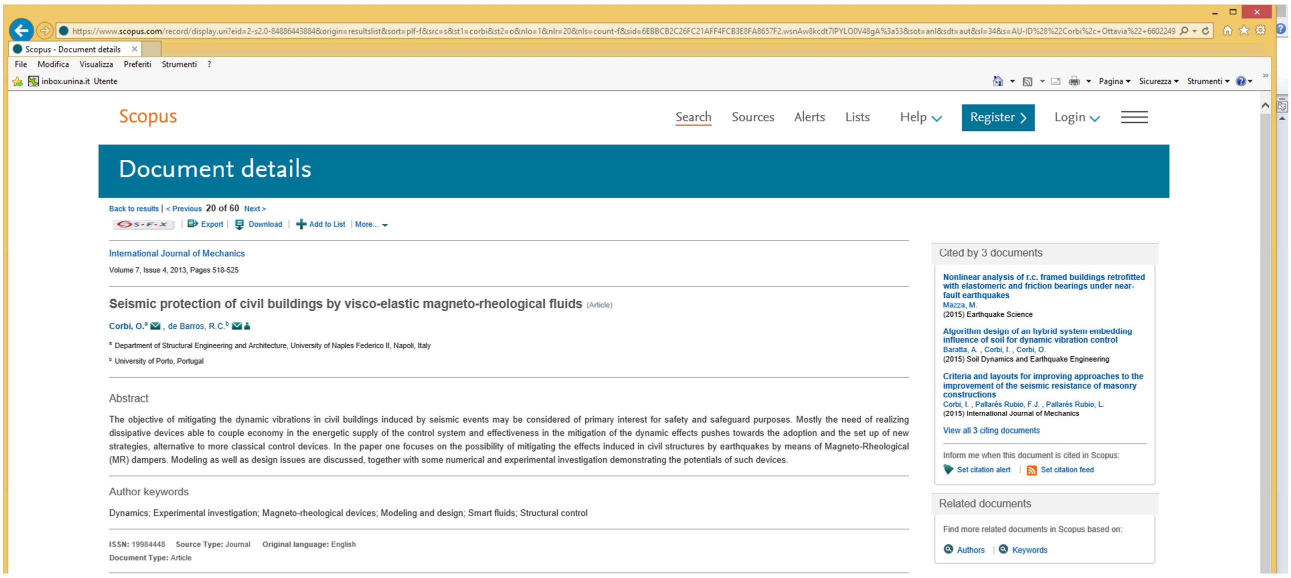


Scopus

Document details

Back to results | < Previous 20 of 60 Next >

Export | Download | Add to List | More...

International Journal of Mechanics
Volume 7, Issue 4, 2013, Pages 518-525

Seismic protection of civil buildings by visco-elastic magneto-rheological fluids (Article)

Corbi, O.[a], de Barros, R.C.[b]

[a] Department of Structural Engineering and Architecture, University of Naples Federico II, Napoli, Italy
[b] University of Porto, Portugal

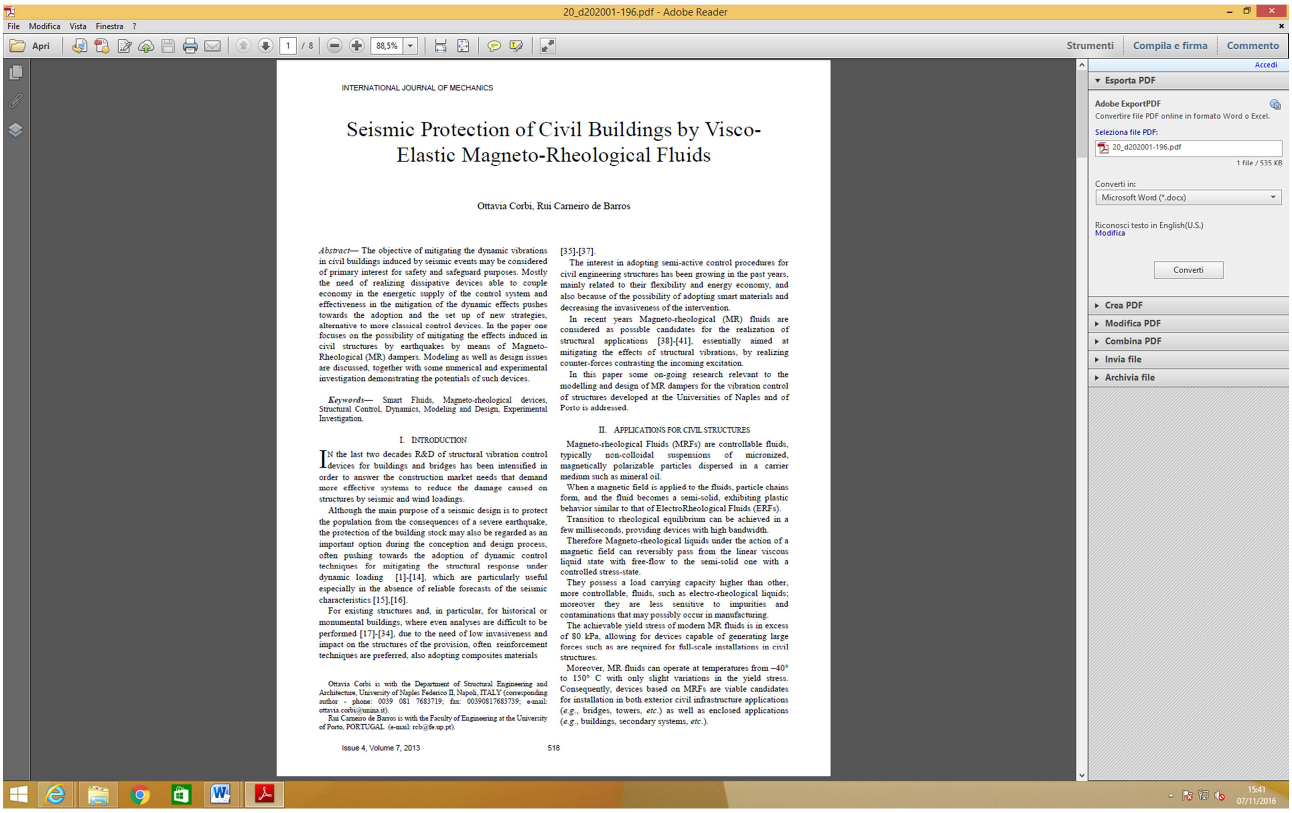
Abstract

The objective of mitigating the dynamic vibrations in civil buildings induced by seismic events may be considered of primary interest for safety and safeguard purposes. Mostly the need of realizing dissipative devices able to couple economy in the energetic supply of the control system and effectiveness in the mitigation of the dynamic effects pushes towards the adoption and the set up of new strategies, alternative to more classical control devices. In the paper one focuses on the possibility of mitigating the effects induced in civil structures by earthquakes by means of Magneto-Rheological (MR) dampers. Modeling as well as design issues are discussed, together with some numerical and experimental investigation demonstrating the potentials of such devices.

Author keywords

Dynamics; Experimental investigation; Magneto-rheological devices; Modeling and design; Smart fluids; Structural control

ISSN: 19984448 **Source Type:** Journal **Original language:** English
Document Type: Article



20_d202001-196.pdf - Adobe Reader

Seismic Protection of Civil Buildings by Visco-Elastic Magneto-Rheological Fluids

Ottavia Corbi, Rui Carneiro de Barros

Abstract— The objective of mitigating the dynamic vibrations in civil buildings induced by seismic events may be considered of primary interest for safety and safeguard purposes. Mostly the need of realizing dissipative devices able to couple economy in the energetic supply of the control system and effectiveness in the mitigation of the dynamic effects pushes towards the adoption and the set up of new strategies, alternative to more classical control devices. In the paper one focuses on the possibility of mitigating the effects induced in civil structures by earthquakes by means of Magneto-Rheological (MR) dampers. Modeling as well as design issues are discussed, together with some numerical and experimental investigation demonstrating the potentials of such devices.

Keywords— Smart Fluids, Magneto-rheological devices, Structural Control, Dynamics, Modeling and Design, Experimental Investigation.

I. Introduction

In the last two decades R&D of structural vibration control devices for buildings and bridges has been intensified in order to answer the construction market needs that demand more effective systems to reduce the damage caused on structures by seismic and wind loadings.

Although the main purpose of a seismic design is to protect the population from the consequences of a severe earthquake, the protection of the building stock may also be regarded as an important option during the conception and design process, often pushing towards the adoption of dynamic control techniques for mitigating the structural response under dynamic loading [1]-[14], which are particularly useful especially in the absence of reliable forecasts of the seismic characteristics [15],[16].

For existing structures and, in particular, for historical or monumental buildings, where even analyses are difficult to be performed [17]-[34], due to the need of low invasiveness and impact on the structures of the provision, often reinforcement techniques are preferred, also adopting composites materials [35]-[37].

The interest in adopting semi-active control procedures for civil engineering structures has been growing in the past years, mainly related to their flexibility and energy economy, and also because of the possibility of adopting smart materials and decreasing the invasiveness of the intervention.

In recent years Magneto-rheological (MR) fluids are considered as possible candidates for the realization of structural applications [38]-[41], essentially aimed at mitigating the effects of structural vibrations, by realizing counter-forces contrasting the incoming excitation.

In this paper some on-going research relevant to the modelling and design of MR dampers for the vibration control of structures developed at the Universities of Naples and of Porto is addressed.

II. Applications for Civil Structures

Magneto-rheological Fluids (MRFs) are controllable fluids, typically non-colloidal suspensions of micronized, magnetically polarizable particles dispersed in a carrier medium such as mineral oil.

When a magnetic field is applied to the fluids, particle chains form, and the fluid becomes a semi-solid, exhibiting plastic behavior similar to that of ElectroRheological Fluids (ERFs).

Transition to rheological equilibrium can be achieved in a few milliseconds, providing devices with high bandwidth.

Therefore Magneto-rheological liquids under the action of a magnetic field can reversibly pass from the linear viscous liquid state with free-flow to the semi-solid one with a controlled stress-state.

They possess a load carrying capacity higher than other, more controllable, fluids, such as electro-rheological liquids; moreover they are less sensitive to impurities and contaminations that may possibly occur in manufacturing.

The achievable yield stress of modern MR fluids is in excess of 80 kPa, allowing for devices capable of generating large forces such as are required for full-scale installations in civil structures.

Moreover, MR fluids can operate at temperatures from −40° to 150° C with only slight variations in the yield stress. Consequently, devices based on MRFs are viable candidates for installation in both exterior civil infrastructure applications (*e.g.*, bridges, towers, *etc.*) as well as enclosed applications (*e.g.*, buildings, secondary systems, *etc.*).

Ottavia Corbi is with the Department of Structural Engineering and Architecture, University of Naples Federico II, Napoli, ITALY (corresponding author - phone: 0039 081 7683719; fax: 00390817683739; e-mail: ottavia.corbi@unina.it).
Rui Carneiro de Barros is with the Faculty of Engineering at the University of Porto, PORTUGAL (e-mail: rcb@fe.up.pt).