UNICUSANO
Università degli Studi Niccolò Cusano - Telematica Roma

PhD program
in Industrial and Civil Engineering

Durability, Design and Structural Optimization with Composite Materials

Simone Spagnuolo
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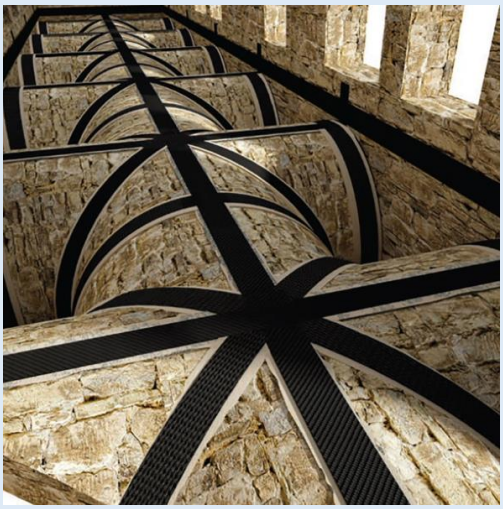

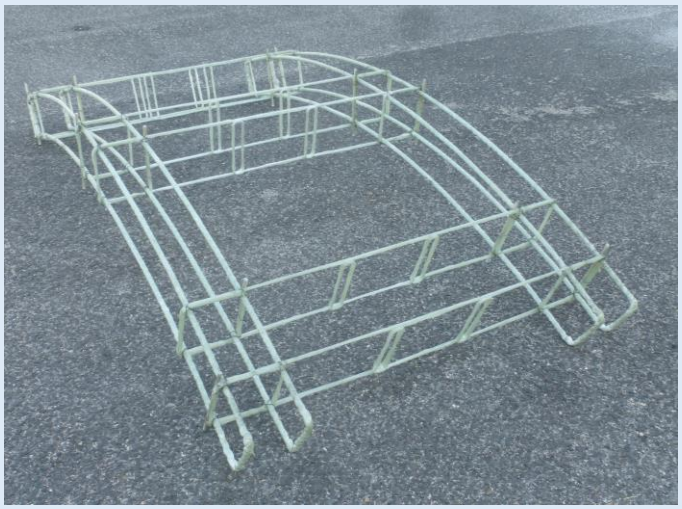

Mission of the course	The use of fiber-reinforced polymer (FRP) in concrete and masonry structures is an innovative solution that can be proposed to increase the performance of existing structures or in alternative to the traditional steel rebars, mainly when a high resistance to the environmental attack is required. Indeed, in comparison with steel, composites do not suffer corrosion problems, presents higher tensile capacity, and lower weight leading to higher durability with low maintenance cost of the structures. Furthermore, compared to steel, mechanical and durability performance of composites can be design and improved by selecting the appropriate constituents and by optimizing their production process.
Main topics	The proposed course want to focus on several aspects related to the characterization, design and manufacturing process of composite reinforcement in order to: ✓ Guarantee higher levels of durability and performance of reinforced structures. ✓ Guarantee a critical analysis of the results obtained from the experimental campaign for the characterization of physical, mechanical and durability properties of the reinforcement designed; ✓ Assess their actual structural performance; ✓ Evaluate their residual safety, robustness, vulnerability, serviceability; ✓ Optimize the reinforcement in order to avoid typical problems related to their use such as lack of bond, anchoring length, fire resistance, and so on; Special attention will be given to their optimization as external/internal reinforcement of curved structures.

Teaching staff

Dr. Simone Spagnuolo achieved Structural and Geotechnical Engineering Ph.D. from University of Rome Tor Vergata, in collaboration with University of Miami, with the thesis: "Evolution of GFRP rebars: tunnel applications". He is specialized in structural analysis, composite materials and fiber reinforced concrete. Simone is actually post-doc researcher at University of Rome Tor Vergata, where he collaborates with the chairs of 'Structural Analysis & Design', 'Tunnel & Bridges' and 'Existing RC Structures'.
The principal research topics are:

- Structural behavior of fiber-reinforced concrete (FRC) structures;
- Innovative composite materials as internal reinforcement of precast concrete linings of tunnel excavated mechanically by TBM;
- Structural behavior of hybrid structures (FRC+FRP bars);
- Composite reinforcements under fire exposure;
- Retrofitting of RC and Masonry structures with Innovative Materials;
- Structural behavior of RC structures damaged by corrosion.

Course organization	The course has an expected duration of 10h. The course will be held electronically on the E-Learning Platform, following the path → Alta Formazione-Seminari Scienetifici e Professionalizzanti For further information, contact: spagnuolo@ing.uniroma2.it or stefania.imperatore@unicusano.it
Course outline	*Lesson 1 - 12/10/2020 (16.00 - 18.00)* Introduction to composite materials. *Durability aspects of structures. Definition of composite materials with their different constituents (fiber phase, matrix phase and interphase). Advantages and Disadvantages in the use of composite materials. (σ-ε) constitutive law of each single phase (fiber/matrix) and final composite material. Production processes.* *Lesson 2 - 14/10/2020 (15.30 - 18.30)* Externally bonded FRP systems for strengthening existing structures. *Debonding mechanisms. Flexural strengthening. Shear strengthening. Torsional strengthening. Confinement. Optimization of FRP reinforcement's application on masonry arches, loaded vertically.* *Lesson 3 - 16/10/2020 (16.00 - 18.00)* Concrete structures reinforced with fiber-reinforced polymer bars. *Characterization of physical, mechanical and durability properties of FRP bars. Reability assessment and data interpretation.* *Lesson 4 - 19/10/2020 (15.30 - 18.30)* Structural optimization and case history. *FRP bars as internal reinforcement for underground applications. Fire problems. Hybrid solutions (FRC+FRP). RC piles/soft-eyes externally confined by means of FRP jacket. Mix design with concrete based on sulphoaluminate. FRP-RC structures with seawater sea-sand concrete. Full-scale applications and case history.*
Learning evaluation	Students are required to prepare a final report on a subject agreed upon with the teacher.

Location: *Niccolò Cusano University- Department of Engineering. Via Don Carlo Gnocchi, 3 Rome.*
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