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Editorial

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The main challenge in engineering future structures is inevitably trying to do more with less. The main building code provisions and regulations are often aimed at ensuring a minimum level of safety. As such there will be an inevitable in-built conservatism as codes contain a distillation of research which has to cover a wide variety of structural forms and loading scenarios.

The key to unlocking this inherent conservatism is a move away from prescriptive design guidance to performance based approaches. Modern codes, such as the Eurocodes, allow such approaches but often the emphasis is put back on the engineer to demonstrate that the methodologies and acceptance criteria they have chosen are within safe limits for the particular application concerned. The inevitable difficulties this presents and the extra time that has to be spent to justify the proposed solution can often act as a barrier to the further adoption of a more economical solution.

To allow engineers to truly unlock the economic and sustainability benefits of performance based approaches, there is a need for good quality research which is adequately disseminated to the engineering and academic professions. This research should ideally explore the boundaries of the particular application concerned to generate confidence in the proposed solution and allow engineers to apply the lessons learnt safely in the knowledge that the solution they are proposing has been adequately researched.

In this issue, we have four varying papers that all contribute to the body of research in different ways. The first paper presents results of a natural fire test in a real structure which demonstrates some of the key attributes of recent understanding on the performance of structures in fire. The second outlines research undertaken to examine a particular problem that may prevent the further adoption of a low energy masonry construction system. The next presents an examination of the design rules of a variety of codes concerning tension laps in reinforced concrete structures to demonstrate how close to the boundary the design rules are. Lastly, the stability of a nonlinear design algorithm is explored to examine the trade-off between computational accuracy and speed.

Gillie *et al.* (2012) present the key results of a natural fire test carried out on an existing reinforced concrete structure at Dalmarnock in Scotland. The testing of real structures in fire is important because the dimensional constraints of furnace tests means that the interaction of key structural elements under realistic restraint conditions cannot be adequately explored. The performance of real structures in fire is a complex phenomenon concerning compartment temperature development, thermal response of the structure and then structural response often including the effects of material degradation with temperature and amplification of forces due to large displacement effects. These phenomena can be captured in numerical models but it is important that these models are calibrated against real data wherever possible. The data provided in this paper will be invaluable to those seeking to calibrate those models and help generate confidence in the results of numerical models under the different design fire scenarios which are required in performance base approaches for fire.

Heath *et al.* (2012) present research into a particular problem affecting an innovative low energy construction material – earth masonry. As the material is unfired it readily picks up moisture from the atmosphere or any moisture bearing materials it may come into contact with. Its material properties, both strength and stiffness, are moisture content dependent and the material has a tendency to expand as moisture content increases. A particular problem is the rendering of the masonry units. The rendering process imparts differential moisture content to the brick units that sets up a complex strain field which in some circumstances can actually lead to cracking and premature failure of the units themselves. The paper presents the technical background to the phenomenon, presents analysis and experimental studies and finally outlines some measures that can be taken to prevent early age cracking of the material. Research such as this is invaluable in building confidence in the performance of low energy alternatives to traditional construction materials.

Canbay and Bozalioglu (2012) present the results of study looking at the code provisions for tension laps in reinforced concrete. The extra tonnage required to adequately lap tension reinforcement can significantly contribute to the embodied energy present within reinforced concrete elements. Therefore, it is important that laps are not over specified. There are some major differences between the provisions for lap splices in the various national codes. The experimental study undertaken gives some confidence that the lap provisions within ACI 318-08 ensures satisfactory performance although in some circumstances lap length can tend to be over specified. In contrast, the lap provisions in the Turkish and Eurocode may not be adequate in some circumstances.

As performance base approaches often involve non-linear material and structural behaviour, it is important that non-linear analysis

procedures are as efficient as possible to allow the necessary analyses to be completed in a timely manner. Rezaiee-Pajand and Sarafrazi (2012) outline a study used to examine the accuracy and speed of various time integration schemes of different orders. Finally, a modified dynamic relaxation technique is proposed which has comparable speed and accuracy to other higher order time integration approaches.

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