**Strengthening of Structures**

**Code: MFSZM31SM3-EN**

**ECTS Credit Points: 3**

**Evaluation: mid-semester grade**

Year, Semester: 4th year/1st semester

Number of teaching hours/week:

Lecture: **2**

Practice: **0**

**Prerequisites:** Steel structures III: MFACS33SS3-EN, Reinforced Concrete Structures III: MFVBS33SS3-EN

**Topics**:

General rules and methods for diagnostics and qualification of load-bearing structures. Rules and methods for strengthening of structures. Reinforcement of concrete beams. Reinforcement of steel frames. Reinforcement of joints of steel frames. Reinforcement of timber structures. Construction of wall openings.

**Literature:**

KORIS K. , BÓDI I.: Strengthening of structures

<http://www.hsz.bme.hu/hsz/oktatas/feltoltesek/BMEEOHSASA4/strengthening_of_structures.pdf>

MAZZOLANI F.M., IVÁNYI M.: Refurbishment of buildings and bridges, ISBN 978-3-211-83690-3 Springer 2002.

CROSWELL R. M., WEBSTER M. D.: Guidelines for the Structural Provisions for the Repair, Alteration, Addition and Change of Use of Existing Buildings, Boston Association Of Structural Engineers, March 2002

Repair, restoration and strengthening of structures <http://www.nicee.org/iaee/E_Chapter9.pdf>

MAZZOLANI F.M., Refurbishment by steelwork

<http://www.arcelormittal.com/sections/fileadmin/redaction/pdf/Brochures/refurbishement_en.pdf>

TALJSTEN B., CFRP- strengthening - concrete structures strengthened with near surface mounted CFRP laminates

<http://quakewrap.com/frp%20papers/CFRP-Strengthening-Concrete-Structures-Strengthened-With-Near-Surface-Mounted-CFRP-Laminates.pdf>

**Schedule**

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| **1st week:**Features of the building diagnostic tests.**2nd week:** Expected lifetime of structures. Effects of reconstruction.**3rd week:**Rules and methods of load tests.**4th week:**Strengthening of reinforced concrete structures with post-tensioning.**5th week:**Strengthening reinforced concrete structures with carbon fiber-reinforced belts.**6th week:**Damages of masonry structures. Ways of strengthening.**7th week:**Damages of arches and vaulted ceilings. Ways of strengthening. **8th week:**Damages of buildings due to the foundation. Methods of strengthening foundations. | **9th week:**TEST1**10th week:**Fixing local injuries of steel structures.**11th week:**Strengthening of steel frame structures.**12th week:**Strengthening of steel structures by modifying the bracing system.**13th week:**Damages of wooden structures and ways of strengthening.**14th week:**Damages of prefabricated structures. Ways of strengthening.**15th week:**TEST2 |

**Requirements**

**A, for a signature:**

Participation at **lectures** is compulsory. Students must attend the lectures 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. Attendance will be recorded. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Students are required to bring a calculator to each lecture. Active participation is evaluated by the teacher in every class. If a student’s behavior or conduct doesn’t meet the requirements of active participation, the teacher may evaluate their participation as an absence due to the lack of active participation in class.

During the semester there are two tests. Students have to reach the minimum level of points on each test.

 If the score of any test is below 30 of 50, the student once can take a retake test covering the whole semester material.

**B, for a grade:**

The course ends in a **mid-term grade (AW5)**, based on the points of the tests.

Based on the points earned during the semester, the grade is given according to the following table:

Score Grade

0-59 fail (1)

60-69 pass (2)

70-79 satisfactory (3)

80-89 good (4)

90-100 excellent (5)