



# Današnje mogućnosti naprednih baza podataka za monitoring

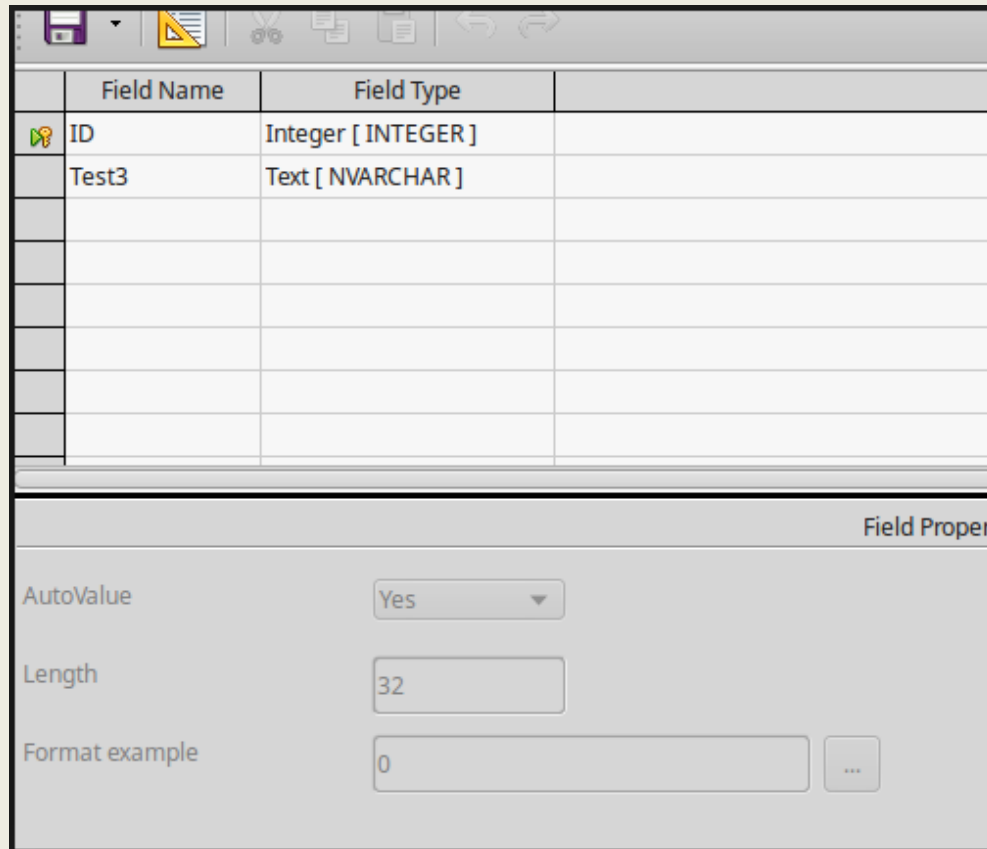
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# Baze podataka za monitoring



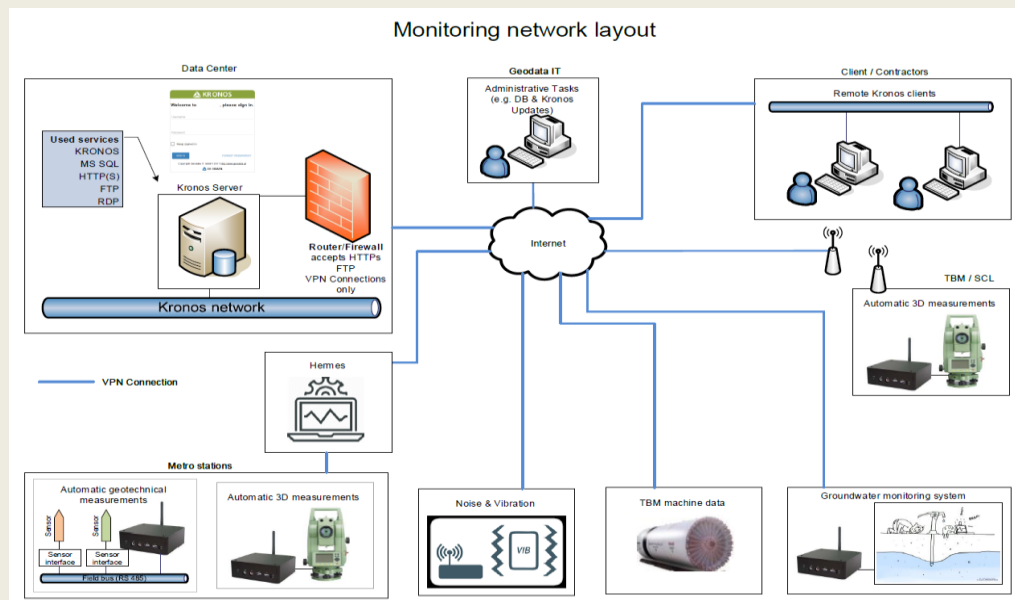
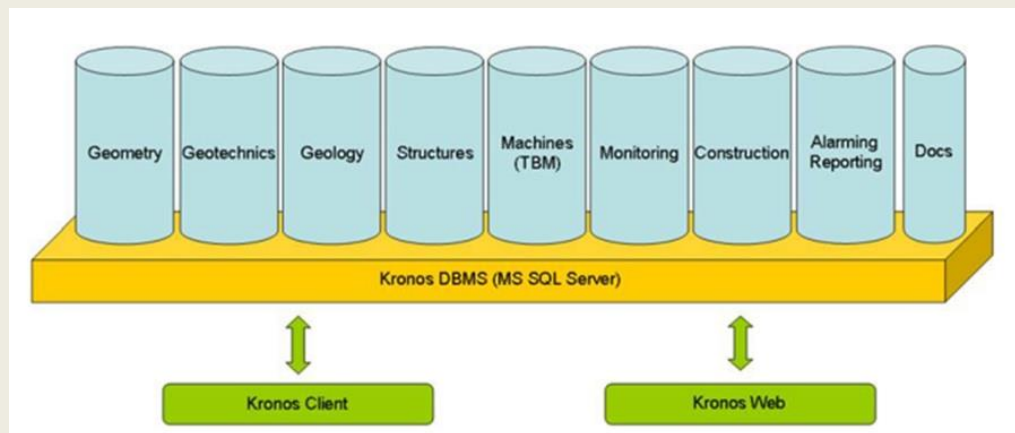
Field Name	Field Type
ID	Integer [ INTEGER ]
Test3	Text [ NVARCHAR ]

AutoValue	Yes
Length	32
Format example	0

- Prve komercijalne baze podataka nastaju 90tih godina prošlog stoljeća
- Jednostavno sučelje, dizajn i mogućnosti
- Tijekom 2000tih počinje razvoj prvih komercijalnih baza podataka za monitoring
- Postepeni razvoj GIS baza podataka sa vizualizacijom geodetskih i geotehničkih mjerenja
- Lokalni pristup podacima sa računala

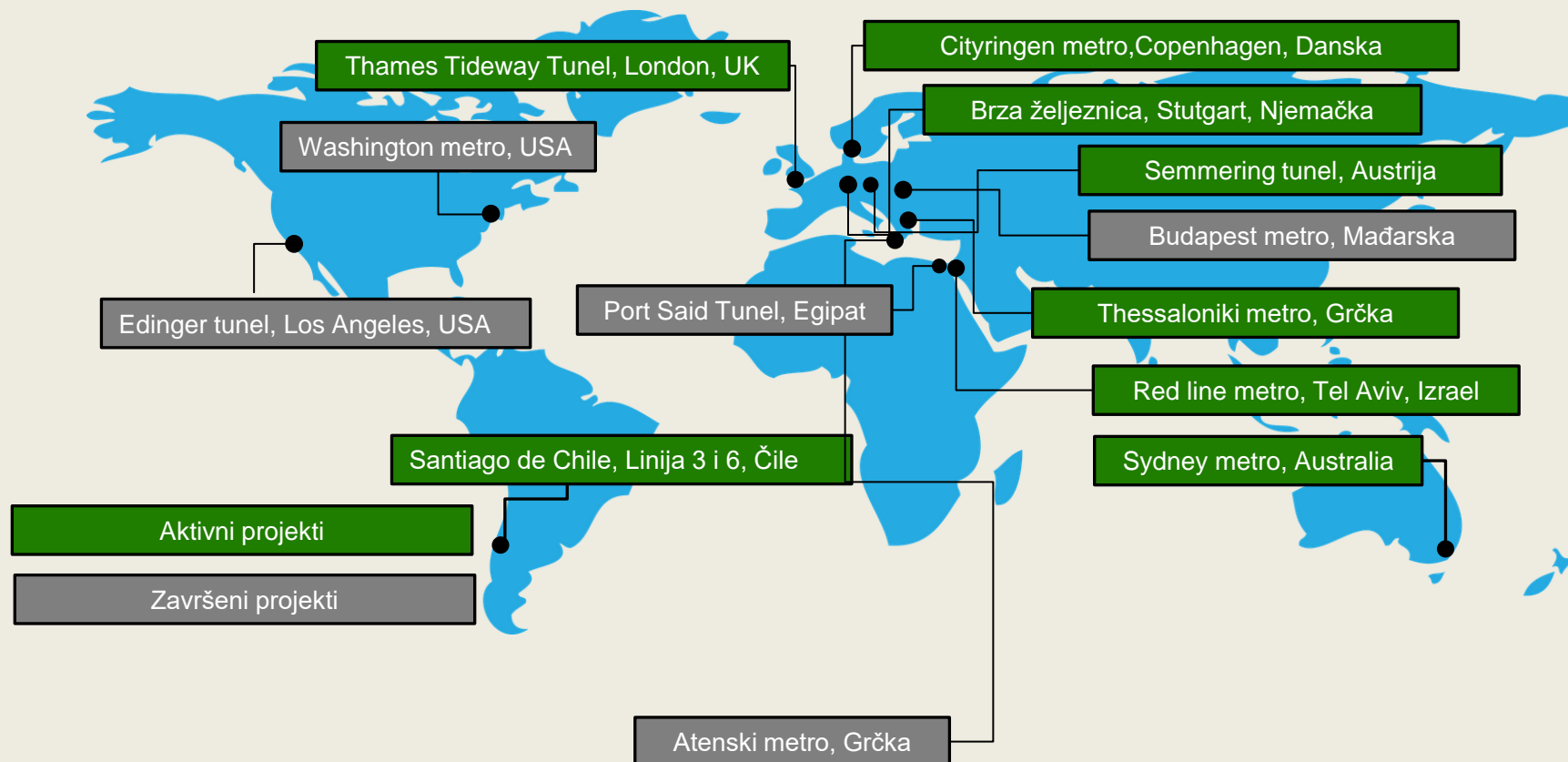
# Današnje baze podataka za monitoring



- Koriste se od malih projekata sa par desetaka točaka do velikih infrastrukturnih projekata sa desecima tisuća točaka i par stotina milijuna mjerenja
- Sva mjerenja te svi podaci potrebni za analizu mjerenja na jednom mjestu (podaci o zgradama, geometrija projekta, stanju izvođenja, sastavu tla)
- “One stop station” sa svim bitnim podacima za projekt management
- Pristup svim podacima monitoringa putem interneta
- Kronos - baza podataka razvijena od strane Geodate IT

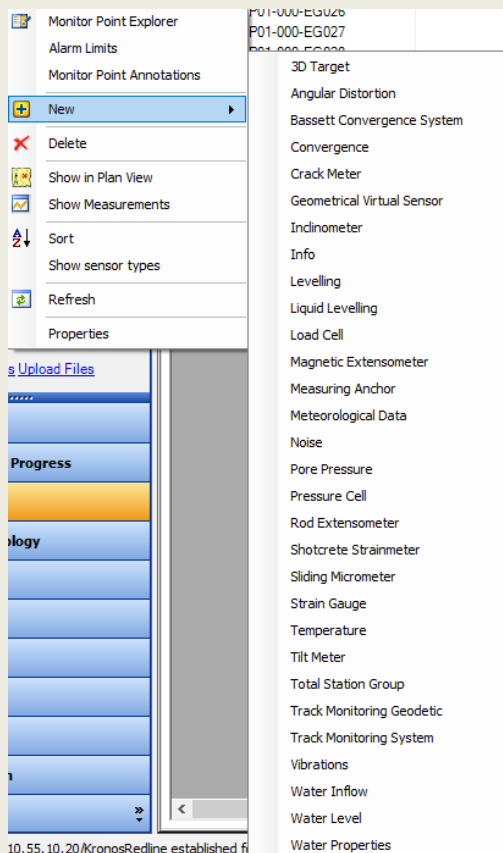
# Kronos na projektima diljem svijeta

- Danas svi veliki infrastrukturni projekti uključuju monitoring te baze podataka za monitoring
- Kronos se koristi na nekim od najvećih svjetskih projekata danas: Copenhagen metro, Thames Tideway, Stuttgart high speed rail, Red line Tel Aviv, Paris i Sydney metro

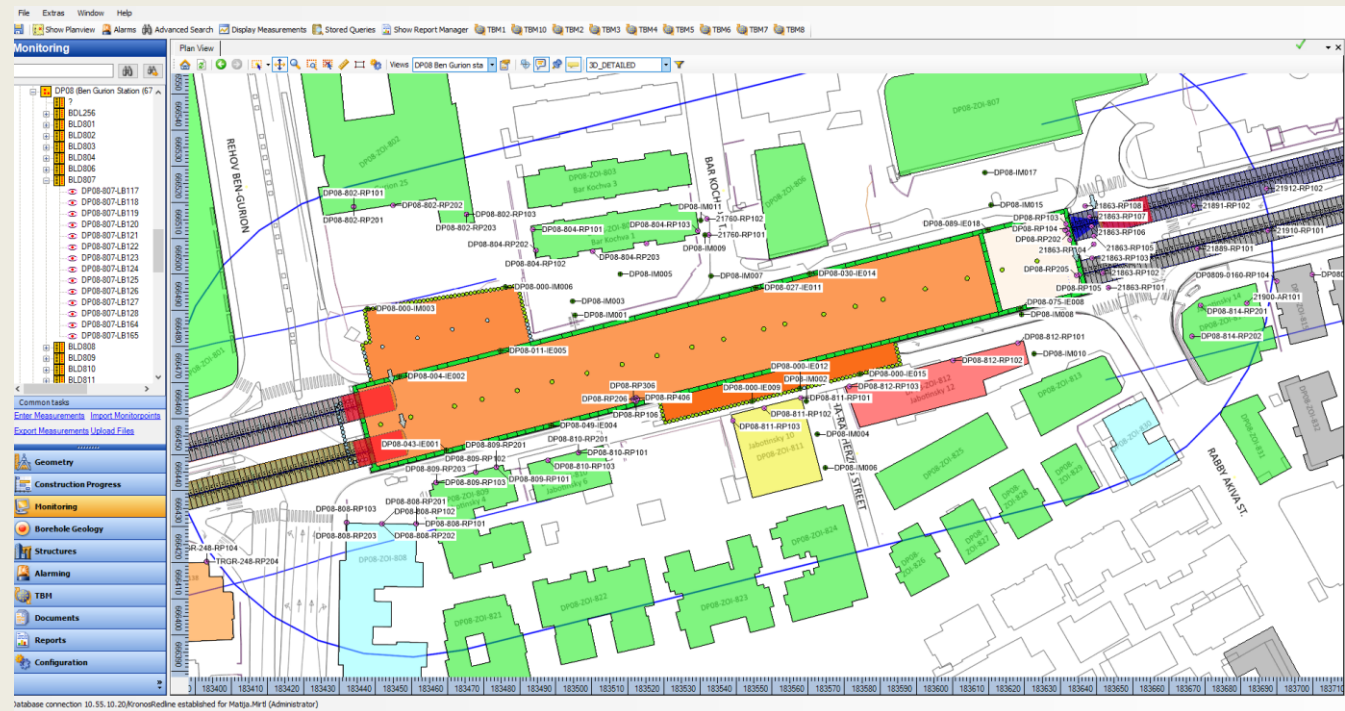


# Moderne baze podataka

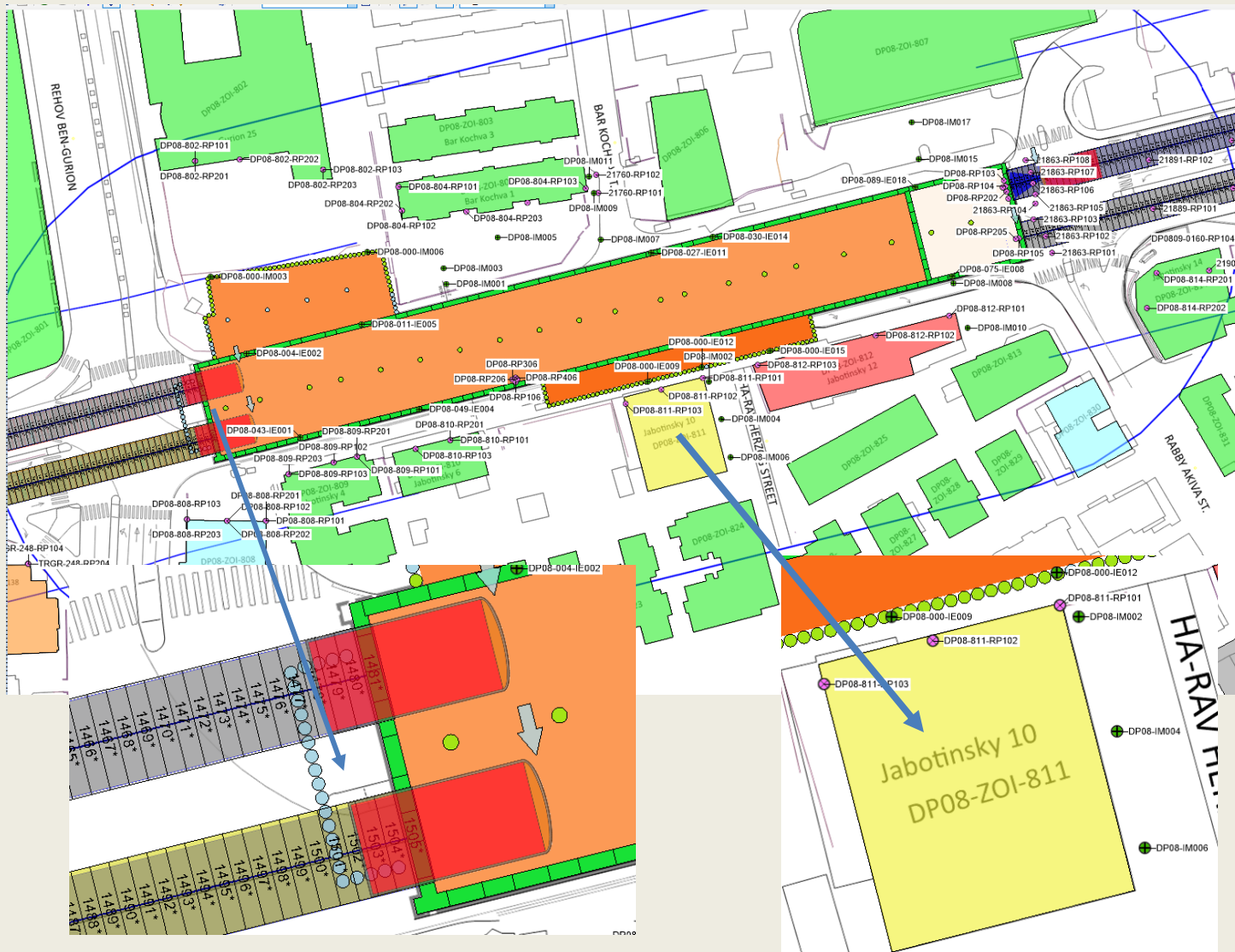
- Svi podaci projekta prikazani su na grafičkom sučelju u pravim 3D koordinatama
- Upload manualnih i automatskih mjerenja svih geodetskih i geotehničkih senzora
- Alarmiranje, reporti, faze izgradnje, zgrade, mjerne točke, zone utjecaja, tuneli
- Pristup svim podacima sa bilo koje lokacije sa internetom



## Kronos interface



# Grafičko sučelje

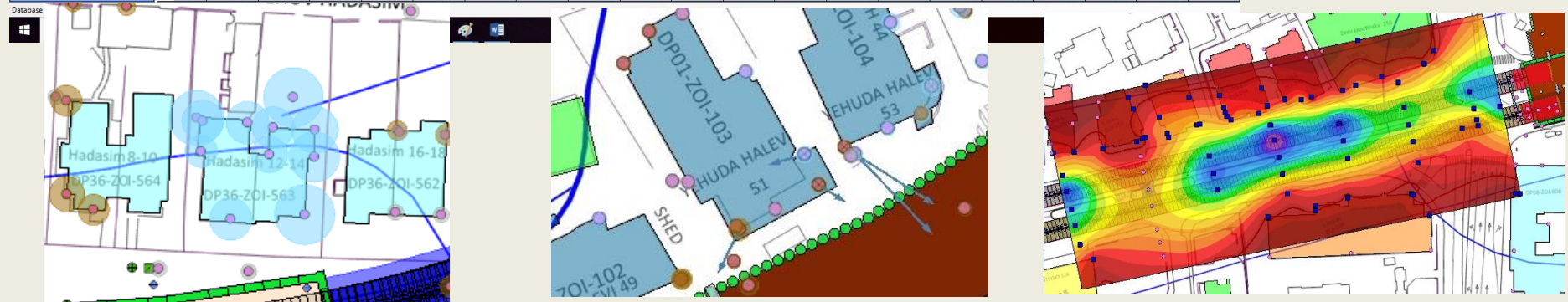
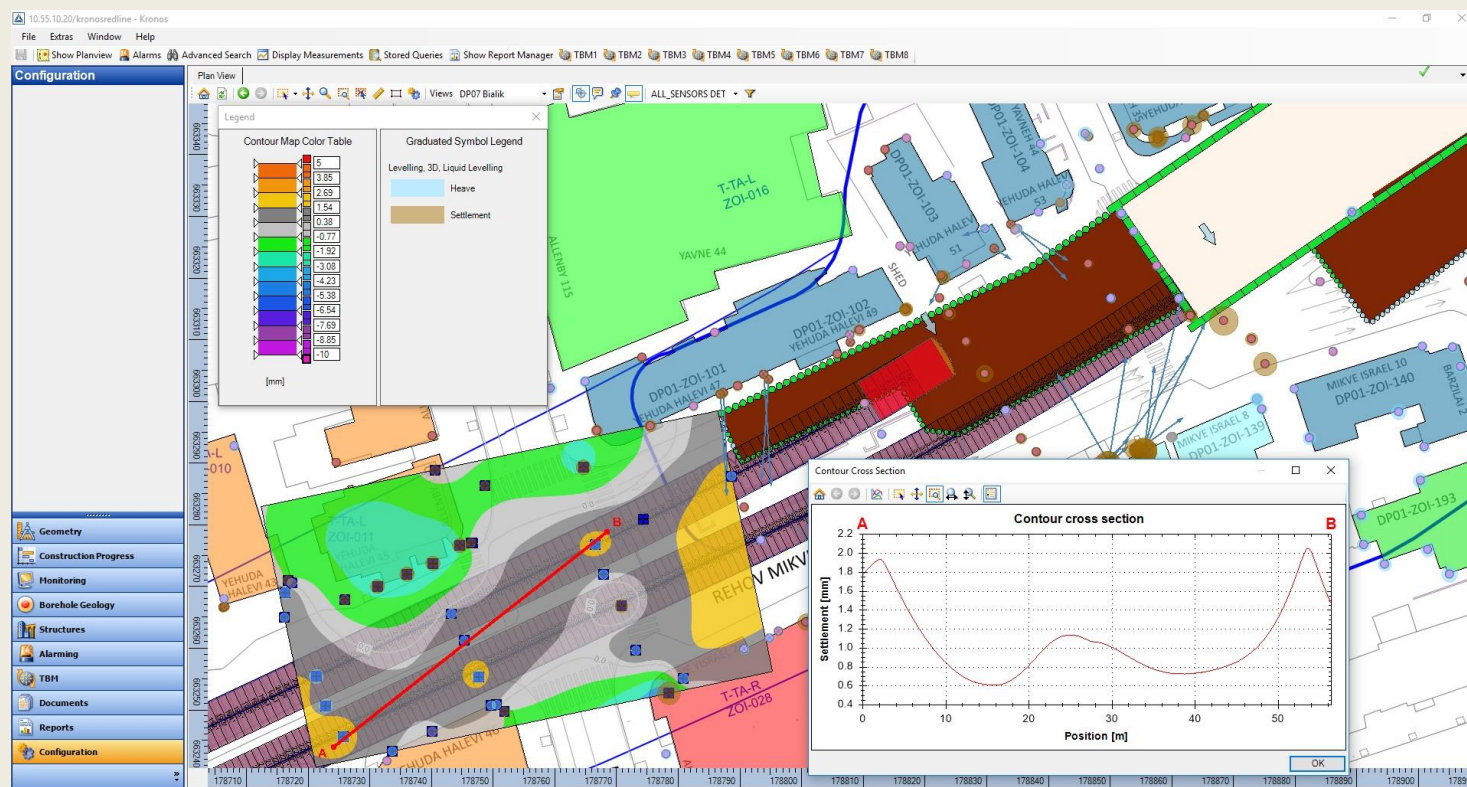


- Katastarske mape
- Topografske mape
- Položaj zgrada
- Adresa zgrada
- Svaki objekt ima svoj jedinstveni kod
- Building risk assessment
- Drugi objekti (šahte, stanice)
- Faze izgradnje:
  - Talpe
  - Piloti
  - Stanje iskopa
- Mjerne točke
  - Geodetska mjerenja
  - Geotehnička mjerenja
  - Razina vode
- Oznake senzora
- Tuneli
- TBM ringovi
- Položaj TBM-a
- Zona utjecaja

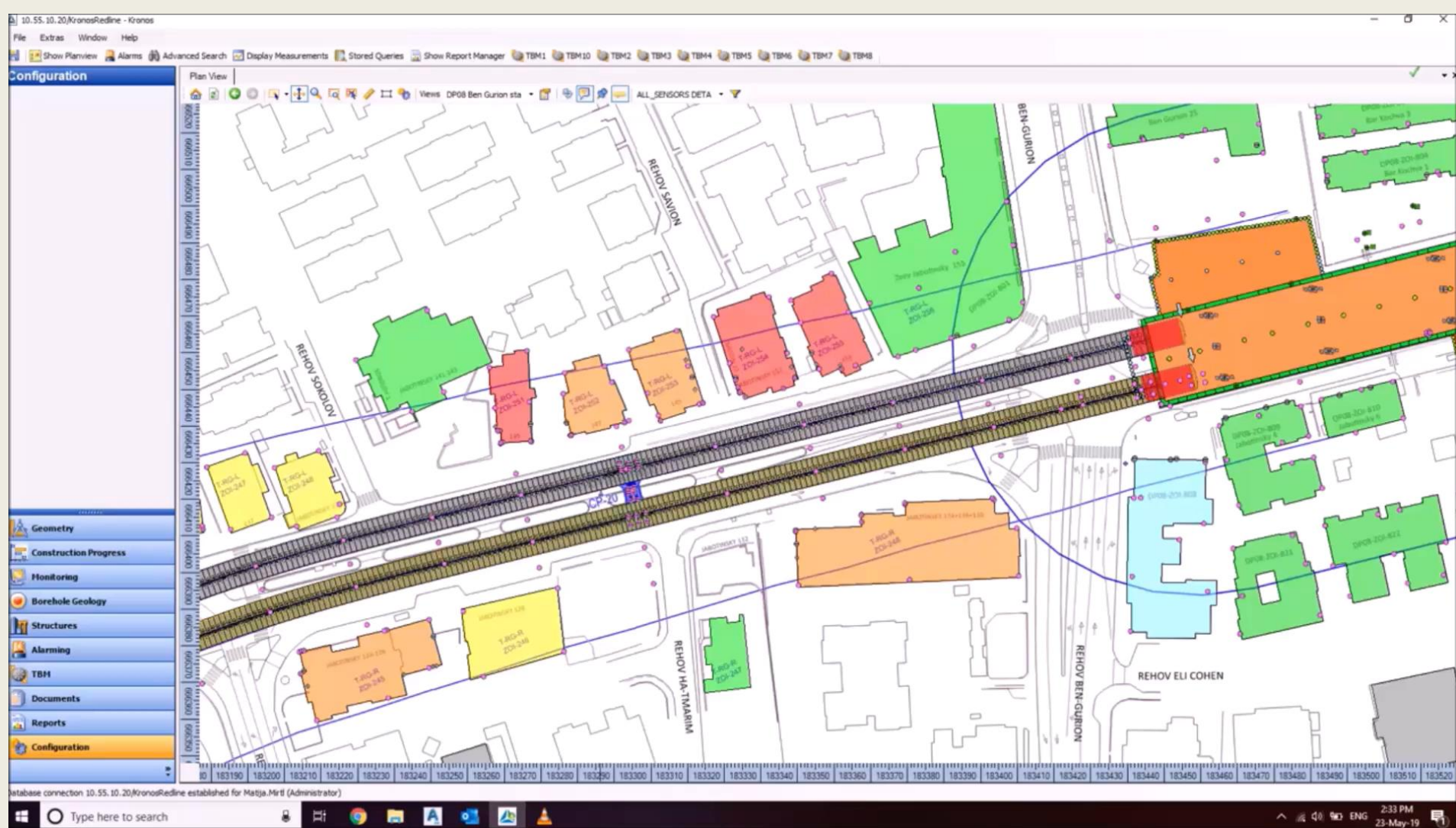


# Analiza podataka

- Mjernje vrijednosti
- 3D vektori za prikaz deformacija
- Graduated symbols
  - prikaz vertikalnih deformacija za svaku točku
- Mape kontura:
  - 3D točke
  - Nivelman
  - Piezometri
- Poprečni presjek kontura



# Analiza podataka





# Construction progress

- Podaci o iskopu talpi, pilota, okna, podzemnih stanica
- Grafička vizualizacija svih podataka

Panel Number	Panel Type	Outline	Depth [m]	Excavation Start [date]	Excavation Finished [date]	Concrete Start [date]	Concrete Finished [date]
148-FRp	PANEL	184876.89265.6...	38.180	30-Aug-17 07:25	30-Aug-17 19:20	30-Aug-17 23:35	31-Aug-17 05:56
098-FRp	PANEL	184876.69823.6...	38.120	18-Dec-16 08:20	19-Dec-16 09:46	19-Dec-16 18:45	19-Dec-16 23:47
099-FRs	PANEL	184876.61059.6...	38.080	28-Dec-16 14:00	29-Dec-16 13:18	29-Dec-16 18:20	29-Dec-16 22:20
146-FRp	PANEL	184877.04715.6...	38.080	07-Feb-18 14:36	09-Feb-18 10:39	11-Feb-18 19:18	12-Feb-18 00:35
145-FRs	PANEL	184877.12897.6...	38.030	18-Feb-18 14:46	19-Feb-18 11:00	19-Feb-18 21:58	20-Feb-18 01:15
097-Rs	PANEL	184879.29203.6...	38.020	12-Feb-18 16:06	13-Feb-18 08:39	14-Feb-18 19:08	14-Feb-18 23:05
100-FRp	PANEL	184876.51700.6...	38.010	13-Dec-16 08:00	13-Dec-16 19:00	14-Dec-16 04:15	14-Dec-16 08:55
096-Rp	PANEL	184882.09044.6...	38.000	29-Jan-18 16:12	30-Jan-18 09:22	30-Jan-18 17:07	30-Jan-18 22:35
095-Rs	PANEL	184884.48944.6...	37.990	05-Feb-18 07:36	05-Feb-18 17:39	06-Feb-18 16:18	06-Feb-18 19:30
144-Rp	PANEL	184876.69332.6...	37.990	07-Feb-18 14:36	07-Feb-18 10:39	07-Feb-18 19:18	08-Feb-18 00:30
094-Rp	PANEL	184887.28788.6...	37.960	03-Jan-18 14:24	04-Jan-18 09:25	04-Jan-18 19:30	04-Jan-18 23:41
085-Rs	PANEL	184910.47760.6...	37.950	01-Jan-18 13:44	02-Jan-18 10:56	02-Jan-18 16:52	02-Jan-18 21:08
086-Rp	PANEL	184908.07863.6...	37.950	21-Dec-17 09:52	21-Dec-17 15:53	24-Dec-17 15:10	24-Dec-17 19:30

**Excavations**

Shaft Information

Name:

Top Level:  m Bottom Level:  m

Excavation Progress | Slab Progress

Area configurations

Area definition mode

▼ Depth [m]

0pla192o25e.2nuA...	17.000
0pla1811o15e.11in...	14.150
0pla1811o15e.11in...	17.000
0pla185o23e.5nuA...	13.350
0pla185o23e.5nuA...	10.000
0pla185o6e.5nuAe...	15.280
0pla185o3e.5nuAe...	17.000
0pla184o16e.4nuA...	18.000
0pla183o29e.3nuA...	21.000
0pla183o29e.3nuA...	18.000
0pla183o29e.3nuA...	16.500

Show excavation for selected entry

Date:

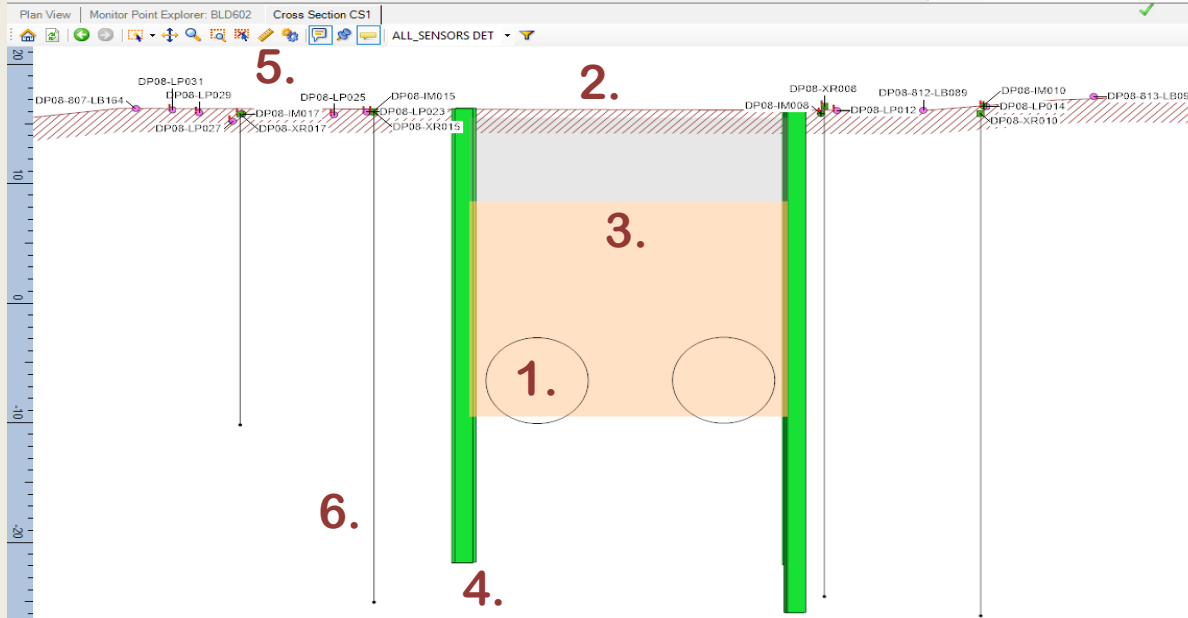
Time:

Depth:  m

Pile Number	Pile Top Level [m]	Excavation Start [date]	Excavation Finished [date]	Concrete Start [date]	Concrete Finished [date]	Concrete Volume [m³]	Drilling Activity Cutting Drilled Quantity [m³]	Pile Reinforcement Cage Installation Start [date]	Pile Reinforcement Cage Installation Finished [date]	Bentonite Loss [m³]	Additional Information	Status
P1		08-Aug-17 07:20	08-Aug-17 13:10	08-Aug-17 21:02		64.000						finished
P2		03-Aug-17 11:00	03-Aug-17 21:20	04-Aug-17 09:00		64.000						finished
P8		06-Jun-17 19:30	06-Jun-17 13:50	07-Jun-17 17:35	07-Jun-17 13:50	64.000						finished
P13		06-Jun-17 08:10	06-Jun-17 11:40	06-Jun-17 15:50	06-Jun-17 18:20	56.000						finished
P12		04-Jun-17 08:20	04-Jun-17 13:40	04-Jun-17 19:50	04-Jun-17 23:20	60.000						finished
P11		01-Jun-17 08:15	01-Jun-17 13:30	01-Jun-17 20:06	01-Jun-17 21:50	56.000						finished
P9		28-May-17 08:30	28-May-17 15:30	28-May-17 19:06	28-May-17 22:35	64.000						finished
P10		22-May-17 10:00	22-May-17 16:20	22-May-17 16:20	23-May-17 01:05	56.000						finished
P6		10-May-17 11:30	11-May-17 13:30	11-May-17 21:31	11-May-17 23:55	53.000						finished
P7		08-May-17 11:30	09-May-17 13:30	09-May-17 21:31	09-May-17 23:55	48.000						finished
P3		22-Jan-17 08:15	22-Jan-17 15:40	22-Jan-17 19:20	22-Jan-17 22:30	48.000						finished
P5		19-Jan-17 08:30	19-Jan-17 16:45	19-Jan-17 21:30	19-Jan-17 23:55	48.000						finished
P4		12-Jan-17 08:30	12-Jan-17 16:10	12-Jan-17 19:20	12-Jan-17 22:40	48.000						finished



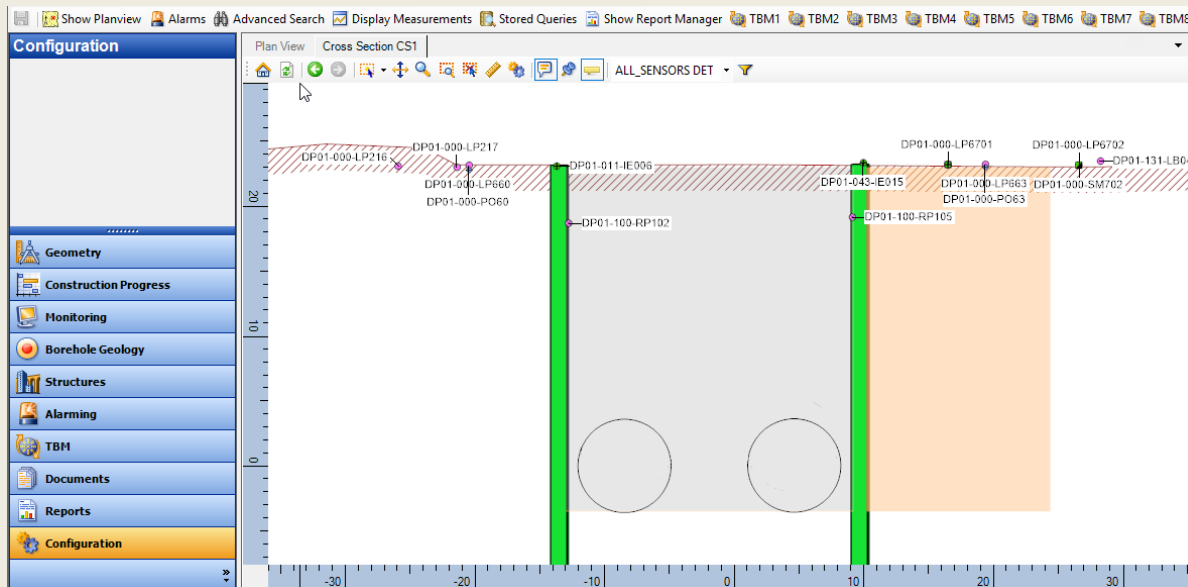
# 3D vizualizacija podataka



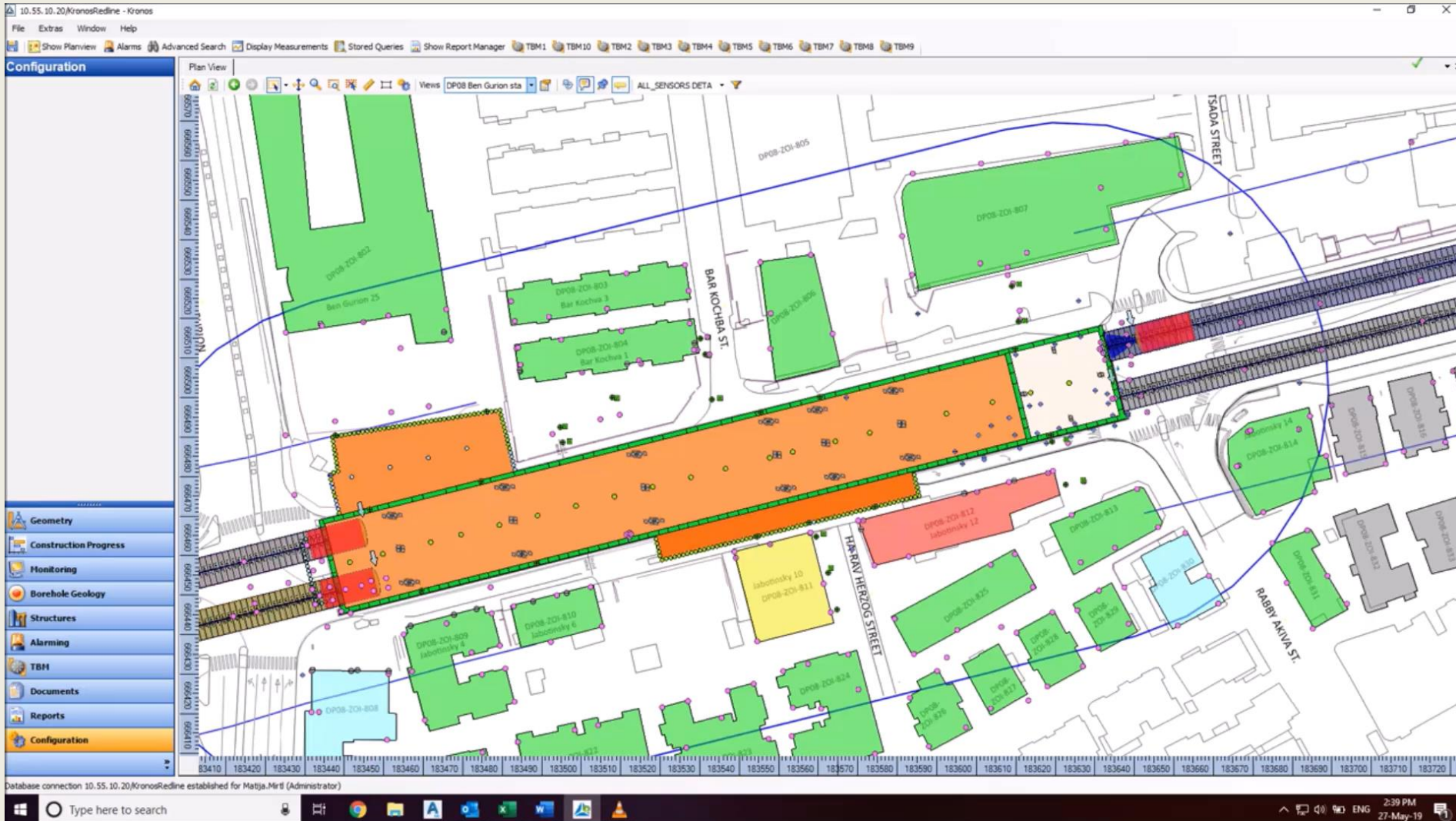
3D vizualizacija podataka

Poprečni presjek

- Položaj tunela 1.
- Razina terena 2.
- Stanje iskopa:
  - Pilota
  - Zemljani radovi 3.
  - Talpi 4.
- Mjerne točke
  - Geodetska mjerenja
  - Geotehnička mjerenja 5.
  - Mjerenje razine vode
- Oznake mjernih točaka
- Dubinski prikaz instrumenata 6.



# 3D vizualizacija podataka



# Monitoring zgrada

- Položaji mjernih točaka su vidljivi na svim objektima u zoni utjecaja
- Automatsko osvježavanje podataka i prikaz zadnjih mjernih rezultata



# Prikaz deformacija

- Kombinacija više senzora na jednome grafu
- Apsolutne i relativne deformacije
- 3D mjerenja + nivelman + klinometar A i B smjer+ razina vode

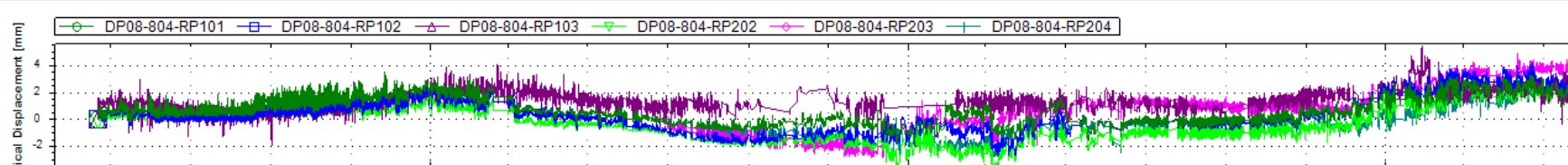
1.

2.

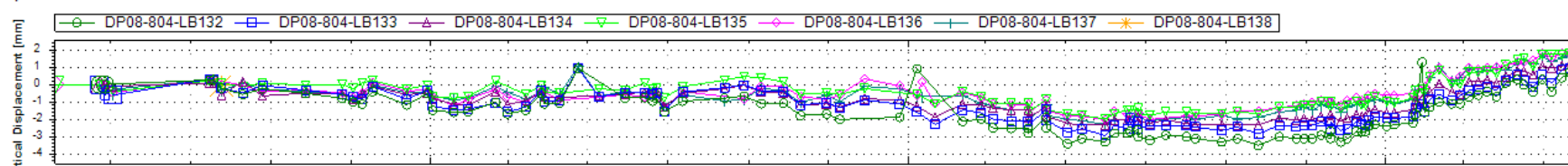
3.

4.

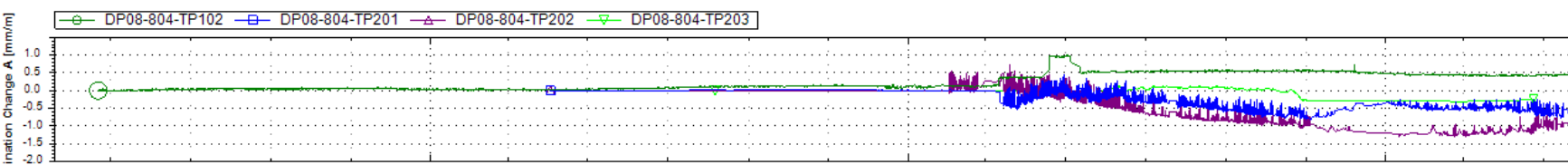
1.



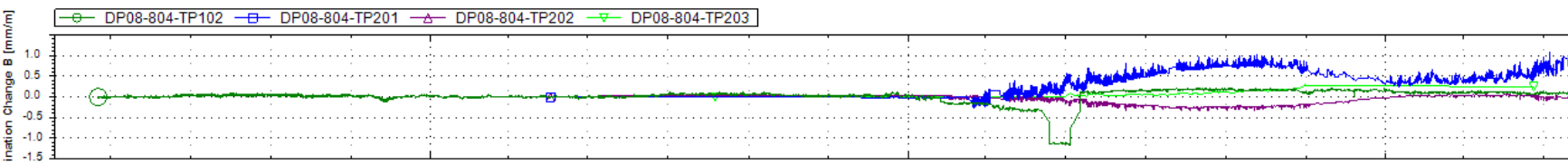
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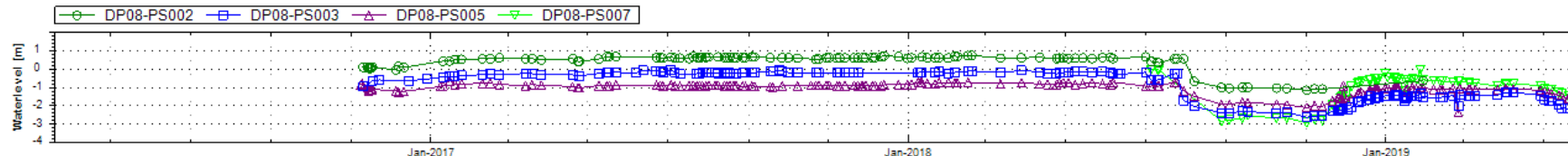
3.



3.



4.



# Prikaz deformacija

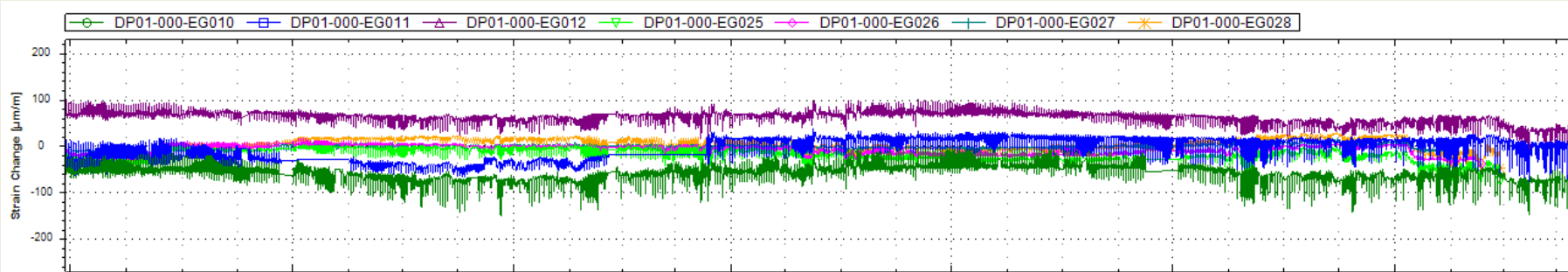
- Kombinacija više podataka o svakome senzoru
- Strain change + strain + temperatura senzora

1.

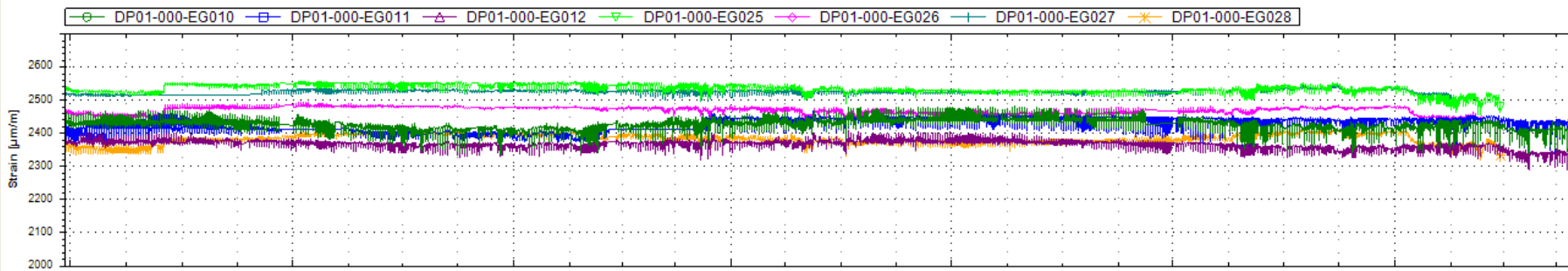
2.

3.

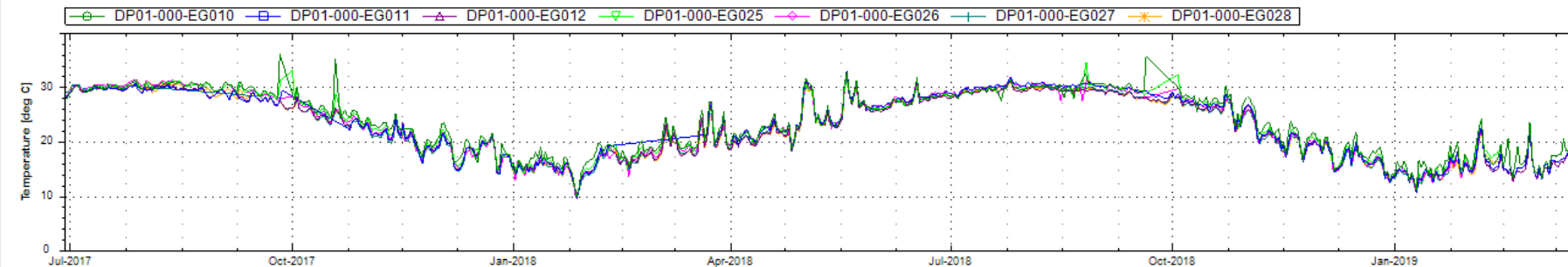
1.



2.



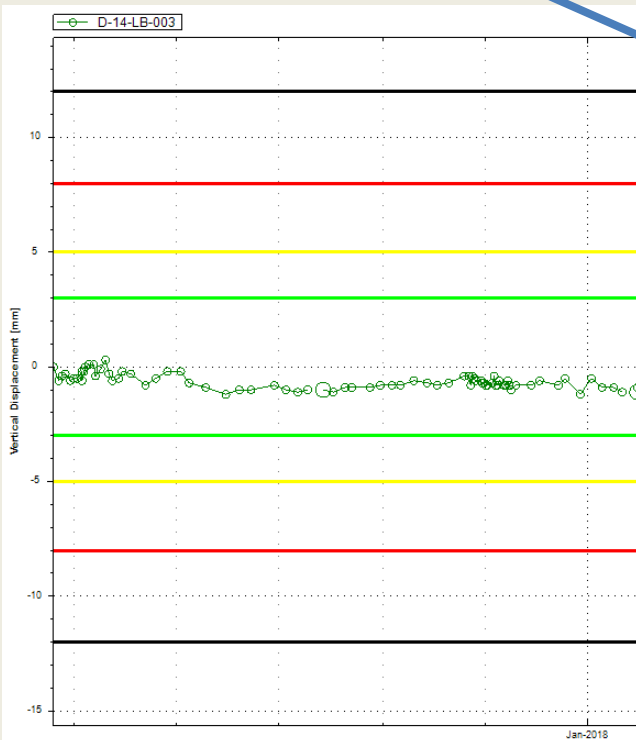
3.



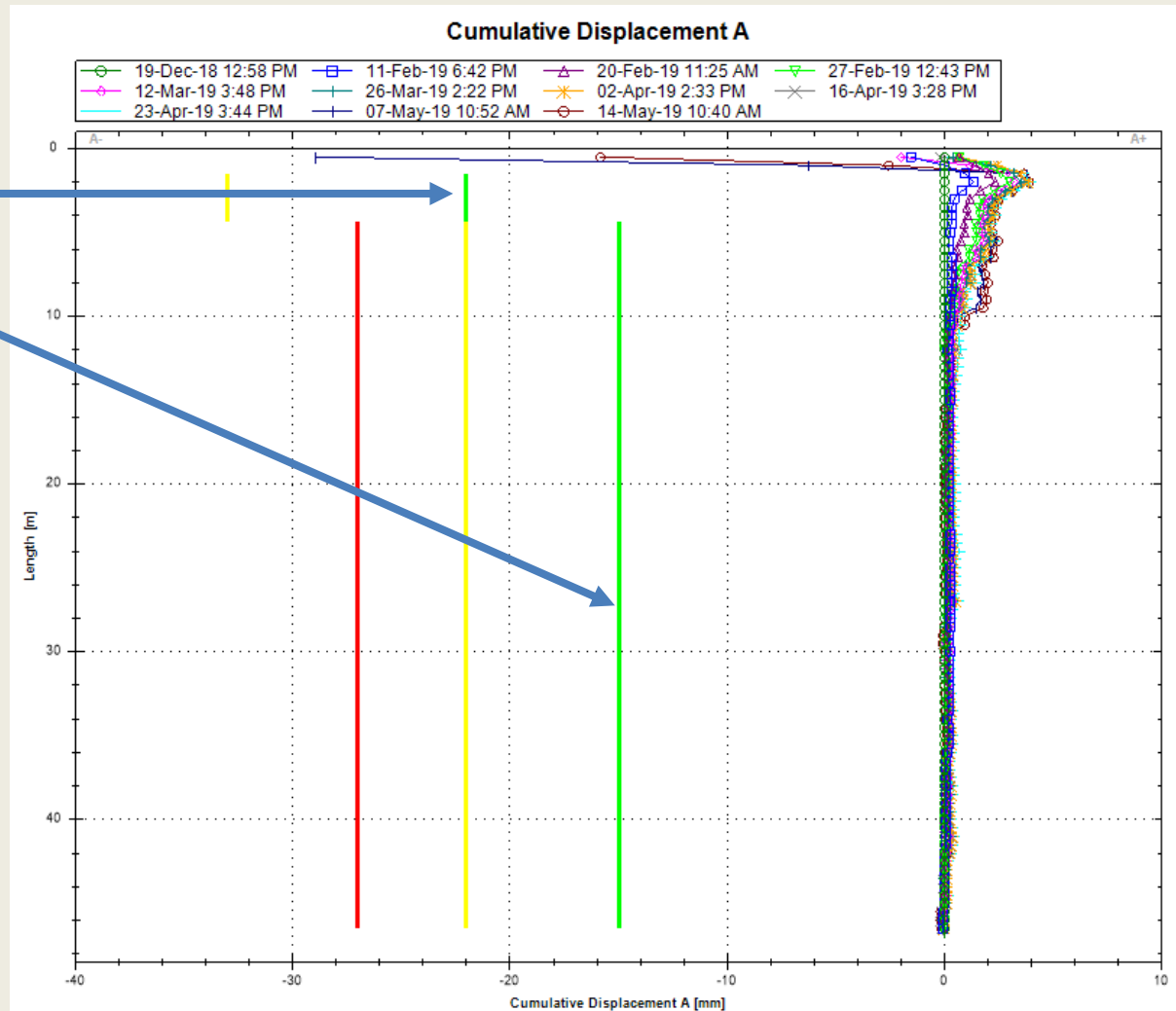
# Prikaz deformacija sa alarmima

- 4 različite razine alarma:
  - Green, Yellow, Amber i Black
- Depth related alarms
- Različite vrijednosti alarma ovisno o dubini

## Nivelman



## Inklinometar



# Alarmi

- Values alarms
- Rate alarms
- Out of range alarms
- Frequency alarms
- Email ili SMS slanje
- Različiti korisnici primaju različite alarme

## Alarm notification targets

Active	Name	Green (1)	Amber (2)	Red (3)	Black (4)	Email
<input checked="" type="checkbox"/>	Alarm	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Alarm@... .nl
<input type="checkbox"/>	Ground Water	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	groundwater@... .nl
<input checked="" type="checkbox"/>	Water Level	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	waterlevel@... .nl
<input type="checkbox"/>	Water Level (outside project)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	waterlevel@... .nl
<input type="checkbox"/>	Flow Range	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	flowrange@... .nl
<input type="checkbox"/>	Tide Level	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	tidelevel@... .nl
<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

## Alarm overview

Display	Level	Construction	Monitor Object	Monitor Point	Alt. Monitor Point	Importsources	Alarm started	Alarm notification	Alarm ended	Description	Confirmed
	Amber	DP0506	LC	DP0506-LC001	TS3-LC001		26-May-19 16:51	26-May-19 17:33		Load exceeds limit of 297.0 kN. ...	<input type="checkbox"/>
	Amber	DP0506	LC	DP0506-LC002	TS3-LC002		26-May-19 16:51	26-May-19 17:33		Load exceeds limit of 290.0 kN. ...	<input type="checkbox"/>
	Amber	DP0506	LC	DP0506-LC003	TS3-LC003		26-May-19 16:51	26-May-19 17:33		Load exceeds limit of 307.0 kN. ...	<input type="checkbox"/>
	Amber	DP0506	ELFTRK	D14	D-14-LB-003	D-14-LB-003	22-Oct-18 16:00	22-Oct-18 17:48		Heave exceeds limit of 12.00 m...	<input type="checkbox"/>
<input checked="" type="checkbox"/>	Red	DP0506	HGWY_N	DP0506-IE001	TS3-IE001		20-Aug-18 10:02	20-Aug-18 10:38		Cumulative Displacement A at 2...	<input type="checkbox"/>
<input type="checkbox"/>	Black	DP0506	HGWY_N	DP0506-IE002	TS3-IE002		20-Aug-18 10:02	20-Aug-18 10:38		Cumulative Displacement A at 2...	<input type="checkbox"/>
<input type="checkbox"/>	Black					TBMRings	28-Jun-18 16:13	28-Jun-18 16:13		No measurements received	<input type="checkbox"/>
<input type="checkbox"/>	Black					TBM_6	27-Jun-18 17:17	27-Jun-18 17:17		No measurements received	<input type="checkbox"/>
<input checked="" type="checkbox"/>	Green	GLG	WL	TS2-19030-P...			04-Jun-18 10:00	04-Jun-18 11:59		Water Level exceeds limit of -2....	<input type="checkbox"/>
<input checked="" type="checkbox"/>	Green	GLG	WL	TS2-19030-P...			28-May-18 10:00	28-May-18 14:44		Water Level exceeds limit of -2....	<input type="checkbox"/>
<input checked="" type="checkbox"/>	Green	GLG	WL	TS3-18930-P...			16-May-18 11:50	16-May-18 15:06		Water Level exceeds limit of -2....	<input type="checkbox"/>
<input checked="" type="checkbox"/>	Green	GLG	WL	TS3-18930-P...			15-May-18 11:50	15-May-18 15:07		Water Level exceeds limit of -2....	<input type="checkbox"/>
<input checked="" type="checkbox"/>	Amber	ELFTRK	D08	D-08-LB-006	D-08-LB-006		14-Mar-18 18:00	14-Mar-18 18:50		Settlement exceeds limit of 3.00 ...	<input type="checkbox"/>
<input checked="" type="checkbox"/>	Red	ELFTRK	D11	D-11-LB-003	D11-LB03		14-Mar-18 18:00	14-Mar-18 18:50		Settlement exceeds limit of 5.00 ...	<input type="checkbox"/>
<input checked="" type="checkbox"/>	Red	ELFTRK	D11	D-11-LB-004	D11-LB04		14-Mar-18 18:00	14-Mar-18 18:50		Settlement exceeds limit of 5.00 ...	<input type="checkbox"/>
<input checked="" type="checkbox"/>	Amber	ELFTRK	D13	D-13-LB-005	D-13-LB-005		14-Mar-18 18:00	14-Mar-18 18:50		Settlement exceeds limit of 3.00 ...	<input type="checkbox"/>

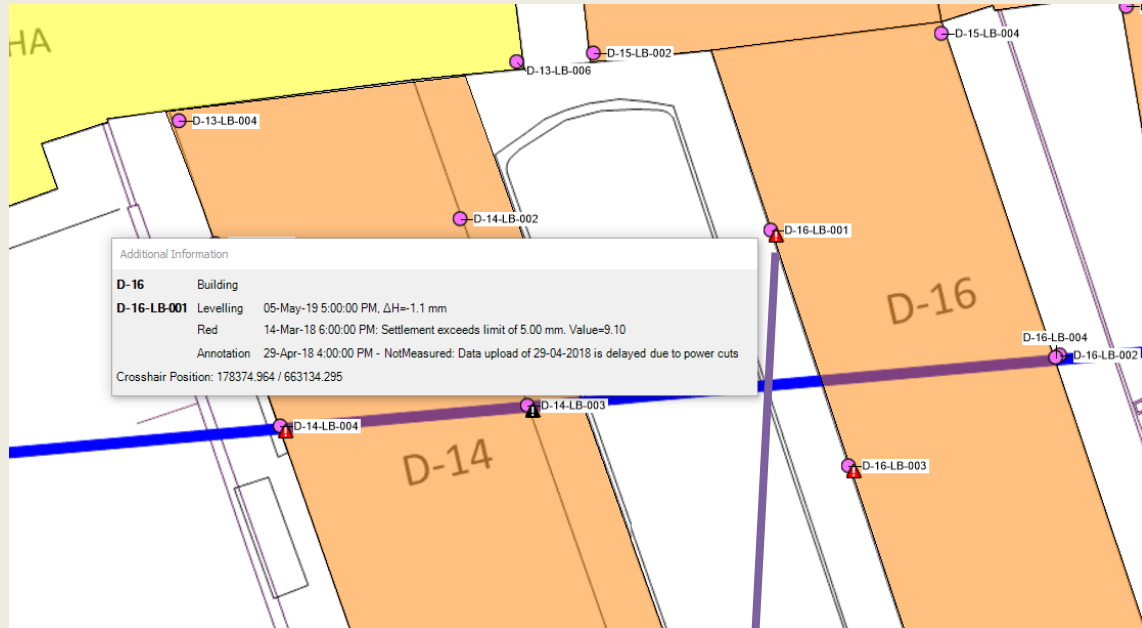




# Alarmi

- Values alarms
- Rate alarms
- Out of range alarms
- Frequency alarms
- Email ili SMS slanje
- Različiti korisnici primaju različite alarme
- Prikaz razine alarma u GUI

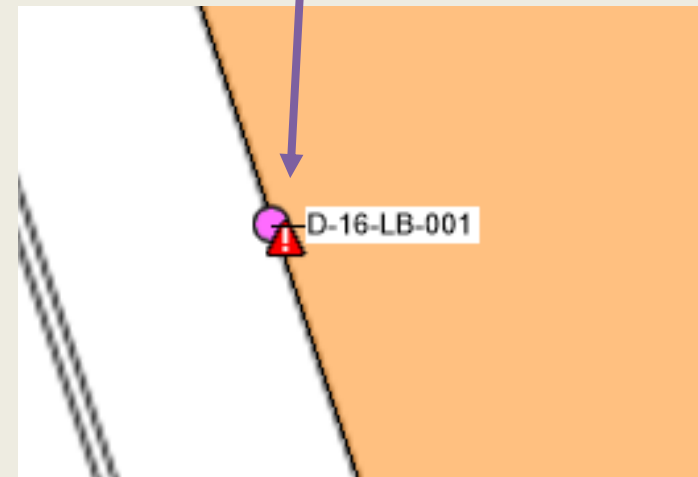
## Primjer emaila sa alarmom



Reply Reply All Forward  
Fri 26-Oct-18 10:18 AM  
KronosRedLine@geodata.at  
Kronos alarm notification for site NTA-RedLine  
To Matija Mirtl

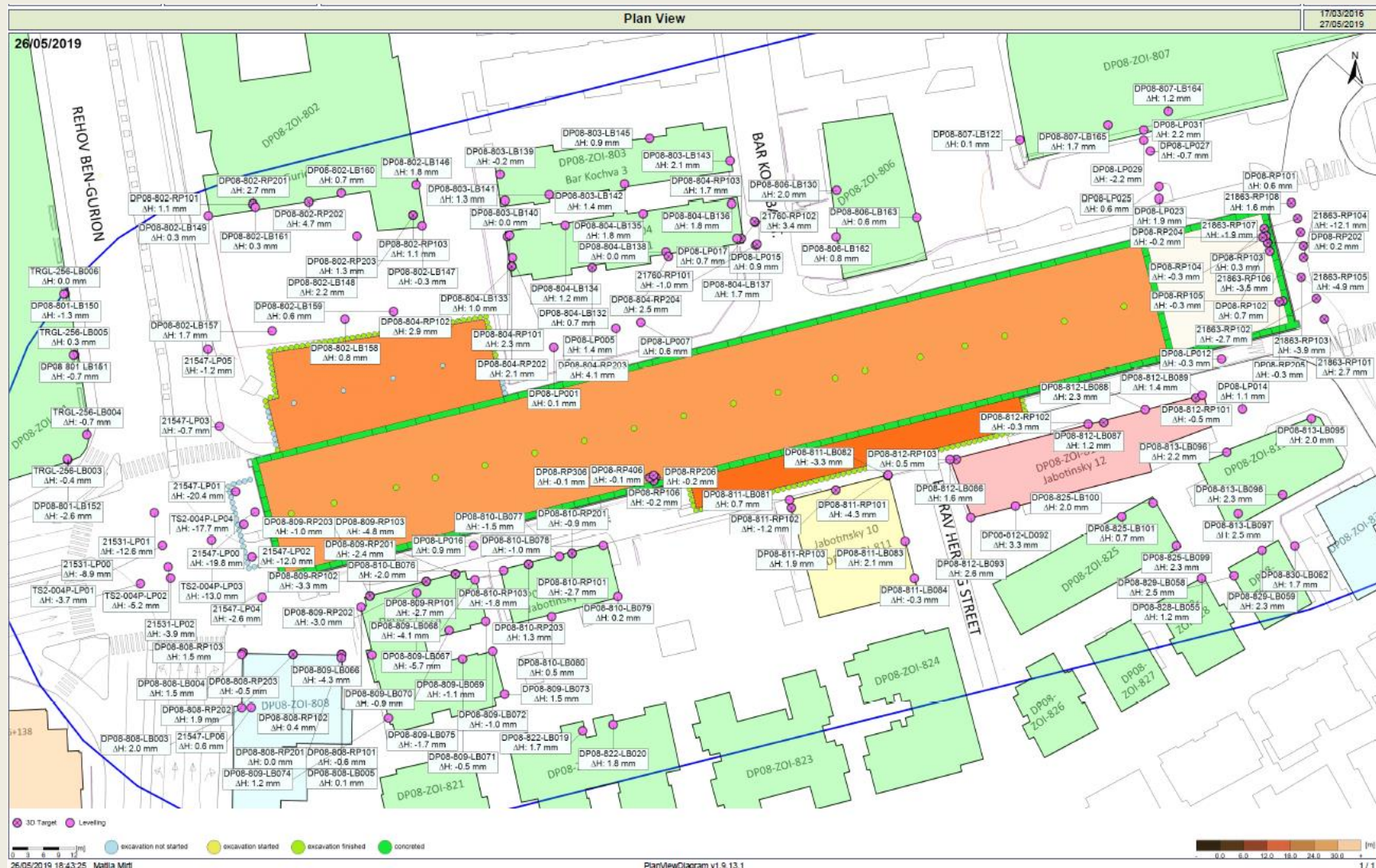
The following sensors raised an alarm:

Constr Monitorpoint	Date measured	Alarm Level	Description
DP0506 DP0506-LC002	2018-10-26 10:44:21	1 Green	Load exceeds limit of 290.0 kN. Value=266.5
DP0506 DP0506-LC001	2018-10-26 10:44:21	1 Green	Load exceeds limit of 297.0 kN. Value=280.9
DP0506 DP0506-LC003	2018-10-26 10:44:21	1 Green	Load exceeds limit of 307.0 kN. Value=302.7

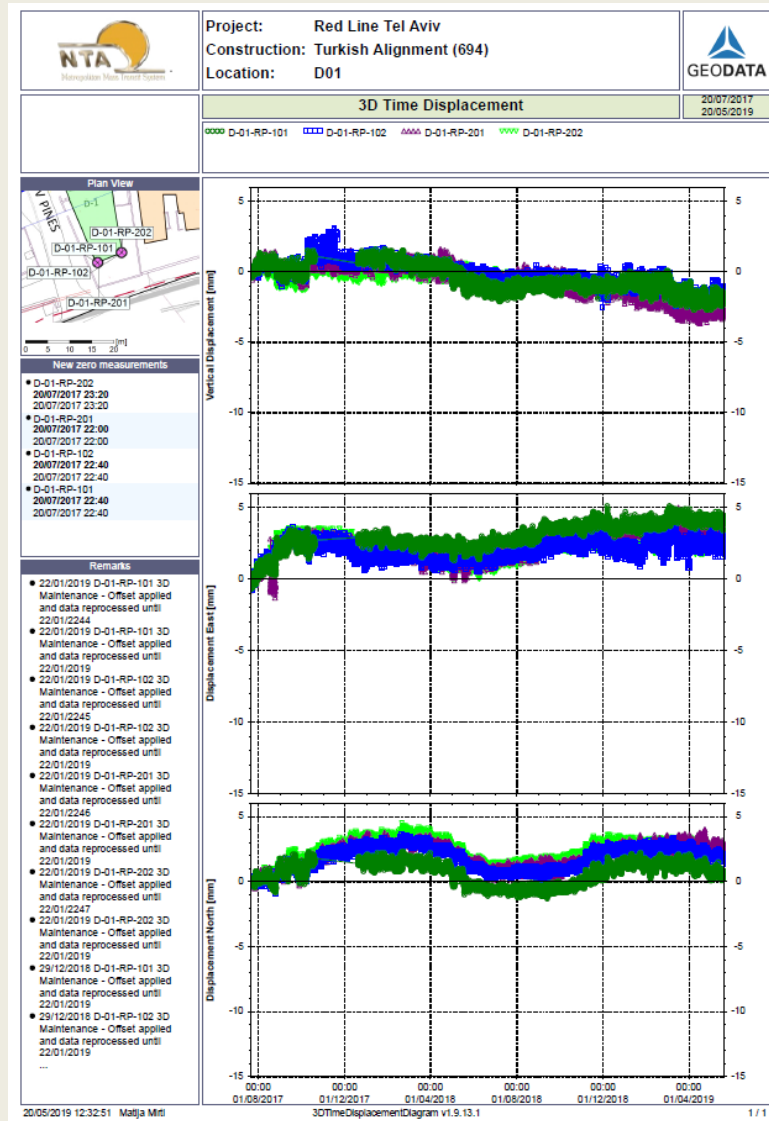
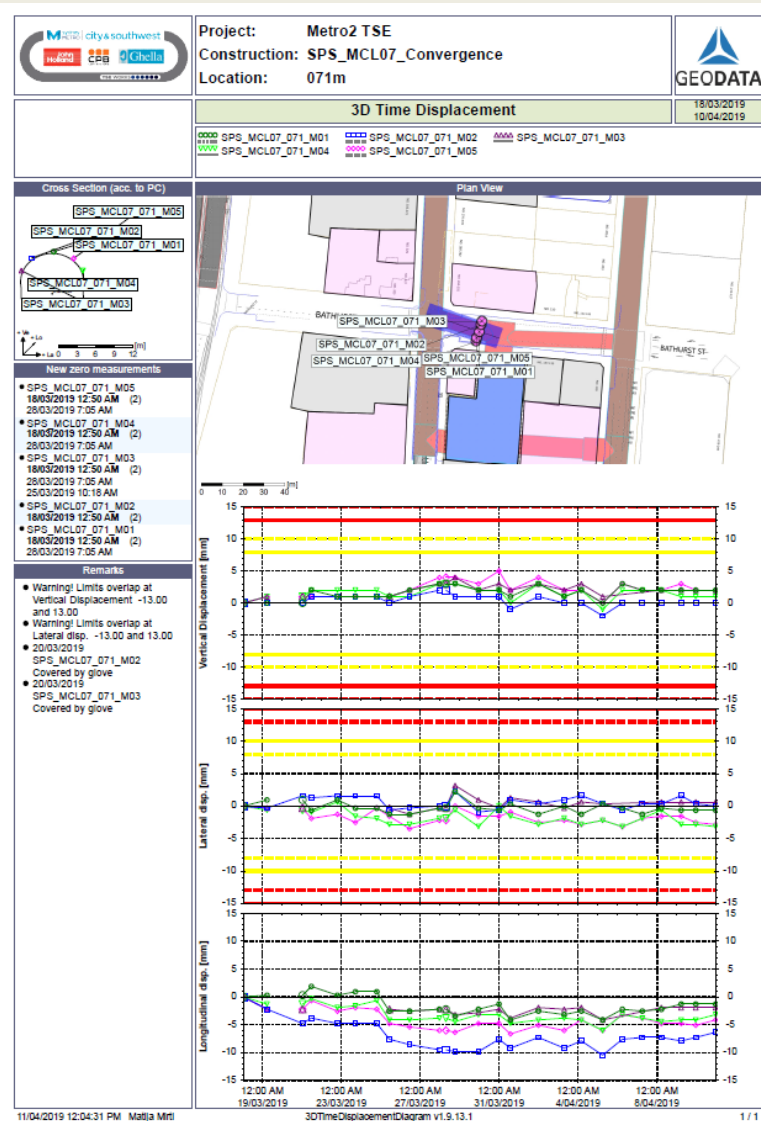


# Reporti- Planview report

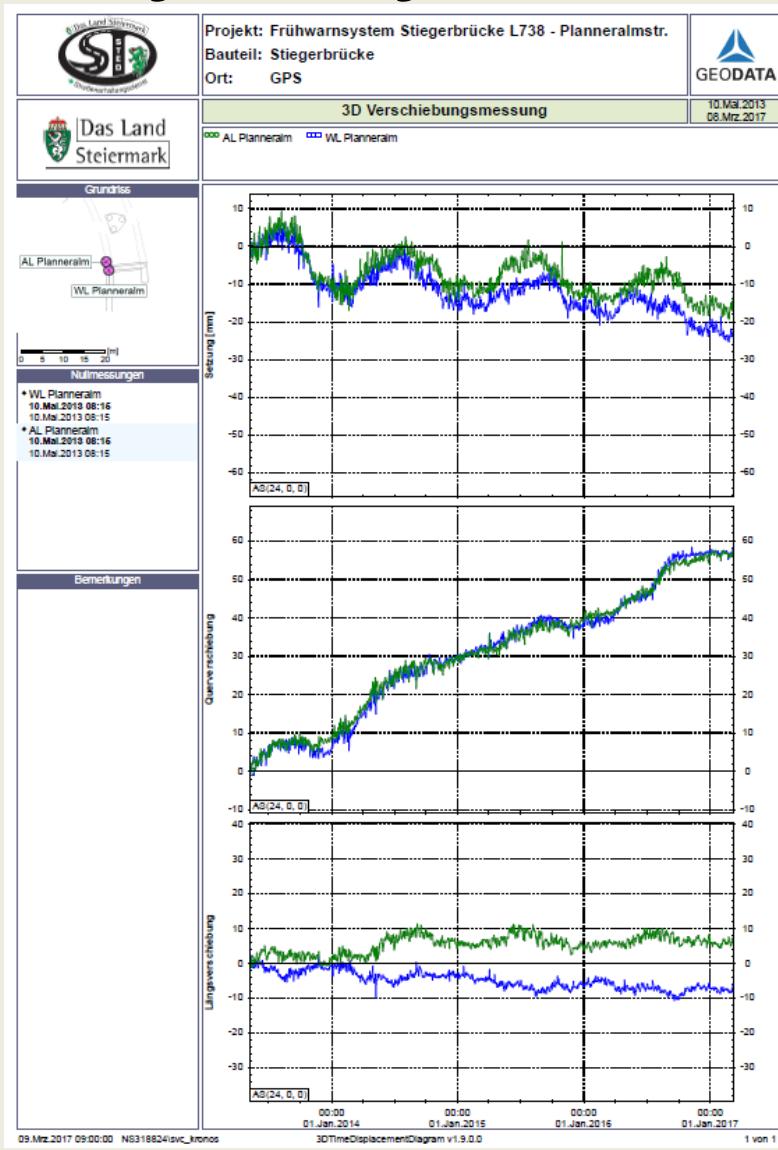
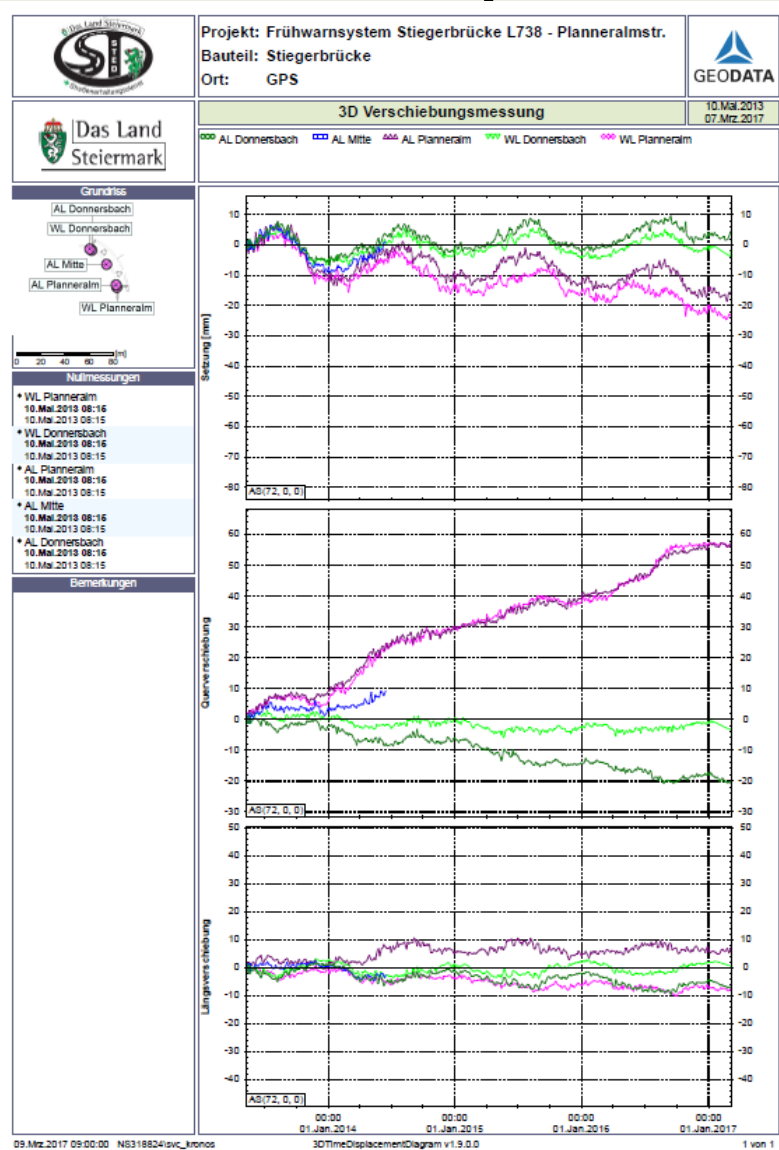
- Prikaz svih mjernih senzora sa zadnjim mjerenim rezultatima



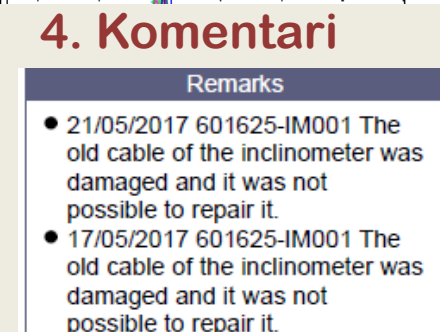
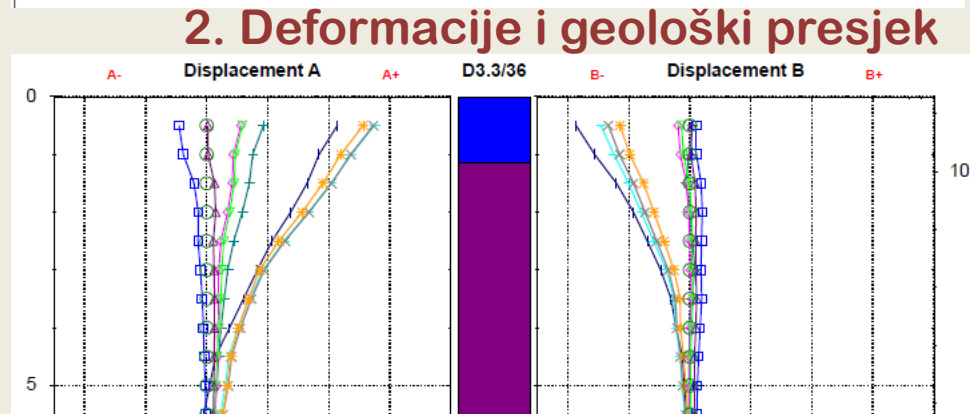
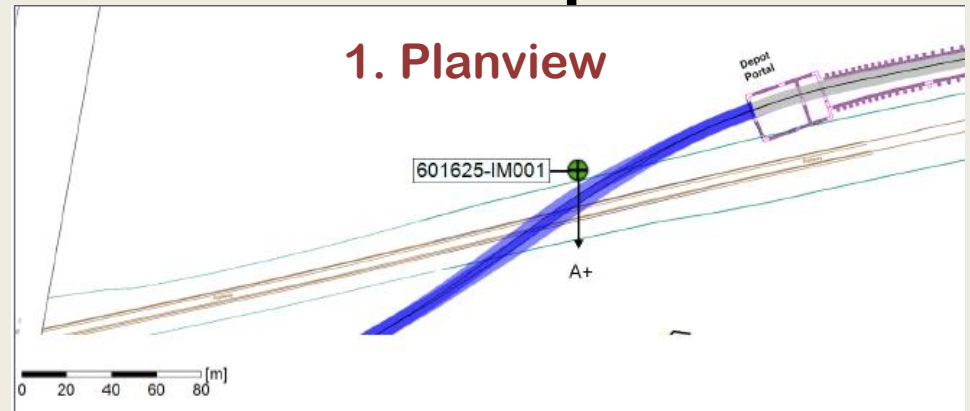
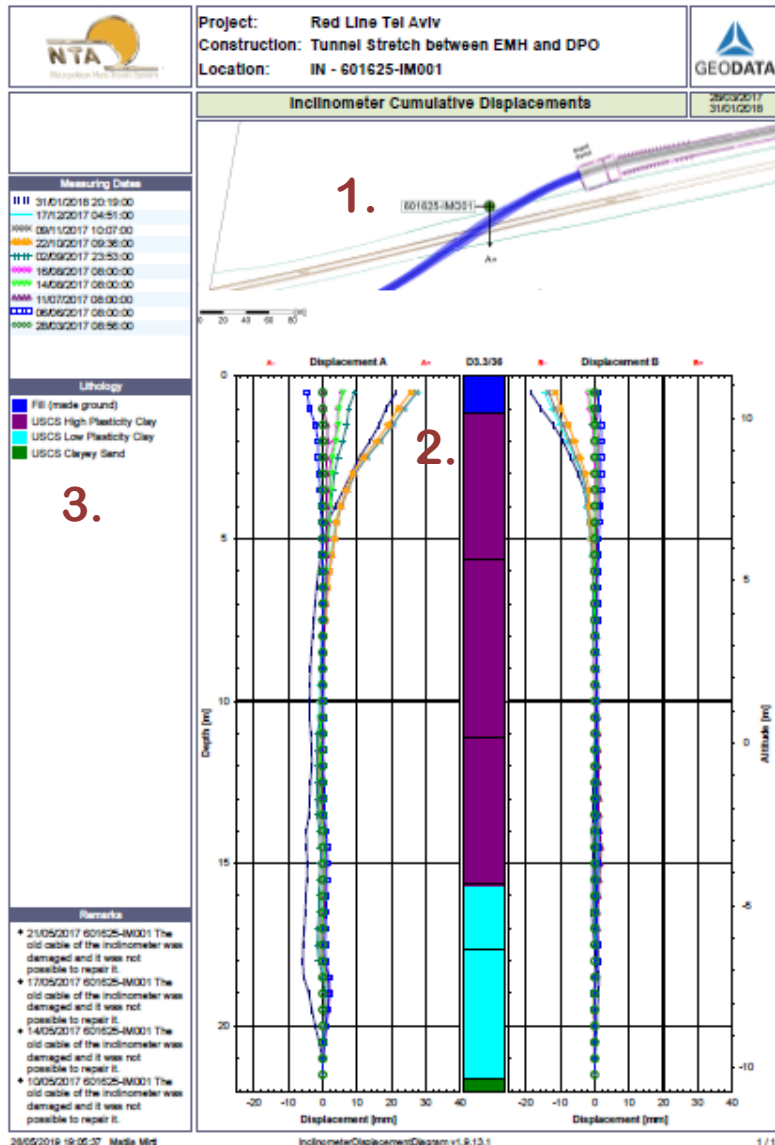
# Reporti– 3D time displacement



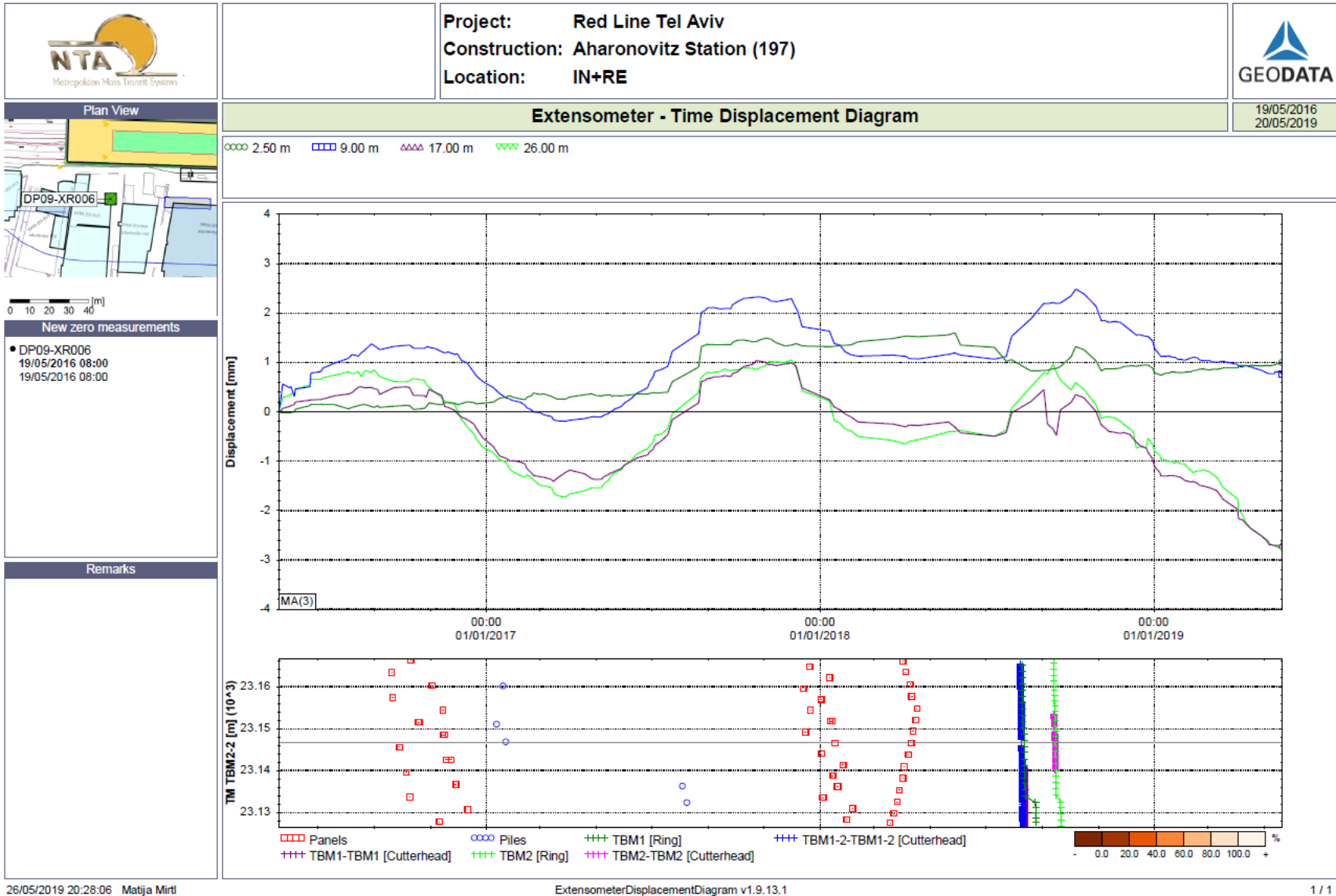
# Reporti– GPS mjerenja



# Reporti – Inklinometer report



# Reporti– Ekstenzometar report

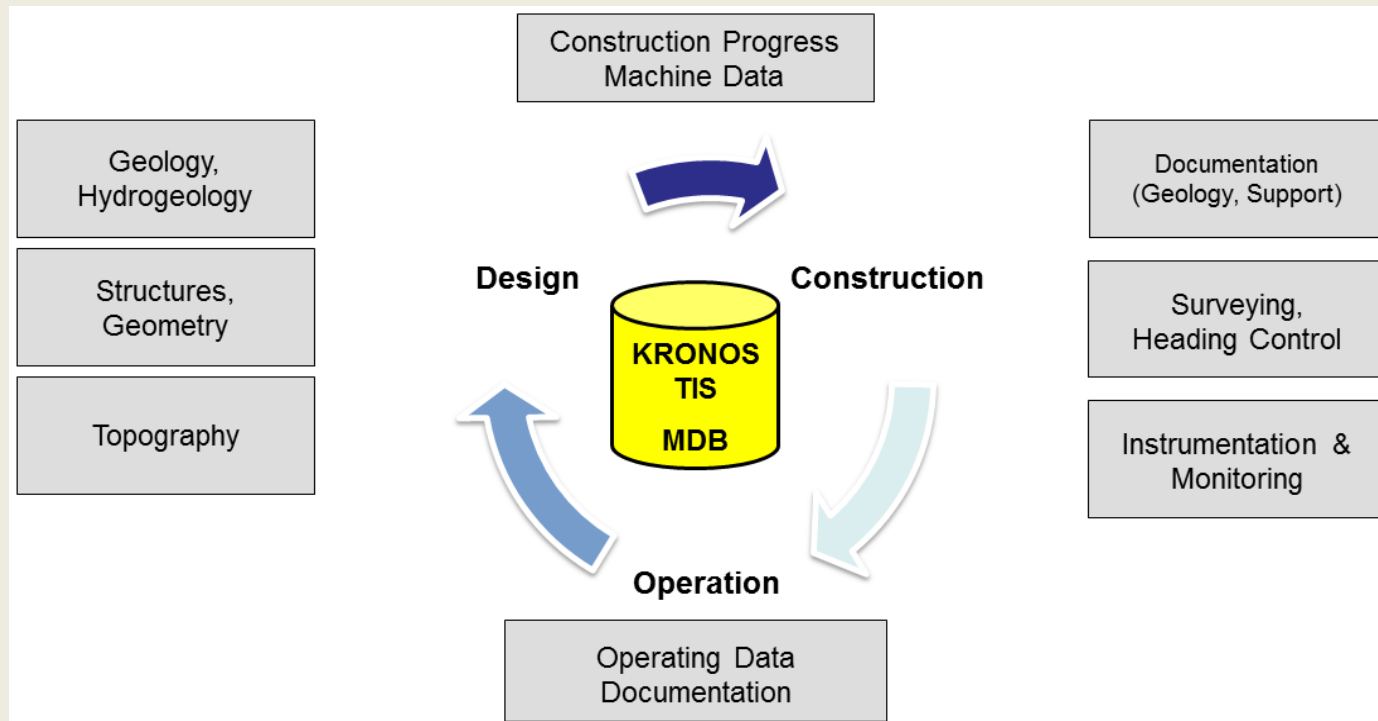


# Zaključak

- Risk management/project management tool – real time mjerenja, alarmi, reporti
- Prikaz svih mjernih senzora, objekata, faza izgradnje u grafičkom sučelju
- Centralna baza podataka sa svim podacima dostupna sa bilo koje lokacije sa internetom
- Upotreba prilikom izgradnje te održavanja infrastrukturnih objekata

## Upotreba na:

- ❖ Tunelima
- ❖ Klizištima
- ❖ Autocestama
- ❖ Branama
- ❖ Željeznicama
- ❖ Podzemnim stanicama
- ❖ Hidroelektranama
- ❖ Kamenolomima
- ❖ Industrijskim objektima



# HVALA NA PAŽNJI!



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INTO INFORMATION

01 | Sensors, Systems &  
Software

02 | Infrastructure and  
Mining

03 | Industrial Surveying

