Sudjelovanje u EU projektima – važna karika za međunarodnu znanstvenu i stručnu prepoznatljivost

Meho Saša Kovačević

prof.dr.sc. Meho Saša Kovačević, dipl.ing.građ., Sveučilište u Zagrebu, Građevinski fakultet

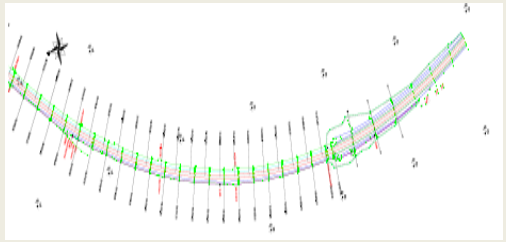
Sadržaj:

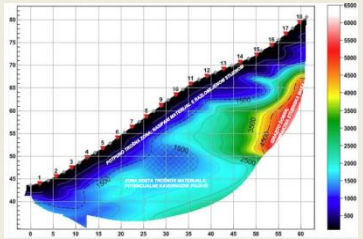

Sprega znanosti i gospodarstva
Domaća znanstvena i stručna prepoznatljivost
Sudjelovanje u EU projektima
Međunarodna znanstvena i stručna prepoznatljivost

HORIZON 2020

- HORIZON 2020. najveći je okvirni program EU-a za istraživanje, tehnologijski razvo i inovacije.
- Tijekom sedam godina (od 2014. do 2020.) dostupno je gotovo 80 milijardi eura za financiranje, uz privatna i nacionalna javna ulaganja koja će dodijeljeni novac privući.
- HORIZON 2020. pomoći će u postizanju pametnog, održivog i uključivog gospodarskog rasta.
- Cilj je osigurati da Europa stvara znanost i tehnologiju na svjetskoj razini, uklanja prepreke za inovacije i olakšava suradnju javnog i privatnog sektora u donošenju rješenja za velike izazove s kojima se europsko društvo suočava.
- Financiranje EU-a pomaže da Europa postane najbolje moguće okruženje za odgovornu i multidisciplinarnu suradnju u pogledu novih i budućih tehnologija.

ZAVOD ZA GEOTEHNIKU
GRAĐEVINSKOG FAKULTETA U ZAGREBU





Geodezija

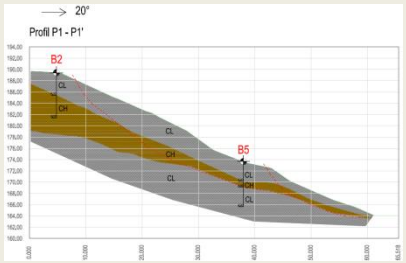
Geofizika

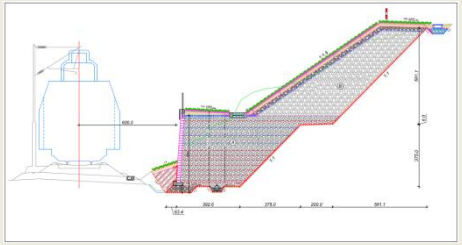
4G pristup

INTERDISCIPLINARNOST

Geologija

Geotehnika





ISTRAŽNI RADOVI
(teren i laboratorij)

ULAZ

PROJEKTIRANJE

1

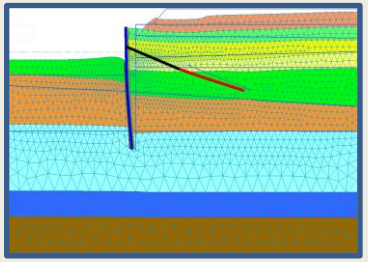
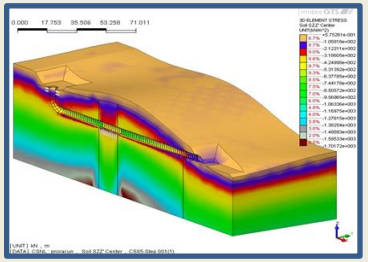
KONTROLA KVALITETE
i
MONITORING

2

REVIZIJE
i
KONZULTACIJE

3





Željeznički nasipi i klizišta (zadnjih 5 godina)

Željeznički tuneli
(zadnjih 5 godina)

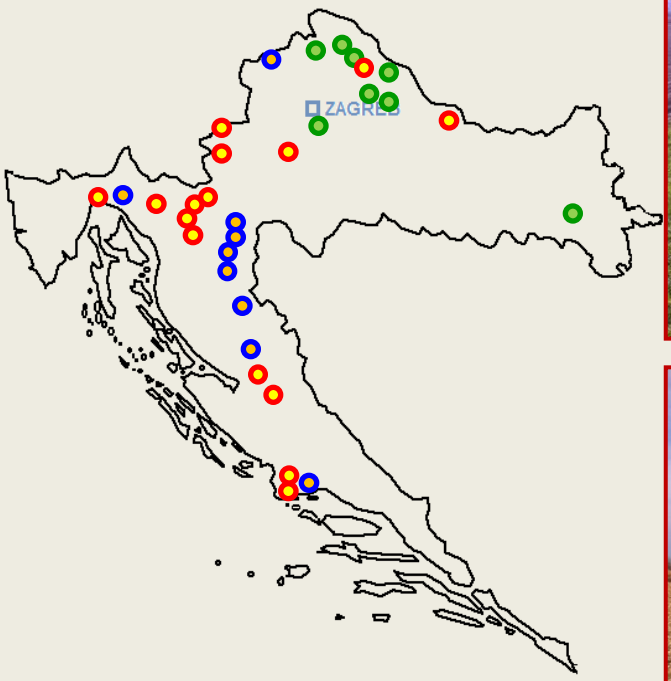
Lupinjak, 87 godina

Pelegrin, 97 godina

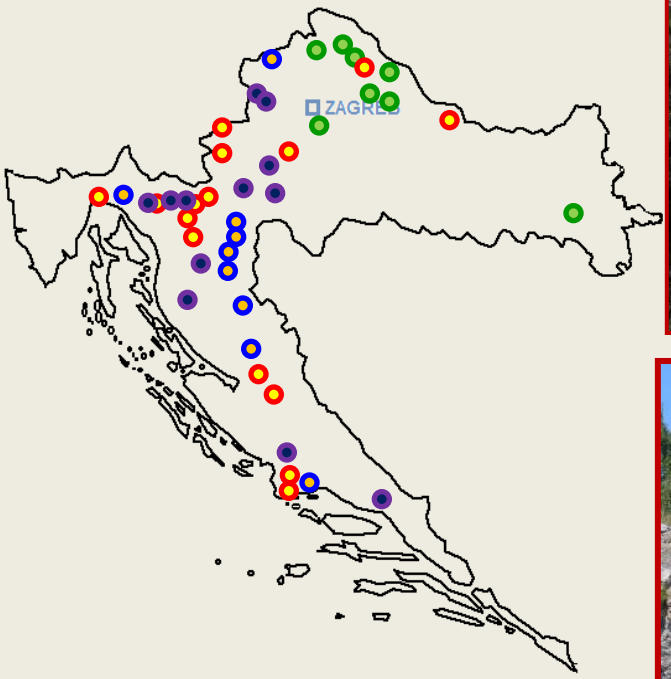
Dujmovača, 59 godina

Sinac, 2.3 km, 95 godina

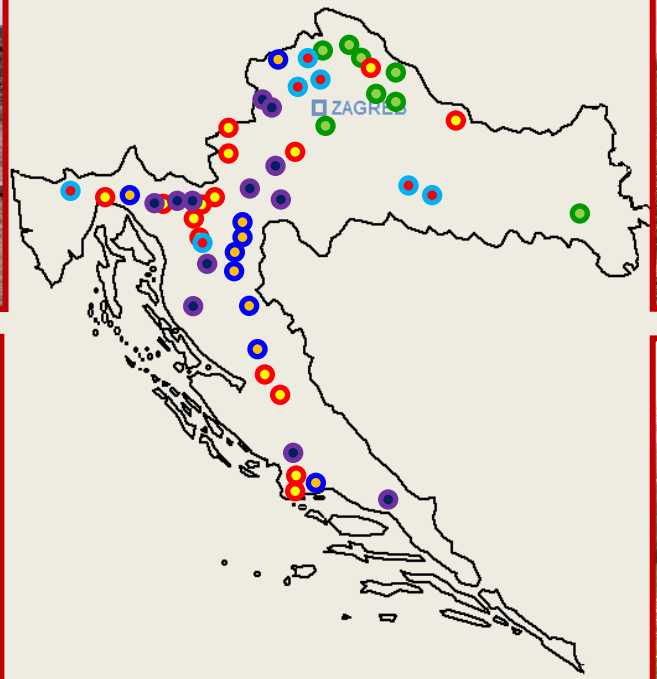
Nasipi za obranu od poplava (zadnjih 5 godina)



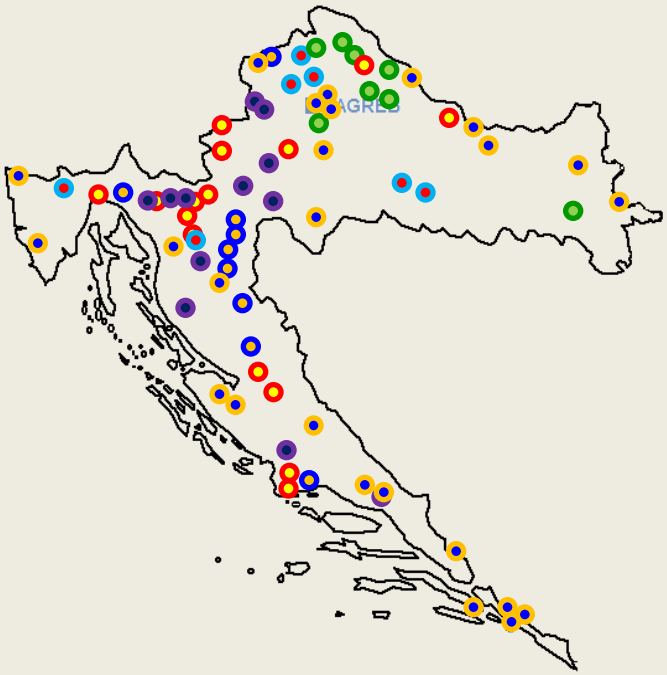
Autoceste i državne ceste
(zadnjih 5 godina)

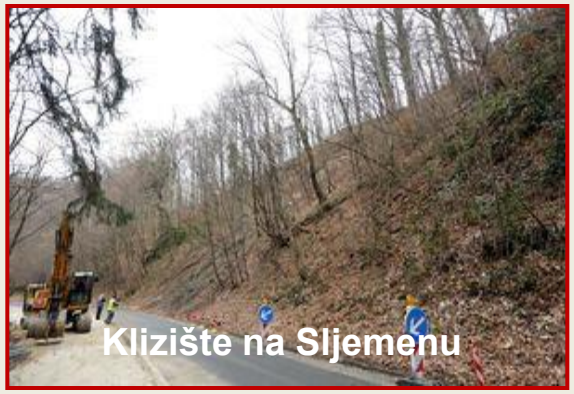


Aglomeracije
(zadnjih 5 godina)

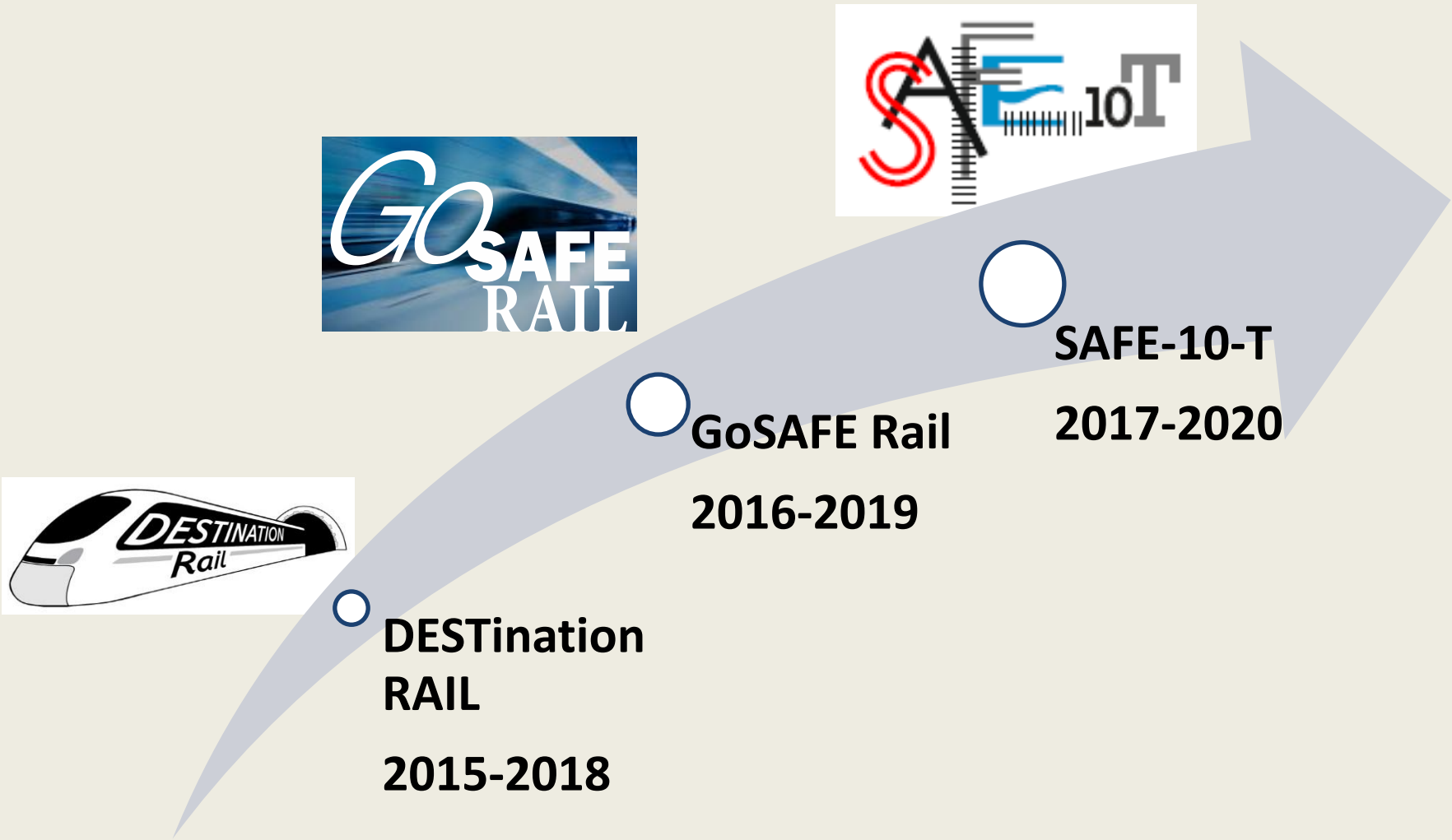


Ostale aktivnosti
(zadnjih 5 godina)





EU Horizon 2020 projekti



DESTinationRAIL

DESTinationRAIL - Decision Support Tool for Rail Infrastructure Managers – 4 000.000 EUR, 2015 - 2018

The project provides solutions for common infrastructure problems encountered in diverse regions of Europe, e.g. deterioration and scour damage to bridges, slope instability, damage to switches and crossings and track performance.

DESTinationRAIL

DESTinationRAIL

no	Institution	Country
1	Gavin & Dorethy Geosolutions (GDG) - coordinator	Ireland
2	Open Track Railway Technology (OTRT)	Austria
3	Faculty of Civil Engineering, University of Zagreb (FCEUZ)	Croatia
4	Croatian Railways (HZ)	Croatia
5	Irish Rail (IE)	Ireland
6	Roughan O'Donovan Innovation Solutions (ROD)	Ireland
7	Technical University of Munich (TUM)	Germany
8	University of Twente (UT)	Netherlands
9	Norwegian Geotechnical Institute (NGI)	Norway
10	Norwegian National Technical University (NTNU)	Norway
11	Slovenian National Building and Civil Engineering (ZAG)	Slovenia
12	Slovenian Railways (SZ)	Slovenia
13	Eidgenoessische Technische Hohchule Zurich (ETH)	Switzerland
14	Transport Research Laboratory (TRL)	UK
15	Robson's International Rail Consultancy (RIRC)	UK

SME **Academia / research institute** **Railway management company**

Primjena multi geofizičkog pristupa za ocjenu stanja željeznica

- širok raspon geofizičkih metoda kojima se na nedestruktivan način određuju struktrurno-geološke karakteristike tla i stijena

1. Georadarsko snimanje

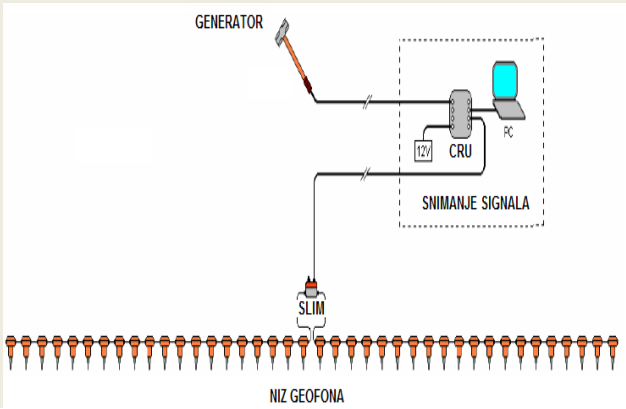
2. Seizmička refrakcija i seizmička refleksija

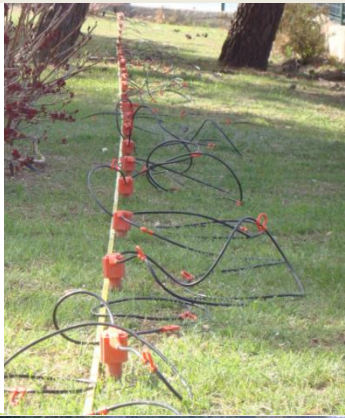
3a. Spektralna analiza površinskih valova

3b. Multikanalna analiza površinskih valova

3c. Kontinuirana analiza površinskih valova

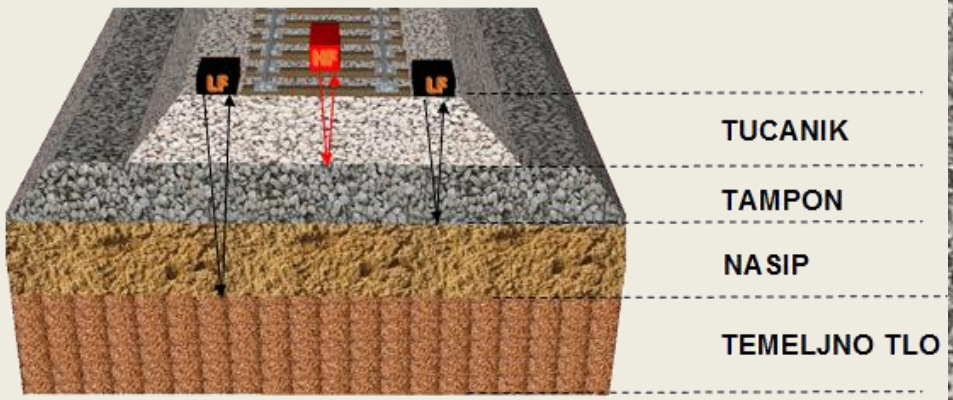
4. Mjerenje vibracija





NADZORNO SREDIŠTE	LINE	SECTIONS (from – to)	LENGTH (km)	TOTAL LENGTH (km)
VARAŽDIN	R201: Zaprešić-Čakovec	57+069 - 88+389	31.32	31.32
	M501: DG-Čakovec-Kotoriba-DG	84+396 - 90+893	6.50	6.50
	L103: Zabok-Đurmanec	0+206 - 16+186	15.98	15.98
	R201: Varaždin-Ludbreg	228+067 - 223+974	4.10	4.10
			NADZORNO SREDIŠTE VARAŽDIN, TOTAL	57.90
SLAVONSKI BROD	M105: Novska - Tovarnik - DG	221+600 - 227+400	5.80	
		244+700 - 249+700	5.00	
		256+100 - 260+400	4.30	15.10
	M303: Striz./Vrp. – Sl. Šamac – DG	5+700 - 9+500	3.80	3.80
			NADZORNO SREDIŠTE SLAVONSKI BROD, TOTAL	18.90
RIJEKA	M602: Škrljevo - Bakar	8+170 - 9+150	0.98	0.98
			NADZORNO SREDIŠTE RIJEKA, TOTAL	0.98
OSIJEK	R202: Varaždin - Dalj	65+000 - 69+000	4.00	4.00
	L209: Vinkovci - Osijek	7+800 - 8+600	0.80	0.80
	M301: DG - B.Manastir - Osijek	4+900 - 5+000	0.10	0.10
			NADZORNO SREDIŠTE OSIJEK, TOTAL	4.90
OGULIN	M202: Zagreb GK – Rijeka	486+900 - 487+000	0.10	
		490+000 - 496+720	6.72	
		498+800 - 502+130	3.33	
		506+490 - 517+100	10.61	
		520+250 - 523+470	3.22	23.98
	L104: Karlovac – Kamanje – DG	22+950 - 25+100	2.15	2.15
	M604: Oštarije – Knin – Split	6+700 - 7+800	1.10	
		16+700 - 19+500	2.80	
		21+450 - 24+000	2.55	
		33+700 - 35+720	2.02	
		37+700 - 39+500	1.80	
		43+000 - 45+000	2.00	
		51+380 – 51+440	0.06	
		55+380 - 55+440	0.06	
		65+000 – 65+200	0.20	
		67+700 - 69+900	2.20	
		79+900 - 81+400	1.50	
		83+700 - 85+760	2.06	
		87+280 - 93+100	5.82	
		95+000 - 95+700	0.70	24.87
			NADZORNO SREDIŠTE OGULIN, TOTAL	51.00
VINKOVCI	R105: Vinkovci - Drenovci - DG	49+400 - 50+550	1.15	1.15
			NADZORNO SREDIŠTE VINKOVCI, TOTAL	1.15
PULA	R101: DG - Buzet-Pula	71+000-71+600	0.60	
		34+540-34+580	0.40	
		63+422-70+286	6.86	
		36+800 - 36+950	0.15	
		70+200 - 70+300	0.10	8.11
			NADZORNO SREDIŠTE PULA, TOTAL	8.11
ZAGREB	M401: Sesvete - Sava	0+664 - 10+444	11.11	11.11
	M407: Sava- V. Gorica	10+444 - 16+739	6.30	6.30
	R102: Sunja - Volinja - DG	0+374 - 21+278	21.65	21.65
			NADZORNO SREDIŠTE ZAGREB, TOTAL	39.06
			TOTAL	183.00

- **Georadarsko snimanje** (GPR - Ground Penetrating Radar), predstavlja elektromagnetnu metodu koja omogućuje dobivanje visoko rezolutne slike dielektričnih karakteristika ispitivanog medija. Frekvencija georadara određuje dva ključna parametra ispitivanja – dubinu ispitivanja i rezoluciju.



- Nakon što su prikupljeni svi podaci proveo se postupak kategorizacije koristeći višekriterijalnu analizu primjenom **tzv. 'utility' funkcije.**

$$U(S_j)=\sum_{i=1}^{n} w_i \overline{U_i}(S_j) \qquad j=1,2,\ldots,m$$

$$w_i=\frac{R_i}{\sum_{k=1}^{n} R_k} \qquad i=1,2,\ldots,n$$

$$\sum_{i=1}^{n} w_i = 1$$

$$\overline{U_i}(S_j)=\frac{U_i(S_j)}{\sum_{k=1}^{m} U_i(S_k)} \qquad i=1,2,\ldots,n;\ j=1,2,\ldots,m$$

KONAČNA KATEGORIZACIJA

$$\sum_{j=1}^{m} U(S_j)=1 \qquad \sum_{i=1}^{n} \overline{U_i}(S_j)=1 \qquad i=1,2,\ldots,n$$

KATEGORIJA	GRAFIČKI	
1		→ izrazito loše stanje
2		→ loše stanje
3		→ zadovoljavajuće stanje
4		→ dobro stanje
5		→ odlično stanje

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	REKAPITULACIJA (km)				
	1	2	3	4	5
NADZORNO SREDIŠTE VARAŽDIN	9.2	14.5	11.9	3.6	0.7
NADZORNO SREDIŠTE SLAVONSKI BROD	3.0	7.7	6.8	0.9	0.2
NADZORNO SREDIŠTE RIJEKA	0.1	0.2	0.8	0.0	0.0
NADZORNO SREDIŠTE OSIJEK	0.7	3.2	1.0	0.0	0.0
NADZORNO SREDIŠTE OGULIN	8.7	14.5	10.8	4.8	2.2
NADZORNO SREDIŠTE VINKOVCI	0.0	0.2	0.8	0.2	0.0
NADZORNO SREDIŠTE PULA	0.8	2.8	3.8	1.3	0.2
NADZORNO SREDIŠTE ZAGREB	5.1	15.1	23.6	14.2	2.8
UKUPNO	27.6 (15.6 %)	58.2 (33.0%)	59.5 (33.7%)	25.0 (14.2%)	6.1 (3.5%)

DESTinationRAIL

Primjena bespilotnih letjelica (dronova) za ocjenu stanja infrastrukturnih građevina

- U novije vrijeme, u svrhu fotogrametrijskih snimanja, sve se češće koriste bespilotne letjelice (eng. UAV - Unmanned Aerial Vehicle) poznatije i pod imenom „dron“.




- To su letjelice ili zrakoplovi bez posade, koje se mogu nadzirati na daljinu ili letjeti samostalno uporabom unaprijed programiranog plana leta ili pomoću složenih autonomnih dinamičkih sustava.




PVC folija radi sprečavanja inflitracije oborinskih voda

kameni nabačaj (privremeno rješenje)

karakteristični poprečni presjeci za proračune

vidljive pukotine na kliznom tijelu




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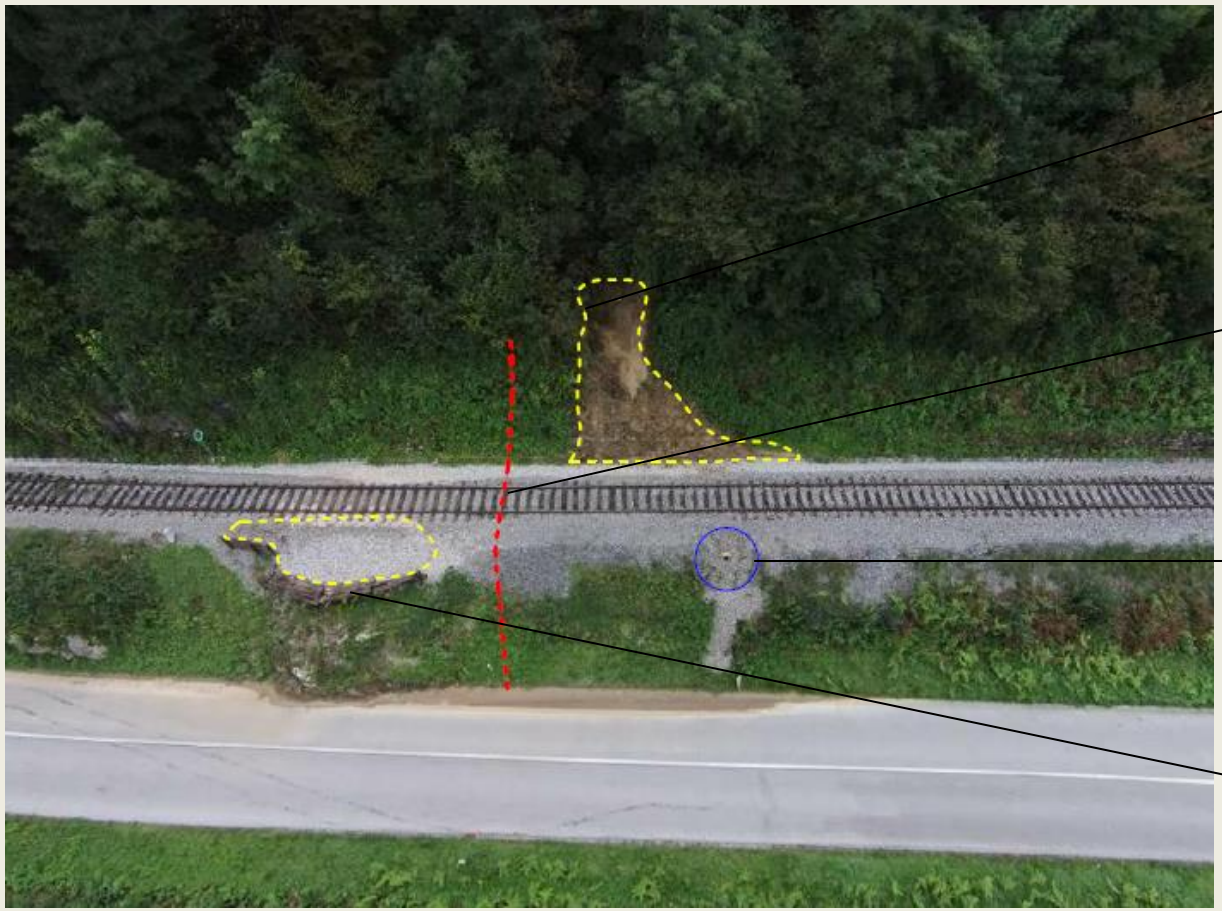

klizište iznad pruge radi neadekvatne odvodnje

karakterističnipoprečni presjek za proračune

začepljeni odvodni kanal

deformiranje postojeće podupore (zabijene željezničke šine i drveni pragovi) uslijed klizanja

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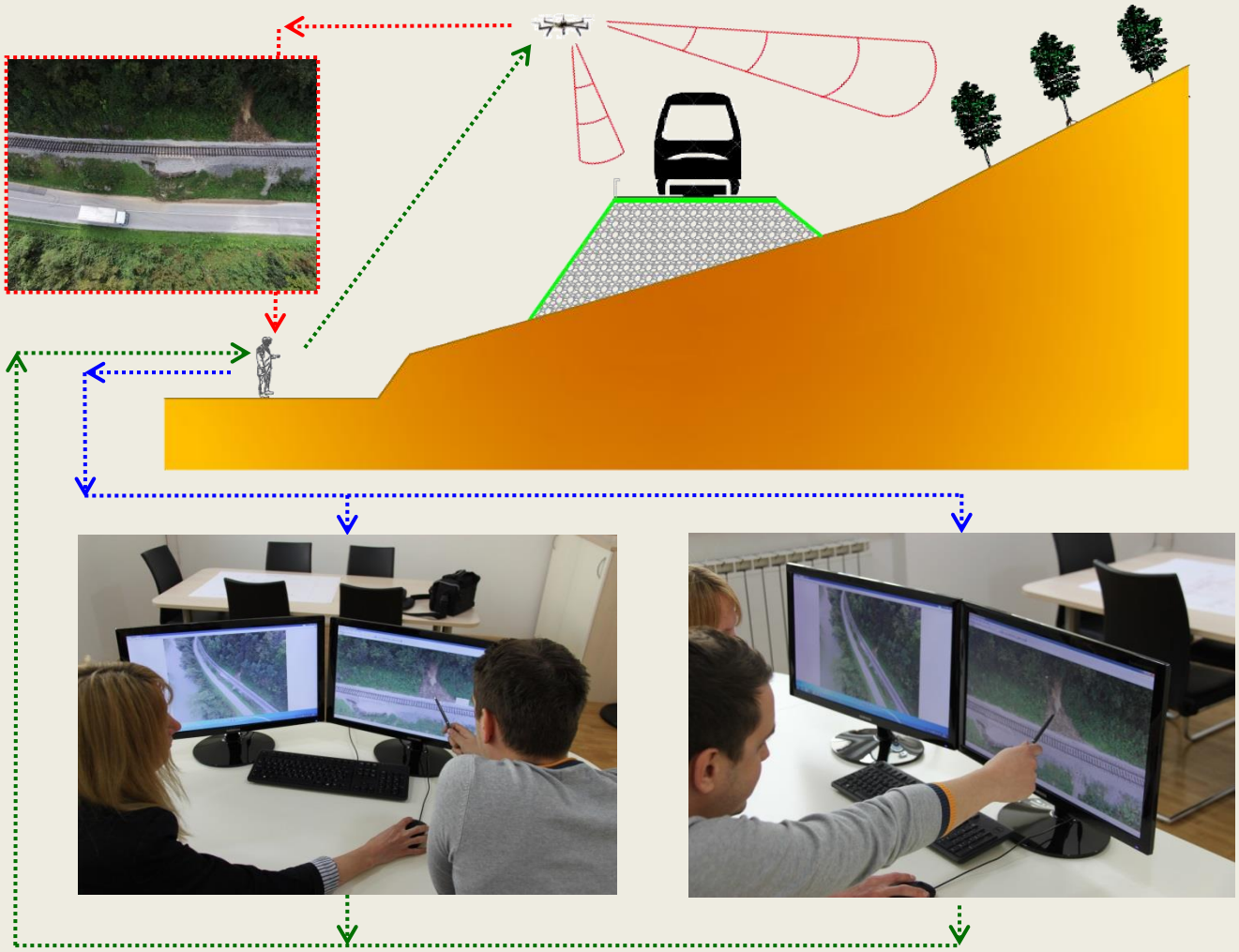




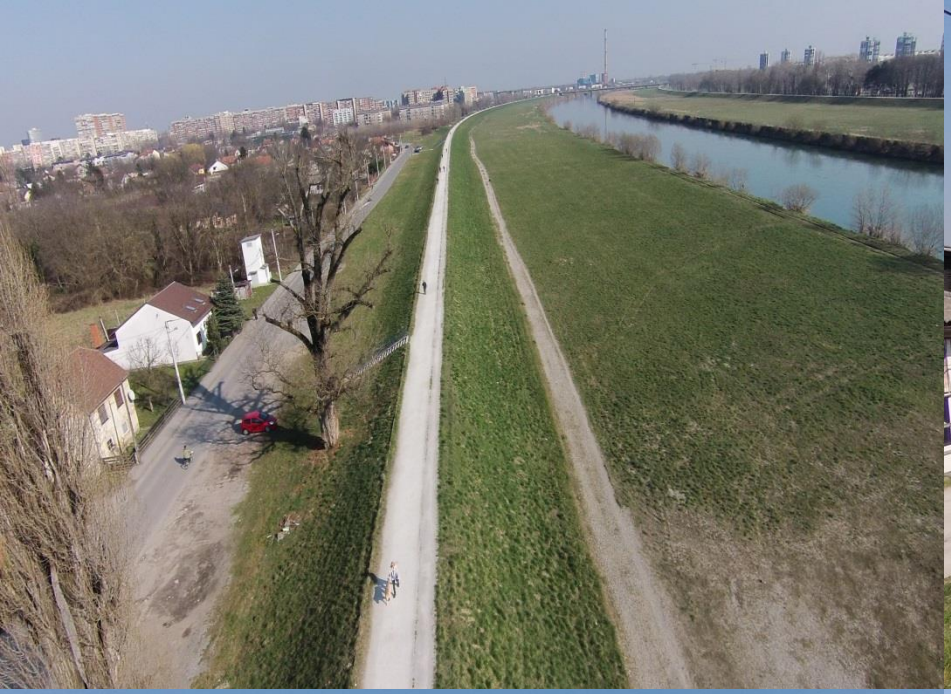


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Nasip Varaždin – Dalj

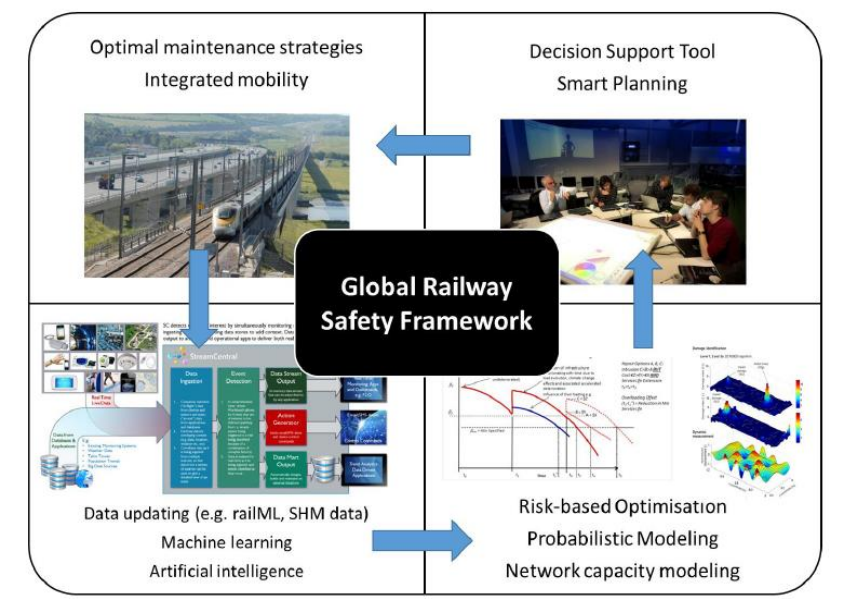
DESTinationRAIL

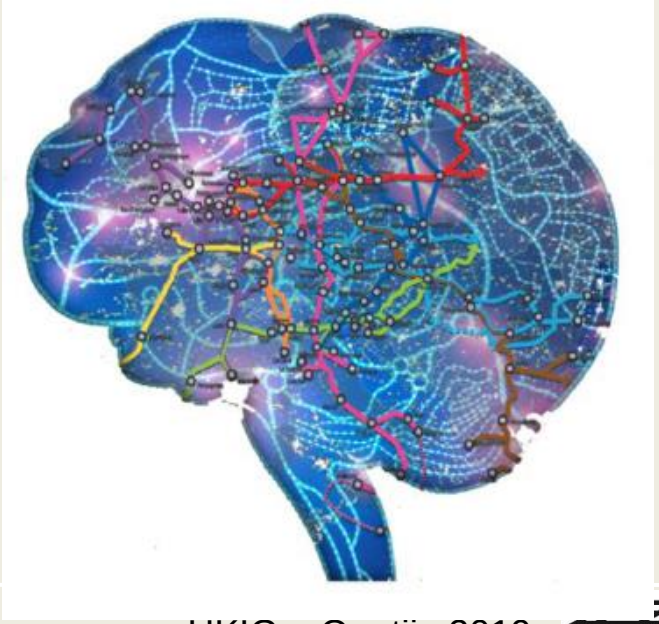
Odron Jurdani

GoSAFE RAIL

GoSAFE RAIL - Global Safety Management Framework for RAIL Operations – 1 300.000 EUR, 2016 - 2019

The project will bring together inter-disciplinary experts from Risk based asset assessment of infrastructure, Artificial Intelligence (AI), object detection and data management sectors with leaders in network micro-simulation modelling to deliver a Decision Support Tool that will allow a step change for infrastructure safety.



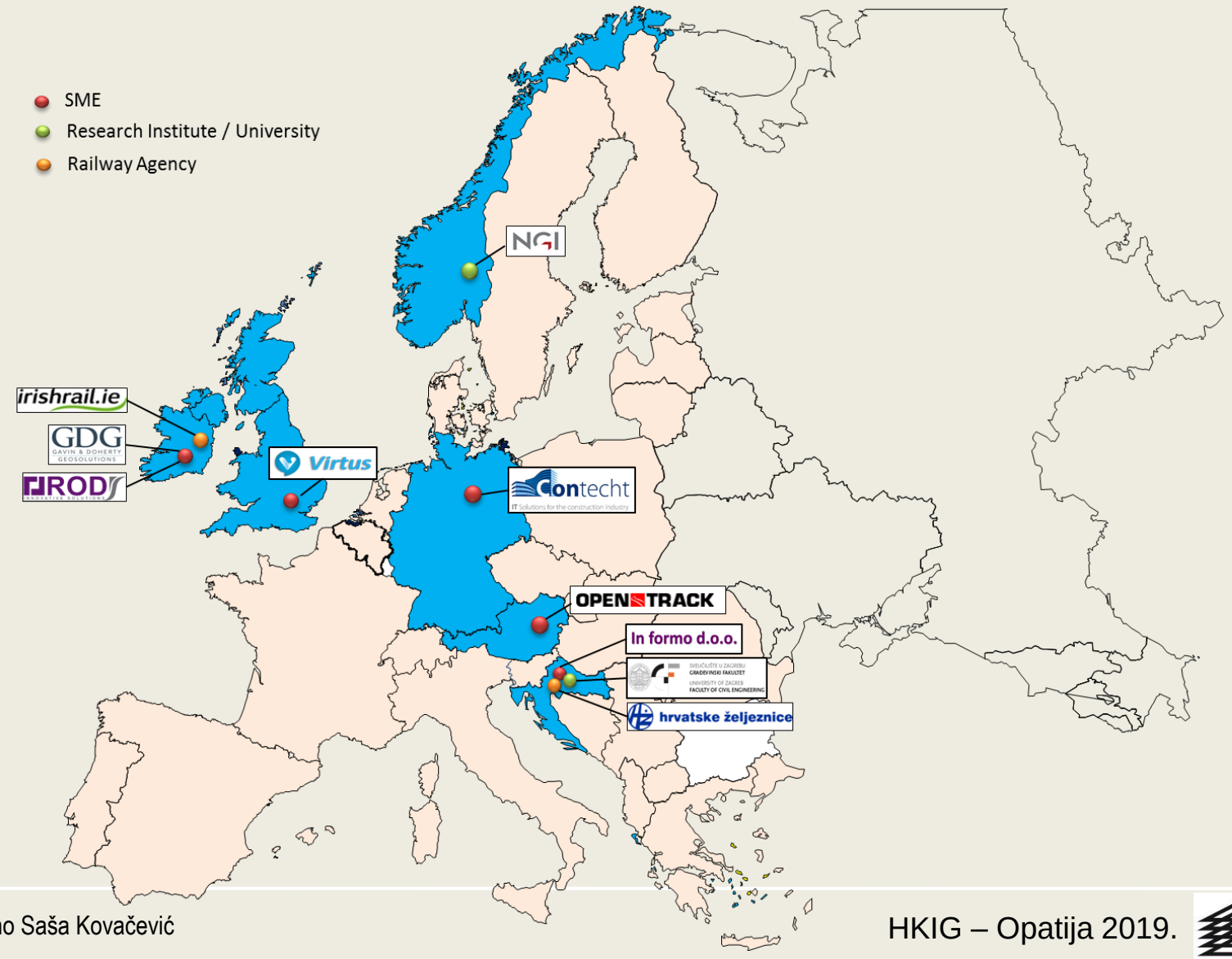


GoSAFE RAIL

no	Institution	Country
1	Gavin & Dorethy Geosolutions (GDG) - coordinator	Ireland
2	Open Track Railway Technology (OTRT)	Austria
3	Faculty of Civil Engineering, University of Zagreb (FCEUZ)	Croatia
4	Infra Plan Konzalting (IPK)	Croatia
5	Croatian Railways (HZ)	Croatia
6	Irish Rail (IE)	Ireland
7	Roughan O'Donovan Innovation Solutions (ROD)	Ireland
8	Norwegian Geotechnical Institute (NGI)	Norway
9	Contecht B.V. (CT)	Germany
10	Virtus IT Limited (VT)	UK

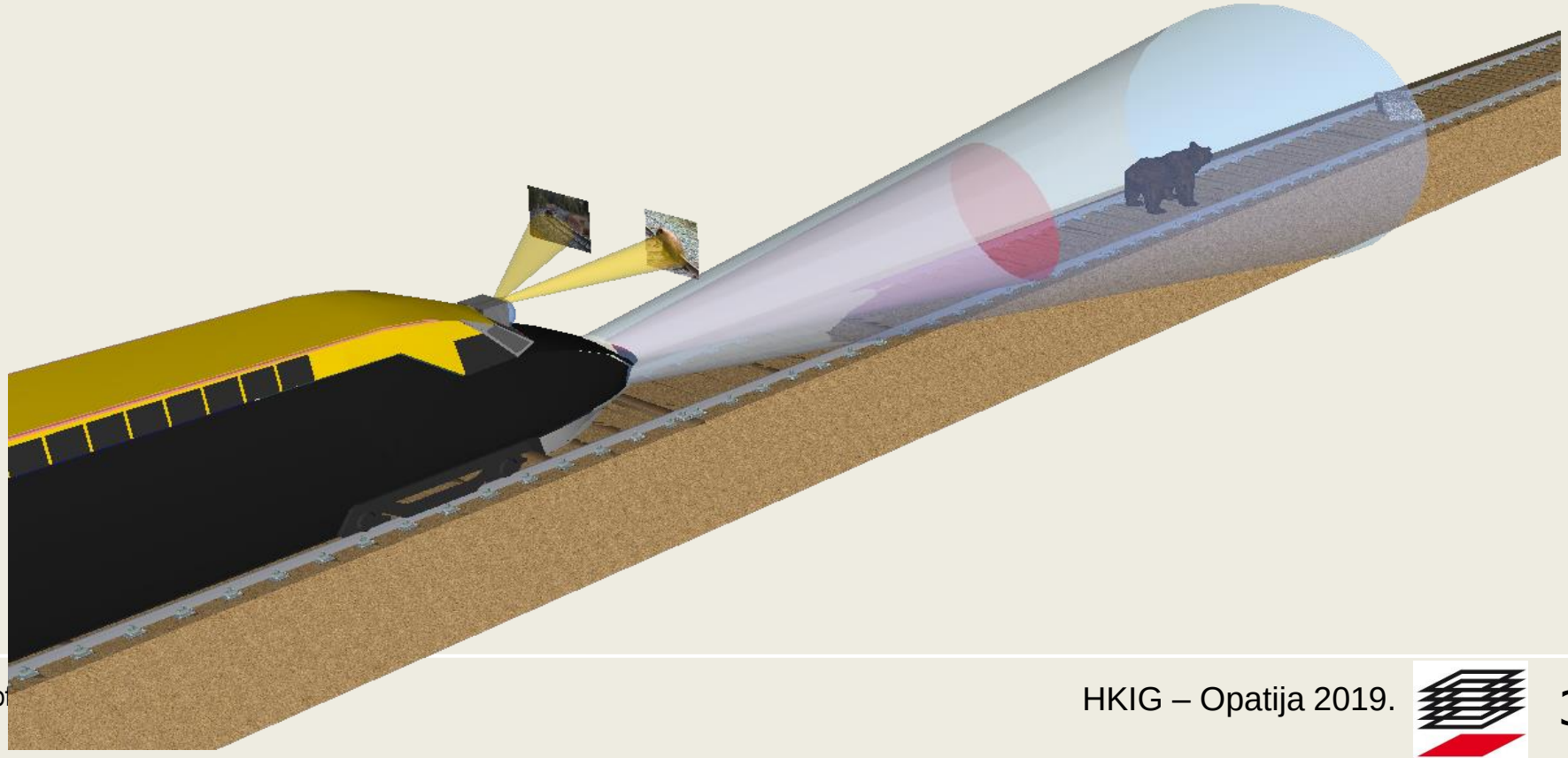
SME **Academia / research institute** **Railway management company**

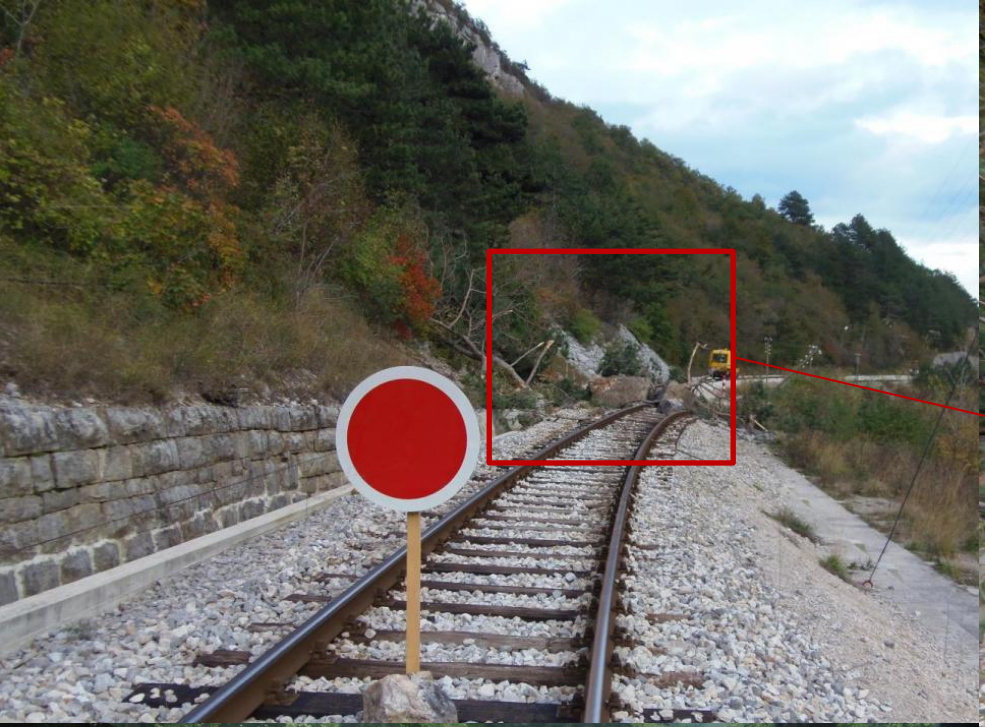
GoSAFE RAIL

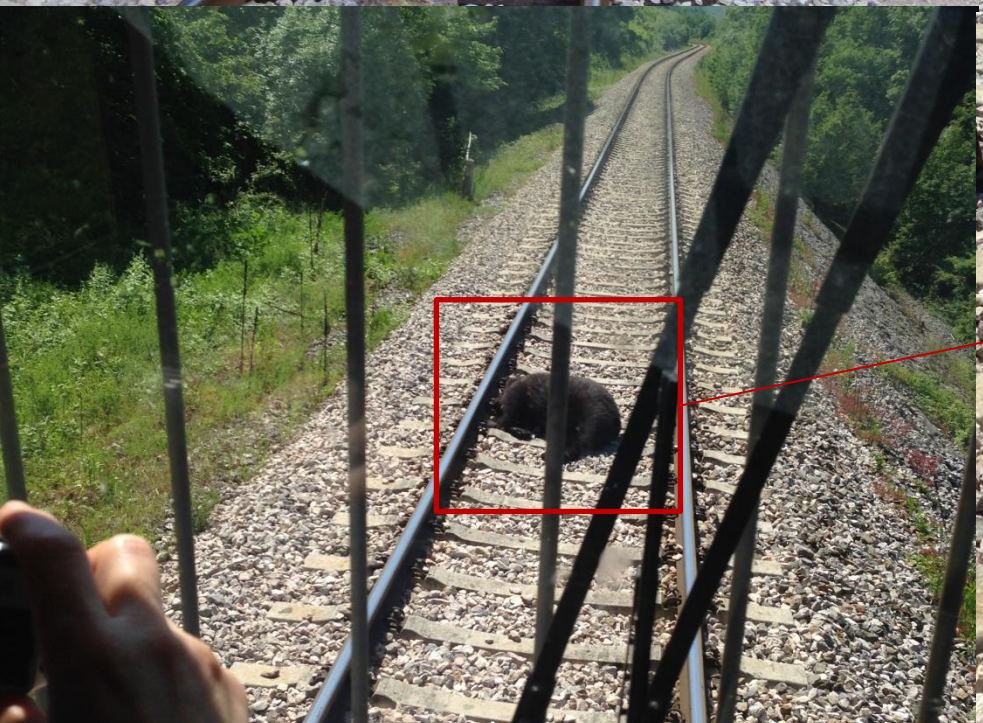

SME
Research Institute / University
Railway Agency
NGI
irishrail.ie
GDG
GAVIN & DOHERTY GEOSOLUTIONS
RODL
Virtus
contecht
IT Solutions for the construction industry
OPEN TRACK
In formo d.o.o.
hrvatske željeznice

GoSAFE RAIL

Razvoj sustava monitoringa za detekciju potencijalnih prepreka duž željezničkih mreža kombinacijom niza kamera, laserskih te radarskih snimanja primjenom algoritma strojnog učenja.







MATLAB

U ovom trenutku istražujemo različite tehnike za detektiranje prepreka na pruzi kao što su ljudi, životinje, vozila, odroni, klizišta, drveće i sl., između kojih su:

- Image comparison
- Movement detection
- Pattern recognition and
- Mashine learning algorithms

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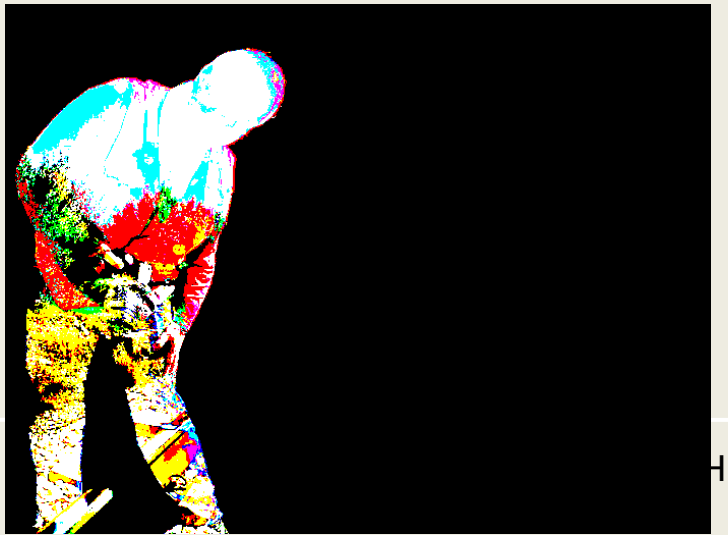


GoSAFE RAIL

GoSAFE RAIL

GoSAFE RAIL

GoSAFE RAIL

SAFE-10-T

SAFE-10-T - Safety of Transport Infrastructure on the TEN-T Network 3 000.000 EUR, 2017 - 2020

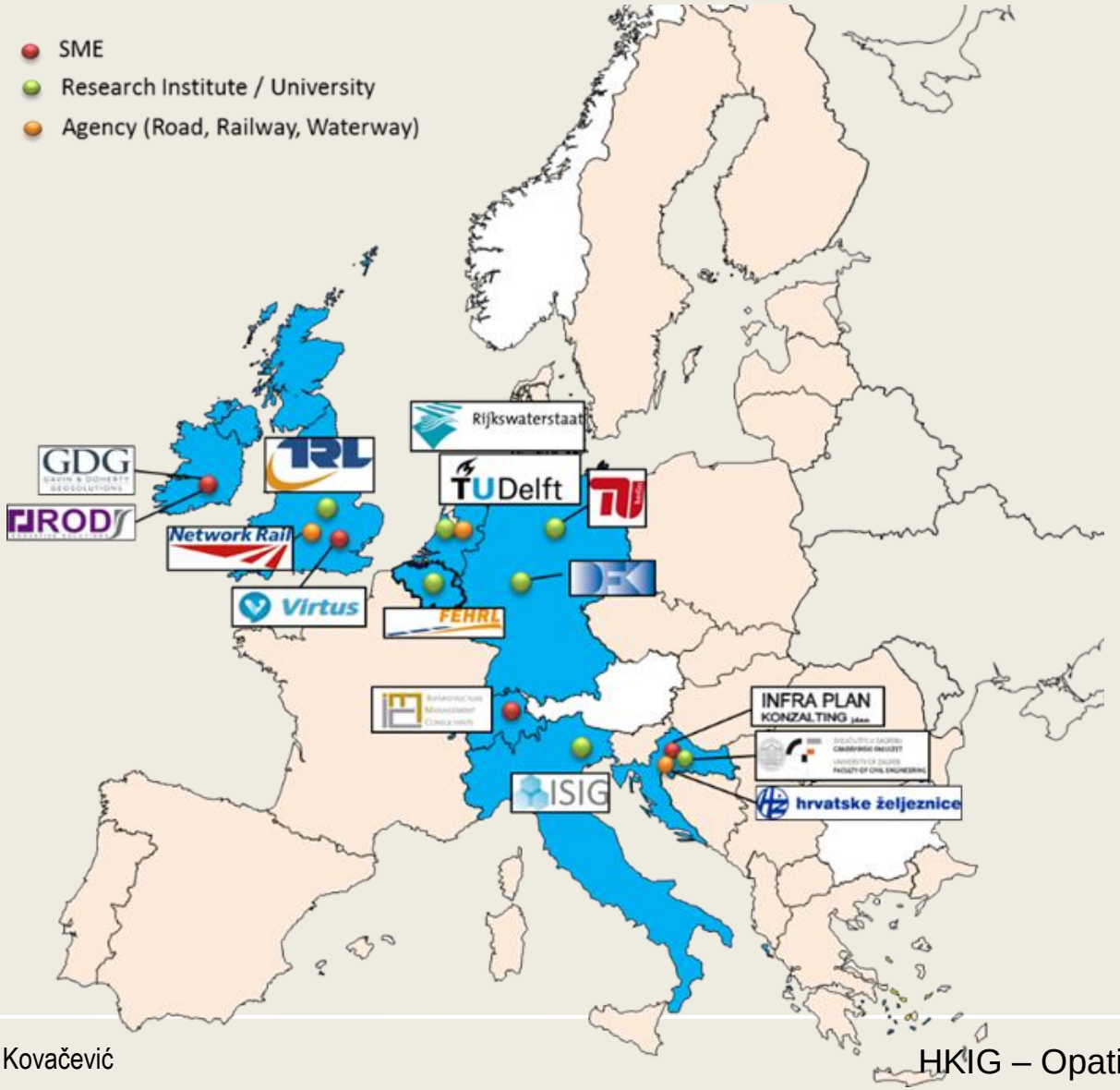
The project will develop a Safety Framework to ensure high safety performance while allowing longer life-cycles for critical infrastructure across the road, rail and inland waterway modes.

SAFE-10-T

no	Institution	Country
1	Gavin & Dorethy Geosolutions (GDG) - coordinator	Ireland
2	Forum des laboratoires nationaux Europeens de recherche routiere (FEHRL)	Belgium
3	Faculty of Civil Engineering, University of Zagreb (FCEUZ)	Croatia
4	Infra Plan Konzalting (IPK)	Croatia
5	Croatian Railways (HZ)	Croatia
6	Roughan O'Donovan Innovation Solutions (ROD)	Ireland
7	Technische Universitaet Berlin (TUB)	Germany
8	Deutsches forschungszentrum fuer kuenstliche intelligenz GMBH (DFKI)	Germany
9	Istituto di sociologia internazionale di Gorizia (ISIG)	Italy
10	Technische Universiteit Delft (TUD)	Netherlands
11	Rijkswaterstaat (RWS)	Netherlands
12	Infrastructure management consultants GMBH (IMS)	Switzerland
13	TRL Limited (TRL)	UK
14	Network rail infrastructure Limited (NR)	UK
15	Virtus IT Limited (VT)	UK

SME **Academia / research institute** **Stakeholder**

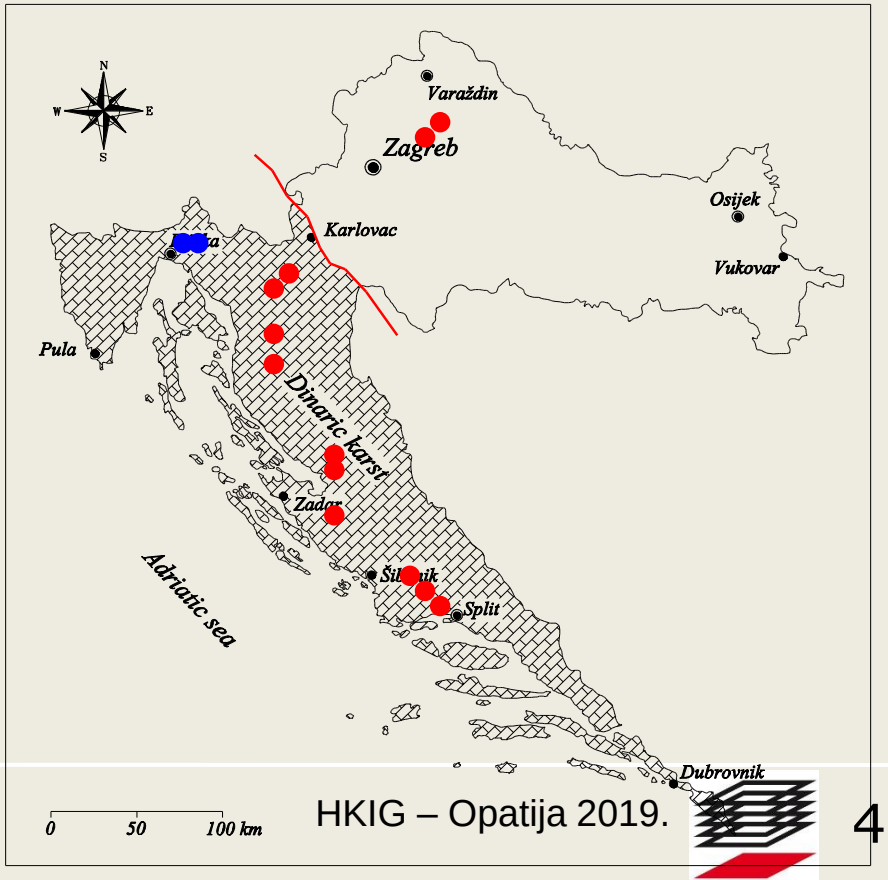
SAFE-10-T


SME
Research Institute / University
Agency (Road, Railway, Waterway)
GDG
RODY
TRL
Network Rail
Virtus
Rijkswaterstaat
TUDelft
DEK
FEHRL
ISIG
INFRA PLAN KONZALTING
hrvatske željeznice

SAFE-10-T

Implementacija sustava kontinuiranog monitoringa u cilju povećanja sigurnosti tunela.

Analiza dugotrajnih deformacija oko tunelskog otvora uz primjenu neuronskih mreža i genetskog algoritma.



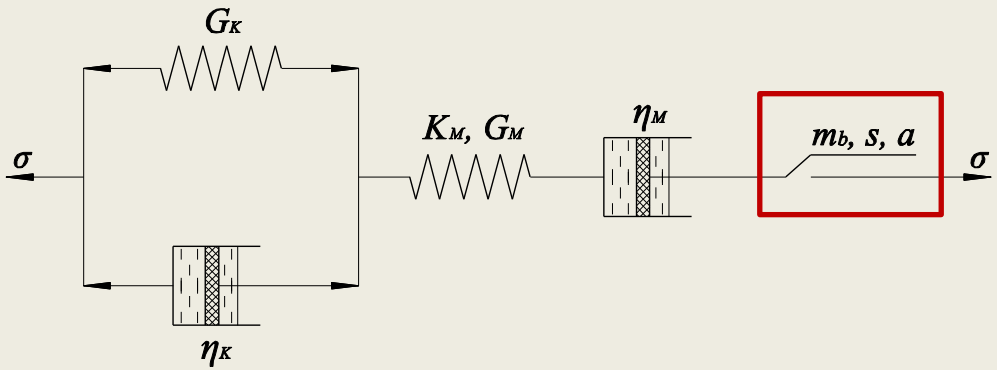
Long-term tunnel settlement

Tunel Pećine

Methodology: Development of structural model

Tunel Bobova

Development of adequate constitutive models for reliable representation of long-term rock mass – support system representation

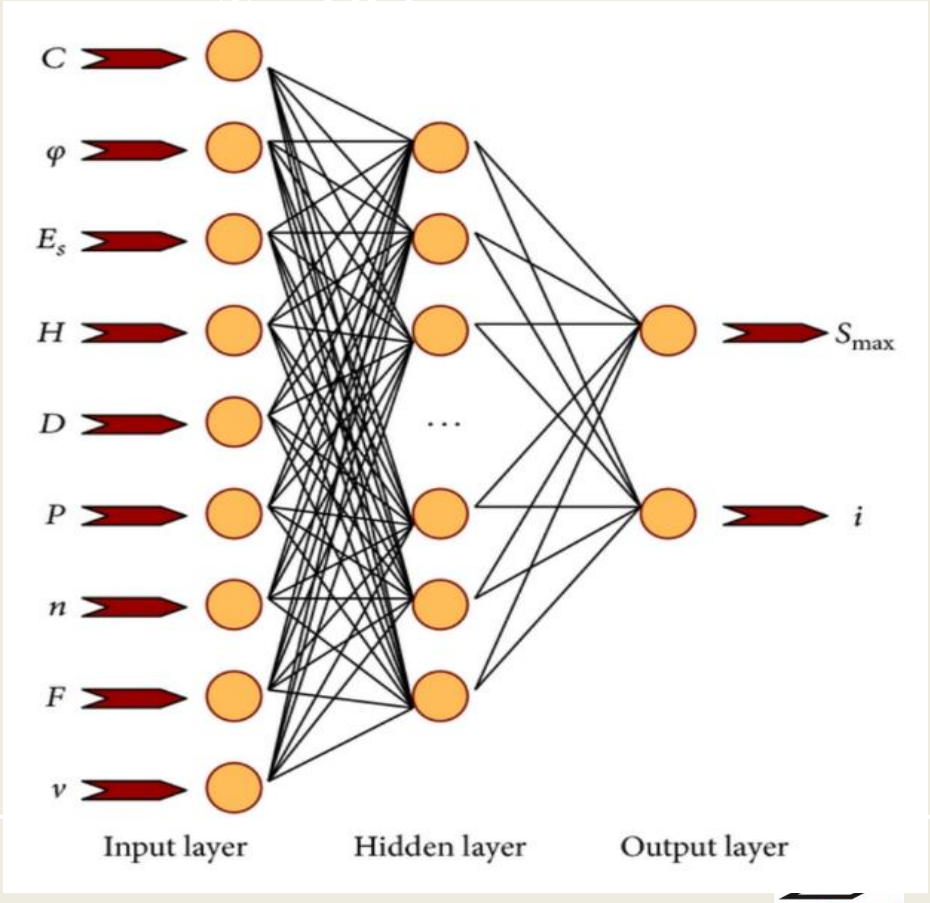


Modified Burger's model with Hoek-Brown plastic element

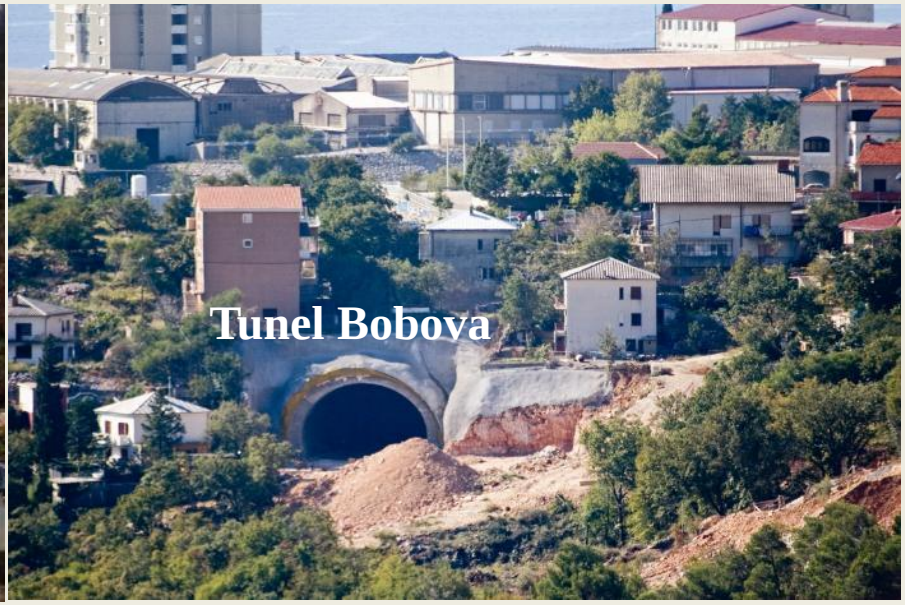
Degradation model, where critical parameters are time dependant

Machine Learning-Predict deformations

Tunel Pećine



SAFE-10-T



Mjerna oprema ugrađena u tunelima i na površini terena:

geodetske mjerne točke, klinometri, inklinometri, klizni deformetri i klizni mikrometri, mjerna sidra, mjerači sile u sidrima, tlačne ćelije, kratki deformetri u betonskoj oblizi i piezometri.

SAFE-10-T

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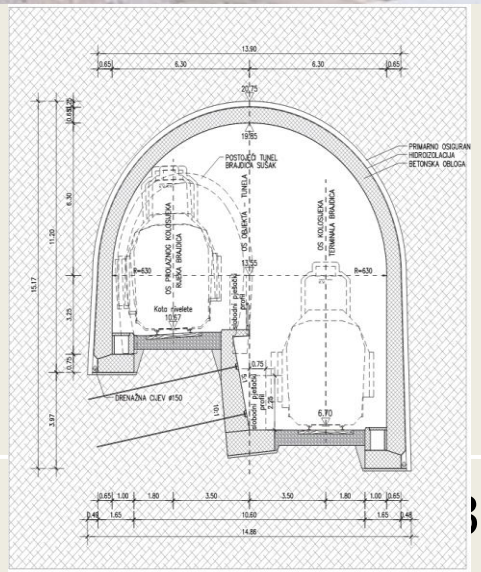
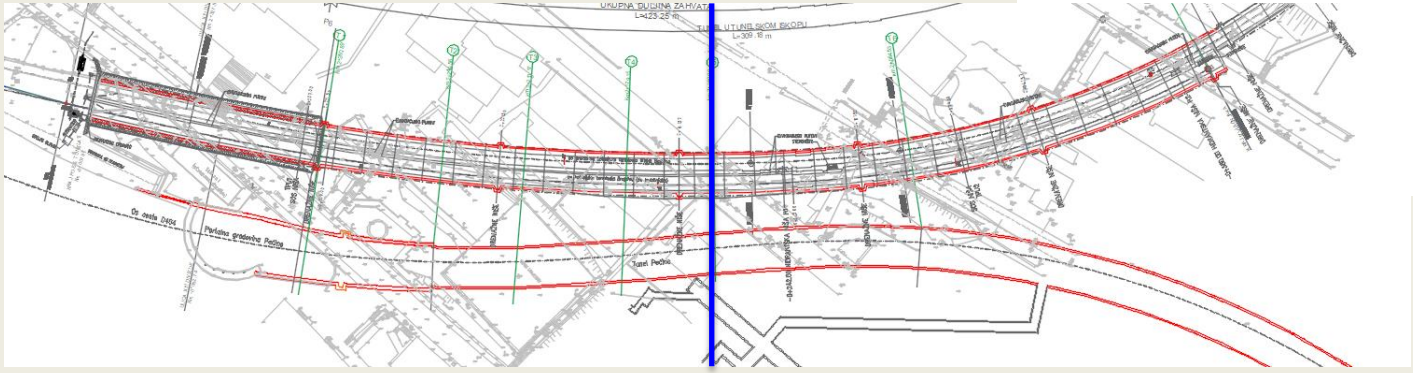
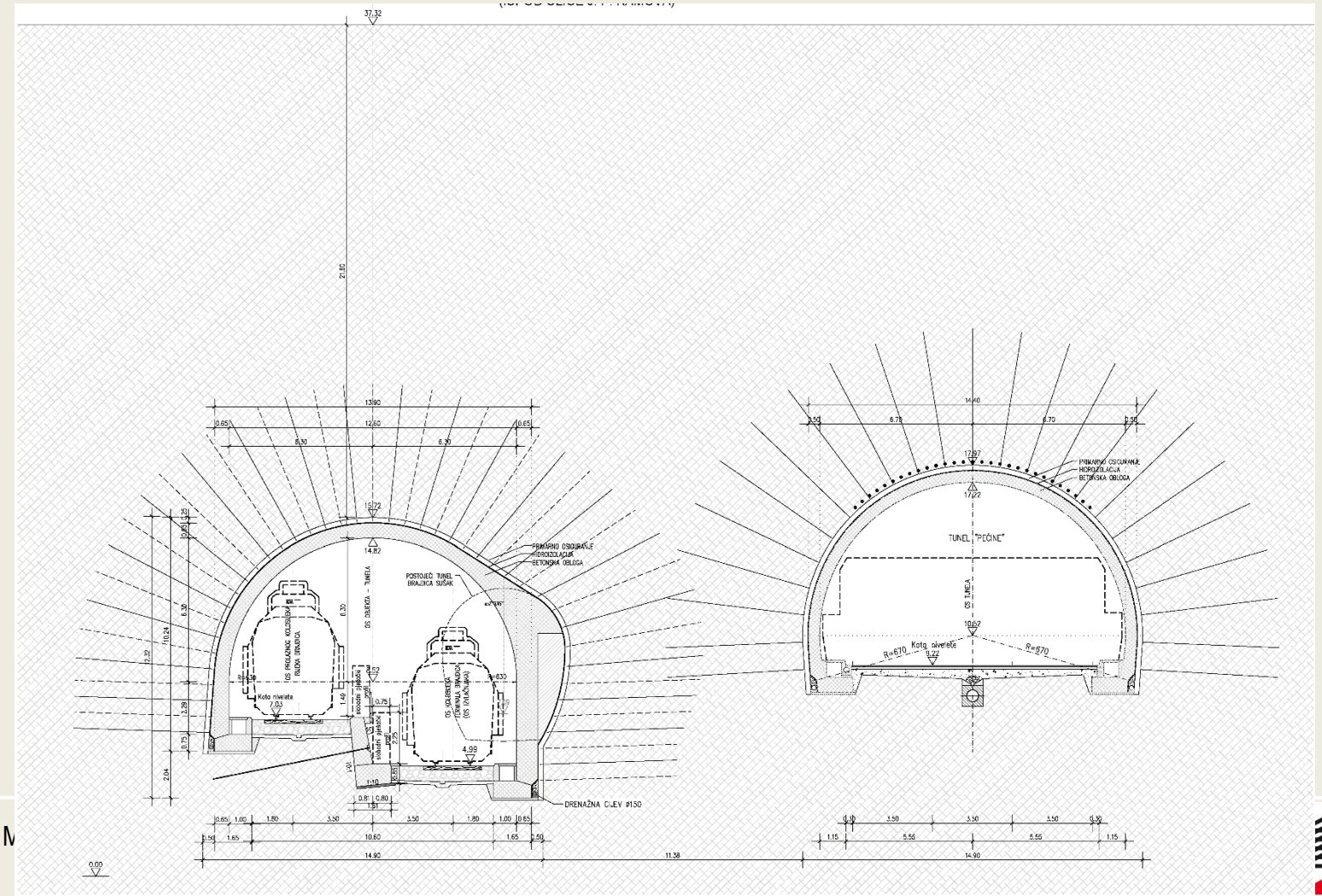
Entrance to the railway Tunnel Brajdica
Entrance to the 4-lane-road Tunnel Pecine – 1260 m long, built in 2006.

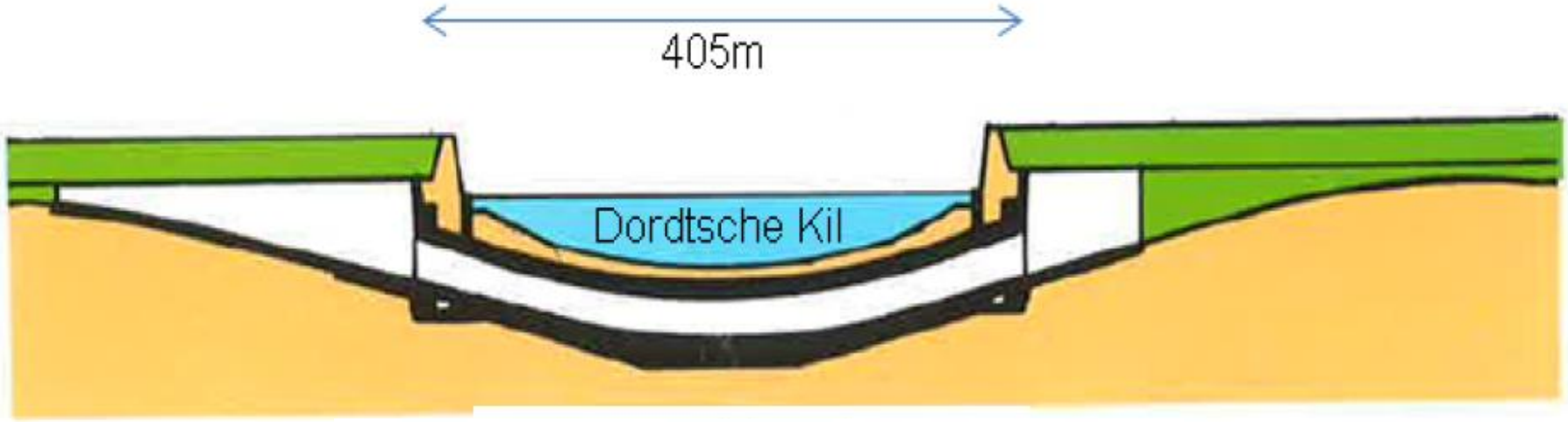




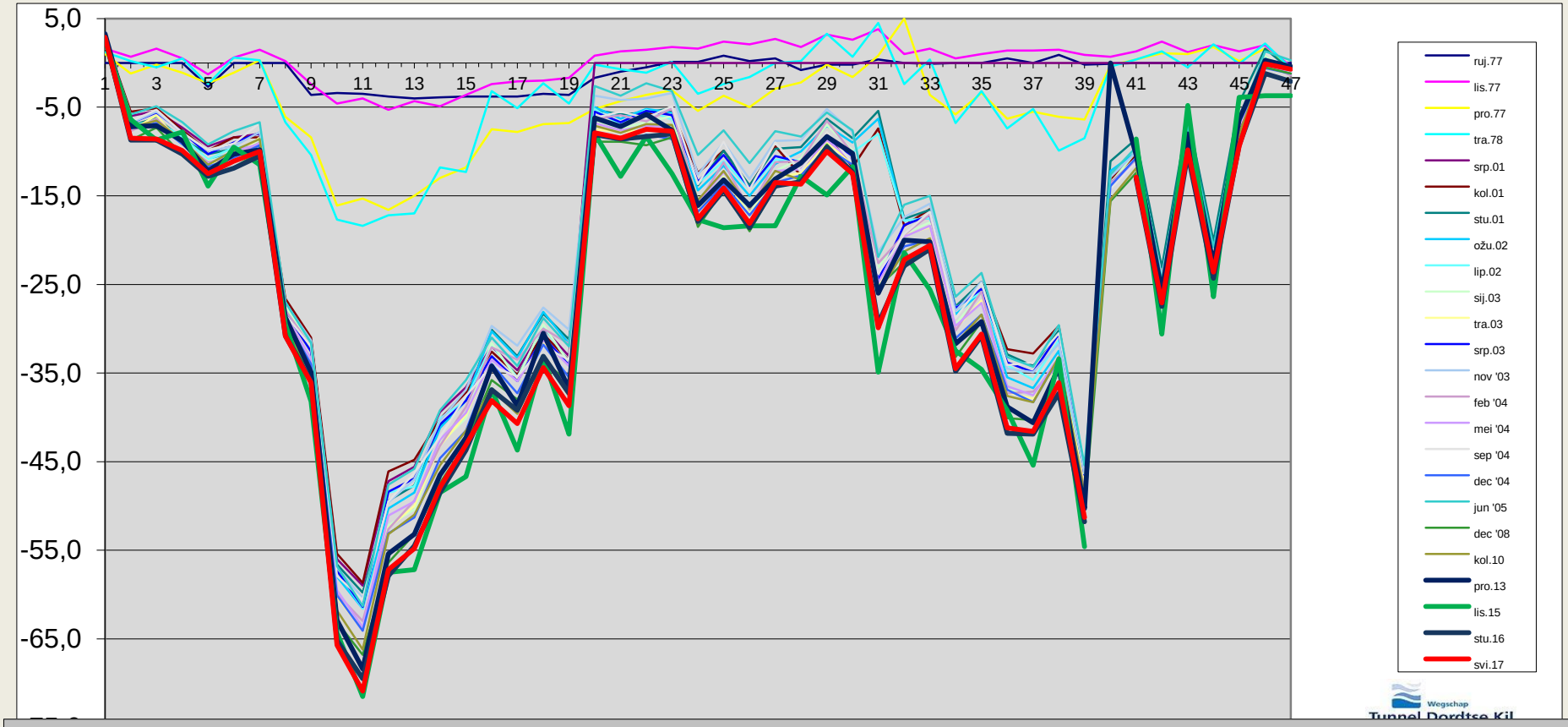

TUNEL "PEĆINE"
PRIMARNO OSIGURANJE
HIDROIZOLACIJA
BETONSKA OBLOGA
POSTOJEĆI TUNEL BRAJDICA SUŠAK
DRENAŽNA CIJEV Ø150
Kota niveleta
R=670

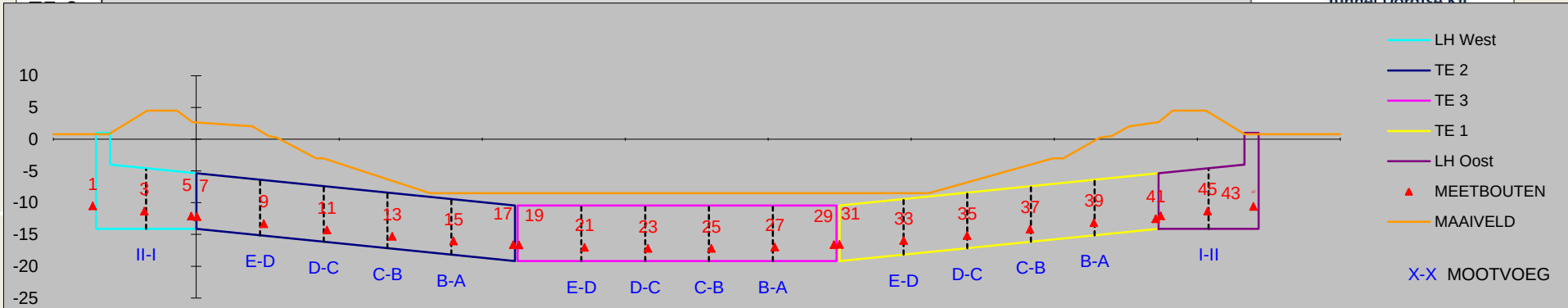
Kil tunnel - Nizozemska

Kil tunnel - Nizozemska



Kil tunnel - Nizozemska





Kil tunnel - Nizozemska

Kil tunnel - Nizozemska

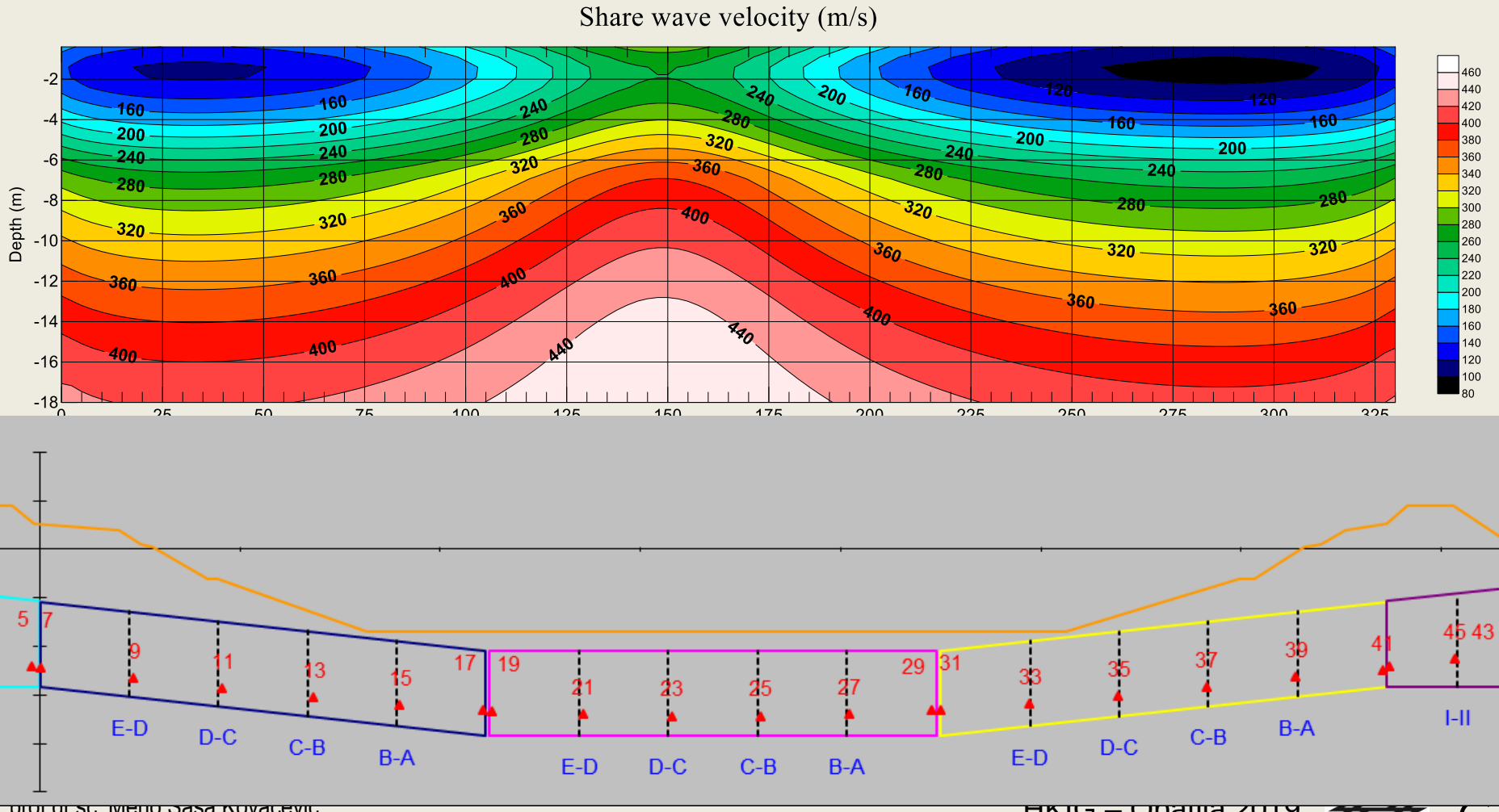
Kil tunnel - Nizozemska

Kil tunnel - Nizozemska

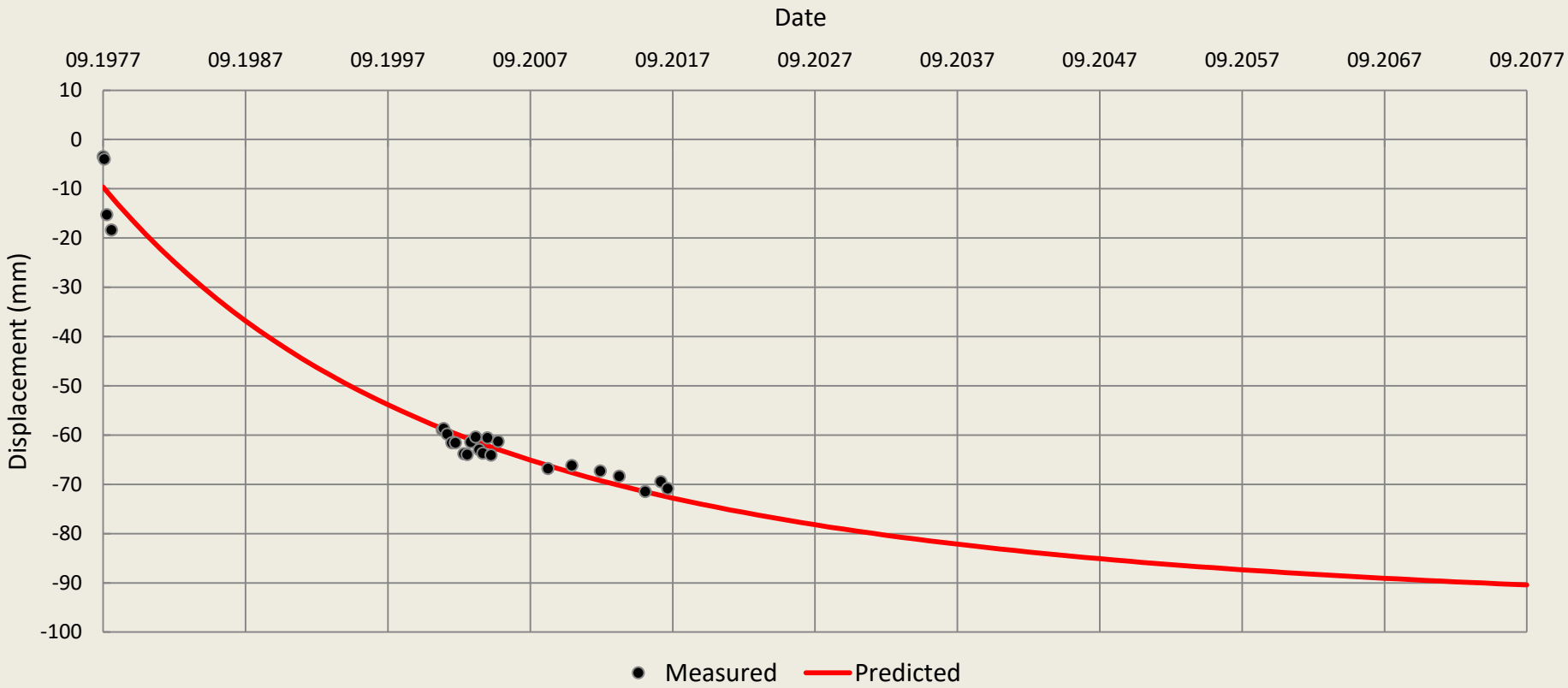
Kil tunnel - Nizozemska

G_0 = 20 MPa

G_0 = 140 MPa



Kil tunnel - Nizozemska



General model Power2:

f(x) = a*x^b+c

Coefficients (with 95% confidence bounds):

a = 3.594e+15 (-5.229e+16, 5.948e+16)

b = -3.057 (-4.601, -1.513)

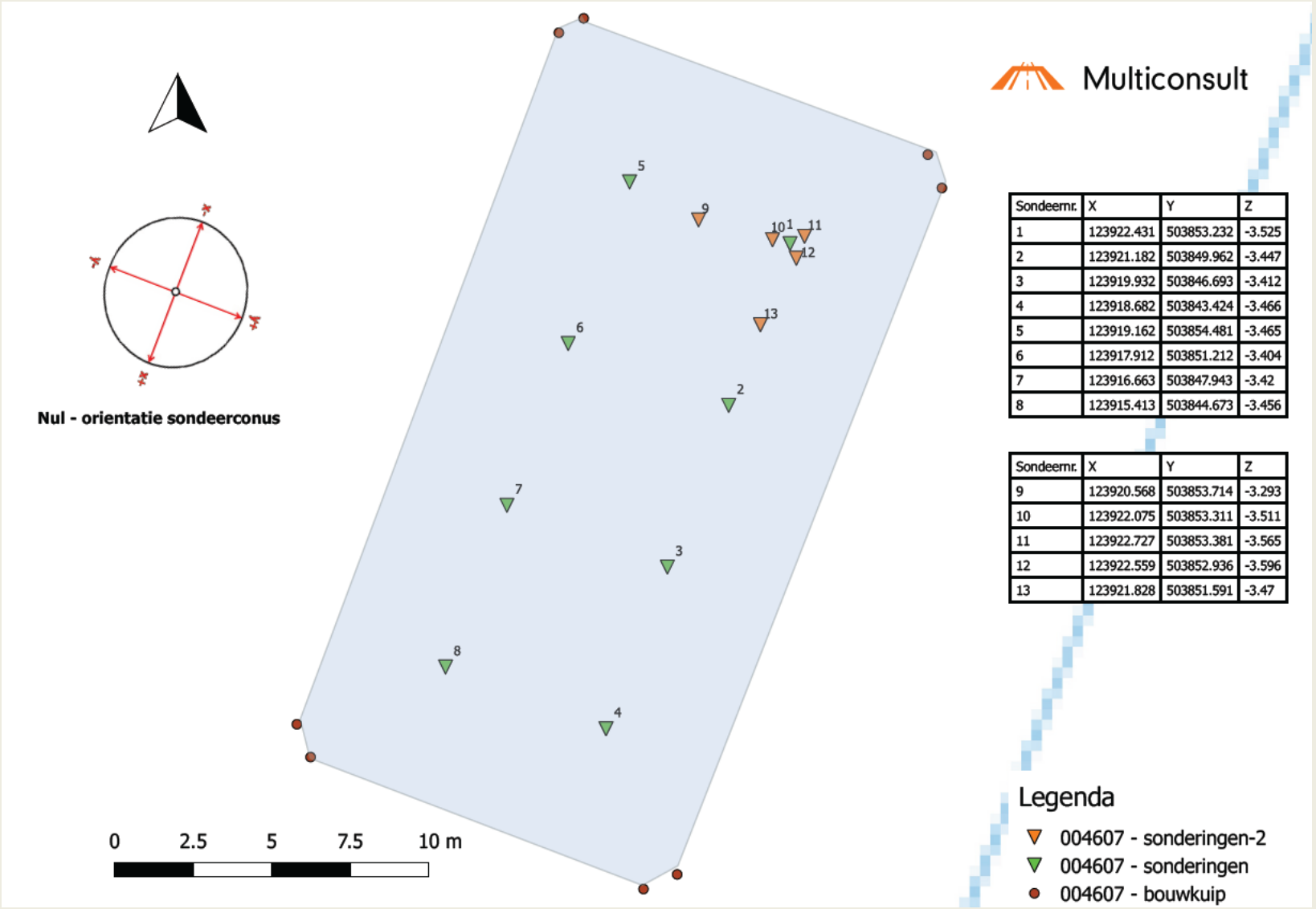
c = -97.41 (-122.9, -71.87)

Goodness of fit:

SSE: 206.7

R-square: 0.9797

Pile test site - Nizozemska



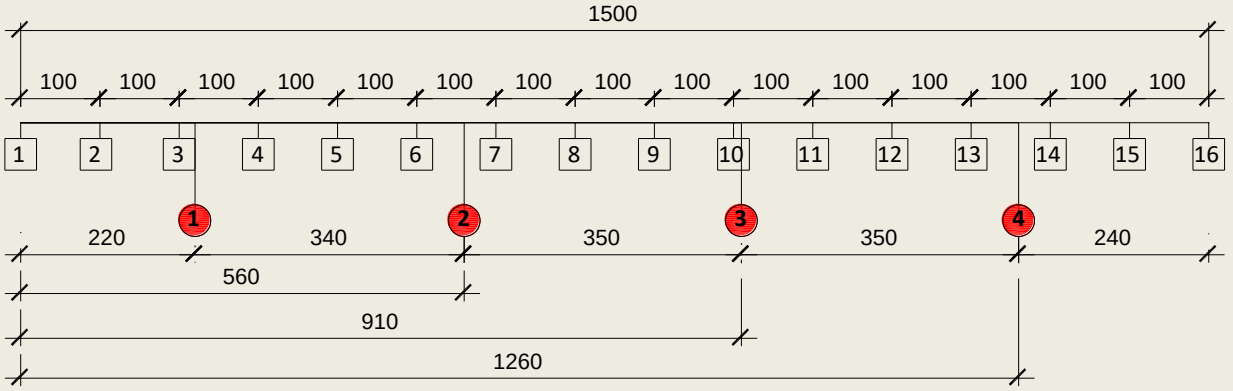
Sondeernr.	X	Y	Z
1	123922.431	503853.232	-3.525
2	123921.182	503849.962	-3.447
3	123919.932	503846.693	-3.412
4	123918.682	503843.424	-3.466
5	123919.162	503854.481	-3.465
6	123917.912	503851.212	-3.404
7	123916.663	503847.943	-3.42
8	123915.413	503844.673	-3.456

Sondeernr.	X	Y	Z
9	123920.568	503853.714	-3.293
10	123922.075	503853.311	-3.511
11	123922.727	503853.381	-3.565
12	123922.559	503852.936	-3.596
13	123921.828	503851.591	-3.47

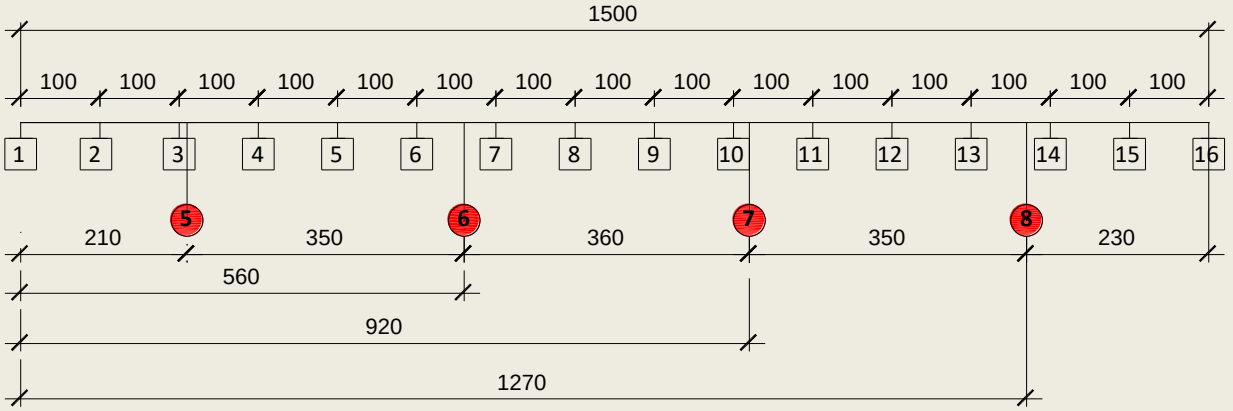
Pile test site - Nizozemska

Pile test site - Nizozemska

1. profil

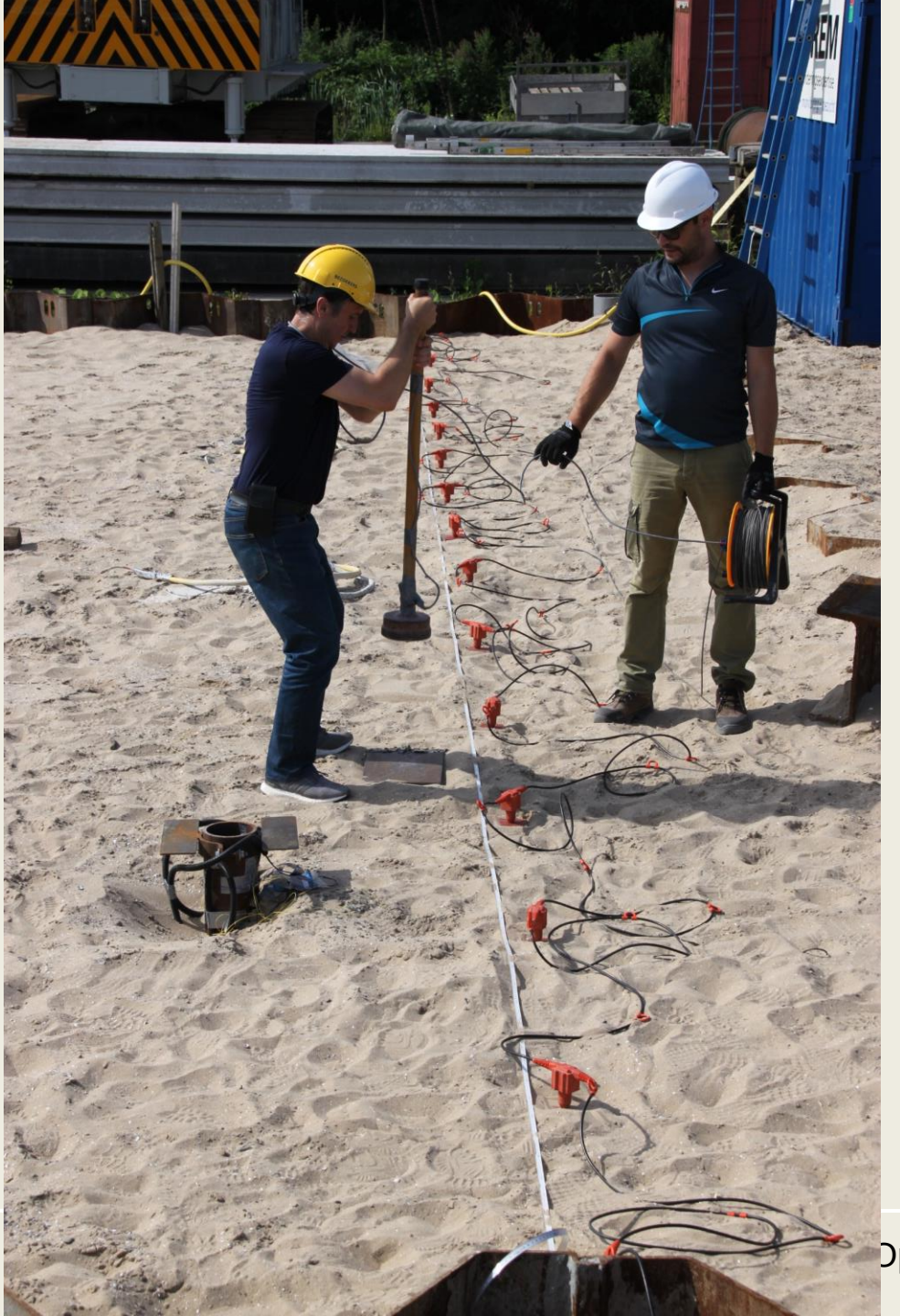


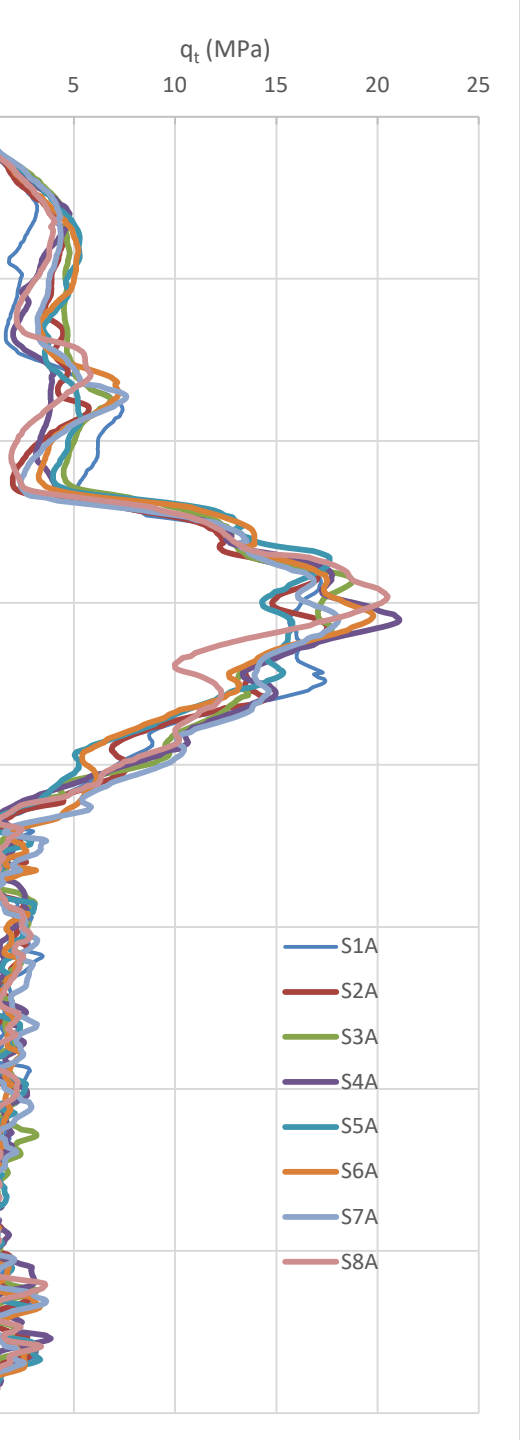
2. profil

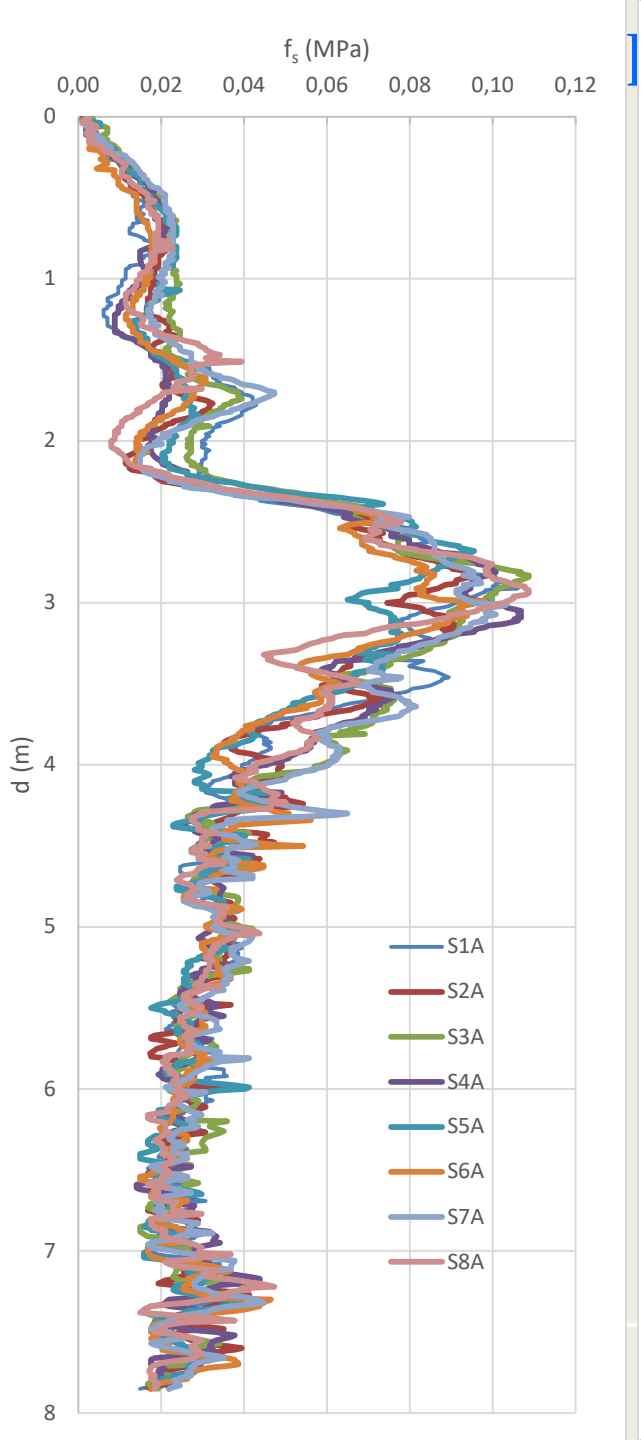


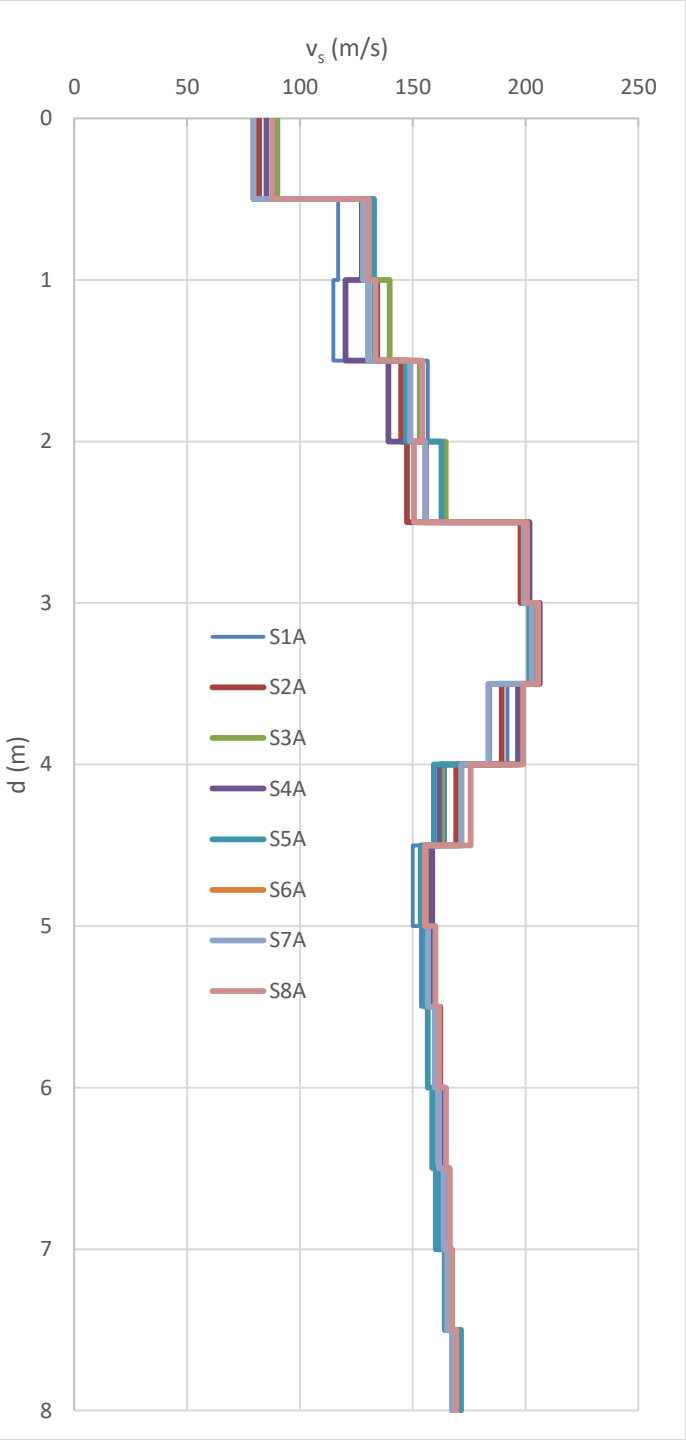
Pile test site - Nizozemska

Pile test site - Nizozemska




q_t (MPa)
5
10
15
20
25
S1A
S2A
S3A
S4A
S5A
S6A
S7A
S8A


f_s (MPa)
0,00
0,02
0,04
0,06
0,08
0,10
0,12
d (m)
0
1
2
3
4
5
6
7
8
S1A
S2A
S3A
S4A
S5A
S6A
S7A
S8A


v_s (m/s)
0
50
100
150
200
250
d (m)
0
1
2
3
4
5
6
7
8
S1A
S2A
S3A
S4A
S5A
S6A
S7A
S8A

Pile test site - Nizozemska

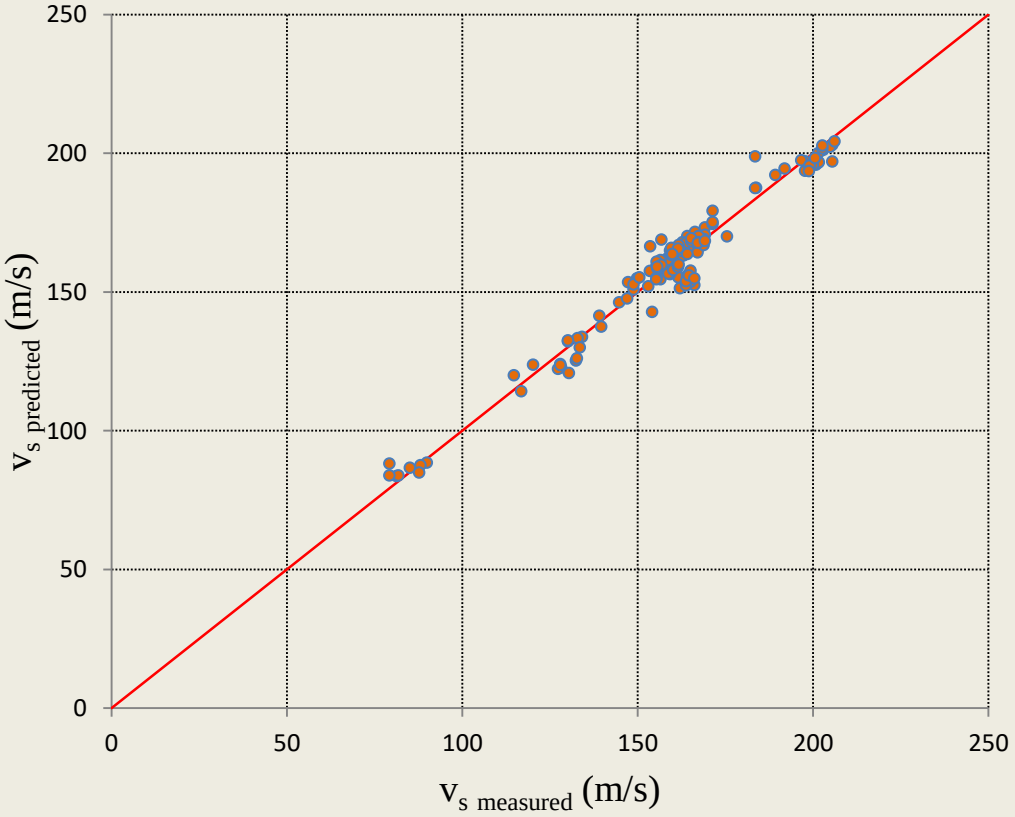
$$v_s = c0 \cdot q_t^{c1} \cdot f_s^{c2} \cdot d^{c3}$$

$$\log v_s = \log c0 + c1 \cdot \log q_t + c2 \cdot \log f_s + c3 \cdot \log d$$

$$y = m_0 + m_1 \cdot x_1 + m_2 \cdot x_2 + m_3 \cdot x_3$$

m_3	m_2	m_1	m_0
c3	c2	c1	log c0
0.179709	0.047935	0.124473	1.59954
0.007556	0.01798	0.010774	0.018044
0.97309	0.014768	#N/A	#N/A
1494.674	124	#N/A	#N/A
0.977981	0.027045	#N/A	#N/A

c0 =	39.769
c1 =	0.124
c2 =	0.048
c3 =	0.180
r^2 =	**0.97309**



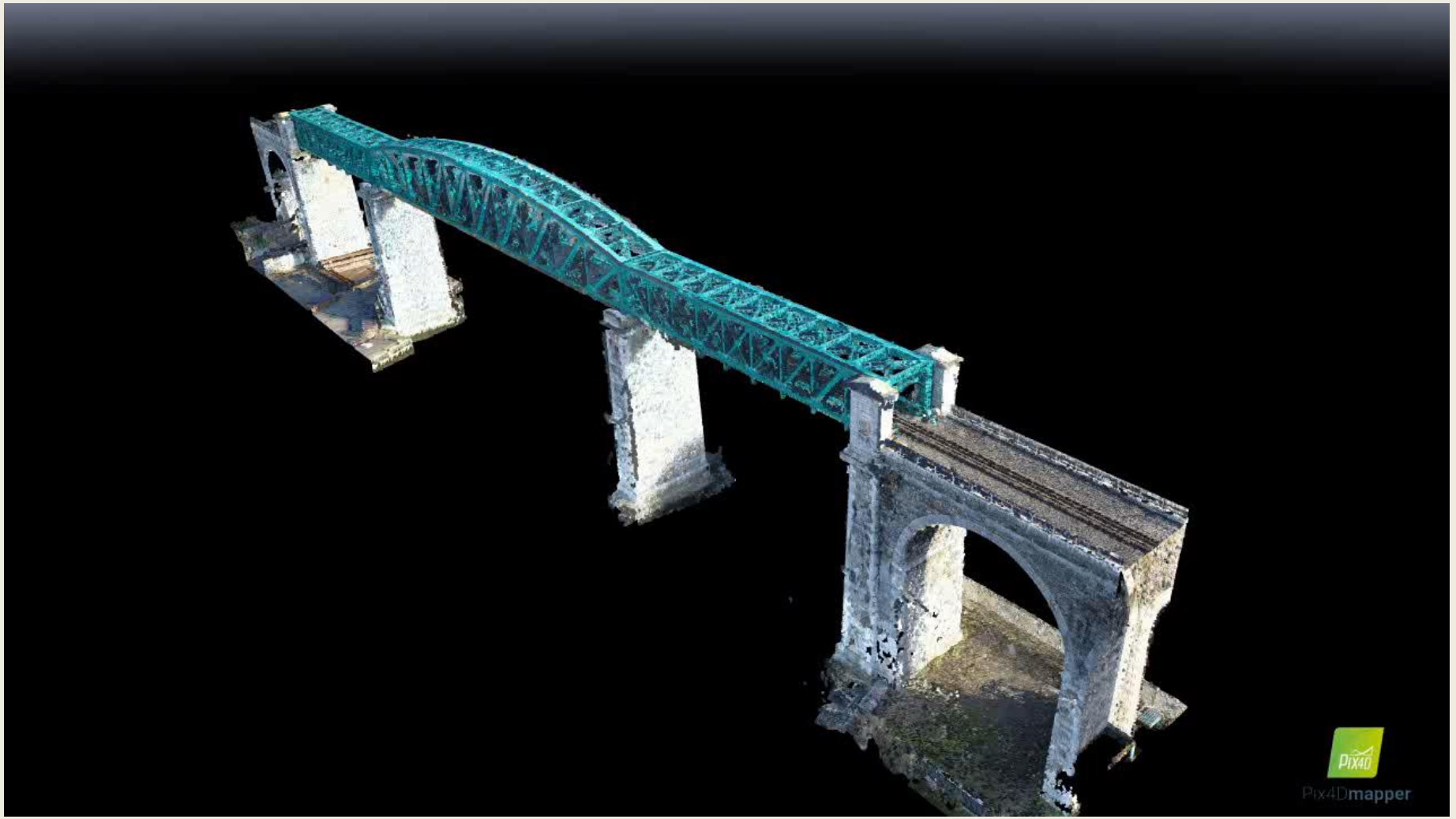
$$v_s = 39.769 \cdot q_t^{0.124} \cdot f_s^{0.048} \cdot d^{0.180} \quad (q_t, f_s \text{ in kPa; } d \text{ in m; } v_s \text{ in m/s})$$

Idrija - Slovenija

Idrija - Slovenija

Boyne Viaduct - Irska

Boyne Viaduct - Irska



Zaključak

Sudjelovanje u EU projektima – važna karika za međunarodnu znanstvenu i stručnu prepoznatljivost

Hvala na pažnji

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