

6. KOLNICI

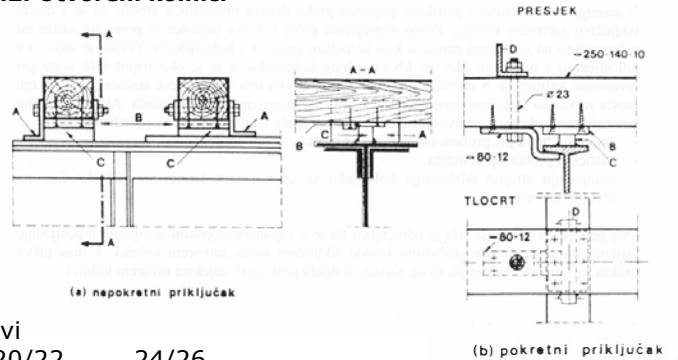
6.1. ŽELJEZNIČKI MOSTOVI

- OTVORENI
- mala težina
 - jednostavnost
 - nema odvodnje
 - prekid zastora u trasi

- ZATVORENI
- smanjuju buku
 - zaštićuju prolaz ispod mosta
 - strojno održavanje bez prekida
 - 30 kN/m za 1 kolosijek – cca 3 puta više nego otvoreni

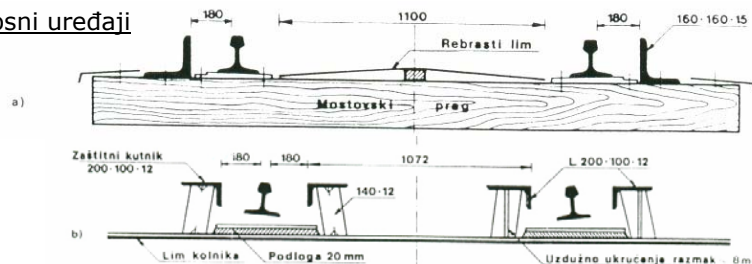
U SUVREMENOJ IZVEDBI PREVLAĐAJU ZATVORENI!

6.1.2. Otvoreni kolnici

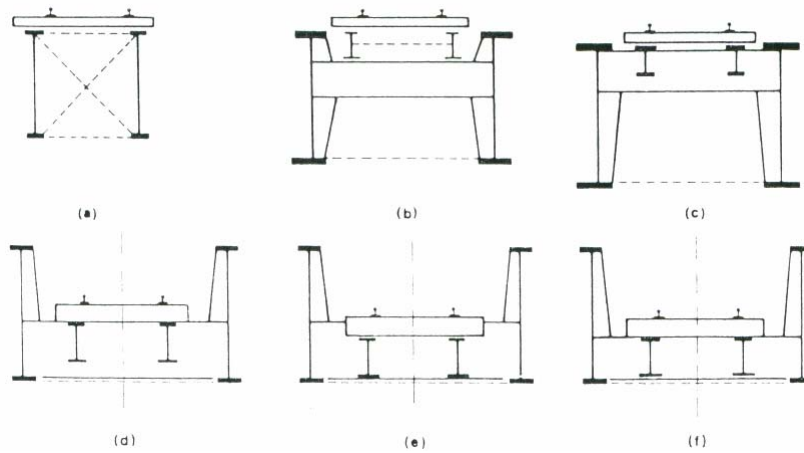


Pragovi
 $b/h=20/22.....24/26$
 $a=1800.....2000$ mm

Sigurnosni uređaji



Dispozicije otvorenih kolnika

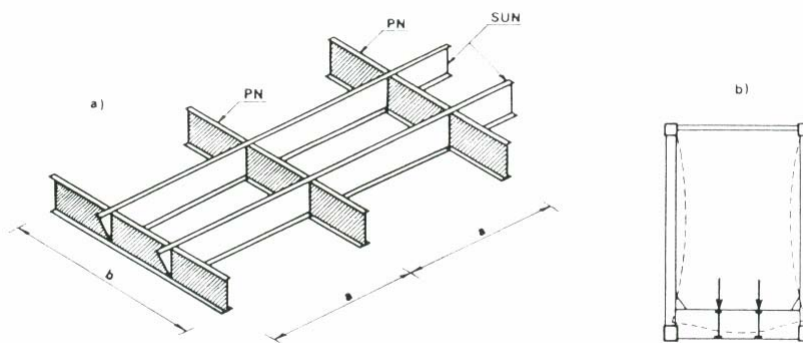


a) $b/L \leq 1/20 \quad \dots \quad b_{\max} = 2m \rightarrow L \leq 40m$

b)c) $L > 40 \quad i \quad h_b > h_k$

d)e)f) $h_b < h_k$

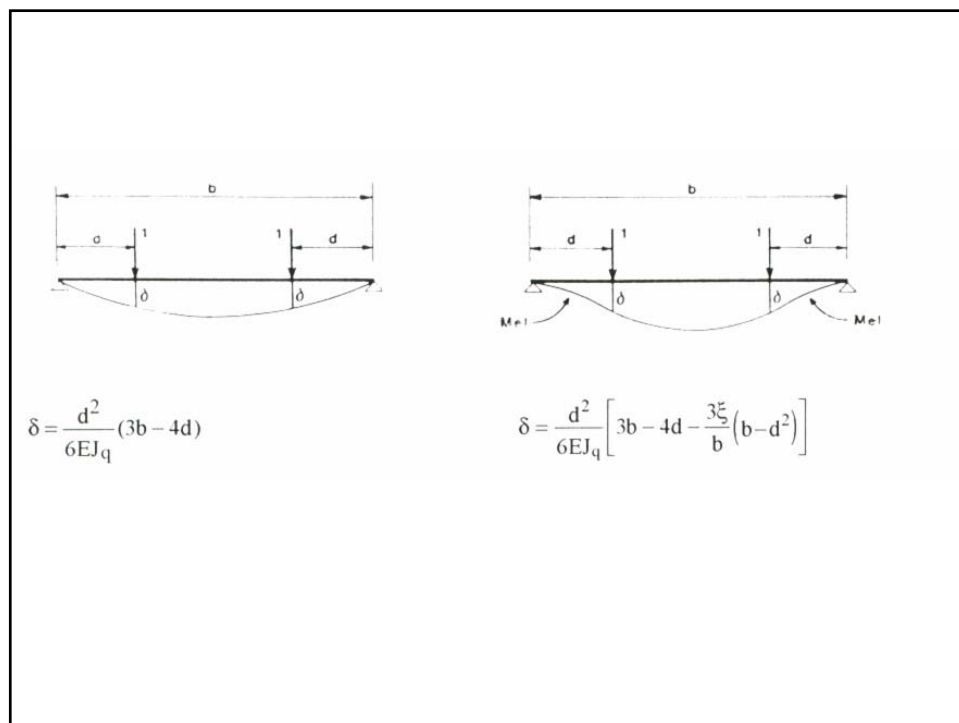
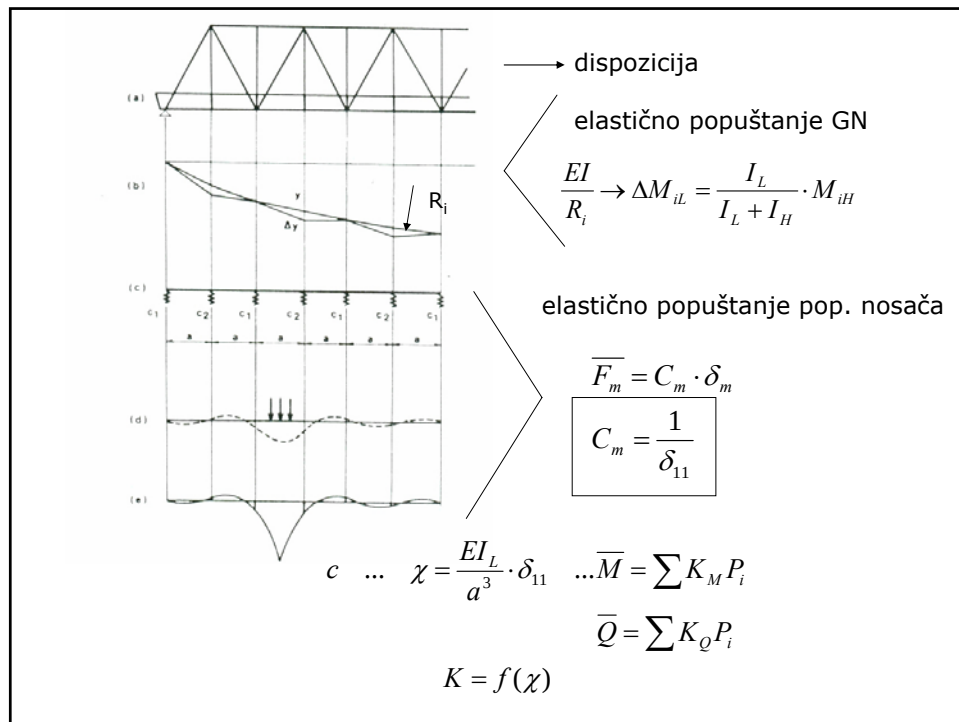
POPREČNI NOSAČI

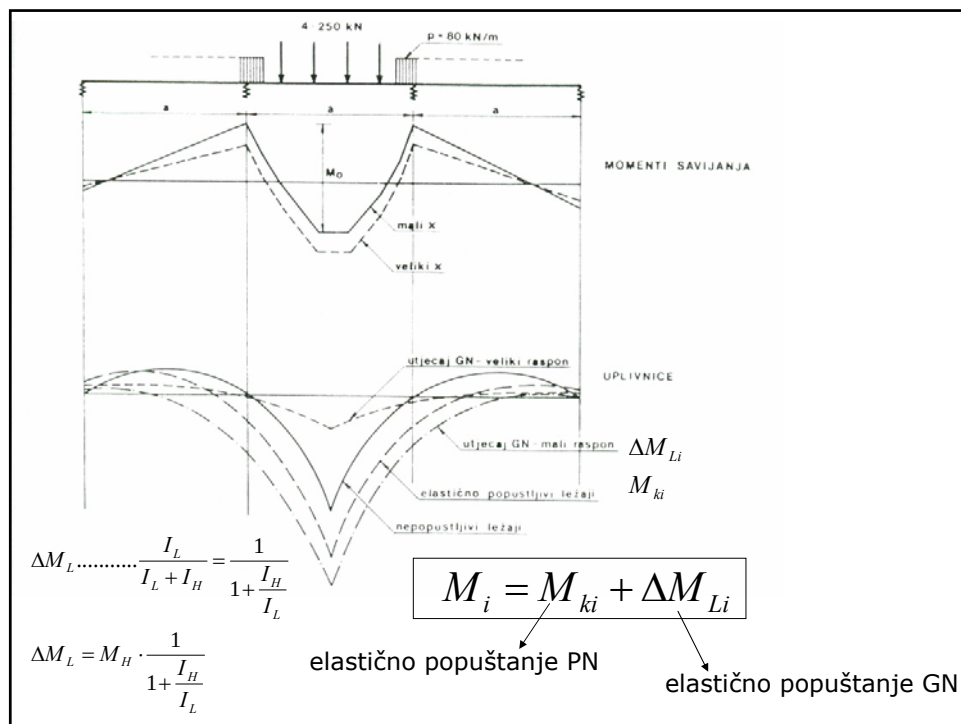


$$h_k \geq \frac{b}{6} - \frac{b}{8}$$

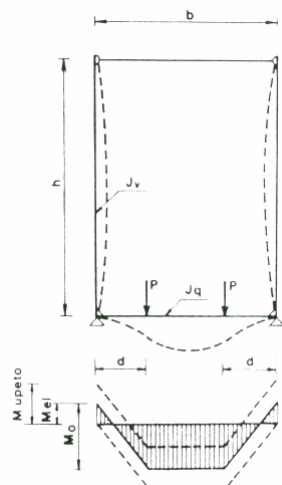
$a = 5 \quad \text{do} \quad 10m$

(2 do 3)





PRORAČUNSKI MODELI



zatvoreni presjeci

$$M_{el} = \xi \cdot M_{upeto}$$

$$\xi = \frac{1}{1 + \frac{2}{3} \frac{h}{b} \frac{J_q}{J_v}}$$

$$M_{upeto} = \frac{P \cdot d}{b} (b - d)$$

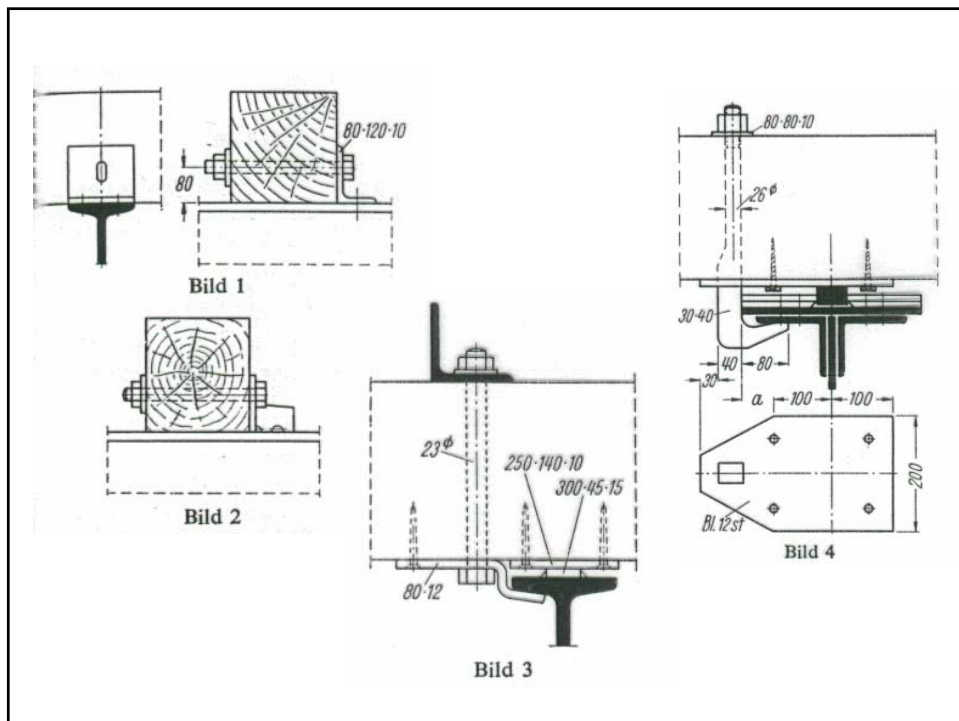
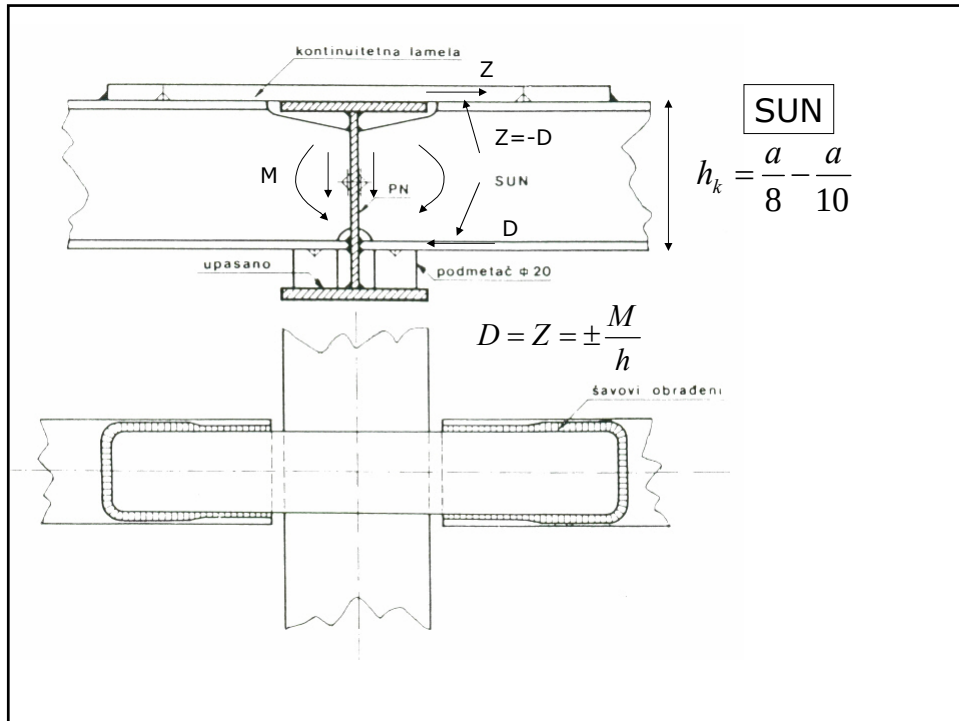
$$M_{upeto} \approx (0,6 - 0,7) \cdot M_0$$

otvoreni presjeci

$$M_{el} \approx 0,5 M_0$$

Polje – mjerodavan M_0

Ležaj – mjerodavan M_{el}



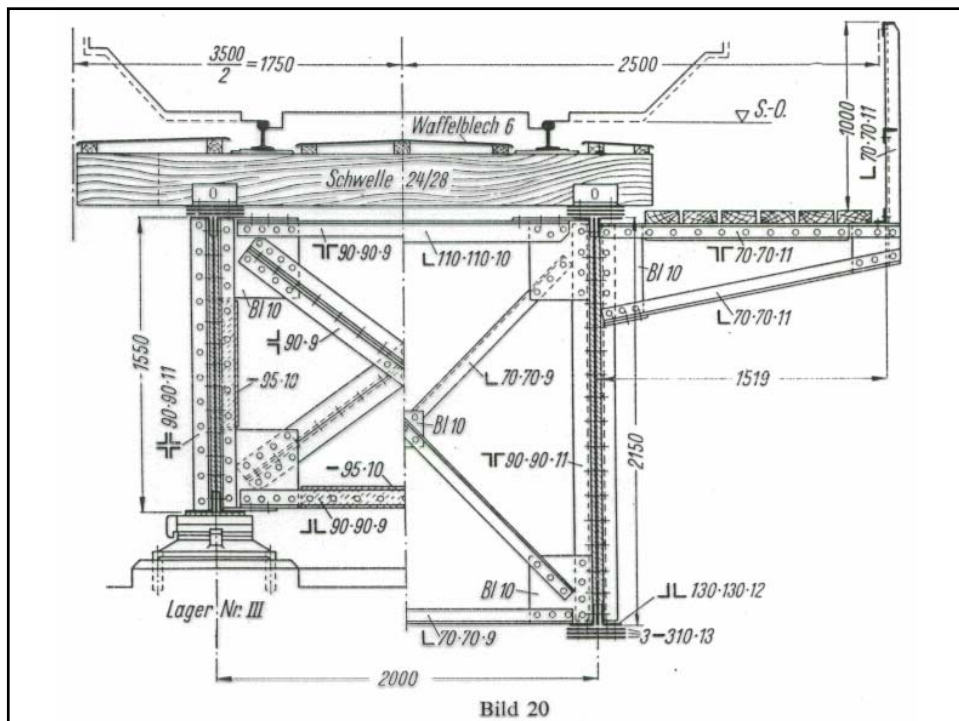
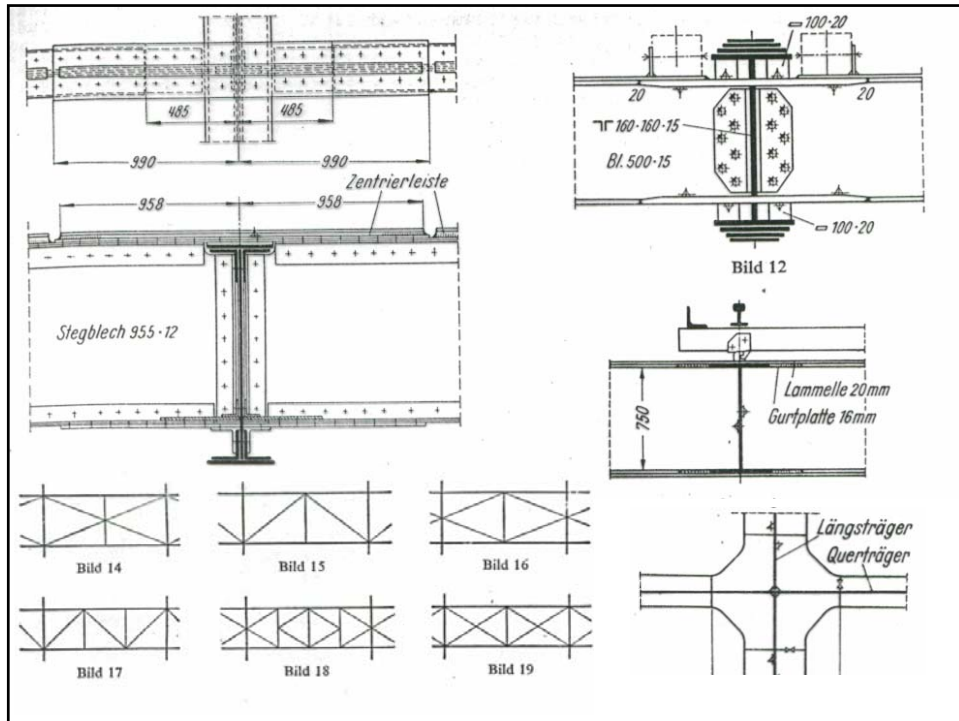
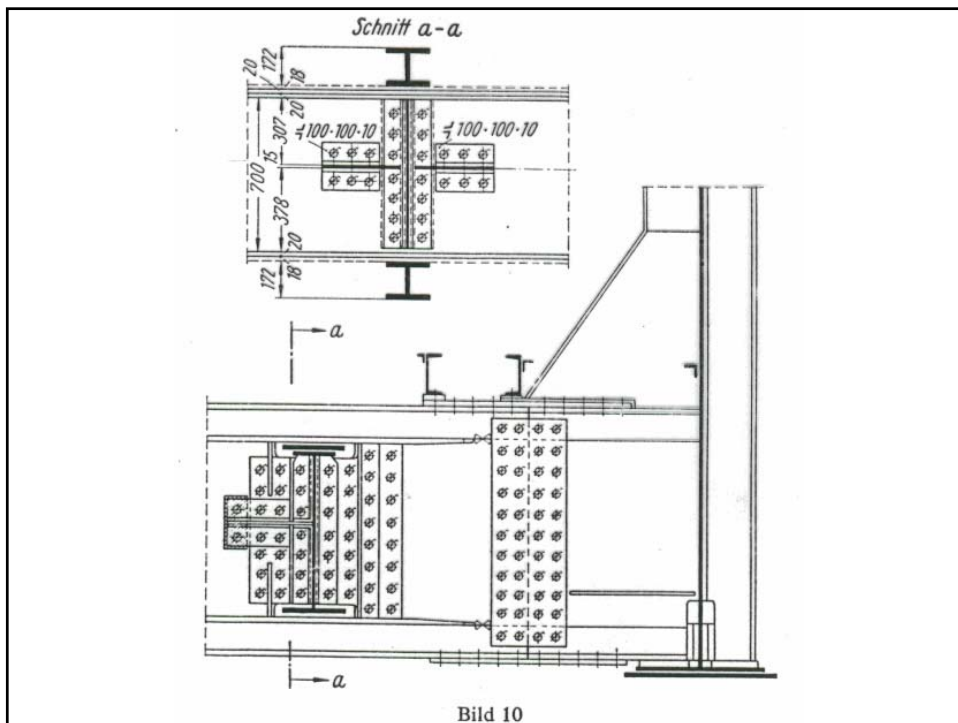
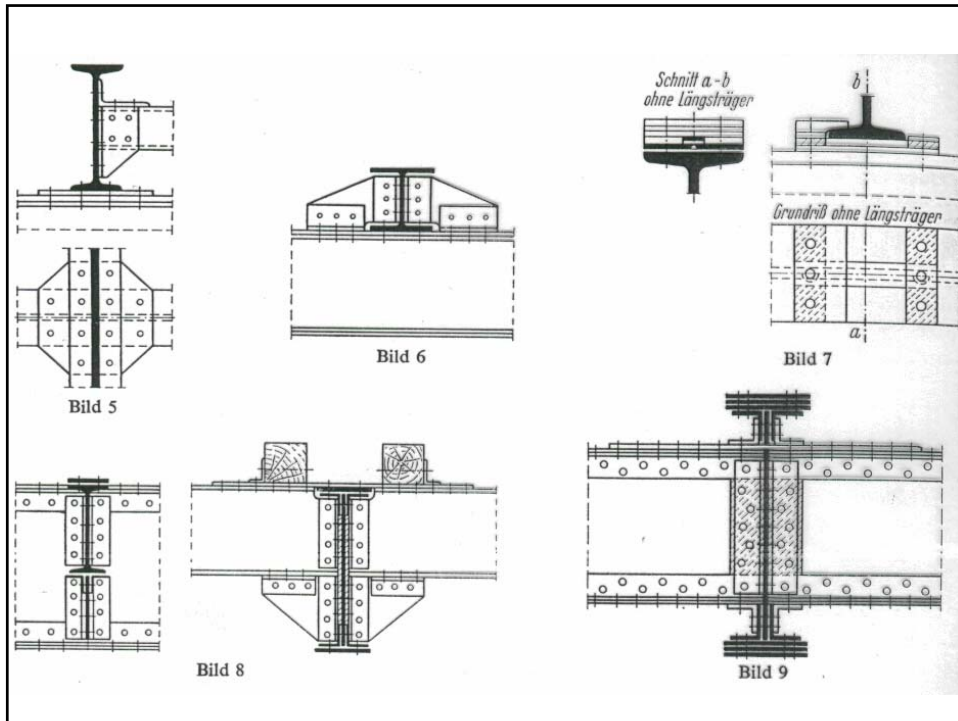


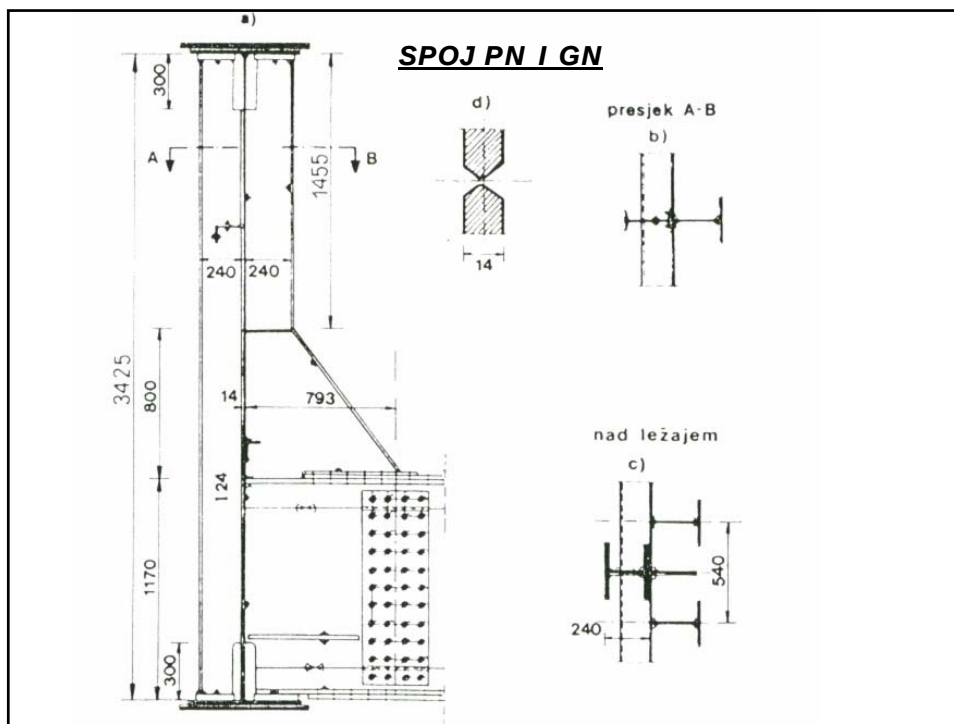
Bild 22

Bild 21

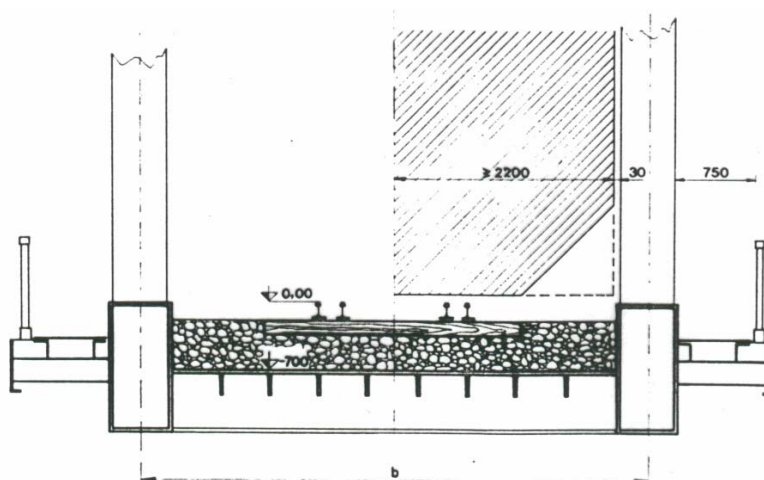
Bild 23

Bild 24





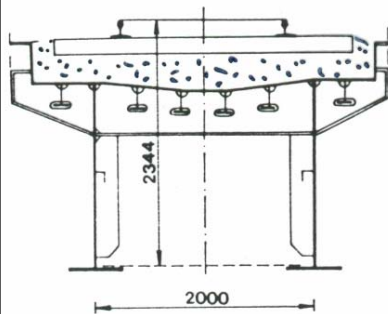
6.1.3 ZATVORENI KOLNICI



$$e = 400 - 600mm \quad a = 2000 - 2500mm$$

ZASTOR pojas savijan

$\Delta h = 40(35)cm$ pojas spregnut

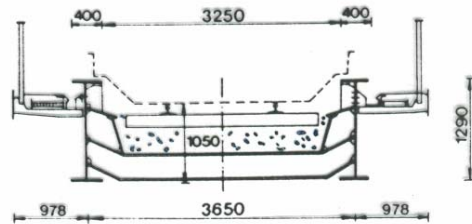


a)

vrlo racionalno

$$e = 400 - 600$$

$$a \geq 3000$$



b)

bez uzdužnih rebara

$$e = 0$$

$$a \approx 400 - 600$$

Eisenbahnbrücken, Fahrbahn

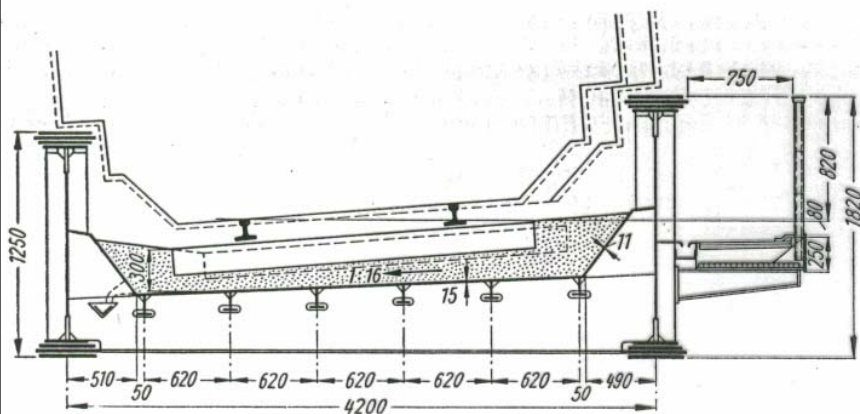


Bild 29

Mit unten liegender Fahrbahn, Variante B

(für kleinere Spannweiten bei extrem kleiner verfügbarer Bauhöhe)

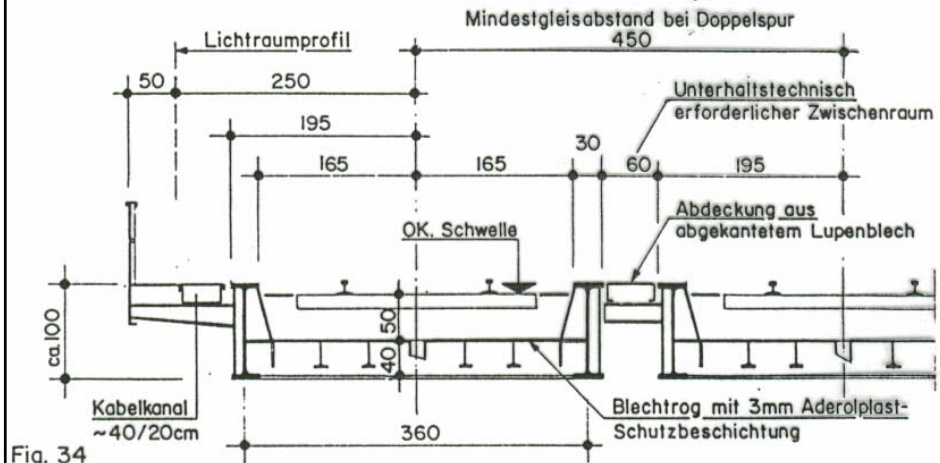
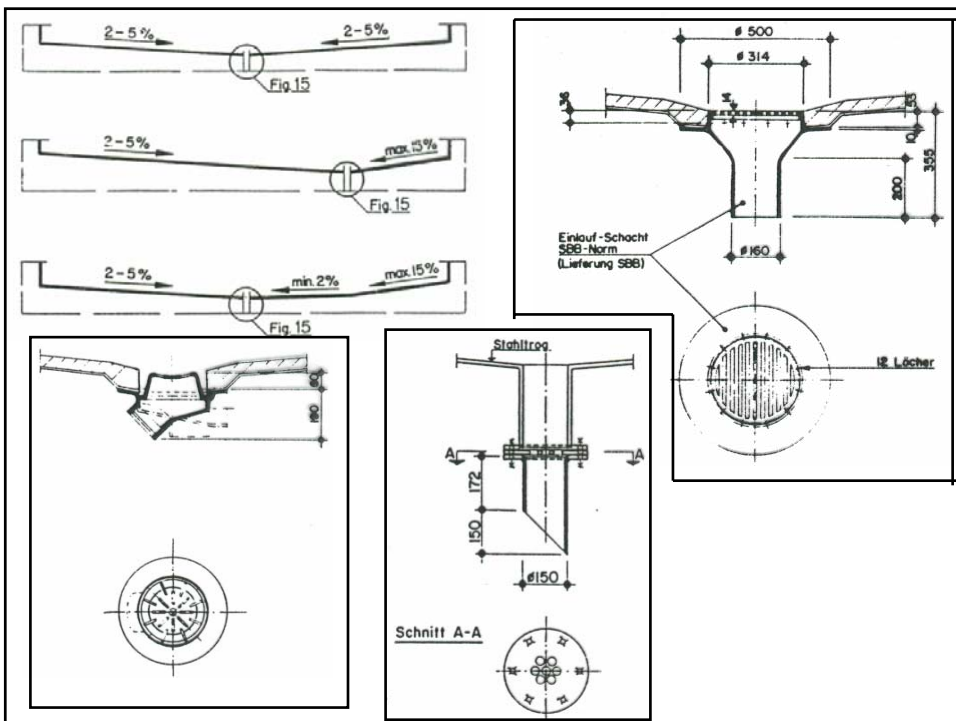
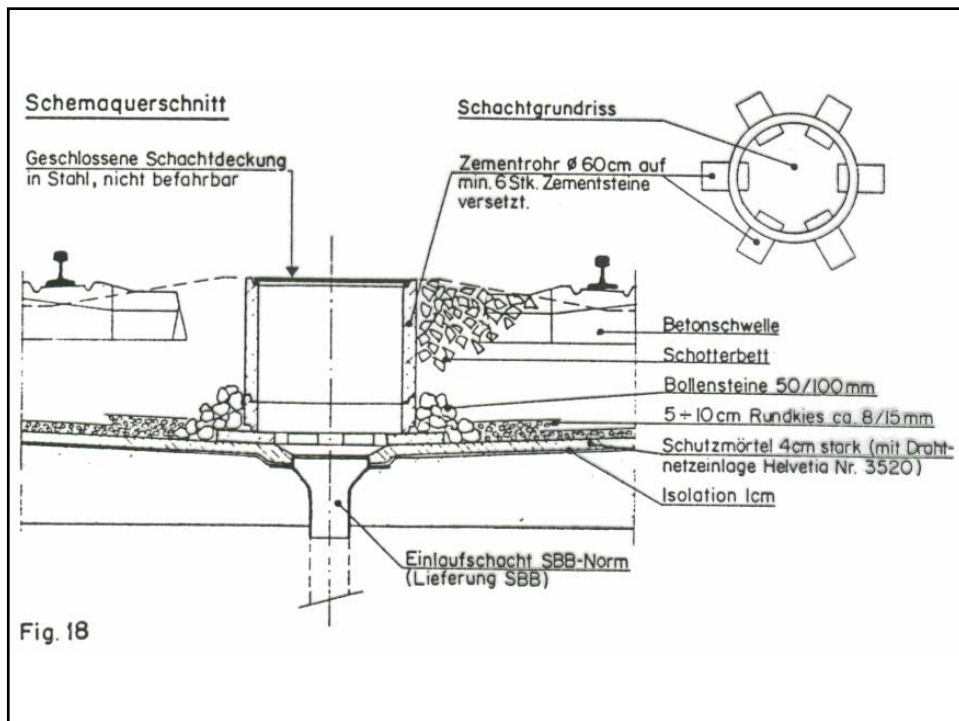
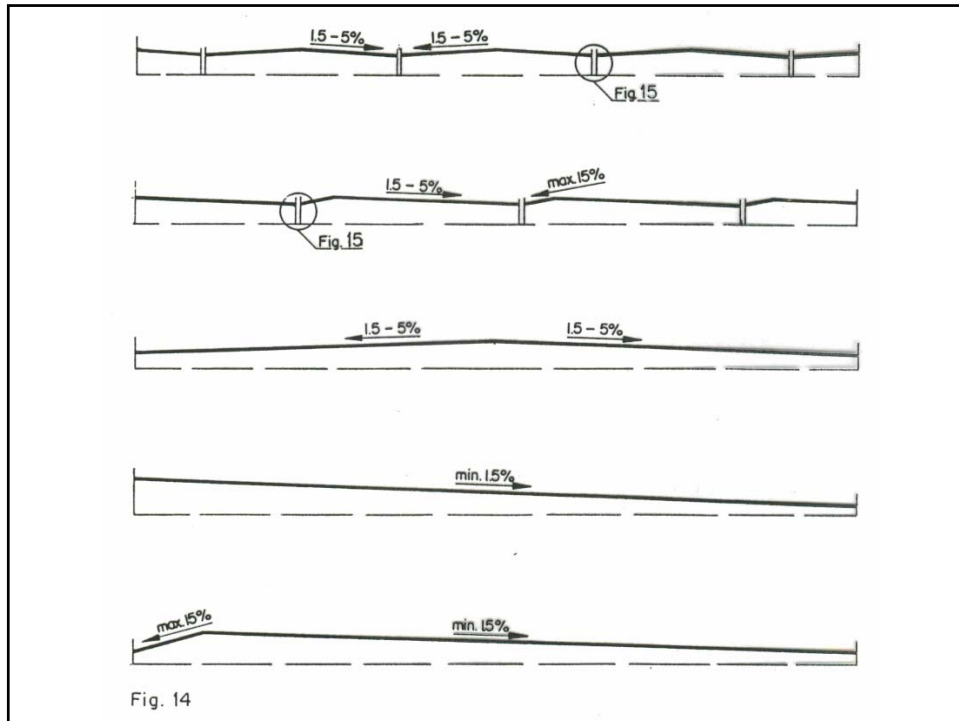
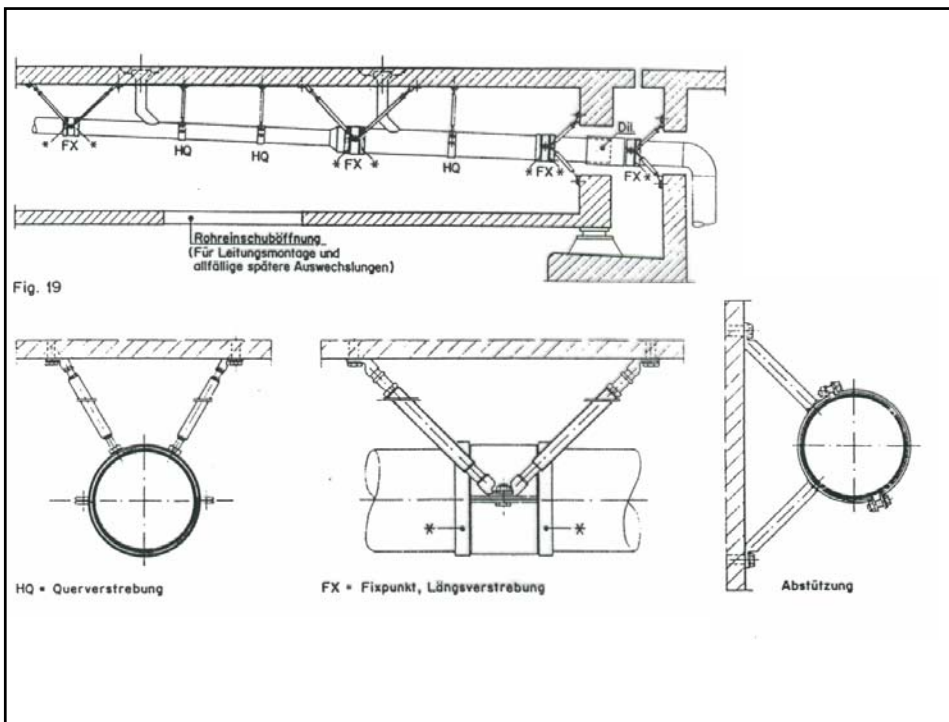


Fig. 34







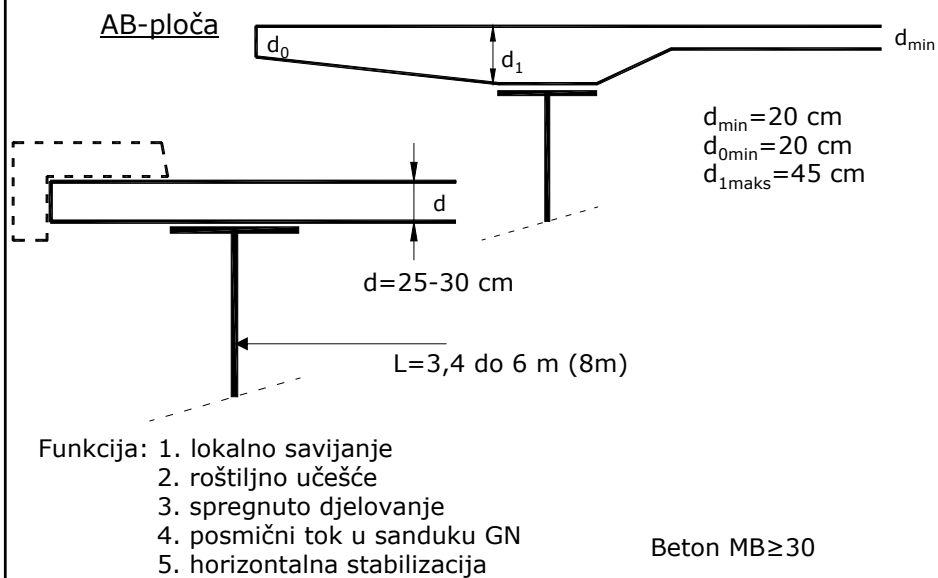
6.2. CESTOVNI MOSTOVI

- OTVORENI
- vrlo iznimno
 - čelične proračunate ploče
 - drvene platice 5-7 cm debele

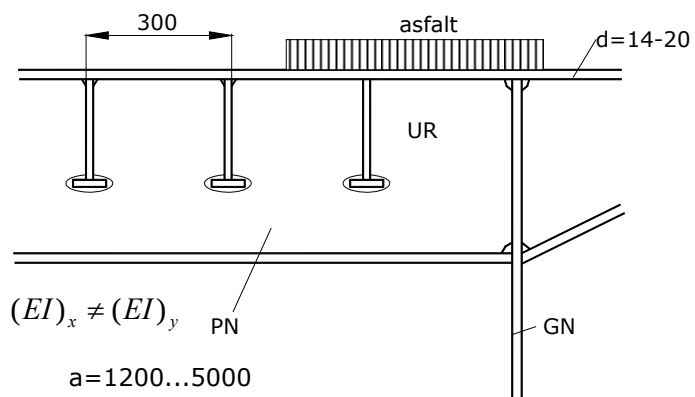
- ZATVORENI
- redovno
 - AB ploča
 - ORTO ploča
- asfaltni zastori + hidroizolacija

$$\text{TRAJNOST} = f(\text{zastora})$$

NOSIVE KONSTRUKCIJE

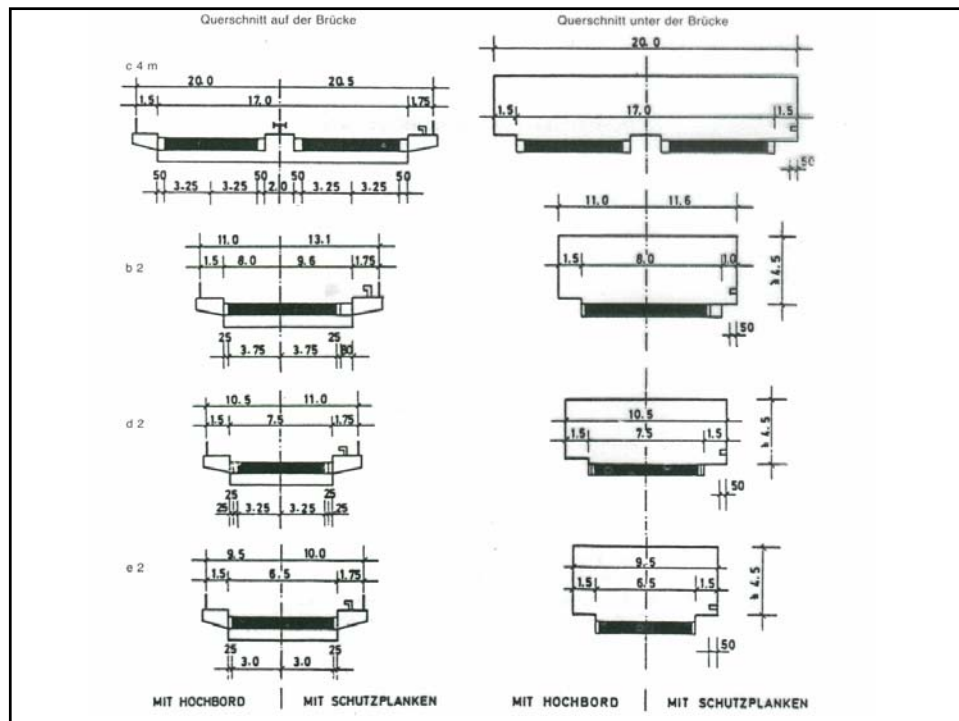
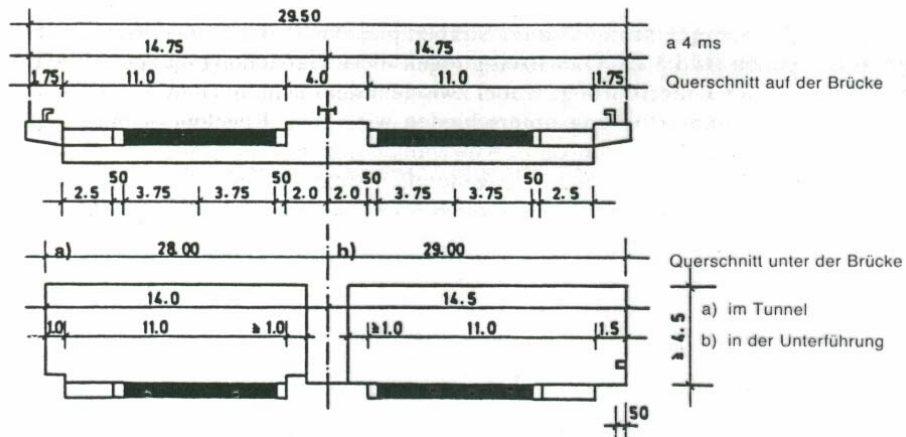


ORTOTROPNA ČELIČNA PLOČA

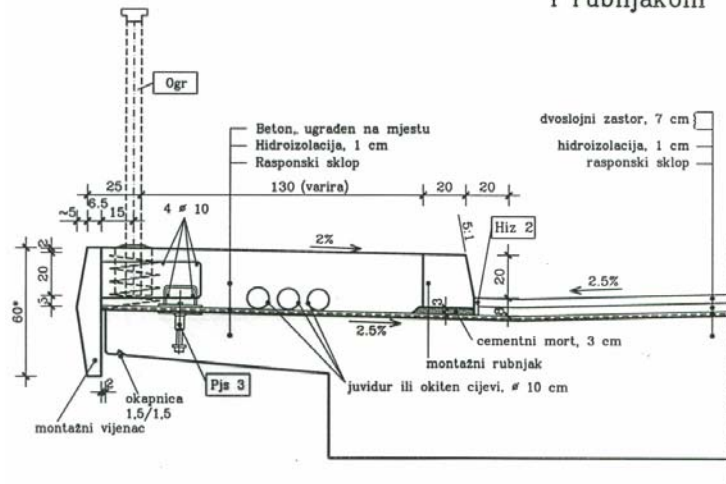


- Funkcija: 1. lokalno savijanje – posebno poglavlje 9.
 2. roštiljno učešće – samo poprečni nosači
 3. spregnuto djelovanje – aktivni presjek
 4. posmični tok
 5. horizontalna stabilizacija

OPREMA

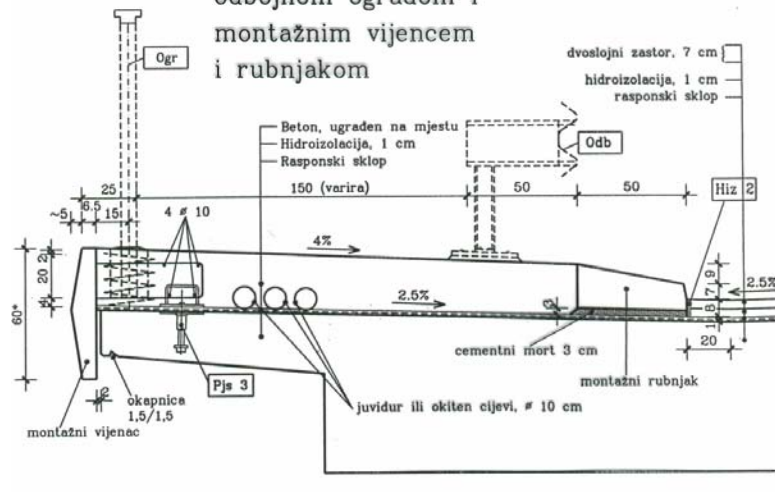


Hodnik s
montažnim vijencem
i rubnjakom



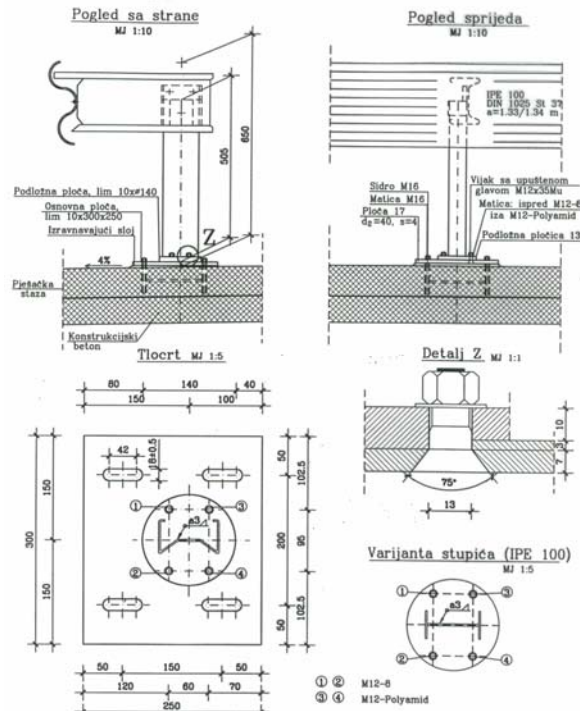
Usidrenje ograde: det. Ogr 12
alternativno: Ogr 13, Ogr 14

Hodnik s čeličnom
odbojnom ogradom i
montažnim vijencem
i rubnjakom

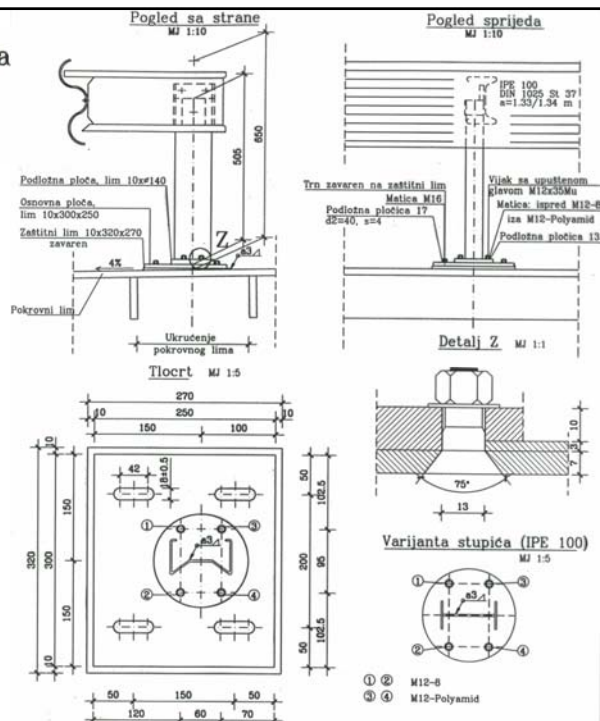


Usidrenje ograde: det. Ogr 12
alternativno: Ogr 13, Ogr 14

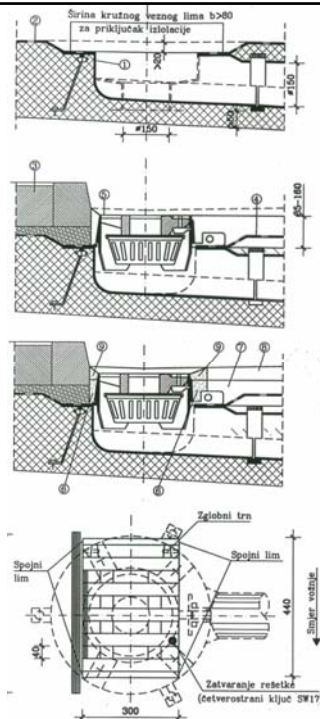
Jednostrana čelična
odbojna ograda
na betonu



Jednostrana čelična
odbojna ograda
na čeliku



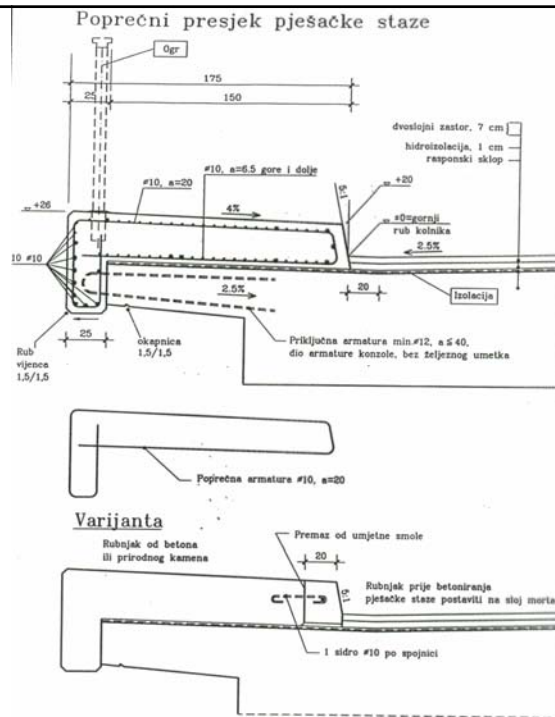
Detalj slivnika
s načinom ugradnje
(detalj prema katalogu
proizvođača: PASSAVANT)



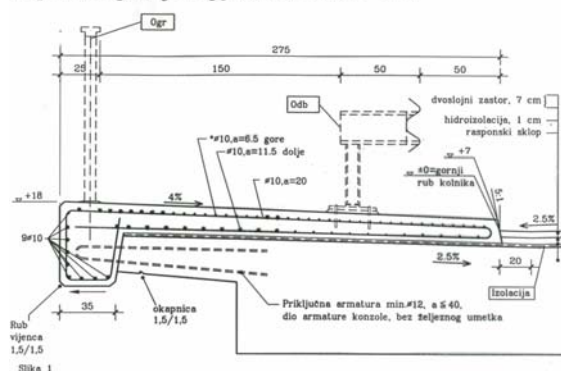
Postupak ugradbe:

- ① Donji dio slivnika povezati s armaturom, postaviti kružni vezni lim i ubetonirati.
- ② Postaviti hidroizolaciju ispod hodnika i zaljepiti na kružni vezni lim.
- ③ Betonirati hodnik.
- ④ Postaviti hidroizolaciju kolkica i zaljepiti na kružni vezni lim.
- ⑤ Gornji dio postaviti na projektiranu visinu i nagib pomoću steznog prstena (vrh 1 cm ispod ruba habajućeg sloja). Postaviti vijke, objesiti taložnicu, spojiti okvirni otvor s kružnim veznim limom.
- ⑥ Ugraditi procjedni sloj od jednoslojnog betona (8-16 mm) s dodatkom umjetne smole, skroz naskolo do gornjeg ruba zaštitnog sloja asfalta, gornji dio pritom zapuniti da bude nosiv.
- ⑦ Postaviti zaštitni sloj, po potrebi ugraditi spojne limove do postavljanja habajućeg sloja radi odvođenja vrijeme gradnje.
- ⑧ Postaviti habajući sloj
- ⑨ Zapuniti reške

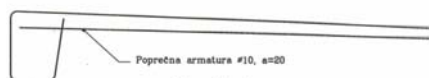
Hodnik
izveden na mjestu



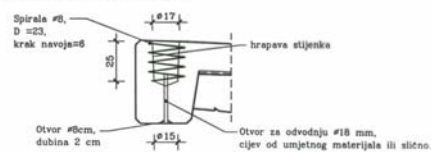
Poprečni presjek pješačke staze MJ 1:20



Silke J

Varijanta

Slika 2. Otvor za ubetoniranje stupca ograde



HIDROIZOLACIJA

- nepropusna
- plastična
- čvrsta

Asfaltni mastiks (15-20%) – elastomer mastiks (5-8%)

Aluminijske folije

Epoksi-katran (50%+50%)

Metalizacija + elastomer-bitumen

Stakleni voal - mrežaste tkanine, odzračivanje

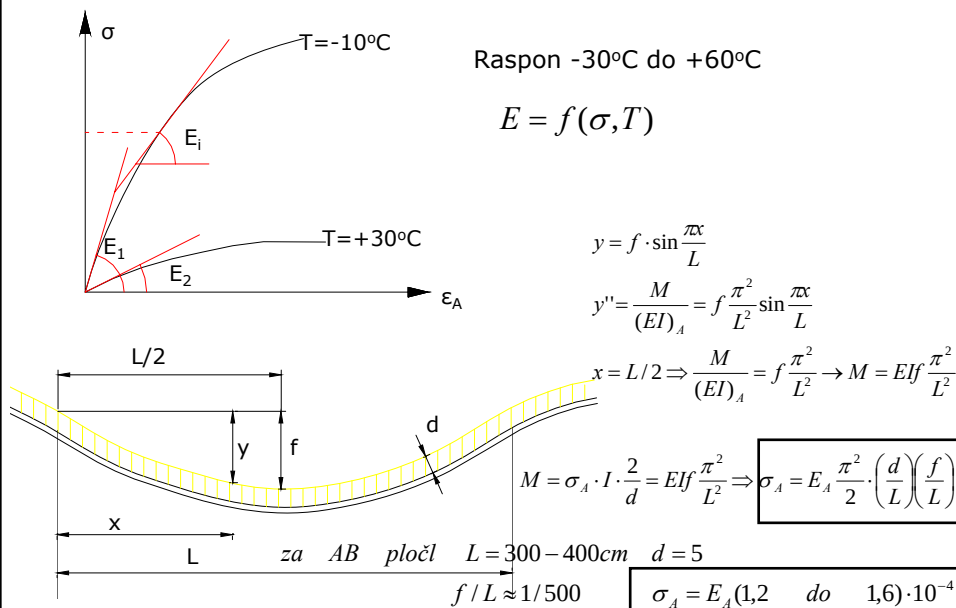
Suvremene izvedbe – elastomer mastiks 2-3 mm

Livomastiks – domaći

Esha isoteks – uvozni

KOLNIČKI ZASTORI

Asfalt – 5-7 cm debljina (2,5-3 cm)



za čelični lim: $L=30\text{ cm}$
 $d=5\text{ cm}$
 $f/L=1/300$ (bez učešća asfalta)

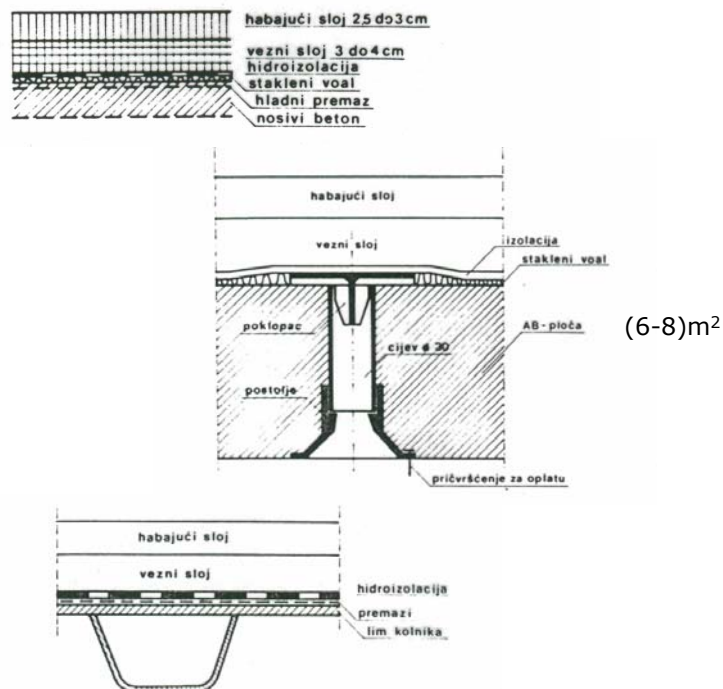
$$\sigma_A = E_A \cdot 27,4 \cdot 10^{-4}$$

za $T=-10^\circ\text{C}$ $E_A \sim 1100-1900\text{ kN/cm}^2$
za $T=-10^\circ\text{C}$ $E_A \sim 10-40\text{ kN/cm}^2$

za betonsku ploču $\sigma_A = 0,13-0,30\text{ kN/cm}^2$
za čeličnu ploču $\sigma_A = 3-5\text{ kN/cm}^2$ – zimske pukotine
granica čvrstoće $\sigma_A \sim 1\text{ kN/cm}^2$

Obavezno lijepljenje – spregnuto djelovanje daje 3-4 puta veći I i analogno manji f/L

$$L_{\max} = 30\text{ cm}$$



SPREGOVI

Elementi za osiguravanje prostorne stabilnosti

Naziv prema normiranim horizontalnim opterećenjima

1 – Spreg za bočne udare

2 – Kočni spregovi

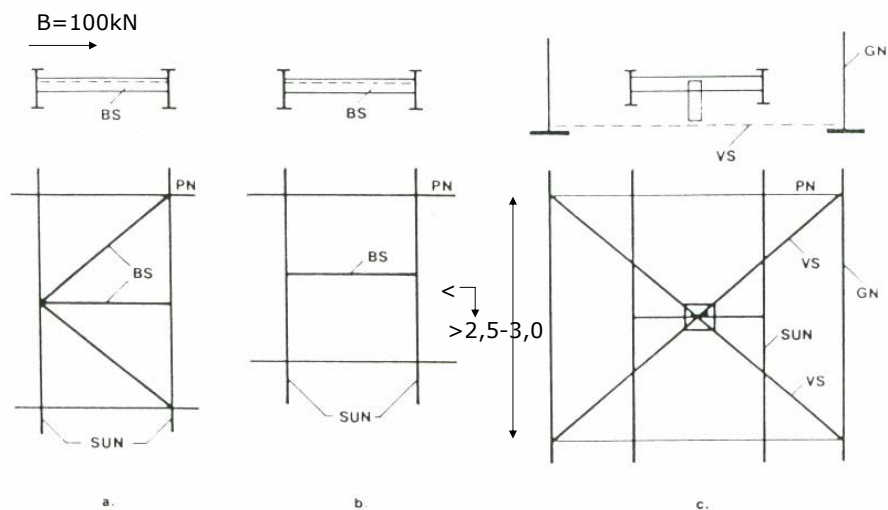
3 – Vjetrovni spregovi

4 – Poprečni spregovi

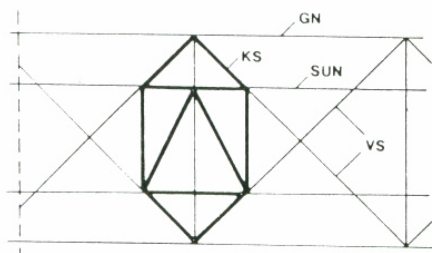
1, 2, 3 – horizontalne ravnine

4 – vertikalna ravnina

SPREG ZA BOČNE UDARE

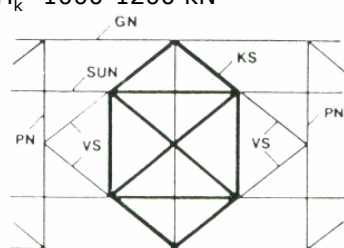


KOČNI SPREGOVI

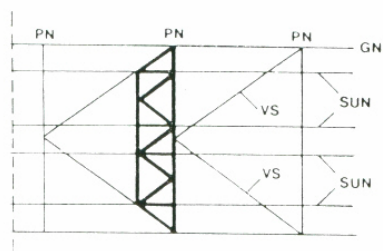


a.

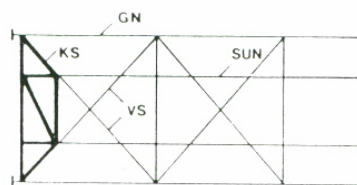
otvoreni kolnici
 $L_k \sim 60 \text{ m}$
 $H_k \sim 1000-1200 \text{ kN}$



b.



c.



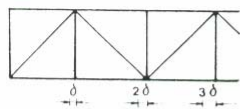
d.

SISTEMI REŠETKASTE ISPUNE V.S.

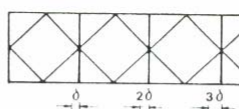
$\lambda < 200$ ($\bar{\lambda} = 2,1$ odnosno $\bar{\lambda} = 2,6$)

$\chi = 0,18$

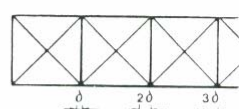
$\chi = 0,13$



a.



b.



c.



d.



e.

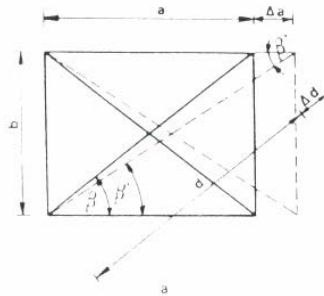


f.

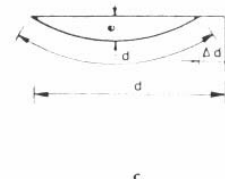
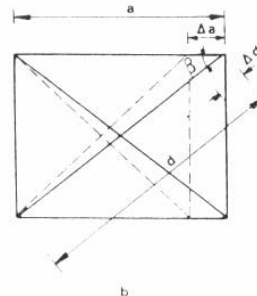
INTERAKCIJA GN I VS

$$\delta = \Delta a$$

vlačni pojas



tlačni pojas



$$\Delta d = \Delta a \cos \beta \rightarrow \frac{\sigma_d}{E} d = \frac{\sigma_a}{E} a \frac{a}{d}$$

$$\sigma_d^{(a)} = \sigma_a \cos^2 \beta; \quad \sigma_d^{(b)} = \sigma_b \sin^2 \beta$$

$$\sigma_d = \sigma_{d(o)} + \sigma_{d(a)} + \sigma_{d(b)}$$

$$\sigma_{d(o)} \leq dop \sigma^{(H)}$$

$$\sigma_{d(a)} + \sigma_{d(b)} \leq dop \sigma^{(H)}$$

$$\sigma_{d(o)} + \sigma_{d(a)} + \sigma_{d(b)} \leq dop \sigma^{H2}$$

Tlačna zona:

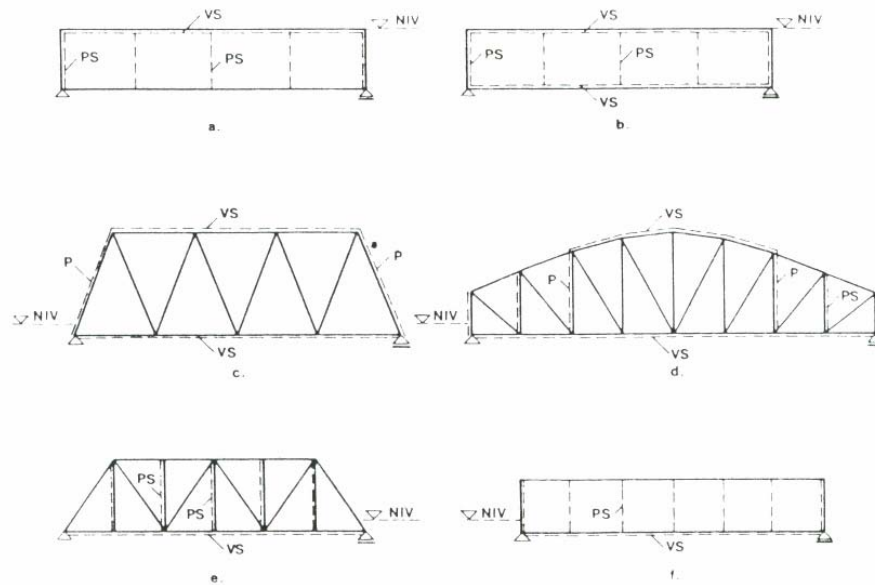
$$\sigma_{d(a)} \approx 0 \quad ali \quad e/d \approx 1/100$$

vrlo veliki ekscentricitet i dijagonala je isključena iz funkcije

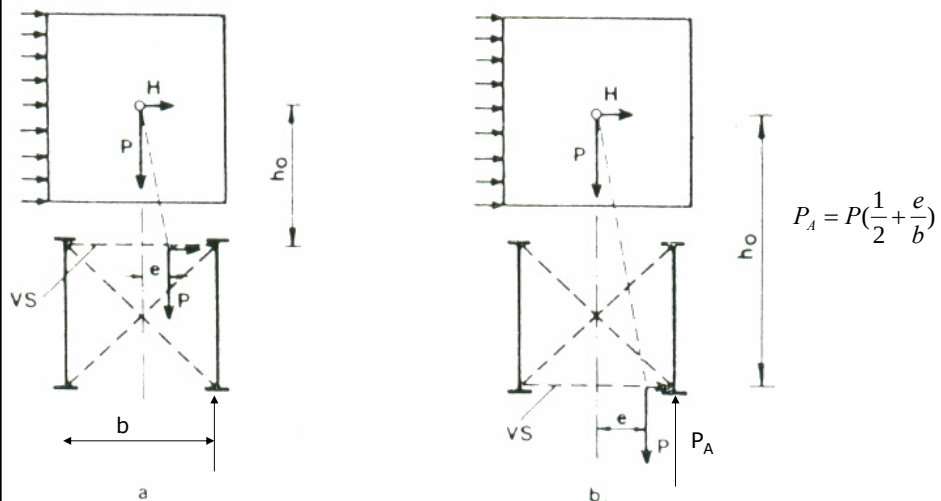
Za osnovnu funkciju $\sigma_{d(o)}$ ostaje samo 1 vlačna dijagonala.

$$\sigma_{d(a)} = \frac{N}{A} \pm \frac{N \cdot e}{W} \gg \sigma_v \quad a \text{ to ne može biti}$$

VJETROVNI SPREGOVI

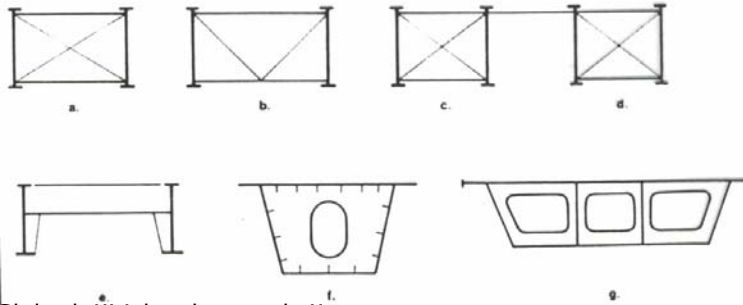


PROSTORNA STABILIZACIJA

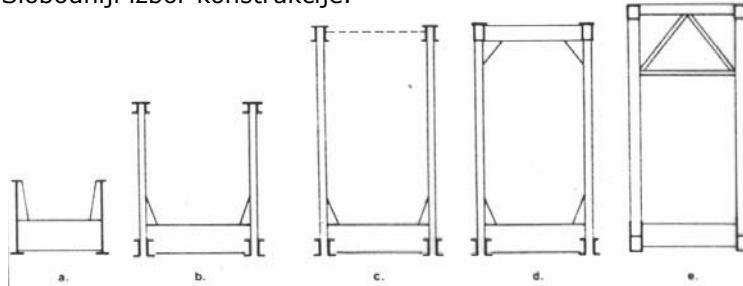


$$\gamma \cdot M_S \geq M_k; \quad M_S = P \cdot \frac{b}{2}; \quad M_k = \sum H \cdot h_0; \quad \gamma = 1,3$$

POPREČNI SPREGOVI



Slobodnji izbor konstrukcije.



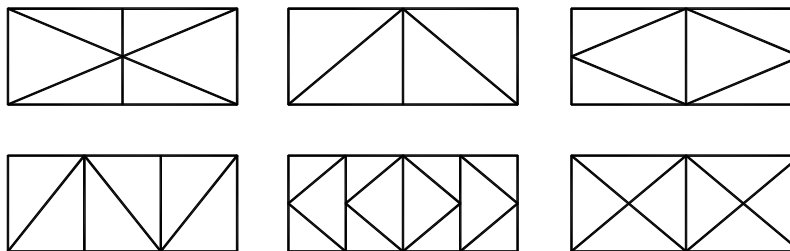
Konstrukcija uvjetovana s propisanim gabaritnim dimenzijama za promet.

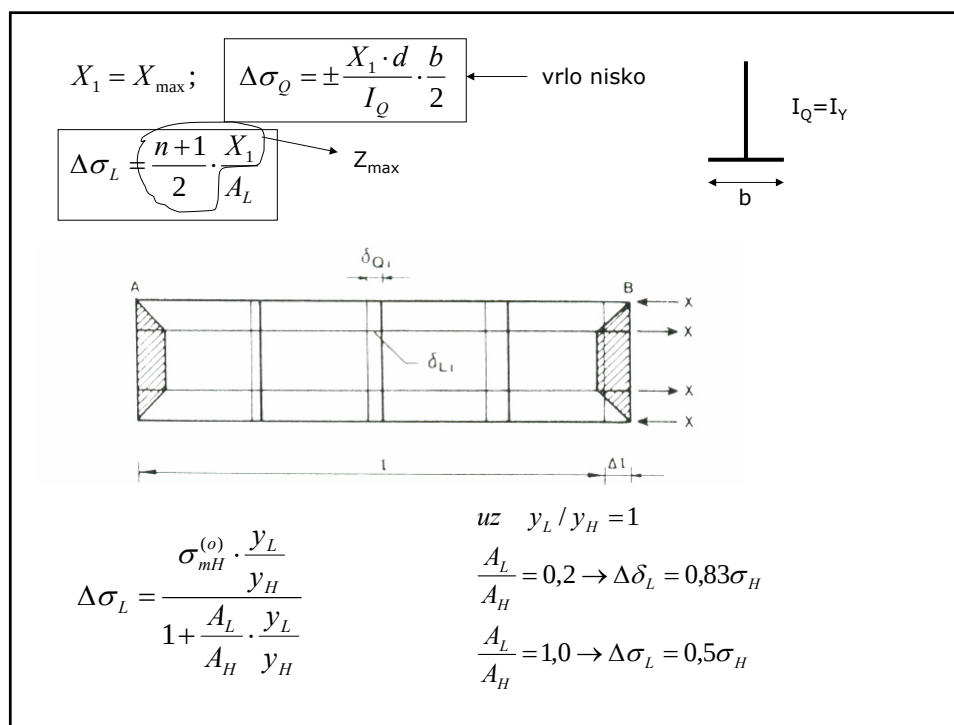
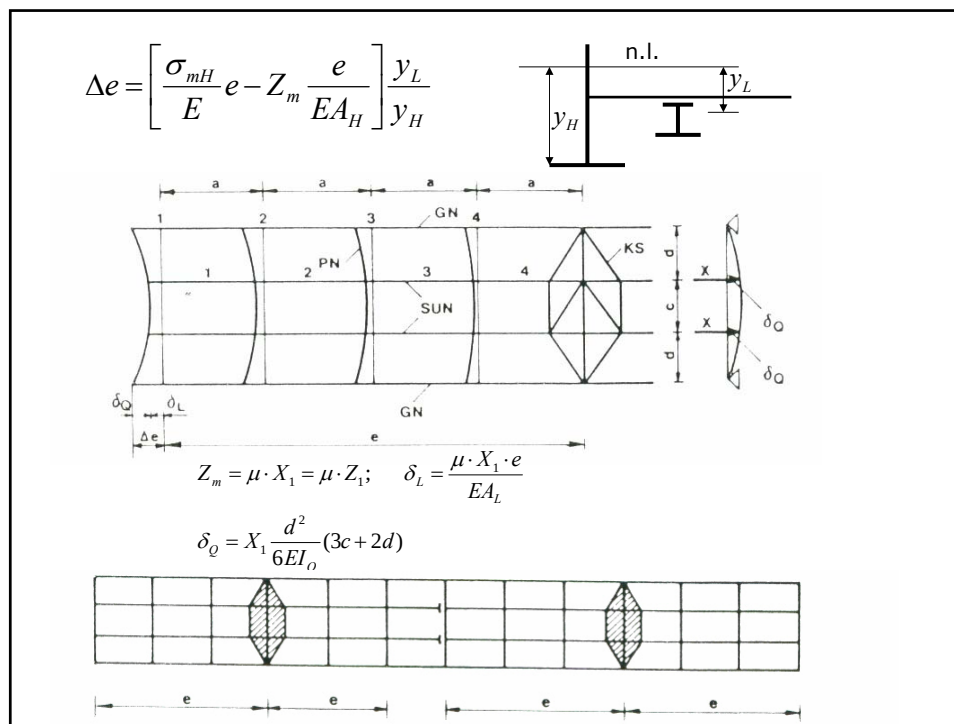
SUN $h/L=1/8-1/10$ ($h/L=1,7$ – praksa)
 PN $h/L=1/5,5-1,7$ optimalno $h/L=1/6$
 dvokolosječni $1/7$ ($1/8$)

SPREG PROTIV VIJUGANJA

SUN normalni profili za $a>2,5m$
 širokopojasni za $a>3,2m$

OBLICI:





σ_{mH} ... prosječni napon u težištu pojasa glavnog nosača
 A_H ... prosječni brutto presjek pojasa glavnog nosača
 Z_m ... prosječna vlačna sila u sekundarnom uzdužnom nosaču

$$\Delta e = \left[\frac{\sigma_{mH}}{E} e - Z_m \frac{e}{EA_H} \right] \frac{y_L}{y_H}$$

$$Z_{\min} = Z_1 = X_1$$

$$Z_{\max} = \frac{n+1}{2} X_1$$

$$Z_m = \frac{(n+1)(2n+1)}{6n} X_1 = \mu X_1$$

$$\delta_L = \frac{\mu X_1 e}{EA_L} \dots \text{rastezanje SUN}$$

$$\delta_Q = X_1 \frac{d^2}{6EI_Q} (3c + 2d) \dots \text{savijanje krajnjeg PN}$$

$$\Delta e - \delta_L - \delta_Q = 0$$

uvrštavanjem

$$\frac{\sigma_{mH}}{y_H} e y_L - \mu X_1 \frac{e y_L}{A_H y_H} - \mu \frac{X_1 e}{A_L} - X_1 \frac{d^2}{6I_Q} (3c + 2d) = 0$$

$$\Rightarrow X_1 = \frac{\sigma_{mH} e \frac{y_L}{y_H}}{\mu \frac{e y_L}{A_H y_H} + \mu \frac{e}{A_L} + \frac{d^2}{6I_Q} (3c + 2d)}$$

$$\Delta \sigma_Q = \pm \frac{X_1 d}{I_Q} \cdot \frac{b}{2} \dots \text{poprečop savijanje PN}$$

$$\Delta \sigma_L = \frac{n+1}{2} \cdot \frac{X_1}{A_L} \dots \text{dodatno naprezanje u SUN}$$

- veličini sile X_1 najviše doprinosi savijanje PN

PRIMJER: jednokolosječni željeznički most s otvorenim kolnikom i rešetkastim GN	$L = 80 - 100m$
	$e = 30m \quad n = 6 \quad \mu = 2,53 \quad A_L = 120cm^2$
	$\frac{y_L}{y_H} = 0,9 \quad c = 180cm \quad d = 160cm \quad A_H = 150 - 300cm^2$
	$I_Q = 3000cm^4 \quad b = 20cm$
	$X_1 = \frac{10(20) \cdot 3000 \cdot 0,9}{45,5(22m^8) + 63,3 + 1223} = 20 - 40kN$
	$\Delta \sigma_Q = \frac{20 \cdot 160}{3000} \cdot 10 = 10,7kN/cm^2$
	$\Delta \sigma_L = \frac{6+1}{2} \cdot \frac{20}{120} = 0,58kN/cm^2$