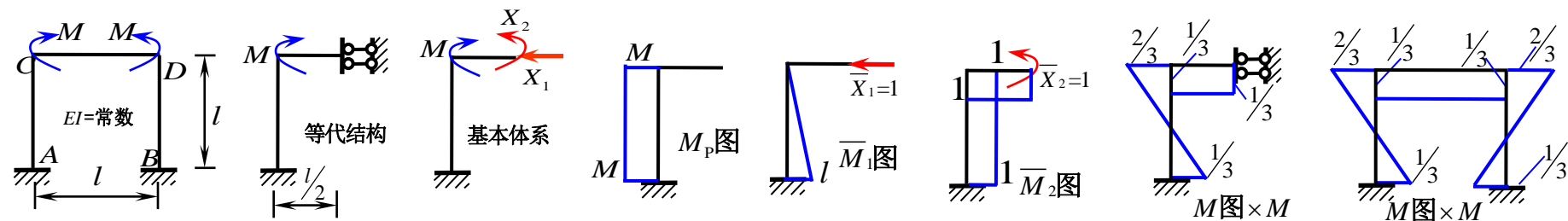


# 【例题1】用力法作弯矩图。（对称1-2）



$$\begin{aligned} \delta_{11}X_1 + \delta_{12}X_2 + \Delta_{1P} &= 0 \\ \delta_{21}X_1 + \delta_{22}X_2 + \Delta_{2P} &= 0 \end{aligned}$$

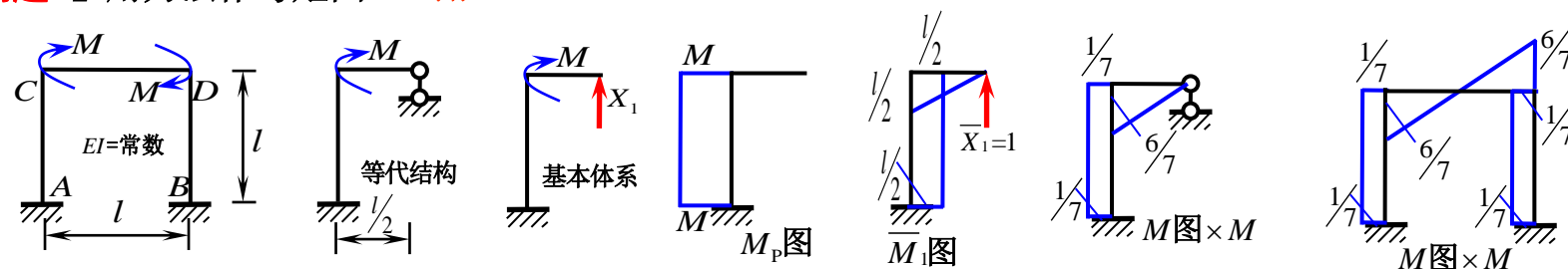
$$\delta_{11} = \sum \int \frac{\bar{M}_1 \bar{M}_1}{EI} ds = \frac{l^3}{3EI} \quad \delta_{12} = \delta_{21} = \sum \int \frac{\bar{M}_1 \bar{M}_2}{EI} ds = \frac{l^2}{2EI} \quad \delta_{22} = \sum \int \frac{\bar{M}_2 \bar{M}_2}{EI} ds = \frac{3l}{2EI}$$

$$\Delta_{1P} = \sum \int \frac{\bar{M}_1 M_P}{EI} ds = \frac{-Ml^2}{2EI} \quad \Delta_{2P} = \sum \int \frac{\bar{M}_2 M_P}{EI} ds = \frac{-Ml}{EI}$$

$$\begin{aligned} \frac{l^3}{3EI} X_1 + \frac{l^2}{2EI} X_2 - \frac{Ml^2}{2EI} &= 0 \\ \frac{l^2}{2EI} X_1 + \frac{3l}{2EI} X_2 - \frac{Ml}{EI} &= 0 \end{aligned}$$

$$X_1 = \frac{M}{l} \quad X_2 = \frac{M}{3} \quad M = \bar{M}_1 X_1 + \bar{M}_2 X_2 + M_P$$

# 【例题2】用力法作弯矩图。（对称1-3）

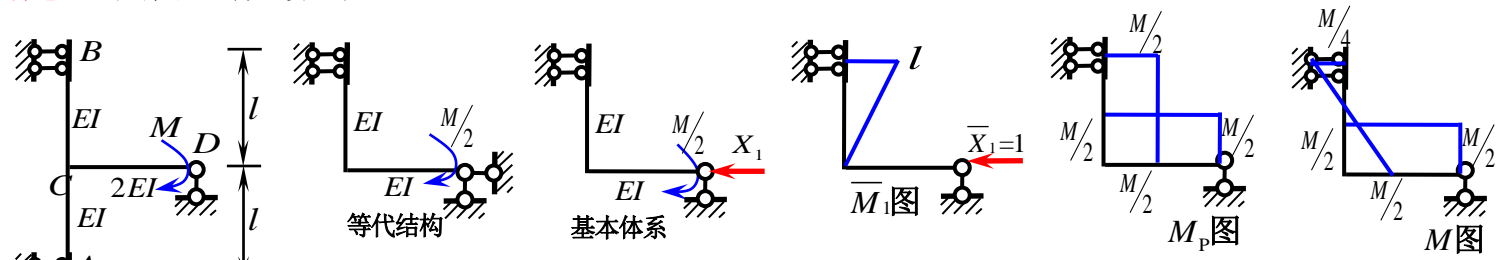


$$\delta_{11}X_1 + \Delta_{1P} = 0$$

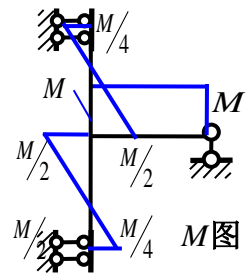
$$\delta_{11} = \sum \int \frac{\bar{M}_1 \bar{M}_1}{EI} ds = \frac{7l^3}{24EI} \quad \Delta_{1P} = \sum \int \frac{\bar{M}_1 M_P}{EI} ds = \frac{-Ml^2}{2EI}$$

$$X_1 = \frac{-\Delta_{1P}}{\delta_{11}} = \frac{12M}{7l} \quad M = X_1 \bar{M}_1 + M_P$$

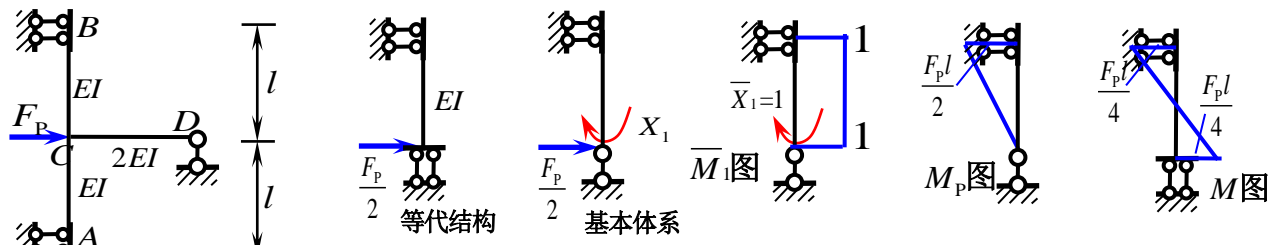
【例题3】用力法作弯矩图。（对称2-3）



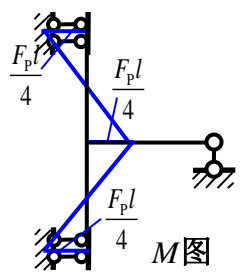
$$\delta_{11}X_1 + \Delta_{1P} = 0 \quad \delta_{11} = \sum \int \frac{\bar{M}_1 \bar{M}_1}{EI} ds = \frac{l^3}{3EI} \quad \Delta_{1P} = \sum \int \frac{\bar{M}_1 M_P}{EI} ds = \frac{Ml^2}{4EI}$$
$$X_1 = -\Delta_{1P} / \delta_{11} = -3M / 4l \quad M = X_1 \bar{M}_1 + M_P$$



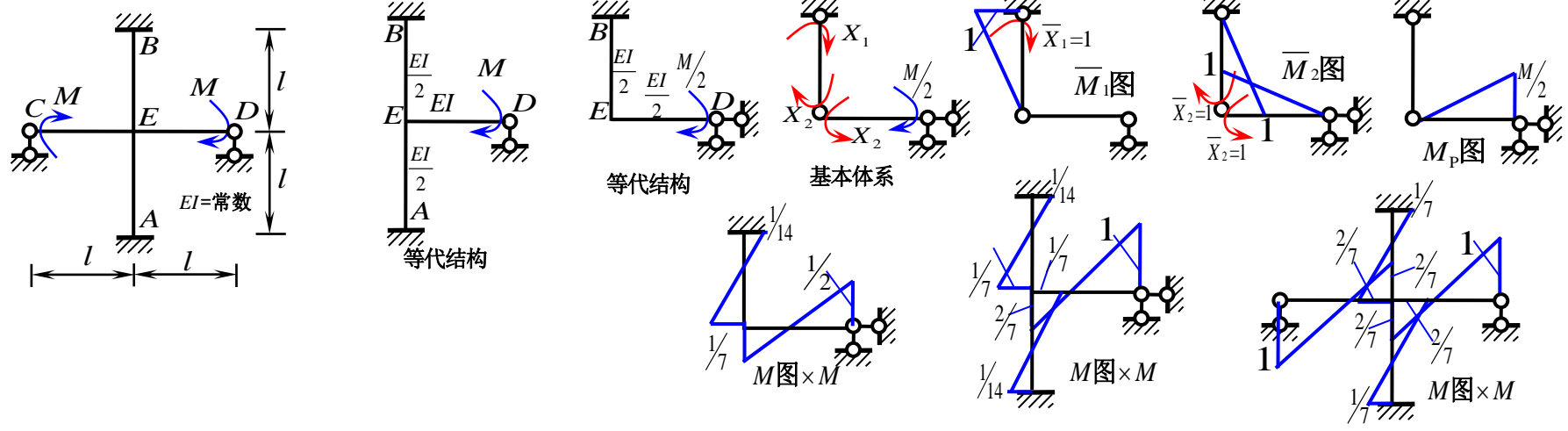
【例题4】用力法作弯矩图。（对称2-4）



$$\delta_{11}X_1 + \Delta_{1P} = 0 \quad \delta_{11} = \sum \int \frac{\bar{M}_1 \bar{M}_1}{EI} ds = \frac{l}{EI} \quad \Delta_{1P} = \sum \int \frac{\bar{M}_1 M_P}{EI} ds = \frac{-F_P l^2}{4EI}$$
$$X_1 = -\Delta_{1P} / \delta_{11} = F_P l / 4 \quad M = X_1 \bar{M}_1 + M_P$$



【例题5】用力法作弯矩图。（对称2-11）



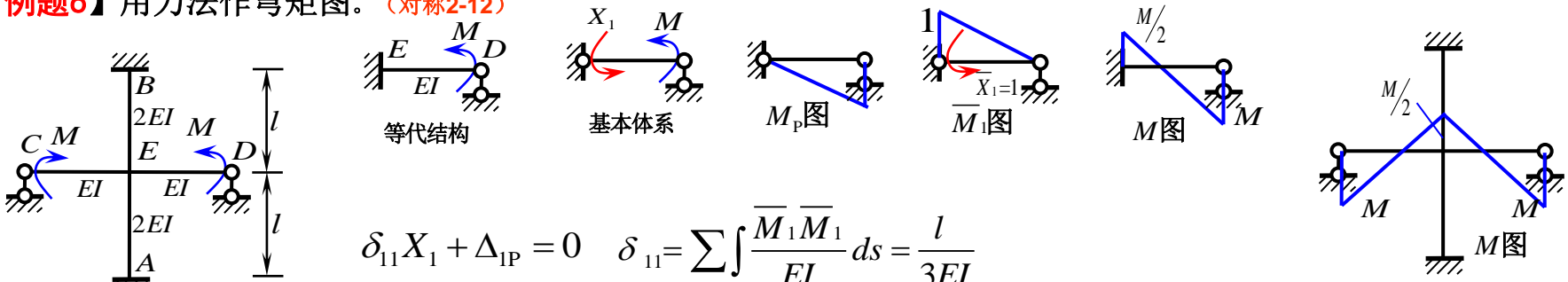
$$\delta_{11}X_1 + \delta_{12}X_2 + \Delta_{1P} = 0$$
$$\delta_{21}X_1 + \delta_{22}X_2 + \Delta_{2P} = 0$$

$$\delta_{11} = \sum \int \frac{\bar{M}_1 \bar{M}_1}{EI} ds = \frac{2l}{3EI}$$
$$\delta_{21} = \delta_{12} = \sum \int \frac{\bar{M}_1 \bar{M}_2}{EI} ds = \frac{-l}{3EI}$$
$$\delta_{22} = \sum \int \frac{\bar{M}_2 \bar{M}_2}{EI} ds = \frac{4l}{3EI}$$

$$\Delta_{1P} = \sum \int \frac{\bar{M}_1 M_P}{EI} ds = 0$$
$$\Delta_{2P} = \sum \int \frac{\bar{M}_2 M_P}{EI} dx = \frac{Ml}{6EI}$$

$$\frac{2l}{3EI}X_1 - \frac{l}{3EI}X_2 = 0$$
$$\frac{-l}{3EI}X_1 + \frac{4l}{3EI}X_2 + \frac{Ml}{6EI} = 0$$
$$X_1 = -M/14 \quad X_2 = -M/7$$
$$M = \bar{M}_1 X_1 + \bar{M}_2 X_2 + M_P$$

【例题6】用力法作弯矩图。（对称2-12）



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

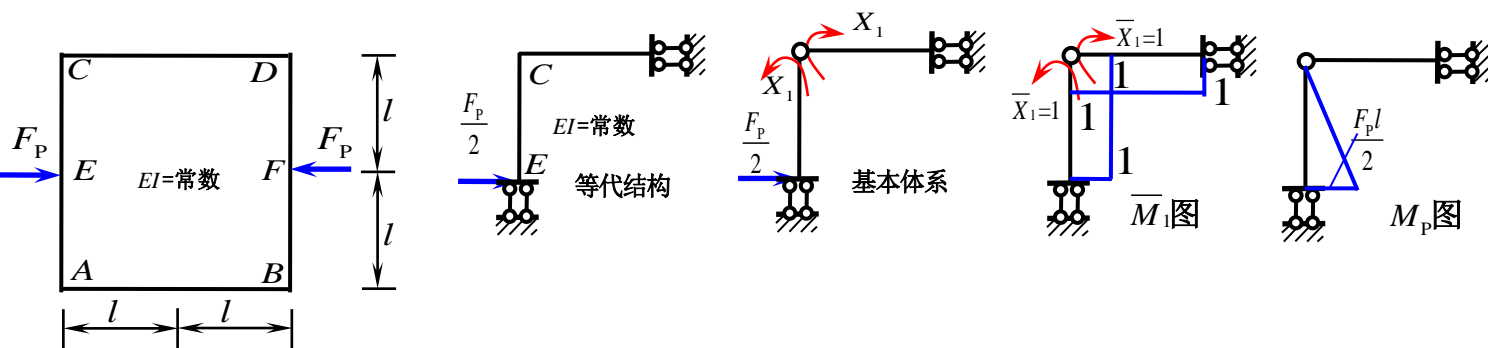
$$\delta_{11} = \sum \int \frac{\bar{M}_1 \bar{M}_1}{EI} ds = \frac{l}{3EI}$$

$$\Delta_{1P} = \sum \int \frac{\bar{M}_1 M_P}{EI} ds = \frac{-Ml}{6EI}$$

$$X_1 = -\Delta_{1P} / \delta_{11} = M/2$$
$$M = X_1 \bar{M}_1 + M_P$$

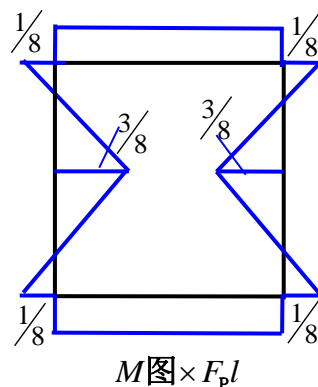


【例题7】用力法作弯矩图。（对称2-22）

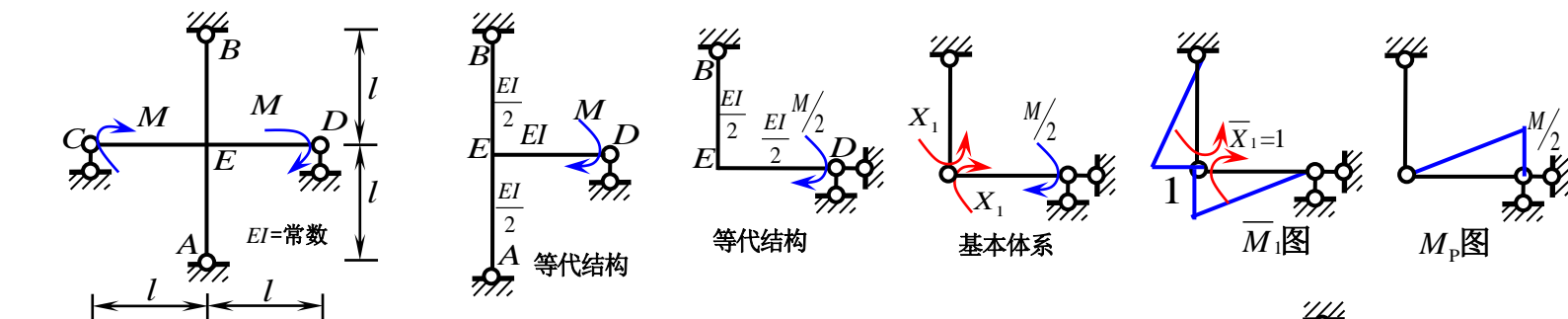


$$\delta_{11}X_1 + \Delta_{1P} = 0 \quad \delta_{11} = \sum \int \frac{\bar{M}_1 \bar{M}_1}{EI} ds = \frac{2l}{EI}$$

$$\Delta_{1P} = \sum \int \frac{\bar{M}_1 M_P}{EI} ds = \frac{F_P l^2}{4EI} \quad X_1 = -\Delta_{1P} / \delta_{11} = -F_P l / 8 \quad M = X_1 \bar{M}_1 + M_P$$

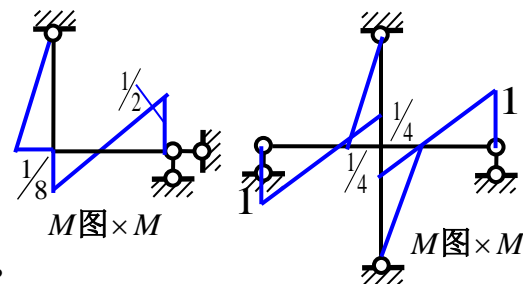


【例题8】用力法作弯矩图。（对称2-25）

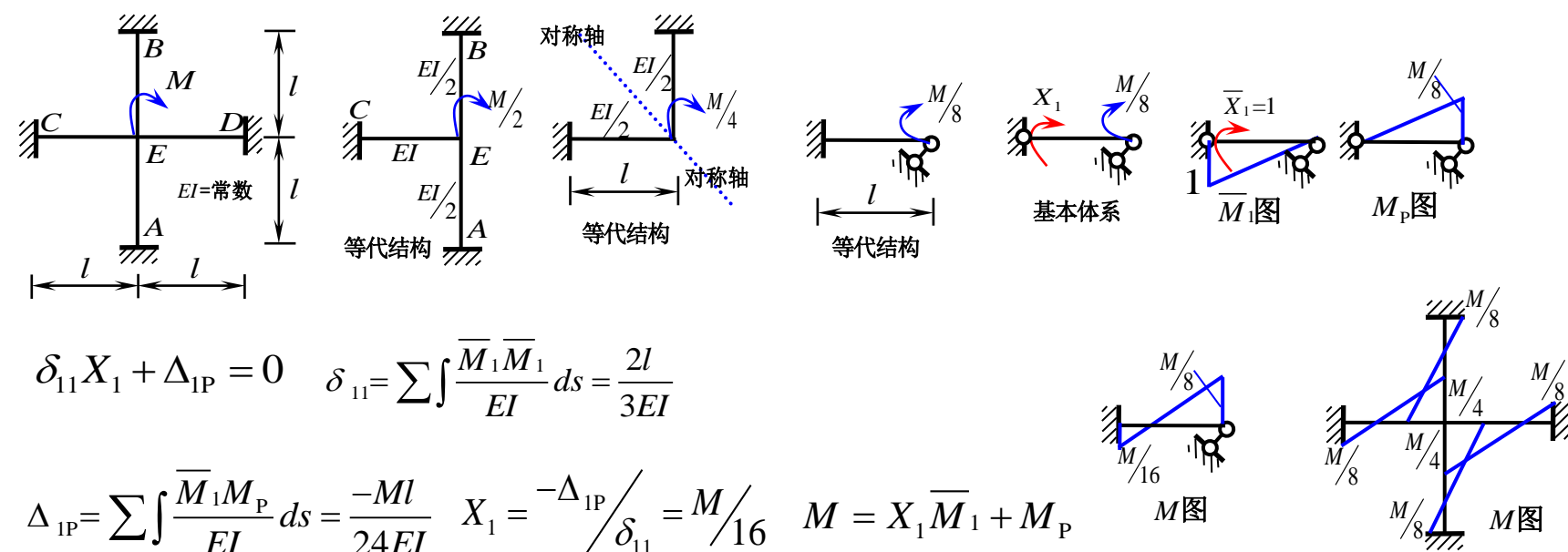


$$\delta_{11}X_1 + \Delta_{1P} = 0 \quad \delta_{11} = \sum \int \frac{\bar{M}_1 \bar{M}_1}{EI} ds = \frac{4l^3}{3EI}$$

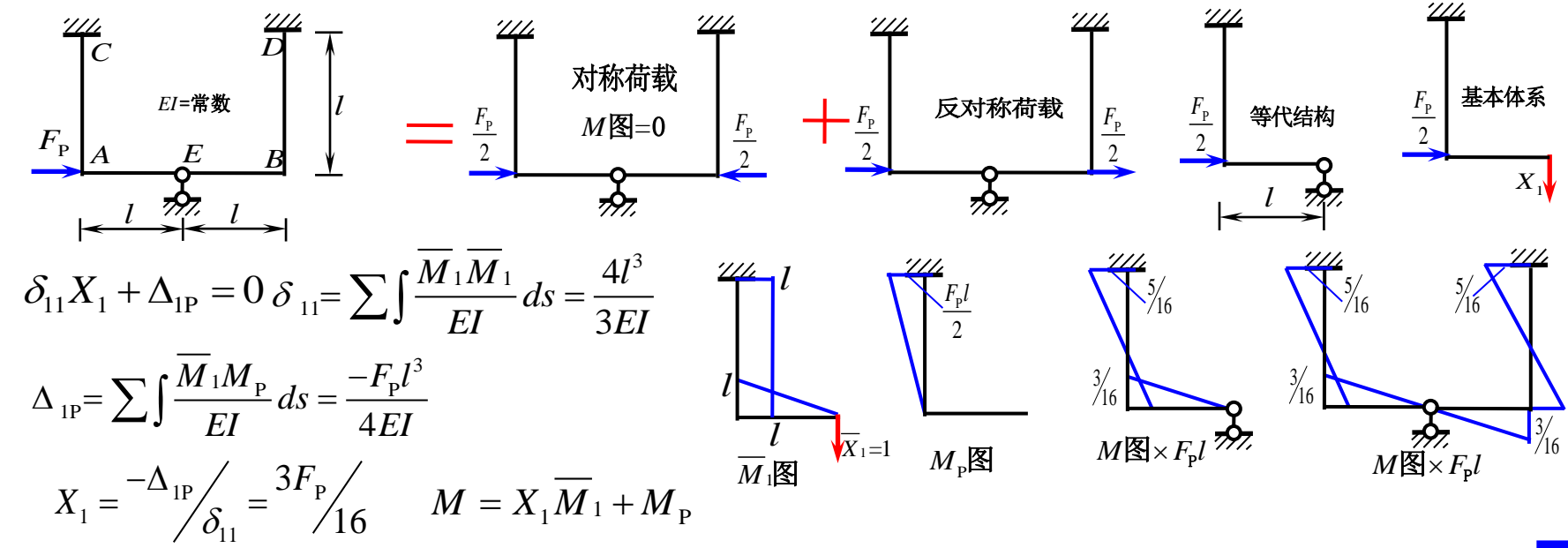
$$\Delta_{1P} = \sum \int \frac{\bar{M}_1 M_P}{EI} ds = \frac{-Ml}{6EI} \quad X_1 = -\Delta_{1P} / \delta_{11} = M / 8 \quad M = X_1 \bar{M}_1 + M_P$$



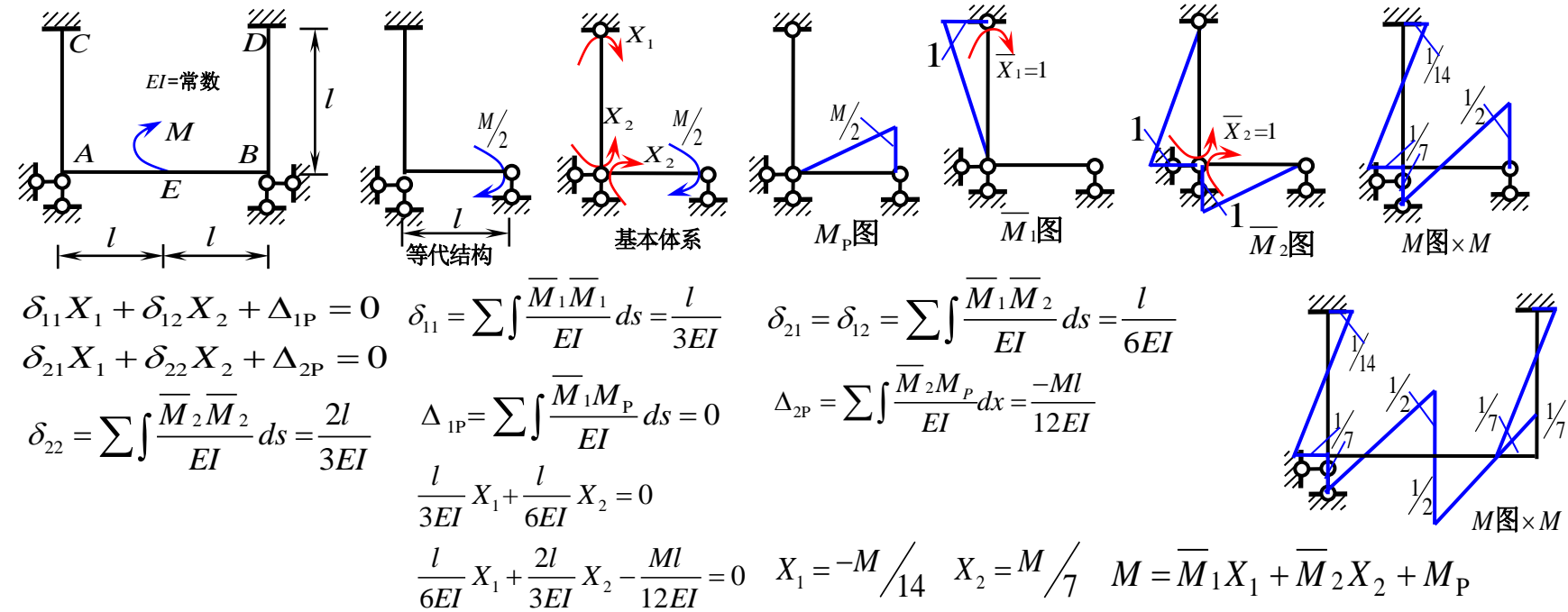
【例题9】用力法作弯矩图。（对称2-32）



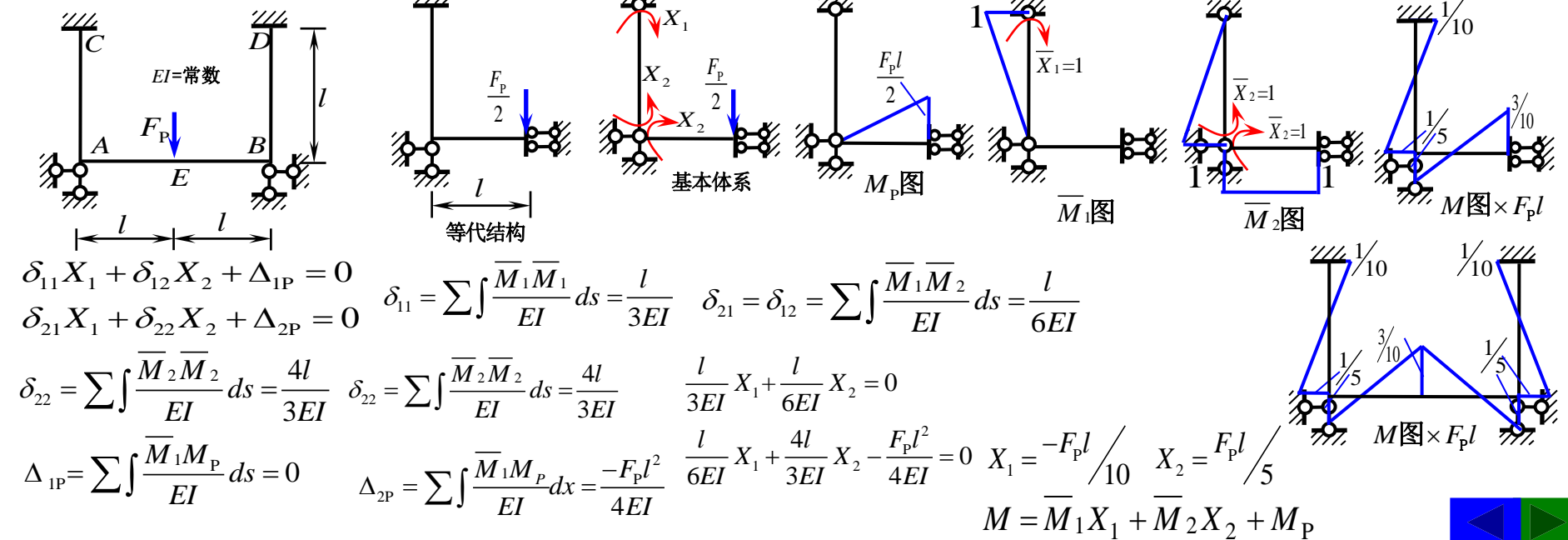
【例题10】用力法作弯矩图。（对称2-33）



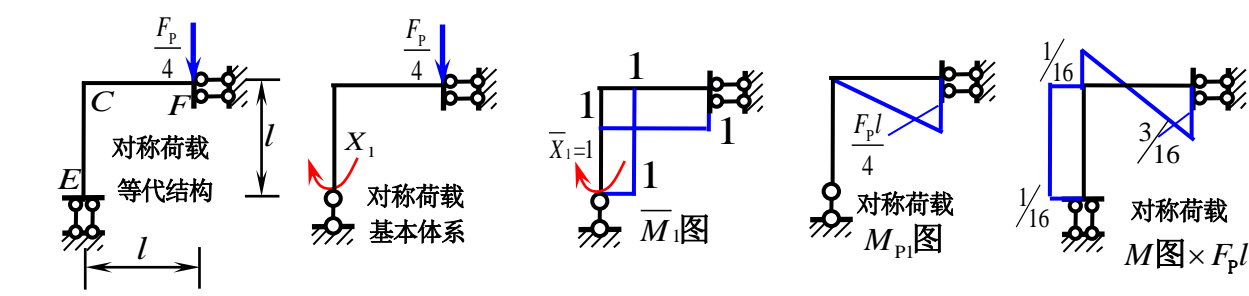
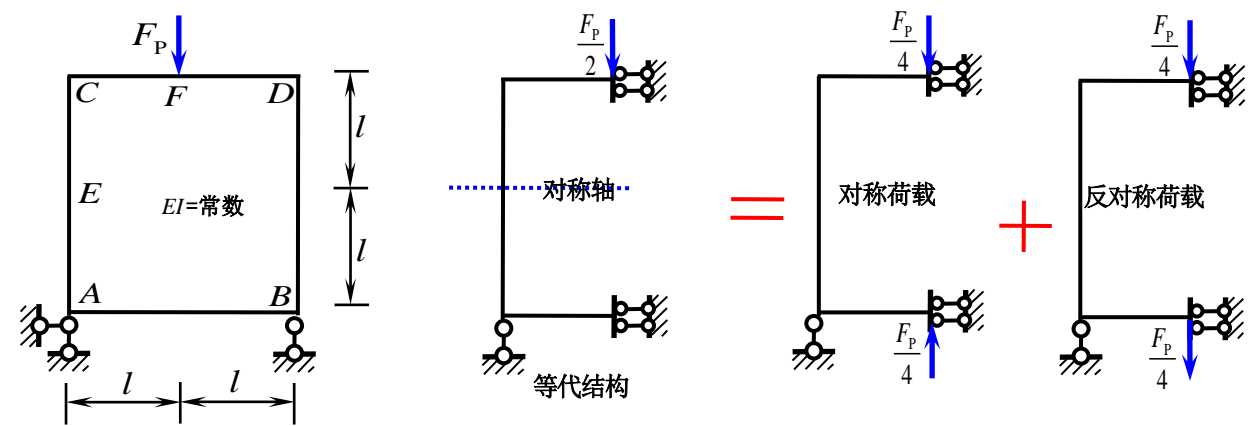
【例题11】用力法作弯矩图。（对称2-34）



【例题12】用力法作弯矩图。（对称2-35）

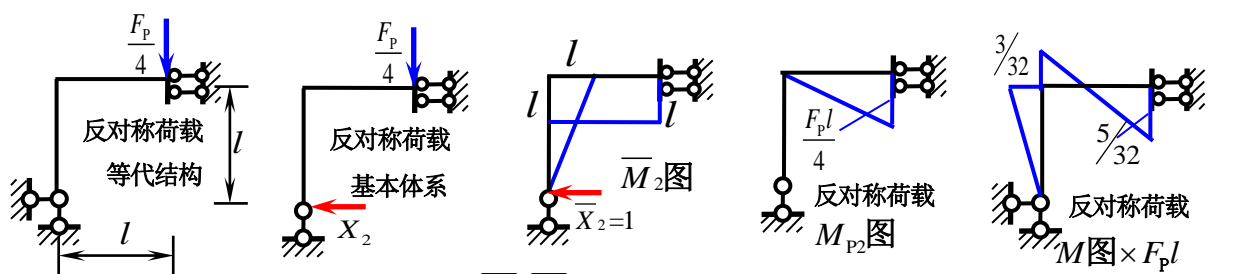


【例题13】用力法作弯矩图。（对称2-38）



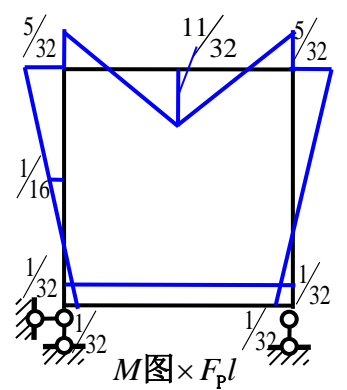
$$\delta_{11} X_1 + \Delta_{1P} = 0$$
$$\delta_{11} = \sum \int \frac{\bar{M}_1 \bar{M}_1}{EI} ds = \frac{2l}{EI}$$
$$\Delta_{1P} = \sum \int \frac{\bar{M}_1 M_{P1}}{EI} ds = \frac{F_P l^2}{8EI}$$
$$X_1 = -\Delta_{1P} / \delta_{11} = -F_P l / 16$$

$$M_{\text{对}} = X_1 \bar{M}_1 + M_P$$



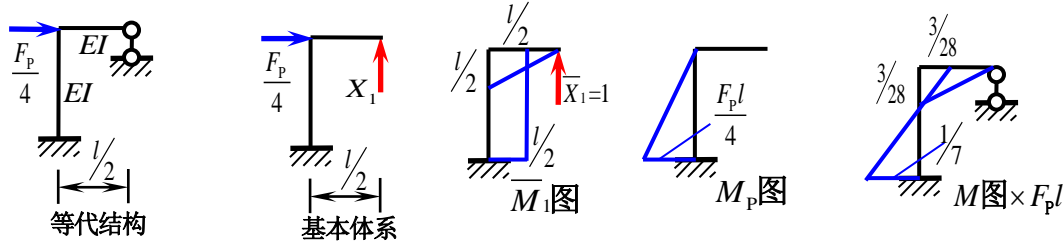
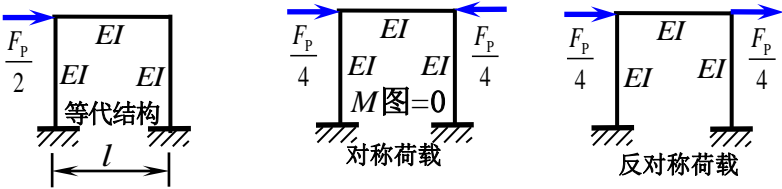
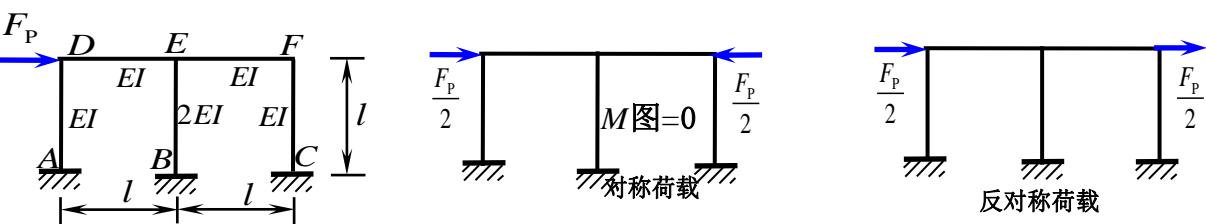
$$\delta_{11} X_1 + \Delta_{1P} = 0 \quad \delta_{11} = \sum \int \frac{\bar{M}_1 \bar{M}_1}{EI} ds = \frac{4l^3}{3EI} \quad \Delta_{1P} = \sum \int \frac{\bar{M}_1 M_{P1}}{EI} ds = \frac{F_P l^3}{8EI}$$

$$X_1 = -\Delta_{1P} / \delta_{11} = -3F_P / 32 \quad M_{\text{反}} = X_1 \bar{M}_1 + M_P$$



$$M = M_{\text{对}} + M_{\text{反}}$$

【例题14】用力法作弯矩图。（对称3-4）

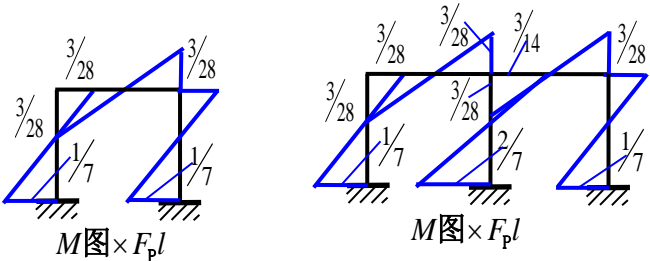


$$\delta_{11}X_1 + \Delta_{1P} = 0$$

$$\delta_{11} = \sum \int \frac{\overline{M}_1 \overline{M}_1}{EI} ds = \frac{7l^3}{24EI}$$

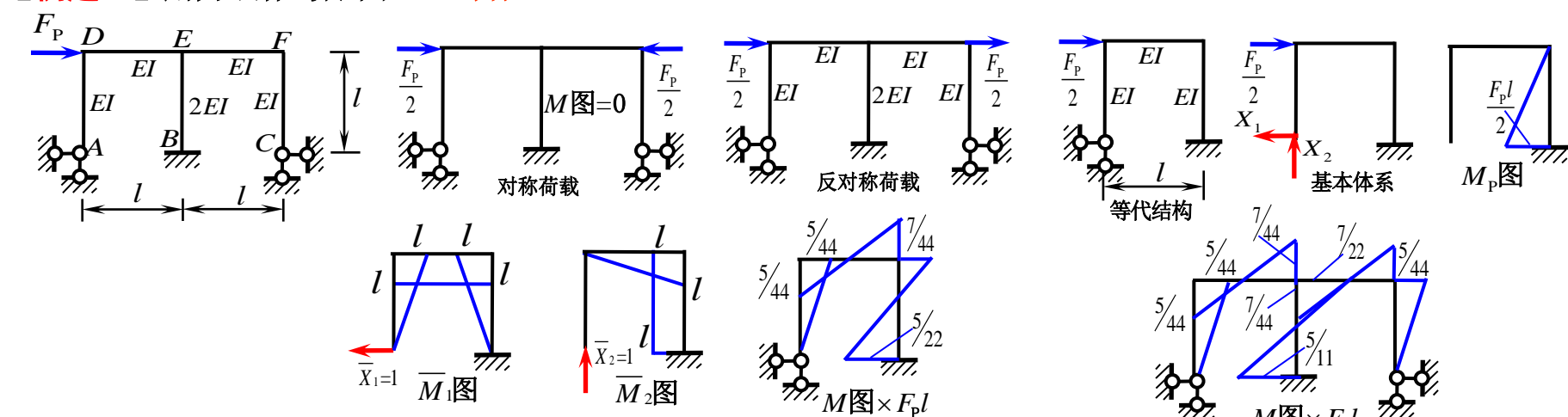
$$\Delta_{1P} = \sum \int \frac{\overline{M}_1 M_P}{EI} ds = \frac{-F_P l^3}{16EI}$$

$$X_1 = \frac{-\Delta_{1P}}{\delta_{11}} = \frac{3F_P}{14} \quad M = X_1 \overline{M}_1 + M_P$$





### 【例题15】用力法作弯矩图。（对称3-5）



$$\begin{aligned} \delta_{11}X_1 + \delta_{12}X_2 + \Delta_{1P} &= 0 \\ \delta_{21}X_1 + \delta_{22}X_2 + \Delta_{2P} &= 0 \end{aligned}$$

$$\delta_{11} = \sum \int \frac{\bar{M}_1 \bar{M}_1}{EI} ds = \frac{5l^3}{3EI} \quad \delta_{21} = \delta_{12} = \sum \int \frac{\bar{M}_1 \bar{M}_2}{EI} ds = \frac{l^3}{EI} \quad \delta_{22} = \sum \int \frac{\bar{M}_2 \bar{M}_2}{EI} ds = \frac{4l^3}{3EI}$$

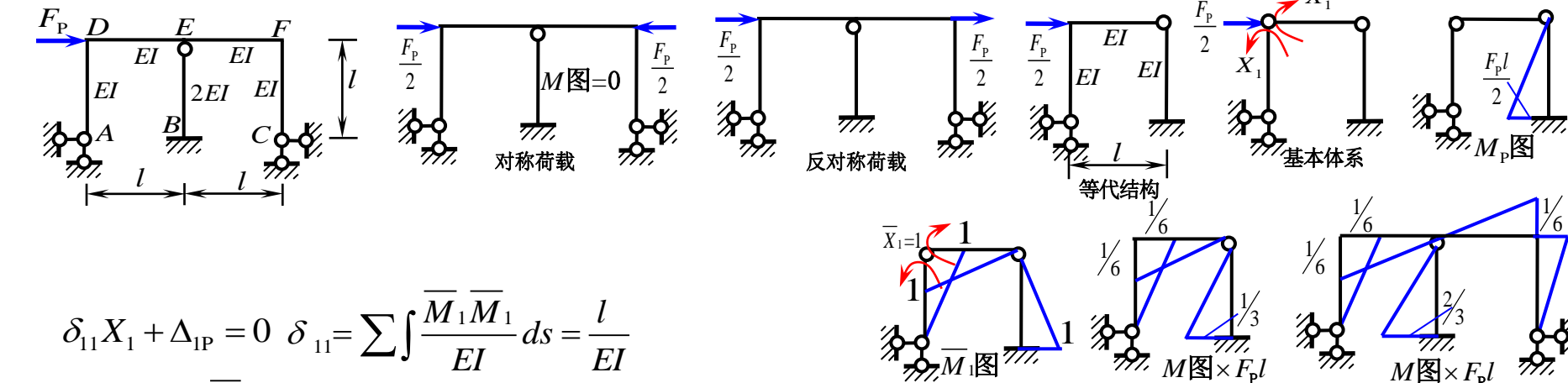
$$\Delta_{1P} = \sum \int \frac{\bar{M}_1 M_P}{EI} dx = \frac{F_P l^3}{12EI} \quad \Delta_{2P} = \sum \int \frac{\bar{M}_2 M_P}{EI} dx = \frac{F_P l^3}{4EI}$$

$$\frac{5l^3}{3EI} X_1 + \frac{l^3}{EI} X_2 + \frac{F_P l^3}{12EI} = 0 \quad X_1 = \frac{5F_P}{44}$$

$$\frac{l^3}{EI} X_1 + \frac{4l^3}{3EI} X_2 + \frac{F_P l^3}{4EI} = 0 \quad X_2 = -\frac{3F_P}{11}$$

$$M = \bar{M}_1 X_1 + \bar{M}_2 X_2 + M_P$$

### 【例题16】用力法作弯矩图。（对称3-8）

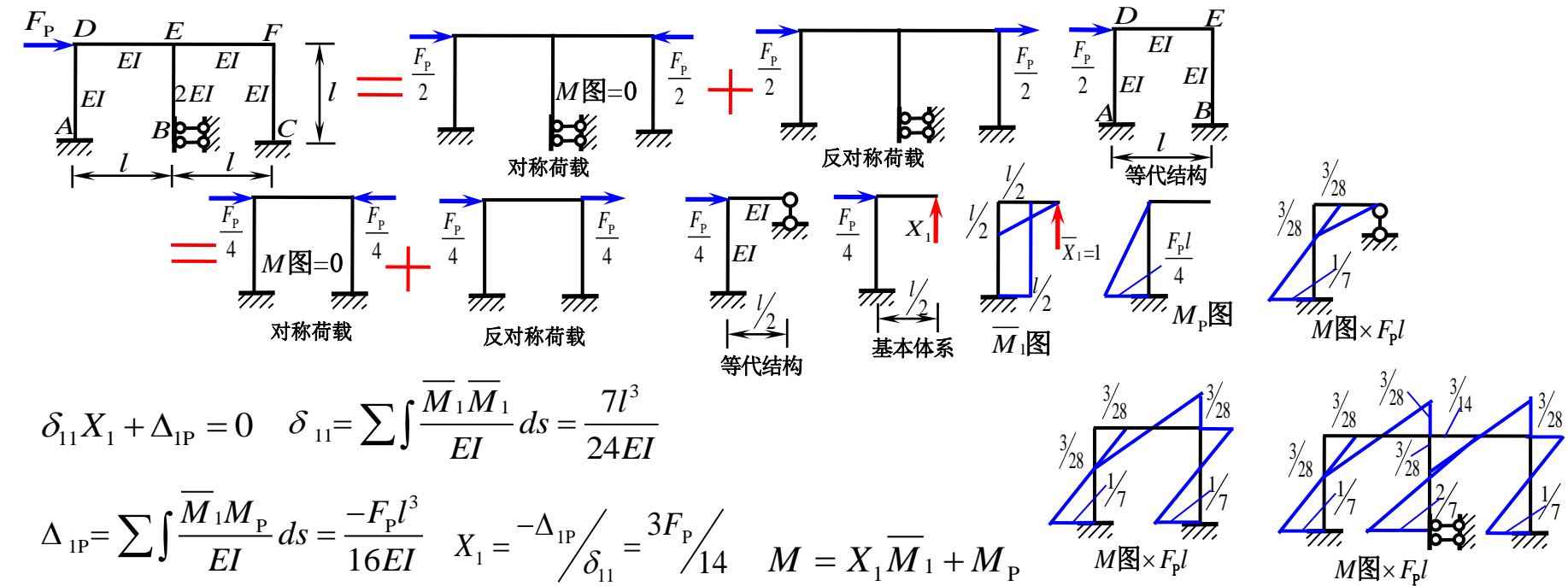


$$\delta_{11}X_1 + \Delta_{1P} = 0 \quad \delta_{11} = \sum \int \frac{\bar{M}_1 \bar{M}_1}{EI} ds = \frac{l}{EI}$$

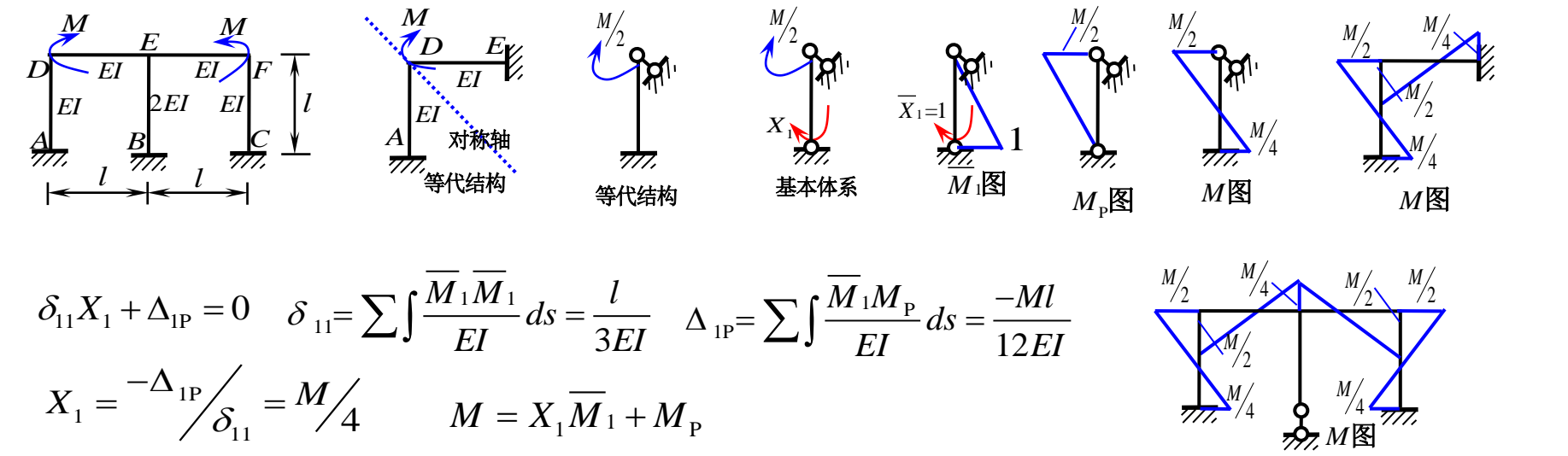
$$\Delta_{1P} = \sum \int \frac{\bar{M}_1 M_P}{EI} ds = \frac{-F_P l^2}{6EI} \quad X_1 = \frac{-\Delta_{1P}}{\delta_{11}} = \frac{F_P l}{6}$$

$$M = X_1 \bar{M}_1 + M_P$$

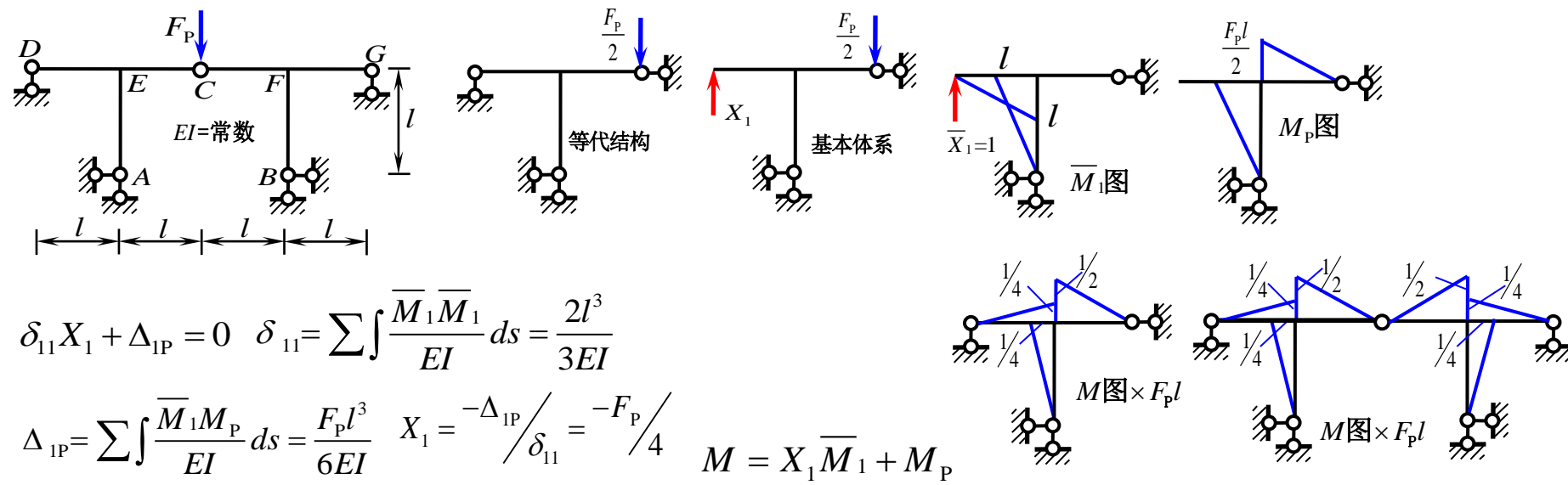
【例题17】用力法作弯矩图。（对称3-9）



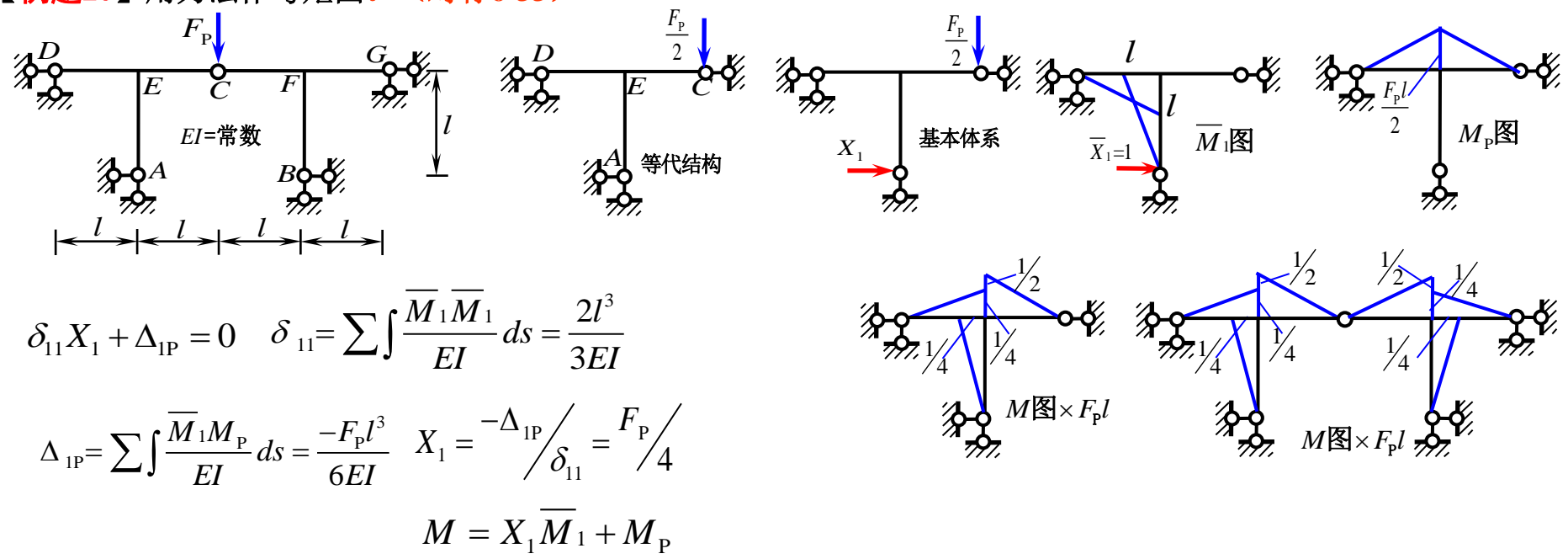
【例题18】用力法作弯矩图。（对称3-20）



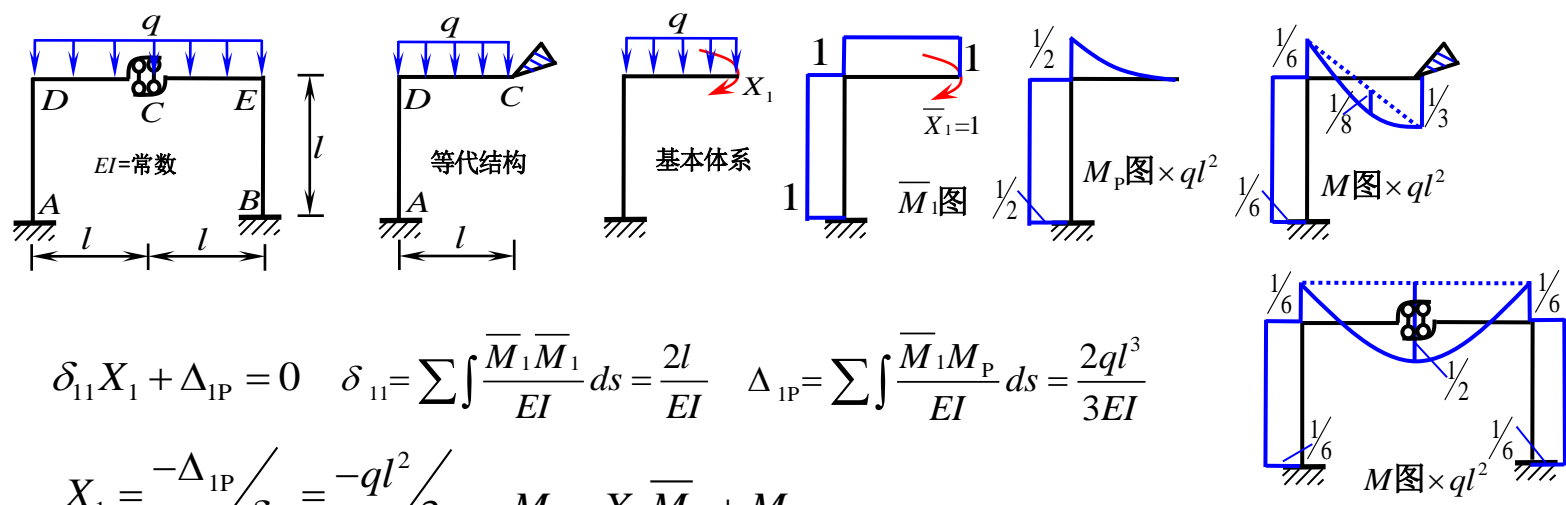
【例题19】用力法作弯矩图。(对称6-25)



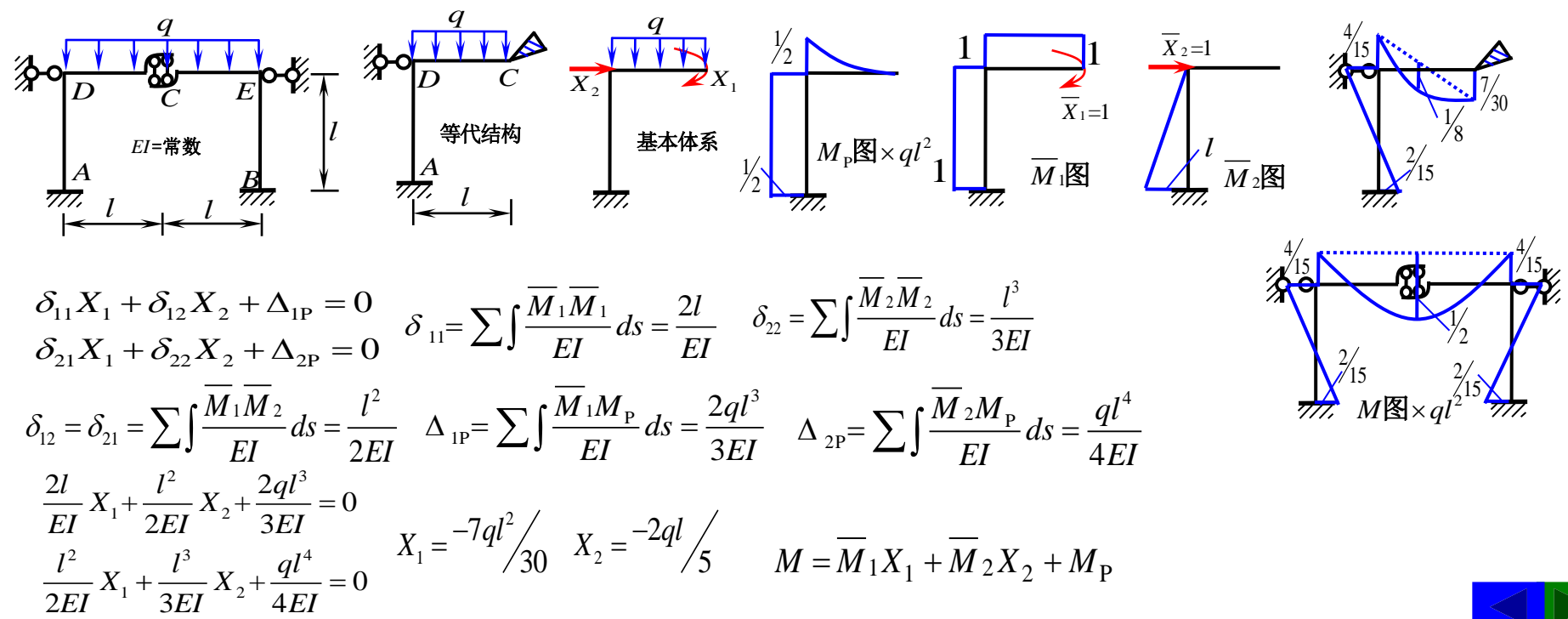
【例题20】用力法作弯矩图。(对称6-33)



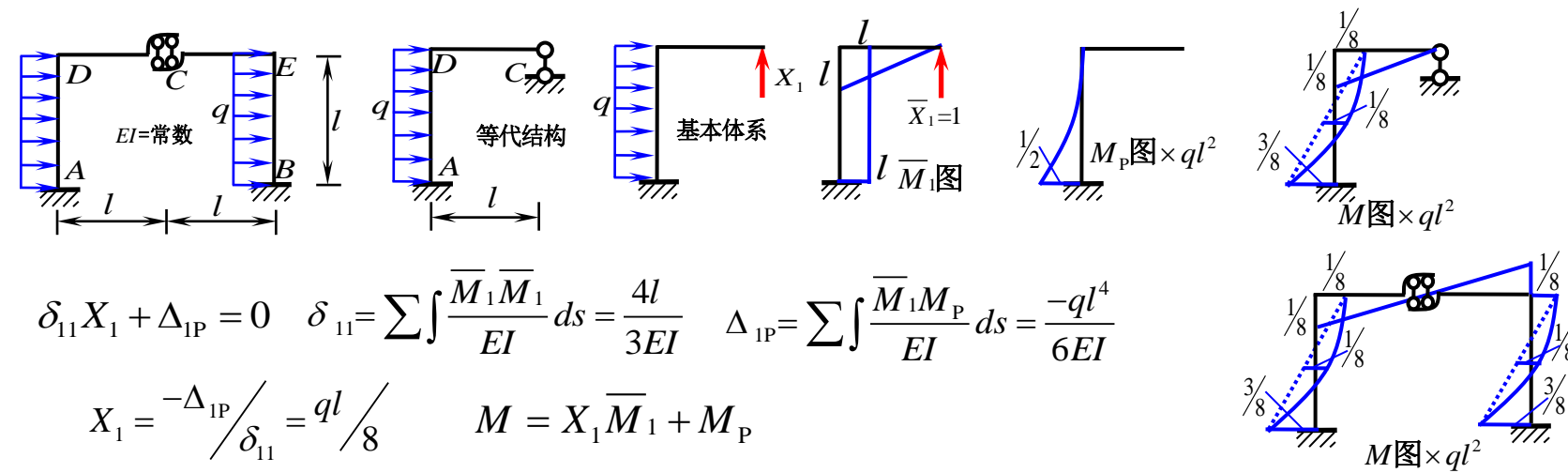
【例题21】用力法作弯矩图。（对称7-11）



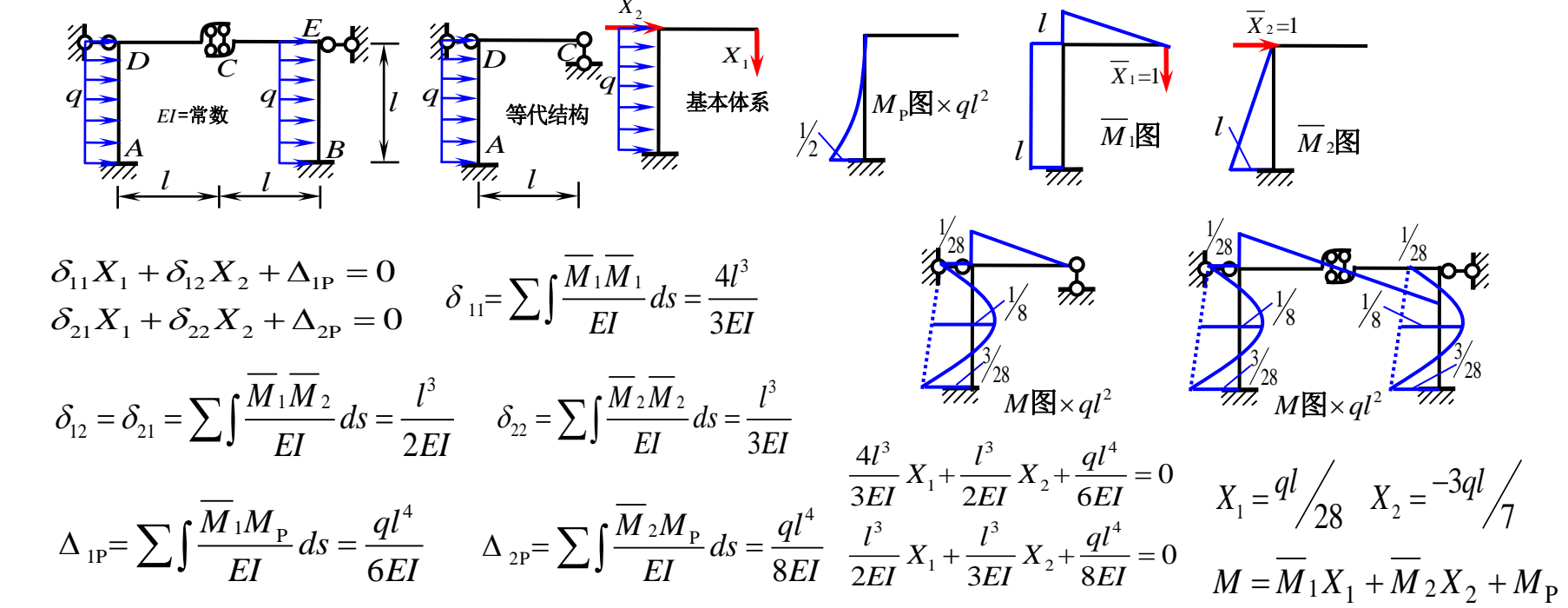
【例题22】用力法作弯矩图。（对称7-12）



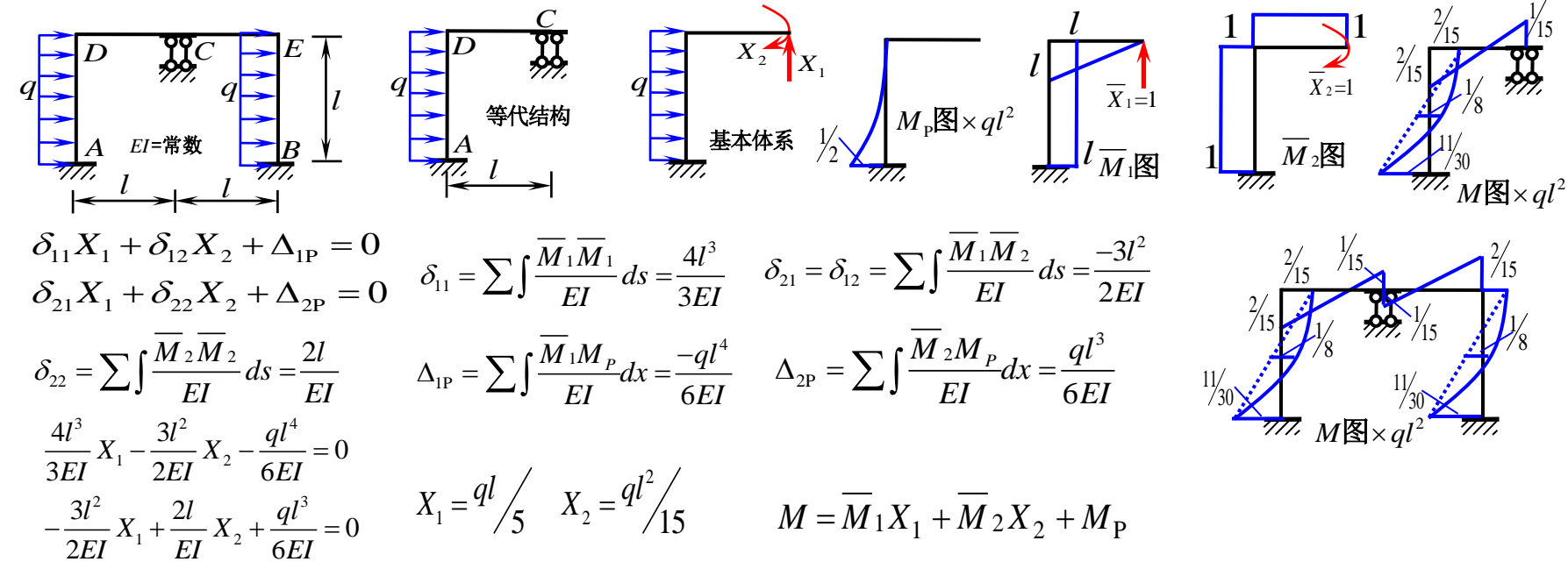
【例题23】用力法作弯矩图。（对称7-13）



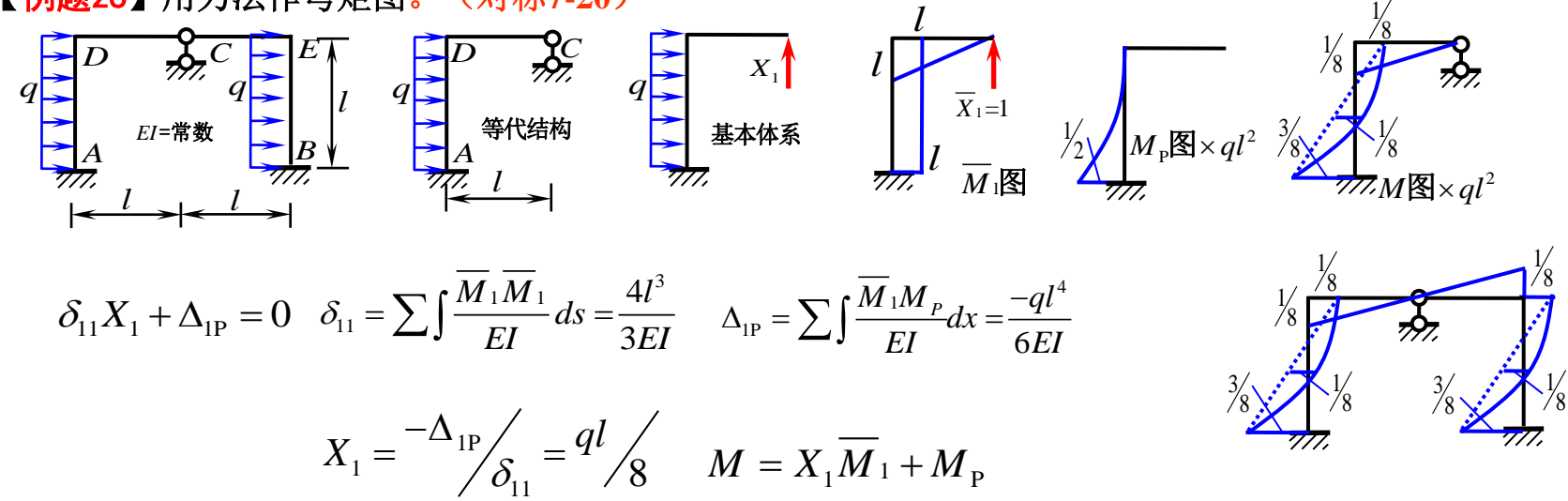
【例题24】用力法作弯矩图。（对称7-14）



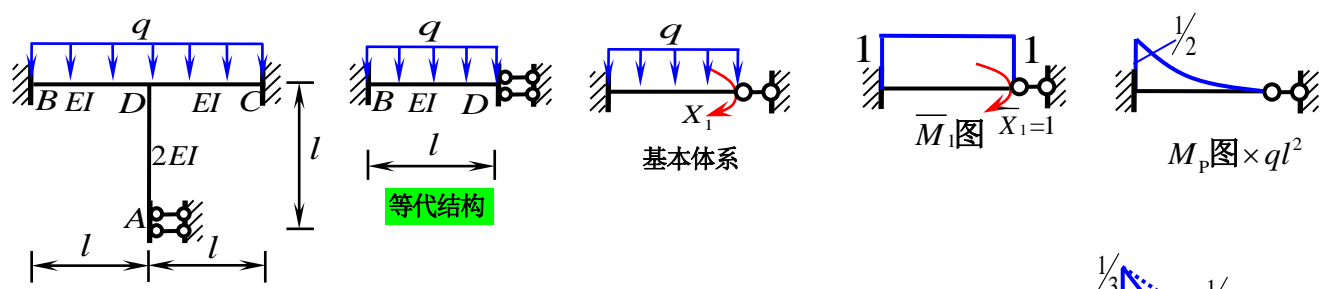
【例题25】用力法作弯矩图。（对称7-15）



【例题26】用力法作弯矩图。（对称7-20）

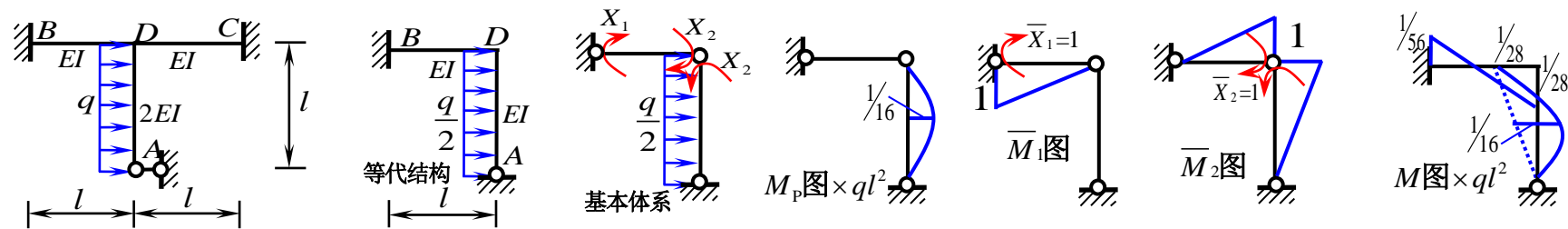


【例题27】用力法作弯矩图。（对称7-21）

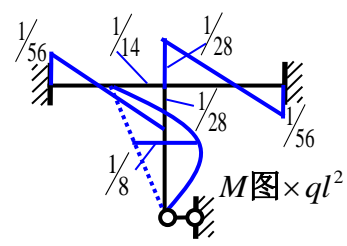


$$\delta_{11}X_1 + \Delta_{1P} = 0 \quad \delta_{11} = \sum \int \frac{\bar{M}_1 \bar{M}_1}{EI} ds = \frac{l}{EI}$$
$$\Delta_{1P} = \sum \int \frac{\bar{M}_1 M_P}{EI} ds = \frac{ql^3}{6EI} \quad X_1 = -\frac{\Delta_{1P}}{\delta_{11}} = -\frac{ql^2}{6} \quad M = X_1 \bar{M}_1 + M_P$$

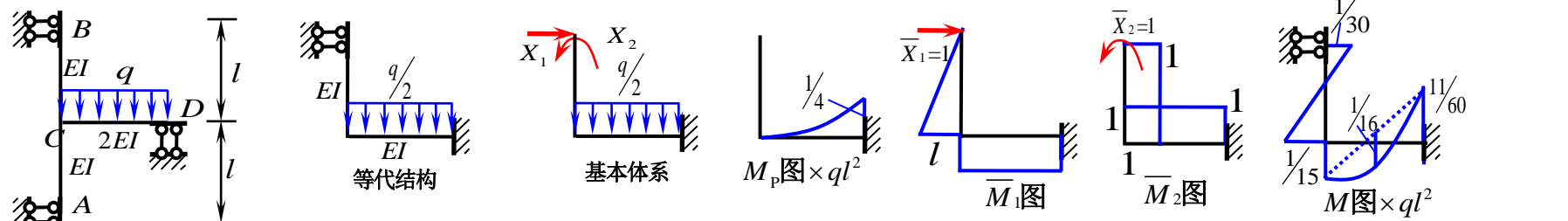
【例题28】用力法作弯矩图。（对称7-28）



$$\delta_{11}X_1 + \delta_{12}X_2 + \Delta_{1P} = 0$$
$$\delta_{21}X_1 + \delta_{22}X_2 + \Delta_{2P} = 0$$
$$\delta_{11} = \sum \int \frac{\bar{M}_1 \bar{M}_1}{EI} ds = \frac{l}{3EI} \quad \delta_{21} = \delta_{12} = \sum \int \frac{\bar{M}_1 \bar{M}_2}{EI} ds = -\frac{l}{6EI}$$
$$\delta_{22} = \sum \int \frac{\bar{M}_2 \bar{M}_2}{EI} ds = \frac{2l}{3EI} \quad \Delta_{1P} = \sum \int \frac{\bar{M}_1 M_P}{EI} dx = 0 \quad \Delta_{2P} = \sum \int \frac{\bar{M}_2 M_P}{EI} dx = \frac{ql^3}{48EI}$$
$$\frac{l}{3EI}X_1 - \frac{l}{6EI}X_2 = 0$$
$$\frac{-l}{6EI}X_1 + \frac{2l}{3EI}X_2 + \frac{ql^3}{48EI} = 0$$
$$X_1 = -\frac{ql^2}{56} \quad X_2 = -\frac{ql^2}{28} \quad M = \bar{M}_1 X_1 + \bar{M}_2 X_2 + M_P$$

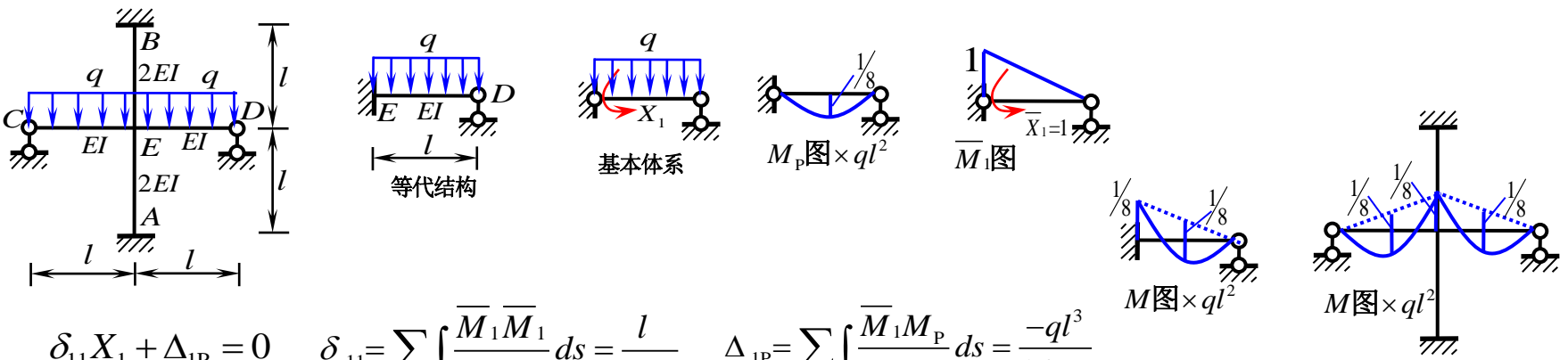


【例题29】用力法作弯矩图。（对称7-30）



$$\begin{aligned} \delta_{11} X_1 + \delta_{12} X_2 + \Delta_{1P} &= 0 \\ \delta_{21} X_1 + \delta_{22} X_2 + \Delta_{2P} &= 0 \end{aligned}$$
$$\delta_{11} = \sum \int \frac{\bar{M}_1 \bar{M}_1}{EI} ds = \frac{4l^3}{3EI} \quad \delta_{21} = \delta_{12} = \sum \int \frac{\bar{M}_1 \bar{M}_2}{EI} ds = \frac{-3l^2}{2EI}$$
$$\delta_{22} = \sum \int \frac{\bar{M}_2 \bar{M}_2}{EI} ds = \frac{2l}{EI} \quad \Delta_{1P} = \sum \int \frac{\bar{M}_1 M_P}{EI} dx = \frac{-ql^4}{12EI} \quad \Delta_{2P} = \sum \int \frac{\bar{M}_2 M_P}{EI} dx = \frac{ql^3}{12EI}$$
$$\frac{4l^3}{3EI} X_1 - \frac{3l^2}{2EI} X_2 - \frac{ql^4}{12EI} = 0$$
$$\frac{-3l^2}{2EI} X_1 + \frac{2l}{EI} X_2 + \frac{ql^3}{12EI} = 0 \quad X_1 = ql / 10 \quad X_2 = ql^2 / 30 \quad M = \bar{M}_1 X_1 + \bar{M}_2 X_2 + M_P$$

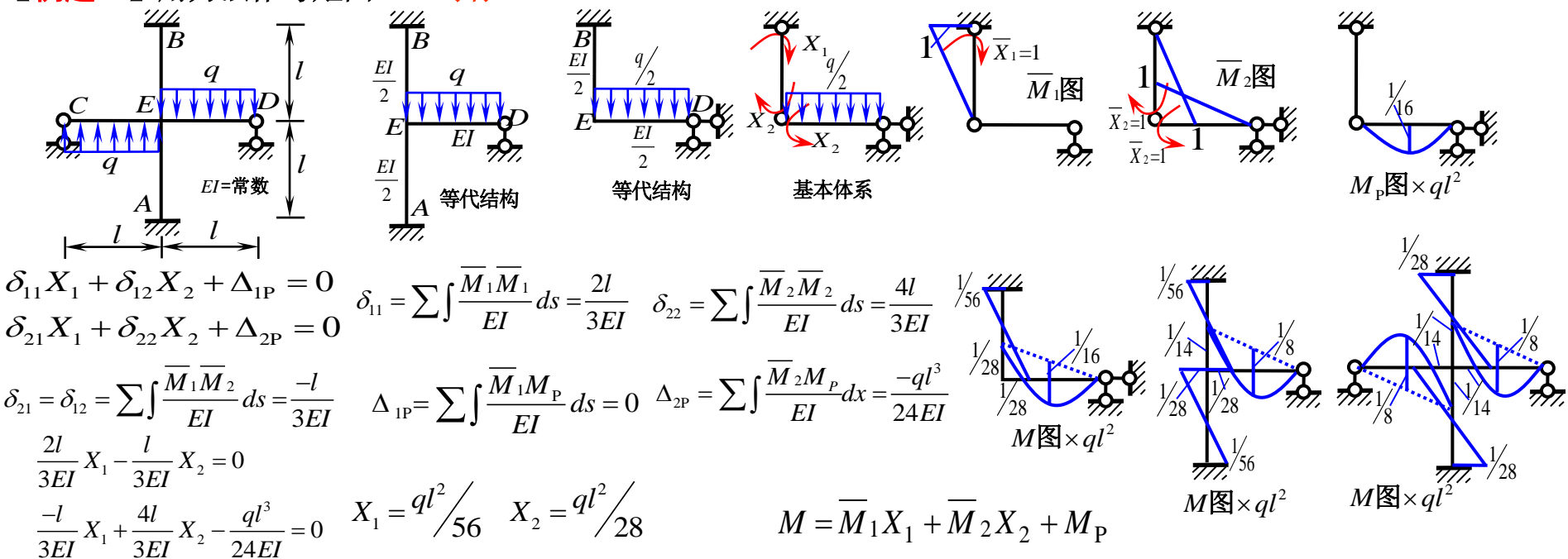
【例题30】用力法作弯矩图。（对称7-33）



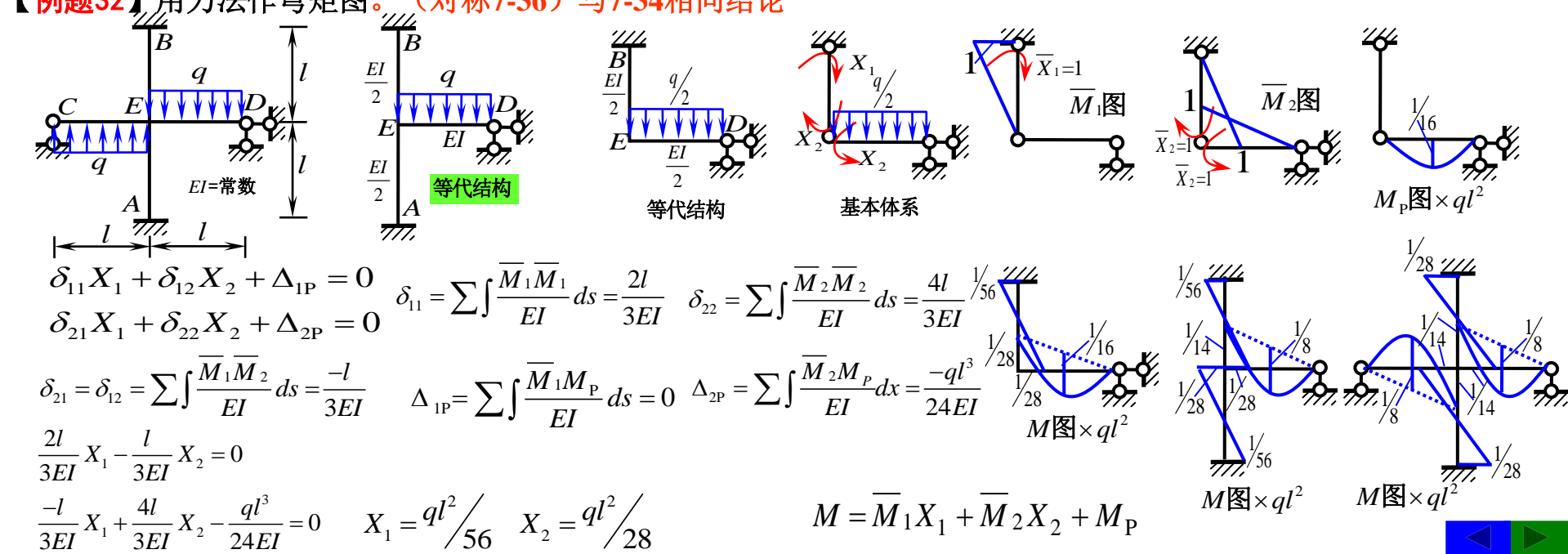
$$\delta_{11} X_1 + \Delta_{1P} = 0 \quad \delta_{11} = \sum \int \frac{\bar{M}_1 \bar{M}_1}{EI} ds = \frac{l}{3EI} \quad \Delta_{1P} = \sum \int \frac{\bar{M}_1 M_P}{EI} ds = \frac{-ql^3}{24EI}$$
$$X_1 = -\Delta_{1P} / \delta_{11} = ql^2 / 8 \quad M = X_1 \bar{M}_1 + M_P$$



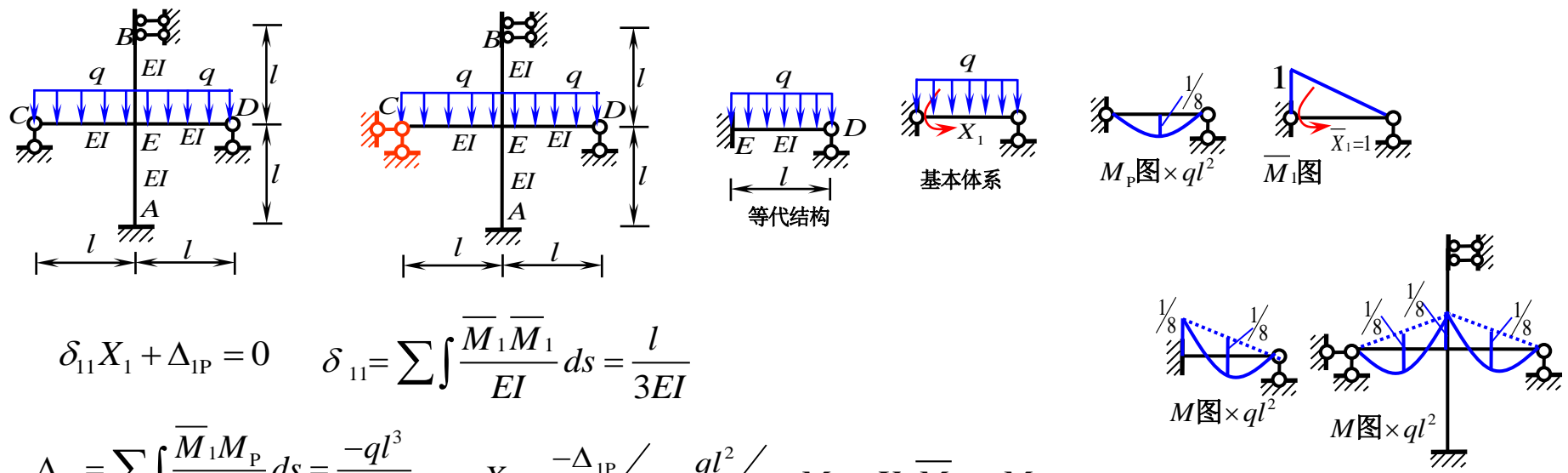
**【例题31】用力法作弯矩图。（对称7-34）**



**【例题32】用力法作弯矩图。（对称7-36）与7-34相同结论**

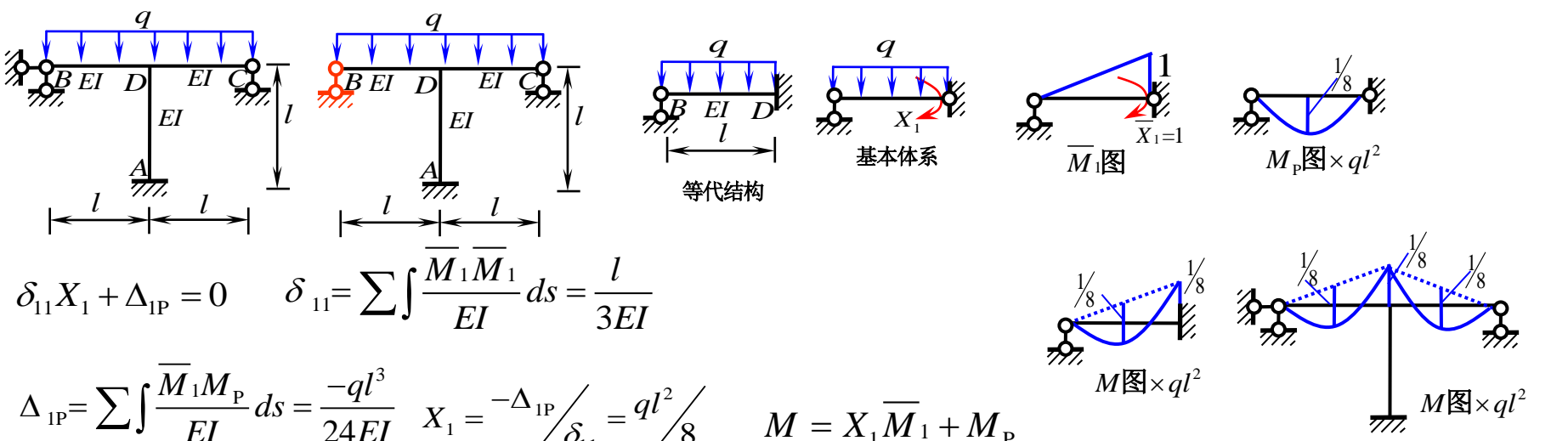


【例题33】用力法作弯矩图。（对称7-38）



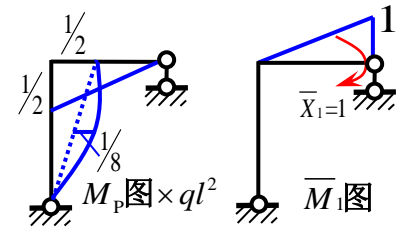
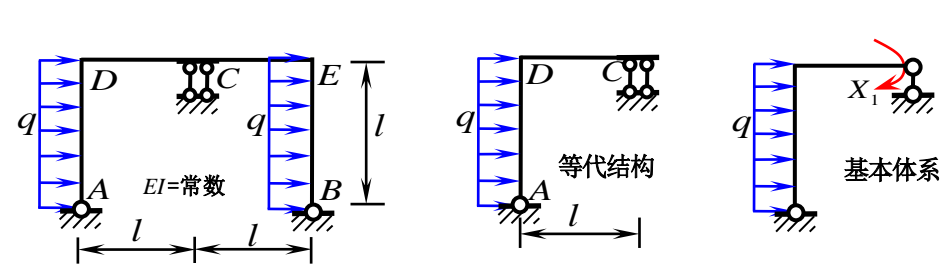
$$\delta_{11}X_1 + \Delta_{1P} = 0$$
$$\delta_{11} = \sum \int \frac{\bar{M}_1 \bar{M}_1}{EI} ds = \frac{l}{3EI}$$
$$\Delta_{1P} = \sum \int \frac{\bar{M}_1 M_P}{EI} ds = \frac{-ql^3}{24EI}$$
$$X_1 = \frac{-\Delta_{1P}}{\delta_{11}} = \frac{ql^2}{8}$$
$$M = X_1 \bar{M}_1 + M_P$$

【例题34】用力法作弯矩图。（对称7-39）



$$\delta_{11}X_1 + \Delta_{1P} = 0$$
$$\delta_{11} = \sum \int \frac{\bar{M}_1 \bar{M}_1}{EI} ds = \frac{l}{3EI}$$
$$\Delta_{1P} = \sum \int \frac{\bar{M}_1 M_P}{EI} ds = \frac{-ql^3}{24EI}$$
$$X_1 = \frac{-\Delta_{1P}}{\delta_{11}} = \frac{ql^2}{8}$$
$$M = X_1 \bar{M}_1 + M_P$$

【例题35】用力法作弯矩图。（对称7-41）



$$\delta_{11}X_1 + \Delta_{1P} = 0 \quad \delta_{11} = \sum \int \frac{\bar{M}_1 \bar{M}_1}{EI} ds = \frac{l}{3EI}$$
$$\Delta_{1P} = \sum \int \frac{\bar{M}_1 M_P}{EI} ds = \frac{-ql^3}{12EI} \quad X_1 = \frac{-\Delta_{1P}}{\delta_{11}} = \frac{ql^2}{4}$$
$$M = X_1 \bar{M}_1 + M_P$$

