Yıldız Technical University-Faculty of Civil Engineering-Department of Civil Engineering 2023-2024 Academic Year Fall Semester Structural Analysis II Worksheet

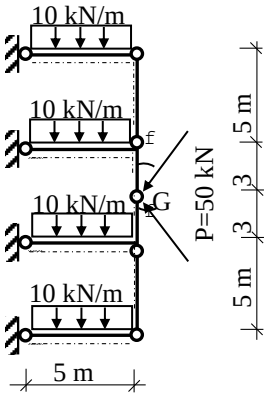
NOTE:

- 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.

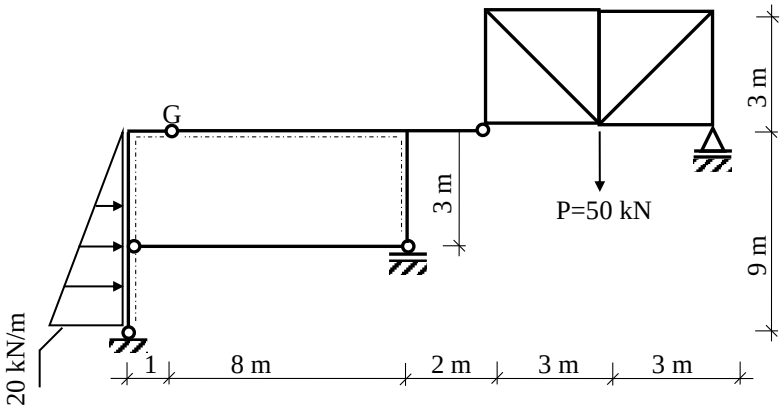
Question 1:

a) Determine the lateral displacement at point 'G' for system given in **Figure-1a** by using **Virtual Work Principle.** (EI=14700 kNm^2, EA=5,25x10^6 kN, GA'= 1,69x10^6 kN, EA, EI and GA' are constant for whole system.)

b) Determine the relative rotation at point 'G' ($\Delta\varphi_G$) 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^{o}C by using **Virtual Work Principle.** External loads and temperature change will be affected separately. (α_T =1,3.10^{-5} 1/°C). (t = 15^o)



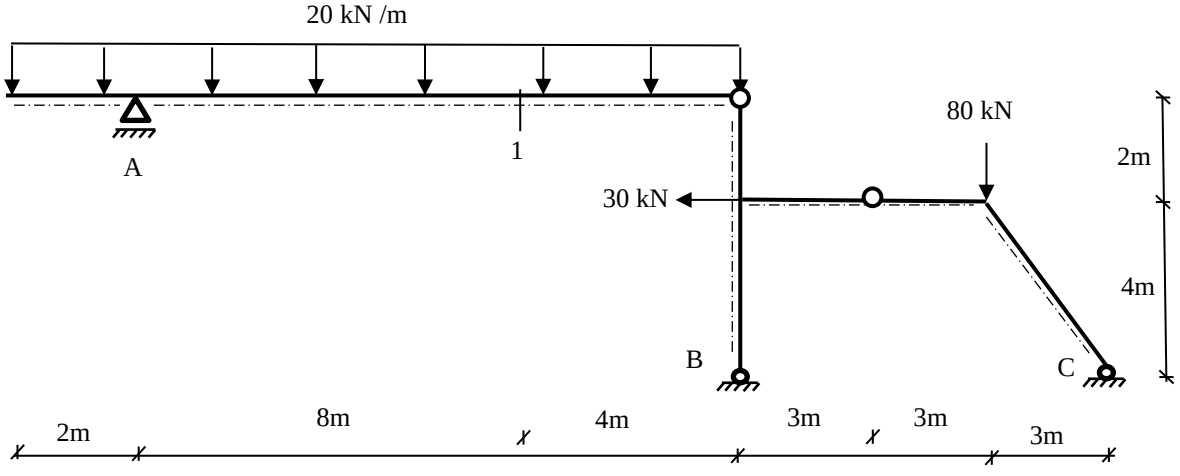
(Figure-1a)



(Figure-1b)

Question 2:

Determine the vertical displacement at section '1' for the system given in **Figure-2** by using **Virtual Work Principle.** (EI= 3×10^4 kNm^2, EA= ∞ ve GA'= ∞)



(Figure-2)

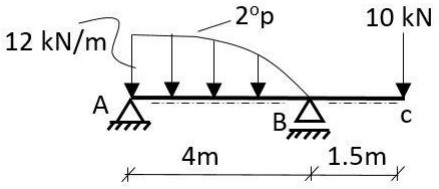
Yıldız Technical University-Faculty of Civil Engineering-Department of Civil Engineering 2023-2024 Academic Year Fall Semester Structural Analysis II Worksheet

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 Δt=30°C. (h=60cm, $\alpha_t = 10^{-5}1/°C$)

by using **Virtual Work Principle**.



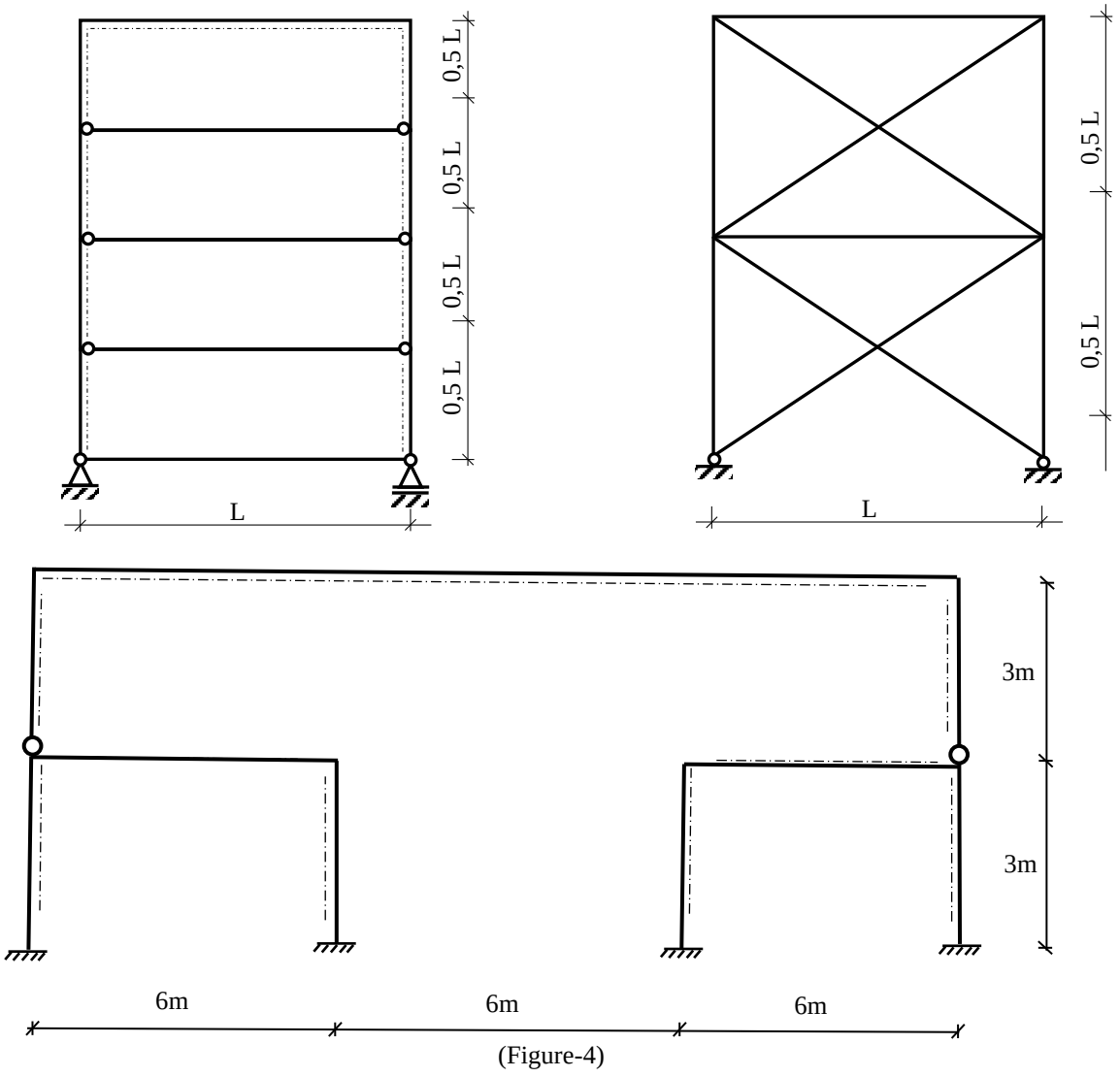
(Figure-3)

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)

Yıldız Technical University-Faculty of Civil Engineering-Department of Civil Engineering 2023-2024 Academic Year Fall Semester Structural Analysis II Worksheet

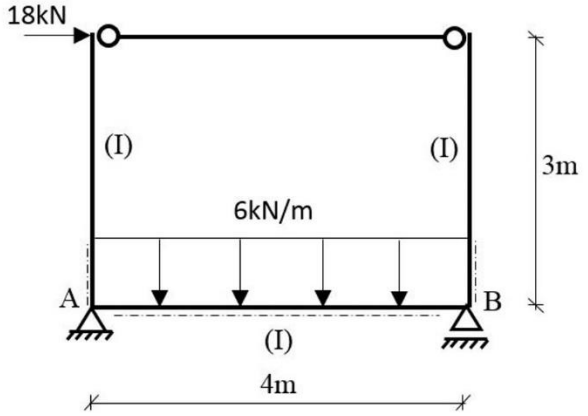
Question 5:

a) Draw the **bending moment (M) diagram** of the system given in **Figure-5**,

b) Determine the angle of rotation at support "A" (φ_A) of the system in terms of EI,

by using **Force Method.**

(EA= ∞ , GA'=∞)



(Figure-5)

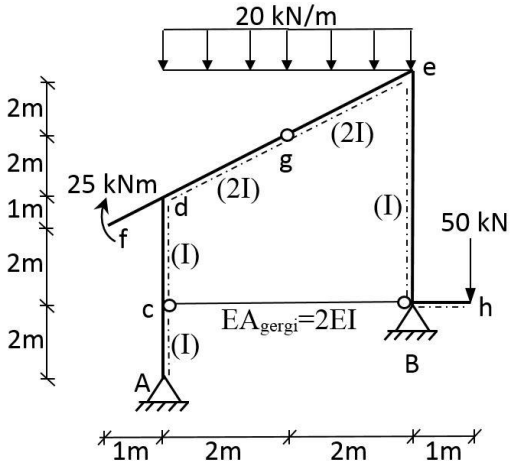
Question 6:

a) Draw **M** and **V** diagrams of the system given in **Figure-6** due to **the given external loads,**

b) Draw the bending moment **(M)** diagram due to **5 cm vertical** settlement**, 2/1000 rad** rotation **at support A** in clockwise direction and **2 cm vertical** settlement **at support B,**

by using **Force Method.**

(EI=2,8×10^4 kNm^2, EA= ∞ (except tie-rod), GA'=∞)



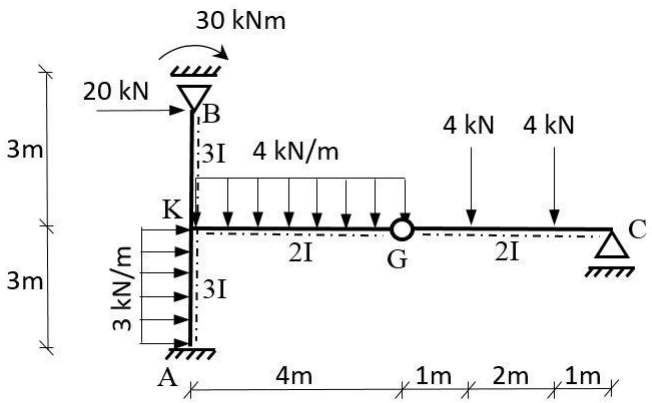
(Figure-6)

Question 7:

a) Draw **M** and **V** diagrams of the system given in **Figure-7** due to **the given external loads,**

b) Determine the rotation angle at point 'K' (φ_K).

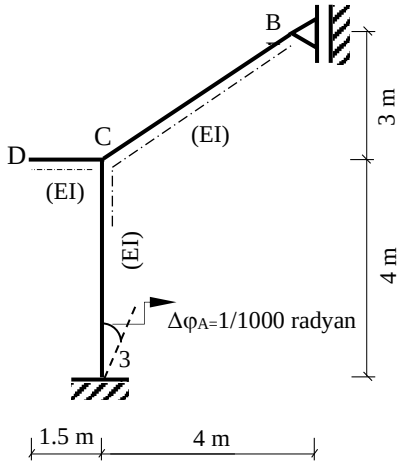
by using **Force Method.** (EI=2,8×10^4 kNm^2, EA= ∞ ,GA'=∞)



(Figure-7)

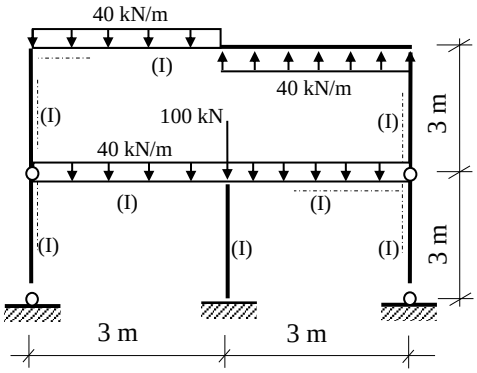
Yıldız Technical University-Faculty of Civil Engineering-Department of Civil Engineering 2023-2024 Academic Year Fall Semester Structural Analysis II Worksheet

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= 3×10^4 kNm^2, EA= ∞ ve GA'= ∞)



(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.**



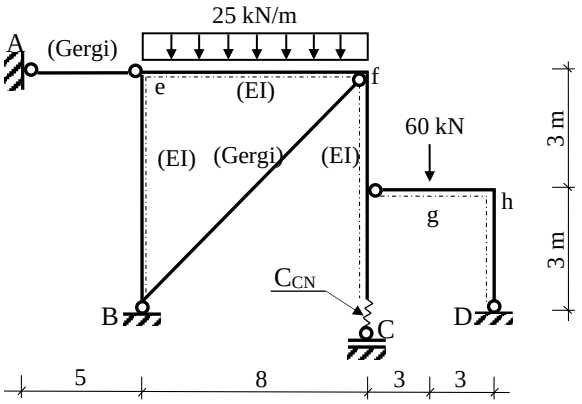
$EA \cong \infty,\ GA' \cong \infty,\ EI = 3.10^4\ kNm^2$

(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: *($\alpha_T=10^{-5}$ 1/°C, h=50 cm, $C_{CN}=3x10^4$ kN/m, $EI=3x10^4$ kNm$^2 \cong 2EA_g$, Δu_A = 4.5 cm, Δv_A = 5 cm).*

(Figure-10)



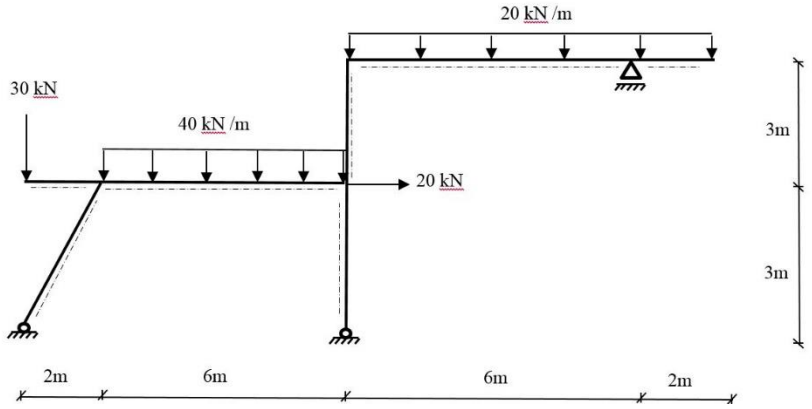
Yıldız Technical University-Faculty of Civil Engineering-Department of Civil Engineering 2023-2024 Academic Year Fall Semester Structural Analysis II Worksheet

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 $\Delta t = 15^o$ C,

by using **Force Method.**

($\alpha_T = 10^{-5}$ 1/ ºC) (EI= 3×10^4 kNm^2, EA= ∞ ve GA'= ∞)



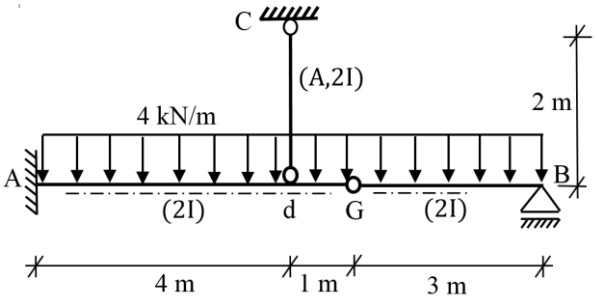
(Figure-11)

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 $\Delta t = 20^o$ C

by using **Force Method.**

(EI=3×10^4 kNm^2, EA=∞(tüm çubuklarda), GA'= ∞, h=60cm, αt = 10-5 1/ºC)

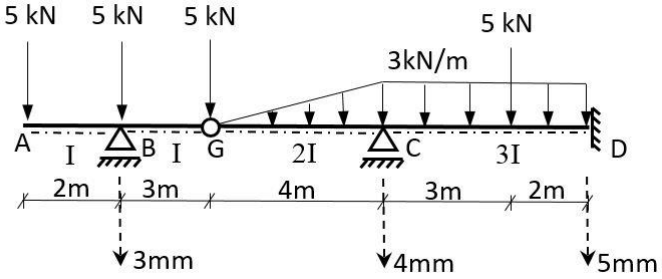


(Figure-12)

Yıldız Technical University-Faculty of Civil Engineering-Department of Civil Engineering 2023-2024 Academic Year Fall Semester Structural Analysis II Worksheet

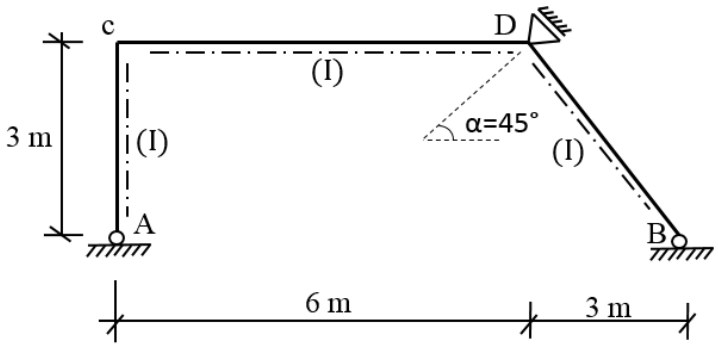
Question 13:

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= 3×10^4 kNm^2, EA= ∞ ve GA'= ∞)



(Figure-13)

Question 14: Draw the bending moment **(M)** diagram of the system given in **Figure-14** due to 1 cm **vertical** settlement (Δv_A=1cm) and 2 cm **lateral** displacement (Δu_A=2cm) at the same time at point A by using **Force Method.**
(EI= 3×10^4 kNm^2, EA= ∞, GA'= ∞)

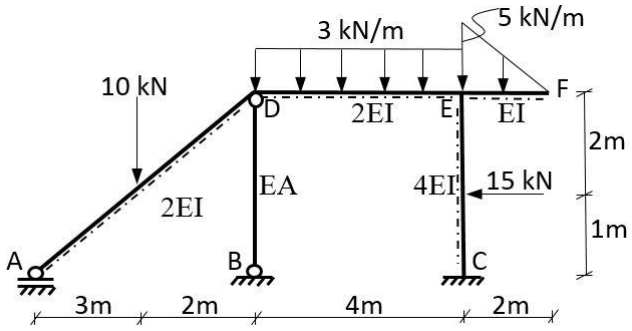


(Figure-14)

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 Δt= 18º C .

by using **Force Method.** (EA= ∞ ve GA'= ∞)



(Figure-15)

Yıldız Technical University-Faculty of Civil Engineering-Department of Civil Engineering 2023-2024 Academic Year Fall Semester Structural Analysis II Worksheet

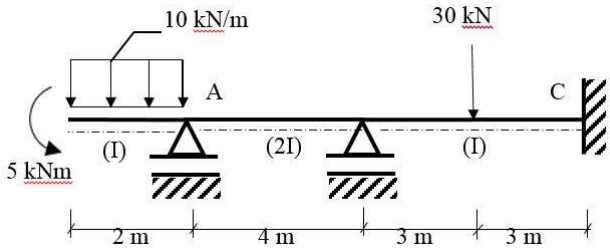
Question 16:

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 Δt=15°C.

by using **Three Moment Equation (Clapeyron)**.

($\alpha_T = 10^{-5}$ 1/ °C, EI=10000 kNm^2). (h=0.5 m)



(Figure-16)

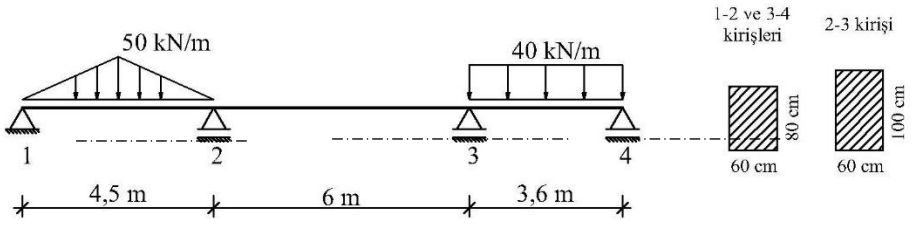
Question 17:

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.

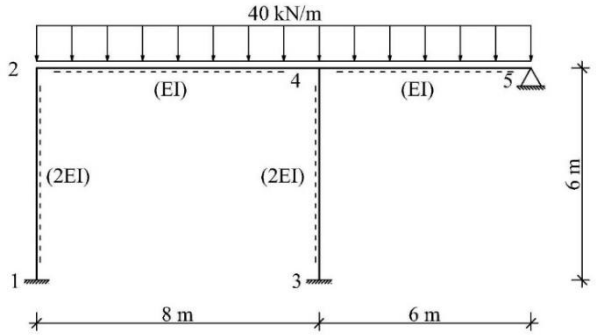
$E = 3.10^5$ kN/m^2

$\alpha_t = 10^{-5}$ 1/°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.**

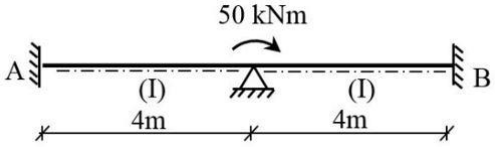


$EI = 1.10^5$ kNm^2

$EA = GA' = \infty$

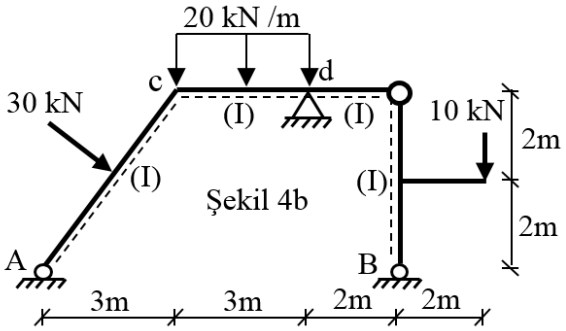
(Figure-18)

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



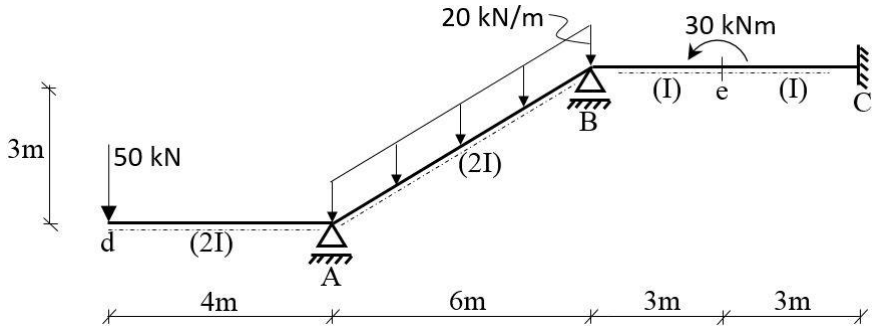
(Figure-19)

Question 20: Determine the moment at point "c" for the system given in **Figure-20** due to given external loads.
(EI= 3×10^4 kNm^2, EA= ∞ ve GA'= ∞)



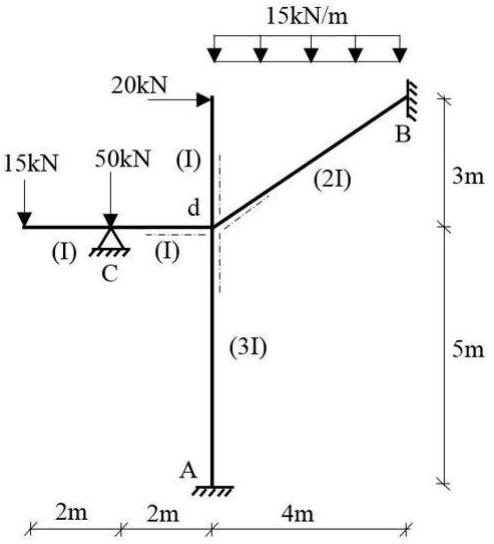
(Figure-20)

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.**



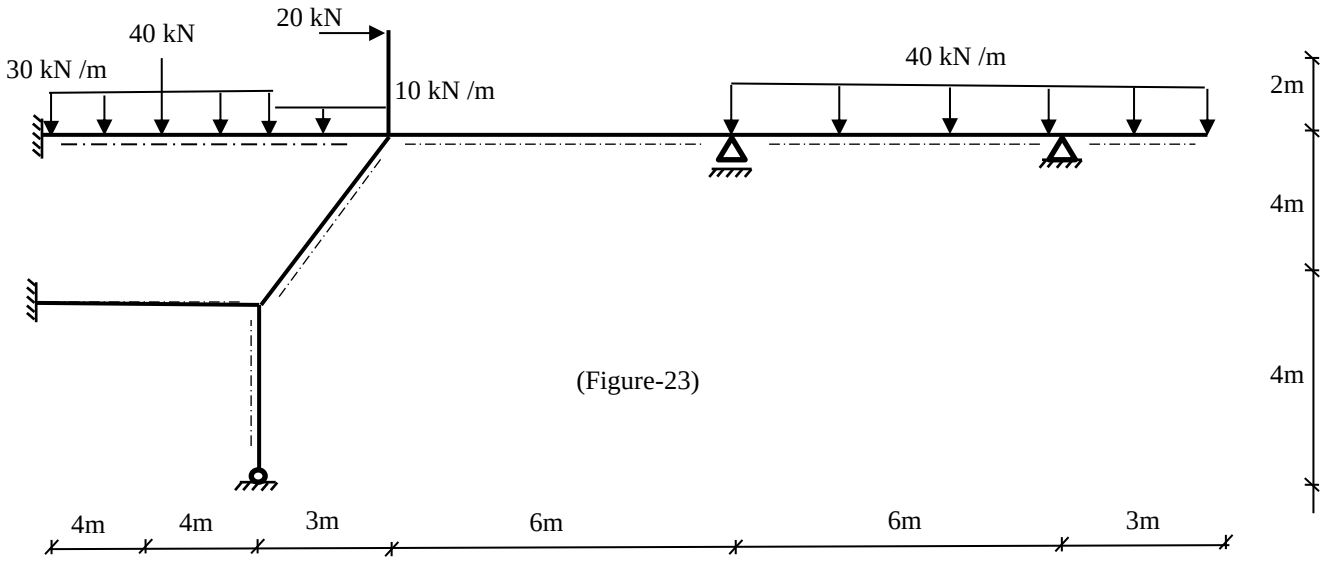
(Figure-21)

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= ∞ ve GA'= ∞)



(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)

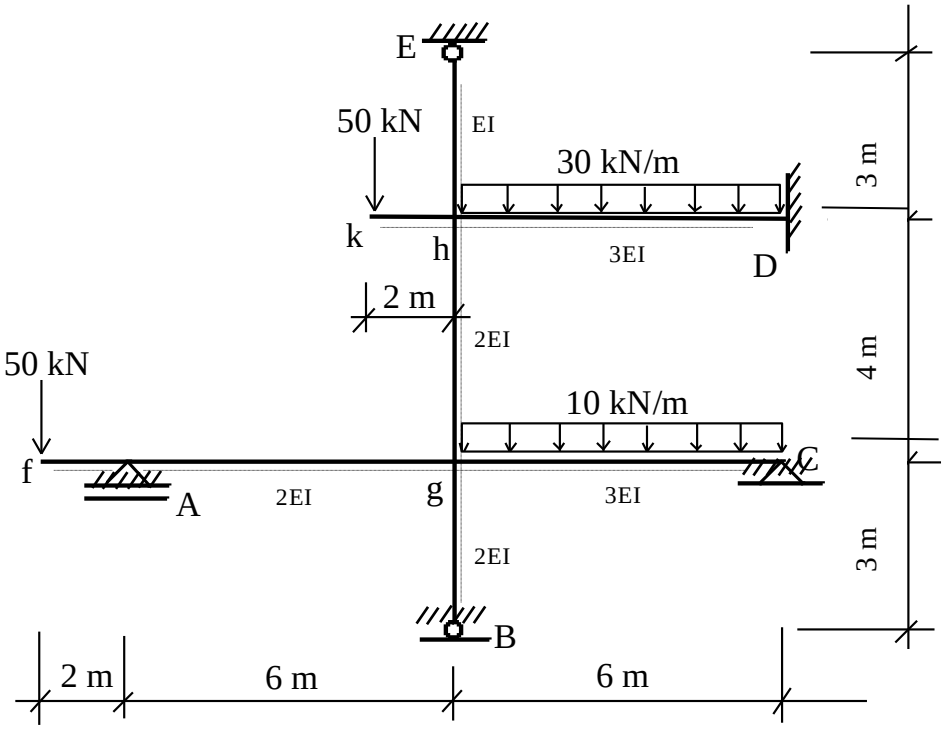
Yıldız Technical University-Faculty of Civil Engineering-Department of Civil Engineering 2023-2024 Academic Year Fall Semester Structural Analysis II Worksheet

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.

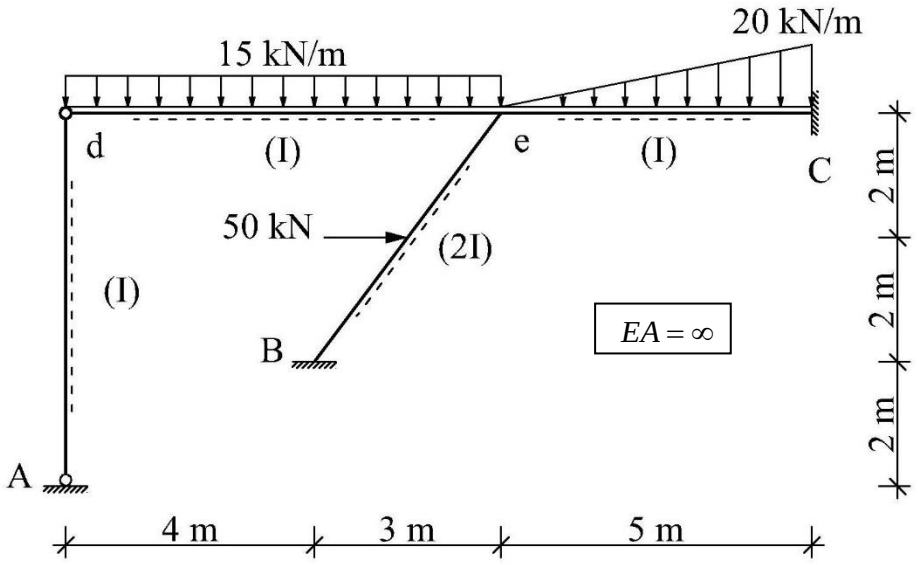


(Figure-24)

Question 25:

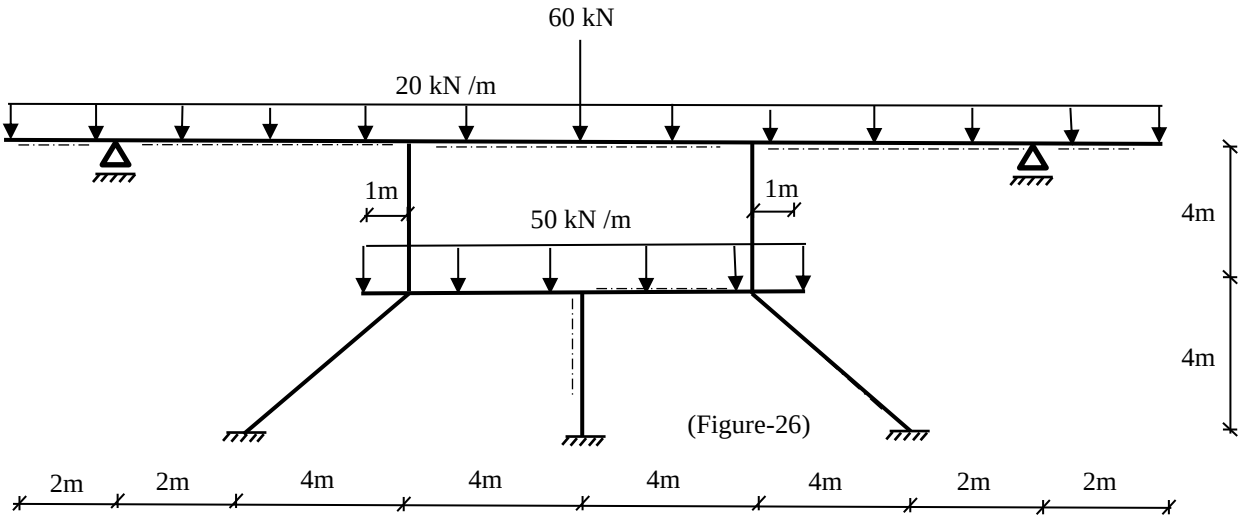
a) Draw the **bending moment (M)** and **shear force (V)** diagrams of the system given in **Figure-25** due to given external loads.

b) Calculate the rotational displacement at point 'd' in terms of EI.



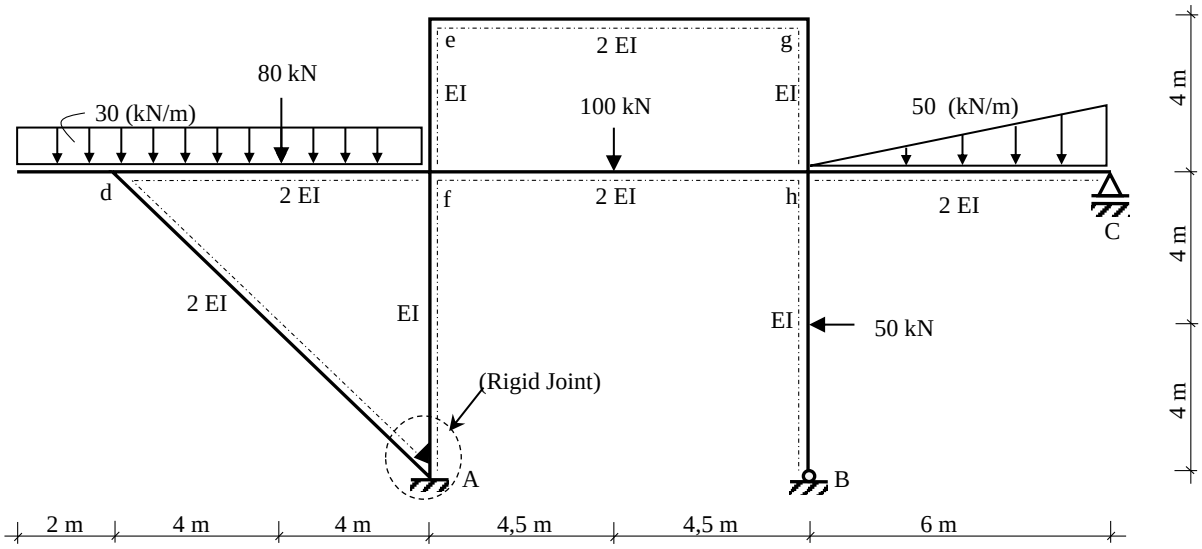
(Figure-25)

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



(Figure-26)

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

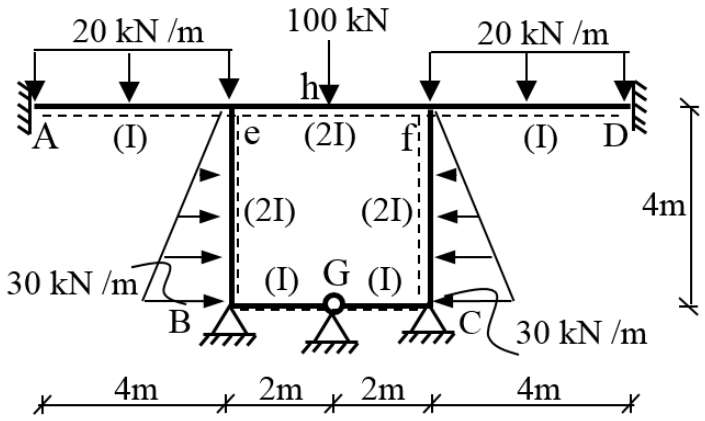


(Figure-27)

Yıldız Technical University-Faculty of Civil Engineering-Department of Civil Engineering 2023-2024 Academic Year Fall Semester Structural Analysis II 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= 3×10^4 kNm^2, EA= ∞ ve GA'= ∞)



(Figure-28)

Good luck,

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