

Надворна - ЕС

Етапи павчи $d_{an} = 14 \text{ cm}$

dead	$\gamma_f = 1,35$	live	$\gamma_f = 1,5$	q_d
0,14 · 25		0,14 · 25		3,5 + 0,75
0,05 · 22	4,36	0,05 · 22	3,0	4,5
0,02 · 18		0,02 · 18		

Преградни зидови - гипс и цимент $q_u = 0,5 \text{ kN/m}^2 \times 1,5 = 0,75 \text{ kN/m}^2$

Тухлена зидови $d = 25 \text{ cm}$: $(0,25 \cdot 15 + 2 \times 0,02 \times 18) \times 1,35 = 6,02 \text{ kN/m}^2$

Снег: $S_u = 1,5 \text{ kN/m}^2$ $\mu = 1,0$ $C_e = 1,0$ $C_t = 1,0$ $S = 1,5 \times 1,5 = 2,25 \text{ kN/m}^2$

Страна - $d_{an} = 16 \text{ cm}$ $\alpha = 28,1^\circ$ (16/30) $h_{cp} = 26,2 \text{ cm}$ - 18 см.

0,262 · 25		$q_d = 8,63 \times 1,35 = 11,7 \text{ kN/m}^2$	$q_d = 3,0 \times 1,5 = 4,5 \text{ kN/m}^2$
0,07 · 22			
0,03 · 18			

Покривна павча $d_{an} = 14 \text{ cm}$ $\alpha = 30^\circ$

мз. 0,03 · 18		$q_d = \frac{5,18}{\cos 30^\circ} \times 1,35 = 8,1 \text{ kN/m}^2$
с.т. 0,14 · 25		
т.т. 0,1 · 25		
х.т. 0,2		
д.т. 0,035 · 6		
вер. 0,48		$S_d = 2,25 \text{ kN/m}^2$

Бетонски покрив армирован - ЕС

$$C_{nom} = C_{min} + \Delta C_{dev} = \max | C_{min, b}; C_{min, d_{u2}}; 10 \text{ mm} | + \Delta C_{dev}$$

клас XC1, конгр. клас S4 $\phi_{line}^{10 \text{ mm}}$ $\phi_{line}^{15 \text{ mm}}$ $\phi_{line}^{10 \text{ mm}}$

$$C_{nom} = 15 + 10 = 25 \text{ mm} \text{ за } \phi_{line} = 14 \text{ mm}: a \geq C_{nom} + \phi_{line} + \phi_{line}/2 = 42 \text{ mm}$$

$a = 40 \text{ mm}$ за RE120; $b_{min} \geq 250 \text{ mm}$, Прието $a = 45 \text{ mm}$ за

за павчи $a = 40 \text{ mm}$, пол. височина $d = h - 40 \text{ mm}$

I. СРИЗМИЧНИ ХАРАКТЕРИСТИКИ

Ниво дуктилност δ_{EM} ; зрмна огнорк - групна проба "Г"
ЕЛГ на змачност II: $\gamma_i = 1,0$

СРИЗМИЧЕН ХИЗКРТ: $a_g R = 0,15g$; СРИЗМИЧЕН СПАКТЕР I
 $a_g = a_g R \cdot \gamma_i = 0,15g$ $S=1,2$ $T_B=0,1$ $T_C=0,5$ $T_D=2,0$ (s)

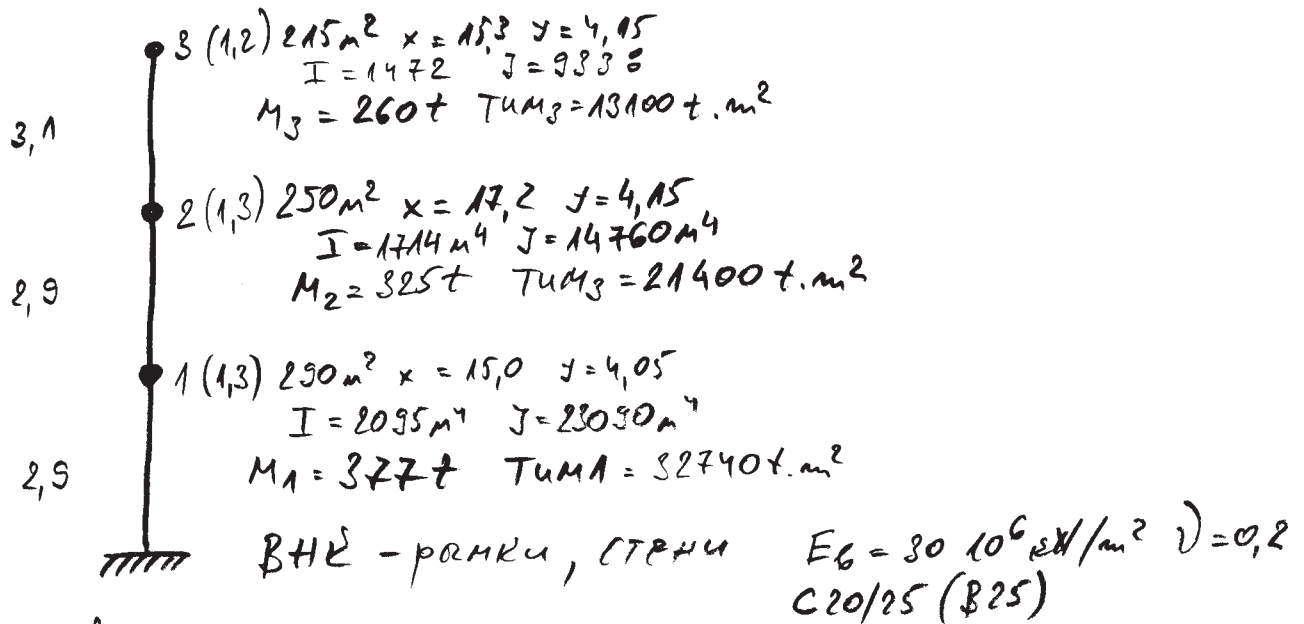
КОЕФИЦИЕНТ НА ПОБРАДНИК $q = q_0 \cdot K_w = 3,0 \times 1,0 = 3,0$

ИЗЧИГАТЕЛЕН СПАКТЕР

$$T_{im} [T_C; T_D]: S_d(T) = \left| \frac{a_g \cdot S \cdot 2,5}{q} \left(\frac{T_C}{T_D} \right) \right| \geq \beta \cdot a_g \quad \beta = 0,2$$

- разпространен изч. спактер
множител $(a_g \times q) \times S_d(T) / a_g$

II. ХАРАКТЕРИСТИКИ НА РТКАНИТЕ МАГИ $m = 1,3 + 1/m^2$ (1,24/2)



3D Model - ETABS

III. РЕЗУЛТАТИ. КОНТРОЛ НА ПРЕМЕСТВОНИЈАТА

$$T_1^{y+20t} = 0,47s \quad T_2^{x+20t} = 0,42s \quad T_3^{20t} = 0,3s$$

ел. м/с ел. прем. - макс $d_{ei}^{ei, 2, y} = 2,2mm$ $d_{2i} \times \nu = 3,3mm < d_{2i}^{lim}$

$$(d_{2i})^{lim} = 0,005 \times h_i = 14,5mm$$

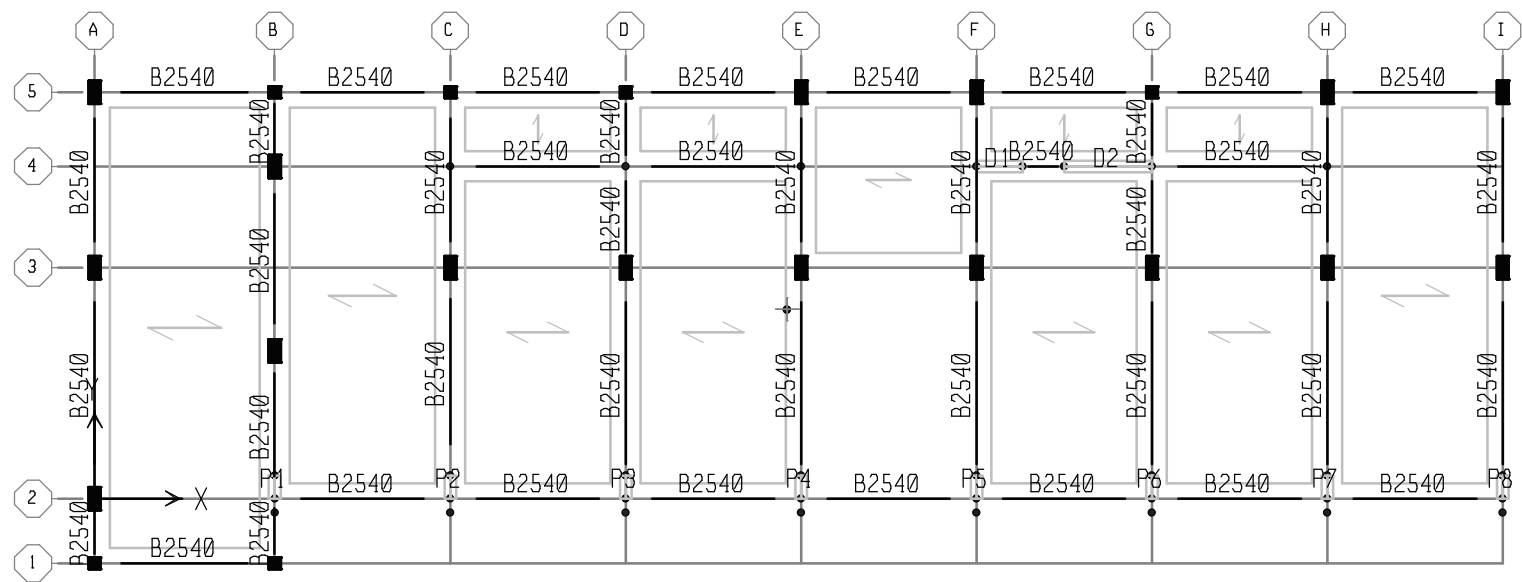
Проверка Р-Δ ефект $Q_2^y = \frac{5850 \cdot 6,6}{867 \cdot 29 \cdot 1000} = 0,015 < 0,10$

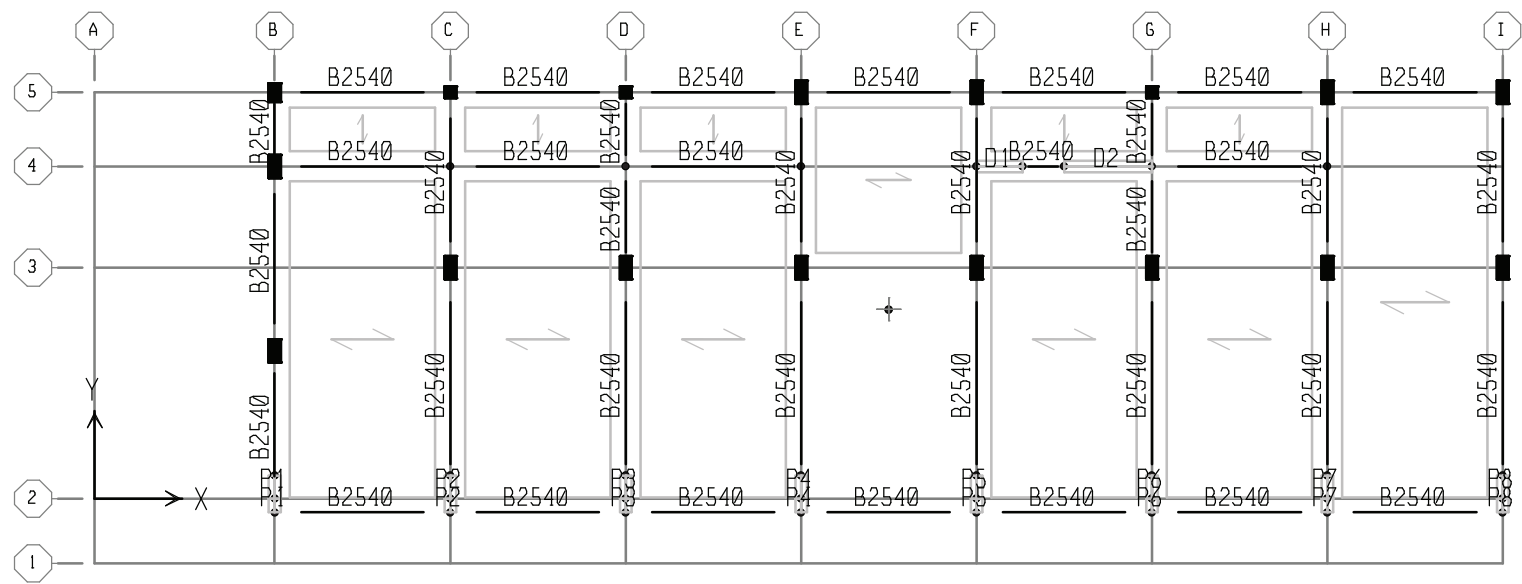
Фуга под граница имаот на ниво 1: $d_{s1}^{max} = q \cdot d_{ei} = 2,2mm = 6,6mm$

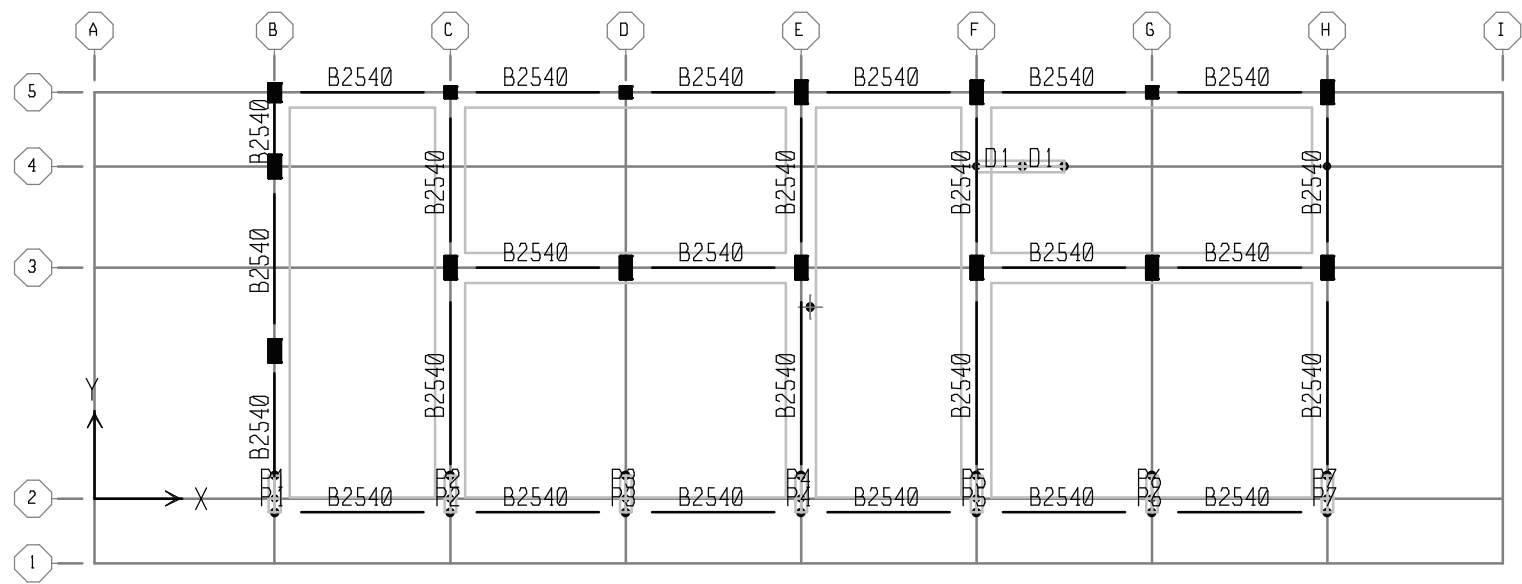
$$\Rightarrow 1/2 \text{ фуга} = 2,5cm$$

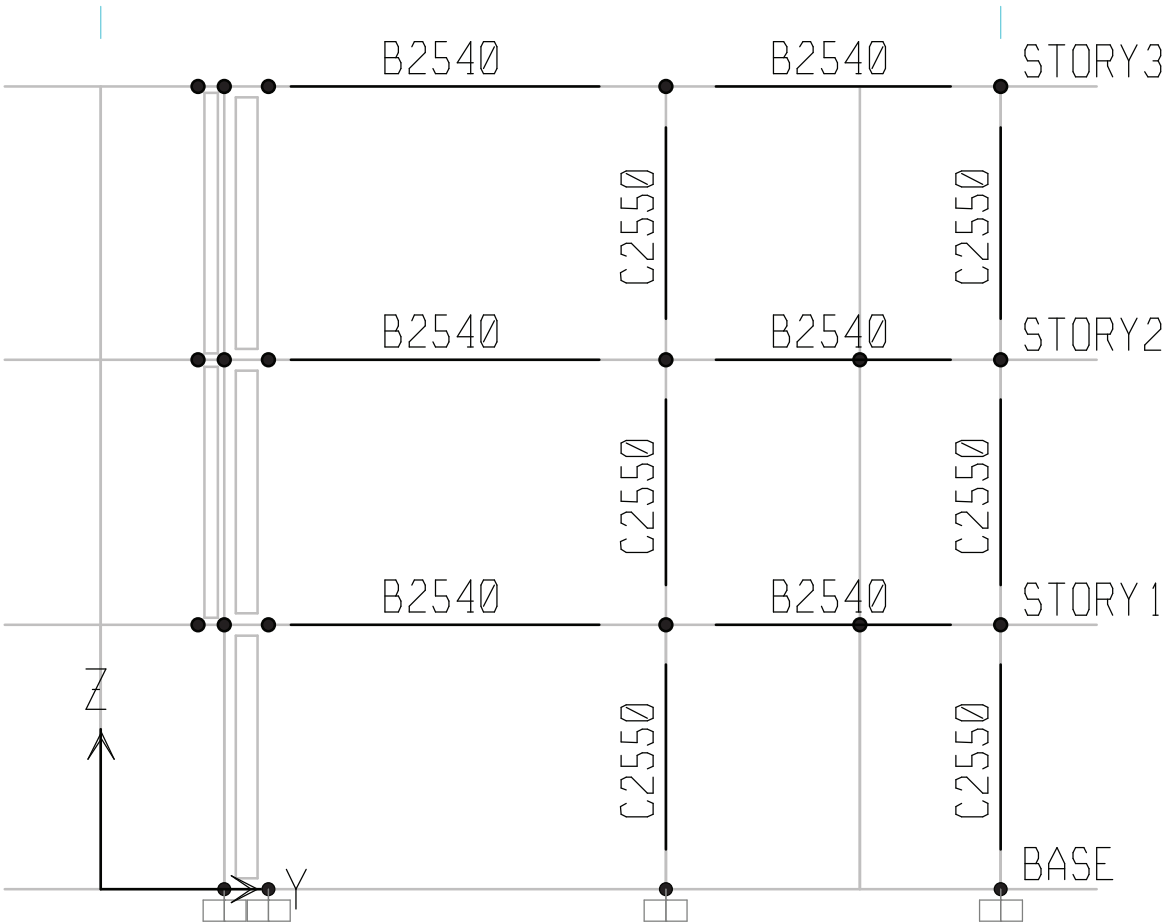
Фуга ниво 2 под гилерия $d_{s2}^{x, max} = 5,4mm \times 3,0 = 16,2mm$

$$\Delta = \sqrt{d_{s2-1}^2 + d_{s2-2}^2} \approx 23mm \Rightarrow \text{фуга } 5cm$$





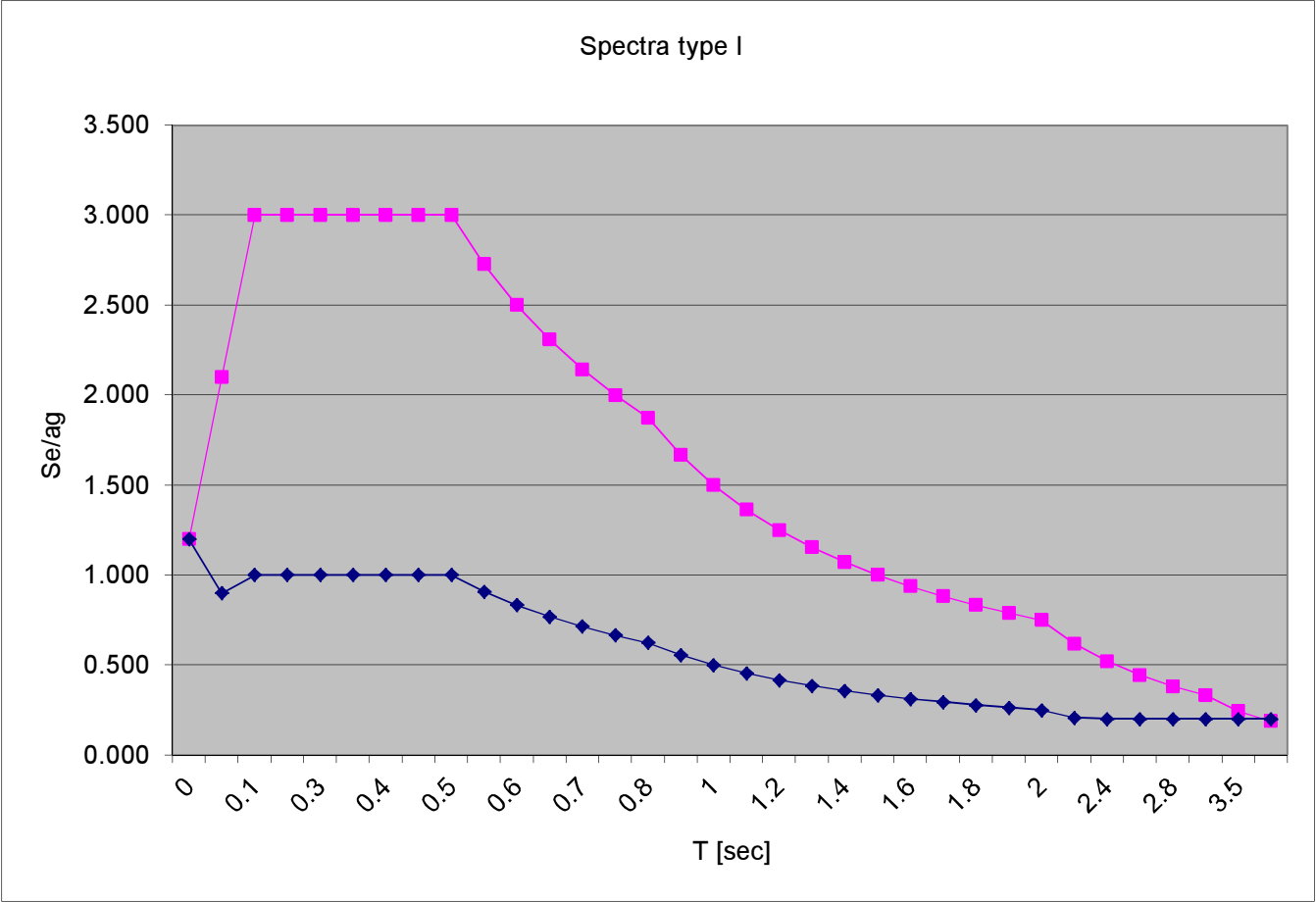




Spectra parameters - Type I

Tb	Tc	Td	agR	S	eta	gama i	q	beta	ag	g
0.10	0.50	2.00	0.15	1.20	1.00	1.00	3.00	0.20	0.150	9.81

T	Se(T)/ag	Sd(T)/ag
0	1.200	1.200
0.05	2.100	0.900
0.1	3.000	1.000
0.2	3.000	1.000
0.3	3.000	1.000
0.35	3.000	1.000
0.4	3.000	1.000
0.45	3.000	1.000
0.5	3.000	1.000
0.55	2.727	0.909
0.6	2.500	0.833
0.65	2.308	0.769
0.7	2.143	0.714
0.75	2.000	0.667
0.8	1.875	0.625
0.9	1.667	0.556
1	1.500	0.500
1.1	1.364	0.455
1.2	1.250	0.417
1.3	1.154	0.385
1.4	1.071	0.357
1.5	1.000	0.333
1.6	0.938	0.313
1.7	0.882	0.294
1.8	0.833	0.278
1.9	0.789	0.263
2	0.750	0.250
2.2	0.620	0.207
2.4	0.521	0.174
2.6	0.444	0.148
2.8	0.383	0.128
3	0.333	0.111
3.5	0.245	0.082
4	0.188	0.063



Сеизмични изчисления - EC8

Резултати. Контрол на преместванията.

1. Периоди на собствените трептения

Период	T1	T2	T3
Стойност [s]	0.47	0.42	0.30
Посока	Y+rot	X+rot	Rot

2. Контрол на преместванията

Еластично междуетажно преместване $De,i = Di - Di-1$

Междуетажно преместване $Dr,i = De,i * q$; $Dr,i * v = Dri * v$

Гранично междуетажно преместване $(Dr,i)_{lim} = [0.005, 0.0075, 0.0100] * h,i$

$q = 3$

$v = 0.5$

$(Dr,i)_{lim} = 0.005$

Етаж	De,i [mm]	Dr,i [mm]	$Dr,i * v$ [mm]	h,i [m]	$(Dr,i)_{lim}$ [mm]	Проверка
3	1.8	5.40	2.70	3.10	15.50	OK
2	2.2	6.60	3.30	2.90	14.50	OK
1	1.2	3.60	1.80	2.90	14.50	OK

3. Проверка на P-Delta ефект

$Qi = (P_{tot,i} * Dri) / (V_{tot,i} * hi) < Q_{lim}$

$Q_{lim} = 0.10$

Етаж	$P_{tot,i}$ [kN]	$V_{tot,i}$ [kN]	Dr,i [mm]	h,i [m]	Qi -	Проверка
3	2600	512	5.40	3.10	0.009	OK
2	5850	867	6.60	2.90	0.015	OK
1	9620	1044	3.60	2.90	0.011	OK

Story	Item	Load	Point	X	Y	Z	DriftX	DriftY
STORY3	Max Drift X	EC8		75	3.9	-0.3	9.1	0.00122
STORY3	Max Drift Y	EC8		25	26.7	8.8	9.1	0.001823
STORY2	Max Drift X	EC8		75	3.9	-0.3	6	0.001151
STORY2	Max Drift Y	EC8		28	30.5	8.8	6	0.002174
STORY1	Max Drift X	EC8		10	3.9	-1.4	3	0.000716
STORY1	Max Drift Y	EC8		72	30.5	0.5	3	0.001211

Story	Load	Loc	P	VX	VY	T	MX	MY
STORY3	EC8	Top		0	425.5	511.54	8507.654	0
STORY3	EC8	Bottom		0	425.5	511.54	8507.654	1585.776
STORY2	EC8	Top		0	707	866.81	15377.49	1585.776
STORY2	EC8	Bottom		0	707	866.81	15377.49	4104.641
STORY1	EC8	Top		0	856.47	1043.81	18420.65	4104.641
STORY1	EC8	Bottom		0	856.47	1043.81	18420.65	7128.713

Story	Pier	Load	Loc	P	V2	V3	M2	M3
STORY3	D1	COMB2 MAX	Top	-52	327	16	21	60
STORY3	D1	COMB2 MAX	Bottom	-116	327	16	18	929
STORY3	D1	COMB2 MIN	Top	-207	-304	-9	-32	-88
STORY3	D1	COMB2 MIN	Bottom	-272	-304	-9	-7	-884
STORY2	D1	COMB2 MAX	Top	437	149	27	32	149
STORY2	D1	COMB2 MAX	Bottom	404	149	27	42	186
STORY2	D1	COMB2 MIN	Top	-864	-84	-21	-40	-262
STORY2	D1	COMB2 MIN	Bottom	-897	-84	-21	-32	-103
STORY1	D1	COMB2 MAX	Top	562	221	17	13	170
STORY1	D1	COMB2 MAX	Bottom	529	221	17	38	451
STORY1	D1	COMB2 MIN	Top	-1237	-191	-17	-14	-214
STORY1	D1	COMB2 MIN	Bottom	-1270	-191	-17	-36	-403
STORY2	D2	COMB2 MAX	Top	519	443	48	64	897
STORY2	D2	COMB2 MAX	Bottom	456	443	48	70	432
STORY2	D2	COMB2 MIN	Top	-978	-509	-40	-74	-902
STORY2	D2	COMB2 MIN	Bottom	-1040	-509	-40	-57	-634
STORY1	D2	COMB2 MAX	Top	497	498	28	17	227
STORY1	D2	COMB2 MAX	Bottom	435	498	28	70	1533
STORY1	D2	COMB2 MIN	Top	-1491	-537	-29	-13	-113
STORY1	D2	COMB2 MIN	Bottom	-1554	-537	-29	-70	-1536

Стени
1. D1 - D2

Прозмерване на BHK

uhg-se-o
VAK
C20/25; B500C
D2 25/210 putel 25/80

D1 25/220
25/100
25/100

ет. 3 D1 25/220 $N_{min} = -116$ $M_{max} = 930 \times 1,5$ тл. 25/80 6N16

ет. 2 D1 25/100 $N_{min} = +437$ $M_{max} = 262$

ет. 1 D1 25/100 $N_{min} = +530$ $M_{max} = 451$

ет. 2 D2 25/210 $N_{min} = +519$ $M_{max} = 302$ тл. 25/30 ~~6N16~~ 6N20

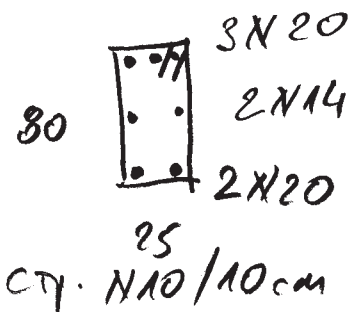
ет. 1 D2 25/210 $N_{min} = +435$ тл. 25/30 $M_{max} = 1536$ тл. 25/30 6N20

V: N10/20 H: N8/15 стр. ф8/15

$$V_{rd,max} = \frac{\kappa_{sw}}{1,0} \cdot \frac{b_w \cdot z}{25cm} \cdot \frac{V_1^{0,5}}{0,9 \cdot l_w = 176cm} \cdot f_{cd} / (\cot \theta + \tan \theta) = 1900 \text{ кН} > V_{Ed} = 1,5 \cdot 390 = 495$$

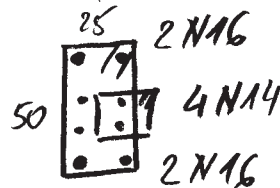
Putel D1-D2 25/80 $M = 152$ $Q = 350$ $V_{Ed} = 1,5 \cdot 350 = 525$ тл.

стр. (N10/10cm)/15 $V_{rd,max} = 600 \text{ кН}$! ок.
3N20 тл. 2N20 д.д. 532 кН



2. Прозмерване рамки (по Y)

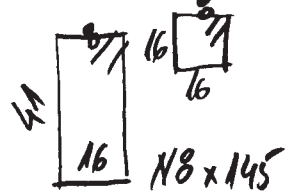
Вички горни 25/50



от горе го долу

N8x95

стр. N8/15



Вички долни 25/25



стр. N8/15 $\ell = 95$

Дължини на стъпки - поочу C20/25, B500C : 73 ф

Вички пръти свързани в 1 сечение $\lambda_G = 1,5$

N12 - 85cm
N14 - 100
N16 - 115
N20 - 145
N25 - 180cm

Закотвяне във фучола (C16/20): 56 ф

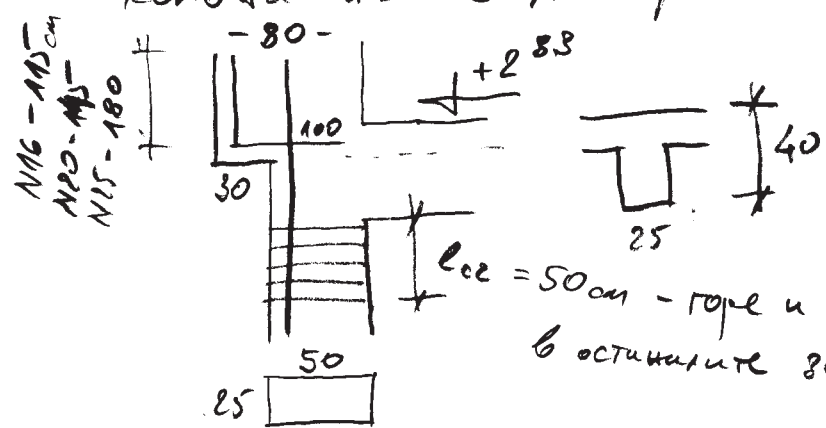
Закотвяне греда/рамки (C20/25): 48 ф

Закотвяне пръти пръти в огън (C16/20): N8 N10 N12
35 45 60cm

ф6 сички : 35cm

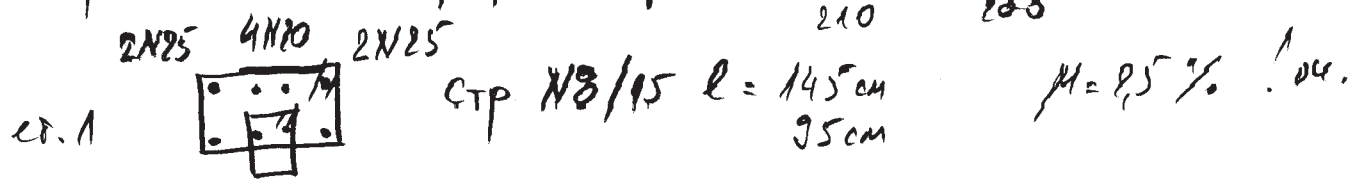
mhg-se-o
VNU
-2-

- Колонны по ос А с промежуточным сечением

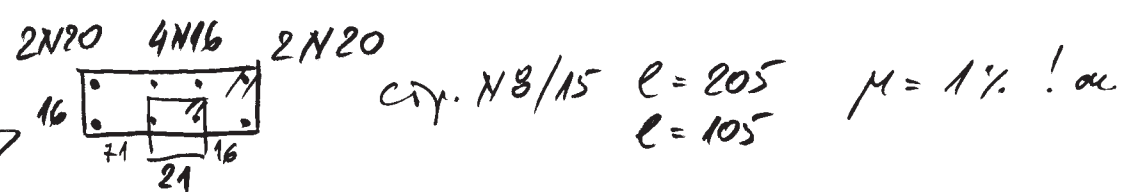


За $\sqrt{}$ колонны на полу и крыше: стержни $\varnothing 8$ 10 см!
в остальных зонах $\varnothing 8$ / 15 см

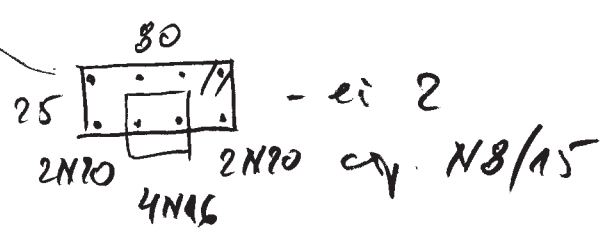
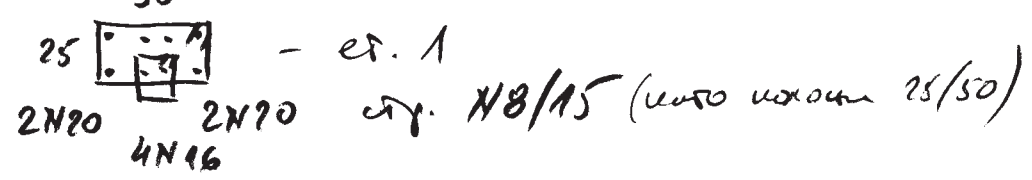
1. Крестовик по ос 2, 8, 9 - 3 д. $M = 250$ $N = 400$



ст. 2/3 $M = 193$ $N = 75$ 25/80



2. Срежунок по ос 3 - 7 $M = 150$ $N = 500$ 25/50 - колонна



Основи

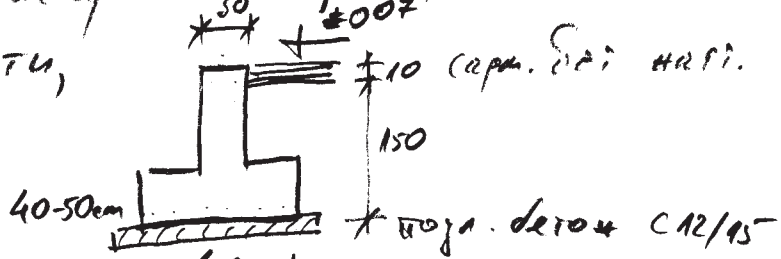
и лг - 32-0
осм - 1-

Почви - прегачиви глини $R_0 = 200 \text{ kN/m}^2$

Двабачина на фундаменти $D_f^{min} = 1,3 \text{ m}$

ивичи фундаменти, свързани

C16/20, B5008



Коеф на ленто $R_z = 15 \text{ MPa/m}$

(45) - сизм комбинация $\gamma_f = 20 \text{ kN/m}^3$

Средна ивица по y $L_f = 0,7 \text{ m}$, отн комбинация



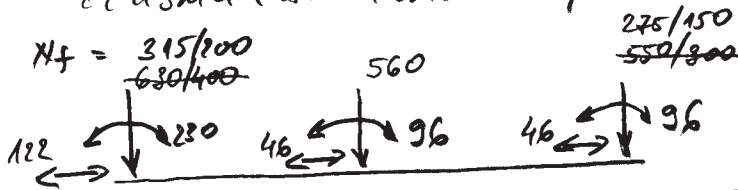
$$b_f = 1,1 \text{ m} \quad \sigma_{\pi} = 195 \text{ kN/m}^2 < R_0$$

$$V_{ED} = 605 \text{ kN} \leq V_{Rd,s} = 1140 \text{ kN/20}$$

$$M_{max} = 532 \text{ kNm} / M_z = 410 \text{ kNm (575)}$$

$$M_{min} = 355 \text{ kNm} - \text{г.а. } 4 \text{ kNm (390 kNm)}$$

сизмична комбинация:



$$R_z = 45 \text{ MPa/m}$$

$$C_z = 45 \cdot 1,1 = 1000 = 49500 / \text{m}^2$$

$$M_f = 425 \quad M_f = 170 \quad L_f = 40 \quad 170$$

$$M_f = 650 < 840 \quad \text{! о.а.}$$

$$V_{ED} = 590 \text{ kN} \quad M_{\text{г.а.}} = 572 \text{ kNm} \quad \text{! о.а.}$$

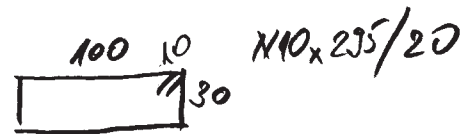
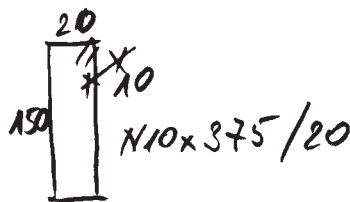
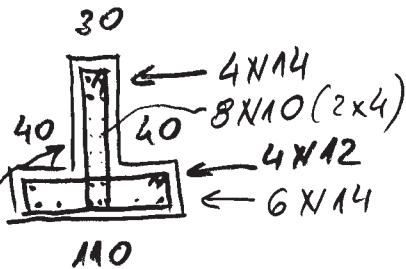
$$M_{\text{г.а.}} = 382 \text{ kNm} \quad \text{! о.а.}$$

$$\Sigma M = 765 \text{ kNm} \quad \Sigma N_{min} = 1250 \text{ kN}$$

$$\text{max } 1500 \text{ kN}$$

$$e_{max} = 0,62 \text{ m} < a_f/6 = 1,15 \text{ m} \quad \text{! о.а.}$$

$$\sigma_{max} = \frac{1500}{1,1 \cdot 0,7} \pm \frac{765 \cdot 55}{1,1 \cdot 0,7^2 \cdot 6} = 215 \text{ kN/m}^2 < 4 \cdot R_0$$



Критична ивица - ос y $L = 0,7$



$$\text{осч: } b_f = 0,7 \text{ m} \quad \sigma_{max} = \frac{1068}{0,7 \cdot 0,7} = 175 < R_0$$

$$V_{ED} = 123,4,4 \cdot 0,625 = 340 \text{ kN} < V_{Rd,s} = 800 \text{ kN}$$

$$M_{ED} = 293 \text{ kNm} \quad 4 \text{ kNm} / 8 \text{ kNm}$$

$$R_{\text{г.а.}} = 200 < M_{\text{г.а.}} = 390$$

N_{Ed}	230	310	200
M_{Ed}	210	107	98
V_{Ed}	106	50	41
M_f	380	190	164

$$\text{сизм: } \Sigma M = 734 \text{ kNm} \quad \Sigma N_{min} = 850$$

$$\text{max } 1088$$

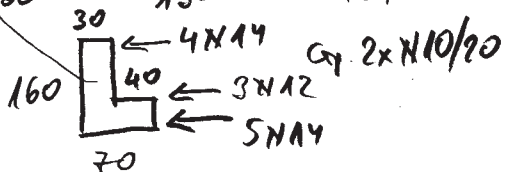
$$e_{max} = 0,9 < a_f/6 = 1,15$$

$$\sigma_{max} = \frac{1088}{0,7 \cdot 0,7} \pm \frac{734}{8,8} = 262 \text{ kN/m}^2 < 4 \cdot R_0$$

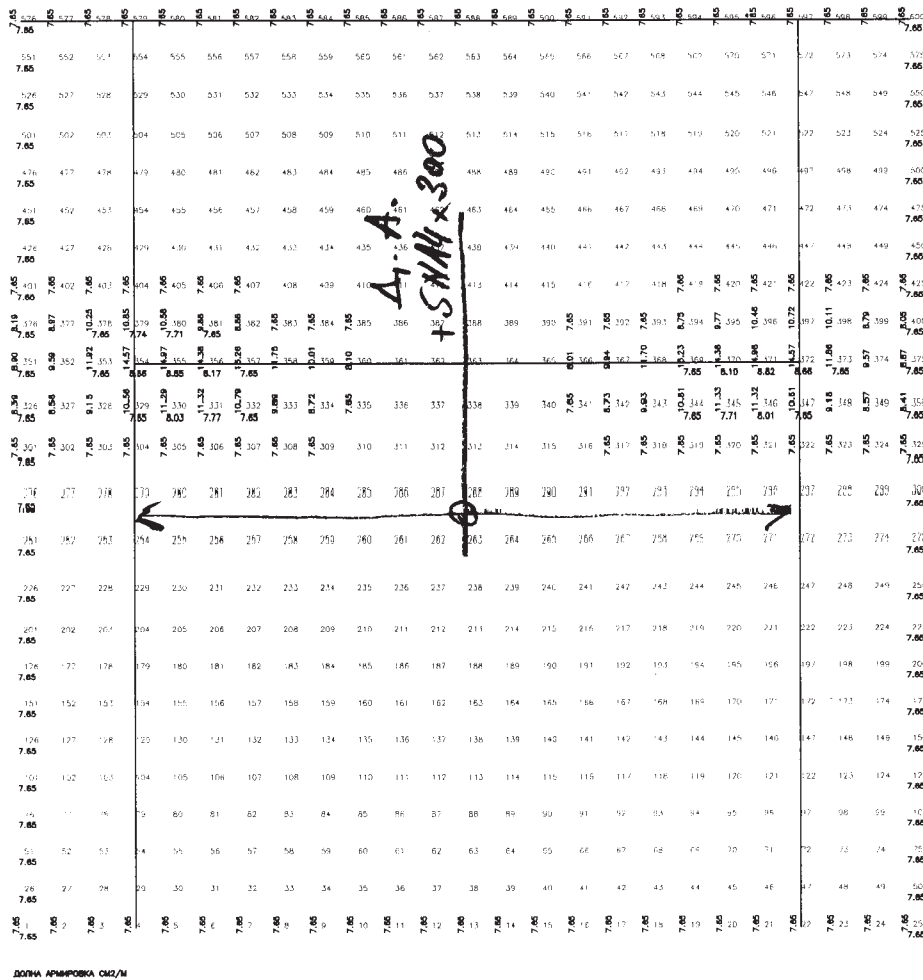
$$V_{ED} = 505$$

$$M_{ED} \text{ г.а.} = 296 \rightarrow 4 \text{ kNm}$$

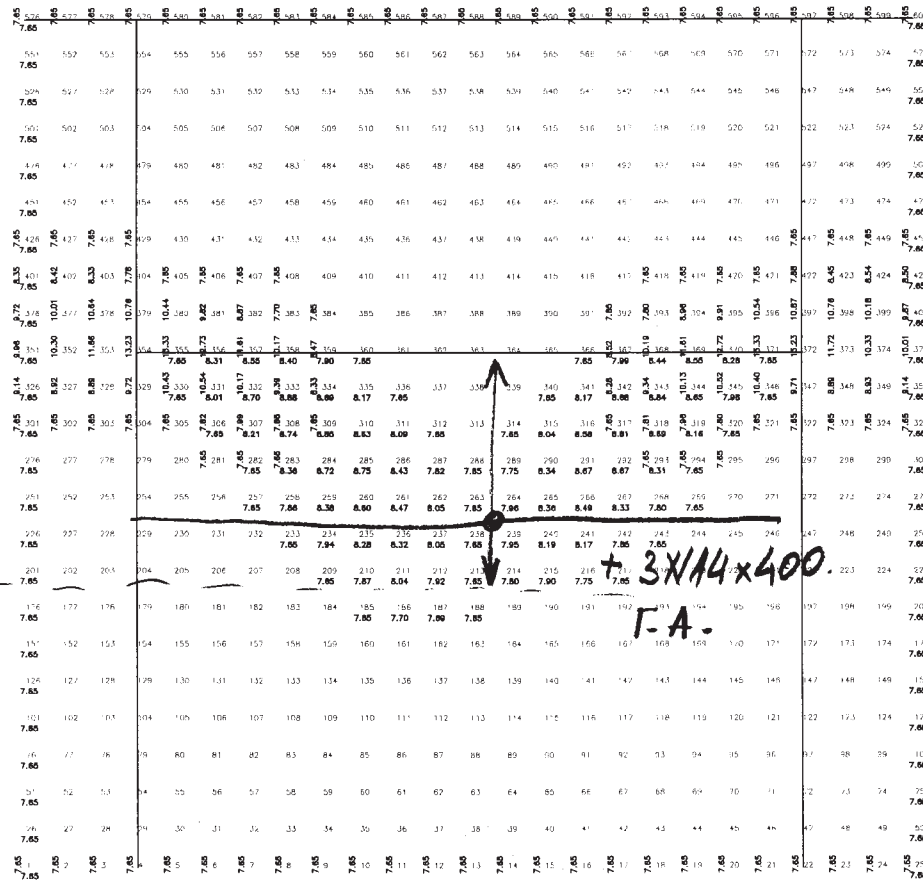
$$\text{г.а.} = 444 \rightarrow 5 \text{ kNm}$$



nhg-sl-fpl



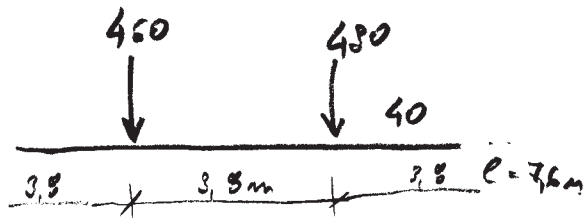
ГОРНА АРИФМЕТИКА ОД/М



ГОРНА АРИФМЕТИКА ОД/М

Основа на мрежа (A-A; Г.А.): 5xH4/м'; D_{TP} = 50cm

Крайний ивуч, по X (оси A и C)



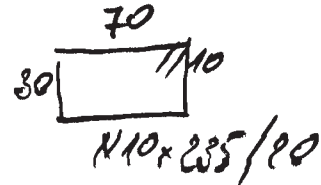
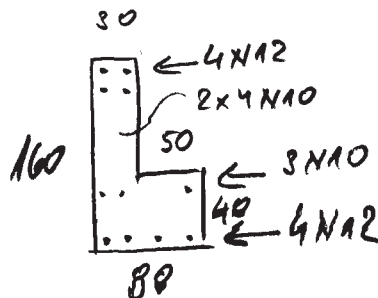
$$\Sigma X = 1200 \text{ кН} \quad p = 1582 \text{ Н/м}^2$$

$$b_f = 0,8 \text{ м} \quad G_{\text{max}} = \frac{1200}{0,8 \cdot 7,6} = 197 \frac{\text{кН}}{\text{м}^2} < R_0$$

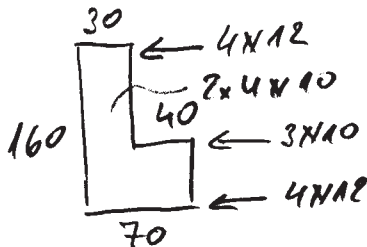
$$V_{ED} = 300 \text{ кН} < V_{RDS} = \frac{N_{10/20}}{20} = 340 \text{ кН}$$

$$M_{4.4.} = 130 \text{ кНм} < M_{4N12} = 290 \text{ кНм}$$

по ос A:



по ос C:



Основы под D1-D2 (оси B-C; 6-7)

$$D12: M_{szm} = 4230 \quad V_{szm} = 725 \quad N_{\text{min}} = 300 \quad N_{\text{max}} = 10322 \text{ кН}$$

$$\Sigma N = 4,85 \cdot 4,6 \cdot 20 + 2340 = 2786 \text{ кН}$$

$$e = 1,52 \text{ м} \quad a_f^{\text{min}} = 3 \cdot e = 4,56 \text{ м} < 4,95 \text{ м} \text{ ! ок.}$$

$$a_f = 4,85 \quad b_f = 4,6 : N = 2786 \quad M = 4230$$

$$x_f = 3 \cdot (0,5 \cdot 4,85 - 1,52) = 2,72$$

$$G_{\text{max}} = \frac{3 \cdot 2786}{4,6 \cdot 2,72} = 670 \frac{\text{кН}}{\text{м}^2} < 4 \cdot R_0 \text{ ! ок.}$$

$$G_1 = (580 + 230 + 680 + 335 + 1020) + 4,95 \cdot 4,6 \cdot 20 = 3350$$

$$= 150 \frac{\text{кН}}{\text{м}^2} < R_0 \text{ ! ок.}$$

Проверка на прогибание: $\delta_{\text{свобод}} = 45 \text{ см} : H_{\text{ф.ит}} = 50 \text{ см}$

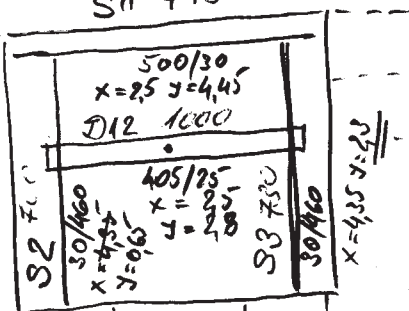
СИ 775

- 4,6

$$p = 252 \text{ Н/м}^2$$

$$D12: \begin{matrix} M_1 & M_2 & M_3 \\ 0 & 4230 & 0 \end{matrix}$$

$$M_{\text{min}} = 0,17\% \cdot 5 \text{ Н/м}^2 (7,69 \text{ см}^2/\text{м}^2)$$



0,65

4,35