Application of Monitoring Systems for the Management of Civil Structures

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Abstract

- Application of Monitoring Systems for the Management of civil structures as part of the service of the life cycle and risk management
- planning of measurement and quality control selection of suitable measures for structural protection and repair
Workshop on Civil Structural Health Monitoring (CSHM-4)
"SHM systems supporting extension of the structures' service life"

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Adapted Risk Management

Live Monitoring with Warning System

Automated Data Management
Monitoring of Civil Structures
Open Questions

Thousands of open Questions to be solved:
- Dynamic and Static Loads
- Leakage Detection
- Deformations
- Vibration Monitoring
- Loads and Frequency
- Loads due to Temperature Changes
- Nondestructive Inventory Monitoring
- Corrosion Protection
- Carbonation process
- Emergency cases

SYSTEMS ENGINEERING
Systems Engineering
who we are...

SYSTEMS ENGINEERING
- creative, innovative Team with more
  than 25 years experience in:
  - Civil Engineering in structural life-cycle-management
  - Qualified support in all phases of your construction project
  - Certificated consulting teams of professionals for different
    tasks
  - Broad coverage of the disciplines of building construction
  - Individual and practical solutions based on the established
    project characteristics

Location Bramsche
Gilkamp 30
48959 Bramsche

Location Essen
Rellinghauser Str. 4
45129 Essen
Monitoring of Civil Structures

Setup and Define

1. Preclarification
   Problem analysis and clarification of the inspection.
   Specification of the Monitoring System
   Define of:
   - Place of Measurement
   - Position (POI)
   - Parameters
   - Timewave

2. Monitoring Technique
   System setup, installation and commissioning in own hand.
   Central Data Acquisition.

3. Monitoring
   With a defined sampling rate the changes are tracked and send to interpretation.

4. Interpretation
   The obtained data enable sustainable analysis of critical parameters for the calculation of such limits of the building structure.

5. Information Management
   Users access to the collected data.
   Regular report sending.

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Monitoring of Civil Structures

Monitoring Technique

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Transfer Function</th>
<th>Measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define Sensor Technique to optimize Signal Value:</td>
<td></td>
<td></td>
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<tr>
<td>- Pressure</td>
<td></td>
<td></td>
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<tr>
<td>- Temperature</td>
<td></td>
<td></td>
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<tr>
<td>- Weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Accelerations</td>
<td></td>
<td></td>
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<tr>
<td>- Vibrations</td>
<td></td>
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<tr>
<td>- Change in Length</td>
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<td></td>
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<tr>
<td>- Chemical Processes (Voltage, Current)</td>
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<tr>
<td>Regarding the different Object Structures the Individual Transfer Function has to be calculated.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Position</td>
<td></td>
<td></td>
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<tr>
<td>- Material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Age</td>
<td></td>
<td></td>
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<tr>
<td>- Pollution Impacts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurements Questions to be solved:</td>
<td></td>
<td></td>
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<tr>
<td>- Thresholds to be defined</td>
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</tr>
</tbody>
</table>

Seite 5
Monitoring of Civil Structures

ON-SITE Setup

- Measurement at POI
- Transmission
- Data Acquisition and Conversion
- Central storage and management of data

Environmental Conditions
Traffic-Related Conditions

- Long-Term Observation (Structural Data)
- Short-Term Observation (Dynamic Data)

On-Site Monitoring Station
SLAVE (Signal Control) MASTER (Network Control)

Structural Data Dynamic Data

- Typical Setup for On-Site Monitoring (Stress, Deformation, Temperature)

Monitoring of Civil Structures

OFF-SITE Setup

- Structural Data
- Dynamic Data

- Communication
- Monitoring User
- Measurement Results

Building owner Operator Structural engineer Liability

Stability Durability Traffic-Safety Rain-Erosion
(Early-Warning System + Evacuation)

- The data of the building are round the clock available where they are needed.
Monitoring of Civil Structures

Special Challenges

Monuments and historic buildings
- Influences for restoration work
- Destructive inventory monitoring
- Crack development in damaged structures

Geotechnics
- Demolition of buildings
- Open-cast mining
- Tunnel linings
- Stability of underground mines
- Stability of embankments and slopes

Planning Errors

- Ambitious designs and lack of experience in the design lay the foundation for lasting damage mechanisms.
- Substandard construction
  - Cost pressures and little-tested construction methods lead to errors that remain hidden for a long time to the client.

High Load
- Unplanned usage increases and ongoing optimization of the structure on the edge of their endurance.

Maintenance
- Cost pressure and HR management often tempt to a failure-based maintenance.
- The results are limitless costs.

Material Failure
- Small cause, big impact: fatigue, wear or corrosion have huge implications on the security and availability.
Monitoring of Civil Structures
Outlook

SYSTEMS ENGINEERING
DELIVERING SOLUTIONS

Thank you for your attention !!!

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