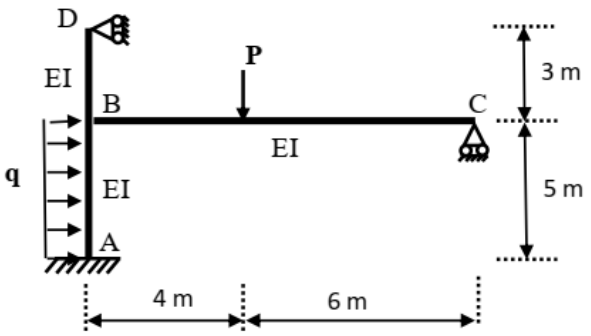
*Soit à calculer le portique ci-dessous a rigidité constante. En utilisant la méthode des déplacements (on donne* $q = 2\ KN/m$ *et* $P = 8\ KN$*) :*

- *Déterminer le nombre d'inconnus ?*
- *Ecrire l'équation canonique ?*
- *Choisir le système de base ?*
- *Tracer le diagramme des moments fléchissant* $M_f$ *?*




## Correction

1/ Déterminer le nombre d'inconnus:

$N = N_r + N_t$ , $N_r = 1$ , $N_t = 2n - (b+e) = 2(4) - (3+4) = 1$

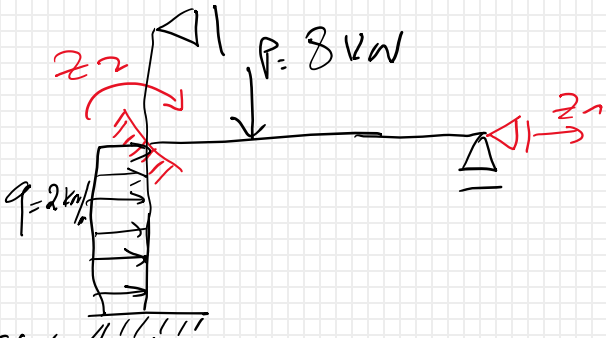
$\boxed{N = 2}$

2/ Ecrire l'équation canonique :

$r_{11} Z_1 + r_{12} Z_2 + R_{10} = 0$

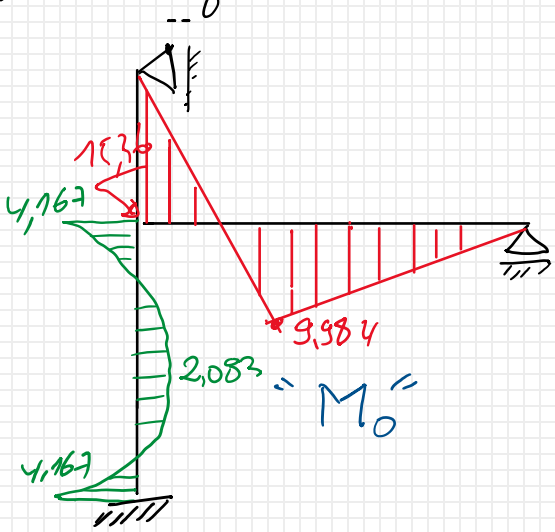
$r_{21} Z_1 + r_{22} Z_2 + R_{20} = 0$

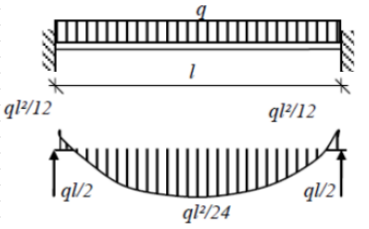
3/ Système de base :

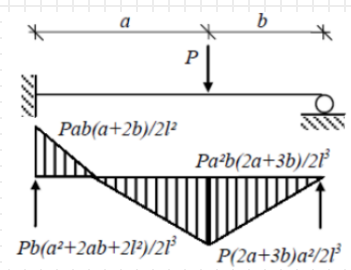



4/ Tracer le diagramme des moments fléchissants

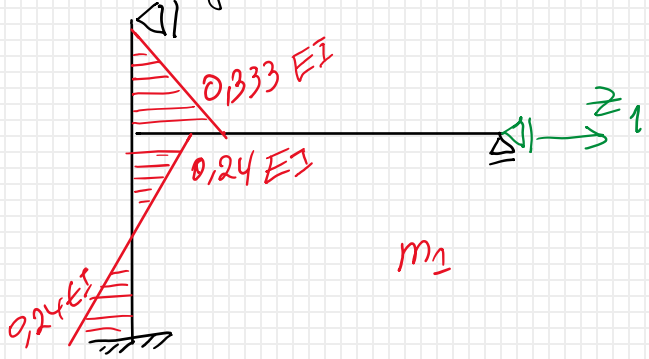
Etat 0 : Charge Extérieures $\neq 0$ , $Z_1 = Z_2 = 0$

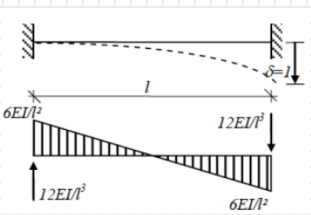


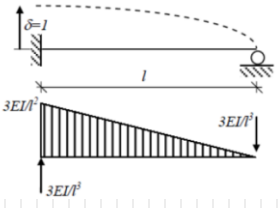



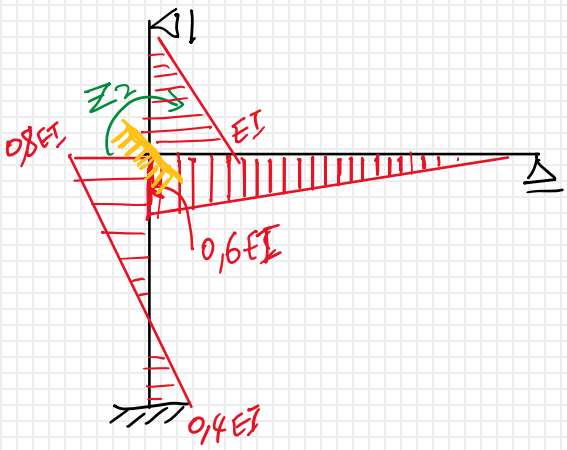

Etat 1 : Charge Extérieures $= 0$ , $Z_1 = 1$ , $Z_2 = 0$

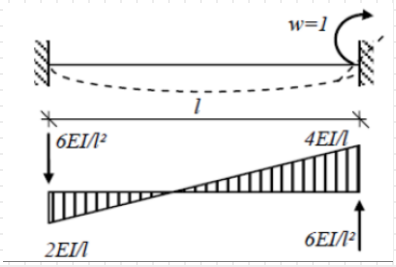


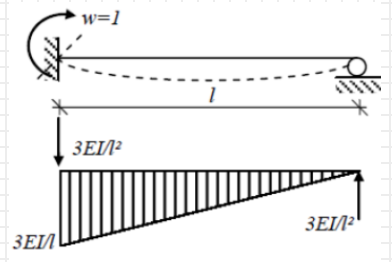



Etat 2 : charge Extérieures = 0, $Z_1 = 0$, $Z_2 \neq 0$

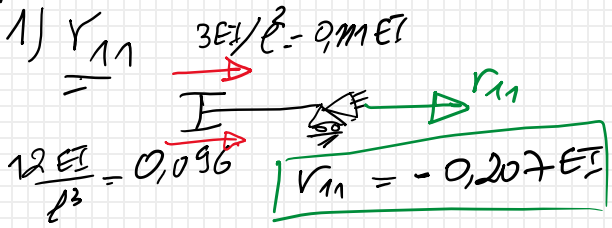


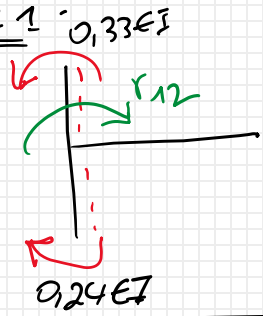

## 5/ Calculer les déplacements $r_{ij}$, $R_{i0}$ :

1/ $r_{11}$ =



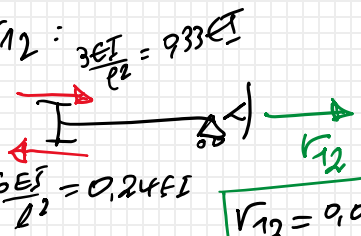

$r_{11} = -0,207\,EI$

2/ $r_{21}$ :



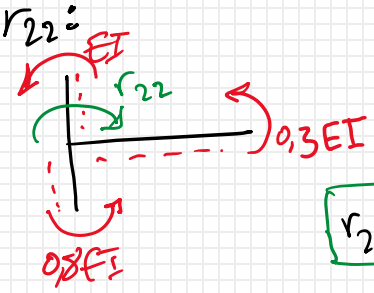

$r_{21} = 0,093\,E$

3/ $r_{12}$ :



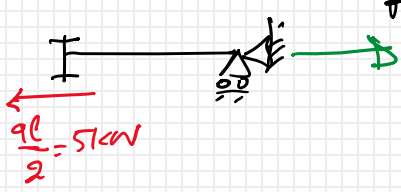

$r_{12} = 0,093\,EI$

4/ $r_{22}$ :



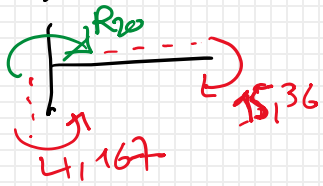

$r_{22} = 2,1\,EI$

5) $R_{10}$ :




$R_{10} = 5\,kN.m$

6) $R_{20}$ :



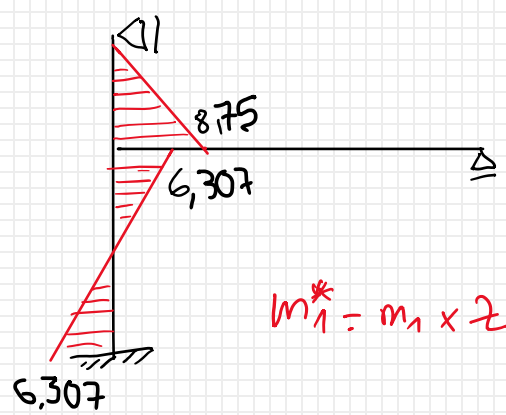

$R_{20} = -11,16\,kN.m$

## 6/ Equation Canonique :

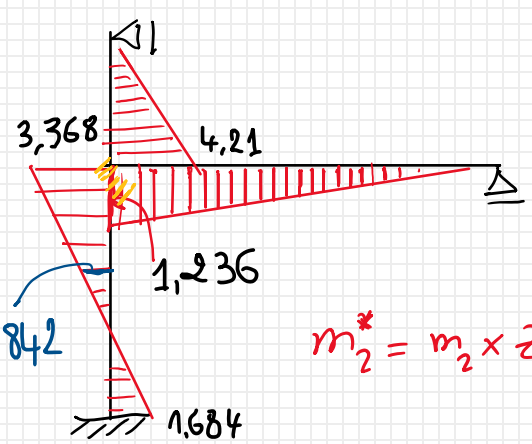
$$\begin{cases} -0,207\,EI\,Z_1 + 0,093\,EI\,Z_2 + 5 = 0 \\ 0,093\,EI\,Z_1 + 2,1\,EI\,Z_2 - 11,16 = 0 \end{cases} \Rightarrow \begin{cases} -0,019\,Z_1 + 0,0086\,Z_2 + 0,465 = 0 \\ 0,0197\,Z_1 + 0,43477\,Z_2 - 2,31 = 0 \end{cases}$$

$\Rightarrow$ $Z_1 = 26,28/EI$ $\quad$ $Z_2 = 4,21/EI$

## 7/ corriger les épures unitaires :




$m_1^* = m_1 \times Z_1$




$m_2^* = m_2 \times Z_2$

8) Tracer le diagramme final : $M_{final}$ :

$$M_{final} = M_0 + m_1^* + m_2^*$$