Vibration Analysis of Self-Healing Hybrid Composite Beam Under Moving Mass

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ABSTRACT

In this study vibration analysis of hybrid epoxy composite beam under moving mass was investigated. Composite beam was reinforced unidirectional by carbon fibres and Shape Memory Alloy (SMA) wires. There is an open crack in the middle of the beam that is extended transversely in the beam structure and modelled as local flexibility. SMA fibres were embedded longitudinally in the layer of epoxy to heal the defected area by strain recovery. The Timoshenko beam model was used and the beam at the crack area was divided into two segments. Transfer Matrix Method (TMM) was then applied to solve the problem. Various volume fractions of wires in the epoxy were studied and found that, volume fraction of 2.5% can repair the defected beam as healthy one. It was observed that, using high volume fraction of SMA wires can significantly reduce deflection. Moreover, it was achieved SMA wires with volume fraction of 15% is capable to increase natural frequency of cracked beam 9.6%. Stress Intensity Factor (SIF) at the crack tip was studied and the recovery of the mode I SIF as a result of embedded wires revealed. The effect of various volume fractions of SMA wires, mass speed and crack depth were studied as well. There is a proper adjustment between the current results and those which were found through FEM.

KEYWORDS: Shape memory alloys; Cracked Timoshenko beam; Hybrid epoxy composite; Moving mass; Transfer matrix method; Stress intensity factor

DOI: 10.1016/j.compstruct.2014.09.020