
Railway Track Engineering

Course Title: 轨道工程

Course Name: Railway Track Engineering

Course Disciplines: Engineering , Road and Railway Engineering

Professional - oriented : Civil Engineering

Course code:

Credits: 3

Hours: 51

Course mission and purpose : Railway track is an important professional courses of track professional. Enable students to master the basic concepts 、 the basic theory and methods of computation of the railway track structure and the railway engineering; Master the composition and function of the track structure , the overturning stiffness of track, orbital mechanics calculations, [unballasted track](#) structure, the basic principle and design computation of jointless line, basic theory of track maintenance and curve Realignment. Understand the design, construction and operation of the railway track work , engaged in railway engineering design , construction, maintenance and repair and technical management of the basics. Develop students' ability to solve practical engineering problems , provide the necessary basis for the future in transportation and civil engineering work and further learning

Course Description: The course content consists of the basic structure of the railway track , track structure mechanics analysis , jointless track , track maintenance and management of contents constitute . Railway track basic structure of the ballasted track and unballasted track structure , characteristics, function ; The analysis of track structure mechanics include the basic principles of applied mechanics , wheel-rail interaction theory, analyze the track and its components in the vehicle loads generated stress, deformation , and other dynamic response With a variety of computational model; Jointless track include the type of the basic principles of Jointless track, analysis of the forces of Jointless track temperature force with the basic principles of applied mechanics,combined with the calculation to determine the stability of Jointless track ; Track maintenance and management, including track inspection , line maintenance and management , line overhaul and management .

Prerequisite: Math class foundation courses,mechanics foundation courses , engineering geology , engineering surveying , construction materials , civil engineering test and measurement technology,civil engineering drawings , bridge engineering , tunneling and foundation engineering

Means and methods of teaching : classroom teaching, classroom large operations

Basic teaching hours arrangements

Chapter 1 Overview of Track Structure (2 hours)

1 . Learning requirements

- 1) know : various parts of the structure in ballasted track structure;
- 2) know : Understand the ordinary rail line reserved for the calculation of rail joints , sleeper spacing knowledge ;
- 3) understand: the basic components of the ballasted track structure ;
- 4) understand: the functions of the various components in the ballasted track structure .

2. Teaching main content

- 1) rail functions , basic requirements and manner of hurt

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- 2) Fasteners and rail joints
 - 3) The sleeper structure and arranged

Chapter 2 the overturning stiffness of track

1 . Learning requirements

- 1) know : Purpose and how to set of superelevation of outer rail on curve.
- 2) master : Basic elements, meaning and standard of straight-line track geometry
the basic elements of the straight-line track geometry , meaning its standards .
- 3) master : geometric spaces and the main features of the straight and curved track .

2 . Teaching main content

- 1) the basic concepts and requirements of the track geometry
- 2) geometrical of straight track
- 3) curved track gauge widening
- 4) curve track outer rail ultra-high
- 5) transition curve

Chapter 3 orbital mechanics analysis(10 hours)

1 . Learning requirements

- 1) know : the purpose of orbital mechanics analysis and role of force in orbit .
- 2) familiarize : the knowledge of the orbital dynamics , the derailment of the vehicle conditions .
- 3) master: two types of static analysis model and method of ballasted track structure vertical force , the quasi-static solution method .
- 4) master : Track parts, especially force calculation of the rails, sleepers and bed .

2 . Teaching main content

- 1) Ballasted track continuous support beam theory , track quasi-static calculation
- 2) strength calculation of Track Parts
- 3) Brief introduction of fasteners Mechanical analysis , Vehicle Derailment conditions , orbital dynamics
- 4) Curriculum design of orbital component strength

Chapter 4 unballasted track (4 hours)

1 . Learning requirements

- 1) master : the needs of the unballasted track on the high-speed railway;
- 2) master : the composition and characteristics of China 's main unballasted track structure .

2 . Teaching main content

- 1) unballasted track structure characteristics
- 2) unballasted track structure type
- 3) unballasted track fasteners
- 4) unballasted track mechanical analysis

Chapter turnout 5 (6 hours)

1 . Learning requirements

- 1) know : the key technologies and the main structure of the high - speed turnouts , general

laying method of turnout ;

2) master : determine principles of geometry and basic requirements of single switch;

3) master: the calculation method of the geometric dimensions in the general arrangement plans of single switch.

2 . Teaching main content

1) Function and type of turnout

2)single switch structure

3) single switch geometry

4) single switch layout calculation

5) through turnout speed and measures to improve turnout speed

6) high-speed turnouts Profile

7) Turnout and maintenance.

Chapter 6 Jointless track (12 hours)

1 . Learning requirements

1) know: the type and working principle of the Jointless track

2) understand : the Jointless track in temperature force distribution .

3) master: Jointless track stability analysis .

2. Main teaching content

1). Basic concept and basic principle of CWR

2). Stability analysis of CWR

3). Design the ordinary CWR

4). CWR on bridge

5). Technology of Cross sectional CWR

Chapter 7 Railway maintenance and management (10 lessons)

1. Learning requirements

1) Realize: the main contents track maintenance, track overhaul and comprehensive maintenance

2) Comprehend: content and function of track inspection. The main content is testing content and testing method of track geometry

3)Master: content and track requirement part stateful inspection

2. Main teaching content

1) Track detection technology

2) Track quality state evaluation

3) Track maintenance and management

4) Track overhaul and management

5) Shortened track

Teaching basic requirements of this course

The teaching program of this course includes: teaching in classroom, doing tests, homework, Course design and examination and so on.

1. Teaching in classroom: teaching method will use “Teachers' guidance, interaction between teachers and students”. Teachers try to use the students' intuitive feel of track structure to guide

them. And teacher could use the multimedia tools to assist teaching, in order to enhance the students' thirst for knowledge, play to their subjective initiative. The following points should be paid attention to with teaching.

(1) Pay attention to master the knowledge system from the internal logic relations

Railway track is important professional foundation course of Railway and Road Projects. In this Syllabus, it composes of Railway track structure, Mechanics analysis of track structure and maintenance and management of the CWR. The relationship of the structure is:

Railway track structure is the basic part of railway structure. This part mainly introduces the basic structure of track structure; it will guide students to deepen the understanding and the understanding of track structure step by step. This part is the foundation and subject of this course.

Mechanics analysis of track structure, this part elaborates on track structure mechanics analysis. It wills analysis of track structure in locomotive vehicle dynamic behavior in different operating conditions. By checking the main components of the intensity, we can strengthen the weak links, optimize of track working state, improve capacity of track, find the optimum matching design of the track structure, and offer the theory basis for track structure reasonable matching and design and development of new types of track structure and materials.

Each part of this course, the knowledge structure, there is a close inner link. When learning this course, students must grasp knowledge system firstly; unify the basic theory, basic method within the logical system. Digest and master the comprehensive system. Avoid to rote learning individual conclusions, concepts, and terminology

(2) To attach importance to integrate theory with practice

Railway track is strong practical and theoretical course. So students should pay attention to the combination of theory with practice in the whole process of learning. Guided by the basic theory, students should use the basic methods and techniques to analyze and solve practical problems of railway track. So that making the knowledge turns into application ability to analyze and solve problems.

(3) In order to consolidate and deepen the understanding of what they have learned basic theoretical knowledge, cultivate students' ability to analyze and solve problems, this course should arrange a number of courses design assignments and questions. Request the student to the understanding of several kinds of common theory the track structure calculation, so that they can do basic structure calculation and design

2. Practical training: In the process of teaching, teachers should adopt the method of theory with practice to training students, including the site visit teaching, etc.

3. Homework: Mainly including exercises after class and curriculum design. Homework should be use the time after class to complete. When one chapter gives out, students need to complete 3~5 exercises after class. Students can choose one direction according to their own interest in this course to finish curriculum design and submit report, at a week before the final exam.

4. Examination: This course which is closed book exam courses. The final exam content is based on the teaching syllabus and the review request. The difficulty and the number of questions are moderate. Test scores: 100, giving consideration to the final scores and regular grade.

Textbooks and reference books

Recommended testbook:

Li Chenghui, 轨道, SWJTU Press, 2010

Reference books:

- (1) YiSiron, 铁道工程（第二版）, China Railway Press, 2009
- (2) LianSongliang, 轨道工程, Tongji University Press, 2006

Evaluation mode

The written test and homework

Copywriter: Ren, Juanjuan Audit:

轨道工程

课程名称: 轨道工程

课程英文名称: Railway Track Engineering

课程学科类别: 工学, 道路与铁道工程

面向专业: 土木工程

课程代码:

学分: 3

学时: 51

课程任务与目的: 铁路轨道是轨道专业的一门重要的专业必修课。使学生掌握铁路轨道结构及工务工程的基本概念、基本理论和基本计算方法;掌握轨道结构组成及功用、轨道几何形位、轨道力学计算、无砟轨道结构、道岔结构及布置计算、无缝线路基本原理及无缝线路设计检算、线路维修的基本理论及曲线整正等方面的知识;了解铁路轨道设计、施工和运营的基本工作内容,获得从事铁路工程设计、施工、养护维修及技术管理方面的基本知识,培养学生解决实际工程问题的能力,为今后从事交通土建工程工作和进一步学习奠定必要的基础

课程主要内容: 本课程的教学内容由铁路轨道基本结构、轨道结构力学分析、无缝线路、轨道维护及管理等内容构成。铁路轨道基本结构包括有砟轨道和无砟轨道的结构组成、特点、功用;轨道结构力学分析包括应用力学的基本原理,结合轮轨相互作用理论,用各种计算模型来分析轨道及其各部件在车辆荷载作用下产生的应力、变形及其他动力响应;无缝线路包括无缝线路的基本原理和类型,应用力学基本原理分析无缝线路在温度力作用下的受力情况,结合计算确定无缝线路的稳定性;轨道维护及管理包括轨道检测、线路维修及管理、线路大修及管理。

先修课程: 数学类基础课程、力学类基础课程、工程地质、工程测量、建筑材料、土木

工程试验与量测技术、土木工程制图、桥梁工程、隧道工程和基础工程

教学手段与方法：课堂多媒体教学，课堂大作业

基本教学内容与学时安排

第1章 轨道结构概述（2 课时）

1. 学习要求

- 1) 了解：有砟轨道结构中各个部件的结构形式；
- 2) 了解：了解钢轨中普通线路预留轨缝的计算，轨枕间距计算等有关知识；
- 3) 掌握：有砟轨道结构的基本组成；
- 4) 理解：有砟轨道结构中各个部件的功能。

2. 教学主要内容

1. 钢轨的功能、基本要求及伤损
2. 扣件及钢轨接头
3. 轨枕结构与布置

第二章 轨道几何形位（2 课时）

1. 学习要求

- 1) 了解：曲线外轨设置超高的目的及其设置方法。
- 2) 掌握：直线轨道几何形位的基本要素、含义及其标准。
- 3) 掌握：直线和曲线轨道的几何形位及主要特征。

2. 教学主要内容

1. 轨道几何形位的基本概念及要求
2. 直线轨道的几何形位
3. 曲线轨道轨距加宽
4. 曲线轨道外轨超高
5. 缓和曲线

第三章 轨道力学分析（10 课时）

1. 学习要求

- 1) 了解：轨道力学分析的目的以及作用于轨道上的力。
- 2) 熟悉：轨道动力学、车辆的脱轨条件等有关知识。

3) 掌握：有砟轨道结构竖向受力的两种静力分析模型及求解方法，准静态求解方法。

4) 掌握：轨道各部件，特别是钢轨、轨枕及道床的受力计算。

2. 教学主要内容

1. 有砟轨道连续支承梁理论、轨道准静态计算
2. 轨道部件强度计算
3. 扣件力学分析、车辆脱轨条件、轨道动力学简介
4. 轨道部件强度课程设计

第四章 无砟轨道（4 课时）

1. 学习要求

- 1) 掌握：高速铁路对无砟轨道的需求；
- 2) 掌握：我国主型无砟轨道的结构组成及特点。

2. 教学主要内容

1. 无砟轨道结构特点
2. 无砟轨道结构类型
3. 无砟轨道扣件
4. 无砟轨道力学分析

第五章 道岔（6 课时）

1. 学习要求

- 1) 了解：高速道岔的关键技术及主要结构，道岔的一般铺设方法；
- 2) 掌握：单开道岔各部分几何尺寸的确定原则及基本要求；
- 3) 掌握：单开道岔总布置图中各项几何尺寸的计算方法。

2. 教学主要内容

1. 道岔的功用及类型
2. 单开道岔的构造，
3. 单开道岔的几何尺寸
4. 单开道岔总布置图计算
5. 过岔速度和提高过岔速度的措施
6. 高速道岔简介
7. 道岔铺设及养护

第六章 无缝线路（12 课时）

1. 学习要求

- 1) 了解：无缝线路的类型和工作原理
- 2) 理解：无缝线路中的温度力分布。
- 3) 掌握：无缝线路的稳定性分析。

2. 教学主要内容

1. 无缝线路的基本概念和基本原理
2. 无缝线路稳定性分析
3. 普通无缝线路的设计
4. 桥上无缝线路
5. 跨区间无缝线路技术

第七章 轨道维护及管理（10 课时）

1. 学习要求

- 1) 了解：线路维修、大修及综合维修的主要内容
- 2) 理解：轨道检测的内容及作用，主要有轨道几何形位检测的内容及检测方法
- 3) 掌握：轨道部件状态检测的内容和各部件状态检测的要求

2. 教学主要内容

1. 轨道检测技术
2. 轨道质量状态评价
3. 线路维修及管理
4. 线路大修及管理
5. 缩短轨计算

课程的教学基本要求

本课程的教学环节包括教学环节主要包括：课堂讲授、实验、作业、课程设计、考试等。

1. 课堂讲授：采用“教师引导、师生互动”的授课方式，授课过程中，任课老师利用学生对铁路轨道结构的直观感受进行引导，并借助多媒体工具辅助教学，以增强学生的求知欲，发挥其主观能动性。在课堂教授中，应注意以下要点：

(1) 要注意从内在逻辑关系上掌握知识体系

“铁路轨道”是铁路与道路工程的重要专业基础课程。在本考纲中，它由铁路轨道结构、轨道结构力学分析、无缝线路和轨道维护及管理有机部分构成完整的知识体系。其结构关系是：

铁路轨道结构部分，即铁路轨道结构所具有的基本部件。该部分主要介绍了轨道结构基本组成结构，引导学生逐步加深对轨道结构的认识和理解，这一部分是本课程的基础也是本课程的主体。

轨道力学分析，该部分具体阐述轨道结构涉及的力学分析，分析轨道结构在机车车辆不同运营条件下所发生的动态行为，对主要部件进行强度检算，以便加强轨道薄弱环节，优化轨道工作状态，提高轨道承载能力，对轨道结构参数进行最佳匹配设计，为轨道结构的合理配套和设计开发新型轨道结构类型及材料提供理论依据。该部分是设计、检算和改进轨道结构的理论基础。

本课程知识结构的各个部分，存在着密切的内在联系。学习时，必须首先抓住知识体系，把基本理论、基本方法统一在逻辑系统内，循序渐进，纵横联系，全面系统地加以消化和掌握，切忌孤立地死记硬背个别结论、概念和术语。

(2) 要重视理论联系实际，学以致用

“铁路轨道”是实践性和理论性都强的课程。因此，在学习的整个过程中都应重视理论与实际的结合，学以致用。以基本理论为指导，运用基本方法和技术去分析和解决铁路轨道工程中的实际问题，从而使知识转化为分析问题和解决问题的能力。

(3) 为巩固和加深理解所学的基础理论知识，培养学生分析问题和解决问题的能力，本课程应安排一定数量的课程设计作业和思考题。要求学生在理解几种常见的轨道结构计算理论的基础上，能进行基本的结构验算和设计。

2. 实训：在课程教学的过程中，采取理论联系实际的方式对学生进行实训，主要包括现场参观教学等。

3. 作业：主要包括课后习题和课程设计，作业需利用课堂授课之余的时间来完成，每个章节授完，学生需完成 3~5 个课后习题，并在期末考试前一周，学生可根据自己的兴趣选择本课程中一个方向进行课程设计并提交报告。

4. 考试：本课程考试为闭卷考试课程。期末考试内容以教学大纲和本课程的考核复习要求为依据，难度适中，题量适度。考试成绩：满分 100 分，兼顾期末成绩与平时成绩。

教材及参考书

建议教材：

李成辉主编，《轨道》，西南交通大学出版社，2010年版

参考教材：

(1) 易思蓉主编，《铁道工程（第二版）》，中国铁道出版社，2009年版

(2) 练松良主编，《铁道工程》，同济大学出版社，2006版

考核方式

书面考试+作业

撰稿人：任娟娟 审核：



西南交通大学轨道实验室