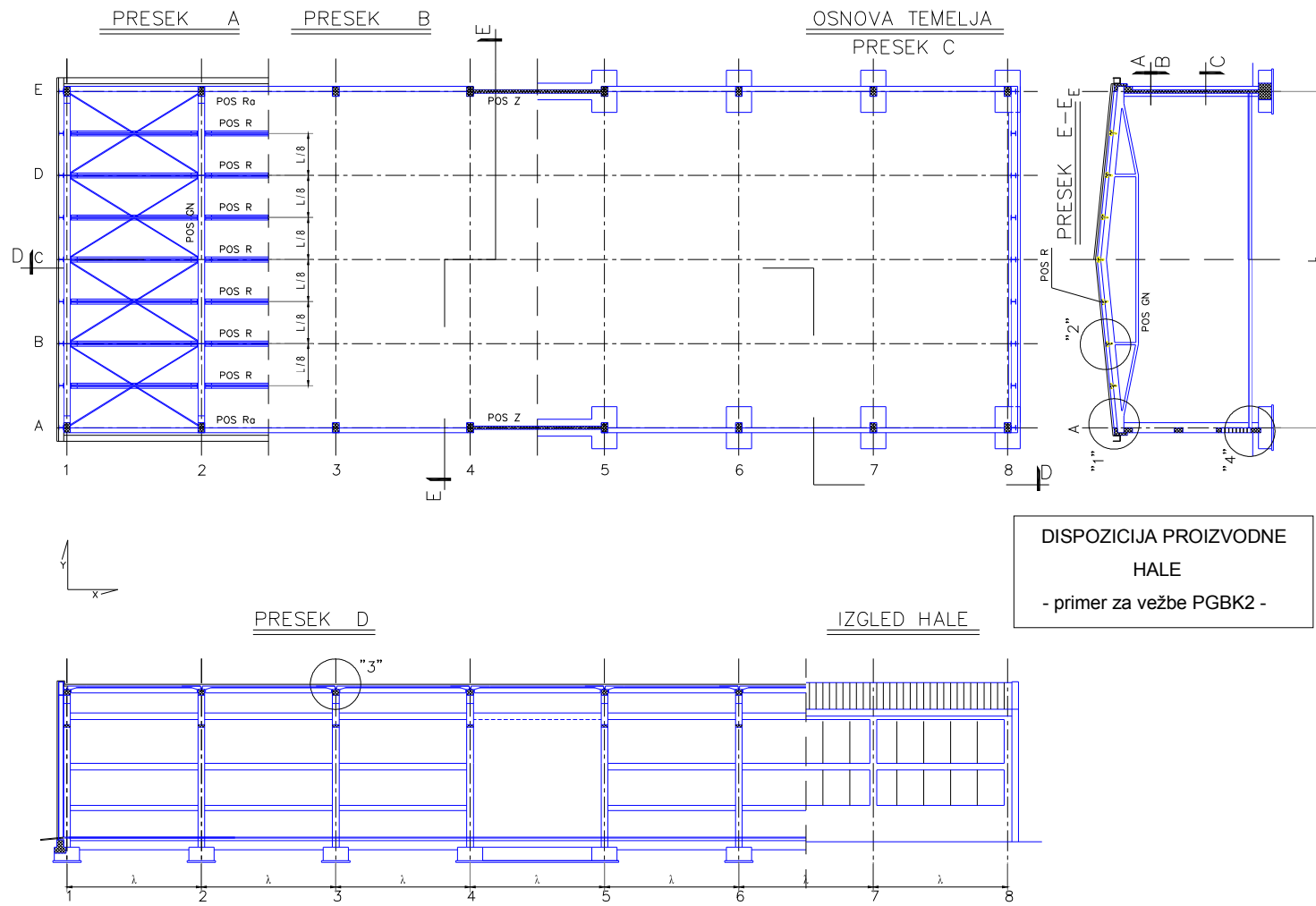
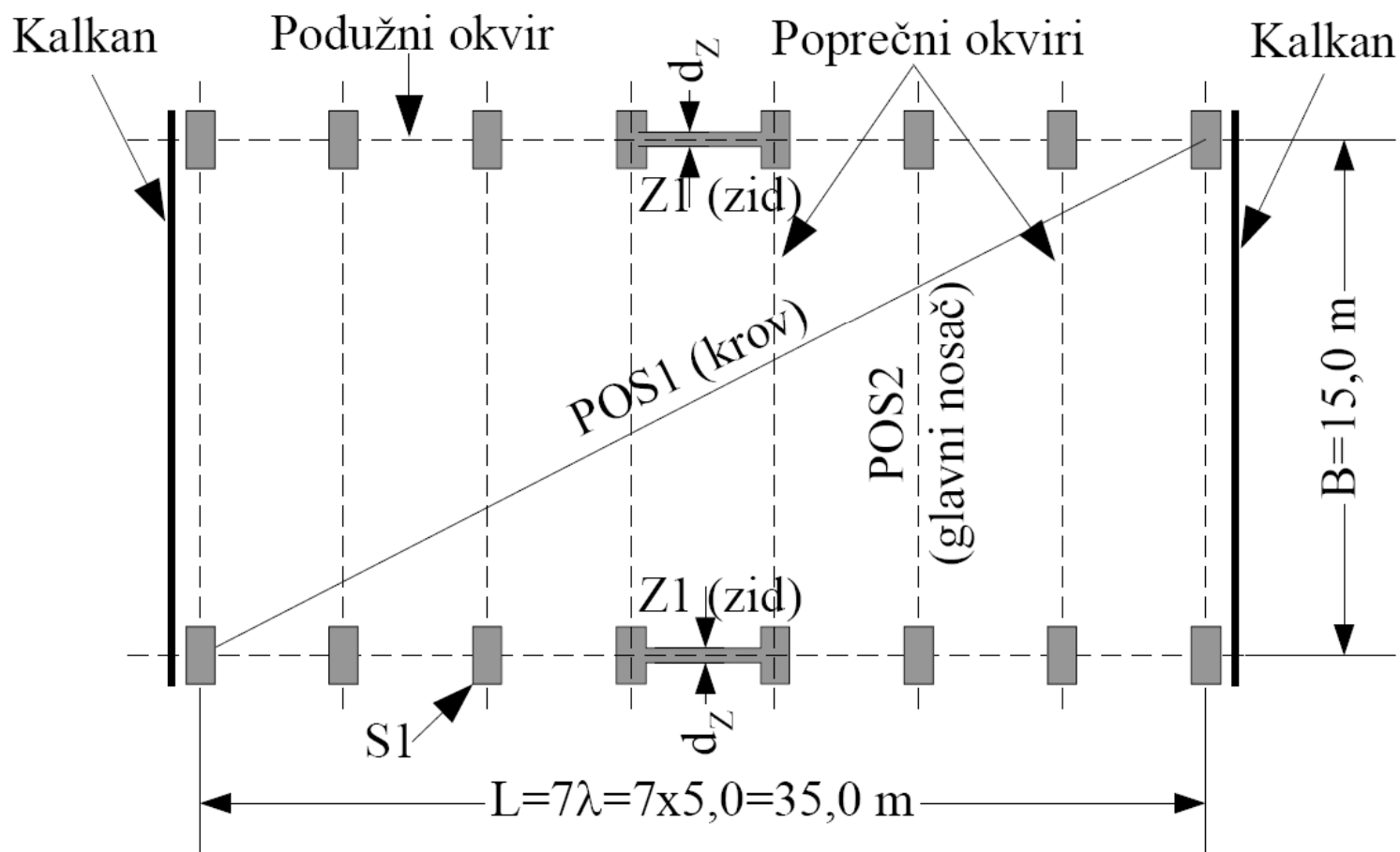


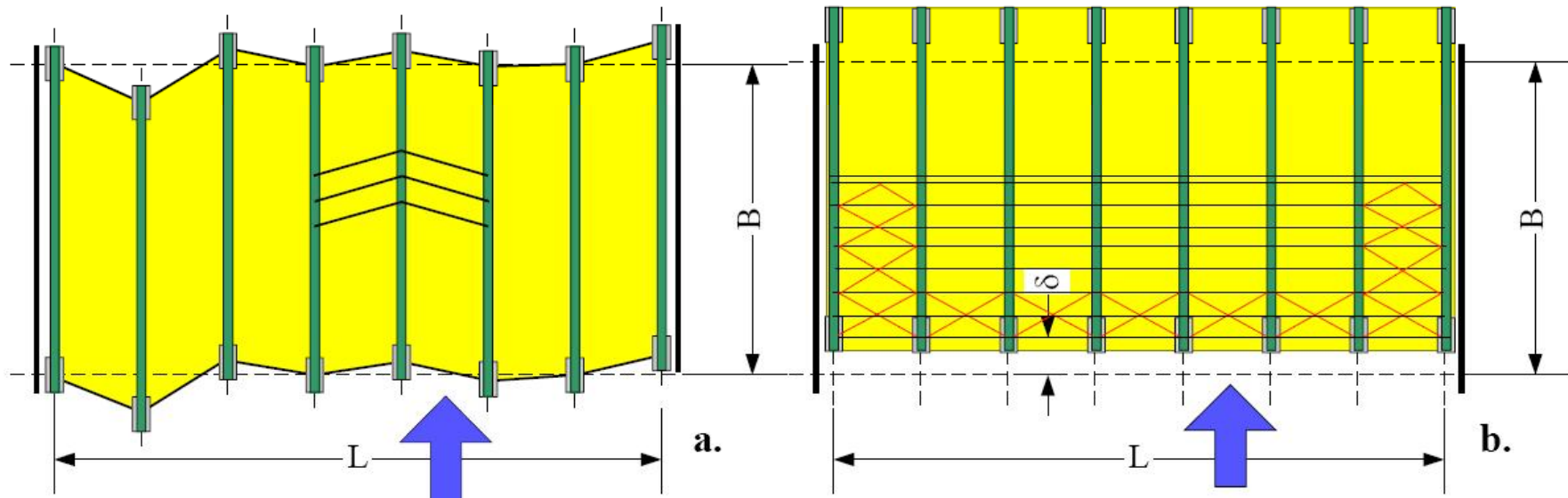
Dispozicija hale



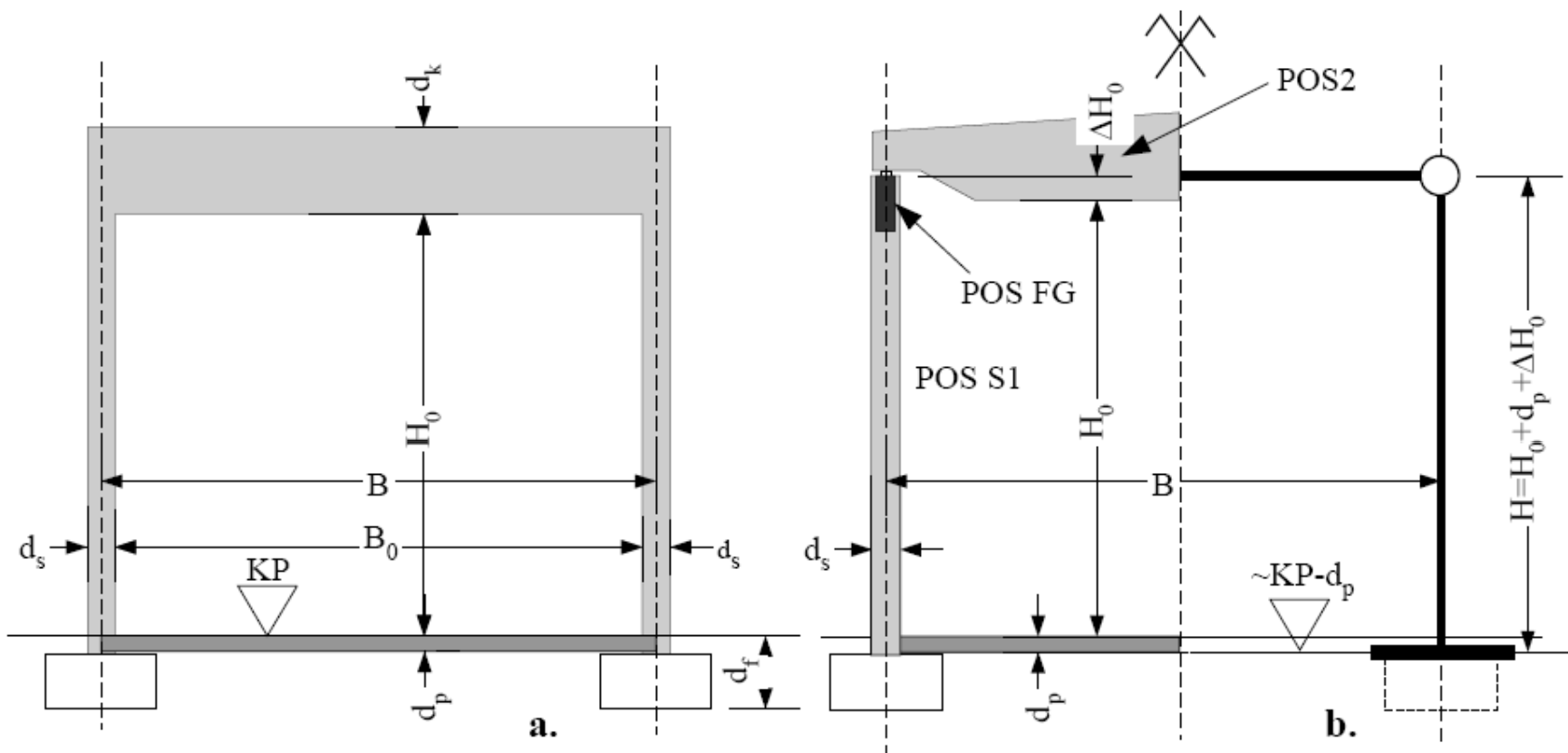
Elementi konstrukcije hale za prijem vertikalnih i horizontalnih uticaja



Krutost krovne ravni



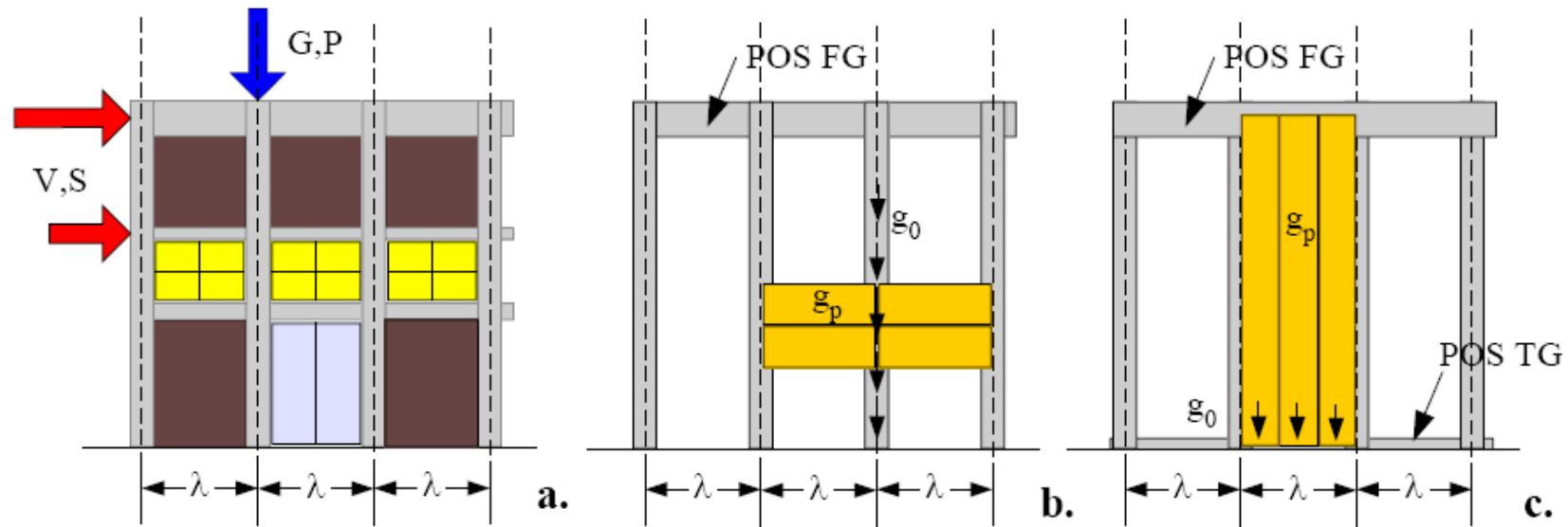
Poprečni ram



Dužina izvijanja stuba u poprečnom pravcu

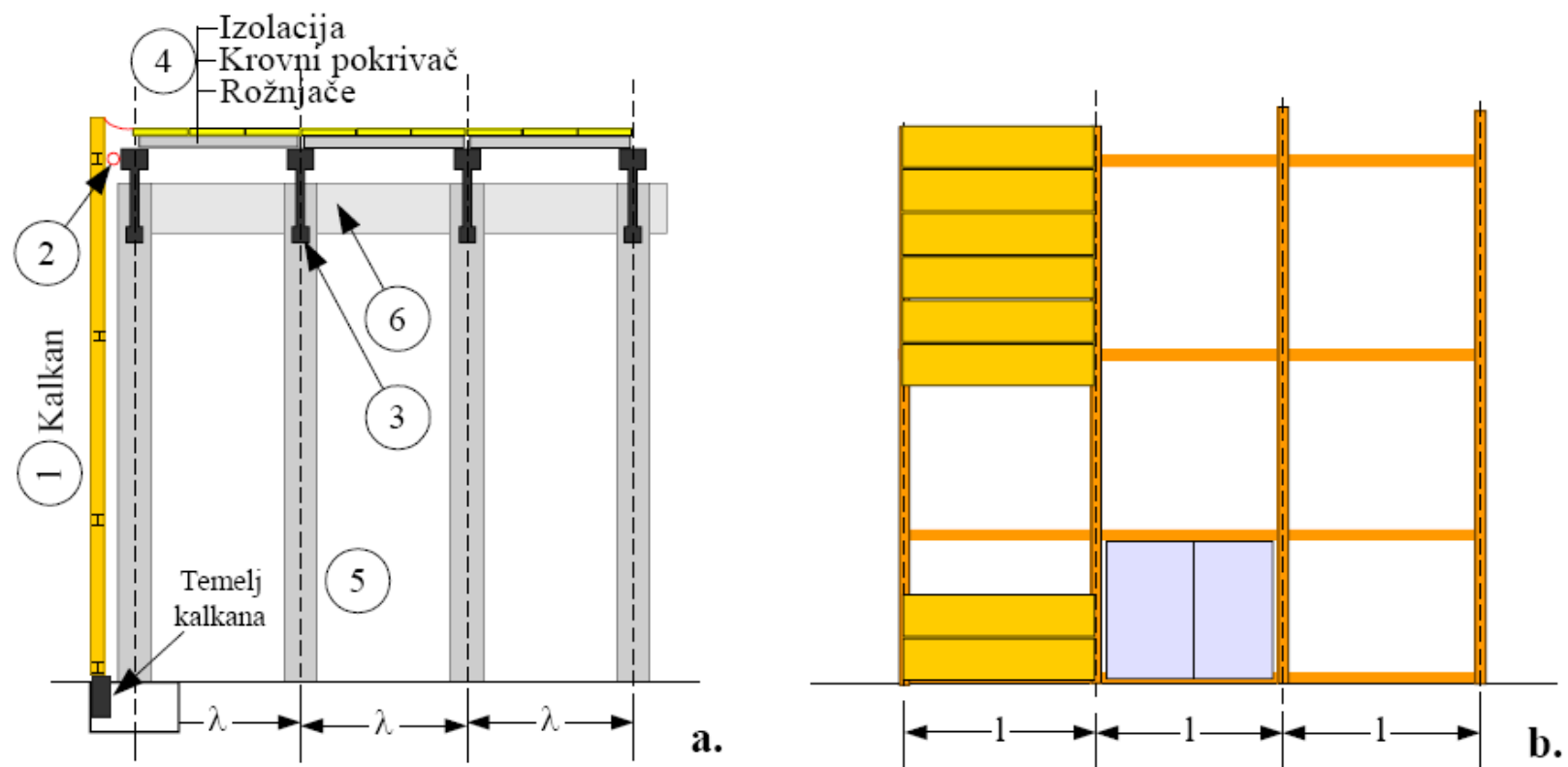
$$l_i = 2 \times H$$

Podužni ram



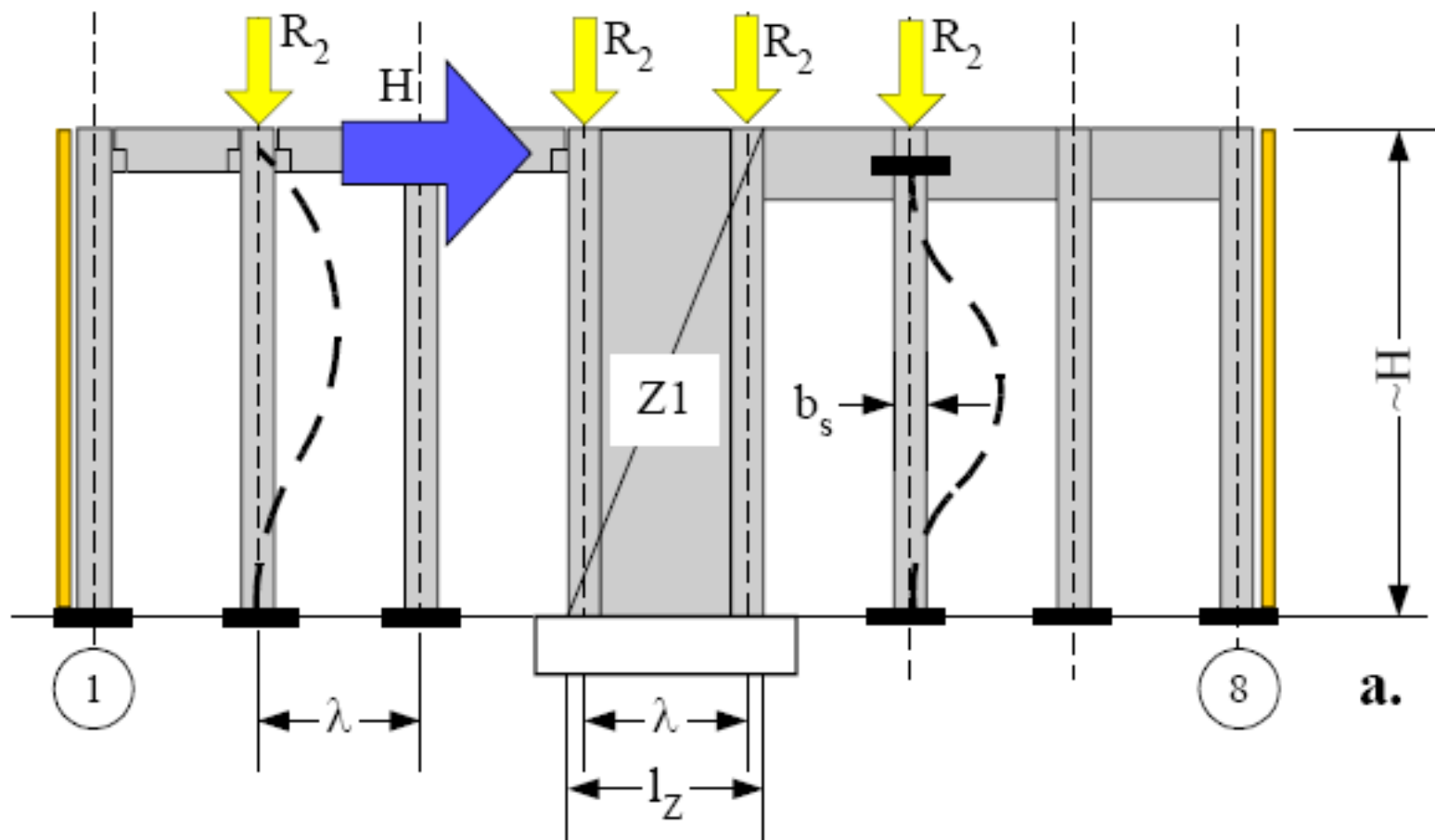
Način prenošenja horizontalnog opterećenja na konstrukciju

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

$$l_i = 2H$$

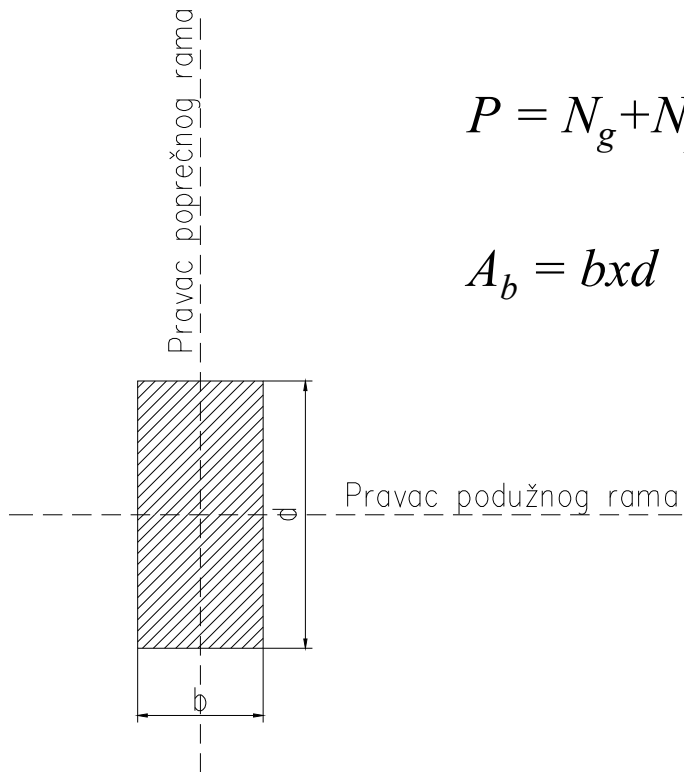
$$\lambda_x = 80-90$$

- Vitkost u podužnom pravcu

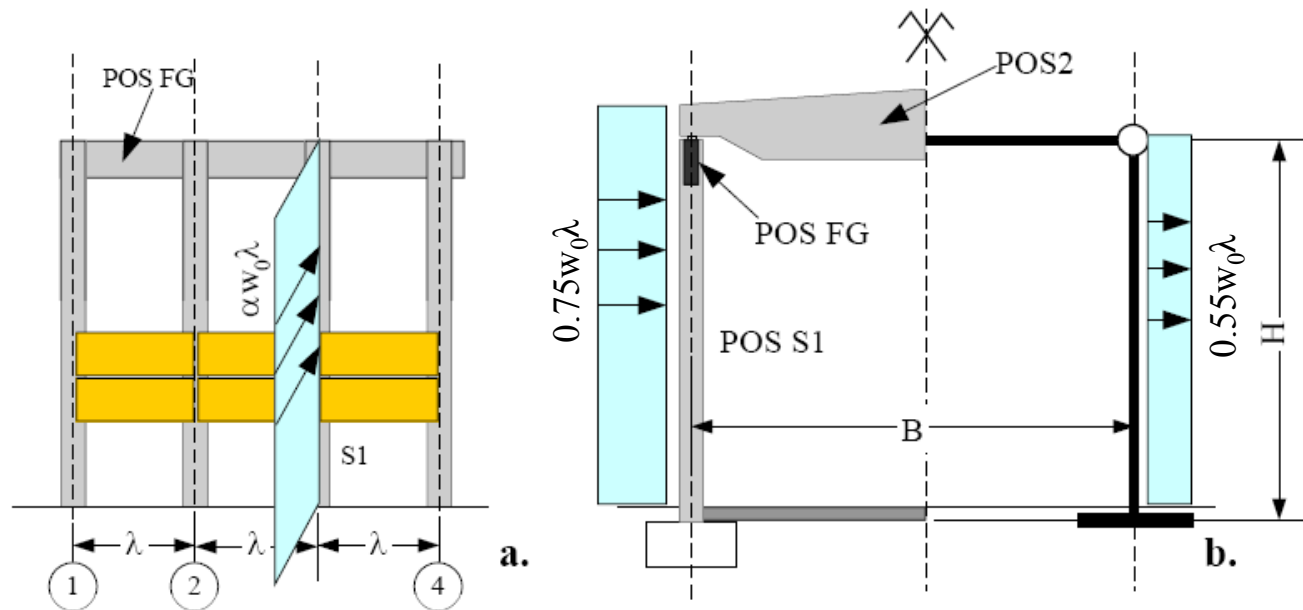
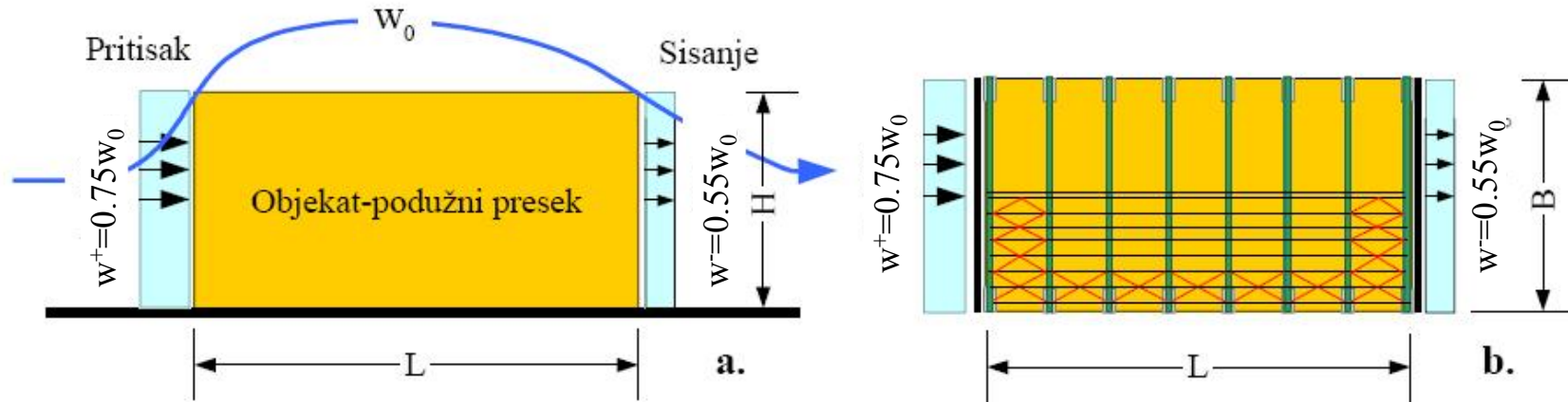
$$l_i = 0.707H$$

$$\lambda_y < 75$$

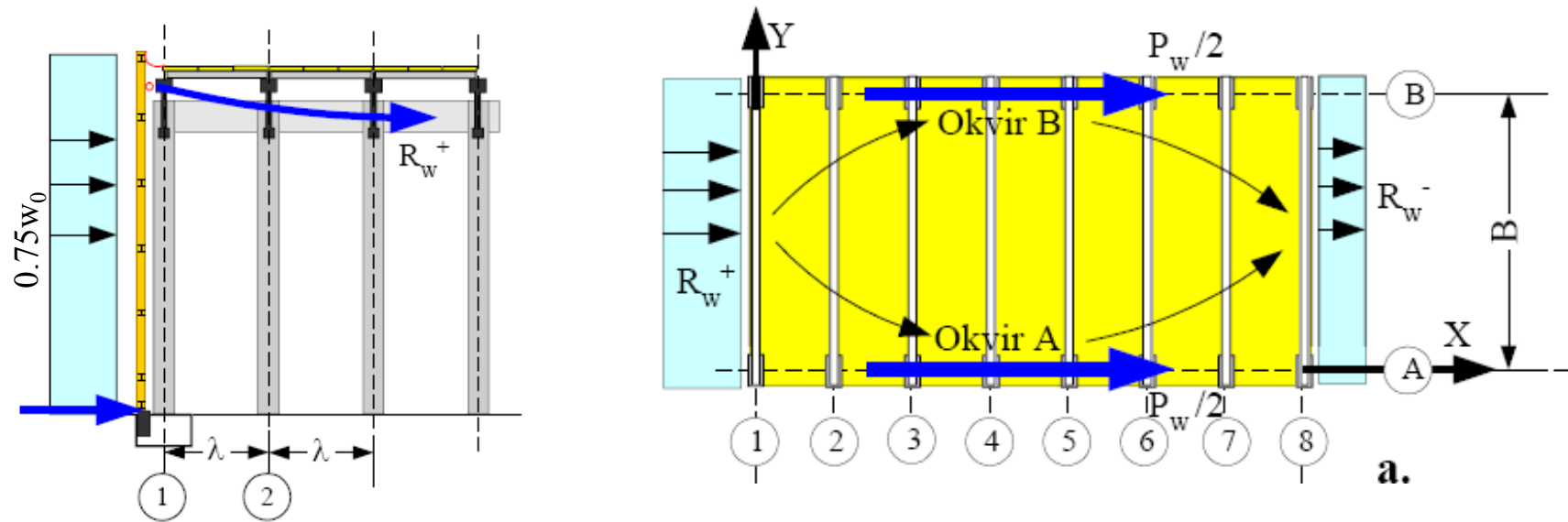
$$b \geq 40\text{cm}$$



Dejstvo vetra na objekt

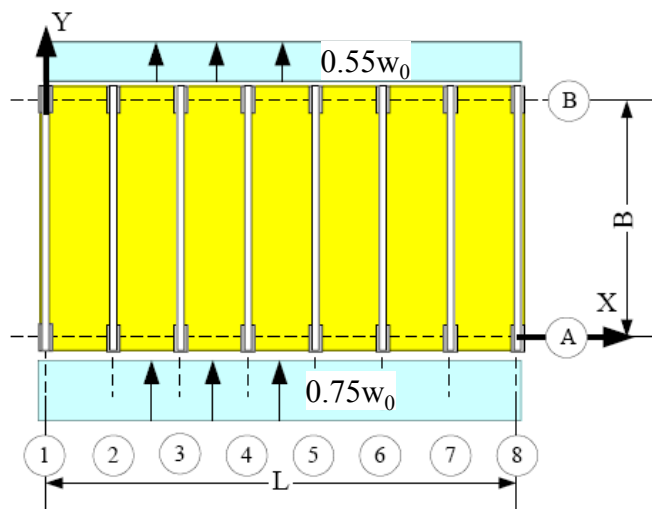


Uticaji od vetra u podužnom pravcu



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

Proračun uticaja od vetra u poprečnom ramu (približno)



Slika 4.20 - Dejstvo vetra u poprečnom Y-pravcu

Uticaji u stubovima od vetra u poprečnom pravcu, slika 4.20, posledica su dva stanja: direktnog dejstva vetra na stub sa pripadajuće širine λ , slika 4.21.b, i uticaja usled pomeranja vrhova stubova zbog pomeranja krova kao krute ploče, slika 4.21.c.

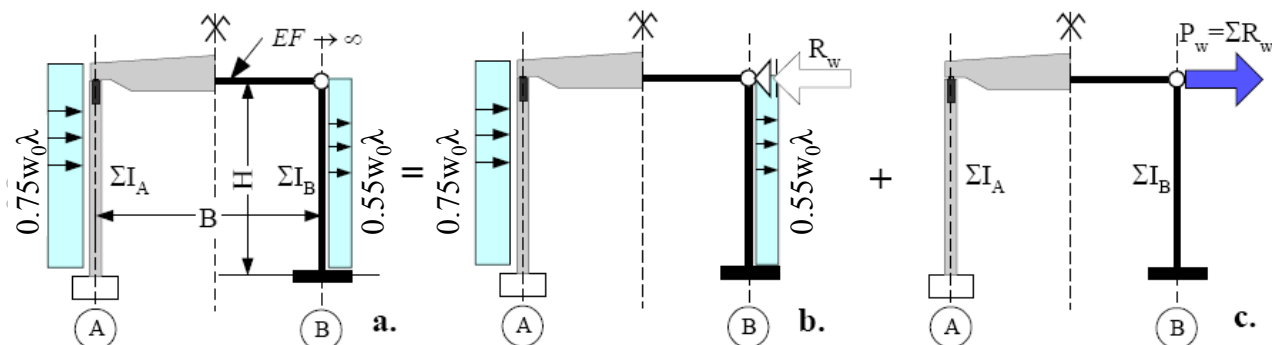
U terminima 'metode deformacija', direktni uticaji vetra na stub dobijaju se analizom 'nepomerljivog sistema', kome je privremeno dodat horizontalni oslonac u ravni krova, slika 4.21.b. U ovom koraku treba odrediti momente i transverzalne sile stuba-grede uklještene u temelj, i zglobno oslonjene o ravan nepomerljivog krova. Moment u uklještenju stuba u osi A , izlo-

ženog pritiskujućem dejstvu vetra iznosi

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

slika 4.22.a, dok je reakcija stuba u ravni krova

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



Slika 4.21 - Određivanje uticaja od vetra u stubovima poprečnog okvira: a.) dispozicija; b.) lokalno dejstvo vetra na jedan okvir; c.) sumarno dejstvo vetra u ravni krova na konstrukciju u celini

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

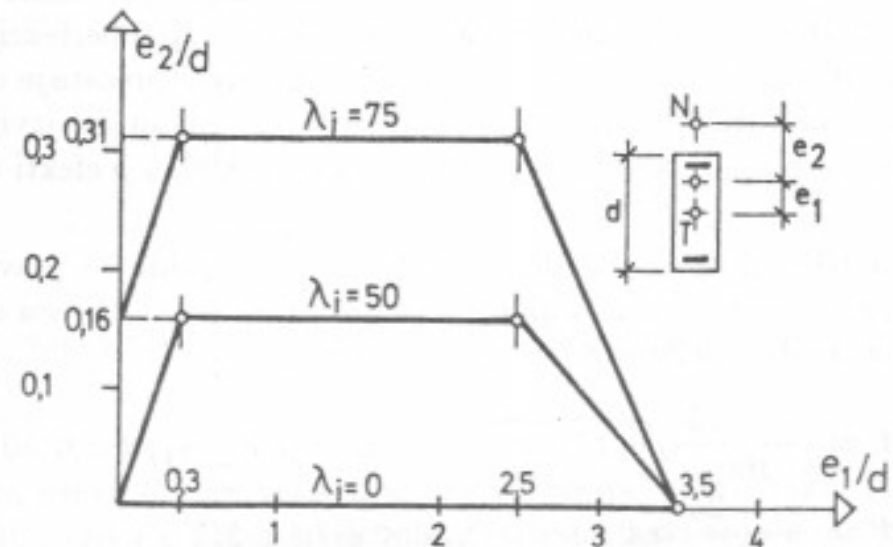
$$e_2/d = \frac{\lambda_i - 25}{100} \sqrt{0,10 + e_1/d} \geq 0 \text{ kada je } 0 \leq e_1/d < 0,30$$

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

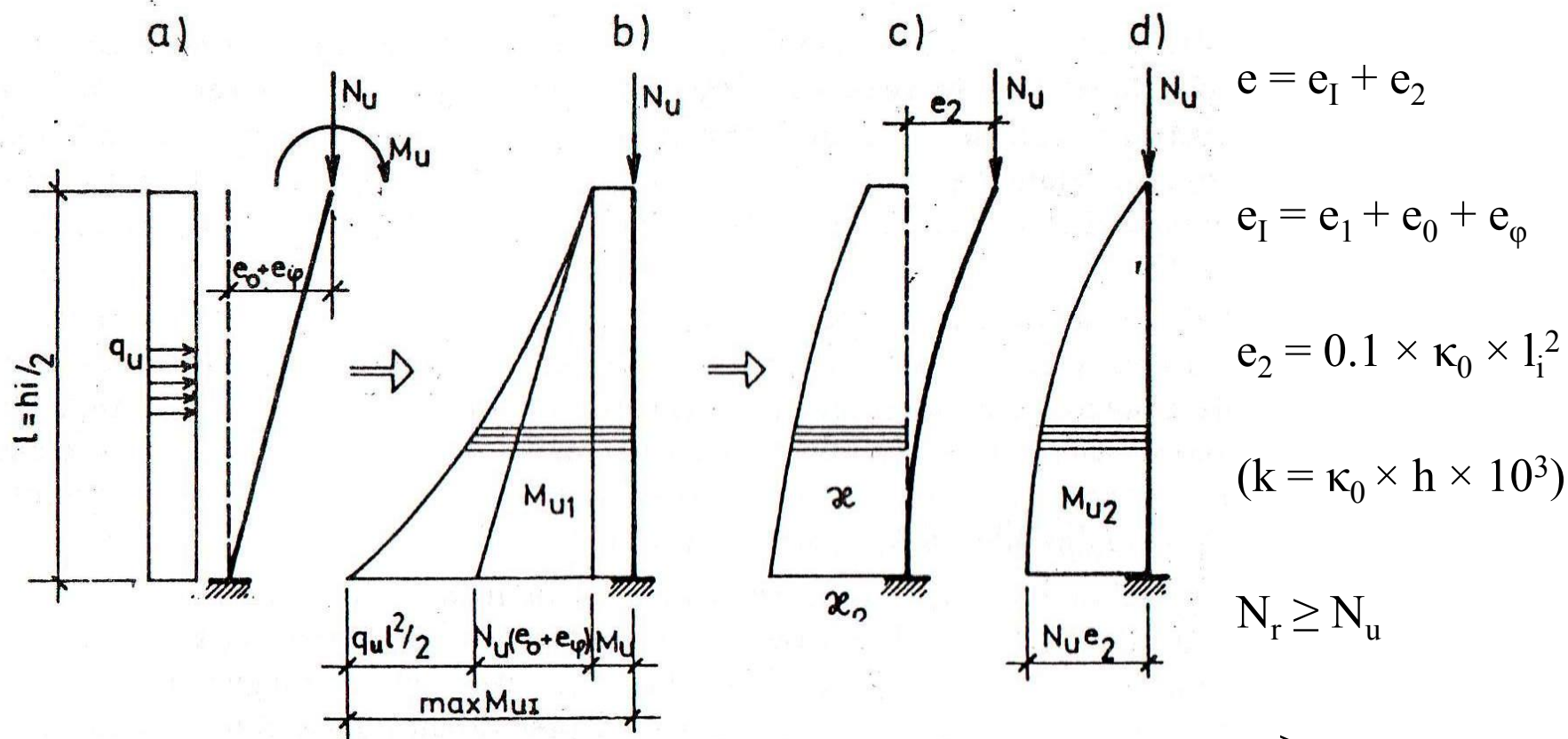
$$e_2/d = \frac{\lambda_i - 25}{160} (3,5 - e_1/d) \text{ kada je } 2,5 \leq e_1/d < 3,5$$

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

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



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:

$$e_1/d = M_u/(N_u \times d) = 21400/(3175 \times 55) = 0.112$$

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

$$e_0/d = 6.3/55 = 0.105$$

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

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:

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

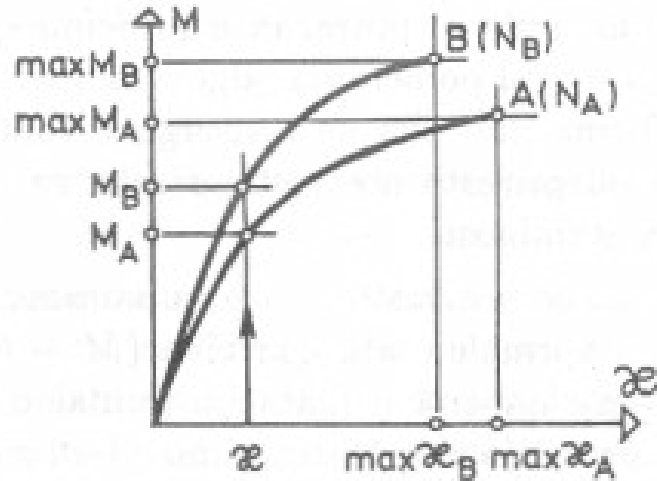
$$A_{a, \text{min.}} = \mu_{\min} \times A_{b, \text{potr.}} = 1.78 \times 10^{-2} \times 2840 = 50.56 \text{ cm}^2$$

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

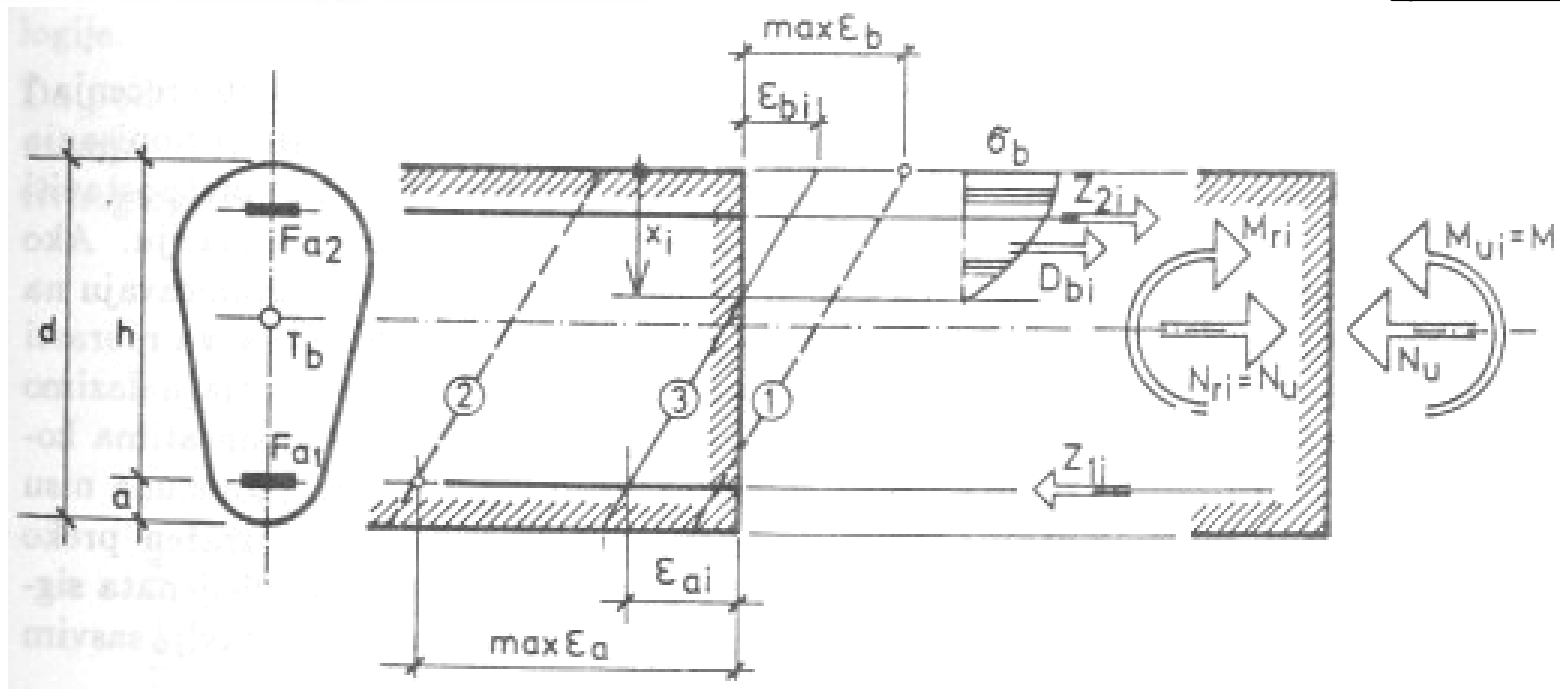
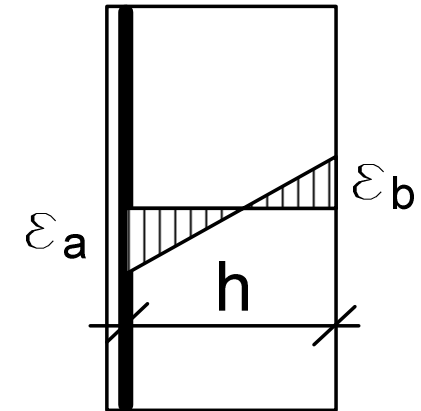
$$A_{a, \text{min.}} = \mu_{\min} \times A_{b, \text{potr.}} = 1.78 \times 10^{-2} \times 3600 = 64.08 \text{ cm}^2$$

Dijagram moment krivina

- konstrukcija dijagrama
- uticaj normalne sile

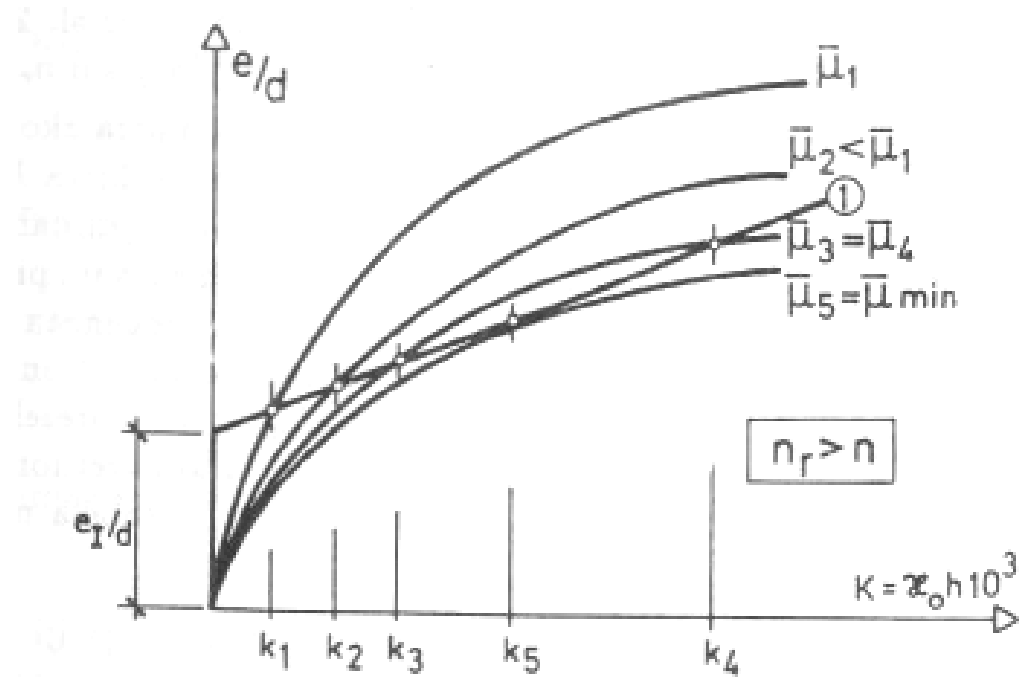


krivina
 $\kappa = (\varepsilon_a + \varepsilon_b)/h$



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

$$\text{usv. } n_r = 0.35$$



Pretpostavka

Izračunato

Tabela



k	K	e ₂ /d	e/d	m _r	μ	A _a
	k × 10 ⁻³ /h	0.1 × κ × L _i ² /d	e ₂ /d + e _I /d	(e ₂ /d + e _I /d) × 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 Pravoougani presек RA 400/500 - Str. 1

Fa*Sigv/b*d*lg

$n \cdot 10^3 = 10^3 \cdot \mu_2 / (b \cdot d \cdot \sigma_{st})$

0.00

n	k	.00	.10	.15	.20	.25	.30	.35	.40	.45	.50	.60	.70	.80	.90	1.00	1.10	1.20
.5	0	0	8	12	15	18	21	24	27	30	33	39	43	48	53	58	63	68
1.0	0	17	24	30	36	42	48	54	60	65	72	80	88	96	104	111	118	125
1.5	0	25	35	45	54	63	72	80	88	97	106	117	128	140	150	160	170	181
2.0	0	32	44	56	68	80	94	106	117	128	140	153	166	179	192	205	218	231
2.5	0	41	54	68	82	96	110	124	138	152	166	181	195	210	225	240	255	270
3.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
max k		0	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.1	3.2	3.3	3.4	3.5	3.5	3.6	3.7	3.7
max m		0	4.2	6.2	8.1	10.1	12.0	14.0	15.9	17.8	19.8	23.6	27.5	31.4	35.2	39.1	43.0	46.9

0.05

0.10

0.15

0.20

0.25

0.30

0.35

0.40

0.45

0.50

0.55

0.60

0.65

0.70

0.75

0.80

0.85

0.90

0.95

1.00

1.05

1.10

1.15

1.20

1.25

1.30

1.35

1.40

1.45

1.50

1.55

1.60

1.65

1.70

1.75

1.80

1.85

1.90

1.95

2.00

2.05

2.10

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2.30

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3.80

3.85

3.90

3.95

4.00

Primer korišćenja tabele
(PBAB2 str 251)
korak 1

Prilog 2.7.2 Pravoougani presек RA 400/500 - Str. 1

Fa*Sigv/b*d*lg

$n \cdot 10^3 = 10^3 \cdot \mu_2 / (b \cdot d \cdot \sigma_{st})$

n	k	.00	.10	.15	.20	.25	.30	.35	.40	.45	.50	.60	.70	.80	.90	1.00	1.10	1.20
.5	0	0	8	12	15	18	21	24	27	30	33	39	43	48	53	58	63	68
1.0	0	17	24	30	36	42	48	54	60	65	72	80	88	96	104	111	118	125
1.5	0	25	35	45	54	63	72	80	88	97	106	117	128	140	150	160	170	181
2.0	0	32	44	56	68	80	94	106	117	128	140	153	166	179	192	205	218	231
2.5	0	41	54	68	82	96	110	124	138	152	166	181	195	210	225	240	255	270
3.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	3.7
max m		0	4.2	6.2	8.1	10.1	12.0	14.0	15.9	17.8	19.8	23.6	27.5	31.4	35.2	39.1	43.0	46.9

0.05

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3.65

3.70

3.75

3.80

3.85

3.90

3.95

4.00

$\mu_2 = 0,152$
 $\mu_2 \cdot 10^3 = 152$
 $151 < 152 < 159$

$\mu_2 = 0,356$

$\mu_2 = 0,152$
 $\mu_2 \cdot 10^3 = 152$
 $151 < 152 < 159$

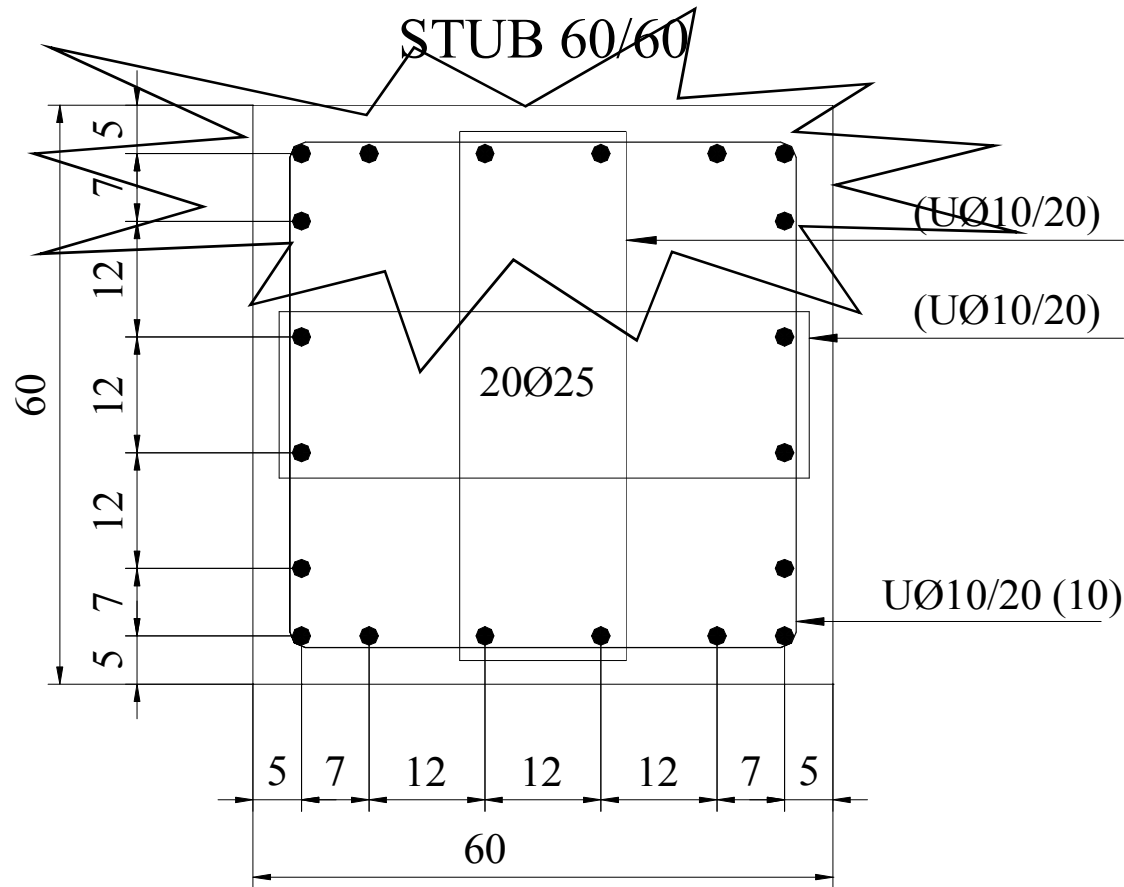
$\mu_2 = 0,356$

5

n	k * Fa * S _{sig} / b * d * f _g																			
	.00	.10	.15	.20	.25	<u>.30</u>	.35	.40	.45	.50	.60	.70	.80	.90	1.00	1.10	1.20			
0.00	5	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	49	56	64	72	80	88	97	112	126	143	158	172	187	201
1.5	0	25	35	45	54	63	72	80	88	97	112	126	143	158	172	187	201	216	231	246
2.0	0	33	47	60	72	84	95	106	117	128	149	169	189	209	228	247	266	285	303	320
2.5	0	41	58	74	90	104	118	132	146	161	176	191	205	220	235	250	265	280	295	310
3.0	0	0	0	0	0	0	0	158	174	189	220	235	250	265	280	295	310	325	340	355
3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	390	423	455	488	521	554
max k	0	2,5	2,6	2,7	2,8	2,9	3,0	3,1	3,1	3,2	3,3	3,4	3,4	3,5	3,5	3,6	3,6	3,7	3,7	3,8
max m	0	4,2	6,2	8,1	10,1	12,0	14,0	15,9	17,8	19,8	23,6	27,5	31,4	35,2	39,1	43,0	46,9	50,8	54,7	58,6

Primer korišćenja tabele (PBAB2 str 251) korak 5

$u_2 = 0,228$
 $u_2 \times 10^3 = 228$
 $215 < 228 < 233$
 $\bar{r} = 0,336$



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

$$8\text{Ø}25 = 39.6 \text{ cm}^2$$