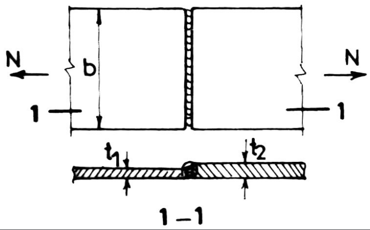
MINISTERUL EDUCATIEI CERCETARII SI TINERETULUI
UNIVERSITATEA TEHNICA "GH. ASACHI" IASI
FACULTATEA DE CONSTRUCTII

Bd. Prof. dr. Dimitrie Mangeron 43, cod 700050 ,IASI, tel: (0232)278683*, 254638, fax: (0232)233368

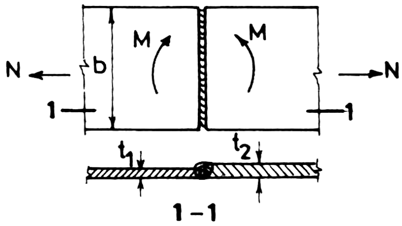
STEEL STRUCTURES

1. The connection in the figure made with butt welds is subjected to tension. The verification of the normal stresses is done with the following relationship:



a. $\sigma_s = \dfrac{N}{t_1 \cdot b} \le R$ b. $\sigma_s = \dfrac{N}{t_1(b-2t_1)} \le 0{,}8\,R$ c. $\sigma_s = \dfrac{N}{t_2(b-2t_2)} \le R_t^s$ d. $\sigma_s = \dfrac{N}{t_2 \cdot b} \le 0{,}8\,R$

2. The welded joint presented in the figure is a butt-welded connection subjected to bending moment (M) and axial force (N). Normal stresses are checked with the relationship:



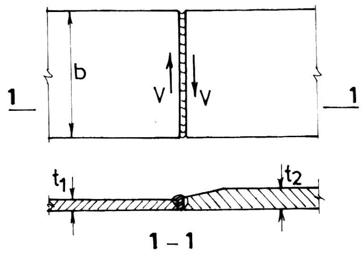
a. $\sigma_s = \dfrac{N}{t_1 \cdot b} + \dfrac{M}{\frac{t_1 \cdot b^2}{6}} \le R$

b. $\sigma_s = \dfrac{N}{t_1(b-2t_1)} + \dfrac{6M}{t_1(b-2t_1)^2} \le 0{,}8\,R$

c. $\sigma_s = \dfrac{N}{t_2 \cdot b} + \dfrac{6M}{t_2 \cdot b^2} \le 0{,}8\,R$

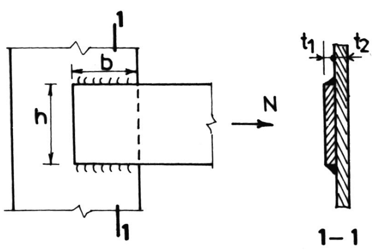
d. $\sigma_s = \dfrac{N}{t_2(b-2t_2)} + \dfrac{6M}{t_2(b-2t_2)^2} \le R_t^s$

3. The welded joint presented in the figure is a butt -welded connection subjected to shear. The verification of the shear stresses is done with the relationship:



a. $\tau_s = \dfrac{V}{t_1 \cdot b} \le R_f^s$ b. $\tau_s = \dfrac{V}{t_1(b-2t_1)} \le 0{,}6\,R$ c. $\tau_s = \dfrac{V}{t_2(b-2t_2)} \le R_f^s$ d. $\tau_s = \dfrac{V}{t_2 \cdot b} \le 0{,}6\,R$

4. The connection in the figure with lap (longitudinal) fillet welds having the thickness (throat) *a* is subjected to axial force (N); the stresses are checked with the relationship:



a. $\tau_s = \dfrac{N}{a \cdot b} \le R_f^s$ b. $\tau_s = \dfrac{N}{a(b-2a)} \le R$ c. $\tau_s = \dfrac{N}{2a(b-2a)} \le R_f^s$ d. $\tau_s = \dfrac{N}{2a \cdot b} \le 0{,}7\,R$

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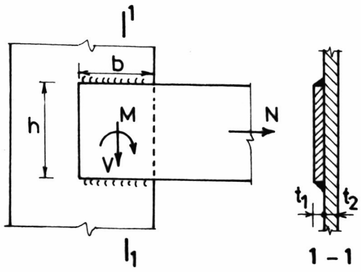
5. The connection in the figure with lap (longitudinal) fillet welds having the thickness (throat) *a* is subjected to bending moment (M), shear force (V) and tension (N). The verifications of strength are performed with the relationship:



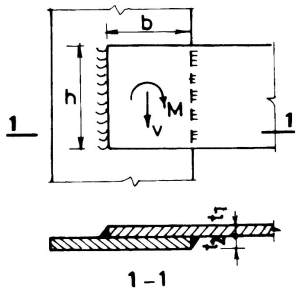
a. $\sqrt{\left(\dfrac{V}{2\,a\cdot b}\right)^2+\left(\dfrac{M/h+N/2}{2\,a\cdot b}\right)^2}\le R_f^s$

b. $\sqrt{\left(\dfrac{V/2}{a\,(\mathrm{b}-2\,\mathrm{a})}\right)^2+\left(\dfrac{M/h+N/2}{a\,(\mathrm{b}-2\,\mathrm{a})}\right)^2}\le R_f^s$

c. $\sqrt{\left(\dfrac{V}{a\cdot b}\right)^2+\left(\dfrac{M/h+N/2}{a\cdot b}\right)^2}\le 0{,}7\,R$

d. $\sqrt{\left(\dfrac{V}{a\,(\mathrm{b}-2\,\mathrm{a})}\right)^2+\left(\dfrac{M/h+N}{\mathrm{a}\,(\mathrm{b}-2\,\mathrm{a})}\right)^2}\le 0{,}7\,R$

6. The welded connection with transversal (side) fillet welds of thickness (throat) *a* in the figure is subjected to bending moment (M) and shear force (V); the strength verification is done with the relationship:



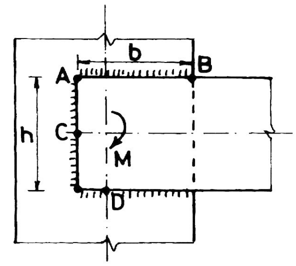
a. $\dfrac{V/2+M/b}{a\cdot h}\le R_f^s$

b. $\dfrac{V}{2\,a\cdot h}+\dfrac{6M}{a\cdot h^2}\le R$

c. $\dfrac{V/2+M/b}{a\,(\mathrm{h}-2\,\mathrm{a})}\le R_f^s$

d. $\dfrac{V+M}{2\,a\cdot(h-2a)}\le 0.7R$

7. In which point of the connection with both longitudinal and transversal fillet welds from the figure we have to check the maximum stresses due to bending moment?



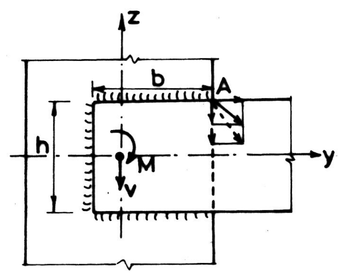
a. **A**

b. **C**

c. **B**

d. **D**

8. Checking the strength in the point A of the welded connection in the figure with both transversal and longitudinal fillet welds, subjected to bending moment (M) and shear force (V) is done with the following relationship:



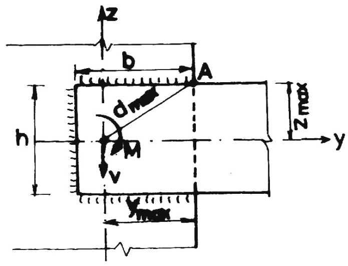
a. $\sqrt{\left(\tau_{s,y}^{M}\right)^2+\left(\tau_{s,z}^{M}+\tau_{s,z}^{V}\right)^2}\le R_f^s$

b. $\left(\tau_{s,y}^{M}\right)^2+\left(\tau_{s,z}^{M}+\tau_{s,z}^{V}\right)^2\le R_f^s$

c. $\sqrt{\tau_{s,y}^{M}+\tau_{s,z}^{M}+\tau_{s,z}^{V}}\le 0{,}7\,R$

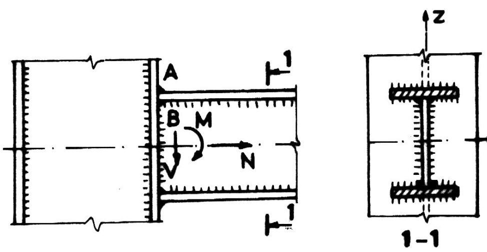
d. $\sqrt{\left(\tau_{s,y}^{M}+\tau_{s,z}^{M}\right)^2+\left(\tau_{s,z}^{V}\right)^2}\le R$

9. Checking the strength in the point A of the welded connection in the figure with both transversal and longitudinal fillet welds, with thickness *a* and length $\sum l_s$ subjected to bending moment (M) and shear force (V) is done with the following relationship:



a.	$\dfrac{M\cdot d_{\max}}{I_{sp}}+\dfrac{V}{a\cdot\sum l_s}\le R_f^s$	b.	$\sqrt{\left(\dfrac{M\cdot z_{\max}}{I_{sy}+I_{sz}}\right)^2+\left(\dfrac{M\cdot y_{\max}}{I_{sy}+I_{sz}}+\dfrac{V}{a\sum l_s}\right)^2}\le R_f^s$
c.	$\sqrt{\left(\dfrac{M\cdot z_{\max}}{I_{sp}}+\dfrac{M\cdot y_{\max}}{I_{sp}}\right)^2+\left(\dfrac{V}{a\sum l_s}\right)^2}\le R$	d.	$\left(\dfrac{M\cdot z_{\max}}{I_{sy}+I_{sz}}+\dfrac{M\cdot y_{\max}}{I_{sy}+I_{sz}}\right)^2+\dfrac{V}{a\sum l_s}\le R_f^s$

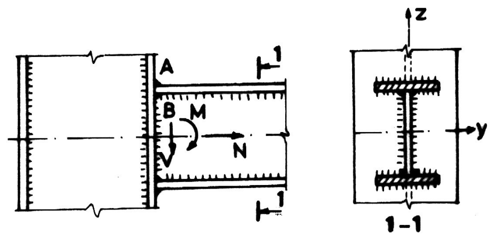
10. Checking the strength in the point A of the welded connection with fillet welds in the figure, with thickness a and length $\sum l_s$ that joins the girder to the column and is subjected to bending moment (M), axial force (N) and shear force (V) is done with the following relationship:



a.	$\dfrac{M}{I_{sy}}\cdot z_{\max}+\dfrac{N}{A_s}\le R_f^s$	b.	$\dfrac{M}{W_{sy}}+\dfrac{N}{a\sum l_s}\le R$	c.	$\dfrac{M}{I_{sy}}\cdot z_{\max}+\dfrac{N}{I_{sy}}\cdot y_{\max}\le R_f^s$	d.	$\dfrac{M}{W_{sy}}+\dfrac{N}{W_{sz}}\le 0{,}7\,R$

11. Checking the strength in the point B of the welded connection with fillet welds with thickness a and length $\sum l_s$ that joins the girder to the column and is subjected to bending moment (M) and tension force (N) is done with the following relationship:

is done with the relationship



a.	$\left(\tau_{sB}^M+\tau_s^N\right)^2+\left(\tau_s^V\right)^2\le R_f^s$	b.	$\sqrt{\left(\tau_{sB}^M+\tau_s^N\right)^2+\left(\tau_s^V\right)^2}\le R_f^s$	c.	$\tau_{sB}^M+\tau_s^N+\tau_s^V\le R_f^s$	d.	$\left(\tau_{sB}^M+\tau_s^N+\tau_s^V\right)^2\le 0{,}7\,R$

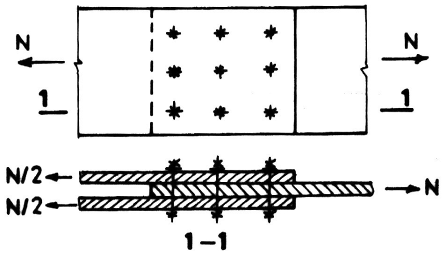
12. The bolts in a bolted connection subjected to axial force that acts in the plane of the connection are able to sustain:

a. Efforts that produce a relative slip between the metal plates;
b. Efforts that produce shear of the shank in a cross section corresponding to the separation surface between the metal plates;
c. Efforts that produce bearing on the ply;
d. Efforts that lead to detaching the plates one from the other.

13. The resistance capacity of an ordinary bolt in a connection subjected to tension (N) in its plane, is:

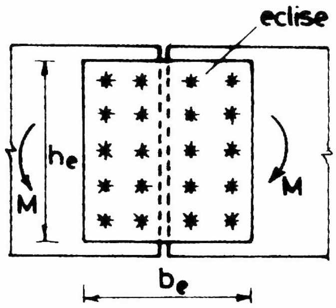
a.	$N_{cf}^b=n_f\dfrac{\pi d^2}{4}R_f^b$	b.	$N_{ci}^b=\dfrac{\pi d_0^2}{4}R_i^b$	c.	$N_{cb}=\min\left(N_{cf}^b,N_{cp}^b\right)$	d.	$N_{cp}^b=d\sum_{\min} t\cdot R_p^b$

14. The total number of bolts, n in the bolted connection in the figure subjected to tension, is determined with the condition imposed:



a.	$n \cdot N_{cf}^{b} \geq N$	b.	$n \cdot N_{cp}^{b} \geq N$	c.	$n \cdot N_{cb} \geq N$	d.	$n \cdot N_{ci}^{b} \geq N$

15. Verification of the connection in the figure using ordinary bolts and subjected to bending moment (M) in its plane is done:



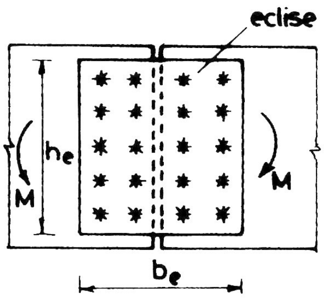
a.	For each bolt in the connection	b.	For the bolts placed in the axis of the connection;	c.	For the bolts extremely situated from the centroid of the connection on each semi-splice;	d.	For all the bolts on the semi-splice.

16. Verification of the bolt from the connection in the figure, subjected to maximum efforts determined by the bending moment (M) acting in the plane of joining pieces is done with the relationship:

$\frac{b_e}{2} > \frac{h_e}{3}$

n = number of the bolts on both sides of the connection, on each semi-splice;

n_1 = number of the vertical rows of bolts on each side of the connected part (on each semi-splice)



a.	$\sqrt{\left(\frac{M \cdot z_{\max}}{\sum\left(z_i^2 + y_i^2\right)}\right)^2 + \left(\frac{M \cdot y_{\max}}{\sum\left(z_i^2 + y_i^2\right)}\right)^2} \leq N_{cb}$	b.	$\left(\frac{M \cdot z_{\max}}{z_i^2 + y_i^2} + \frac{M \cdot y_{\max}}{z_i^2 + y_i^2}\right)^2 \leq N_{cp}^{b}$
c.	$\sqrt{\left(\frac{M \cdot y_{\max}}{\sum\left(z_i^2 + y_i^2\right)}\right)^2 + \left(\frac{M \cdot y_{\max}}{\sum\left(z_i^2 + y_i^2\right)}\right)^2} \leq N_{cf}^{b}$	d.	$\sqrt{\left(\frac{M \cdot z_{\max}}{n_1 \sum z_i^2}\right)^2 + \left(\frac{M \cdot y_{\max}}{n_1 \sum z_i^2}\right)^2} \leq N_{cb}$

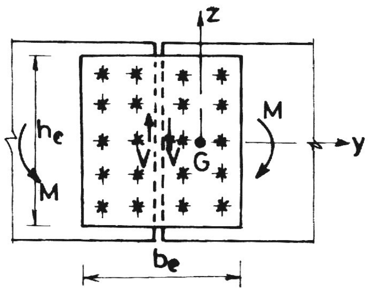
17. Verification of the bolts in the connection with ordinary bolts from the figure and subjected to bending moment (M) and shear force (V) in the plane of the joined parts,

$\frac{b_e}{2} < \frac{h_e}{3}$

n = number of bolts on each side of the connected parts (each semi-splice)

n_1 = number of vertical rows on each side of the splice

is done with the following relationship:



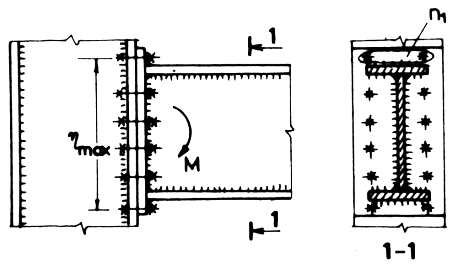
a. $\sqrt{\left(\frac{M \cdot z_{max}}{\sum\left(z_i^2 + y_i^2\right)}\right)^2 + \left(\frac{M \cdot y_{max}}{\sum\left(z_i^2 + y_i^2\right)} + \frac{V}{n}\right)^2} \leq N_{cb}$

b. $\sqrt{\left(\frac{M \cdot z_{max}}{\sum\left(y_i^2 + z_i^2\right)}\right)^2 + \left(\frac{M \cdot y_{max}}{\sum\left(z_i^2 + y_i^2\right)} + \frac{V}{n_1 \cdot n}\right)^2} \leq N_{cb}$

c. $\sqrt{\left(\frac{M \cdot z_{max}}{n_1 \cdot \sum z_i^2}\right)^2 + \left(\frac{V}{n}\right)^2} \leq N_{cb}$

d. $\sqrt{\left(\frac{M \cdot z_{max}}{n_1 \cdot \sum z_i^2}\right)^2 + \left(\frac{M \cdot y_{max}}{n_1 \cdot \sum y_i^2} + \frac{V}{n_1 \cdot n}\right)^2} \leq N_{cb}$

18. Checking the connection in the figure made with *n* ordinary bolts and subjected to bending moment (M) normal to its plane is done with the following relationship:



a. $\frac{M \cdot \eta_{max}}{n \cdot \sum \eta_i^2} \leq N_{cb}$ b. $\frac{M \cdot \eta_{max}}{n_1 \cdot \sum \eta_i^2} \leq N_{ci}^b$ c. $\frac{M \cdot \eta_{max}}{n \cdot \sum \eta_i} = \frac{\pi d_0^2}{4} \cdot R_i^b$ d. $\frac{M \cdot \eta_{max}}{n_1 \cdot \sum \eta_i^2} \leq N_{cb}$

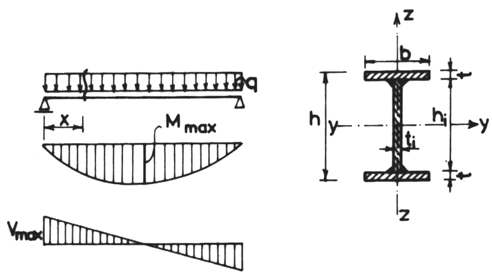
19. The capacity of resistance of a connection with high strength friction grip bolts is:

a. $N_{SIRP} = n \cdot n_F \cdot m \cdot f \cdot 0{,}8 A_0 R_c$ b. $N_{SIRP} = \min\left(\mathrm{N}_{cf}^{b}, \mathrm{N}_{cp}^{b}\right)$ c. $N_{SIRP} = \mathrm{N}_{ci}^{b}$ d. $N_{SIRP} = n_F \cdot m \cdot f \cdot N_t$

20 H. S. F. G. B. (high strength friction grip bolts) transfer the stresses by:

a. shear b. bearing on the ply c. tension in the rod d. friction between the surfaces in contact

21. Verification of the equivalent stresses to the plate girders having a build up section, is done with the following relationship:



a. $\sigma_{ech} = \sqrt{\left(\frac{M_{max}}{I_y} \cdot \frac{h}{2}\right)^2 + 3\left(\frac{V_{max}}{t_i \cdot h_i}\right)^2} \leq 1{,}1\, R$

b. $\sigma_{ech} = \sqrt{\left(\frac{M_x}{I_y} \cdot \frac{h}{2}\right)^2 + 3\left(\frac{V_x}{t_i \cdot h_i}\right)^2} \leq 1{,}1\, R$

c. $\sigma_{ech} = \sqrt{\left(\frac{M_x}{I_y} \cdot \frac{h_i}{2}\right)^2 + 3\left(\frac{V_x}{t_i \cdot h_i}\right)^2} \leq 1{,}1\, R$

d. $\sigma_{ech} = \sqrt{\left(\frac{M_{max}}{I_y} \cdot \frac{h_i}{2}\right)^2 + 3\left(\frac{V_{max}}{t_i \cdot h_i}\right)^2} \leq R$

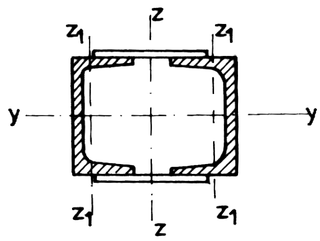
22. The build up sections used for plate girders subjected to concentrated forces acting on the top flange are verified for the equivalent stresses at the level of joint between the flange in compression and web, with the relationship:

a.	$\sigma_{ech} = \sqrt{\sigma_x^2 + \sigma_l + 3\,\tau_x^2} \le R$	b.	$\sigma_{ech} = \sqrt{\sigma_x^2 + \sigma_l^2 - \sigma_x \sigma_l + 3\tau_x^2} \le m\,R$
c.	$\sigma_{ech} = \sqrt{\sigma^2 + 3\,\tau^2} \le m\,R$	d.	$\sigma_{ech} = \sqrt{\sigma^2 - \sigma_l^2 + \sigma\sigma_l + 3\,\tau^2} \le m\,R$

23. Plate girders with symmetrical sections have the area of the flange, $\mathbf{A_t}$ and the area of the web, $\mathbf{A_i}$, in the following inter-relation:

a.	$A_i = A_t$	b.	$A_i = 2 \cdot A_t$	c.	$A_i << 2 \cdot A_t$	d.	$A_i >> 2 \cdot A_t$

24. Verification against buckling of the steel column with the cross section in the figure is done with the help of the slenderness ratio, λ_z, determined with the relationship:

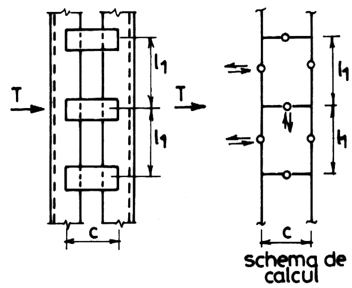


a.	$\lambda_z = \dfrac{l_{f_z}}{i_z}$	b.	$\lambda_{tr} = \sqrt{\lambda_z^2 + n\dfrac{A}{A_d}}$	c.	$\lambda_{tr} = \sqrt{\lambda_z^2 + \lambda_{z1}^2}$	d.	$\lambda_z = \sqrt{\lambda_y^2 + \lambda_{z1}^2}$

25. Buckling of the steel columns with simple section subjected to compression is checked with the help of buckling ratios extracted from the buckling curves, depending on:

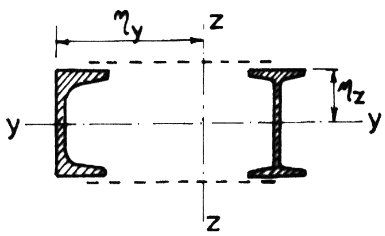
a.	λ_{tr}	b.	λ_y ; λ_z	c.	N /A	d.	φ_g

26. For the battened column in the figure, the value of the shear force in the batten is:



a.	$T_p = \dfrac{T \cdot l_1}{4\,c}$	b.	$T_p = \dfrac{T \cdot l_1}{2\,c}$	c.	$T_p = \dfrac{T_1 \cdot l_1}{4\,c}$	d.	$T_p = \dfrac{T_1 \cdot l_1}{2\,c}$

27. Verification against buckling of the steel columns with compound section, made with laced hot rolled shapes and subjected to bending moment (M) and compression (N) is done with the following relationship:



a.	$\dfrac{N}{\varphi\,A} + \dfrac{c_z \cdot M_z \cdot \eta_y}{\left(1 - \dfrac{\sigma}{\sigma_{cr}}\right) \cdot I_z} \le R$	b.	$\dfrac{N}{A} + \dfrac{c_z \cdot M_z \cdot \eta_z}{\left(1 - \dfrac{\sigma}{\sigma_{cr}}\right) \cdot I_y} \le 1{,}1R$	c.	$\dfrac{N}{\varphi\,A} + \dfrac{c_z \cdot M_z \cdot \eta_y}{\varphi_g \left(1 - \dfrac{\sigma}{\sigma_{cr}}\right) \cdot I_z} \le R$	d.	$\dfrac{N}{\varphi\,A} + \dfrac{M_z \cdot \eta_y}{\varphi_g \cdot I_z} \le 1{,}1R$

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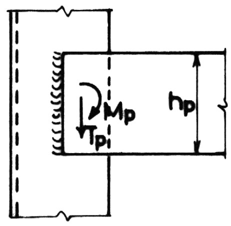
28. The fillet welds with thickness *a*, between a batten and the leg of a column are checked with the relationship:



a.	$\frac{6\,M_p}{a \cdot \mathrm{h}_\mathrm{p}^2} + \frac{T_p}{a \cdot h_p} \leq 0{,}7\,R$	b.	$\sqrt{\left(\frac{6\,M_p}{a \cdot (\mathrm{h}_\mathrm{p} - 2a)^2}\right)^2 + \left(\frac{T_p}{a \cdot (\mathrm{h}_\mathrm{p} - 2a)}\right)^2} \leq R_f^s$
c.	$\sqrt{\frac{6\,M_p}{a \cdot h_p^2} + \frac{T_p}{a \cdot h_p}} \leq R_f^s$	d.	$\frac{6\,M_p}{a \cdot (\mathrm{h}_\mathrm{p} - 2a)^2} + \frac{T_p}{a \cdot (\mathrm{h}_\mathrm{p} - 2a)} \leq 0{,}7\,R$