Sensors and Materials, Vol. 21, No. 2 (2009) 65–85
MYU Tokyo

S & M 0749

Performance of a Fibre-Optic Sensor for Monitoring Cracks of Concrete, Masonry and Bituminous Elements

Paulo J. S. Cruz*, Abraham Diaz de León[1] and Christopher K. Y. Leung[2]

ISISE, University of Minho, Azurém, 4800-058 Guimarães, Portugal
[1]Formerly PhD student at the Civil Engineering Department, University of Minho, Azurém, 4800-058 Guimarães, Portugal
[2]Hong Kong University of Science & Technology, Clear Water Bay, Hong Kong, P.R.C.

(Received November 12, 2007; accepted November 26, 2008)

Key words: fibre-optic sensor, crack sensor, crack monitoring, OTDR

Advances in emerging fibre-optic sensing technology have contributed to the recent development of innovative systems for monitoring the health of civil engineering structures. The main reasons for this development are the reduced weight and dimensions of fibre-optic sensors, their strong immunity to electromagnetic interference, their improved environmental resistance and their scale flexibility for small-gauge and long-gauge measurements. In companion papers, an overview of the challenges related to the design and mechanical characterization of a novel fibre-optic plate sensor for crack monitoring was explained and discussed. The proposed sensor does not require prior knowledge of the locations of cracks, which is a significant advancement over existing crack-monitoring techniques. Moreover, several cracks can be detected, located and monitored using a single fibre. In this paper, we will first present the results of calibration tests on the crack sensor, which aim at determining the relationship between optical intensity loss and crack opening under static conditions. Then, the performance of the sensors with respect to the detection and monitoring of internal and external flexural cracks in concrete, masonry and bituminous elements is assessed. Two versions of the sensor were examined. The first version was externally attached to fibre-reinforced concrete beams and reinforced masonry slabs; the second version was embedded into fibre-reinforced concrete beams and bituminous slabs. The results presented in this paper demonstrate the viability of implementing the attached and the embedded plate sensors to detect the formation and propagation of internal and external cracks and to measure the crack opening width in a wide range of applications.

*Corresponding author: e-mail: pcruz@civil.uminho.pt