Cyprus University of Technology
Faculty of Engineering and Technology

Master's Thesis

BIO – INSPIRED METAL FOAM APPLICATIONS FOR ENERGY DISSIPATION IN STRUCTURAL SYSTEMS

Ioanna Nicolaou

Limassol, December 2018

CYPRUS UNIVERSITY OF TECHNOLOGY

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING AND GEOMATICS

Master's Thesis

BIO-INSPIRED METAL FOAM APPLICATIONS FOR ENERGY DISSIPATION IN STRUCTURAL SYSTEMS

Ioanna Nicolaou

Limassol, December 2018

Approval Form

Master's Thesis

BIO-INSPIRED METAL FOAM APPLICATIONS FOR ENERGY DISSIPATION IN STRUCTURAL SYSTEMS

Presented by

Ioanna Nicolaou

Supervisor: Stylianos Yiatros, Supervisor

Signature _____

Member of the committee:

Signature _____

Member of the committee:

Signature _____

Cyprus University of Technology

Limassol, December 2018

Copyrights

I dedicate this thesis to my remarkable family, for their endless love and support.

ABSTRACT

Most buildings are expected to deform beyond their limit of linearly elastic behaviour when subjected to strong ground shaking. In this point, design codes, require the method of capacity design in structures, in order to ensure an overall dissipative and ductile behaviour, obtain the hierarchy of resistance of the various structural components and hence, ensuring suitable plastic mechanisms. Therefore, the behaviour of critical regions and/or elements, are parameters that highly affect the seismic performance of a structure, thus the detailing of the parameters and the structure's in general, shall be such as to maintain the capacity to transmit the necessary forces and to dissipate energy under cyclic conditions.

In this thesis, a relatively new material; metal foam, is presented as a replaceable energy absorbing constituent of a sub-component in conventional steel braces (or sacrificial elements in such structures). This porous metal material is capable of combining large energy absorption with ductility and low weight. Many researchers concluded that closed-cell metal foams are ideal to be used as energy dissipation means in structural applications, due to their varying properties, i.e. highly anisotropic cell – morphologies, higher relative density, high tensile strength and ductility up to, etc, compared to open cell metallic foams. This thesis aims to document existing efforts in this area of applications, while aiming to approach the problem as a design challenge via biomimetic methods.

Keywords: metal foam structural application, energy dissipation, ductility, hysteric damper