

# **Integrated approaches in engineering: structural and energy efficiency improvement techniques for buildings in the perspective of Life Cycle Thinking**

Held by  
**Linda Giresini, PhD**  
*Assistant Professor in Structural Design*

Venue: to be defined, according to the number of students

Date: 5 hours

Thursday, October 8<sup>th</sup> 2020, 3:00 p.m. - 6:00 p.m.

Friday, October 9<sup>th</sup> 2020, 9:00 p.m. - 11:00 p.m.

## **Abstract**

Any engineering system should meet specific economic and technical needs. Recently, climate changes increased the awareness of environmental impact of anything is manmade. Therefore, together with economic costs and solutions optimal from a technical point of view, the today's engineers should take into account the rate of sustainability of their devices, structures and components. Their effort should be addressed to invent and put in practice integrated approaches to combine technical, social and environmental needs. This holistic approach is currently known with the circumlocution "Life Cycle Thinking" (LCT). As for civil engineering, nowadays the protection of buildings from earthquakes and the energy upgrading move on two different pathways. Therefore, a structural intervention on an existing building does not consider at all its impact on the energy upgrading and vice-versa. To combine them is a new frontier in civil and energy engineering: effective solutions have to be optimized, in order to save precious sources and preserve our planet. This cannot be done without life cycle assessment, which gives a more correct estimation of the economic and environmental costs over the whole life cycle of the engineering system.

In this course, after an introduction about the effects of climate changes on the risk assessment on engineering systems, the LCT is presented. A general overview of issues arising in evaluating the seismic capacity of buildings is presented, together with the fundamentals of life cycle assessment. Afterwards, an innovative methodology currently under the study of the Italian Department of Civil Protection is discussed. This methodology is addressed to improve, in a combined way, both structural and energy behavior of existing buildings. Seismic and energy performance indicators are introduced as flexible tool functional to the integrated approach. To better explain the methodology, two real cases of existing masonry buildings are discussed, comparing the assessment in case of life cycle assessment to show how the latter strongly influences the final results.

The course is addressed to PhD students, post-doc researchers and anyone interested in developing skills on multi-disciplinary and integrated approaches in civil, industrial and energy engineering. Indeed, the methodology presented is a broad-spectrum approach and the underlying assumptions can be adopted in different fields where life cycle thinking and life cycle assessment enter the engineering design.

# Agenda

## Day #1

### **Fundamentals of structural retrofitting of existing buildings and life cycle assessment**

- Effects of climate changes on risk assessment: the need of integrated approaches and Life-Cycle Thinking
- Fundamentals of structural retrofitting of existing buildings under earthquakes
- Fundamentals of life cycle assessment in engineering systems

## Day #2

### **Integrated approaches in civil engineering**

- Methodology for combining seismic retrofitting and energy efficiency of existing buildings
- Definition of seismic and energy performance indicators
- How life cycle assessment enters the methodology
- Applications on two real masonry buildings

### **CV dr. Lnda Giresini, PhD**

- Author of over 60 papers/book chapters published in international journals or conference proceedings
- Research interests: earthquake engineering, experimental tests on masonry and r.c. structures, seismic vulnerability assessment of existing and new buildings, rocking and seismic isolation techniques, sustainable and resilient infrastructures, low-cost structural solutions for developing countries, rehabilitation of archaeological sites
- M.Sc. Civil Engineering at the University of Pisa, on 2011, 9th May ( 110/110 cum laude)
- Ph.D. Scuola Leonardo da Vinci, University of Pisa. Thesis's title: "Modelling techniques and rocking analysis for historic structures: influence of vaulted systems in the seismic response of churches"
- 18 months-fellowship in the project Master and Back, University of Sassari, on the topic "Tecniche e analisi per il consolidamento di costruzioni storiche e tradizionali nel bacino del Mediterraneo" SSD ICAR/09 – Tecnica delle Costruzioni ("Techniques and analysis for consolidation of historic and traditional buildings in the Mediterranean area"), May 2014 - October 2015
- 4 months-scholarship Erasmus Placement "Traineeship post laurea all'estero" provided by the University of Pisa, first place among engineering PhD students ("Traineeship post-lauream in foreign countries"), March 2013 - July 2014
- 6 months-scholarship financed by DAAD (Deutscher Akademischer Austauschdienst, German Academic Exchange Service), September 2013 - March 2014
- 18 months-scholarship financed by Polo Universitario dei Sistemi Logistici in Leighorn (Italy) entitled "Analisi di rischio sismico di edifici pubblici esistenti" ("Analysis of seismic risk of public existing buildings")- February 2012 - August 2013

### **Research collaborations**

- October 2018-September 2019: Visiting Researcher at the Technical University of Munich (Lehrstuhl für Baumechanik)

- Since January 2017: responsible of the UNUPI research group in the framework of ReLUIIS (network of university laboratories in earthquake engineering), financed by the Italian Civil Protection Department
- December 2017: Visiting professor at the Lehrstuhl für Baustatik und Baudynamik, RWTH Aachen
- February 2017: Visiting professor at the Universidade do Minho, Departamento de Engenharia Civil. Guimarães - Portugal
- June 2015: Visiting post-doc at the Universidade do Minho, Departamento de Engenharia Civil. Guimarães - Portugal
- Seismic Damage Surveying after the earthquakes of 2009-2012-2016 in Abruzzo, Emilia Romagna and Central Italy in collaboration with the Ministero per i Beni e le Attività Culturali (MIBAC) and the Department of Civil Protection
- Site Engineer at the UNESCO archaeological site of Al Balid (Salalah, Oman) for Sultanate of Oman (Office of the Adviser of HM the Sultan for Cultural Affairs) – 3 months in 2011-2012