

Non-linear and Plastic Methods of Structural Analysis (E044571)

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

Credits	3.0	Study time	90 h	Contact hrs	30.0 h
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Course offerings and teaching methods in academic year 2018-2019

A (semester 1)	English	lecture	15.0 h
		seminar	15.0 h

Lecturers in academic year 2018-2019

Caspeele, Robby	TW14	lecturer-in-charge
Wan-Wendner, Roman	TW14	co-lecturer

Offered in the following programmes in 2018-2019

Master of Science in Civil Engineering	crdts	offering
	3	A

Teaching languages

English

Keywords

limit analysis, non-linear analysis, plastic analysis, steel structures, concrete structures

Position of the course

The aim of this course is to make the students acquainted with the fundamental principles and the basic applications of non-linear and plastic methods of structural analysis for steel and concrete structures. Based on previous design courses, more advanced analysis and design methods are treated in this course.

Contents

- Basic principles of limit analysis and the application to steel structures: stepwise calculation, Principles of the plastic analysis, Methods for the determination of the ultimate load or the necessary plastic moment, Deformations
- Concrete structures: Non-linear analysis of concrete structures, Yield line theory for concrete slabs, Strip method for the analysis of concrete slabs.

Initial competences

Theory of Elasticity and Plasticity, Strength of Materials, Structural Analysis I, II and III; Reinforced and Prestressed Concrete I and II

Final competences

- 1 Have insight in the basic principles of limit analysis. Demonstrate the differences with a linear elastic analysis.
- 2 Explain the notions: plastic hinge, collapse mechanism, safe and statically admissible distribution of bending moments, kinematically possible mechanism, the real collapse mechanism.
- 3 Perform a step by step calculation of the collapse load with estimation of the deflections just prior to collapse.
- 4 Direct calculation of the ultimate load of simple continuous beams and frames.
- 5 Elucidate the basic principles of moment redistribution in continuous reinforced concrete beams. Substantiate the influence on the reinforcement distribution.
- 6 Assess the factors which influence the plastic rotation capacity of reinforced concrete sections. Derive simplified ductility conditions.
- 7 Apply a limited moment redistribution with check of the ductility conditions on practical cases.
- 8 Demonstrate the basic principles of the yield line theory. Derive kinematically admissible yield line patterns for isotropic and orthotropic slabs.
- 9 Select and justify possible load transfer patterns based on the strip method.

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

Extra information on the teaching methods

The theory is taught during lecture sessions.

The seminars consist of coached exercises

Learning materials and price

English lecture notes (about 15 Euro)

References

- D. Vandepitte, "Berekening van constructies", Deel III-1982, Wetenschappelijke uitgeverij E. Story-Scientia
- R. Park, W. Gamble, "Reinforced Concrete Slabs", John Wiley and Sons, 2000
- M.P. Nielsen, "Limit analysis and concrete plasticity", CRC Press, 1999
- Eurocode 2: Design of concrete structures - Part 1-1: general rules and rules for buildings (EN 1992-1-1), CEN, Brussels
- fib Model Code 2010, Volumes 1 & 2, fib Bulletins, fib Bulletins, 65 and 66, fib, Lausanne

Course content-related study coaching

Coaching by the lecturers. Contacts possible during or after the lectures and problem solving sessions or via electronic appointment and e-mail;

Evaluation methods

end-of-term evaluation

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

Open book examination, oral examination

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

Open book examination, oral examination

Examination methods in case of permanent evaluation

Possibilities of retake in case of permanent evaluation

not applicable

Extra information on the examination methods

End-of-term assessment:

1. Written exam open book (steel and concrete structures)

2. Written exam closed book including oral explanation (concrete structures)

Calculation of the examination mark

part on steel structures: 50%

part on concrete structures: 50%