**Construction Materials**

**Code:** MK3EPA1S6SX17EN

**ECTS Credit Points:** 6 credits

**Evaluation:** exam

**Year, Semester:** 2nd year, 3rd semester

**Its prerequisite(s):** Civil engineering orientation

**Further courses are built on it:** Yes

**Number of teaching hours/week**

Lecture: 4

Practice: 2

**Topics**:

The lectures are focused on the material properties of construction materials. It reviews the manufacturing and the requirements of different construction materials and those components. Basic topics are the following: Design of aggregate and normal concrete (concrete recipes). New concrete technologies (SFRC, SCC, HSC). Recycling of concrete. Steel. Load bearing glasses. Ceramics. Plastics. Wooden materials, etc. The presentations are connected with laboratory tests of construction materials. Glass as building material (types of glasses and properties of different glass types, mechanical and physical properties of glass, introduction in possibilities of creating load bearing glasses.). Wooden materials in building industry, mechanical and hydro-technical properties (laboratory testing of wood, effect of fiber direction on properties of wood, force-deflection diagrams, determination of Young’s modulus etc.). Steel in engineering applications. Mechanical properties of hot and cold formed steels. Stress-strain diagrams. Effect of carbon content on forming and welding of steel. Laboratory tensile testing of steel (reinforcement). Hardness of steel. Effect of temperature on the external work of steel (Charpy-hammer tests). Alloys. Plastics in engineering applications. Organic binder materials (bituminous materials). Ceramic. History of ceramics. Strength and durability of ceramic materials. Laboratory compression tests of bricks.

**Literature:**

*Compulsory:*

1. Stephen Timoshenko (1955): Strength of Materials: Elementary Theory and Problems, Van Nostrand
2. Hegger M., Auch-Schwelk V., Fuchs M., Rosenkranz T. (2006): Construction Materials Manual, Birkhäuser Edition Detail, ISBN 3-7643-7570-1
3. Kind-Barkauskas, Kauhsen, Polonyi, Brandt. (2002): Concrete Construction Materials Manual, Birkhäuser Edition Detail, ISBN 3-7643-6724-5

*Recommended:*

1. Pankhardt, K. (2012): Load bearing glasses, LAP Lambert Academic Publishing, ISBN 978-3-8473-2191-0
2. Schulitz, Sobek, Habermann W.: Steel Construction Manual, ISBN 3-7643-6168-6, Birkhäuser Publishers, Basel, (2000)
3. Herzog T., Natterer J., Schweizer R., Volz M. , Winter W. (2004): Timber Construction Manual, Birkhäuser Edition Detail, ISBN 3-7643-7025-4
4. Pfeifer G., Ramcke R., Achtziger J. et. al. (2001): Masonry Construction Manual, Birkhäuser Basel, ISBN: 978-3-7643-6543-1
5. Hegger M., Auch-Schwelk V., Fuchs M., Rosenkranz T. (2006): Construction Materials Manual, Birkhäuser Edition Detail, ISBN 3-7643-7570-1
6. Schultz H. C., Sobek, W., Haberman K.J. (2000): Steel Construction Manual, Birkhäuser Publishers, ISBN 3-7643-6181-5
7. Herzog T., Natterer J., Schweizer R., Volz M. , Winter W. (2004): Timber Construction Manual, Birkhäuser Edition Detail, ISBN 3-7643-7025-4
8. Schittich, C., Staib, G., Balkow, D., Schuler, M., Sobek, W. (1999): Glass Construction Manual, Birkhäuser Publishers, Basel, ISBN 3-7643-6077-1
9. Knippers J., Cremers J., Gabler M., Lienhard J., (2012): Plastic and Membranes Construction Manual, Birkhäuser Architecture, ISBN: 978-3-0346-0726-1

**Schedule**

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| **1st week Registration week** | |
| **2nd week:**  **Lecture:** Basic definitions. History of construction materials. Development of construction materials. Grouping of construction materials. Rheology of materials. Idealisation diagrams.  **Practice:** Weight, density of solid and liquid type materials. Discussing the homework topics. | **3rd week:**  **Lecture:** Aggregates. Sieve curve. Sieve curve design. Inorganic binder materials.  **Practice:** Aggregates. Sieve curve design. Curing of binder materials |
| **4th week:**  **Lecture:** Modifiers. Concrete mix-design. Properties of fresh concrete.  **Practice:** Consistency of fresh concrete | **5th week:**  **Lecture:** Hardened concrete properties, Durability of concrete.  **Practice:** Determination of compressive strength of concrete with laboratory measurements with classification. |
| **6th week:**  **Lecture:** Mortars. Classification of mortals. Masonry. Plasters. Bedding and covering mortals. Surface and wall-forming mortals. Waterproof cement mortar. Special-purpose mortals. Special concrete. (Mass concrete, fiber, recycled, lightweight concrete, self-compacting, high strength, looking ...)  **Practice:** Special concrete (four kinds of mix / break). Distribute of homework: small expertise: The use of construction materials through good and bad examples shown. | **7th week:**  Study trip |
| **8th week: 1st drawing week / 1st test** |  |
| **9th week:**  **Lecture:** Wooden materials in building industry, mechanical and hydro-technical properties  **Practice:** Effect of fibre direction on properties of wood, force-deflection diagrams, determination of Young’s modulus etc. | **10th week:**  **Lecture:** Plastics. The properties of plastics. The use of special plastics. Composites, for example glass-fiber reinforced plastic, tarpaulins.  **Practice:** PVC, PE, PP, fire resistance, chemical resistance. Presentation of composite, fiber-reinforced plastics, such as glass, carbon fiber materials.  Insulation systems.  Heat, water, - sound insulation materials and their requirements. Paints. Opacity, layer thickness, coverage. |
| **11th week:**  **Lecture:** Steel in engineering applications. Mechanical properties of hot and cold formed steels. Stress-strain diagrams. Effect of carbon content on forming and welding of steel. Effect of temperature on the external work of steel.  **Practice:** Laboratory tensile testing of steel (reinforcement). Hardness of steel. | **12th week:**  **Lecture:** Ceramic. History of ceramics. Strength and durability of ceramic materials.  **Practice:** Laboratory compression tests of bricks. |
| **13th week:**  **Lecture:** Glass as building material (types of glasses and properties of different glass types, mechanical and physical properties of glass, introduction in possibilities of creating load bearing glasses.)  **Practice:** Bending tests of float glasses. | **14th week:**  Study trip |
| **15th week: 2nd drawing week / 2nd test** | |

**Requirements for a signature:**

Participation at **lectures** is **compulsory**. Students must attend on lectures and may not miss more than three lectures during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at lectures will be recorded by the staff of the department. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Students are required to bring the calculator and the printed materials of the lectures to each lecture and practice. Active participation is evaluated by the teacher in every class. Active student’s participation should be required.

Students have to submit all the laboratory tasks as scheduled minimum on a sufficient level. During the semester there are two tests – the 1st test in the 8th week and the 2nd test in the 15th week – and there is one homework task. In order to take the signature minimum points of the test and the homework task has to be taken, and submit all the laboratory tasks.

**Requirements for an exam grade:**

In order to take the exam grade – minimum (2) pass grade, – minimum point of test and homework task and written exam has to be taken (Summa minimum 61 points from 100 points). The minimum and the maximum points related to the tests and homework and exam can be obtained are the follows:

**Tests:**

1. Test: Maximum: **20 points** Minimum: **12 points**

2. Test: Maximum: **20 points** Minimum: **12 points**

Summa: **40 points 24 points**

**Homework:**

Homework: Maximum: **10 points** Minimum**: 6 points**

**Written exam:** Maximum: **50 points 30 points**

**Summa points:** Maximum: **100 points 60 points**

The course ends with an **exam grade**. Based on the summa points of the tests and the points of the homework and points of the written exam, the final grade is defined according to the following calculation:

**Score Grade**

0 – 60 points: fail (1)

61 – 70 points: pass (2)

71 – 80 points: satisfactory (3)

81 – 90 points: good (4)

91 – 100 points: excellent (5)