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Građevinski i arhitektonski fakultet Osijek
Josip Juraj Strossmayer University of Osijek
Faculty of Civil Engineering and Architecture Osijek



DETALJI I UPORABA PROGRAMA

Izv. prof. dr. sc. Emmanuel Karlo Nyarko

Prof. dr. sc. Marijana Hadzima-Nyarko



Zagreb, 09.11.2022.



SADRŽAJ

1. *Tehničke karakteristike softvera*
2. *Procjena potresne oštetljivosti upotrebom softvera na primjeru armiranobetonskih zgrada*
3. *Procjena potresne oštetljivosti upotrebom softvera na primjeru zidanih zgrada*
4. *Spektralne funkcije za zagrebački potres 22.03.2022.*

TEHNIČKE KARAKTERISTIKE SOFTVERA



Input parameters:

- period
- elastic base shear capacity
- post-elastic stiffness
- damping

STRUCTURE → SDOF SYSTEM

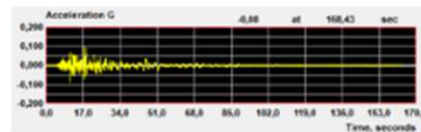
$$DI = \frac{1}{30} \left[D + \Delta K + \sqrt[3]{N_y E_H / W} \right]$$



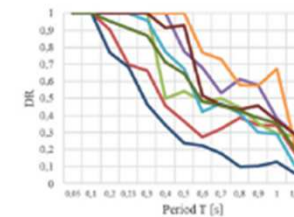
**NONLINEAR DYNAMIC
STEP-BY-STEP ANALYSIS**

Input parameters:

- accelograms of earthquakes



**DI SPECTRAL
FUNCTIONS**



TEHNIČKE KARAKTERISTIKE SOFTVERA

Web aplikacija

Backend - kotlin (spring boot)

Frontend - angular

Baza - postgres

PROCJENA POTRESNE OŠTETLJIVOSTI UPOTREBOM SOFTVERA

Unos podataka: armiranobetonske zgrade

Armiranobetonski okvir; 4 kata; $a_g=0,1g$

The screenshot shows a software interface for data entry. The background is a dark, textured image of a brick wall. The interface is organized into several sections:

- Konstrukcija zgrade:** Vrsta zgrade * with radio buttons for Armiranobetonske and Zidane. Below it, Okvir and Zidovi.
- Tlorisne izmjere:** Dužina * 30 m and Širina * 20 m.
- Ostalo:** Broj katova * 4, Visina kata * 2.8 m, and Potres * 0.1 g.
- Additional parameters:** drX: 0.05, 1°, Beznačajno; drY: 0.03081711274540596, 1°, Beznačajno.
- Buttons:** Resetiraj and Izračunaj.

PROCJENA POTRESNE OŠTETLJIVOSTI UPOTREBOM SOFTVERA

Unos podataka: zidane zgrade

Zidana zgrada s krutom stropnom konstrukcijom; 2 kata; $a_g=0,15g$

The screenshot shows a software interface for inputting data for a masonry building. The background is a dark image of a brick wall. The interface is organized into several sections:

- Vrsta zgrade ***: Radio buttons for Armiranobetonske and Zidane.
- Konstrukcija zgrade**: Radio buttons for Armirano, Omeđeno, and Nearmirano.
- Stropna konstrukcija ***: Radio buttons for AB Ploča, Drveni grednik sa zategama, and Drveni grednik.
- Tlorisne izmjere**: Input fields for **Dužina *** (25 m) and **Širina *** (20 m).
- Ostalo**: Input fields for **Broj katova *** (2) and **Visina kata *** (2.8 m).
- Potres ***: Input field for **Potres *** (0.15 g).
- Koeficijent oštetljivosti**: A large green bar displays the value **1°** and the text **Beznačajno**.
- Buttons**: **Resetiraj** (orange) and **Izračunaj** (green).

PROCJENA POTRESNE OŠTETLJIVOSTI UPOTREBOM SOFTVERA

Unos podataka: armiranobetonske zgrade

Vrsta: armiranobetonski zidovi

Broj katova: 6

Katna visina: 4 m

Dužina: 32 m

Širina: 16 m



PROCJENA POTRESNE OŠTETLJIVOSTI UPOTREBOM SOFTVERA

Unos podataka: armiranobetonske zgrade

Vrsta: armiranobetonski okvir

Broj katova: 11

Katna visina: 4 m

Dužina: 40 m

Širina: 20 m



PROCJENA POTRESNE OŠTETLJIVOSTI UPOTREBOM SOFTVERA

Unos podataka: zidane zgrade

Vrsta: nearmirano ziđe s drvenim grednicima

Broj katova: 3

Katna visina: 3,25 m

Dužina: 20 m

Širina: 12 m



PROCJENA POTRESNE OŠTETLJIVOSTI UPOTREBOM SOFTVERA

Unos podataka: zidane zgrade

Vrsta: nearmirano ziđe s drvenim grednicima

Broj katova: 3 + potkrovlje

Katna visina: 4,2-4,8 m; potkrovlje 5 m

Zapadno krilo (smjer sjever-jug)

Dužina: 42 m

Širina: 14 m

Sjeverno krilo (smjer istok zapad)

Dužina: 28 m

Širina: 16 m

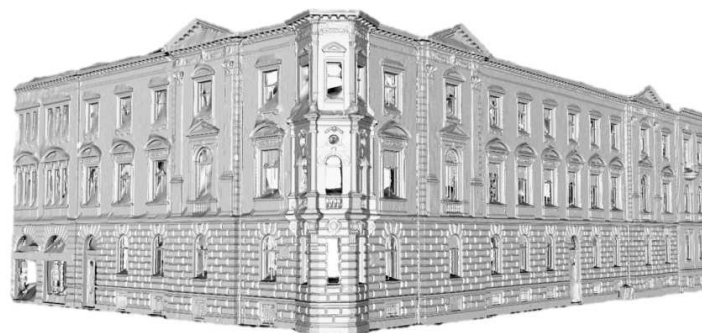
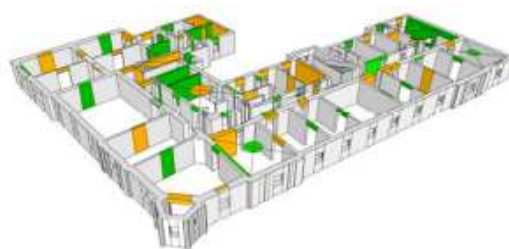


Figure 6. Laser scan of the building's façade.



Legend
1 – smaller damage
2 – medium damage, removal of plaster and detail checkup
3 – severe damage, retrofitting needed
⊗ Ceilings

Figure 10. Damage scheme for the 1st floor of the building.



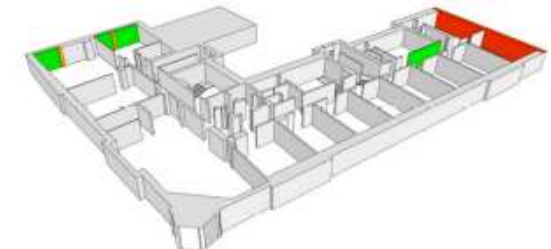
Legend
1 – smaller damage
2 – medium damage, removal of plaster and detail checkup
3 – severe damage, retrofitting needed
⊗ Ceilings

Figure 11. Damage scheme for the 2nd floor of the building.



Legend
1 – smaller damage
2 – medium damage, removal of plaster and detail checkup
3 – severe damage, retrofitting needed
⊗ Ceilings

Figure 12. Damage scheme for the 3rd floor of the building.

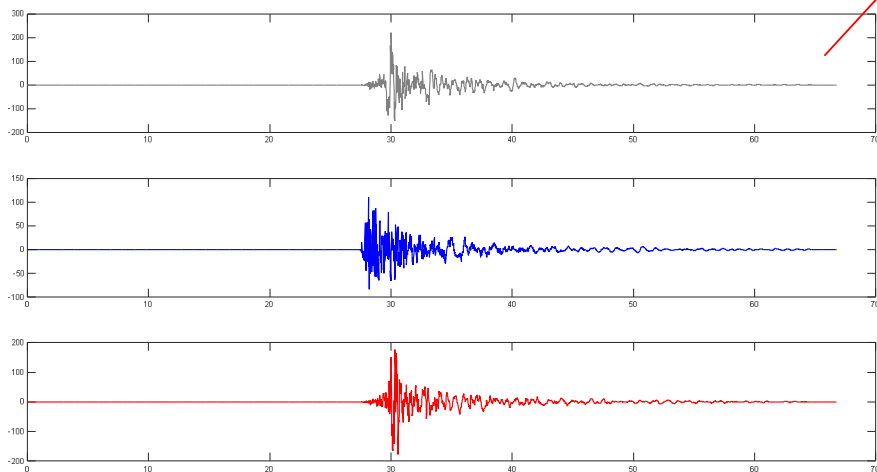


Legend
1 – smaller damage
2 – medium damage, removal of plaster and detail checkup
3 – severe damage, retrofitting needed
⊗ Ceilings

Figure 13. Damage scheme for the attic of the building.

SPEKTRI FUNKCIJE KOEFICIJENTA OŠTETLJIVOSTI ZA ZAGREBAČKI POTRES

Kod postaje	Komponenta zapisa	PGA_{raw} [m/s ²]	PGA_{corr} [m/s ²]
ARZG	Z	-0,79	-0,72
	N	-1,48	-1,47
	E	1,89	1,92
UHS	Z	1,38	1,11
	N	2,27	2,20
	E	1,80	-1,77

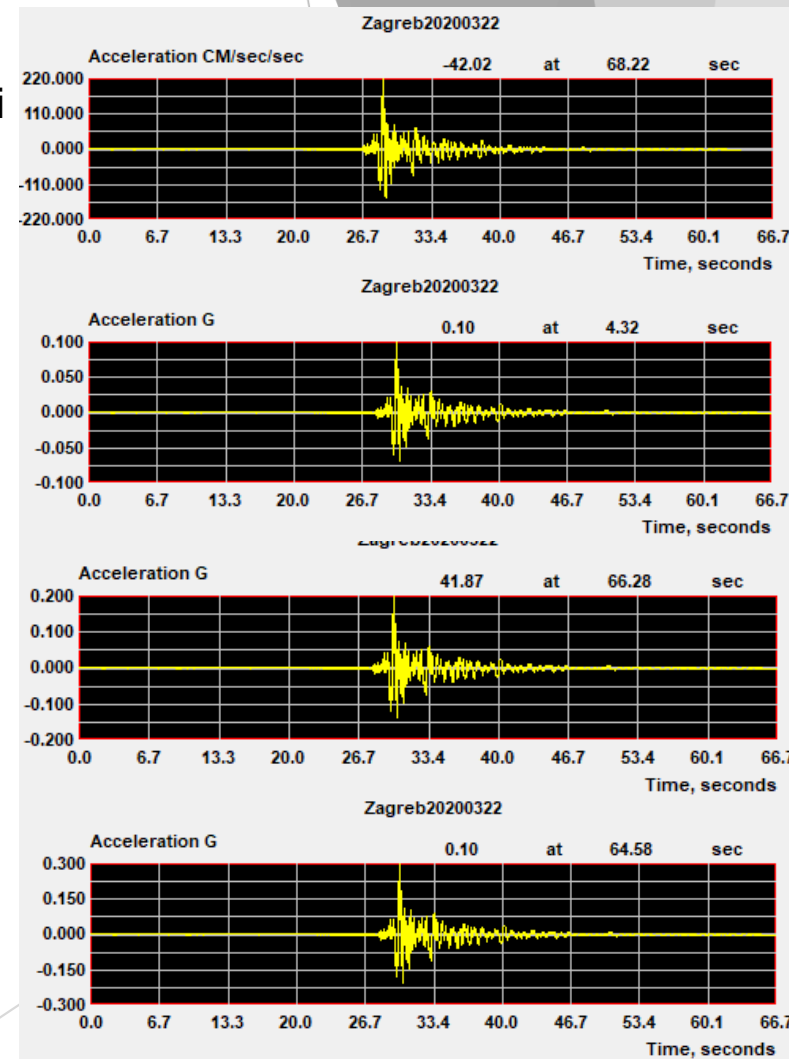


Originalni zapis

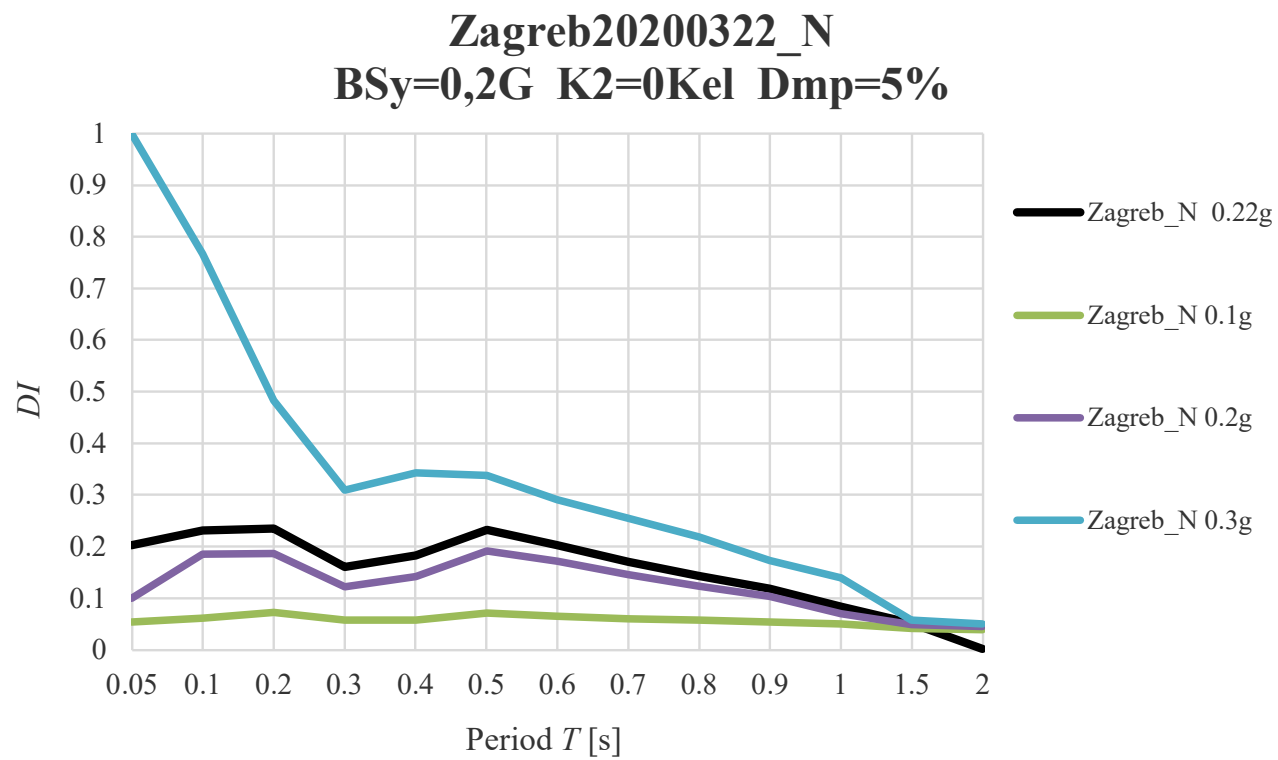
Skalirani 0,1g

Skalirani 0,2g

Skalirani 0,3g



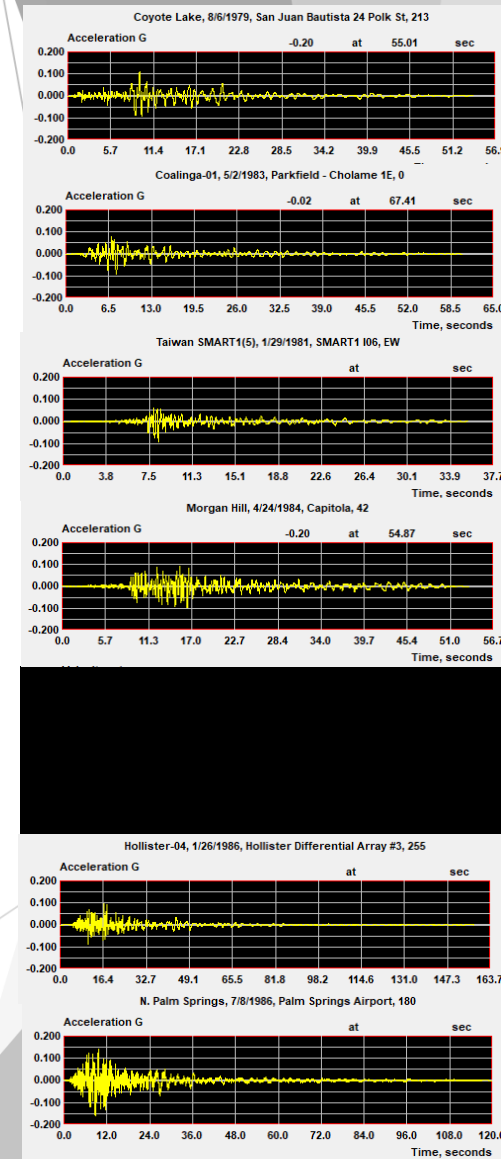
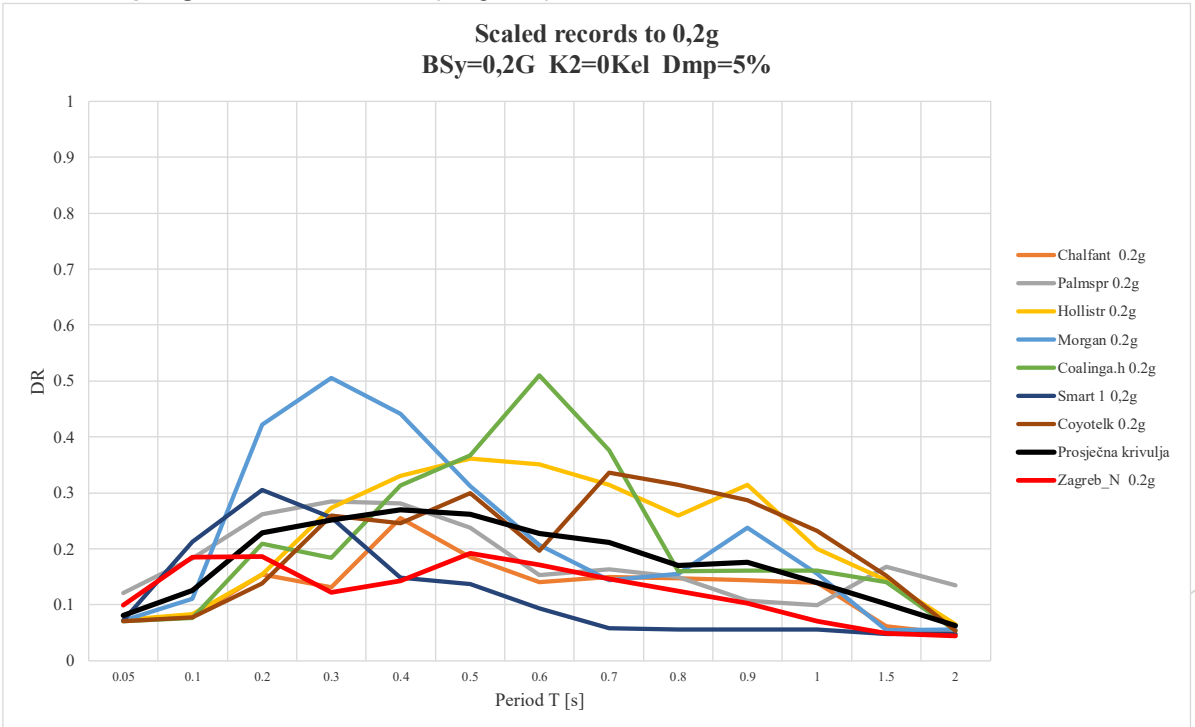
SPEKTRI FUNKCIJE KOEFICIJENTA OŠTETLJIVOSTI ZA ZAGREBAČKI POTRES



SPEKTRI FUNKCIJE KOEFICIJENTA OŠTETLJIVOSTI ZA ZAGREBAČKI POTRES I SET ODABRANIH POTRESA

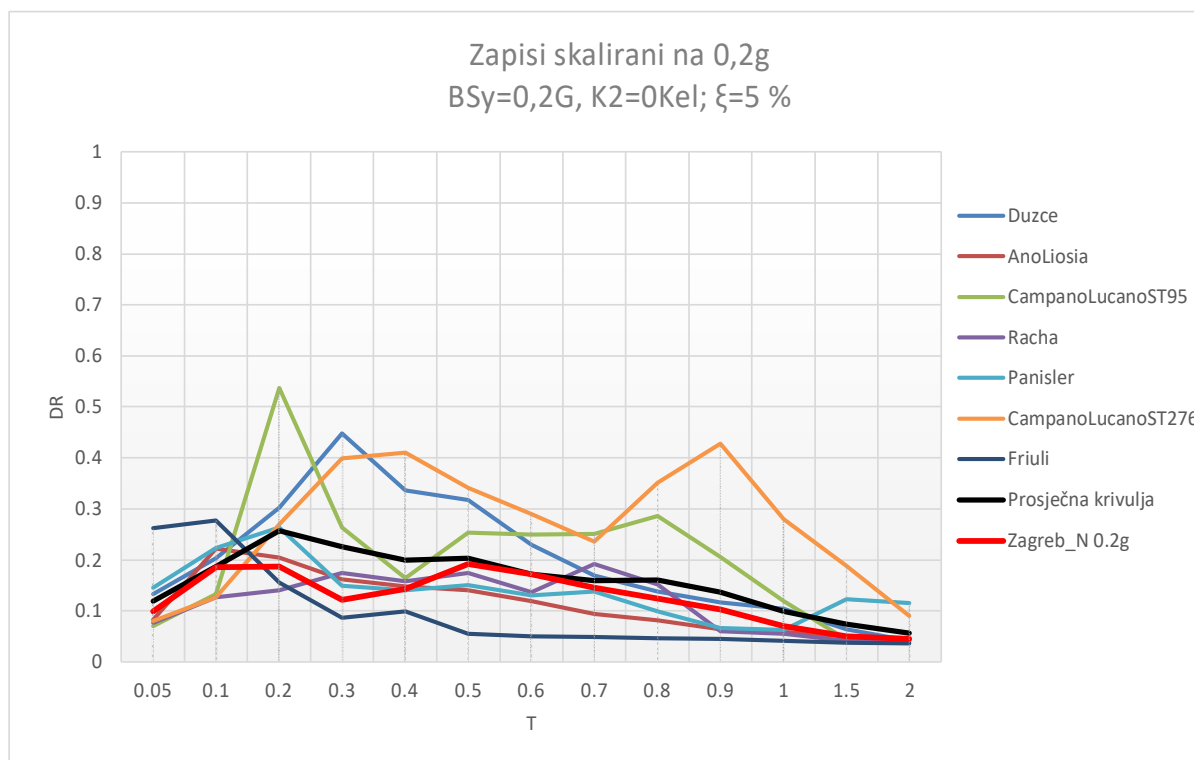
Details of selected earthquakes from PEER Ground Motion Database

Earthquake Name	Year	Station Name	Magnitude	Distance to rupture plane R_{rup} (km)	Shear wave velocity V_{s30} (m/sec)
Coyote Lake	1979	San Juan Bautista_ 24 Polk St	5.74	19.70	335.50
Coalinga-01	1983	Parkfield - Cholame 1E	6.36	43.68	326.64
Taiwan SMART1(5)	1981	SMART1 106	5.9	26.40	309.41
Chalfant Valley-03	1986	Bishop - LADWP South St	5.65	24.41	303.47
Morgan Hill	1984	Capitola	6.19	39.08	288.62
Hollister-04	1986	Hollister Differential Array #3	5.45	14.11	215.54
N. Palm Springs	1986	Palm Springs Airport	6.06	10.84	312.47

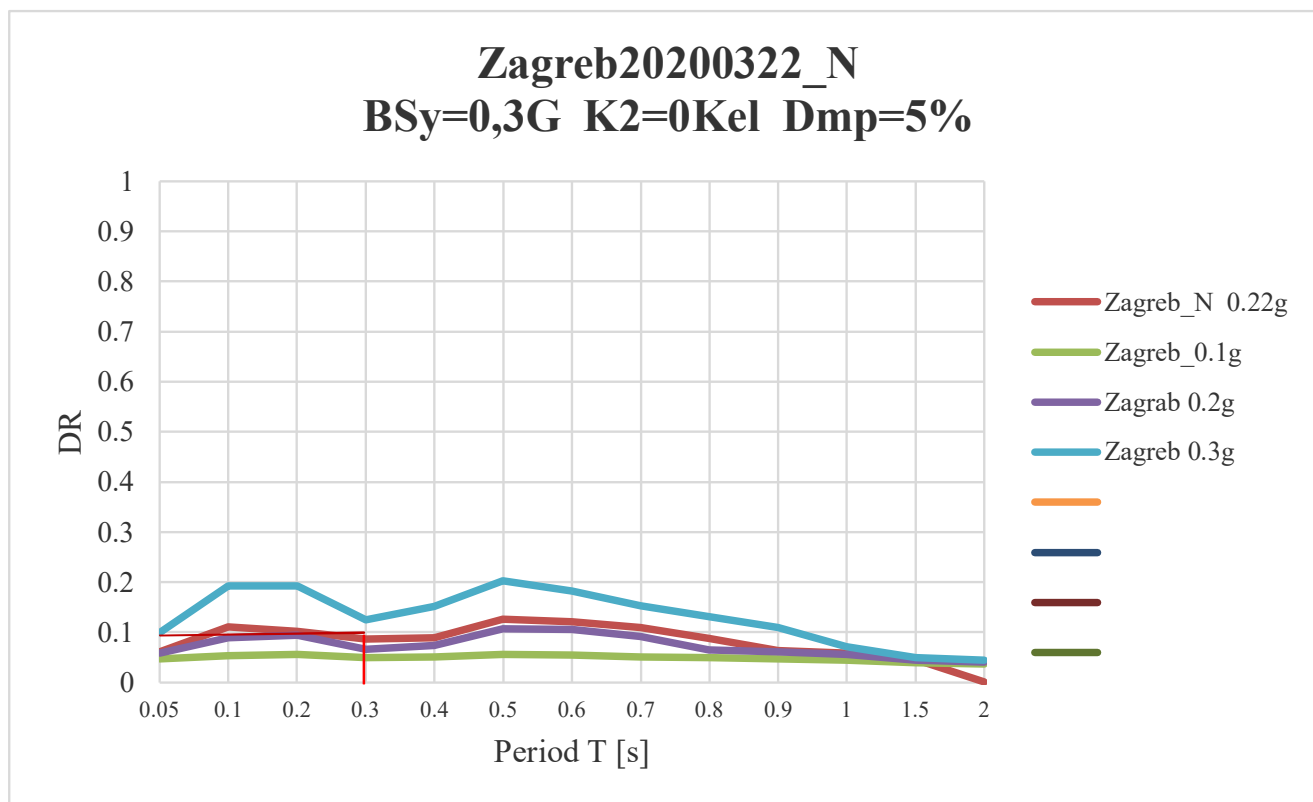


SPEKTRI FUNKCIJE KOEFICIJENTA OŠTETLJIVOSTI ZA ZAGREBAČKI POTRES I SET ODABRANIH POTRESA

Waveform ID	Earthquake	Station ID	Earthquake	Date	Mw	Fault Mechanism	Central Distance	PGA_X [m/s ²]	PGA_Y [m/s ²]	PGV_X [m/s]	PGV_Y [m/s]	ID_X	ID_Y	Np_X	Np_Y	EC8 Site class
6501	497	ST3141	Duzce 1	12.11.1999	7.2	oblique	26	1.2273	1.5452	0.0979	0.0884	21.1418	20.129	0.54233	0.65855	B
1314	474	ST1101	Ano Liosia	7.9.1999.	6	normal	17	1.171	1.0661	0.0874	0.0881	5.8033	4.3468	0.48015	0.69801	B
289	146	ST95	Campano	23.11.1980	6.9	normal	48	1.0578	1.3625	0.0769	0.1203	25.2786	20.2659	1.3466	0.96121	B
530	248	ST200	Racha (after)	15.6.1991.	6	thrust	40	1.0967	1.0317	0.0699	0.0774	6.9584	5.8496	0.58002	0.69114	B
354	171	ST133	Panislav		6.6	strike slip	33	1.2389	1.5754	0.3688	0.26	6.0864	6.023	0.82719	0.67878	B
291	146	ST276	Campano	23.11.1980	6.9	normal	16	1.5256	1.7247	0.271	0.2745	15.8452	17.7004	0.7465	0.92385	B
113	60	ST35	Friuli (after)	11.9.1976.	5.3	thrust	21	1.3304	1.7013	0.0347	0.0518	13.8355	10.1191	0.68228	0.45693	B
mean:					6.414286		28.71429	1.235385714	1.429557143	0.1438	0.1372143	13.56417	12.06197	0.743581	0.724066	



SPEKTRI FUNKCIJE KOEFICIJENTA OŠTETLJIVOSTI ZA ZAGREBAČKI POTRES



Godina izgradnje: 1938.

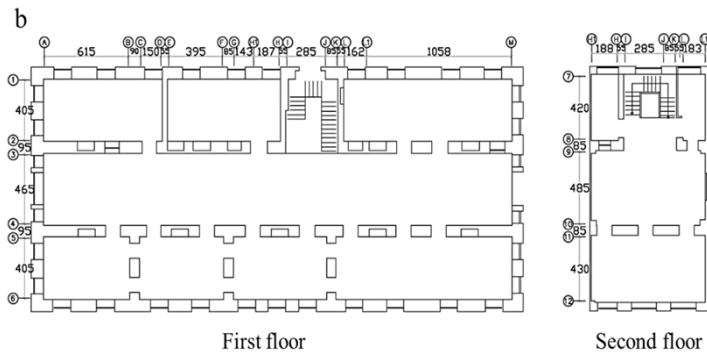
Vrsta: omeđeno zide

Broj katova: 5

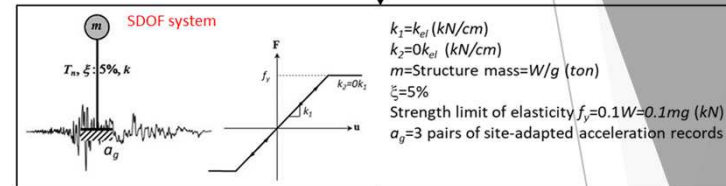
Katna visina: 3,75 m

Osnovni period: $T = 0,016 \cdot 18,75 = 0,3$ s

SPEKTRI FUNKCIJE KOEFICIJENTA OŠTETLJIVOSTI ZA IRANSKI POTRES



Kazazi high school a) North view photo
b) first-floor and second-floor plan

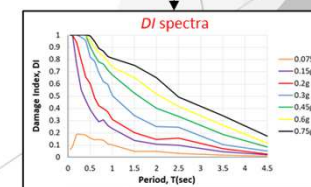
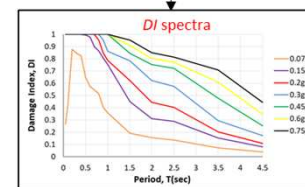
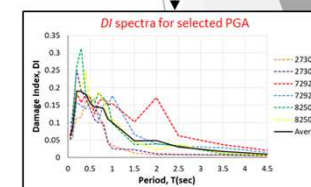
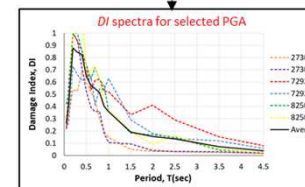


Park and Ang (1985)

$$DI = \frac{u_{max}}{u_{ult}} + 0.15 \frac{E_H}{F_{Cr} u_{ult}}$$

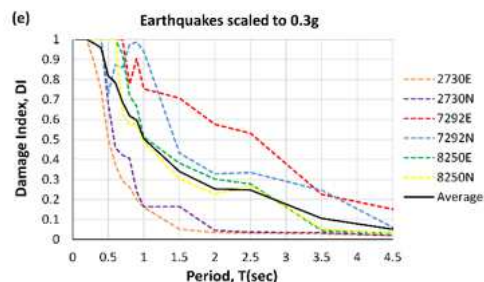
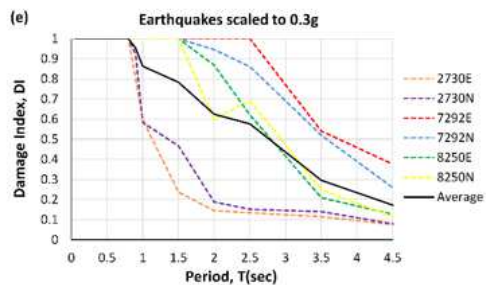
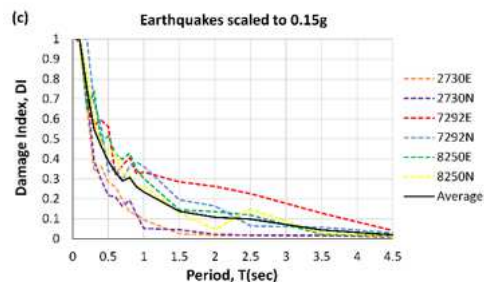
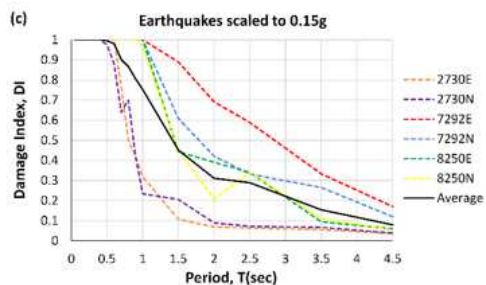
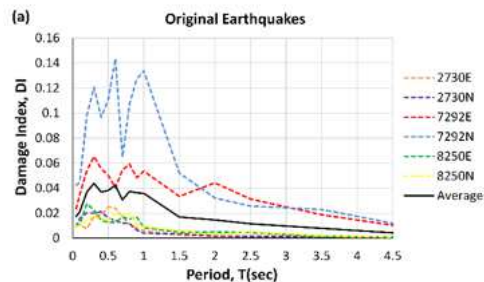
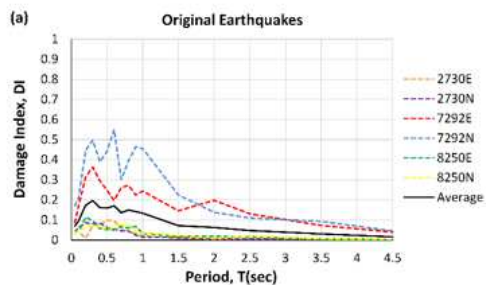
Moric et al. (2001)

$$DI = \frac{1}{30} \left[\mu + \Delta k + \sqrt[3]{\frac{N_Y E_H}{W}} \right]$$



- Determine fundamental period of the structure
- Determine the desired acceleration
- Determine corresponding DI index
- Definition of the structure seismic vulnerability

SPEKTRI FUNKCIJE KOEFICIJENTA OŠTETLJIVOSTI ZA IRANSKI POTRES



Park Ang

Morić

DI function	PGAs			
	0.075g	0.15g	0.2g	≥ 0.3g
Park and Ang [18]	0.86	1	1	1
Modified Moric et al. [19]	Extensive	Collapse	Collapse	Collapse
	0.19/0.28=0.68	0.65/0.28 considered 1	0.87/0.28 considered 1	1
	Moderate	Collapse	Collapse	Collapse

Hvala na pozornosti!

Graduate university study programme information:
<http://www.gfos.unios.hr/teaching-and-education>

Full professor Marijana Hadzima-Nyarko
Department for materials and structures
mhadzima@gfos.hr;

<http://www.gfos.unios.hr/cv/preddiplomski-sveucilisni-studij-gradevinarstvo/marijana-hadzima-nyarko>

