

STATIČKI PRORAČUN
UZ PROJEKAT PORODIČNE STAMBENE ZGRADE P+1
PROFESORA MILUTINOVIĆ VELJKA, U PIPERIMA

OVLAŠĆENI PROJEKTANT

ANALIZA OPTEREĆENJA

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Osnovni podaci za objekat

Lokacija	Piperi, Crna Gora
Seizmička zona	VIII
Osnovna brzina vetra	$v_{m,50,10} = 19$ m/s
Opterećenje od snega	$s = 1,00$ kN/m ²
Vrsta objekta	stambeni
Konstrukcija	armirano betonska, livena na licu mesta
Način fundiranja	Plitko
Krov	Drveni sa crepom

krovni pokrivač

	d	zap. Tež.	g	
	cm	kN/m ³	kN/m ²	
mediteran crep (d=3.8cm)	3,8	11,80	0,45	
hidroizolacija	0,4	10,00	0,04	
potkonstrukcija drvo (po m ²)	100,0	0,15	0,15	
termoizolacija	8,0	1,30	0,10	
opšivka	100,0	0,15	0,15	
		g=	0,89	kN/m ²
dodatno stalno		g=	0,90	kN/m ²

potkrovlje

	d	zap. Tež.	g	
	cm	kN/m ³	kN/m ²	
daske	2,5	7,00	0,18	
AB ploča	20,0	25,00	5,00	
cementni malter	2,0	21,00	0,42	
		g=	5,60	kN/m ²
dodatno stalno		g=	0,60	kN/m ²

visoko prizemlje

	d	zap. Tež.	g	
	cm	kN/m ³	kN/m ²	
daske	2,5	7,00	0,18	
AB ploča	20,0	25,00	5,00	
cementni malter	2,0	21,00	0,42	
		g=	5,60	kN/m ²
dodatno stalno		g=	0,60	kN/m ²

Vpr ognjište

	d	zap. Tež.	g	
	cm	kN/m ³	kN/m ²	
kamena obloga	3,0	28,00	0,84	
cementni malter	2,0	21,00	0,42	
AB ploča	20,0	25,00	5,00	
cementni malter	2,0	21,00	0,42	
		g=	6,68	kN/m ²
dodatno stalno		g=	1,70	kN/m ²

Vpr kupatilo

	d	zap. Tež.	g	
	cm	kN/m ³	kN/m ²	
keramičke pločice	1,5	24,00	0,36	
cementni malter	2,0	21,00	0,42	
AB ploča	20,0	25,00	5,00	
cementni malter	2,0	21,00	0,42	
		g=	6,20	kN/m ²
dodatno stalno		g=	1,20	kN/m ²

Žardinjere

	d	zap. Tež.	g	
	cm	kN/m ³	kN/m ²	
zemlja	40,0	18,00	7,20	
cementni malter	2,0	21,00	0,42	
AB ploča	20,0	25,00	5,00	
cementni malter	2,0	21,00	0,42	
		g=	13,04	kN/m ²
dodatno stalno		g=	8,10	kN/m ²

pregradni zid Pk

	spratna visina:		1,50	m
	d	zap. Tež.	g	
	cm	kg/m ²	kN/m	
gips karton 15cm	15,0	60,00	0,60	
		g=	0,60	kN/m'
dodatno stalno		g=	0,90	kN/m'

pregradni zid Pk

	spratna visina:			1,80	m
	d	zap. Tež.	g		
	cm	kg/m ²	kN/m		
gips karton 15cm	15,0	60,00	0,60		
		g=	0,60		
			kN/m'		
dodatno stalno		g=	1,10		
			kN/m'		

pregradni zid Pk

		spratna visina: 1,80		m
	d	zap. Tež.	g	
	cm	kg/m ²	kN/m	
gips karton 12cm		12,0	35,00	0,35
		g=	0,35	kN/m'
dodatno stalno		g=	0,70	kN/m'

pregradni zid Pk

		spratna visina: 2,20		m
	d	zap. Tež.	g	
	cm	kg/m ²	kN/m	
gips karton 12cm		12,0	35,00	0,35
		g=	0,35	kN/m'
dodatno stalno		g=	0,80	kN/m'

pregradni zid Pk

		spratna visina: 2,60		m
	d	zap. Tež.	g	
	cm	kg/m ²	kN/m	
gips karton 12cm		12,0	35,00	0,35
		g=	0,35	kN/m'
dodatno stalno		g=	1,00	kN/m'

pregradni zid Vpr

		spratna visina: 2,55		m
	d	zap. Tež.	g	
	cm	kg/m ²	kN/m	
gips karton 15cm		15,0	60,00	0,60
		g=	0,60	kN/m'
dodatno stalno		g=	1,50	kN/m'

pregradni zid Vpr

		spratna visina: 2,55		m
	d	zap. Tež.	g	
	cm	kg/m ²	kN/m	
gips karton 12cm		12,0	40,00	0,40
		g=	0,40	kN/m'
dodatno stalno		g=	1,00	kN/m'

ograda

		visina: 1,00		m
	d	zap. Tež.	g	
	cm	kg/m ²	kN/m	
hrastova ograda		6,0	100,00	1,00
		g=	1,00	kN/m'
dodatno stalno		g=	1,00	kN/m'

Kamena kuća

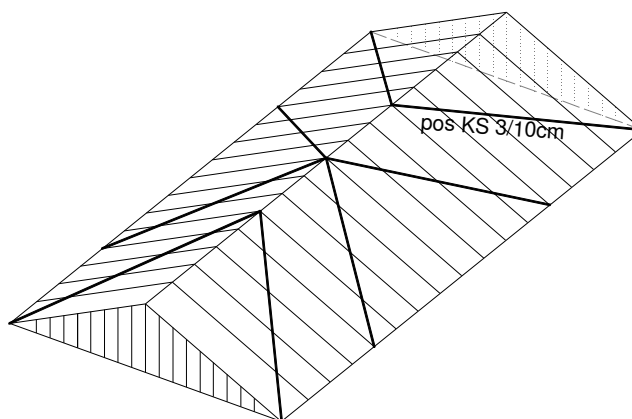
-pos KKK

Kao nosač krova predviđa se drvena konstrukcija koja se sastoji od glavnih nosača:

- rogovi 8/12cm - pos KR
- krovna greda 10/16cm - pos KG
- krovni spreg 3/10cm - pos KS
- AB greda 20/50cm – pos 201
- drveni stubici 12/12cm – pos DSK

glavni nosači se postavljaju na međusobnom razmaku od 74-90cm.

Nakon montaže glavnih nosača potrebno je međusobno ih povezati krovnim spregom pos KS, dimenzija 3/10cm, koji će obezbediti bočnu stabilnost krovnih nosača. Krovni spreg se spaja sa rogom sa njegove donje strane.



Rogovi se vezuju za horizontalnu krovnu gredu vezom na zasek. Horizontalna greda, dalje, prenosi sile na drvene stubove 12/12cm.

Rogovi takođe prenose sile i na AB grede krova 20/50cm preko tvrdog drveta i čeličnog ankera, prema detalju.

Statički proračun i dimenzionisanje krovnih elemenata:

Za krovne nosače od drveta, usvaja se četinar druge klase, $E_{\parallel}=1000\text{kN/cm}^2$

s.t. krovne konstrukcije.....	0.90	kN/m^2
sneg.....	1.00	kN/m^2
vetar..... $\pm 1.00 \times 0.5 =$	0.50	$\text{kN/m}^2 \perp$ na krovnu ravan

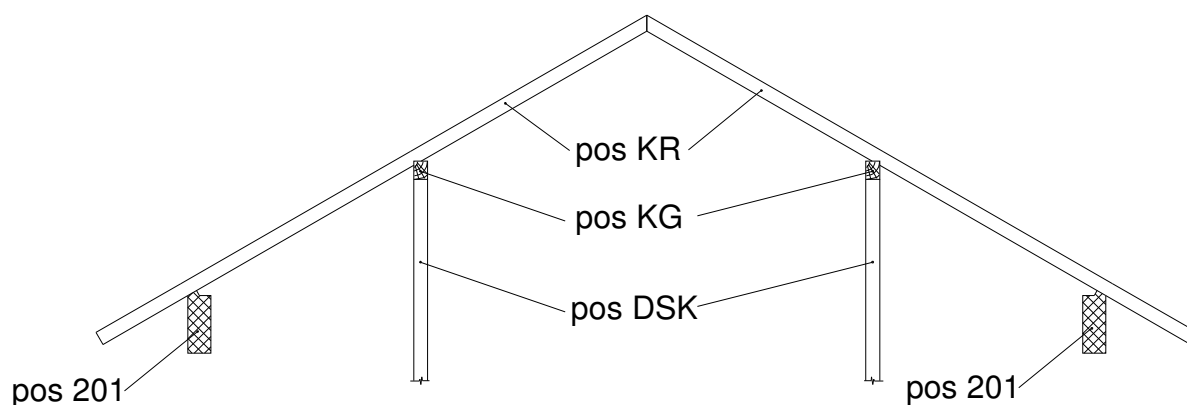
$$e_{\max} = 90\text{cm} \quad \alpha = 30^\circ$$

s.t. krovne konstrukcije.....	$g_{\perp} = 0.9 \times 0.9 \times \cos \alpha =$	0.70kN/m^1
sneg.....	$s_0 = 1.0 \times 0.9 \times \cos^2 \alpha =$	0.68kN/m^1
vetar.....	$w_0 = 0.5 \times 0.9 =$	$0.45 \text{kN/m}^1 \perp$ na kr. ravan

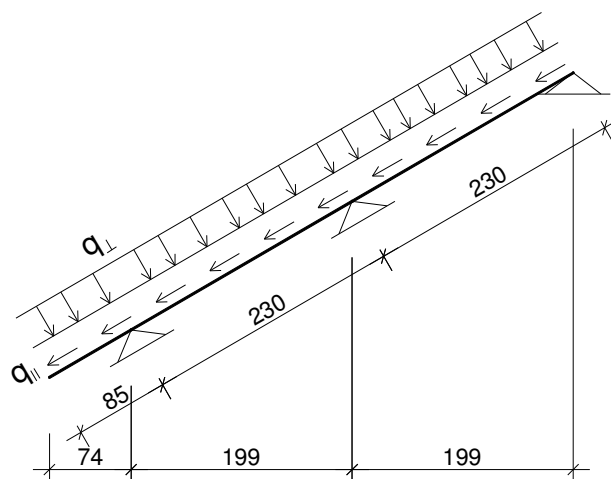
kombinacije opterećenja:	I	$g+s =$	1.38kN/m
	II	$(g+s) \times \cos \alpha + w =$	$1.64 \text{kN/m} = q_{\perp}$

$$(1.64 - 1.38) / 1.38 = 0.19 = 19\% > 15\% \rightarrow \text{merodavan je II sl. Opterećenja sa}$$

uvećanjem osnovnih sopuštenih napona za 15%



Pos. KR



$$q_{\perp} = 1.64 \text{ kN/m}$$

$$q_{\parallel} = 0.9 \times \sin^2 \alpha + 0.5 \times 0.9 \times \sin \alpha \times \cos \alpha = 0,60 \text{ kN/m}$$

$$\max M = 0.9 \text{ kNm} = 90000 \text{ Ncm}$$

$$\max T = -2.28 \text{ kN} = -2280 \text{ N}$$

$$\max f = 0.23 \text{ cm} < L/150 = 850/150 = 0.57 \text{ cm}$$

$$I = 8 \times 12^3 / 12 = 1152 \text{ cm}^4$$

$$W = 1152 / 6 = 192 \text{ cm}^3$$

$$A = 8 \times 12 = 96 \text{ cm}^2$$

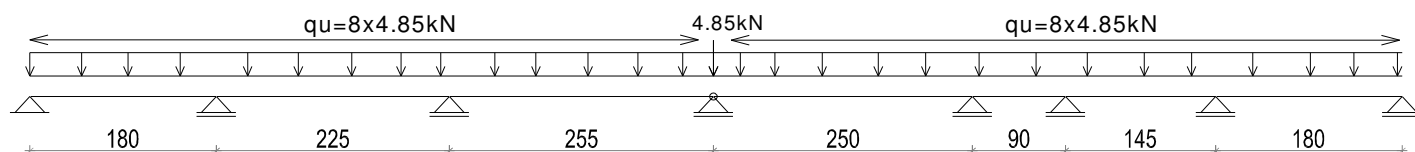
$$\sigma_{\parallel} = 90000 / 192 = 469 \text{ N/cm}^2 < 850$$

(četinari II klase)

Usvaja se presek 8/12cm

Reakcije: 1.4kN(vert) i 4.5kN(horiz) na pos 201
4.8kN na pos KG
1.8kN na pos KR

Pos. KG



Pretpostavlja se raspodela optrećenja q_u u razmeri $g:p=40:60$

$$g = 0.4 \times 4.85 = 1.94 \text{ kN}$$

$$p = 0.6 \times 4.85 = 2.90 \text{ kN}$$

$$\max f = 3.9 \text{ cm} < L/400 = 250/400 = 6.25 \text{ mm}$$

$$\max M = 3.48 \text{ kNm} = 348000 \text{ Ncm}$$

$$\max T = 6.23 \text{ kN} = 6230 \text{ N}$$

$$I = 12 \times 16^3 / 12 = 4096 \text{ cm}^4$$

$$W = 4096 / 8 = 512 \text{ cm}^3$$

$$A = 12 \times 16 = 192 \text{ cm}^2$$

$$\sigma_{c\parallel} = 348000 / 512 = 680 \text{ N/cm}^2 < 850 \text{ N/cm}^2$$

(četinari II klase)

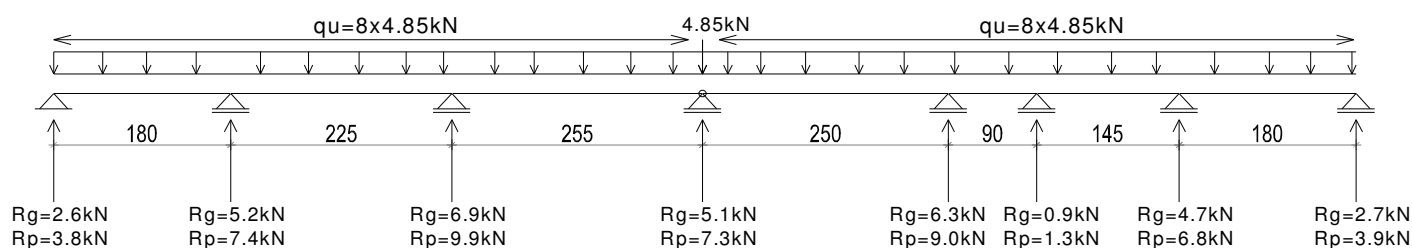
$$\tau = 1.5 \times 6230 / 192 = 49 \text{ N/cm}^2 < 90 \text{ N/cm}^2$$

(četinari II klase)

Usvaja se presek 12/16cm

prilikom izvođenja veze na zasek pos KG upustiti u pos KR za max 2.50 cm.

Reakcije na stubove DSK



Pos. DSK

Uzima se stub koji prolazi pored stepeništa i pada na ploču visokog prizemlja pos 100, na koti $\pm 0,00$ jer je njegova dužina najveća.

$$H_u = 385 \text{ cm}$$

$$N_{\max} = 15.3 \text{ kN}$$

Pretpostavlja se stub dimenzija 12/12cm od četinara II klase.

$$\text{s.t. stuba: } 0.12 \times 0.12 \times 3.85 \times 7 = 0.4 \text{ kN}$$

$$\text{obloga: } 5 \text{ kg/m}^3 = 0.2 \text{ kN}$$

usvaja se $N_{\max}=16\text{kN}$

$$\lambda = H u / i$$

$$i = \sqrt{\frac{I}{F}} = \sqrt{\frac{12^4}{12^3}} = 3.464$$

$$\lambda = 385 / 3.46 = 111.1 \quad \rightarrow \quad \omega = 3.97$$

$$\sigma_{c\parallel} = 3.97 \times 16000 / 12^2 = 441 \text{ N/cm}^2 < 850 \text{ N/cm}^2$$

(četinari II klase)

Usvaja se presek 12/12cm

Procenat iskorišćenosti napona od 52% daje dodatni stepen sigurnosti na bočne incidentne udare u stub (pomeranje nameštaja itd.)

ARMIRANO BETONSKA KONSTRUKCIJA

Osnovni podaci o modelu

Datoteka: pip 1.3.twp
Datum proračuna: 16.11.2010

Način proračuna: 3D model

- ☒ Teorija I-og reda ☐ Modalna analiza ☐ Stabilnost
☐ Teorija II-og reda ☐ Seizmički proračun ☐ Faze građenja
☐ Nelinearan proračun

Veličina modela

Broj čvorova: 2292
Broj pločastih elemenata: 2027
Broj grednih elemenata: 338
Broj graničnih elemenata: 2448
Broj osnovnih slučajeva opterećenja: 2
Broj kombinacija opterećenja: 2

Jedinice mera

Dužina: m [cm,mm]
Sila: kN
Temperatura: Celsius

Ulazni podaci - Konstrukcija

Šema nivoa

Naziv	z [m]	h [m]
Pk	2.80	2.80
Vpr	0.00	2.55

Npr	-2.55
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Tabela materijala

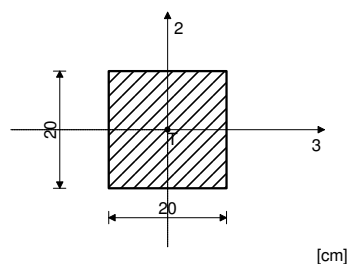
No	Naziv materijala	E[kN/m ²]	μ	γ [kN/m ³]	α [1/C]	Em[kN/m ²]	μ
1	Beton MB 30	3.150e+7	0.20	25.00	1.000e-5	3.150e+7	0.20

Setovi ploča

No	d[m]	e[m]	Materijal	Tip proračuna	Ortotropija	E2[kN/m ²]	G[kN/m ²]	α
<1>	0.200	0.100	1	Tanka ploča	Izotropna			
<2>	0.350	0.175	1	Tanka ploča	Izotropna			

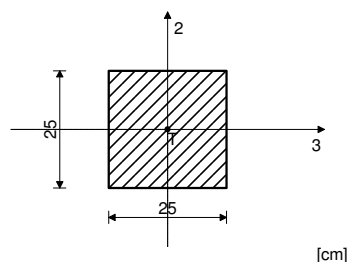
Setovi greda

Set: 1 Presek: b/d=20/20, Fiktivna ekscentričnost



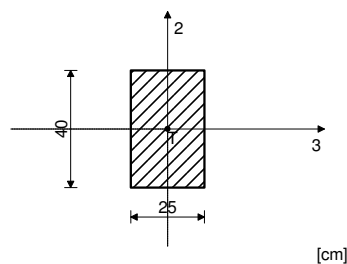
Mat.	A1	A2	A3	I1	I2	I3
1 - Beton MB 30	4.000e-2	3.333e-2	3.333e-2	2.253e-4	1.333e-4	1.333e-4

Set: 2 Presek: b/d=25/25, Fiktivna ekscentričnost



Mat.	A1	A2	A3	I1	I2	I3
1 - Beton MB 30	6.250e-2	5.208e-2	5.208e-2	5.501e-4	3.255e-4	3.255e-4

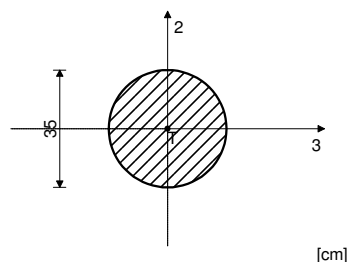
Set: 3 Presek: b/d=25/40, Fiktivna ekscentričnost



[cm]

Mat.	A1	A2	A3	I1	I2	I3
1 - Beton MB 30	1.000e-1	8.333e-2	8.333e-2	1.273e-3	5.208e-4	1.333e-3

Set: 4 Presek: D=35, Fiktivna ekscentričnost

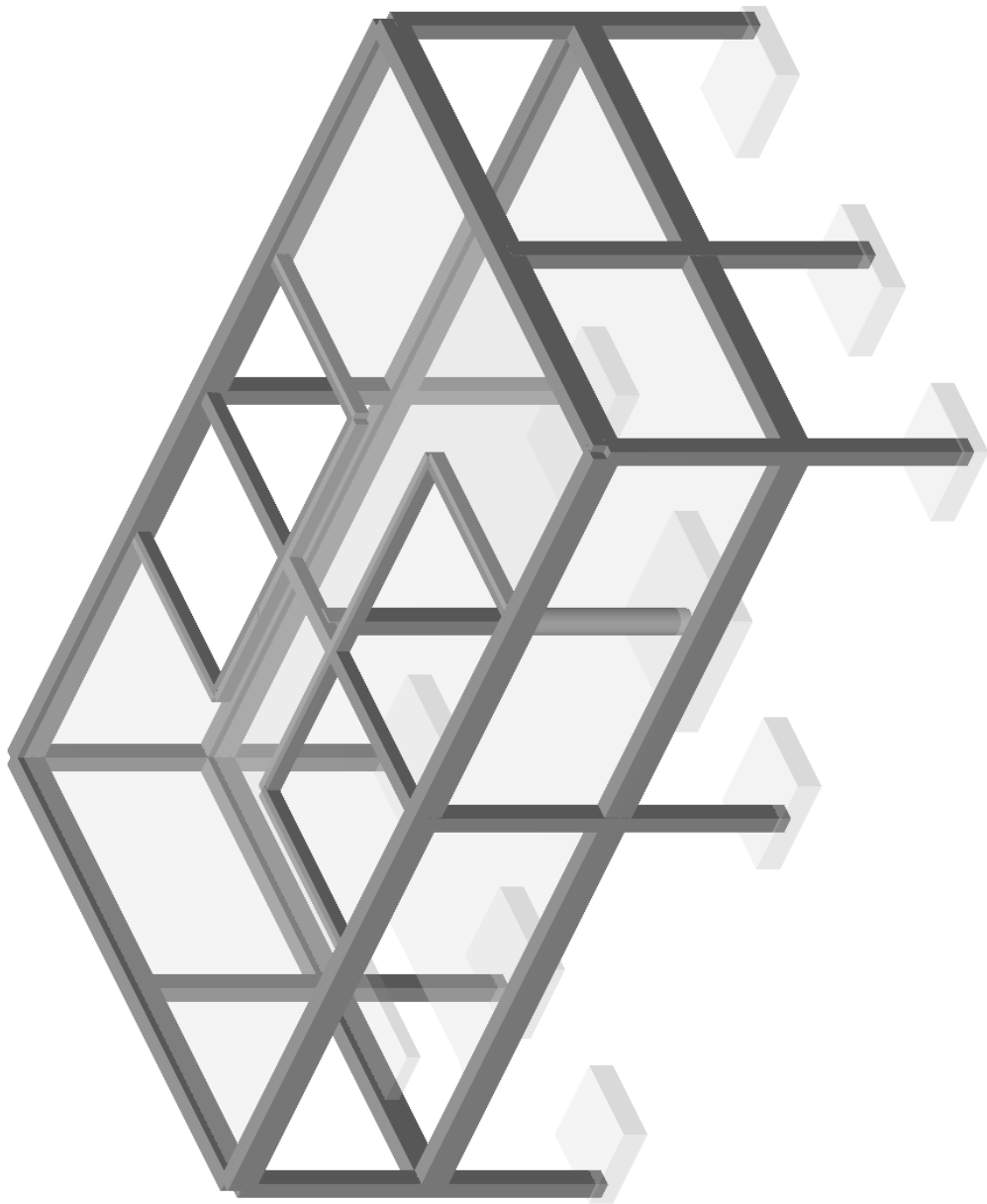


[cm]

Mat.	A1	A2	A3	I1	I2	I3
1 - Beton MB 30	9.621e-2	8.659e-2	8.659e-2	1.473e-3	7.366e-4	7.366e-4

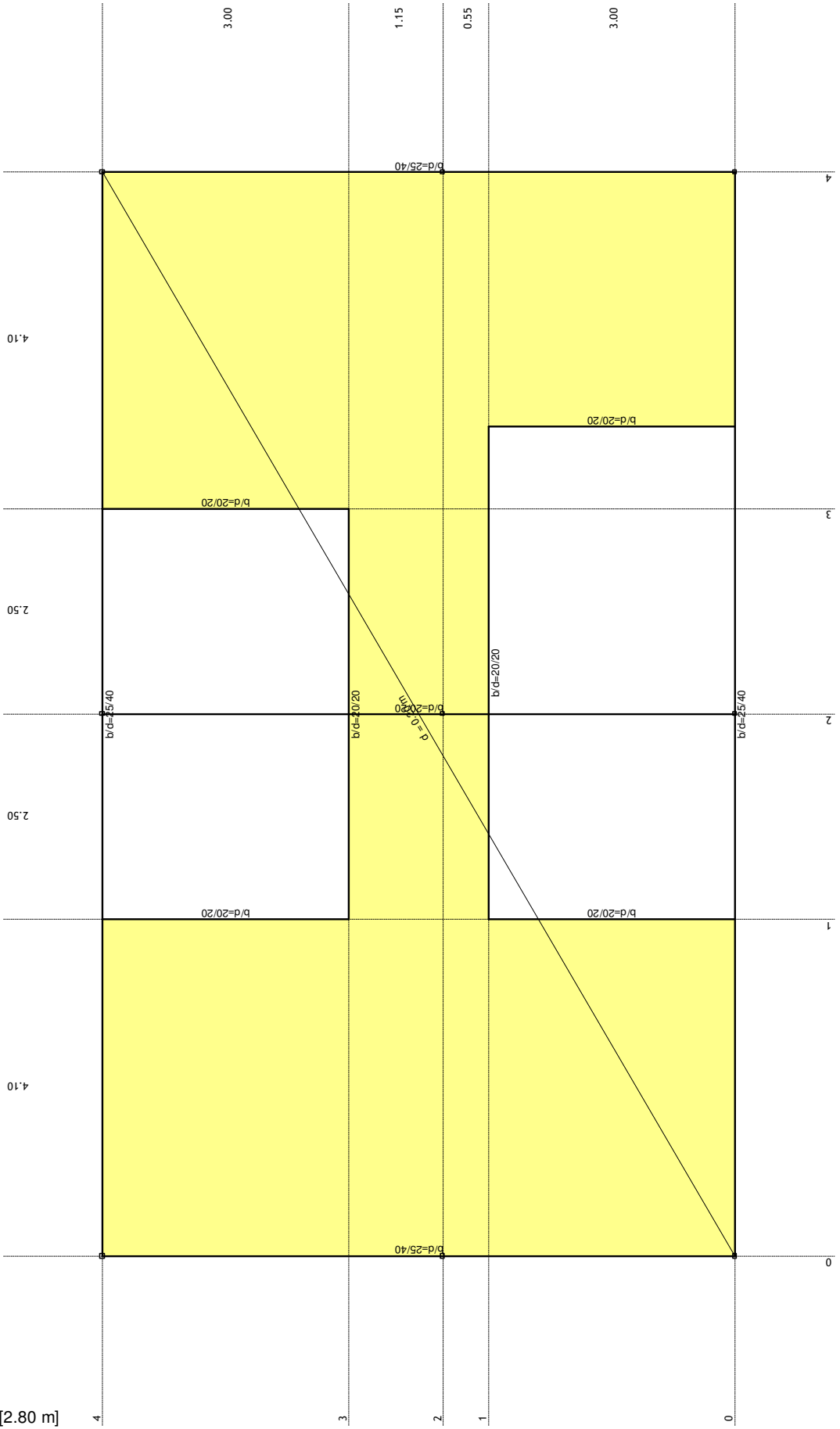
Setovi površinskih oslonaca

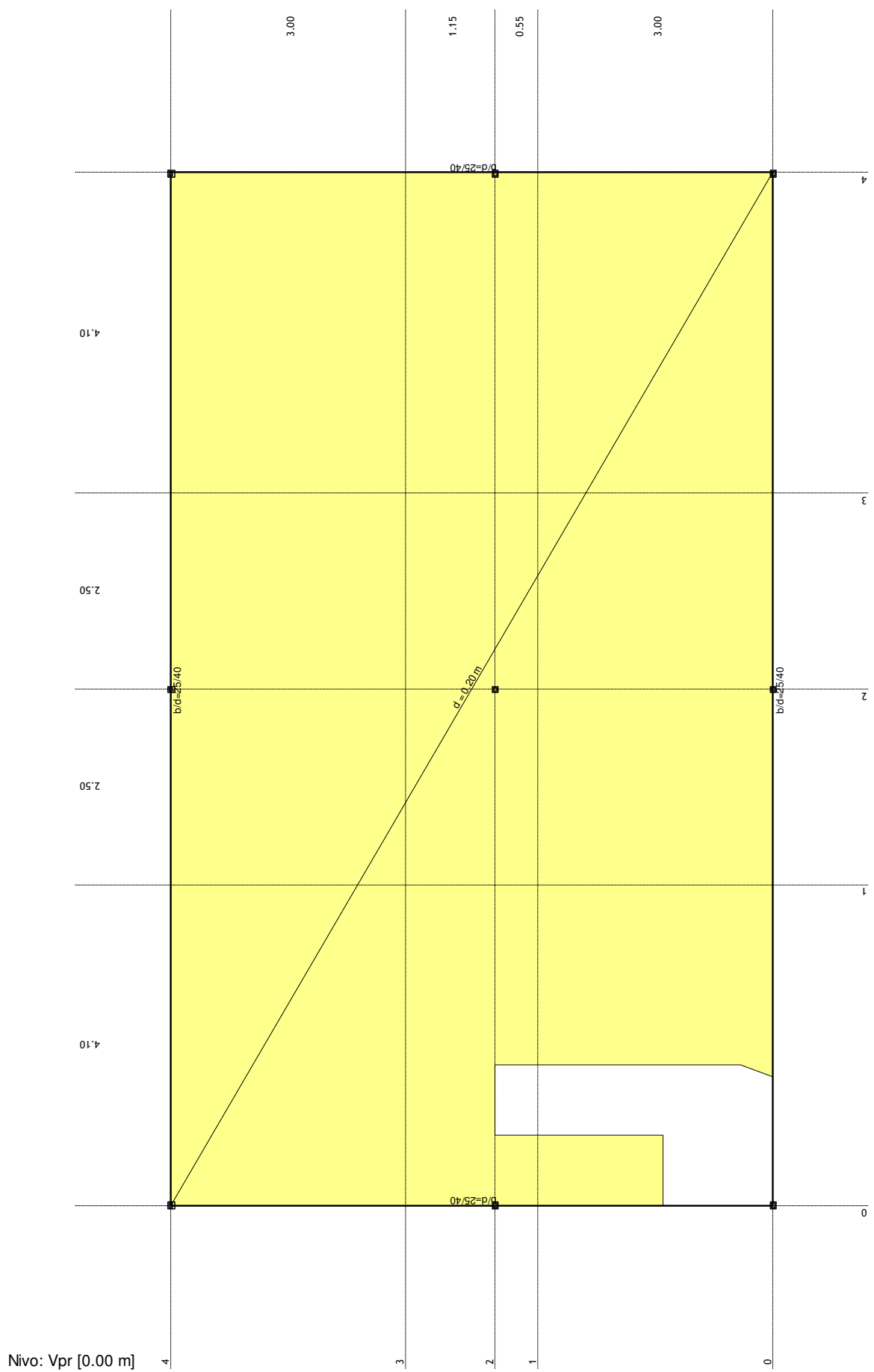
Set	K,R1	K,R2	K,R3
1	6.500e+3	6.500e+3	6.500e+3



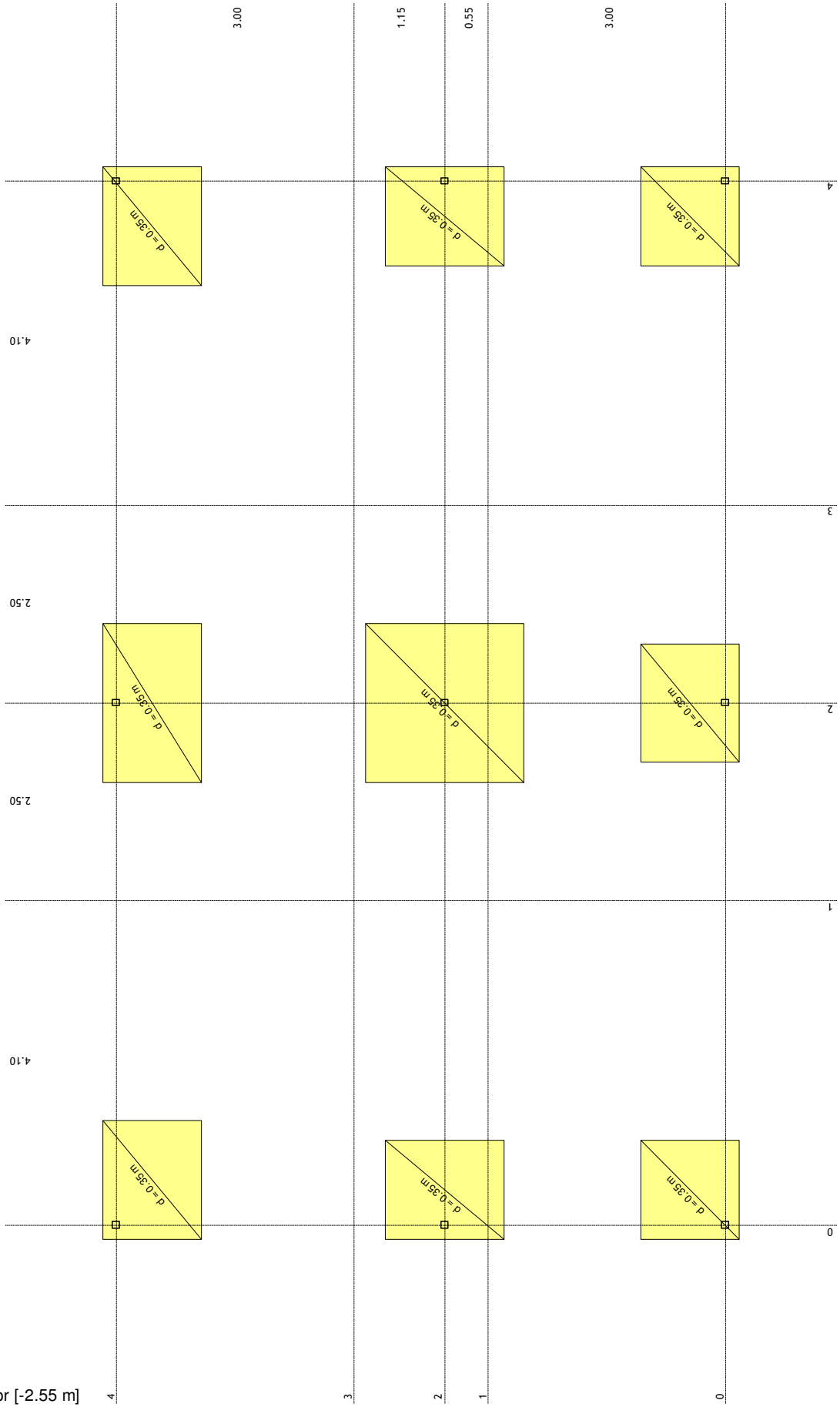
Izometrija (Top)

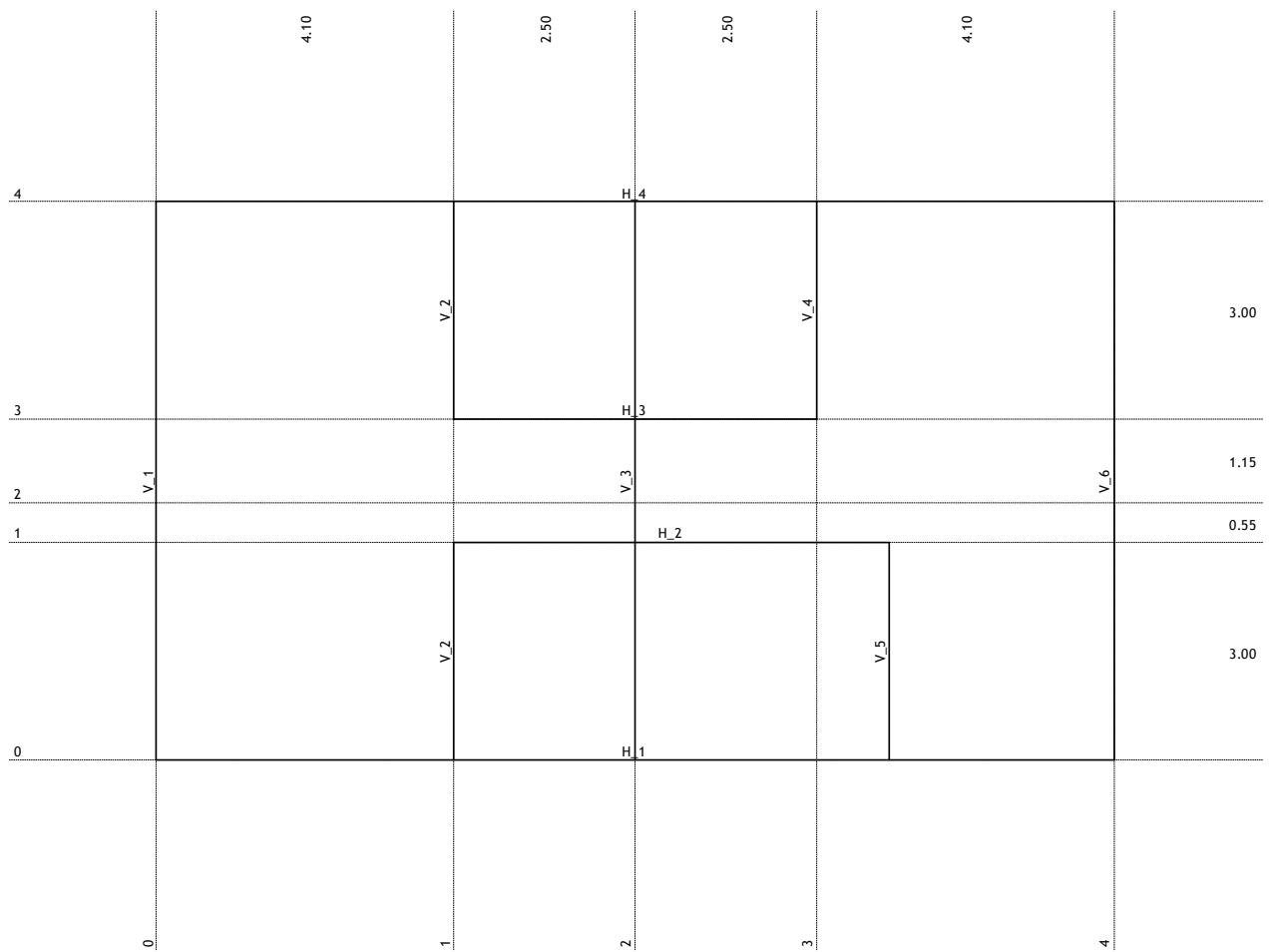
Nivo: Pk [2.80 m]





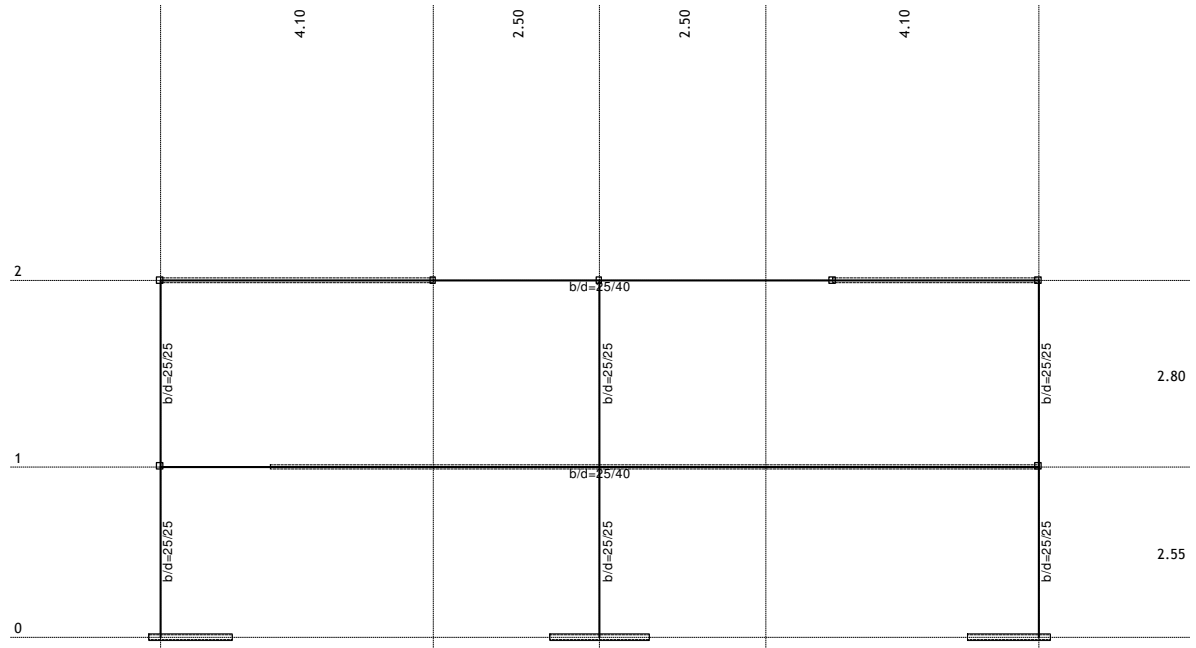
Nivo: Npr [-2.55 m]



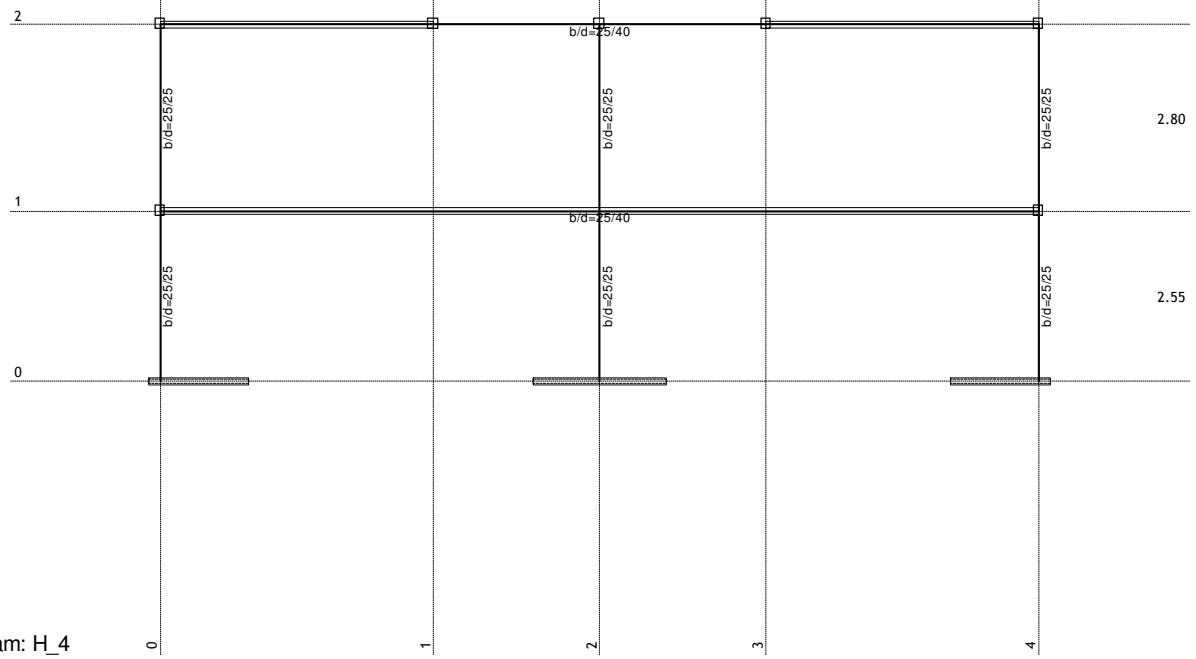


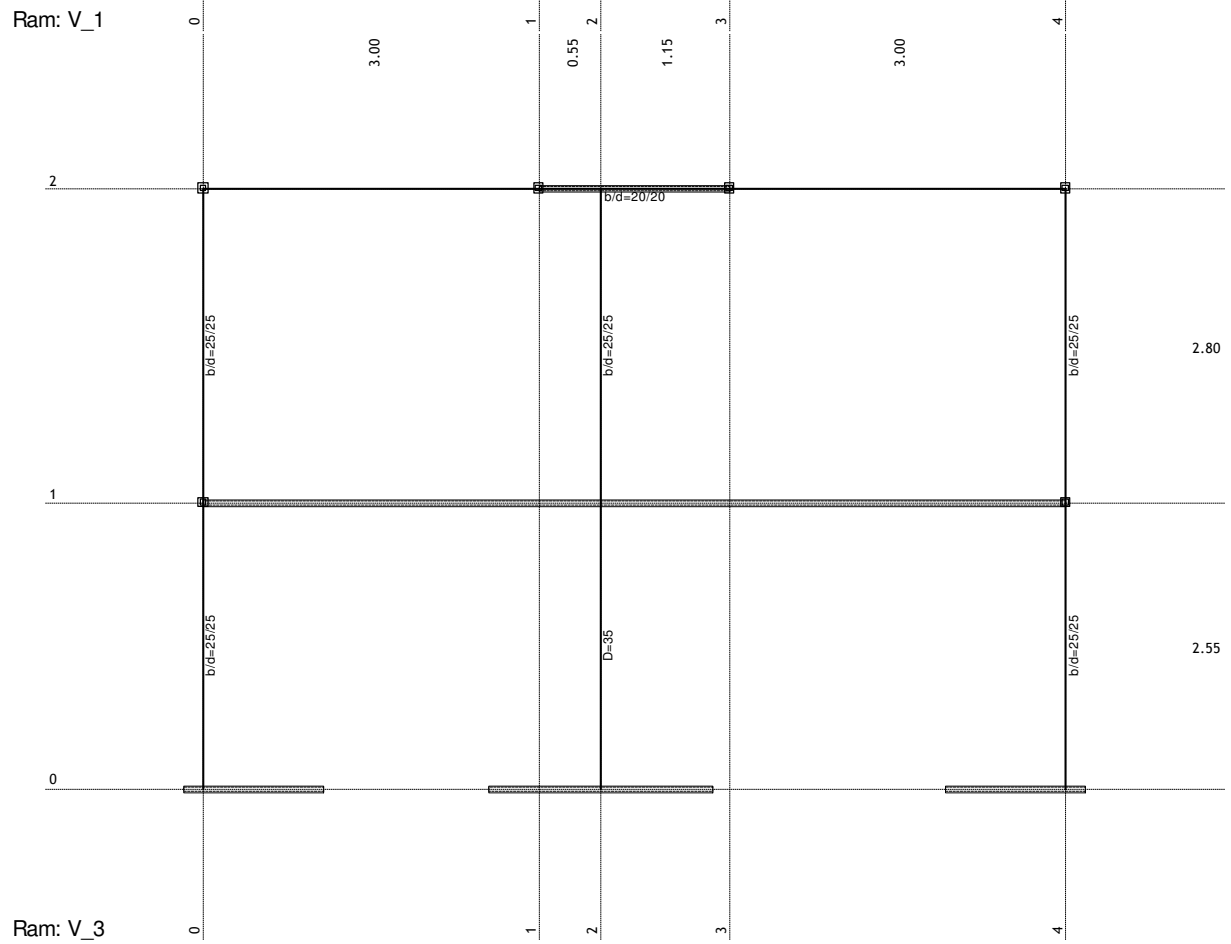
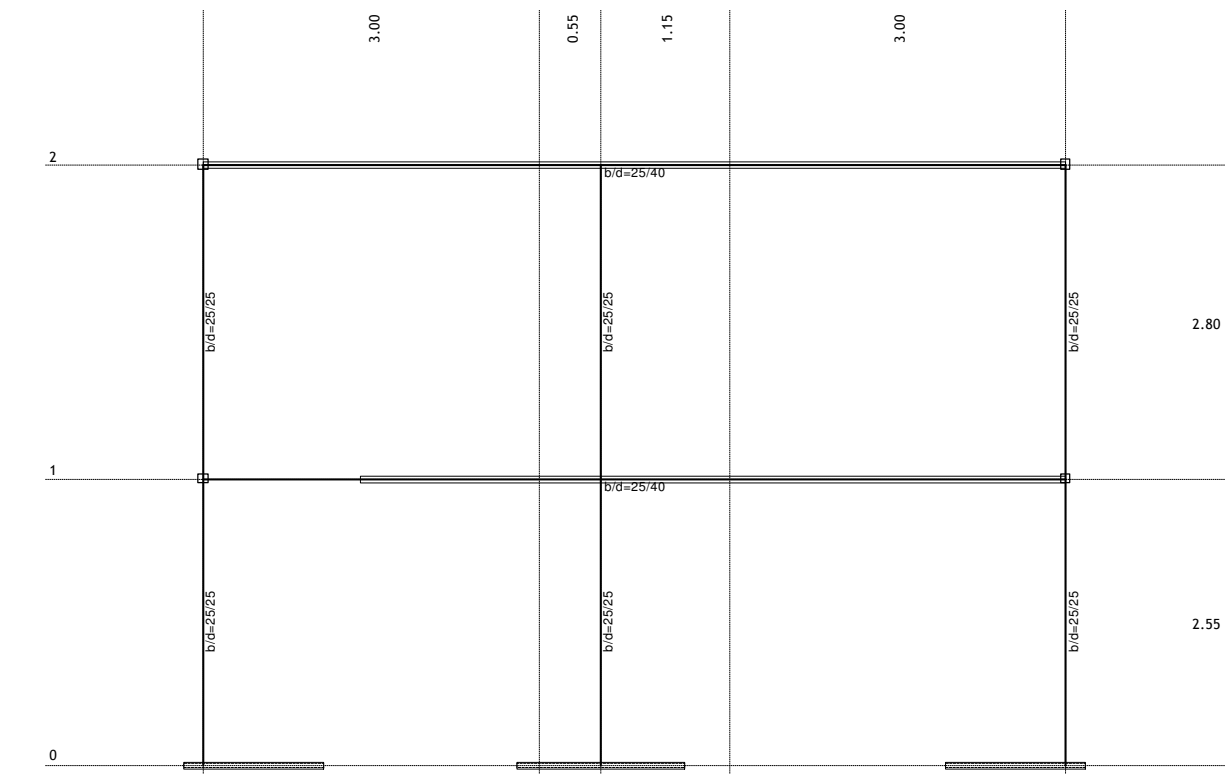
Dispozicija ramova

Ram: H_1

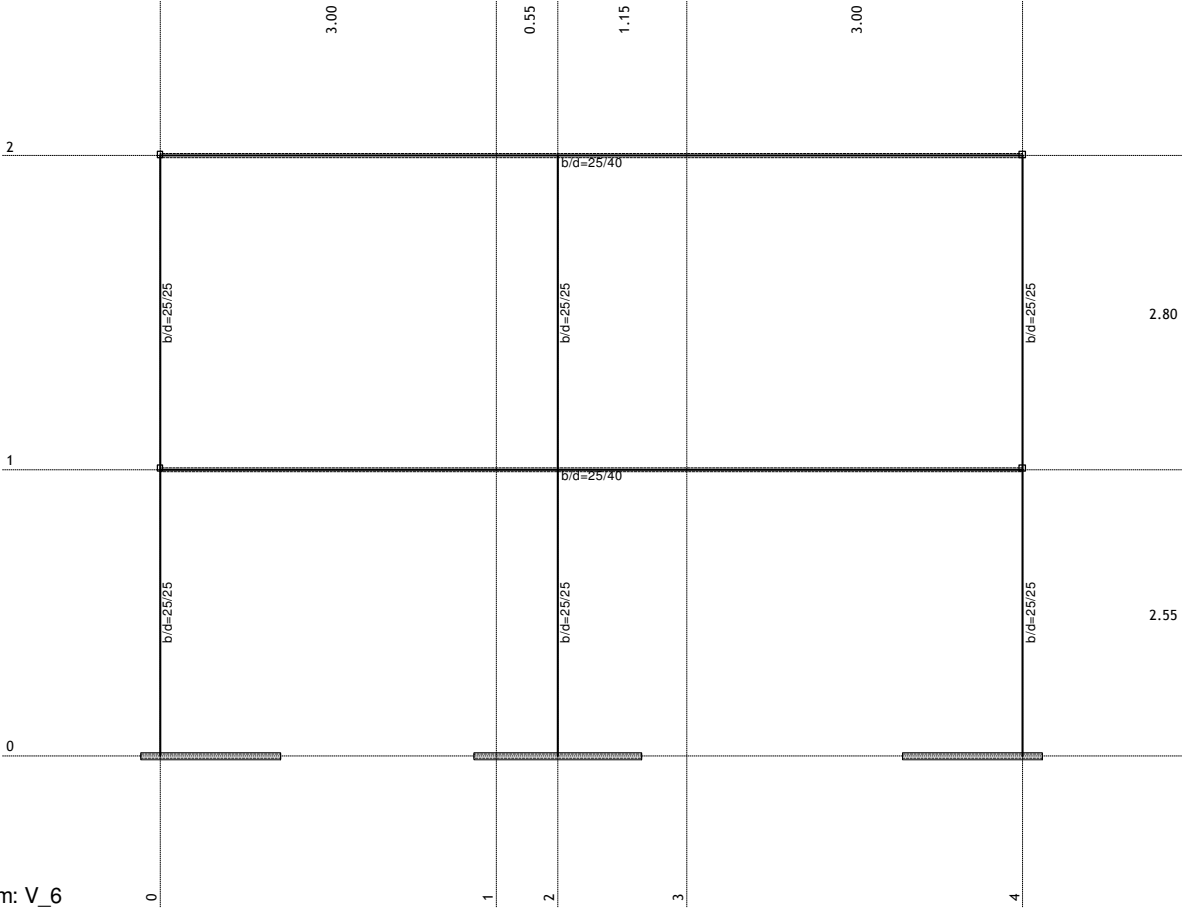


Ram: H_4



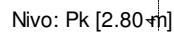


Ram: V_6

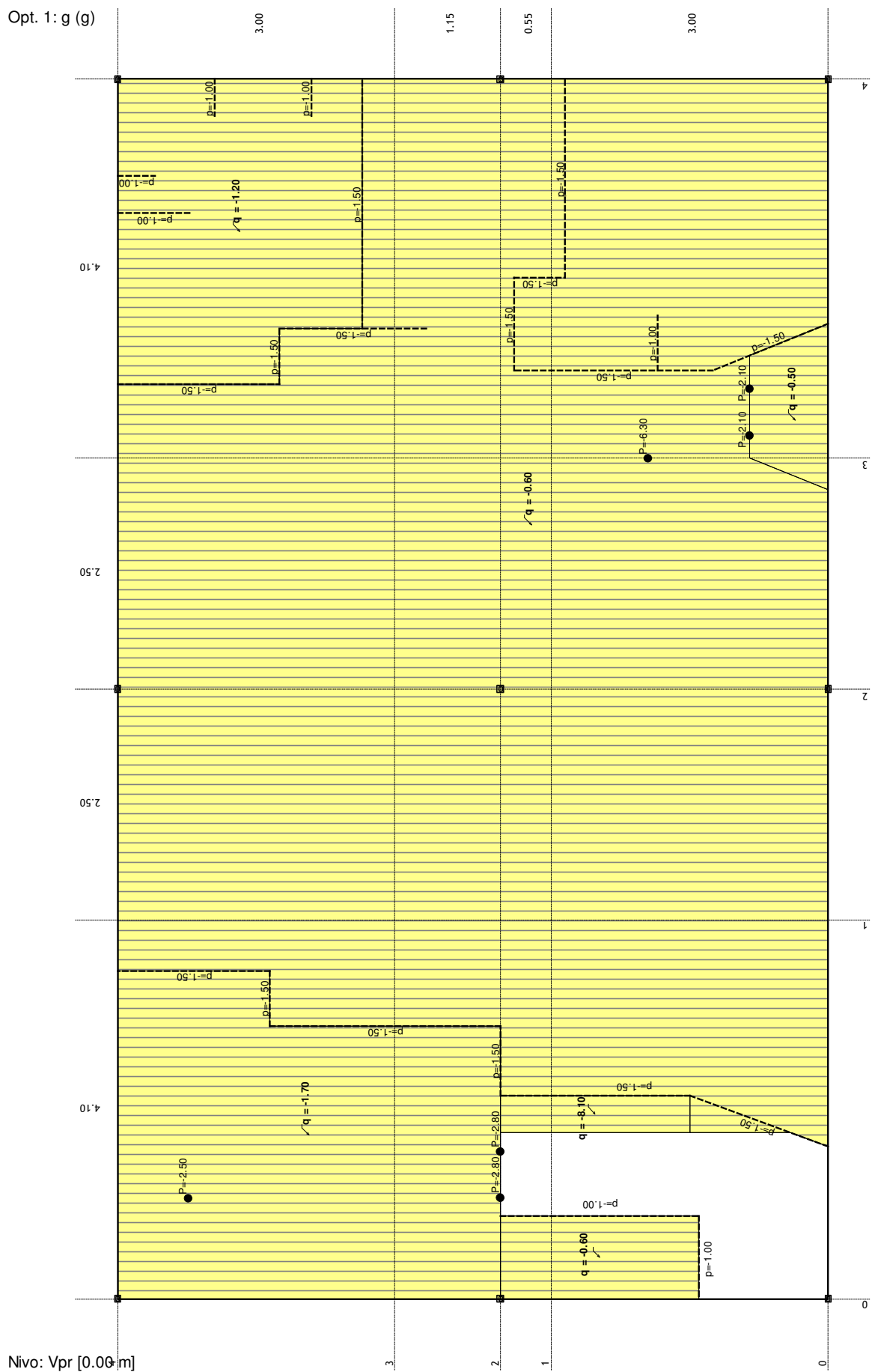


Ulazni podaci - Opterećenje

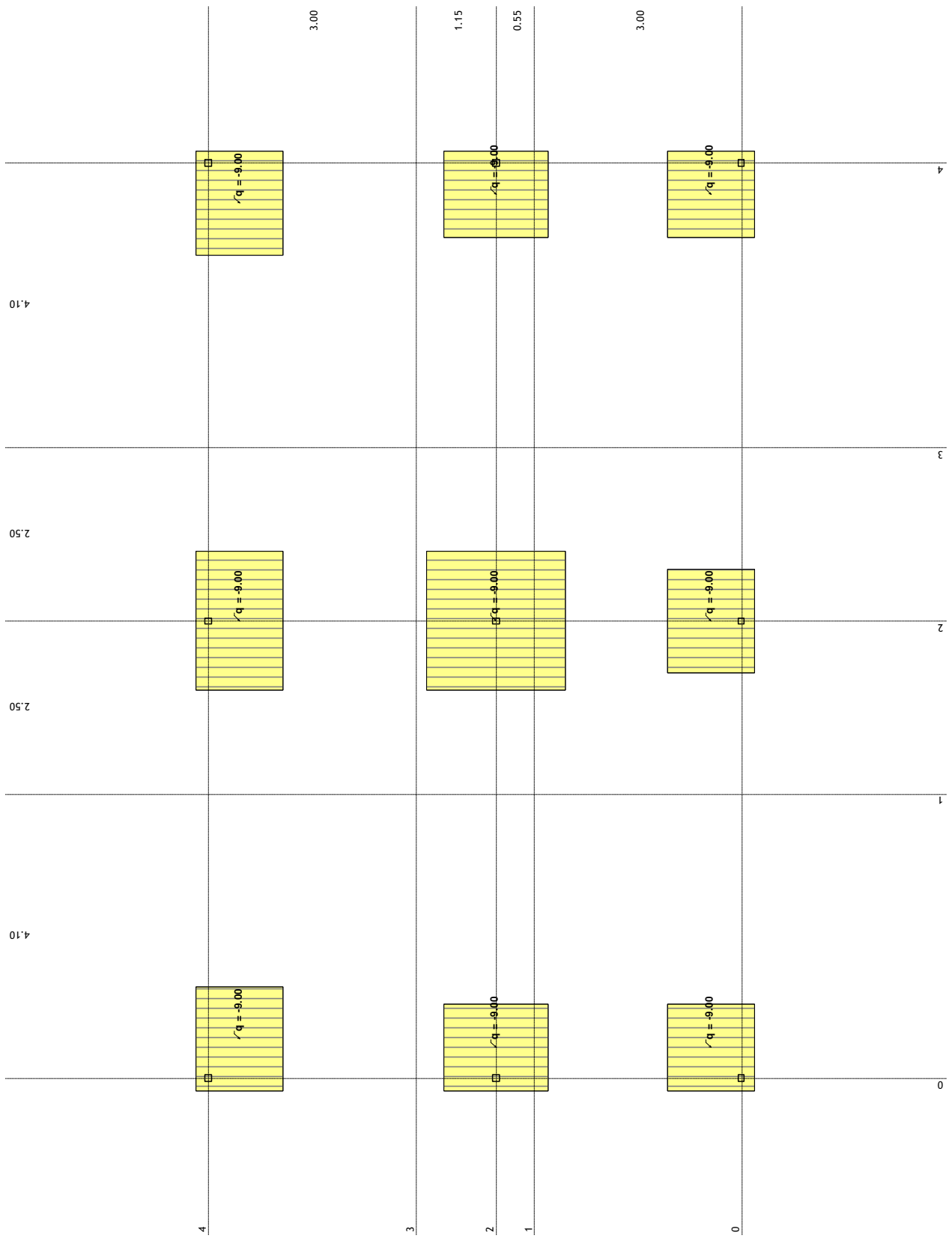
Opt. 1: g (g)



Nivo: Pk [2.80 m]

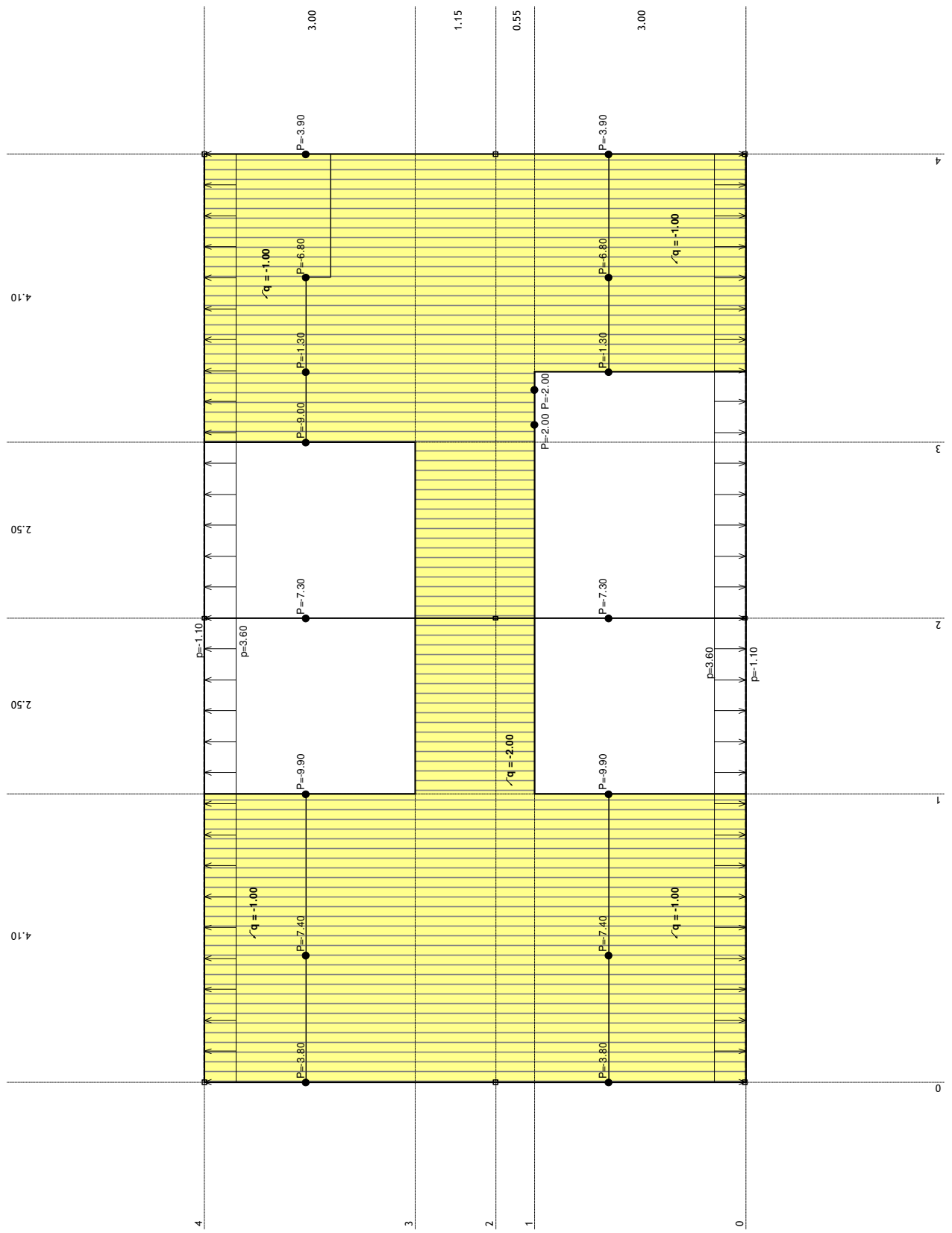


Opt. 1: g (g)

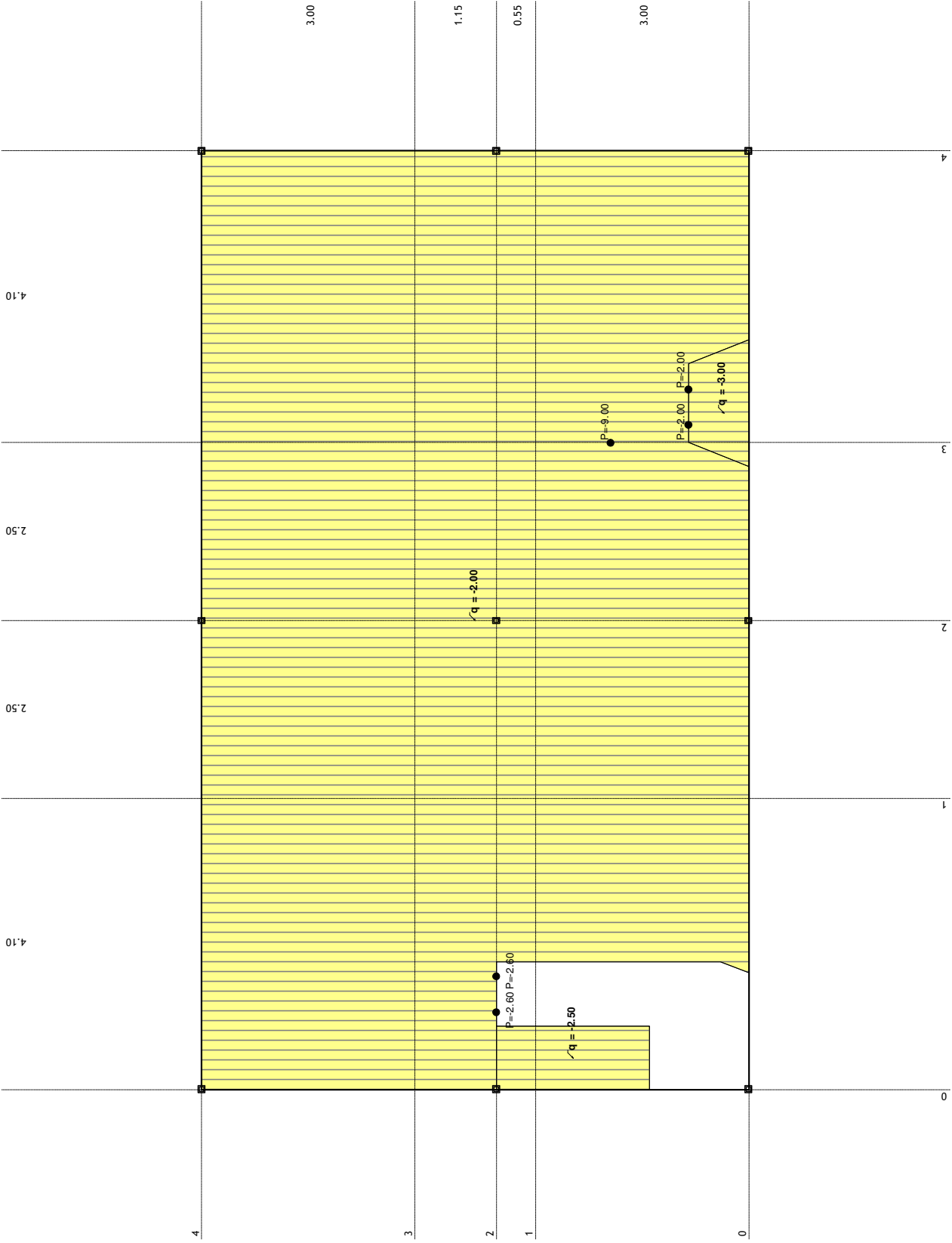


Nivo: Npr [-2.55 m]

Opt. 2: p



Nivo: Pk [2.80 m]



Modalna analiza

Napredne opcije seizmičkog proračuna:

Ploče - redukcija krutosti na savijanje: 0.100
Multiplikator krutosti oslonaca: 10000.000
Sprečeno oscilovanje u Z pravcu

Faktori opterećenja za proračun masa

No	Naziv	Koeficijent
1	g (g)	1.00
2	p	0.50

Raspored masa po visini objekta

Nivo	Z [m]	X [m]	Y [m]	Masa [T]	T/m2
Pk	2.80	6.53	3.98	80.57	1.17
Vpr	0.00	6.72	3.92	89.64	0.92
Npr	-2.55	6.60	3.94	33.91	1.78
Ukupno:	0.68	6.62	3.95	204.12	

Položaj centara krutosti po visini objekta

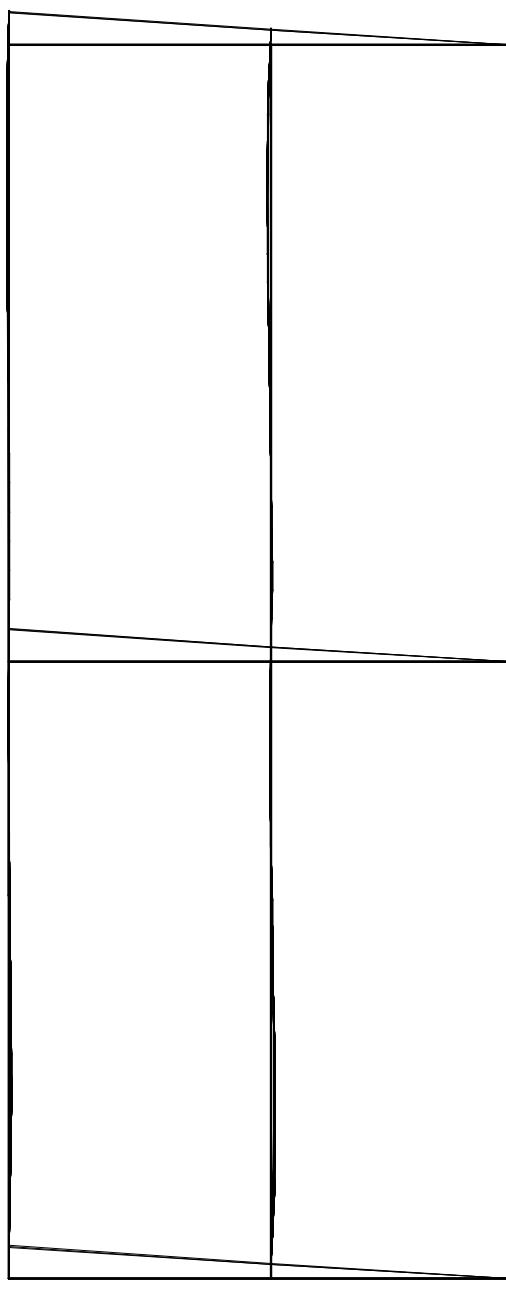
Nivo	Z [m]	X [m]	Y [m]
Pk	2.80	6.60	3.75
Vpr	0.00	6.60	3.74
Npr	-2.55	6.60	3.73

Ekscentricitet po visini objekta

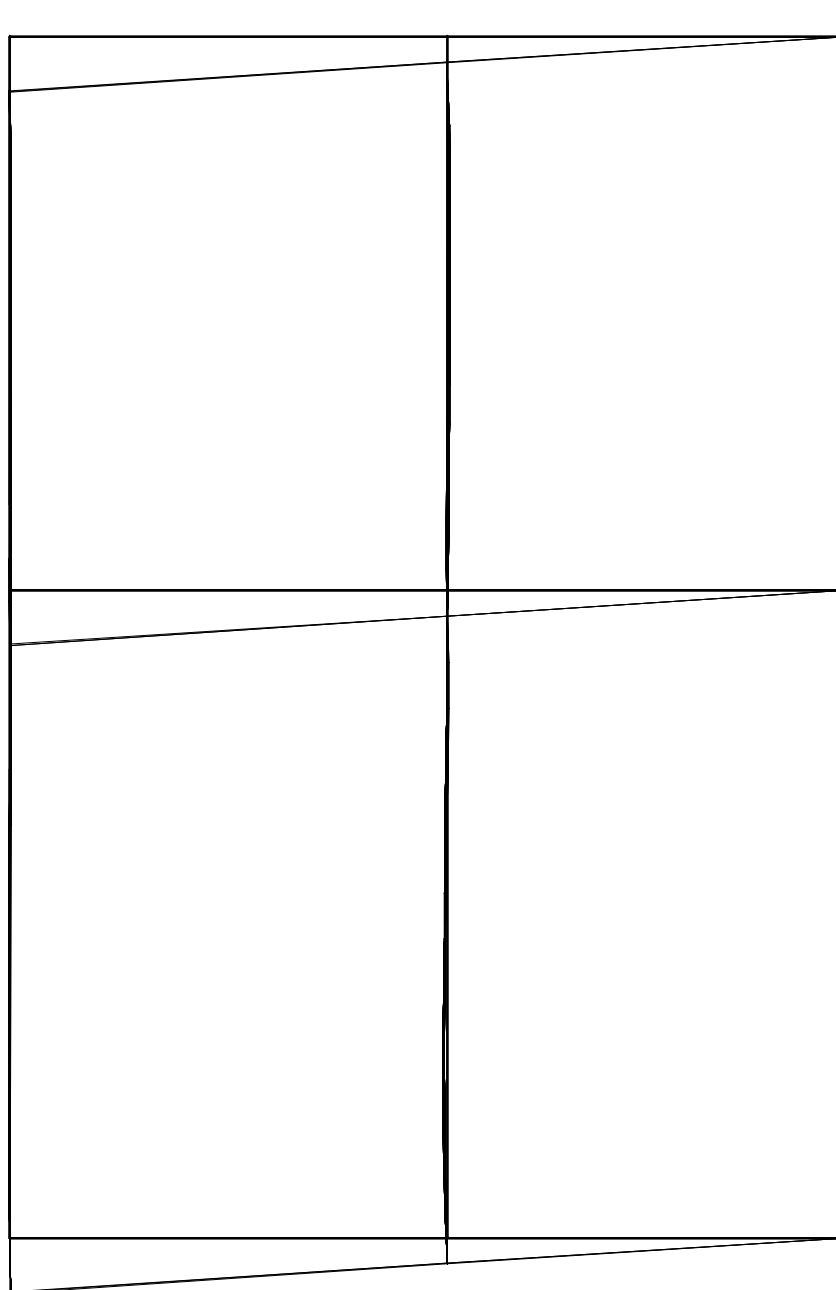
Nivo	Z [m]	eo _x [m]	eo _y [m]
Pk	2.80	0.07	0.23
Vpr	0.00	0.12	0.19
Npr	-2.55	0.00	0.21

Periodi oscilovanja konstrukcije

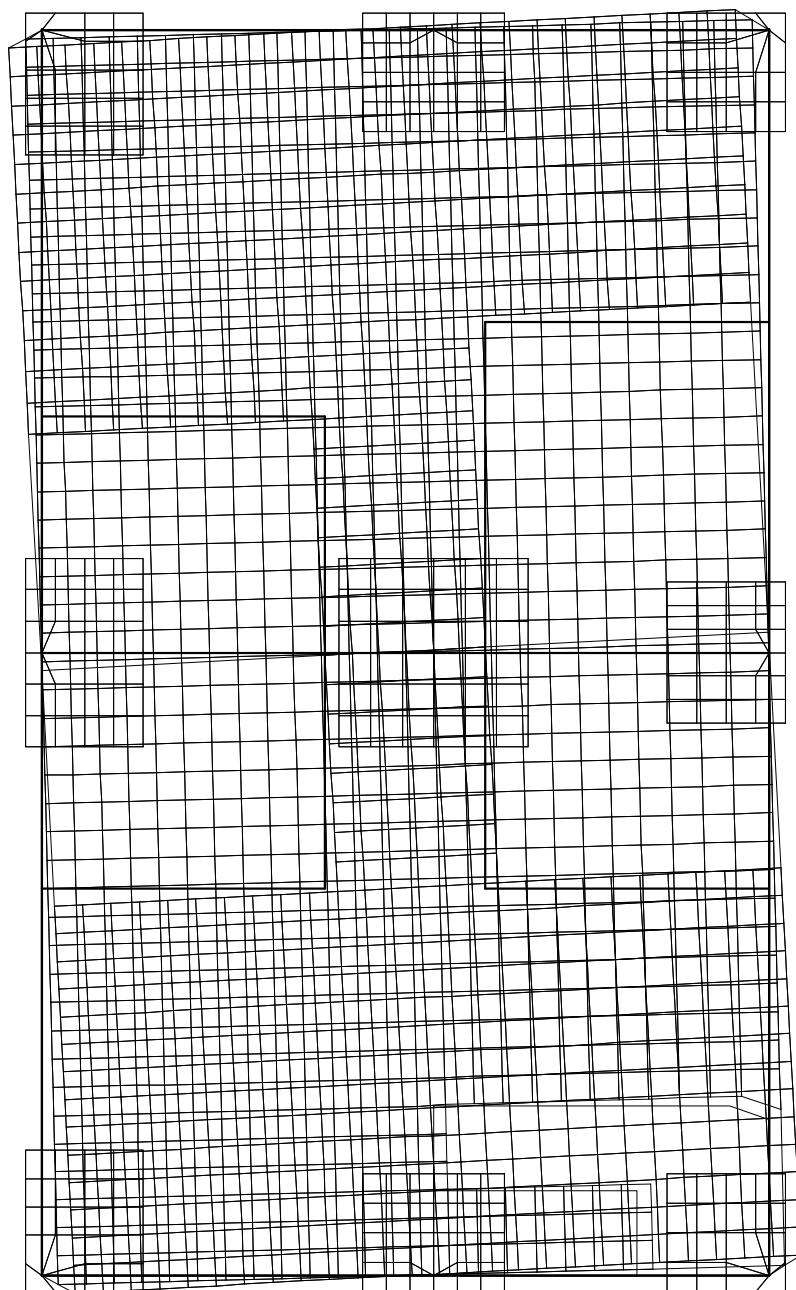
No	T [s]	f [Hz]
1	0.5092	1.9637
2	0.4726	2.1160
3	0.3483	2.8708



Izometrija (Front)
Forma oscilovanja: 1/3 [T=0.5092sec / f=1.96Hz]



Izometrija (Left)
Forma oscilovanja: 2/3 [T=0.4726sec / f=2.12Hz]



Izometrija (Top)
Forma oscilovanja: 3/3 [T=0.3483sec / f=2.87Hz]

Seizmički proračun

Seizmički proračun: JUS (Ekvivalentno statičko opterećenje)

Kategorija tla: II
Seizmička zona: IX ($K_s = 0.100$)
Kategorija objekta: II
Vrsta konstrukcije: 1
Kota uklještenja: $Z_d = 0.00$ m
Ploče - redukcija krutosti na savijanje: 0.100
Multiplikator krutosti oslonaca: 10000.000

Ugao dejstva zemljotresa:

Naziv	T [sec]	α [°]
Sx	0.509	0.00
Sy	0.473	90.00

Raspored seizmičkih sila po visini objekta (Sx)

Nivo	Z [m]	S [kN]
Pk	2.80	79.02
Vpr	0.00	0.00
Npr	-2.55	0.00
	$\Sigma =$	79.02

Raspored seizmičkih sila po visini objekta (Sy)

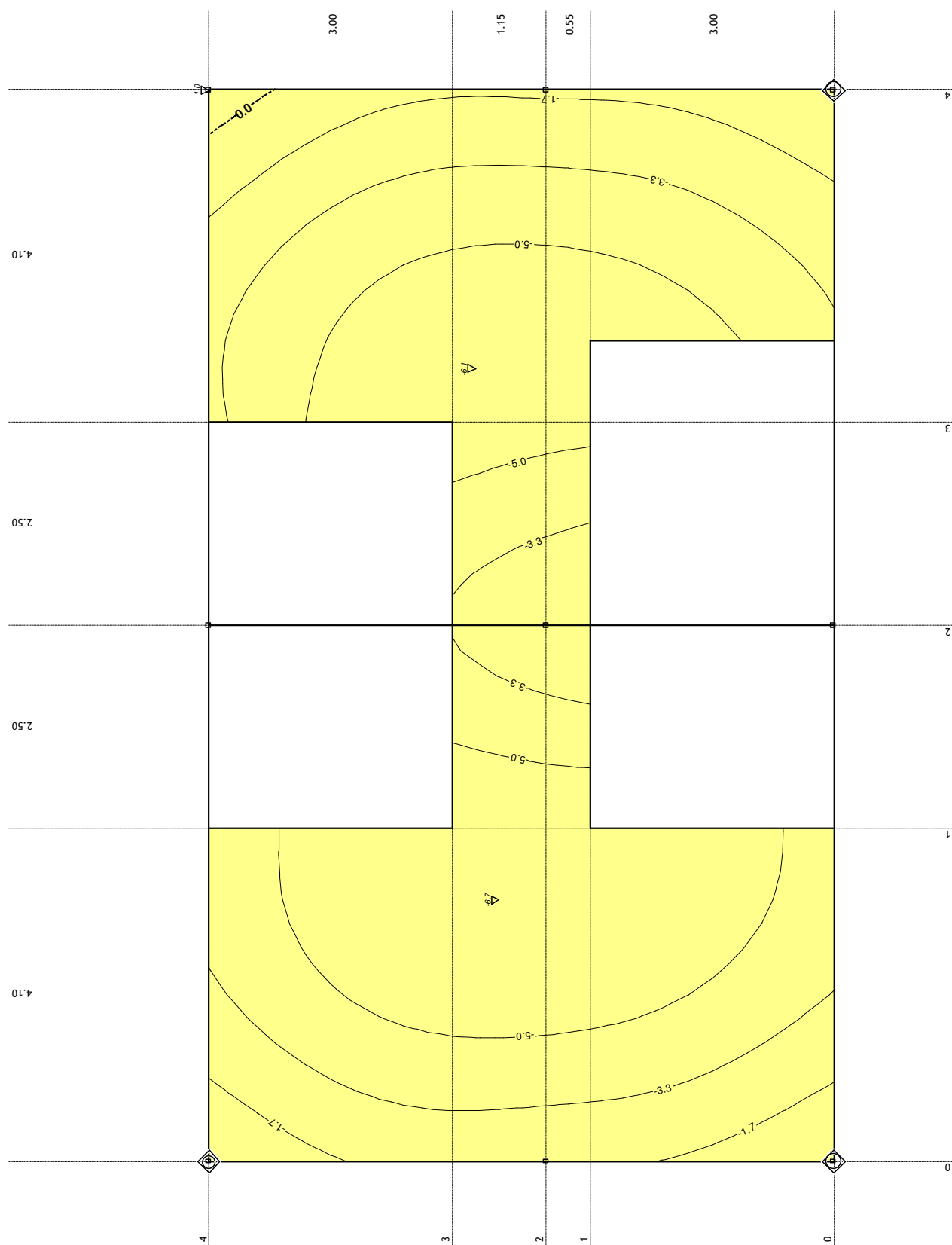
Nivo	Z [m]	S [kN]
Pk	2.80	79.02
Vpr	0.00	0.00
Npr	-2.55	0.00
	$\Sigma =$	79.02

Raspored masa po visini objekta

Nivo	Z [m]	X [m]	Y [m]	Masa [T]	T/m2
Pk	2.80	6.53	3.98	80.57	1.17
Vpr	0.00	6.72	3.92	89.64	0.92
Npr	-2.55	6.60	3.94	33.91	1.78
Ukupno:	0.68	6.62	3.95	204.12	

Statički proračun

Opt. 3: I+II

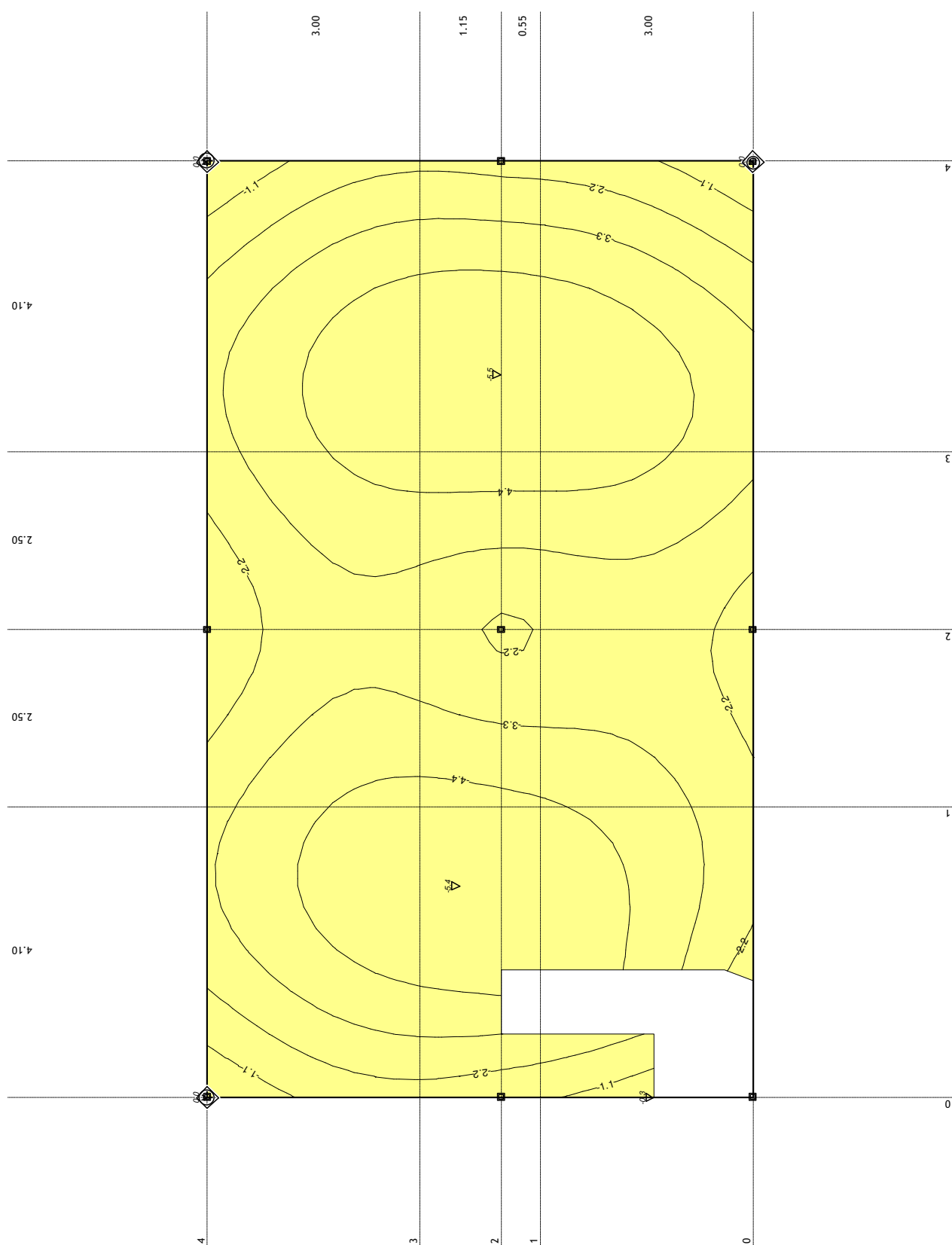


Nivo: Pk [2.80 m]

Relativni ugib ploča: max $w_r = 1.0$ / min $w_r = -6.7$ m / 1000

Vremenski ugib: $6.7 \times 3 = 20.1 \text{ mm} < L/300 = 6600/300 = 22 \text{ mm}$

Opt. 3: I+II

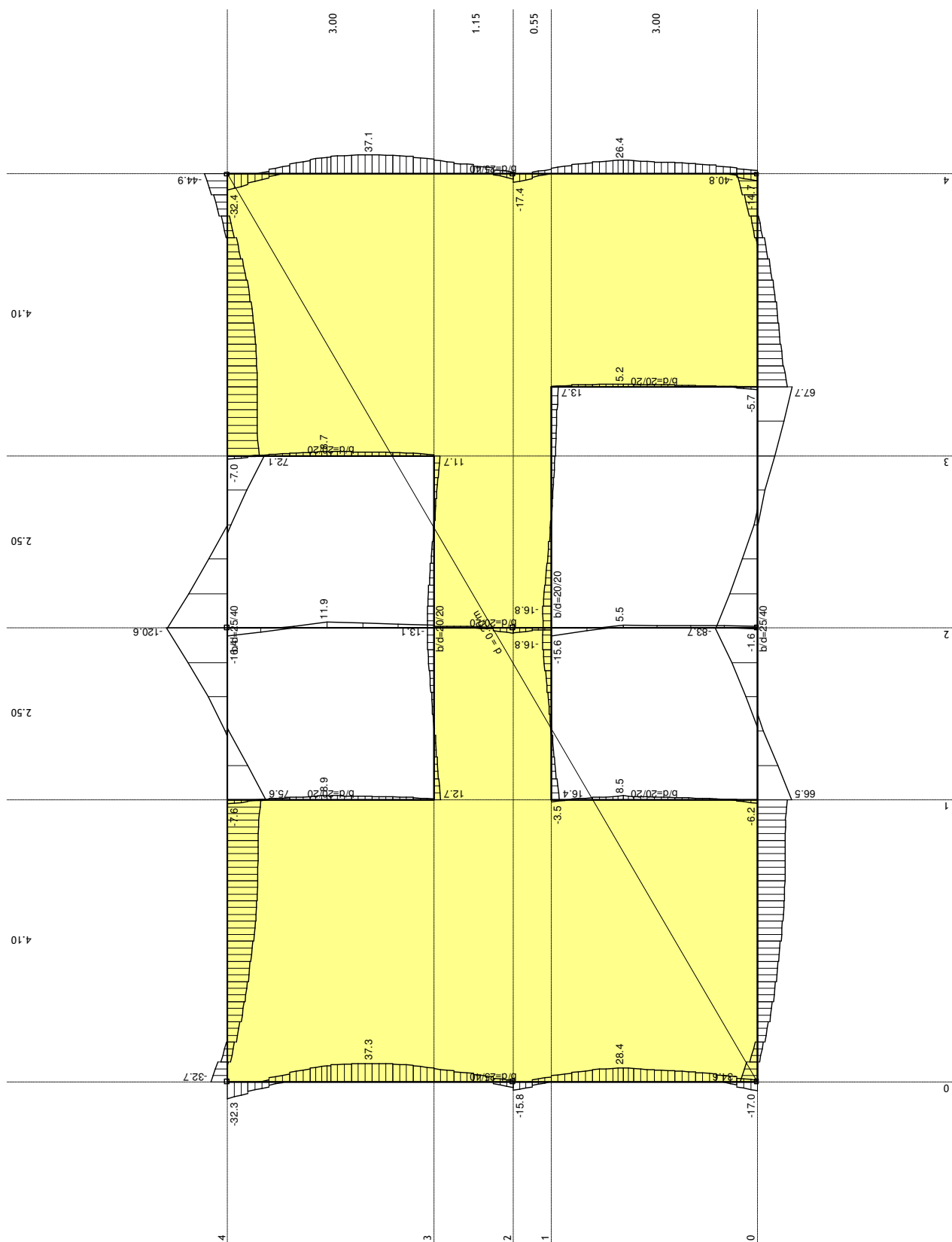


Nivo: Vpr [0.00 m]

Relativni ugib ploča: max $w_r = 0.0$ / min $w_r = -5.5$ m / 1000

Vremenski ugib: $5.5 \times 3 = 16.5 \text{ mm} < L/300 = 6600/300 = 22 \text{ mm}$

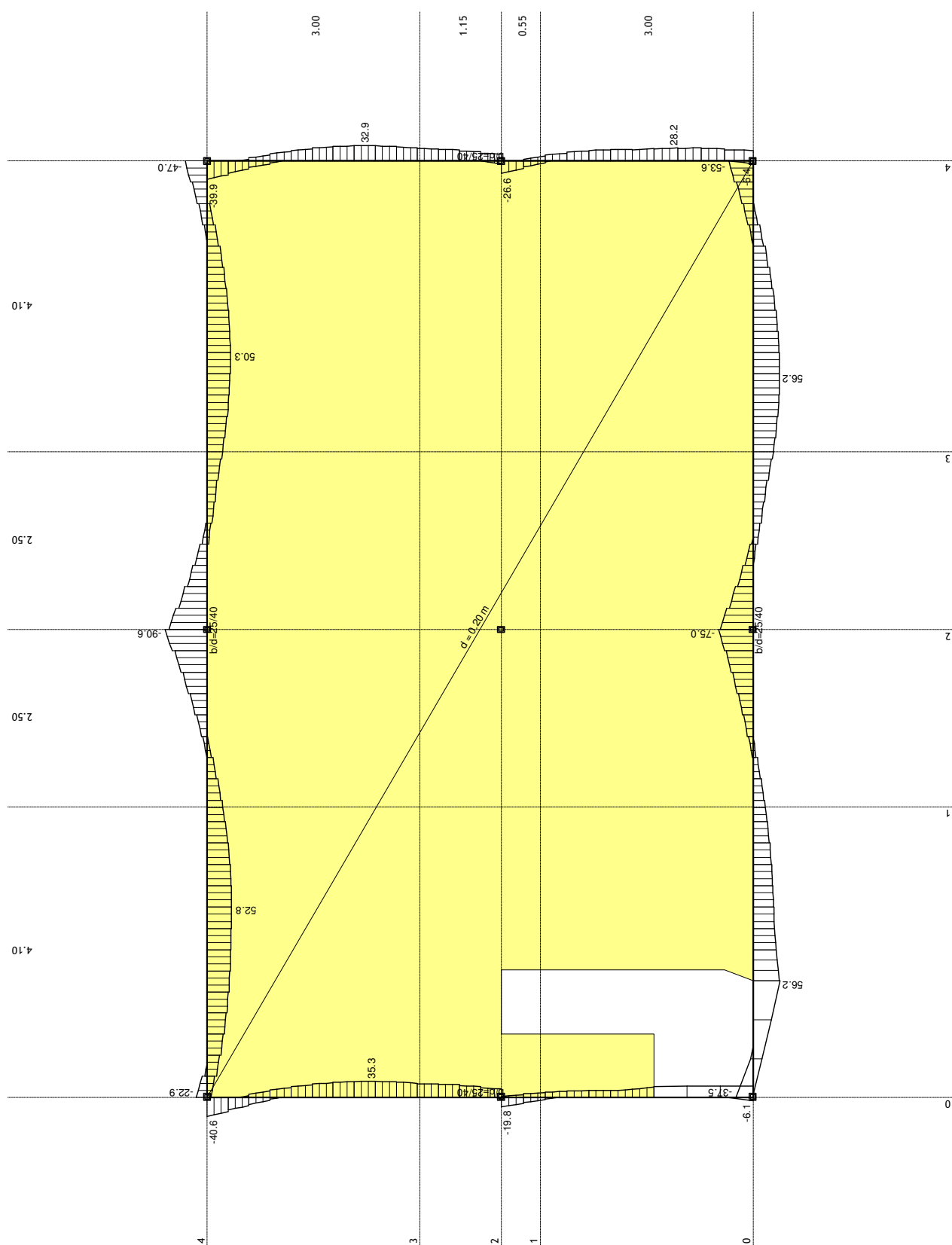
Nivo: Pk [2.80 m]
 Uticaji u gredi: max M3= 75.6 / min M3= -120.6 kNm



Technical drawing of a building floor plan, showing a layout with yellow rooms and dimensions. The plan is oriented horizontally on the page. The drawing includes a grid of rooms, with dimensions labeled in meters (m) and millimeters (mm). The overall dimensions are 4.10 m by 2.50 m. The drawing is a technical drawing of a building floor plan, showing a layout with yellow rooms and dimensions. The plan is oriented horizontally on the page. The drawing includes a grid of rooms, with dimensions labeled in meters (m) and millimeters (mm). The overall dimensions are 4.10 m by 2.50 m.

Uticaji u gredi: max T2= 87.4 / min T2= -85.0 kN

Opt. 9: [Anv] 5-8



Nivo: Vpr [0.00 m]

Uticaji u gredi: max M3= 56.2 / min M3= -90.6 kNm

Uticaji u gredi: max T2= 57.1 / min T2= -49.6 kN

Proračun nosivosti preseka na T-sile

presek 25/40 cm

Beton:

MB - marka betona: 40 $\rightarrow \tau_r = 0,130 \text{ kN/cm}^2$

AB presek:

b - širina preseka: 25 cm

d - visina preseka: 40 cm

h - st. visina približna: 35 cm

max T-sila sa koef. sig. 88 kN

Uzengije:

GA, RA, MA? GA $\rightarrow \sigma_v = 24 \text{ kN/cm}^2$

Ø preseka: 8 mm $\rightarrow a_{u,1} = 0,503 \text{ cm}^2$

razmak e= 10 cm (preporučeno: 5; 7,5; 10; 12,5; 15; 17,5; 20...cm)

sečnost 2

ugao nagiba α : 90 °

ugao Θ (25-55°): 45 °

Proračun:

$$\tau_{u,u} = \frac{m \cdot a_u^{(1)}}{b \cdot e_u} \cdot \sigma_v \cdot (\cos \alpha + \sin \alpha \cdot \operatorname{ctg} \theta)$$

$$\tau_{u,u} = 0,097 \text{ kN/cm}^2$$

$$\tau_{Ru,A} = \frac{3}{2} \cdot (\tau_{u,A} - \tau_r)$$

$$\tau_{Ru,A} = 0,097 \text{ kN/cm}^2$$

$$\rightarrow \tau_{u,A} = 0,194 \text{ kN/cm}^2$$

$\tau_r < \tau_{u,A} < 3\tau_r$ - deo sile prihvata beton a deo prihvataju uzengije ili koso gvožđe.

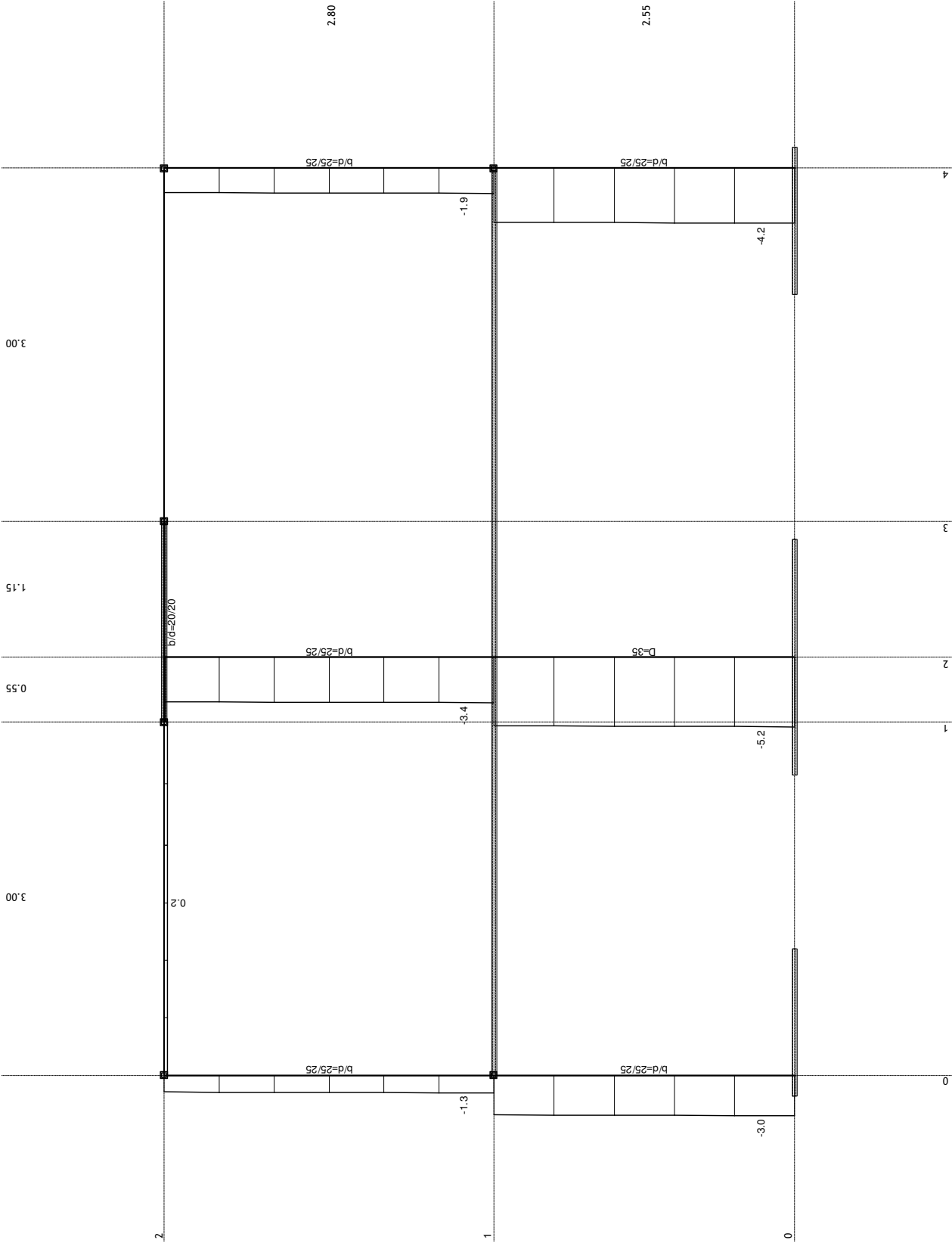
$$\tau_{u,A} = \frac{T_u}{0,9 \cdot h \cdot b}$$

$$\rightarrow T_u = 153,1 \text{ kN}$$

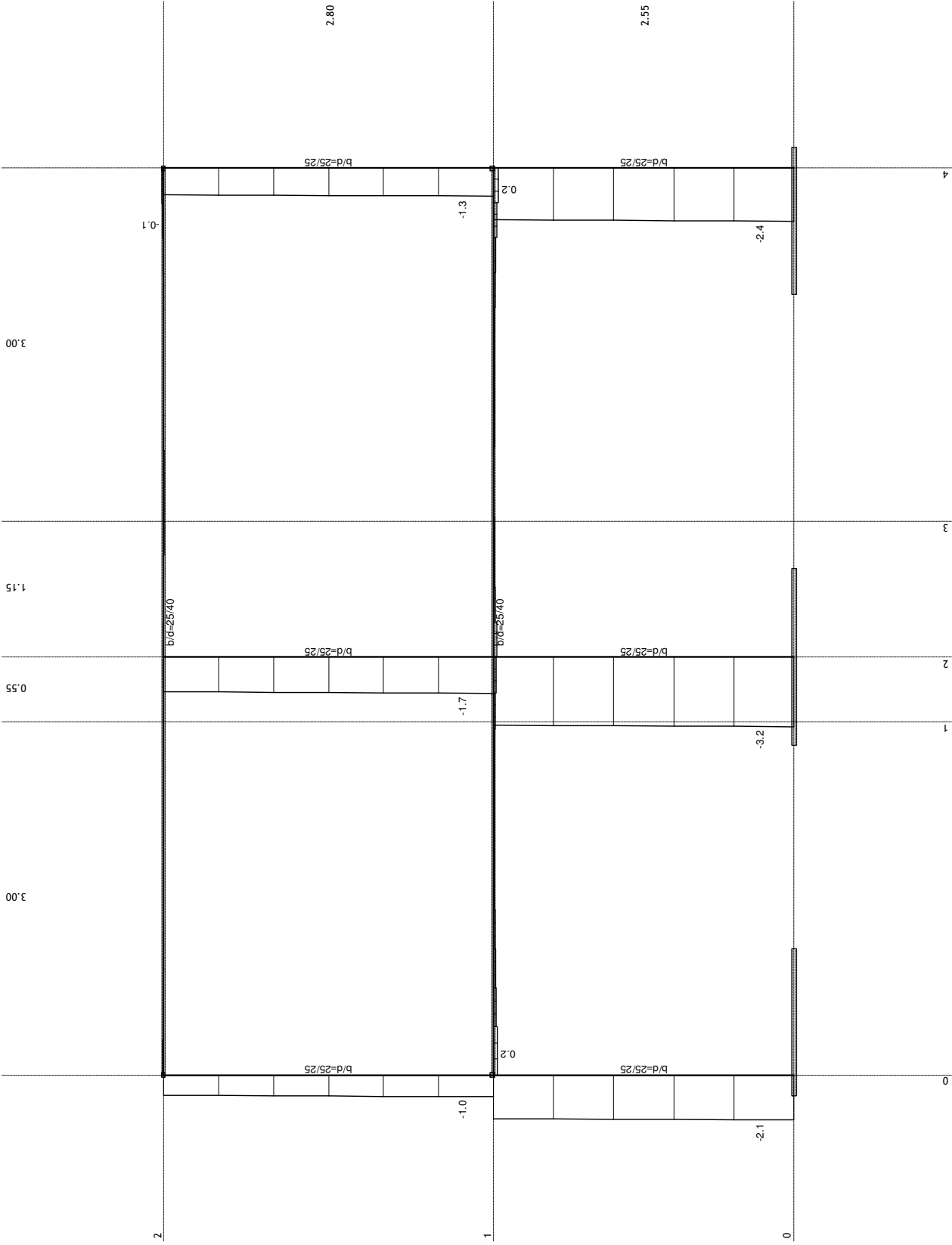
Nosivost preseka je 153,1kN za slučaj kada u nosivosti učestvuju i beton i uzengije prečnika 8mm na međusobnom rastojanju od 10cm.

Sila na AB preseku od 88kN je manja od granične sile koja iznosi 153,1kN te je nosivost zadovoljena.

Uticaji u gredi: $\max \sigma_{,0} = 0.4$ / $\min \sigma_{,0} = -3.0$ MPa



Ram: V_3
Uticaji u gredi: max $\sigma_0=0.2$ / min $\sigma_0=-5.3$ MPa



Ram: V_6
Uticaji u gredi: max $\sigma_0= 0.2$ / min $\sigma_0= -3.2$ MPa

DUKILNOST STUBOVA
USVOJENA ARMATURA PRESEKA

MB 30 → $f_b =$ $f_{bk} = 2,050$
RA 400/500 → $\sigma_v =$ $\sigma_v = 40$

$$Ab_{,i} = Ab \cdot \left(1 + \mu \cdot \frac{E_a}{E_b} \right)$$

$$\frac{E_a}{E_b} \approx 10$$

$$\frac{\sigma_o}{\beta_p} \leq 0.35$$

$$\sigma_o = \frac{N}{Ab_{,i}}$$

$$N = N_g + N_p$$

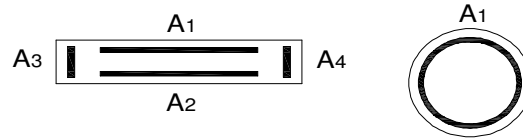
$$\beta_p = 0.7 \cdot \beta_k$$

usvojen min % armiranja: 0,8 %

za stubove:
 $\sigma_{dop} = 7,35 \text{ kN/cm}^2$

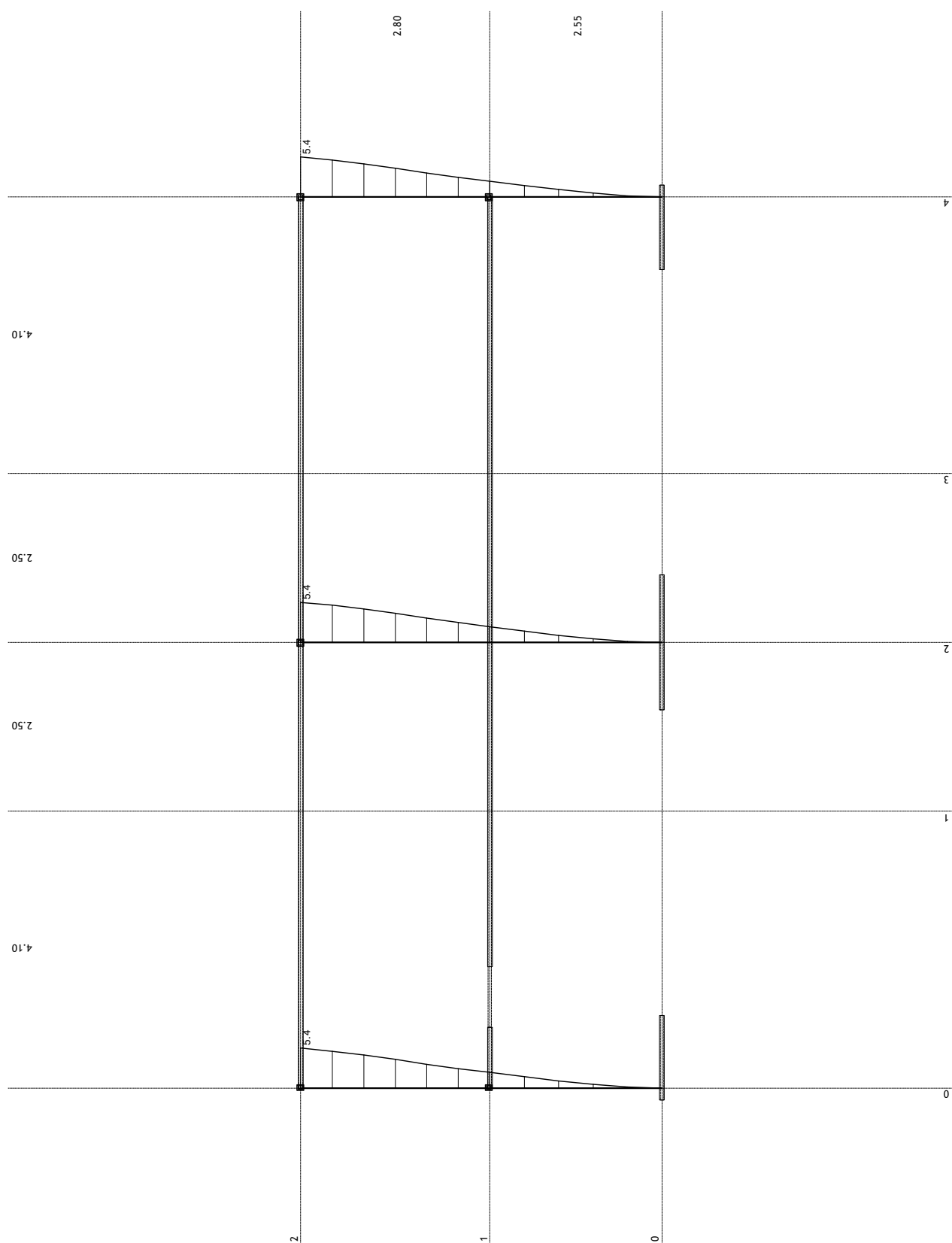
Aa1/Aa2
Aa3/Aa4

- Armatura dobijena dimenzionisanjem stubova na koso savijanje - G+P+vetar/seizmika



pozicije stubova	●/■	<i>b</i>	<i>d</i>	<i>Ab</i>	<i>N_{g+p}</i>	σ_o	μ_{potr}	Aa1/Aa2	Aa3/Aa4	Usvojena armatura	Napomena	μ_{st}	μ_{potr2}
	presek	cm	cm	cm ²	kN	Mpa	%	cm ²	cm ²			%	%
S00	■	25	25	625	125	2,00	min	8,50	8,50	12 RØ 16		3,86	min
S02	■	25	25	625	191	3,06	min	7,70	7,70	12 RØ 16		3,86	min
S04	■	25	25	625	132	2,11	min	9,10	9,10	12 RØ 16		3,86	min
S20	■	25	25	625	196	3,14	min	7,80	7,80	12 RØ 16		3,86	min
S22	●	35		961,625	500	5,20	min	10,00	10,00	12 RØ 16		2,51	min
S24	■	25	25	625	199	3,18	min	8,00	8,00	12 RØ 16		3,86	min
S40	■	25	25	625	156	2,50	min	12,10	12,10	12 RØ 16		3,86	min
S42	■	25	25	625	261	4,18	min	10,50	10,40	12 RØ 16		3,86	min
S44	■	25	25	625	156	2,50	min	12,10	12,10	12 RØ 16		3,86	min

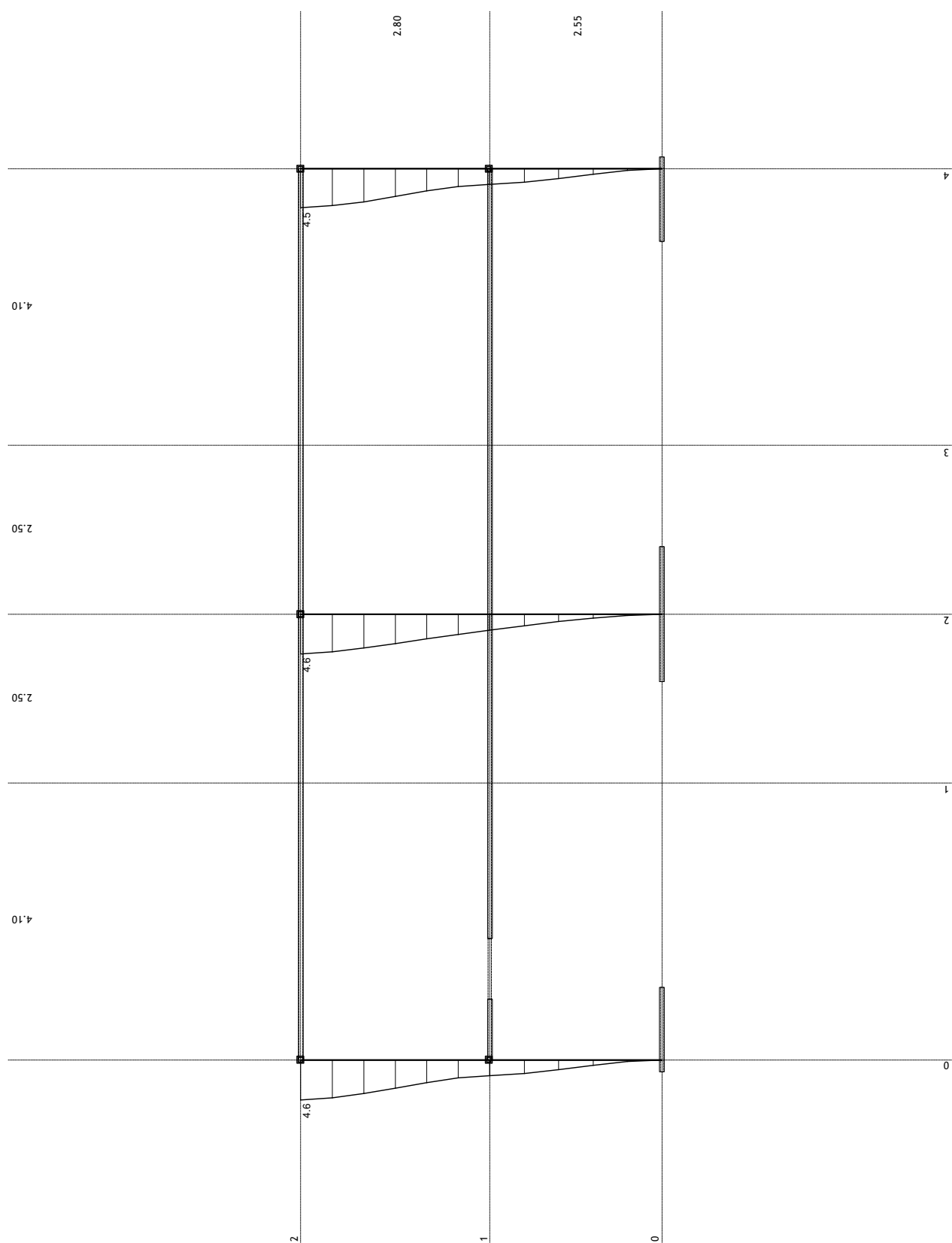
Opt. 3: Sx



Ram: H_5

Uticaji u gredi: max $X_p = 5.4$ / min $X_p = 0.0$ m / 1000
 $5.4\text{mm} < H/600 = 5350/600 = 8.9\text{mm}$

Opt. 4: Sy



Ram: H_5
 Uticaji u gredi: max $Y_p = 4.6$ / min $Y_p = 0.0$ m / 1000
 $4.6\text{mm} < H/600 = 5350/600 = 8.9\text{mm}$

Figure 10 displays a 4x4 grid of diagrams illustrating the distribution of bending moments (M) and displacements (d) for a continuous beam with four supports. The grid is labeled 0, 1, 2, 3 vertically and 0, 1, 2, 3 horizontally. Each diagram shows a beam segment with various values for M and d, and a small square indicating a specific point of interest.

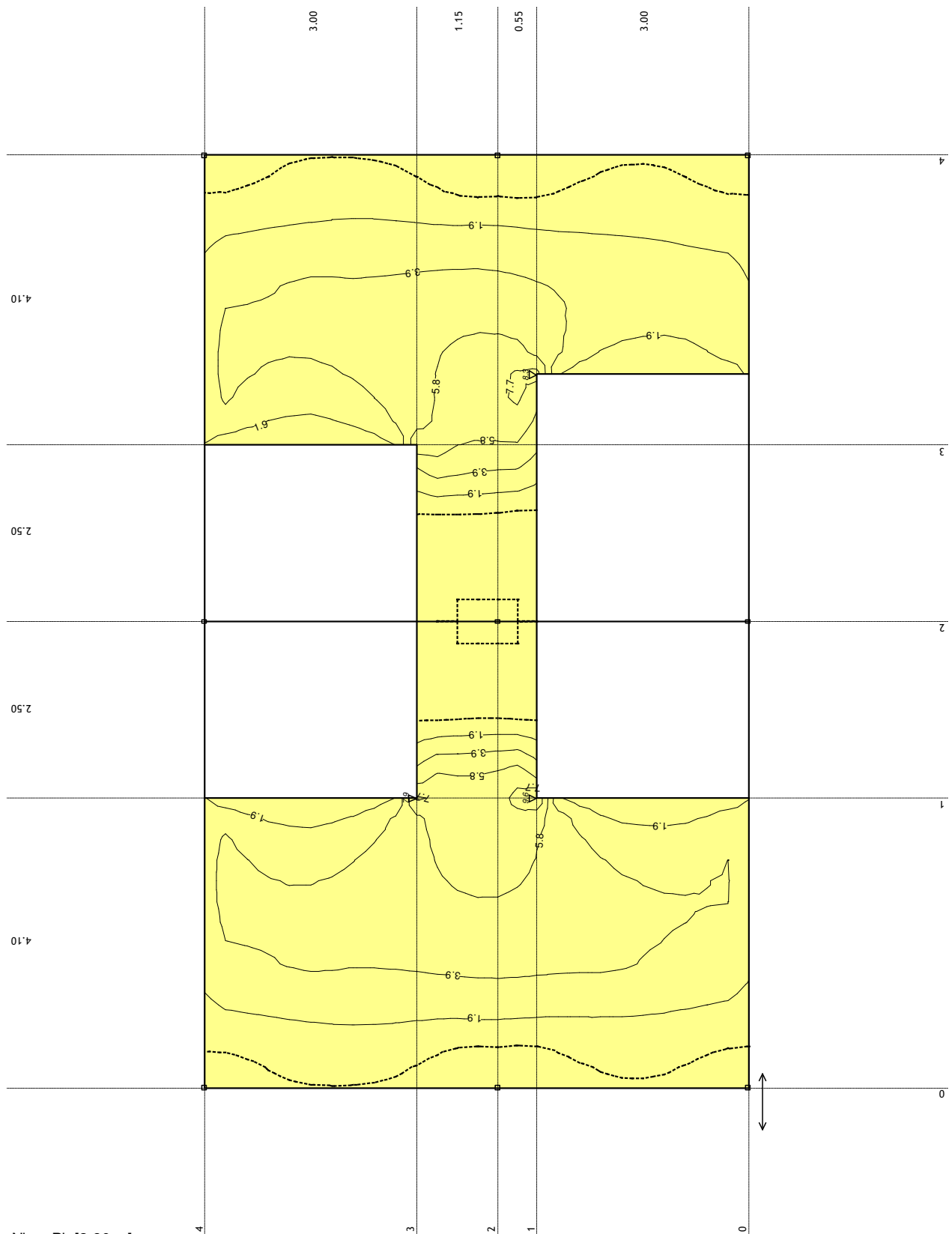
The diagrams are arranged in a 4x4 grid, with the following values for M and d (in kNm and m, respectively):

- Row 0:
 - Column 0: $M = 10.1$, $d = 0.36$ m
 - Column 1: $M = 10.1$, $d = 0.36$ m
 - Column 2: $M = 10.1$, $d = 0.36$ m
 - Column 3: $M = 10.1$, $d = 0.36$ m
- Row 1:
 - Column 0: $M = 10.1$, $d = 0.36$ m
 - Column 1: $M = 10.1$, $d = 0.36$ m
 - Column 2: $M = 10.1$, $d = 0.36$ m
 - Column 3: $M = 10.1$, $d = 0.36$ m
- Row 2:
 - Column 0: $M = 10.1$, $d = 0.36$ m
 - Column 1: $M = 10.1$, $d = 0.36$ m
 - Column 2: $M = 10.1$, $d = 0.36$ m
 - Column 3: $M = 10.1$, $d = 0.36$ m
- Row 3:
 - Column 0: $M = 10.1$, $d = 0.36$ m
 - Column 1: $M = 10.1$, $d = 0.36$ m
 - Column 2: $M = 10.1$, $d = 0.36$ m
 - Column 3: $M = 10.1$, $d = 0.36$ m

Utjecaji u pov. osloncu: max s,tla= -6.03 / min s,tla= -24.61 m / 1000

Dimenzionisanje (beton)

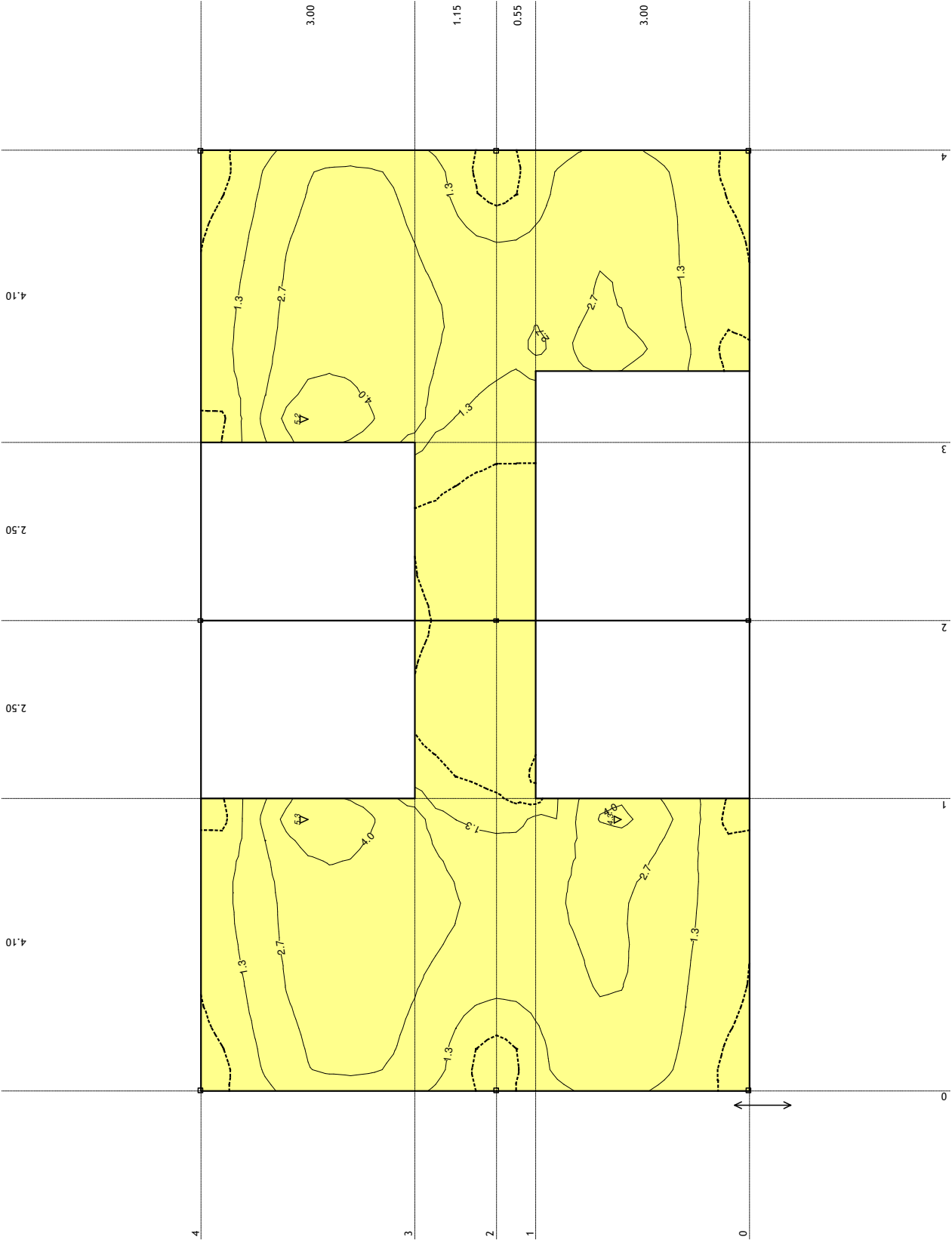
Merodavno opterećenje: 1.60xl+1.80xll
PBAB 87, MB 30, RA 400/500, a=2.00 cm



Nivo: Pk [2.80 m]

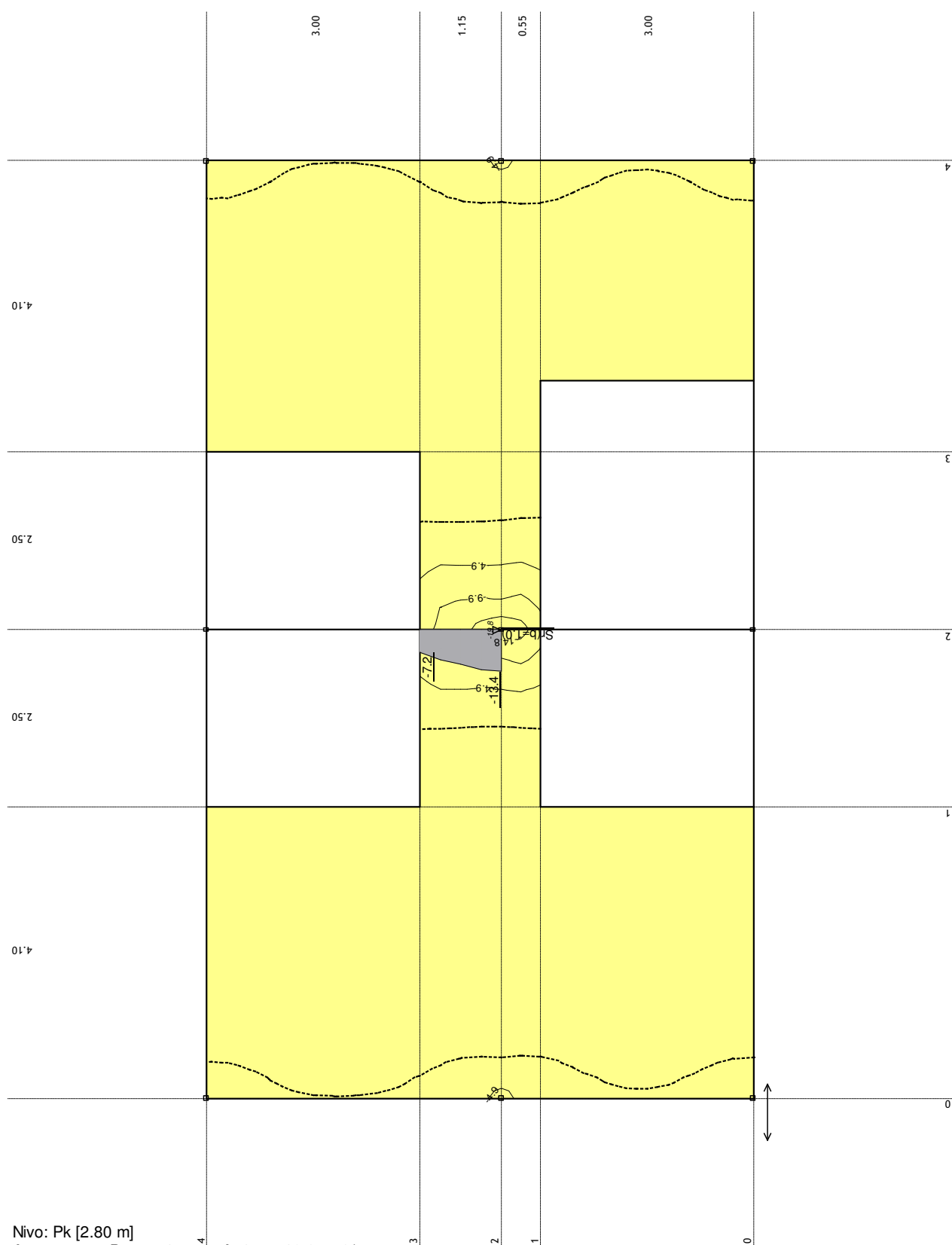
Aa - d.zona - Pravac 1 - max Aa1,d= 9.6 cm²/m
usvaja se ojačanje oko otvora +2fi16
usvaja se armatura u polju fi10/15

Opt. 5: I+II



Nivo: Npr [-2.55 m]
Uticaji u pov. osloncu: max s,tla= -6.03 / min s,tla= -24.61 m / 1000

Merodavno opterećenje: 1.60xI+1.80xII
PBAB 87, MB 30, RA 400/500, a=2.00 cm



Nivo: Pk [2.80 m]

Aa - g.zona - Pravac 1 - max Aa1,g= -19.8 cm²/m

usvaja se ojačanje oko otvora +-2fi16

osnovna armatura fi10/15

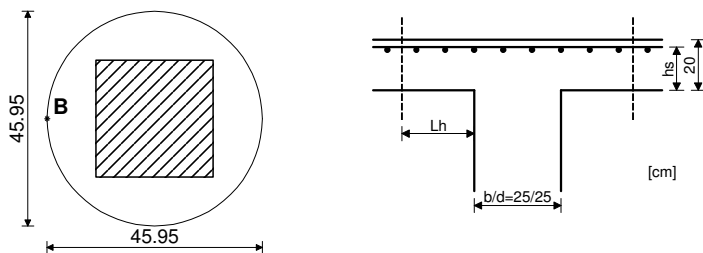
usvaja se dodatna armatura nad osloncem fi16/15

Technical drawing of a site plan. The drawing shows a yellow rectangular area with a central grey area. The yellow area is divided into four quadrants by a central grey area. The central grey area contains a contour line labeled "Srd=1.00". The drawing includes a grid with dimensions: 4.10, 2.50, 2.50, 4.10 (vertical) and 3.00, 1.15, 0.55, 3.00 (horizontal). A scale bar is located at the bottom right, indicating a distance of 1.00 m. The drawing is labeled "Nivo: Pk [2.80 m]" at the bottom left.

Aa - g.zona - Pravac 2 - max Aa2,g= -10.7 cm2/m
 usvaja se ojačanje oko otvora +2fi16
 osnovna armatura fi10/15
 usvaja se dodatna armatura nad osloncem fi16/15

Nivo: Pk [2.80 m]
Presek 2 (6.60,3.55,2.80)

MB 30



KONTROLA KRITIČNOG PRESEKA 1. ($L_h = 0.09\text{m}$ od ivice stuba)
(stub zamenjujućeg kružnog preseka, $d_s = 0.28\text{m}$)

Merodavna kombinacija: I+II	
Sila u stubu	$N = 211.55 \text{ kN}$
Merodavni smičući napon (tačka B)	$\tau = 0.828 \text{ MPa}$
Debljina ploče	$d, pl = 0.200 \text{ m}$
Statička visina ploče	$hs = 0.177 \text{ m}$
Obim kritičnog preseka	$Okp = 1.444 \text{ m}$
Postojeća armatura u ploči	
Procenat armiranja - pravac 1	$\mu, 1 = 0.850 \%$
Procenat armiranja - pravac 2	$\mu, 2 = 0.850 \%$
Srednja vrednost procenta armiranja	$\mu = 0.850 \%$
Koeficijent	$\alpha_a = 1.300$
Koeficijent	$\gamma_1 = 1.558$
Koeficijent	$\gamma_2 = 0.539$
Dopušteni glavni napon zatezanja	$\tau_a = 0.800$
Dopušteni glavni napon zatezanja	$\tau_b = 2.200$
Maksimalna otpornost($\gamma_2 \times \tau_b$)	$\tau_{max} = 1.187 \text{ MPa}$

Uslov: $\tau \leq \tau_{max}$ ($0.83 \leq 1.19$)

Uslov je ispunjen

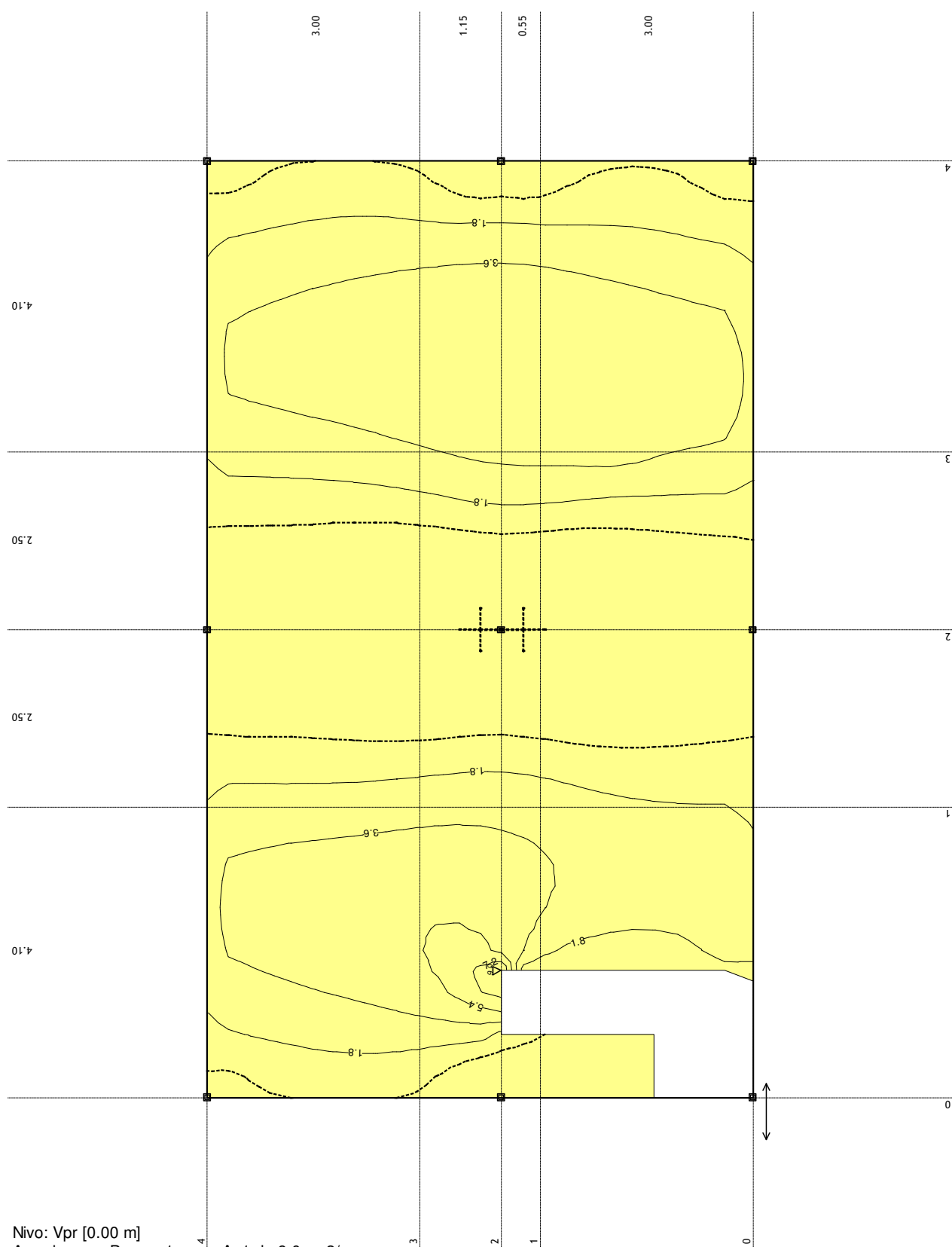
Otpornost na probijanje ploče bez dodatne armature za
obezbeđenje ($2/3 \times \gamma_1 \times \tau_a$)

$\tau_{gr} = 0.831 \text{ MPa}$

Uslov: $\tau \leq \tau_{gr}$ ($0.83 \leq 0.83$)

**Uslov je ispunjen, nije potrebna dodatna armatura za obezbeđenje
od probijanja ploče.**

Merodavno opterećenje: 1.60xI+1.80xII
PBAB 87, MB 30, RA 400/500, a=2.00 cm



Nivo: Vpr [0.00 m]

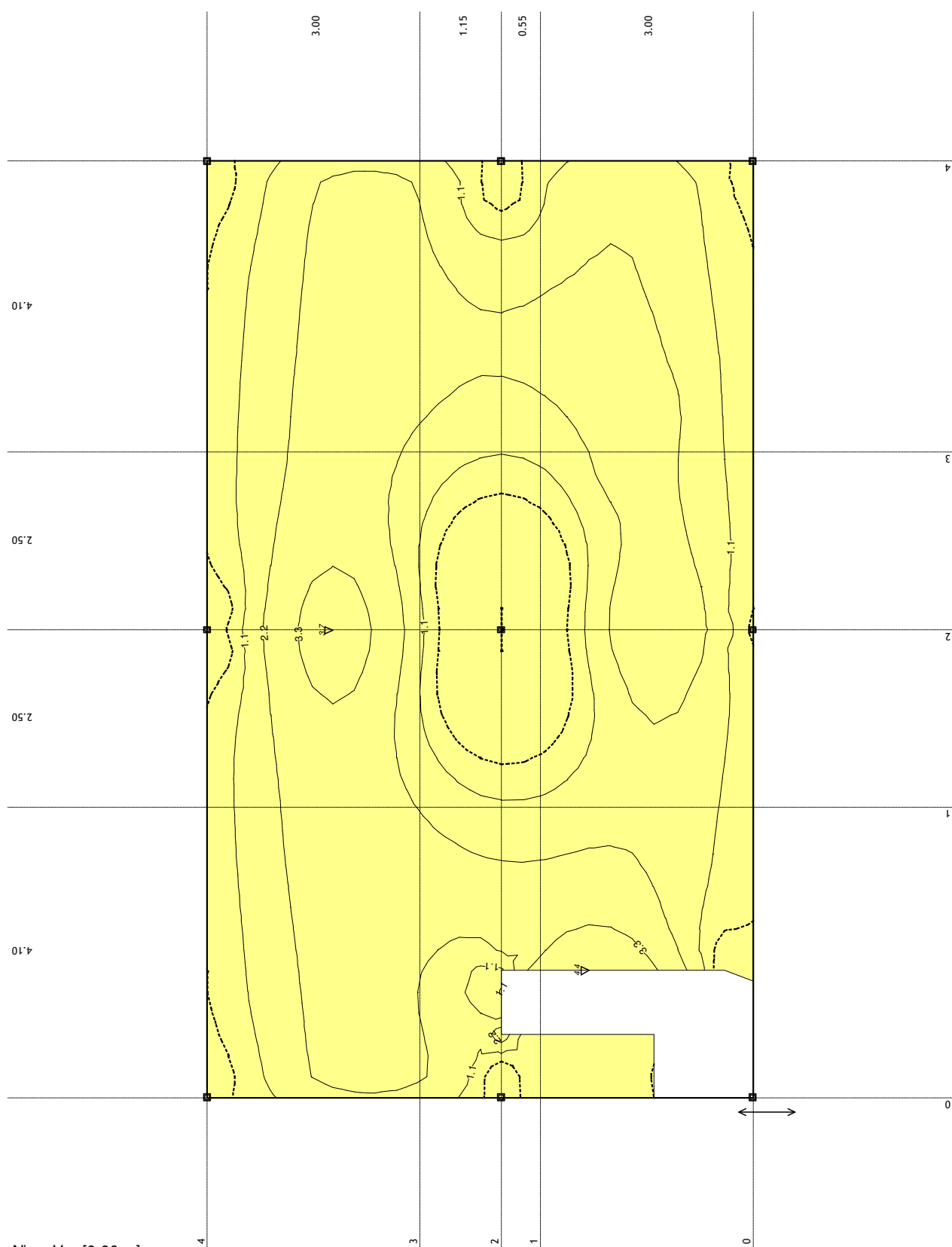
Aa - d.zona - Pravac 1 - max Aa1,d= 9.0 cm²/m

usvaja se ojačanje oko otvora +-2fi16

usvaja se armatura u polju fi12/15

osnovna armatura fi10/15

Merodavno opterećenje: 1.60xI+1.80xII
PBAB 87, MB 30, RA 400/500, a=2.00 cm



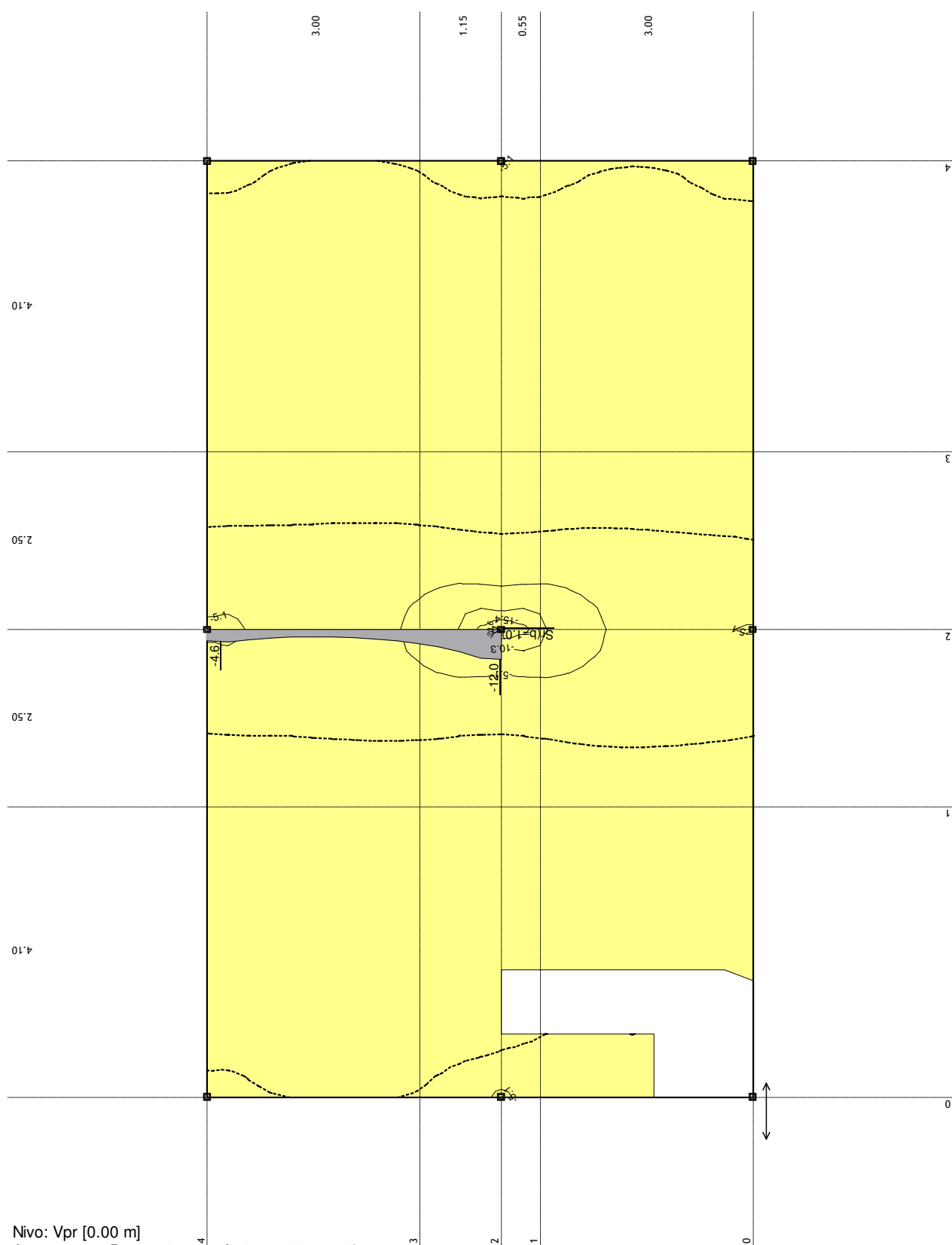
Nivo: Vpr [0.00 m]

Aa - d.zona - Pravac 2 - max Aa2,d= 4.4 cm²/m

usvaja se ojačanje oko otvora +-2fi16

usvaja se armatura u polju fi10/15

Merodavno opterećenje: 1.60xI+1.80xII
PBAB 87, MB 30, RA 400/500, a=2.00 cm

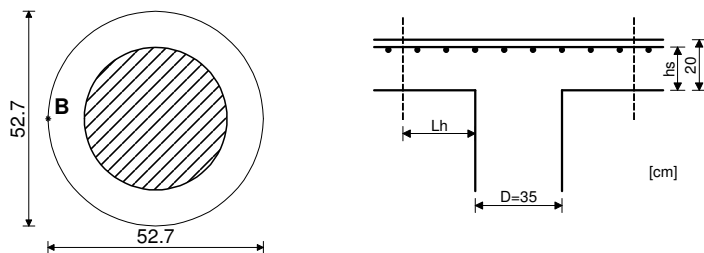


Nivo: Vpr [0.00 m]
Aa - g.zona - Pravac 1 - max Aa1,g= -20.6 cm²/m
usvaja se ojačanje oko otvora +-2fi16
osnovna armatura fi10/15
usvaja se dodatna armatura nad osloncem fi19/15

Technical drawing of a building floor plan. The drawing shows a yellow highlighted area, a blue shaded area, and a dashed line. The drawing includes a grid with dimensions 4.10, 2.50, and 3.00. A scale bar is present at the bottom right.

Kontrola ploča na probijanje

MB 30



KONTROLA KRITIČNOG PRESEKA 1. ($L_h = 0.09\text{m}$ od ivice stuba)

Merodavna kombinacija: I+II

Sila u stubu

$N = 284.02 \text{ kN}$

Merodavni smičući napon (tačka B)

$\tau = 0.969 \text{ MPa}$

Debljina ploče

$d_{pl} = 0.200 \text{ m}$

Statička visina ploče

$h_s = 0.177 \text{ m}$

Obim kritičnog preseka

$Okp = 1.656 \text{ m}$

Postojeća armatura u ploči

Procenat armiranja - pravac 1

$\mu_1 = 1.160 \%$

Procenat armiranja - pravac 2

$\mu_2 = 1.160 \%$

Srednja vrednost procenta armiranja

$\mu = 1.160 \%$

Koeficijent

$\alpha_a = 1.300$

Koeficijent

$\gamma_1 = 1.820$

Koeficijent

$\gamma_2 = 0.630$

Dopušteni glavni napon zatezanja

$\tau_a = 0.800$

Dopušteni glavni napon zatezanja

$\tau_b = 2.200$

Maksimalna otpornost ($\gamma_2 \times \tau_b$)

$\tau_{max} = 1.386 \text{ MPa}$

Uslov: $\tau \leq \tau_{max}$ ($0.97 \leq 1.39$)

Uslov je ispunjen

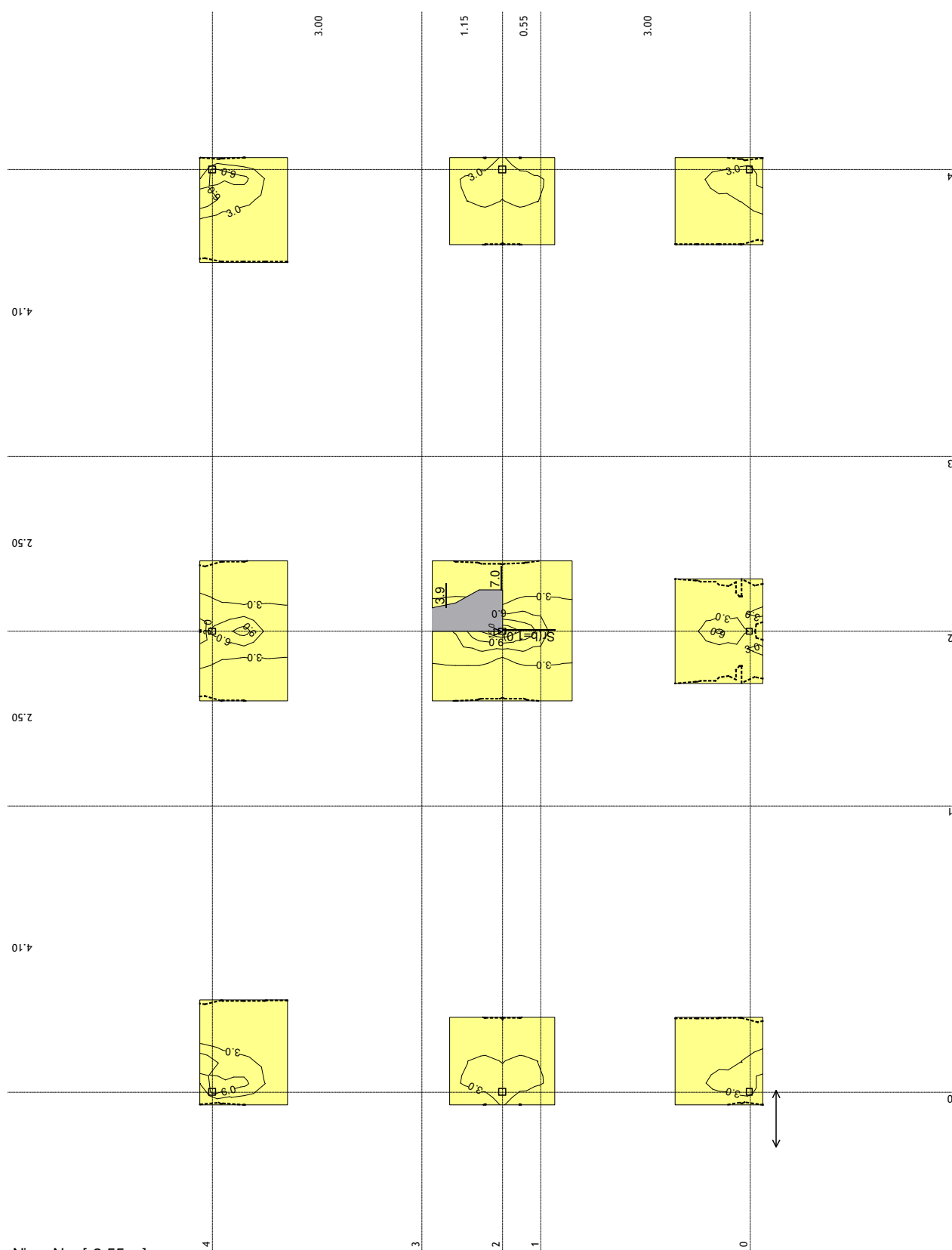
Otpornost na probijanje ploče bez dodatne armature za obezbeđenje ($2/3 \times \gamma_1 \times \tau_a$)

$\tau_{gr} = 0.971 \text{ MPa}$

Uslov: $\tau \leq \tau_{gr}$ ($0.97 \leq 0.97$)

Uslov je ispunjen, nije potrebna dodatna armatura za obezbeđenje od probijanja ploče.

Merodavno opterećenje: 1.60xl+1.80xll
PBAB 87, MB 30, RA 400/500, a=2.00 cm



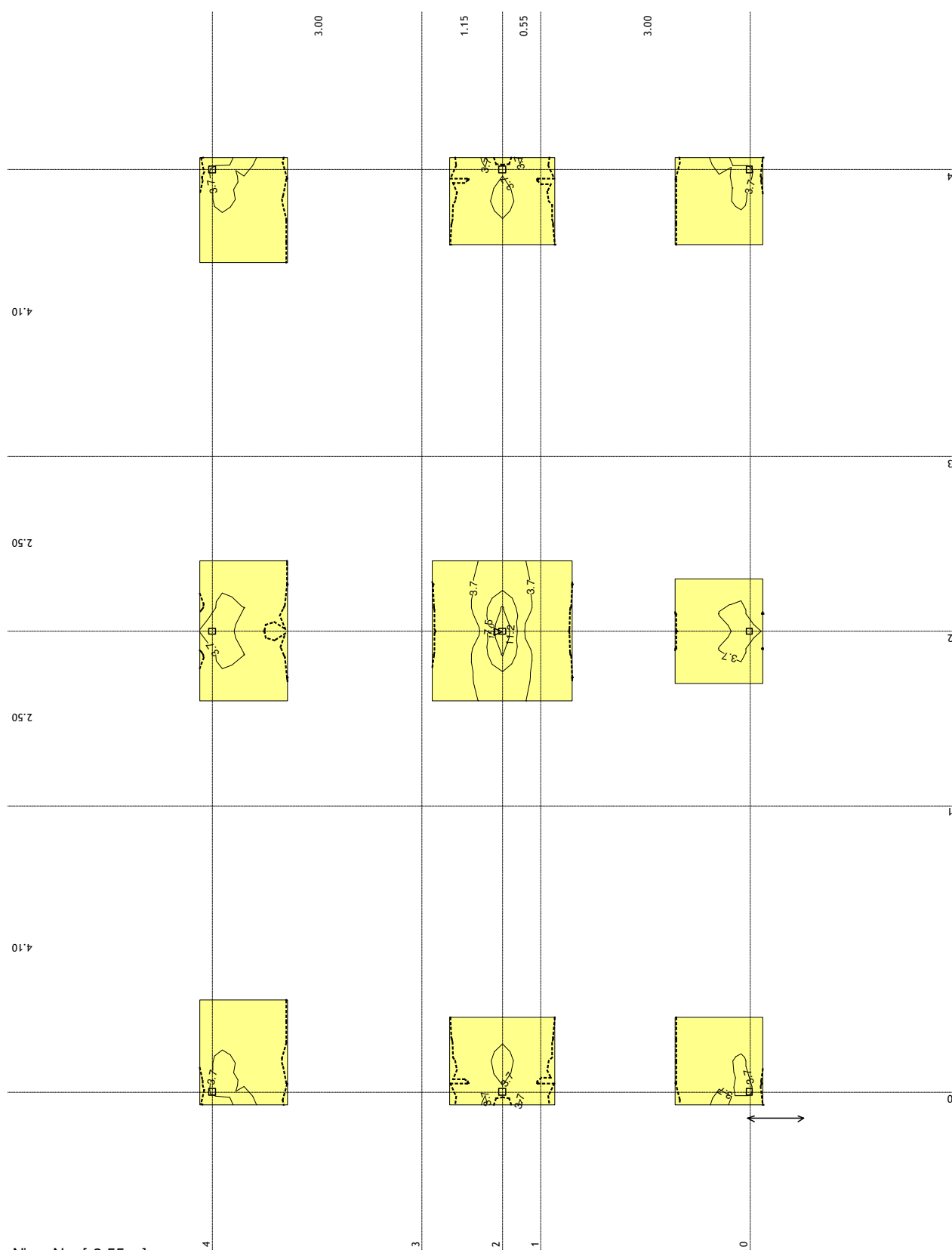
Nivo: Npr [-2.55 m]

Aa - d.zona - Pravac 1 - max Aa1,d= 15.0 cm²/m

usvaja se fi22/15 u srednjim temeljima

usvaja se fi16/15 u ugaonim temeljima

Merodavno opterećenje: 1.60xl+1.80xll
PBAB 87, MB 30, RA 400/500, a=2.00 cm



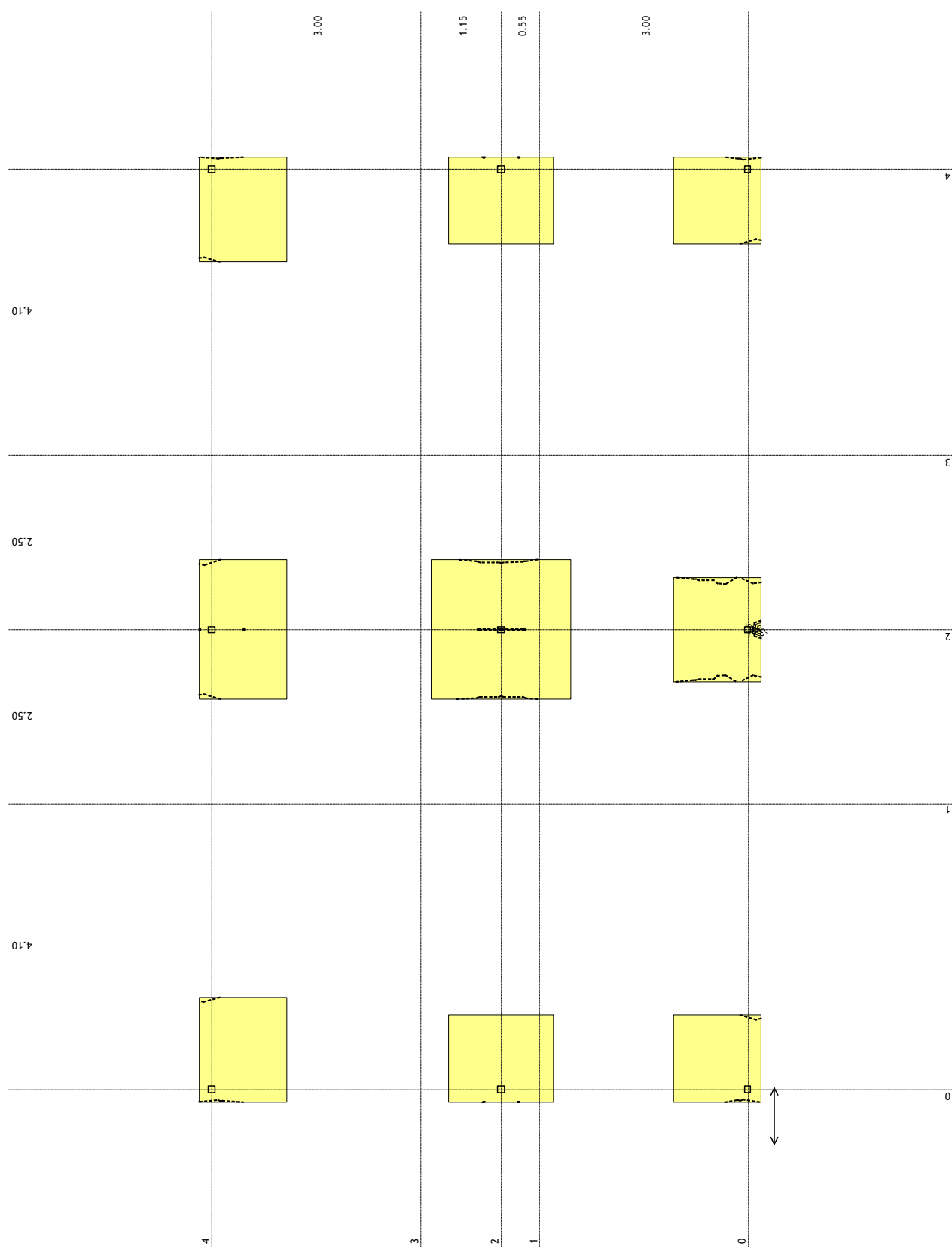
Nivo: Npr [-2.55 m]

Aa - d.zona - Pravac 2 - max Aa2,d= 15.0 cm²/m

usvaja se fi22/15 u srednjim temeljima

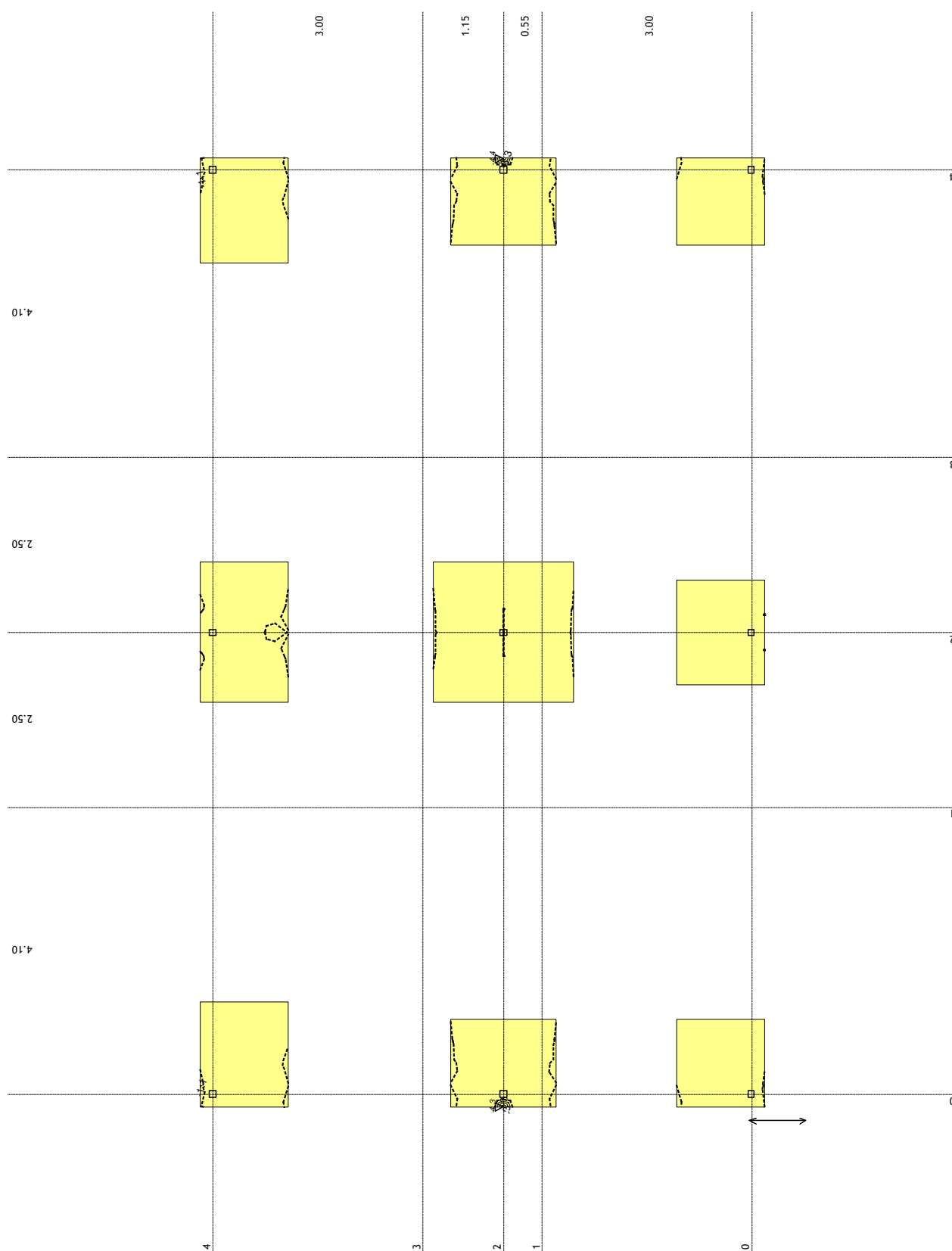
usvaja se fi16/15 u ugaonim temeljima

Merodavno opterečenje: 1.60xl+1.80xll
PBAB 87, MB 30, RA 400/500, a=2.00 cm



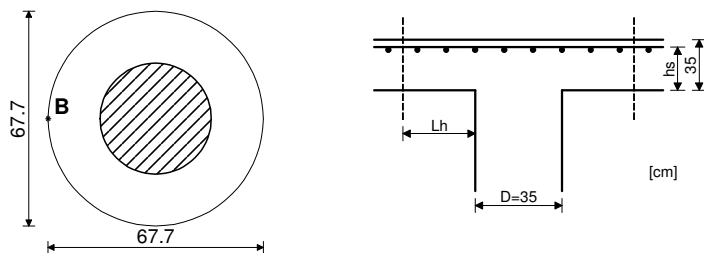
Nivo: Npr [-2.55 m]
Aa - g.zona - Pravac 1 - max Aa1,g= -4.5 cm²/m
usvaja se fi10/15

Merodavno opterećenje: 1.60xl+1.80xll
PBAB 87, MB 30, RA 400/500, a=2.00 cm



Nivo: Npr [-2.55 m]
Aa - g.zona - Pravic 2 - max Aa2,g= -4.4 cm²/m
usvaja se fi10/15
Kontrola ploča na probijanje
Nivo: Npr [-2.55 m]
Presek 1 (6.60,3.55,-2.55)

MB 30



KONTROLA KRITIČNOG PRESEKA 1. ($L_h = 0.16\text{m}$ od ivice stuba)

Merodavna kombinacija: I+II

Sila u stubu

$N = 506.22\text{ kN}$

Merodavni smičući napon (tačka B)

$\tau = 0.728\text{ MPa}$

Debljina ploče

$d_{pl} = 0.350\text{ m}$

Statička visina ploče

$h_s = 0.327\text{ m}$

Obim kritičnog preseka

$Okp = 2.127\text{ m}$

Postojeća armatura u ploči

Procenat armiranja - pravac 1

$\mu_1 = 0.700\%$

Procenat armiranja - pravac 2

$\mu_2 = 0.700\%$

Srednja vrednost procenta armiranja

$\mu = 0.700\%$

Koeficijent

$\alpha_a = 1.300$

Koeficijent

$\gamma_1 = 1.414$

Koeficijent

$\gamma_2 = 0.489$

Dopušteni glavni napon zatezanja

$\sigma_a = 0.800$

Dopušteni glavni napon zatezanja

$\sigma_b = 2.200$

Maksimalna otpornost ($\gamma_2 \times \sigma_b$)

$\tau_{max} = 1.077\text{ MPa}$

Uslov: $\tau \leq \tau_{max}$ ($0.73 \leq 1.08$)

Uslov je ispunjen

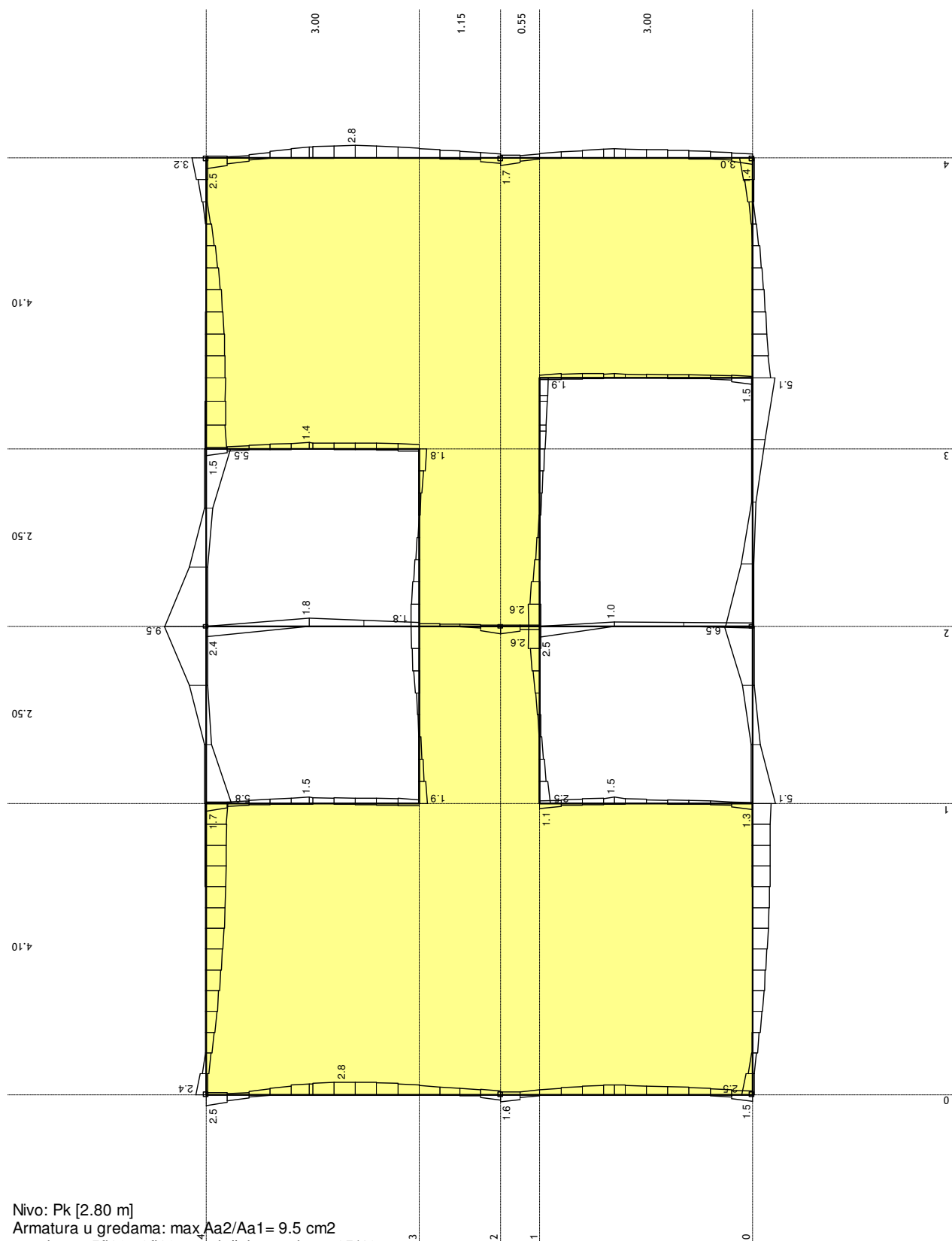
Otpornost na probijanje ploče bez dodatne armature za obezbeđenje ($2/3 \times \gamma_1 \times \sigma_a$)

$\tau_{gr} = 0.754\text{ MPa}$

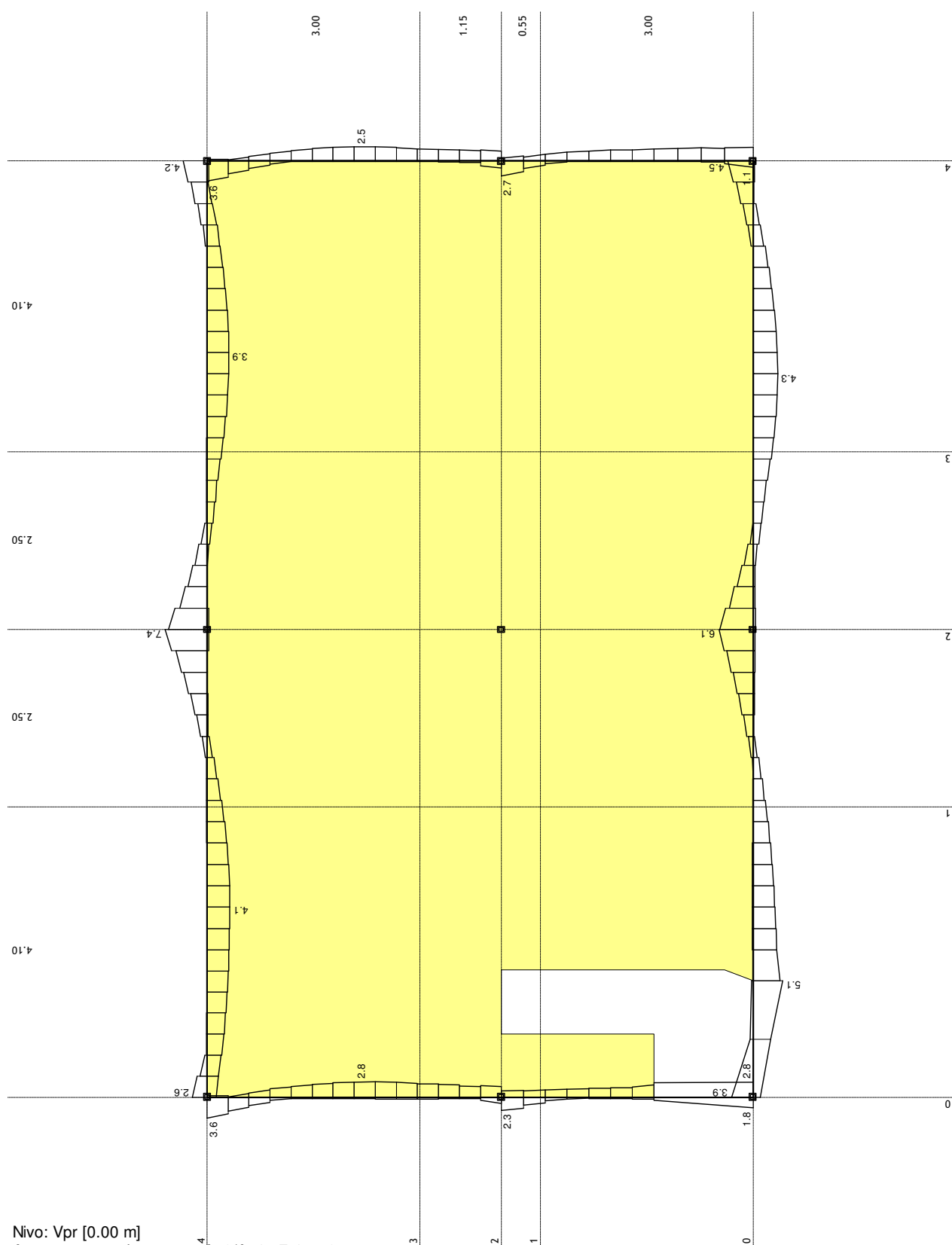
Uslov: $\tau \leq \tau_{gr}$ ($0.73 \leq 0.75$)

Uslov je ispunjen, nije potrebna dodatna armatura za obezbeđenje od probijanja ploče.

Merodavno opterećenje: 5-8
PBAB 87, MB 30, RA 400/500



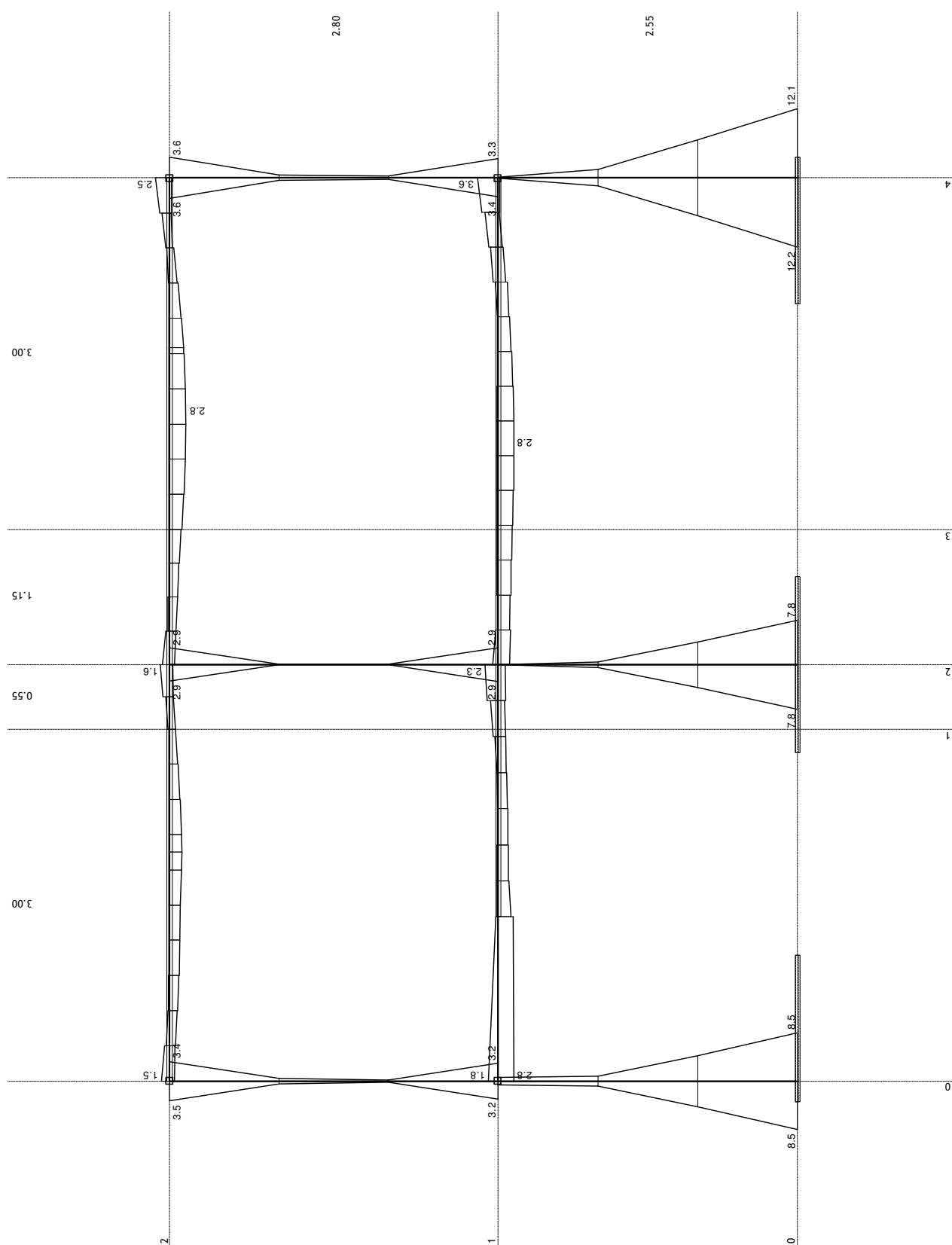
Merodavno opterećenje: 5-8
PBAB 87, MB 30, RA 400/500



Nivo: Vpr [0.00 m]

Armatura u gredama: max $A_{a2}/A_{a1} = 7.4 \text{ cm}^2$
 usvaja se -4fi16 +3fi16 u podužnim gredama 25/40
 usvaja se +-3fi14 u poprečnim gredama 25/40
 uzengije Ufi8/20/10 GA

Merodavno opterećenje: 5-8
PBAB 87, MB 30, RA 400/500

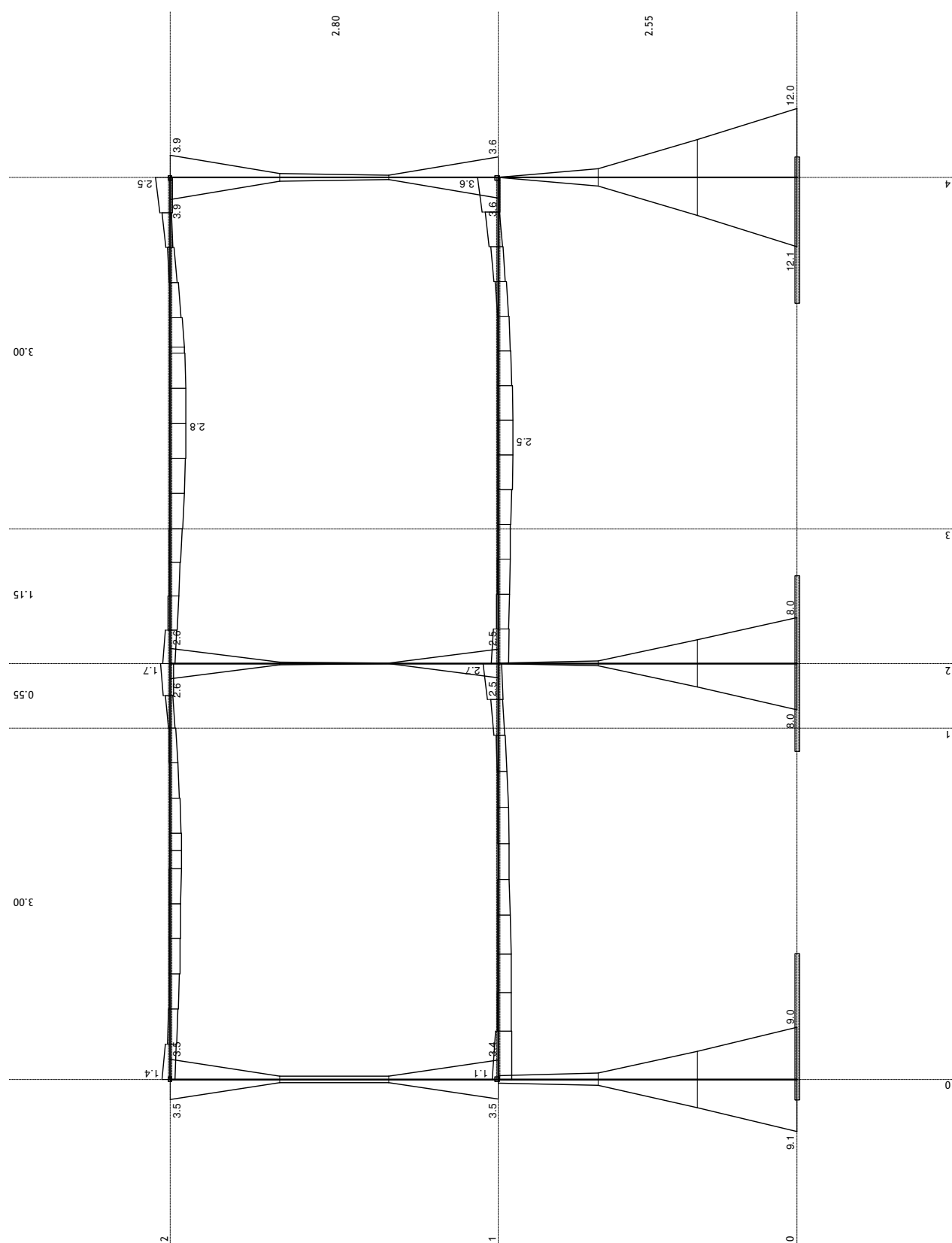


Ram: V_1
Armatura u gredama: max $A_{a2}/A_{a1} = 12.2 \text{ cm}^2$
uzengije u stubovima $\phi 10/15/7.5 \text{ GA}$

The drawing shows a rectangular building plan with the following dimensions and details:

- Overall Dimensions:**
 - Width: 10.4 (left) and 10.5 (right)
 - Height: 2.80 (left) and 2.55 (right)
- Internal Dimensions and Divisions:**
 - Top section: 1.7 (left) and 1.8 (right)
 - Middle section: 1.8 (left) and 1.8 (right)
 - Bottom section: 1.3 (left) and 1.2 (right)
- Structural Details:**
 - Four corner trapezoidal shapes, each divided into two triangles.
 - Four vertical lines, each divided into two segments.
 - Four horizontal lines, each divided into two segments.
- Annotations:**
 - Top-left: 2.80
 - Top-right: 2.55
 - Bottom-left: 1.7
 - Bottom-right: 1.8
 - Left side: 10.4
 - Right side: 10.5
 - Internal left: 1.7, 1.8, 1.3
 - Internal right: 1.8, 1.8, 1.2

Merodavno opterećenje: 5-8
PBAB 87, MB 30, RA 400/500



Ram: V_6
Armatura u gredama: max $A_{a2}/A_{a1} = 12.1 \text{ cm}^2$
uzengije u stubovima $\phi 10/15/7.5 \text{ GA}$

STEPENIŠTE

Osnovni podaci o modelu

Datoteka: step Pk pip.twp
Datum proračuna: 15.11.2010

Način proračuna: 2D model (Xp, Zp, Yr)

- ☒ Teorija I-og reda ☐ Modalna analiza ☐ Stabilnost
☐ Teorija II-og reda ☐ Seizmički proračun ☐ Faze građenja
☐ Nelinearan proračun

Veličina modela

Broj čvorova: 3
Broj pločastih elemenata: 0
Broj grednih elemenata: 2
Broj graničnih elemenata: 6
Broj osnovnih slučajeva opterećenja: 2
Broj kombinacija opterećenja: 1

Jedinice mera

Dužina: m [cm,mm]
Sila: kN
Temperatura: Celsius

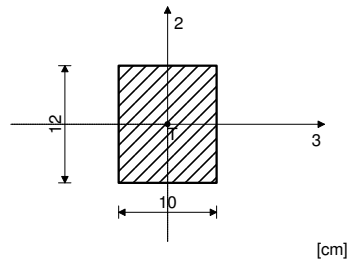
Ulazni podaci - Konstrukcija

Tabela materijala

No	Naziv materijala	E[kN/m ²]	μ	γ [kN/m ³]	α_t [1/C]	E _m [kN/m ²]	μ_m
1	Drvo - listari - masivno	1.250e+7	0.20	7.00	1.000e-5	1.250e+7	0.20

Setovi greda

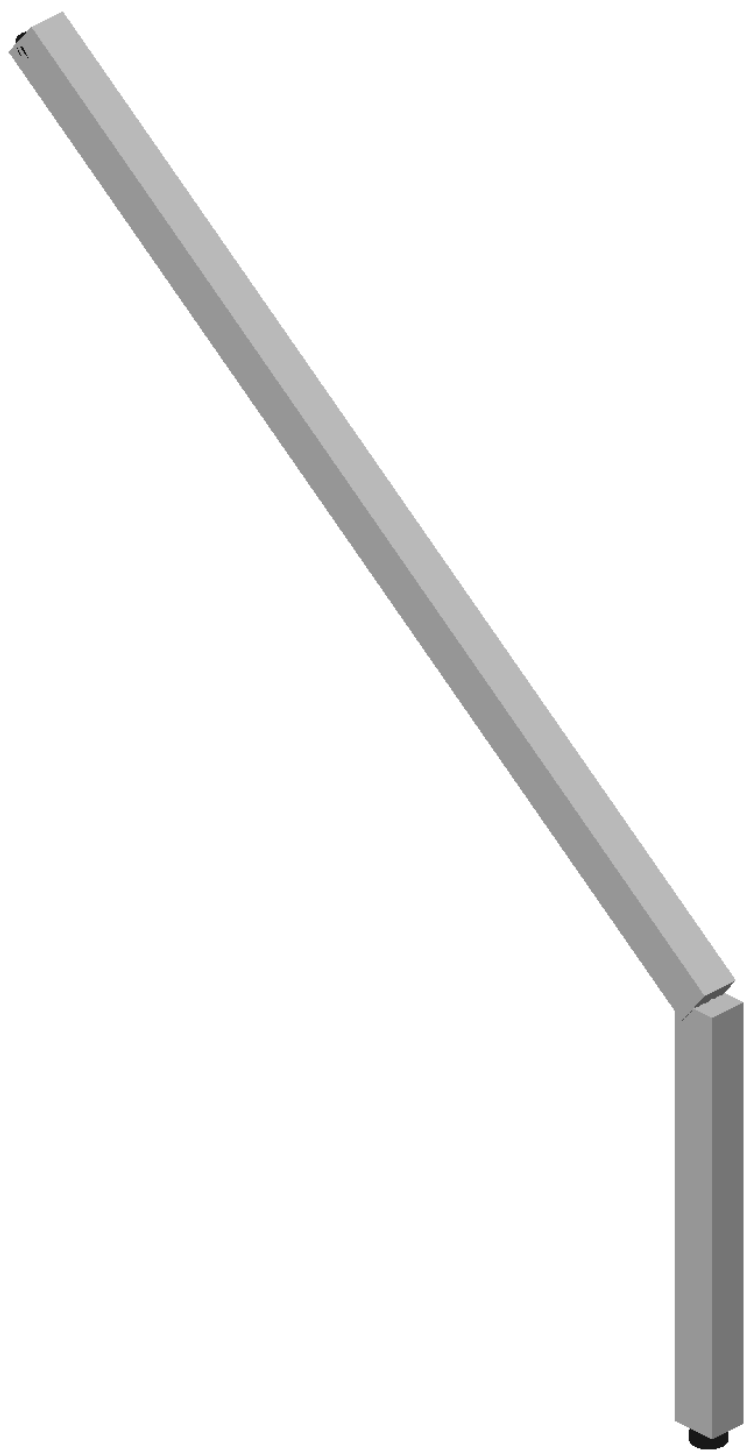
Set: 1 Presek: b/d=10/12, Fiktivna ekscentričnost



Mat.	A1	A2	A3	I1	I2	I3
1 - Drvo - listar...	1.200e-2	1.000e-2	1.000e-2	1.984e-5	1.000e-5	1.440e-5

Setovi tačkastih oslonaca

	K,R1	K,R2	K,R3	K,M1	K,M2	K,M3
1	1.000e+10	1.000e+10	1.000e+10			



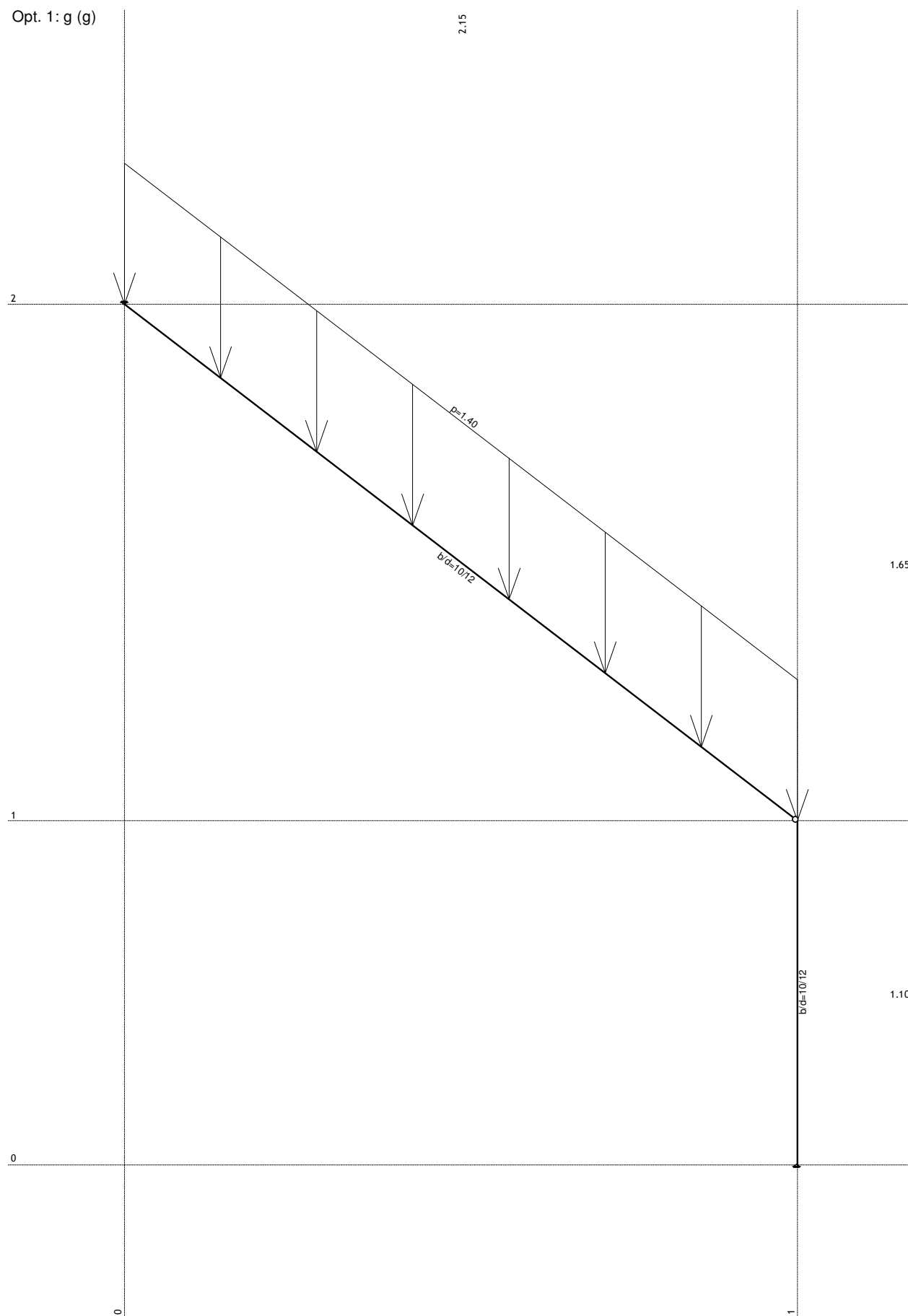
Ulazni podaci - Opterećenje

Lista slučajeva opterećenja

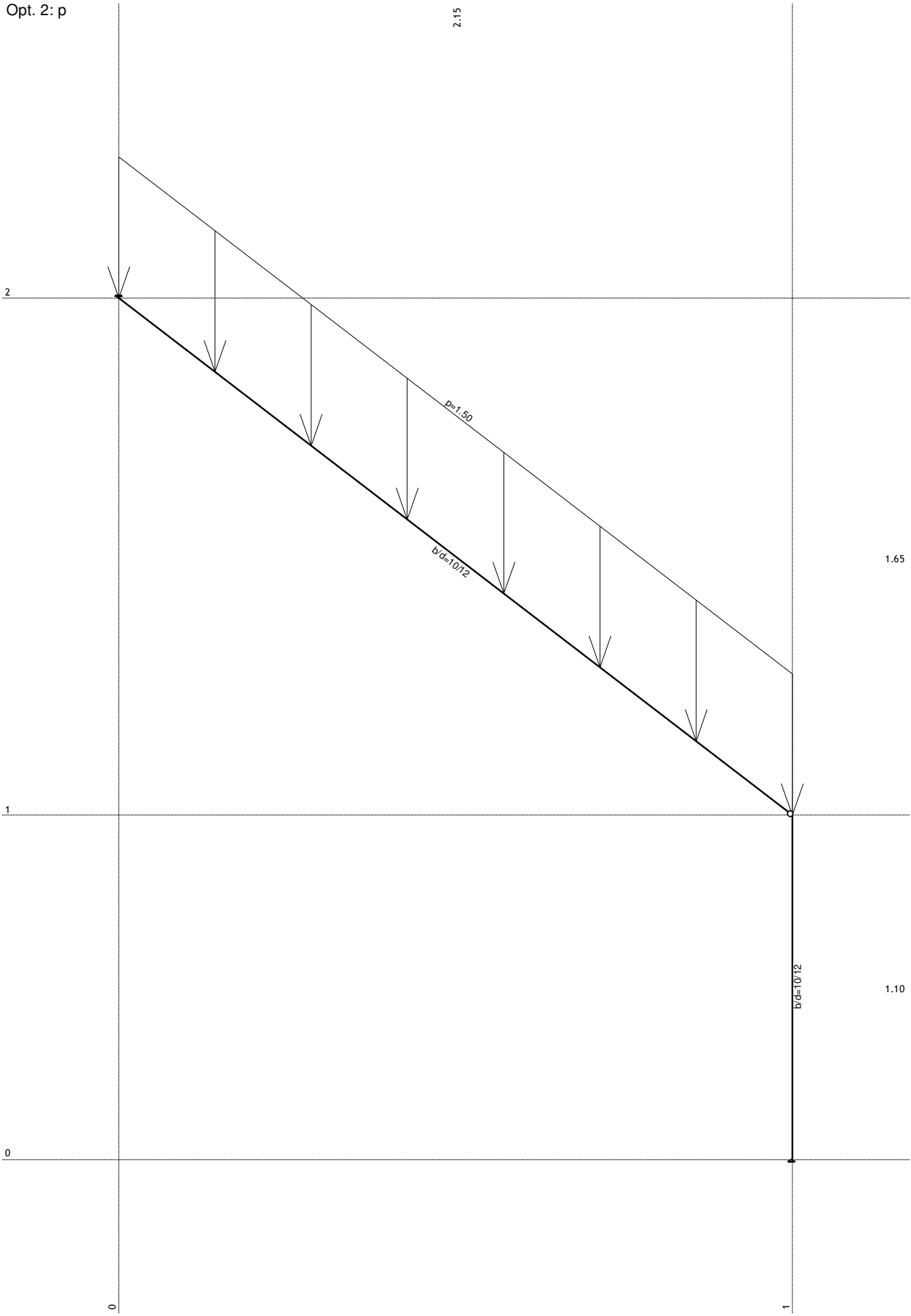
No	Naziv
1	g (g)
2	p
3	Komb.: I+II

Opt. 1: g (g)

2.15

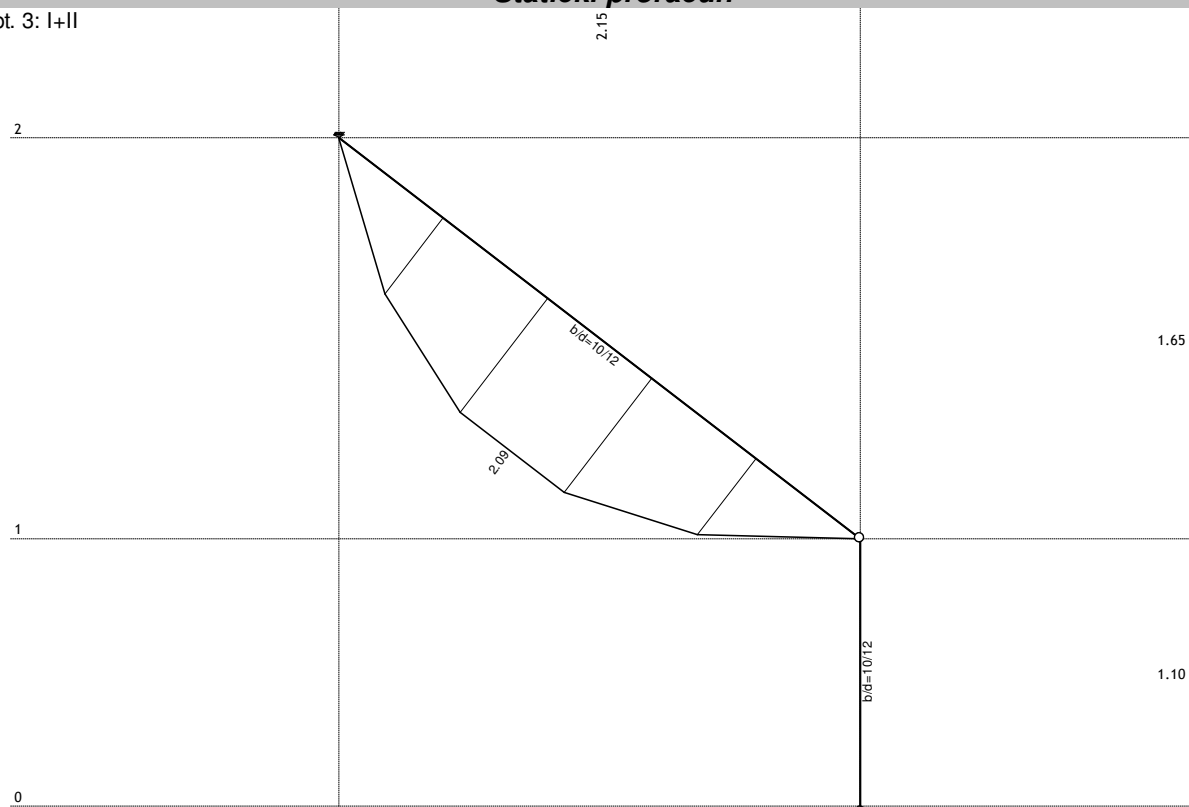


Opt. 2: p



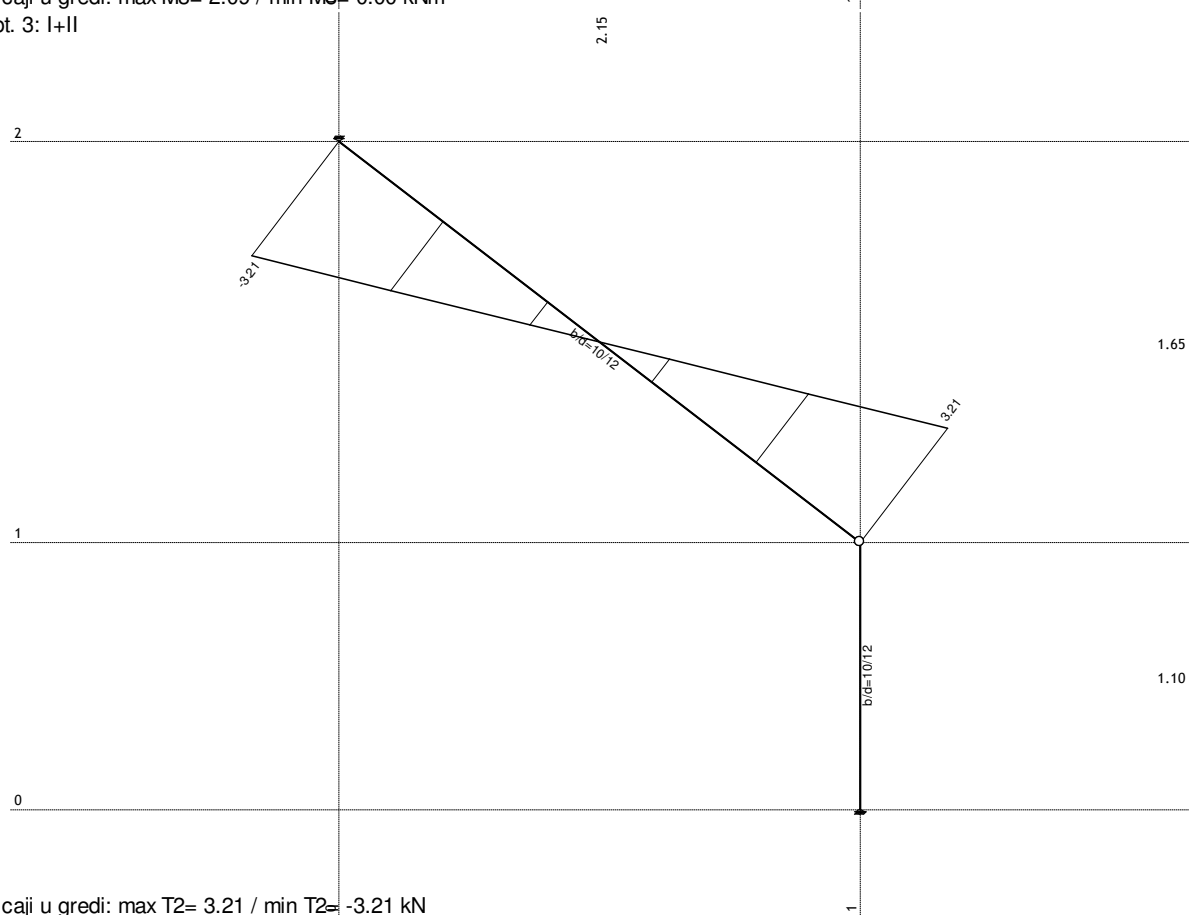
Statički proračun

Opt. 3: I+II



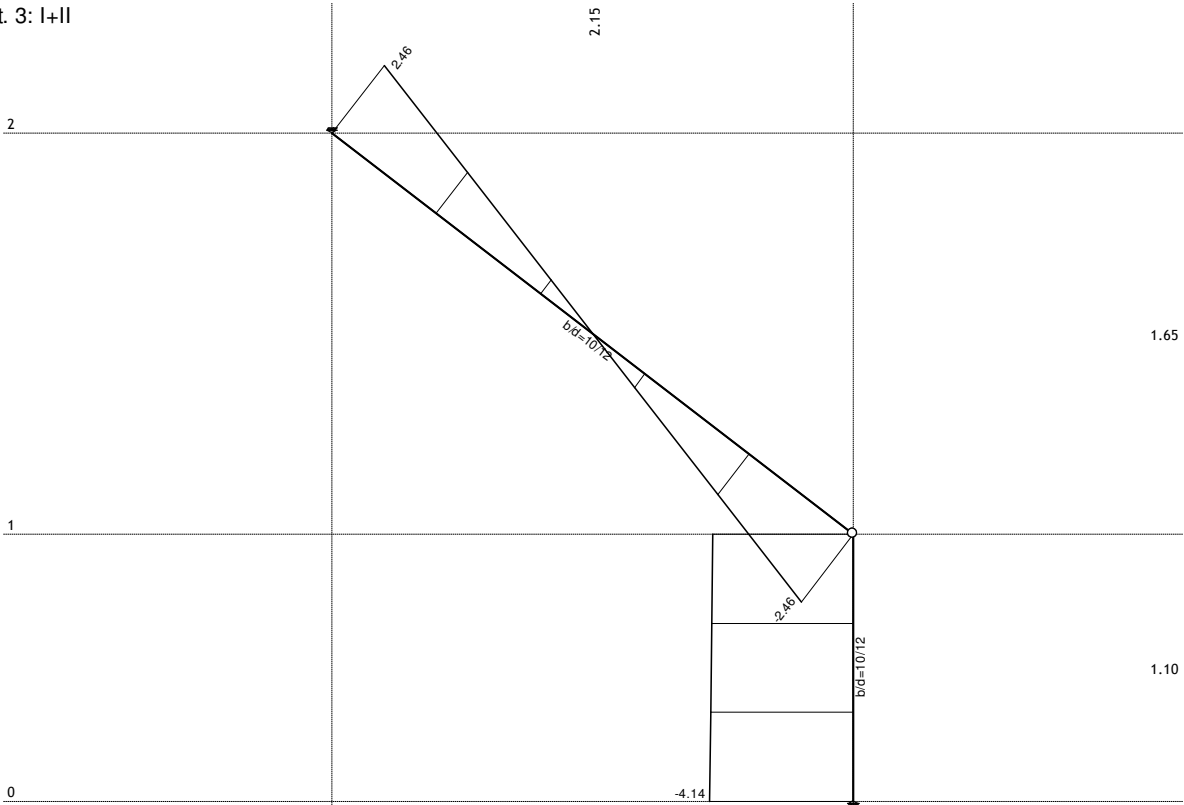
Uticaji u gredi: max $M_3 = 2.09$ / min $M_3 = 0.00$ kNm

Opt. 3: I+II

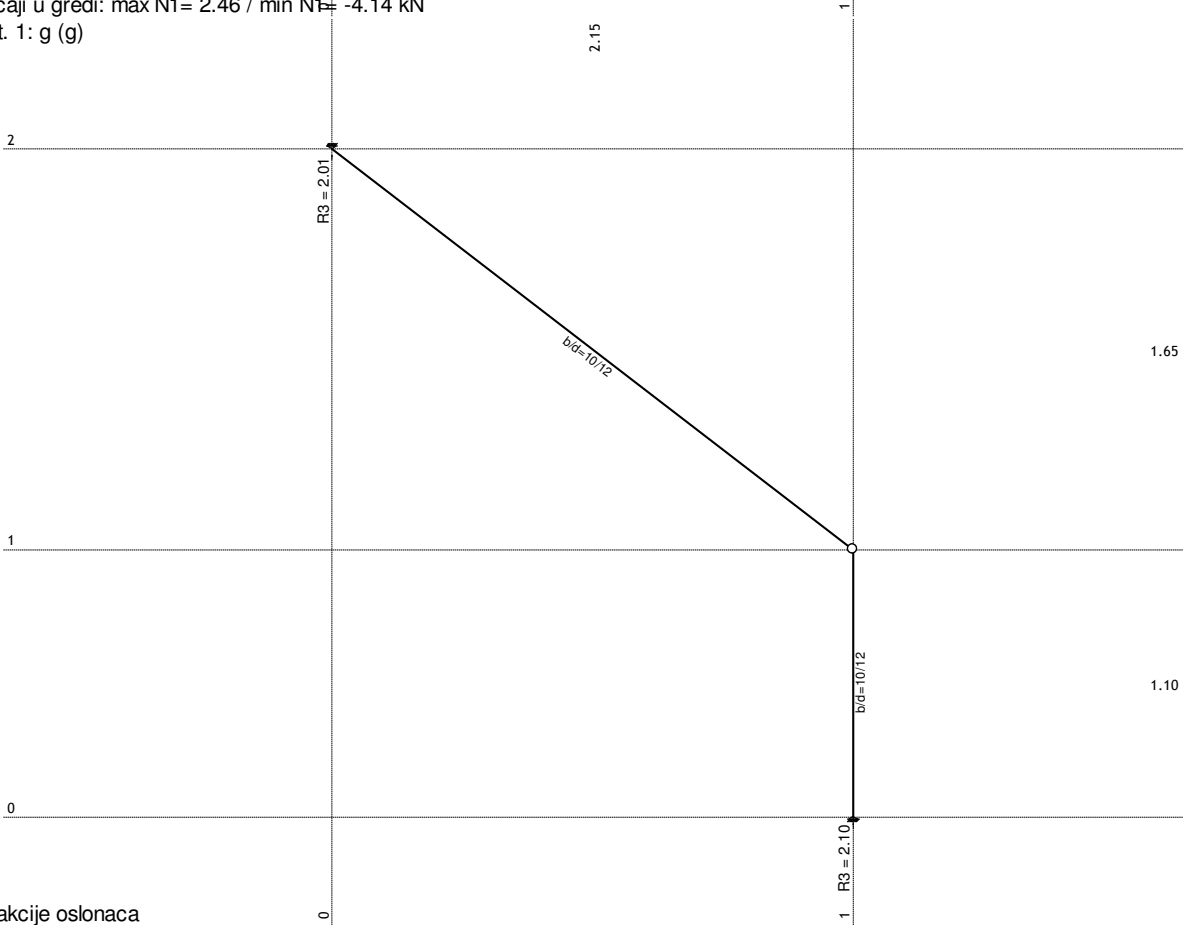


Uticaji u gredi: max $T_2 = 3.21$ / min $T_2 = -3.21$ kN

Opt. 3: I+II

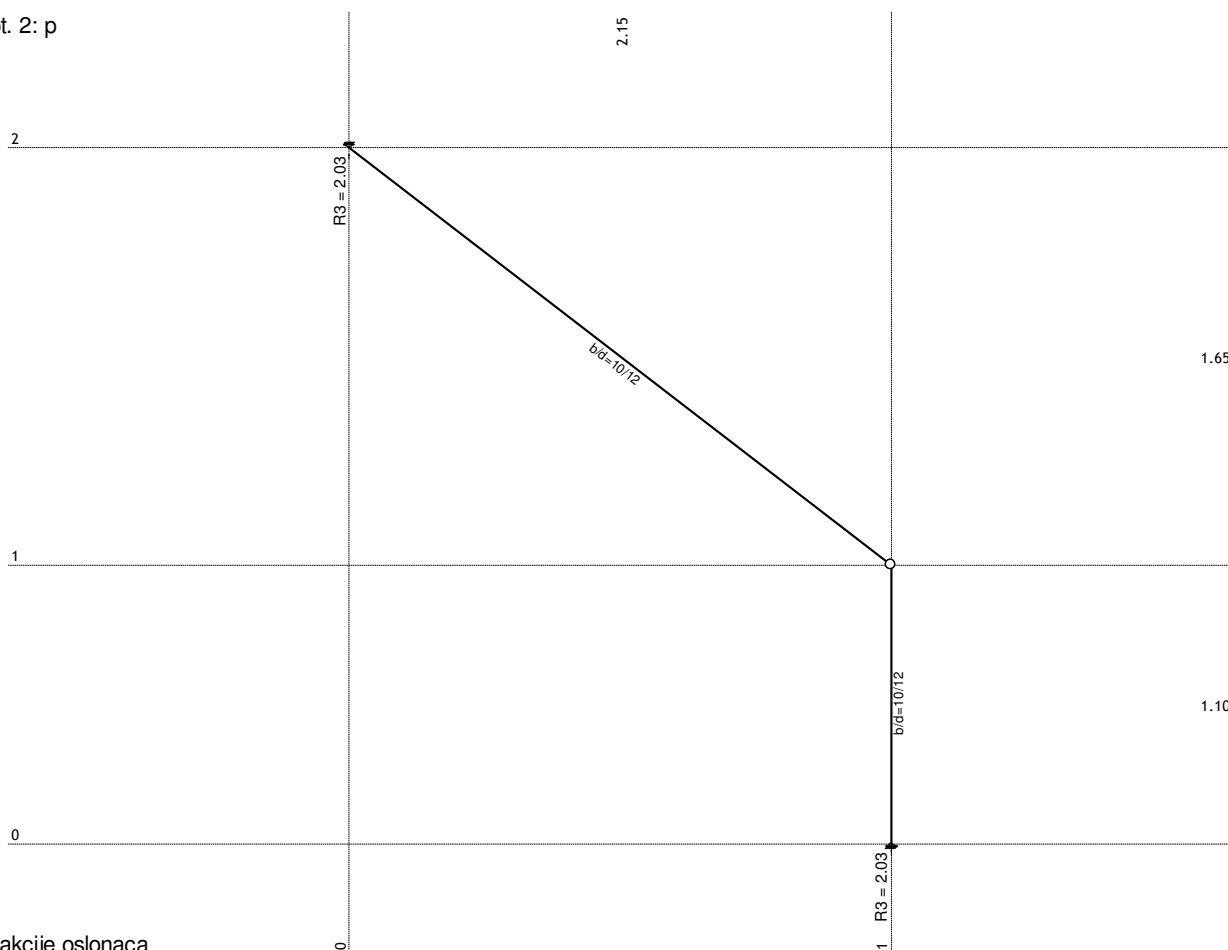


Uticaji u gredi: max $N_1 = 2.46$ / min $N_1 = -4.14$ kN
Opt. 1: g (g)



Reakcije oslonaca

Opt. 2: p



Reakcije oslonaca

Analiza opterećenja:

s.t. grede	$0.12 \times 0.12 \times 7 =$	0.1	kN/m
gazišta	$0.1 \times 0.8 \times 7/2 =$	0.3	kN/m
ograda		1.0	kN/m
		<u>g=</u>	1.4 kN/m
korisno	$3.0/2 =$	1.5	kN/m
		<u>p=</u>	1.5 kN/m

$$\max f = 6.92 \text{ cm} < L/300 = 2150/300 = 7.2 \text{ mm}$$

$$\max M = 2.09 \text{ kNm} = 209000 \text{ Ncm}$$

$$\max T = 3.21 \text{ kN} = 3210 \text{ N}$$

$$I = 12 \times 12^3 / 12 = 1728 \text{ cm}^4$$

$$W = 1728 / 6 = 288 \text{ cm}^3$$

$$A = 12 \times 12 = 144 \text{ cm}^2$$

$$\sigma_c = 209000 / 288 = 726 \text{ N/cm}^2 < 850 \text{ N/cm}^2$$

(četinari II klase)

$$\tau = 1.5 \times 3210 / 144 = 34 \text{ N/cm}^2 < 90 \text{ N/cm}^2$$

(četinari II klase)

Usvaja se presek 12/12cm

Stubič 12x12cm

usvaja se $N_{\max}=5\text{kN}$

$$\lambda = H_u / i$$

$$i = \sqrt{\frac{I}{F}} = \sqrt{\frac{12^4}{12^3}} = 3.464$$

$$\lambda = 110\text{cm} / 3.464 = 32 \rightarrow \omega = 1.09$$

$$\sigma_c = 1.09 \times 5000 / 144 = 38\text{N/cm}^2 < 850\text{ N/cm}^2$$

(četinari II klase)

Usvaja se presek 12/12cm

Ovlašćeni projektant