Bridge Design

Prof. Dr. W. Kaufmann
Spring Semester 2022
Bridge Design

Objectives, Content and Organisation
Learning Objectives

After successful completion of this course, the student should be able to:

• Define the main bridge design parameters and identify constraints and boundary conditions
• Explain the structural behaviour and peculiarities of today’s most important bridge typologies
• Explain the main elements of bridges and their structural behaviour
• Define the relevant actions on bridges
• Dimension a standard bridge (pre-dimensioning by hand; dimensioning using computer-aided tools)
• Explain the most relevant bridge construction and erection methods
• Select an appropriate typology and conceive a convincing bridge for a site with its specific boundary conditions
• Name the most eminent bridge designers and their relevant works
Study and Reference Material

Primary Material:

    (Basics of the lecture) → available online: concrete.ethz.ch


[3] Swiss society of engineers and architects (SIA), standards 260-267, 269, with emphasis on:
    - SIA 261 *Actions on Structures*, 2003 (Partial rev. 2014)
    - SIA 262 *Concrete Structures*, 2003 (Partial rev. 2013)
    - SIA 263 *Steel Structures*, 2003 (Partial rev. 2013)
    - SIA 264 *Steel-Concrete Composite Structures*, 2003 (Partial rev. 2014)

[4] Eurocodes, EN 1990-1999, with emphasis on:
    - EN 1990:2002 *Basis of Structural Design*
    - EN 1993-2:2006 *Design of steel structures - Part 2: Steel bridges*
Supplementary References:

[11] North American Codes and Standards:
    - AASHTO LRFD Bridge Design Specifications
    - CSA S6 – Canadian Highway Bridge Design Code

*Reading assignments will be provided throughout the semester to supplement the lecture notes*
Content

1. Introduction

2. Conceptual Design

3. Superstructure / Girder Bridges
   - Bridge Deck
   - Bridge Girder
   - Structural Efficiency
   - Modelling
     … Overview (Warping vs. Uniform Torsion)
     … Spine Model
     … Grillage Model
     … Slab Model
   - Design and Erection

4. Support and Artication

5. Substructure
   - Abutments
   - Piers
   - Foundations

6. Arch Bridges

7. Frame Bridges

8. Special Girder Bridges
   - Cantilever-Constructed Girder Bridges
   - Truss Bridges
   - Skew Bridges
   - Curved Bridges

9. Cable-supported Bridges

Lectures will be supplemented with Guest Lectures & Flipped Classrooms
Lectures
- **Tuesday & Wednesday, HIL E 3, 11:45-13:30** [Online: https://video.ethz.ch/]
- Detailed semester program and lecture materials available online at https://concrete.ethz.ch/brd/

Exercises & Flipped Classroom
- Enhancement of the understanding of the topics discussed in the lecture
- Submission/participation optional, questions can be discussed during the consultation hours

Consultation hours
- HIL E 41.2 or online (Zoom) by appointment
- HIL E 41.2, Assistants: Dr. Alejandro Giraldo Soto & George Klonaris
- For questions concerning the lecture or the exercises

Exam
- Written, 180 minutes, English language
- Part 1 (Conceptual Design): 60 minutes; Part 2: 120 minutes
Prerequisites

The course is part of the MSc specialisation in structures and requires solid knowledge in structural analysis and design. Students are assumed to be proficient in the material taught in the following courses offered in the BSc in Civil Engineering at ETH Zurich (or have acquired equivalent knowledge elsewhere):

- Theory of structures I+II
- Steel structures I+II (incl. steel-concrete *composite* structures)
- Structural Concrete I+II (incl. *prestressed* concrete)

The *flipped classroom* exercises are preparing the students for Part 1 of the exam (conceptual design). Active participation is highly recommended to all students who have not conceived a bridge.