civil Engineering 2024-2025 Academic Year Fall Semester Structural Analysis II Worksheet

Question 13:

- a) Draw **M** and **V** diagrams of the system given in **Figure-13** due to the given external loads,
 b) Draw **M** diagram in case of support settlements given in **Figure-13**

by using **Force Method**.

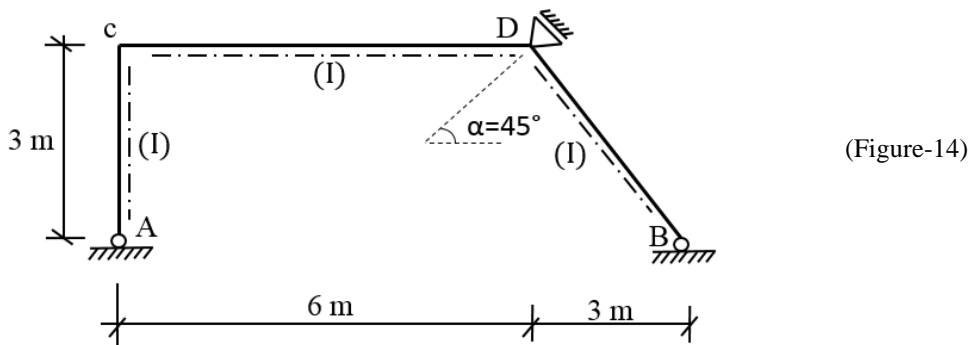
($EI= 3 \times 10^4 \text{ kNm}^2$, $EA= \infty$ ve $GA'= \infty$)



(Figure-13)

- Question 14:** Draw the bending moment (**M**) diagram of the system given in **Figure-14** due to 1 cm vertical settlement ($\Delta v_A=1\text{cm}$) and 2 cm lateral displacement ($\Delta u_A=2\text{cm}$) at the same time at point A by using **Force Method**.

($EI= 3 \times 10^4 \text{ kNm}^2$, $EA= \infty$, $GA'= \infty$)

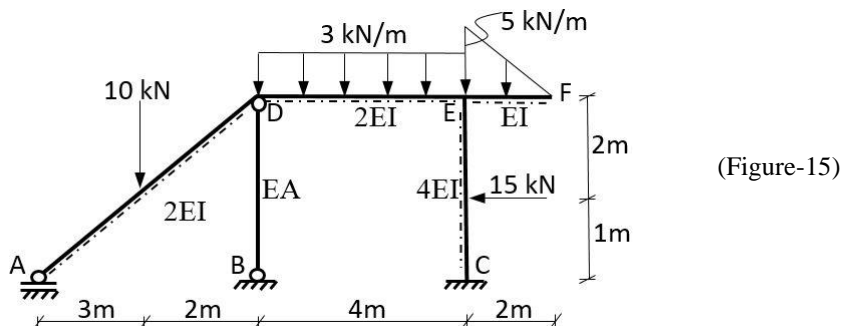


(Figure-14)

Question 15:

- a) Draw **M** and **V** diagrams of the system given in **Figure-15** due to the given external loads,
 b) Draw the bending moment (**M**) diagram of the system due to a non-uniform temperature change $\Delta t= 18^\circ \text{ C}$.

by using **Force Method**. ($EA= \infty$ ve $GA'= \infty$)

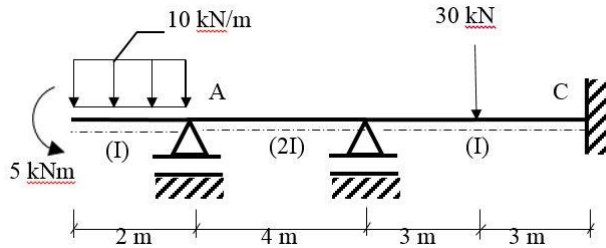


(Figure-15)

Yıldız Technical University-Faculty of Civil Engineering-Department of Civil Engineering 2024-2025 Academic Year Fall Semester Structural Analysis II Worksheet

Question 16:

- a) Draw the **bending moment (M)** diagram of the system given in **Figure-16** due to given external loads,
 b) Draw the **bending moment (M)** and **shear force (V)** diagrams of the system due to a non-uniform temperature change for whole system $\Delta t=15^\circ\text{C}$.
 by using **Three Moment Equation (Clapeyron)**.
 ($\alpha_T = 10^{-5} \text{ 1/}^\circ\text{C}$, $EI=10000 \text{ kNm}^2$). ($h=0.5 \text{ m}$)

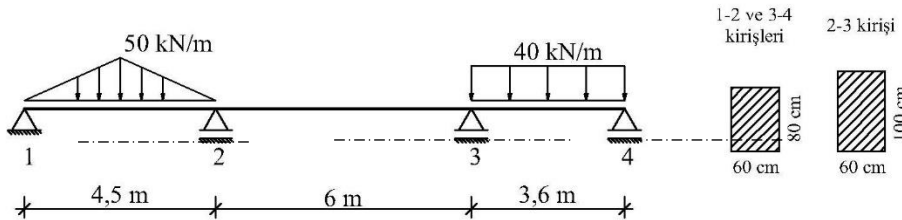


(Figure-16)

Question 17:

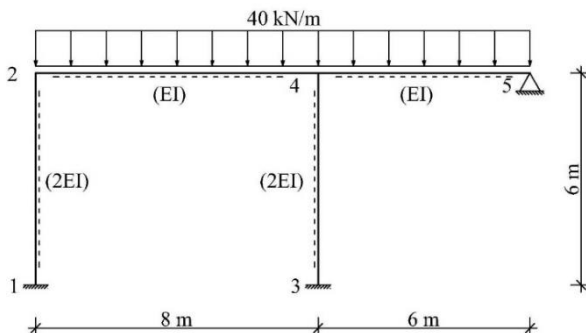
- a) Draw the **bending moment (M)** diagram of the system given in **Figure-17** due to given external loads.
 b) For non-uniform temperature change in only 2-3 elements, draw the bending moment (M) diagrams separately.

$E = 3.10^5 \text{ kN/m}^2$
 $\alpha_t = 10^{-5} \text{ 1/}^\circ\text{C}$



(Figure-17)

- Question 18:** Draw the **bending moment (M)** and **shear force (V)** diagrams of the system given in **Figure-18** due to given external loads and calculate the slope angle at joint '4' by using **Slope-Deflection Method**.

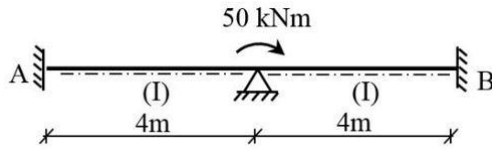


$EI = 1.10^5 \text{ kNm}^2$
 $EA = GA' = \infty$

(Figure-18)

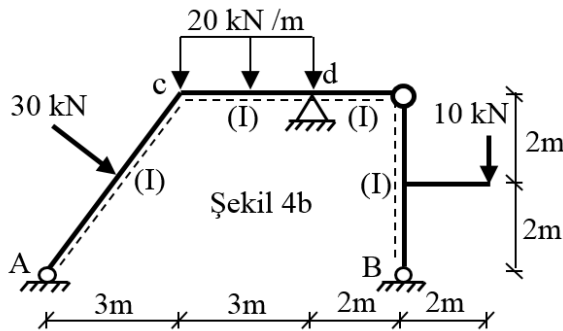
Yıldız Technical University-Faculty of Civil Engineering-Department of Civil Engineering 2024-2025 Academic Year Fall Semester Structural Analysis II Worksheet

Question 19: Draw the **bending moment (M)** diagram of the system given in **Figure-19**.
($EA = \infty$ ve $GA' = \infty$)



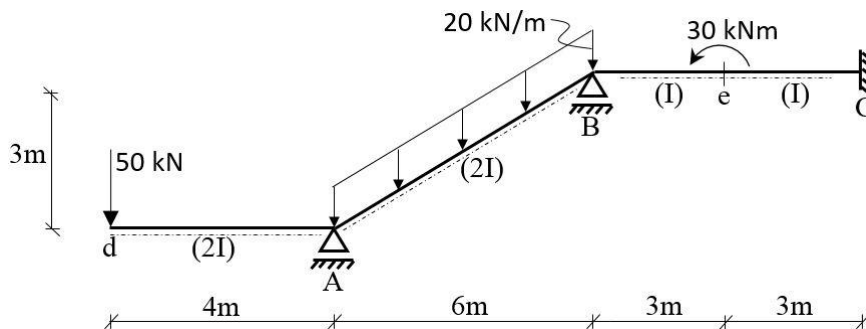
(Figure-19)

Question 20: Determine the moment at point “c” for the system given in **Figure-20** due to given external loads.
($EI = 3 \times 10^4 \text{ kNm}^2$, $EA = \infty$ ve $GA' = \infty$)



(Figure-20)

Question 21: Draw the **bending moment (M)** and **shear force (V)** diagrams of the system given in **Figure-21** due to given external loads by using **Slope-Deflection Method**.

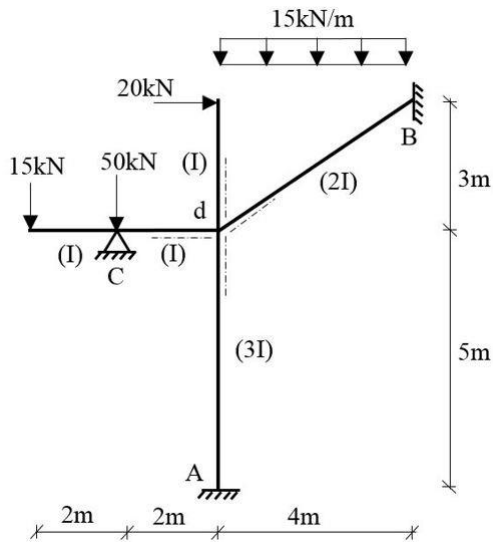


(Figure-21)

Worksheet

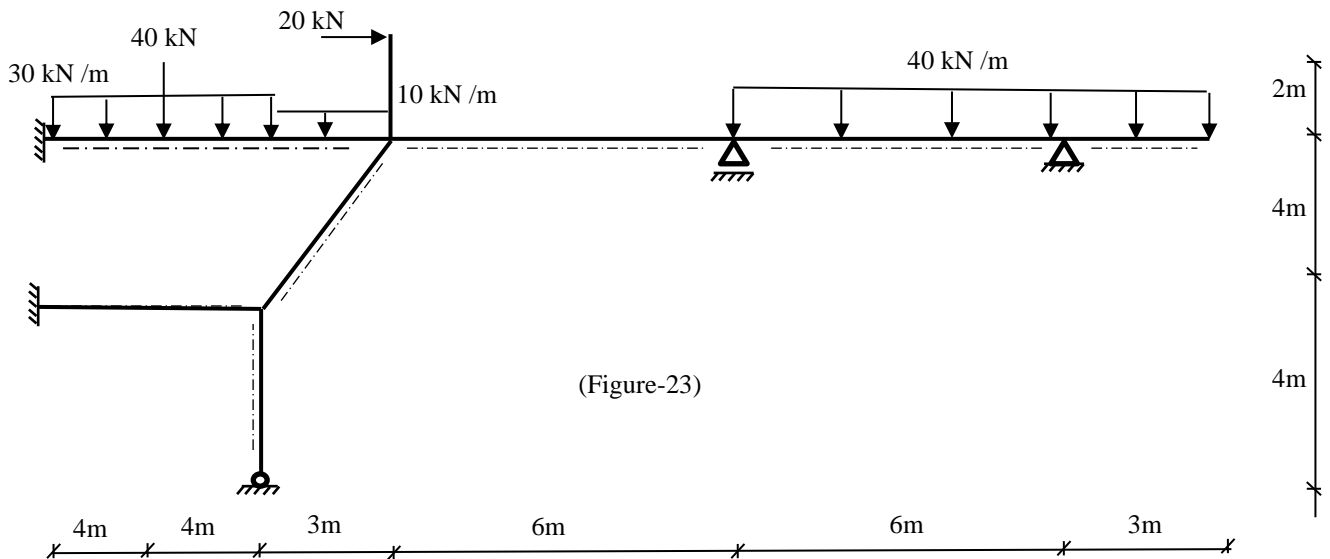
Question 22: Draw the **bending moment (M)** and **shear force (V)** diagrams of the system given in **Figure-22** due to given external loads by using **Slope-Deflection Method**.

($EA = \infty$ ve $GA' = \infty$)



(Figure-22)

Question 23: Draw the **bending moment (M)** and **shear force (V)** diagrams of the system given in **Figure-23** due to given external loads by using **Slope-Deflection Method**.

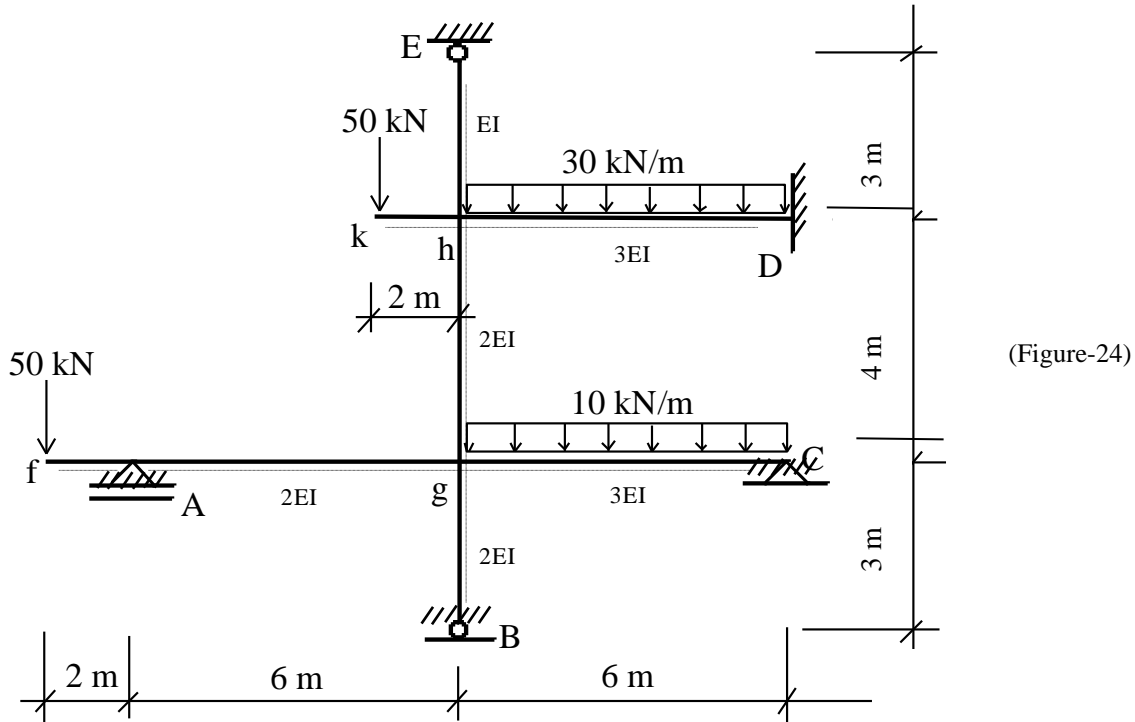


(Figure-23)

Yıldız Technical University-Faculty of Civil Engineering-Department of Civil Engineering 2024-2025 Academic Year Fall Semester Structural Analysis II Worksheet

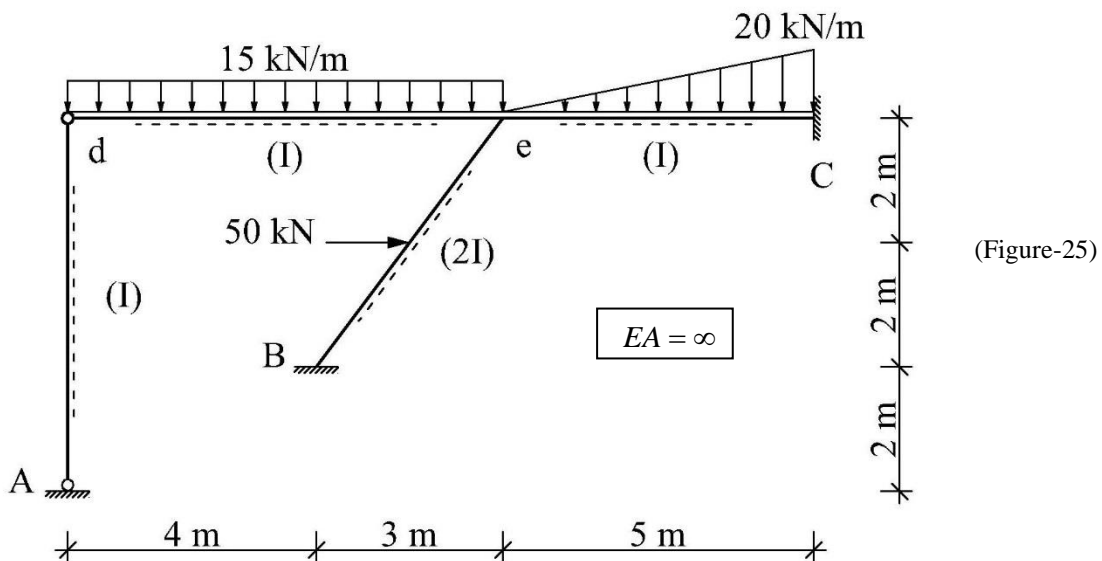
Question 24:

- a) Calculate the rotational displacement at point 'g' and 'h' of the system given in **Figure-24** due to the given external loads by using **Slope-Deflection Method**.
- b) Draw bending moment (**M**) and shear force (**V**) diagrams by using any method.
- c) Calculate the vertical displacement at point 'f' in terms of EI.



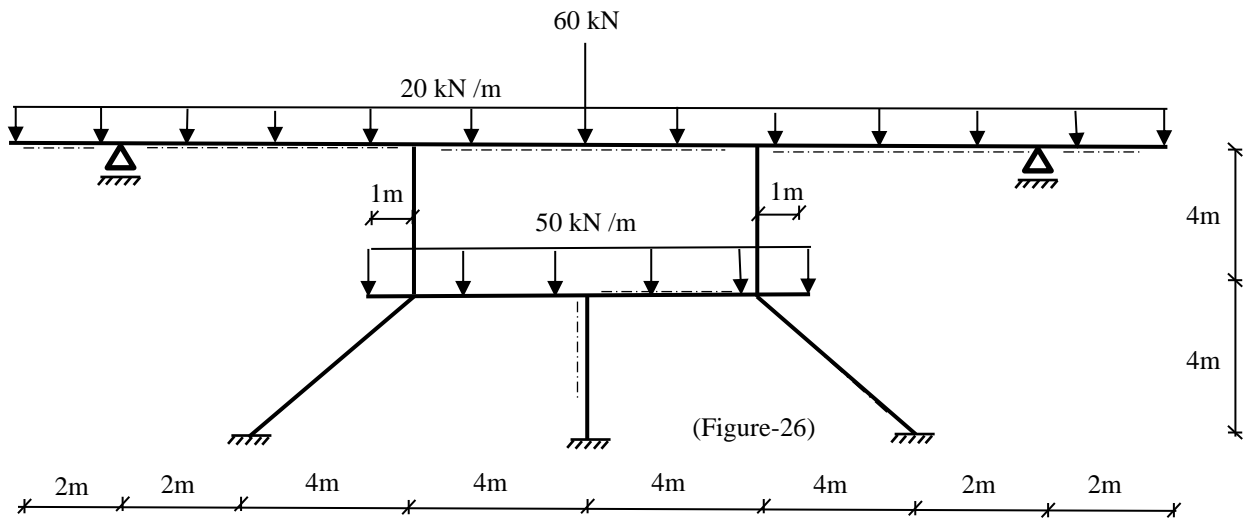
Question 25:

- a) Draw the **bending moment (M)** and **shear force (V)** diagrams of the system given in **Figure-25** due to given external loads.
- b) Calculate the rotational displacement at point 'd' in terms of EI.

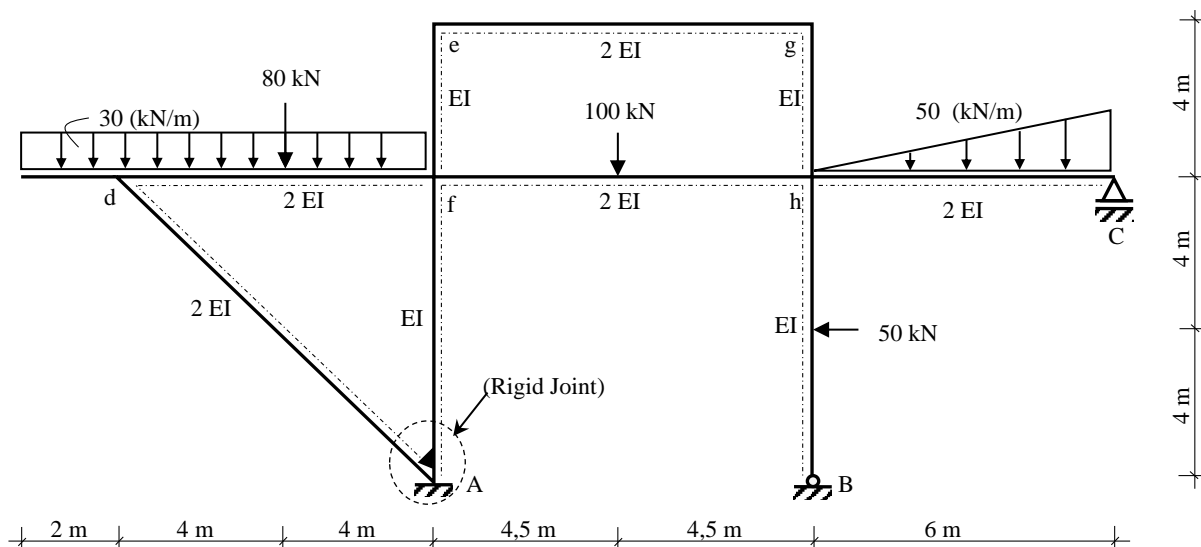


Worksheet

Question 26: Calculate the rotation of angle at joints of the system given in **Figure-26** by using **Moment Distribution (Cross) Method**.



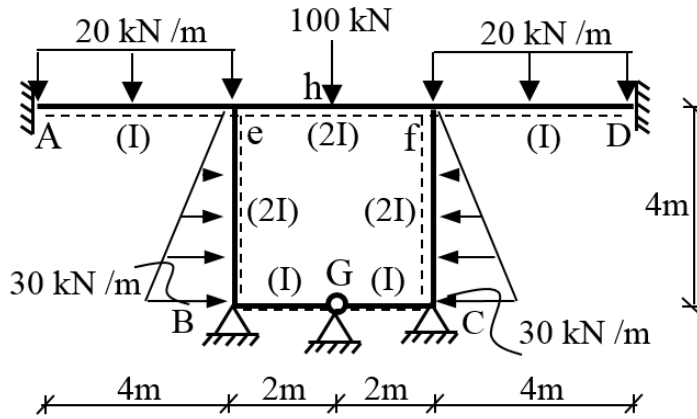
Question 27: Calculate the end moments of elements shown in **Figure-27**.



Worksheet

Question 28:) Draw the **bending moment (M)** and **shear force (V)** diagrams of the system given in **Figure-28** due to the given external loads by using **Moment Distribution (Cross) Method**.

($EI= 3 \times 10^4 \text{ kNm}^2$, $EA= \infty$ ve $GA'= \infty$)



(Figure-28)

Good luck,

Prof. Dr. Bilge DORAN
Prof. Dr. Ali KOÇAK
Prof. Dr. Barış SEVİM
Asst. Prof. Dr. Muzaffer BÖREKÇİ
Asst. Prof. Dr. Habib Cem YENİDOĞAN
Res. Asst. Dr. Alkız MERMER
Res. Asst. Birkan DAĞ
Res. Asst. Ahmet YILDIRIM