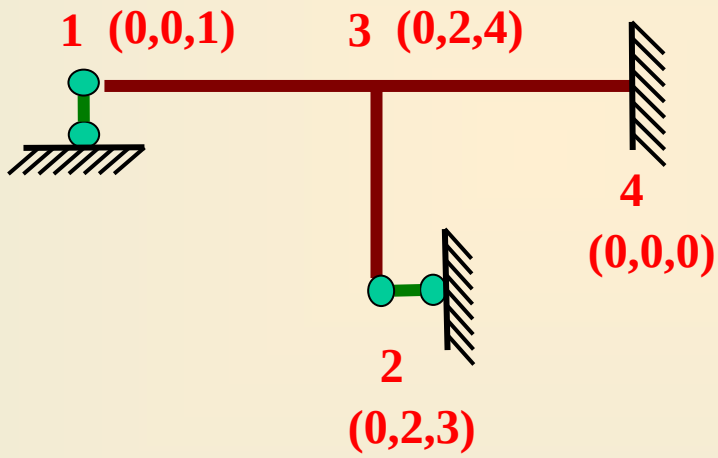
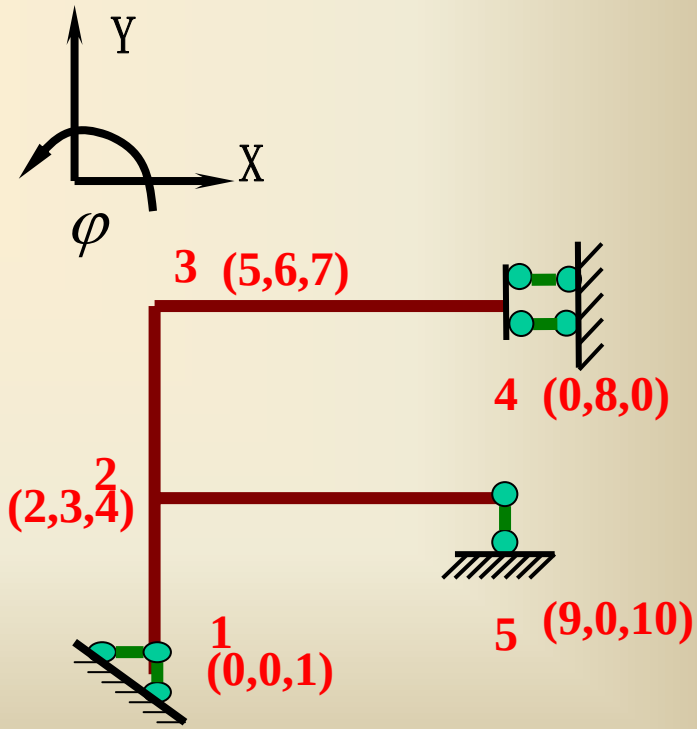
矩阵位移法习题讨论

一.离散化

1.不计轴变时先处理法的结点位移编码



2. 计轴变时先处理法的结点位移编码



二. 单元分析

1.单元刚度方程表示什么量之间的关系方程?

2.单元刚度矩阵(自由式单元)是什么样的矩阵?

3.单刚元素 k_{23} **的物理意义是什么?**

4.坐标转换矩阵是一个什么样的矩阵?

5.局部坐标系下的杆端位移与整体坐标下的有何关系?

$$\{\bar{\delta}\}^e = [T]^e \{\delta\}^e$$

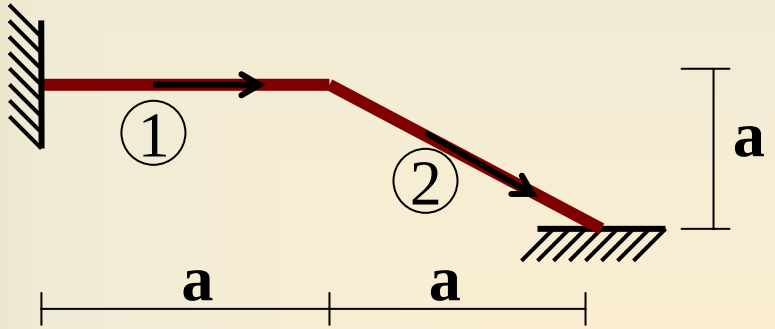
6.单元刚度矩阵均是奇异

7.试写出自由式单元坐标

$$[T]^e = \begin{bmatrix} \cos\alpha & \sin\alpha & 0 & 0 & 0 & 0 \\ -\sin\alpha & \cos\alpha & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & \cos\alpha & \sin\alpha & 0 \\ 0 & 0 & 0 & -\sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

二. 单元分析

8.求图示结构2单元的坐标转换矩阵中的元素 T_{11}, T_{12}



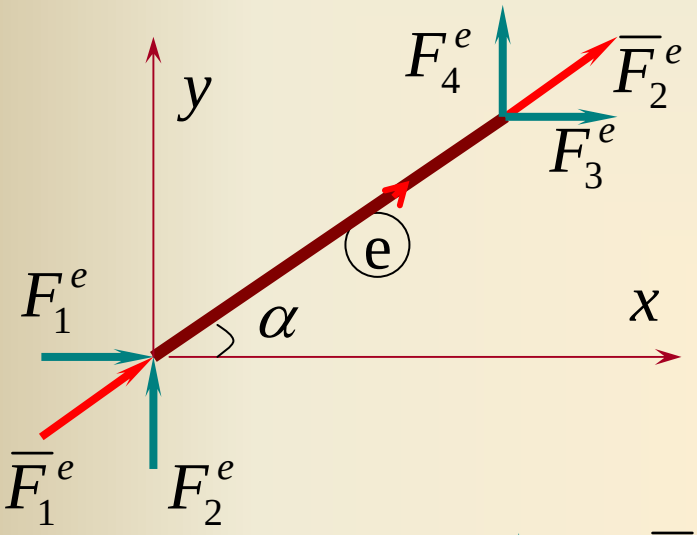
$$T_{11} = \cos(-45^\circ) = \sqrt{2}/2$$

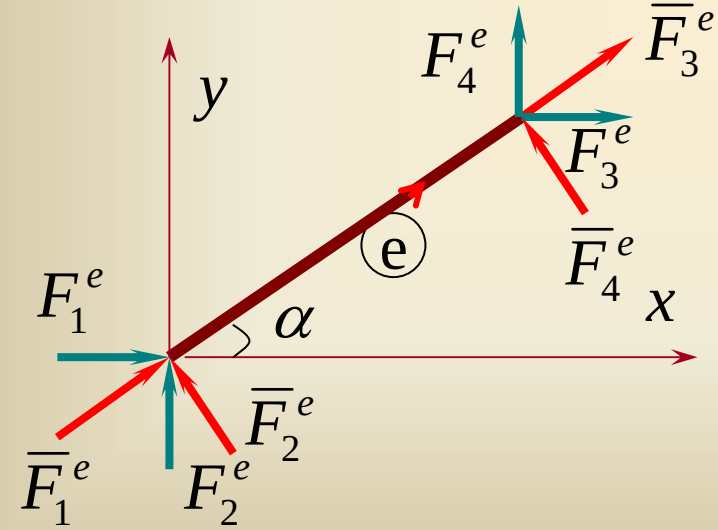
$$T_{12} = \sin(-45^\circ) = -\sqrt{2}/2$$

$$[T]^e = \begin{bmatrix} \cos\alpha & \sin\alpha & 0 & 0 & 0 & 0 \\ -\sin\alpha & \cos\alpha & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & \cos\alpha & \sin\alpha & 0 \\ 0 & 0 & 0 & -\sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

二. 单元分析

9.试写出桁架单元坐标转换矩阵中的第二行元素.





$$\overline{F}_1^e = F_1^e\cos\alpha + F_2^e\sin\alpha$$

$$\overline{F}_2^e = F_3^e\cos\alpha + F_4^e\sin\alpha$$

$$\begin{Bmatrix}\overline{F}_1\\ \overline{F}_2\end{Bmatrix}^e = \begin{bmatrix}\cos\alpha & \sin\alpha & 0 & 0\\ 0 & 0 & \cos\alpha & \sin\alpha\end{bmatrix}\begin{Bmatrix}F_1\\ F_2\\ F_3\\ F_4\end{Bmatrix}^e$$

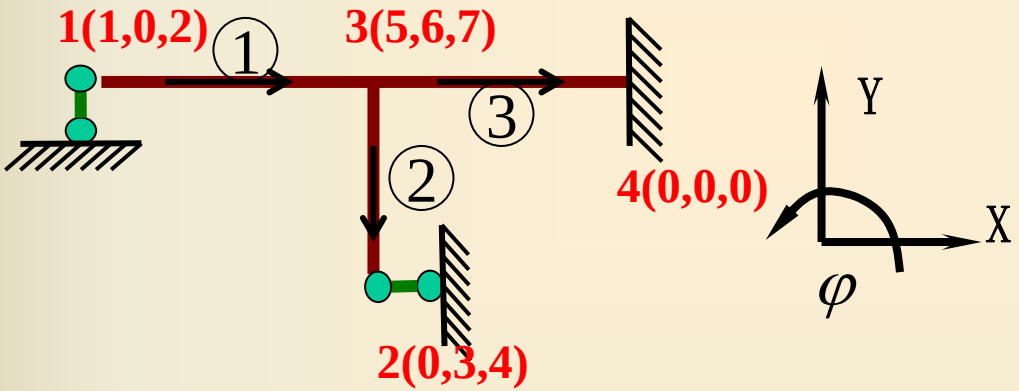
$$\begin{Bmatrix}\overline{F}_1\\ \overline{F}_2\\ \overline{F}_3\\ \overline{F}_4\end{Bmatrix}^e = \begin{bmatrix}\cos\alpha & \sin\alpha & 0 & 0\\ 0 & 0 & 0 & 0\\ 0 & 0 & \cos\alpha & \sin\alpha\\ 0 & 0 & 0 & 0\end{bmatrix}\begin{Bmatrix}F_1\\ F_2\\ F_3\\ F_4\end{Bmatrix}^e$$

三. 整体分析

1.结构刚度方程 $[k]\{\Delta\}=\{P\}$ 是整体结构所应满足的变形协调条件吗?

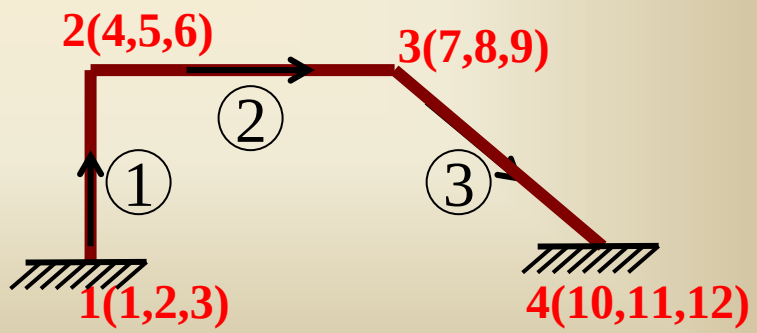
2.总刚元素 k_{23} 的物理意义是什么?

3.试写出图示刚架2单元的单元定位向量.



$$\begin{Bmatrix}5\\6\\7\\0\\3\\4\end{Bmatrix}$$

4.图示结构2单元的整体单刚元素 k_{23} 应放在总刚的什么位置?

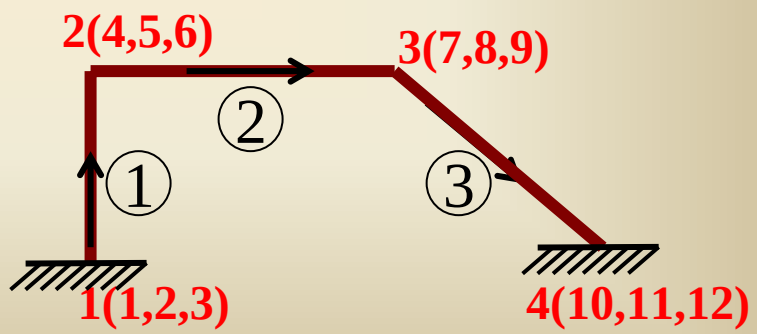


三. 整体分析

$$\begin{Bmatrix} 4 \\ 5 \\ 6 \\ 7 \\ 8 \\ 9 \end{Bmatrix}$$

第5行第6列

4.图示结构2单元的整体单刚元素 k_{23} 应放在总刚的什么位置?

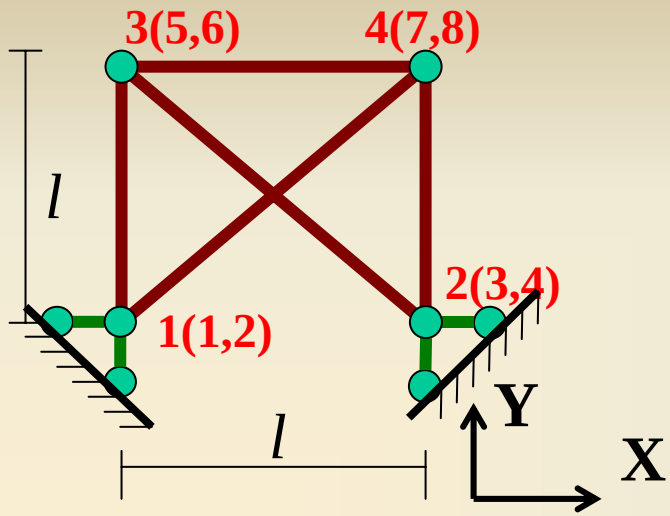


三. 整体分析

5.试求总刚元素 k_{65}

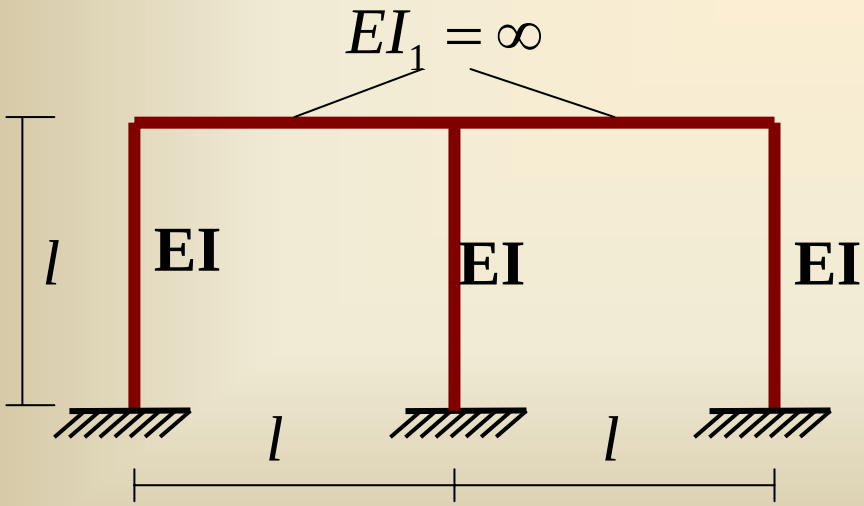
EA=常数

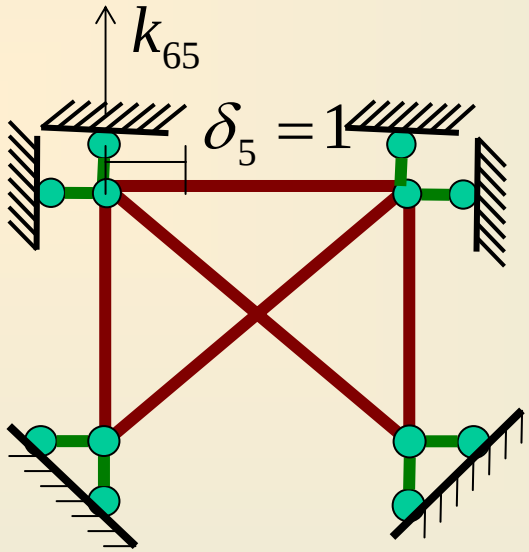
$$k_{65}=-\frac{\sqrt{2}}{4}\cdot\frac{EA}{l}$$

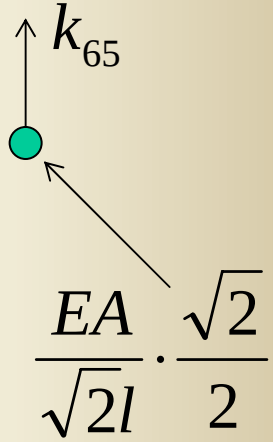


6.先处理法求图示结构总刚

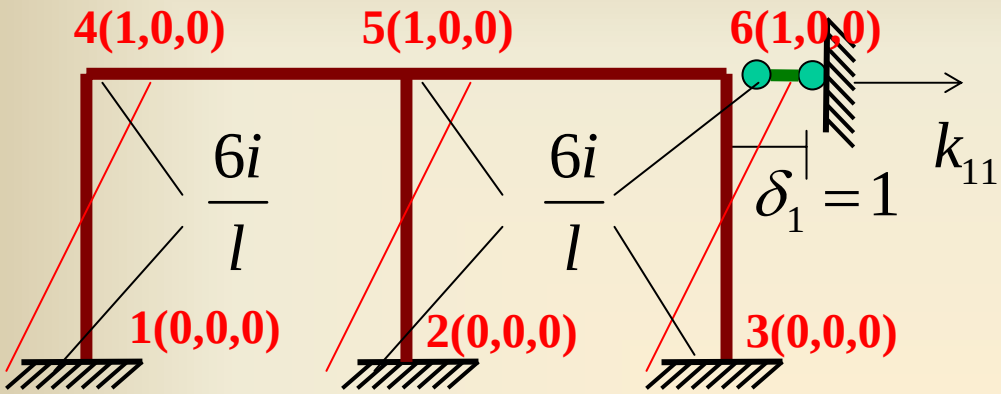
(不计轴变)





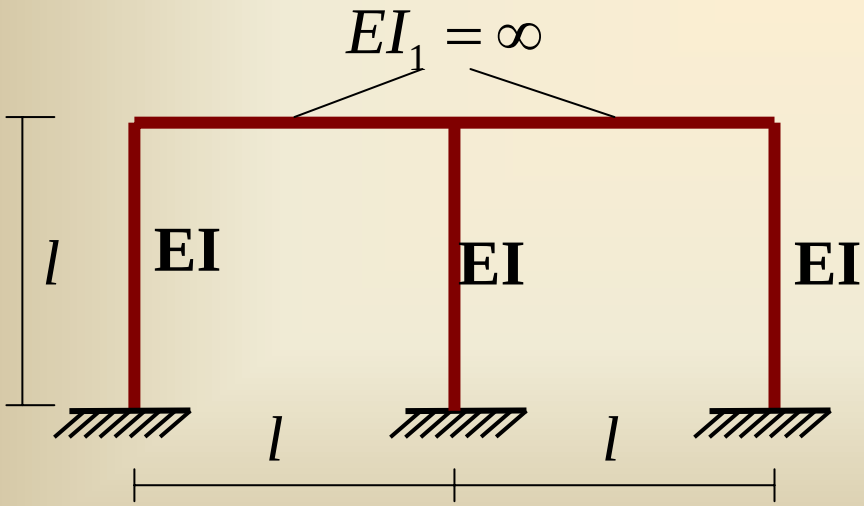


三. 整体分析

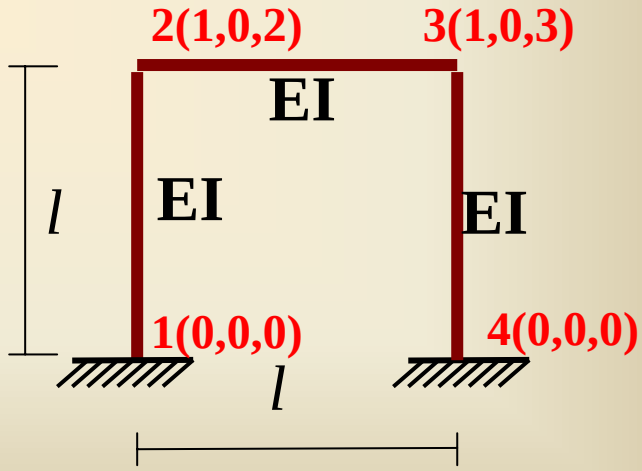


$$[k]=[36EI/l^3]$$

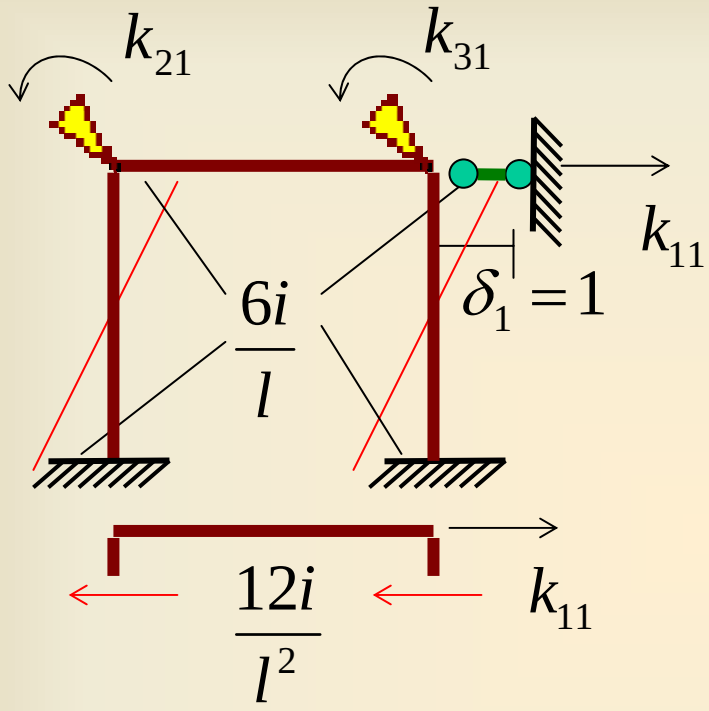
6.先处理法求图示结构总刚
(不计轴变)



7.先处理法求图示结构总刚
(不计轴变)



三. 整体分析



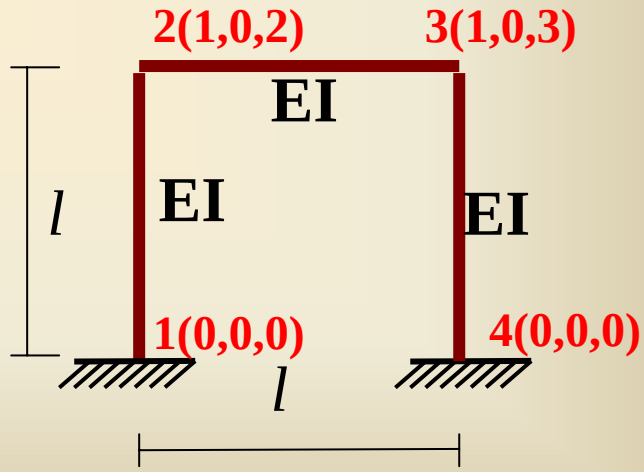
$$[k] = \begin{bmatrix} 24i/l^2 & 6i/l & 6i/l \\ 6i/l & 8i & 2i \\ 6i/l & 2i & 8i \end{bmatrix}$$

$$k_{11} = 24i/l^2$$

$$k_{21} = 6i/l$$

$$k_{31} = 6i/l$$

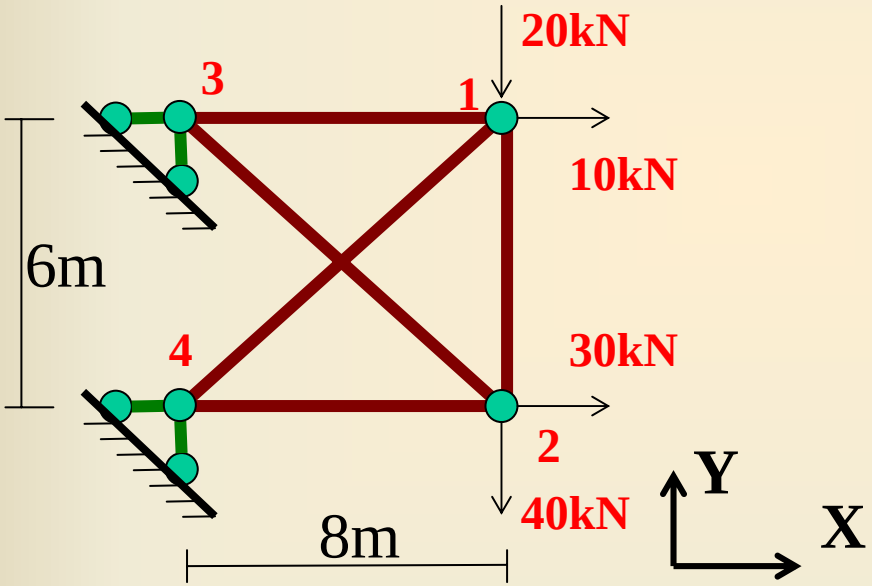
7.先处理法求图示结构总刚(不计轴变)



三. 整体分析

8.等效结点荷载的数值等于汇交于该结点的所有单元固端力之和. 此结论对否?

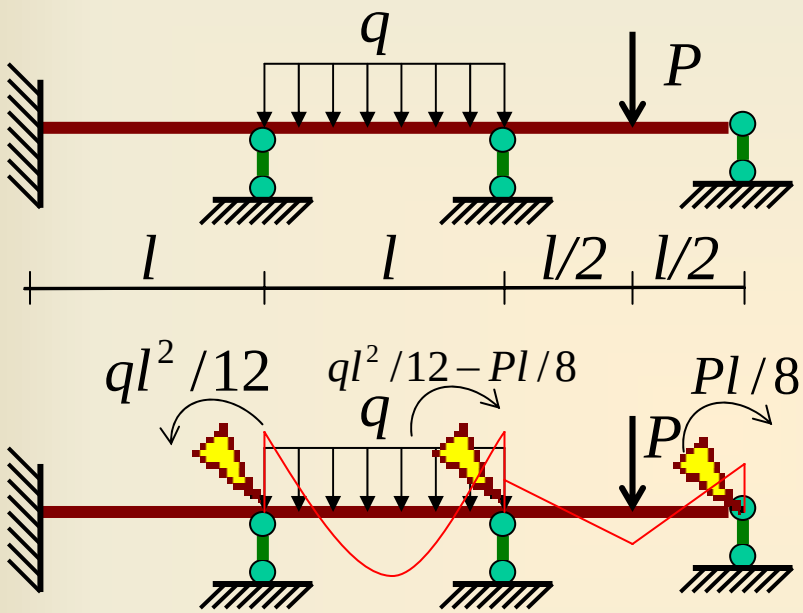
9.试求图示结构的荷载列阵(先处理法).



$$\{P\}=\begin{Bmatrix}10\\-20\\30\\-40\end{Bmatrix}$$

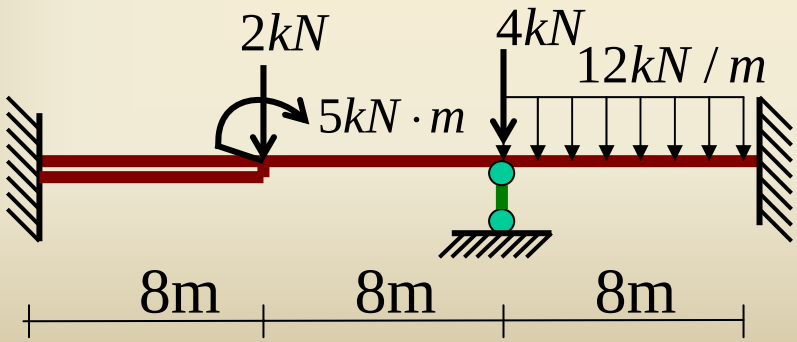
三. 整体分析

10.试求图示结构的荷载列阵(先处理法).

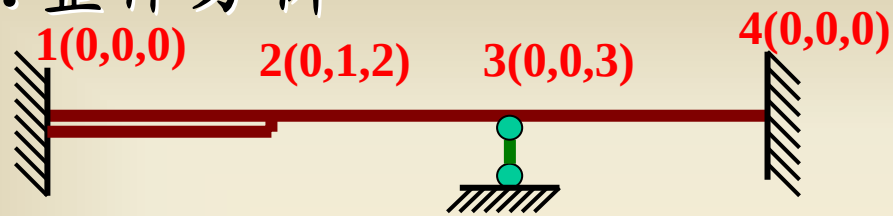


$$\{P\}=\begin{Bmatrix}-ql^2/12\\ ql^2/12-Pl/8\\ Pl/8\end{Bmatrix}$$

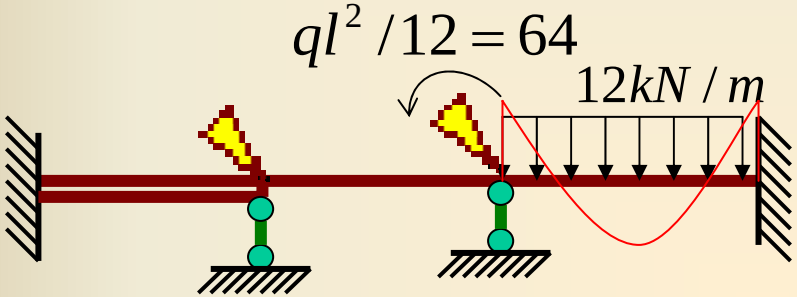
11.试求图示结构(不计轴变)的荷载列阵(先处理法).



三. 整体分析



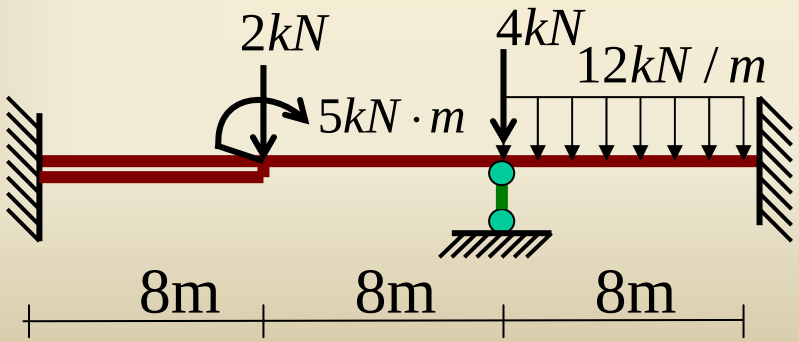
$$\{P_D\}=\begin{Bmatrix}-2\\-5\\0\end{Bmatrix}$$



$$\{P_E\}=\begin{Bmatrix}0\\0\\-64\end{Bmatrix}$$

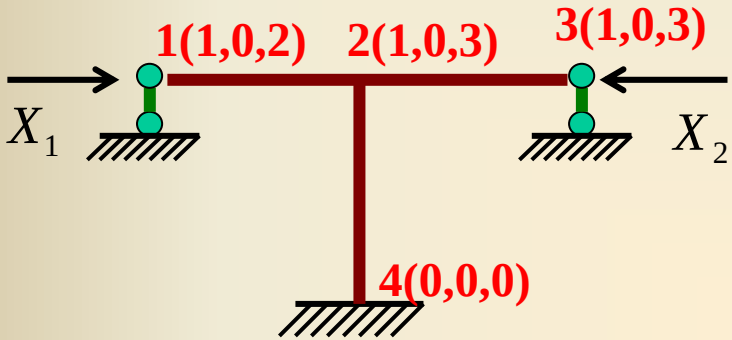
$$\{P\}=\begin{Bmatrix}-2\\-5\\-64\end{Bmatrix}$$

11.试求图示结构(不计轴变)的荷载列阵(先处理法).



三. 整体分析

12.试求图示结构(不计轴变)的荷载列阵(先处理法).



$$\{P\}=\begin{Bmatrix} X_1 - X_2 \\ 0 \\ 0 \end{Bmatrix}$$

四. 求杆端力

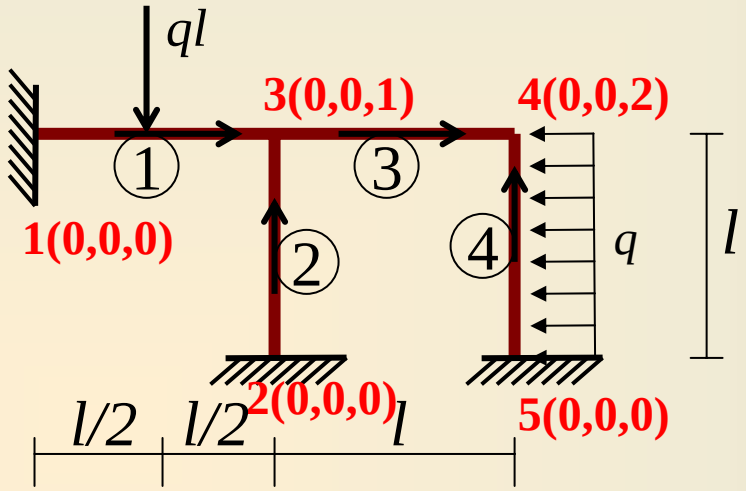
1.连续梁在一般荷载作用下,单元杆端力由下式计算. 是否正确?

$$\{\overline{F}\}^e = [\overline{k}]^e \{\overline{\delta}\}^e + \{F_q\}^e$$

2.已知:图示结构(不计轴变,EI=常数)的结点位移为

$$\{\Delta\}=\left[7ql^2/552\ i \quad -5ql^2/368\ i\right]^T$$

求:1单元的杆端力



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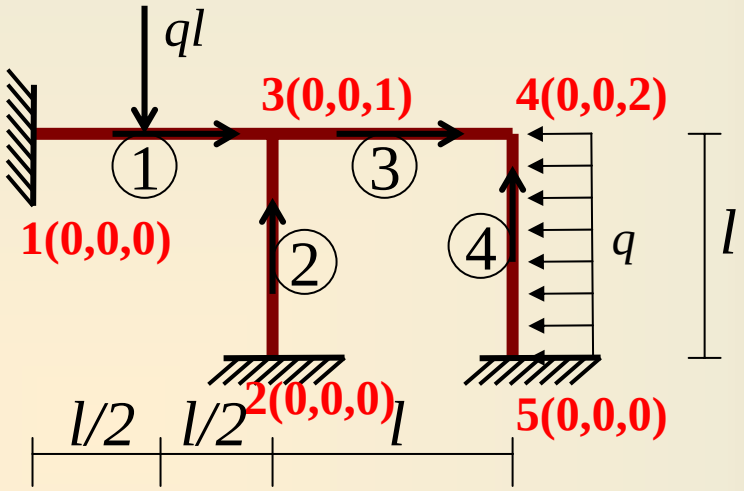
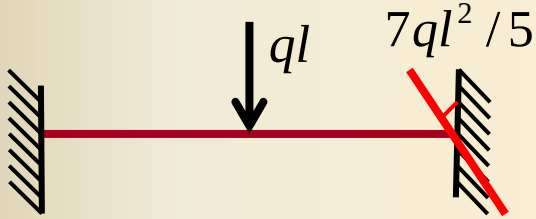
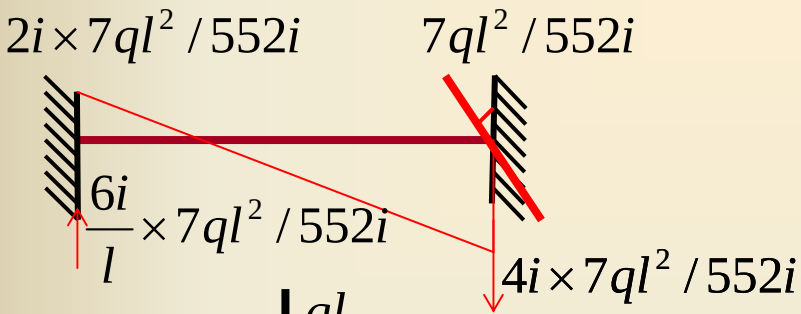
$$\{\Delta\}=\begin{bmatrix}7ql^2/552\,i & -5ql^2/368\,i\end{bmatrix}^T$$

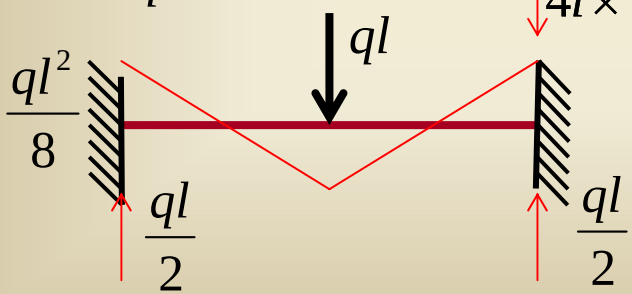
求:1单元的杆端力

$$\{\overline{F}\}^1=[\overline{k}]^1\{\overline{\delta}\}^1+\{F_q\}^1$$







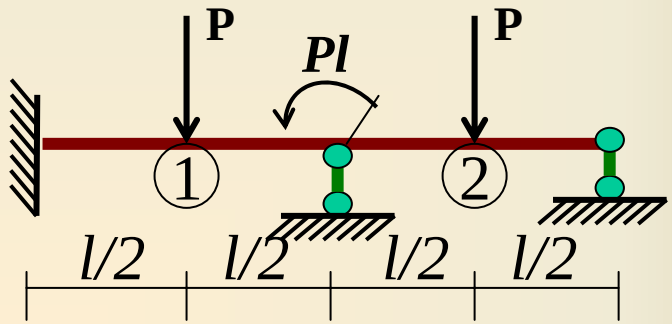


$$\{\overline{F}\}^1=\begin{Bmatrix}7/92+1/2\\7/276+1/8\\-7/92+1/2\\7/138-1/8\end{Bmatrix}$$

3.已知:图示结构(不计轴变,EI=常数)的结点位移为

$$\{\Delta\}=\begin{bmatrix}0 & 0 & 0 & 0 & 17\,Pl\,/112\,i & 0 & 5\,Pl\,/112\,i\end{bmatrix}^T$$

求:1单元的杆端力



4.已知:图示结构(不计轴变,EI=常数)的结点位移为

$$\{\Delta\}=\begin{bmatrix}-\,ql^{3}/12\,EI & -\,ql^{4}/8\,EI\end{bmatrix}^T$$

求:2单元的杆端力