STRUCTURAL HEALTH MONITORING OF THE PERISTYLE OF DIOCLETIAN`S PALACE IN SPLIT

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Introduction

• Inspections of the structures are extremely important in order to detect damages at early stage of their occurrence.

• Structures remain safe and reliable to use

• Many structures are subjected:
  – changes in load
  – structural deterioration
  – external environmental influences
  – random affects
Introduction

• Damages on masonry structures mainly relate to:
  – cracks
  – foundation settlements
  – material degradation
  – structural deformations

• There are many techniques which are capable to detect and locate damages even if they are not visible on the surface of the structure.

• Implementing MONITORING system for measuring behaviour of the structure
• Implemented STATIC monitoring system:
  – displacement
  – strain
  – temperature

• The objective of this investigation is to detect damage of historical masonry structure.

• Monitoring system is a part of the:
  – conservation
  – restoration
  – reconstruction
Introduction

- Installation of the monitoring system was carried out in two phases
- First phase of the research included assessment of embedded material: bearing stone and copper clamps
- Second phase is installation of structural health monitoring system
- Investigations are carried out by the Structural Testing Laboratory of Faculty of Civil Engineering University of Zagreb
I. Phase – determination of mechanical properties

- Base for the installation of continuous static monitoring
- Mechanical properties, in laboratory:
  - copper clamps (tensile test)
  - stone (compression test)
I. Phase – determination of mechanical properties

- On the site, residual strain measurement was performed in order to determine the actual force in the clamps using hole-drilling method.
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1. Phase – determination of mechanical properties

Results of measured residual force (kN)
II. Phase – Monitoring system

- Continuous static monitoring system
- Based on LabVIEW and CompaqDAQ (National Instruments)
- Displacement (LVDT), strain (strain gauge) and temperature
- Graphic interface on which important measuring values are visualized.
- Acquired data as well as software support are available to monitor at remote location via the internet.
- Regular inspections and condition assessments of engineering structures can allow programmed repair works and avoid undesired economic, cultural and life losses
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II. Phase – Monitoring system
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II. Phase – Monitoring system
II. Phase – Monitoring system

Legend:
- Strain gauge - SG
- LVDT - L

Disposition of the measuring points at Chapel St. Roche
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II. Phase – Monitoring system

Disposition of the measuring points at East and West colonnade
II. Phase – Monitoring system

Disposition of the measuring points at Protiron
Time series of displacements (Chapel St. Roche and East colonnade)
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Measurement results

Time series of displacements (Protiron)
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Measurement results

Time series of strains (Chapel St. Roche)
Time series of strains (Protiron and West colonnade)
Conclusions

• The aim of monitoring is the early detection of structural damage, that timely alert the system and in that way prevents further degradation.
• Monitoring of Peristyle is useful instrument for improving the efficiency of maintenance of historical structure.
• Based on the measurement results, current state of the structure is stable.
• Behaviour of masonry structures is very difficult to assess in short period of monitoring because of the small displacement and strain.
• It is necessary to monitor the condition of structure through years.
Thank you for your attention

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