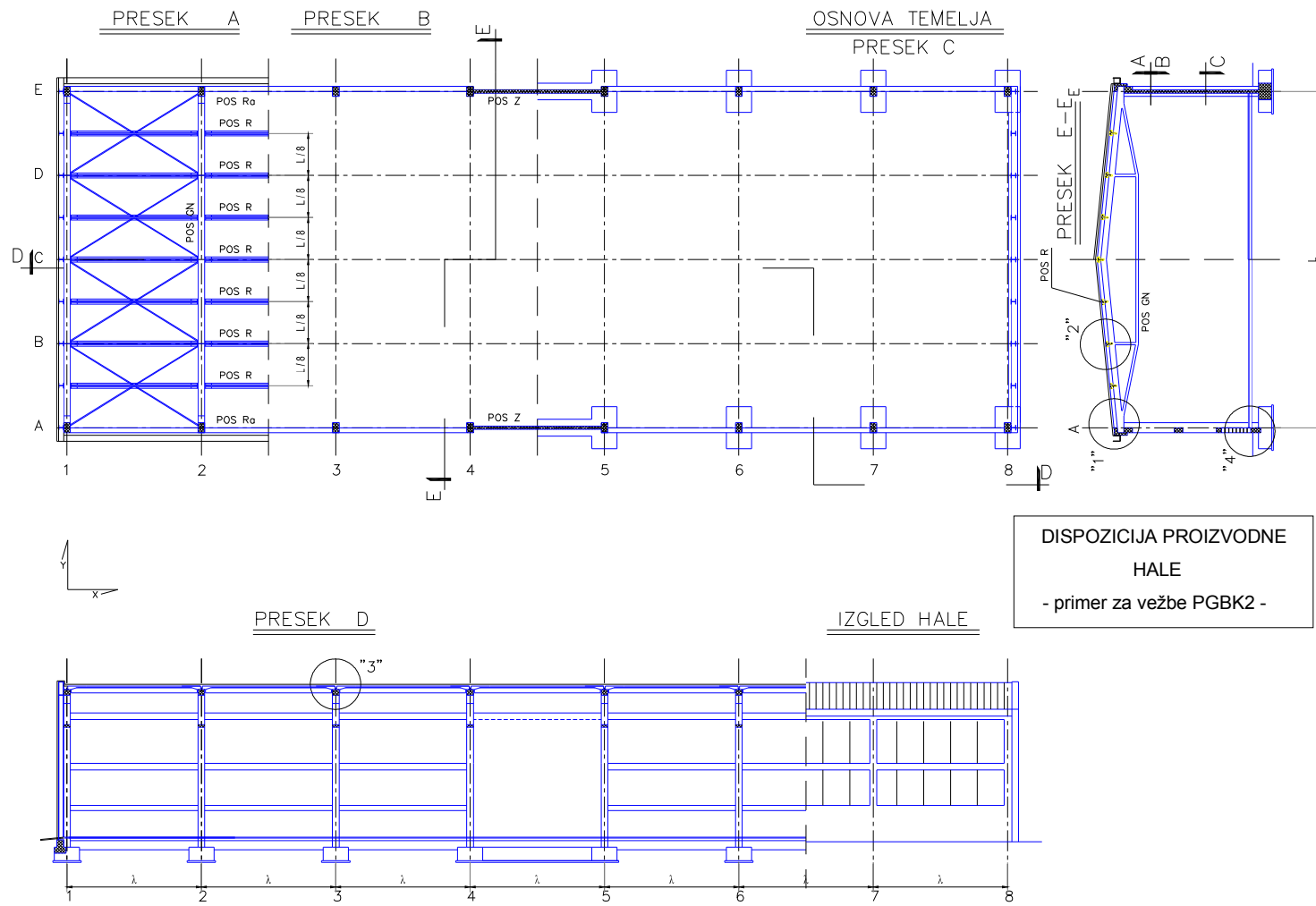
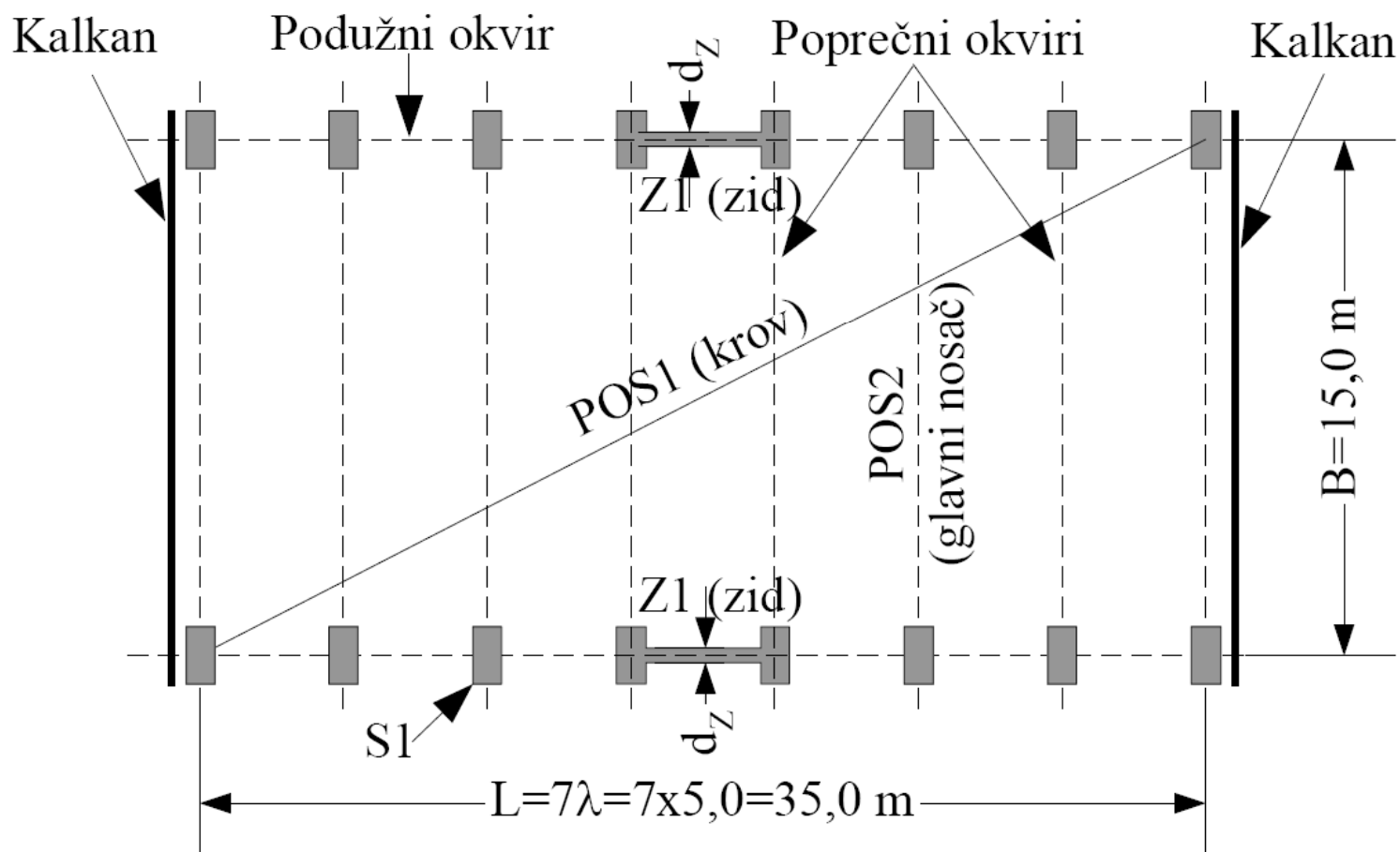


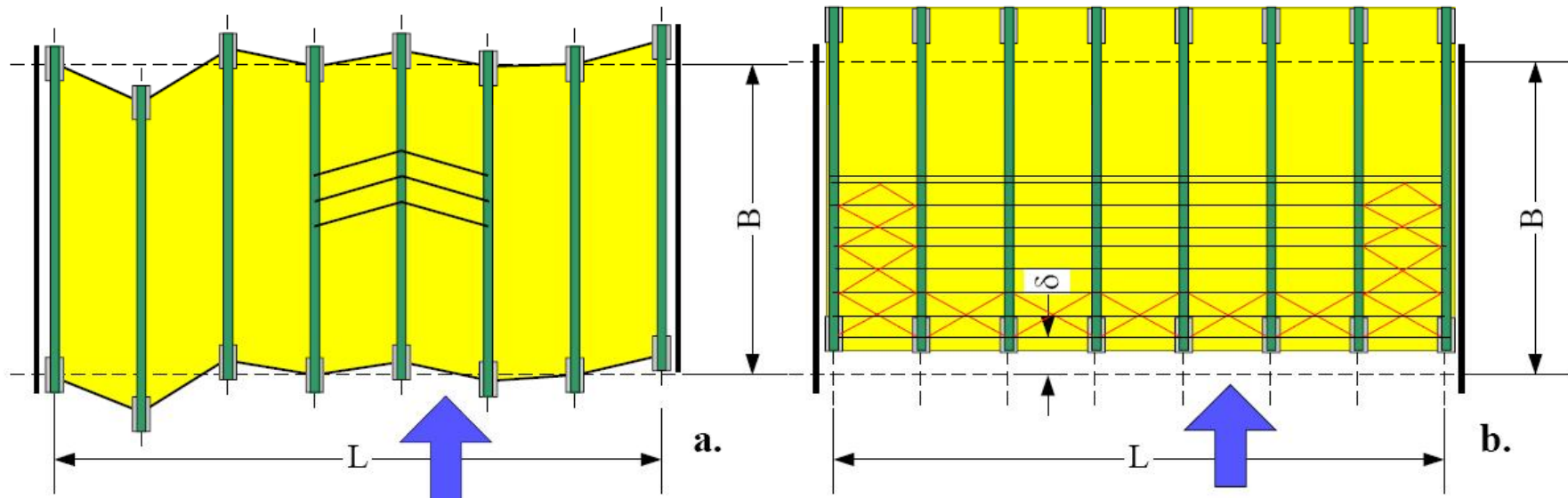
Dispozicija hale



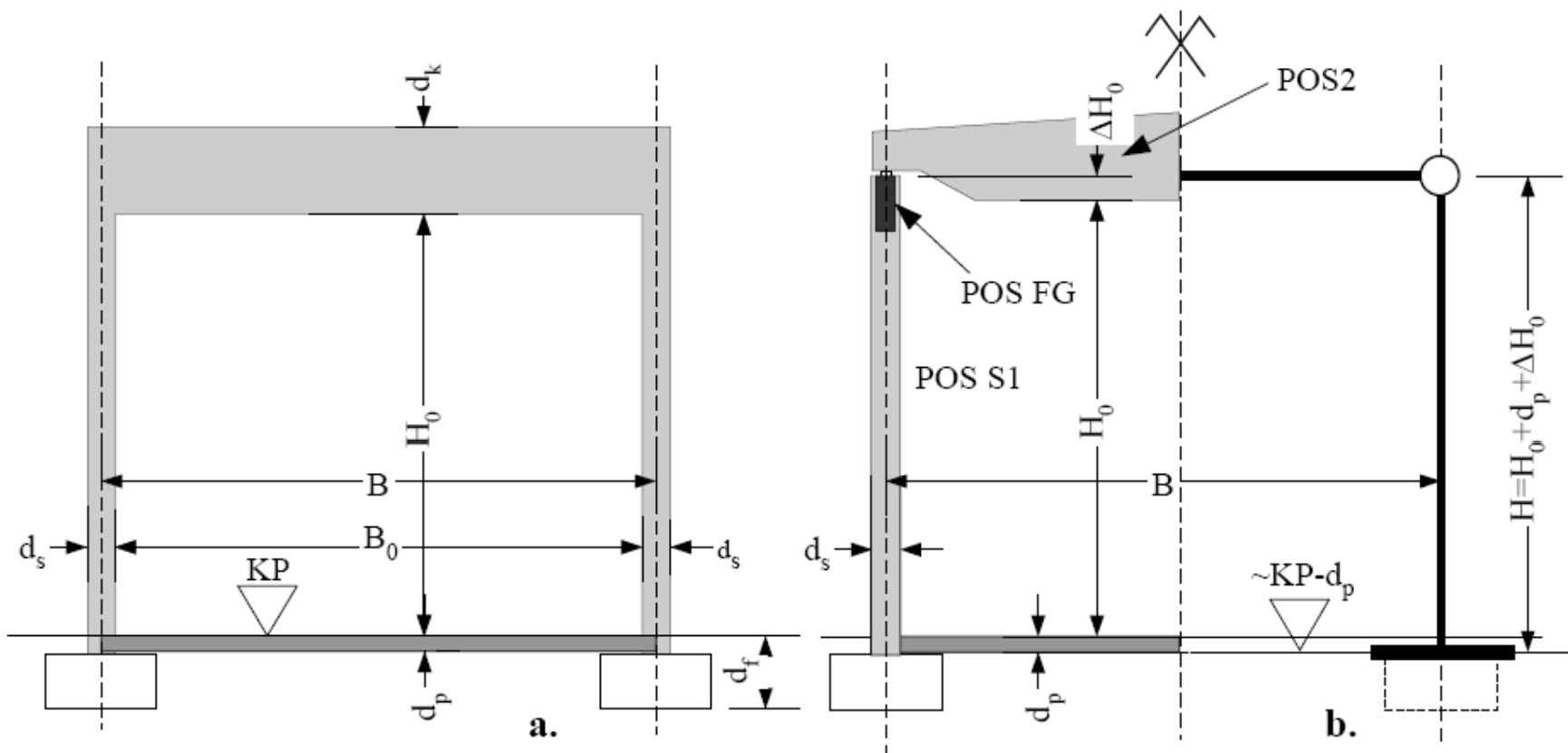
Elementi konstrukcije hale za prijem vertikalnih i horizontalnih uticaja



Krutost krovne ravni



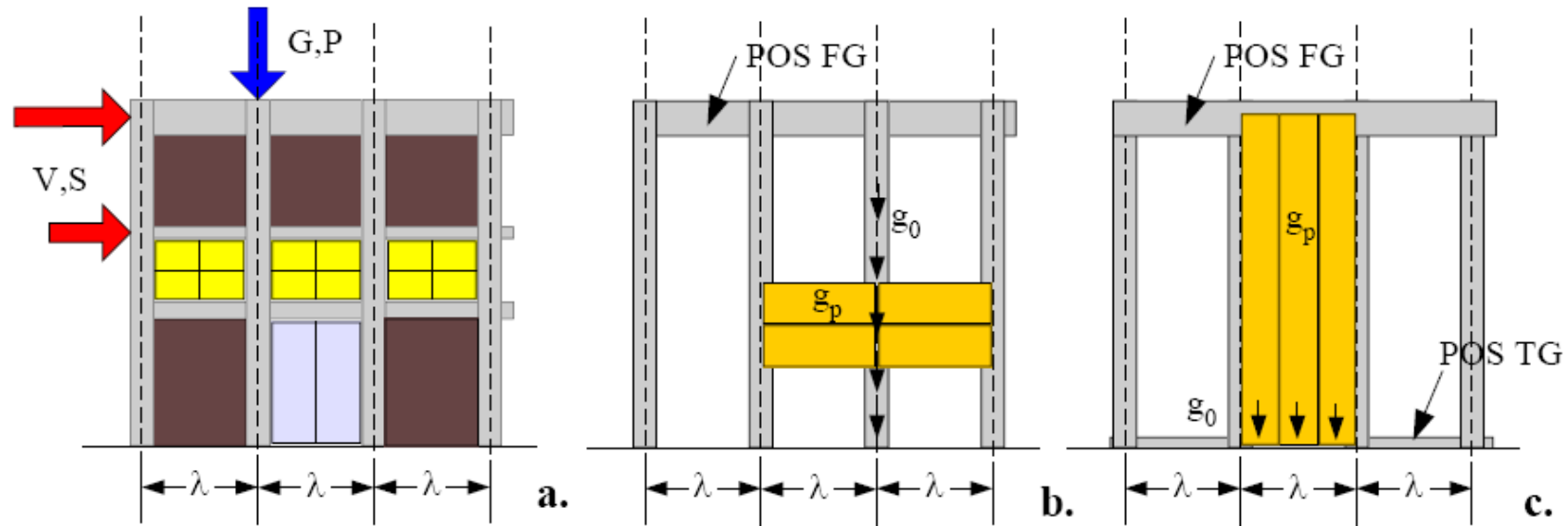
Poprečni ram



Dužina izvijanja stuba u poprečnom pravcu

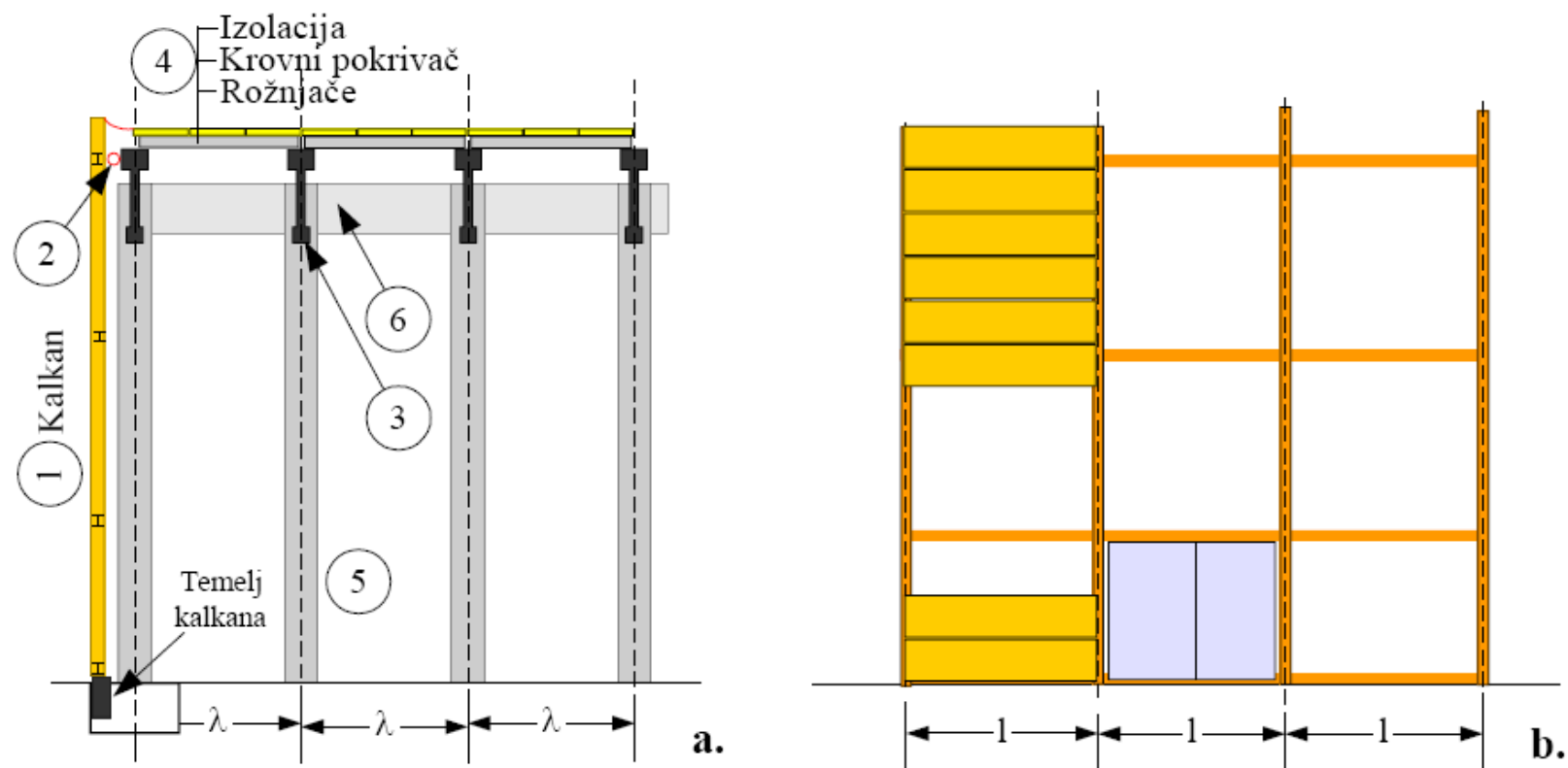
$$l_i = 2 \times H$$

Podužni ram



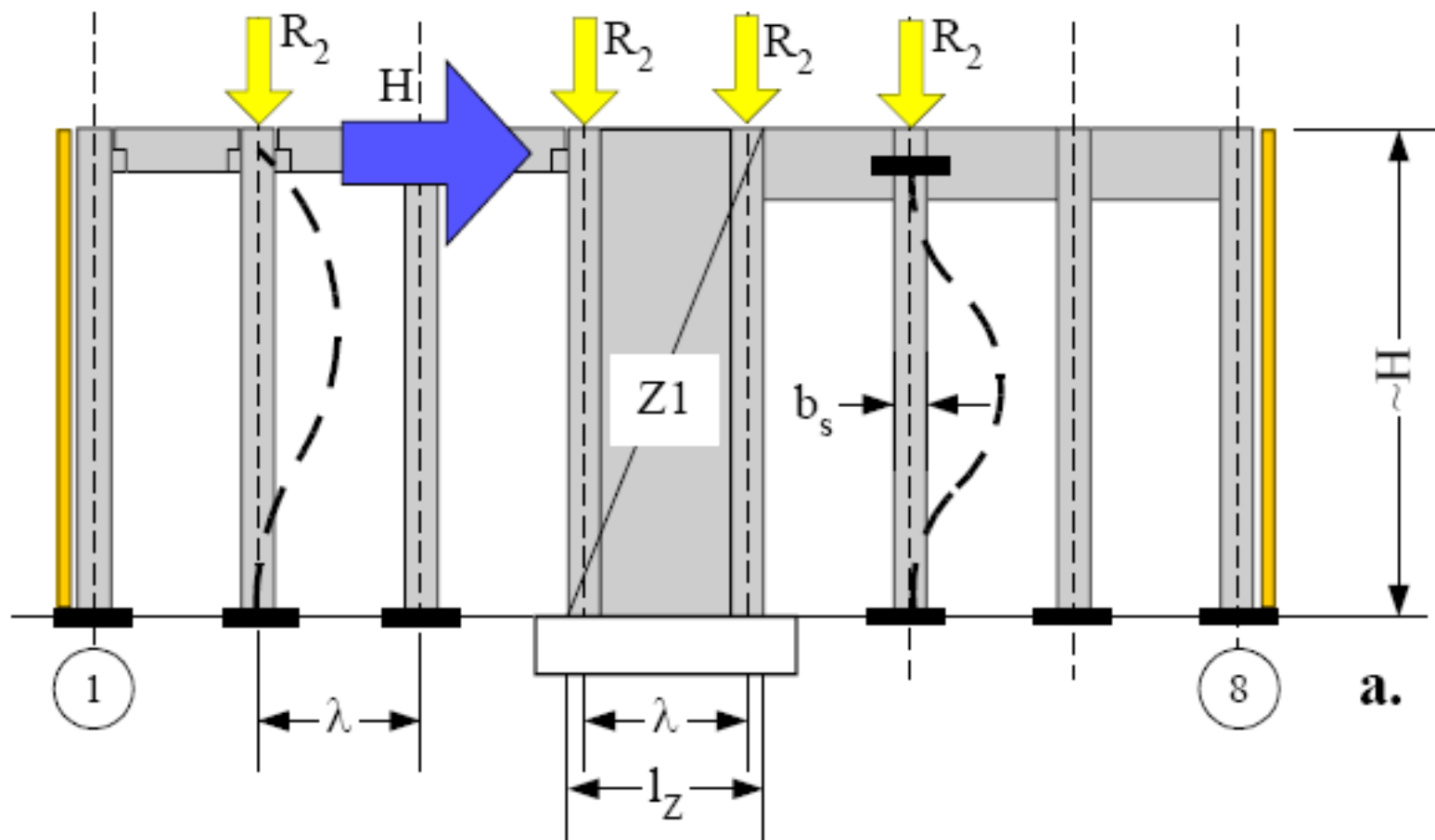
Način prenošenja horizontalnog opterećenja na konstrukciju

Kalkanski ram



Slika 4.8 - Konstrukcija demontažnog, privremenog kalkana: 1 - kalkan; 2 - bočna veza kalkana i krova; 3 - glavni nosač poprečnog okvira; 4 - krovni pokrivač sa rožnjačama; 5 - stub; 6 - fasadna greda

Konstrukcija podužnog rama



Dimenzije stuba

- Duktilnost

$$P/(0.7\beta_k A_b) \leq 0.35$$

$$P = N_g + N_p$$

$$A_b = bxd$$

- Vitkost u poprečnom pravcu

$$l_i = 2H$$

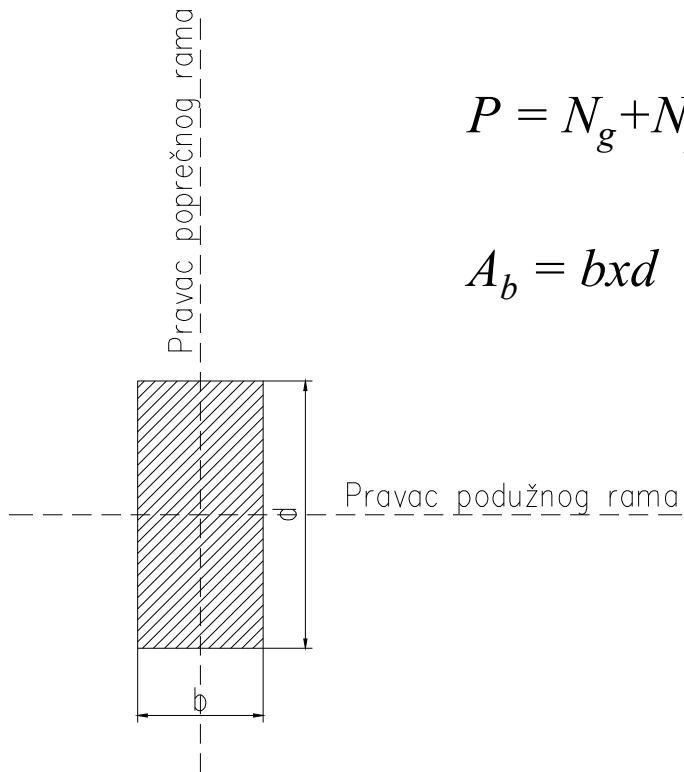
$$\lambda_x = 80-90$$

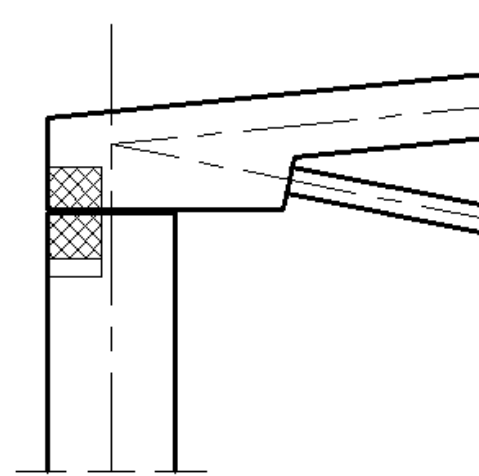
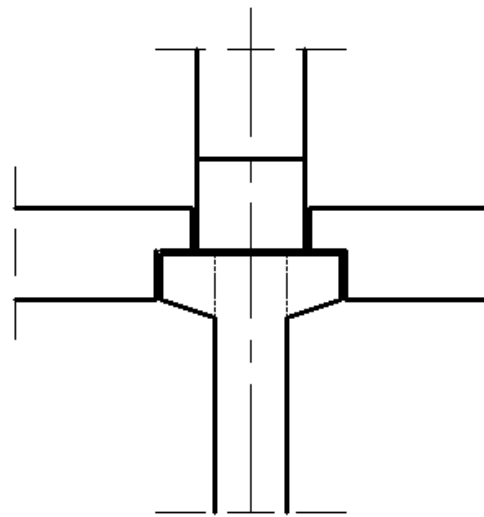
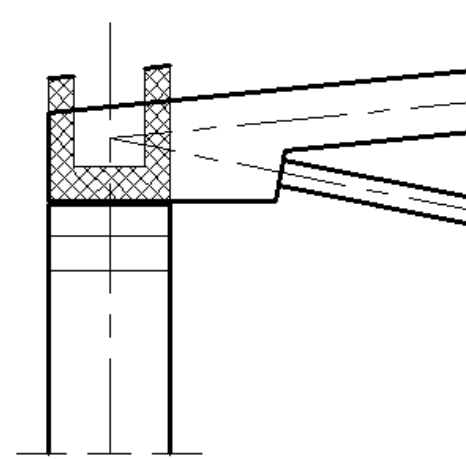
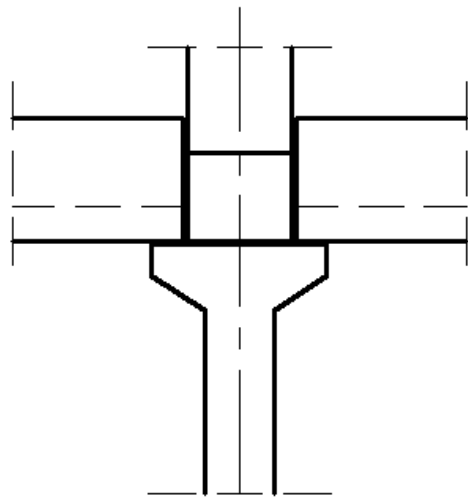
- Vitkost u podužnom pravcu

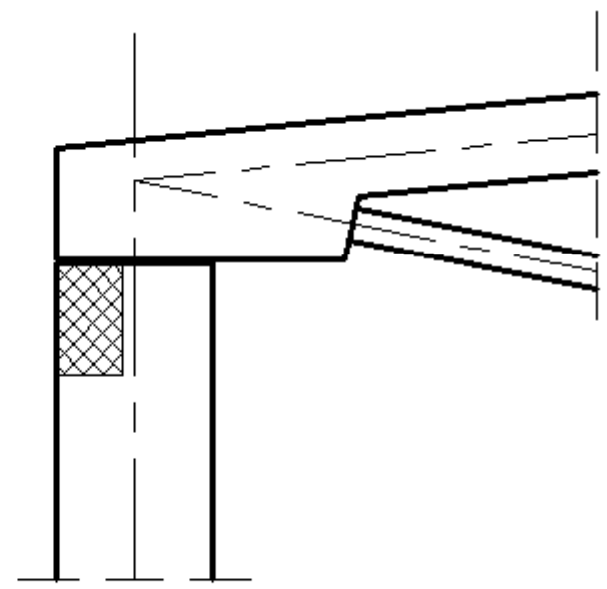
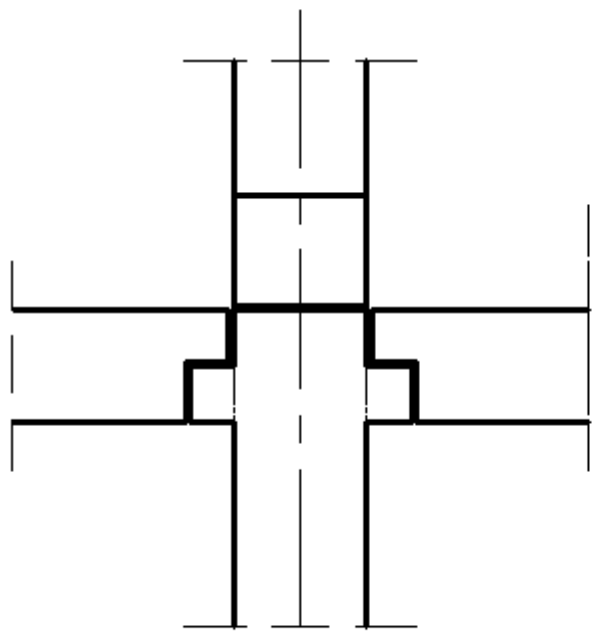
$$l_i = 0.707H$$

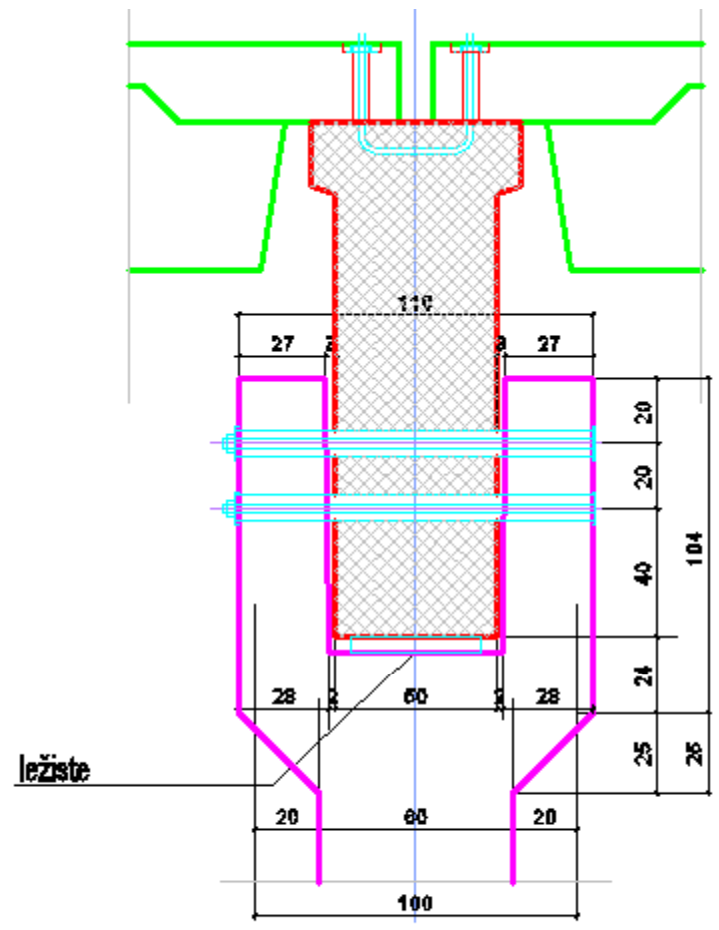
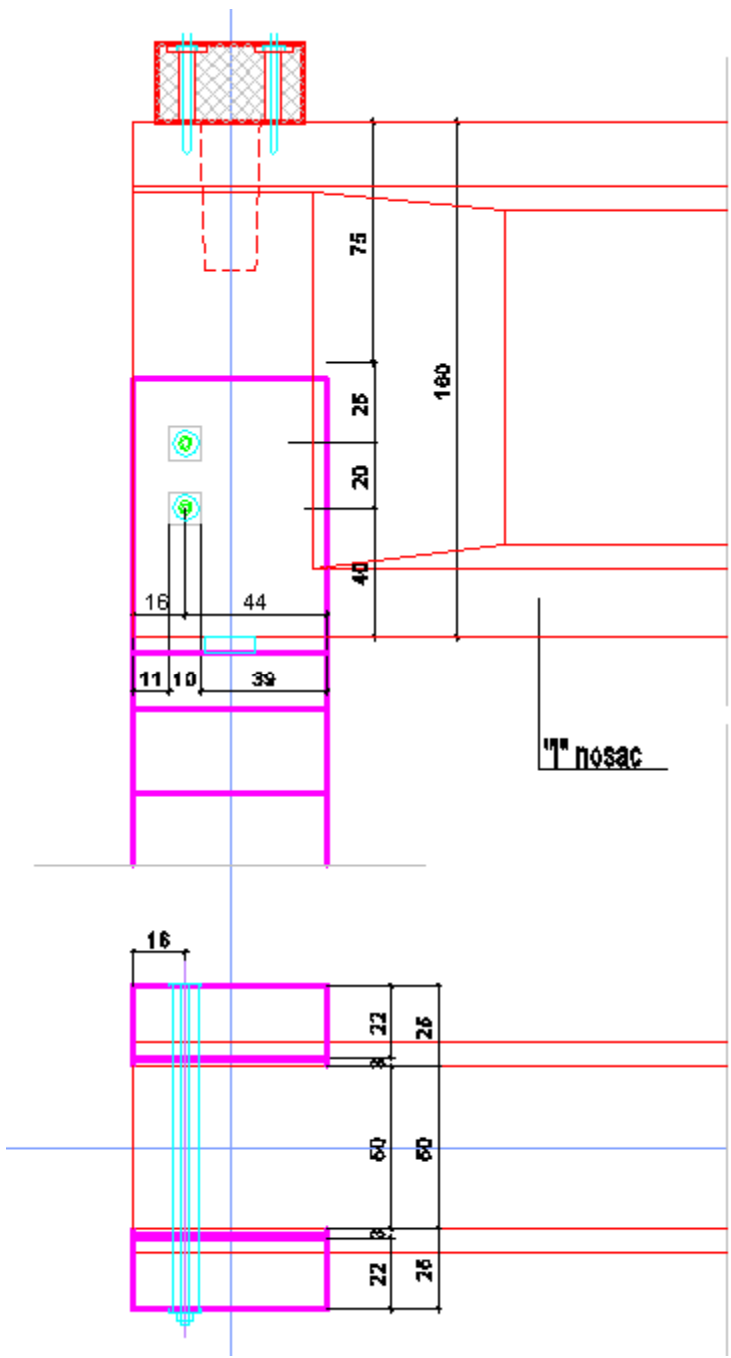
$$\lambda_y < 75$$

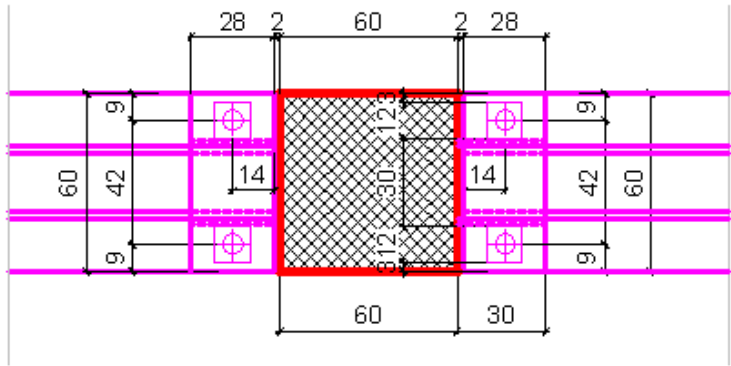
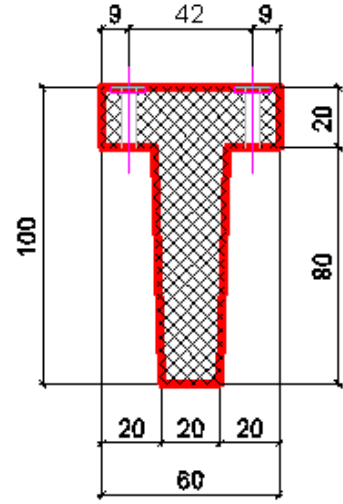
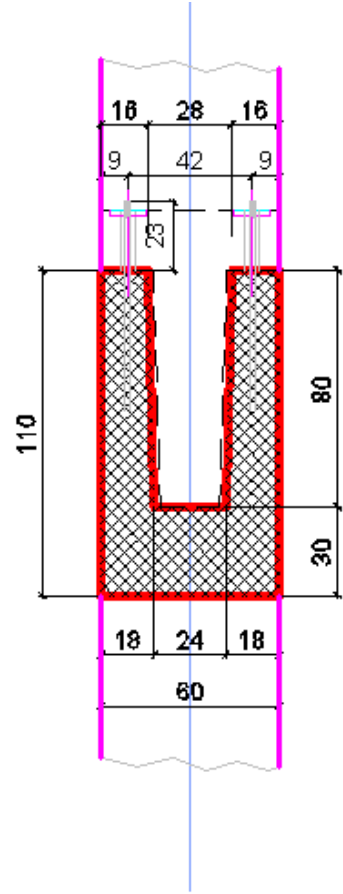
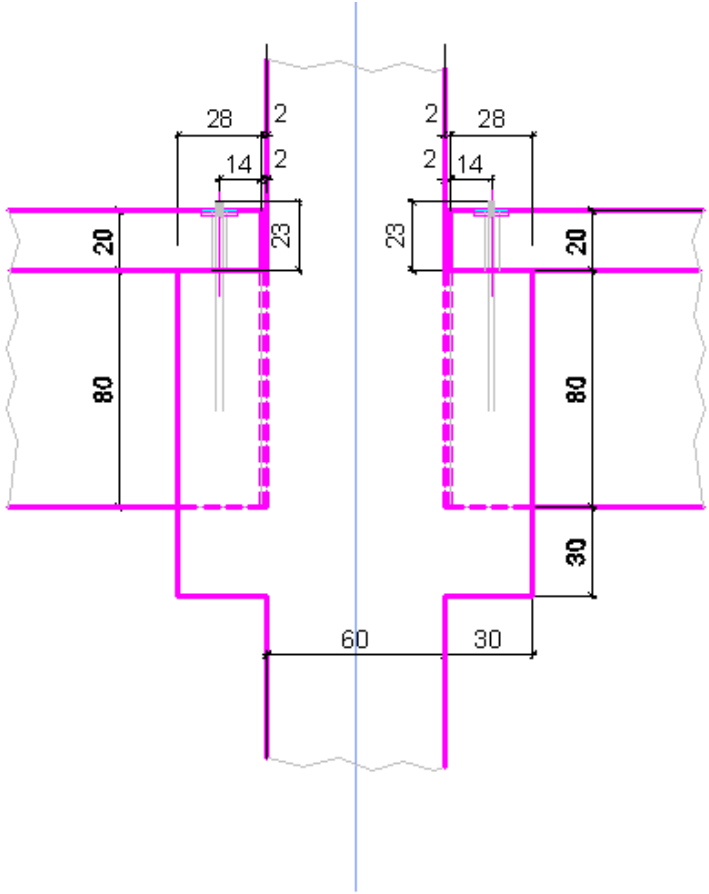
$$b \geq 40\text{cm}$$



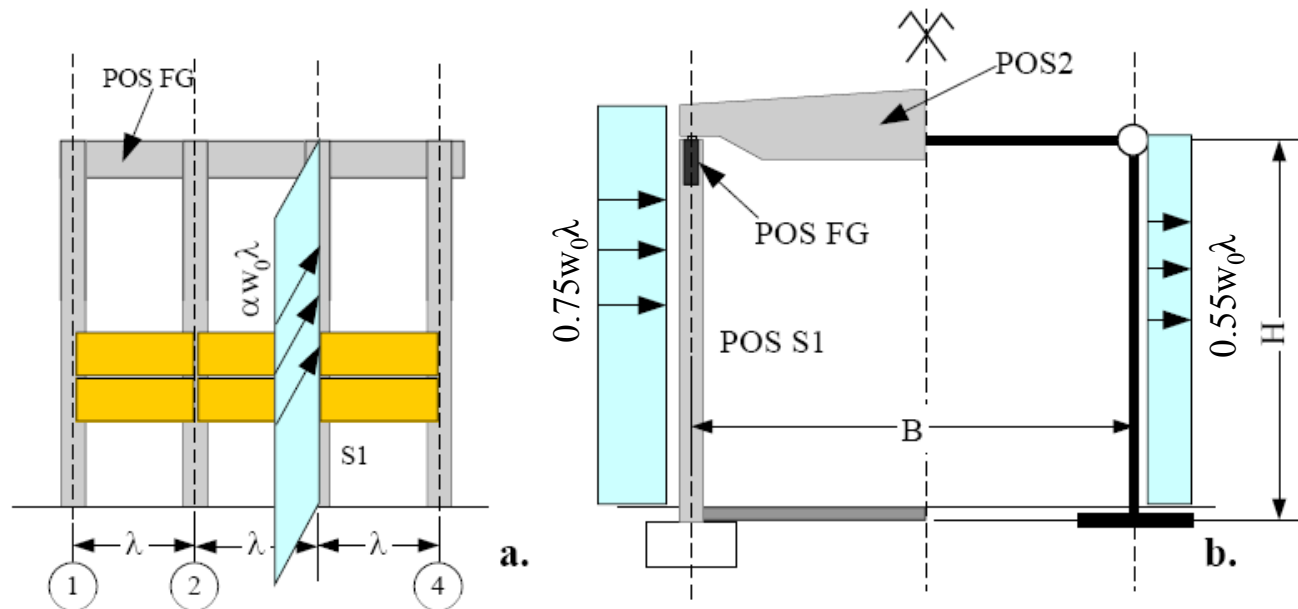
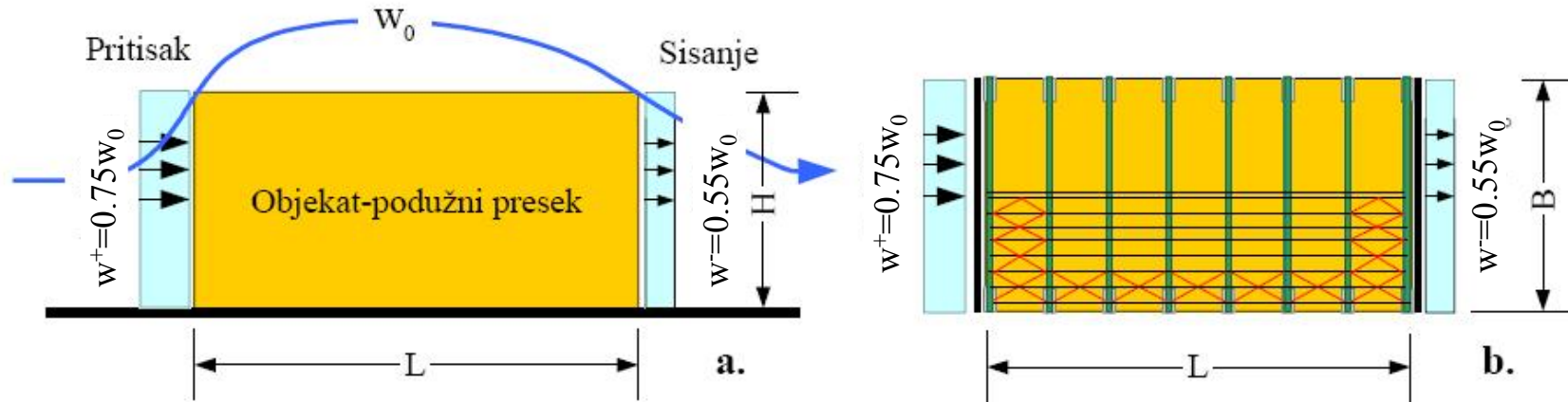




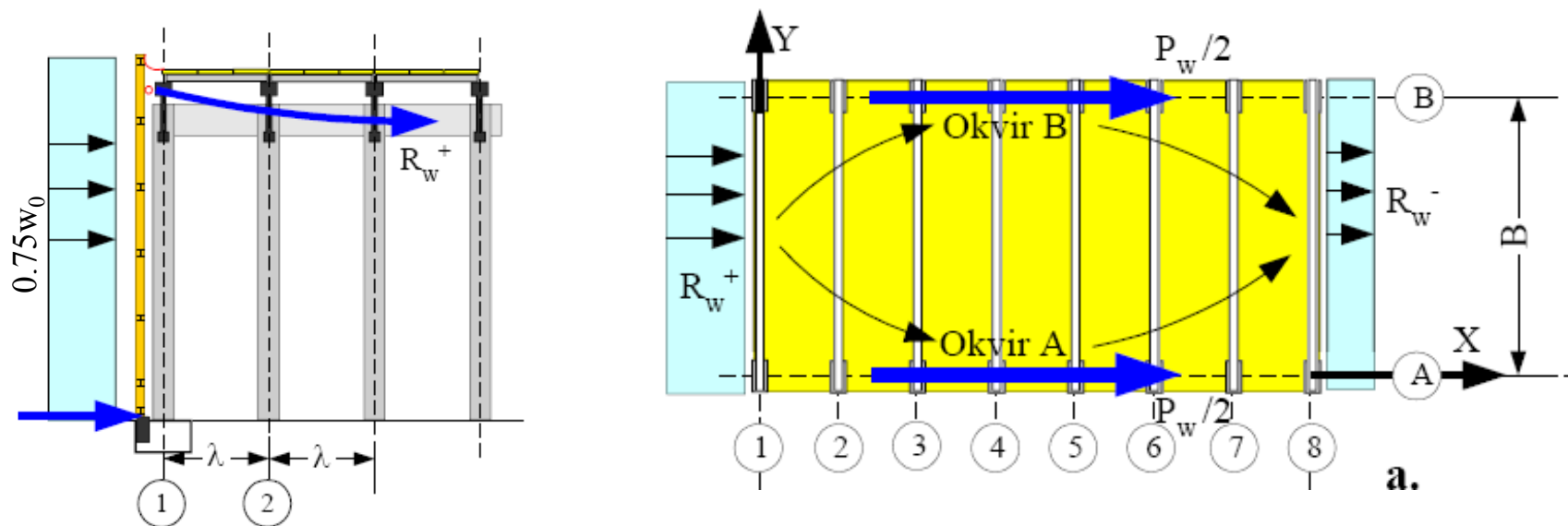




Dejstvo vetra na objekt

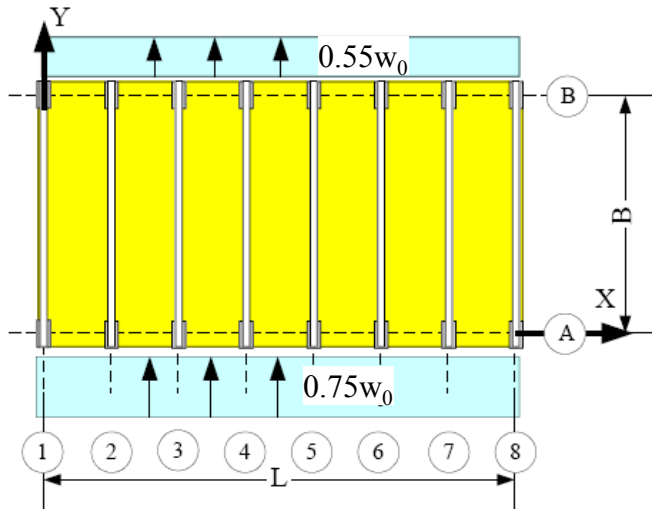


Uticaji od vetra u podužnom pravcu



Uticaje od vetra sa kalkana prihvataju zidovi Z1 i Z2 u okvirima A i B

Proračun uticaja od vetra u poprečnom ramu (približno)



Direktan uticaj vetra na stub

$$M_{sw1} = (0.75w_0\lambda)H^2/8$$

Efekat zajedničkog pomeranja vrhova (GN)

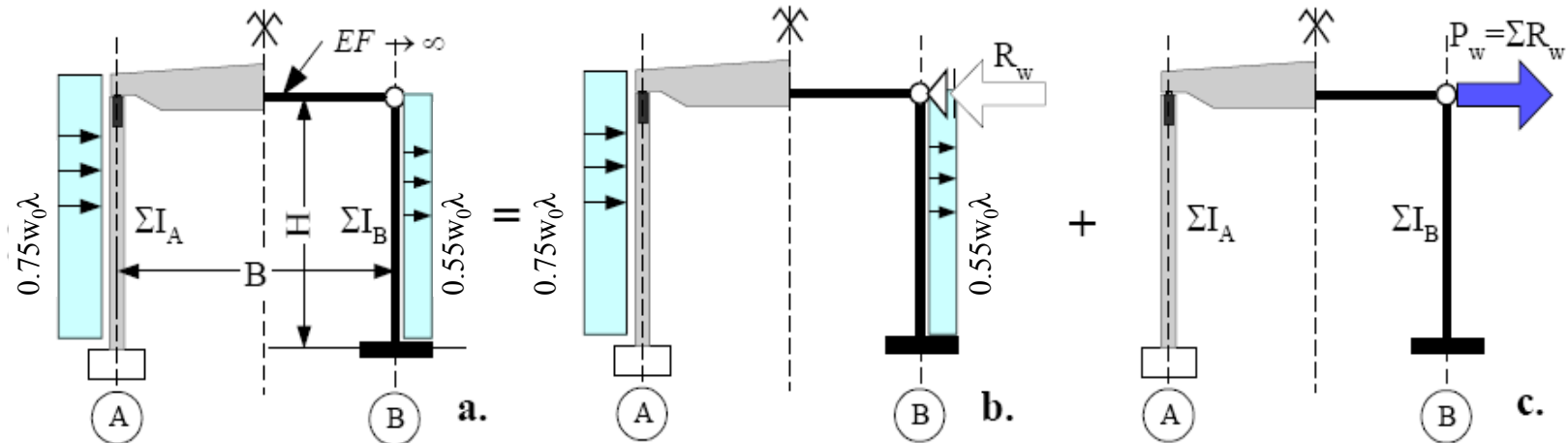
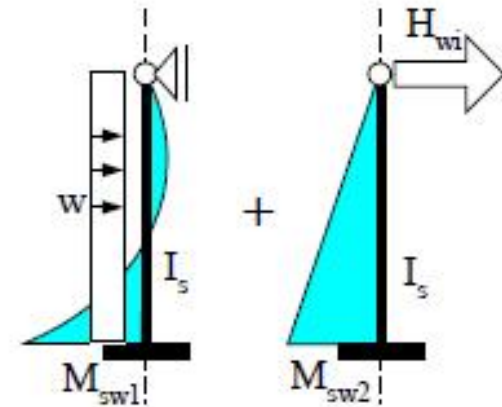
$$R_w = 3(0.75 + 0.55)w_0\lambda H/8$$

$$H_{wi} = R_w/2 \quad (=R_w k_i / \Sigma k_i)$$

$$M_{sw2} = H_{wi}H$$

Ukupni moment uklještenja

$$M_{sw} = M_{sw1} + M_{sw2}$$



Proračun pomerljivih i nepomerljivih umereno vitkih stubova postupkom "Dopunske ekscentričnosti", $\lambda \leq 75$ (PBAB2 str. 247)

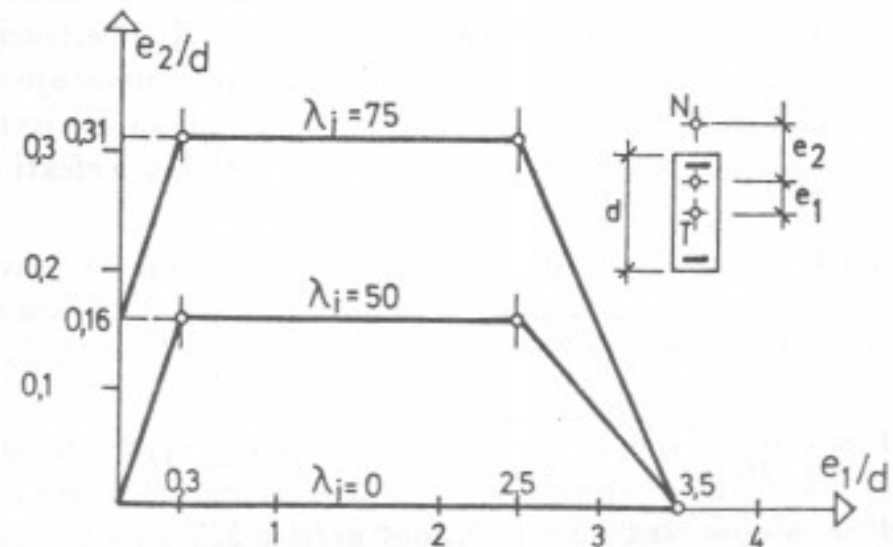
$$e_2/d = \frac{\lambda_i - 25}{100} \sqrt{0,10 + e_1/d} \geq 0 \text{ kada je } 0 \leq e_1/d < 0,30$$

$$e_2/d = \frac{\lambda_i - 25}{160} \geq 0 \text{ kada je } 0,30 \leq e_1/d < 2,5$$

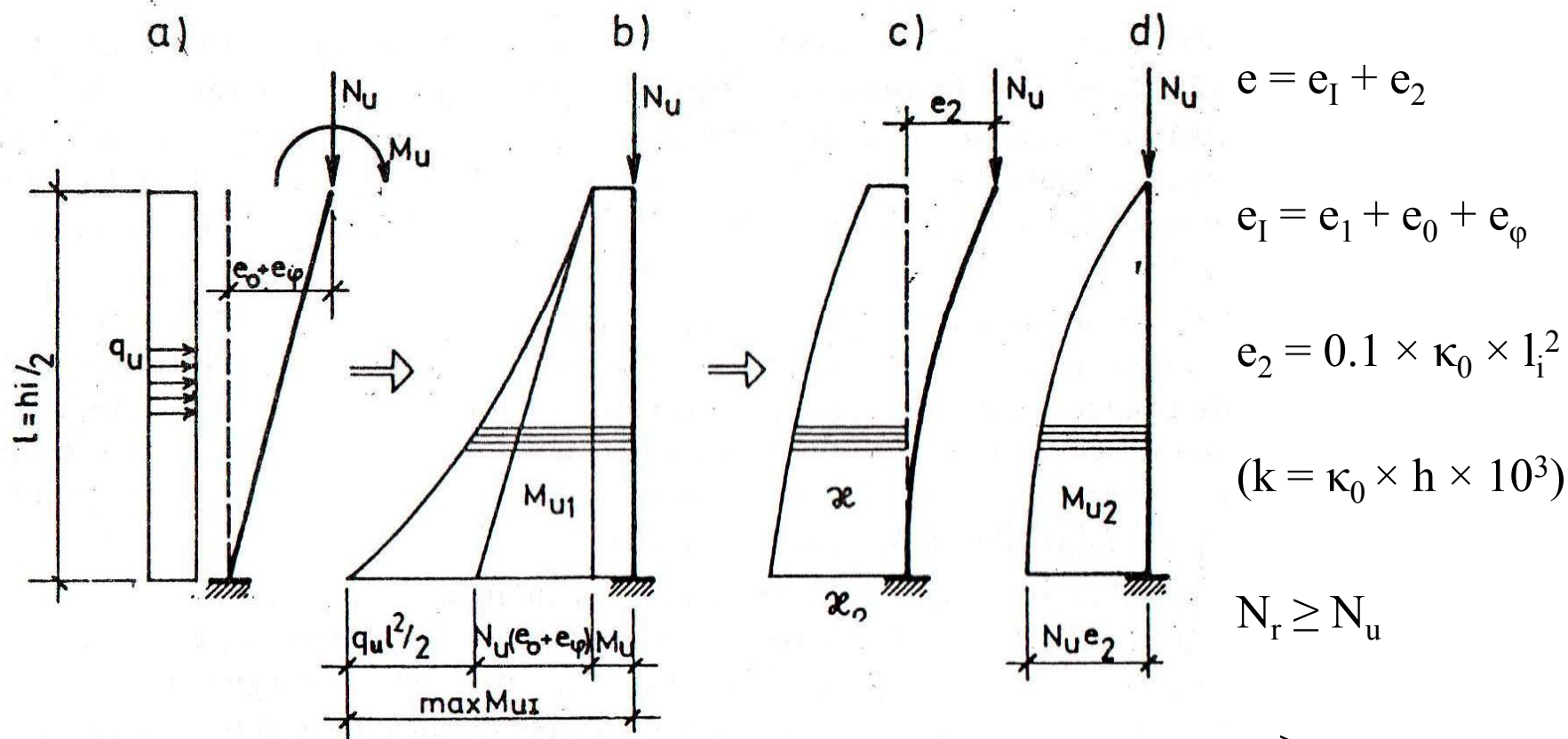
$$e_2/d = \frac{\lambda_i - 25}{160} (3,5 - e_1/d) \text{ kada je } 2,5 \leq e_1/d < 3,5$$

$$N_u = \gamma_g N_g + \gamma_p N_p + \gamma_d N_d$$

$$M_u = \gamma_g N_g (e_{1g} + e_o + e_\varphi + e_2) + \gamma_p N_p (e_{1p} + e_o + e_\varphi + e_2) + \gamma_d N_d (e_{1d} + e_o + e_\varphi + e_2)$$



Proračun stuba za vertikalno opterećenje i dejstvo vetra – proračun po teoriji drugog reda ($\lambda > 75$) (PBAB2 str. 228)



Slika 2.7/22 Model stuba; (a)-granično opterećenje i imperfekcija ose stuba; (b)-momenti savijanja prvog reda; (c)-deformacija ose, pomeranje vrha i krivina κ stuba usled ukupnih momenata prvog i drugog reda; (d)-momenti savijanja drugog reda

Primer proračuna stuba

Ulazni podaci:

$$h = 9.46 \text{ m}$$

$$L_i = 2 \times h = 1892 \text{ cm}$$

$$f_B = 25.5 \text{ Mpa}$$

$$b = 60 \text{ cm}$$

$$d = 60 \text{ cm}$$

$$h = d - a = 55 \text{ cm}$$

$$N_u = 3175 \text{ kN}$$

$$M_u = 214 \text{ kNm}$$

Ekcentricitet po teoriji I reda:

$$e_1/d = M_u/(N_u \times d) = 21400/(3175 \times 60) = 0.112$$

$$e_0 = L_i/300 = 1892/300 = 6.3 \text{ cm}$$

$$e_0/d = 6.3/60 = 0.105$$

$$e_1/d = e_1/d + e_0/d = 0.217$$

Proračun minimalne armature po Pravilniku BAB 87 (proračun se sprovodi po teoriji dopuštenih napona)

Dopušteni napon:

$$\sigma_i = 1.4 \times \sigma_s - 0.4 - (\sigma_s - 1) \times \frac{\lambda}{125} \quad ; \quad \sigma_s \text{ u [MPa]} \quad , \text{ iz Tabele 21 u Pravilniku BAB}$$

$$\sigma_i = 1.4 \times 10 - 0.4 - (10 - 1) \times \frac{109}{125} = 5.75 \text{ MPa} \quad \lambda = 109$$

minimalni procenat armiranja:

$$\mu_{\min} = \frac{\lambda}{50} - 0.4 \geq 0.6\% \quad \mu_{\min} = \frac{109}{50} - 0.4 = 1.78\% \quad \bar{\mu}_{\min} = \frac{1.78}{100} \times \frac{400}{25.5} = 0.279$$

$$N = N_g + N_p = 1924 \text{ kN}$$

potrebna površina betonskog preseka:

$$A_{b, \text{potr.}} = \frac{N}{\sigma_i \times (1 + n \times \mu_{\min})} = \frac{1924}{0.575 \times (1 + 10 \times 1.78 \times 10^{-2})} = 2840 \text{ cm}^2$$

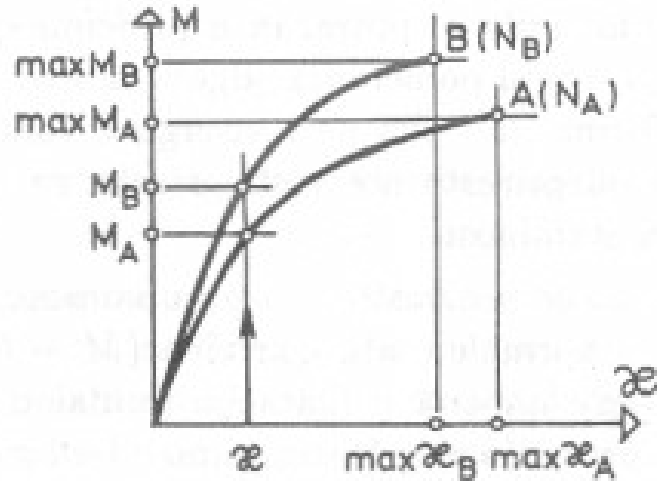
$$A_{a, \text{min.}} = \mu_{\min} \times A_{b, \text{potr.}} = 1.78 \times 10^{-2} \times 2840 = 50.56 \text{ cm}^2$$

Ako bi se primenila formula za μ_{\min} na stvarni presek ($60 \times 60 = 3600 \text{ cm}^2$):

$$A_{a, \text{min.}} = \mu_{\min} \times A_{b, \text{potr.}} = 1.78 \times 10^{-2} \times 3600 = 64.08 \text{ cm}^2$$

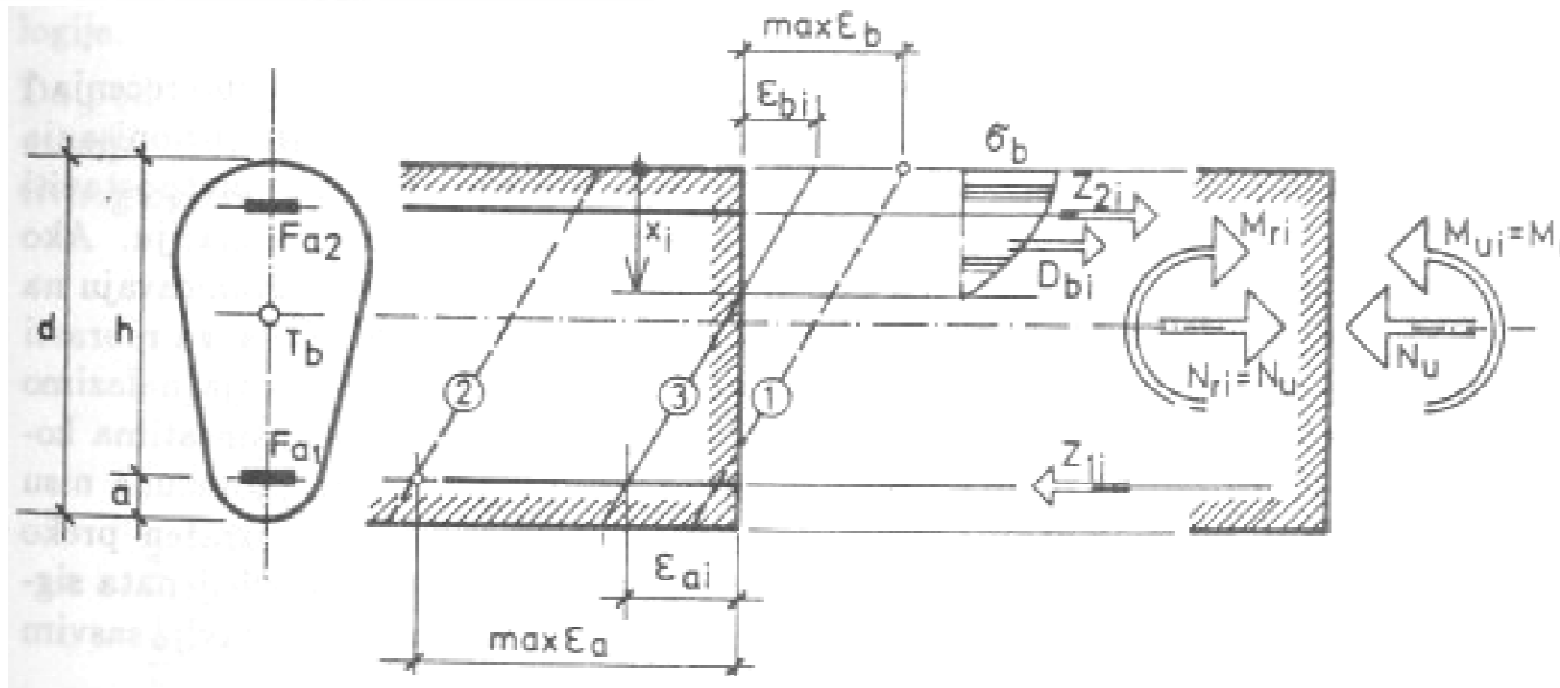
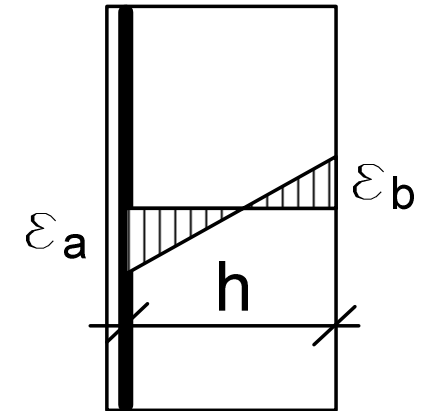
Dijagram moment krivina

- konstrukcija dijagrama
- uticaj normalne sile



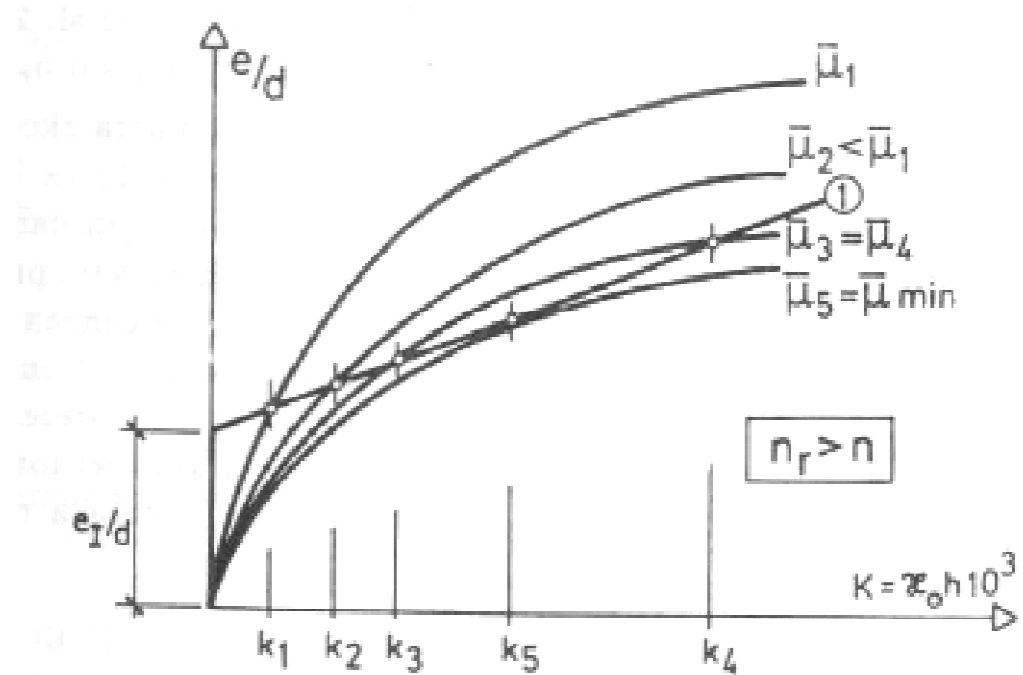
krivina

$$\kappa = (\varepsilon_a + \varepsilon_b)/h$$



$$n_u = N_u / (b \cdot d \cdot f_B) = 0.346$$

usv. $n_r = 0.35$



Pretpostavka

Izračunato

Tabela



k	K	e_2/d	e/d	m_r	μ	Aa
	$k \times 10^{-3}/h$	$0.1 \times k \times L_i^2/d$	$e_2/d + e_I/d$	$(e_2/d + e_I/d) \times n_r$		
2	3.63636E-05	0.217	0.434	0.152	0.356	81.70
2.5	4.54545E-05	0.271	0.489	0.171	0.340	78.03
3	5.45455E-05	0.325	0.543	0.190	0.334	76.65
3.5	6.36364E-05	0.380	0.597	0.209	0.333	76.42
4	7.27273E-05	0.434	0.651	0.228	0.336	77.11
				min	0.333	76.42

$$A_a = 76.45 \text{ cm}^2$$

1

Prilog 2.7.2 Pravougaoni presek RA 400/500 - Str. 1

* Fa*Sigv/b*d*lg

		.00	.10	.15	.20	.25	.30	.35	.40	.45	.50	.60	.70	.80	.90	1.00	1.10	1.20	
0.00	n	$n \cdot 10^3 = 10^3 \cdot Nu/b^2 \cdot d^2 \cdot lg$																	
0.00	k	0	8	12	15	18	21	24	27	30	33	36	43	48	53	58	63	68	
1.0	k	0	17	24	30	36	42	48	54	60	65	72	81	96	106	116	127	138	
1.5	k	0	25	35	45	54	63	72	80	88	97	112	126	143	158	172	187	201	
2.0	k	0	32	45	60	74	88	102	116	130	144	165	189	209	228	247	266	285	
2.5	k	0	41	58	74	90	104	118	132	146	159	185	210	235	259	283	307	330	
3.0	k	0	0	0	0	0	0	0	0	0	0	158	189	220	250	279	308	337	
3.5	k	0	0	0	0	0	0	0	0	0	0	0	0	0	0	390	423	455	
max k		0	2,5	2,6	2,7	2,8	2,9	3,0	3,0	3,1	3,1	3,2	3,3	3,4	3,5	3,6	3,7	3,7	
max m		0	42	62	81	101	120	140	159	178	198	236	275	314	352	391	430	469	

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Primer korišćenja tabele (PBAB2 str 251) korak 1

Prilog 2.7.2

* Fa*Sigv/b*d*lg

		.00	.10	.15	.20	.25	.30	.35	.40	.45	.50	.60	
0.00	n	$n \cdot 10^3 = 10^3 \cdot Nu/b^2 \cdot d^2 \cdot lg$											
0.00	k	0	8	12	15	18	21	24	27	30	33	36	
1.0	k	0	17	24	30	36	42	48	54	60	65	72	
1.5	k	0	25	35	45	54	63	72	80	88	97	112	
2.0	k	0	32	45	60	74	88	102	116	130	144	165	
2.5	k	0	41	58	74	90	104	118	132	146	159	185	
3.0	k	0	0	0	0	0	0	0	0	0	158	189	
3.5	k	0	0	0	0	0	0	0	0	0	0	390	
max k		0	2,5	2,6	2,7	2,8	2,9	3,0	3,0	3,1	3,1	3,2	
max m		0	42	62	81	101	120	140	159	178	198	236	

252

$u_{L2} = 0,152$
 $u_{L2} \cdot 10^3 = 152$
 $157 < 152 < 159$

$\bar{\mu} = 0,356$

$u_{L2} = 0,152$
 $u_{L2} \cdot 10^3 = 152$
 $157 < 152 < 159$

$\bar{\mu} = 0,356$

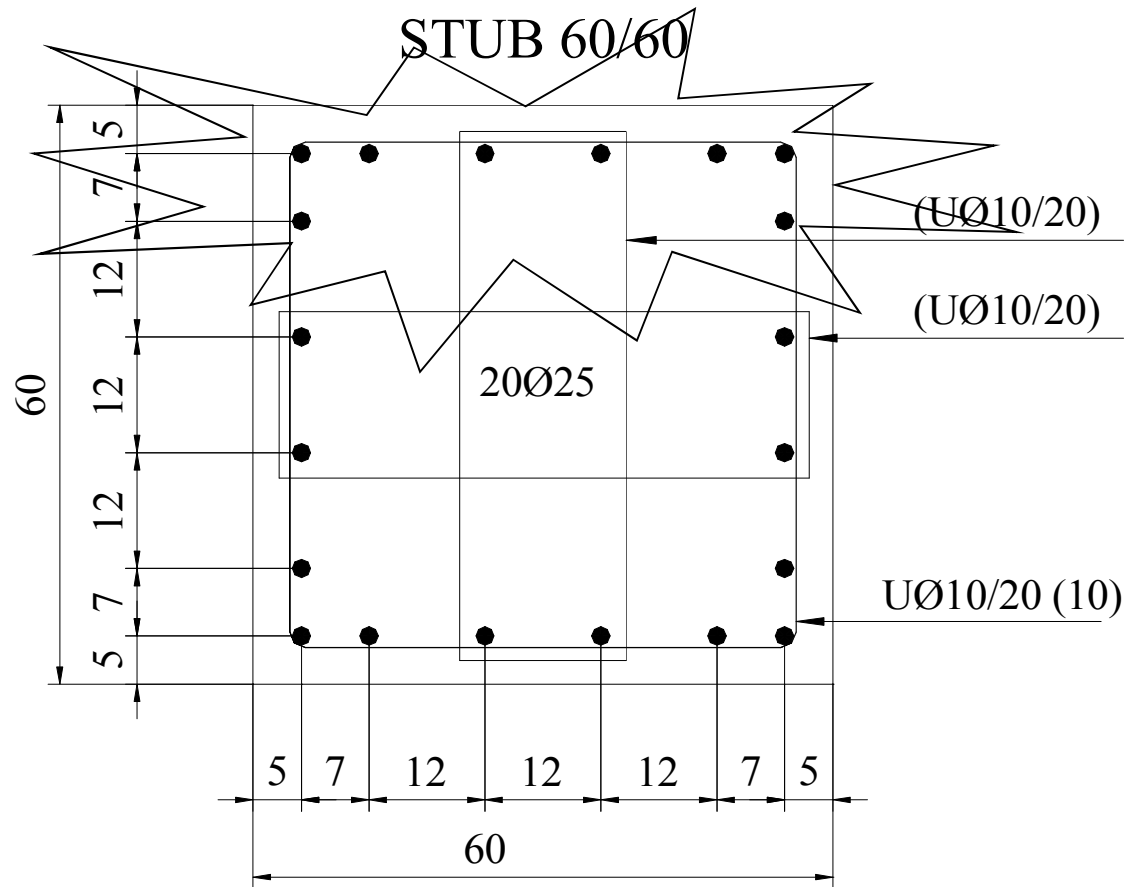
4

n	k	Fa * Sigv / b * d * fg																
		.00	.10	.15	.20	.25	.30	.35	.40	.45	.50	.60	.70	.80	.90	1.00	1.10	1.20
0.00	0	0	8	12	15	18	21	24	27	30	33	36	43	48	53	58	63	68
1.0	0	17	24	30	36	42	48	54	59	65	73	86	96	106	116	125	135	
1.5	0	35	45	54	63	72	80	88	97	112	128	143	158	172	187	201	215	
2.0	0	53	67	80	92	104	116	128	140	159	179	199	229	249	269	289	309	
2.5	0	71	91	108	125	141	158	174	189	210	235	259	283	307	331	355	379	
3.0	0	89	113	136	155	173	191	207	223	250	279	308	337	365	393	421	449	
3.5	0	107	136	165	188	210	228	244	259	292	323	352	381	409	437	465	493	
max k	0	2.5	2.6	2.7	2.8	2.9	3.0	3.0	3.1	3.1	3.2	3.3	3.4	3.5	3.5	3.6	3.6	
max m	0	42	62	81	101	120	140	159	178	198	236	275	314	352	391	430	469	

Primer korišćenja tabele (PBAB2 str 251) korak 4

$\mu_2 = 0,209$
 $\mu_2 \cdot 10^3 = 209$
 $199 < 209 < 214$

$\bar{\mu} = 0,333$



$$A_a/2 = 76.4/2 = 38.2 \text{ cm}^2$$

$$8\text{Ø}25 = 39.6 \text{ cm}^2$$