Modelling of railway tracks - BMEEOUVDT83

I. Subject Specification

1. Basic Data

1.1 Title

Modelling of railway tracks

1.2 Code

BMEEOUVDT83

1.3 Type

Module with associated contact hours

1.4 Contact hours

Type	Hours/week / (days)
Lecture	2

1.5 Evaluation

Exam

1.6 Credits

3

1.7 Coordinator

name	Dr. Liegner Nándor
academic rank	Associate professor
email	liegner.nandor@emk.bme.hu

1.8 Department

Department of Highway and Railway Engineering

1.9 Website

https://epito.bme.hu/BMEEOUVDT83
https://edu.epito.bme.hu/course/view.php?id=2567

1.10 Language of instruction

english

1.11 Curriculum requirements

Ph.D.

1.12 Prerequisites

1.13 Effective date

1 September 2022

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2. Objectives and learning outcomes

2.1 Objectives

The aim of the course is to model the superstructure of the railway track with FEM softwares with regards of load bearing capacity and stability of the track. Laboratory tests are to carry out so the results serve as basis of the FEM models. The students will get acquainted with the methods of the use and stability testing of the railway superstructure in addition to the latest developed track structures. After completing the course, they are able to determine the behavior of the various superstructures, the relationship between the bridges and the superstructure. Participants can also listen to case studies related to state-of-the-art superstructures.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge

1. knows the most important superstructure dimensioning procedures,
2. knows the latest developed superstructure elements, their background,
3. knows the internal forces of a CWR track,
4. knows how to model the loads transferred to the track during deceleration and acceleration of trains
5. is familiar with the superstructure solutions of bridges, in connection with this, the types of rail expansion devices and their location on bridges,
6. knows the theoretical background and technical solutions of the transitional sections formed at the connection of the bridges and the earthwork.
7. is familiar with the theoretical background and modelling methods of the lateral stability test of the track.

B. Skills

1. be able to form an opinion on superstructure dimensioning procedures,
2. is able to determine the relevant loads using FEM models even in more complex cases,
3. be able to determine the forces and displacements in a CWR superstructure in both crushed stone and flexible bearing tracks as well as in the case of a rail with expansion device,
4. able to compile gap tables,
5. able to model track stability testing,
6. able to model load bearing capacity of railway track structural elements such as rail-joints, rail fastenings, sleepers and ballast bed, embedded rail superstructure, etc.

C. Attitudes

1. cooperates with the instructor in the preparation of partial performance evaluations,
2. strives for an accurate and error-free solution,
3. strives for precise, professional wording in its oral and written statements,
4. In the course of its written performance evaluations, it strives to produce orderly documentation of the

quality and appearance expected at the researcher level.

D. Autonomy and Responsibility

1. prepare responsibly for the successful completion of performance appraisals,
2. perform the tasks issued during the independent partial performance assessments independently and to the best of his / her knowledge,
3. openly welcomes substantiated critical remarks.

2.3 Methods

Lectures and laboratory tests with presentations, self-made home planning assignment, written and oral communication: performance evaluation, exam, and active participation in contact classes.

2.4 Course outline

Week	**Topics of lectures and/or exercise classes**
1.	Development and evaluation of railway superstructure dimensioning procedures. Use of the Zimmermann-Eisen mann superstructure sizing method.
2.	Presentation of the latest rail fastening systems and track structures, developments (case study).
3.	Building up FEM models to model the load bearing capapcity of the railway tracks. Computation of internal forces in the track.
4.	Laboratory test to measure the static and dynamic stiffness of rail fastening systems and investigate the effect of stiffness on the internal forces of the track by FEM models.
5.	Longitudinal forces in the CWR superstructures. Determination of rail end motion in case of a superstructure with crushed stone and in case of slab tracks. Modeliing oneway change of temperature and return change of temperatue.
6.	Laboratory test on determining the longitudinal rail restraint of different types of rail fastenings. Effects of rail clips with reduced and increased longitudinal rail restraint.
7.	Modelling the effect of reduced and increased longitudinal rail restraint on expansion of the rail with FEM models in case of ballasted tracks and concrete slab tracks.
8.	Types of rail expansion devices. Calculation of gap tables, factors influencing its design. Structures of bridges, static layouts. Longitudinal forces arising from the movement of bridges in the rail and on the supports. Effect of loaded and unloaded superstructure. Case study.

9.	Modelling the effects of breaking and acceleration forces of trains, superimposed on effects of change of temperature.
10.	Expansion behavior of rail fiber embedded in elastic material. More accurate determination of inhibited dilatation based on experimental resistance curves. Effect of train start - up and braking.
11.	FEM modelling of flexible transition sections between bridges and CWR tracks. Case study on the behavior of bridge structures.
12.	Stability of CWR tracks against buckling, factors influencing stability. The equation of equilibrium. Options for increasing resistance of ballast bed.
13.	Modelling stability of CWR tracks.
14.	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

Coenraad Esveld: Modern Railway Tracks, Digital Edition 2014, version 3.1, ISBN 978-1-326-05172-3

2.6 Other information

2.7 Consultation

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 formulated in point A is based on two homework assignments (continuous independent partial performance assessment).

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Homework (small homework, one-time partial performance evaluation	HW	A.2-A.3
Written exam (summary performance evaluation)	E	A.1-A.7; B.1-B.6

The actual place and date of the assessments carried out in the active period, the dates of handing out and handing in the homeworks are contained in the "Detailed schedule of the semester", that is available on the website of the subject.
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
HW	20
Exam	80
Sum	**100%**

3.4 Requirements and validity of signature

3.5 Grading system

Grade	Points
excellent (5)	87.5
good (4)	75
satisfactory (3)	62.5
passed (2)	50
failed (1)	0

3.6 Retake and repeat

3.7 Estimated workload

Activity	Hours/semester
participation in contact classes	28
homework preparation	30
preparing for the exam	32

Sum	**90**

3.8 Effective date

1 September 2022

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Inactive courses