

题编号: 425

试题名称: 结构力学

# 东南大学

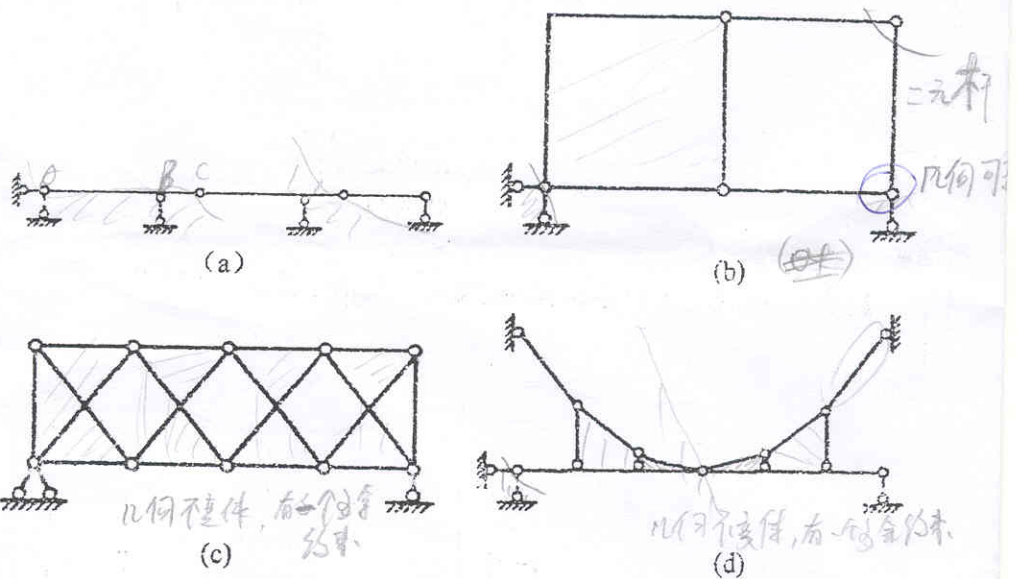
## 二〇〇五年攻读硕士学位研究生入学考试试卷

请考生注意: 试题解答务请考生做在专用“答题纸”上!  
做在其它答题纸上或试卷上的解答将被视为无效答题, 不予评分。

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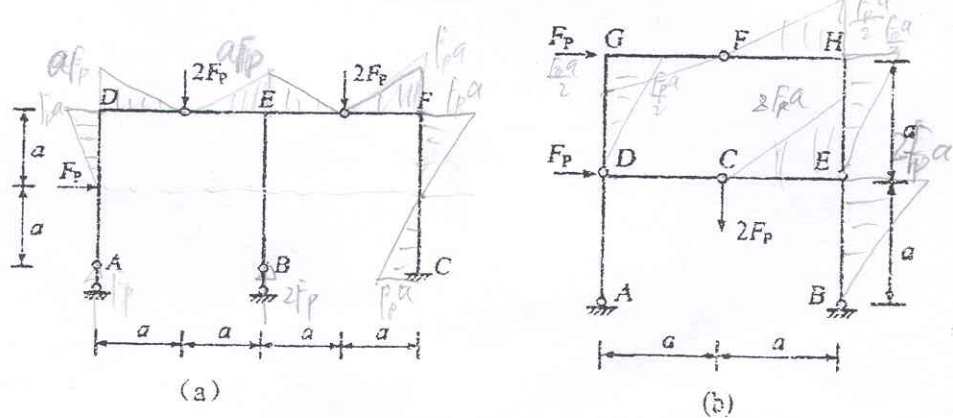
课程名称: 结构力学

题一、分析图示体系的几何稳定性, 写出分析过程 (20 分)



题一图

题二、作图示结构的弯矩图, 可不写分析过程 (20 分)



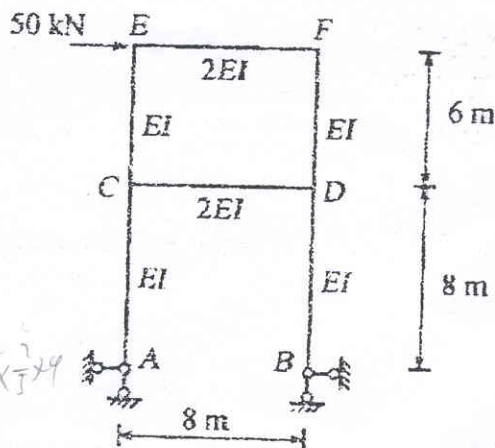
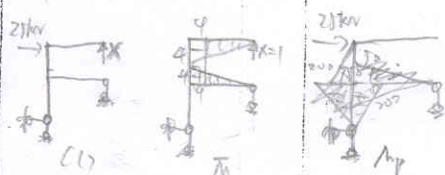
题二图

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题三、用力法作图示结构的弯矩图, 写出分析过程 (30 分)

利用对称性可简化结构  
取对称结构下半部分  
因为对称结构下又有外力荷载  
而结构在对称  
取6度基本体系如(a)。

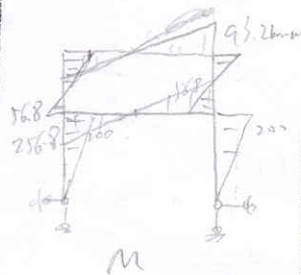


题三图

$$\begin{aligned} \delta_{11} &= \frac{1}{2EI} \times \frac{1}{2} \times 4^2 \times 4 + \frac{4 \times 6 \times 4}{EI} + \frac{1}{2EI} \times \frac{1}{2} \times 4^2 \times 4 \\ &= \frac{32}{3} \frac{1}{EI} \\ \delta_{1p} &= -\frac{1}{EI} \times \frac{1}{2} \times 10 \times 6 \times 4 - \frac{1}{2EI} \times 50 \times 4 \times \frac{1}{2} \times 4 \\ &= -\frac{800}{EI} \end{aligned}$$

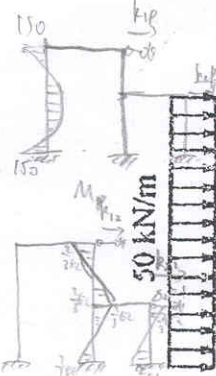
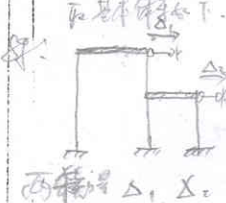
平衡方程:

$$\begin{aligned} \delta_{11} X + \delta_{1p} &= 0 \\ X &= \frac{10.15}{EI} \\ \bar{M} &= \bar{M}_X + \bar{M}_p \end{aligned}$$



题四、用位移法作图示结构的弯矩图, 写出分析过程 (30 分)

取基本体系如下。



题四图

计算:

$$\begin{aligned} k_{1p} &= -\frac{1}{2} \times 50 \times 6 = -150 \text{ kN}, k_{1p} = 0 \\ k_{11} &= \frac{1}{2} EI, k_{12} = k_{21} = -\frac{4}{9} EI, k_{22} = \frac{4}{3} EI \end{aligned}$$

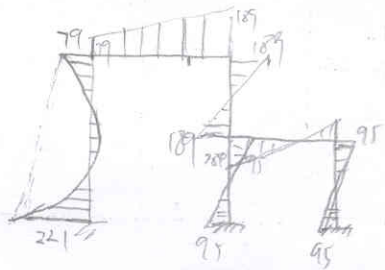
平衡方程:

$$\begin{aligned} k_{11} \Delta_1 + k_{12} \Delta_2 + k_{1p} &= 0 \\ k_{21} \Delta_1 + k_{22} \Delta_2 + k_{2p} &= 0 \end{aligned}$$

代入计算:

$$\begin{aligned} \Delta_1 &= \frac{8.19}{19} \frac{1}{EI} \\ \Delta_2 &= \frac{21.00}{19} \frac{1}{EI} \end{aligned}$$

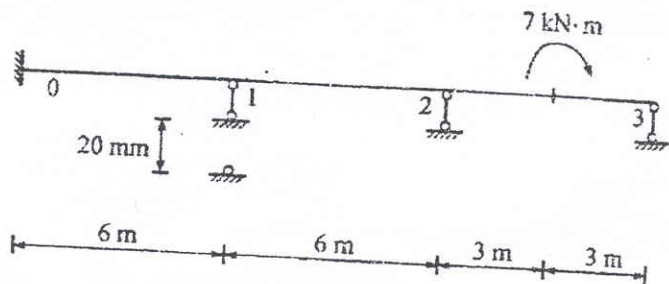
$$\bar{M} = \bar{M}_1 \Delta_1 + \bar{M}_2 \Delta_2 + \bar{M}_p$$



试题编号: 425

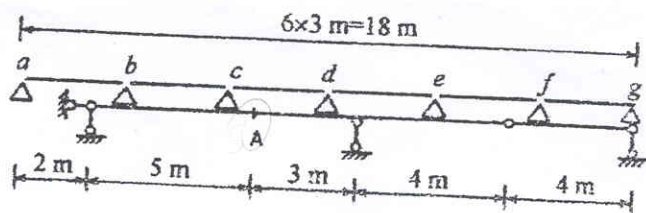
试题名称:

题五、图示结构支座 1 下沉 15mm, 已知  $E = 2.1 \times 10^{11} \text{ Pa}$ ,  $I = 4 \times 10^{-4} \text{ m}^4$ , 用力矩分配法作图示结构的弯矩图, 写出分析过程 (15 分)



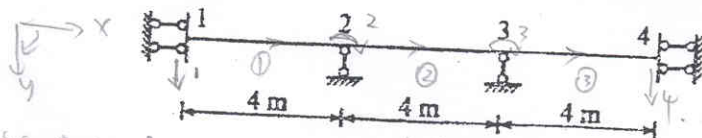
题五图

题六、做图示结构 A 点的弯矩和剪力影响线, 可不写分析过程 (15 分)



题六图

题七、写出图示结构的整体刚度矩阵, EI 为常数, 写出分析过程 (20 分)



解: 未知量为  $\{\Delta_1, \Delta_2, \Delta_3, \Delta_4\}$  题七图: 整体刚度矩阵

$$k = k^{(1)} = k^{(2)} = k^{(3)} = k^{(4)} = k^{(5)} = \begin{bmatrix} \frac{12EI}{L^3} & \frac{6EI}{L^2} & -\frac{12EI}{L^3} & \frac{6EI}{L^2} \\ \frac{6EI}{L^2} & \frac{4EI}{L} & -\frac{6EI}{L^2} & \frac{2EI}{L} \\ -\frac{12EI}{L^3} & -\frac{6EI}{L^2} & \frac{12EI}{L^3} & -\frac{6EI}{L^2} \\ \frac{6EI}{L^2} & \frac{2EI}{L} & -\frac{6EI}{L^2} & \frac{4EI}{L} \end{bmatrix} \times$$

采用集权法合成整体刚度矩阵

$$\{ \lambda \}^{(1)} \rightarrow \{ 1, 0, 0, 2 \}$$

$$\{ \lambda \}^{(2)} \rightarrow \{ 0, 2, 0, 3 \}$$

$$\{ \lambda \}^{(3)} \rightarrow \{ 0, 3, 4, 0 \}$$

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

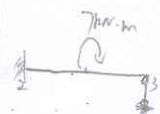
$$= \begin{bmatrix} \frac{3}{4} \\ \frac{3}{2} \\ 0 \\ 0 \end{bmatrix}$$

共 3 页 第 3 页

解:  $\Delta = 20 \text{ mm} = 0.02 \text{ m}$  时, 杆端弯矩:

$$M_{10} = M_{01} = -6 \frac{EI}{L^2} \Delta = -6 \times \frac{2.1 \times 10^4 \times 4 \times 10^6}{6^2} \times 0.02 \text{ N}\cdot\text{m} = -2.8 \times 10^5 \text{ N}\cdot\text{m} = -280 \text{ kN}\cdot\text{m}$$

$$M_{12} = M_{21} = 6 \frac{EI}{L^2} \Delta = 2.8 \times 10^5 \text{ N}\cdot\text{m} = 280 \text{ kN}\cdot\text{m}$$

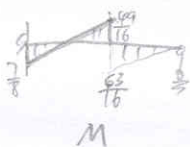


$$S_{11} = \frac{b^3}{3EI} = \frac{7^2}{EI}, \quad S_{1P} = \frac{1}{EI} \cdot \frac{1}{2} (6+3) \times 3 \times 7 = -\frac{189}{2EI}$$

$$S_{11} X + S_{1P} = 0$$

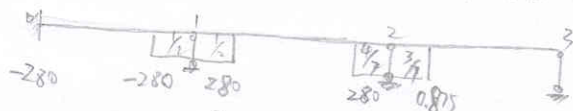
$$\frac{1}{16} X = \frac{21}{16}$$

$$M = \bar{M}_X + \bar{M}_P$$



$$P_p M_{23} = \frac{7}{8} \text{ kN}\cdot\text{m}$$

在 1 处,  $M_{10} = M_{01} = \frac{1}{2}$ ,  
在 2 处,  $M_{21} = \frac{1}{2}, M_{23} = \frac{3}{2}$



$$-280 \quad -280 \quad 280 \quad -80.2 \quad -169.4 \quad -120.55$$

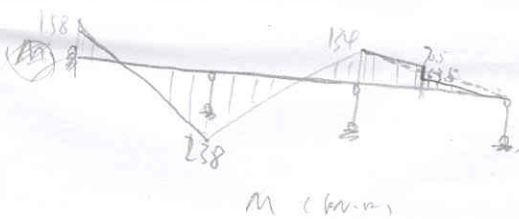
$$20.5 \leftarrow 40.1 \quad 40.1 \rightarrow 20.5$$

$$1.18 \leftarrow 2.35 \quad 2.35 \rightarrow 1.18$$

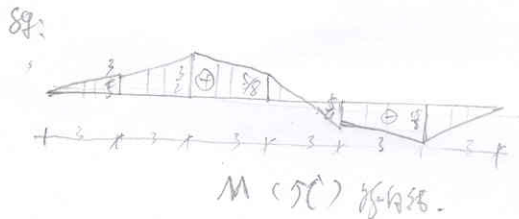
$$-158.32 \quad -237.55 \quad 237.55 \quad 133.7 \quad -133.6$$

$$-158 \quad -238 \quad 238 \quad 134 \quad -134$$

(单位 kN·m)



E. 89:



Q (kN) 影响线.

$$\begin{bmatrix} \frac{3}{8} & 0 & 0 \\ 2 & \frac{1}{2} & 0 \\ \frac{1}{2} & 2 & -\frac{3}{8} \\ 0 & -\frac{3}{8} & \frac{3}{4} \end{bmatrix}$$