

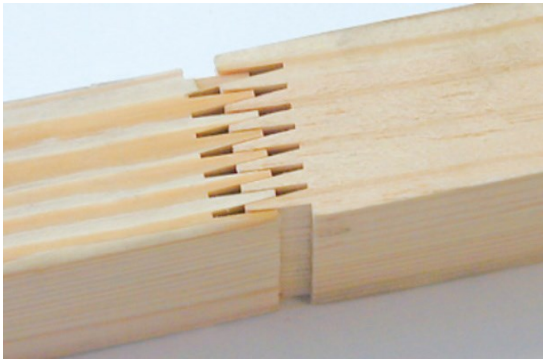
SPOJEVI U KONSTRUKCIJAMA PROIZVODA OD DRVETA

**SPAJANJE (NASTAVLJANJE)
ELEMENATA
PO DUŽINI**



SPAJANJE ELEMENATA RADI POVEĆANJA MERA

- **Spajanje po dužini**
- Spajanje po širini
- Spajanje po debljini

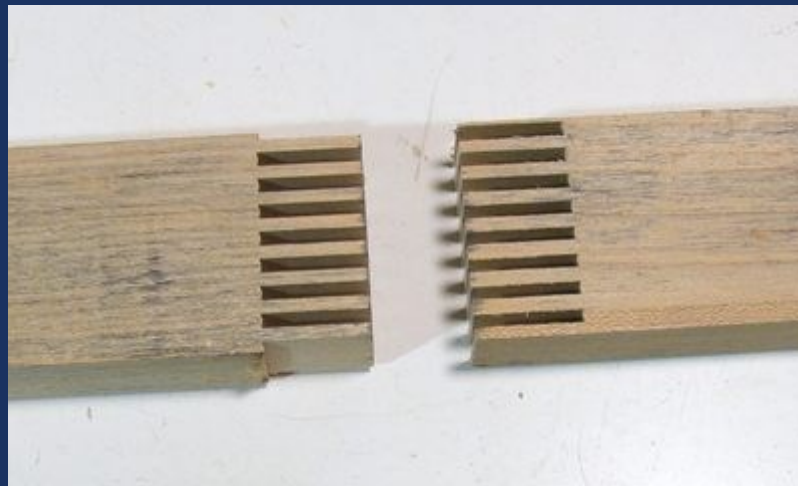


SPAJANJE ELEMENATA PO DUŽINI



SPAJANJE (NASTAVLJANJE) ELEMENATA PO DUŽINI

SPAJANJE GREDICA OD MASIVA PO DUŽINI



TIPOVI SPOJEVA

Osnovni spojevi po dužini :

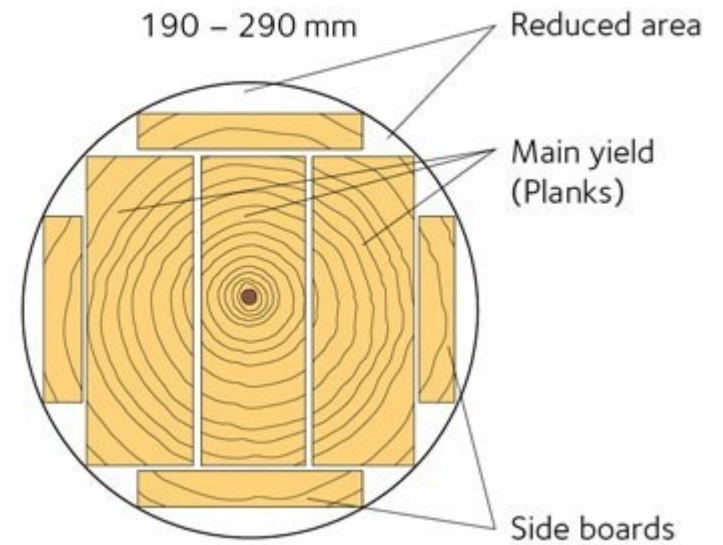
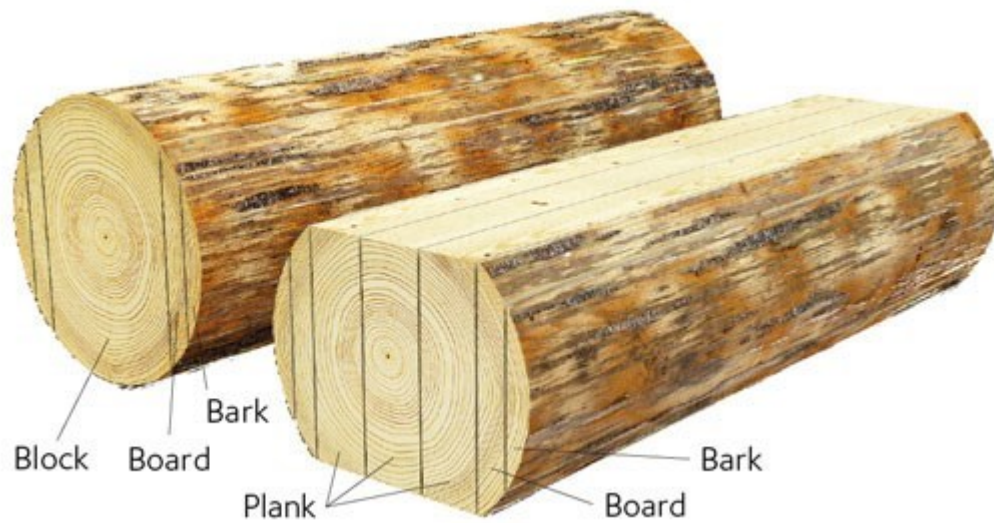
- Preklopni spojevi
- Spojevi sa čepom i prerezom
- Spojevi sa tiplovima
- Spojevi sa klinovima – rastavljivi spojevi
- **Klinasto-zupčasti spojevi**



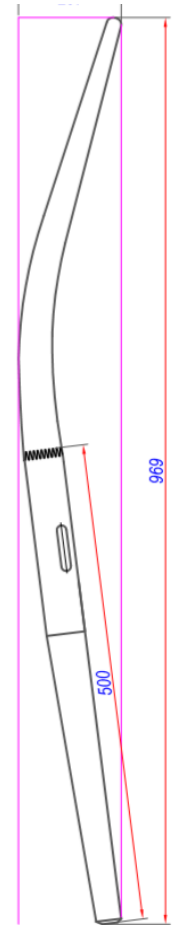
RAZLOZI DUŽINSKOG NASTAVLJANJA GREDICA

- Dobijanje dugačkih elemenata ujednačenih svojstava iz kraćih elemenata koji imaju ograničenu upotrebu
- Bolje iskorišćenje rezane građe





PRIMENA DUŽINSKI NASTAVLJENIH ELEMENATA





oplat za vodeni toranj, Finska



detalj konstrukcije



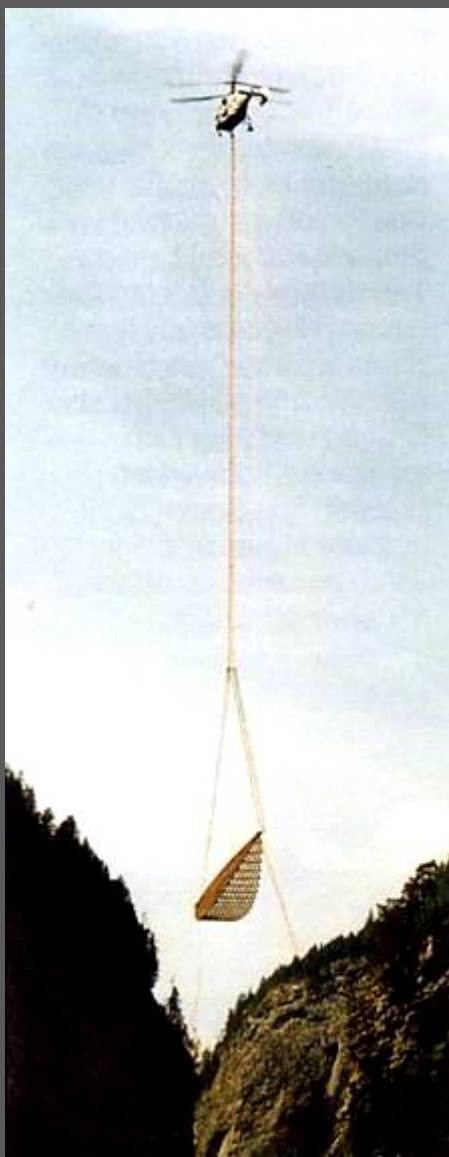
krovná konstrukcija, drvo u kombinaciji sa čelikom



most, Austrija, 1995



sala za sastanke, banka u Budimpešti, 1994



montaža mosta, Alpi



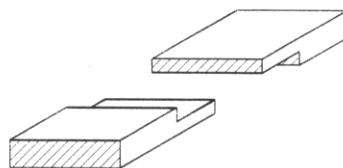
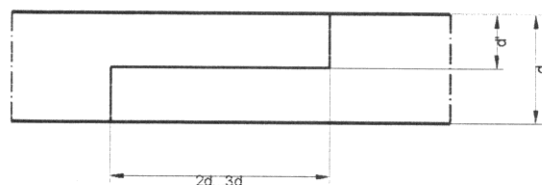
Preklopni spojevi

Spojevi sa čepom i prerezom

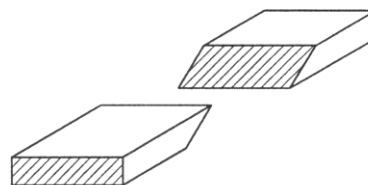
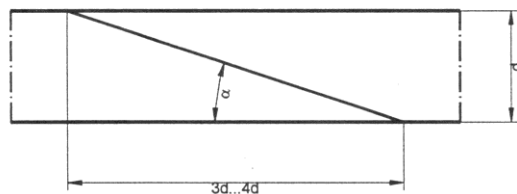
Spojevi sa tiplovima

Spojevi sa klinovima

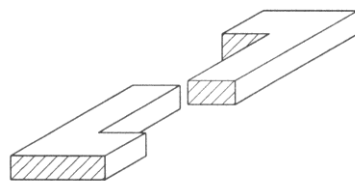
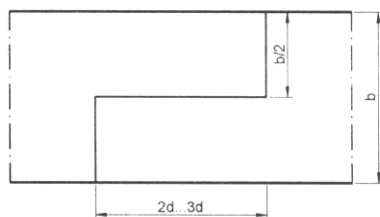
Klinasto-zupčasti spojevi



Bočni spoj na ravan sudar i ravan preklop



Bočni spoj na kosi preklop



Stranični spoj a ravan sudar i ravan preklop

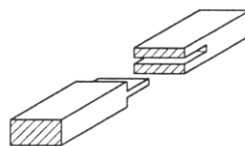
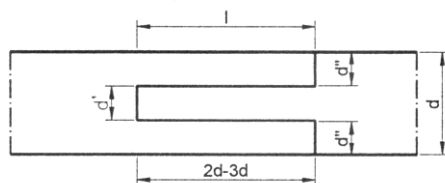
Preklopni spojevi

Spojevi sa čepom i prerezom

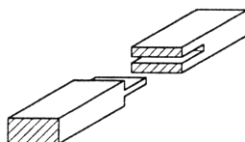
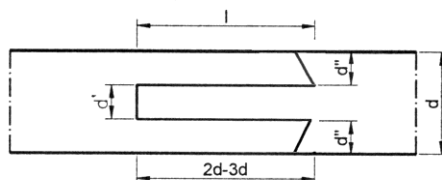
Spojevi sa tiplovima

Spojevi sa klinovima

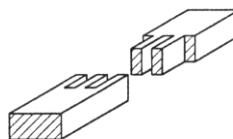
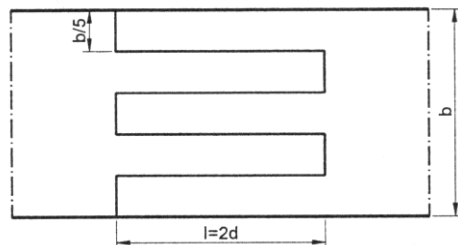
Klinasto-zupčasti spojevi



Bočni spoj sa čepom i
prerezom na ravni sudar



Bočni spoj sa čepom i
prerezom na kosi sudar



Stranični spoj sa čepom i
prerezom na ravni sudar

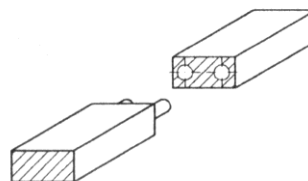
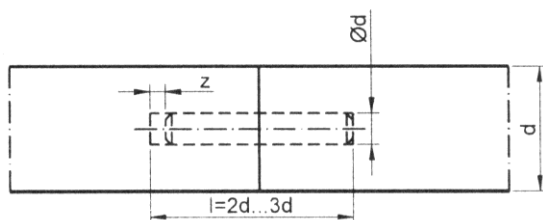
Preklopni spojevi

Spojevi sa čepom i prerezom

Spojevi sa tiplovima

Spojevi sa klinovima

Klinasto-zupčasti spojevi

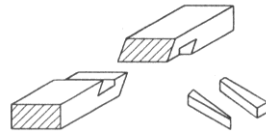
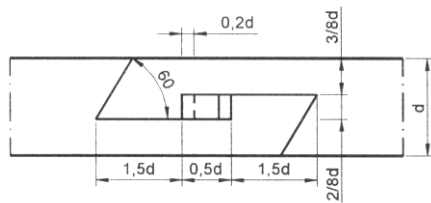


Spoj sa
tiplovima

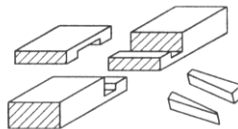
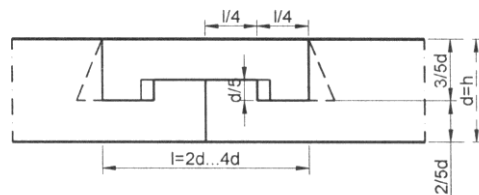
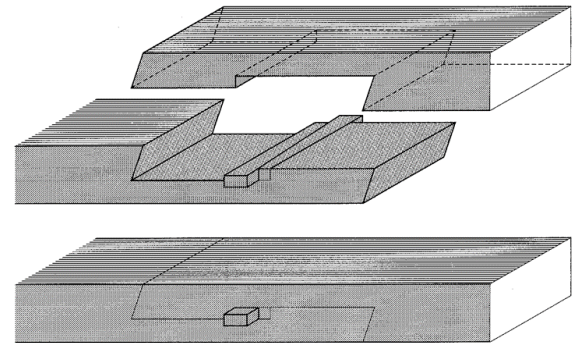
Spojevi sa tiplovima

Spojevi sa klinovima – rastavljivi spojevi

Klinasto-zupčasti spojevi



Spoj sa klinovima (francuski klin)



Spoj sa klinovima (nemački klin)

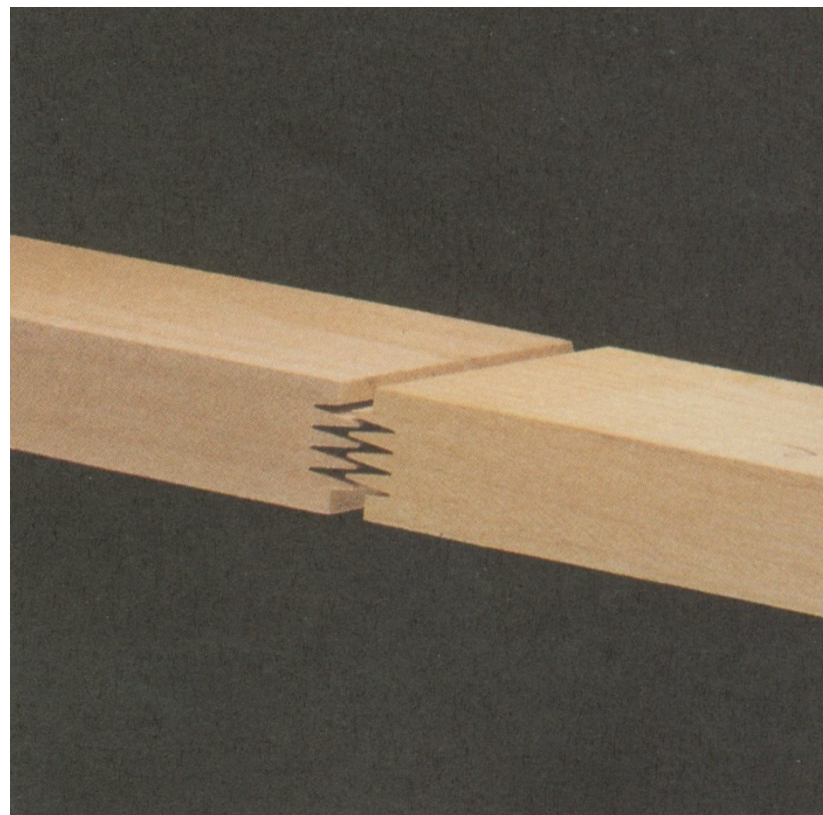
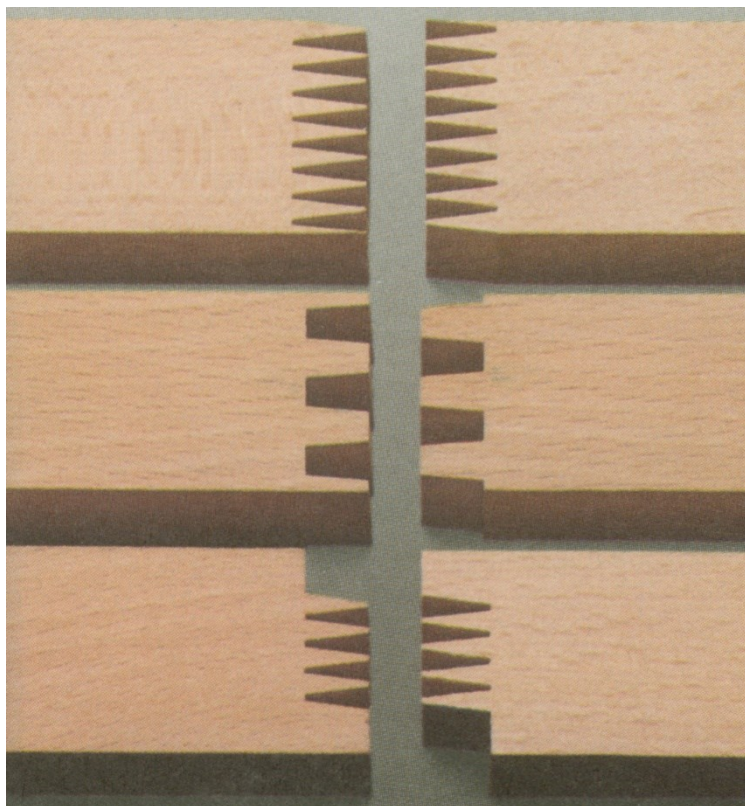
Preklopni spojevi

Spojevi sa čepom i prorezom

Spojevi sa tiplovima

Spojevi sa klinovima – rastavljivi spojevi

Klinasto-zupčasti spojevi



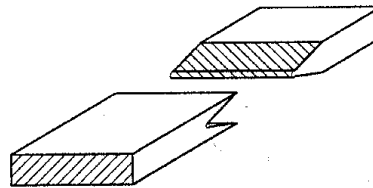
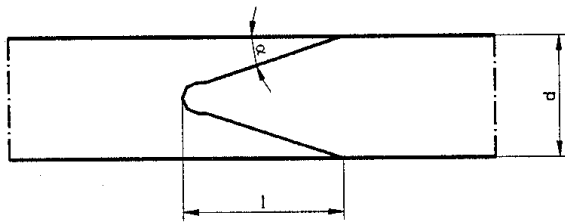
Preklopni spojevi

Spojevi sa čepom i prerezom

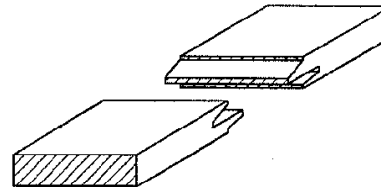
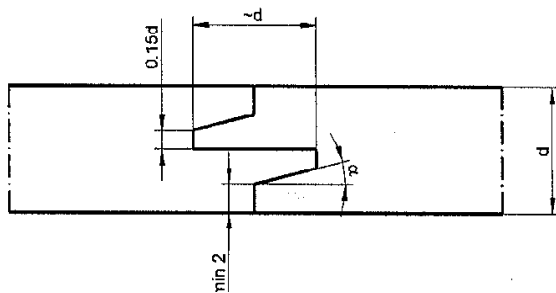
Spojevi sa tiplovima

Spojevi sa klinovima – rastavljivi spojevi

Klinasto-zupčasti spojevi



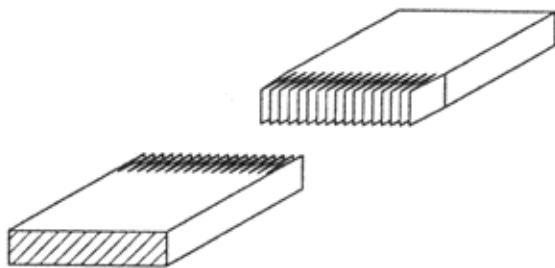
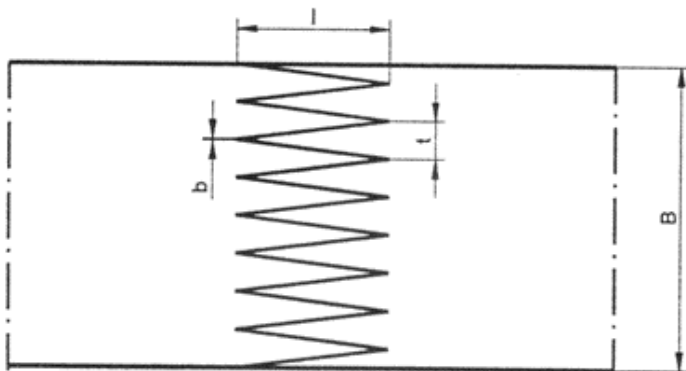
Bočni spoj na zubac



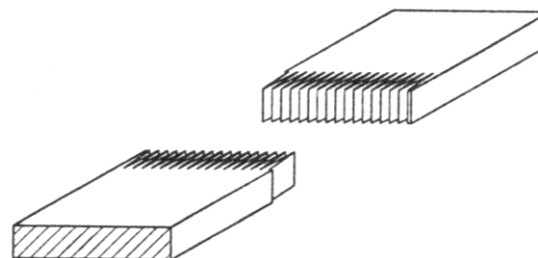
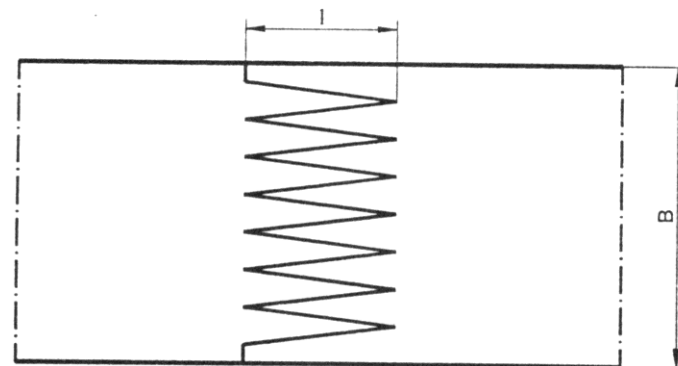
Bočni spoj na
profil-kontra-profil

TIPOVI K-Z SPOJEVA

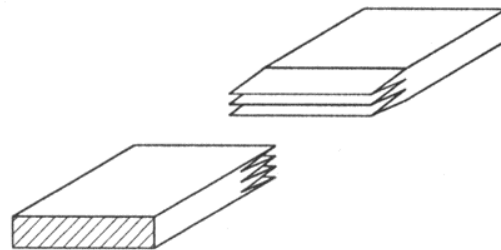
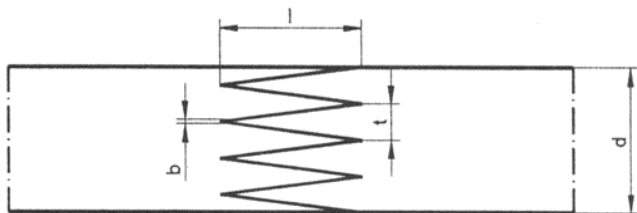
Tip A



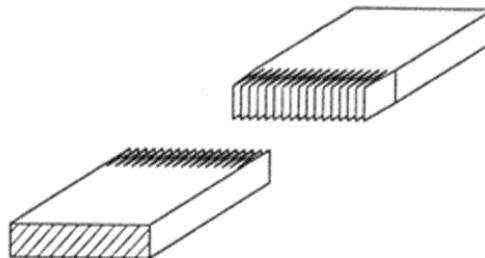
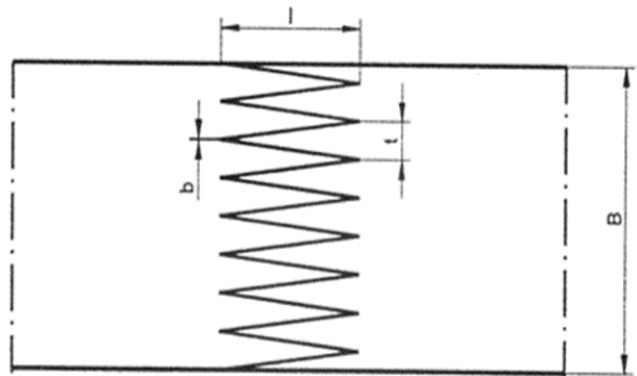
Tip B



TIPOVI K-Z SPOJEVA - TIP A

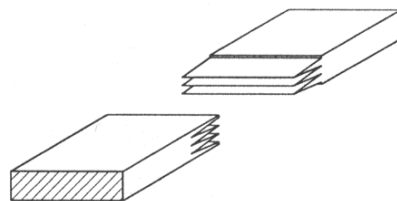
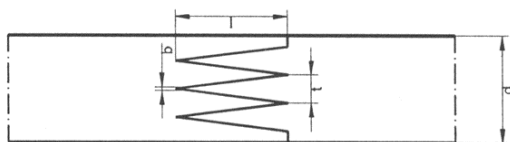


Boční klinasto
zupčasti spoj –tip A

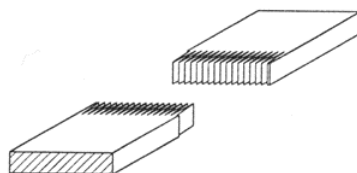
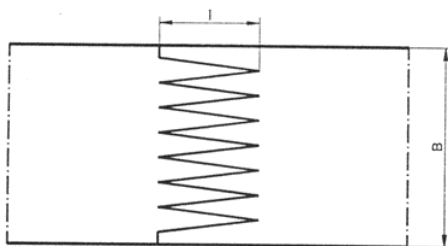


Straniční klinasto
zupčasti spoj –tip A

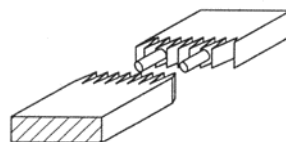
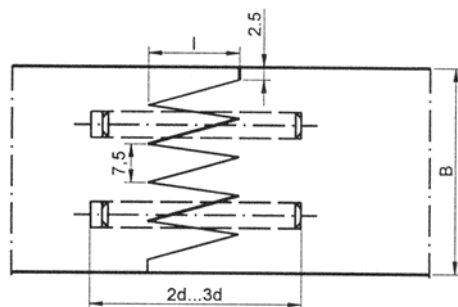
TIPOVI K-Z SPOJEVA - TIP B



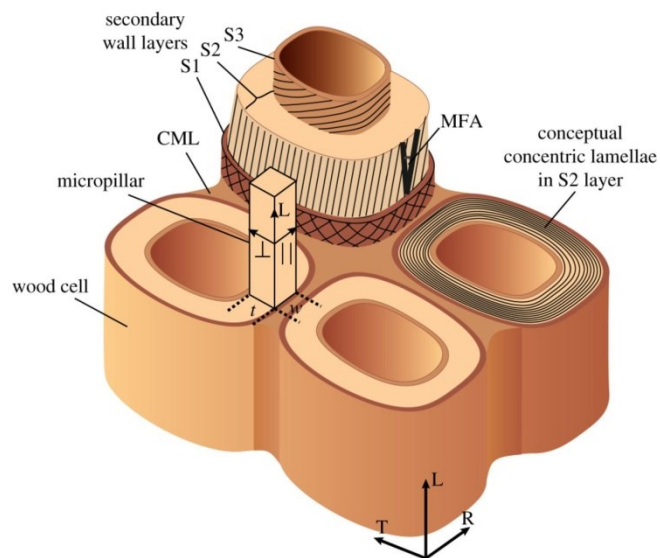
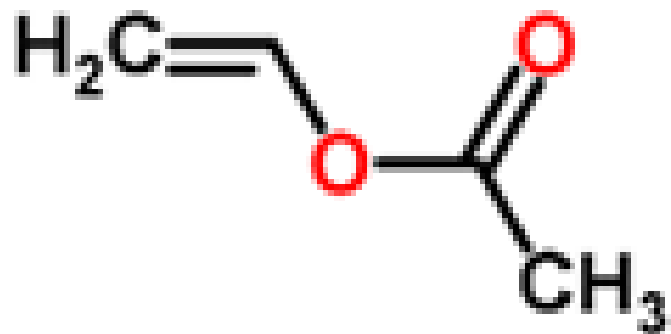
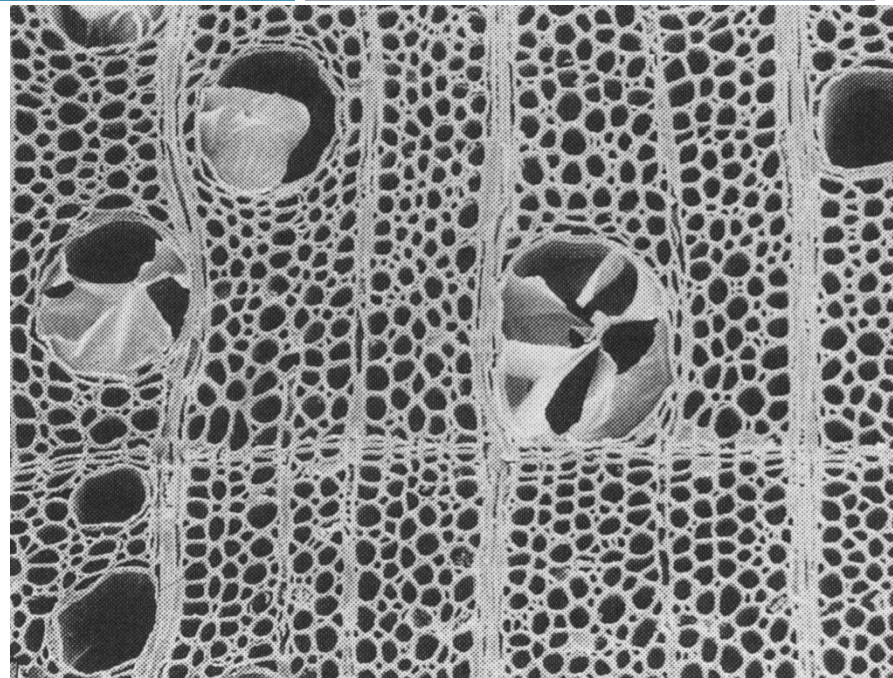
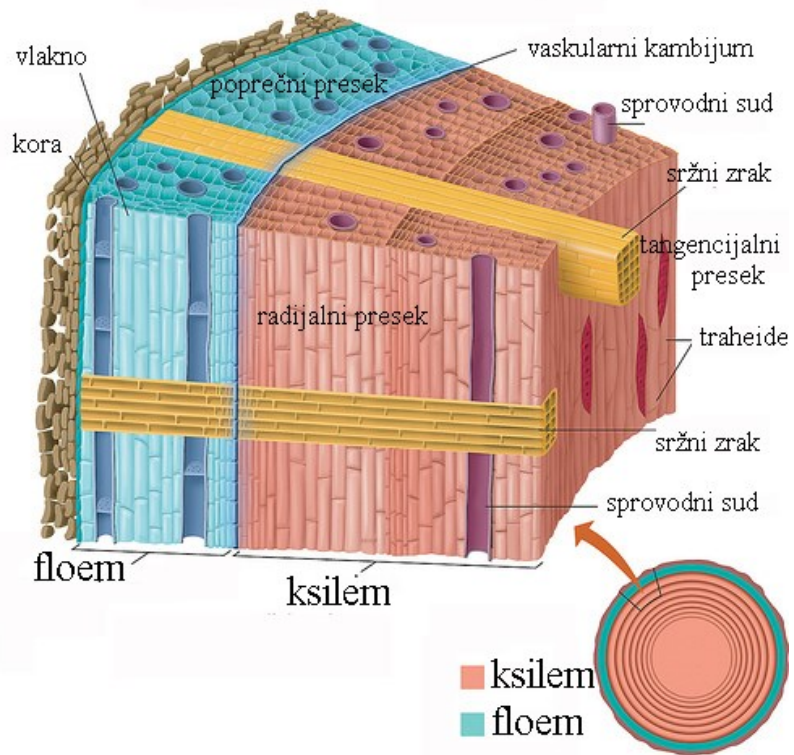
Bočni klinasto
zupčasti spoj –tip B



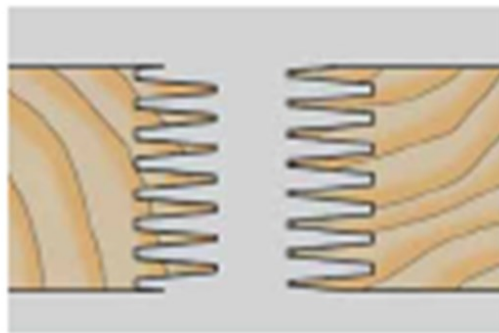
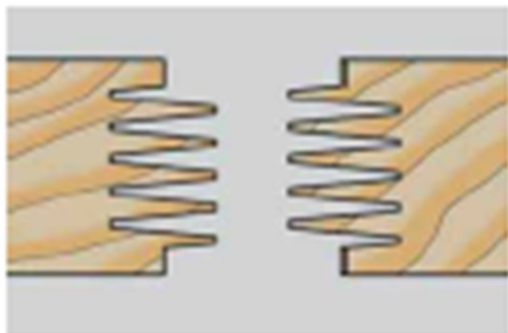
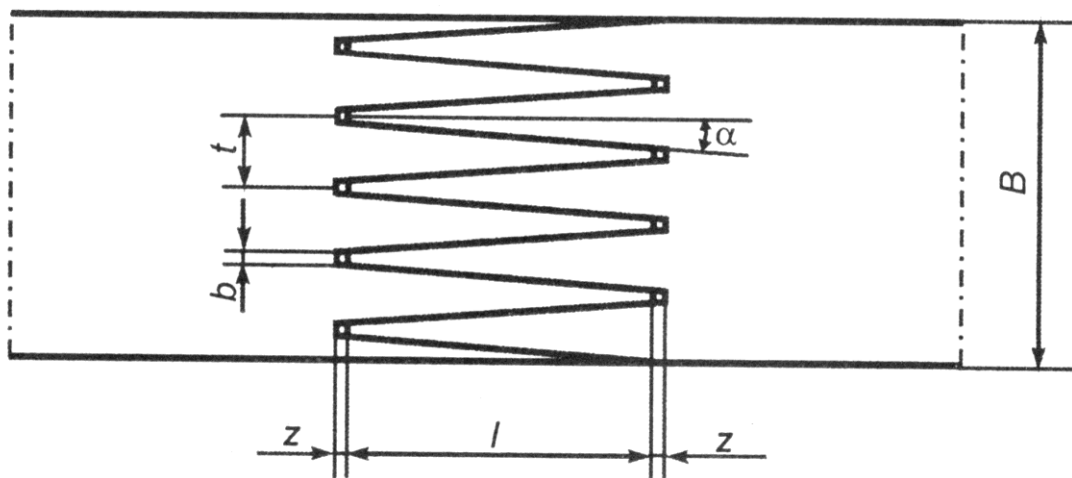
Stranični klinasto
zupčasti spoj –tip B



Stranični klinasto
zupčasti spoj –tip B,
ojačan tiplovima



GEOMETRIJA K-Z SPOJA

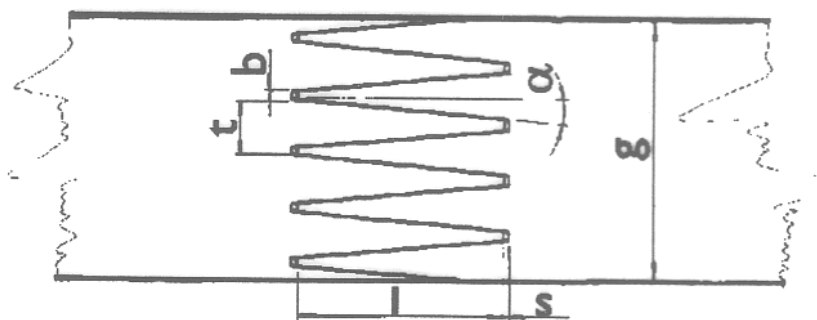


B – širina spoja,
 l – dužina zupca,
 t – korak zupca, b –
zatupljenje zupca,
 z – zazor u pazuhu zupca,
 α – nagib zupca

Kako biramo spojeve?

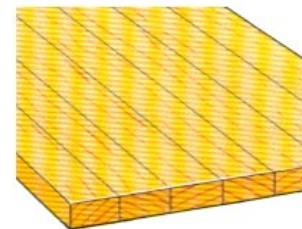
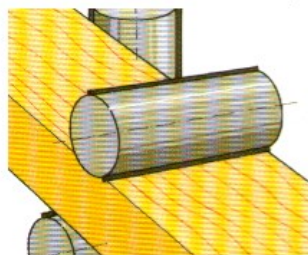
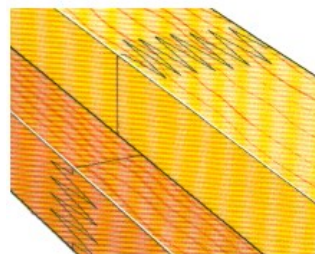
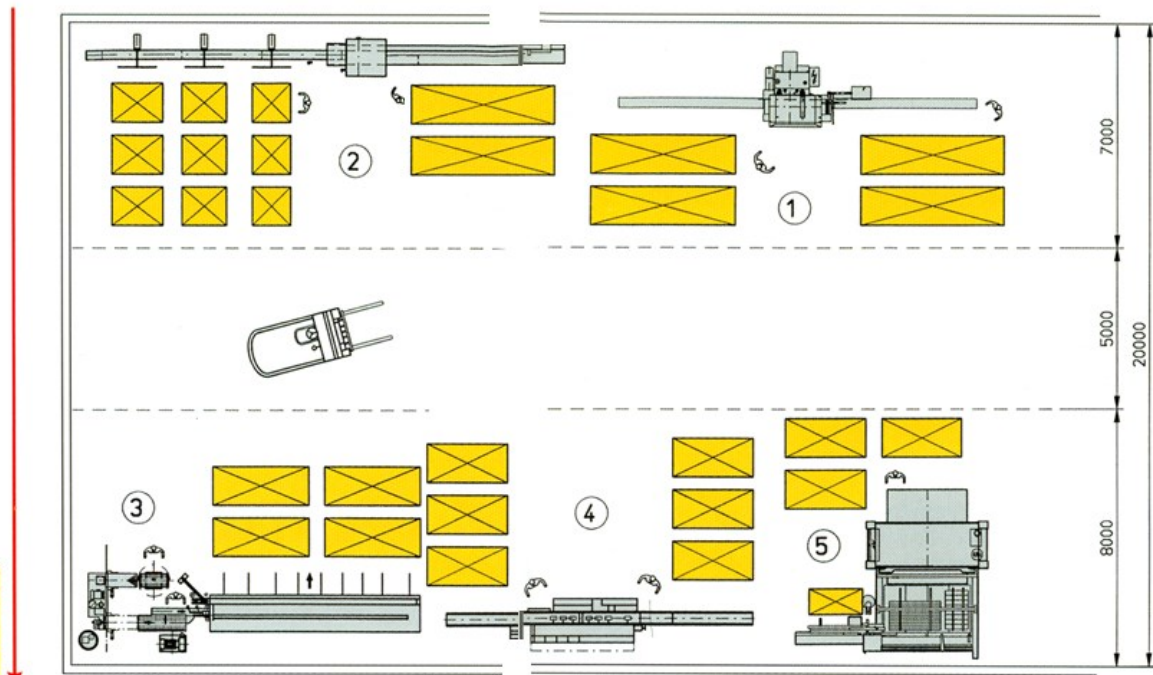
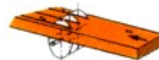
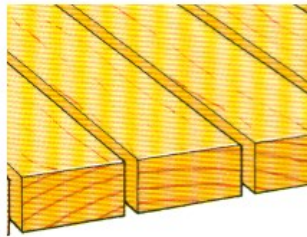
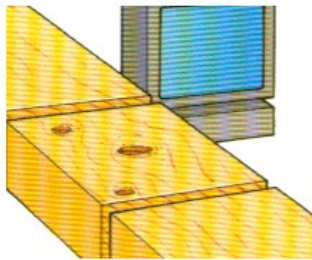
Podela klinasto zupčastih spojeva prema opterećenju - prema DIN-u 68140

Grupa naprezanja	v	l (mm)	α°
Visoko naprezanje	$\leq 0,18$	≤ 10 > 10	$\leq 1: 7,6 (7,5^\circ)$ $\leq 1: 8 (7,1^\circ)$
Srednje naprezanje	$\leq 0,25$	≤ 10 > 10	$\leq 1: 7,6 (7,5^\circ)$ $\leq 1: 8 (7,1^\circ)$

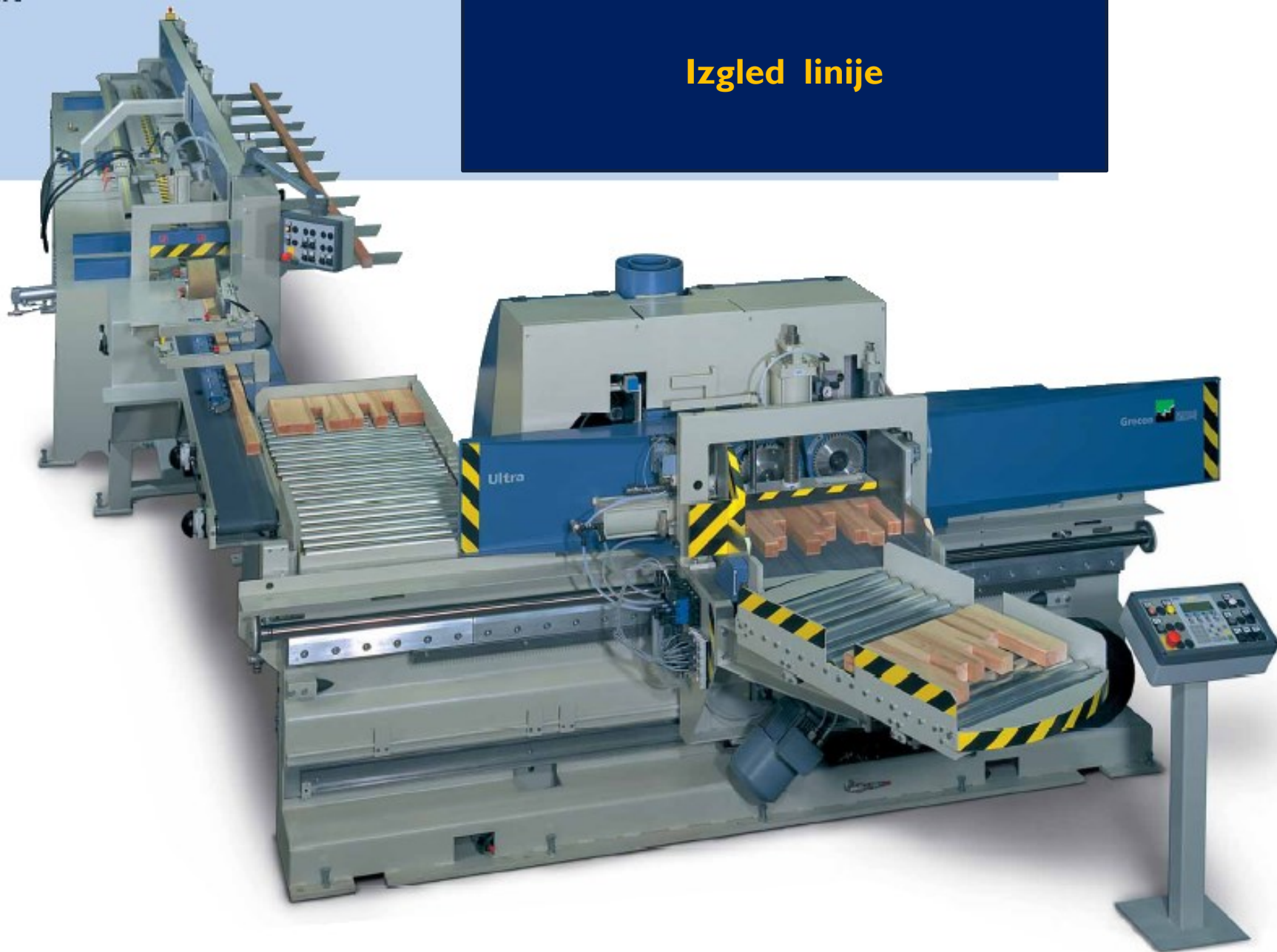


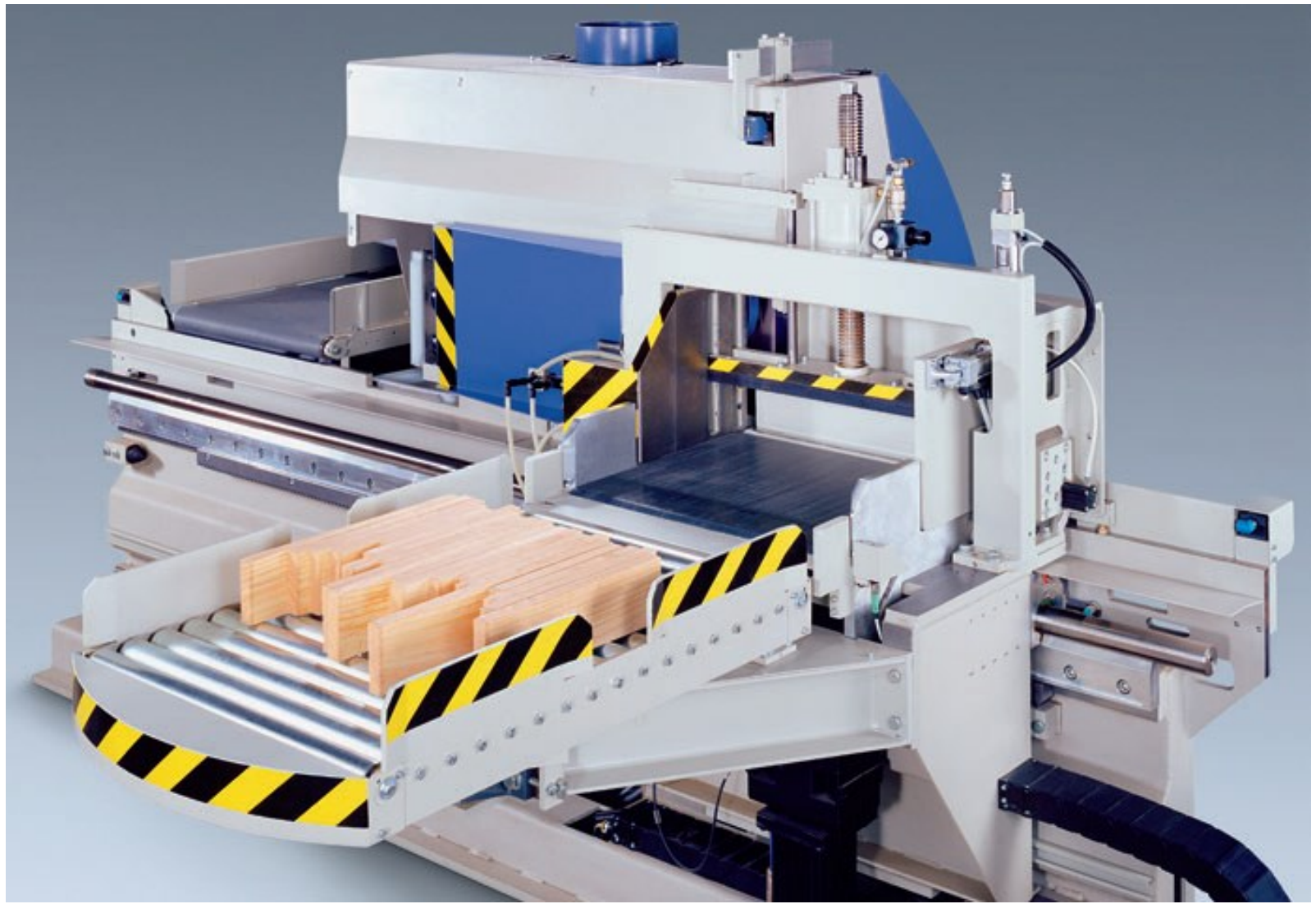
Veličine geometrijskih karakteristika kod spojeva
izloženih visokom i srednjem naprezanju

Grupna naprezanja	l	t	b	v
	mm			
Visoko i srednje mehaničko naprezanje	7,5	2,5	0,2	0,08
	10	3,7	0,6	0,16
	20	6,2	1	0,16
	50	12	2	0,17
	60	15	2,7	0,18
Srednje mehaničko naprezanje	4	1,6	0,4	0,25
	15	7	1,7	0,24
	30	10	2	0,2

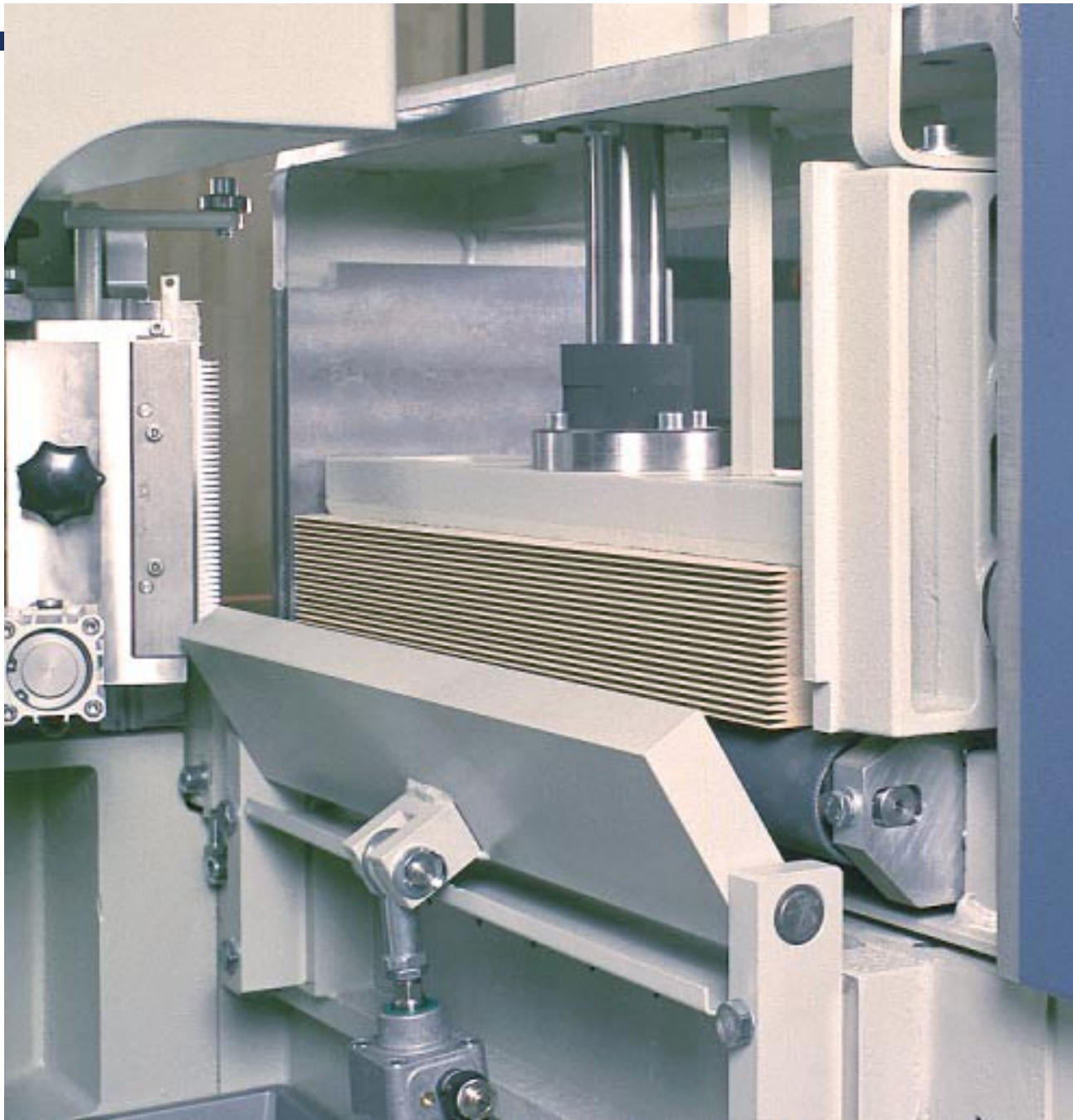


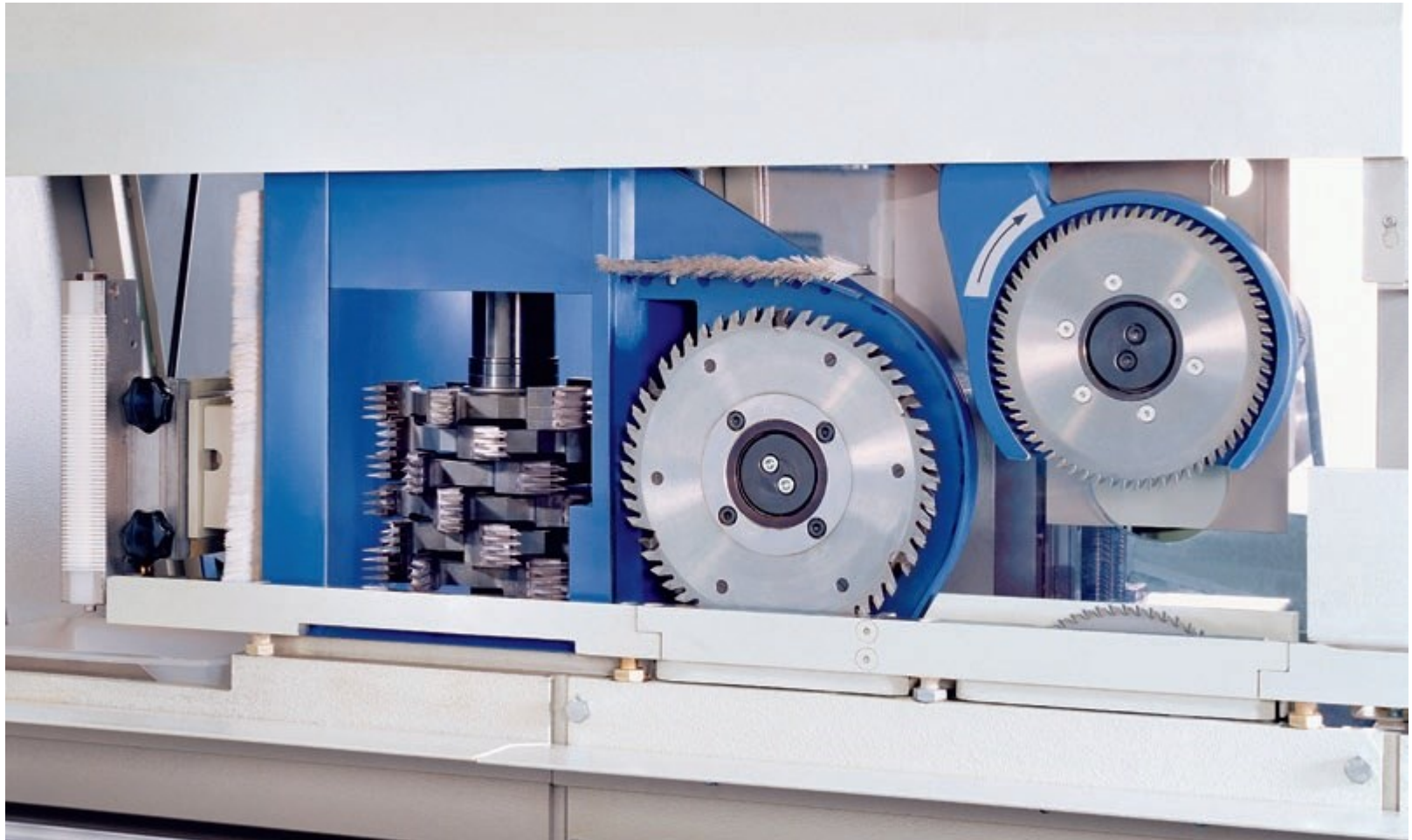
Izgled linije

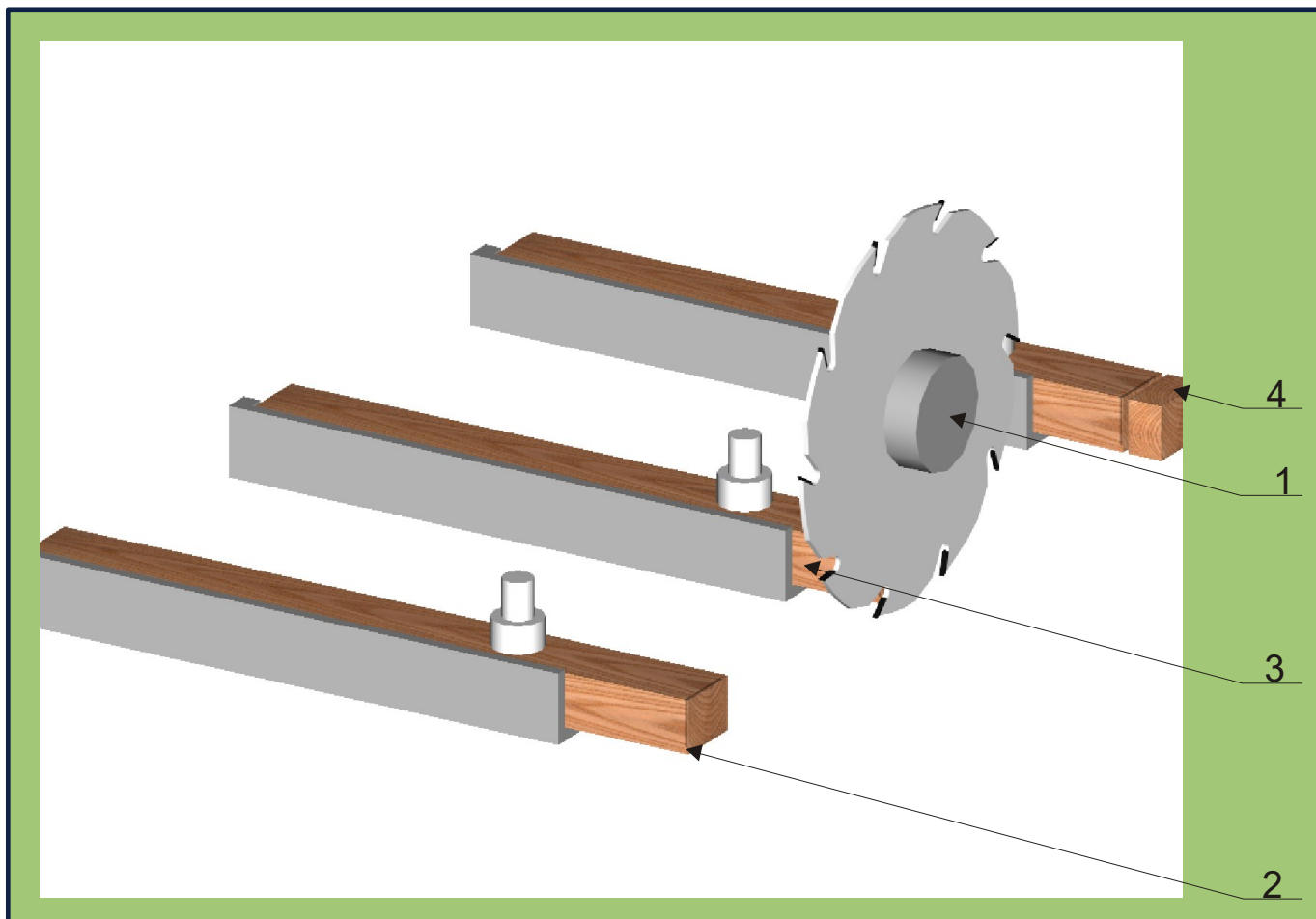


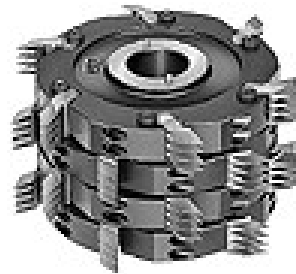














e.g. rough sizing

Workpiece material

Tool

Diameter

No. of teeth

Tooth shape

Machine

Adaptor

RPM

Cutting speed

Feed rate

Cutting width

Cutting depth

Special application

Regrinding area

Performance time

Notes

Hogging set in cutter design, TC

chipboard, uncoated

Hogging set in cutter design

250 mm

42

FZ

Double-end tenoner

Standard flanged sleeve

6000 min⁻¹

78,5 m s⁻¹

80 m min⁻¹

15,4 mm

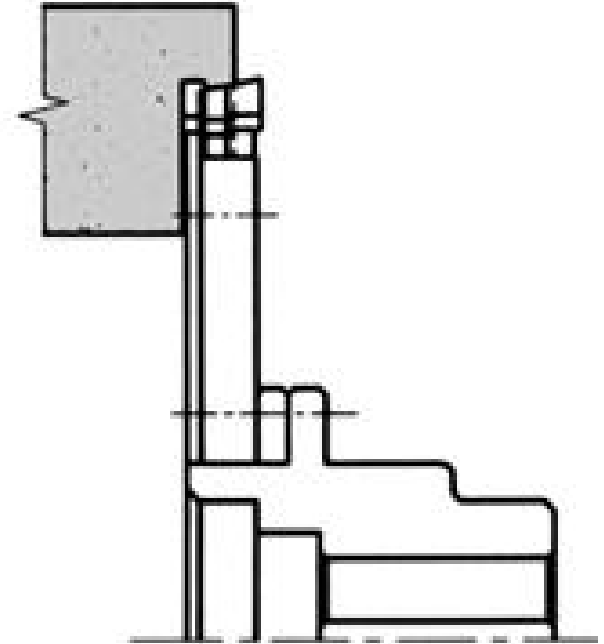
12 mm

cutting against feed, $f_z = 0.32$ mm

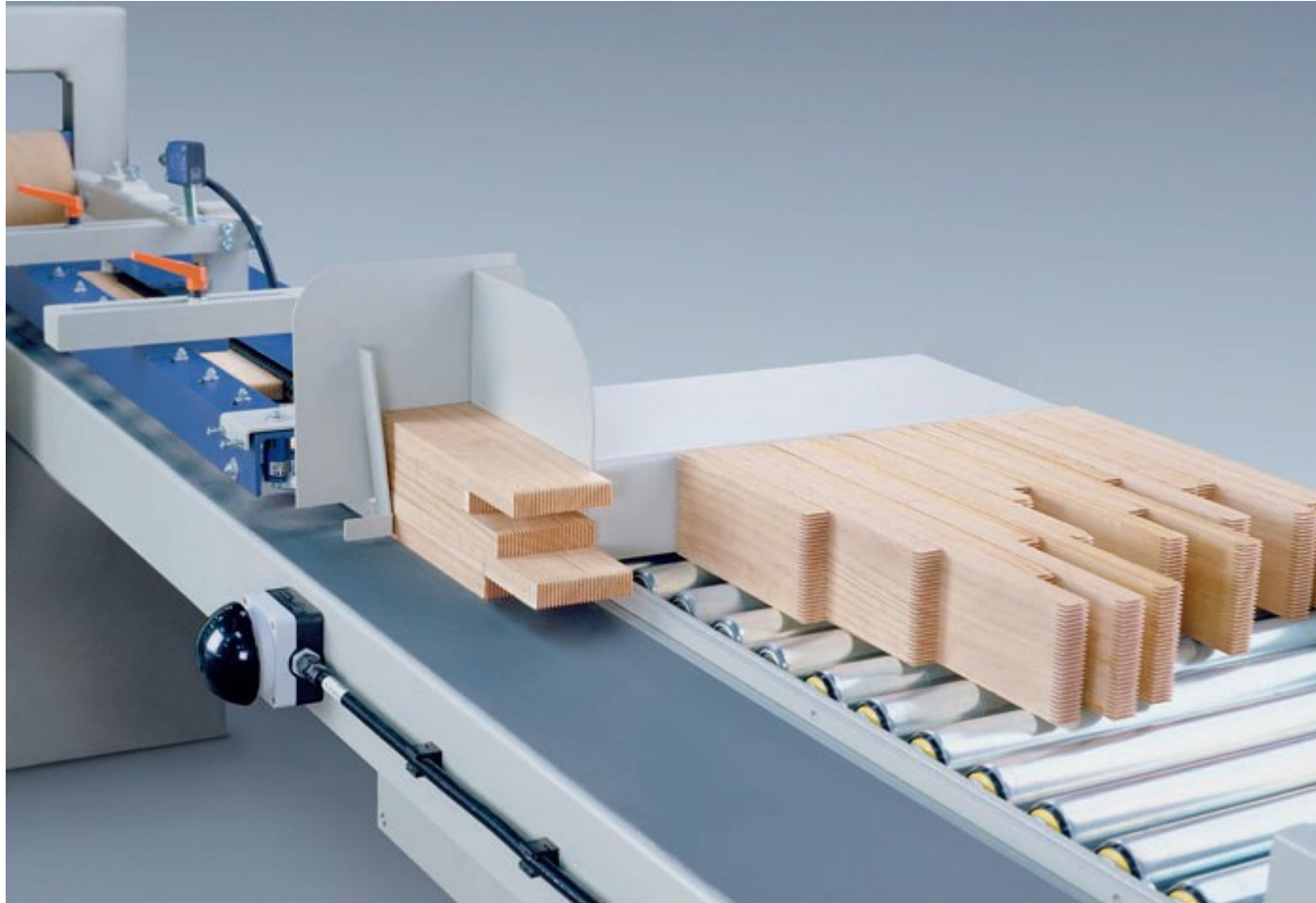
8 mm

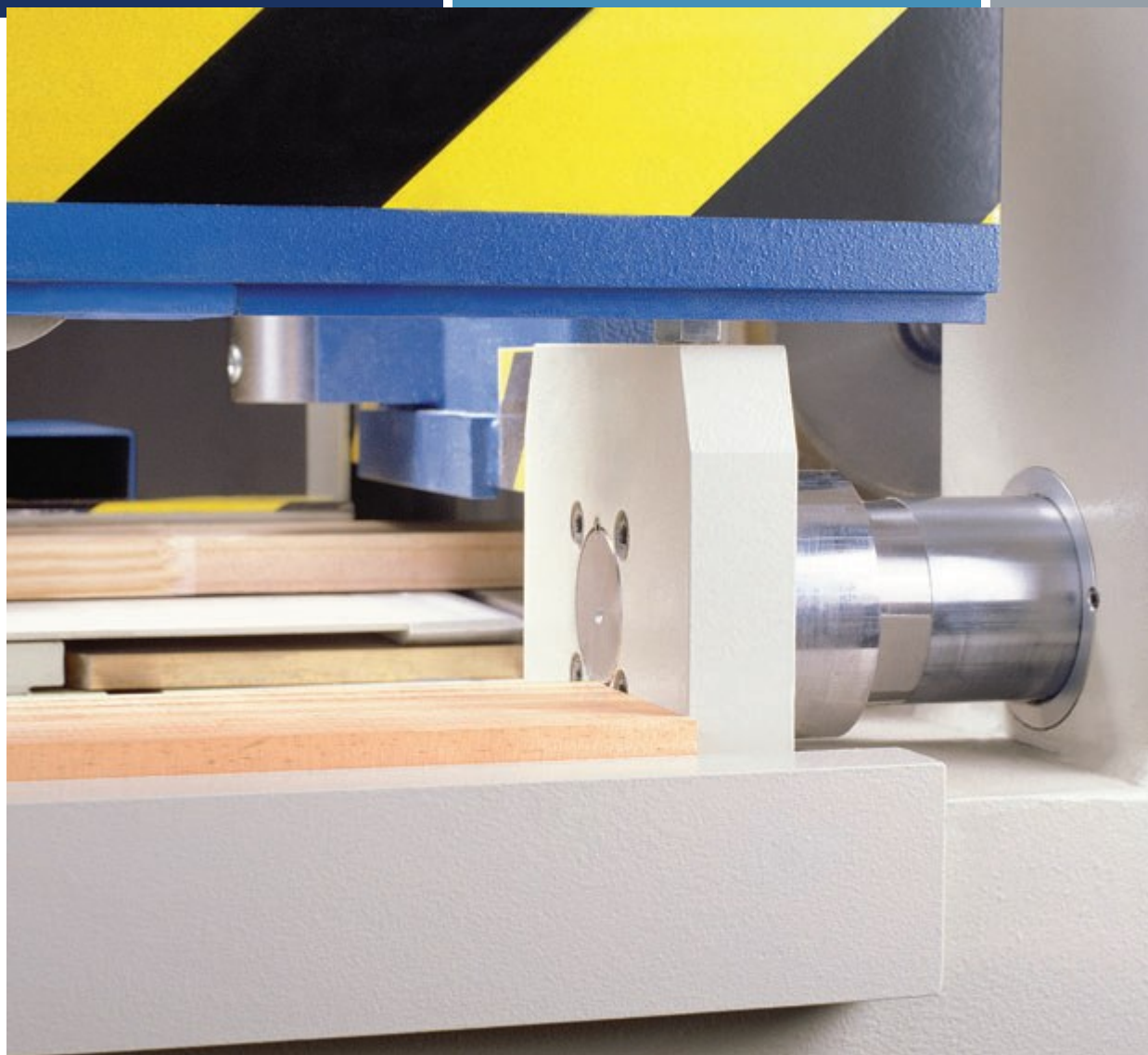
25 000 m

Sizing of chip boards for subsequent covering with solid wood edge bandings







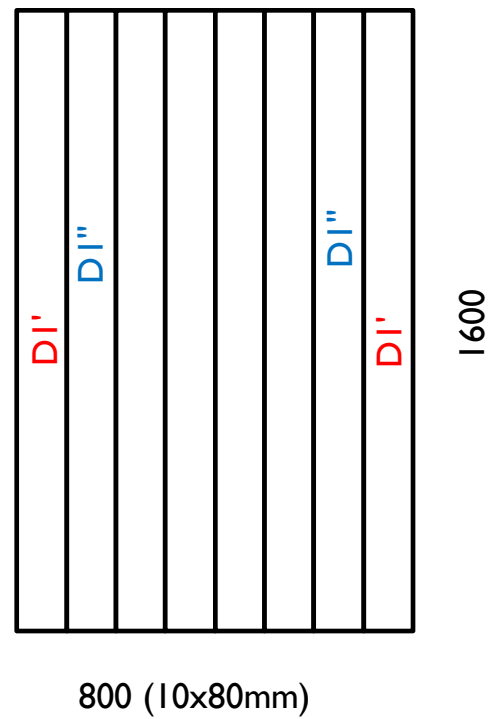




PRIMER 3



1600x800x20mm



ZADATAK I

- Ploča trpezarijskog stola, dimenzija rozora, dimezija 1600x900x19mm, slika 1, izrađuje se iz dužinski nastavljenih lamela bukovine. Svaka ploča sastavljena je iz 10 lamela.
- Dimenzija poprečnog preseska gredica koje dolaze na dužinsko nastavljanje iznosi 22x95mm. Elementi veze za nastavljanje po dužini se narezuju po boku gredice. Za nastavljanje gredica po dužini koristiti zubce srednje veličine. Dužinsko nastavljanje se vrši na gredicama koje su prethodno obrađene.



I Ulazni podaci

- potrebna količina ploča: $N_d = 250$ ploča/smeni
- broj smena: $n_s = 2$
- granične dimenzije pripremake za nastavljjanje: $l_{\min} = 150\text{mm}$:
 $l_{\max} = 1000\text{mm}$
- širina paketa (pripremnog transportera) na liniji za nastavljjanje: $b_p = 600\text{mm}$

II METOD RADA

1. Odrediti geometriju spoja klinasto-zupčaste veze
2. Izabrati alat za izradu klinasto-zupčastih spojeva i prikazati opštu geometriju alata (naziv kataloga, stranu kataloga, kataloški broj, D, B, z, n), ako je $d=50\text{mm}$.
3. Odrediti režime lepljenja (vrstu lepka, temperaturu lepljenja, silu stezanja, količinu nanosa i vreme stezanja)
4. Odrediti tehnološki kapacitet linije za dužinsko nastavljjanje
5. Proračunati utrošak lepka

1. Geometrija klinasto -zupčaste veze

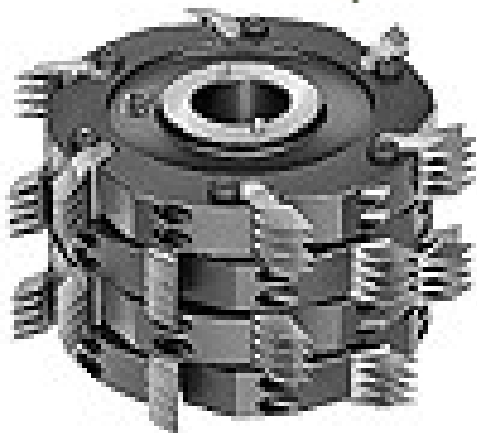
grupa naprezanja	l	t	b	v



2. Izbor alata (d, D, B, z, n)

Veličine geometrijskih karakteristika kod spojeva izloženih visokom i srednjem naprezanju

Grupna naprezanja	l	t	b	v
	mm			
Visoko i srednje mehaničko naprezanje	7,5	2,5	0,2	0,08
	10	3,7	0,6	0,16
	20	6,2	1	0,16
	50	12	2	0,17
	60	15	2,7	0,18
Srednje mehaničko naprezanje	4	1,6	0,4	0,25
	15	7	1,7	0,24
	30	10	2	0,2



3. REŽIMI LEPLJENJA (VRSTA LEPKA, T, PC, Q, T)

- vrsta lepka – PVA-c
- t – » $18 \div 22$ °C
- P_c –sila stezanja / izračunati
- q – količina nanosa
- Q – utrošak lepka / izračunati
- T – vreme stezanja / vreme takta prese /
manipulativna čvrstoća / tehnička čvrstoća

3. REŽIMI LEPLJENJA (VRSTA LEPKA, T, PC, Q, T)

SPECIFIČNI PRITISAK PREMA DIN 68140

dužina zuba l (mm)	Ps (daN/cm ²)
4÷10	120
10÷20	100
20÷30	80
30÷40	60
40÷50	40
50÷60	20

$$P_c = A \cdot P_s \quad [daN]$$

A – površina poprečnog preseka gredice
za nastavljjanje

P_c – sila stezanja

P_s – specifični pritisak

4. Tehnološki kapacitet linije za dužinsko nastavljjanje

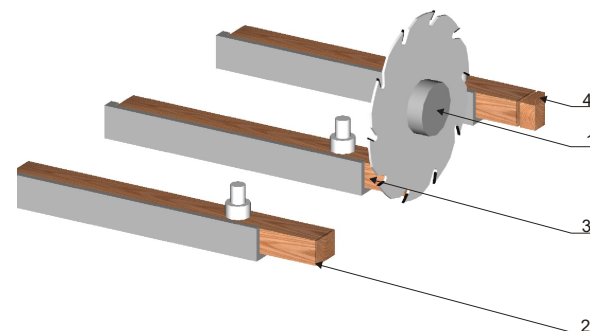
- prosečne dimenzije gredica za spajanje po dužini

$l_{sr}=400\text{mm}$: $b_{sr}=\dots\dots\dots\text{mm}$: $d_{sr}=\dots\dots\dots\text{mm}$

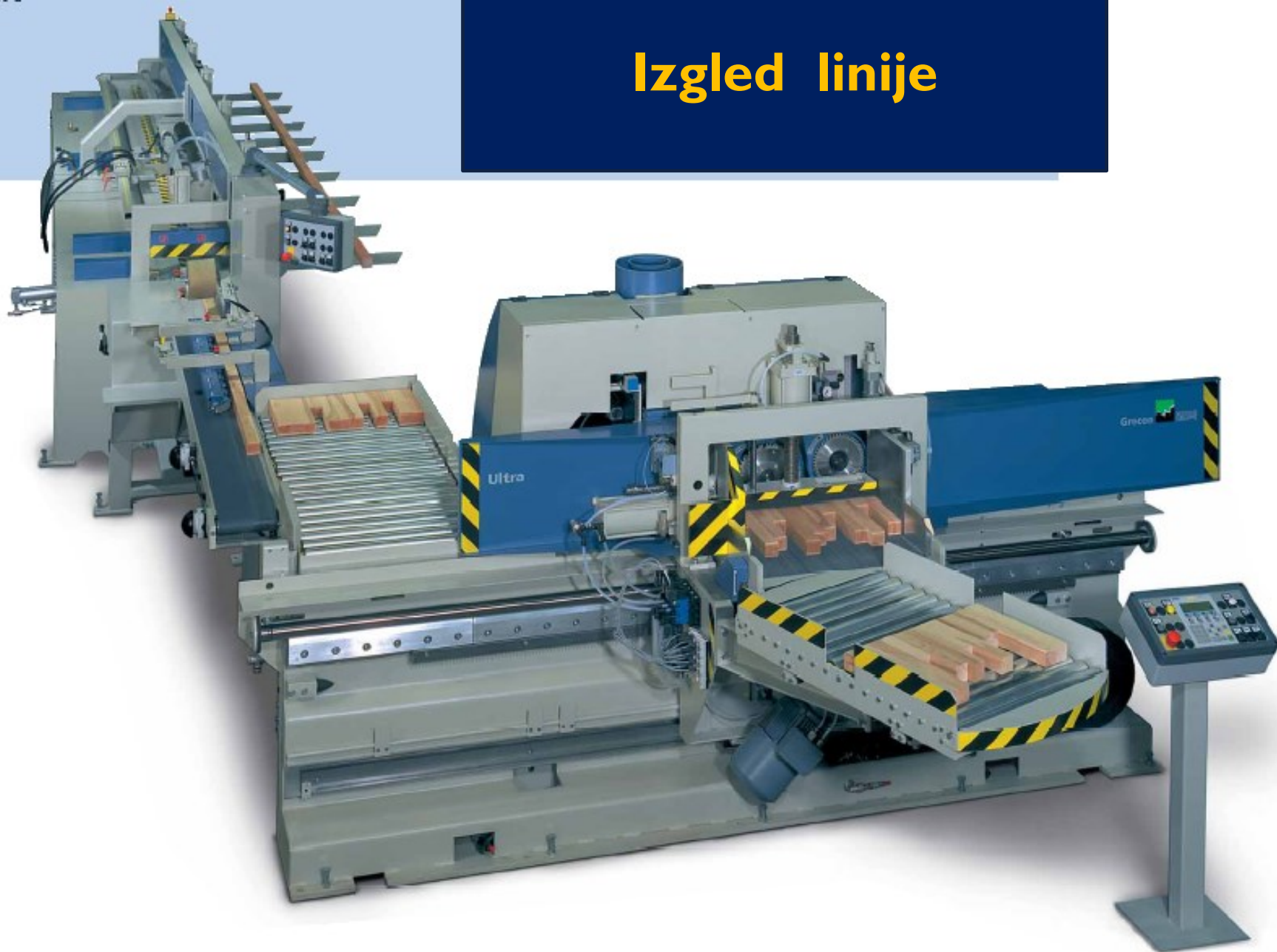
$V_{sr}=\dots\dots\dots(\text{m}^3)$

- dužina gredica posle izrade elementa veze

$l'_{sr} = l_{sr} - 25\text{mm}$



Izgled linije



KARAKTERISTIKE LINIJA



Kapacitet	Profijoint 2	Profijoint 3	Profijoint 4	Profijoint K4	Profijoint K6
Deo za izradu el.veze (paketa/min)	2	2	2	4	4
Prebacivač (kom/min)	30	35	40	60	100
Presa (takt/min)	2	2	2	4	6

broj elemenata u paketu

$$n_{el} = \frac{b_p}{d_{sr}} = \left[\frac{kom}{paketu} \right]$$

- proračun proizvodnosti

$$N = \frac{Q_{du}}{P_{sm} \cdot b \cdot c} = [kom]$$

$$P_{sm} = \frac{Q_{du}}{N \cdot b \cdot c} = \left[\frac{m^3}{smeni} \right]$$

N – potreban broj mašina (kom)

Q_{du} – godišnja količina građe

koja se nastavlja dužinski (m³/god)

P_{sm} – smenska proizvodnost (m³/smeni)

b – broj radnih dana u godini: b = 250

c – broj radnih smena u danu: c = 2

broj komada (gredica) u smeni

$$n_{sm} = \frac{P_{sm}}{V_{sr}} = \left[\frac{\text{kom}}{\text{smeni}} \right]$$

- broj komada po minuti

$$n_{\min} = \frac{n_{sm}}{T \cdot k_r} = \left[\frac{\text{kom}}{\text{min}} \right]$$

T – radno vreme smene: T = 480min/smeni

k_r – koeficijent iskorišćenja radnog vremena

$$k_r = 0.7$$

smene:

- broj paketa po minuti

$$n_{pak} = \frac{n_{\min}}{n_{el}} = \left[\frac{\text{paketa}}{\text{min}} \right]$$

Prosečan broj obradaka u presi
po taktu

$$n_{pr} = \frac{l_p}{l_{sr}} = \left[\frac{kom}{min} \right]$$

broj taktova prese po minuti

$$n_{preb} = \frac{n_{min}}{n_{pr}} \left[\frac{takta}{min} \right]$$

smenska proizvodnost (sa kapacitetom uskog grla)

$$P_{sm} = T \cdot k \cdot n_{min} \cdot V_{sr} = \left[\frac{m^3}{sm} \right]$$

- potreban broj mašina

$$N = \frac{Q_{du}}{P_{sm} \cdot b \cdot c} = [kom]$$

5. Proračun utroška lepka

dnevna količina
lepka

$$Q_l = \frac{S_d \cdot 2 \cdot A \cdot q}{k_i} = \left[\frac{Kg}{danu} \right]$$

S_d – broj klinasto zupčastih sastava na dan (kom/dan)

A – površina lepljenja po čelu (m^2/kom)

q – količina nanosa (g/m^2) ($160 \div 200 g/m^2$)

k_i – koeficijent iskorišćenja lepka: $k_i=0.95$ (0.7-0.95)

**broj klinasto zupčastih
sastava na dan**

$$S_d = L_d \cdot s = \left[\frac{\text{kom}}{\text{dan}} \right]$$

L_d – dužina koja dolazi na lepljenje ($\text{m'}/\text{dan}$)

s – broj klinasto zupčastih spojeva po m' ($\text{kom}/\text{m'}$)

$$s = \frac{1000 \text{ mm}}{375 \text{ mm}} = 2.6 \frac{\text{kom}}{\text{m}}$$

- površina lepljenja

$$A = n_z \cdot l_z \cdot d = \left[\frac{\text{m}^2}{\text{kom}} \right]$$