#### Reinforced Concrete Structures for Buildings

Code: MK3TAR7S6SS17-EN

ECTS Credit Points: 6 credits

Evaluation: exam grade

Year, Semester: 4th year, 7th semester

Its prerequisite(s): Reinforced Concrete Structures

Further courses are built on it: Yes

Number of teaching hours/week (lecture + practice): 4+2

Topics:

Theory of elastic slab. Loads and stresses of elastic slab. Differential equitation of the 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 analysis 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.

Types, loads, classification and design considerations for RC columns. Braced and unbraced columns. Eccentricities, imperfections, second order effects. Design possibilities of RC columns. Loads and stresses of RC frames. Approximate determination of frame loads for vertical and horizontal loads. Beam and disturb zones and joints of RC frames, Analysis of different type of frame corners, corbels, half-end beams. Reinforced concrete walls. Loads and design of reinforced concrete walls. Determination of loads and stresses of the bracing systems of high rise reinforced concrete buildings. Special problem of the under reinforced structures subjected normal force. Elastic analysis of reinforced concrete deep beams and shear walls. Plastic analysis of reinforced concrete walls, shear walls and deep beams by strutand-tile models. Design of reinforced concrete foundations. Types, properties, applications and design aspects of different kind of fibre reinforced concrete. Fire resistance of reinforced concrete structures, design for fire.

Literature:

*Compulsory:*

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

*Recommended:*

* 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:978-2-88394-093-8
* 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

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

Schedule

|  |  |
| --- | --- |
| 1st week Registration week |  |
| 2nd week:  Lecture / Practice: Theory of elastic slab. Loads and stresses of elastic slab. Differential equitation of the elastic slab.  One- and two-way slabs. | 3rd week:  Lecture / Practice: Approximate solutions for slabs, Marcus type solutions, FEM methods. |
| 4th week:  Lecture / Practice: Design and  reinforcement detail of one-way and twoway slabs, the use of individual steel bars and welded steel meshes. | 5th week:  Lecture / Practice: 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. |
| 6th week:  Lecture / Practice: Plastic analysis 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. | 7th week:  Study trip |
| 8th week: 1st drawing week / 1st test |  |
| 9th week:  Lecture / Practice: Types, loads, classification and design considerations for RC columns. Braced and unbraced columns. | 10th week:  Lecture / Practice: Loads and stresses of RC frames. Approximate determination of frame loads for vertical and horizontal loads. Beam and disturb zones and joints of |
| Eccentricities, imperfections, second order effects. Design possibilities of RC columns. | RC frames, Analysis of different type of frame corners, corbels, half-end beams. |
| 11th week:  Lecture / Practice: Reinforced concrete walls. Loads and design of reinforced concrete walls. Determination of loads and stresses of the bracing systems of high rise reinforced concrete buildings. Special problem of the under reinforced structures subjected normal force. | 12th week:  Lecture / Practice: Elastic analysis of reinforced concrete deep beams and shear walls. Plastic analysis of reinforced concrete walls, shear walls and deep beams by strutand-tile models. |
| 13th week:  Lecture / Practice: Design of reinforced concrete foundations. Types, properties, applications and design aspects of different kind of fibre reinforced concrete. Fire resistance of reinforced concrete structures, design for fire. | 14th week:  Study trip |
| 15th week: 2nd drawing week / 2nd test |  |

Requirements

Attendance at lectures and practices is compulsory. Students must attend lectures and 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 class with another group. Attendance at lectures and practice 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 with them to each lecture and practice. Active participation is evaluated by the teacher in every class. Active student’s participation should be required.

A, for a signature:

In order to take signature, students have to submit all the two tests and the six homeworks as scheduled minimum at 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 are six homework tasks. In order to take the signature, minimum point of tests (min. 18 points from 30 points) and homework tasks min. 32 points from 50 points) has to be taken (min. 50 points from 80 points).

B, for a grade:

In order to take an exam grade – minimum (2) pass grade – minimum point of tests (min. 18 points from 30 points), minimum points of homework (min. 32 points from 50 points) and minimum points of exam points (min. 11 points from 20 points) has 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 follows:

Two tests:

1. Test: Maximum: 15 points Minimum: 9 points
2. Test: Maximum: 15 points Minimum: 9 points

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| --- | --- | --- | --- | --- | --- |
| Summa: 30 points | | | | 18 points | |
| Six homeworks:  1. Homework: | Maximum: | 8 points | Minimum: | | 5 points |
| 2. Homework: | Maximum: | 8 points | Minimum: | | 5 points |
| 3. Homework: | Maximum: | 8 points | Minimum: | | 5 points |
| 4. Homework: | Maximum: | 8 points | Minimum: | | 5 points |
| 5. Homework: | Maximum: | 8 points | Minimum: | | 5 points |
| 6. Homework: | Maximum: | 10 points | Minimum: | | 7 points |
|  | Summa: 50 points |  | 32 points | |  |
| Points required for signature:  Maximum: | | 80 points | Minimum: | | 50 points |
| Exam:  Maximum: | | 20 points | Minimum: | | 11 points |

Summa points:

Maximum: 100 points Minimum: 61 points

The course ends with an exam grade. Based on the summa points of the tests, the summa points of the homeworks 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) |