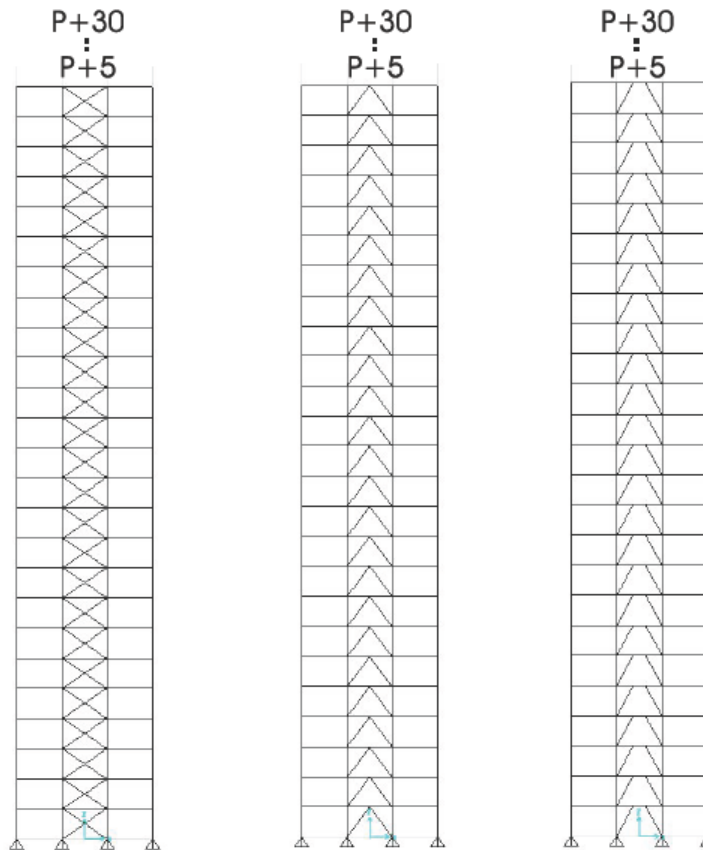


Studiu comparativ privind raspunsul seismic al unei familii de cadre plane avand structura metalica, pentru inaltimi pana la 30 niveluri si diferite sisteme de contravantuire

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Folosind Metoda Spectrului de Capacitate, s-a incercat descrierea raspunsului cladirilor inalte pe structura metalica regulata - cadre contravantuite, pentru diverse sisteme de contravantuire si diverse inaltimi.



Pentru dispunerea contravantuirilor, s-au luat in considerare urmatoarele variante:

- Contravantuiri X, articulate la capete, pe deschiderea centrala
- Contravantuiri V invers, articulate la capete, pe deschiderea centrala
- Contravantuiri excentrice (link), cu excentricitate mare, articulate, amplasate pe deschiderea centrala.

In cadrul studiului, s-a utilizat programul de calcul SAP2000, avand integrata metoda spectrului de capacitate.

Criteriile de dimensionare au fost criteriul de rezistenta si stabilitate si criteriul de drift - limitarea deformatiilor relative intre 2 nivele succesive.

Nivelul limita la drift a fost de 0.008 din inaltimea de nivel de 4m, adica 3.2cm, conform P100.

Spectrul de proiectare, conform P100 a fost Vrancea-Bucuresti:

$$\begin{aligned}
 g &= 9.807 \text{ m s}^{-2} \\
 \beta_0 &= 2.75 \\
 T_C &= 1.6 \text{ s} \\
 T_B &= 0.16 \text{ s} \\
 T_D &= 2 \text{ s}
 \end{aligned}
 \quad
 \beta(T) := \begin{cases} 0 & \text{if } T < T_B \\ 1 + \frac{\beta_0 - 1}{T_B} \cdot T & \text{if } T \leq T_B \\ \beta_0 & \text{if } T_B < T \leq T_C \\ \left(\beta_0 \cdot \frac{T_C}{T} \right) & \text{if } T_C < T \leq T_D \\ \left(\beta_0 \cdot \frac{T_C \cdot T_D}{T^2} \right) & \text{if } T > T_D \end{cases}$$

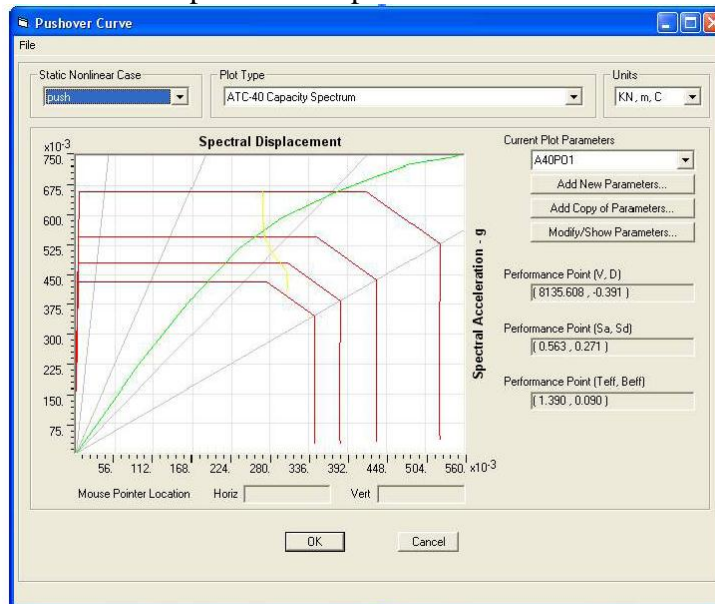
$$\begin{aligned}
 a_g &= 0.24g & a_g &= 2.354 \text{ m s}^{-2} \\
 S_e(T) &:= a_g \cdot \beta(T)
 \end{aligned}$$

$$\begin{aligned}
 \text{VecT} &= \begin{pmatrix} 0 \text{ s} \\ T_B \\ T_C \\ T_D \\ 2 \text{ s} \\ 4 \text{ s} \\ 6 \text{ s} \\ 8 \text{ s} \end{pmatrix} & \text{VecT} &= \begin{pmatrix} 0 \\ 0.16 \\ 1.6 \\ 2 \\ 3 \\ 4 \\ 6 \\ 8 \end{pmatrix} \text{ s}
 \end{aligned}$$

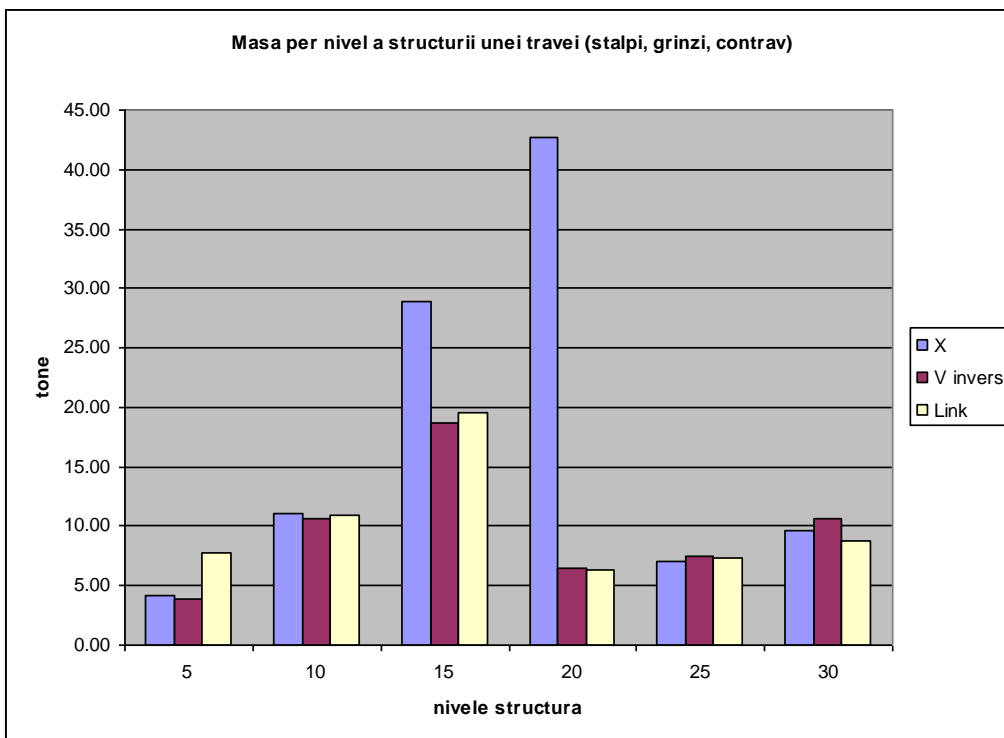
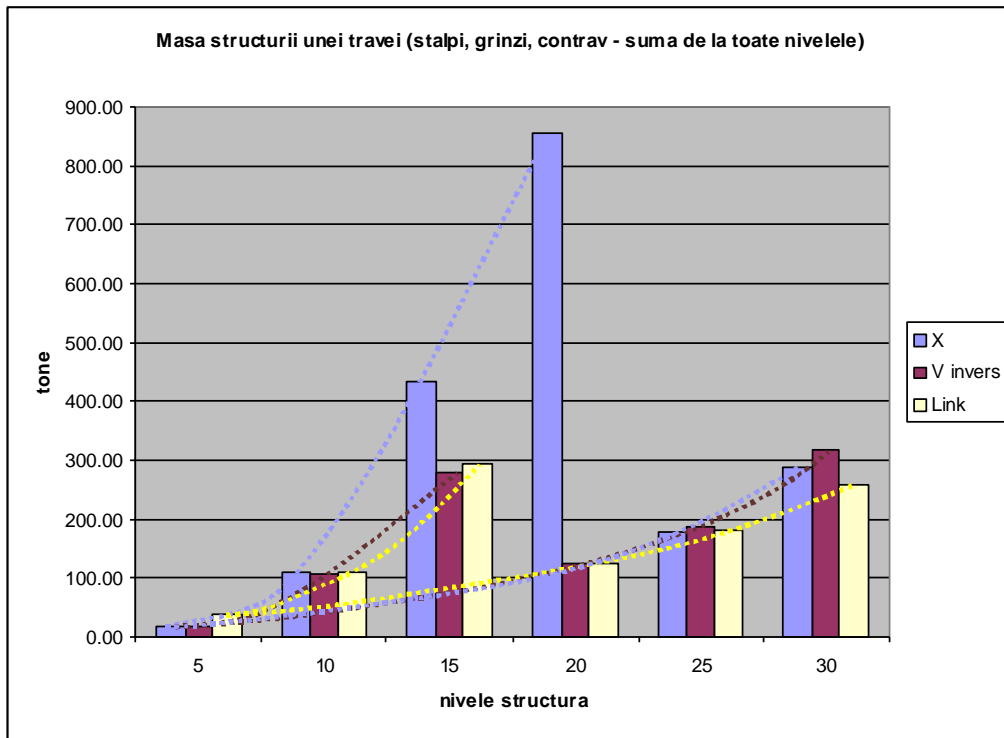
$$\begin{aligned}
 S_e(\text{VecT}_0) &= 2.354 \text{ m s}^{-2} \\
 S_e(\text{VecT}_1) &= 6.472 \text{ m s}^{-2} \\
 S_e(\text{VecT}_2) &= 6.472 \text{ m s}^{-2} \\
 S_e(\text{VecT}_3) &= 5.178 \text{ m s}^{-2} \\
 S_e(\text{VecT}_4) &= 2.301 \text{ m s}^{-2} \\
 S_e(\text{VecT}_5) &= 1.294 \text{ m s}^{-2} \\
 S_e(\text{VecT}_6) &= 0.575 \text{ m s}^{-2} \\
 S_e(\text{VecT}_7) &= 0.324 \text{ m s}^{-2}
 \end{aligned}$$

Masele modelate au provenit din incarcarea de 6000kgf/m pe grinzi si din masa proprie a elementelor.

Proiectarea s-a facut in punctul de capacitate:



Rezultatele au fost puse in grafic pentru toate cele 3 tipologii de contravantuiri si in functie de inaltimea de nivel:



Se observa ca, in conditiile date, structura unei suprastructuri metalice contravantuite avand intre 10 si 19 nivele este ineficienta, existand un prag de design intre design rigid si design flexibil al structurii, in canditiile date acesta situandu-se

unde va in jurul valorii de 20 nivele, peste care, este posibil designul flexibil al structurii, aceasta, fiind flexibila, nu preia forta seismica astfel incat sa depaseasca pragul de deformatii propus.

Trebuie specificat faptul ca aceasta concluzie este strict valabila pentru cazul Vrancea-Bucuresti, structura metalica regulata in tipologiile de mai sus, inaltime de nivel de 4m constanta si doar pentru nivelul de deformatii de $0.008 \times H$.nivel.

Conceptul existentei unui prag de rigiditate in designul structurii in functie de inaltime este insa valabil.

In anumite cazuri, un design eficient poate face posibila o abordare flexibila cu consum de material de pana la 2-3 ori mai mic (doar pentru suprastructura, exclusiv plansee).

Trebuie remarcat totusi in incheiere ca, desi concluzia are un caracter radical cu privire la inaltimele la care se poate construi mai economic, valoarea finala a pretului constructiei este afectata de multi alti factori cum ar fi solutia de fundare, raportul pret finisaje / pret structura, timpi de executie, fonduri disponibile, organizare de santier si nu in ultimul rand valoarea imobiliara a suprafetelor in zona, factori care pot contribui la alegerea unei variante diferite cu privire la inaltimea si numarul de nivele optim.

**Se vor anexa integral, sub forma de tabel toate rezultatele sintetice ale analizei comparative*

Raport comparativ - Structuri cu contravantuiri X, V invers, Link - 5-30 nivele

5 nivele (P+4) - 1 contravantuire X / nivel										
H(m)	M Str (tone)	M Str /etaj (tone)	G total (tf)	T1(s)	T1 plastic(s)	Depl vf (cm)	FTB(tf)	FTB / Gtotal	G str / G.total	Criteriu Design
20.00	20.86	4.17	560.90	0.72	0.73	11.80	281.20	50.13%	3.72%	drift
10 nivele (P+9) - 1 contravantuire X / nivel										
H(m)	M Str (tone)	M Str /etaj (tone)	G total (tf)	T1(s)	T1 plastic(s)	Depl vf (cm)	FTB(tf)	FTB / Gtotal	G str / G.total	Criteriu Design
40.00	110.70	11.07	1191.00	1.06	1.08	26.70	601.20	50.48%	9.29%	drift, rez: st&cv niv
15 nivele (P+14) - 1 contravantuire X / nivel										
H(m)	M Str (tone)	M Str /etaj (tone)	G total (tf)	T1(s)	T1 plastic(s)	Depl vf (cm)	FTB(tf)	FTB / Gtotal	G str / G.total	Criteriu Design
60.00	433.00	28.87	2053.00	1.26	1.30	38.90	1138.00	55.43%	21.09%	drift
20 nivele (P+19) - 1 contravantuire X / nivel										
H(m)	M Str (tone)	M Str /etaj (tone)	G total (tf)	T1(s)	T1 plastic(s)	Depl vf (cm)	FTB(tf)	FTB / Gtotal	G str / G.total	Criteriu Design
80.00	855.00	42.75	3014.00	1.53	1.59	54.60	1652.00	54.81%	28.37%	drift
25 nivele (P+24) - 1 contravantuire de tip X / nivel										
H(m)	M Str (tone)	M Str /etaj (tone)	G total (tf)	T1(s)	T1 plastic(s)	Depl vf (cm)	FTB(tf)	FTB / Gtotal	G str / G.total	Criteriu Design
100.00	177.70	7.11	2877.00	5.95	6.07	72.60	121.80	4.23%	6.18%	drift&GF
30 nivele (P+29) - 1 X semi-rigid / nivel										
H(m)	M Str (tone)	M Str /etaj (tone)	G total (tf)	T1(s)	T1 plastic(s)	Depl vf (cm)	FTB(tf)	FTB / Gtotal	G str / G.total	Criteriu Design
120.00	289.00	9.63	3528.00	6.31	6.36	78.20	136.90	3.88%	8.19%	GF, drift, rez(st)
5 nivele (P+4) - 1 contravantuire V invers / nivel										
H(m)	M Str (tone)	M Str /etaj (tone)	G total (tf)	T1(s)	T1 plastic(s)	Depl vf (cm)	FTB(tf)	FTB / Gtotal	G str / G.total	Criteriu Design
20.00	19.70	3.94	560.00	0.71	0.76	12.00	217.00	38.75%	3.52%	drift
10 nivele (P+9) - 1 contravantuire V invers / nivel										
H(m)	M Str (tone)	M Str /etaj (tone)	G total (tf)	T1(s)	T1 plastic(s)	Depl vf (cm)	FTB(tf)	FTB / Gtotal	G str / G.total	Criteriu Design
40.00	106.38	10.64	1386.00	1.09	1.13	27.50	588.00	42.42%	7.68%	drift
15 nivele (P+14) - 1 contravantuire V invers / nivel										
H(m)	M Str (tone)	M Str /etaj (tone)	G total (tf)	T1(s)	T1 plastic(s)	Depl vf (cm)	FTB(tf)	FTB / Gtotal	G str / G.total	Criteriu Design
60.00	279.50	18.63	1899.00	1.38	1.49	43.10	949.20	49.98%	14.72%	drift
20 nivele (P+19) - 1 contravantuire V invers / nivel										
H(m)	M Str (tone)	M Str /etaj (tone)	G total (tf)	T1(s)	T1 plastic(s)	Depl vf (cm)	FTB(tf)	FTB / Gtotal	G str / G.total	Criteriu Design
80.00	128.00	6.40	2288.00	4.09	5.58	57.60	99.86	4.36%	5.59%	drift
25 nivele (P+24) - 1 contravantuire de tip V invers										
H(m)	M Str (tone)	M Str /etaj (tone)	G total (tf)	T1(s)	T1 plastic(s)	Depl vf (cm)	FTB(tf)	FTB / Gtotal	G str / G.total	Criteriu Design
100.00	186.96	7.48	2887.00	5.12	5.97	60.60	112.37	3.89%	6.48%	GF
30 nivele (P+29) - 1 contravantuire de tip V invers										
H(m)	M Str (tone)	M Str /etaj (tone)	G total (tf)	T1(s)	T1 plastic(s)	Depl vf (cm)	FTB(tf)	FTB / Gtotal	G str / G.total	Criteriu Design
120.00	317.60	10.59	3557.00	6.27	6.74	68.20	114.92	3.23%	8.93%	GF
5 nivele (P+4) - 1 contravantuire dubla de tip Link / nivel										
H(m)	M Str (tone)	M Str /etaj (tone)	G total (tf)	T1(s)	T1 plastic(s)	Depl vf (cm)	FTB(tf)	FTB / Gtotal	G str / G.total	Criteriu Design
20.00	39.00	7.80	579.00	0.76	0.87	12.10	276.00	47.67%	6.74%	drift
10 nivele (P+9) - 1 contravantuire dubla de tip Link / nivel										
H(m)	M Str (tone)	M Str /etaj (tone)	G total (tf)	T1(s)	T1 plastic(s)	Depl vf (cm)	FTB(tf)	FTB / Gtotal	G str / G.total	Criteriu Design
40.00	109.00	10.90	1189.00	1.13	1.18	28.50	633.00	53.24%	9.17%	drift
15 nivele (P+14) - 1 contravantuire dubla de tip Link / nivel										
H(m)	M Str (tone)	M Str /etaj (tone)	G total (tf)	T1(s)	T1 plastic(s)	Depl vf (cm)	FTB(tf)	FTB / Gtotal	G str / G.total	Criteriu Design
60.00	294.00	19.60	1913.00	1.31	1.32	39.20	1105.00	57.76%	15.37%	drift
20 nivele (P+19) - 1 contravantuire dubla de tip Link / nivel										
H(m)	M Str (tone)	M Str /etaj (tone)	G total (tf)	T1(s)	T1 plastic(s)	Depl vf (cm)	FTB(tf)	FTB / Gtotal	G str / G.total	Criteriu Design
80.00	126.50	6.33	2287.00	5.09	5.92	58.30	90.70	3.97%	5.53%	drift
25 nivele (P+24) - 1 contravantuire dubla de tip Link / nivel										
H(m)	M Str (tone)	M Str /etaj (tone)	G total (tf)	T1(s)	T1 plastic(s)	Depl vf (cm)	FTB(tf)	FTB / Gtotal	G str / G.total	Criteriu Design
100.00	182.60	7.30	2882.00	6.67	7.51	60.00	76.64	2.66%	6.34%	GF, drift
30 nivele (P+29) - 1 contravantuire dubla de tip Link / nivel										
H(m)	M Str (tone)	M Str /etaj (tone)	G total (tf)	T1(s)	T1 plastic(s)	Depl vf (cm)	FTB(tf)	FTB / Gtotal	G str / G.total	Criteriu Design
120.00	261.00	8.70	3501.00	7.54	8.35	63.10	78.79	2.25%	7.46%	GF