Reinforced concrete modelling - BMEEOHSDT81

I. Tantárgyleírás

1. Alapadatok

1.1 Tantárgy neve

Reinforced concrete modelling

1.2 Azonosító (tantárgykód)

BMEEOHSDT81

1.3 Tantárgy jellege

Kontaktórás tanegység

1.4 Óraszámok

Típus	Óraszám / (nap)
Előadás (elmélet)	2

1.5 Tanulmányi teljesítményértékelés (minőségi értékelés) típusa

Vizsga

1.6 Kreditszám

3

1.7 Tárgyfelelős

név	István Sajtos, PhD
beosztás	Egyetemi docens
email	sajtos.istvan@epk.bme.hu

1.8 Tantárgyat gondozó oktatási szervezeti egység

Hidak és Szerkezetek Tanszék

1.9 A tantárgy weblapja

https://epito.bme.hu/BMEEOHSDT81
https://edu.epito.bme.hu/course/view.php?id=2541

1.10 Az oktatás nyelve

angol

1.11 Tantárgy típusa

Ph.D.

1.12 Előkövetelmények

There are no subject prerequisites. Students participating in the course must be proficient in the design and analysis of reinforced concrete structures. The students should know the design principles and analysis methods of load-bearing structures based on Eurocode, and the basis of the finite element method. Intermediate English language knowledge is expected.

1.13 Tantárgyleírás érvényessége

2022. szeptember 1.

2. Célkitűzések és tanulási eredmények

2.1 Célkitűzések

The aim of the PhD course is to gain knowledge on fracture mechanics based numerical modelling of concrete and reinforced concrete structures. The course will introduce the elements of reinforced concrete numerical modelling with the practical application possibilities and limitations. The effects of concrete constituents on capacity and ductility and their possible numerical models will be discussed The fracture mechanics-based models of reinforced concrete are also introduced (linear elastic-, and non-linear fracture mechanics models). Students who complete the course gain knowledge in the following topics:

- numerical modelling possibilities of reinforced concrete structures;
- linear and non-linear behaviour of concrete structures;
- numerical models of cracks;
- models of secondary effects; strain softening, dowel action; creep and shrinkage; size effect; aggregate interlock;
- effect of concrete constituents on capacity and ductility of concrete,
- models of cracks based on linear elastic fracture mechanics;
- models of cracks based on nonlinear fracture mechanics;
- models of crack propagation.

2.2 Tanulási eredmények

A tantárgy sikeres teljesítése utána a hallgató

A. Tudás

1. knows numerical modelling techniques,
2. knows linear and nonlinear behaviour of concrete structures,
3. knows numerical modelling possibilities of cracks,
4. knows the secondary effects: strain softening, dowel action; creep and shrinkage; size effect; aggregate interlock,
5. knows the effects and modelling possibilities of concrete constituents on strength and ductility of concrete,
6. knows linear elastic fracture mechanics models of cracks,
7. knows nonlinear fracture mechanics models of cracks,
8. knows the criteria of crack propagation.

B. Képesség

1. able to apply numerical modeling techniques in practice,
2. able to design reinforced concrete structures based on a numerical model, selecting the appropriate model level and creating the numerical model,
3. able to carry out the designing of reinforced concrete structures based on the results of the numerical model, evaluate the results from a theoretical point of view,
4. able to model cracks in reinforced concrete structures and determine their effect on load-bearing

capacity.

C. Attitűd

1. cooperates with the teacher and fellow students during the expansion of knowledge,
2. open to using numerical tools,
3. pursue to use of advanced design methods,
4. strives for accurate and error-free task solutions,

D. Önállóság és felelősség

1. independently performs numerical modeling problems and designing of structures based on calculation results,
2. accepts and considers new designing procedures, their principles, and correctness with an open mind.

2.3 Oktatási módszertan

Lectures, practical analysis, communication in writing and orally, using IT tools and techniques.

2.4 Részletes tárgyprogram

Week	**Topics of lectures and/or exercise classes**
1.	Introduction: micro-, meso-, macro models of concrete, reinforced concrete
2.	Models of reinforced concrete - linear elastic models
3.	Models of reinforced concrete - nonlinear behaviour models (discrete crack model, smeared crack model)
4.	Models of reinforced concrete - nonlinear models (secondary effects: softening for tension and compression, the effect of confinement, tension stiffening, aggregate interlock, shear friction, dowel action, size effect, creep and shrinkage)
5.	Structure of cement and concrete and its effect on the strength and ductility - uniaxial compression
6.	Structure of cement and concrete and its effect on the strength and ductility - uniaxial tension
7.	Structure of cement and concrete and its effect on the strength and ductility - shearing
8.	Structure of cement and concrete and its effect on the strength and ductility - multiaxial stress state
9.	Fracture mechanics of reinforced concrete - linear elastic models
10.	Fracture mechanics of reinforced concrete - nonlinear models

11.	Fracture mechanics of reinforced concrete - approximate non-linear fracture models

A félév közbeni munkaszüneti napok miatt a program csak tájékoztató jellegű, a pontos időpontokat a tárgy honlapján elérhető "Részletes féléves ütemterv" tartalmazza.

2.5 Tanulástámogató anyagok

a) Books:

- S. Kumar - S.V. Barai: Concrete Fracture Models and Applications, Springer-Verlag, Berlin, 2011.
- J.G.M. van Mier: Fracture Processes of Concrete, CRC Press, 1997.
- B.L. Karihaloo: Fracture Mechanics of Concrete, Addison-Wesely Longman Ltd., 1995.
- A.R. Ingraffea: Computational Fracture Mechanics, Chp.11 in: ed. E Stein et al: Encyclopaedia of Computational Mechanics, Vol.2: Solids and Structures, John Wiley and Sons, 2004.
- R. Lackner et al: Computational Concrete Mechanics, Chp.15 in: ed. E Stein et al: Encyclopaedia of Computational Mechanics, Vol.2: Solids and Structures, John Wiley and Sons, 2004.
- Structural Concrete: Journal of the fib

b) Downloadable materials:

- Slides of lecture materials
- Kármán T.: Mitől függ az anyag igénybevétele? Magyar Mérnök és Építészegylet Közlönye, 44 (10), 1910, p.212-226.

2.6 Egyéb tudnivalók

2.7 Konzultációs lehetőségek

Appointments for consultation:

according to the announcement on the department’s web page, or

asking for an appointment in e-mail; e-mail: sajtos.istvan@epk.bme.hu

Jelen TAD az alábbi félévre érvényes:

Inactive courses

II. Tárgykövetelmények

3. A tanulmányi teljesítmény ellenőrzése és értékelése

3.1 Általános szabályok

The evaluation of the learning outcomes stated in point 2.2 is done on the basis of a project task (report) and the result shown in the exam.

3.2 Teljesítményértékelési módszerek

Evaluation form	Abbreviation	Assessed learning outcomes
Homework – project task (report)	HW	A.1-A.8; B.1-B.4; C.1-C.4; D.1-D.2
Exam (performance evaluation)	E	A.1-A.8; B.1-B.4; C.1-C.4; D.1-D.2

The time of the evaluations held during the semester is in the "Semester schedule", which is available on the subject's website.
A szorgalmi időszakban tartott értékelések pontos idejét, a házi feladatok ki- és beadási határidejét a "Részletes féléves ütemterv" tartalmazza, mely elérhető a tárgy honlapján.

3.3 Teljesítményértékelések részaránya a minősítésben

Abbreviation	Score
HW	20%
Sum during the semester	**20%**
E	80%
Sum	**100%**

The condition for passing the subject is that the student achieves 50% of the scores on the homework.
Insufficient performance in the exam will result in a fail grade.

3.4 Az aláírás megszerzésének feltétele, az aláírás érvényessége

The condition for obtaining the signature is that, according to point 3.3, the student achieves at least 50% of the points that can be obtained during the semester on the homework.
Mid-semester results previously obtained from the subject, which can be taken into account when determining the exam grade, can be accepted for up to 6 semesters.

3.5 Érdemjegy megállapítása

The grades of those who meet the attendance requirements are determined according to the following criteria:
The final grade is calculated based on the weighted average of the homework and the exam according to point 3.3:

Grade	Points (P)
excellent (5)	80<=P
good (4)	70<=P<80%
satisfactory (3)	60<=P<70%
passed (2)	50<=P<60%
failed (1)	P<50%

3.6 Javítás és pótlás

According to the Study Rules.

3.7 A tantárgy elvégzéséhez szükséges tanulmányi munka

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Activity	**Hours/semester**
attendance of the lectures	12×2=24
preparing project task	36
self- learning of written course material	6
preparing for exam	24
Sum	**90**

3.8 A tárgykövetelmények érvényessége

2022. szeptember 1.

Jelen TAD az alábbi félévre érvényes:

Inactive courses