

## SYLLABUS

### 1. Data about the program of study

1.1	Institution	The Technical University of Cluj-Napoca
1.2	Faculty	Faculty of Civil Engineering
1.3	Department	of Structures
1.4	Field of study	Civil Engineering
1.5	Cycle of study	Master of Science
1.6	Program of study/Qualification	Durable concrete constructions
1.7	Form of education	Full time
1.8	Subject code	5.00

### 2. Data about the subject

2.1	Subject name	Lightweight structures: faades, roofs, canopies									
2.2	Subject area	Load-bearing structures									
2.3	Course responsible/lecturer	Conf. Dr. Ing. Puskas Attila – attila.puskas@dst.utcluj.ro									
2.4	Teachers in charge of seminars	As. Dr. Ing. Toader Traian-Nicu – traian.toader@dst.utcluj.ro									
2.5	Year of study	I	2.6	Semester	1	2.7	Assessment	E	2.8	Subject category	DS/DI

### 3. Estimated total time

3.1	Number of hours per week	2	3.2	of which, course:	1	3.3	applications:	1
3.4	Total hours in the curriculum	28	3.5	of which, course:	14	3.6	applications:	14
Individual study								hours
Manual, lecture material and notes, bibliography								28
Supplementary study in the library, online and in the field								10
Preparation for seminars/laboratory works, homework, reports, portfolios, essays								28
Tutoring								2
Exams and tests								4
Other activities								
3.7	Total hours of individual study			72				
3.8	Total hours per semester			100				
3.9	Number of credit points			4				

### 4. Pre-requisites (where appropriate)

4.1	Curriculum	Not applicable
4.2	Competence	Not applicable

### 5. Requirements (where appropriate)

5.1	For the course	Cluj-Napoca, street Bariiu No 25, (room with videoprojector)
5.2	For the applications	Cluj-Napoca, street Bariiu, No 25, (room with videoprojector)

## 6. Specific competences

Professional competences	<p><b>Theoretical knowledge (What to know):</b></p> <p>To know what are the particularities of "Theory of Lightweight Constructions" and the guiding principles in Werner Sobek's Approach;</p> <p>Distinguish the terminology of "lightweight building materials", "lightweight structures" and "lightweight systems";</p> <p>To know the methods of analysis for lightweight structures;</p> <p>To understand the definition for "tensegrity" and how the advantages of this type of structure can be transferred, adapted and implemented as pragmatic solutions;</p> <p>To know modern, innovative systems for building lightweight constructions.</p> <p><b>Achieved Skills (What He Can Do):</b></p> <p>To determine the stress state for different structural systems loaded with external forces, using analysis methods applicable to lightweight structures;</p> <p>Use data from manufacturers' catalogues dedicated to the production of load-bearing elements and joining solutions for glass panes and cable structures;</p> <p>Apply the constructive measures specific to the design of lightweight structures;</p> <p>Determination of the load-bearing capacity of a lightweight structure.</p> <p><b>Gained skills (What Tools He Can Manage):</b></p> <p>To know the applicability and validity of calculation methods specific to the theory of lightweight constructions;</p> <p>To appreciate when it is appropriate to use lattice elements, cables or reticular systems to obtain a lightweight structure;</p> <p>To be able to use appropriate structural engineering software when designing and / or checking lightweight structures.</p>
Cross competences	<p>Linking the gained knowledge of technology of construction execution with the results of the structural calculations;</p> <p>Application of design standards for metal constructions;</p> <p>Using concepts related to engineering seismology.</p>

## 7. Discipline objectives (as results from the *key competences gained*)

7.1	General objective	Skills in the design of lightweight façades, roofs and canopies.
7.2	Specific objectives	<p>Specific competences in the analysis and conceptual design of:</p> <ul style="list-style-type: none"> <li>- façades with glass panes and lattice structure and / or cables;</li> <li>- Reticulated structure canopies;</li> <li>- Roofs with a tensegrity structure.</li> </ul>

## 8. Contents

8.1. Lecture (syllabus)		Teaching methods	Notes
1	Introduction in the Theory of lightweight structures.	Lecture, worked examples and case studies	Videoprojector and bibliography
2	Cables and tension rods.		

3	Design concepts.		
4	Design methods.		
5	Cable-stayed structures.		
6	Tensegrity structures.		
7	Branched structures.		

#### Bibliography

- 1) Sobek, W.: Entwerfen im Leichtbau. Bauingenieur 70 (1995), 323-329
- 2) Leonhardt, F.: Leichtbau – eine Forderung unserer Zeit. Bautechnik 18 (1940), H. 36/37, 413-423
- 3) Wiedenmann, J.: Leichtbau. Bd. 1+2. Berlin, Heidelberg, New York Springer 1989
- 4) Ashby, M.: Materials Selection In Mechanical Design, Butterworth-Heinemann, 1999
- 5) Motro, René: Tensegrity: structural systems for the future. London: Kogan Page Science, 2003
- 6) Peters, Stefan: Tensional Integrity. Diplomarbeit an der Universität Stuttgart, Institut für Konstruktion und Entwurf II, 1998
- 7) Pugh, Anthony: An introduction to tensegrity. University of California Press, 1976
- 8) Mitteilungen des SFB 230 Heft 4: Verzweigungen
- 9) Application of Structural Morphology to Architecture. IASS-Proceedings 2. Int. Seminar on Structural Morphology, 1994
- 10) Kopenetz, L. și Cătărig A.: Teoria structurilor ușoare cu cabluri și membrane, U.T.Pres, 2006
- 11) Kopenetz, L. și Pârv B. R.: Introducere în teoria structurilor înalte și a structurilor cu deschideri mari, U.T.Pres, 2014
- 12) Toader, T.-N.: Structuri zvelte, Revista AICPS Review, no. 1-2/2016, 138-141, București
- 13) Kopenetz, L.: Probleme de siguranță la structuri zvelte, Revista Construcțiilor, no. 150, 36-40, 2018

8.2. Applications/Seminars		Teaching methods	Notes
1	Design theme. Discussions. Dividing students into teams.	Lecture, Applications	Structural calculation software and bibliography
2	Applying an experimental design method (Experimental Analysis).		
3	Final determination of materials and structural details.		
4	Analysis of the structure using the FEM.		
5	Dimensioning of structural elements.		
6	Dimensioning the structural joints.		
7	Drawing up technical drawings.		

#### Bibliography

- 1) Sobek, Werner: Auf pneumatisch gestützten Schalungen hergestellte Betonschalen. Dissertation 1987
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- (Schriftenreihe des Instituts für Leichte Flächentragwerke)
- 2) IL 5: Wandelbare Dächer
- 3) IL 9: Pneus in Natur und Technik
- 4) IL 12: Wandelbare Pneus
- 5) IL 15: Lufthallenhandbuch
- 6) IL 16: Zelte 1
- 7) IL 19: Wachsende und sich teilende Pneus
- 8) IL 25: Form - Kraft - Masse 3 „Konstruktion“
- \*\*\*
- 9) Leonhardt, F.; Schlaich, J.: Vorgespannte Seilkonstruktionen - Das Olympiadaach in München. Selbstverlag SFB 64; Sonderdruck "Der Stahlbau" 1974

- 10) Noesgen, J.: Vorgespannte Seilnetztragwerke - Zum Tragverhalten des quadratischen Netzes mit starrem Rand. Werner-Verlag, Düsseldorf 1976
- 11) Noesgen, J.: Vorgespannte Seilnetztragwerke - Zum Tragverhalten des quadratischen Netzes mit elastischem Rand. Werner-Verlag, Düsseldorf 1976
- 12) Schriftenreihe des Instituts für Leichte Flächentragwerke (IL): IL8: Netze in Natur und Technik, 1976
- 13) Müller, R. K.; Stiemer, S. F.; Vessolly, L.: Modelltechnik für Seilnetze. Selbstverlag SFB 64, 1976
- 14) Brinkmann, G.: Statische Berechnung von gleichmaschigen Netzen und Membranen auf speziellen Flächen mit Hilfe der Vektoranalysis. Selbstverlag SFB 64, 1977
- 15) Alber, D.; Gabriel, K.: Zugbeanspruchte Stabtragwerke - Systematische Darstellung ihrer Eigenschaften. Werner-Verlag, Düsseldorf 1983
- 16) Wessolly, L.: Vorgespannte Seilnetztragwerke - Zur Sicherheit gegen Weiterreißen. Werner-Verlag, Düsseldorf 1983
- 17) Kopenetz, Ludovic; Prada, Marcela Florina: Introducere în teoria structurilor speciale. Publisher Universităţii din Oradea, Oradea 2011
- 18) Opincariu, Dana: Formă și structură – Metode didactice și de cercetare în arhitectură. U.T.PRESS, Cluj-Napoca 2010

**9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field**

The skills acquired will be required by the employees who will work in the design offices, but also in the building site related activities.

**10. Evaluation**

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	Solving two theoretical topics from course.	Written exam – duration 2,0 hours	50%
10.5 Applications	Evaluation of seminar papers.	Oral exam	50%
10.6 Minimum standard of performance			
Oral examination based on the seminar papers require all problems to be fully solved and a grade of minimum a 5 to pass.			
The written part require to be evaluated with minimum 5 for each topic.			

Date of filling in: dd.mm.yyyy		Title Surname Name	Signature
	Lecturer	Conf. Dr. Ing. PUSKÁS Attila	
	Teachers in charge of application	As. Dr. Ing. TOADER Traian-Nicu	

Date of approval in the department .....

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Head of department of Structures  
Conf.dr.ing. PUSKÁS Attila

Date of approval in the faculty .....

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Dean  
Conf. Dr. Ing. Nicolae CHIRA