# General information:

**Curriculum:** Architect MSc 1., Architect OTM 7.

**Course name: COMPLEX BUILDING CONSTRUCTIONS**

**Course code:** EPM115ANEM

**Semester:** 1

**Credit value:** 6

**Lecture number/week:** Lecture 2 + Labor 3x2

**Evaluation:** midterm grade

## Pre-course: -

**Course Host : Dr. Bálint BARANYAI Ph.D., assistant professor**

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**Lecturers: Dr. Bálint BARANYAI Ph.D., assistant professor**

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## Syllabus

Based on the preliminary mechanical studies the studends getting a general overview about special, complex, unconventional building structures.

Analisys of the following tasks:

* property and application of different structural materials,
* behaviour of different loadbearing structures
* functionality
* geometry related structural benefits

## The aim of the course

The aim of the course giving basic structural knowledge enable students applying the appropriate architectural design methodology through the analisys of unconventional structures of case studies, including different long span structures, shell structures, membrane structures and special structures.

## Content of the course

Detailed introduction and analisys of special, unconventional building structures.

1. **Selection and design the appropriate structure through the analisys of the following tasks**
2. Function
3. Geometry
4. Structure
5. Material
6. **Loads and effects**
7. **Aspects of classification of structures**

1. Stress characteristic and load path

 2. Load bearing method

 3. Geometry

1. **Structure systems**
	* + 1. **Form active systems\_1 - structures without shear stress**

(bending active structures, 2D and 3D cable structures)

* + - 1. **Form active systems\_2 - structures partly without shear stress**

(2D and 3D tent/membrane structures)

* + - 1. **Bulk active systems - structures partly with moment**

(wall structures, 2D and 3D arch structures (arch/vault), horizontal beams, one way slabs, two way slabs)

* + - 1. **Vector active systems - structures with moment**

(trusses, flat space trusses, curved trusses, curved space trusses, space frames)

* + - 1. **Surface active systems - structures without moment**

(plate structures, folded plate structures, shell structures withoutmoment, grid shells, curved shell structures, translational surface, elliptic surface, hiperbolic surface, parabolic surface, conoid)

* + - 1. **Surface active systems**

(highrise structures)

* + - 1. **Special structures**

(reciprocal structures, tensegrity)

## Exams and evaluation

The attendance on the *Lectures* and active participation in *Exercise* is compulsory according to the Education and Exam Rules of the University of Pécs.

*Exercise* attendance can only be verified by the presentation and consultation of the actual task/exercise

The Semester terminates on the 15th academic week.

The course can be accomplished with successful midterm grade gained by the followings:

* submitted design task
* submitted study
* submitted model
* presentation

**1. Study** **20 p**

Presentation of the study: 5th week

Late presentation of the study: 6th week

Submission of the study: 15th week

Late submission or correction

of the final study 16th week

**2. Semester design task** **50 p**

The design task consist of 2 phases:

Presentation of the 1st design phase: 10th. week

Max points to be gained: **25 p**

Late submission or correction

of the 1st presentation: 11th week

Final presentation: 15th week

Max points to be gained: **25 p**

Late submission or correction

of the final presentation: 16th week

Minimum total points to be gained: **25 p**

**3. Model 30 p**

Midterm presentation of the model: 10th. week

Late midterm submission of the model: 11th week

Late submission or correction

of the final model: 16th week

**Acquiring the signiture:**

The minimum requirement for acquiring the signiture and the final grade is to submit all the required tasks.

Any task missing after the last correction deadline will cause the refusal of the signiture hence the final grade.

In accordance with the faculty educatioonal and exam rules for those who would be absent more than 30 % of the lectures and labor occasions will cause the refusal of the signiture hence the final grade.

**Evaluation**

Maximum achievable points: 100 points

1. Study 20 p
2. Semester design task 50 p
3. Model 30 p

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| 85 p – 100 p | 85-100% | A (5, jeles, excellent,sehr gut) |
| 70 p – 84 p | 70-84% | B (4, jó, good, gut) |
| 55 p – 69 p | 55-69% | C (3, közepes, avarage, befriedigend) |
| 40 p – 54 p | 40-54% | D (2, elégséges, satisfactory, genügend) |
| 0 p – 39 p | 0-39% | F (1, elégtelen, fail, ungenügend) |

## Compulsory bibliography

The uploaded lecture presentations

## Recommended bibliography

The Ebtissam Mohamed Farid Moustapha: Theories of Architecture (3)\_week1-week8 <https://issuu.com/ebtissammohamedfarid/docs>

Design works of the following architects and structural engineers for structural inspiration:

* + - Antony Gaudí (Cat) experimental structures (understand the flow of forces)
		- Eduardo Torroja (Esp) concrete shells
		- Pier Luigi Nervi (It) concrete shells
		- Felix Candela (Esp-Mex) concrete shells
		- Vladimir G. Suhov (Rus) hyperboloid
		- Otto Frei (Ger) cable and membrane
		- Heinz Isler (Swiss) concrete shells
		- Fritz Leonhardt (Ger) cable bridge structures
		- Eladio Dieste (Urug) reinvention of the calalan brick shell-vault
		- Stefan Kolchev (Bulg) concrete structures
		- Santiago Calatrava (Esp) nature inspired concrete and steel structures

##  Education methodology

1. **Lectures**: - active student attendance required (question and discuss emerging task related questions)

2. **Exercise**: 2.1 Selection of a case study with unconventional load bearing structure – teamwork (max 3 students)

 2.2 Selection of a design task with unconventional load bearing structure– teamwork (max 3 students)

2.3 Building a model of the chosen design task– teamwork (max 3 students)

 - Evaluation of the geometry and the load bearing method

- Consultation, discussion in groups

 - Experimental group work in groups

- Presentations: evaluation of the chosen tasks and the case study.

3. Individual work at home

The Exercise work attempt to represent the real design process – complex and simultaneous evaluation of the function-structure-geometry principle of the design task, while deepening the academic aspects of the university education – researh and analisys

The Exercise work also promotes experiencing the benefits of teamwork.

The Presentations help to explore the questions and present the evaluation process and results of the chosen design task.

## Tasks and requirements

1. **Study**

Selection of a case study building with unconventional geometry and structure - teamwork (max 3 students)

Deatailed analisys and evaluation of the load bearing method via the following properties of the load bearing structure: material + structure + function + geometry

 - Individual research in groups

- Consultation, discussion in groups

 - Experimental group work in groups

- Presentation: evaluation of the geometry, load bearing and structural system of the chosen case study.

 Volume: min 10 pages

 Format: PDF

##  *For submission schedule see Exams and evaluation*

1. **Semester design task and the aim of it.**

Designing a small-medium scale building onto one of the given site and program - teamwork (max 3 students)

Widening the knowledge gained in the previous semesters. Beside getting familiar with the functional requirements of the chosen task, developing the capability of the students on the fields of theory of architectural and structural design. While considering siting, layout and geometry implementing structural aspects into the architectural design procedure. Creating the ability for complex problem identification, analisys and strategic design program proposal.

**2.1 Design of a Hangar for small sport planes at the airport of Pécs-Pogány**

Hangar for 2-3 small sport airplanes. Lecture and simulation room for trainings for people interested in aviation. Should align with the existing infrastucture of the airport. Room for basic maintenance and service of the planes.

Basic functions: hangar, lecture room for training, simulation room, storage, maintenance room, room for building services, social block, kitchenette, etc….

**2.2. Covering the open air pool of „Pollack Strand” – usability for 4 seasons**

The pool and its services are operating only in simmer seson. Because its periodic operation it is almost cannot be used by the students of the faculty.

The case is to design a space around the existing pool to create a swimming area which could be used all over the year considering the existing site situation.

Basic functions: heatable pool space, foyer, cassa, office, kitchenette for the staff, changing rooms or cabinets, social block, storage, buffet, room for building services, emergency room, etc….

**2.3. Design of a dedicated building for Butterflies/Giraffes/Elephants/etc in ZOO** **Pécs**

A new building for large wild animals inserting it into the site of the ZOO Pécs, considering the existing site situation.

Basic functions: heatable space for the animals (for sleeping and for some basic movement during winter time),

storage for food supply, social block for the caretaker, room for building services, etc

**2.4 Design of a Palm house (Greenhouse) for the Botanic garden of the University of Pécs**

The greenhouses of the Botanic garden of the University are mainly in bad condition despite of some recent improvements.

The theorethical case is to design a brand new optimal geenhouse in the place of the existing ones for the protected greenery accomodated in those.

Basic functions: heatable space for the greenary, storage for supply, social block for the caretaker, room for building services, etc

**General requirements for all of the design tasks:**

To design a building with an unconventional geometry and structure. The students should optimize the use of the proper system for the actual case. Parameric or biomimetic solutions also can be applied.

*The design task consist of 2 phases:*

1st phase: conceptual design – function and geometry.

2nd phase: selection of the structure and material, final plans

*Content of the design task:*

- Site plan M=1:1000

- Floor plan(s) M=1:100

- Sections (min 2) M=1:100

- Structural details (min 4) M=1:50

- Facades M=1:100

- 3D renderings

 Format: PDF

## *For submission schedule see Exams and evaluation*

1. **Model**

To build a model of the designed building - teamwork (max 3 students)

The case is to attract the geometry and the structural system

##  *For submission schedule see Exams and evaluation*

# **Detailed program of the semester**

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| **1st week** | Tuesday 09.30-11.00 | Wednesday 7.45-9.15.+13.15-14.45+Thursday 13.15-14.45 |
|  | Lecture | Exercise |
| Methodology | presentation | consultation and individual/teamwork |
| 9-10-11 September | Introduction  | Introduction of the semester tasks: Study, Design task and Model  |

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| **2nd week** | Tuesday 09.30-11.00 | Wednesday 7.45-9.15.+13.15-14.45+Thursday 13.15-14.45 |
|  | Lecture | Exercise |
| Methodology | presentation | consultation and individual/teamwork |
| 13-14-15 September | Form active systems\_1 | Consultation of the Design task **and Study** |

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| **3rd week** | Tuesday 09.30-11.00 | Wednesday 7.45-9.15.+13.15-14.45+Thursday 13.15-14.45 |
|  | Lecture | Exercise |
| Methodology | presentation | consultation and individual/teamwork |
| 20-21-22 September | Form active systems\_2 | Consultation of the Design task **and Study** |

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| **4th week** | Tuesday 09.30-11.00 | Wednesday 7.45-9.15.+13.15-14.45+Thursday 13.15-14.45 |
|  | Lecture | Exercise |
| Methodology | presentation | consultation and individual/teamwork |
| 27-28-29 September | Bulk active systems\_1 | Consultation of the Design task **and Study** |

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| **5th week** | Tuesday 09.30-11.00 | Wednesday 7.45-9.15.+13.15-14.45+Thursday 13.15-14.45 |
|  | Lecture | Exercise |
| Methodology | presentation | consultation and individual/teamwork |
| 4-5-6October | Bulk active systems\_2 | **Presentation of the study,** Consultation of the Design task  |

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| **6th week** | Tuesday 09.30-11.00 | Wednesday 7.45-9.15.+13.15-14.45+Thursday 13.15-14.45 |
|  | Előadás | Exercise |
| Methodology | presentation | consultation and individual/teamwork |
| 11-12-13October | Vector active systems\_1 | Late Presentation or correction of the study Consultation of the Design task  |

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| **7th week** | Tuesday 09.30-11.00 | Wednesday 7.45-9.15.+13.15-14.45+Thursday 13.15-14.45 |
|  | Lecture | Exercise |
| Methodology | presentation | consultation and individual/teamwork |
| 18-19-20October | Vector active systems\_2 | Consultation of the Design task  |

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| **8th week** | Tuesday 09.30-11.00 | Wednesday 7.45-9.15.+13.15-14.45+Thursday 13.15-14.45 |
|  | Lecture | Exercise |
| Methodology | presentation | consultation and individual/teamwork |
| 25-26-27October | Surface active systems\_1 | Consultation of the Design task  |

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| **9th week** | Tuesday 09.30-11.00 | Wednesday 7.45-9.15.+13.15-14.45+Thursday 13.15-14.45 |
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|  | AUTUMN HOLIDAY | AUTUMN HOLIDAY |
| Október 31. |   |  |

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| **10th week** | Tuesday 09.30-11.00 | Wednesday 7.45-9.15.+13.15-14.45+Thursday 13.15-14.45 |
|  | Lecture | Exercise |
| Methodology | presentation | **Midterm Presentation** |
| 8-9-10 November | Surface active systems\_2 | Presentation of the 1st Design phase, preliminary Model |

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| **11th week** | Tuesday 09.30-11.00 | Wednesday 7.45-9.15.+13.15-14.45+Thursday 13.15-14.45 |
|  | Lecture | Exercise |
| Methodology | presentation | consultation and individual/teamwork |
| 15-16-17 November | Surface active systems\_3 | Late Presentation or correction of the 1st Design phase, preliminary Model, Consultation of the Design task  |

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| **12th week** | Tuesday 09.30-11.00 | Wednesday 7.45-9.15.+13.15-14.45+Thursday 13.15-14.45 |
|  | Lecture | Exercise |
| Methodology | presentation | consultation and individual/teamwork |
| 22-23-24 November | Special structures | Consultation of the Design task  |

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| **13th week** | Tuesday 09.30-11.00 | Wednesday 7.45-9.15.+13.15-14.45+Thursday 13.15-14.45 |
|  | Lecture | Exercise |
| Methodology | presentation | consultation and individual/teamwork |
| 29-30-1 November/Dec | Special structures | Consultation of the Design task  |

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| **14th week** | Tuesday 09.30-11.00 | Wednesday 7.45-9.15.+13.15-14.45+Thursday 13.15-14.45 |
|  | Lecture | Exercise |
| Methodology | presentation | consultation and individual/teamwork |
| 6-7-8December | Special structures | Consultation of the Design task  |

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| **15th week** | Tuesday 09.30-11.00 | Wednesday 7.45-9.15.+13.15-14.45+Thursday 13.15-14.45 |
|  | Lecture | Exercise |
| Methodology | presentation | **Final Presentation, final submission** |
| 13-14-15December | SUMMARY | Final submission of the final Study / Final Presentation / Model |

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|  | **1st week of exam period** |
| **16th week** | Tuesday 09.30-11.00 |
|  | Late submission or correction |
| Metodika |  -  |
| December 19. | Late submission or correction of the final Study / Presentation / Model |

We keep the right of the changes (date/place/time) which will be announced in every case in advance. All the questions regarding the course can be addressed to Dr Bálint Baranyai.

Dr. Bálint Baranyai

course host

Pécs, 31. 08. 2022.