



HRVATSKA KOMORA INŽENJERA GRAĐEVINARSTVA

15. Dani Hrvatske komore inženjera građevinarstva

Opatija, 2021.

PRIMJENA MODERNIH ORUĐA PRI SAKUPLJANJU, OBRADI I POHRANI PODATAKA OCJENE STANJA DRVENIH KONSTRUKCIJA

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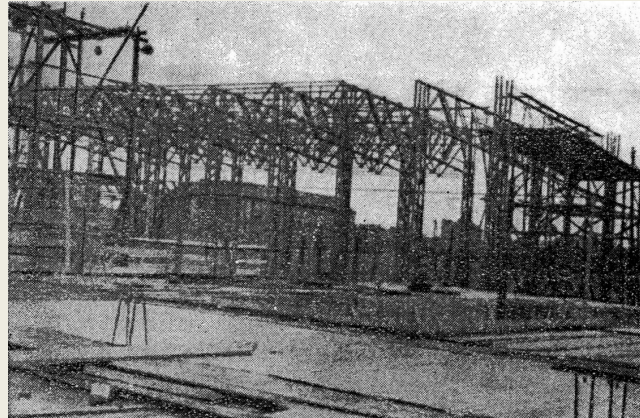
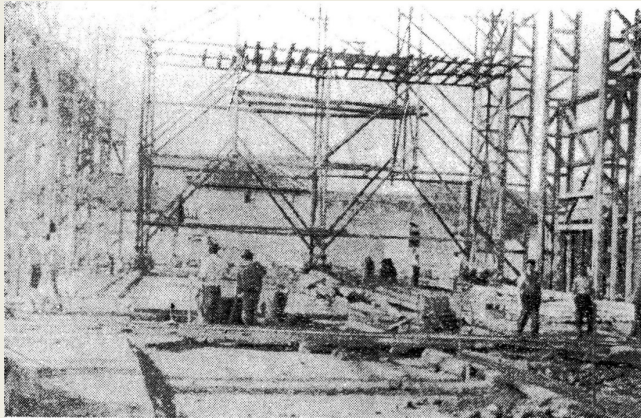
prof.dr.sc. Vlatka Rajčić, dipl.ing.građ., Građevinski fakultet Sveučilišta u Zagrebu

SADRŽAJ

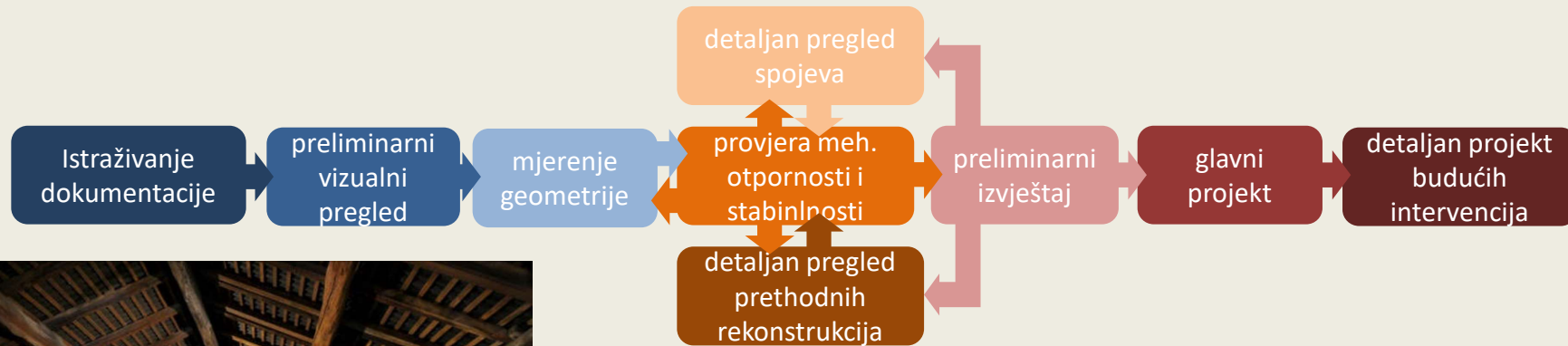
- uvod
- suvremene metode određivanja geometrije
- ne-destruktivne metode ocjenjivanja stanja
- polu-destruktivne metode ocjenjivanja stanja
- problematika analize podataka
- pohrana i korištenje podataka



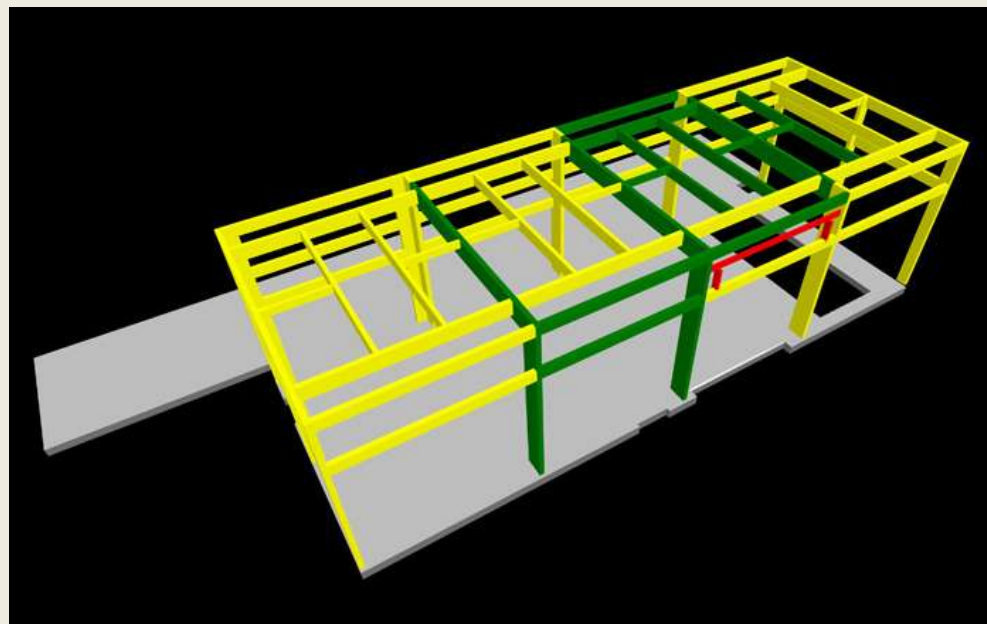
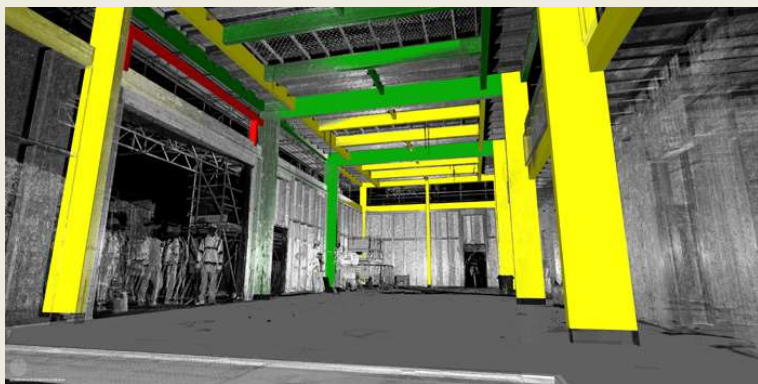
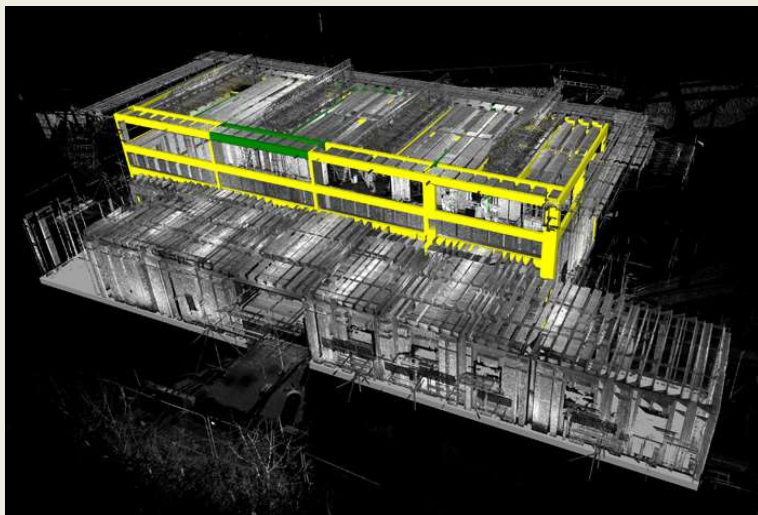
UVOD



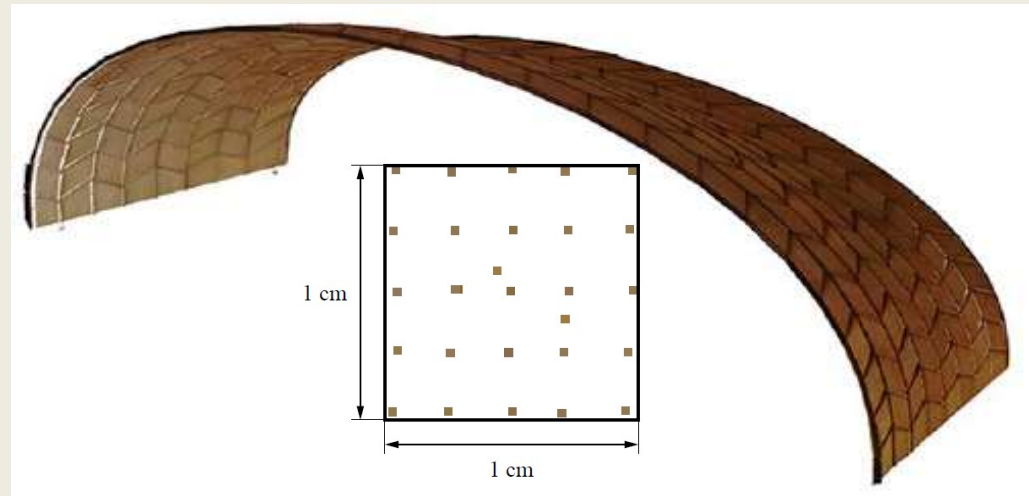
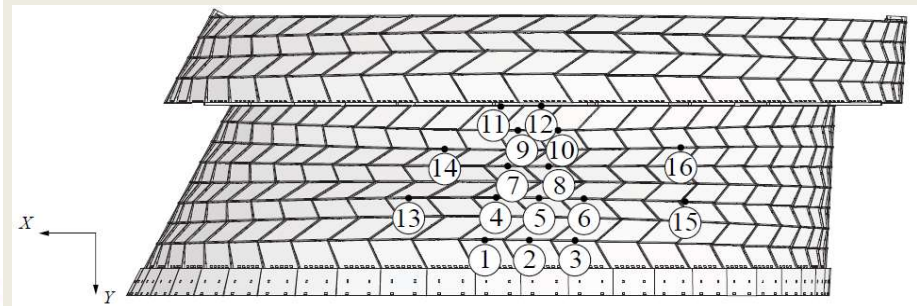
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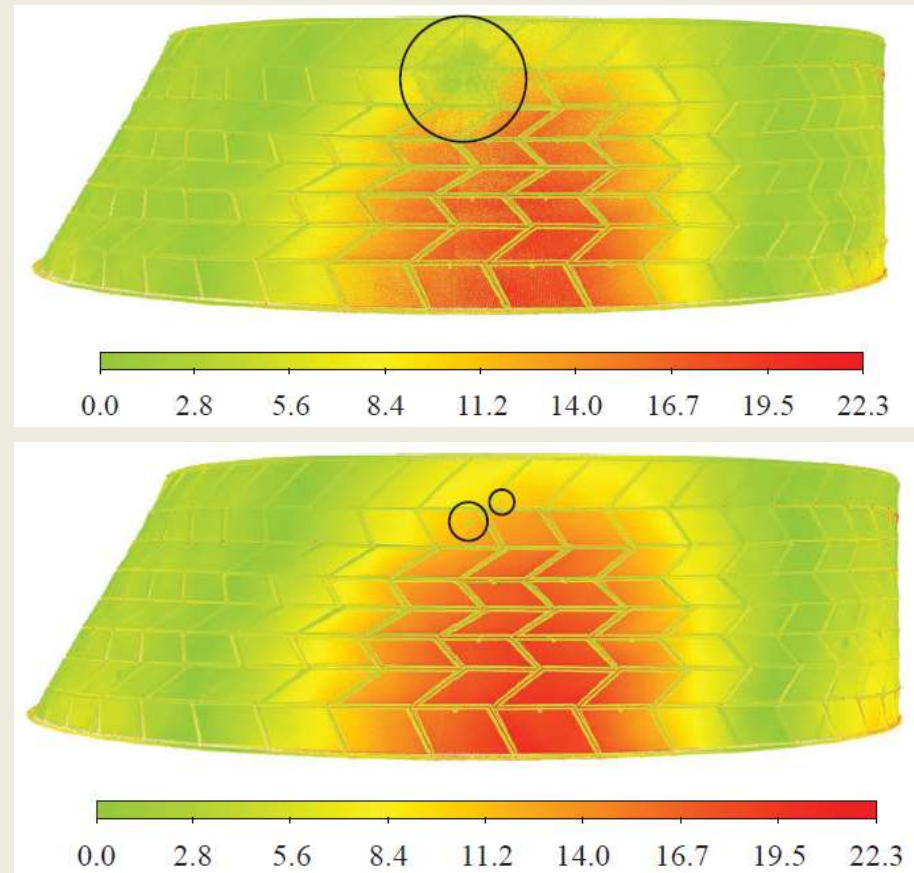
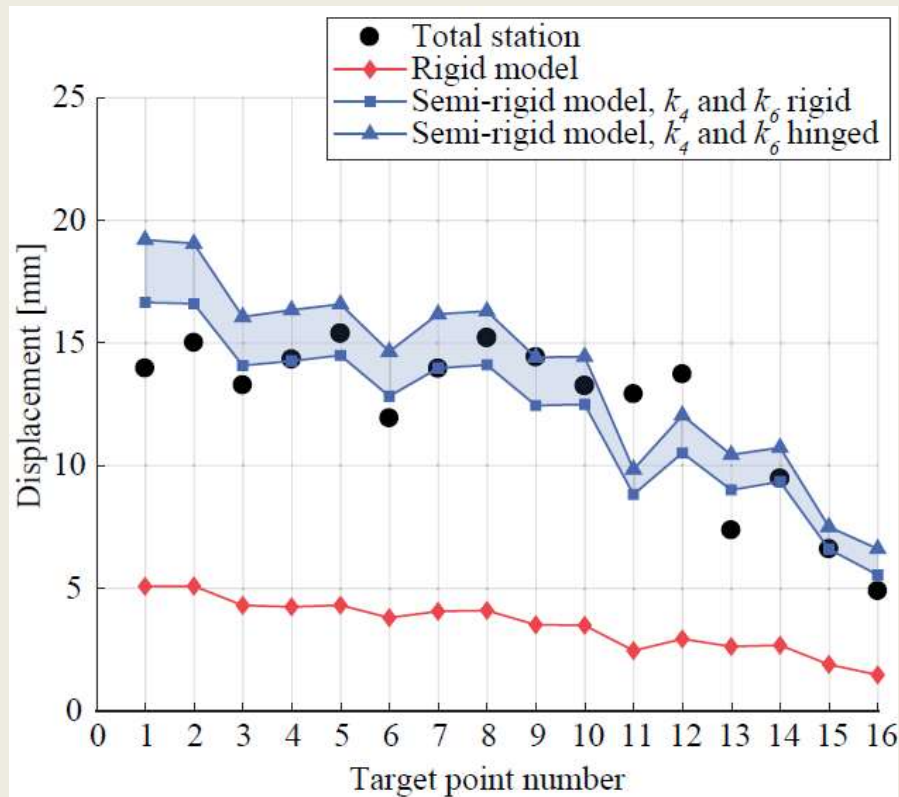
SUVREMENE METODE ODREĐIVANJA GEOMETRIJE



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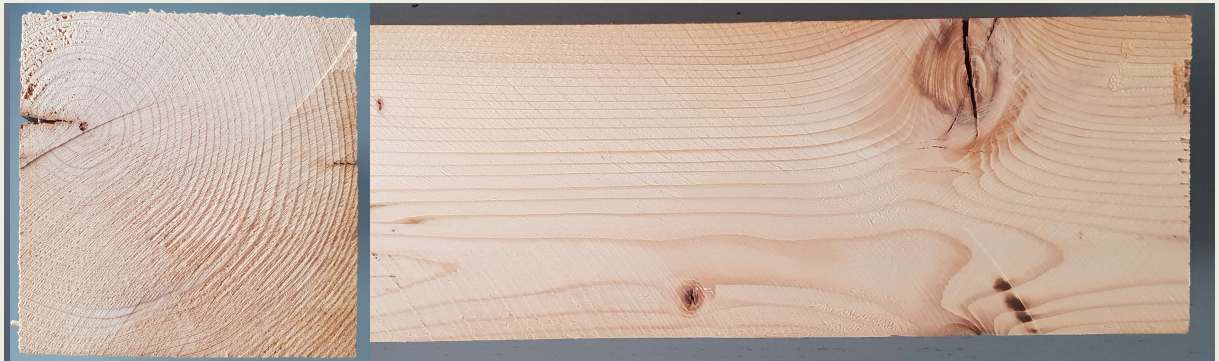


SUVREMENE METODE ODREĐIVANJA GEOMETRIJE



NE-DESTRUKTIVNE METODE ODREĐIVANJA STANJA

- vizualni pregled



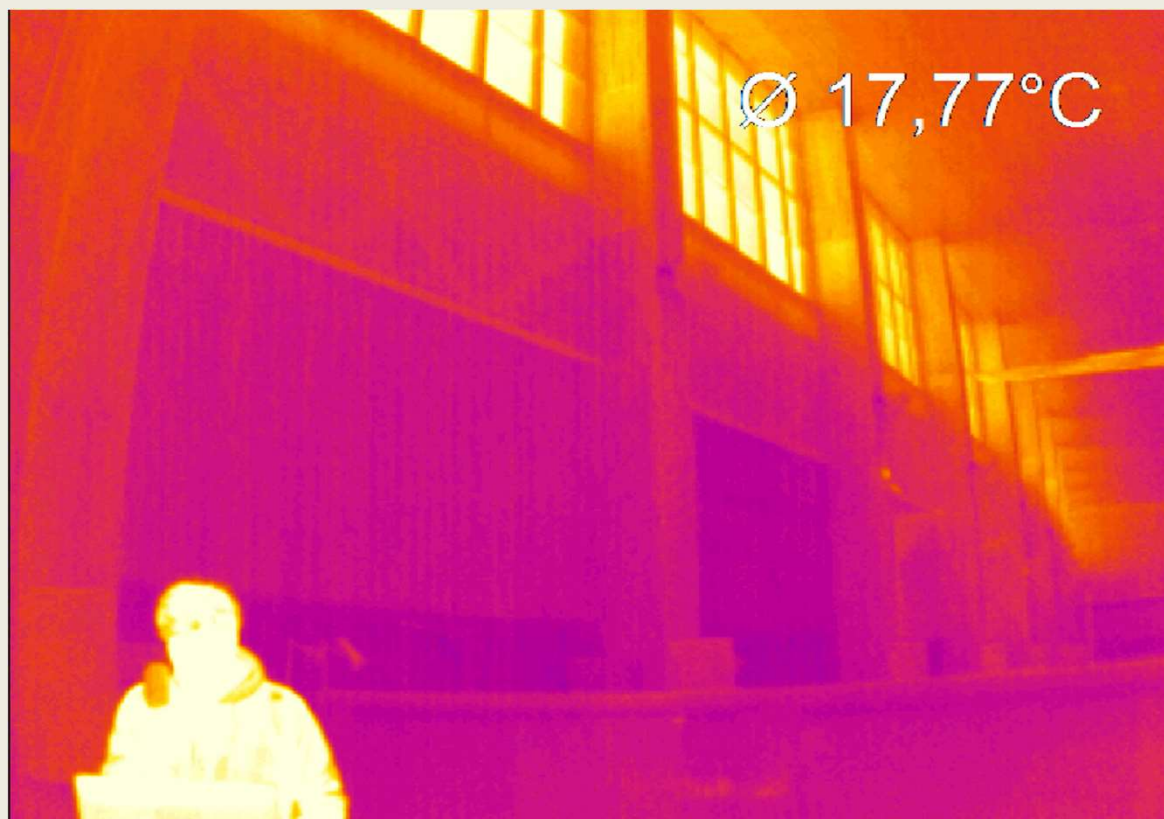
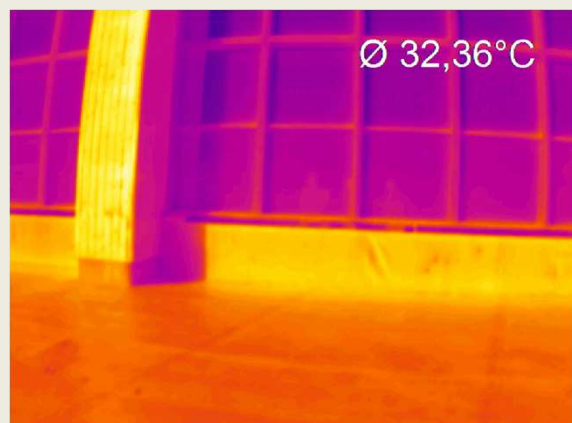
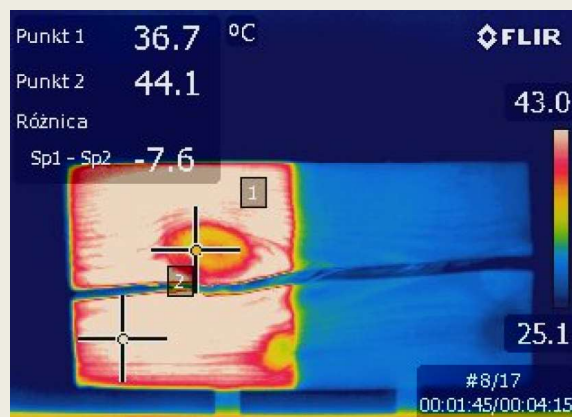
NE-DESTRUKTIVNE METODE ODREĐIVANJA STANJA

- određivanje uvjeta okoline



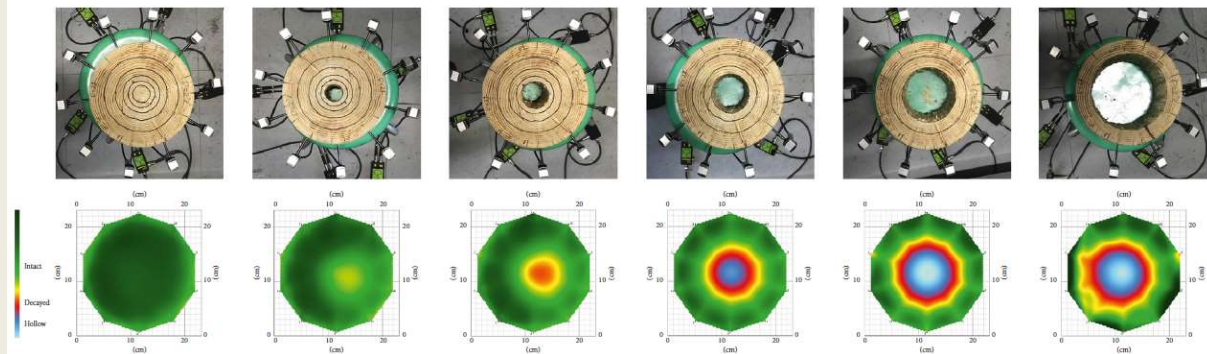
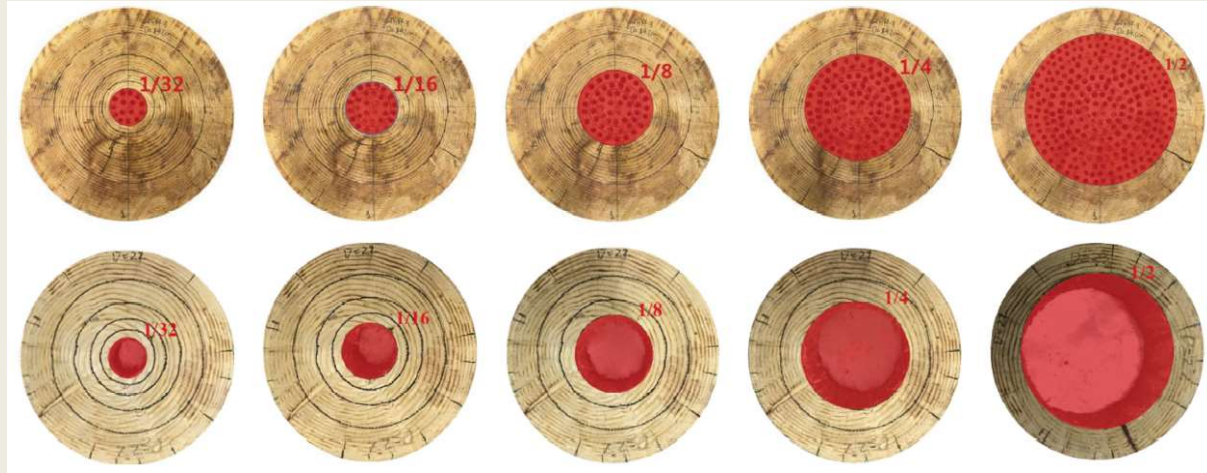
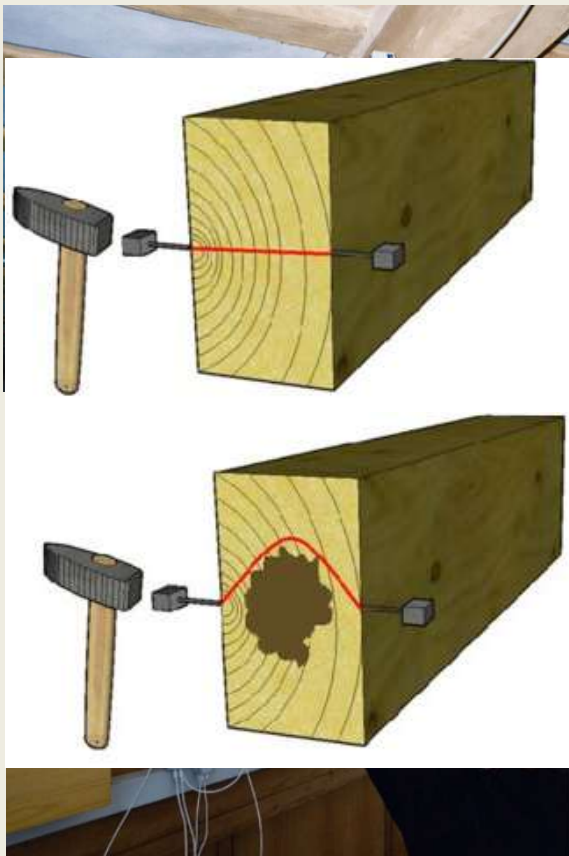
NE-DESTRUKTIVNE METODE ODREĐIVANJA STANJA

- IC termografija



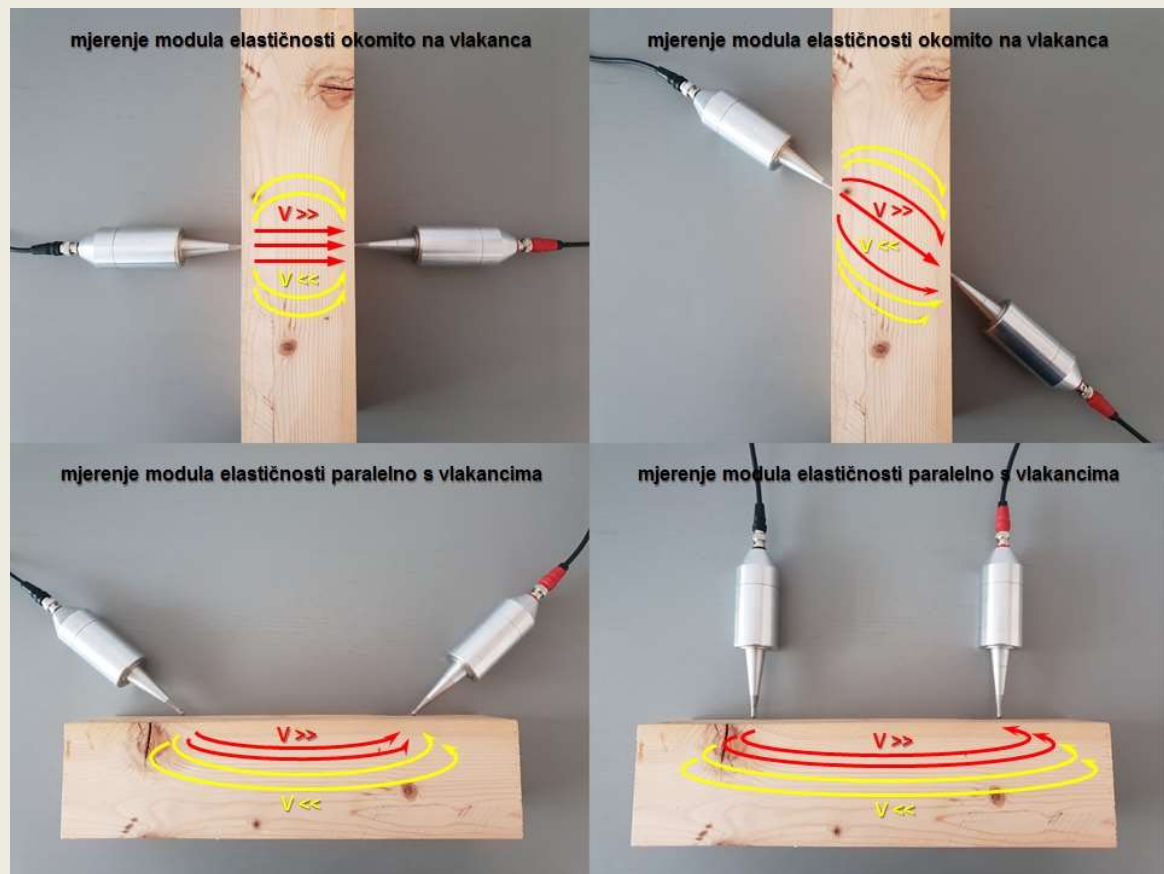
NE-DESTRUKTIVNE METODE ODREĐIVANJA STANJA

- mjerenja principima perkusije i zvučnih valova



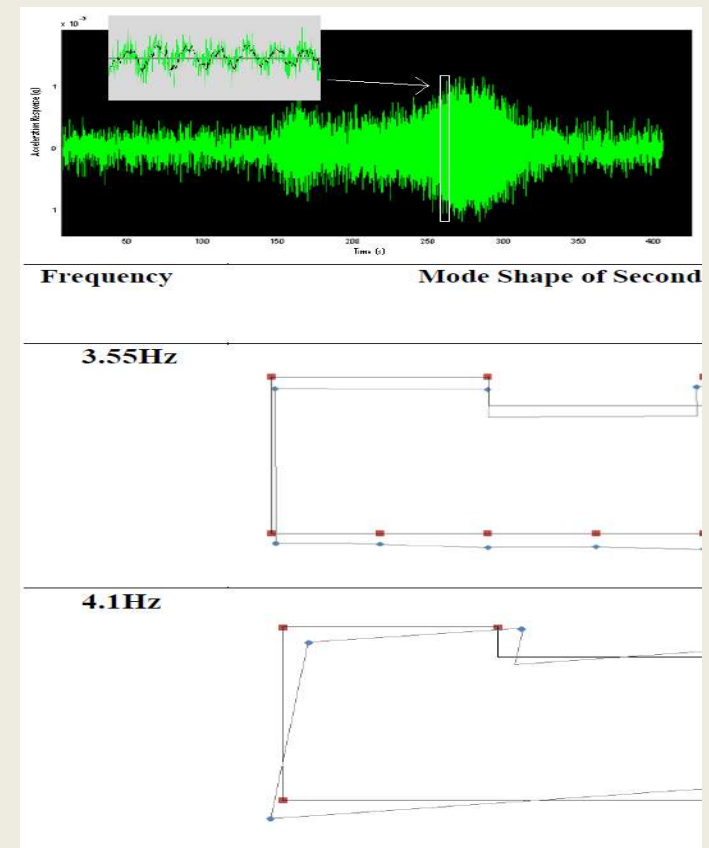
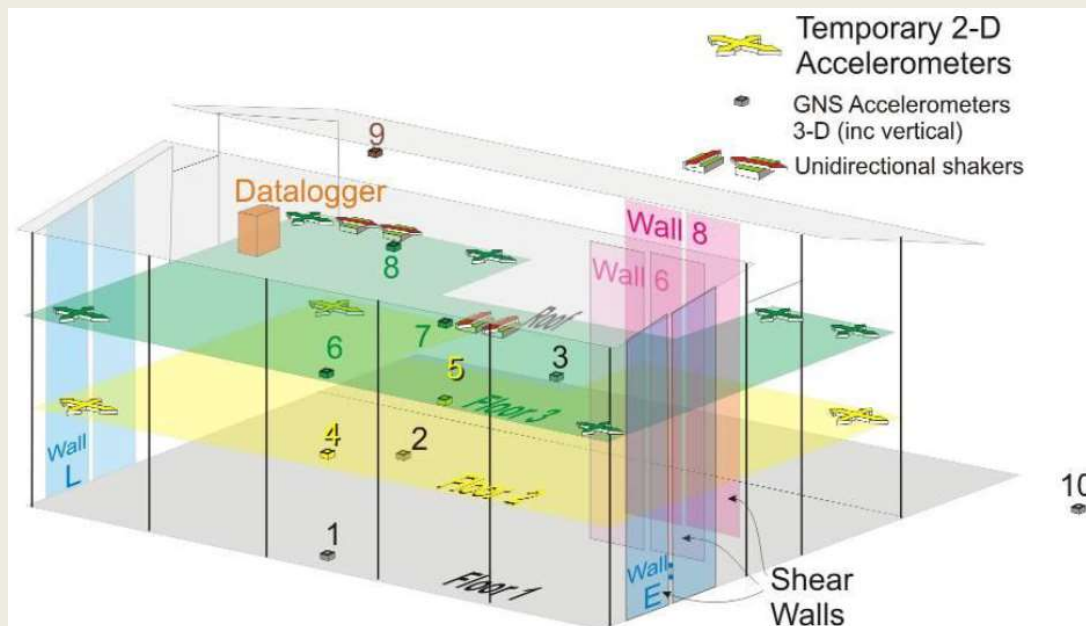
NE-DESTRUKTIVNE METODE ODREĐIVANJA STANJA

- mjerenje modula elastičnosti ultrazvukom



NE-DESTRUKTIVNE METODE ODREĐIVANJA STANJA

- eksperimentalna modalna analiza



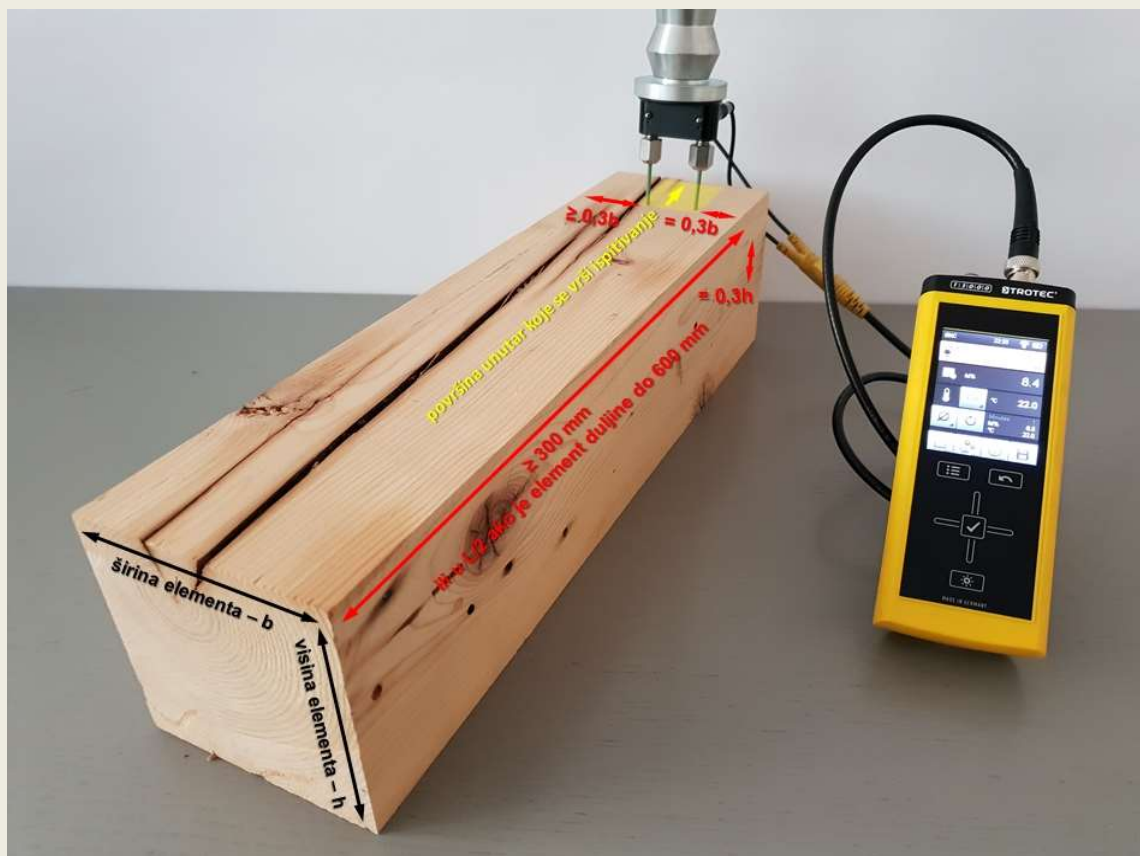
POLU-DESTRUKTIVNE METODE ODREĐIVANJA STANJA

- mjerenje gustoće



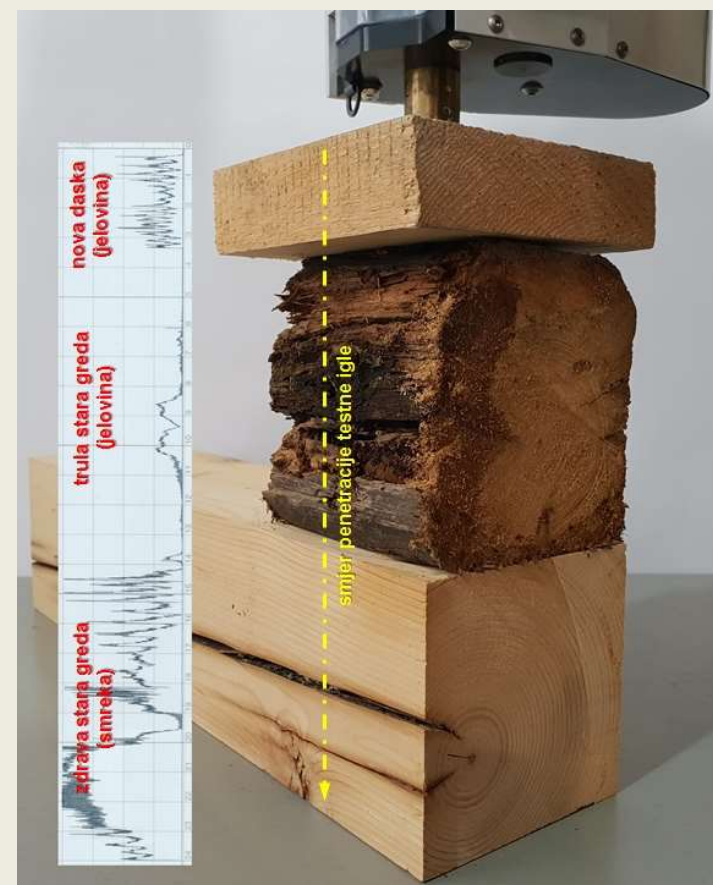
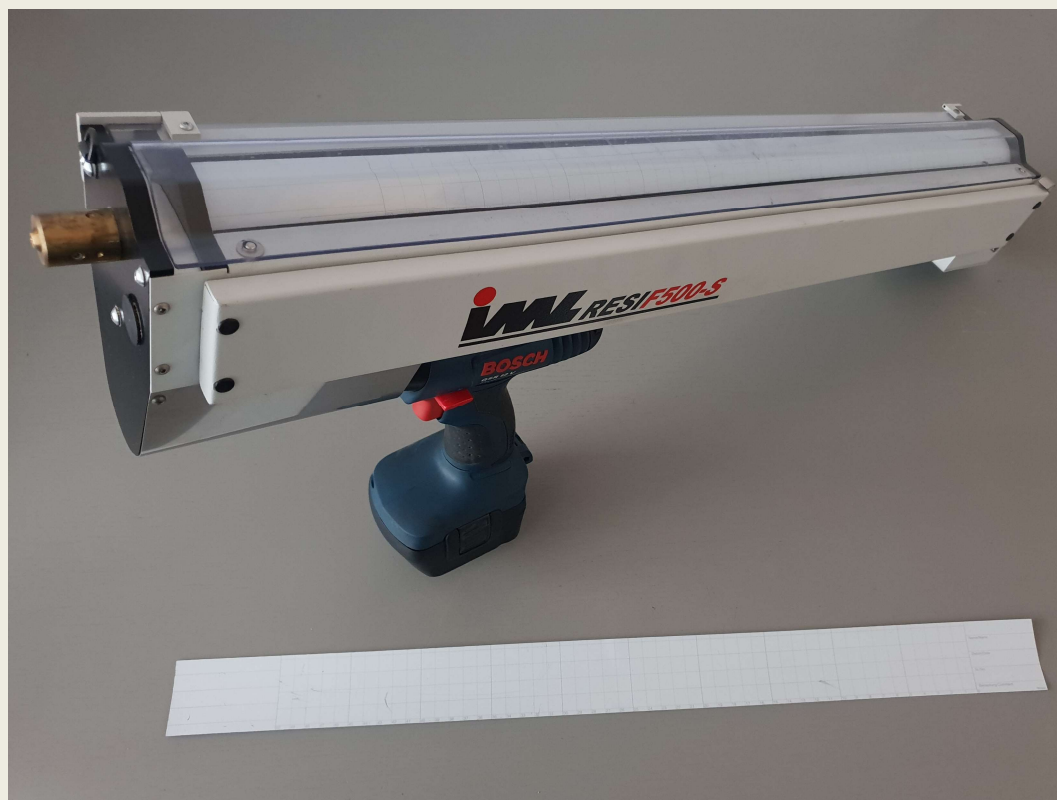
POLU-DESTRUKTIVNE METODE ODREĐIVANJA STANJA

- mjerenje vlage



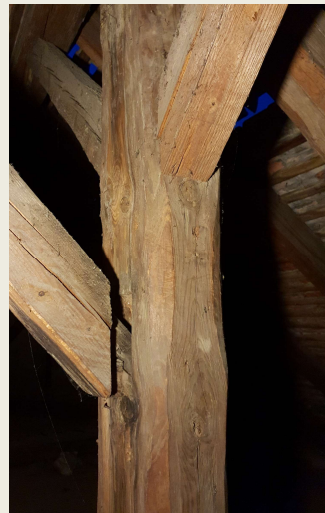
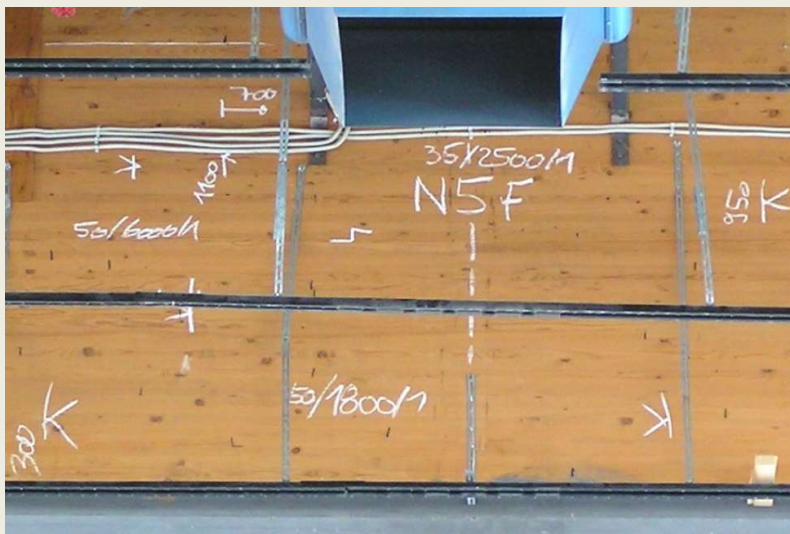
POLU-DESTRUKTIVNE METODE ODREĐIVANJA STANJA

- određivanje stanja presjeka



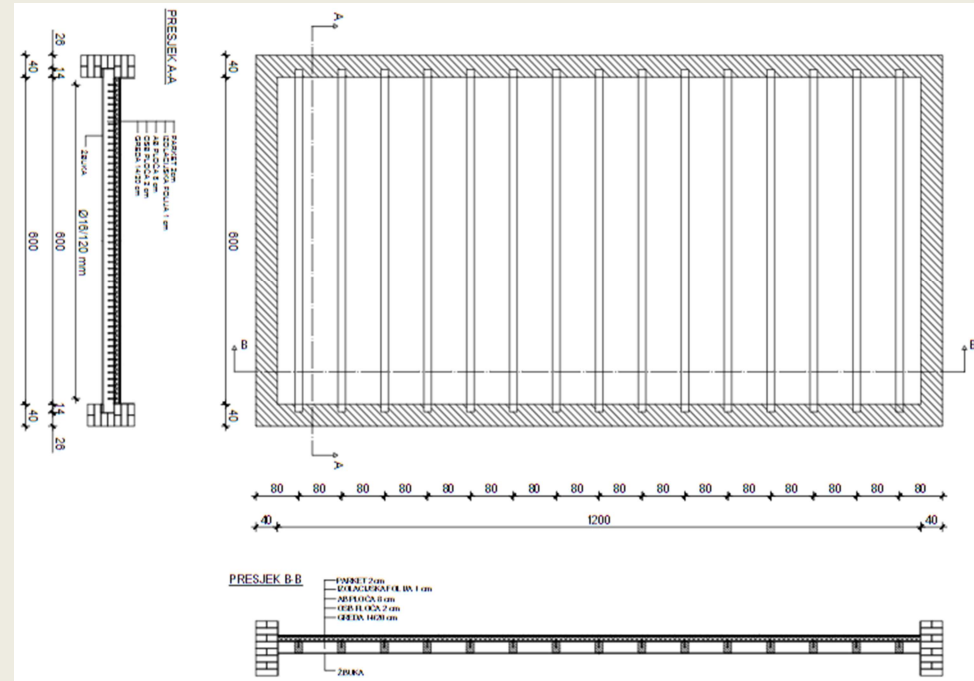
PROBLEMATIKA ANALIZE PODATAKA

- mapiranje te procjena važnosti pukotina, kao i općeg stanja konstrukcije



PROBLEMATIKA ANALIZE PODATAKA

- utjecaj trajnih deformacija



- Za ukupni progib mora biti zadovoljen sljedeći uvjet:

$$u_{inst}^{Gk,j} + u_{inst}^{Qk,j} \leq \frac{L}{200}$$

$$13,61 + 11,11 = 24,7 < \frac{6000}{200}$$

- Za ukupni progib mora biti zadovoljen sljedeći uvjet:

$$u_{inst}^{Gk,j} + u_{inst}^{Qk,j} \leq \frac{L}{200}$$

$$15,31 + 12,5 = 27,81 < \frac{6000}{200}$$

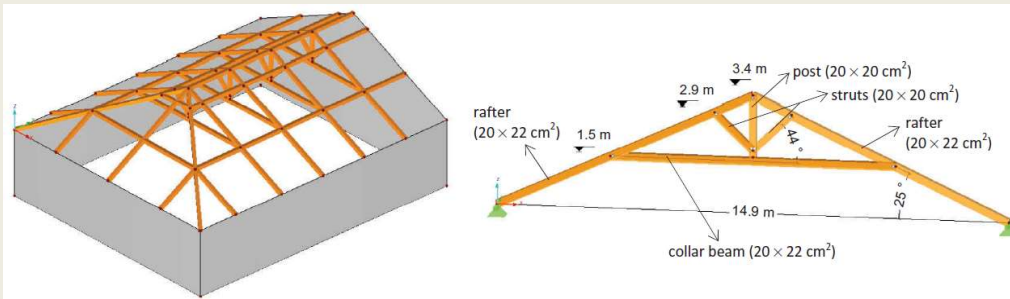
- Za ukupni progib mora biti zadovoljen sljedeći uvjet:

$$u_{inst}^{Gk,j} + u_{inst}^{Qk,j} \leq \frac{L}{200}$$

$$53,81 \text{ mm} < \frac{6000}{200} = 30 \text{ mm} \rightarrow \text{Ne zadovoljava!}$$

PROBLEMATIKA ANALIZE PODATAKA

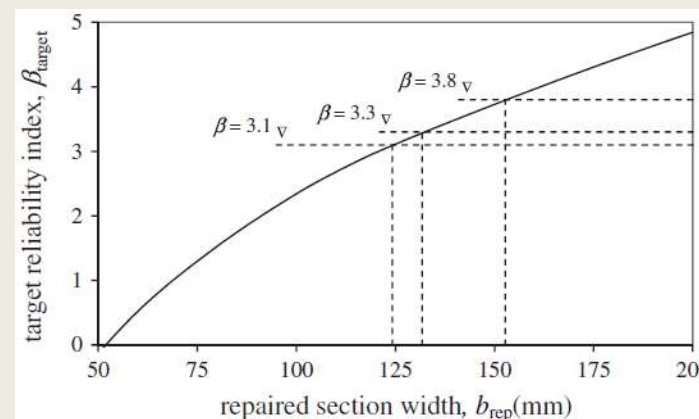
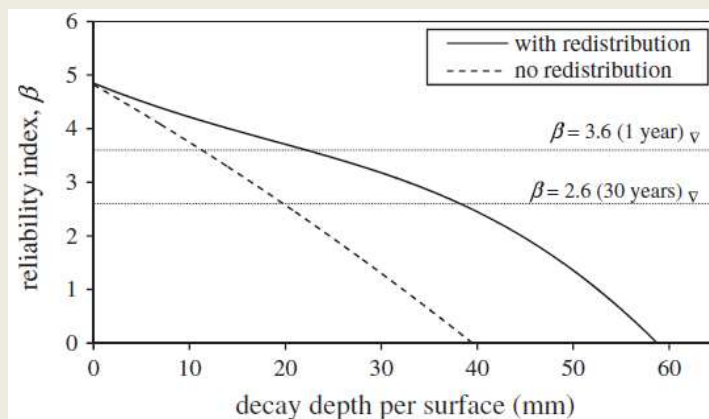
- pitanje ispravne procjene pouzdanosti



Lifetime	1 year		5 years		15 years		30 years	
	<500	>500	<500	>500	<500	>500	<500	>500
A_{col} (m ²)								
CC1	3.1	3.1	2.6	2.6	2.2	2.2	1.9	1.9
CC2	3.6	4.2	3.2	3.8	2.8	3.5	2.6	3.4
CC3	3.9	4.8	3.5	4.5	3.2	4.2	3.0	4.1

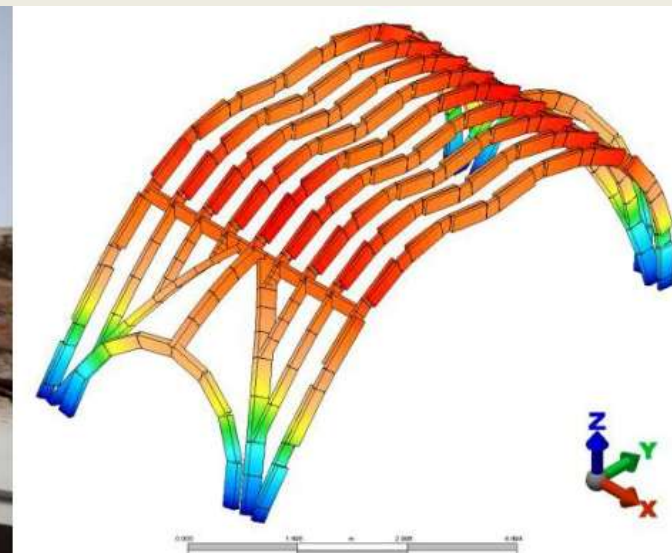
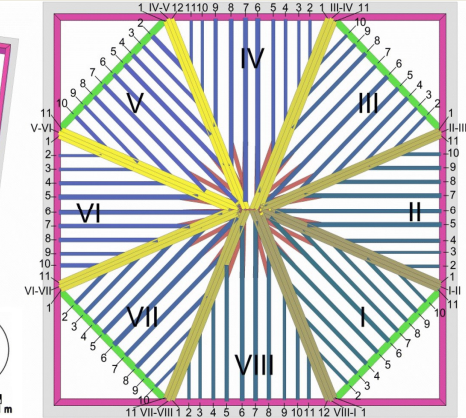
Variable	Distribution	Expected value	CoV
Bending strength, f_m	Lognormal	36.2 N/mm ²	0.25
Bending stiffness, E_m	Lognormal	11,000 N/mm ²	0.13
Compression parallel to the grain strength, $f_{c,0}$	Lognormal	29.2 N/mm ²	0.20
Permanent load, P	Normal	1.00 kN/m ²	0.10
Live load, Q	Gumbel	0.32 kN/m ²	0.40
Wind load - upwind, W_{up}	Gumbel	0.23 kN/m ²	0.35
Wind load - downwind, W_{down}	Gumbel	0.32 kN/m ²	0.35

$$G = 1 - \left(\left(\frac{\sigma_{c,0}}{f_{c,0} \cdot k_{mod}} \right)^2 + \left(\frac{\sigma_m}{f_m \cdot k_{mod}} \right)^2 \right)$$



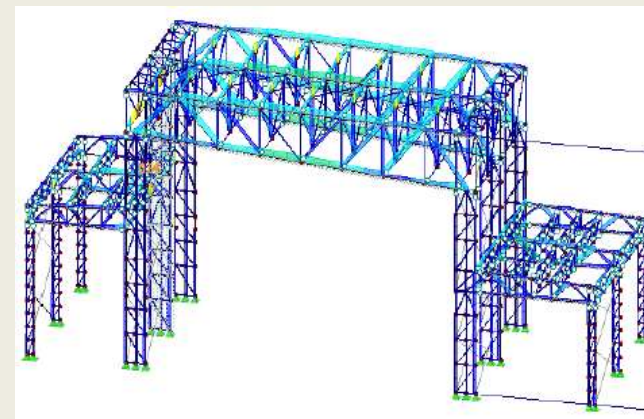
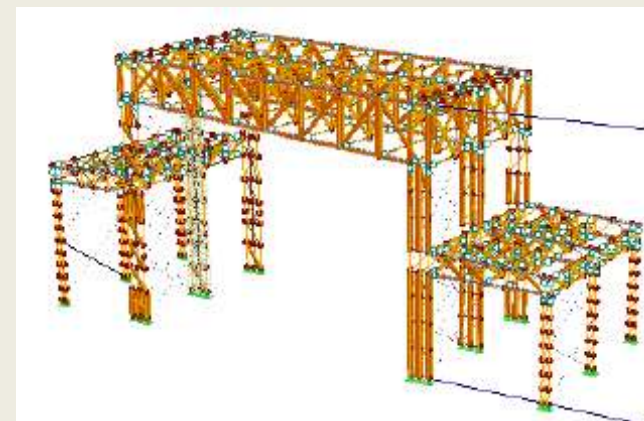
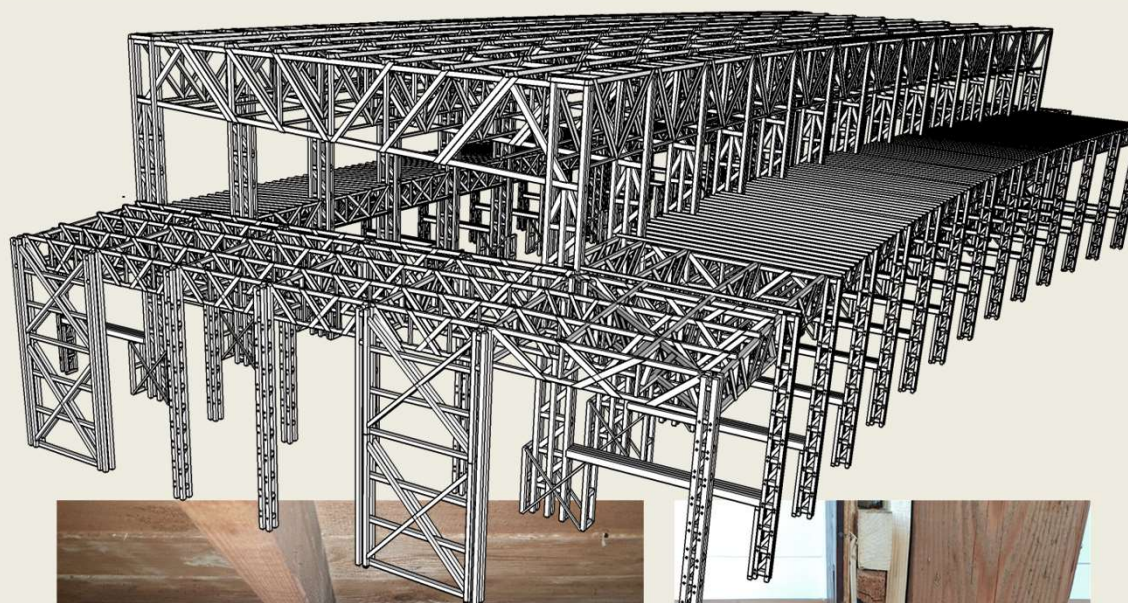
PROBLEMATIKA ANALIZE PODATAKA

- numerički modeli



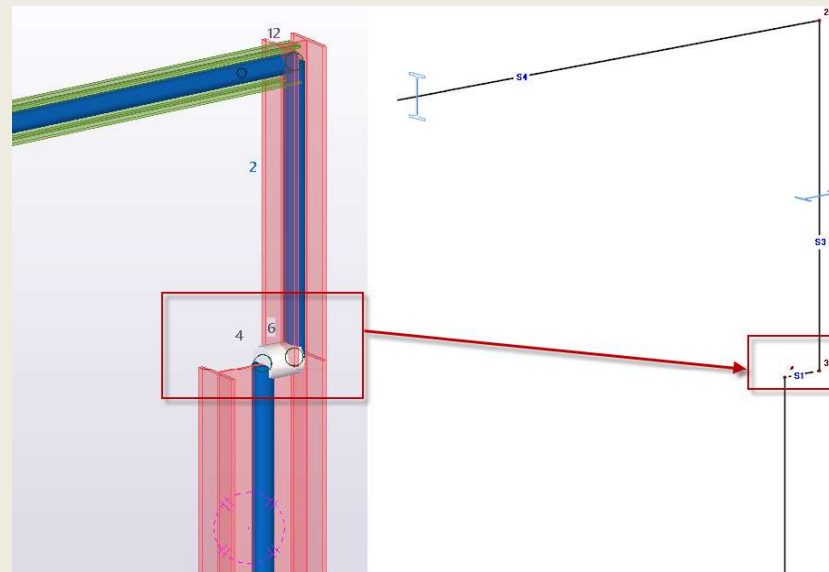
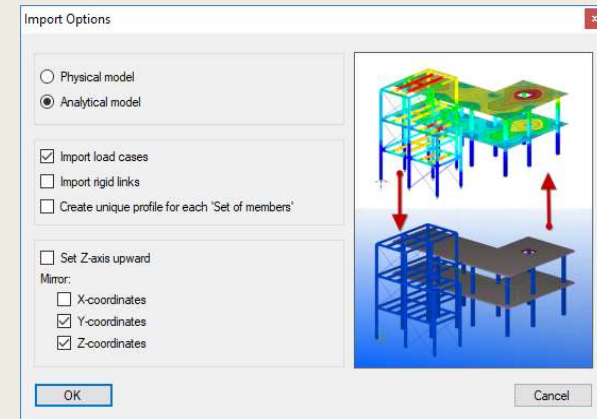
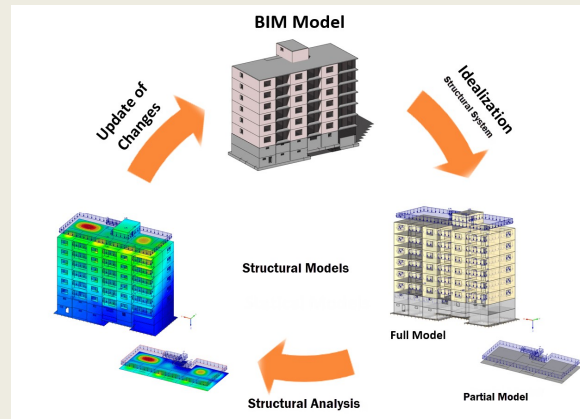
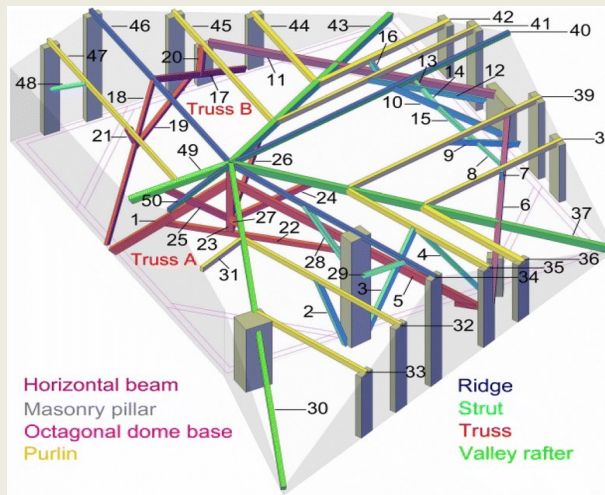
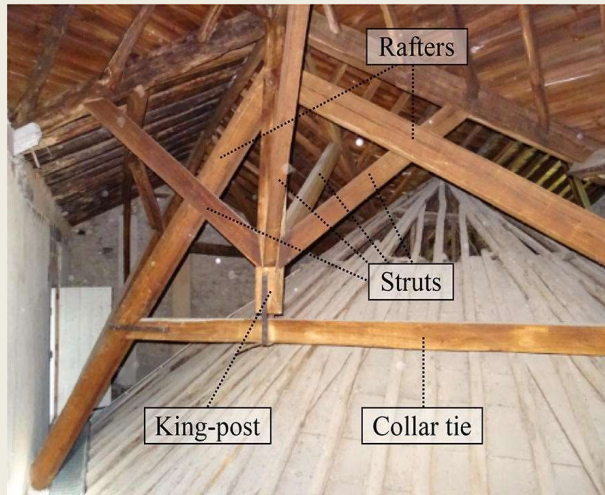
PROBLEMATIKA ANALIZE PODATAKA

- numerički modeli



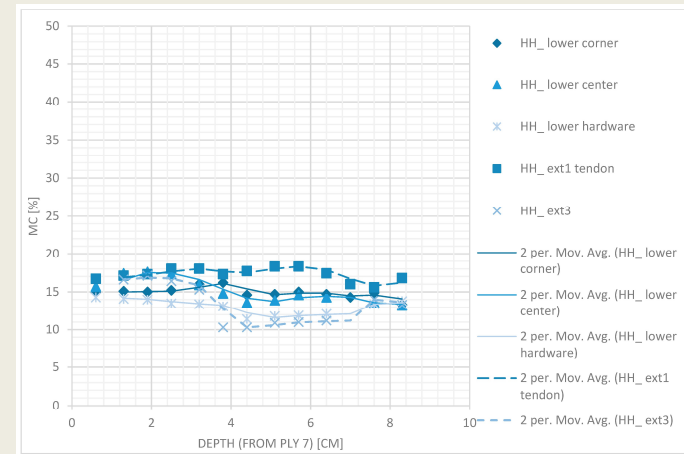
PROBLEMATIKA ANALIZE PODATAKA

- numerički modeli



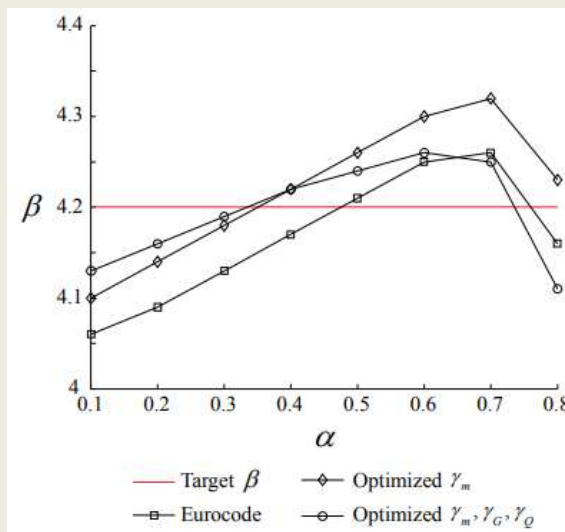
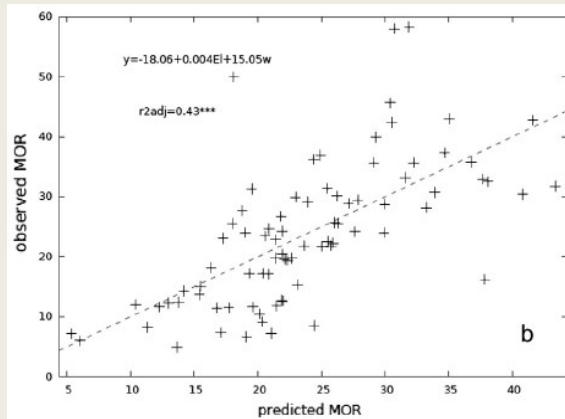
PROBLEMATIKA ANALIZE PODATAKA

- monitoring



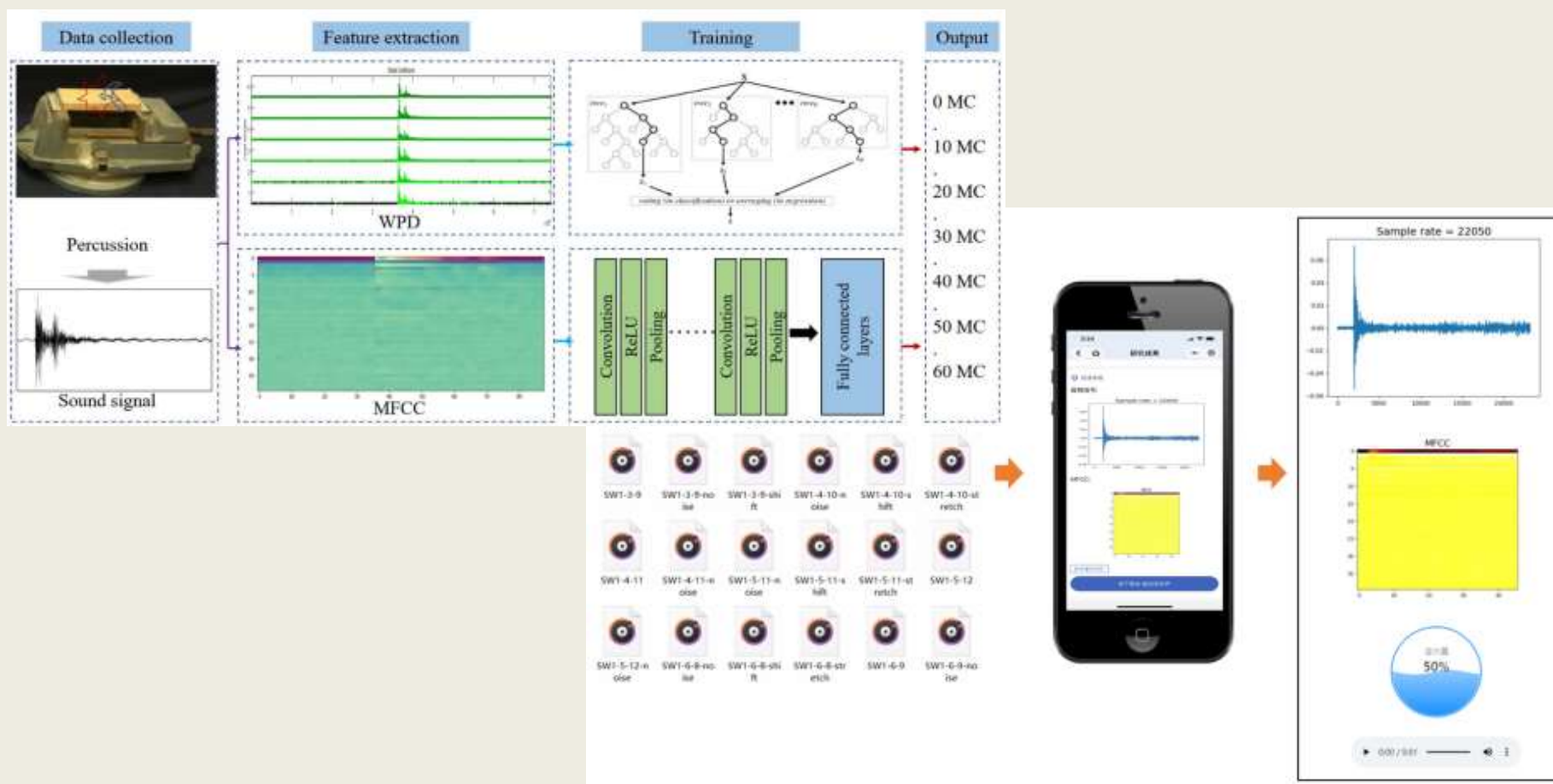
POHRANA I KORIŠTENJE PODATAKA

- virtualne baze



POHRANA I KORIŠTENJE PODATAKA

- neuralne mreže i umjetna inteligencija



PRIMJENA MODERNIH ORUĐA PRI SAKUPLJANJU, OBRADI I POHRANI PODATAKA OCJENE STANJA DRVENIH KONSTRUKCIJA

Hvala na pažnji!

