Course unit English denomination	Historic construction and infrastructures: Analysis and structural assessment
SSD	CEAR-11/A (ex ICAR18), CEAR-08/A (ex ICAR10), CER 07/A (ex ICAR09)
Teacher in charge (if defined)	Gianmario Guidarelli, Angerlo Bertolazzi, Paolo Zampieri
Teaching Hours	24 (6+6+12)
Number of ECTS credits allocated	4 (1+1+2)
Course period	June
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (80 % minimum of presence) ☐ No
Course unit contents	The course aims to provide a solid basis for the analysis and evaluation of historic buildings. Through a multidisciplinary expertise, the sources of historic construction techniques (archives, treatises and technical manuals and publications) are addressed in view of their typological classification and characterization of mechanical and structural properties. The topics covered in the course are both pre-industrial techniques (wood, stone and brick masonry) and modern ones (reinforced concrete, iron and prefabricated structures). The course delves into simplified approaches for the analysis and structural verification of existing buildings. Particular importance will be given to methods based on limit analysis that are well suited to be reused in a modern way through computational approaches: - simplified and/or detailed approaches for the evaluation of the effects of degradation in existing structures; - detailed approaches for the evaluation of the safety level starting from the evaluation of the degradation of buildings - analysis and improvement of the structural robustness of existing buildings.
Learning goals	The aim of the course is to provide a safe and multidisciplinary methodology for the analysis of the built environment that, starting from the research of the sources, allows to identify the main typological and constructive aspects in function of an evaluation of the behaviour of the residual structural capacities of the artefact, both through a simplified and detailed analysis. The course also aims to provide knowledge of the cutting-edge technological tools for the data mining activity (consultation of digital archives and databases and data banks) and data managing (structural modelling) of the built environment, both with regard to the historical and constructive aspects and the material and structural ones). Finally, the aim is to develop even unconventional assessment procedures and propose innovative solutions for increasing the structural robustness of existing structures.
Teaching methods	The course includes a part of lectures, dedicated to the in-depth study of the

	subject of the course (which each year includes a different theme among the masonry of wood, stone and brick, or the use of reinforced concrete, iron or prefabricated structures) and to the acquisition of the methodology and work tools. A second part will instead be dedicated to laboratory activities for the development of the theme of the year, during which innovative and transversal research methodologies are put into practice, on the case studies that will be the subject of the final exam.
Course on transversal, interdisciplinary, transdisciplinary skills	☒ Yes ☐ No
Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites (not mandatory)	Digital Geometric Drawing and Modeling, History of Architecture and Built Environment, Construction Techniques, Structural analysis.
Examination methods	In a learning by doing perspective, the course includes an ongoing assessment that measures the participation in the course by the doctoral student and his interaction with the teachers. The final grade will then be given on the final paper related to the case study, in which the results of the theoretical and laboratory parts of the course will be condensed.
Suggested readings	The following volumes are recommended as working tools and basis for the course, which will be integrated based on the theme of the year. - Palladio, Andrea. "I Quattro Libri dell'Architettura", Vicenza: Centro Internazionale di Studi di Architettura Andrea Palladio, 2018; - Leon Battista Alberti, "L'arte di costruire", a cura di: V. Giontella, Torino: Bollati Boringhieri. 2010; - Guenzi C., a cura di, L'Arte di edificare. Manuali in Italia (1750-1950), Milano: BE-MA Editrice, 1981; - Benvenuto E., La scienza delle costruzioni e il suo sviluppo storico, Firenze: Sansoni, 1981; - Ramazzotti L., L'Edilizia e la Regola. Manuali nella Francia dell'Ottocento, Roma: Edizioni Kappa, 1984; - Heyman J., Lo scheletro di Pietra. Ingegneria strutturale dell'architettura in muratura, Roma: EPC, 2014; - Heyman J., Plastic Design of Frames: Structures and Solid Body Mechanics, Oxford: Pergamon Press, 1979; - Heyman J., Plastic Design of Frames: Volume 2, Application, Cambrige: Cambridge University Press, 2004; - Como M., Statics of Historic Masonry Constructions, Berlin: Springer, 2013; - Angelillo M.(ed), Mechanics of Masonry Structures, Berlin: Springer nature, 2004; - Ghiassi B, Milani G., (ed.), Numerical Modelling of Masonry and Historical Structures. From Theory to Application, Amsterdam: Elsevier, 2019.
Additional information	