Solution TD. CHAP 2

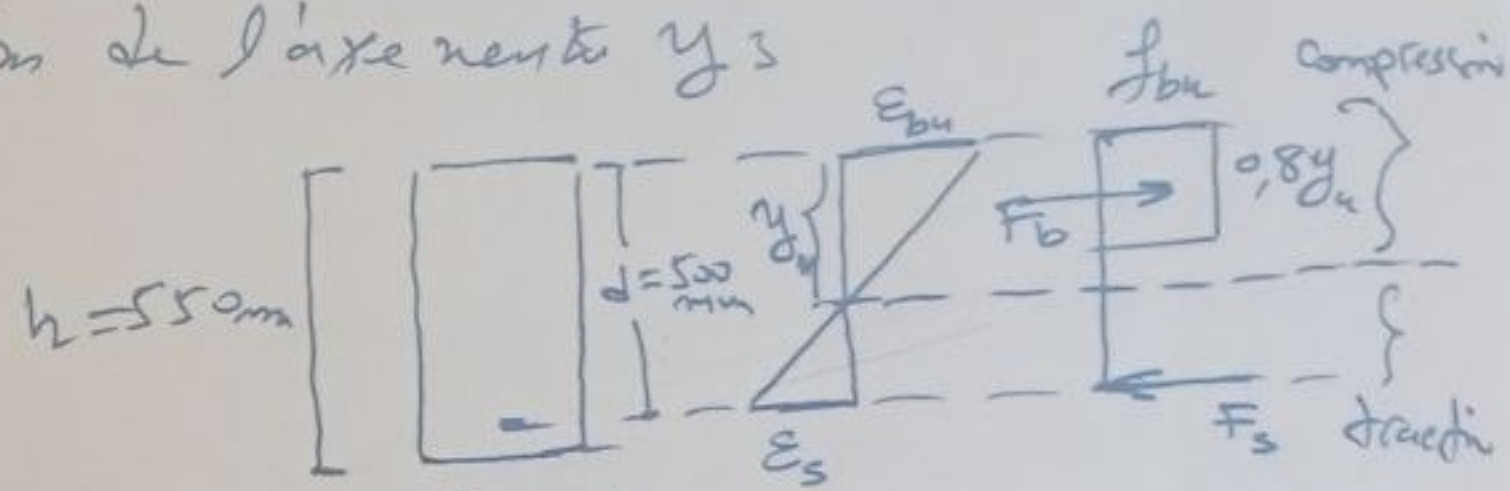
<u>ex04</u> : $b = 300mm$; $h = 550mm$; $d = 500mm$

$f_{cj} = 30MPa$; $\gamma_b = 1,5$; $f_e = 500MPa$; $\gamma_s = 1,15$

$A_s = 1800mm^2$

① - calcul de f_{bu} ? $f_{bu} = \dfrac{0,85 f_{c28}}{\gamma_b} = \dfrac{0,85.30}{1,5} = 17MPa$

② calcul de la position de l'axe neutre y_u



équilibre des forces : traction du béton = compression du béton

$b = 300mm$

$A_s \cdot f_{su} = 0,8 y_u \cdot b \cdot f_{bu}$

$F_b = F_s$

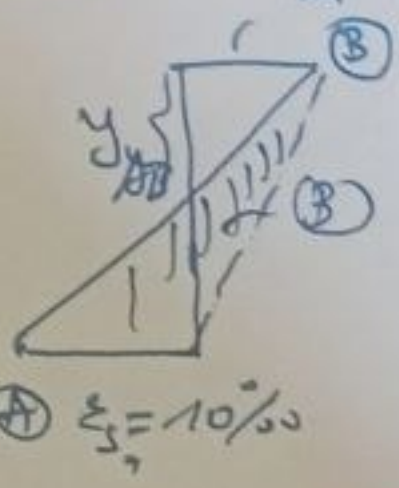
$\Rightarrow A_s f_{su} = 0,8 y_u \cdot b \cdot f_{bu} \Rightarrow y_u = \dfrac{A_s f_{su}}{0,8 \cdot b \cdot f_{bu}}$

$y_u = \dfrac{1800 f_{su}}{0,8.300.17}$; $f_{su} = \dfrac{f_e}{\gamma_s} = \dfrac{500}{1,15} = 434,78MPa$

$y_u = \dfrac{1800.434,78}{0,8.300.17} = 191,8158mm$. $\varepsilon_{bu} = 3,5‰$

③ Vérification du type de Pivot :

triangles semblables : $\dfrac{\varepsilon_{bu}}{y_{AB}} = \dfrac{\varepsilon_s}{d - y_{AB}}$



$\Rightarrow y_{AB} = \left(\dfrac{3,5}{3,5+10}\right) \cdot d$

$y_{AB} = 129,629mm \Rightarrow y_{AB} < y = 191,858$

$\Rightarrow$ Pivot (B)

④ - rupture par écrasement du béton
- l'acier n'atteint pas la déformation maximale

exo5) $b = 300mm$; $h = 500mm$; $d = 450mm$

$A_s = 4\phi 20$; $f_{ck} = 30MPa$; $f_e = 500MPa$

$\varepsilon_{bu} = 3,5/00$; $\varepsilon_{su} = 10/00$; $E_s = 2.10^5 MPa$.

b. Déformations mx dans le béton pour chaque Pivot :

Pivot (A) : voir figure 2.6 chap 2 :

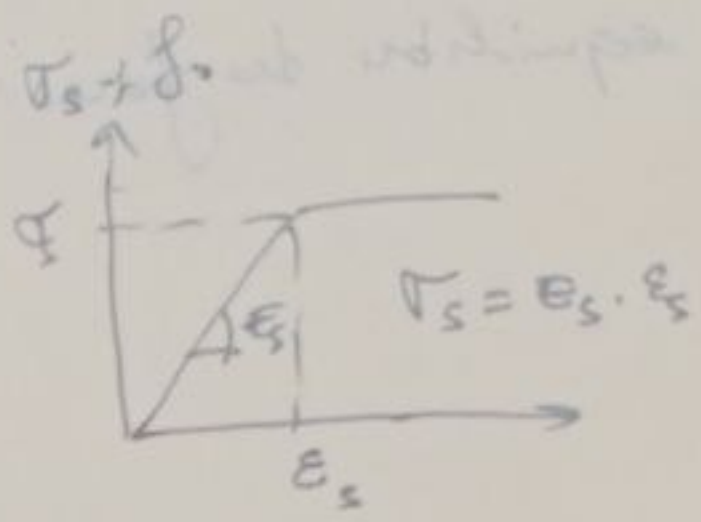
$\varepsilon_{su} = 10/00$; $0 < \varepsilon_b < 3,5/00$

Pivot (B) : $\varepsilon_{bu} = 3,5/00$; $0 < \varepsilon_s < 10/00$

Pivot (C) : $\varepsilon_s < 0$

$2/00 < \varepsilon_b < 3,5/00$.

② $f_{su} = \frac{f_e}{\gamma_s} = \frac{500}{1,15} = 434,78MPa$



- Pivot (A) : $\varepsilon_{su} = 10/00$ constant

$\Rightarrow \sigma_s = f_{su} = 434,78MPa$

Pivot (B) : ε_s = variable

cas (1) - $\sigma_s = E \cdot \varepsilon_s = 2.10^5 \cdot \varepsilon_s$

(2) - $\sigma_s = \frac{f_e}{\gamma_s} = 434,78MPa$

Pivot (C) : $\varepsilon_s < 0$ $\Rightarrow$ acier comprimé

$\sigma_s = E_s \varepsilon_s$ $\Rightarrow$ (contrainte négative)

Valeur extrême : $f_{su} = -434,78MPa$

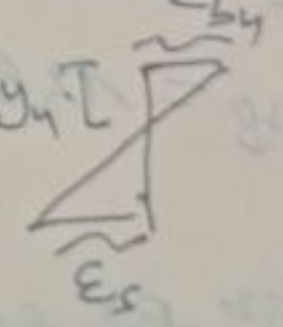
③ Mode de rupture :

Pivot (A) : rupture ductile

Pivot (B) : rupture fragile

Pivot (C) : rupture très fragile

④ (A) $\frac{y_u}{d} = \frac{\varepsilon_b}{\varepsilon_b + \varepsilon_s = 10/00}$ $\Rightarrow$ plage $0 \leq \frac{y_u}{d} \leq 0,259$



(B) : $\frac{y_u}{d} = \frac{3,5}{3,5 + \varepsilon_s}$ $\Rightarrow$ plage $0,259 \leq \frac{y_u}{d} \leq 1$

(C) : $\varepsilon_s < 0$ $\Rightarrow$ $\frac{y_u}{d} = \frac{2}{2 + \varepsilon_s}$ $\Rightarrow$ $\frac{y_u}{d} > 1$