**Reinforced Concrete Structures II.**

**Code: MFVBS32SS3-EN**

**ECTS Credit Points: 3**

**Evaluation: exam**

Year, Semester: 3rd year/1st semester

Number of teaching hours/week:

Lecture: **2**

Practice: **1**

**Prerequisites:** Reinforced Concrete Structures I.: MFVBS31S03-EN

**Topics**:

Theory of elastic slabs. Loads and stresses of elastic slabs. Differential equitation of an elastic slab. One- and two-way slabs. Approximate solutions for slabs, Marcus type solutions, FEM methods. Design and reinforcement detail of one-way and two-way slabs, the use of individual steel bars and welded steel meshes. Classification of flat slabs (column-head slabs, flat slabs). Design approaches for flat slabs. Reinforcement layout of flat slabs. Shear in flat slabs. Punching shear of flat slabs. Design of punching shear reinforcement, detail of punching shear reinforcement. Plastic analyses of reinforced concrete struts. Static and kinematic methods for determining the plastic capacity of RC structures. Plastic hinge. Plastic analysis of reinforced concrete slabs. Yield line theory. Application of static and kinematic methods for RC slabs.

**Literature:**

fib Bulletin 51 Structural Concrete – Textbook on behavior, design and performance – Second Edition – Volume 1., Federation International du Béton – International Federation for Structural Concrete, (2009) ISSN: 1562-3610, ISBN:978-2-88394.091-8

fib Bulletin 52 Structural Concrete – Textbook on behavior, design and performance – Second Edition – Volume 2., Federation International du Béton – International Federation for Structural Concrete, (2010) ISSN: 1562-3610, ISBN:978-2-88394.091-8

fib Bulletin 53 Structural Concrete – Textbook on behavior, design and performance – Second Edition – Volume 3., Federation International du Béton – International Federation for Structural Concrete, (2009) ISSN: 1562-3610, ISBN:978-2-88394-093-2

fib Bulletin 54 Structural Concrete – Textbook on behavior, design and performance – Second Edition – Volume 4., Federation International du Béton – International Federation for Structural Concrete (2010), ISSN: 1562-3610, ISBN:978-2-88394-094-9

fib Bulletin 62 Structural Concrete – Textbook on behavior, design and performance – Second Edition – Volume 5., Federation International du Béton – International Federation for Structural Concrete, (2012) ISSN: 1562-3610, ISBN:978-2-88394-102-1

EN 1990:2002/A1:2005 Eurocode - Basis of structural design.

EN 1991-1-1:2002 Eurocode 1: Actions on structures - Part 1-1: General actions - Densities, self-weight, imposed loads for buildings.

MSZ EN 1992-1-1: 2010 Design of concrete structures Part 1-1.:General rules and rules for buildings

MSZ EN 1992-1-2: 2010 Design of concrete structures Part 1-2: General rules. Structural fire design

MSZ 4798-1:2004 Concrete Part 1: Specification, performance production, conformity, and rules of application of MSZ EN 206-1 in Hungary

Robert Park & Thomas Paulay: Reinforced Concrete Structures, Wiley-India Edition (2010), ISBN: 978-81-265-2362-5

Prab Bhatt, Thomas J. MacGinley & Ban Seng Choo: Reinforced Concrete Design Theory and Examples, Taylor & Francis Group (2010), ISBN: 0-415-30796-1

Prab Bhatt, Thomas J. MacGinley & Ban Seng Choo: Reinforced Concrete Design to Euroceodes – Design Theory and Examples, Taylor & Francis Group (2014), ISBN-13: 978-1-4665-5252-4

A. M. Neville: Properties of concrete Fourth and Final Edition Standarts updated to 2002, Pearson Prentice Hall (2004), ISBN: 0-582-23070-

Jack C. McCormac: Design of Reinforced Concrete Fifth Edition, John Wiley &Sons Inc. (2001), ISBN: 0-471-39576-5

**Schedule**

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| **1st week:**  **Lecture:** Theory of elastic slabs. Loads and stresses of elastic slabs. Differential equitation of elastic slabs. One and two way slabs. Examples for one-way and two-way RC slabs.  ***Outgiving and discussion of the******1st Design Task****.*  **2nd week:**  **Lecture:** Approximate solutions of slabs, Marcus type solutions, FEM methods. Further examples for one-way and two-way RC slabs.  ***Outgiving and discussion of the 2nd Design Task.***  **3rd week:**  **Lecture:** Design and reinforcement details of one-way and two-way slabs by the usage of individual steel bars, reinforcement Examples for one-way and two-way RC slab design.  ***Outgiving and discussion of the rdh Design Task.***  **4th week:**  **Lecture:** Design and reinforcement details of one-way and two-way slabs by the usage of welded steel meshes. Examples for one-way and two-way RC slab design.  ***Outgiving and discussion of the 4th Design Task.***  **5th week:**  **Practice:**  Complex design of RC slabs I. (One way type) / Laboratory practice.  **6th week:**  **Practice:**  Complex design of RC slabs II. (Two way type) / Laboratory practice.  **7th week:**  ***1st Test***  ***Hand in of the 1st Design Task***  ***Hand in of the 2nd Design Task***  **8th week:**  **Lecture:** Classification of flat slabs. Design approaches for flat slabs. Reinforcement layout of flat slabs.  ***Outgiving and discussion of the 5th Design Task.*** | **9th week:**  **Lecture**: Shearing in flat slabs. Punching shear of flat slabs. Design of punching shear reinforcement, detail of punching shear reinforcement. Examples for punching shear design.  **10th week:**  **Lecture:** Plastic analysis of reinforced concrete struts. Static and kinematic methods for determining the plastic capacity of RC cross sections. Plastic hinge. Examples for determination of plastic capacity.  **11th week:**  **Lecture:** Plastic analysis of reinforced concrete slabs. Yield line theory. Application of static and kinematic methods for RC slabs. Examples for the determination of the plastic capacity of slabs.  ***Outgiving and discussion of the******6th Design Task****.*  ***Outgiving and discussion of the******7th Design Task****.*  ***Handing in of the 6th Design Task***  ***Handing in of the 7th Design Task***  **12th week:**  **Lecture:** Plastic analyses of reinforced concrete slabs II. Two-way and flat slab analysis. Examples for plastic capacity determination of slabs.  **13th week:**  **Practice:** Selected design problems of the plastic capacity of RC struts ad RC slabs I.  **14th week:**  **Practice:** Selected design problems of the plastic capacity of RC struts ad RC slabs II.  ***Hand in of the 5th Design Task***  **15th week:**  ***2nd Test***  ***Hand in of the 6th Design Task***  ***Hand in of the 7th Design Task*** |

**Requirements**

Attendance at **lectures** is **strongly recommended**, but not compulsory. Participation at **practice** classes is **compulsory**. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can’t make up a practice with another group. Attendance at lectures and at practice classes will be recorded by the staff of the department. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, being discussed with the tutor. Students are required to bring a calculator and the printed materials of the lectures to each lecture and practice class. Active participation is evaluated by the teacher in every class. Students’ active participation is required.

Students have to **submit all the two tests and the seven design tasks** as scheduled minimum at a sufficient level. During the semester there are two tests – the 1st test in the 7th week and the 2nd test in the 15th week – and there are seven design tasks. In order to get the **signature**, minimum points of tests and design tasks have to be taken (min. 50 points from 80 points). In order to take an exam grade (ESE) – minimum (2) pass grade – minimum points of tests and design tasks as well as exam points have to be taken (Summa minimum 61 points from 100 points). The minimum and the maximum points related to the tests and design tasks can be obtained are the following:

**Two tests:**

Test I: Maximum: **15 points** Minimum: **9 points**

Test II: Maximum: **15 points** Minimum: **9 points**

Summa: **30 points 18 points**

**Seven design tasks:**

Design Task 1: Maximum: **5 points** Minimum**: 3 points**

Design Task 2: Maximum: **10 points** Minimum**: 7 points**

Design Task 3: Maximum: **5 points** Minimum**: 3 points**

Design Task 4: Maximum: **10 points** Minimum**: 7 points**

Design Task 5: Maximum: **15 points** Minimum**: 9 points**

Design Task 6: Maximum: **2 points** Minimum**: 1 points**

Design Task 7: Maximum: **3 points** Minimum**: 2 points**

Summa: **50 points 32 points**

**Points required for signature:**

Maximum: **80 points** Minimum**: 50 points**

(In case of having min. 50 points of the Tests and of the Design Tasks, signature can be obtained)

**Exam:**

Maximum: **20 points** Minimum: **11 points**

**Summa points:**

Maximum: **100 points** Minimum: **61 points**

The course ends in an **exam grade (ESE)**. Based on the summa points of the tests, the summa points of the design tasks and the summa point of the exam, the exam grade is defined according to the following calculation:

**Score Grade**

0 – 60 points: fail (no signature)

61 – 70 points: pass (2)

71 – 80 points: satisfactory (3)

81 – 90 points: good (4)

91 – 100 points: excellent (5)