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, air pressure, wind force and direction sensors
- Time server – Local Time Server
- PC with data processing and registration software
- Equipments – power supply, cables and data cables

Measuring system

PC 1 – top of the bridge arch
PC 2 – route level of the bridge

PC 3 – control point VB16
Measuring system

Time synchronization AMS

Geodetic monitoring – 24 h
Termin: 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

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Data analysis

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Data analysis

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Data analysis

- Bridge deformation – temperature loading
Data analysis

- 3D deformation of meas. points PBH01 - PBH11

![3D deformation graph]

Data analysis

- Vertical deformation of PBH01 - PBH11

![Vertical deformation graph]
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 friendly software – include all this req. + req. of civil engineers
Thank you for your attention!

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