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HYBRID APPROACH FOR TWO DIMENSIONAL DAMAGE LOCALIZATION USING PIEZOELECTRIC SMART AGGREGATES

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HIGHLIGHTS

- The hybrid approach uses two criteria of tracking: energy and time of flight.
- The approach is flexible, and easy for application, practical and highly reliable.
- Approach is capable to derive the damage location.
- It can be used for the tracking of damage propagation in structure through time.

Summary

In the paper, a novel approach for damage localization in reinforced concrete plates, based on the computational analysis of piezoelectric smart aggregates, has been presented. The hybrid approach for damage localization is based on two criteria: wave propagation energy and time of flight. The comprehensive numerical analysis using standard and explicit finite element method has been conducted. In addition, the proposed algorithm of the hybrid method has been coded in MATLAB. The approach has been verified numerically using different square reinforced concrete plate models, considering different number, position and size of damage, as well as different number and position of the piezoelectric smart aggregates. Obtained results confirm the successful application of the novel approach to the damage localization.

Keywords: Piezoelectric sensors, hybrid approach, structural health monitoring, damage localization, wave propagation

1. INTRODUCTION

Structural Health Monitoring (SHM) is the well-established multidisciplinary engineering field dealing with the innovative methods of tracking of the structural safety, reliability, integrity and properties, without the influence on the structure itself, and also without the prevention of the structural function [1]. Active Structural Health Monitoring (ASHM) provides the direct assessment of the structural damage state by the damage detection, initiation and further propagation [2].

Piezoelectric smart aggregates (PZT SA) proved to be multifunctional components which can be applied for different purposes in civil engineering: monitoring of impact forces of the vehicle on the bridge [3], detection of the reinforcement damage inside the reinforced concrete (RC) element [4], monitoring of the humidity change in the concrete [5], vibration control in civil engineering structures [6], derivation of early concrete strength in-situ [7] and derivation of the compression stress under the seismic action [8]. The applications of PZT sensors are mainly developed for damage detection purposes. Different structural elements have been considered, i.e.: beams [9], columns [10], RC walls [11]. The previously mentioned attempts use the damage detection methods based on the wave propagation and tracking of the energy of input signal. Besides that, the impedance based method is also used in [12].

Beside the application of PZT for damage detection, damage localization presents the most challenging aspect. So far the majority of the developed damage localization methods are applied in thin steel plates. The examples are methods