GHENT UNIVERSITY

Course Specifications

From the academic year 2017-2018 up to and including the

Spatial Structures (E061502)

Course size (nominal values; actual values may depend on programme)

Credits	6.0	Study time	180 h	Contact hrs	60.0 h

Course offerings and teaching methods in academic year 2018-2019

A (semester 1)	English	seminar: coached exercises	30.0 h
		lecture	30.0 h

Lecturers in academic year 2018-2019

Belis, Jan	TW14	lecturer-in-charge

Offered in the following programmes in 2018-2019	crdts	offering
Master of Science in Engineering: Architecture (main subject Architectural Design and Construction Techniques)	6	A
Master of Science in Engineering: Architecture (main subject Urban Design and Architecture)	6	A
Master of Science in Civil Engineering	6	A
Exchange Programme Architecture	6	A

Teaching languages

English

Keywords

space trusses, shells, shell structures, folded plates, cable nets, prestressed membranes, pneumatic structures, formfinding, erection methods

Position of the course

'Spatial Structures' is lectured in the second Master of Structural Engineering: Major Construction Design.
With the present course we wish to focus on the actual trend that more and more civil engineering realisations manifest themselves in the domain of spatial structures. Insights into the response and form definition of a number of important types of spatial structures that collect and transfer loads in a specific manner to the foundation, are gained. However, our main concern is not to outline how a precise analysis of the play of forces in such structures should be done. Quite to the contrary, we shall often content ourselves with presenting simplified but nevertheless acceptable methods of analysis design in order to gain the necessary insights into the structural behaviour. Complex and highly sophisticated software tools such as ABAQUS and EASY for instance, which are based upon finite element methods or typically devised for the analysis of cable nets and membrane structures respectively, are only used as instruments of demonstration and to validate the simplified methods.
The course aims to contribute to advanced knowledge of civil engineering structures (MaB.1.1, MaB.1.2, MaB.1.3, MaB.1.5, MaB.1.6, MaB.1.7) and to scientific (MaB.2.2, MaB.2.3), intellectual (MaB.3.2) and co-operative comptence (MaB.4.1, MaB.4.2) of graduating Masters of Civil Engineering.

Contents

- Introduction: Definition and aims
- Polyhedra and other basic spatial volumes: definition, properties
- Space frames: Space trusses, Reticulated membrane networks, Case studies
- Shells and shell structures: Introduction and definitions, Membrane theory of equilibrium, Instability of thin-walled shells, Case studies
- Folded plates: Theory, Design example
- Cable nets, suspended roofs and lightweight membrane structures.: Generalities, The single cable, Cable beams and cable trusses, Guyed wide-span roof structures,

Cable nets and prestressed membranes, Case studies
- Data generation and design: The force-density method
- Methods of erection: Realisation of large spans and of modern space structures
- Special topics (specific subject may vary): e.g. Tensegrity structures, Pneumatic structures, Retractable roof structures
- Project: Description of the assignment

Initial competences

Structural Analysis I, Structural Analysis II, Finite Element Method for Civil Engineers, Reinforced and Prestressed Concrete, (Analysis of) metallic structures.

Final competences

1 Understand the behaviour, formfinding, design and erection methods of spatial structures.
2 Analyse and design spatial structures using simplified methods.
3 Use three-dimensional thinking with respect to structural design and analysis.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Lecture, seminar: coached exercises

Extra information on the teaching methods

Classroom lectures; Projects

Learning materials and price

Syllabus (ca. 15 EUR). Softwarepackages ABAQUS and Easy are available through Athena.

References

- International Journal of Space Strucures on CD-Rom, Multi Science Publishing Ltd, Brentwood, Essex, CM15 9TB, United Kingdom.
- Journal of the International Association for shell and spatial structures, IASS,Madrid, Spain, ISSN:0304-3662, available for consultation at the Laboratory for Research on Structural Models (EA14).
- Barnes M., Dickson M., Widespan Roof Structures, Thomas Telford Publishing Ltd, London, 2000.
- Z.S. Makowski , Space Frames and Trusses, in Constructional Steel Design - an International Guide (eds. P.J. Dowling, J.E. Harding, R. Bjorhovde), Elsevier Applied Science, London, 1992.

Course content-related study coaching

Teaching staff is available just before and after classes. Individual appointments possible.

Evaluation methods

end-of-term evaluation and continuous assessment

Examination methods in case of periodic evaluation during the first examination period

Written examination, open book examination

Examination methods in case of periodic evaluation during the second examination period

Open book examination

Examination methods in case of permanent evaluation

Assignment, report

Possibilities of retake in case of permanent evaluation

examination during the second examination period is not possible

Extra information on the examination methods

During examination period: written open-book exam; written open-book exam - problems. During semester: graded project reports; graded oral presentation..

Calculation of the examination mark

The final score is determined by the following components and weight factors: assignment 50%, examination 50%. In case for one or more components a score of less than 10/20 is obtained, the student cannot pass for this course. The final score is then the minimum of 9/20 and the weighted result as mentioned above.