SUBJECT DATASHEET

I. SUBJECT SPECIFICATION

1 BASIC DATA

1.1 Title

REINFORCED CONCRETE BRIDGES

1.2 Code

BMEEOHSA-B2

1.3 Type

Module with associated contact hours

1.4 Contact hours

type	hours/week
lectures	2
exercise classes	1

1.5 Evaluation

examination

1.6 Credits

4

1.7 Coordinator

name: Dr. Kovács Tamás
academic rank: associate professor
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1.8 Department

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

1.9 Website

www.epito.bme.hu/BMEEOHSA-B2

1.10 Language of instruction

Hungarian and English

1.11 Curriculum requirements

Compulsory in the Bridges and Engineering Structures specialization of the Structural engineering (BSc) programme

1.12 Prerequisites

Required previous subjects (need to be completed to register)

Reinforced concrete and masonry structures (BMEEOHSAS42)

Timber structures (BMEEOHSAS44)

Subjects from which previous midterm signature are required to register

Bridges and infrastructures (BMEEOHSAS43)

1.13 Effective date

September 1, 2017.

2 OBJECTIVES AND LEARNING OUTCOMES

2.1 Objectives

The primary aim of the course is to provide the students with basic knowledge on structural behaviour as well as aspects of structural details for reinforced concrete and timber bridges. During the semester the following topics are discussed in lectures: long-term behaviour of concrete; typical cross-sectional forms of concrete superstructures: reinforced concrete slabs, grid-type and box girder bridges, precast concrete superstructures; prestressing in bridges: idea and technologies; modern construction methods: incremental launching, segmental and monolithic balanced cantilever methods; cable-stayed bridges; arch bridges; typical structural types of timber bridges: truss, frame, arch, plate, hipped-plate and suspension bridges; structural analysis of timber pedestrian bridges; durability and fire resistance of timber bridges; constructive timber preservation.

Another aim of the course is to make the students experienced in verifying the most important structural requirements of pre- and post-tensioned concrete as well as timber bridges.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge
   1. knows the basic systems of reinforced and prestressed concrete bridges and the basic principles of their structural behaviour,
   2. knows the recent pre- and post-tensioning technologies applied for concrete bridges,
   3. knows the recent erection methods for concrete bridges,
   4. knows the structural system and behaviour as well as the basic design aspects for concrete arch and cable-stayed bridges,
   5. knows the structural system and behaviour as well as the basic design aspects for timber bridges.

B. Skills
   1. able to determine the necessary minimum number of girders as well as the preliminary verification of most important design requirements for precast concrete superstructures,
   2. able to determine the necessary amount of prestressing as well as the cable layout for post-tensioned concrete bridges,
   3. able to verify the most important design requirements for timber bridges as well as to control their dynamic behaviour.

C. Attitudes
   1. cooperates with the lecturer,
   2. improves his/her knowledge by consecutive learning activities,
   3. open to use numerical software,
   4. makes effort to perform exact and error-free calculations,
   5. makes effort to understand the structural behavior of bridges and to acquire their design procedures,
   6. makes effort to apply cost-effective and sustainable structural solutions.

D. Autonomy and responsibility
   1. capable of designing and sizing the prestressing system of pre- or post-tensioned concrete bridges at basic level,
   2. able to determine the necessary minimum sizes of timber pedestrian bridges as well as to design and size the connections of these bridges at basic level,
   3. uses systematized thinking approach.

2.3 Methods

Lectures, individually performed homework (analysis and verification tasks), written and oral communication, use of IT tools and techniques.

2.4 Course outline

week:	Topics of lectures and/or exercise classes
1.	Typical cross-sectional forms of concrete superstructures.
2.	Prestressing in bridges I: General principles. Modification of internal forces by prestressing. Prestressing materials. Bonded and unbonded prestressing. Prestressing technologies (pre-tensioning, post-tensioning). Structural details, cable arrangement, anchorages.
3.	Precast concrete superstructures, change of structural system during execution, effect of long-term behaviour of concrete, continuity reinforcement.
4.	Design of a precast concrete bridge girder
5.	Prestressing in bridges II: Consideration of prestressing effect in analysis. Losses of prestress, design of beam end.
6.	Reinforced concrete slabs. Grid type and box girder bridges (modelling, torsional behaviour, models for the division of loads between main girders in transverse direction).
7.	Typical structural types of timber bridges. Timber truss bridges. Constructional principles, structural details
8.	Structural analysis of timber pedestrian bridges. Traffic loads from pedestrian traffic. Design for ultimate and serviceability limit states. Analysis of the main load-carrying structure for pedestrian and vehicle traffic as well as wind-induced vibration. Preliminary dynamic analysis of a timber pedestrian bridge
9.	Frame, arch, plate, hipped-plate and suspension timber bridges. Durability and fire resistance of timber bridges. Constructive timber preservation.
10.	Preliminary design of a post-tensioned box girder superstructure
11.	Modern construction methods for concrete girder bridges: incremental launching, segmental
12.	and monolithic balanced cantilever methods, other construction methods. Flow of forces, Transient design situations. Technology and auxiliaries.
13.	Cable-stayed bridges. Structural forms, flow of forces, modelling, structural details, construction method. Preliminary and detailed design. Dynamic effects and analysis methods.
14.	Arch bridges. Structural forms, flow of forces, modelling, structural details, construction method. Thrust line. Stability verifications.

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. Pipinato, A. (Ed.): Innovative Bridge Design Handbook – Construction, Rehabilitation and Maintenance, Elsevier, 2016, ISBN: 978-0-12-800058-8 (recommended)

b) Online materials

1. Structural analysis of a precast concrete superstructure (manual to homework)
2. Structural analysis of a post-tensioned box girder (manual to homework)

2.6 Other information

1) The homework focus on the most important structural verifications of a precast concrete and a post-tensioned box girder type superstructure. The homework shall be completed individually in steps (subtasks related to midterms) with oral consultation.
2) Solution of subtasks of homework are presented in exercise classes included in the official schedule. Attendance on these lectures is compulsory.

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 to the instructors.

II. SUBJECT REQUIREMENTS

3 ASSESSEMENT 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 homework (HW) during the semester and an oral exam at the end of the semester. The maximum points for the homework are 13 (HW1), 7 (HW2) and 10 (HW3) and those for the exam are 70. In total 100 points (100%) are acquirable.

3.2 Assessment methods

Evaluation form	abbrev.	**assessed learning outcomes**
Homework#1 (midterm evaluation)	HF1	A.1-A.3; B.1; C.1-C.6; D.1, D.3
Homework#2 (midterm evaluation)	HF2	A.5; B.3; C.1-C.6; D.2-D.3;
Homework#3 (midterm evaluation)	HF3	C.6
exam (synthetized evaluation)	V	A.1-A.5; B.1-B.3; C.1-C.6; D.1-D.3

The dates of midterm deadlines of homework can be found in the "detailed subject requirements" on the subject's website.

3.3 Evaluation system

abbreviation	**score**
HW	30%
exam	70%
Total	**100%**

3.4 Requirements and validity of signature

1) Attendance on at least 70% of lectures.
2) Successful submission of homework (min. 50%).

3.5 Grading system

The final grade is determined on the basis of acquired total points as follows:

grade	**points (P)**
excellent (5)	85<=P
good (4)	75<=P<85%
satisfactory (3)	65<=P<75%
passed (2)	50<=P<65%
failed (1)	P<50%

3.6 Retake and repeat

1) If the result of the homework submitted until the submission deadline set in the detailed subject requirements remains below 50% according to clause 3.4 above, the homework may be improved until the improvement deadline set in the detailed subject requirements but is subject to payment of repetition fee. The improved homework cannot be evaluated higher than 50%. Students submitting improved homework cannot take part in pre-exam.
2) The homework not submitted until the submission deadline set in the detailed subject requirements may be submitted until the retake deadline set in the detailed subject require-

ments but is subject to payment of repetition fee. Homework submitted after the submission deadline (retake of submission) cannot be improved and the related student cannot take part in pre-exam.

3) If the result of either improved or retaken homework remains below 50% according to clause 3.4 above, or when the improvement deadline has been missed, the signature of the subject shall be refused.
4) Improvement of already successful exam result is only possible in the last exam of the related semester.

3.7 Estimated workload

Total: 4 credits × 30 hours/credits = 120 hours/semester.

activity	**hours/semester**
contact hours	14×3=42
homework	22+12+18=52
preparation for the exam	26
in total	**120**

3.8 Effective date

September 1, 2017.