Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Dr. Jaime Mata Falcón
Lukas Gebhard
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Institute of Structural Engineering
D-BAUG, Master Civil Engineering
Autumn Semester 2022

Advanced Structural Concrete

(101-0127-00L)

Felsenau bridge (C. Menn, 1975), O. Monsch

Content:
- In-plane loading: (i) walls and beams (stress fields, compatibility and deformation capacity); (ii) membrane elements (yield conditions, compatibility and deformation capacity).
- Slabs (Equilibrium solutions, yield conditions, shear and punching shear)
- Numerical modelling (in-plane loading and slabs).
- Other topics (Long-term behaviour, fire behaviour, fibre reinforced concrete).

Learning objectives:
- Deepen the understanding of structural concrete models and apply them to general design problems including existing structures.
- Enhance the knowledge about the load-deformation response of reinforced and prestressed concrete structures.
- Evaluate the long-term behaviour and the behaviour under fire conditions.

Lecture: Thursday, 09:45 – 11:30, HIL E 7
Start: Thursday, 22. September 2022

Exercises: The exercises refer to the material covered in the lectures and serve to enhance the understanding of the discussed topics. It is recommended to solve them independently and continuously. Questions can be discussed with the assistant during the consultation hours. The exercises can be found on the teaching website (http://concrete.ethz.ch/asc/).

Consultation hour: Tuesday, 13:00 – 14:00, HIL E 10.3
Start: Monday, 03. October 2022, sign-up: karin.yu@ibk.baug.ethz.ch

Assistant: Karin Yu, HIL E 42.1

Literature:
[1] Lecture notes W. Kaufmann, SB I-II (http://concrete.ethz.ch/)
[2] Marti, P., “Theory of Structures” , Ernst & Sohn / Wiley, 2012
[3] Structural design norms SIA 260/261/262
[4] “Tragverhalten von Stahlbeton”, vdf Hochschulverlag, 1999.
[5] “Design of Concrete Structures with Stress Fields”, Birkhäuser, 1997
[6] Nielsen, M.P., Hoang, L.C., “Limit Analysis and Concrete Plasticity”, CRC Press, 2010.
[7] Lecture notes P. Marti, SB I-II (kaufmann.ibk.ethz.ch/education/bachelor/archiv/)
[8] Kaufmann W. et al., “Compatible Stress Field Design of Structural Concrete: Principles and Validation“, ETH Zurich & IDEA StatiCa, 2020.
[9] Lecture notes W. Kaufmann & J. Mata-Falcón, ASC (http://concrete.ethz.ch/asc/)

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Date	**Time**	**Lecture (HIL E 7)**	**Exercises (Submission optional)**
22.09.22	10-12	**Introduction** **In-plane loading: walls & beams** – Stress fields	
29.09.22	10-12	**In-plane loading: walls & beams** – Stress fields	
06.10.22	10-12	**In-plane loading: walls & beams** – Stress fields	
13.10.22	10-12	**In-plane loading: walls & beams** – Stress fields with prestressing	Introduction Exercise 1
20.10.22	10-12	**In-plane loading: walls & beams** – Compatibility and deformation capacity	
27.10.22	10-12	**In-plane loading: membrane elements** – Equilibrium, yield conditions	Introduction Exercise 2
03.11.22	10-12	**In-plane loading: membrane elements** – Compatibility and deformation capacity	
10.11.22	10-12	**In-plane loading:** Numerical modelling	
17.11.22	10-12	**Long term effects** – Basics	
17.11.22	*16-18*	***Workshop "Compatible Stress Fields"*** *(optional)*	
24.11.22	10-12	**Long term effects** – Application	Introduction Exercise 3
01.12.22	10-12	**Slabs** – Equilibrium, yield conditions	
08.12.22	10-12	**Slabs** – Shear and punching shear, Numerical modelling	Introduction Exercise 4
15.12.22	10-12	**Steel fibre reinforced concrete**	
22.12.22	10-12	**Fire behaviour**	