Automated Monitoring of the Danube Bridge Apollo in Bratislava

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Topics

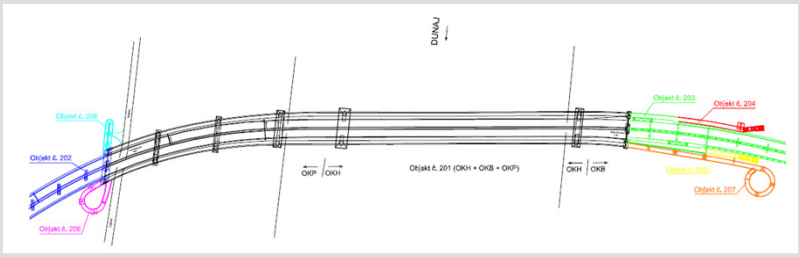
1. Apollo Bridge characteristics
2. Bridge monitoring
3. Measurement system development
4. Data processing and analysis
5. Conclusion

Apollo Bridge

- 8 parts (SO 201 až SO 208)
- total length 854,0 m

SO 201 – main bridge object

- main steel structure over the Danube
- steel structure at Petržalka river bank
- Steel structure at Bratislava river bank

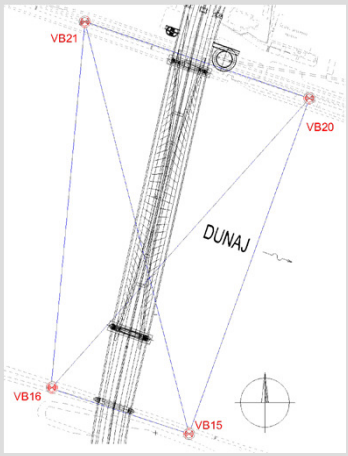


Bridge monitoring

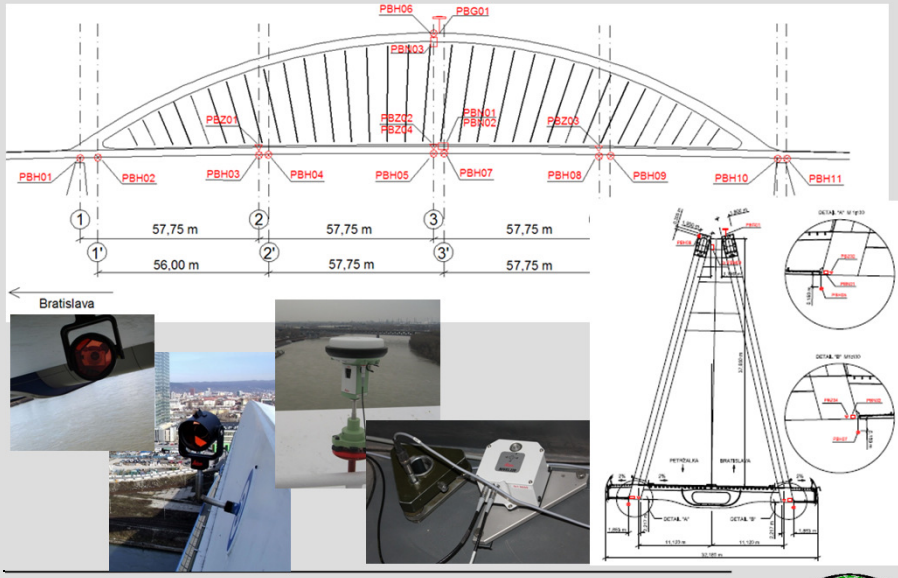
- 3D deformation of bridge structure – points situated at the bottom part of the main structure and the top of the bridge arch,
- horizontal deformation of points situated at the top of the bridge arch,
- transversal and longitudinal inclination of the main bridge structure (at route level),
- dynamic deformation of the main steel structure

Control network points

- control points VB15, VB16, VB20 a VB21



Measuring points

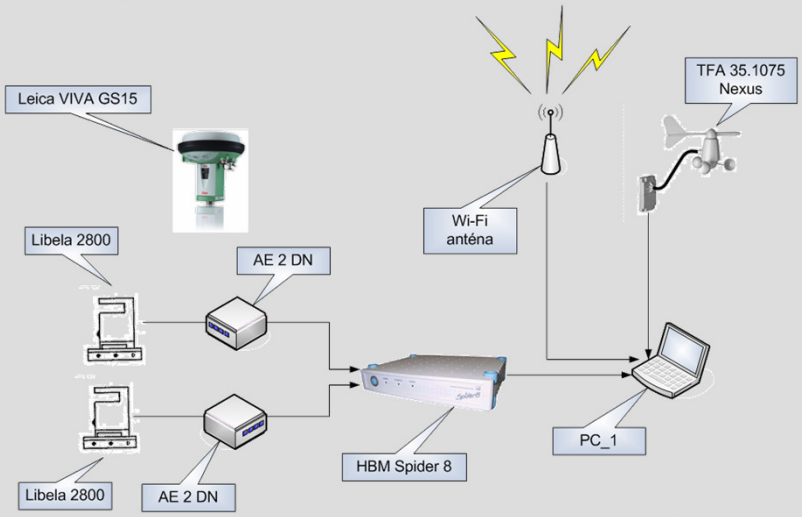


Measuring system

- UMS Leica TS30
- GNSS Leica Viva GS15
- inclination sensors Leica Nivel 210, Leica Nivel 220 a Libela 2800
- accelerometers HBM B12
- meteo station with temperature, airpressure, wind force and direction sensors
- time server – Local Time Server
- PC with data processing and registration software
- equipments – power supply, cables and data cables

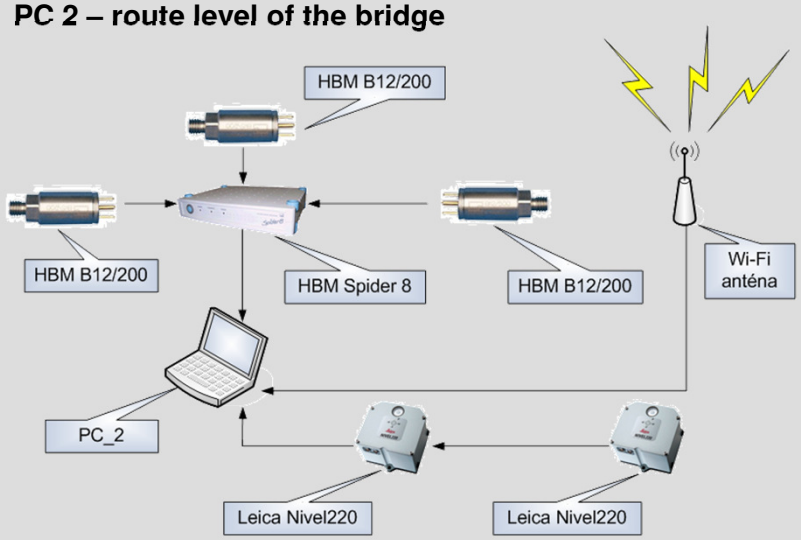
Measuing system

PC 1 – top of the bridge arch



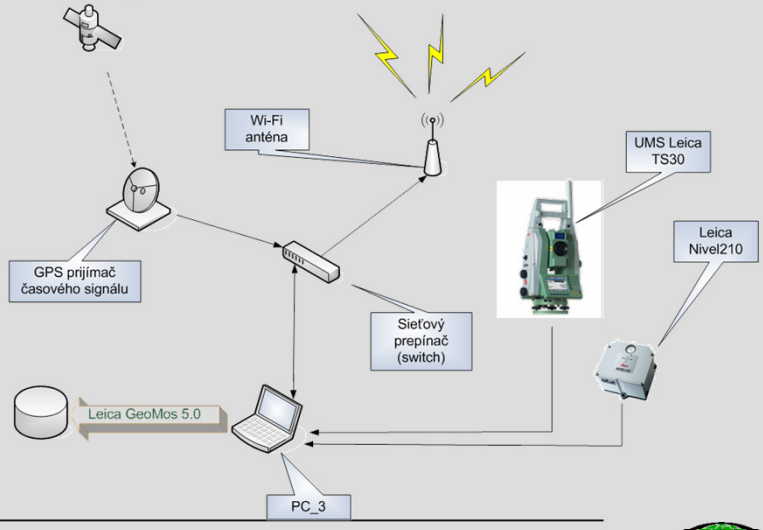
Measuing system

PC 2 – route level of the bridge



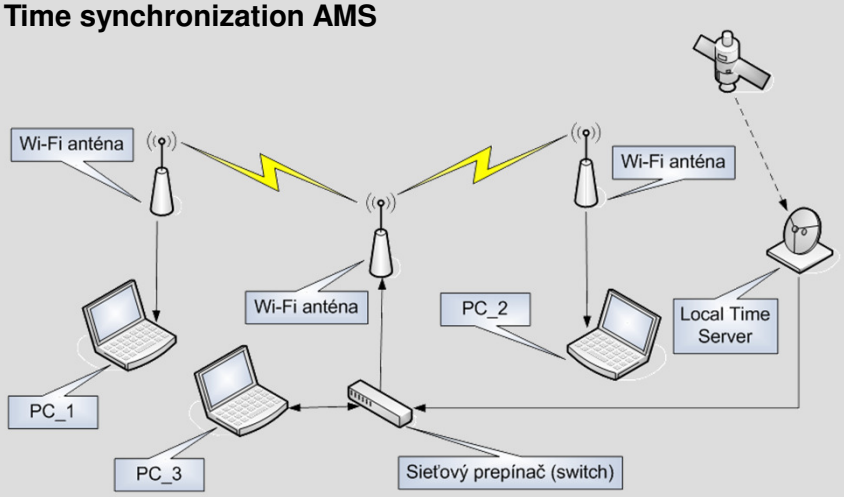
Measuring system

PC 3 – control point VB16



Measuring system

Time synchronization AMS



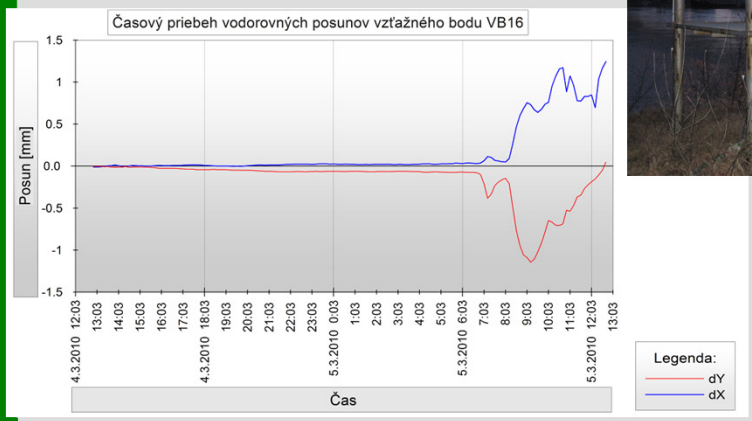
Geodetic monitoring – 24 h

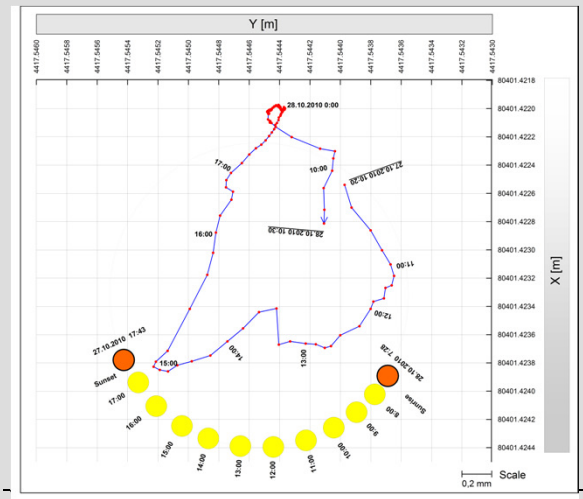
Termín: 4.3.2010, 13.00 hod – 5.3.2010, 13.00 hod.

3D deformation ➢ UMS Leica TS30 ➢ Meas.periode – 10 Minute	**Horizontal deformation** ➢ GNSS Leica Viva GS15 ➢ Meas. frequency – 1 Hz
Inclination ➢ Leica Nivel 220,Libela 2800 ➢ Meas.frequency – 1 Hz	**Dynamic deformation** ➢ HBM B12 ➢ Meas.frequency – 1 Hz

Data analysis

- **Stability of the control point VB16**



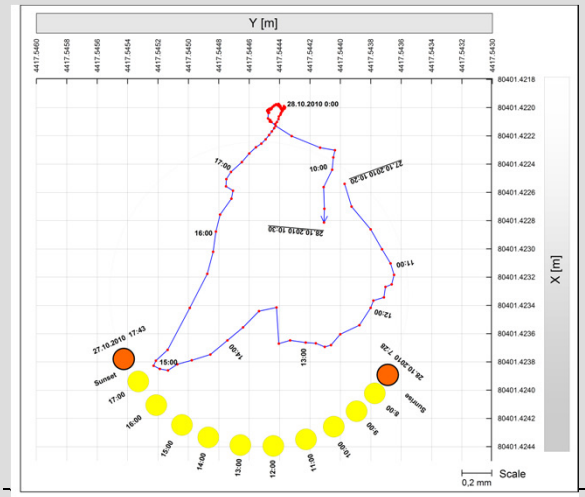


Data analysis

- **Stability of the control point VB16**

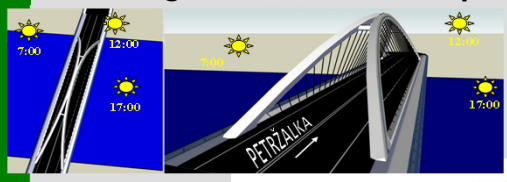
Data analysis

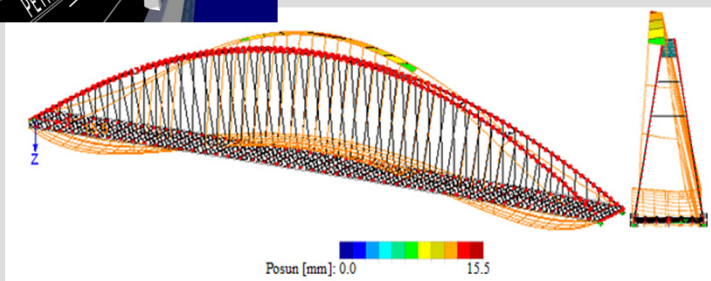
- Stability of the control point VB16

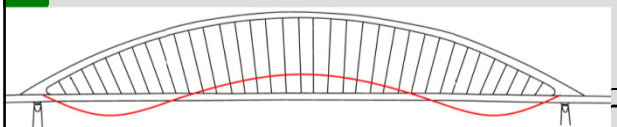


Data analysis

- Bridge deformation – temperature loading

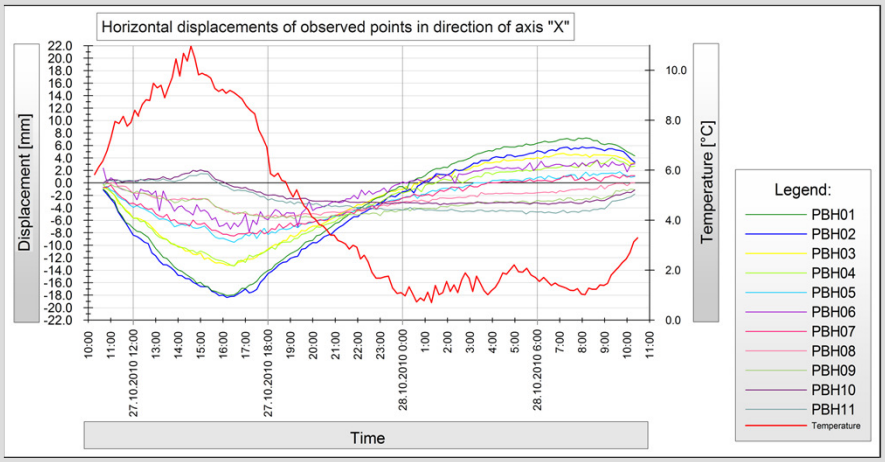






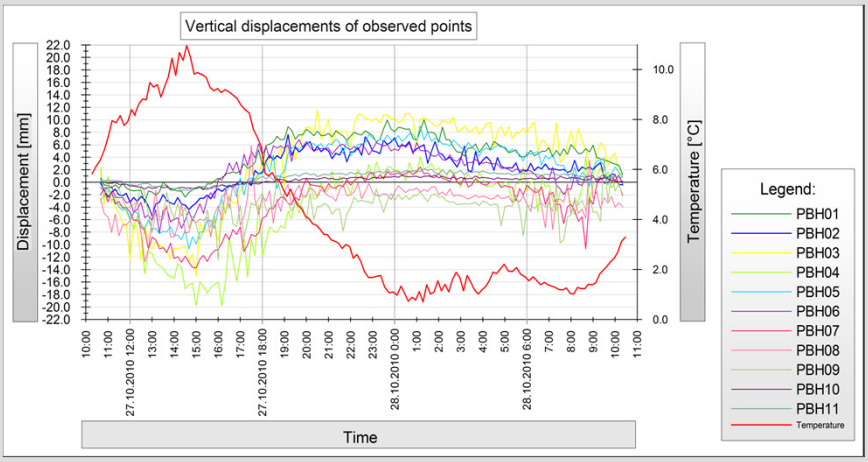
Data analysis

- **3D deformation of meas. points PBH01 - PBH11**



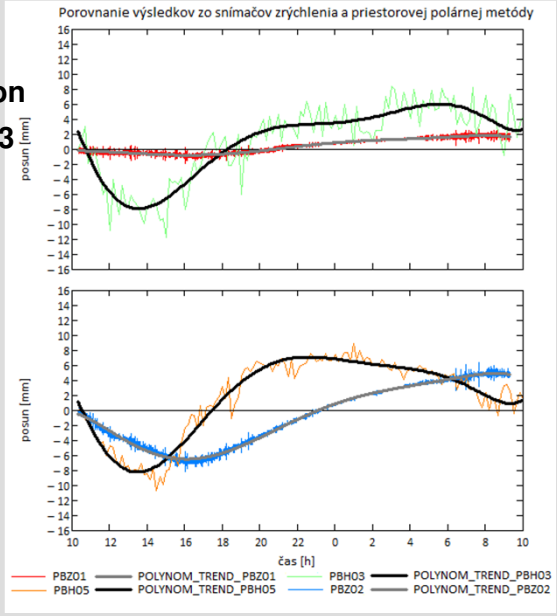
Data analysis

- **Vertical deformation of PBH01 - PBH11**



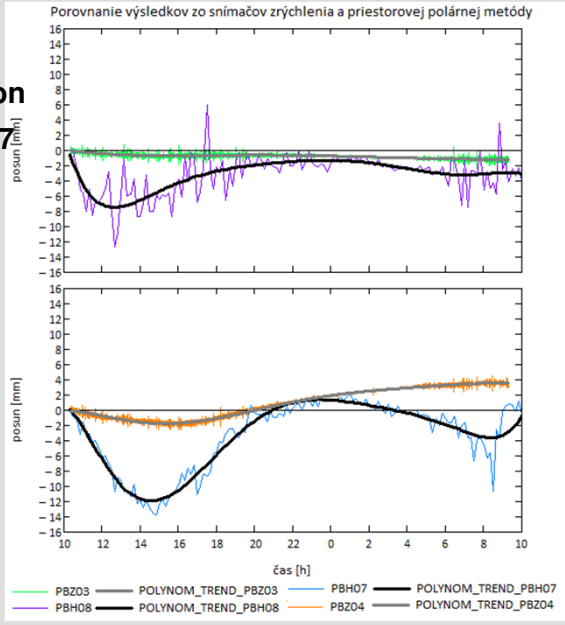
Data analysis

- Vertical deformation of PBH05 and PBH03



Data analysis

- Vertical deformation of PBH03 and PBH07



Conclusion

Measuring system – operating, bridge characteristics, combination of geodetic method and other sensors, measuring points, data processing and analysis base on time series analysis

Outcomes

- strength cooperation is needed with bridge designers (sensor location, temperature loading)
- permanent monitoring possible with mm-resolution
- detailed (time, position) structure changes could be determined
- sensor calibration (laboratory, on the fly), sensor drift elimination
- user fraindly software – include all this req. + req. of civil engineers

Thank you for your attention!

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