



Modeling of the behaviour of concrete elements containing a self-healing agent

Todor Zhelyazov

Technical University of Sofia, Sofia, Bulgaria

Radan Ivanov

National Institute of Geophysics, Geodesy and Geography. Bulgarian Academy of Sciences, Sofia, Bulgaria

Contact: elovar@yahoo.com

Abstract

This contribution focuses on the numerical modelling and simulation of the mechanical behaviour of structural elements containing a self-healing agent. Specifically, the finite element modelling of the mechanical response of plain concrete structural element, containing a healing agent and subject to various loading conditions is discussed. A customized numerical procedure designed to implement the Damage Mechanics-based constitutive relation for concrete into a general-purpose finite element code is developed. The procedure comprises algorithms for evaluation of the volume of newly-formed cracks, the recovery of stiffness of the structural element due to crack closure, the initiation of healing and its effect on the overall response of the structural element. The procedure is demonstrated by simulations of a concrete cylinder subjected to compression and torsion.

Keywords: cracking of concrete; Damage Mechanics; self-healing concrete.

1 Introduction

The motivation of this study is to develop a computational tool for assessing the effects of self-healing on cracked concrete structures that is portable into a general purpose analysis or design code, and therefore readily available to researchers and practitioners. A comprehensive numerical simulation of the long-term behaviour of a self-healing concrete beam has been reported in [1], which includes all relevant phenomena such as mechanical damage, creep, shrinkage, thermal effects, self-healing and the interactions among them. However, it is based on a particular

structure – a simple beam with a notch in the middle, and cannot be applied directly to general structures. On the other hand, most advanced general purpose Finite Element codes, such as ANSYS, ABAQUS, Oasys etc., possess some form of scripting functionality for user-defined properties or computation procedures.

The phenomenon of self-healing has been known for a long time and has attracted a substantial research interest. Its applications are of great practical interest, since although at present self-healing concrete is more expensive than regular one, it has the potential of bringing cost benefits in the long run due to reduced maintenance