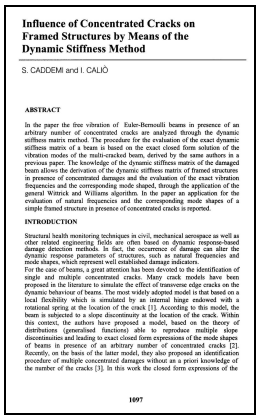

Influence of Concentrated Cracks on Framed Structures by Means of the Dynamic Stiffness Method

S. CADDEMI and I. CALIÒ

ABSTRACT

In the paper the free vibration of Euler-Bernoulli beams in presence of an arbitrary number of concentrated cracks are analyzed through the dynamic stiffness matrix method. The procedure for the evaluation of the exact dynamic stiffness matrix of a beam is based on the exact closed form solution of the vibration modes of the multi-cracked beam, derived by the same authors in a previous paper. The knowledge of the dynamic stiffness matrix of the damaged beam allows the derivation of the dynamic stiffness matrix of framed structures in presence of concentrated damages and the evaluation of the exact vibration frequencies and the corresponding mode shaped, through the application of the general Wittrick and Williams algorithm. In the paper an application for the evaluation of natural frequencies and the corresponding mode shapes of a simple framed structure in presence of concentrated cracks is reported.

INTRODUCTION

Structural health monitoring techniques in civil, mechanical aerospace as well as other related engineering fields are often based on dynamic response-based damage detection methods. In fact, the occurrence of damage can alter the dynamic response parameters of structures, such as natural frequencies and mode shapes, which represent well established damage indicators.
For the case of beams, a great attention has been devoted to the identification of single and multiple concentrated cracks. Many crack models have been proposed in the literature to simulate the effect of transverse edge cracks on the dynamic behaviour of beams. The most widely adopted model is that based on a local flexibility which is simulated by an internal hinge endowed with a rotational spring at the location of the crack [1]. According to this model, the beam is subjected to a slope discontinuity at the location of the crack. Within this context, the authors have proposed a model, based on the theory of distributions (generalised functions) able to reproduce multiple slope discontinuities and leading to exact closed form expressions of the mode shapes of beams in presence of an arbitrary number of concentrated cracks [2]. Recently, on the basis of the latter model, they also proposed an identification procedure of multiple concentrated damages without an a priori knowledge of the number of the cracks [3]. In this work the closed form expressions of the

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Код: 10708

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Издательство DEStech Publications, Lancaster, 2010 год

5 стр; формат: 23,5 x 16 см; библиографический список: 6 единиц
ISBN: 978-1-60595-024-2

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Ключевые слова:

Содержание.