RC and Masonry Structures - BMEEOHSAS42

I. Subject Specification

1. Basic Data

1.1 Title

RC and Masonry Structures

1.2 Code

BMEEOHSAS42

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lecture	2
Seminar	1

1.5 Evaluation

Midterm grade

1.6 Credits

4

1.7 Coordinator

name	Dr. Koris Kálmán
academic rank	Associate professor
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1.8 Department

Department of Structural Engineering

1.9 Website

https://epito.bme.hu/BMEEOHSAS42
https://edu.epito.bme.hu/course/view.php?id=1376

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Compulsory in the Civil Engineering (BSc) programme

1.12 Prerequisites

Strong prerequisites:

- Reinforced Concrete Structures (BMEEOHSAT43)

Weak prerequisites:

- Building Construction I. (BMEEOEMAS42)

1.13 Effective date

1 September 2024

2. Objectives and learning outcomes

2.1 Objectives

The aim of the course to let the students master the principles, design methods and the typical structural design of different reinforced concrete and masonry structures. Within the scope of the subject, frame and slab structures, bracing systems of reinforced concrete buildings, various reinforced concrete structural details (beam end, corbel, frame corner, curved axis beam, stairs, force transfer, expansion joints, etc.), as well as load-bearing non-reinforced and reinforced masonry walls are discussed. The course provides students with an overview of IT solutions and digital technologies used in the design of reinforced concrete and masonry structures. By completing the course, students will develop digital skills that will contribute to the effective performance of tasks related to reinforced concrete frame structures, bracing systems, slabs and detailing, as well as masonry structures. Students will be provided with and use digital skills (e.g. Autocad, Nemetschek, Tekla, Mathcad, AxisVM, ChatGPT) to perform the engineering tasks in the course. The digital teaching methodology used in the course will effectively support students' skill development and mastery of the outcome requirements.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. Knows the modelling possibilities of reinforced concrete frames, the approximate and accurate calculation methods of internal forces, and the effects to be taken into account in the calculation,
2. knows the approximate stability checking methods of buildings, the possible configurations of bracing systems, the principle of calculating statically determinate bracing systems, and the principles of column and wall design and reinforcing,
3. knows the typical internal forces and their distribution in RC slabs, the available approximate methods for the calculation of internal forces in case of different slab and load types, the internal force distribution around openings, as well as the principles of punching shear analysis in case of flat slabs and the design of RC slabs,
4. knows the basic principles of plasticity theory, and the theoretical principles of plastic slab design,
5. knows the configuration, force distribution and material properties of non-reinforced and reinforced masonry walls, as well as the dimensioning principles of non-reinforced masonry walls,
6. knows the internal force distribution and the design principles of RC beam ends, force introduction zones, corbels and columns with helical reinforcement.

B. Skills

1. The student is able to approximately and exactly determine the internal forces and deformations of RC frames, to approximately verify the stability of frames, and to determine the necessary reinforcement of RC columns and walls,
2. the student is able to determine the forces acting to walls of a statically determinate bracing system,
3. the student is able to approximately and exactly determine the internal forces and deformations of different RC slabs, to determine the necessary reinforcement of slabs and to verify the punching shear resistance of flat slabs,
4. the student is able to determine the plastic load bearing capacity (collapse load) of simple slabs,
5. the student is able to verify the load bearing capacity of non-reinforced masonry walls subjected to

eccentric compression or shear,
6. the student is able to determine the forces acting to walls of a statically indeterminate bracing system.

C. Attitudes

1. The student cooperates with the lecturer,
2. the student is open to the use of IT tools,
3. the student makes an effort to get to know and use the tools needed for the dimensioning of RC frame and plate structures, as well as masonry walls,
4. the student makes an effort to accurate and error-free task solving,
5. the student seeks to enforce the principle of energy efficiency and environmental awareness in the design of reinforced concrete and masonry structures.

D. Autonomy and Responsibility

1. Independently performs the task of thinking and solving tasks and problems related to the dimensioning of RC and masonry structures,
2. welcomes the well-founded critical remarks,
3. uses the systemic approach in its thinking.

2.3 Methods

Presentations, exercise classes, written and oral communication, use of IT tools and techniques, independent task solving, work organization techniques, active consultations.

2.4 Course outline

Week	**Topics of lectures and/or exercise classes**
1.	Configuration and modelling of RC frames, approximate and exact methods for the calculation of internal forces. Approximate consideration of imperfections and second order effects in case of frames. Bracing of buildings, calculation of statically determine bracing systems, determination of forces acting to the walls. Stability verification of frames. Design and reinforcement of RC columns and walls - 1.
2.	Configuration and modelling of RC frames, approximate and exact methods for the calculation of internal forces. Approximate consideration of imperfections and second order effects in case of frames. Bracing of buildings, calculation of statically determine bracing systems, determination of forces acting to the walls. Stability verification of frames. Design and reinforcement of RC columns and walls - 2.

3.	Configuration and modelling of RC frames, approximate and exact methods for the calculation of internal forces. Approximate consideration of imperfections and second order effects in case of frames. Bracing of buildings, calculation of statically determine bracing systems, determination of forces acting to the walls. Stability verification of frames. Design and reinforcement of RC columns and walls - 3.
4.	Load bearing and typical internal forces of RC slabs. Approximate slab calculation methods (strip method, Menyhárd method, calculation of flat slabs using the method of equivalent beams, continuous slabs systems). FEM calculation of internal forces and deformations of RC slabs. Calculation of slabs loaded by concentrated forces. Force distribution around openings. Punching of flat slabs. Calculation of stairs. The basics of plasticity theory, calculation of collapse load in case of slabs. Reinforcement of concrete slabs, reinforcement drawing - 1.
5.	Load bearing and typical internal forces of RC slabs. Approximate slab calculation methods (strip method, Menyhárd method, calculation of flat slabs using the method of equivalent beams, continuous slabs systems). FEM calculation of internal forces and deformations of RC slabs. Calculation of slabs loaded by concentrated forces. Force distribution around openings. Punching of flat slabs. Calculation of stairs. The basics of plasticity theory, calculation of collapse load in case of slabs. Reinforcement of concrete slabs, reinforcement drawing - 2.
6.	Load bearing and typical internal forces of RC slabs. Approximate slab calculation methods (strip method, Menyhárd method, calculation of flat slabs using the method of equivalent beams, continuous slabs systems). FEM calculation of internal forces and deformations of RC slabs. Calculation of slabs loaded by concentrated forces. Force distribution around openings. Punching of flat slabs. Calculation of stairs. The basics of plasticity theory, calculation of collapse load in case of slabs. Reinforcement of concrete slabs, reinforcement drawing - 3.
7.	Load bearing and typical internal forces of RC slabs. Approximate slab calculation methods (strip method, Menyhárd method, calculation of flat slabs using the method of equivalent beams, continuous slabs systems). FEM calculation of internal forces and deformations of RC slabs. Calculation of slabs loaded by concentrated forces. Force distribution around openings. Punching of flat slabs. Calculation of stairs. The basics of plasticity theory, calculation of collapse load in case of slabs. Reinforcement of concrete slabs, reinforcement drawing - 4.
8.	Load bearing and typical internal forces of RC slabs. Approximate slab calculation methods (strip method,

	Menyhárd method, calculation of flat slabs using the method of equivalent beams, continuous slabs systems). FEM calculation of internal forces and deformations of RC slabs. Calculation of slabs loaded by concentrated forces. Force distribution around openings. Punching of flat slabs. Calculation of stairs. The basics of plasticity theory, calculation of collapse load in case of slabs. Reinforcement of concrete slabs, reinforcement drawing - 5.
9.	Configuration, materials and dimensioning of non-reinforced and reinforced masonry walls. Verification of masonry walls subjected to eccentric compression and shear - 1.
10.	Configuration, materials and dimensioning of non-reinforced and reinforced masonry walls. Verification of masonry walls subjected to eccentric compression and shear - 2.
11.	RC structural details: corbel, strut and tie model, introduction of forces, local compression, helical reinforcement - 1.
12.	RC structural details: corbel, strut and tie model, introduction of forces, local compression, helical reinforcement - 2.
13.	RC structural details: corbel, strut and tie model, introduction of forces, local compression, helical reinforcement - 3.
14.	Foundations, statically indeterminate bracing systems, consultation.

The above programme is tentative and subject to changes due to calendar variations and other reasons specific to the actual semester. Consult the effective detailed course schedule of the course on the subject website.

2.5 Study materials

a) Textbooks:

1. György Deák, András Draskóczy, Endre Dulácska, László Kollár, György Visnovitz: *Reinforced Concrete Design Aids*, Dept. of Mechanics, Materials and Structures, Faculty of Architecture, 2011. (compulsory)
2. Phil M. Ferguson, John E. Breen, James O. Jirsa: *Reinforced Concrete Fundamentals*, Wiley, April 1988. (recommended)

b) Online materials:

1. Reinforced concrete design aid – Supplement to the 2011 edition, Electronic Lecture Note.
2. Reinforced concrete frames, Electronic Lecture Note.
3. Reinforcement of concrete frames, Electronic Lecture Note.
4. Bracing systems, Electronic Lecture Note.
5. Reinforcemed concrete slabs, Electronic Lecture Note.
6. Masonry Structures Lecture Notes.
7. Basis of the design of masonry structures according to EC, Electronic Lecture Note.
8. Masonry structures design aid to be used on the Test, Electronic Lecture Note.
9. Reinforced concrete detailing, Electronic Lecture Note.

2.6 Other information

2.7 Consultation

The instructors are available for consultation during their office hours, as advertised on the department website.

This Subject Datasheet is valid for:

Inactive courses

II. Subject requirements

Assessment and evaluation of the learning outcomes

3.1 General rules

The assessment of the learning outcomes specified in clause 2.2. above and the evaluation of student performance occurs via three midterm exams, three active consultations and two drawing homeworks.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
1. midterm test	ZH1	A.1-A.2; B.1-B.2; C.4; D.1
2. midterm test	ZH2	A.3-A.4; B.3-B.4; C.4; D.1
3. midterm test	ZH3	A.3, A.5-A.6; B.3, B.5-B.6; C.4; D.1
1. active consultation	AC1	A.1-A.2; B.1-B.2; C.1-C.5; D.1-D.3
2. active consultation	AC2	A.3-A.4; B.3-B.4; C.1-C.5; D.1-D.3
3. active consultation	AC3	A.3, A.5-A.6; B.3, B.5-B.6; C.1-C.5; D.1-D.3
1. drawing homework	HW1	A.1-A.2; B.1-B.2; C.1-C.5; D.1-D.3
2. drawing homework	HW2	A.3-A.4; B.3-B.4; C.1-C.5; D.1-D.3

The dates of deadlines of assignments/homework can be found in the detailed course schedule on the subject's website.

3.3 Evaluation system

Abbreviation	Score
ZH1	32,5%
ZH2	32,5%
ZH3	32,5%
AC1	5%
AC2	5%
AC3	5%
HW1	10%
HW2	10%
Total achievable during the semester	100%
Sum	**100%**

The test is not successful if the average of two better tests is less than 50% of the available points (32,5 points), or if the average of two better results of theoretical part of the tests is less than 40% of the points available with the theoretical part.

3.4 Requirements and validity of signature

No signature can be obtained from the subject.

3.5 Grading system

The marks for those who meet the attendance criteria will be determined according to the following aspects:

The final mark will be calculated on the basis of the weighted average of the two best midterm exams, the *performance on the 3 active consultations and the 2 drawing homeworks as described in point 3.3.*

The maximum score for each of the midterm exams is 65 points. Additional points can be obtained by writing the third (weakest) final examination with a score of ≥50%. The extra point is 10% of the score of the weakest (but successful) midterm exam (max. 7 points).

3 active consultations are worth a maximum of 5+5+5 points. Technical details on how to conduct the active consultation are given in the guidelines issued at the beginning of the semester.

The 2 drawing assignments submitted by the deadline are worth a maximum of 10+10 points. Drawings must be consulted at least once before submission and must be submitted digitally. Further details on submission are given in the homework assignment.

A total of 100 points (107 points including extra points) can be achieved during the semester. The final grade based on the points:

Grade	**Points (P)**
excellent (5)	90<=P
good (4)	75<=P<90%
satisfactory (3)	60<=P<75%
passed (2)	45<=P<60%
failed (1)	P<45%

3.6 Retake and repeat

There is no minimum requirement for individual mid-term benchmarking, therefore individual retake of the tests is not possible.

3.7 Estimated workload

Activity	**Hours/semester**
contact hours	14×3=42
preparation for the tests	14+14+14=42
active consultation and homework	36
Sum	**120**

3.8 Effective date

1 September 2024

This Subject Datasheet is valid for:

Inactive courses