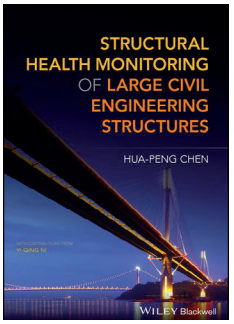
Review

Gareth Evans finds this to be an informative text on structural health monitoring – a subject that will become increasingly important to structural engineers in the future.

Structural health monitoring of large civil engineering structures



Author: Hua-Peng Chen
Publisher: Wiley-Blackwell
Price: £84.95 (hardcover); £76.99 (e-book)
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This book provides a comprehensive description of the current state of structural health monitoring (SHM) and is a good primer for the subject. The only slight drawback is that it does not provide any examples of simple SHM systems; the complexity of the systems discussed may discourage engineers from considering simple low-cost SHM on more smaller structures.

This is a subject that will become increasingly important to engineers in the future. As the cost of implementation reduces, SHM systems within structures will become more prevalent. Where SHM is proposed, it will be the structural engineer who will need to consider its implementation at the design stage and be closely involved in the design and specification of the system. For this reason, it will become increasingly important that engineers have a good working knowledge of SHM, its benefits and limitations, in addition to the instrumentation and data-handling requirements.

There are extensive references throughout the book to papers from other researchers in this field. In these, an interesting quote is from Farrar *et al.* (2009) where the objectives of SHM are outlined as five levels:

- Level 1: Damage detection giving a qualitative indication that damage might be present in the structure.
- Level 2: Damage localisation giving information about the probable location of the damage.
- Level 3: Damage classification giving information about the type of damage.
- Level 4: Damage assessment giving an estimate as to the extent of damage.
- Level 5: Damage prognosis giving information about the safety of the structure, e.g. an estimate of remaining useful life.

"THERE IS EXCELLENT COVERAGE OF THE PRACTICAL APPLICATION OF ADVANCED STRUCTURAL HEALTH MONITORING"

From reviewing the levels outlined by Farrar *et al.*, the value of obtaining a load history may not be obvious. From my own experience in the maritime sector, enhanced knowledge of load history can be hugely informative.

There is excellent coverage of the practical application of advanced SHM on two large bridges and one very tall building, which provides context to the more theoretical elements of the text. The systems installed in these structures are extensive and demonstrate the requirement for complex data-handling systems to clean and verify the large quantity of data coming from the sensors. In addition, since these structures are in areas of potential earthquakes, the ability to see the structural response to a quake means they can be assessed very quickly following a seismic event.

There is a detailed description of advanced techniques available for monitoring and non-destructive testing, together with the theoretical background to these methods. Some of the techniques described are still at the research stage and, while of interest, are not necessarily of practical use at present.

The work focuses on the instrumentation and analysis of vibration-based methods of SHM and covers this subject in detail. This is very useful when dealing with predominantly dynamically loaded structures. There is good coverage of the methods of analysis of the vibration results obtained from the SHM system and the frequencies required to be measured for various conditions. The book describes how the SHM system is used to compare and update the analytical design models using the structural response data from the as-built structure.

In the later sections of the book, data-analysis techniques are examined and there is coverage of artificial intelligence and machine learning with a discussion on neural networks.

In summary this is a well-written and presented piece of work and will be of interest to anyone working in this field.

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Gareth is Managing Director of Constructex Ltd, a specialist maritime construction company. He has worked in the construction industry for 40 years, as both a consultant and contractor. Gareth has recently been involved in a government-awarded research project into the use of remotely operated vehicles (both aerial and underwater) for the inspection of structures. The company is also carrying out a research programme with Southampton University into structural health monitoring for maritime structures.