Editorial

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Themed issues are focused on specific areas of interest, with the benefit for readers of having papers already collected and published together. For this specific themed issue, we have the pleasure of presenting exceptional works in the areas of Non-Destructive Testing (NDT) and Structural Health Monitoring (SHM) of structures as part of the Forensic Engineering process. This issue is Part I of a planned set of two issues, with the intention of having Part II published in 2022.

1. Condition assessment and analysis of a reinforced concrete building in India: a case study by Anand, Andrushia, Paul and Arulraj

The first paper is an excellent example of the ‘case study’ type of article, being the most typical type for journals aiming to satisfy the expectations of both professional expert readers and readers with broader research interests. The paper presents detailed and well-developed information about the assessment of the condition, detailed analysis, and a design solution for strengthening/retrofitting of heavily damaged RC structures with a focus on improving the capacity and significant increase of the expected service life.

The investigated structure is six storey RC building in India constructed in 2002 and subjected to forensic investigation and design for retrofitting in 2018. The most obvious defects of the structure, established during the preliminary visual inspection, include intensive cracking in a range of slabs, beams and columns, and corrosion of the reinforcement, including spalling of the concrete cover effects due to the corrosion products. The presented work could be generally divided into two parts: diagnosis of damages including NDT and failure analysis, and rehabilitation measures.

The first part includes a wide range of in-situ NDT methods and techniques such as:

- Rebar and cover meter survey, allowing to estimate the thickness of the concrete cover of the reinforcement and positioning of reinforcing bars via electromagnetic scanning.
- Rebound hammer test conducted on a range of locations. Obtained results were verified at a later stage with the data from concrete core samples taken in the same locations and tested on compression.
- Ultrasonic Pulse Velocity (UPV) test and comparison of obtained results with rebound hammer test results.
- Half-cell Potential (HCP) survey, allowing to estimate the level of corrosion of rebars deeper inside the concrete cross section.
- Core samples taken between the reinforcing bars, 56 mm diameter, 200 mm length.
- Chloride and sulphate content and pH value for concrete.

- Rapid Chloride Penetration Test (RCPT) estimating the ability of the concrete to resist chloride ion penetration. It was conducted on core samples 100 mm diameter by 200 mm length.
- Depth of the carbonation of the concrete, which allows for estimation of the service life of the concrete.

In addition to the above-mentioned traditional methods, a porosity analysis using image processing method was applied via calculating the sum of the areas of the pores within specific borders and comparing it with the same type of data obtained from control cube sample. The results from the NDT investigation show a significantly lower compressive strength of the concrete than expected (16 MPa instead of the required 25 MPa), a high level of porosity, active corrosion due to high level of carbonisation (depth of carbonisation 62 mm) and insufficient concrete cover (less than 23 mm compared with 40 mm required for the columns). Analysis of the structure using software package STAAD Pro with the updated characteristics of the elements allowed for mapping of the damages and the choosing of appropriate retrofitting techniques to obtain sufficient load bearing capacity and performance-based design for achieving the desired service life of the structure. Two types of retrofitting techniques are employed – RC jacketing and wrapping with CFRP sheets, with sufficient detailing and information about the way of implementation provided.

The main conclusions indicate that the minimum strength, durability and corresponding desired service life are not achieved for range of structural elements, and that the application of the adopted retrofitting techniques varies between different type of damages and defects detected in the underperforming elements.

2. Assessing suitability of bridge-scour monitoring devices by Vardanega, Gavriel and Pregnolato

This paper is an excellent example of an article about SHM, with an appropriate combination of general knowledge in adopting appropriate monitoring systems and instrumentation and the practical aspects of implementing a novel rating system, combined with examples of its usage for seven different case studies.

The introductory part discusses the importance of scour monitoring of bridges, difficulties in respect of applying a visual inspections approach, and the need for introducing key elements allowing for scour prediction and modelling. The need of a wider usage of modelling which is based on in-situ measurements as opposed to lab-based and numerical approaches is explained.

The discussion about different monitoring technologies starts with a review of range of important sources of information in this area, including BD 97/12 and the US Geological Survey (USGS) database. General information and characteristics of a range of monitoring methods, such as soundings, fathometer, Ground Penetrating Radar (GPR), scour rod, ADCP, Brisco Scour Monitor and others are presented. The need for criteria when choosing an appropriate system for SHM in case of bridge-scour is discussed.

A novel rating system is described and analysed. The criteria for the choosing of appropriate SHM system is divided into five categories, namely: ease of installation (Q1), ease of operation (Q2), ease of data logging (Q3), ease of data interpretation (Q4) and measurement frequency (Q5). The scoring for each of the categories is in the range of 1 to 5, where 5 is the highest level and 1 is the lowest. The way of applying of the proposed rating system is explained in detail.

In addition to the general instructions, a range of case studies are discussed as examples of application of the proposed rating system. The discussed cases are about bridges from several countries (Italy, Taiwan, USA and UK). Four of the cases are from UK. The adopted types of monitoring instrumentation

include Sonar (2 cases), FBG sensors (2 cases), Interferometric Radar (ISAR) (1 case), Accelerometers (1 case) and Smart Probes (1 case). The application of the proposed rating for each of the cases is explained in detail.

Discussion about key review findings, the potential use of the rating system in practice, and the perspectives of scour management using inspections and monitoring is offered.

The summary and main conclusions include the range of monitoring options (inspections and forensic investigations), a new rating methodology for ranking available monitoring devices, and the need for collected data to be stored in national or regional databases, allowing for perspective modelling of scour on the basis of field measurements.

REFERENCES

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