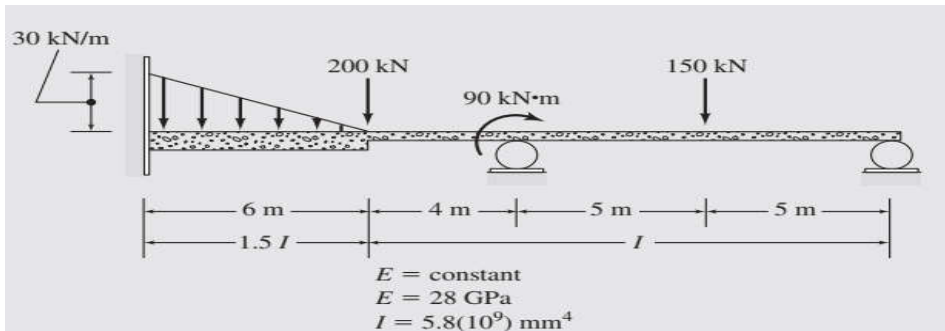


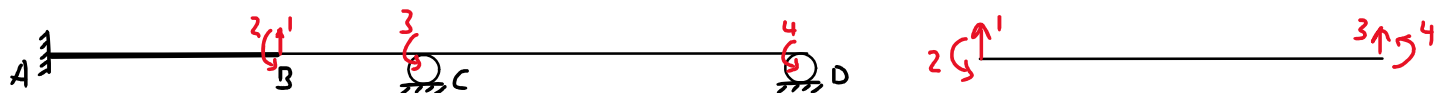
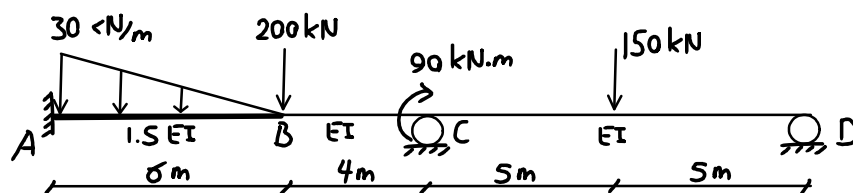
مثال: تير شکل زير را با روش ماتريسي تحليل کنيد.



$$EI = 28 \times 10^3 \frac{N}{mm^2} \times 5.8 \times 10^9 mm^4$$

$$= 162.4 \times 10^{12} N \cdot mm^2$$

$$= 162400 kN \cdot m^2$$



$$[k_{ff}]_{AB} = \begin{bmatrix} \frac{12(1.5EI)}{L^3} & \frac{6(1.5EI)}{L^2} \\ \frac{6(1.5EI)}{L^2} & 4(1.5EI) \end{bmatrix} = EI \begin{bmatrix} 0.08333 & -0.25 \\ -0.25 & 1 \end{bmatrix}$$

$$k_L = \begin{bmatrix} \frac{12EI}{L^3} & \frac{6EI}{L^2} & -\frac{12EI}{L^3} & \frac{6EI}{L^2} \\ \frac{6EI}{L^2} & \frac{4EI}{L} & \frac{6EI}{L^2} & \frac{2EI}{L} \\ -\frac{12EI}{L^3} & \frac{6EI}{L^2} & \frac{12EI}{L^3} & \frac{6EI}{L^2} \\ \frac{6EI}{L^2} & \frac{2EI}{L} & \frac{6EI}{L^2} & \frac{4EI}{L} \end{bmatrix}$$

$$[k_{ff}]_{BC} = \begin{bmatrix} \frac{12EI}{L^3} & \frac{6EI}{L^2} & \frac{6EI}{L^2} \\ \frac{6EI}{L^2} & \frac{4EI}{L} & \frac{2EI}{L} \\ \frac{6EI}{L^2} & \frac{2EI}{L} & \frac{4EI}{L} \end{bmatrix} = EI \begin{bmatrix} 0.1875 & 0.375 & 0.375 \\ 0.375 & 1 & 0.5 \\ 0.375 & 0.5 & 1 \end{bmatrix}$$

$$[k_{ff}]_{CD} = \begin{bmatrix} \frac{4EI}{L} & \frac{2EI}{L} \\ \frac{2EI}{L} & \frac{4EI}{L} \end{bmatrix} = EI \begin{bmatrix} 0.4 & 0.2 \\ 0.2 & 0.4 \end{bmatrix}$$

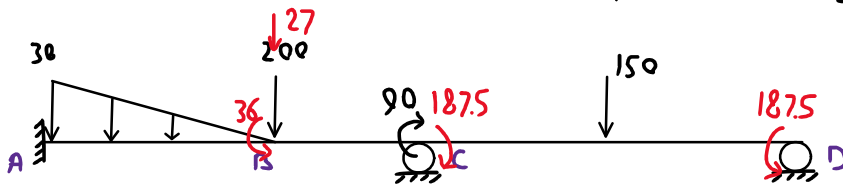
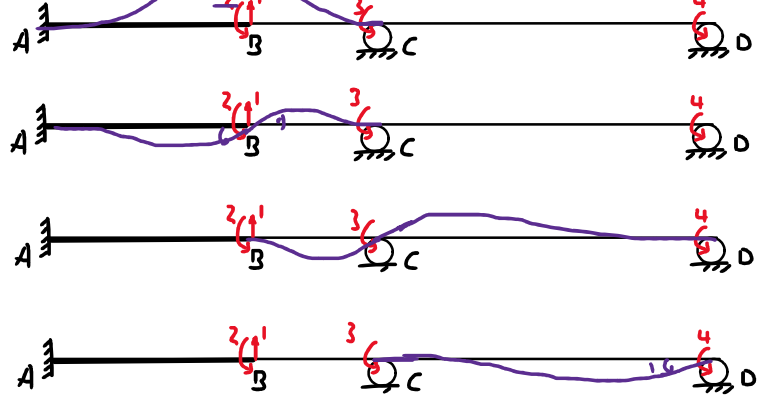
②  $k_{ff}$  سازه با سرهم بند

$$K_{ff} = EI \begin{bmatrix} 0.27083 & 0.125 & 0.375 & 0 \\ 0.125 & 2 & 0.5 & 0 \\ 0.375 & 0.5 & 1.4 & 0.2 \end{bmatrix}$$

$$K_{ff} = EI \begin{bmatrix} 0.375 & 0.5 & 1.4 & 0.2 \\ 0 & 0 & 0.2 & 0.4 \end{bmatrix} \begin{matrix} \textcircled{1} \\ \textcircled{2} \\ \textcircled{3} \\ \textcircled{4} \end{matrix}$$

②  $k_{ff}$  از به صورت مستقیم

$$K_{ff} = EI \begin{bmatrix} \textcircled{1} & \textcircled{2} & \textcircled{3} & \textcircled{4} \\ 0.2708? & 0.125 & 0.375 & 0 \\ 0.125 & 2 & 0.5 & 0 \\ 0.375 & 0.5 & 1.4 & 0.2 \\ 0 & 0 & 0.2 & 0.4 \end{bmatrix} \begin{matrix} \textcircled{1} \\ \textcircled{2} \\ \textcircled{3} \\ \textcircled{4} \end{matrix}$$



③ محاسبه  $P_f$  و  $\delta_f$

$$K_{ff} \delta_f = P_f$$

$$EI \begin{bmatrix} 0.2708? & 0.125 & 0.375 & 0 \\ 0.125 & 2 & 0.5 & 0 \\ 0.375 & 0.5 & 1.4 & 0.2 \\ 0 & 0 & 0.2 & 0.4 \end{bmatrix} \begin{Bmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \\ \delta_4 \end{Bmatrix} = \begin{Bmatrix} -227 \\ 36 \\ -277.5 \\ 187.5 \end{Bmatrix}$$

$$P_f = \begin{Bmatrix} -227 \\ 36 \\ -277.5 \\ 187.5 \end{Bmatrix}$$

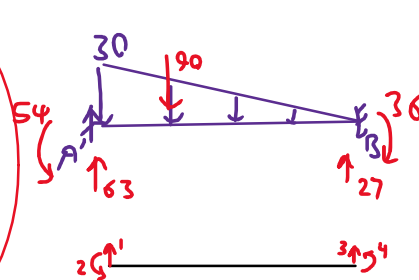
$$\delta_f = 10^{-3} \begin{Bmatrix} -4.4729 \\ 0.56143 \\ -0.68416 \\ 3.2285 \end{Bmatrix}$$

$$P_L = k_L \delta_L + FER$$

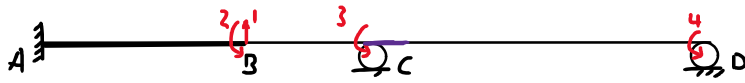
④ محاسبه نیروها اعضا

$$EJ \rightarrow 1.5EI \quad L \rightarrow 6m$$

$$(P_L)_{AB} = \begin{bmatrix} \frac{12EI}{L^3} & \frac{6EI}{L^2} & -\frac{12EI}{L^3} & \frac{6EI}{L^2} \\ \frac{6EI}{L^2} & \frac{4EI}{L} & -\frac{6EI}{L^2} & \frac{2EI}{L} \\ -\frac{12EI}{L^3} & -\frac{6EI}{L^2} & \frac{12EI}{L^3} & -\frac{6EI}{L^2} \\ \frac{6EI}{L^2} & \frac{2EI}{L} & -\frac{6EI}{L^2} & \frac{4EI}{L} \end{bmatrix} \cdot 10^{-3} \begin{Bmatrix} 0 \\ 0 \\ -4.4729 \\ 0.56143 \end{Bmatrix} + \begin{Bmatrix} 63 \\ 54 \\ 27 \\ -36 \end{Bmatrix} = \begin{Bmatrix} 146.33 \\ 281.19 \\ -56.33 \\ 236.78 \end{Bmatrix}$$



$$\begin{matrix} EI \rightarrow EI \\ L \rightarrow 4 \end{matrix}
 \begin{pmatrix} P_L \end{pmatrix}_{BC} = \begin{bmatrix} \frac{12EI}{L^3} & \frac{6EI}{L^2} & -\frac{12EI}{L^3} & \frac{6EI}{L^2} \\ \frac{6EI}{L^2} & \frac{4EI}{L} & \frac{6EI}{L^2} & \frac{2EI}{L} \\ -\frac{12EI}{L^3} & \frac{6EI}{L^2} & \frac{12EI}{L^3} & -\frac{6EI}{L^2} \\ \frac{6EI}{L^2} & \frac{2EI}{L} & -\frac{6EI}{L^2} & \frac{4EI}{L} \end{bmatrix} 10^{-3} \begin{Bmatrix} -4.4729 \\ 0.56143 \\ 0 \\ -0.68416 \end{Bmatrix} + \begin{Bmatrix} 0 \\ 0 \\ 0 \\ 0 \end{Bmatrix} = \begin{Bmatrix} -143.67 \\ -236.78 \\ 143.67 \\ -337.92 \end{Bmatrix}$$



$$\begin{matrix} EI \rightarrow EI \\ L \rightarrow 10 \text{ m} \end{matrix}
 \begin{pmatrix} P_L \end{pmatrix}_{CD} = \begin{bmatrix} \frac{12EI}{L^3} & \frac{6EI}{L^2} & -\frac{12EI}{L^3} & \frac{6EI}{L^2} \\ \frac{6EI}{L^2} & \frac{4EI}{L} & \frac{6EI}{L^2} & \frac{2EI}{L} \\ -\frac{12EI}{L^3} & \frac{6EI}{L^2} & \frac{12EI}{L^3} & -\frac{6EI}{L^2} \\ \frac{6EI}{L^2} & \frac{2EI}{L} & -\frac{6EI}{L^2} & \frac{4EI}{L} \end{bmatrix} 10^{-3} \begin{Bmatrix} 0 \\ -0.68416 \\ 0 \\ 3.2285 \end{Bmatrix} + \begin{Bmatrix} 75 \\ 187.5 \\ 75 \\ -187.5 \end{Bmatrix} = \begin{Bmatrix} 99.79 \\ 247.92 \\ 50.21 \\ 0 \end{Bmatrix}$$

