Editorial

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The design of structures and buildings to meet the needs of society requires consideration not only of the static behaviour of the structure, but also of the structural response to dynamic actions. To satisfy the need for occupant comfort as well as preserve durability and ensure the performance of specialist equipment, it will often be necessary to limit or manage structural vibration. As modern buildings have become lighter and made use of longer spans, the correct assessment of dynamic performance of structures and buildings has become increasingly important; in many instances vibration-related criteria may be found to govern aspects of the structural design. Research into the design and assessment of structural vibration from a range of internal and external sources is therefore increasingly important to enable designers to reliably design efficient structures that will provide the level of performance that the owners, occupiers and society as a whole expect.

Footfall-induced floor vibration as a consequence of occupant movement is one of the more commonly encountered sources of structural vibration, particularly where modern lightweight floor structures are used. In our first paper, Zhang *et al.* (2016) present the result of an extensive experimental study of lightweight floors constructed using metal web timber joists. The experimental work investigates how placement of strong-backs within the floor depth can be used to improve vibration performance, while also considering the effect of ceiling type and joist spacing.

Structural vibration also frequently arises due to external vibration sources including rail and heavy vehicle movements. As cities densify and transport networks expand, the problem of rail-induced ground-borne vibration is becoming increasingly significant for new and existing developments. Gjølstrup *et al.* (2016) have developed a novel probabilistic approach to the assessment of structural vibration and structure-borne noise in buildings close to railways. An extensive measurement campaign has been conducted to develop and subsequently assess performance of this model, which the authors have now made available as a web-driven tool.

Where a new building is to be constructed in the vicinity of a rail line or other source of ground-borne vibration, the provision of base isolation may be used to mitigate the effect of structural vibration and re-radiated noise on building occupants. The design of these systems is often done by empirical methods, and there may be divergent views on the design requirements of the base isolation system or even the need for isolation at all. Talbot (2016) has undertaken a review of

current practice in the design of base isolation and highlights some of the challenges that will need to be addressed in order to move towards a performance-based design approach for these systems.

Medical and research facilities containing precision equipment are particularly sensitive to the effects of ground-borne vibration. The Orion laser facility at the UK Atomic Weapon Establishment is one such highly sensitive scientific instrument. Brownjohn *et al.* (2016a) present a case study detailing the experimental and numerical studies undertaken to guide design of this facility and to assess performance prior to and during construction, such that the stringent vibration criteria could be met.

In the design of stadia and public assembly buildings, the expectation that modern facilities serve as multi-functional entertainment facilities brings with it a need for engineers to make a robust assessment of the dynamic performance of the structure under crowd loading. Practitioners and facility operators typically make reference to *Dynamic Performance Requirements for Permanent Grandstands Subject to Crowd Action* (IStructE, 2008) for guidance in the specification and design of these facilities. With reference to a series of experimental studies conducted at the University of Bath, UK, Browning (2016) challenges the Institution of Structural Engineers criteria and proposes a new approach to specifying stadium vibration requirements. The design of lightweight pedestrian bridges is also often governed by the performance under crowd loading, and in our sixth paper Brownjohn *et al.* (2016b) experimentally investigate the dynamic performance of an unusual bridge that also serves as a viewing platform.

In taller buildings, wind-induced lateral vibration frequently governs the serviceability performance of the structure. Criteria used to set lateral acceleration limits are typically based on the concept of avoiding occupant complaint. However, Lamb *et al.* (2016) present new multidisciplinary research that suggests significant vibration serviceability issues can arise at a level of vibration well below that which might give rise to complaint, and indeed at a level that may not even be perceptible to occupants. A need for further research to determine appropriate new vibration criteria is proposed, with potential to change the way in which tall and super-tall buildings are specified and designed.

Where the level of lateral vibration in a tall building has been identified as excessive, there is often scope for designers to control acceleration levels by introducing additional structural

damping. For many buildings, the use of a tuned liquid column damper (TLCD) is an efficient solution. Cammelli and Li (2016) present a case study demonstrating the use of experimental and numerical studies to guide design of a large TLCD to be installed in a high-rise structure in the East Coast of USA. Damping can also be used to mitigate the effects of seismic events on buildings. In our final paper, Kasinos *et al.* (2016) investigate the response of building subsystems subject to seismic vibration events and present a new methodology giving improved predictions for irregular structures.

The breadth of papers included in this themed issue of *Structures and Buildings* is indicative of the level of interest in the dynamic performance of structures and the relevance of this field to the engineering profession. As buildings become lighter, urban transport networks expand and brownfield development is pursued, the ability of practising engineers to design to limit the detrimental effects of unwanted vibration will become more ever more important to enable our built infrastructure to satisfy the needs and expectations of society into the future.

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