Advanced Structural Concrete

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Advanced Structural Concrete

Objectives and content of the lecture

The lecture Advanced Stuctural Concrete is an mandatory part of the specialisation in construction in the Master's programme Civil Engineering at the ETH Zurich.

The lecture builds on the basic knowledge of reinforced and prestressed structures, slabs and membrane elements taught in the course Stahlbeton (lectures and exercises Stahlbeton I and Stahlbeton II) in the bachelor's degree.

Overarching learning objectives

Within this course, the students are able to:

- deepen their understanding of structural concrete models and apply them to general design problems, including the assessment of existing structures.
- enhance their knowledge about the load-deformation response of reinforced and prestressed concrete structures.
- identify and assess the limits of applicability of limit analysis methods.
- recognise the assumptions of models suitable for computer-aided structural design and use in a critical way structural concrete design software.
- evaluate the long-term behaviour and the behaviour under fire conditions of concrete structures.
- assess the behaviour of fibre reinforced concrete structures.

The knowledge acquired in the Bachelor's programme is enhanced and expanded. The focus lies on the understanding of the load-bearing and deformation behaviour, as it is required in particular for the correct assessment of the structural safety of existing structures (see Introduction).

Basics / additional documents

[1] Kaufmann, W., *Stahlbeton I/II*, Lecture notes, ETH Zurich, 2016/17
(Basics of the lecture) → available online

[2] Marti, P., *Theory of Structures*, Wilhelm Ernst & Sohn, Berlin, 2011

[3] Swiss society of engineers and architects (SIA), standards:
- SIA 262 *Concrete Structures*, Zürich, 2003 (Partial rev. 2013)
- SIA 260 *Basis of Structural Design*, 2003 (Partial rev. 2013)
- SIA 261 *Actions on Structures*, 2003 (Partial rev. 2014)

[4] Marti, P., Alvarez, M., Kaufmann, W., Sigrist, V., *Tragverhalten von Stahlbeton*, IBK, ETH Zurich, 1999 → available online

[5] Muttoni, A., Schwartz, J., Thürlimann, B., "Design of Concrete Structures with Stress Fields“, Birkhäuser, Basel, 1997

[6] Marti, P., *Stahlbeton I/II*, Lecture notes, ETH Zurich, 2009/10 → available online

[7] Nielsen, M.P., Hoang, L.C., “Limit Analysis and Concrete Plasticity”, CRC Press, 2010

[8] Kaufmann W., Mata-Falcón J., Weber M., Galkovski T., Tran D.T., Kabelac J., Konecny, M. et al., *Compatible Stress Field Design of Structural Concrete: Principles and Validation*, ISBN 978-3-906916-95-8, ETH Zurich & IDEA StatiCa, 2020.
→ available as an E-Book and at the ETH Store

[9] fib Bulletin 100, “Design and assessment with strut-and-tie models and stress fields: from simple calculations to detailed numerical analysis”, 2021

→ Technical terms and designations shall be used in accordance with SIA 262 (Clause 1).

→ Translation and calculation aids → available online

The content of the lecture is mostly independent of standards. The expressions and nomenclature are basically according to the Swiss codes (structural standards of the SIA); they are mostly compatible with the Eurocodes.

The exercises are based on the Swiss codes, which were introduced in the course Stahlbeton in the bachelor's degree.

Additional literature

Kaufmann W., Mata-Falcón J., Weber M., Galkovski T., Tran D.T., Kabelac J., Konecny, M. et al., *Compatible Stress Field Design of Structural Concrete: Principles and Validation*, ISBN 978-3-906916-95-8, ETH Zurich & IDEA StatiCa, 2020.

- Paper copy available at ETH Store
  85 CHF regular price / 25 CHF student price
- E-Book available at https://payhip.com/b/DP6N
  60 € regular price / 18 € student price
  70% student discount voucher by request

Content

The content of chapters 2, 4 is based on the training course for civil engineers "Tragverhalten von Stahlbeton" held at ETH Zurich in 1999, supplemented by findings from more recent work, particularly in the field of deformation capacity and computer-aided structural design.

Chapter 3 is based on the section "Long-term effects" of the lecture "Stahlbeton III" held by Prof. Menn until 1993.

Organisation Advanced Structural Concrete

Lecture

- Thursday, 09:45-11:30, HIL E 7. No streaming available
  Detailed semester program and lecture materials available online at http://www.concrete.ethz.ch/asc

Exercises

- Enhancement of the understanding of the topics discussed in the lecture
- Introduction to the exercises in the lecture: 12.10., 26.10., 30.11., 14.12.
- Submission optional, questions can be discussed during the consultation hours

Consultation hours

- Every Tuesday, 13:00 – 14:00, HIL E10.3
- Assistant: Karin Yu
- For questions concerning the lecture or exercises, sign-up via karin.yu@ibk.baug,ethz.ch

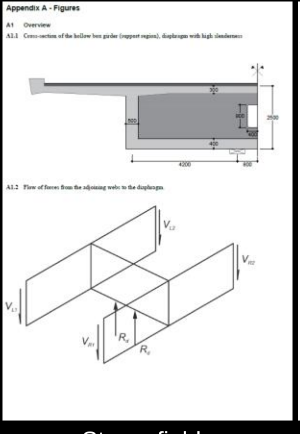
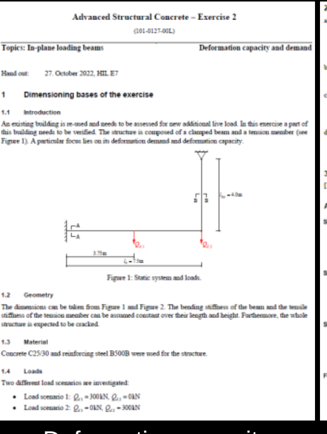
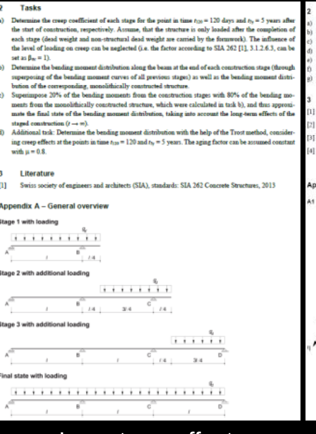
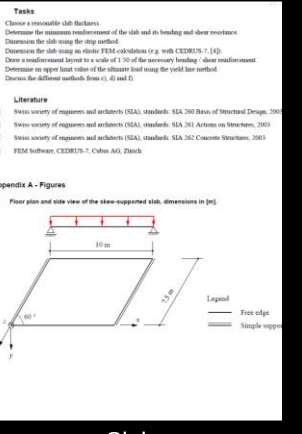
Workshop “Compatible Stress Fields” (optional)

- Tuesday, 21.11., 16:00 – 18:00, in-person, room to be announced
- More information will follow

Exam

- 18’ task preparation, followed by 18’ oral examination (9’ task presentation + 9’ additional questions), language: English

Exercises

Exercise 1	Exercise 2	Exercise 3	Exercise 4
			
Stress fields	Deformation capacity	Long term effects	Slabs