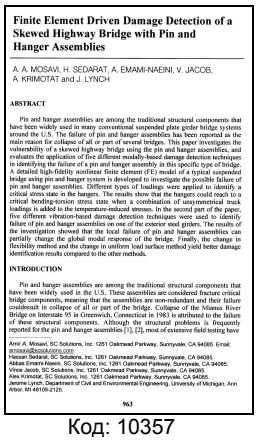

Finite Element Driven Damage Detection of a Skewed Highway Bridge with Pin and Hanger Assemblies

A. A. MOSAVI, H. SEDARAT, A. EMAMI-NAEINI, V. JACOB, A. KRIMOTAT and J. LYNCH

ABSTRACT

Pin and hanger assemblies are among the traditional structural components that have been widely used in many conventional suspended plate girder bridge systems around the U.S. The failure of pin and hanger assemblies has been reported as the main reason for collapse of all or part of several bridges. This paper investigates the vulnerability of a skewed highway bridge using the pin and hanger assemblies, and evaluates the application of five different modally-based damage detection techniques in identifying the failure of a pin and hanger assembly in this specific type of bridge. A detailed high-fidelity nonlinear finite element (FE) model of a typical suspended bridge using pin and hanger system is developed to investigate the possible failure of pin and hanger assemblies. Different types of loadings were applied to identify a critical stress state in the hangers. The results show that the hangers could reach to a critical bending-torsion stress state when a combination of unsymmetrical truck loadings is added to the temperature-induced stresses. In the second part of the paper, five different vibration-based damage detection techniques were used to identify failure of pin and hanger assemblies on one of the exterior steel girders. The results of the investigation showed that the local failure of pin and hanger assemblies can partially change the global modal response of the bridge. Finally, the change in flexibility method and the change in uniform load surface method yield better damage identification results compared to the other methods.

INTRODUCTION

Pin and hanger assemblies are among the traditional structural components that have been widely used in the U.S. These assemblies are considered fracture critical bridge components, meaning that the assemblies are non-redundant and their failure couldresult in collapse of all or part of the bridge. Collapse of the Mianus River Bridge on Interstate 95 in Greenwich, Connecticut in 1983 is attributed to the failure of these structural components. Although the structural problems is frequently reported for the pin and hanger assemblies [1], [2], most of extensive field testing have

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Ключевые слова:

Содержание.