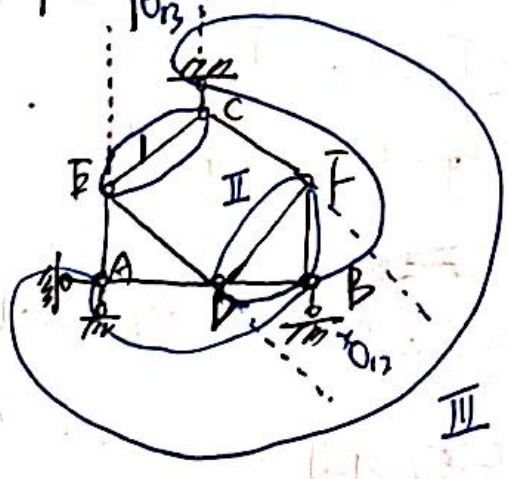
广州大学2022年结构力学839真题解析

(一)

解：视C点为刚片Ⅰ，BD杆为刚片Ⅱ，

地基为刚片Ⅲ。



刚片Ⅰ与刚片Ⅲ之间用链杆CF，ED相连，形成虚铰在无穷远处O_{12}；

刚片Ⅰ与刚片Ⅲ之间用AE链杆和C处支座链杆相连，形成无穷远处铰O_{13}；

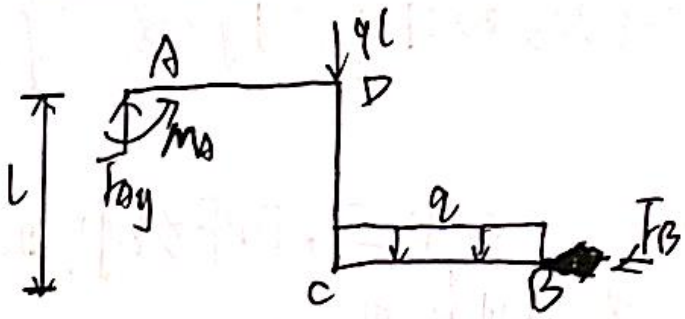
刚片Ⅱ与刚片Ⅲ之间由AB和B处支座链杆相连形成虚铰O_{23}；

三个虚铰构成三角形，满足三刚片规则，则整个体系为无多余约束和可变体系。

(二) 取上部为隔离体

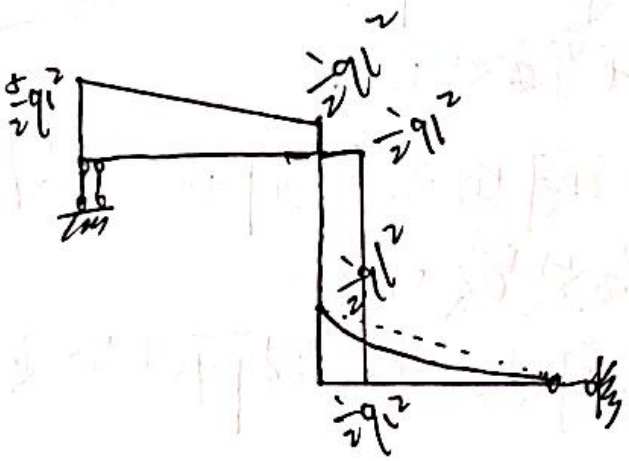
$\Sigma F_x = 0$, $F_B = 0$

$\Sigma F_y = 0$, $F_{Ay} = 2ql$



对A点取矩, $M_A = ql \cdot L + ql \times (L + \frac{L}{2}) = \frac{5}{2}ql^2$

弯矩图:



(三) 取上部活构为隔离体如图(1)

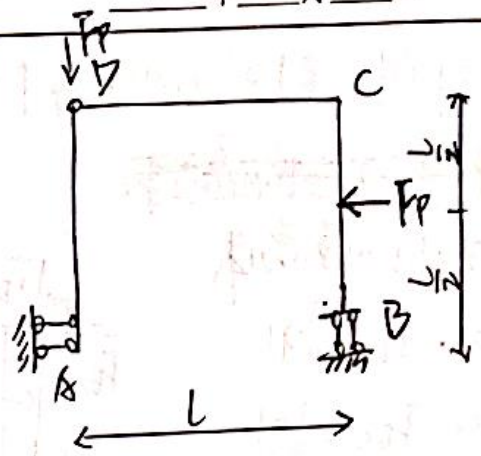
$\Sigma F_x=0$, $F_{Dx}=F_P$

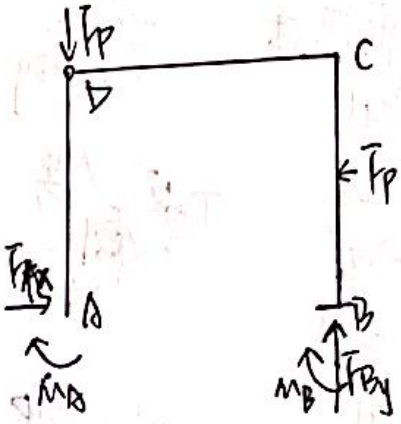
$\Sigma F_y=0$, $F_{By}=F_P$

再取AD, BCD为隔离体如图(2)(3)

求得 $F_{Dx}=F_P$, $F_{Dy}=F_P$, $M_B=F_P L$

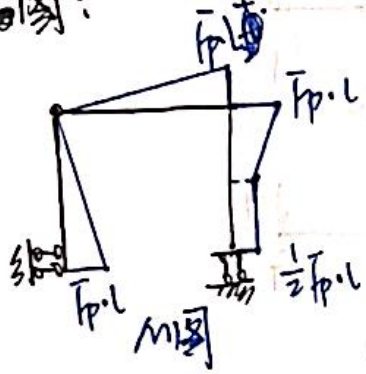
$M_B=\frac{1}{2}F_P \cdot L$

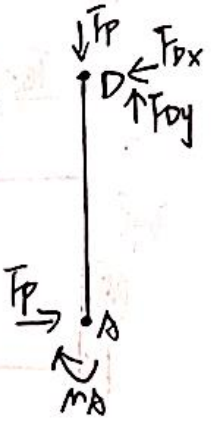




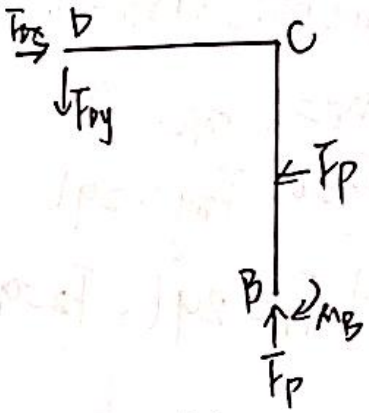
(1)

画M图:

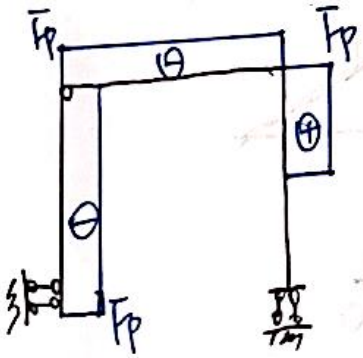




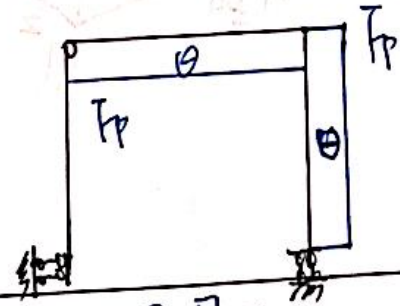
(2)



(3)



F_S图



F_N图

导师签名:

(四) 作图示结构弯矩图，并求杆件1，2杆轴力。

解：~~取整体为隔离体~~

取BC为隔离体

$\Sigma M_B=0$, $F_{Cx}=\frac{1}{2}ql$

$\Sigma F_x=0$, $F_{Bx}=\frac{1}{2}ql$

再取DEFG为隔离体

$\Sigma F_x=0$, $F_{Dx}=\frac{1}{2}ql$

取整体为隔离体

$\Sigma M_A=0$, $M_D=-3ql^2$

$\Sigma F_x=0$, $F_{Ax}=\frac{1}{2}ql$

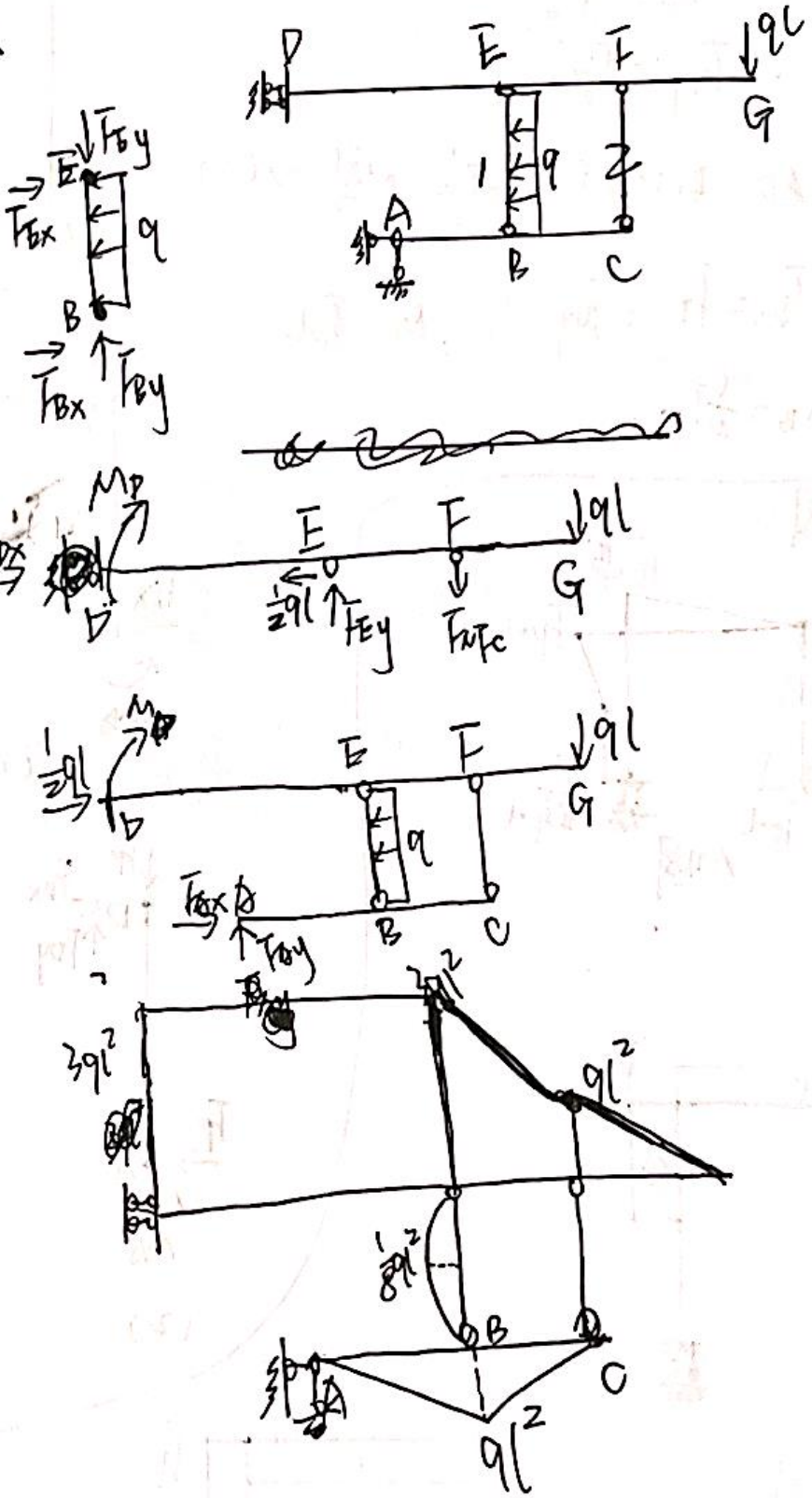
$\Sigma F_y=0$, $F_{Ay}=ql$

再以DEFG为隔离体

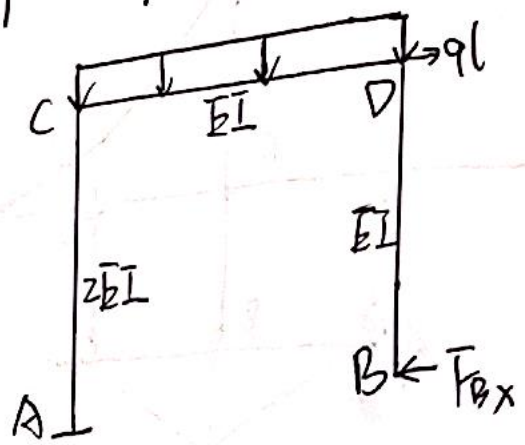
$\Sigma M_E=0$, $F_{NFC}=ql$

$\Sigma F_y=0$, $F_{Ey}=2ql$

则 $F_1=2ql$, $F_2=ql$



(3) 求图示结构C点竖向位移。各杆EI为常数。



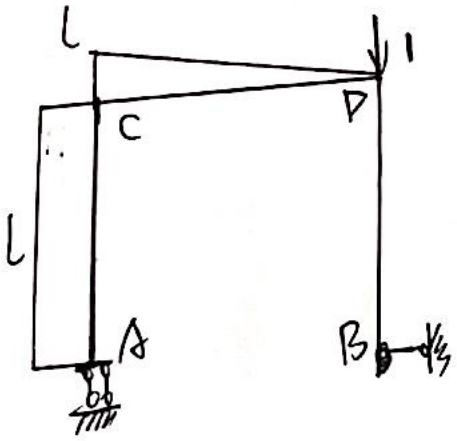
解：取整体为隔离体

$\sum F_x = 0$，$F_{Ax} = ql$

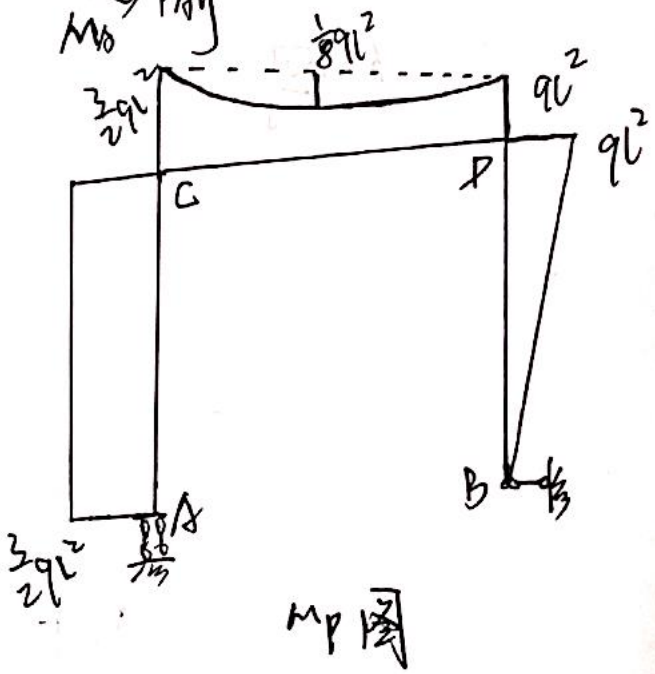
$\sum F_y = 0$，$F_{Ay} = ql$

~~对A点取矩~~，得 $M_A = \frac{3}{2}ql^2$

作单位力矩作用下的弯矩



$\overline{M}_1$



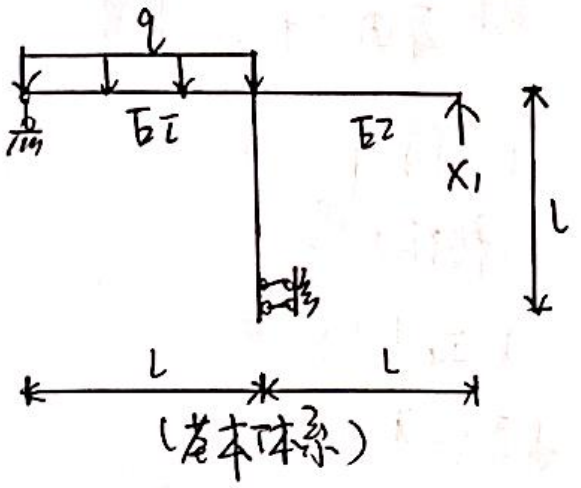
M_P 图

图乘：$\Delta_{Dy} = \frac{1}{2EI}\left(l \times l \times \frac{3}{2}ql^2\right) + \frac{1}{EI}\left(ql^2 \times l \times \frac{l}{2} + \frac{1}{2}ql^2 \times l \times \frac{1}{2} \times \frac{2}{3}l - \frac{2}{3} \times \frac{1}{8}ql^2 \cdot l \times \frac{l}{2}\right)$

$= \frac{11}{8EI}ql^4 (\downarrow)$

导师签名：

(六) 由图可知，体系有一个多余联系，则基本体系为



(基本体系)

解、力法典型方程为：

$$\delta_{11}X_1+\Delta_{1P}=0$$

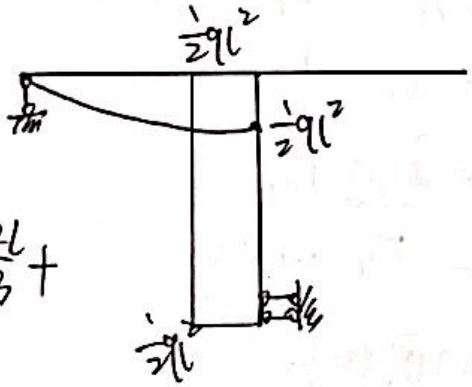
取外荷载作用下的弯矩图如图(1)

作单位力下的弯矩图如图(2)

由 M_P 和 $\overline{M}_1$ 图可求得

$$\delta_{11}=\frac{1}{EI}\left(l\times l\times\frac{1}{2}\cdot\frac{2l}{3}\times 2\right)+\frac{1}{2EI}\left(l\times 2l\times 2l\right)$$

$$=\frac{8}{3EI}l^3$$

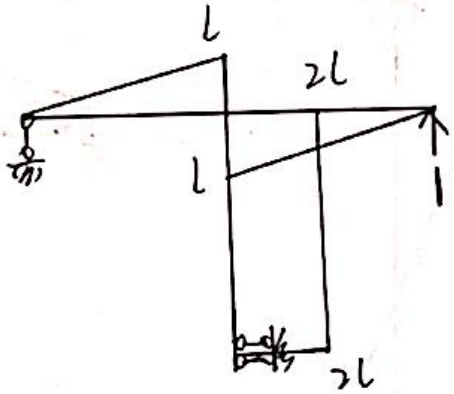


M_P (1)

$$\Delta_{1P}=\frac{1}{2EI}\left(-2l\times l\times\frac{1}{2}ql^2\right)+\frac{-1}{EI}\left(\frac{1}{2}ql^2\times l\times\frac{1}{2}\times\frac{2l}{3}+\frac{2}{3}\times\frac{1}{8}ql^2\cdot l\times\frac{l}{2}\right)$$

$$=-\frac{17}{24EI}ql^4$$

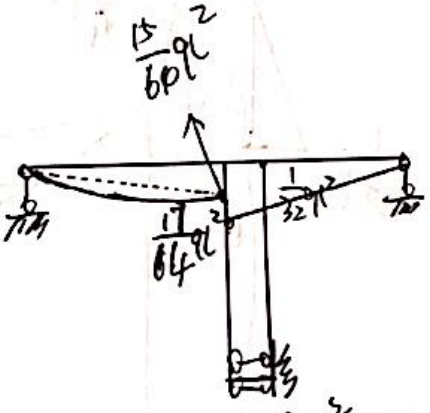
代入 $\delta_{11}X_1+\Delta_{1P}=0$ 求得 $X_1=\frac{17}{64}ql$



$\overline{M}_1$ (2)

最终弯矩图为

$$M=\overline{M}_1X_1+M_P$$



M 图

导师签名：

(七) 利用对称性，取半结构如图(1)

解：采用位移法计算

平衡条件 $R_{1P}=0$

位移法方程

$$k_{11}Z_1+R_{1P}=0$$

求系数和自由项

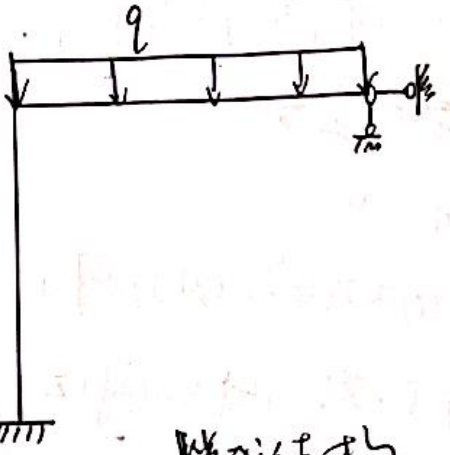
$k_{11}=7i$ $R_{1P}=-\frac{1}{8}ql^2$

求得 $Z_1=\frac{1}{56i}ql^2$

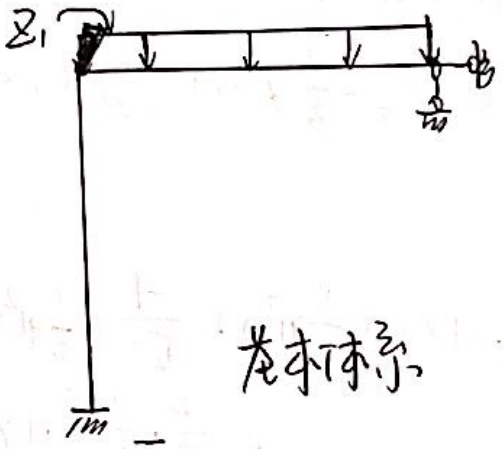
最终弯矩图

$M=\overline{M}_1Z_1+M_P$

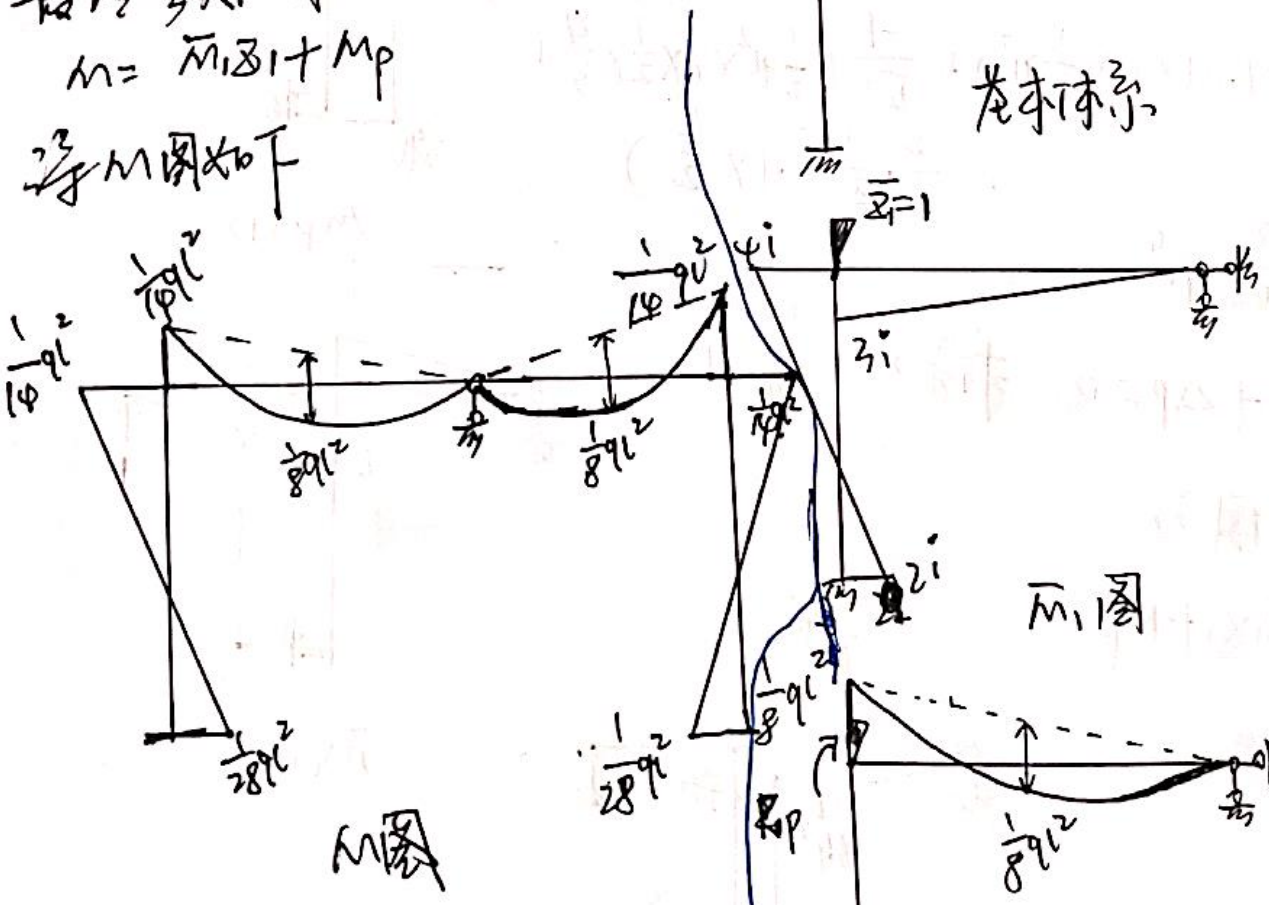
等M图如下



等代结构



原来体系



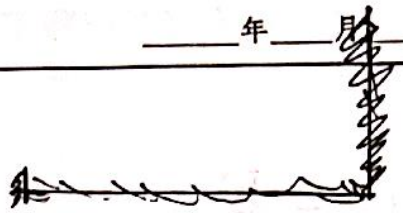
M图

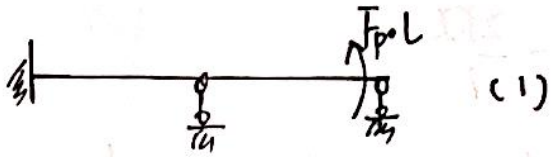
$\overline{M}_1$图

M_P图

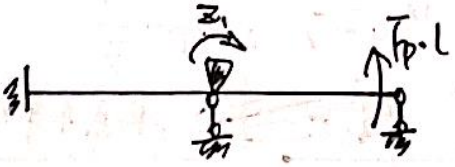
导师签名：

(八) 原结构等价于如图(1)





(1)



基本体系

解: 位移法典型方程

$k_{11}Z_1 + R_{1P} = 0$

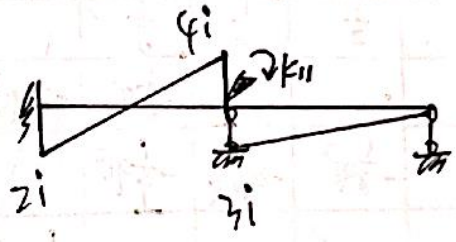
求系数和自由项

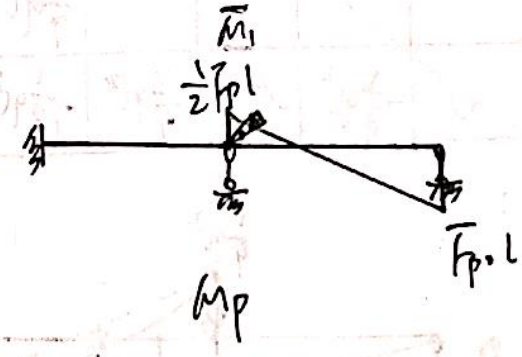
$k_{11} = 7i$, $R_{1P} = -\frac{1}{2}Fp \cdot l$

求得 $Z_1 = \frac{1}{14i}Fp \cdot l$

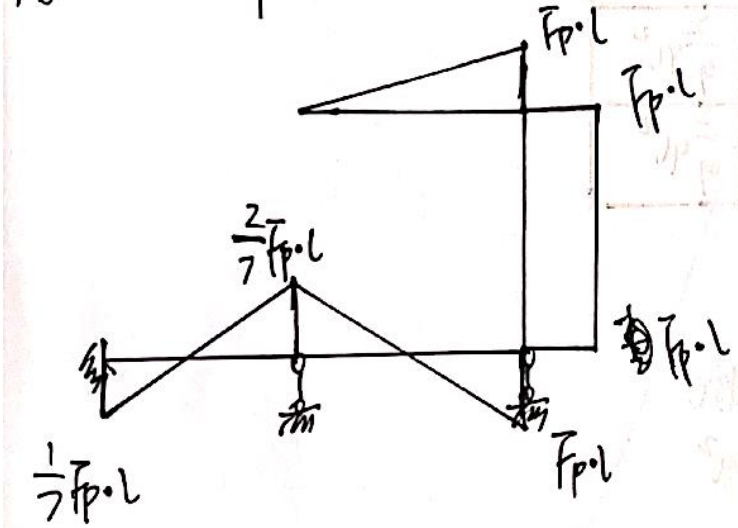
最终弯矩图为

$M = \overline{M}_1 Z_1 + M_P$





M_P

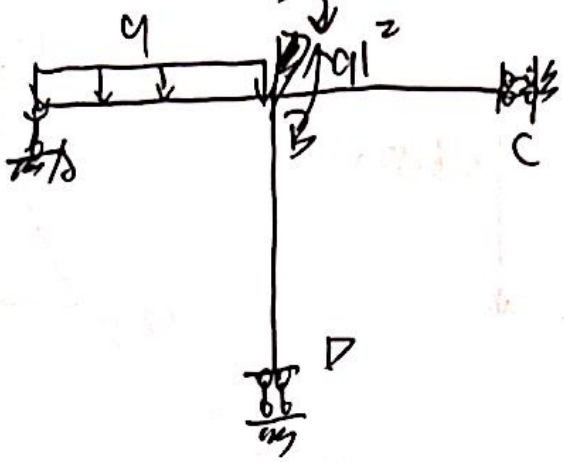


M图

解：$S_{BA}=\frac{3i_{BA}}{l}$，$S_{BC}=\frac{i_{BC}}{l}$

$S_{BD}=\frac{2i_{BD}}{l}$

$\mu_{BA}=\frac{1}{2}$，$\mu_{BC}=\frac{1}{6}$，$\mu_{BD}=\frac{1}{3}$



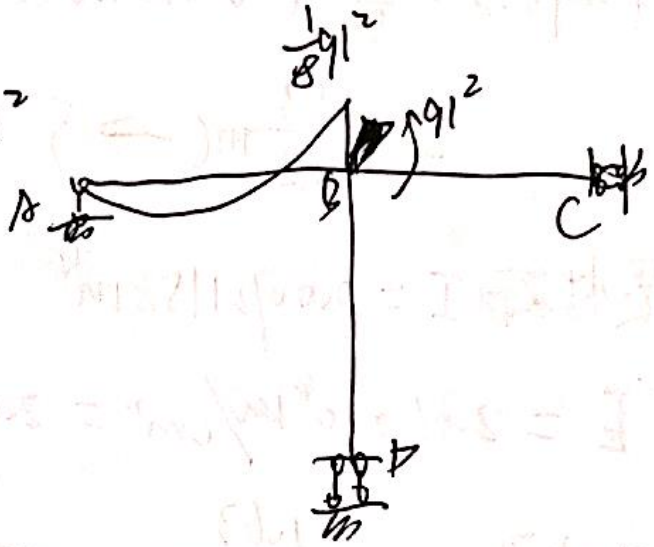
最终结果

$M^F_{BA}=M^F_{AB}=M^F_{BD}=M^F_{DB}=M^F_{BC}=M^F_{CB}=0$

$M^F_{AB}=\frac{1}{8}ql^2$

杆端弯矩 $M_{BA}=M^F_{BA}=\frac{1}{8}ql^2$

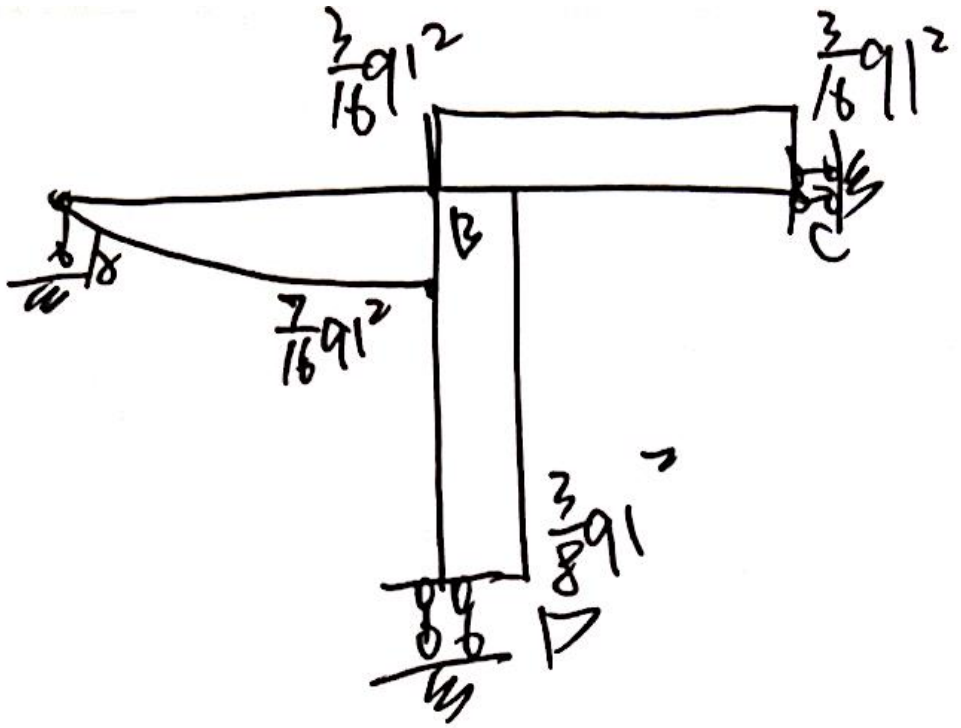
被分离之处 $M=-\frac{1}{8}ql^2-ql^2=-\frac{9}{8}ql^2$



M_P

结点	A	B			C	D
杆端	AB	BA	BD	BC	CB	DB
μ		$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{6}$		
M^F	0	$\frac{1}{8}ql^2$	0	0	0	0
分配弯矩		$-\frac{9}{16}ql^2$	$-\frac{3}{8}ql^2$	$-\frac{3}{16}ql^2$		
传递弯矩	0				$\frac{3}{16}ql^2$	$\frac{3}{8}ql^2$
杆端弯矩		$-\frac{1}{16}ql^2$	$-\frac{3}{8}ql^2$	$-\frac{3}{16}ql^2$	$\frac{3}{16}ql^2$	$\frac{3}{8}ql^2$

导师签名



M図.

(十) 作影响线如下

解：