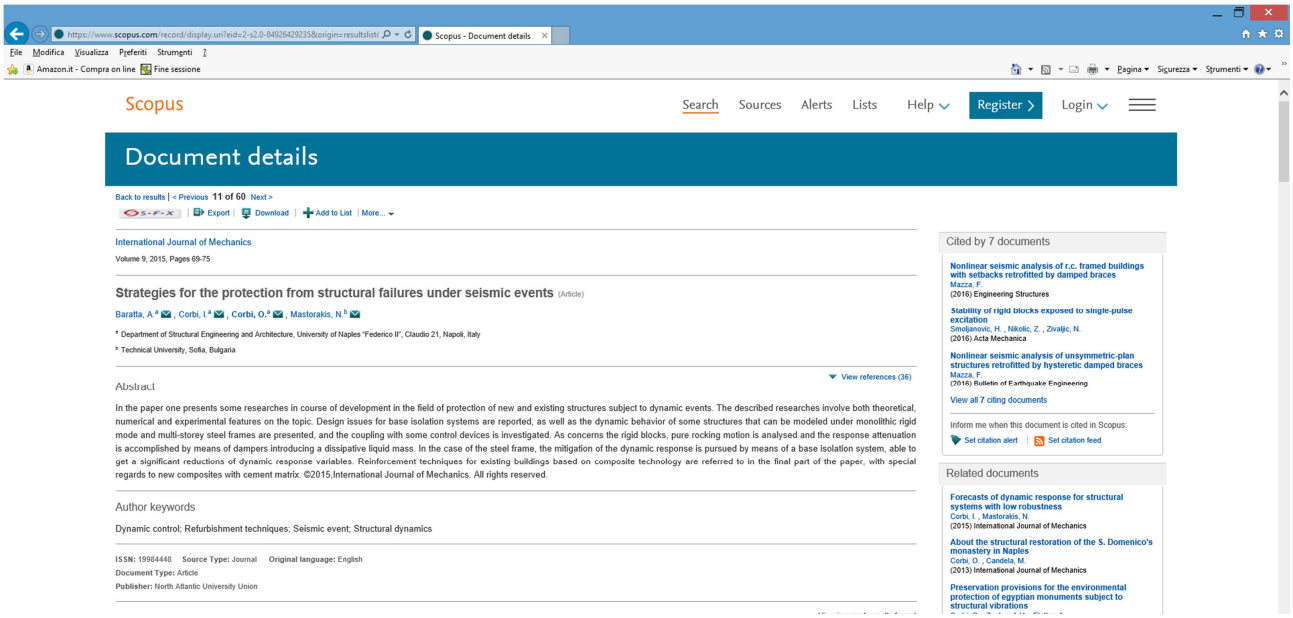

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Strategies for the protection from structural failures under seismic events (Article)

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Abstract

In the paper one presents some researches in course of development in the field of protection of new and existing structures subject to dynamic events. The described researches involve both theoretical, numerical and experimental features on the topic. Design issues for base isolation systems are reported, as well as the dynamic behavior of some structures that can be modeled under monolithic rigid mode and multi-storey steel frames are presented, and the coupling with some control devices is investigated. As concerns the rigid blocks, pure rocking motion is analysed and the response attenuation is accomplished by means of dampers introducing a dissipative liquid mass. In the case of the steel frame, the mitigation of the dynamic response is pursued by means of a base isolation system, able to get a significant reductions of dynamic response variables. Reinforcement techniques for existing buildings based on composite technology are referred to in the final part of the paper, with special regards to new composites with cement matrix. ©2015,International Journal of Mechanics. All rights reserved.

Author keywords

Dynamic control; Refurbishment techniques; Seismic event; Structural dynamics

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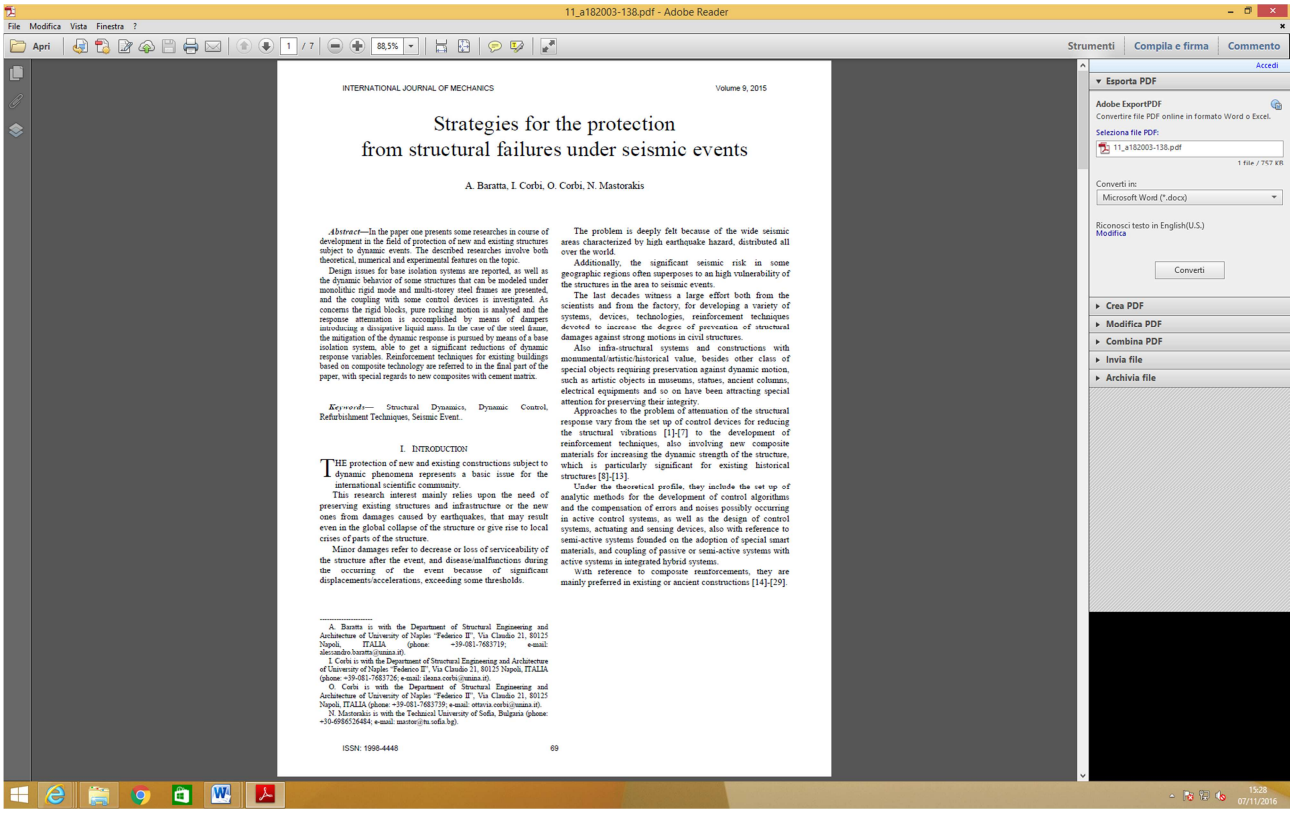

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INTERNATIONAL JOURNAL OF MECHANICS Volume 9, 2015

Strategies for the protection from structural failures under seismic events

A. Baratta, I. Corbi, O. Corbi, N. Mastorakis

Abstract—In the paper one presents some researches in course of development in the field of protection of new and existing structures subject to dynamic events. The described researches involve both theoretical, numerical and experimental features on the topic.

Design issues for base isolation systems are reported, as well as the dynamic behavior of some structures that can be modeled under monolithic rigid mode and multi-storey steel frames are presented, and the coupling with some control devices is investigated. As concerns the rigid blocks, pure rocking motion is analysed and the response attenuation is accomplished by means of dampers introducing a dissipative liquid mass. In the case of the steel frame, the mitigation of the dynamic response is pursued by means of a base isolation system, able to get a significant reductions of dynamic response variables. Reinforcement techniques for existing buildings based on composite technology are referred to in the final part of the paper, with special regards to new composites with cement matrix.

Keywords— Structural Dynamics, Dynamic Control, Refurbishment Techniques, Seismic Event..

I. Introduction

THE protection of new and existing constructions subject to dynamic phenomena represents a basic issue for the international scientific community.

This research interest mainly relies upon the need of preserving existing structures and infrastructure or the new ones from damages caused by earthquakes, that may result even in the global collapse of the structure or give rise to local crises of parts of the structure.

Minor damages refer to decrease or loss of serviceability of the structure after the event, and disease/malfunctions during the occurring of the event because of significant displacements/accelerations, exceeding some thresholds.

The problem is deeply felt because of the wide seismic areas characterized by high earthquake hazard, distributed all over the world.

Additionally, the significant seismic risk in some geographic regions often superposes to an high vulnerability of the structures in the area to seismic events.

The last decades witness a large effort both from the scientists and from the factory, for developing a variety of systems, devices, technologies, reinforcement techniques devoted to increase the degree of prevention of structural damages against strong motions in civil structures.

Also infra-structural systems and constructions with monumental/artistic/historical value, besides other class of special objects requiring preservation against dynamic motion, such as artistic objects in museums, statues, ancient columns, electrical equipments and so on have been attracting special attention for preserving their integrity.

Approaches to the problem of attenuation of the structural response vary from the set up of control devices for reducing the structural vibrations [1]-[7] to the development of reinforcement techniques, also involving new composite materials for increasing the dynamic strength of the structure, which is particularly significant for existing historical structures [8]-[13].

Under the theoretical profile, they include the set up of analytic methods for the development of control algorithms and the compensation of errors and noises possibly occurring in active control systems, as well as the design of control systems, actuating and sensing devices, also with reference to semi-active systems founded on the adoption of special smart materials, and coupling of passive or semi-active systems with active systems in integrated hybrid systems.

With reference to composite reinforcements, they are mainly preferred in existing or ancient constructions [14]-[29].

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