UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II

DIPARTIMENTO DI STRUTTURE PER L'INGEGNERIA E L'ARCHITETTURA
CORSO DI DOTTORATO DI RICERCA IN
INGEGNERIA STRUTTURALE GEOTECNICA E RISCHIO SISMICO

XXXIX CICLO

Il sottoscritto prof. **Elena Mele**

(PO **X** PA □ RU □ RTD □) afferente al Dipartimento di Strutture per l'Ingegneria e l'Architettura

S.S.D. (*indicare codice e nome per esteso)* ICAR/09 Tecnica delle Costruzioni

CHIEDE

di essere inserito tra i possibili tutor di studenti di dottorato per il XXXIX ciclo.

1. Curriculum sintetico del proponente (max 500 parole)

2010 full professor, 2006-2010 associate professor, 1999-2006 assistant professor, University of Napoli Federico II, 1995-1997 post-doc research assistant, 1994 PhD in structural engineering.

Research activity:
Topics:

- generative design of megastructures, diagrid and gridshells;
- retrofit of existing buildings with exoskeleton;
- innovative structures for tall buildings;
- robustness and design for collapse prevention;
- seismic isolation at the base and intermediate level;
- tuned mass dampers;
- seismic assessment of masonry structures;
- seismic design of steel structural systems and connections;
- aluminium structures and foams.

Author of more than 260 publications in international and national journals and conference proceedings.

Since 2018 member of board of directors of Council of Steel Technicians (CTA), since 2018 member of Academic and Teaching Committee of Council of Tall Buildings and Urban Habitat, since 2017 fellow of Accademia delle Scienze d'Abbruzzo e delle Regioni Adriatiche, since 2015 member of Council of Tall Buildings and Urban Habitat.
2004 JSPS fellowship for Invited Visiting Professor at Disaster Prevention Research Institute, Kyoto University, Japan Society for Promotion of Science; 2001, 1999, 1998, 1996 visiting researcher at Instituto Superior Tecnico of Lisbon within FCT projects; 1999 visiting researcher at National Technical University of Athens, Laboratory for Earthquake Engineering, (ECOEST 2 - Access to Large Scale Facilities); 1999 visiting researcher at ELSA Laboratory of Joint Research Center, ISPRA.

Member of the Editorial Board on the journals: Buildings, MDPI; Costruzioni Metalliche; Sustainability, MDPI. 2020 Reviewer for book proposals The Institution of Engineering and Technology (IET); 2017-2018 Engineering Structures award for outstanding contribution in reviewing; 2016-2017 Peer Reviewer of CTBUH document: Perfomance Based Seismic Design Guidelines of Tall Buildings; Reviewer for several international journals.

2022-2026: member of the steering committee of FreeGrid, a benchmark on design and optimization of gridshells to be launched at the IASS 2023 Annual Symposium in Melbourne (July 2023).
2022-2024 project DPC-ReLUIS, WP15. RU UNINA-DIST coordinator: Design code contributions on seismic isolation and energy dissipation – the Intermediate Isolation System (IIS).

Teaching activity:
Courses for undergraduate and graduate students at University of Napoli Federico II:
since 2004: Design of steel structures; since 2005: Structures for high-rise and long-span buildings; 2012-2015: Structural design of reinforced concrete buildings; 2001-2005: Tecnica delle Costruzioni II (advanced structural analysis and design).
2006-2015: International II level Master Design of Steel Structures in Smart Cities, University of Naples Federico II: course Structures for high-rise and long-span buildings, Lectures and student project tutoring in Atelier 2, member of executive committee and of the teaching board.
Since 2009: member of thesis-lab board, Engineering Architecture Course. University of Napoli Federico II. Tutor and reviewer of several thesis (around 10/year)
Since 2014 responsible of student internship in UK (AtelierOne) and USA (SOM San Francisco, Columbia University NY), 2021 responsible of student internship at Ufficio Regionale Genio Civile di Napoli.
Since 2001 tutor or co-tutor of 15 PhD students: 3 in Structural engineering, Geotechnics and Seismic Risk; 11 in Construction Engineering, 1 in Drawing and Representation in Architecture.
2016-2017 tutor of 1 post-doc from Cassino University research project funded by Regione Lazio POR FSR.

2. Dottorandi dei quali il proponente è stato tutor nell'ultimo triennio

n. ___2__	*Mario Argenziano, Francesco Esposito*

3. Titolo della ricerca proposta

Tall_Timber_Hybrids: Sustainable and efficient structural system solutions for timber and steel-timber hybrid tall buildings

4. Area tematica

Ingegneria Geotecnica □

Ingegneria Strutturale **X**

Rischio Sismico □

5. Tipologia di borsa per la quale si propone il progetto

Ateneo **X**

DM 117 (Investimento 3.3) □
(in questo caso indicare l'azienda co-finanziatrice)

DM 118 (Investimento 4.1 P.A.) □

DM 118 (Investimento 4.1 generici) **X**
DM 118 (Investimento 4.1 Patrimonio culturale) □

6. Sintesi del progetto di ricerca (max 500 parole. Stato dell'arte, obiettivi e breve programma previsto per le attività e)

Background and Objectives

Urbanized areas in the world are growing due increasing demand for living and working spaces in cities. The need to exploit the used land leads to favor tall buildings, which, however, often do not represent an environmentally sustainable choice. In this perspective, tall timber buildings could play a very important role thanks to the inherent sustainability of wood products. Furthermore, steel-timber hybrids represent an alternative and innovative solution, also thanks to the growing attention of steel producers to environmental issues and to the possibility of using steel members to provide greater stiffness to the structure.

Timber structures are nowadays a feasible and real solution for tall buildings; however, until 2019, the tallest timber building was the Pagoda of Fongong (China), built in 1056 with solid wood. Currently, the tallest structure in the world, realized with GLT, is only approximately 15 m taller than the Fongong Pagoda.

Therefore, there is a need to examine the classical structural systems for tall buildings, and assessing the potentials for application in timber and/or steel-timber solutions. More importantly, innovative solutions, best fitting the inherent properties of timber materials and components, should be proposed and tested on case studies and archetypes defined *ad hoc*. Finally, design criteria and optimization procedures should be formulated to address the specific advantages (lightness, sustainability, etc.) and criticalities (drift, floor accelerations, etc.) associated to the use of timber materials.

Major aim of this project is to fill the knowledge and design practice gap above defined.

For this aim the most suitable structural systems for tall timber and tall steel-timber hybrid are identified, varying the building height and slenderness, and considering both wind and seismic loads. The structural solutions are then organized according to a hierarchical classification as a function of building height, similarly to the traditional classifications already proposed for steel and concrete buildings, as well as for interior- and exterior-type structures. However, being design a holistic activity accounting for multiple goals, this research project takes into account not only the structural efficiency, but also the practical buildability and environmental sustainability. Therefore, multiple performance metrics, not necessarily exhaustive, are identified and weighted in a single, synthetic quantitative metric.

Research activities:

- literature review;
- definition of performance indicators (structural efficiency, buildability, sustainability);
- selection of case studies; identification of structural systems of selected case studies, derivation of archetypes, proposal of new solutions;
- definition of design criteria and parameters;
- structural modeling and analyses, varying building slenderness, columns tributary area, type and strength of structural materials;
- identification of load paths, resisting mechanisms and deformation modes;
- assessment of dynamic behavior;
- identification of drawbacks and potential solutions;
- identification of aspects that can be optimized;
- assessment of structural efficiency, buildability, sustainability;
- definition of height-based hierarchy of structural systems;
- definition of hierarchy of structural systems according to synthetic quantitative metric accounting for structural efficiency, buildability, sustainability.

Expected Outcomes:

For timber and steel-timber hybrid tall buildings:

- • theoretical framework, design criteria and optimization procedures;
- • hierarchy of structural systems according to building height;
- • definition of holistic design parameter accounting for structural efficiency, buildability, sustainability;
- • hierarchy of structural systems according to holistic design parameter.
- • project examples, case-studies; design guidelines.

- Orta, B.; Martínez-Gayá, J.E.; Cervera, J.; Aira, J.R. (2020). Timber high rise, state of the art.
- Rune Abrahamsen. Mjøstårnet – Construction of an 81 m tall timber building – 23. International Holzbau-Forum IHF 2017
- Daniel Safarik, Jacob Elbrecht, William Miranda. CTBUH Research – Journal 2022. State of tall timber 2022
- Sustainable High-Rise Buildings Design, technology and innovation; Eds. Kheir AI-Kodmany, Peng Du and Mir M.Ali (2022)

7. Eventuali pubblicazioni del tutor sul tema di ricerca (max 10)

V. Tomei, D. Faiella, F. Cascone, E. Mele. Structural grammar for design optimization of grid shell structures and diagrid tall buildings. Automation in Construction, 143 (2022) https://doi.org/10.1016/j.autcon.2022.104588

F. Cascone, D. Faiella, V. Tomei, E. Mele, Stress lines inspired structural patterns for tall buildings, Engineering Structures (2021) https://doi.org/10.1016/j.engstruct.2020.111546.

F. Cascone, D. Faiella, V. Tomei, E. Mele, A Structural Grammar Approach for the Generative Design of Diagrid-Like Structures, Buildings 11 (2021) https://doi.org/10.3390/BUILDINGS11030090

A. Alavi, E. Mele, R. Rahgozar, E.N. Farsangi, I. Takewaki, C. Málaga-Chuquitaype. 2021. Uniform deformation design of outrigger braced skyscrapers: a simplified method for the preliminary design stage. Structures, 31, pp. 395–405.

E. Mele, M. Fraldi, G.M. Montuori, G. Perrella, V. Della Vista. Hexagrid-Voronoi transition in structural patterns for tall buildings. Frattura e Integrità Strutturale, 13 (2019) https://doi.org/10.3221/IGF-ESIS.47.15

V. Tomei, M. Imbimbo, E. Mele. 2018. Optimization of structural patterns for tall buildings: the case of diagrid. Engineering Structures, 171, pp. 280–297

G.M. Montuori, M. Fadda, G. Perrella, E. Mele. 2015. Hexagrid–hexagonal tube structures for tall buildings: patterns, modeling, and design. The Structural Design of Tall and Special Buildings, 24 (15), pp. 912-940.

E. Mele, M. Toreno, G. Brandonisio, A. De Luca. 2014. Diagrid structures for tall buildings: Case studies and design considerations. The Structural Design of Tall and Special Buildings. 23(2), pp. 124–145.

G.M. Montuori , E. Mele, G. Brandonisio, A. De Luca. 2014. Geometrical patterns for diagrid buildings: exploring alternative design strategies from the structural point of view. Engineering Structures. 71, pp. 112–127.

G.M. Montuori , E. Mele, G. Brandonisio, A. De Luca. 2014. Secondary Bracing Systems for diagrid structures in tall buildings. Engineering Structures75, pp. 477–488.

8. Eventuali progetti di ricerca finanziati in cui l'attività si inserisce

CTBUH International Research Competition: Sustainable and efficient structural system solutions for timber and steel-timber hybrid tall buildings – **submitted, under review**

9. Eventuali fondi disponibili a supporto dell'attività del dottorando (escluso finanziamento borse)

10. Informazioni relative ad un periodo di ricerca all'estero (minimo tre mesi) previsto per il dottorando (*indicare Università/ente di ricerca e docente/ricercatore di riferimento* con indirizzo mail) (max 300 parole)
University of Kassel, Germany. Prof. M. Clobes or

11. Eventuali collaborazioni con imprese/aziende sul tema di ricerca (max 300 parole)
ArcelorMittal Steligence, Luxembourg, Luxembourg AKT II, London, UK Atelier One, London, UK Council of Tall Buildings and Urban Habitat, CTBUH, Chicago, USA

Napoli, 30/06/2023

Il presente modulo va compilato in ogni sua parte ed inviato all'indirizzo di posta elettronica phd.dist@unina.it entro e non oltre **il 30/06/2023.**