

Course unit title	REHABILITATION AND MAINTENANCE OF BUILDINGS
Course unit code	1E7
Type of course unit	Elective
Semester	First
Number of ECTS credits allocated	5
Name of lecturer(s)	Mikeš (CTU); Lecturer (UC); Mazzolani (UNINA); Lecturer (UPT); Lecturer (ULg); Lecturer (LTU); Lecturer(Associate 1); Lecturer (Associate2).
Learning outcomes of the course unit	<p>After completing the course, the student is expected to have understanding of the behaviour of existing constructions and different methods of reinforcing. In particular, students are expected to:</p> <ul style="list-style-type: none"> • understand the behaviour of existing constructions • understand the main causes of structural failures • carry out calculations on load bearing capacity of structures • be able to draw, read and understand diagrams, normal force, shear force and bending moments • be able to understand the reason for retrofit • be able to select proper strengthening methods • Have skill to design repair interventions of different type of civil structures.
Mode of delivery	Frontal lesson , laboratory
Prerequisites and co-requisites	General admission requirements
Course contents	The aim of the course is to provide students with both the theoretical and constructional bases for the design of retrofit intervention of existing constructions with a special focus on steel structures. Scope of the course is to provide the required background knowledge for the design of retrofit intervention and maintenance plan. During the course students will learn the fundamental aspects of retrofit, the material properties used in

steel structures, the main causes of structural failures, the reason to design a retrofit intervention, the basis of design according to European codes, the basic methods of reinforcing steel structures and the use of steel for retrofit of existing constructions.

Thirteen topics, listed below are covered in the course.
Description of topics

1. Errors in the design of structures and modern reconstruction

- 1.1 Introduction,
- 1.2 history,
- 1.3 basic terms,
- 1.4 principles of the design and assessment.

2. Mechanical properties of cast iron, mild iron and steel at historical structures

- 2.1 Material used in steel structures – historical review.

3. Causes and analysis of steel structural failures

- 3.1 Common causes of defects and failures of steel structures in history,
- 3.2 errors in the design of structures,
- 3.3 defective material,
- 3.4 errors during the construction process.

4. Assessment of load bearing structures and reasons for refurbishment of steel structures

- 4.1 Methods of assessment,
- 4.2 Consolidation levels: safeguard, repairing, reinforcement and restructuring (gutting, insertion, extension and lightening)
- 4.3 monitoring,
- 4.4 assessment before refurbishment,
- 4.5 measurement of the geometric shape of a structure.

5. Overview of codes for design and actions on structures

- 5.1 Historical codes,
- 5.2 action on structures according previous valid codes,
- 5.3 design according to Eurocodes.

6. Inspections and material testing

	<p>6.1 Assessment with respect to corrosion, 6.2 instruments and devices for assessment.</p> <p>7. Introduction of basic methods of reinforcing steel structures</p> <p>7.1 Reinforcement of elements by enlargement of the original cross-section, 7.2 reinforcement of joints and connections, 7.3 reinforcement by changes to the static system, 7.4 reinforcement by prestressing draw bars.</p> <p>8. Strengthening of individual members subjected to axial load (tension, compression) – elastic and plastic check procedures</p> <p>8.1 Reinforcement of different types of sections.</p> <p>9. Strengthening of individual members subjected to bending</p> <p>9.1 Reinforcement of different types of sections.</p> <p>10. Strengthening of individual members subjected to combination of effects – elastic and plastic check procedures</p> <p>10.1 Reinforcement of different types of sections.</p> <p>11. Strengthening of riveted/bolted/welded connections</p> <p>11.1 Detailing of strengthening, combination of different types of binding matters.</p> <p>12. Repair and reconstruction of civil structures</p> <p>12.1 Specialty of design, reconstruction of different types of structures.</p> <p>Reserve</p>
<p>Recommended or required reading</p>	<p>Agócs, Z. – Ziolko, J – Vičan, J. – Brodniansky, J.: Assessment and Refurbishment of Steel Structures. Spon Press Taylor & Francis Group, 2005, 359 s.</p> <p>Silva, L.S. – Simoes, R. – Gervásio, H.: Design of steel structures. ECCS Eurocode Design Manuals, Ernst & Sohn, 2010, 438 s.</p> <p>Trahair, N.S. – Bradford, M.A. – Nethercot, D.A. – Gardner, L.: The behaviour and design of steel structures to EC3. Taylor &</p>

	<p>Francis, 2008, 490 s.</p> <p>Mazzolani, F. M.: Refurbishment. Arbed, Luxembourg, 1990.</p> <p>Mazzolani, F.M. – Ivanyi, M. (editors): Refurbishment of buildings and bridges (CISM Course). Springer – Verlag, Wien - New York, 2002.</p> <p>Mazzolani, F. M.: Refurbishment by steelwork. Arcelor Mittal, 2007.</p> <p>Berlanda, T. – Bruno, A. – Engel, P. - Mazzolani, F. M.: Steel and Refurbishment. Featuring Steel Resources Architecture Reflections, Arcelor Mittal, Detail, ISBN: 978-3-920034-32-4, p. 96-109, 2009.</p>
Planned learning activities and teaching methods	<p>The course will be held in two weeks. Each topic will be undertaken in one week. The course is organized in theoretical lectures and tutorials. Teaching is given in classes including numerical examples and exercises. Compulsory assignments are given during the course. A final assignment is given concerning the preliminary design of a retrofit intervention of an existing building. This work should be done in group of two students.</p>
Assessment methods and criteria	<p>The final oral exam only after having completed all the homework and the final project, which have to be brought at the exam. The homework has to be delivered within two weeks after the assignment. The final assignment has to be delivered within to week after the end of the course. All the assignment must be approved by the tutor. Grading system. Passed or not passed. A certificate awarding ECCS credits after the course accomplishment may be provided upon the request.</p>
Language of instruction	English