UNIONI BULLONATE

Unioni

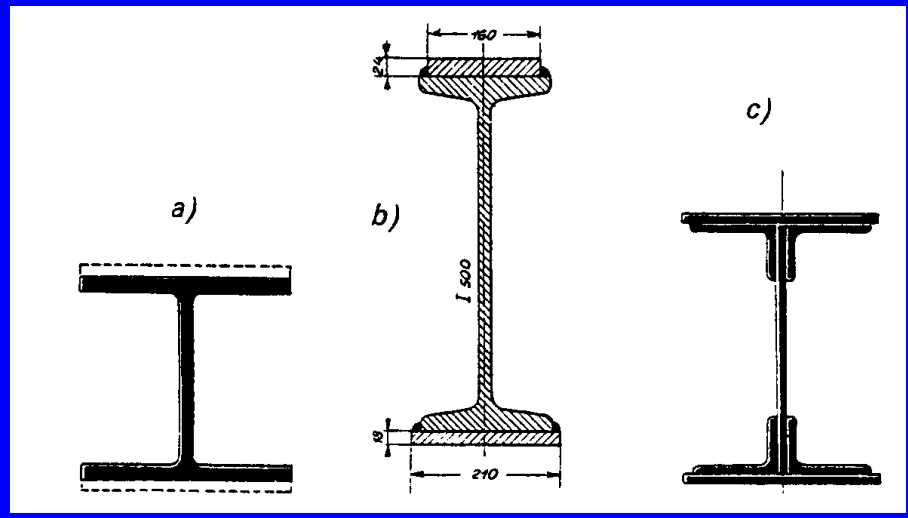
Collegamento permanente o smontabile di due o più elementi strutturali

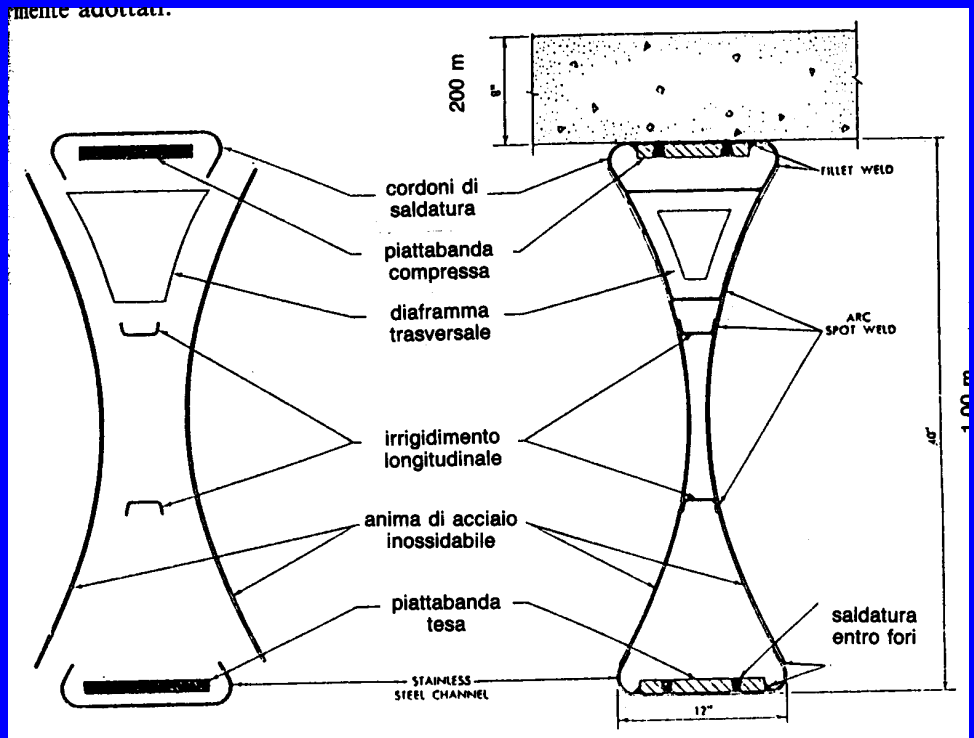
- **Unioni di forza:** uniscono tra loro i vari elementi strutturali (travi, aste, colonne…) per formare la struttura.

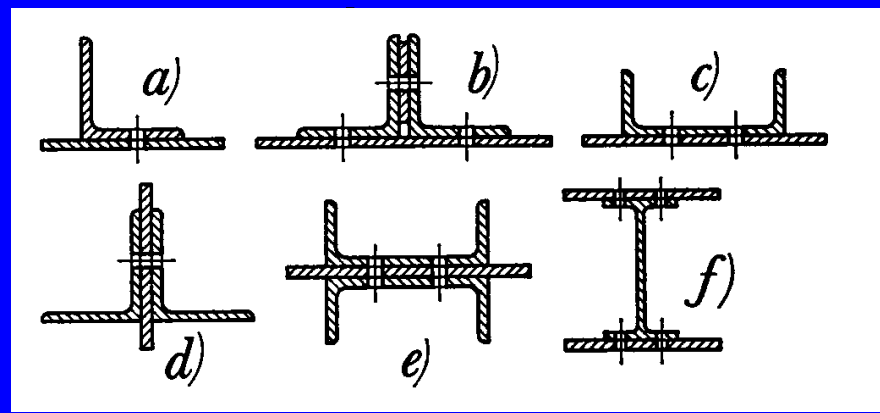
- **Unioni correnti:** necessarie per formare profili non presenti nel sagomario, mediante l'unione di lamiere e di profilati o in strutture particolari in cui necessita un collegamento continuo (serbatoi, tubazioni);

Unioni di forza

Unioni correnti








SIPE

Unioni di forza

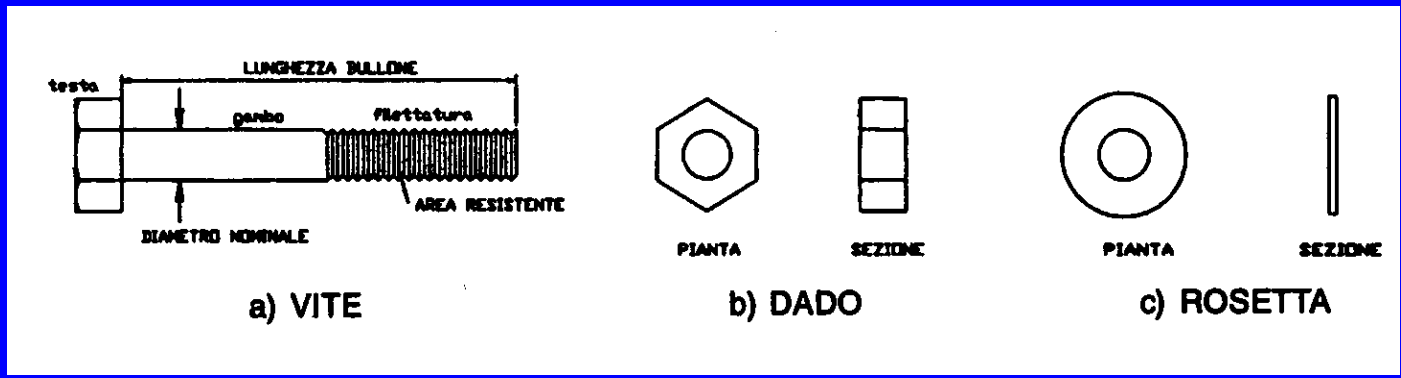
Costituiscono una parte molto delicata delle strutture: il loro cedimento è **la seconda causa che provoca il collasso** delle strutture metalliche (30%).


TILATI
GHIROTTO

Unioni normate

- Bullonature normali
- Bullonature ad attrito
- Saldature
- Chiodature
- Perni

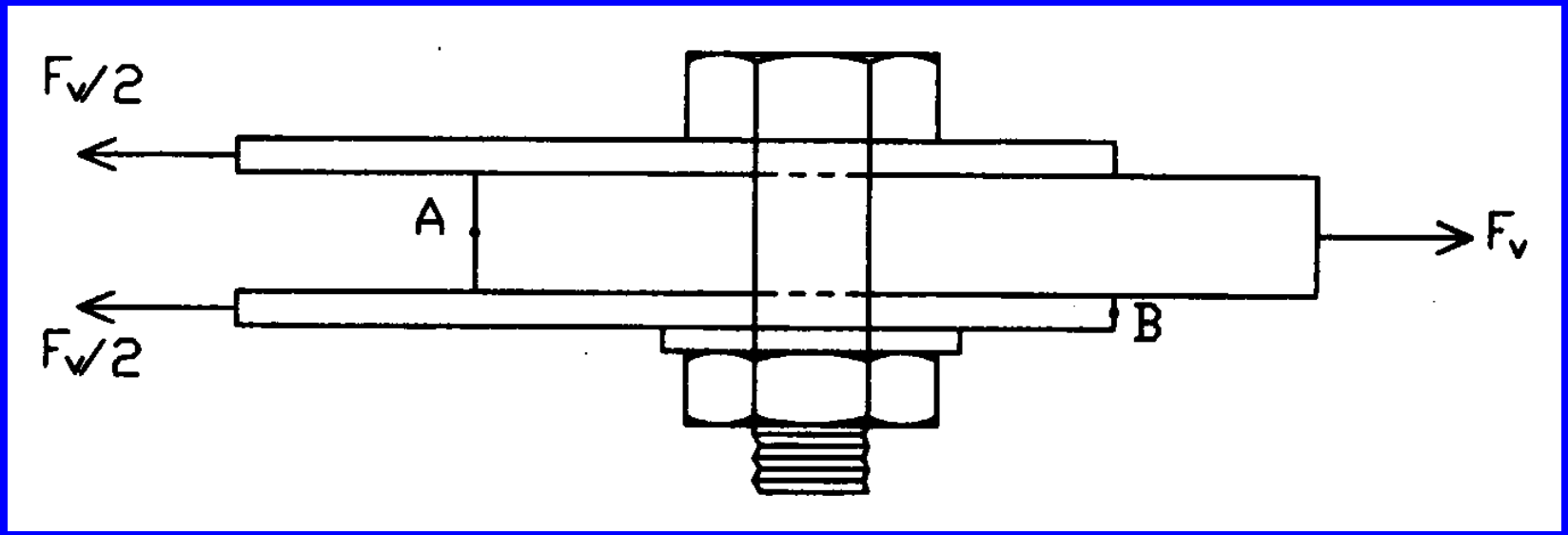
Bullonatuere normali



Tensione ammissibile					
Classe vite	f_t N/mm²	f_y N/mm²	$f_{k,N}$ N/mm²	$\sigma_{b,adm}$ N/mm²	$\tau_{b,adm}$ N/mm²
4.6	400	240	240	160	113
5.6	500	300	300	200	141
6.6	600	360	360	240	170
8.8	800	640	560	373	264
10.9	1 000	900	700	467	330

$f_{k,N}$ è assunto pari al minore dei due valori $f_{k,N} = 0{,}7\, f_t$, $f_{k,N} = f_y$ essendo f_t ed f_y le tensioni di rottura e di snervamento secondo UNI 3740.

$\sigma_{b,adm}$, $\tau_{b,adm}$ tensioni ammissibili a trazione ed a taglio.

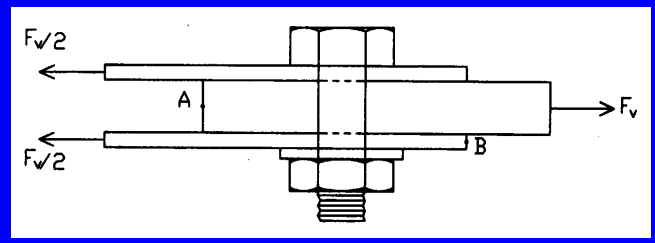


La lunghezza del tratto non filettato deve essere superiore allo spessore delle parti da collegare, il serraggio viene garantito dalla rosetta

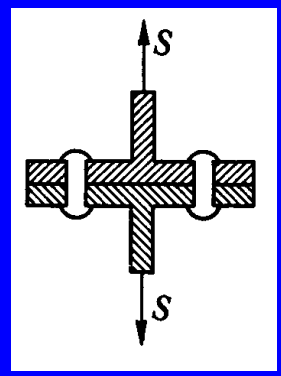
In tutte e due le unioni i bulloni devono essere serrati con una coppia tale da provocare nel gambo uno sforzo pari all'80% del carico di snervamento

Classificazione delle unioni bullonate

Si classificano in base all'azione che agisce sulle viti

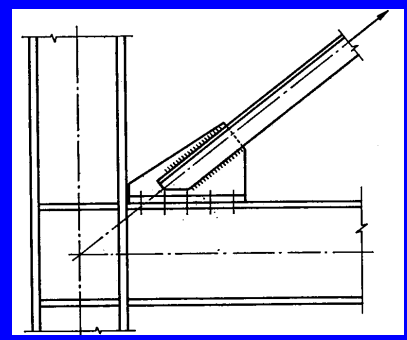


- Soggette a sforzo tagliante

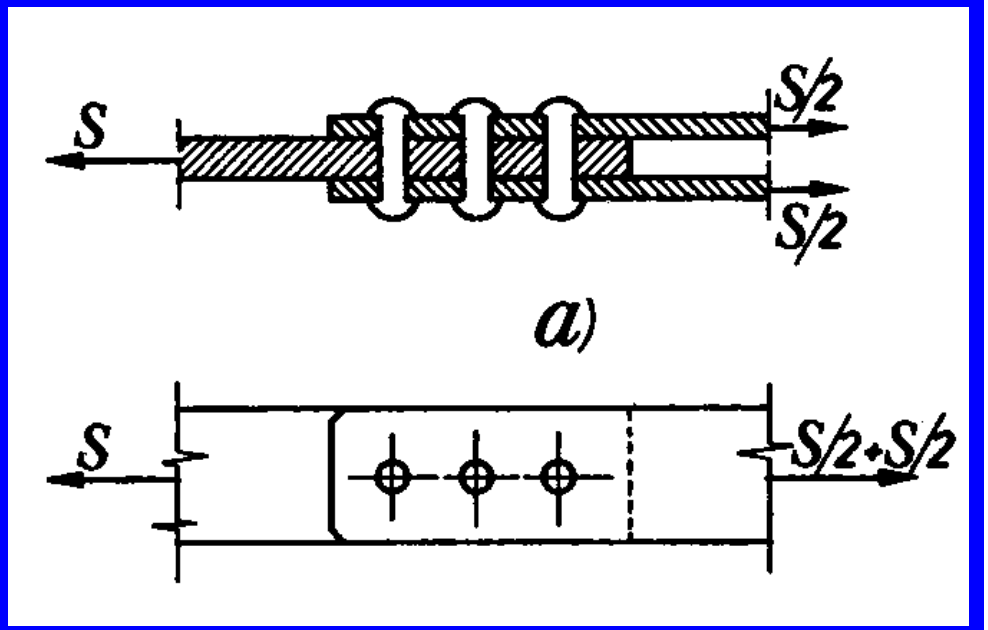


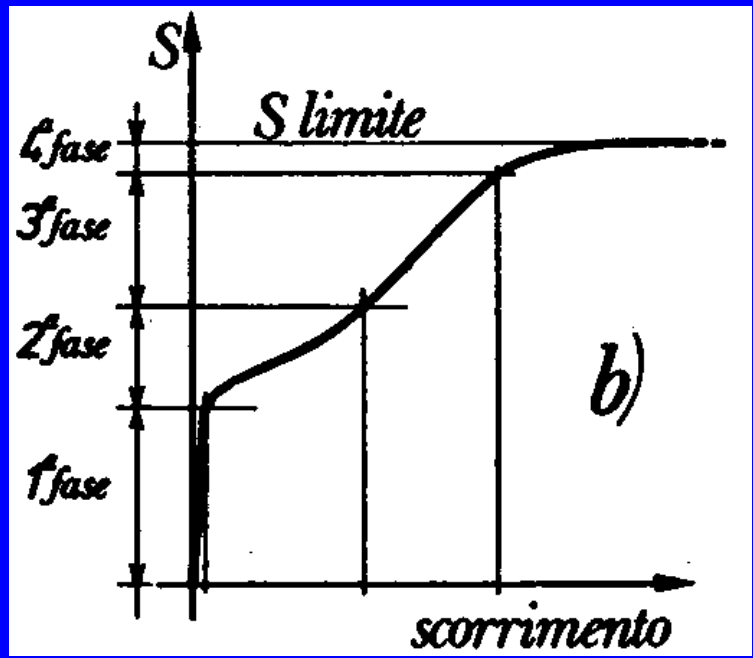
- Soggette a sforzo normale

- Soggette a sforzo misto

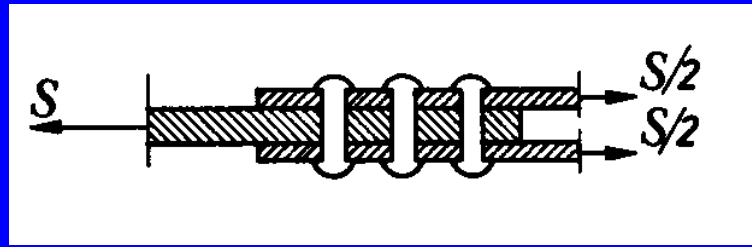


Bullonature soggette a sforzo tagliante

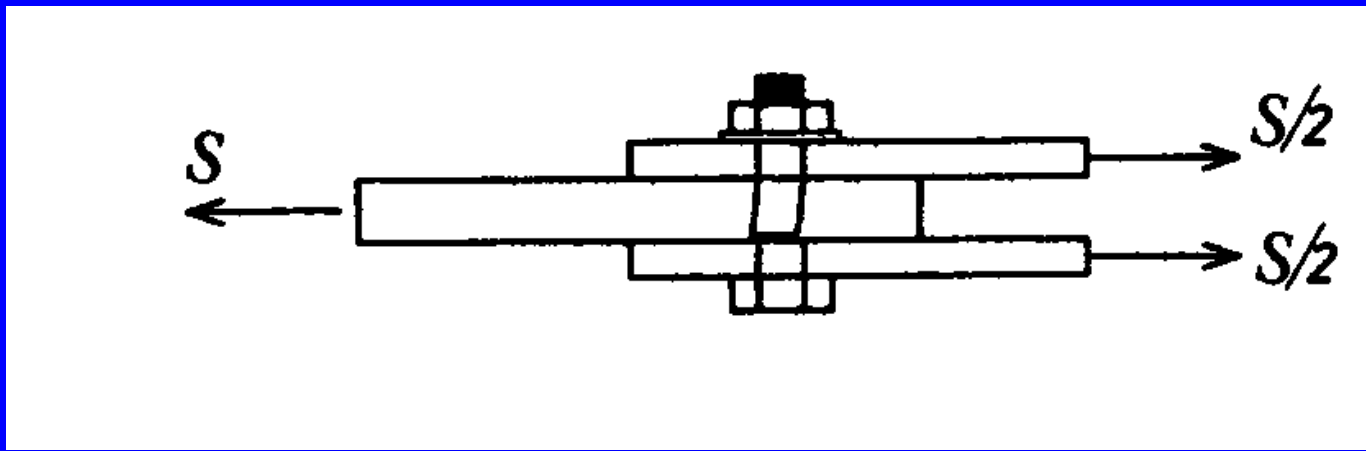




Cedimento

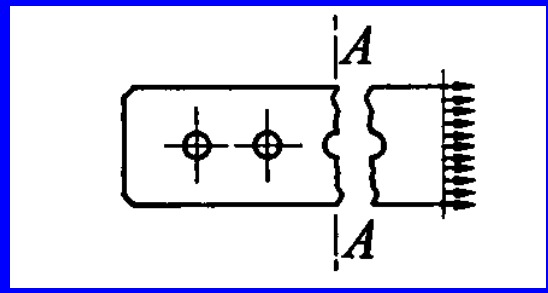


- Cedimento della vite

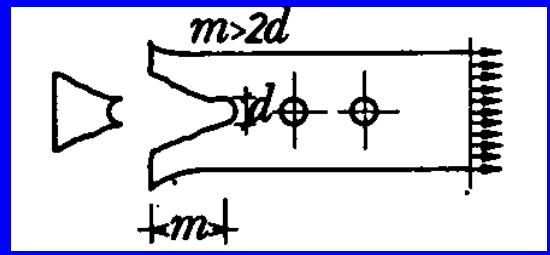


➢ Cedimento della piastra

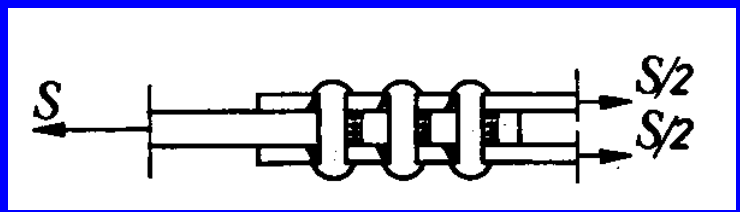
- Per distacco

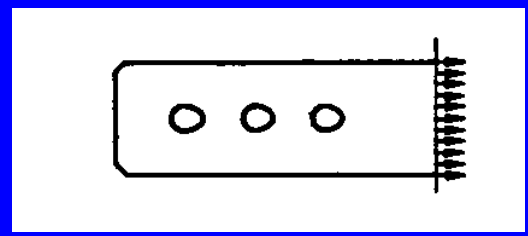


- Per scorrimento

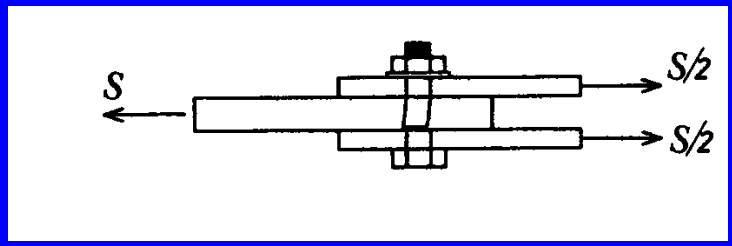


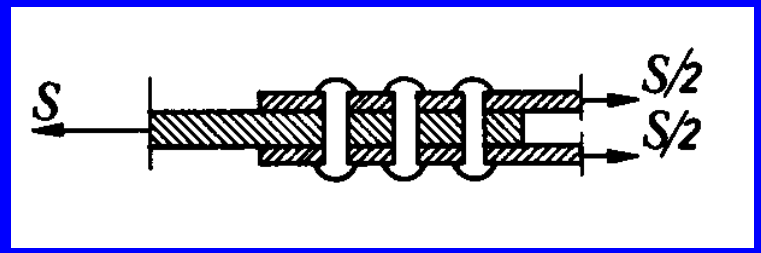
- Per plasticizzazione localizzata





Cedimento della vite



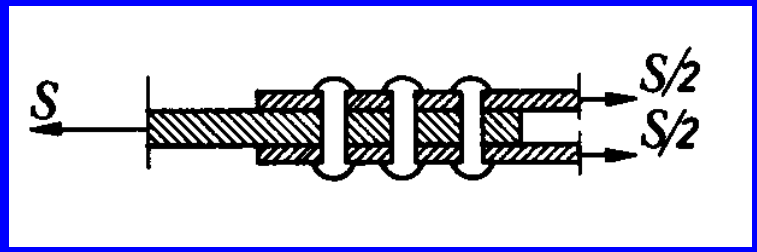


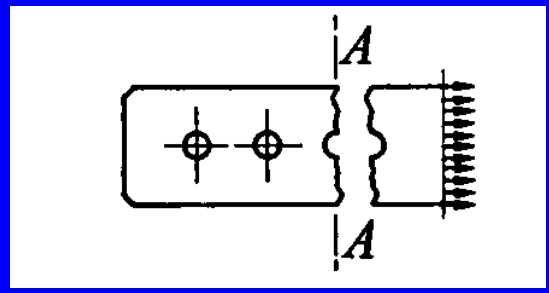
- Si ipotizza che:
  - ✓ Il carico si ripartisca uniformemente sulle viti
  - ✓ Le tensioni si ripartiscano uniformemente sulla sezione

$$\tau = \frac{S}{A_{res}} \leq \tau_{adm}$$

Cedimento della piastra

- Per distacco

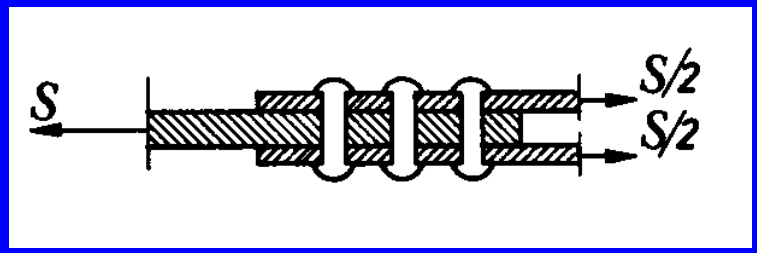


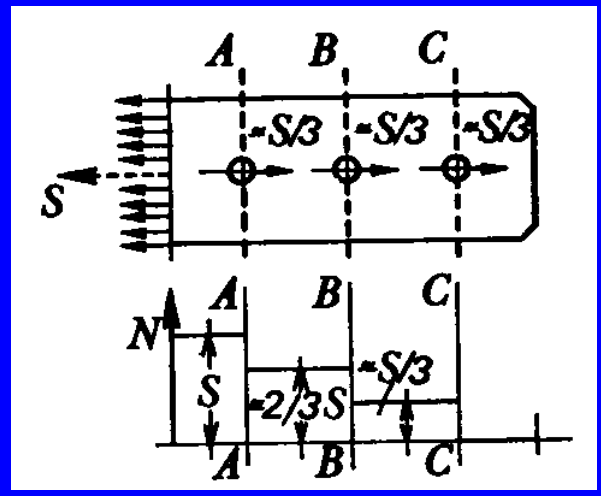


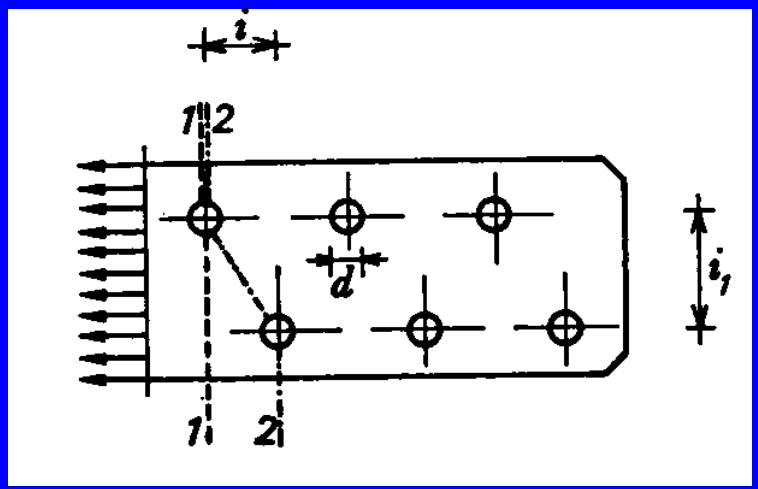
  - Si ipotizza che:
    - ✓ Il carico si ripartisca uniformemente sulle viti
    - ✓ Le tensioni si ripartiscano uniformemente sulla sezione

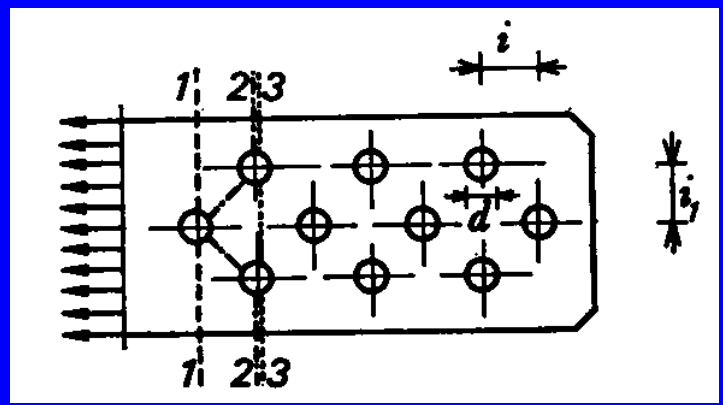
$$\sigma = \frac{\frac{S}{2}}{A_{res}} \leq \sigma_{adm}$$

- Quale sezione verificare?

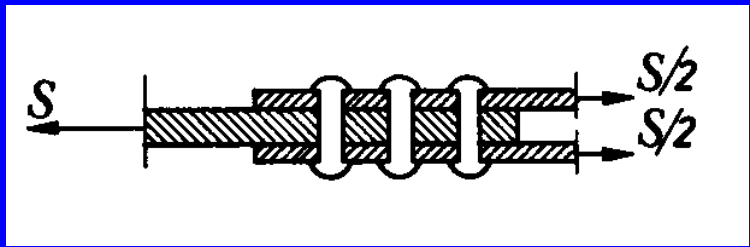


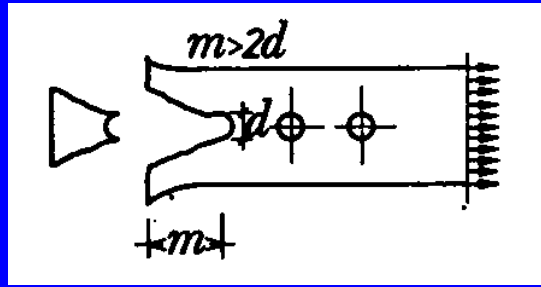






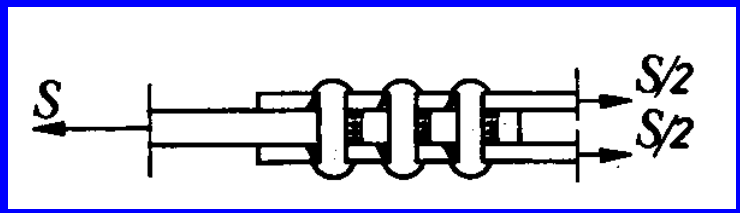
- Per scorrimento

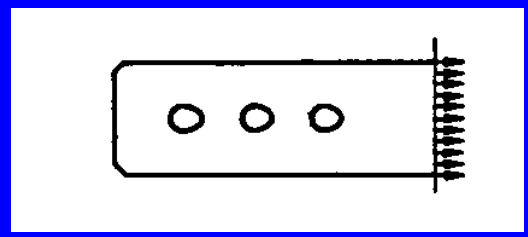




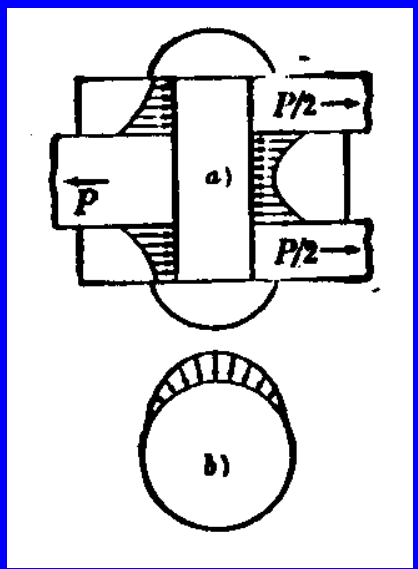
Se si rispetta la distanza dal bordo si possono evitare le verifiche

- Per plasticizzazione localizzata



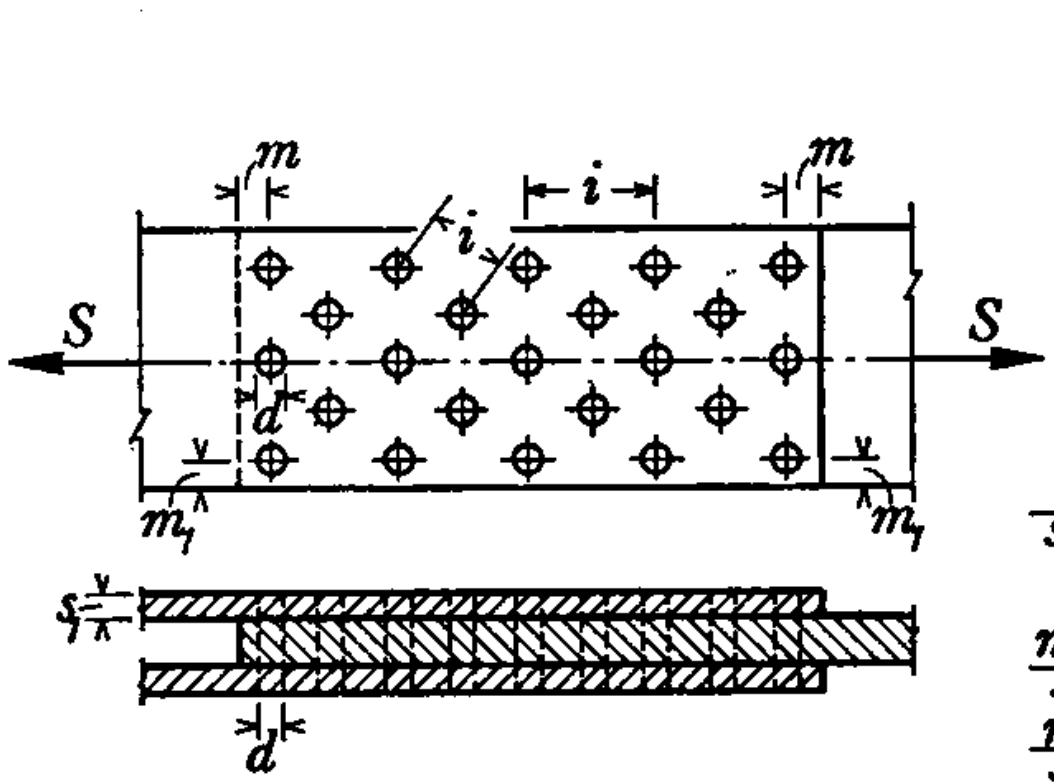


- Si ipotizza che:
  - ✓ Il carico si ripartisca uniformemente sul foro



$$\sigma_{rif} = \frac{T}{d \cdot s} \leq 2 \cdot \sigma_{adm}$$

Disposizione



$$3 \leq \frac{i}{d} \leq 10$$

$$2 \leq \frac{m}{d} < 3$$

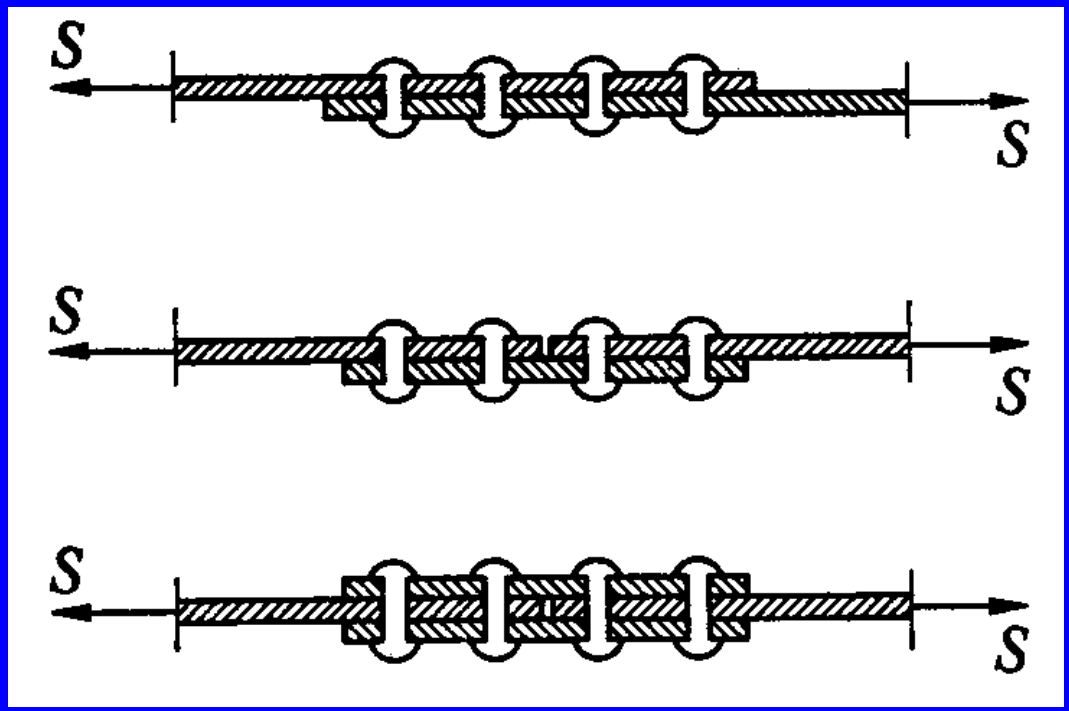
$$1{,}5 \leq \frac{m_1}{d} < 3$$

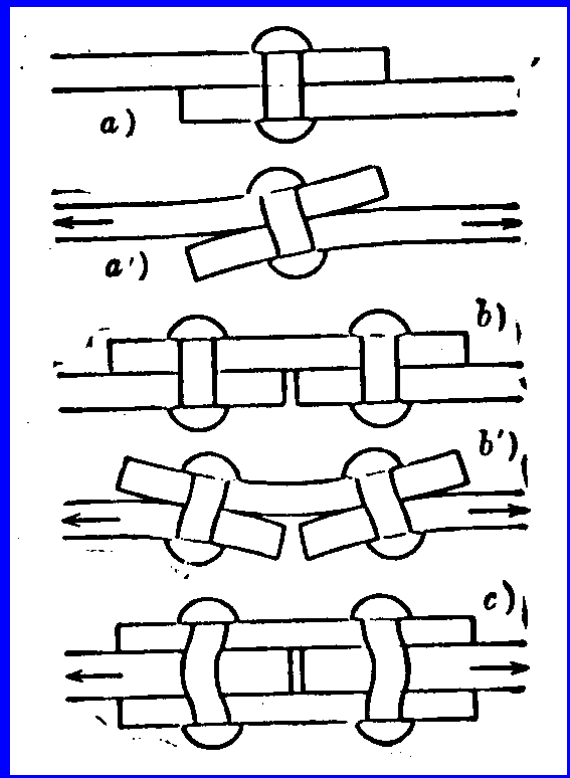
$$\frac{i}{s_1} \begin{cases} \leq 15 \text{ (compressione)} \\ < 25 \text{ (trazione)} \end{cases}$$

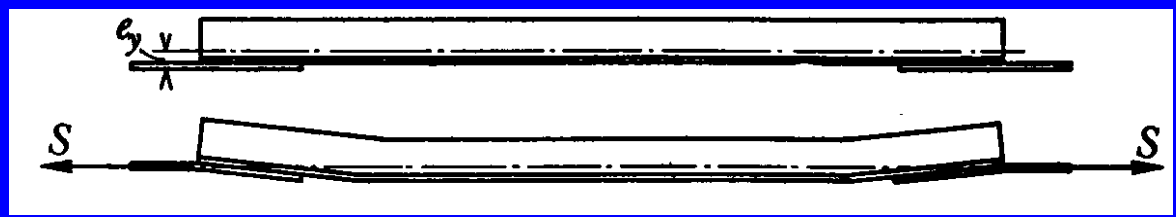
$$\frac{m_1}{s_1} \leq 6 \text{ (bordi liberi)}$$

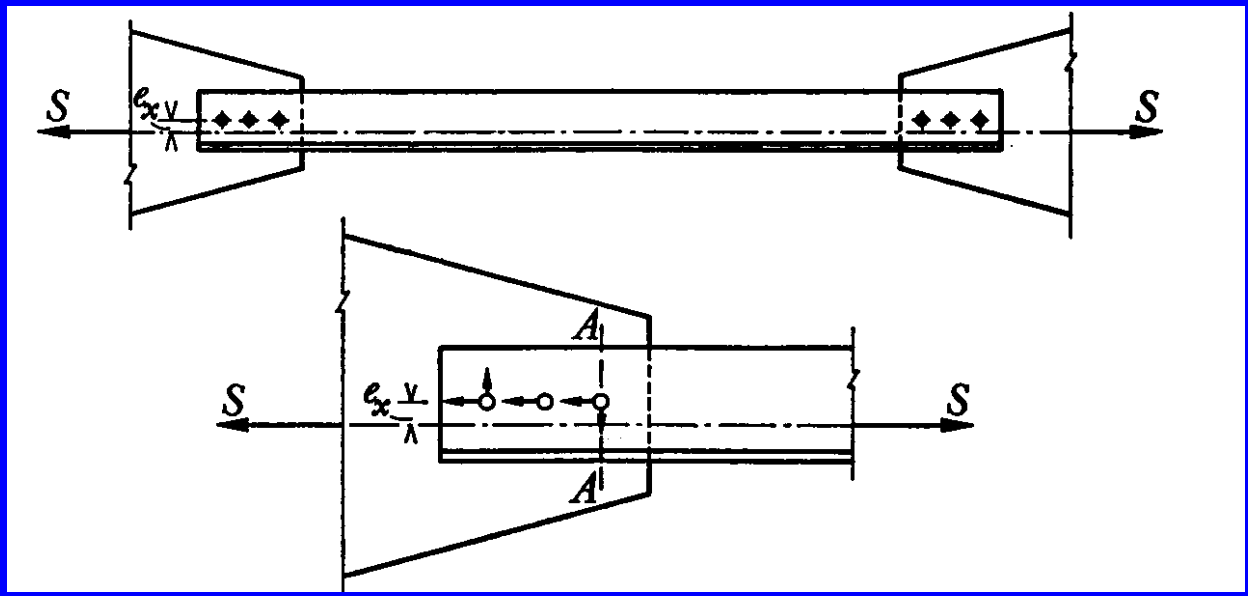
$$\frac{m}{s_1} < 9 \text{ (bordi irrigiditi)}$$

Tecnica





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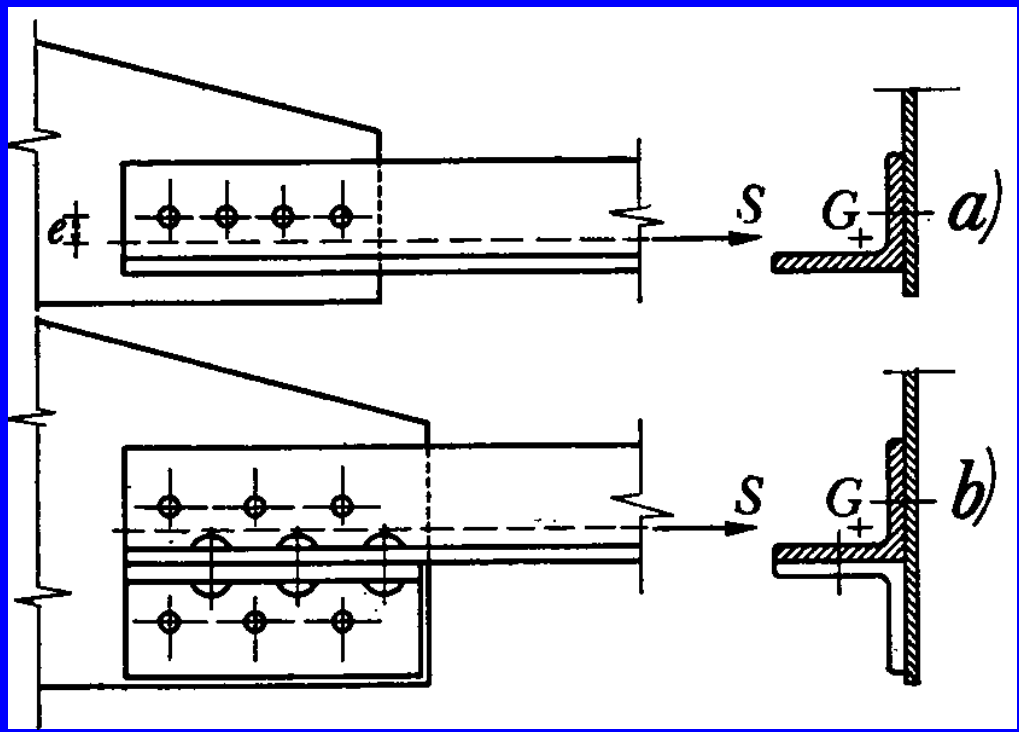
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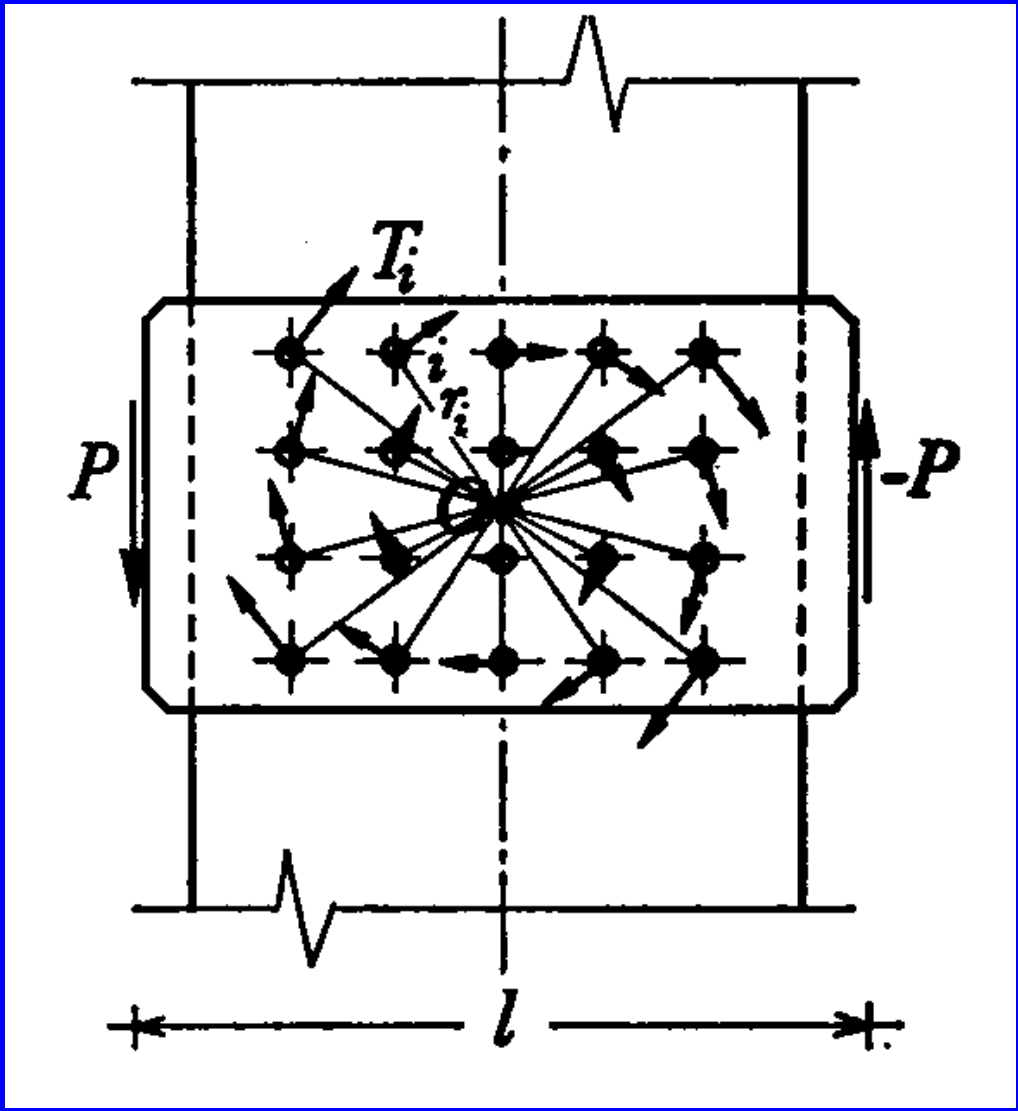
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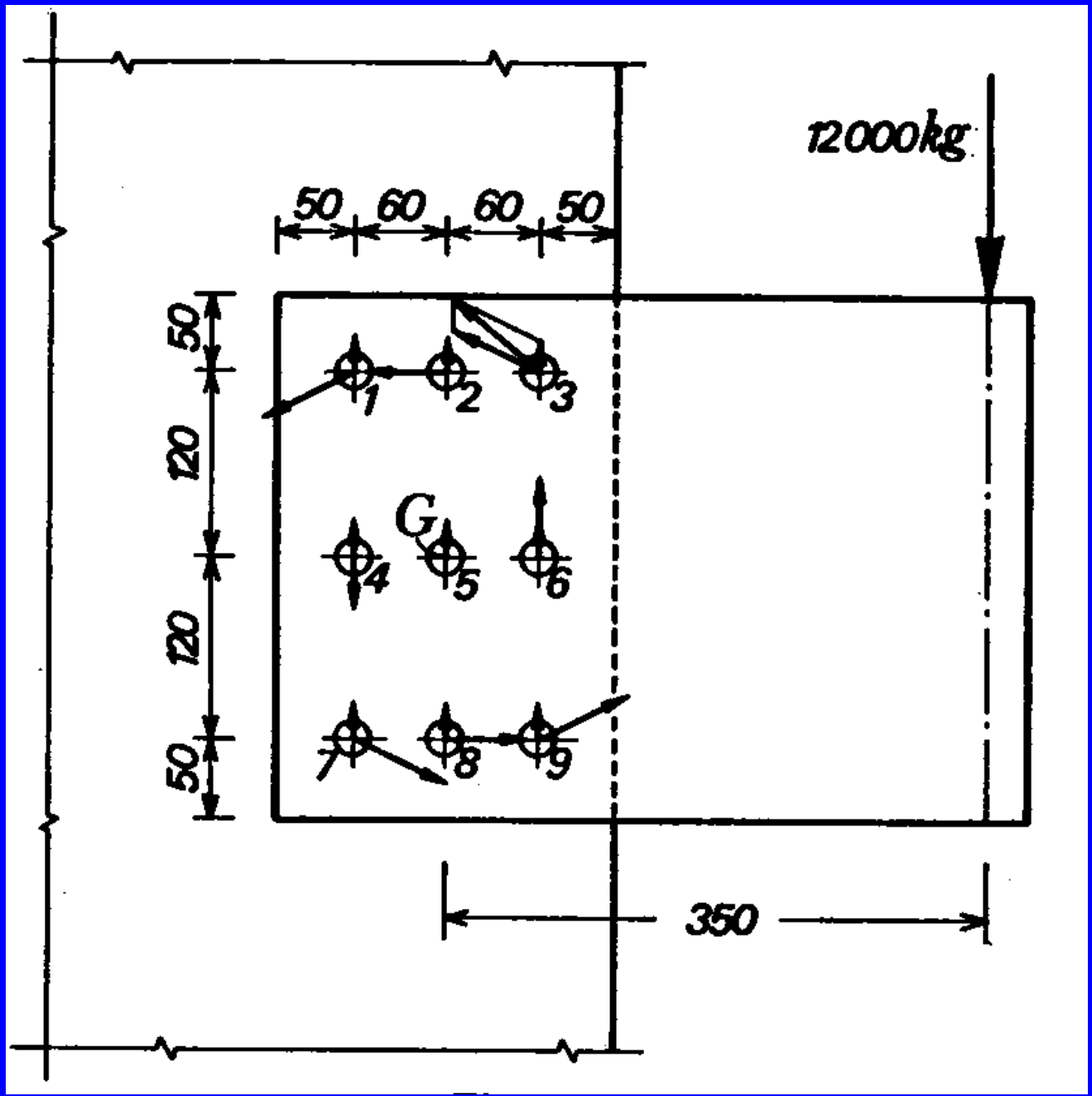
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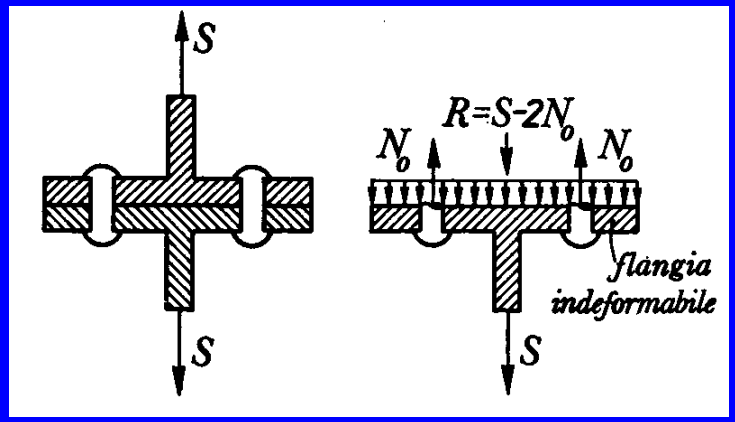
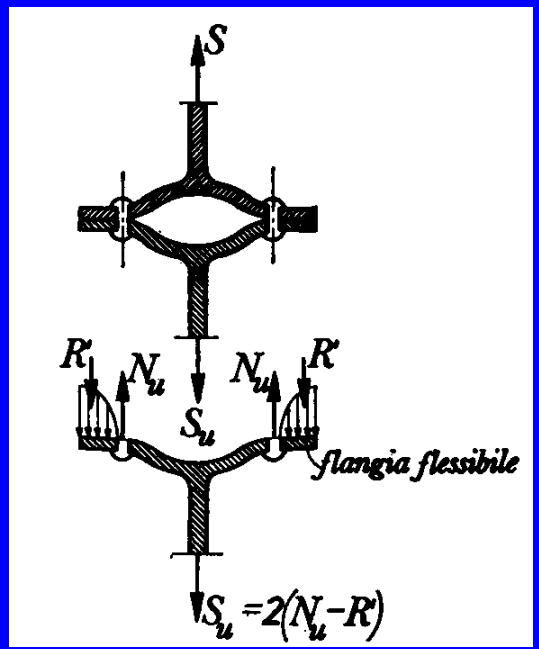
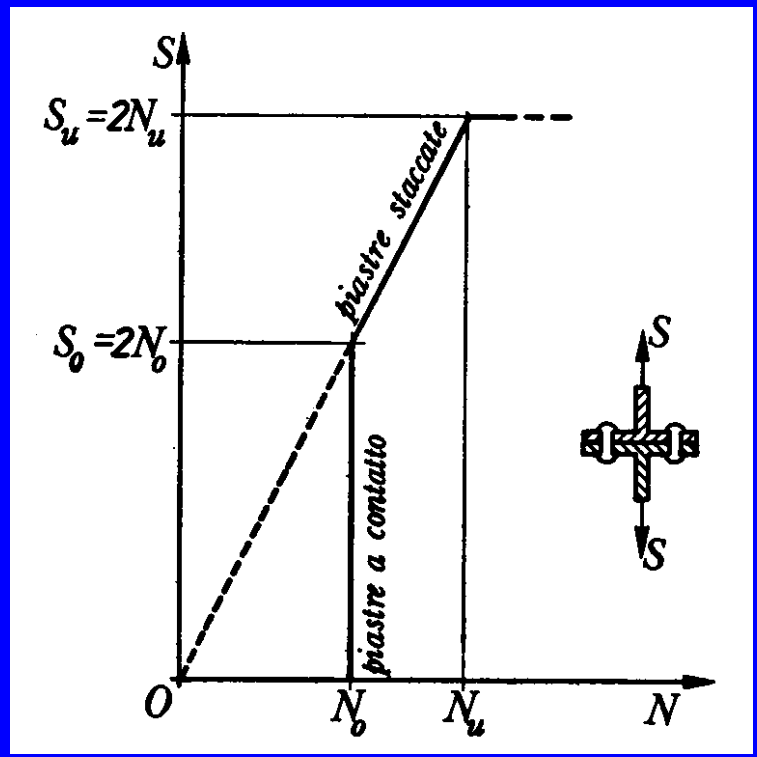
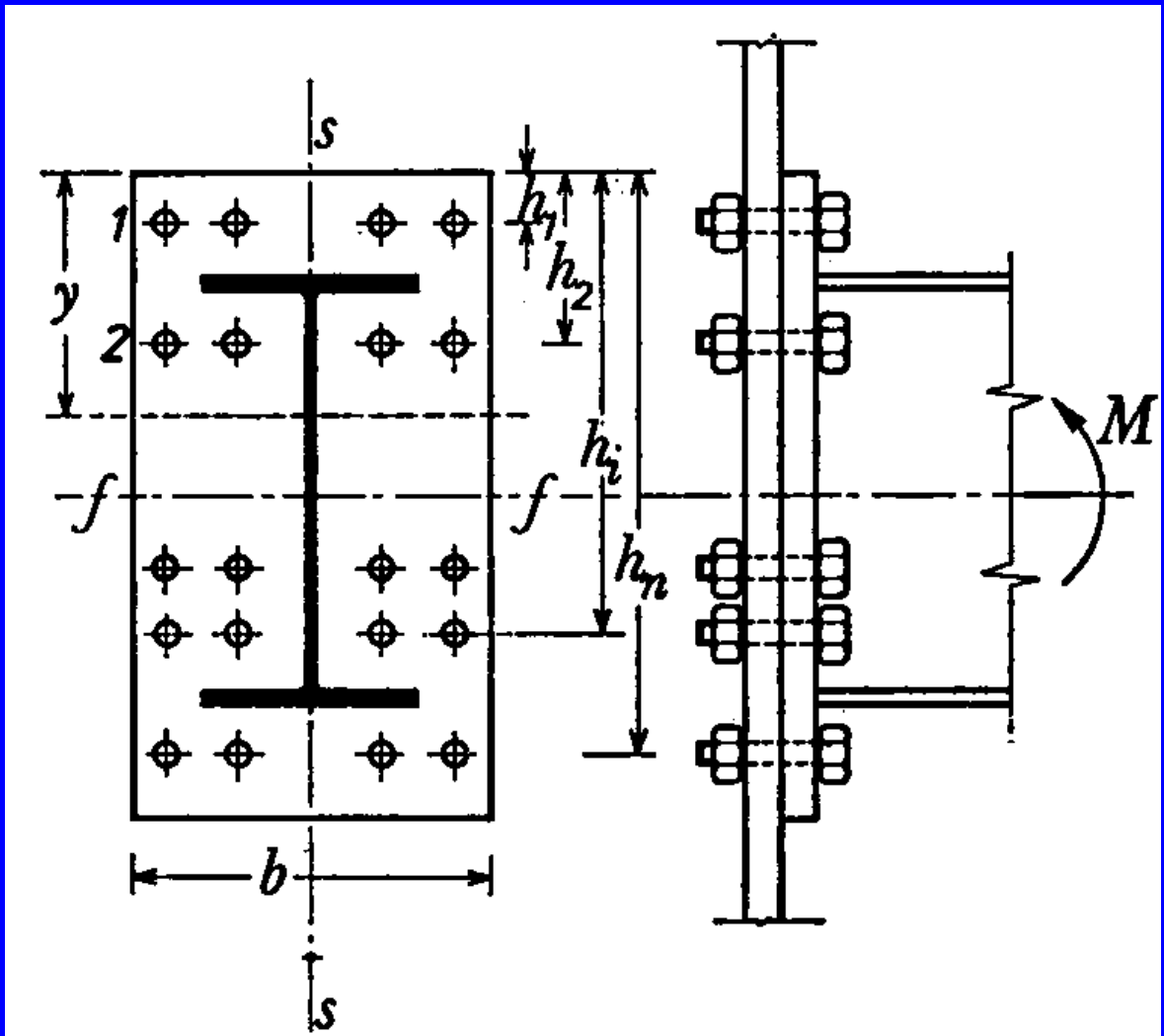
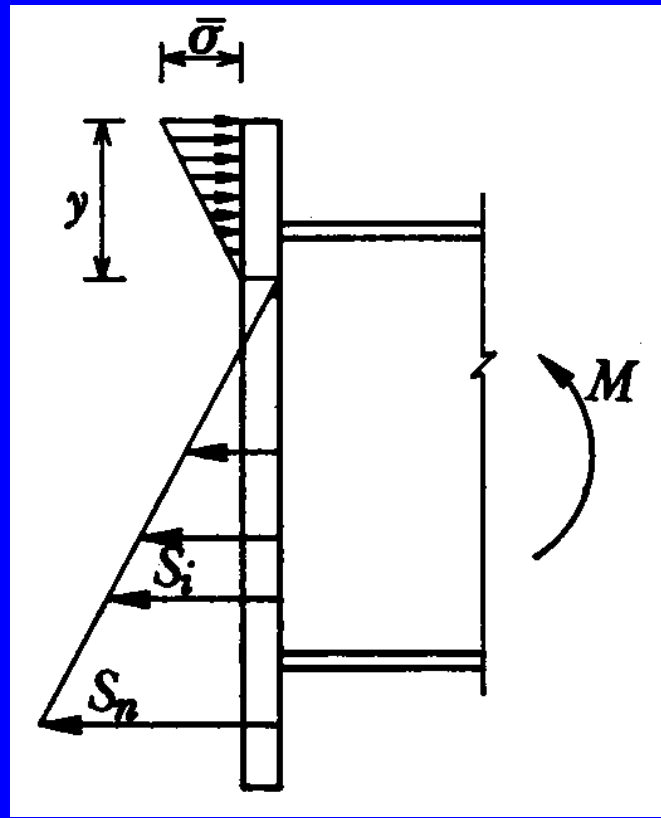
Bullonature soggette a sforzo di trazione



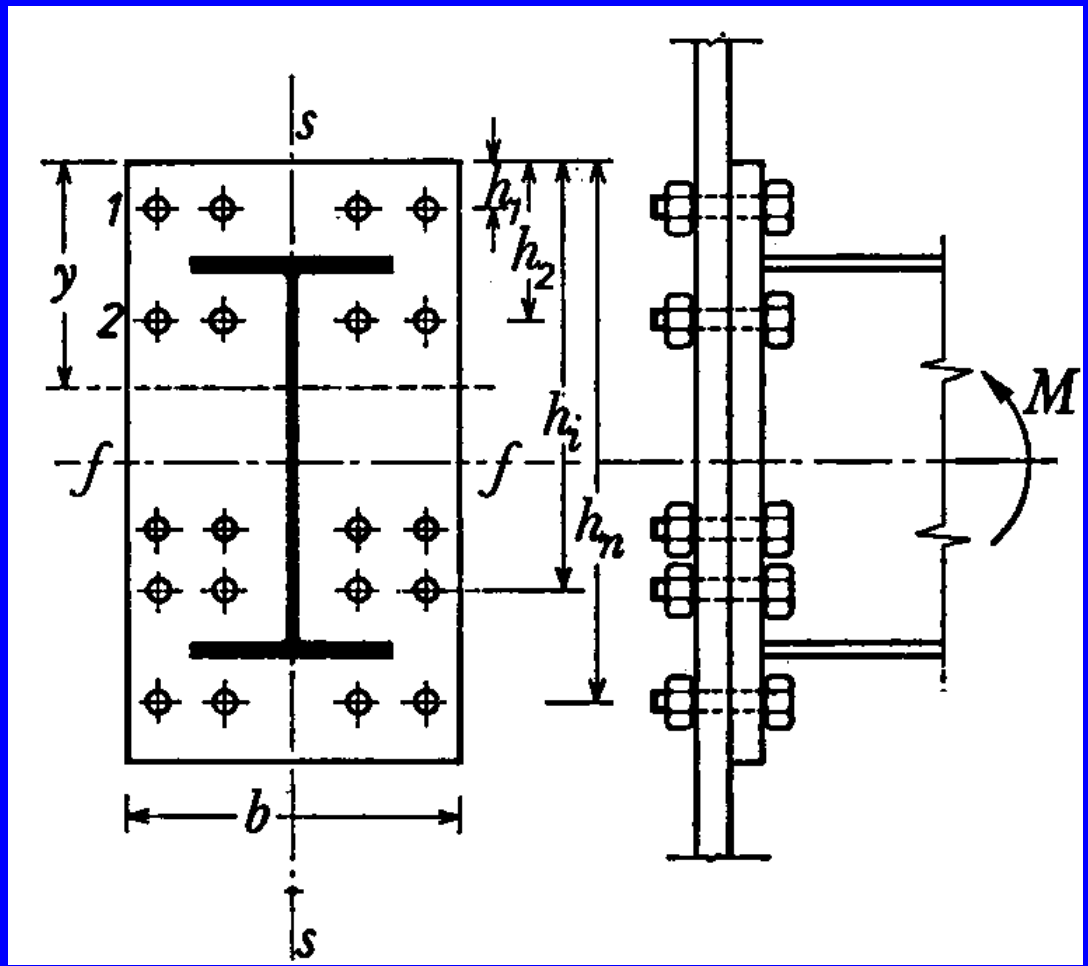


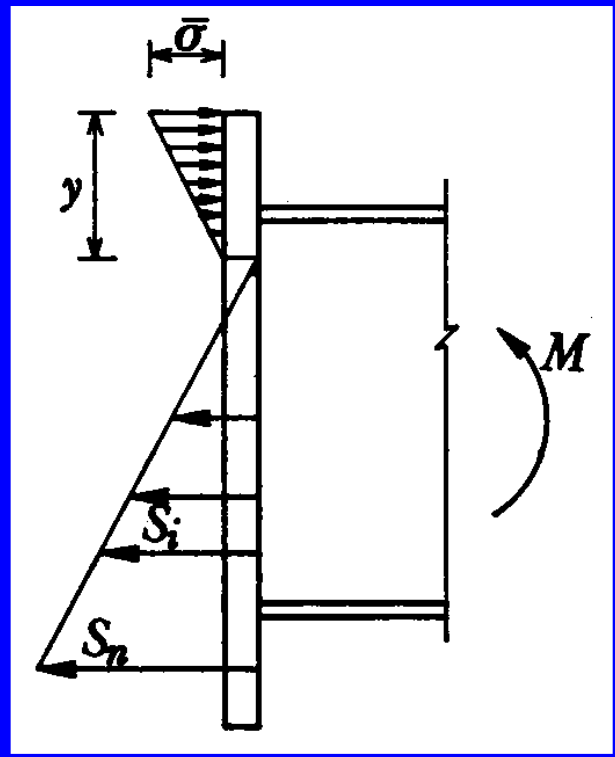






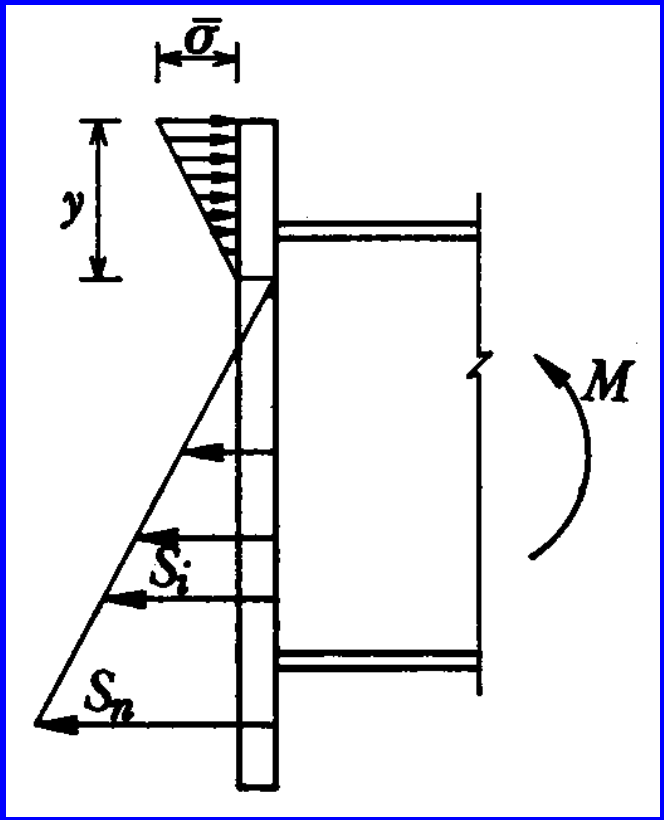
- Si ipotizza che:
  - ✓ Le piastre siano rigide
  - ✓ I bulloni non siano pretensionati



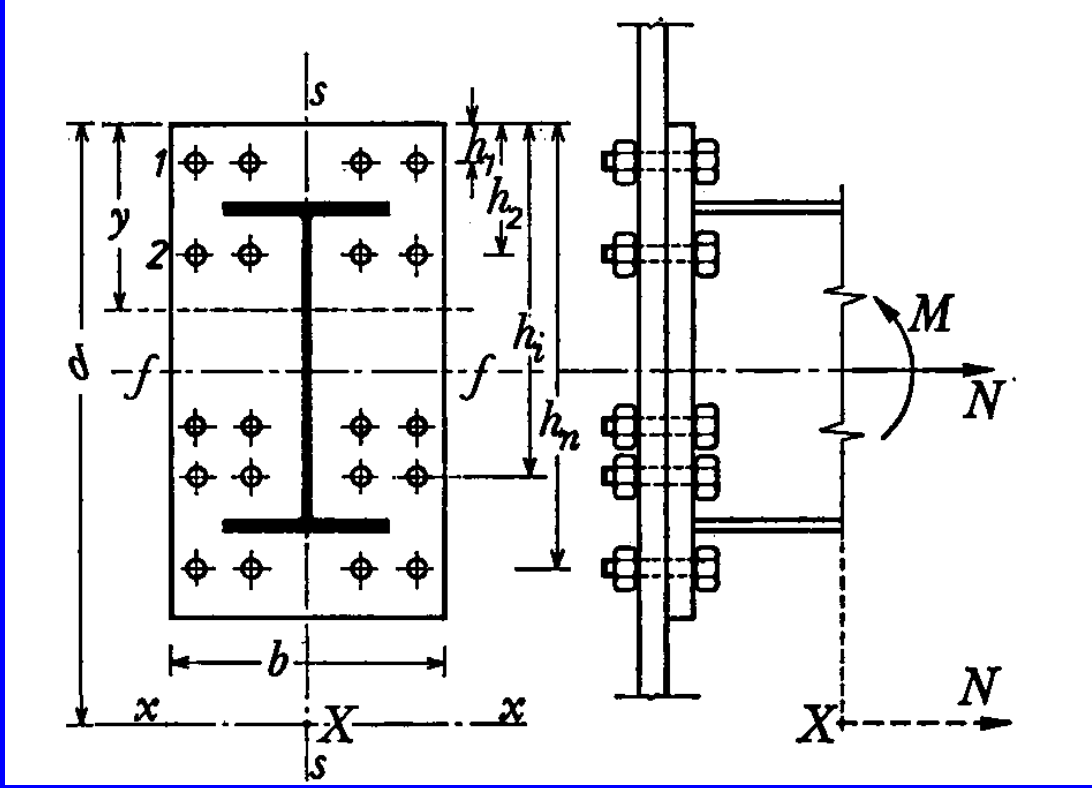


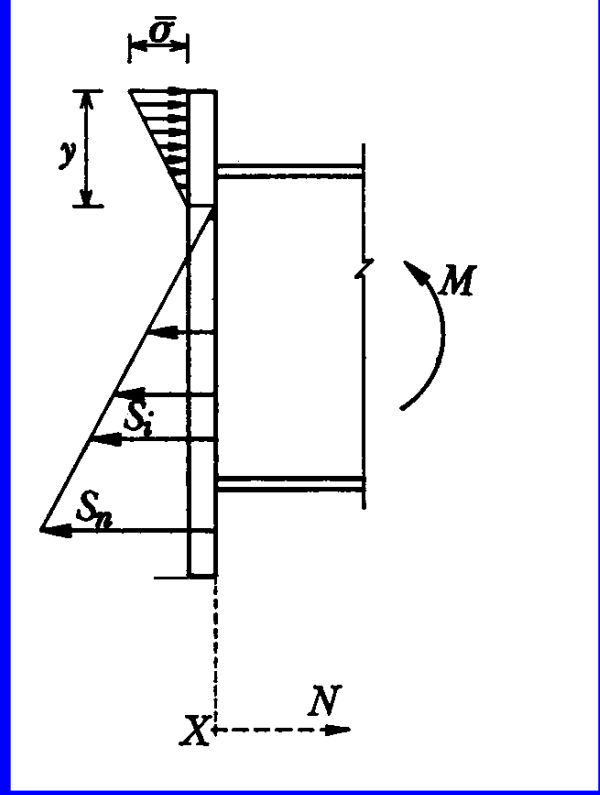
$$b \cdot y \cdot \frac{y}{2} - \ldots - A_i \cdot (h_i - y) - \ldots - A_n \cdot (h_n - y) = 0 \Rightarrow y$$

$$J = b \cdot \frac{y^3}{3} + \ldots + A_i \cdot (h_i - y)^2 + \ldots + A_n \cdot (h_n - y)^2$$



$$\sigma = \frac{M \cdot y_i}{J}$$





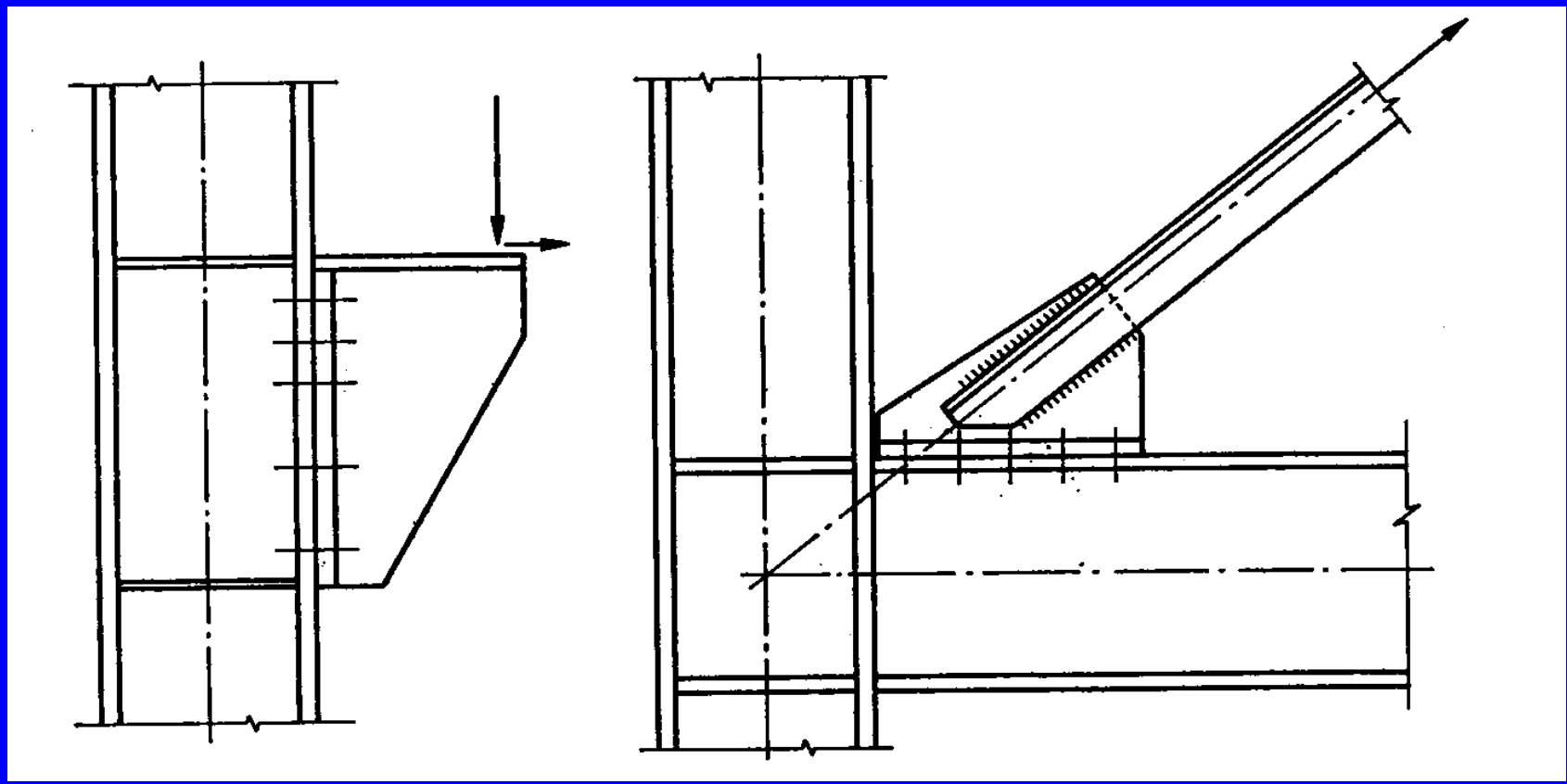
- ✓ Non posso sovrapporre gli effetti perché le sezioni reagenti sono diverse

$$\frac{\bar{\sigma}\cdot y}{2}\cdot b\cdot\left(d-\frac{y}{3}\right)-\ldots-\sigma_i\cdot A_i\cdot(d-h_i)-\ldots-\sigma_n\cdot A_n\cdot(d-h_n)=0$$

$$\bar{\sigma}=k\cdot y$$

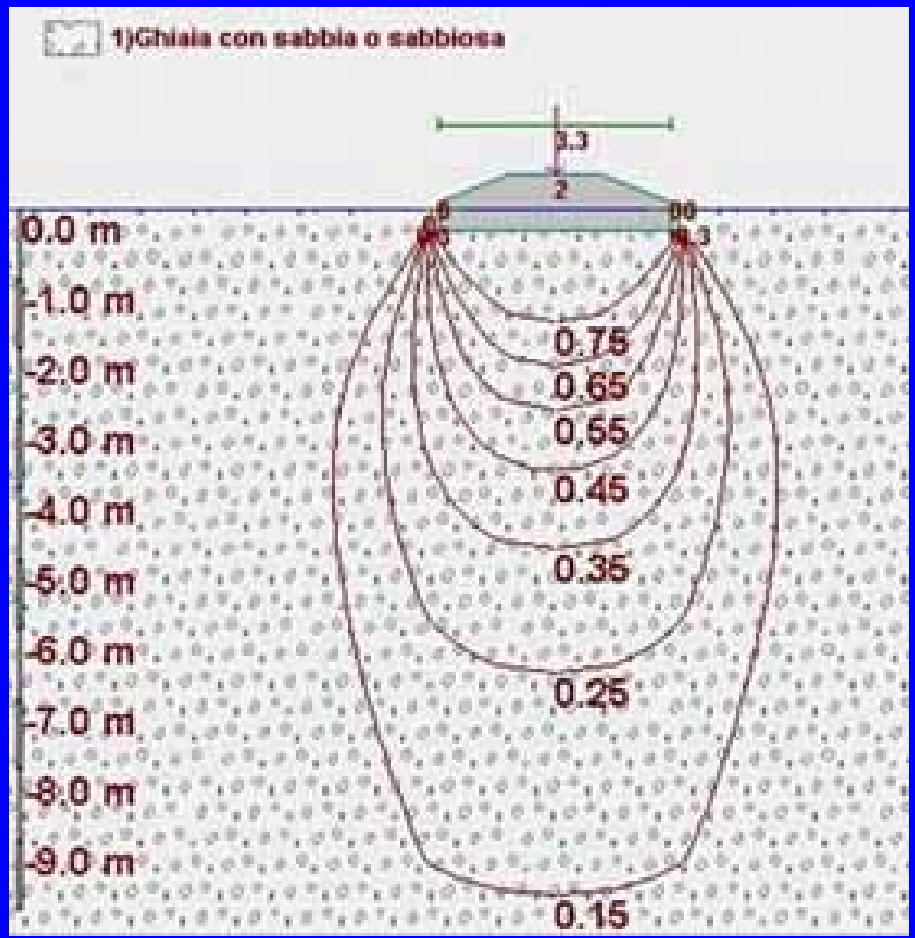
$$\sigma_i=k\cdot(h_i-y)$$

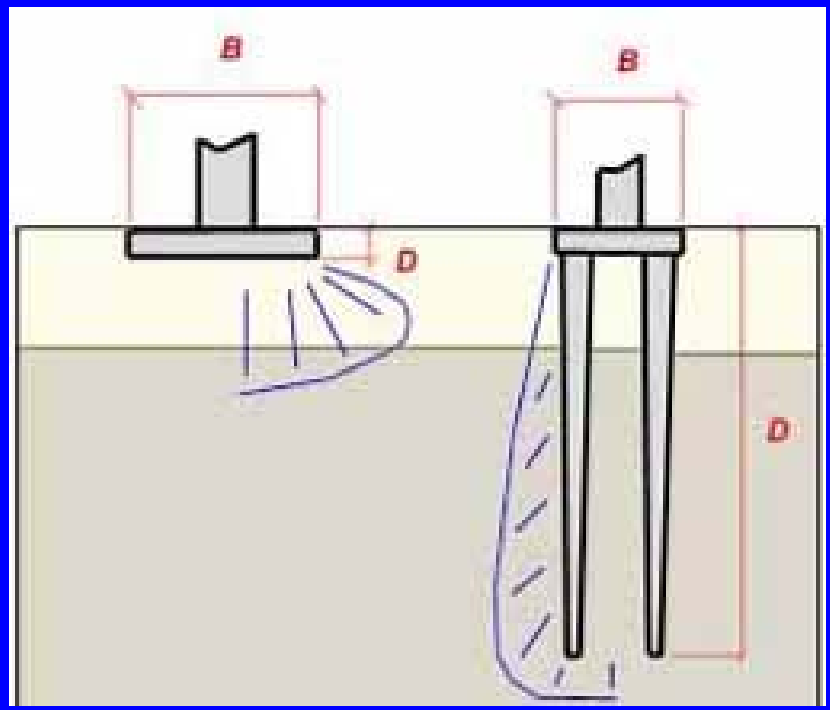
Bullonature soggette a sforzo misto

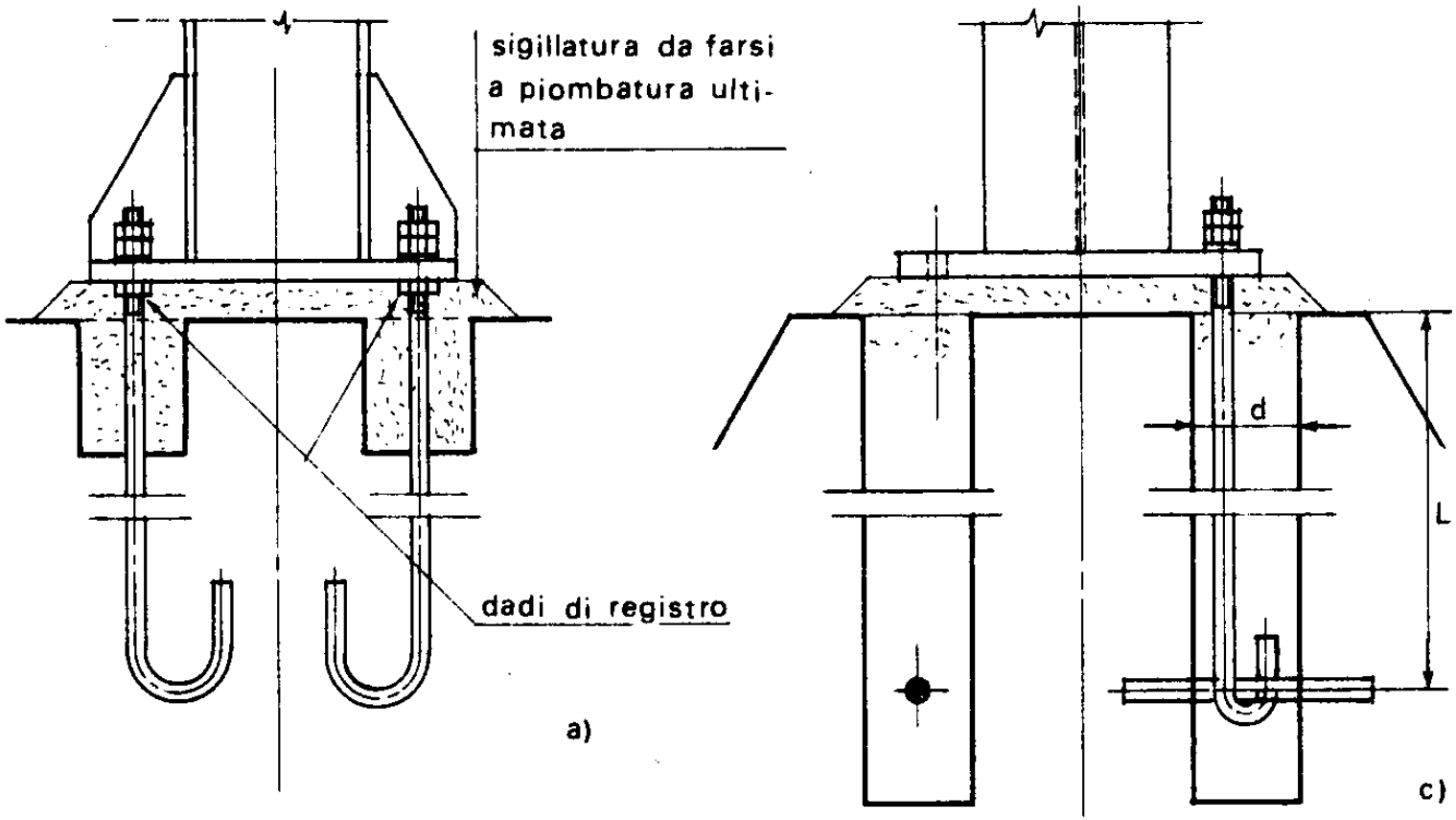


$$\left(\frac{\tau}{\tau_{adm}}\right)^2 + \left(\frac{\sigma}{\sigma_{adm}}\right)^2 \leq 1$$

Unioni di base

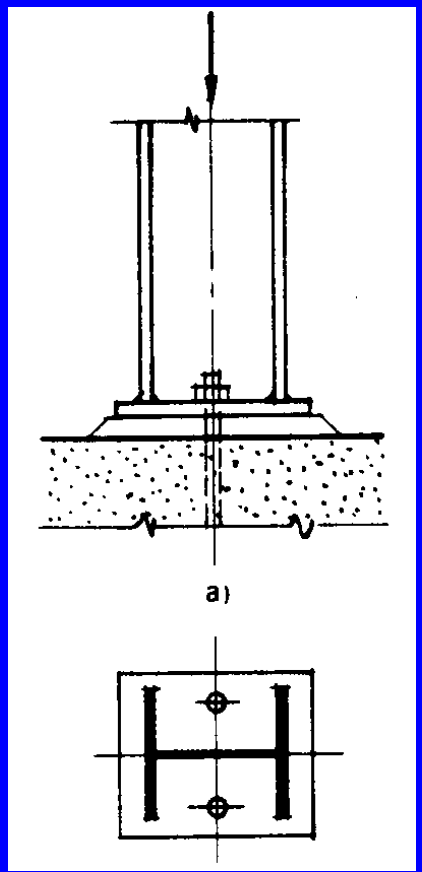


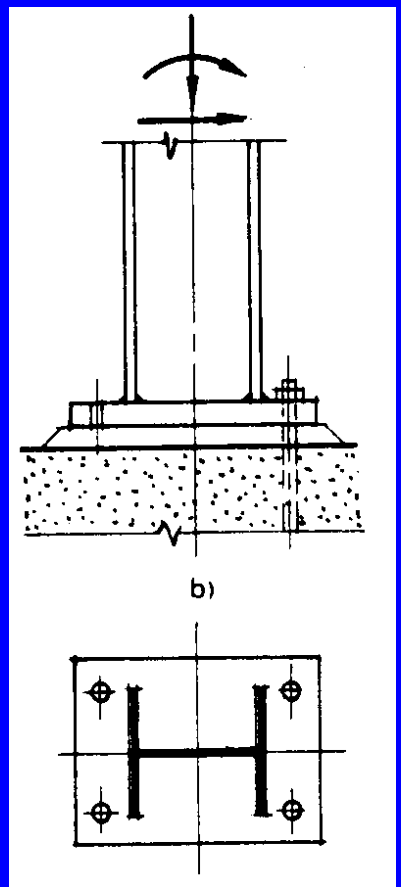


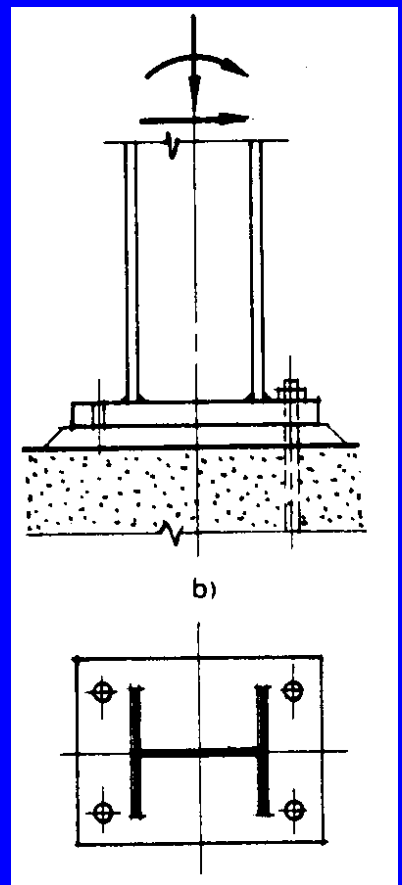

sigillatura da farsi a piombatura ultimata
dadi di registro
a)
d
L
c)

Classificazione

- Azione assiale
- Azione assiale e momento
- Azione assiale momento e taglio

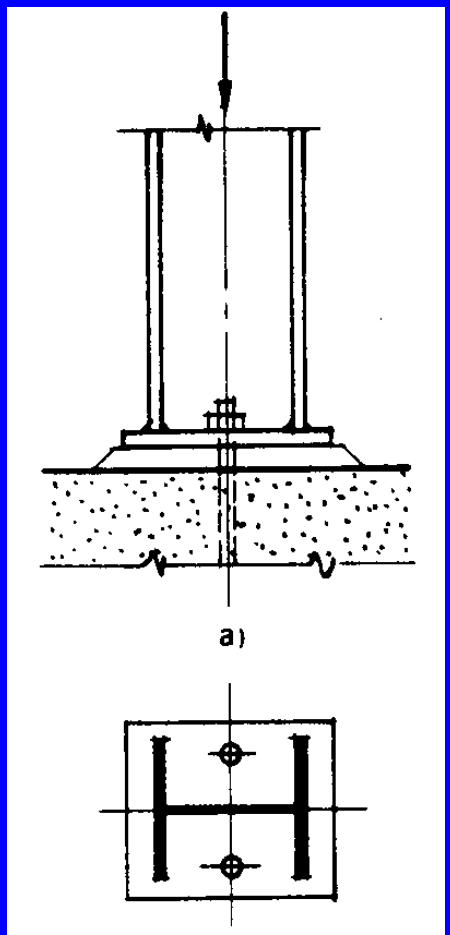


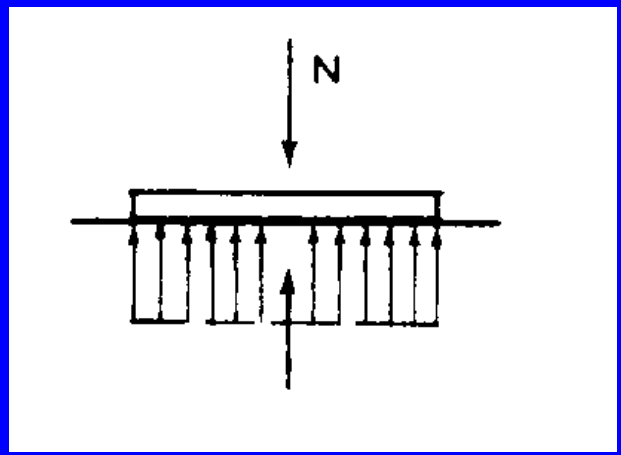




Dimensione della piastra

- Sola azione assiale





$$\sigma_{\max} = \sigma_m = \frac{N}{b \cdot a}$$

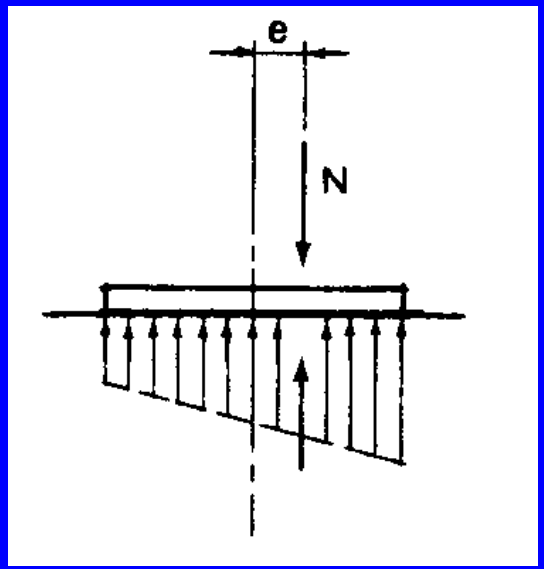
$$\sigma_{\max} \leq p_{adm} \Rightarrow b \cdot a$$

$$s_{tirafondi} \geq 0{,}003 \cdot b \cdot a$$

$$p_{adm} = \sigma_{cadm} = \left[6 + \frac{R_{ck} - 15}{4}\right]\left[\frac{N}{mm^2}\right]$$

$$R_{ck} = 8 \div 50 \left[\frac{N}{mm^2}\right]$$

➢ Azione assiale e momento flettente



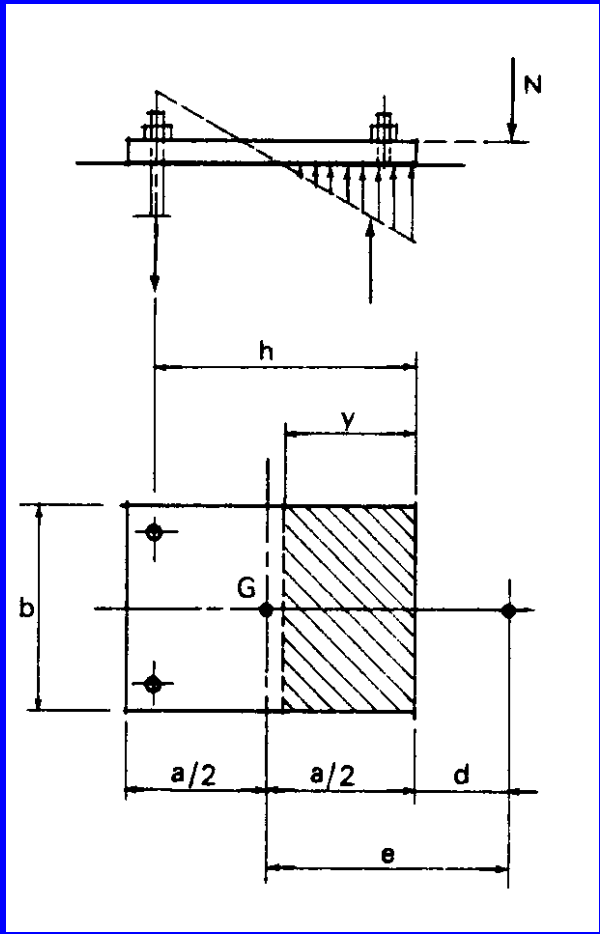
$$e = \frac{M}{N} \qquad 0 \le e \le \frac{a}{6}$$

$$\sigma_{\max} = \frac{N}{b \cdot a} \cdot \left(1 + \frac{6 \cdot e}{a}\right)$$

$$\sigma_{\max} \le p_{adm} \Rightarrow b \cdot a$$

$$s_{tirafondi} \ge 0{,}003 \cdot b \cdot a$$

➢ Azione assiale e momento flettente



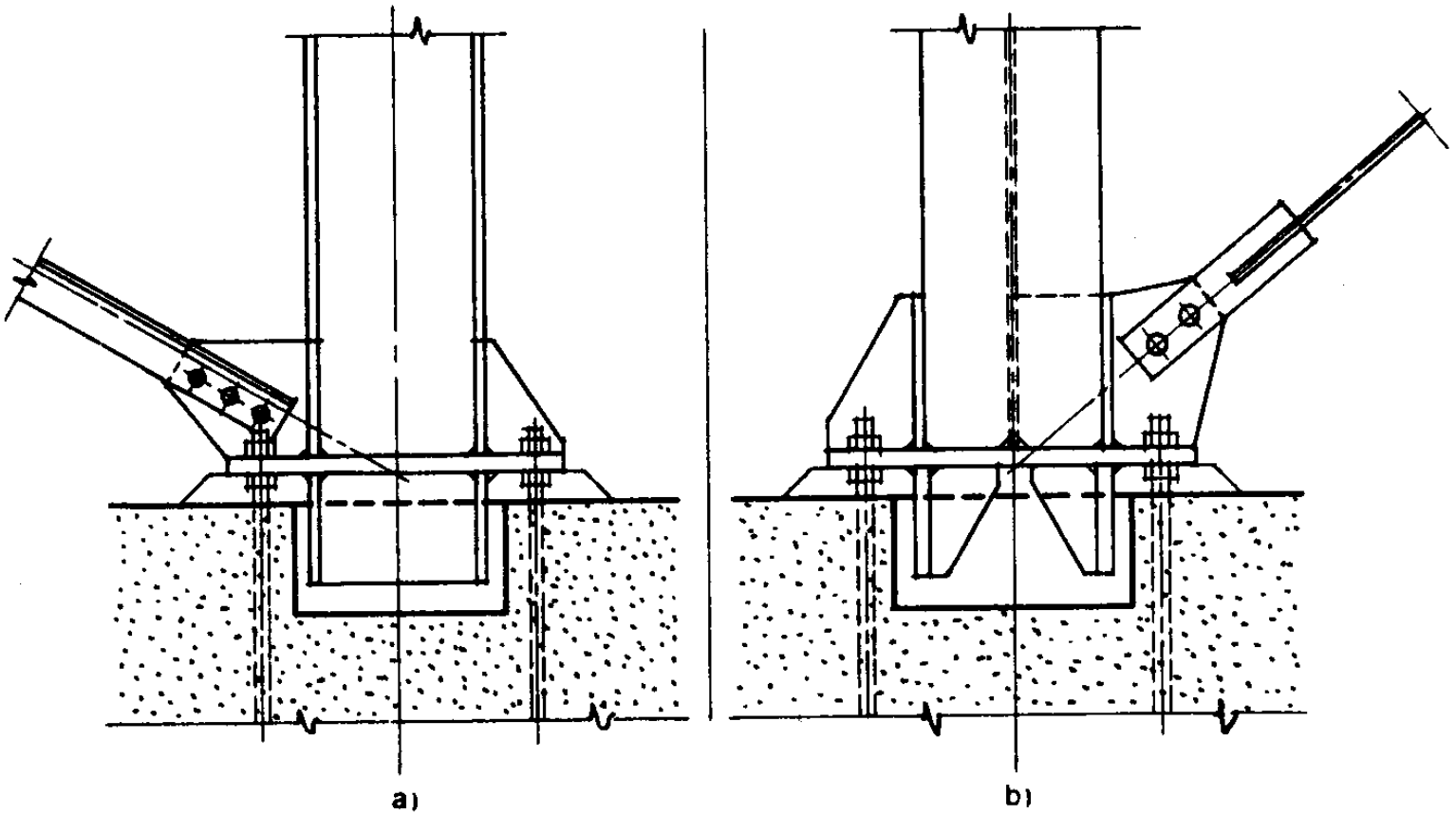
$$\frac{a}{6} \leq e$$

- Dimensiono la piastra in modo che sia:

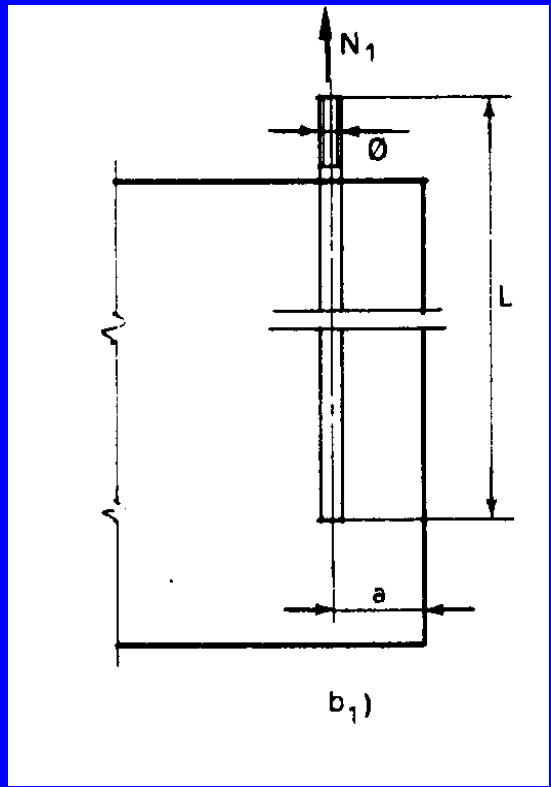
$$\sigma_{\max} \leq p_{adm}$$

- Dimensiono il diametro dei tirafondi in base alla corrispondente tensione di trazione.

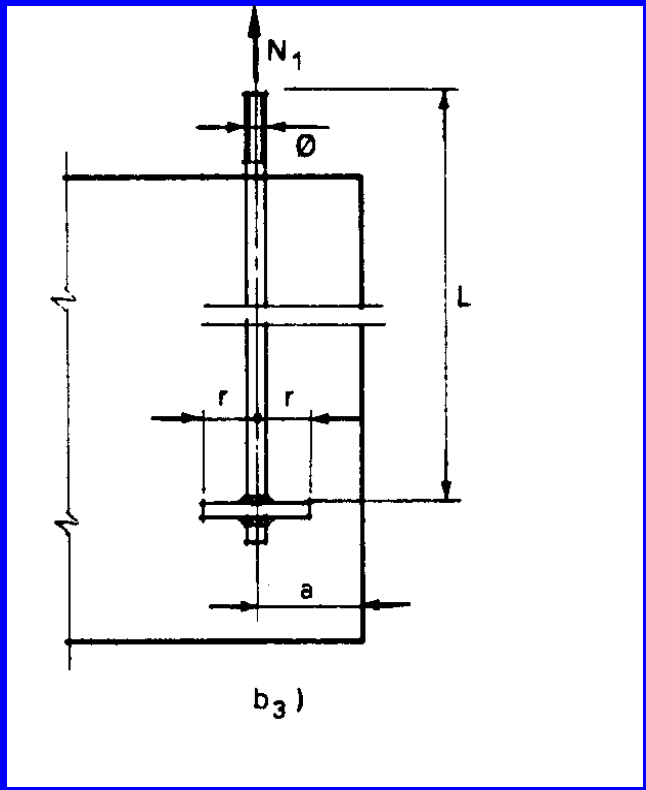
➢ Azione assiale momento flettente e taglio



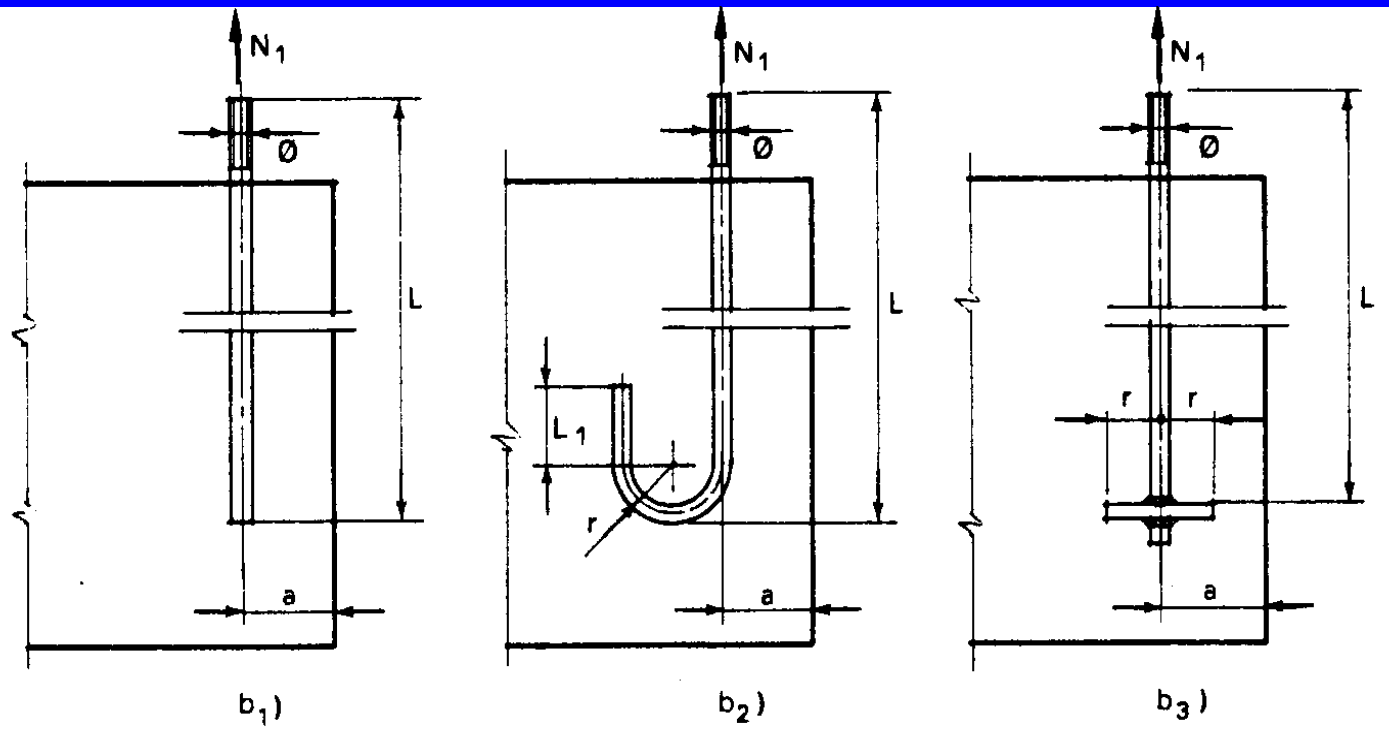
Ancoraggio dei tirafondi



$$\tau_{aadm} = 1{,}2 \cdot \tau_{adm} = 1{,}2 \cdot \left[1{,}4 + \frac{R_{ck} - 15}{75} \right]$$



- Ipotizzo che tutta l'azione normale sia trasmessa dalla rosetta.
  - Dimensiono il diametro della rosetta in modo da rendere ammissibile la pressione di contatto
  - Dimensiono lo spessore della rosetta trattandola come una lastra circolare


N1
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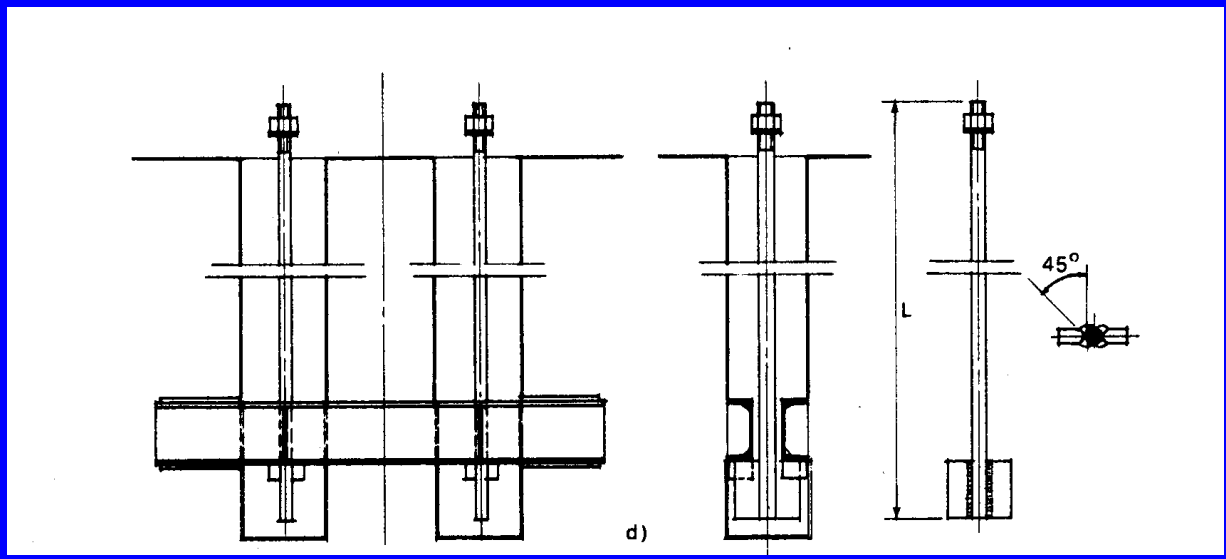
b1)
N1
Ø
L
L1
r
a
b2)
N1
Ø
L
r
r
a
b3)


d)
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45°