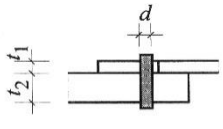
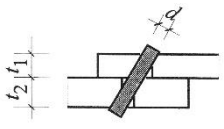
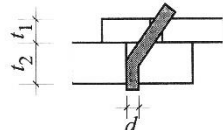
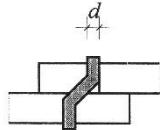


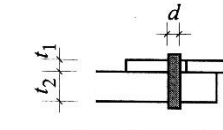
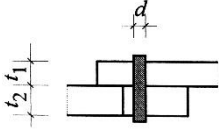
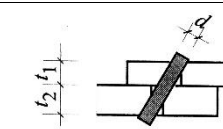
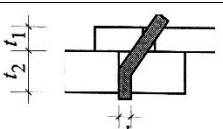
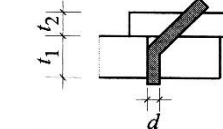
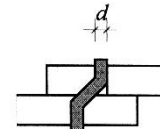
TABLICE I FORMULE - DETALJI U DRVENIM KONSTRUKCIJAMA

Modovi loma: drvo-drvo

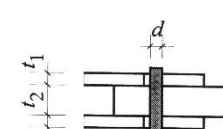
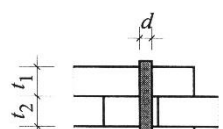
1. Projektne vrijednosti nosivosti R_d za $\beta = 1$ – mjerodavna je najmanja vrijednost

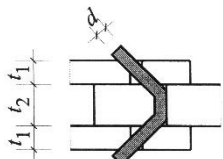
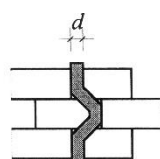
<p>(a) </p> $R_d = f_{h,1,d} t_1 d \quad (6.31)$	<p>(c) </p> $R_d = 0,5 f_{h,1,d} t_1 d (\sqrt{3k_t^2 + 2k_t + 3} - k_t - 1) \quad (6.32)$
<p>(d) </p> $R_d = 0,367 f_{h,1,d} t_1 d (2\sqrt{1 + 3/k_M^2} - 1) \quad (6.33)$	<p>(f) </p> $R_d = 1,556 f_{h,1,d} t_1 d / k_M \quad (6.34)$

2. Projektne vrijednosti nosivosti R_d za $\beta \neq 1$ – mjerodavna je najmanja vrijednost

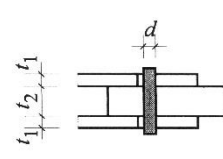
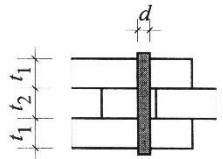
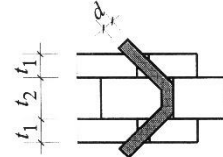
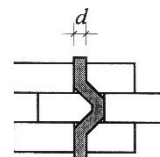
<p>(a) </p> $R_d = f_{h,1,d} t_1 d \quad (6.31)$	<p>(b) </p> $R_d = f_{h,1,d} t_2 d \beta \quad (6.35)$
<p>(c) </p> $R_d = \frac{f_{h,1,d} t_1 d}{1 + \beta} \left\{ \sqrt{\beta + 2\beta^2 \left[1 + \frac{t_2}{t_1} + \left(\frac{t_2}{t_1} \right)^2 \right] + \beta^3 \left(\frac{t_2}{t_1} \right)^2} - \beta \left(1 + \frac{t_2}{t_1} \right) \right\} \quad (6.36)$	<p>(d) </p> $R_d = 1,1 \frac{f_{h,1,d} t_1 d}{2 + \beta} \left[\sqrt{2\beta(1 + \beta) + \frac{4\beta(2 + \beta)M_{y,d}}{f_{h,1,d} d t_1^2}} - \beta \right] \quad (6.37)$
<p>(e) </p> $R_d = 1,1 \frac{f_{h,1,d} t_2 d}{1 + 2\beta} \left[\sqrt{2\beta^2(1 + \beta) + \frac{4\beta(1 + 2\beta)M_{y,d}}{f_{h,1,d} d t_2^2}} - \beta \right] \quad (6.38)$	<p>(f) </p> $R_d = 1,1 \sqrt{\frac{2\beta}{1 + \beta}} \sqrt{2M_{y,d} f_{h,1,d} d} \quad (6.39)$

3. Projektne vrijednosti nosivosti R_d za jednu reznu ravninu i $\beta = 1$

<p>(g) </p> $R_d = f_{h,1,d} t_1 d \quad (6.31)$	<p>(h) </p> $R_d = 0,5 f_{h,1,d} t_2 d \quad (6.40)$
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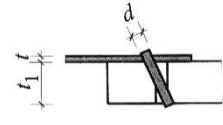
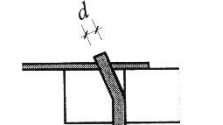
<p>(j)</p> 	<p>(k)</p> 
$R_d = 0,367 f_{h,1,d} t_1 d \left[2\sqrt{1+3/k_M^2} - 1 \right] \quad (6.33)$	$R_d = 1,556 f_{h,1,d} t_1 d / k_M \quad (6.34)$

4. Projektne vrijednosti nosivosti R_d u jednoj reznjoj ravni i $\beta \neq 1$

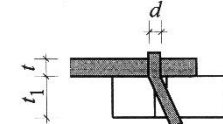
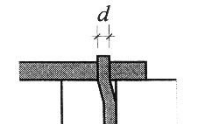
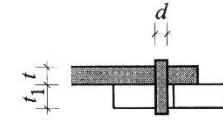
<p>(g)</p> 	<p>(h)</p> 
$R_d = f_{h,1,d} t_1 d \quad (6.31)$	$R_d = 0,5 f_{h,1,d} t_2 d \beta \quad (6.40)$
<p>(j)</p> 	<p>(k)</p> 
$R_d = 1,1 \frac{f_{h,1,d} t_1 d}{2+\beta} \left[\sqrt{2\beta(1+\beta) + \frac{4\beta(2+\beta)M_{y,d}}{f_{h,1,d} d t_1^2}} - \beta \right] \quad (6.37)$	$R_d = 1,1 \sqrt{\frac{2\beta}{1+\beta}} \sqrt{2M_{y,d} f_{h,1,d} d} \quad (6.39)$

Modovi loma: drvo-lim

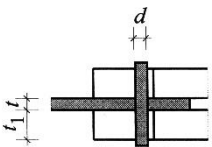
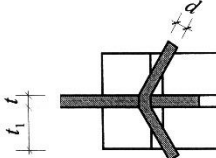
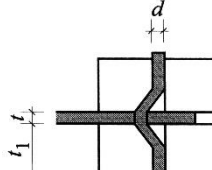
1. Projektna vrijednost nosivosti R_d štapastih spajala u vezama s tankim limom, $t \leq 0,5d$

<p>(as)</p> 	<p>(bs)</p> 
$R_d = (\sqrt{2} - 1) f_{h,1,d} t_1 d \quad (6.41)$	$R_d = 1,1 \sqrt{2M_{y,d} f_{h,1,d} d} \quad (6.42)$

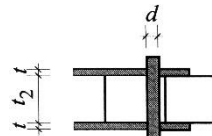
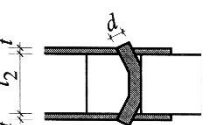
2. Projektna vrijednost nosivosti R_d spojnih sredstava u vezama s debelim limom, $t \geq d$

<p>(cs)</p> 	<p>(ds)</p> 
$R_d = 1,1 f_{h,1,d} t_1 d \left[\sqrt{2 + \frac{4M_{y,d}}{f_{h,1,d} d t_1^2}} - 1 \right] \quad (6.43)$	$R_d = 1,5 \sqrt{2M_{y,d} f_{h,1,d} d} \quad (6.44)$
<p>(as)</p> 	<p>Za čelične limove debljine $0,5d < t < d$ radi se linearna interpolacija projektnih vrijednosti nosivosti R_d.</p>
$R_d = f_{h,1,d} t_1 d \quad (6.31)$	

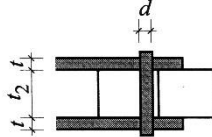
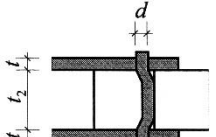
3. Projektna vrijednost nosivosti R_d u jednoj reznjoj ravнини veze s utisnutim čeličnim limom

<p>(es)</p>  $R_d = f_{h,1,d} t_1 d \quad (6.31)$	<p>(fs)</p>  $R_d = 1,1 f_{h,1,d} t_1 d \left[\sqrt{2 + \frac{4 M_{y,d}}{f_{h,1,d} d t_1^2}} - 1 \right] \quad (6.43)$
<p>(gs)</p>  $R_d = 1,5 \sqrt{2 M_{y,d} f_{h,1,d} d} \quad (6.44)$	<p>Za čelične limove debljine $0,5 d < t < d$ radi se linearna interpolacija projektnih vrijednosti nosivosti R_d.</p>

4. Projektna vrijednost nosivosti R_d u vezama s obostranim tankim limom, $t \leq 0,5 d$

<p>(hs)</p>  $R_d = 0,5 f_{h,2,d} t_2 d \quad (6.45)$	<p>(js)</p>  $R_d = 1,1 \sqrt{2 M_{y,d} f_{h,2,d} d} \quad (6.46)$
---	---

5. Projektna vrijednost nosivosti R_d spajala u vezama s obostranim debelim limom, $t \geq d$

<p>(ks)</p>  $R_d = 0,5 f_{h,2,d} t_2 d \quad (6.45)$	<p>(ls)</p>  $R_d = 1,5 \sqrt{2 M_{y,d} f_{h,2,d} d} \quad (6.46)$
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Spojna sredstva: čavli

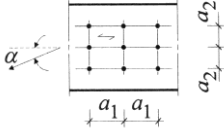
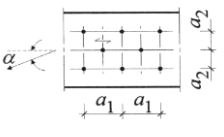
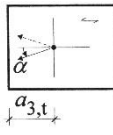
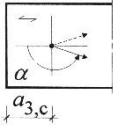
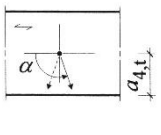
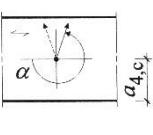
Najmanja debljina drva u koje se čavli zabijaju (bez predbušenja) ograničava se prema: $\min b = \max \left\{ \begin{array}{l} 7d \\ \frac{(13d - 30) \rho_k}{400} \end{array} \right.$

Ako se čavli zabijaju bez prethodnog bušenja i raspoređuju obostrano s preklapanjem (mimoilazno), najmanja širina zadnjeg elementa veze (u kojem je vrh čavla dubine zabijanja, t_2) mora biti: $\min b_2 > t_2 + 4d$

Najmanje dubine zabijanja čavala

Vrsta čavala	Opterećenje okomito na os čavla	Opterećenje u smjeru osi čavla
Glatki čavli	8 d	12 d
Posebni čavli	6 d	8 d

Najmanji dopušteni razmaci između čavala

Najmanji dopušteni razmaci čavala		Bez predbušenja rupa		
		Puno i lijepljeno lamelirano drvo $\rho_k \leq 420$ (kg/m ³)	Puno drvo $420 < \rho_k < 500$ (kg/m ³)	S predbušenjem rupa
a₁ međusobno i u smjeru (II) vlakanca		Za $d < 5$ mm $(5 + 5 \cos \alpha) d$ Za $d \geq 5$ mm $(5 + 7 \cos \alpha) d$	$(7 + 8 \cos \alpha) d$	$(4 + 3 \cos \alpha) d^2$
a₂ međusobno i okomito na vlakanca (razmak redaka)		5d	7d	$(3 + \sin \alpha) d$
a_{3,t} od opterećenog ruba drva II s vlakancima		$(10 + 5\cos \alpha) d$	$(15 + 5\cos \alpha) d$	$(7 + 5\cos \alpha) d$
a_{3,c} od neopterećenog ruba drva II s vlakancima		10d	15d	7d
a_{4,t} od opterećenog ruba drva ⊥ na vlakanca		$(5 + 5\sin \alpha) d$	$(7 + 5\sin \alpha) d$	$(3 + 4\sin \alpha) d$
a_{4,c} od neopterećenog ruba drva ⊥ na vlakanca		5d	7d	3d

Karakteristična vrijednost čvrstoće pritiska po omotaču rupe u drvu:

- zabijani čavli (ugrađeni bez predbušenja rupa) $f_{h,k} = 0,082 \cdot \rho_k \cdot d^{-0,3}$ [N/mm²]
- bušeni čavli (ugrađeni s predbušenjem rupa) $f_{h,k} = 0,082 \cdot (1 - 0,01d) \cdot \rho_k$ [N/mm²]

Karakteristični moment tečenja čavla:

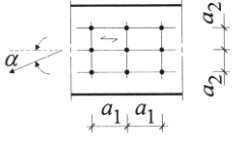
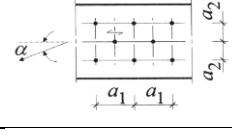
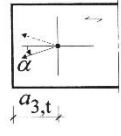
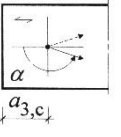
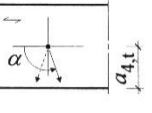
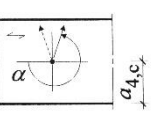
- okrugli čavli $M_{y,k} = 180 d^{2,6}$ [Nmm]
- kvadratični čavli $M_{y,k} = 270 d^{2,6}$ [Nmm]

Spojna sredstva: vijci

Klase nosivosti čelika za izradu vijaka

Klasa čvrstoće	Karakteristična vlačna čvrstoća $f_{u,k}$ [N/mm ²]
3.6	300
4.6 i 4.8	400
5.6 i 5.8	500

Najmanje dopušteni razmaci vijaka

a₁ međusobno i u smjeru (II) vlakanca (razmak stupaca)		II s pravcem vlakanca drva	$(4 + 3 \cos \alpha) d$
a₂ međusobno i okomito (⊥) na vlakanca (razmak redaka)		⊥ na pravac vlakanca drva (razmak redova)	4d
a_{3,t} od opterećenog ruba drva II s vlakancima		$-90^\circ \leq \alpha \leq 90^\circ$	7d (≥ 80mm)
a_{3,c} od neopterećenog ruba drva II s vlakancima		$150^\circ \leq \alpha \leq 210^\circ$	4d
		$90^\circ < \alpha < 150^\circ$	$(1 + 6 \sin \alpha) d$
		$210^\circ \leq \alpha \leq 270^\circ$	(ali ≥ 4d)
a_{4,t} od opterećenog ruba drva ⊥ na vlakanca		$0^\circ \leq \alpha \leq 180^\circ$	$(2 + 2 \sin \alpha) d$ (ali ≥ 4d)
a_{4,c} od neopterećenog ruba drva ⊥ na vlakanca		Svi ostali α	3d

Čvrstoća drva po omotaču rupe:

$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha}$$

$$f_{h,0,k} = 0,082 (1 - 0,01d) \rho_k$$

DRVENE KONSTRUKCIJE
LAGANE KONSTRUKCIJE

$k_{90} = 1,35 + 0,015 d$ za crnogoricu

$k_{90} = 0,90 + 0,015 d$ za bjelogoricu

Pritom su gustoća drva ρ_k u kg/m^3 , promjer vijka (d) u mm, a čvrstoće drva na tlak po omotaču rupe za opterećenje u pravcu vlakana ($f_{h,0,k}$) i pod kutom na vlakna ($f_{h,\alpha,k}$) u N/mm^2 .

Karakteristični moment tečenja (plastifikacije) čelika: $M_{y,k} = 0,8 f_{u,k} d^3 / 6$

Spojna sredstva: trnovi

Klase nosivosti čelika za izradu trnova

Klasa čvrstoće	Karakteristična vlačna čvrstoća $f_{u,k}$ [N/mm^2]
S 235	360
S 275	430
S 355	510

Najmanje dopušteni razmaci trnova (nastavak tablice s prethodne stranice)

a₁ međusobno i u smjeru (II) vlakanca (razmak stupaca)		II s pravcem vlakanca drva (razmak stupaca)	$(3 + 4 \cos \alpha) d$
a₂ međusobno i okomito (\perp) na vlakanca (razmak redaka)		\perp na pravac vlakanca drva (razmak redova)	3d
a_{3,t} od opterećenog ruba drva II s vlakancima		$-90^\circ \leq \alpha \leq 90^\circ$	7d ($\geq 80\text{mm}$)
a_{3,c} od neopterećenog ruba drva II s vlakancima		$150^\circ \leq \alpha \leq 210^\circ$	3d
		$90^\circ < \alpha < 150^\circ$	$a_{3,t} \sin \alpha $
		$210^\circ \leq \alpha \leq 270^\circ$	(ali $\geq 3d$)
a_{4,t} od opterećenog ruba drva \perp na vlakanca		$0^\circ \leq \alpha \leq 180^\circ$	$(2 + 2 \sin \alpha) d$ (ali $\geq 3d$)
a_{4,c} od neopterećenog ruba drva \perp na vlakanca		Svi ostali α	3d

Spojna sredstva: vijci za drvo

Vijci za drvo spajala su slična i čavlima i vijcima. U skladu s tom činjenicom, EC5 propisuje sljedeće:

- za vijke za drvo promjera $d < 8\text{mm}$ vrijede pravila kao za čavle
- za vijke za drvo promjera $d \geq 8\text{mm}$ vrijede pravila kao za vijke

Uporaba vijaka za drvo dopuštena je isključivo u jednoreznim spojevima, a najčešće se koriste u vezama čelični lim – drvo ili drvo – materijal na osnovi drva.