SMART Monitoring System---

Knowledge taking people further

RAMBØLL

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The Great Belt Link

Using SMART Monitoring System provides:

- **Internet-based access to monitoring data**
- **Easy access to all additional structural information needed to make a conclusion**
- **A high level of safety**
- **State-of-the-art approach to consistent maintenance management**

Information about a structure's current condition is often very limited as knowledge typically relies on periodic inspections alone. The limited information makes optimal planning of maintenance and repair difficult. The result is frequently expensive repairs, which could have been avoided or postponed with more and better information about the actual condition of the structure.

SMART introduces a new strategy utilising information obtainable from monitoring with conventional data from records of design, construction and inspections. A traditional approach requires extensive inspections to provide this level of information and may result in inconvenient disruptions in the use of the structure.

Lack of adequate information may not only be expensive, but may in a worst-case scenario lead to partial collapse or large, unexpected repair costs.

SMART uses sensors and probes to monitor the actual condition of the structure. This allows for observing processes of deterioration, efficiency of repairs as well as the performance of the structure – with negligible operational costs.

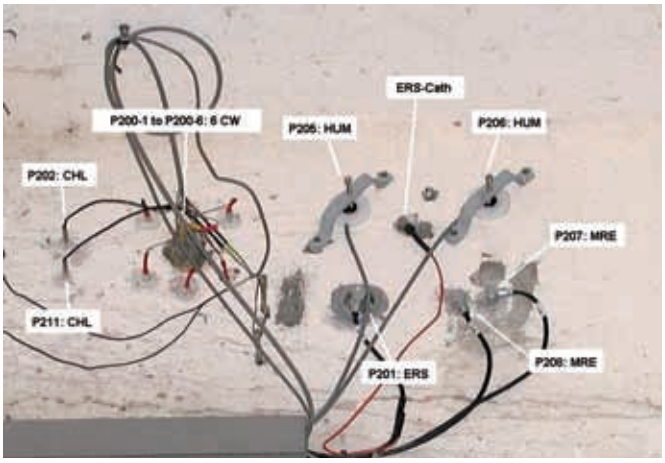
Why use SMART?

SMART offers many advantages:

- Automatically updated information from all sensors
- Easy web-based access to all other types of data on the structure(s). The data may comprise information on design, construction, repairs and ongoing inspections.
- Access to and utilisation of data in all kinds of formats comprising eg reports, spreadsheets, photos, and videos.
- Presentation and evaluation of monitoring data as input to inspection and maintenance planning.
- Internet access for an unlimited number of users to the monitoring data. Access to different data and information can be restricted, depending on the user profile.

The robust solution

SMART comprises a number of standard set-ups, which have been prepared for making SMART monitoring easily available for most users. However, the set-up of SMART is flexible and can cope with any monitoring task or type of structure. SMART can work with any data logging and data transfer approach.



Group of sensors measuring deterioration on concrete structure.

SMART user interface through internet integrating monitoring data with other structural information.

SMART has been tested and used on sites and has proved to function efficiently over a long period of time.

The economic benefits

SMART provides an optimal approach to:

- Structures where access to potentially critical positions is difficult or impossible.
- Structures where damage may reach critical or fatal levels before the deterioration can be detected by visual inspection.
- Structures where a detailed inspection or full repair requires significant traffic regulation, or where repairs are expensive.
- Groups of similar structural elements, where monitoring of a limited number of elements provides information on all the elements.

Economic analyses show that the monitoring approach is often better than the conventional inspection approach because it may postpone the need for rehabilitation significantly. Furthermore, the need for detailed inspections can be reduced substantially by monitoring.

Monitoring of structures

Monitoring is often initiated in connection with a detailed inspection which documents the need for action and identifies the critical positions and the parameters that are relevant for the monitoring. With a monitoring approach, extensive rehabilitation work can often be reduced or postponed.
The monitoring approach allows the owner to postpone and tailor the need for rehabilitation to the optimum time and actually required extent. This means reduction of direct costs and less interference with the daily use and operation of the structure. Limiting the frequency and the extent of repairs also reduces the indirect operational costs such as eg road user costs due to traffic interference and costs for traffic regulation.

Problems solved by monitoring

The monitoring approach has been applied successfully in a number of cases, such as:

- Verification of moisture protection, repair or drainage by monitoring corrosion risk, moisture content and chloride ingress
- Verification of cost-efficient, simple repairs in structures
- Life extension of deteriorated structures by periodic updating of safety level
- Verification of long-term performance of the repair
- Monitoring of deterioration rates in highway bridge columns and decks caused by chloride-initiated corrosion
- Verification of structural modeling by recording deflections and vibrations.

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