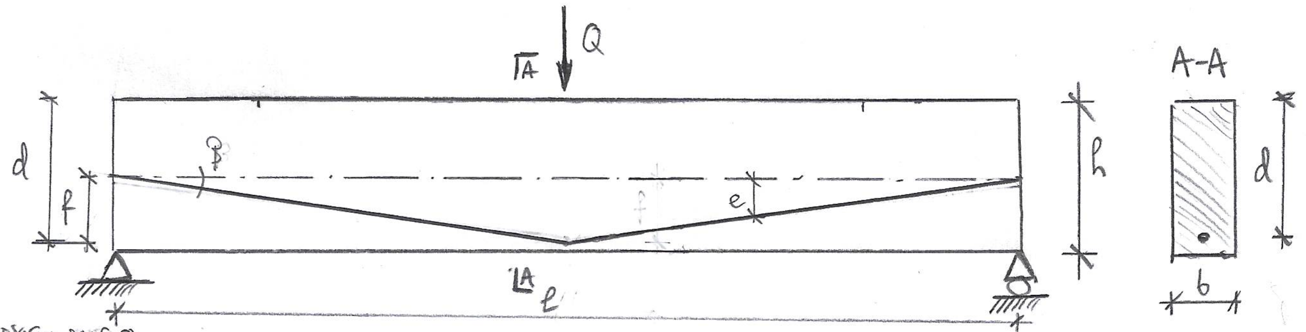
Comparaison entre l'approche auto-contrainte et l'approche forces

Isostatique

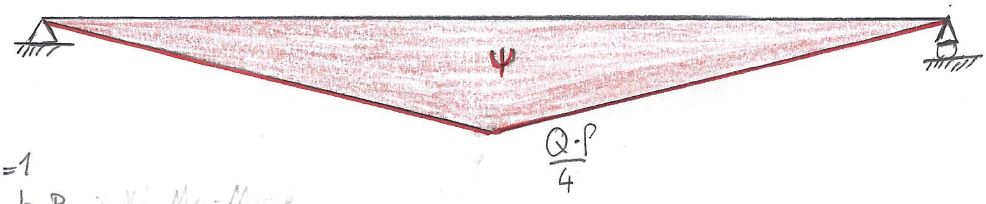
Frédéric Monney
18.10.2023

Géométrie

Approximation
$\cos\beta = 1$
$\sin\beta = \tan\beta$



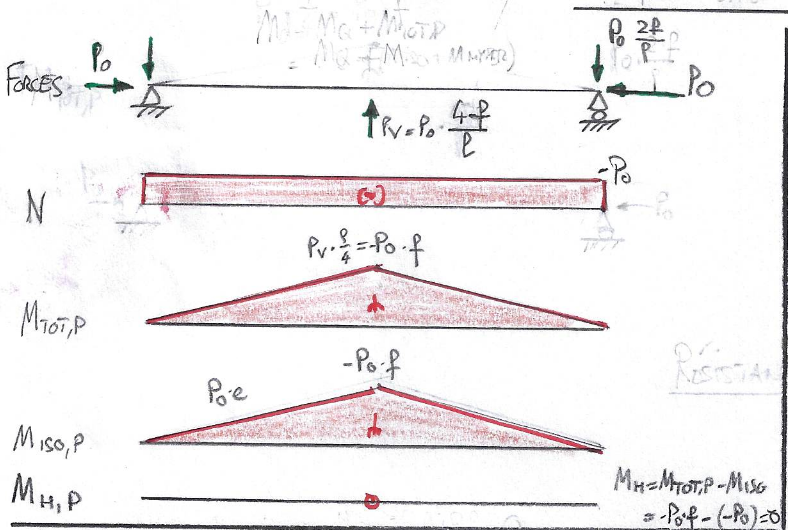
Moment de flexion sous Q

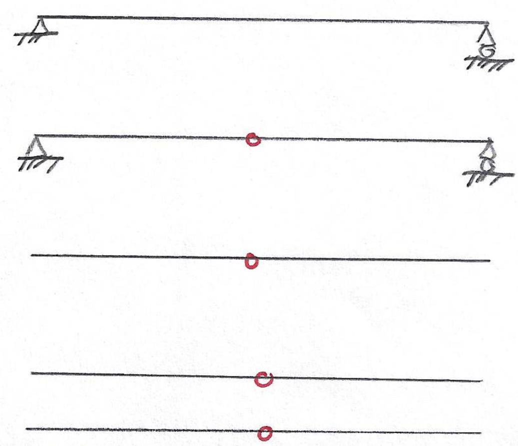


Approximation: $\cos\beta = 1$
$\sin\beta = \tan\beta$

Approche forces	Approche autocontrainte

Efforts internes dû à la précontrainte



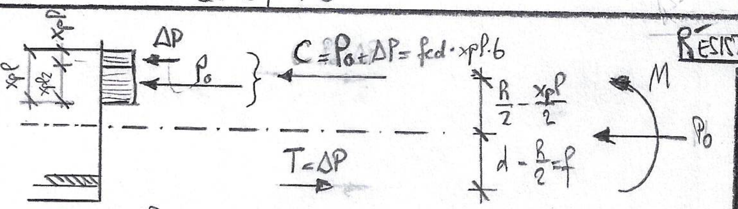


Moment de flexion sollicitant

$M = M_Q + M_{TOT,P} = M_Q + M_{ISO,P} + M_{H,P}$
$= M_Q - P_0 f + 0$

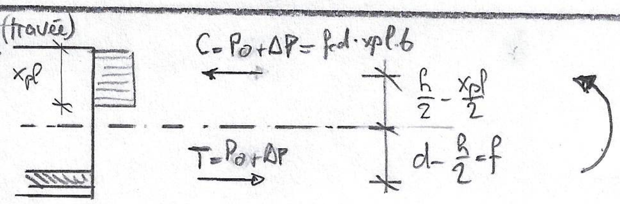
$M = M_Q + M_{TOT,P}$
$= M_Q + 0$

Résistance (travée)



$x_{pl_1} = \frac{\Delta P}{b \cdot f_{cd}}$, $x_{pl_2} = \frac{P_0}{b \cdot f_{cd}}$ $\Big\}$ $x_{pl} = \frac{P_0 + \Delta P}{b \cdot f_{cd}}$

$$M_{Rd} = \Delta P \cdot f + (P_0 + \Delta P) \cdot \left(\frac{h}{2} - \frac{x_{pl}}{2}\right)$$



$x_{pl} = \frac{P_0 + \Delta P}{b \cdot f_{cd}}$

$$M_{Rd} = (P_0 + \Delta P) \cdot f + (P_0 + \Delta P)\left(\frac{h}{2} - \frac{x_{pl}}{2}\right)$$

Vérification (travée)

$M_{Rd} \geq M$

$$\Delta P \cdot f + (P_0 + \Delta P)\left(\frac{h}{2} - \frac{x_{pl}}{2}\right) \geq M_Q - P_0 \cdot f$$

$$(P_0 + \Delta P) \cdot f + (P_0 + \Delta P)\left(\frac{h}{2} - \frac{x_{pl}}{2}\right) \geq M_Q$$

$$(P_0 + \Delta P) \cdot f + (P_0 + \Delta P) \cdot \left(\frac{h}{2} - \frac{x_{pl}}{2}\right) \geq M_Q$$

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Géométrie

Approximation:
$\cos\beta = 1$
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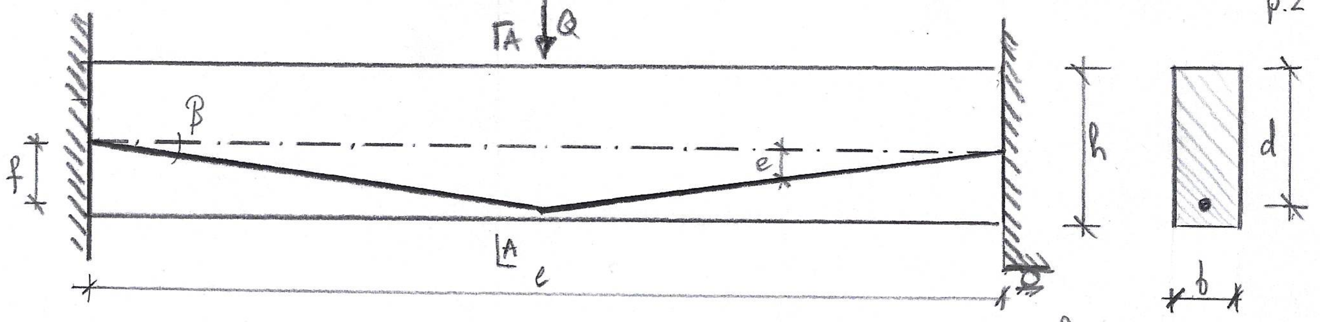
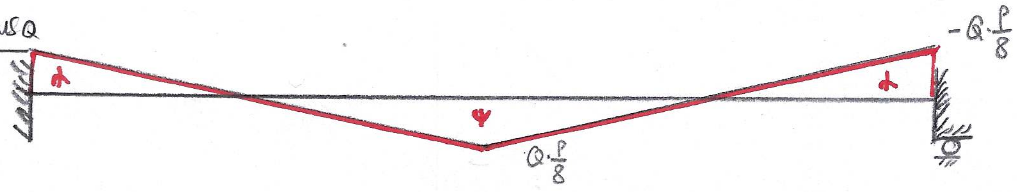


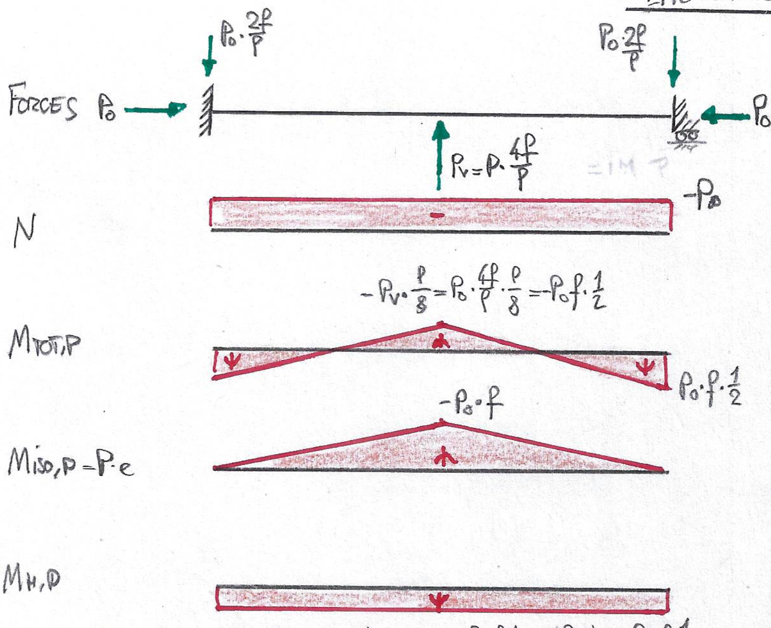
Moment de flexion sous Q

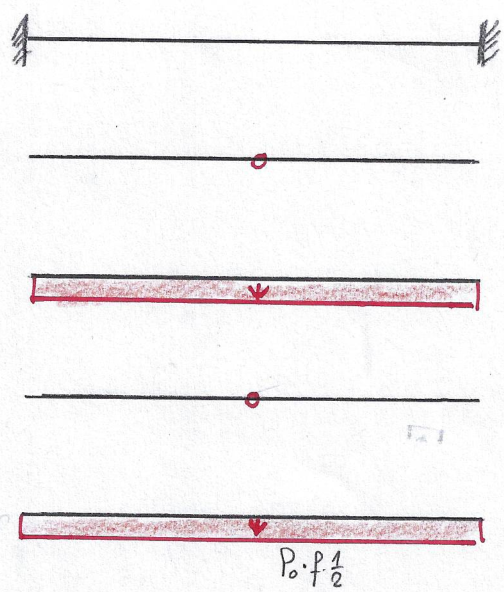
M_Q



APPROCHE FORCES	APPROCHE AUTO-CONTRAINTE

Efforts internes dû à la précontrainte





TRAVÉE: $M_H = M_{TOT,P} - M_{ISO,P} = -P_0\cdot f\cdot\frac{1}{2} - (-P_0\cdot f) = P_0\cdot f\cdot\frac{1}{2}$

APPUIS: $M_H = M_{TOT,P} - M_{ISO,P} = P_0\cdot f\cdot\frac{1}{2} - 0 = P_0\cdot f\cdot\frac{1}{2}$

Moment de flexion sollicitant

Approche forces:

$M = M_Q + M_{TOT,P} = M_Q + M_{ISO,P} + M_{H,P}$
$= M_Q - P_0\cdot f + P_0\cdot\frac{f}{2}$

Approche auto-contrainte:

$M = M_Q + M_{TOT,P} = M_Q + M_{H,P}$
$= M_Q + P\cdot\frac{f}{2}$

Résistance (travée)

Approche forces: identique à page 1

Approche auto-contrainte: identique à page 1

Vérification $M_{Rd} \geq M_d$ (travée)

Approche forces:

$\Delta P\cdot f + (P_0+\Delta P)\left(\frac{h}{2} - \frac{x_p\ell}{2}\right) \geq M_Q - P_0 f + P_0\cdot\frac{f}{2}$

$(P_0+\Delta P)\cdot f + (P_0+\Delta P)\left(\frac{h}{2} - \frac{x_p\ell}{2}\right) \geq M_Q + P_0\cdot\frac{f}{2}$

Approche auto-contrainte:

$(P_0+\Delta P)\cdot f + (P_0+\Delta P)\left(\frac{h}{2} - \frac{x_p\ell}{2}\right) \geq M_Q + P\cdot\frac{f}{2}$

IDENTIQUE