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NUMERICAL SIMULATION OF SELF-HEALING PROCESSES IN CEMENTITIOUS MATERIALS

ANTHONY D JEFFERSON*, LIBERATO FERRERA† AND GIOVANNI DI LUZIO†

* Cardiff University School of Engineering
The Parade, Cardiff, CF24 3AA, UK
JeffersonAD@cardiff.ac.uk and www.cardiff.ac.uk

† Politecnico di Milano, Department of Civil and Environmental Engineering
Piazza Leonardo da Vinci n. 32, 20133 Milan, Italy
liberato.ferrara@polimi.it, giovanni.diluzio@polimi.it and www.dica.polimi.it

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ABSTRACT

Cracking continues to be a major problem in concrete structures and the presence of such cracks frequently leads to a reduction in service life and/or the need for maintenance and repair work. Much effort has been directed towards improving the quality of concrete and refining design standards to minimise cracking; however, the problem persists due to the very nature of cementitious materials. An alternative approach to solving this problem is to endow concrete with self-healing (SH) capabilities such that cracks heal as they form. The three main techniques explored to-date for delivering and releasing healing agents are embedded brittle tubes, microcapsules and vascular networks. The healing agents used in these systems include autonomic agents, such as cyanoacrylate and epoxy resins, as well as agents that enhance natural autogenic processes. The majority of the research effort to date has been experimentally based but more recently there has been increased interest in developing numerical models to simulate these self-healing processes[1-3]. This work has been undertaken with a view to guiding future experimental developments and –ultimately- to producing design tools for SH structures.

There are many physical processes involved in self-healing that need to be simulated accurately if SH models are to become useful. These include cracking; the breakage of capsules or vessels; the transport of autonomic healing agents through discrete cracks and through micro-cracked continua; the transport of autogenic agents through the moisture phase within cracked matrices; as well as the chemical processes of agent curing and bonding. A number of groups have been working on developing models for various self-healing systems and it is the aim of this MS to bring together researchers and scientists developing such models to present their work and exchange ideas on the best numerical approaches for simulating the complex coupled mechanisms that govern the behaviour of self-healing cementitious materials.

The MS organisers are part of an EU COST action, named SARCOS, which is investigating self-healing construction materials. A major part of this action is the development of SH models and this MS will draw upon the expertise of the SARCOS working group on modelling.

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