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Editorial

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It is a privilege for us to introduce this Special Issue of *Construction Materials*, which is focused on natural building stone – the first, oldest and most fundamental geomaterial used by humankind for building purposes and now in a phase of rapid technical advances.

However, before we preface the topic and explain the excellent papers that follow, we should provide some background to the Special Issue and its development. Several years ago, a successful seminar was arranged by STATS Limited (now part of the RSK Group plc) on the subject of *Stone Materials in Building and Construction*, chaired by Professor Peter Fookes, who had also been Chairman of the Geological Society (Engineering Group) Working Party on Stone (Sims, 1996; Smith, 1999). The seminar was held at the University of Hertfordshire in Hatfield and satisfyingly well oversubscribed. Proceedings started with a fascinating pictorial appreciation of the centuries-old role of stone in building by architect, Roger Bloomfield. There followed state-of-the-art technical presentations and lively discussions on some major applications for stone in modern construction, including Peter Harrison on cladding, Derek Fordyce on external paving and Ian Blanchard on flooring. A fitting climax was provided by structural engineer, Geoff Werran, who described some recent innovative and daring uses of stone, enabling architects' up-to-the-minute concepts to be translated into reality.

Following the launch of ICE's *Construction Materials* journal, it was soon decided that this milestone seminar and its instructive presentations could form an ideal starting point for a Special Issue on Stone. We envisaged that the original seminar material would be augmented and extended by invited and volunteered submissions from other stone specialists. However, converting the seminar talks by busy practitioners into full journal papers has proved more of a challenge than we envisaged and, even after several rescheduled final deadlines, we have had to go ahead without some of the key contents. We understand that all of these currently 'missing' papers are firmly on the drawing board and most are quite advanced, but sadly, to be fair to the other authors, we have had to proceed at this stage without them. Hopefully they will be published before too long, either together within a complementary follow-up special issue or otherwise within forthcoming standard issues of *Construction Materials*.

Most of us are influenced by first impressions. Often, as in the case of many buildings, the first impression is created by natural stone, variously forming imposing masonry, appealing decorative cladding and/or strikingly attractive flooring. Impressive final effects often belie the effort beforehand to ensure the successful use of stone materials that will achieve the architect's conceptual ambitions, while also meeting the demanding engineering requirements of modern structures and, sometimes forgotten, the durability challenges of service in today's busy and often aggressive environment. The potential incompatibility of these objectives has been nicely summarised: 'Stone gives architects a problem. They love to use it because there is no finer building material for the realisation of their ideas. But it is a low-tech, awkwardly inconsistent material in a high-tech world' (Jefferson, 1996).

The assembled papers in this Special Issue will help provide readers and users with valuable and expert guidance on stone properties and how these can be assessed and managed in modern construction. We have tried to arrange the papers in a logical sequence, but each is complete and self-contained, for direct access by those needing particular information.

Yates *et al.* (2012) explore the practical effects of variously gradual or short-term changes in the engineering properties of stone including, for example, those reductions in strength and sometimes deformations slowly brought about by weathering

cycles over a period of service, or, variations in performance between dry and water-saturated stone conditions. They go on to explain how these property variations may be allowed for at the design stage and have provided some examples from practice experience relating to cladding. It is presumed that appropriate recent test data will be available for the stone materials being evaluated, but the authors consider that, with the imminent requirements in Europe for CE marking and product verification, this is a reasonable expectation.

One stone application that is particularly exposed to the effects of weathering, and to the rigours of vehicular trafficking, is rigid road pavements using traditional setts or slabs, which is enjoying a resurgence in some urban areas. Li *et al.* (2012) provide a potentially useful outline guide to the staged design of a modern stone pavement, modelled on the current BS 7533-10 (BSI, 2010). Making reference to their more substantial advice note published previously (Li and Fordyce, 2008), the authors provide examples of the advocated procedure, one using stone setts and the other using stone slabs. Looking forward, they also propose that the performance of some pavements should be monitored, to enable the design process to be refined and to investigate issues such as stone recycling and environmental impact.

Returning to stone cladding applications, there are two thoughtful papers by Rui S. Camposinhos (2012) and Rui S. Camposinhos and Rui Pedro A. Camposinhos (2012). In the first paper, the author is concerned at the common use of imprecise 'rules of thumb' and 'global safety factors', which he feels are often 'archaic' and less applicable for modern thin cladding systems. He argues for application of a limit state design instead of an allowable stress design. An example is provided, to illustrate the two approaches and demonstrate the apparent advantages of the proposed limit state method. Designers may wish to contemplate the arguments in this paper. In the second paper, the authors investigate the performance of a particular ('continuous kerf') anchorage system with different limestone and marble varieties, showing the crucial importance of analysing the kerf geometry as well as the stone properties.

Fortunately there is a comprehensive paper on internal flooring, one of the largest and most familiar uses of stone in modern buildings, ranging from vast acreages in shopping malls, through features in prestigious hotels and headquarters, to increasingly popular selection for domestic settings. Blanchard (2012) presents an expert update on the factors and considerations that enable such flooring to be successful, despite exceptional contemporary demands: floors must be aesthetically pleasing, as well as exhibiting limitless durability without evidence of wear, be safe for pedestrians in all conditions and also tolerate rigours such as under-floor heating and/or occasional heavy loading. The author draws on his experience of both new-build and forensic investigation of under-performance to present guidance on stone selection, system design, installation and the assurance of in-service performance, all illustrated by five case studies.

This special set of papers concludes, as it began, with the engineering properties of stone. Karaca and Onargan (2012) present a laboratory investigation into short-term deformation behaviour, studying three marbles and three limestones from Turkey, using two load levels maintained for seven hours. Based on their findings, the authors propose a 'stone deformability index' (SD_i), being the ratio of the lowest strain value to the final strain value, and discuss the factors that influence the index. They find the SD_i to be lower for limestone than for marble, with crystalline size (and presumably crystal interlock) being an important factor for marble.

As with many standard issues of *Construction Materials*, this Special Issue concludes with some relevant book reviews. Paul Bennett-Hughes assesses *Natural Stone Resources for Historical Monuments* (Prĺkryl and Tőrők, 2010) and recommends it as a specialist reference for those involved with most facets of construction, repairs and selection of stone for historic monuments. Jacqueline Glass considers a new textbook on *Building Decorative Materials* (Li and Ren, 2011), which includes stone among other materials. However, while being impressed by the structure of each chapter and the coverage of generic concepts, Dr Glass finds that the book was written for the Chinese context and is likely to be less helpful for those working on projects outside China.

We hope you will enjoy reading and using this Special Issue, which will eventually be complemented by the other papers on the subject that are still in preparation. It is hoped that the contents of these papers will be practically useful and might inspire some readers to submit discussions, to confirm, develop or even question some of the themes and recommendations presented.

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