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Editorial

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The papers contained within this issue illustrate well not only the range of topics covered by the journal but also the continuing demand for the application of sophisticated modelling techniques to practical engineering problems. On this occasion, the issue contains two briefing papers – short contributions that are offered a rapid publication route by the journal to provide topical updates on recent work and/or to stimulate debate within the ICE community.

The first briefing paper (Macdonald, 2012) is timely because it summarises current developments in structural mechanics design and offers cautionary insight into the incorporation of dynamic loading effects into current design practice. The author identifies specific areas of dynamic loading (for example, due to unsteady wind loading and/or human-induced vibrations) where uncertainties underlie the structural design process and prevent complete descriptions of structural behaviour. Though advances in modelling techniques offer the prospect of improving design guidelines, the limitations of some of these models are shown to be non-trivial. In his comprehensive and painstaking overview of this topic, Macdonald identifies fundamental uncertainties in design that are inherently associated with the present limitations of finite-element and nonlinear dynamics models for the complex structures under consideration. In approaching the current state of structural dynamics from a critical perspective, the author is able to categorise systematically the various different contributions to design uncertainties and to provide guidance on research avenues to follow to reduce these uncertainties.

The second briefing paper (Fenna, 2012) deals with a fascinating, practice-based case study of flood risk management of urbanised portions of a river (the Medlock) flowing through a part of a large city (Manchester) with a strong industrial heritage and, in consequence, a water management system dating, at least partially, from the industrial revolution. The study illustrates the significant problems faced in modelling such complex flows, not least because of the difficulties faced in gaining access to many of these structures to obtain or verify the survey data needed for the model calibration. Most significantly, the study informs other flood risk studies for similar urbanised river reaches with Victorian hydraulic infrastructure.

Two archetypal structural analysis papers are included in this issue, both of which contain results from sophisticated model investigations. The first paper by Si *et al.* (2012) addresses the computational challenges of modelling numerically the time-dependent behaviour of pre-stressed concrete structures under the action of creep, concrete shrinkage and cable relaxation. For such problems, improvements in the efficiency of time-dependent analysis using finite-element (FE) methods offer substantial gains. The authors outline such improvements via a general single-step method for the specific actions indicated above. The paper by Currie *et al.* (2012) investigates (by means of numerical and laboratory modelling) the problematic area of damage detection in plate-like structures through the use of inverse vibration methods that exploit changes in the modal properties of the structure to infer and detect the damage that induces such changes. The study focuses on comparisons between measured and computed (FE) mode shapes in order to assess errors in measured mode shapes and thereby provide benchmark guidance on the limitations of vibration-based methodologies to detect damage.

The devastating, terrifying and tragic effects upon coastal communities of highly non-linear, long, tsunami waves arriving at the shores of the world's oceans has been drawn into sharp focus by the recent catastrophic consequences of the Sumatra (2004), Chile (2010) and Japan (2011) earthquakes. An understanding of the behaviour of such waves as they reach the shore is the subject of the paper by Klettner *et al.* (2012) who have carried out an extensive set of laboratory simulations of the draw-down and run-up of tsunami waves on sloping beaches and have constructed a hydraulic model against which the predictions based on the laboratory data can be tested. Most significantly, the study has sought to relate the practically-significant tsunami wave properties to the geophysical forcing generating the waves, in order to improve warning protocols.

Double diffusion convection occurs whenever fluid systems are stratified with components (e.g. thermal and compositional gradients) having different rates of diffusion. The phenomenon has been much studied theoretically and in the laboratory in the context of marine, astrophysical and geological systems (see, for example, the excellent review by Huppert and Turner (1981)) but the paper in this issue by Dimitrova *et al.* (2012) illustrates how the process of double diffusion convection has direct engineering relevance to the practice of strategic storage of oil in salt caverns. Of particular importance is the consequence of double diffusive convection within the stored oil reservoir, namely the formation of a staircase of layers across which strong gradients of temperature and solute concentration are generated. The authors report laboratory modelling experiments that simulate the forcing conditions for real oil storage caverns and show how computational fluid dynamics (CFD) runs with a commercial package (Fluent) in which the turbulence model if modified can predict the internal flow structure within the caverns.

The recent tendencies to apply to biological and medical problems the analytical tools and techniques that have been developed over many years for structural engineering applications have provided benefits for both fields and have stimulated many new and profitable areas of multi and cross-disciplinary research. A prominent example of the success of such an approach is in the application of FE techniques in ophthalmology (e.g. corneal mechanics), but, in the present issue, the paper by Phillips (2012) illustrates another promising avenue of research, namely the deployment of the structural optimisation approach to the mechanical and structural properties of bone (the femur).

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