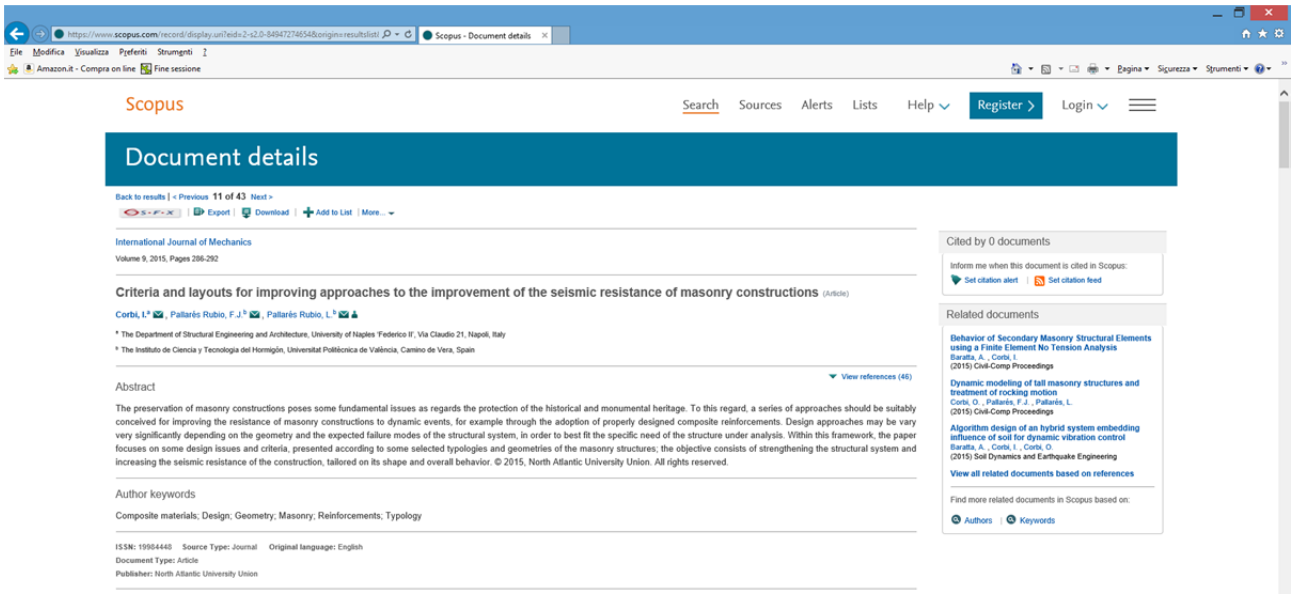

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International Journal of Mechanics
Volume 9, 2015, Pages 286-292

Criteria and layouts for improving approaches to the improvement of the seismic resistance of masonry constructions (Article)

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Abstract

The preservation of masonry constructions poses some fundamental issues as regards the protection of the historical and monumental heritage. To this regard, a series of approaches should be suitably conceived for improving the resistance of masonry constructions to dynamic events, for example through the adoption of properly designed composite reinforcements. Design approaches may be vary very significantly depending on the geometry and the expected failure modes of the structural system, in order to best fit the specific need of the structure under analysis. Within this framework, the paper focuses on some design issues and criteria, presented according to some selected typologies and geometries of the masonry structures; the objective consists of strengthening the structural system and increasing the seismic resistance of the construction, tailored on its shape and overall behavior.

Author keywords

Composite materials; Design; Geometry; Masonry; Reinforcements; Typology

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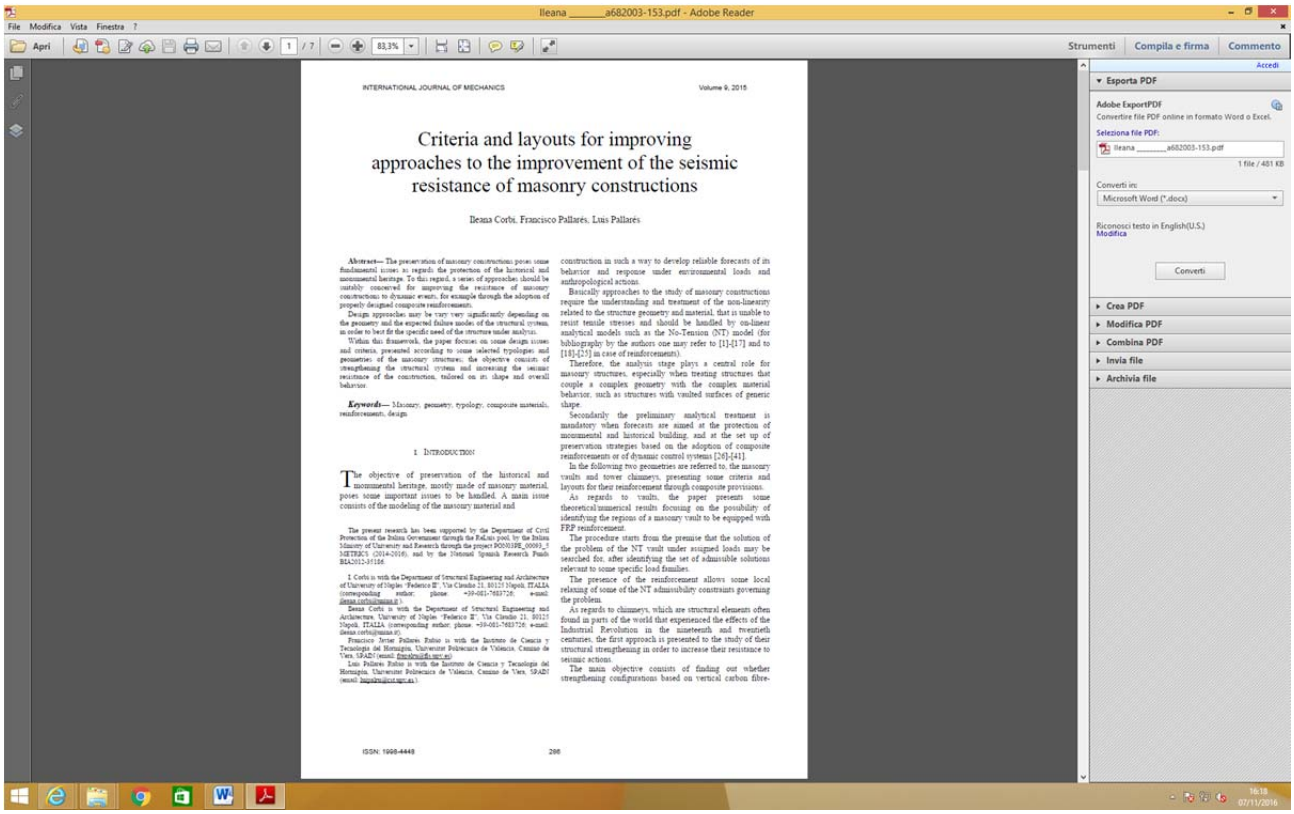

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INTERNATIONAL JOURNAL OF MECHANICS Volume 9, 2015

Criteria and layouts for improving approaches to the improvement of the seismic resistance of masonry constructions

Ileana Corbi, Francisco Pallarés, Luis Pallarés

Abstract— The preservation of masonry constructions poses some fundamental issues as regards the protection of the historical and monumental heritage. To this regard, a series of approaches should be suitably conceived for improving the resistance of masonry constructions to dynamic events, for example through the adoption of properly designed composite reinforcements.

Design approaches may be vary very significantly depending on the geometry and the expected failure modes of the structural system, in order to best fit the specific need of the structure under analysis.

Within this framework, the paper focuses on some design issues and criteria, presented according to some selected typologies and geometries of the masonry structures; the objective consists of strengthening the structural system and increasing the seismic resistance of the construction, tailored on its shape and overall behavior.

Keywords— Masonry, geometry, typology, composite materials, reinforcements, design

I. Introduction

The objective of preservation of the historical and monumental heritage, mostly made of masonry material, poses some important issues to be handled. A main issue consists of the modeling of the masonry material and construction in such a way to develop reliable forecasts of its behavior and response under environmental loads and anthropological actions.

Basically approaches to the study of masonry constructions require the understanding and treatment of the non-linearity related to the structure geometry and material, that is unable to resist tensile stresses and should be handled by on-linear analytical models such as the No-Tension (NT) model (for bibliography by the authors one may refer to [1]-[17] and to [18]-[25] in case of reinforcement).

Therefore, the analysis stage plays a central role for masonry structures, especially when treating structures that couple a complex geometry with the complex material behavior, such as structures with vaulted surfaces of generic shape.

Secondarily the preliminary analytical treatment is mandatory when forecasts are aimed at the protection of monumental and historical building, and at the set up of preservation strategies based on the adoption of composite reinforcements or of dynamic control systems [26]-[41].

In the following two geometries are referred to, the masonry vaults and tower chimneys, presenting some criteria and layouts for their reinforcement through composite provisions.

As regards to vaults, the paper presents some theoretical/numerical results focusing on the possibility of identifying the regions of a masonry vault to be equipped with FRP reinforcement.

The procedure starts from the premise that the solution of the problem of the NT vault under assigned loads may be searched for, after identifying the set of admissible solutions relevant to some specific load families.

The presence of the reinforcement allows some local relaxing of some of the NT admissibility constraints governing the problem.

As regards to chimneys, which are structural elements often found in parts of the world that experienced the effects of the Industrial Revolution in the nineteenth and twentieth centuries, the first approach is presented to the study of their structural strengthening in order to increase their resistance to seismic actions.

The main objective consists of finding out whether strengthening configurations based on vertical carbon fibre-

The present research has been supported by the Department of Civil Protection of the Italian Government through the ReLuis pool, by the Italian Ministry of University and Research through the project PON03PE_00093_3 InTERIcS (2014-2016), and by the National Spanish Research Funds BIA2012-35166.

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