

SUBJECT DATASHEET

I. SUBJECT SPECIFICATION

1 BASIC DATA

1.1 Title

STRENGTHENING OF STRUCTURES

1.2 Code

BMEEOHSMT63

1.3 Type

Module with associated contact hours

1.4 Contact hours

type	hours/week
lectures	1
seminars/exercise classes	1

1.5 Evaluation

midterm grade

1.6 Credits

3

1.7 Coordinator

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academic rank: senior assistant professor
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1.8 Department

Department of Structural Engineering (<http://www.epito.bme.hu/hidak-es-szerkezetek-tanszek>)

1.9 Website

<http://www.epito.bme.hu/BMEEOHSMT63>

1.10 Language of instruction

Hungarian and English

1.11 Curriculum requirements

Recommended elective in the Structural engineering (MSc) programme

1.12 Prerequisites

1.13 Effective date

February 1, 2019.

2 OBJECTIVES AND LEARNING OUTCOMES

2.1 Objectives

The objective of the subject is the presentation of the diagnostic of existing structures with different materials and structural systems, the possible causes of structural damages, methods of reinforcement and the most common building materials. According to this, the tools and steps of the diagnostic of existing structures, the verification of the structure's load bearing capacity, the basic principles of qualification, the required content of expertise, the methods of reconstruction and reinforcement, the most common ways of structural damages (direct and indirect) and the different structural systems of existing residential buildings are presented during the semester. Case studies are also introduced.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. will learn the diagnostic of existing structures, the verification of the structure's load bearing capacity, the basic principles of qualification,
2. will learn the methods of reinforcement of structures with different materials (concrete, reinforced concrete, masonry, steel, timber),
3. will learn the steps of loading tests and the required content of expertise,
4. will learn the most typical forms of structural damages,
5. will learn the typical structural systems of existing residential buildings in Hungary,
6. will learn the reconstruction methods of slabs and stairs,
7. will learn the types of slab systems in Hungary.

B. Skills

1. will be able to do diagnostic and verify the load bearing capacity of existing structures, and to do the reinforcement of a structure,
2. will be able to choose the proper method of diagnostic and reinforcement depending on the structural material,
3. will be able to determine the required tasks of loading tests,
4. will be able to recognize the type of structural damage,
5. will be able to recognize the most typical types of structural systems,
6. will be able to choose the proper method of diagnostic and reinforcement of different types of slabs and stairs,
7. will be able to recognize the different types of slab systems in Hungary (according to their material, dimensions, shape and location).

C. Attitudes

1. continuously extends his/her knowledge,
2. is open to the application of modern diagnostic and reinforcement technics,
3. is intent on learning and using the tools of diagnostic and reinforcement,
4. is intent on precise and error-free problem solving.

D. Autonomy and responsibility

1. is able to autonomously evaluate the different methods of reinforcement, diagnostic and recognize the different structural systems and damages,
2. is open to new reconstruction and reinforcement methods and design procedures related to these.

2.3 Methods

Lectures, exercises, written and oral communications, application of IT tools and techniques, assignments solved individually.

Week: Topics of lectures and/or exercise classes

1. Steps of diagnostic of existing structures, the verification of the structure's load bearing capacity, the basic principles of qualification.
2. Basic principles of reinforcement and analysis of structural systems I. (concrete, reinforced concrete and masonry structures).
3. Basic principles of reinforcement and analysis of structural systems II. (steel and timber structures).
4. Basic principles of reinforcement and analysis of structural systems III. (foundations). Loading tests. Content of expertise.
5. Damages of existing structures.
6. Reconstruction and diagnostic of foundations.
7. Reconstruction and diagnostic of masonry structures.
8. Reconstruction and diagnostic of concrete and reinforced concrete structures.
9. Reconstruction and diagnostic of steel and timber structures.
10. Structural systems of old residential buildings I. (from the age of Monarchy to the second world war)
11. Structural systems of old residential buildings II. (from the second world war to panel-system buildings)
12. Reconstruction and diagnostic of slabs and stairs.
13. Old slab systems.
14. Case studies.

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, printed lecture notes

1. Dulácska Endre: *Épületek tartószerkezeteinek diagnosztikája és rekonstrukciója*, Egyetemi jegyzet, Budapest, 2013.
2. Dulácska Endre: *Falazatok és boltozatok*, segédlet építészmérnök hallgatók részére, Egyetemi jegyzet, Budapest, 1994.
3. Dulácska Endre: *Földrengés elleni védelem, egyszerű tervezés az Eurocode 8 alapján*, gyakorlati útmutató, Magyar Mérnöki Kamara, Tartószerkezeti Tagozat, 2009.
4. É-65, Tervezési segédlet: *Rehabilitációs területek épületvédelme*, Tervezésfejlesztési és Technikai Építészeti Intézet, Budapest, 1985.
5. FÉ-09, Tervezési segédlet – Fenntartási építés: *Panelos lakótelepek használati értékét növelő felújítások*, Tervezésfejlesztési és Technikai Építészeti Intézet, Budapest, 1988.
6. Mihailich Győző, Haviár Győző: *A vasbeton építés kezdete és első létesítményei Magyarországon*, Akadémiai Kiadó, Budapest, 1966.

b) Online materials

1. Koris Kálmán: *Lectures notes for the Bsc subject Strengthening of Structures*, 2014.
2. Dulácska Endre, Korda János, Körmöczi Ernő: *TSZ 01-2013 Műszaki Szabályzat, Épületek megépült teherhordó szerkezeteinek erőtani vizsgálata és tervezési elvei*, Mérnöki Kamara Nonprofit Kft., 2013.
3. Koris Kálmán: *Examination and classification of damaged structures*, Lecture notes.
4. Koris Kálmán: *Structural damages*, Lecture notes.
5. Koris Kálmán: *Strengthening methods I. – Anchored and bonded steel plates*, Lecture notes.
6. Koris Kálmán: *Strengthening methods II. – Application of FRP materials*, Lecture notes.
7. Koris Kálmán: *Strengthening methods III. – Sprayed concrete*, Lecture notes.
8. Koris Kálmán: *Strengthening of reinforced concrete, masonry, steel and timber structures*, Lecture notes.

2.6 Other information

2.7 Consultation

The instructors are available for consultation during their office hours, as advertised on the department website. Special appointments can be requested via e-mail:

koris.kalman@epito.bme.hu

II. SUBJECT REQUIREMENTS

3 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 3 control tests.

3.2 Assessment methods

Evaluation form	abbrev.	assessed learning outcomes
1. control test	ED1	A.1-A.3; B.1-B.3; C.1-C.4; D.1-D.2
2. control test	ED2	A.4-A.5, B.4-B.5; C.1-C.4; D.1-D.2
2. control test	ED3	A.6-A.7, B.6-B.7; C.1-C.4; D.1-D.2

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

3.3 Evaluation system

abbreviation	score
ED1	50%
ED2	50%
ED3	50%
Total achievable during the semester	100%
Sum	100%

Criterion for completion of the subject is to collect the 50% of the points from the two better control tests (15 points).

3.4 Requirements and validity of signature

Signature can't be obtained.

3.5 Grading system

If the student satisfies the attendance criteria, his/her mark will be determined as follows.

The final marks are calculated according to the table in Section 3.3, from the weighted average of the two better test results. The maximum point of a control test is 30 points. Bonus points can be obtained with the successful ($\geq 50\%$) third test (weakest result). The bonus points are the 20% of the points of the weakest control test (max. 6 points). The marks according to the points:

grade	points (P)
excellent (5)	$26 p \leq P$
good (4)	$22 p \leq P \leq 25 p$
satisfactory (3)	$18 p \leq P \leq 21 p$
passed (2)	$15 p \leq P \leq 17 p$
failed (1)	$P < 15 p$

3.6 *Retake and repeat*

- 1) There is no requirement for the individual tests, therefore the repetition of the tests is not possible.

3.7 *Estimated workload*

activity	hours/semester
contact hours	14×2=28
preparation for the tests	3×16=48
home studying of the written material	14×1=14
in total	90

3.8 *Effective date*

February 1, 2019.