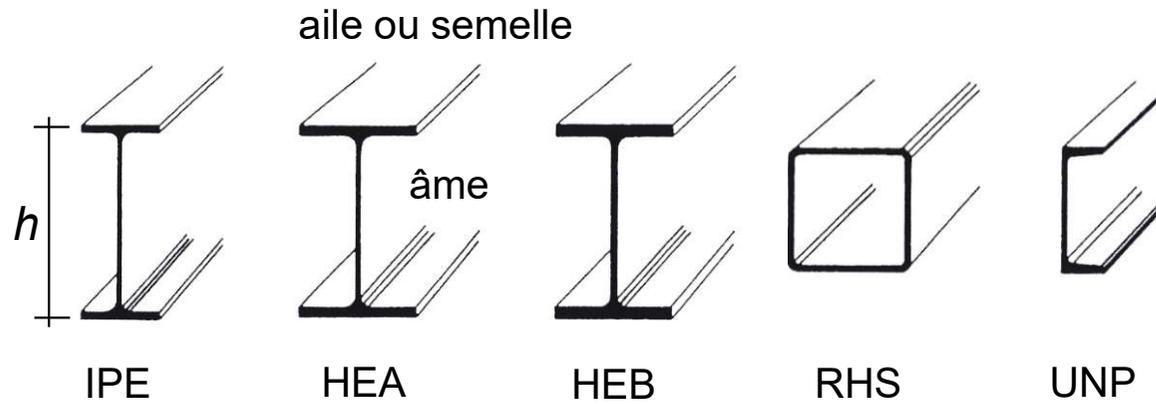
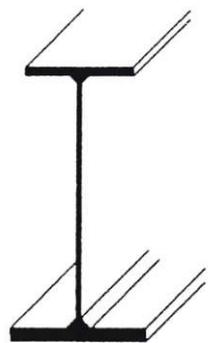


## Poutres – sections types en acier

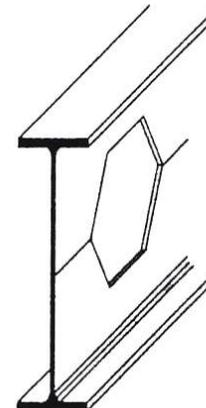


Profils laminés

$$h \cong \frac{L}{20} - \frac{L}{30}$$



Profils composés soudés  
à âme pleine



Profils ajourés

$L$  : portée de la poutre



*Baldaqin place de la gare, Marchwell Valentino Marchisella, Berne, 2008*

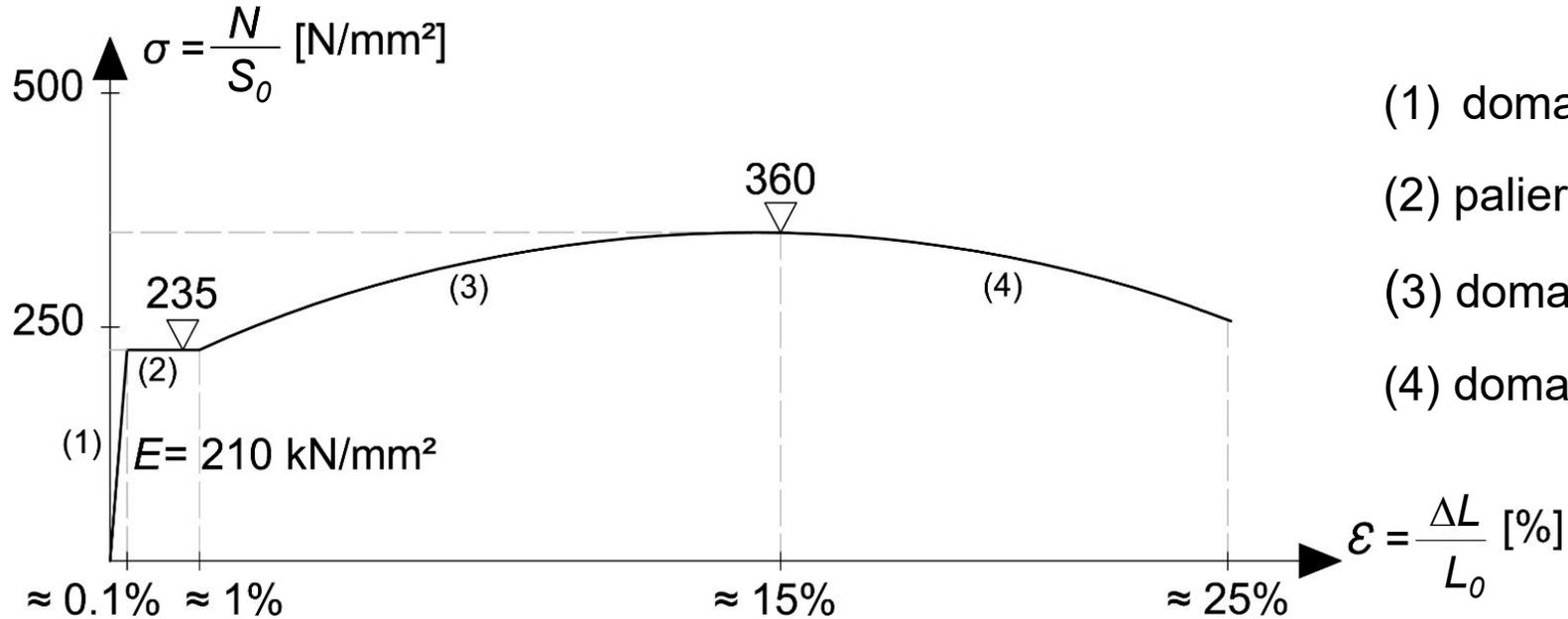


*Aéroport de Barajas, Rogers, Madrid, 2005*

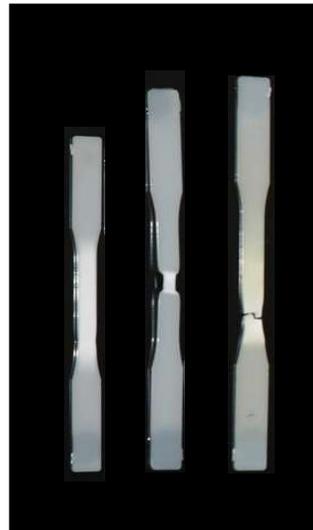
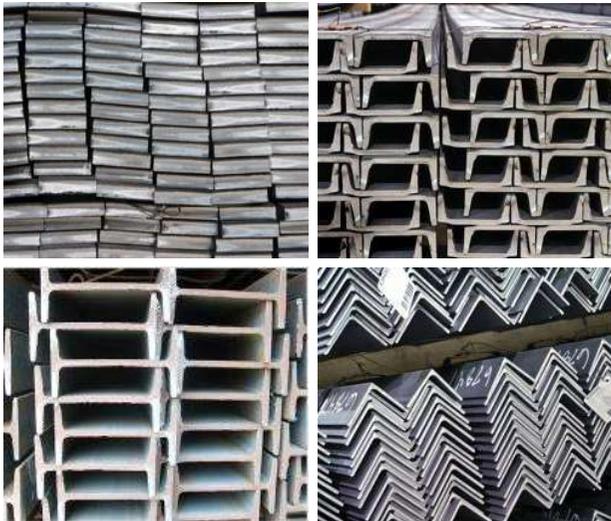


*Usine Reese-Teknik, Berlin, 1961*

## Acier de construction S 235

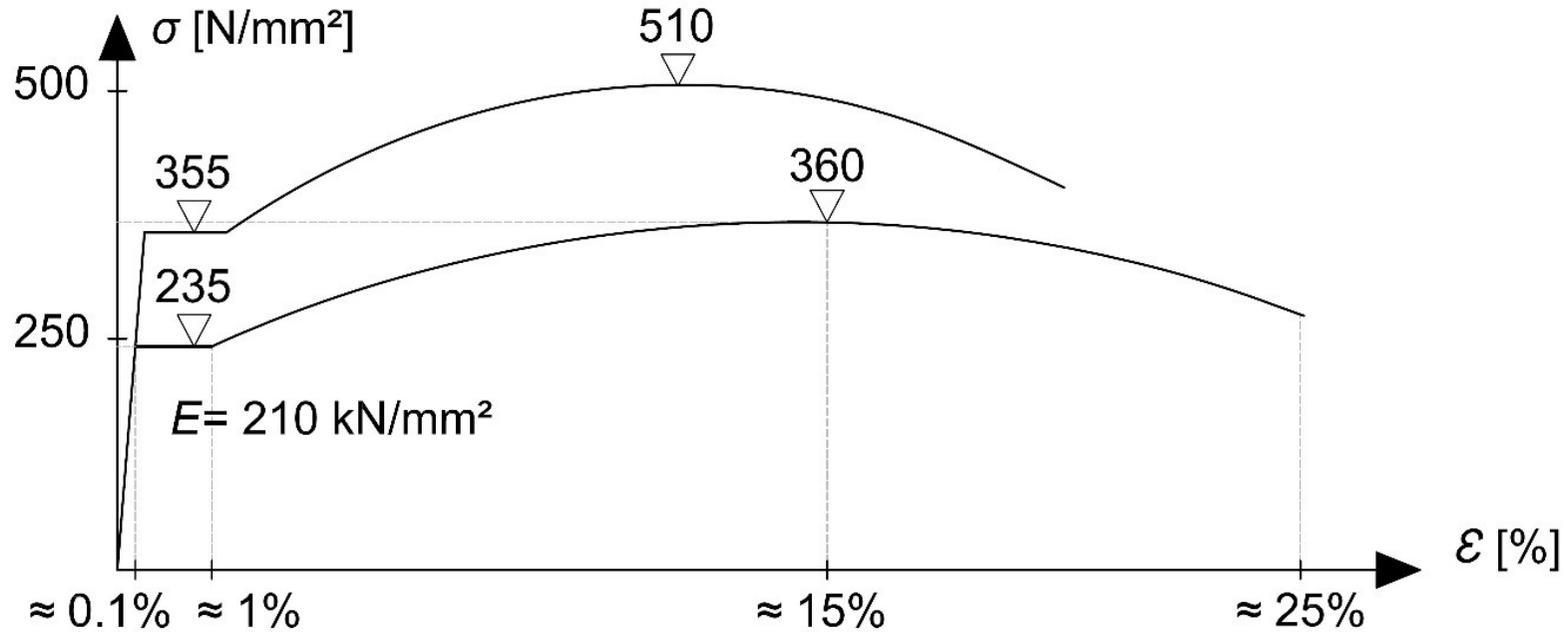


- (1) domaine élastique
- (2) palier d'écoulement
- (3) domaine d'écrouissage
- (4) domaine de la striction



- **isotrope** =
- **compression = traction**  
 =
- **régularité des propriétés**  
(faible dispersion)

## Aciers de construction S 235 et S 355



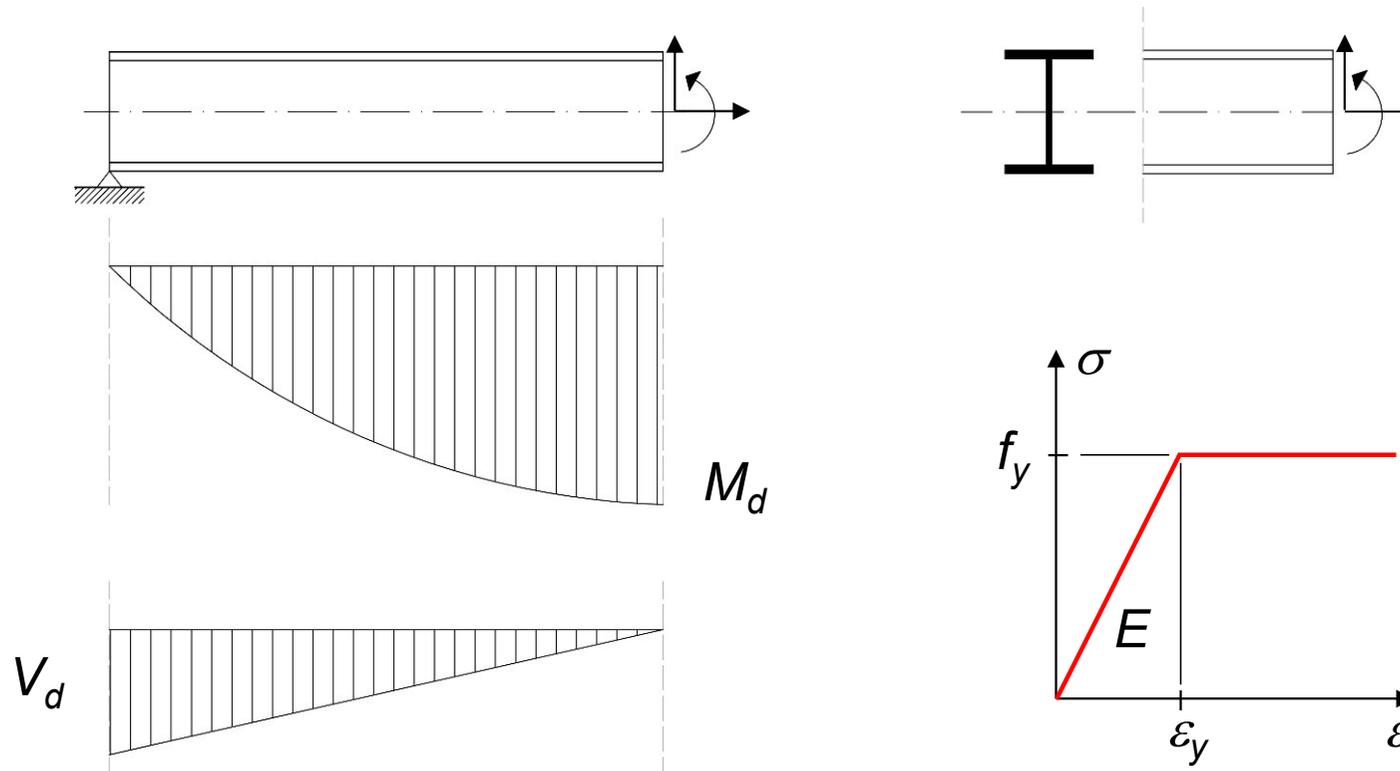
nuance d'acier	limite d'élasticité $f_y$ [N/mm <sup>2</sup> ]	résistance à la traction $f_u$ [N/mm <sup>2</sup> ]	allongement de rupture [%]	désignation ou utilisation
S 235	235	360	26	acier doux
S 355	355	510	22	acier à haute résistance

Vérifier la sécurité structurale consiste en comparer :

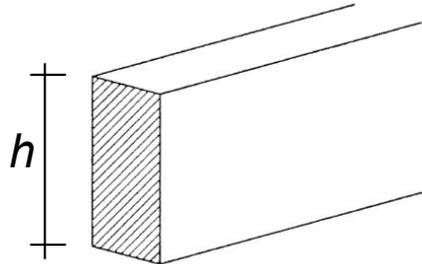
Efforts intérieurs  $\leq$  Résistance

$N_d, V_d, M_d$

$N_{Rd}, V_{Rd}, M_{Rd}$

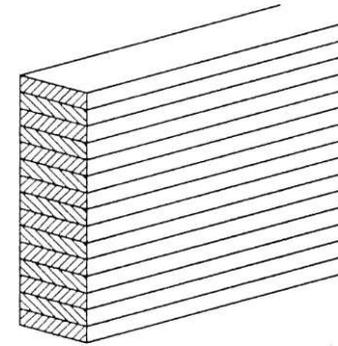


## Poutres – sections types en bois

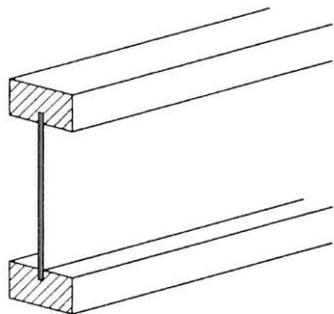


Bois massif  
(équarri ou scié)

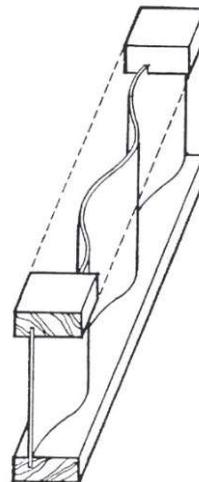
$$h \cong \frac{L}{10} - \frac{L}{20}$$



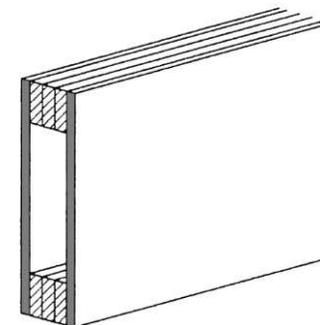
Bois lamellé-collé



Section en I



Section en I  
à âme ondulée

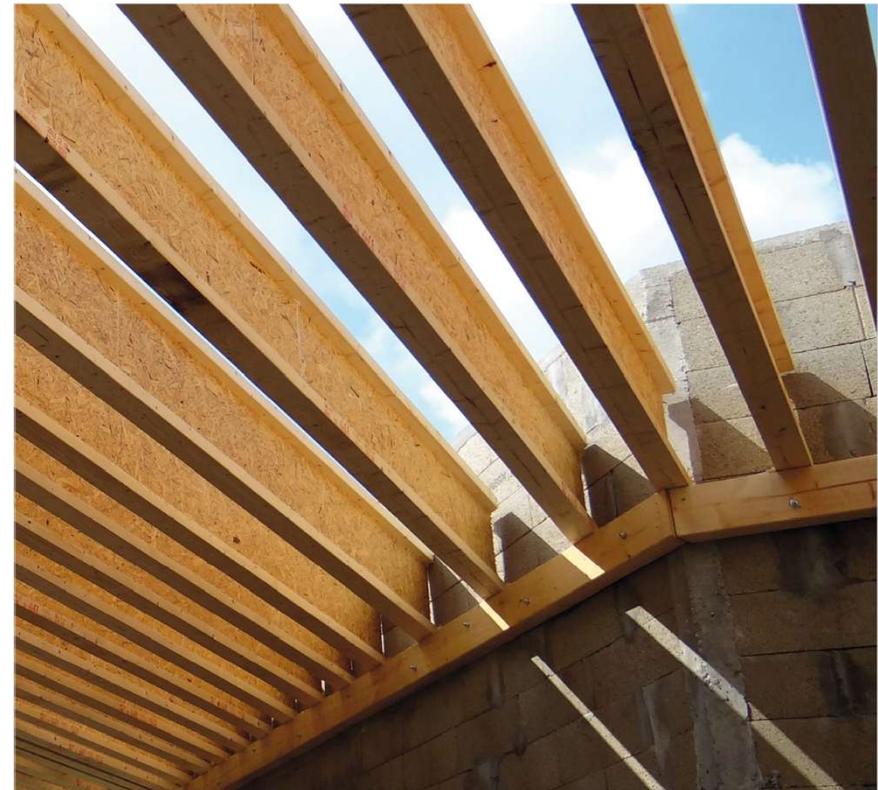


Section en caisson

$L$  : portée de la poutre

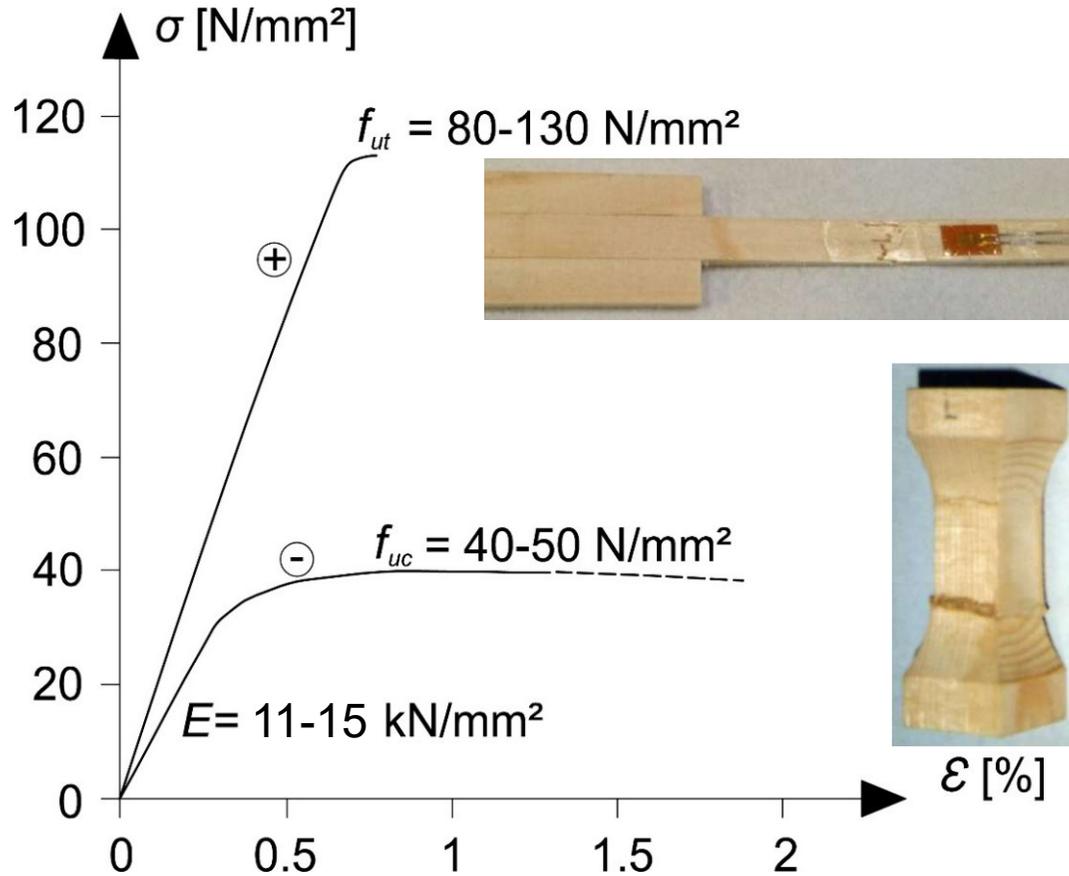


*Archi Legno*



*poutre-en-l.com*

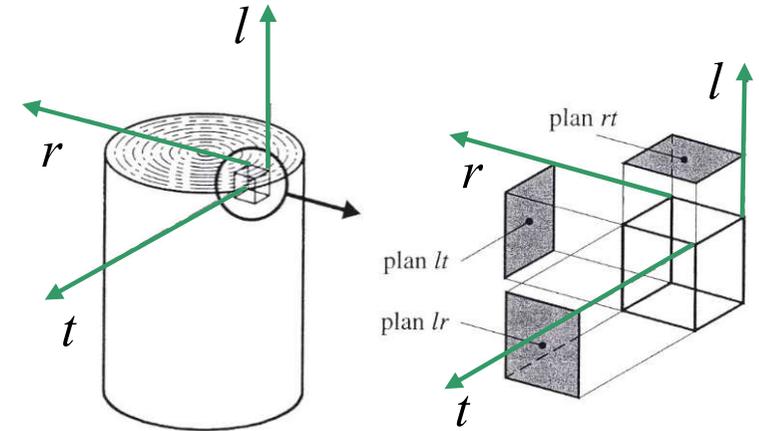
# Bois



Traction et compression parallèle aux fibres

Comportement  $\perp$  aux fibres :

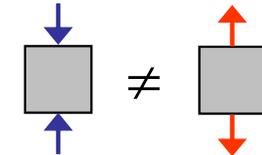
valeurs  $\perp$  aux fibres < 10% valeurs  $\parallel$  aux fibres



• **anisotrope**  $\neq$

propriétés  $\parallel \gg \perp$

• **compression**  $\neq$  **traction**



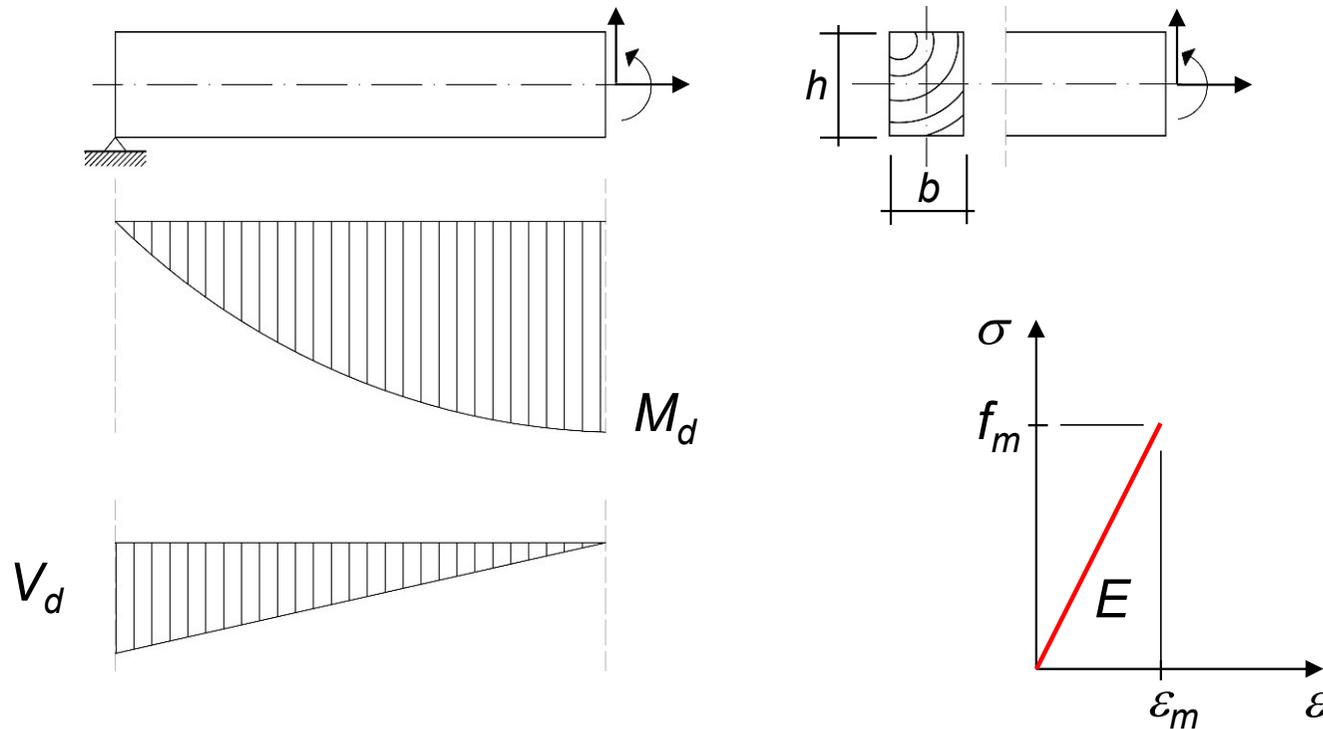
• **variabilité des propriétés**  
(grande dispersion)

Vérifier la sécurité structurale consiste en comparer :

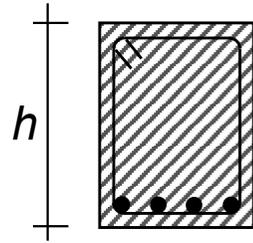
Efforts intérieurs  $\leq$  Résistance

$N_d, V_d, M_d$

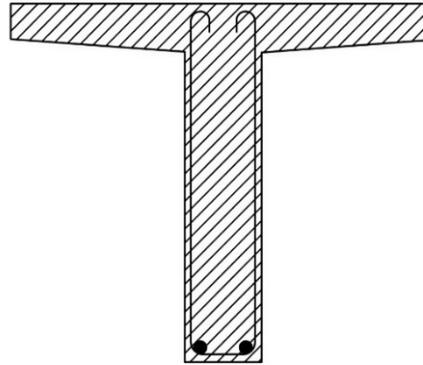
$N_{Rd}, V_{Rd}, M_{Rd}$



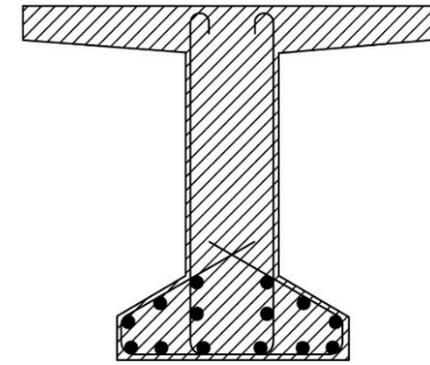
## Poutres – sections types en béton armé



rectangulaire

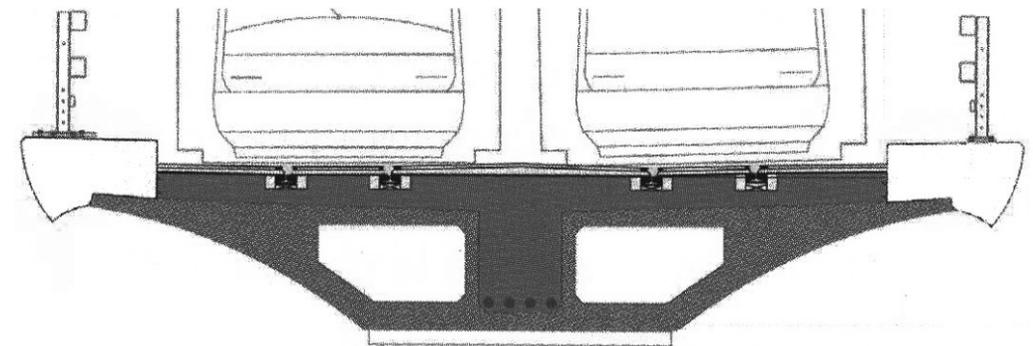
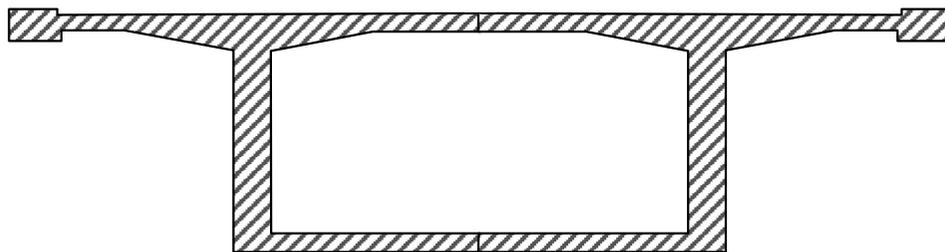


en té



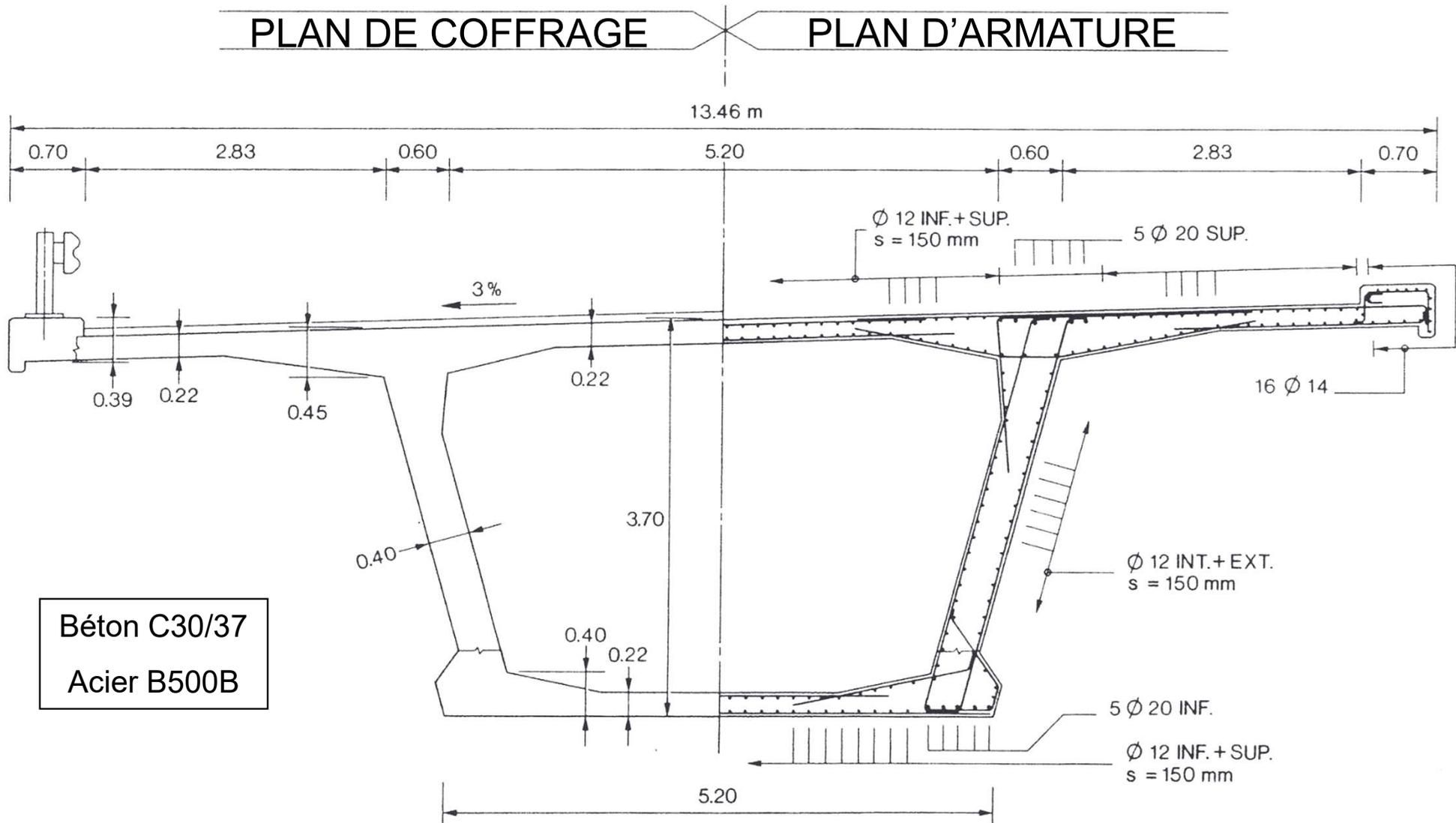
en té avec talon

Sections pleines  $h \cong \frac{L}{20}$



Sections en caisson

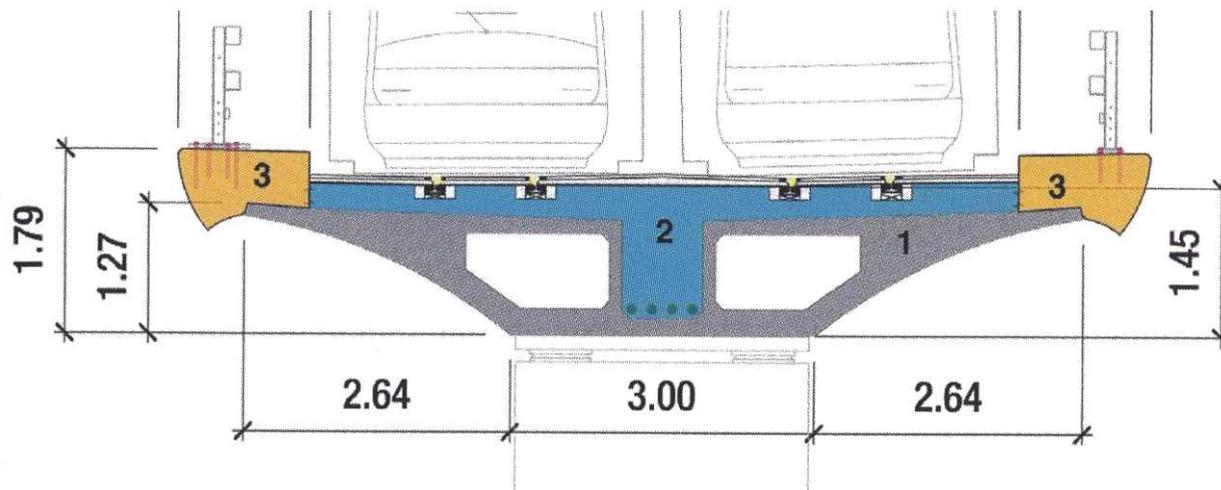
$L$  : portée de la poutre



Exemple de coupe transversale type et schéma d'armature d'un pont d'autoroute

## Poutres – sections types en béton armé et précontraint

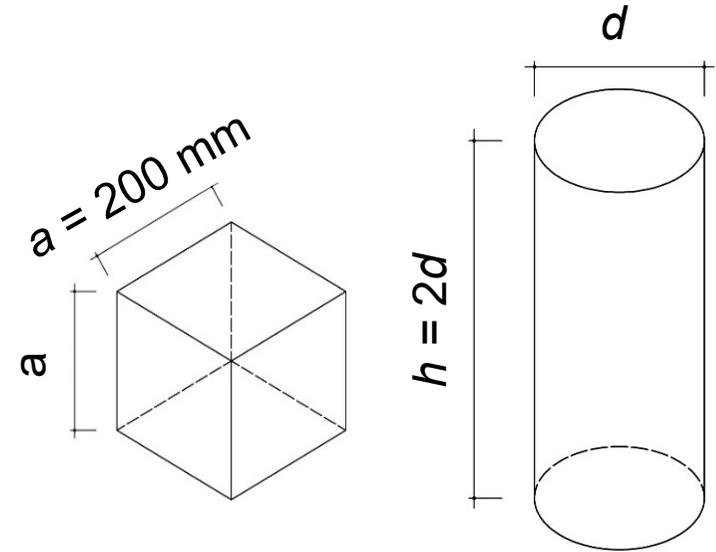
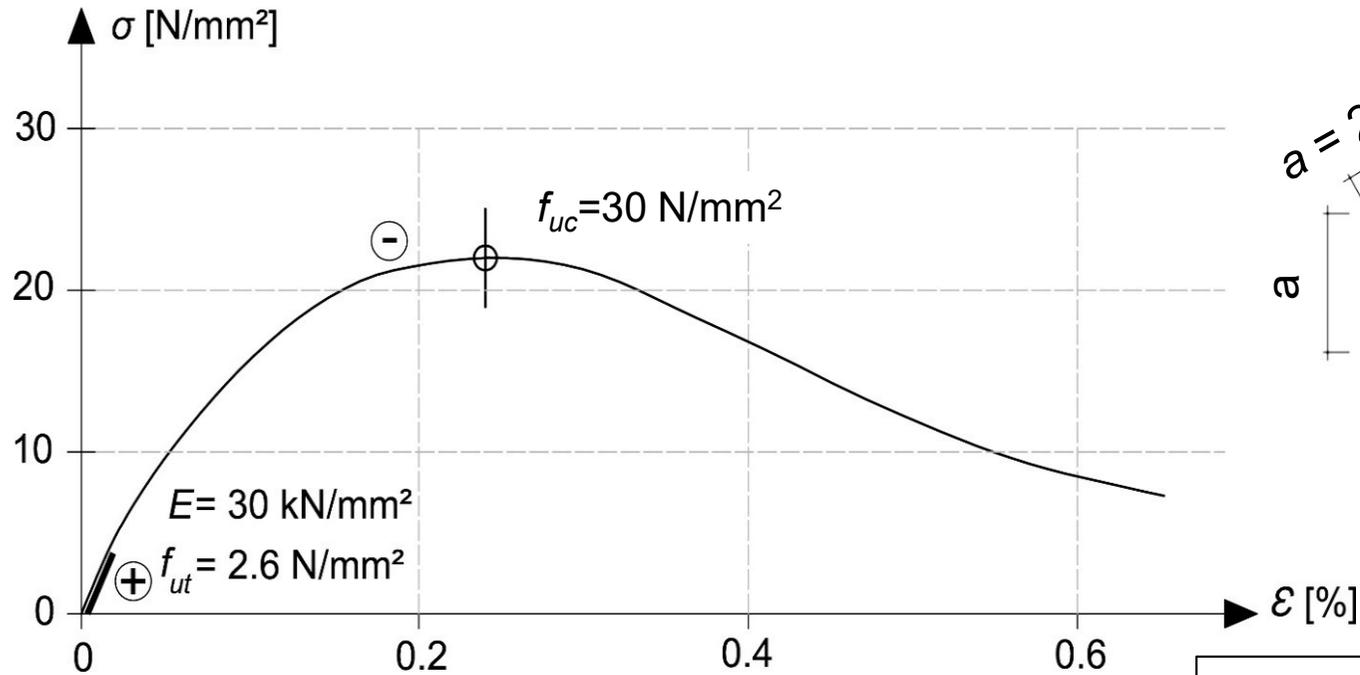
Combinaison d'éléments préfabriqués et de béton  
coulé surplace (Viaduct Lect, Genève, ing : T-ing)



- |         |                            |   |                      |
|---------|----------------------------|---|----------------------|
| Phase 1 | precast element            | } | voussoir préfabriqué |
| Phase 2 | cast in place central core |   | béton coulé surplace |
| Phase 3 | edge beams                 |   |                      |



# Béton C25/30



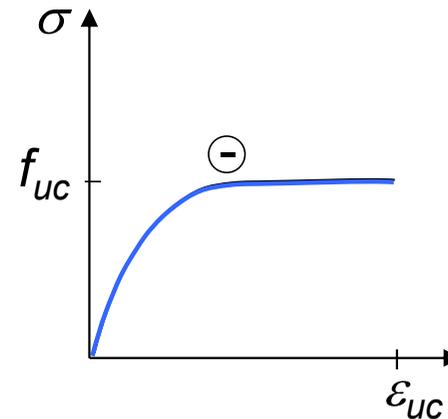
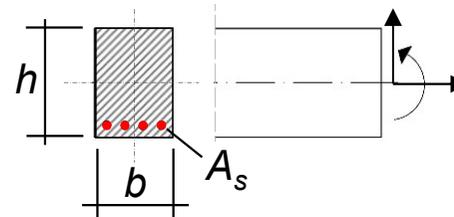
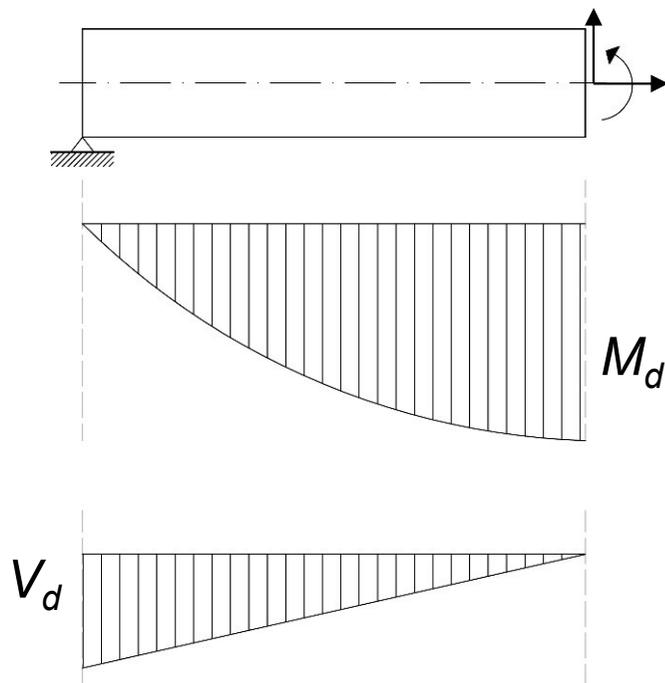
- **isotrope** =
- **compression  $\neq$  traction**  
 $\neq$
- **régularité des propriétés**  
(dispersion moyenne)

Vérifier la sécurité structurale consiste en comparer :

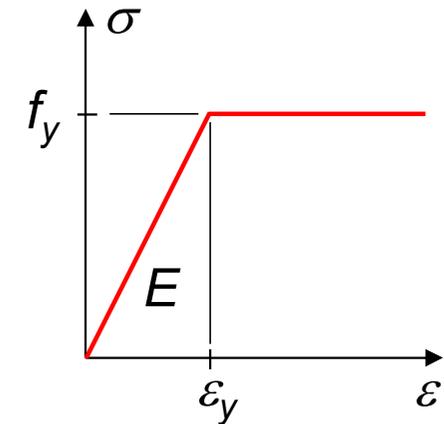
Efforts intérieurs  $\leq$  Résistance

$N_d, V_d, M_d$

$N_{Rd}, V_{Rd}, M_{Rd}$

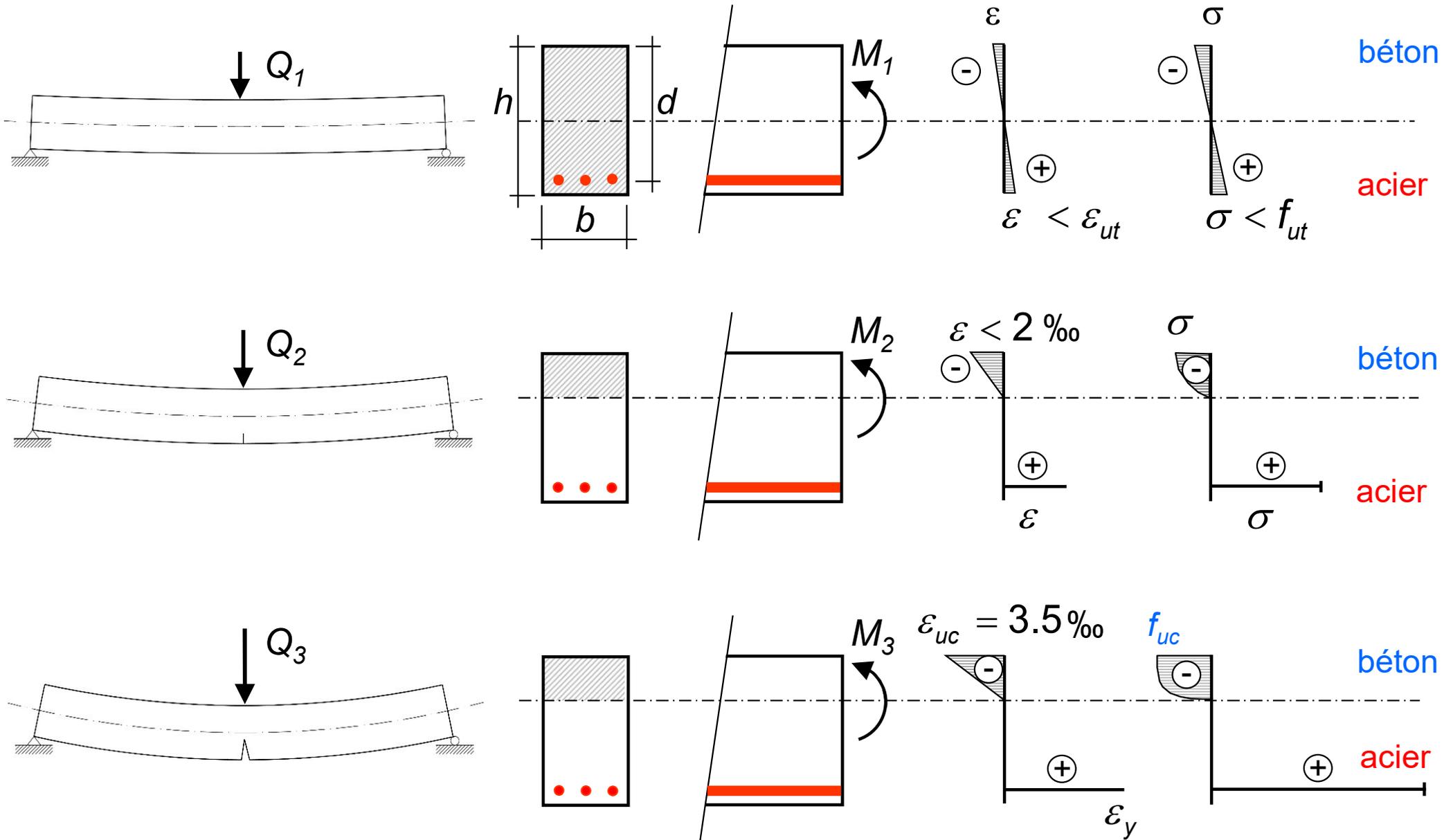


béton



acier d'armature  
ou de précontrainte

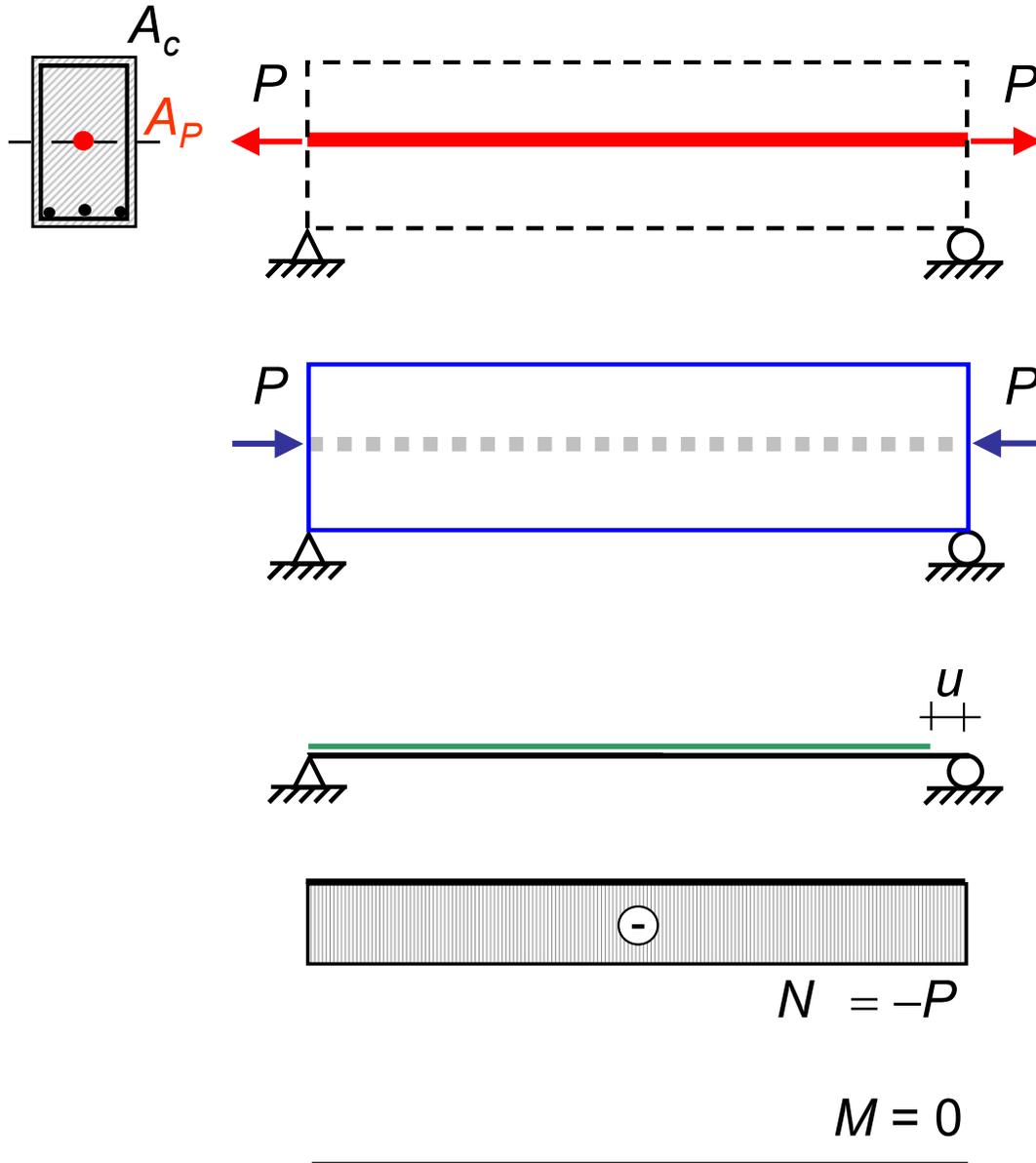
déformation      contrainte





[www.youtube.com/watch?v=QWkqQmagHfs](https://www.youtube.com/watch?v=QWkqQmagHfs)

## Béton armé et précontraint – Précontrainte centrée

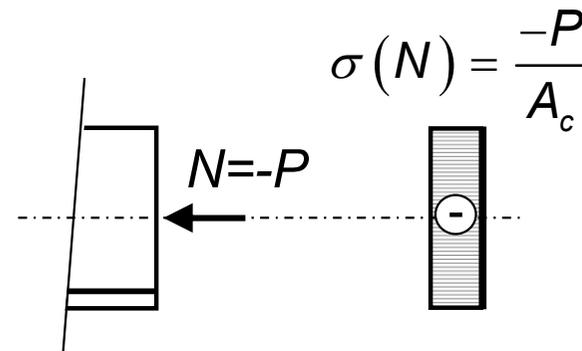


Force de précontrainte :  $P \cong 0.7f_y A_p$

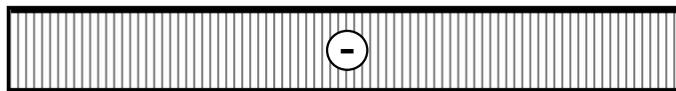
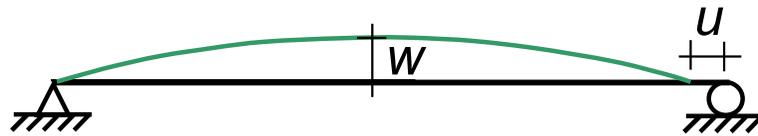
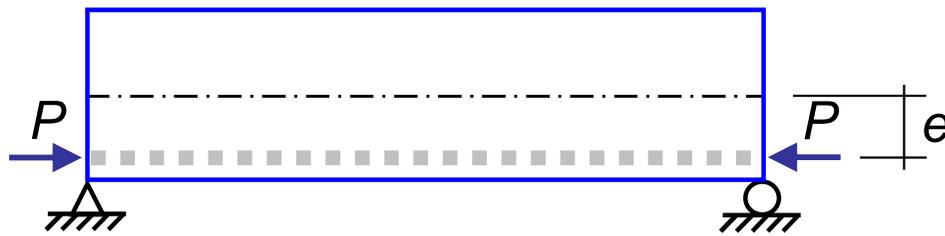
$A_c$  : section de béton

$A_p$  : section de précontrainte

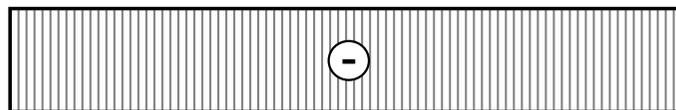
$f_y$  : limite élastique de  
l'acier de précontrainte



## Béton armé et précontraint – Précontrainte centrée



$$N = -P$$



$$M^- = -P \cdot e$$

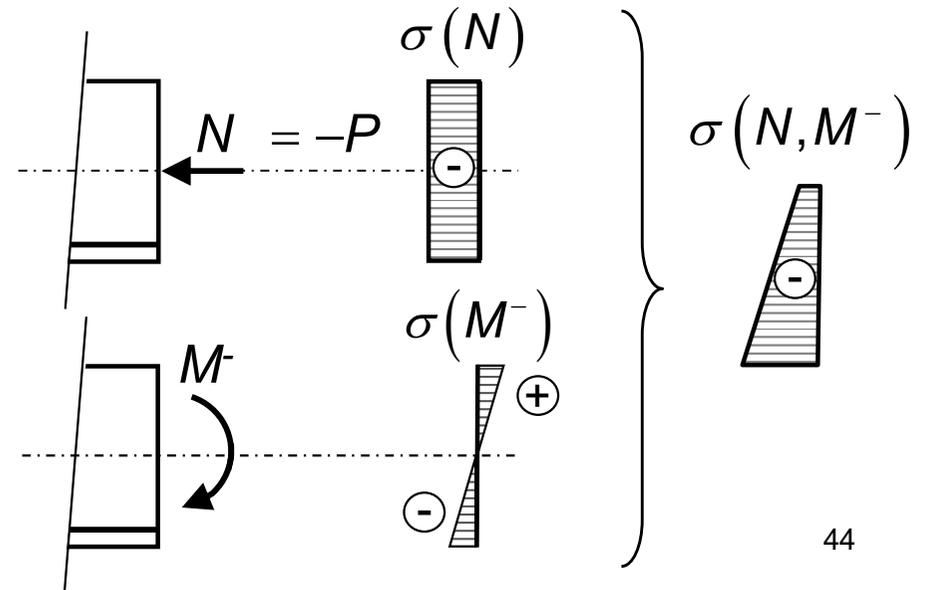
Force de précontrainte :  $P \cong 0.7f_y A_P$

$A_P$  : section de précontrainte

$f_y$  : limite élastique de  
l'acier de précontrainte

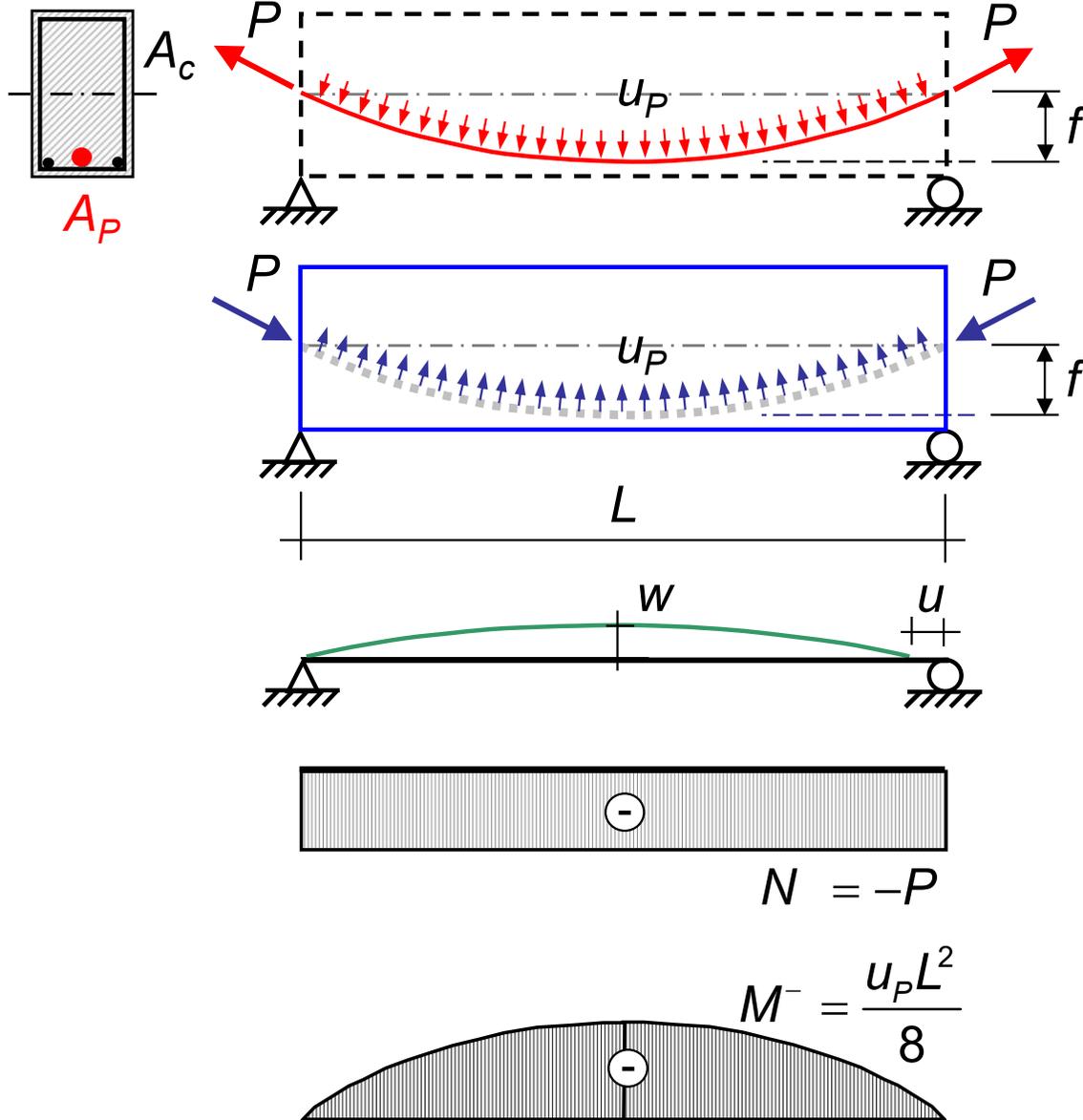
$A_c$  : section de béton

$e$  : excentricité de  $P$



## Béton armé et précontraint – Précontrainte parabolique

mi-travée



Force de précontrainte :  $P \cong 0.7f_y A_p$

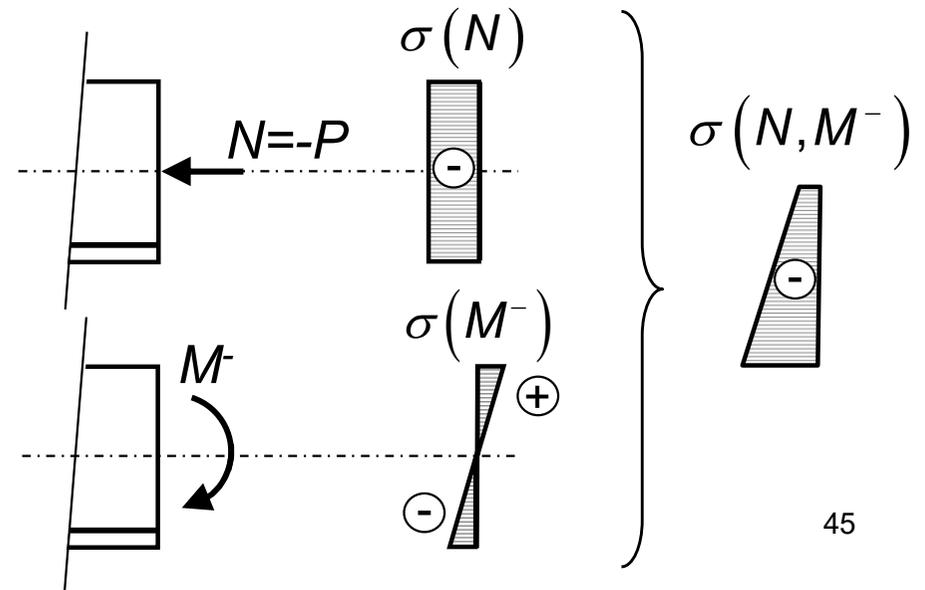
Force de déviation :  $u_p = \frac{8f}{L^2} P$

$A_c$  : section de béton

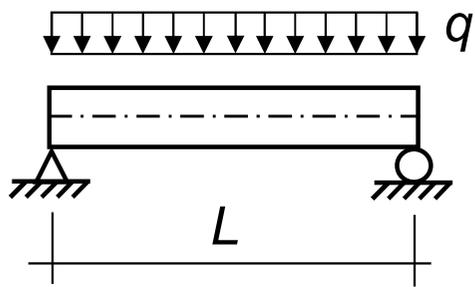
$A_p$  : section de précontrainte

$f$  : flèche de la précontrainte

$f_y$  : limite élastique de  
l'acier de précontrainte

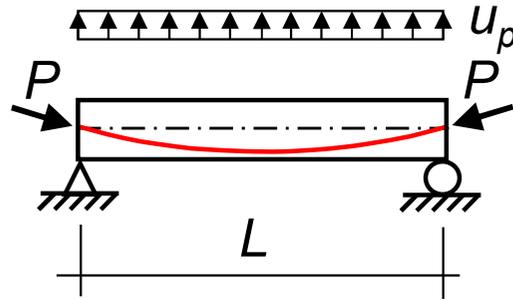
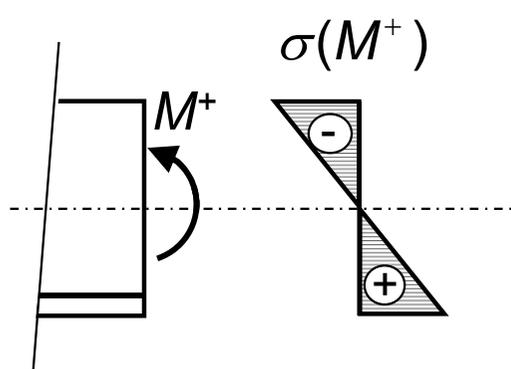


# Béton armé et précontraint – Précontrainte parabolique



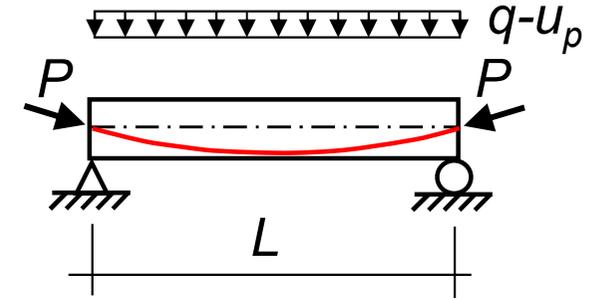
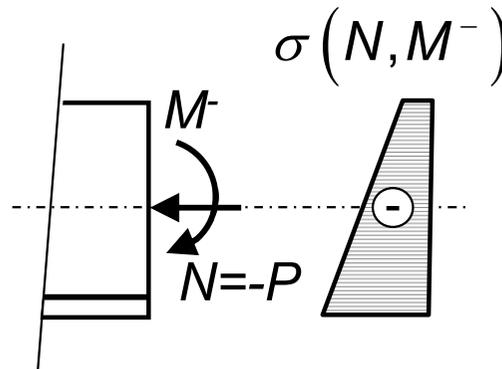
$N=0$

$M^+ = \frac{qL^2}{8}$



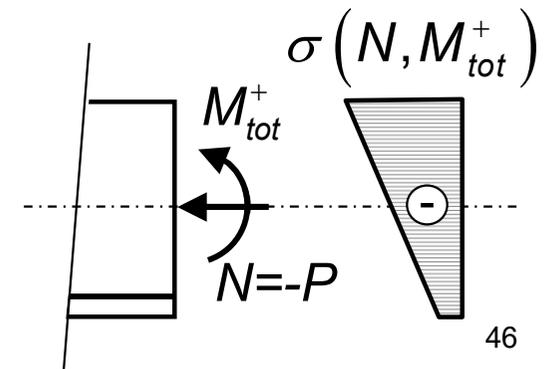
$N=-P$

$M^- = \frac{U_p L^2}{8}$

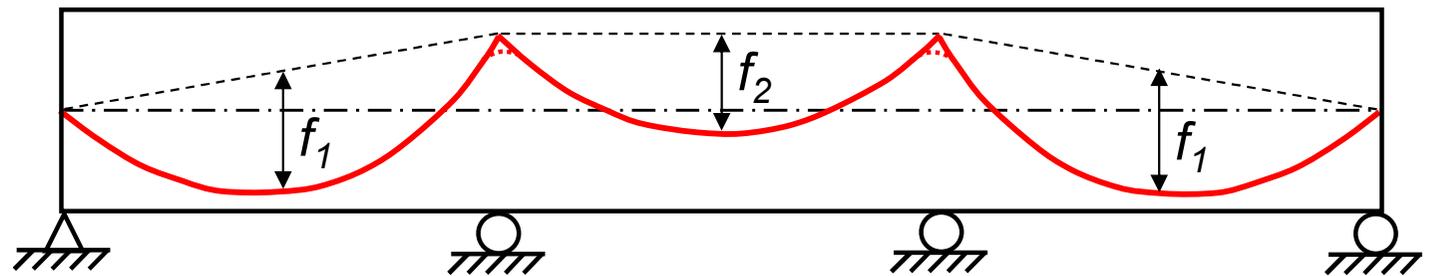
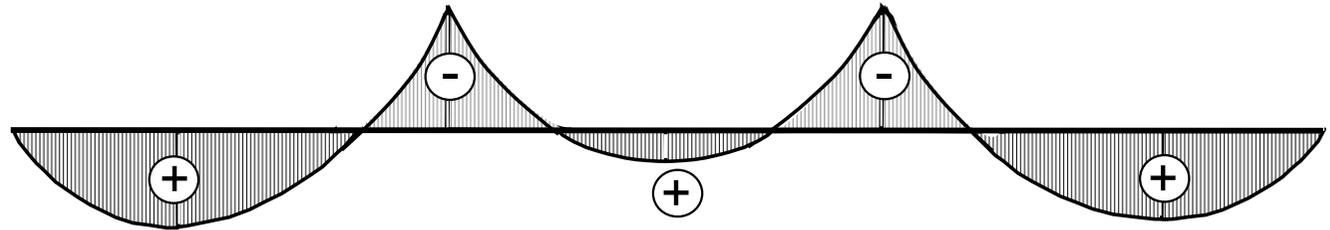
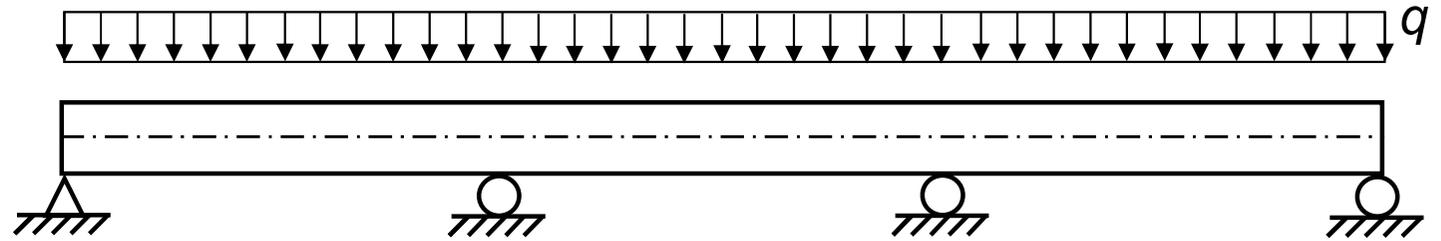
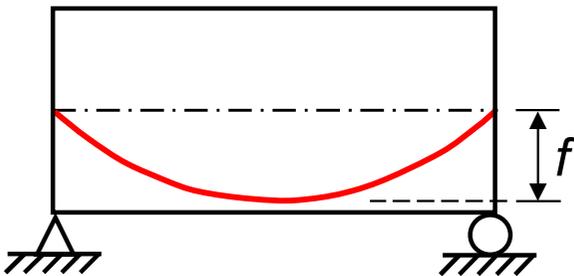
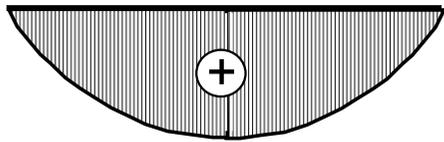
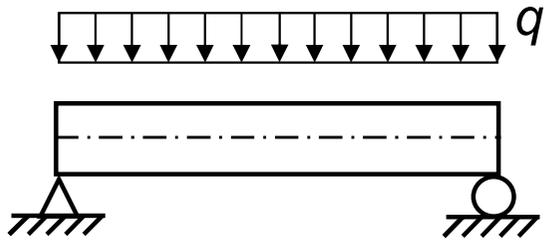


$N=-P$

$M_{tot}^+ = \frac{(q - U_p)L^2}{8}$

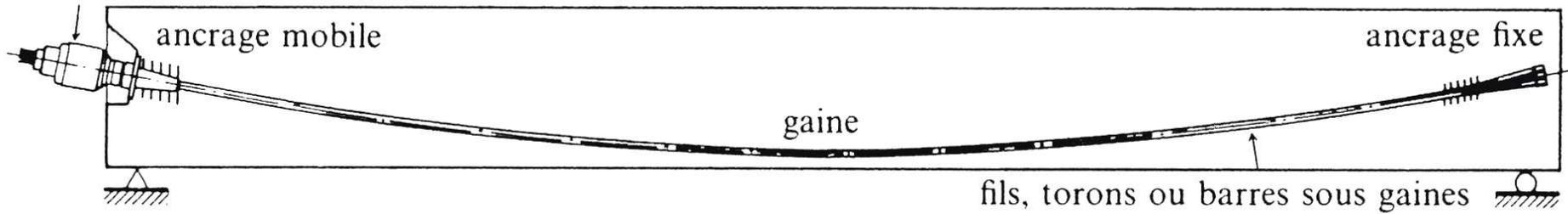


## Béton armé et précontraint – Précontrainte parabolique

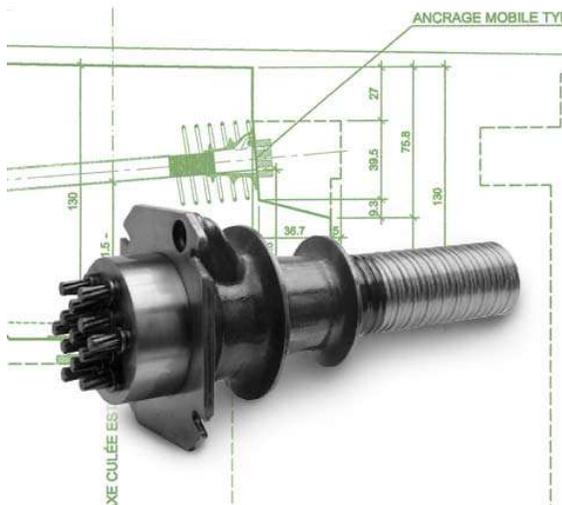


# Béton armé et précontraint – Procédé de post-tension

vérin de mise en tension



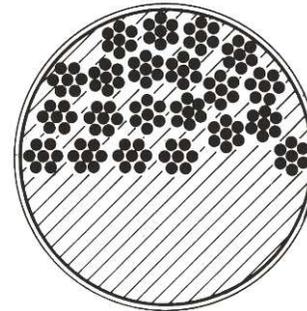
ancrage mobile



ancrage fixe



gaine



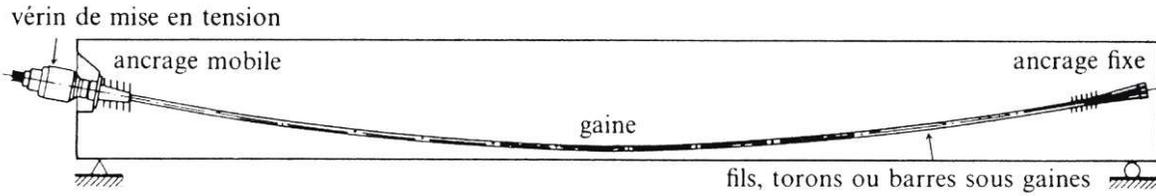
support gaine



torons

# Béton armé et précontraint – Procédé de post-tension

ancrages fixes



ancrages mobiles



gaines

