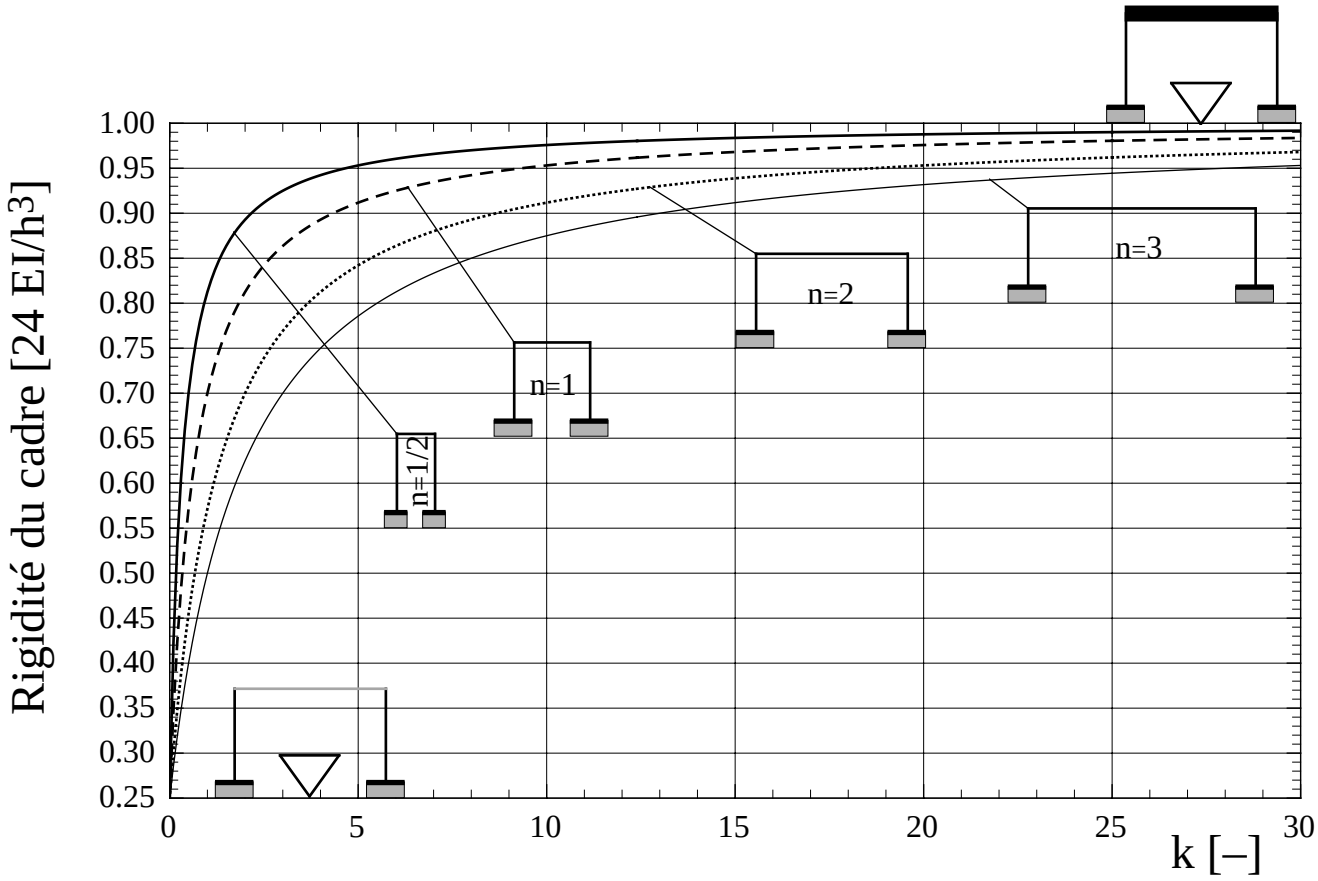
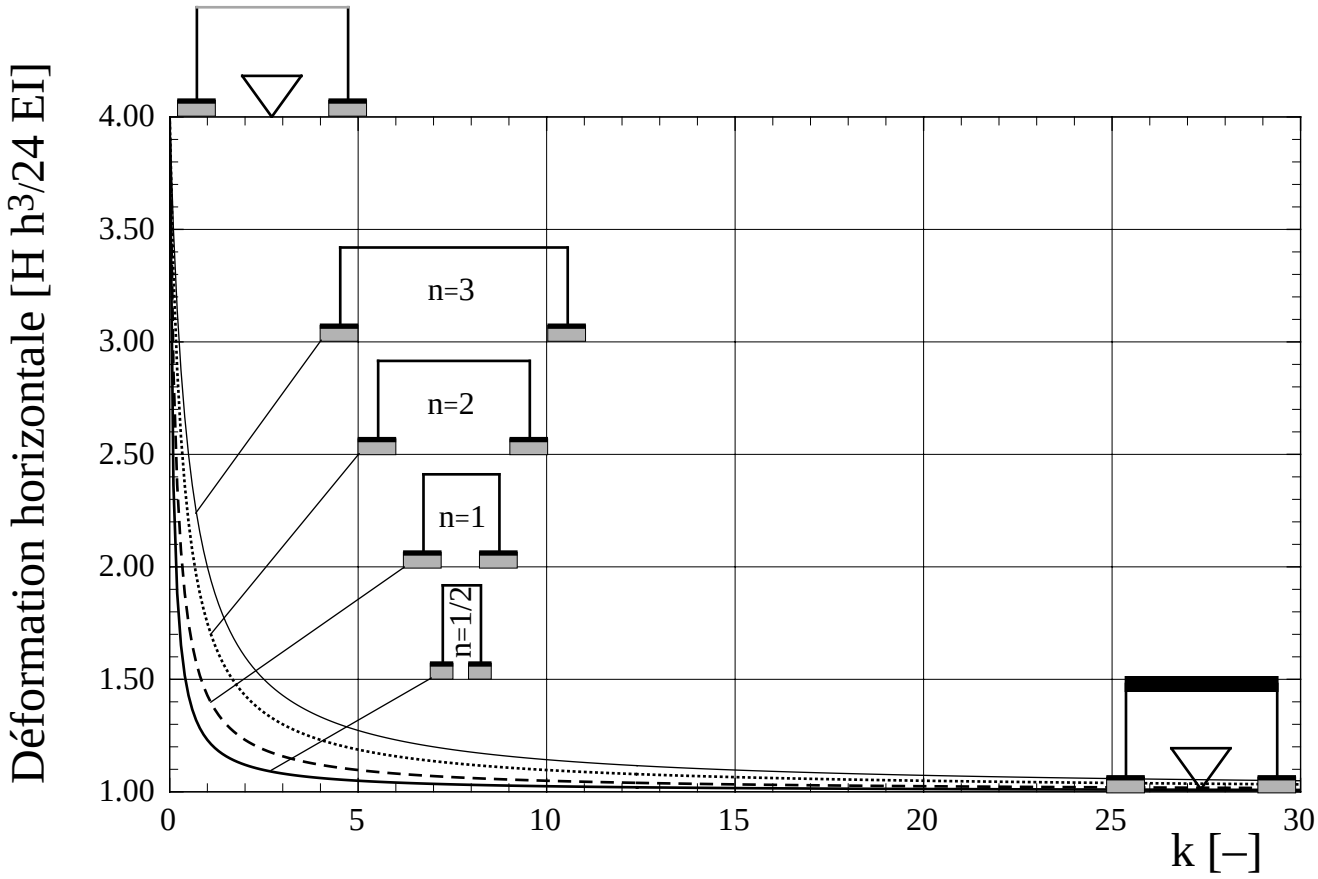
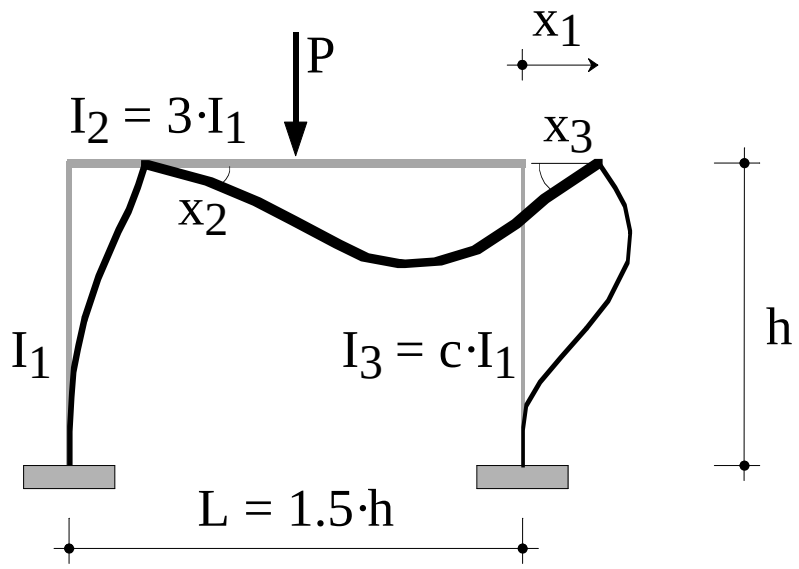
# Influence de l'inertie relative de la traverse et des montants:



Cadre bi-encastré sollicité verticalement:




| Causes / Effets | $X_1 = 1$ | $X_2 = 1$ | $X_3 = 1$ | P |
|---|---|---|---|---|
| Forces selon $X_1$ | $\frac{12EI_1}{h^3}$ ; $\frac{12cEI_1}{h^3}$ | $\frac{6EI_1}{h^2}$ | $\frac{6cEI_1}{h^2}$ | |
| Moments selon $X_2$ | $\frac{6EI_1}{h^2}$ | $\frac{4EI_2}{L}$ ; $\frac{4EI_1}{h}$ | $\frac{2EI_2}{L}$ | $\frac{PL}{8}$ |
| Moments selon $X_3$ | $\frac{6cEI_1}{h^2}$ | $\frac{2EI_2}{L}$ | $\frac{4EI_2}{L}$ ; $\frac{4cEI_1}{h}$ | $\frac{PL}{8}$ |

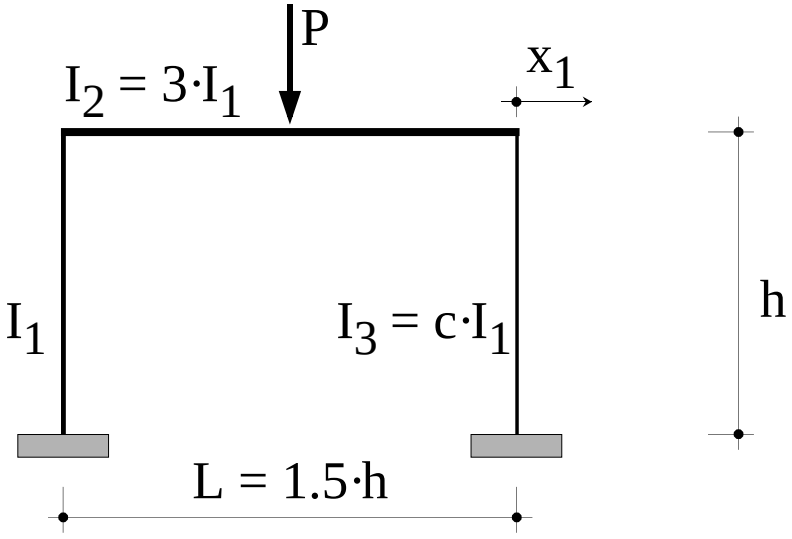
## Conditions d'équilibre :

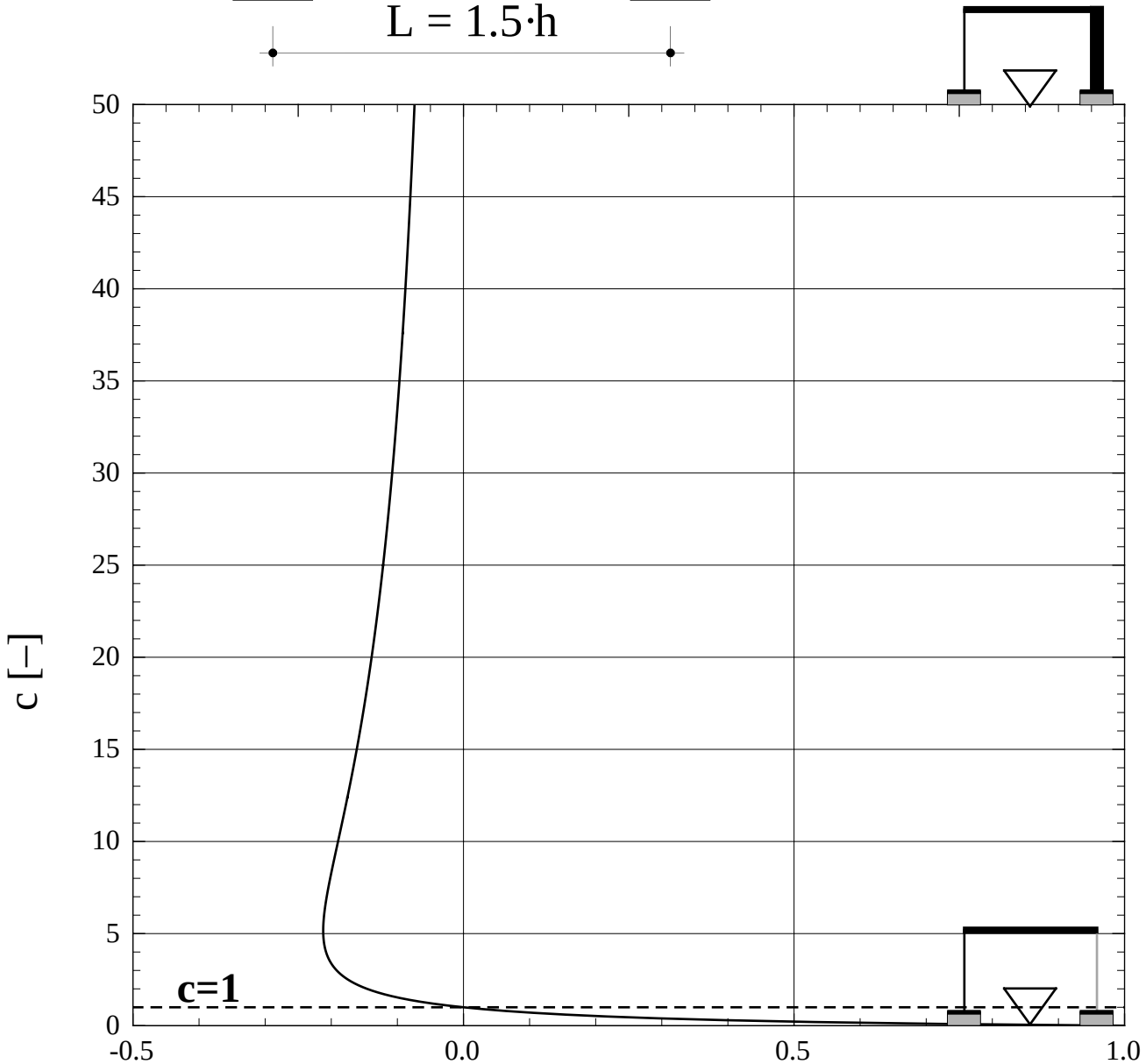
$$\frac{12\,(1+c)\,EI_1}{h^3}\,x_1 - \frac{6\,EI_1}{h^2}\,x_2 + \frac{6\,c\,EI_1}{h^2}\,x_3 = 0$$

$$-\frac{PL}{8} - \frac{6\,EI_1}{h^2}\,x_1 + \frac{12\,EI_1}{h}\,x_2 - \frac{4\,EI_1}{h}\,x_3 = 0$$

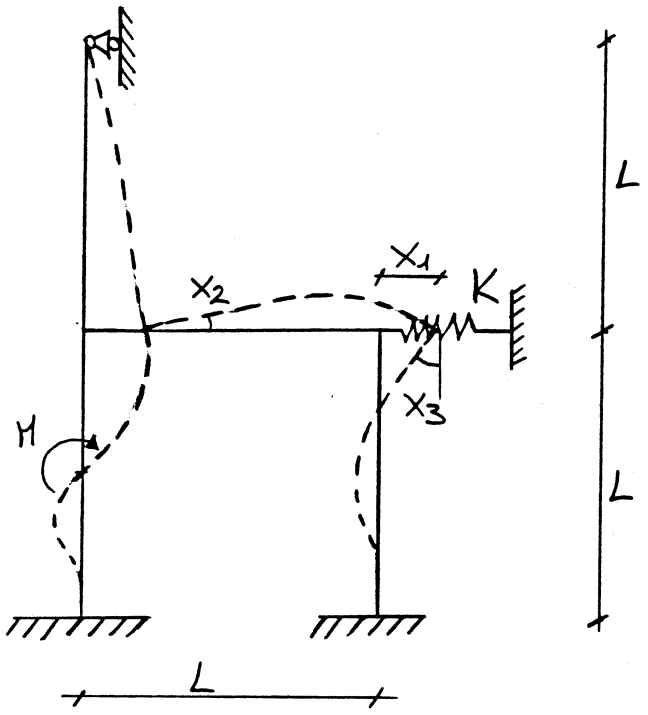
$$-\frac{PL}{8} + \frac{6\,c\,EI_1}{h^2}\,x_1 - \frac{4\,EI_1}{h}\,x_2 + \frac{4\,(c+2)\,EI_1}{h}\,x_3 = 0$$

**résolution du système:** $X_1 = -\frac{9\,P\,h^3}{32\,EI_1}\left(\frac{c-1}{3c^2+35c+14}\right)$



# Structure à plusieurs degrés de liberté:




| causes / effets | $X_1 = 1$ | $X_2 = 1$ | $X_3 = 1$ | M |
|---|---|---|---|---|
| Forces selon $X_1$ | $\frac{3EI}{L^3}$, K, $\frac{12EI}{L^3}$, $\frac{12EI}{L^3}$ | $\frac{3EI}{L^2}$, $\frac{6EI}{L^2}$ | $\frac{6EI}{L^2}$ | $\frac{3M}{2L}$ |
| Moments selon $X_2$ | $\frac{3EI}{L^2}$, $\frac{6EI}{L^2}$ | $\frac{3EI}{L}$, $\frac{4EI}{L}$, $\frac{4EI}{L}$ | $\frac{2EI}{L}$ | $\frac{M}{4}$ |
| Moments selon $X_3$ | $\frac{6EI}{L^2}$ | $\frac{2EI}{L}$ | $\frac{4EI}{L}$, $\frac{4EI}{L}$ | |

Conditions d'équilibre:

$$\left(\frac{27EI}{L^3}+K\right)X_1+\frac{3EI}{L^2}X_2-\frac{6EI}{L^2}X_3-\frac{3M}{2L}=0$$

$$\frac{3EI}{L^2}X_1+\frac{11EI}{L}X_2-\frac{2EI}{L}X_3-\frac{M}{4}=0$$

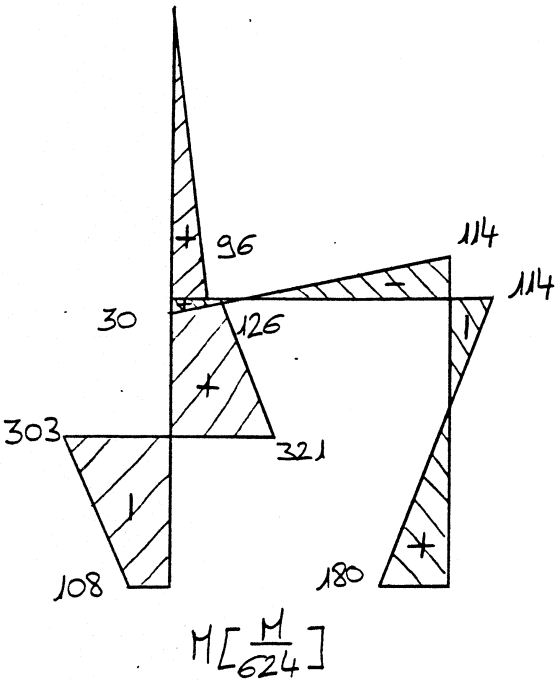
$$-\frac{6EI}{L^2}X_1-\frac{2EI}{L}X_2+\frac{8EI}{L}X_3=0$$

$$\longrightarrow \quad X_1=\frac{41M}{28\left(\frac{156EI}{7L^3}+K\right)L}$$

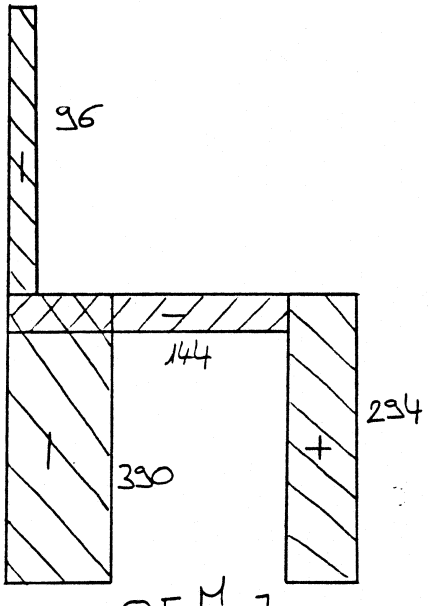
$$X_2=\frac{4ML}{168EI}-\frac{41M}{196\left(\frac{156EI}{7L^3}+K\right)L^2}$$

$$X_3=\frac{ML}{168EI}+\frac{205M}{196\left(\frac{156EI}{7L^3}+K\right)L^2}$$

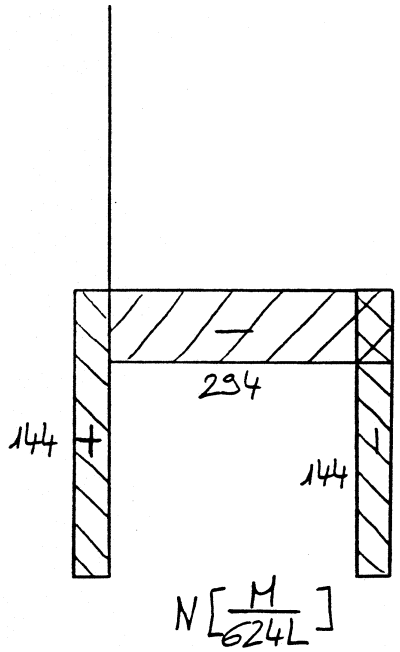
$K=0$: $\longrightarrow$ $X_1=\frac{41ML^2}{624EI}$ $\qquad X_2=\frac{9ML}{624EI}$ $\qquad X_3=\frac{33ML}{624EI}$



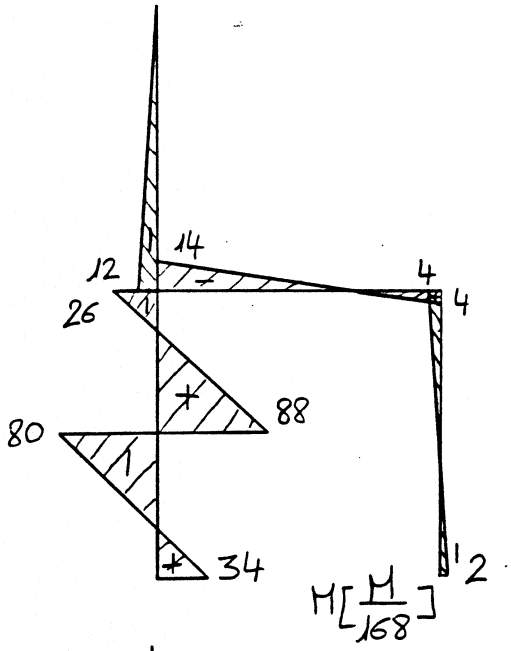

$M\left[\frac{M}{624}\right]$

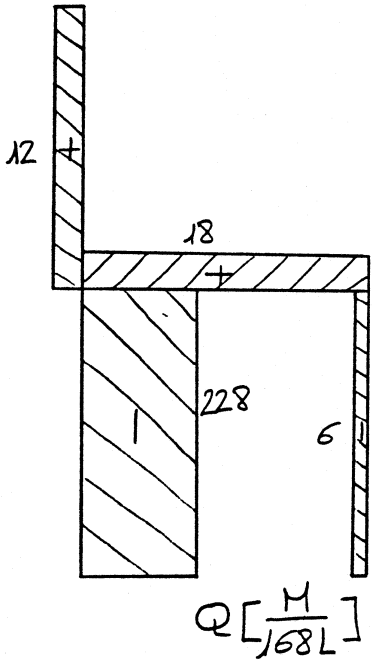


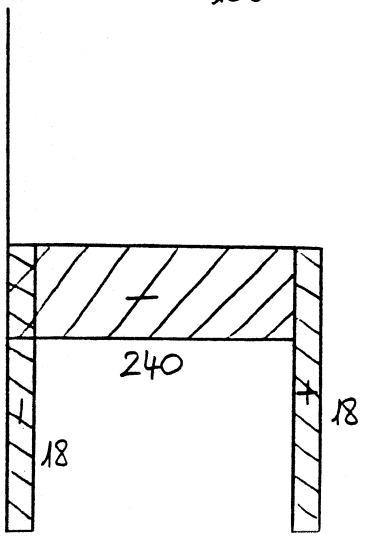

$Q\left[\frac{M}{624L}\right]$



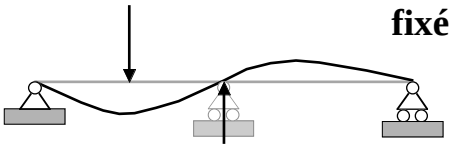
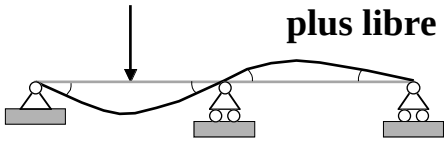
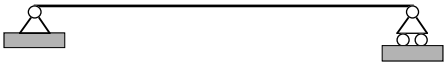
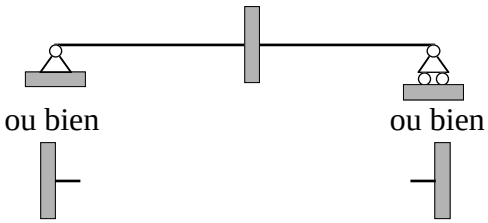
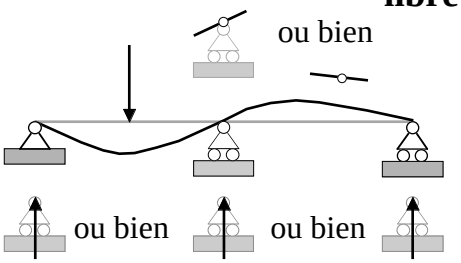
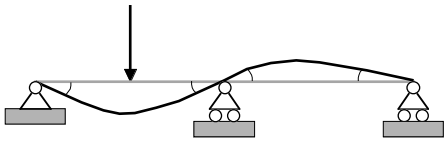

$K=\infty \rightarrow X_1=0 \qquad X_2=\frac{4ML}{168EI} \qquad X_3=\frac{ML}{168EI}$



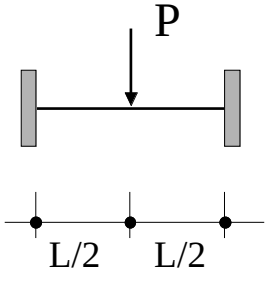
Inconnues dans les méthodes de résolution respectives:

| | **Méthode des Forces** | **Méthode des Déplacements** |
|---|---|---|
| Nombre d' inconnues | **fixé**  | **plus libre**  |
| Système fondamental | **isostatique (souple)**  | **hyperstatique (rigide)**   |
| Choix des inconnues | **libre**   | **restreint**  |

**Motivations pour ajouter des inconnues:**

– programmation de la méthode des déplacements

– détermination directe des déformations




$$b_{11} = 2\,\frac{12\,EI}{L^3/8}$$

$$b_{10} = -P$$

$$x_1 = \frac{P\,L^3}{192\,EI}$$