

## COURSE DESCRIPTION

<b>Name of the Course:</b>		<b>Rehabilitation of concrete structures</b>						
<b>Specialization Code:</b>		<b>U02.07.ICV.IZ.M26</b>		<b>Course Code:</b>		<b>3.DS.OP14</b>		
<b>Year of study:</b>	<b>2</b>	<b>Semester:</b>	<b>3</b>	<b>Examination form:</b> (E-Exam; Co- Colloquy; P-Project; P/F-Passed/Failed)		<b>ECTS credits granted (CR):</b>	<b>E (Co)</b>	<b>3</b>
					<b>P</b>		<b>P (P/F)</b>	
<b>Course Category:</b> (DF- Fundamental; DD- General engineering; DS-Specialty engineering; DC-Complementary; PR-Practical stage)								<b>DS</b>
<b>Course Type:</b> (OB-Compulsory; OP-Elective; FC-Facultative)								<b>OP</b>
<b>Number of hours per semester:</b> Total of hours per week (TH) x Number of weeks per semester								
<b>TOTAL :</b>	<b>70</b>	<b>Individual study (IS):</b>		<b>42</b>	<b>Contact hours (C + S;L;P):</b>		<b>28</b>	
<b>Academic staff member in charge:</b> (Full name, Academic position and Department)				Viorel POPA, Assoc. Professor., Reinforced concrete structures Stoica Nicolae Daniel – Associate Professor – CCIUT Șerban DIMA, Ph.D., C. Eng., Professor Ruxandra ERBASU – Lecturer - CCIUT				

<b>Faculty</b>	<b>Engineering in foreign languages Master study programme</b>	Number of contact hours per semester				
		Total	Course	Seminar	Laboratory	Project
<b>Field</b>	<b>Civil Engineering</b>	28				28
<b>Specialization</b>	<b>Structural Engineering</b>					

**Course objectives - Description of the main competences: Acquire the knowledge necessary for assessment of existing concrete structures safety level. Rehabilitation methods. Types of intervention. Technologies.**

**Content description:**

<b>1. Seminar / Laboratory / Project / Practical stage</b>	<p><b>Concrete structures</b></p> <p>1. Evolution of Romanian Seismic Codes: Evaluation of seismic horizontal load according to: P.13-63, P100-78, P100-92, P100-1/2006 and P100-1/2013.</p> <p>2. Seismic evaluation project for a reinforced concrete frame structure: analytical evaluation by calculation using level 1 methodology.</p> <p><b>Steel structures</b></p> <p><i>Repairing a corroded bar by welding</i></p> <p><i>Rehabilitation of a compressed bar by welding</i></p> <p><i>Repair of a metal beam by bolting</i></p> <p><b>Masonry structural</b></p> <p>Case study for an existing building:</p> <ul style="list-style-type: none"> <li>• Development of technical documentation for existing buildings: architectural surveys, structural surveys, resistance characteristics of materials (mortar, masonry elements) determination; structural and non-structural degradation identification;</li> <li>• Determination of the strength characteristics for masonry;</li> <li>• Models for structural analysis of masonry walls, structural calculations to identify their gravitational and seismic actions behavior;</li> <li>• Retrofitting solution to improve seismic performance or to change the building functions: structural calculation models and structural calculations to identify their gravitational and seismic actions behavior.</li> </ul> <p><b>Wooden Structural</b></p> <p>Technical survey for an existing wooden structure:</p> <ul style="list-style-type: none"> <li>• Structural surveys;</li> </ul>
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|  | <ul style="list-style-type: none"><li>• Mechanical and biological degradation surveys;</li><li>• Structural models to determine the strength capacities for the existing structure elements;</li><li>• Proposals for structural rehabilitation</li></ul> |
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### 3. Bibliography

1. ATC 40, Seismic Evaluation and Retrofit of Concrete Buildings, Applied Technology Council, 1996.
  2. FEMA 356, Prestandard and Commentary for the Seismic Rehabilitation of Buildings, Federal Emergency Management Agency.
  3. FEMA 440, Improvement of Nonlinear Static Seismic Analysis Procedures, Federal Emergency Management Agency.
  4. EN 1998-3 (2005): Eurocode 8: Design of structures for earthquake resistance – Part 3: Assessment and retrofitting of buildings. The European Union Per Regulation 305/2011, Directive 98/34/EC, Directive 2004/18/EC.
  5. P100-3/ Cod de evaluare si proiectare a lucrarilor de consolidare la cladiri existente, vulnerabile seismic, vol. 1 - Evaluare, vol. 2 – Consolidare
  6. Aguilar, J.A. (1995). Case studies of rehabilitation of existing reinforced concrete buildings in Mexico-City. Master Degree Dissertation, University of Texas, Austin, SUA.  
<http://fsel.engr.utexas.edu/publications/docs/thesis6.pdf>
  7. Rizkalla, S., Hassan, T. (2002). Rehabilitation of concrete structures with FRP. Proceedings of the 3rd International Conference on the Behaviour of Damaged Structures, Rio de Janeiro, Brazil.  
[http://www.ce.ncsu.edu/srizkal/linked\\_files/RehabilitationOfConcreteStructuresWithFRP\\_Brazil-july02.pdf](http://www.ce.ncsu.edu/srizkal/linked_files/RehabilitationOfConcreteStructuresWithFRP_Brazil-july02.pdf)
  8. FEMA 273. (1997). NEHRP guidelines for the seismic rehabilitation of buildings.  
<http://www.wbdg.org/ccb/DHS/ARCHIVES/fema273.pdf>
  9. EN 1998-1 – Eurocode 8: Design of structures for earthquake resistance – Part 1: General rules, seismic actions and rules for buildings
  10. EN 1998-3 – Eurocode 8: Design of structures for earthquake resistance – Part 3: Assessment and retrofitting of buildings
  11. Muir, L. Rehabilitation and retrofit of existing steel buildings.  
<http://www.larrymuir.com/Documents/Existing%20Structures.pdf>
  12. FEMA 273. (1997). NEHRP guidelines for the seismic rehabilitation of buildings.  
<http://www.wbdg.org/ccb/DHS/ARCHIVES/fema273.pdf>
  13. V.Popescu, N. Patrinoche, E Chesaru *Calitatea și siguranța construcțiilor metalice*, Ed.Tehnică, 1986.  
E.Chesaru, D. Preda *Expertizarea și consolidarea construcțiilor metalice*, Ed. Conspres, UTCB, 1998.
- CR6 - Masonry Structures Design Code
- Daniel Stoica - Structural modeling of masonry wall with ETABS program
  - Daniel Stoica – Soil-structure interaction modeling with ETABS program
  - Daniel Stoica – Wooden structure modeling with ETABS or SAP2000 program
  - Daniel Stoica – Courses notes
  - Ehsan Minaie – Vulnerability of reinforced masonry structures in seismic regions
  - Miha Tomazevic – Earthquake resistant design of masonry buildings
  - Narendra Taly – Design of reinforced masonry structures
  - Frederick Putnam Spalding – Masonry structures
  - Thomas Paulay, M.J.Nigel Priestley – Seismic design of reinforced concrete and masonry buildings
  - A.W. Hendry, B.P. Sinha, S.R. Davies – Design of Masonry Structures
  - Paulo José Brandão Barbosa Lourenço - Computational strategies for

	masonry structures - Donald E. Breyer, Kenneth J. Fridley, Kelly E. Cobeen, David G. Pollocj Jr. – Design of wood structures - E.C. Ozelton, J.A. Baird – Timber Designers’s Manual - J. Porteous, A. Kermani – Structural Timber Design to Eurocode 5 - A. Kemany – Structural Timber Design - F. Naeim, J.M. Kelly – Design of Seismic Isolated Structures – From Theory to Practice - FEMA 273. (1997). NEHRP guidelines for the seismic rehabilitation of buildings. <a href="http://www.wbdg.org/ccb/DHS/ARCHIVES/fema273.pdf">http://www.wbdg.org/ccb/DHS/ARCHIVES/fema273.pdf</a> - Bay Area Regional Earthquake Preparedness Project Strengthening wood frame houses for earthquake safety <a href="http://www.johnmartin.com/earthquakes/Eqresid/">http://www.johnmartin.com/earthquakes/Eqresid/</a> - Rashadul I., Inventory of FRP strengthening methods in masonry structures <a href="http://upcommons.upc.edu/pfc/bitstream/2099.1/7901/1/01.pdf">http://upcommons.upc.edu/pfc/bitstream/2099.1/7901/1/01.pdf</a>
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Criteria to be considered for the final mark	Weight of each criterion in the final mark (%)
1. Exam defence (final examination)	50
2. Appreciation during the entirely semester	
2.1 Seminar activity	
2.1 Laboratory activity	
2.2 Project activity (the project has not a distinct final mark)	
3. Periodical examinations	
3.1 Written / oral examination	
3.2 Home works, reports, essays etc.	50
4. Other criteria (to be specified)	
Short description of the final evaluation procedure: Oral exam, ½ regarding theoretical knowledge obtained during the course with questions from the prepared report and ½ a written report on a topic selected by the professor.	

Estimation of the total number of hours per semester requested for the individual study (IS)			
Type of individual activity	No. of hours	Type of individual activity	No. of hours
1. Study of the course notes	10	8. Preparation of the final examination	10
2. Study of the compulsory bibliography		9. Advisory class participation	
3. Study of the supplementary bibliography		10. Practical documentation on site	
4. Preparation of specific activities	10	11. Additional documentation on library	
5. Preparation of home works	12	12. Internet network documentation	
6. Preparation of periodical written examinations		13. Others (to be specified)	
7. Preparation of periodical oral examinations		<b>TOTAL number of hours</b>	<b>42</b>

**Date:**  
Septembrie 2017

**Signature of the Academic Staff member in charge:**  
Viorel POPA  
Stoica Nicolae Daniel  
Șerban DIMA, Ph.D.,  
Ruxandra ERBASU