SIMoNET Structural Integrity Monitoring Network

http://www.simonet.org.uk

Report on 16th SIMoNET Meeting "SIM in Civil Infrastructure and Offshore" Held at UCL on Nov. 14th 2007

Introduction

Professor John Sharp (Cranfield University) welcomed the participants to the seminar and chaired the first session. Dr. Paul Fromme (UCL) took the chair for the second session.

1. Infrastructure Monitoring - A Review: from CIRIA's civils infrastructure projects on inspection, assessment and maintenance

Chris Chiverell
CIRIA

CIRIA has produced a number of key reports for those involved with managing civils infrastructure assets in the UK. The common focus is condition appraisal, maintenance and remedial treatment, an integral part of which is which inspection and monitoring. The current project report status is:
C591 Infrastructure Cuttings – (2003)
C592 Infrastructure Embankments – (2003)
C656 Masonry Arch Bridges – (2006)
C664 Iron and Steel Bridges – (Dec 2007)
C671 Tunnels – (2008)
RP 723 Drystone Retaining Walls – (2008)
These projects have all been supported by the major infrastructure owners and CIRIA core members.

Civil's infrastructure in the UK is extensive with for example:
350,000 km of roads
34,000+ km of rail routes
3450 km of canals
408 km of London Underground rail
300,000 km of sewers.
Network Rail alone has over 40,000 bridges, 17,000 retaining walls (over 13,000 km), and 20,000 km of earthworks. Its stock of 20,000 masonry bridges was built from around 1760 to 1900.

All of the big infrastructure owners, (Network Rail, Highways Agency, Local Authorities, British Waterways and London Underground) carry a huge stock of aged assets, which are maintained and fully operational well beyond current concepts of design life and for which replacement is not a realistic option.
The talk focuses on characteristics of infrastructure structures and their associated inspection and monitoring methods and regimes.

Conclusions are:
Civils infrastructure structures are highly complex and are often located in inhospitable environments with limited and restricted access. The extensive nature of these assets has to be recognised in any planned asset management inspection programme. Visual and tactile inspections are the most common and is the prime source of monitoring information. Installed instrumentation for monitoring must be robust and allow remote data access. There is a need to future proof data access for medium and long term – a software and hardware issue. Keep all raw data – who knows what will be needed in 10 or 20 years time

2. Condition assessment and monitoring masonry arch bridges using acoustic emission techniques

Dr Adrienn Tomor
University of the West of England

Condition assessment and monitoring of the ageing European masonry arch bridge stock generally relies on visual observation and there is practically no information available on the bridge's actual response to its traffic loading. The efficacy of acoustic emission monitoring technique has been investigated on a series of masonry arch bridge tests in laboratory and in field conditions. The technique has shown to be able to identify damaged regions, potential areas of damage, record ongoing crack propagation prior to crack opening, warn of residual damage and help identify the fatigue limit of masonry arches for the first time. It can help adjust the weight of traffic to prevent residual damage and avoid sudden failure. Due to the quick and easy installation process, the technique has shown great potentials as a routine condition assessment and monitoring tool for masonry arch bridges in the field.

3. Learning From Structural Monitoring – Mount Pleasant Bridge

Lee Canning
Mouchel Parkman

Mount Pleasant bridge comprises two 25m simply supported spans over the M6 motorway between Junctions 32 and 33. The bridge provides access to a farm and equestrian centre. The superstructure consists of a pultruded FRP deck supported on steel plate girders. Due to the novelty of the structure, a structural monitoring system was installed during bridge fabrication to i) confirm short and long-term structural behaviour and ii) further develop design guidelines for FRP bridge decks.

The monitoring system used laser target levels, conventional strain gauges and optical fibre sensors to provide data under controlled load tests. Two load tests have now been undertaken, immediately after bridge installation and one year later. The monitoring system has provided useful information on i) installation and protection methods for optical fibre sensors, ii) effective width of FRP decks and iii) composite action between FRP decks and main girders.

This information will be used to update the current Highways Agency guidance on FRP bridge decks, BD 90/05.

4. GPS monitoring of bridge deflections – Forth Road bridge

Gethin Roberts
University of Nottingham

Abstract awaited

5. Digital Image Correlation

Nick McCormick and Jerry Lord
NPL

Digital image correlation is an image based technique that can measure the differences between images at a local level to provide information on in-plane displacement and strain. When used with multiple camera systems it can also give out of plane information. At NPL we have explored some of the issues involved with calibration, accuracy and validation. The technique has wide applicability and can be used to measure strain and displacement over a large range of scales from images derived from electron microscopes up to images of buildings and large structures. We are currently exploring the applicability to structural health monitoring, both for monitoring the large scale deformation of structures and for model comparison.

6. Modelling losses in the layered steel/grout/steel structures, with applications to modelling inspection of the wind turbine monopod

Victor Zernov* and Larissa Fradkin
Waves and Fields Research Group, ECCE, FESBE, London South Bank University,

Corrosion and defects in inaccessible areas of the support structures of oil platforms and wind turbine towers can remain unnoticed and undetected until there is a catastrophic failure. The inspection of these structures is required to ascertain their structural integrity throughout their life cycle.

The EU funded OPCOM research project focuses on developing novel Ultrasonic Guided Wave technology that sends guided waves along the tubular monopile constituting the support of a wind turbine tower. One of the challenging tasks is the minimization of energy losses, which would result in improvement of the inspection range.

As part of this project, we model the Ultrasonic Guided Waves propagation through a layered steel/grout/steel joint submerged in water. For simplicity, we deal with the 2D model as the curvature of the monopole tube is much greater than its wall thickness. The vibrations are excited by transducer installed on the joint's butt-end. The model allows for energy losses caused by the radiation into water. We split the construction into several simple waveguides, in which the displacement field is represented as a sum of Rayleigh-Lamb modes, which are chosen to satisfy the appropriate boundary conditions. The resulting system of linear equations is solved taking into account the corner singularities. The solution allows us to calculate the reflection and transmission coefficients that are of importance in inspection design.

7. Sci Site Update

Matthew Hocking
SciSite Ltd

SciSite has developed a non destructive technology to detect rust. The unique selling point is the direct measurement of rust through any other material. Structures can be assessed quickly and accurately without expensive disruption.

The current testing of reinforced concrete uses electrical, electrochemical and destructive techniques to show if the steel reinforcement is corroding. These tests only show the likelihood of corrosion processes and provide detailed information only where core samples are used for calibration. These methods do not and cannot directly detect rust non-destructively. The SciSite Corrosion Probe uses a patented technique developed over 10 years. Whether from the outside of a building or from above a motorway, the Corrosion Probe detects the presence of rust on any ferrous material through any other material.
The Scisite corrosion probe uses a proprietary combination of electromagnetic signals to energize the steel and rust together. By taking a scan of the steel, applying an energizing field, then scanning again, the rust is highlighted. Only where corrosion is present does the method detect a signal. The scanning is rapid and can quickly cover large areas. No connection to the steel is required. There is no need to remove tarmac, other coatings, brickwork etc. The SciSite corrosion probe can be fitted to automatic scanning vehicles.
This new technique has undergone field trials with many leading industry experts including Network Rail, Mott Mc Donald, Concrete Repairs Surveys, Atkins and other leading consultancies.

Conclusion

Dr. Paul Fromme thanked the speakers and those attending for an interesting meeting.