



MSc Programme

## Railway Engineering and Operations

### Shaping the future of railways worldwide

Diploma	Master of Science
Certificate	Annotation Railway Systems
Credits	120 ECTS, 24 months
Starts in	September
International students	35%
Language of instruction	English

#### Faculties involved

- Civil Engineering and Geosciences
- Technology, Policy and Management
- Materials Science and Engineering

#### Introduction

Railways are complex systems. Infrastructure, rolling stock, operations, safety and policy all need to be integrated. Rail transport is the fastest and most reliable way of transportation, used more than any other way of public transport worldwide. Keeping the system up and running, brings many challenges each day. Anticipating on the changing demands asks for continuous innovation, co-operation and a long-term vision.

Railway systems facilitate passenger and freight transportation, within cities and on both national and international scale. To stay competitive to other ways of transportation, it must be fast, safe, comfortable and cost effective. Railway engineers can only address this permanent challenge when they are equipped with integral knowledge, covering all involved disciplines and aspects.

#### New Master Annotation

The annotation Railway Systems has been developed to provide the industry with scientifically trained engineers. Knowledge of the entire railway system is vital to deal with the challenges of today and tomorrow. Due to retirements, the railway sector is losing its skilled professionals rapidly. Therefore, a significant demand exists for well-trained engineers that can create, test and validate our future railway networks.

Delft University of Technology is well known for its wide range of railway education and research. This new rail annotation provides an opportunity for students of various Master's profiles to add a fundamental set of railway courses to their curriculum. From a systems approach, integrating operations and engineering, you will be prepared to become a certified railway expert.

# Curriculum

The annotation Railway Systems consists of the following components:

- **Compulsory courses** (8 ECTS)
- **Elective courses** (14 ECTS or more)
- **Graduation thesis** on rail related topic (30-40 ECTS, depending on Master's programme)

1 ECTS = 28 hrs study, according to the European Credit Transfer System (ECTS)

One academic year is 60 ECTS; Always check the latest info about the courses in Study Guide of TU Delft ([studiegids.tudelft.nl](http://studiegids.tudelft.nl)).

## Compulsory

**CIE5826**  
Railway Operations  
and Control  
4 ECTS - Q3

**CIE4874**  
Elements of Railway  
Engineering  
4 ECTS - Q2

## Electives

**CIE4811**  
Planning & Operations  
of Public Transport  
6 ECTS - Q1

**CIE4870**  
Structural Design of  
Railway Track  
4 ECTS - Q3

**CIE4871**  
Design and Maintenance  
of Railway Vehicles  
4 ECTS - Q4

**CIE5803**  
Railway Traffic  
Management  
4 ECTS - Q4

**CIE4873**  
Wheel Rail Interface  
4 ECTS - Q4

**CIE5874**  
Life-Cycle Performance  
by Design of R. Asset  
4 ECTS - Q1

**TPM004A**  
Transport Safety  
4 ECTS - Q1

**CIE5871**  
Capita Selecta  
4 ECTS - Q4

**CIE5875**  
Railway Asset  
Management  
4 ECTS - Q1

## Operations

## Engineering



**Prof. Rolf Dollevoet**  
Professor of Railway Engineering

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To build a better, safer train system, starting one step ahead in railways is necessary. This is not based on just a good idea. The idea must be worked out in a research based environment and it must be business case balanced. Also a stakeholder analysis needs to be carried out for technological innovation to be proved and implemented. Most people focus only at the technology on its own, but railway systems are more complicated. It takes time to develop, prove and implement new ideas in general. The aim for better rail transport starts with understanding the basics and relationship between the multiple assets in the railway system.

As a Master's student, you will work on every day railway challenges. Our Railway Engineering group will guide you to find a scientifically based answer to solve such cases during your study, and thus bring knowledge into practice in a unique academic environment. Our leading researchers, rail laboratory and TU Delft measurement train (CTO) will facilitate you to bring out the best innovations and creative techniques. In close cooperation with the railway industry, our team works towards smarter railway systems to stay one step ahead of tomorrow's demands. Develop an idea and challenge yourself. Create, test and validate; your ticket for a professional career in railways!

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## Compulsory Courses

### **Elements of Railway Engineering**

Understanding of the basic principles of railway systems, which include both the railway track and rolling stock, is essential for all railway related activities, such as design of railway systems, management of railway asset, policy making etc. In this course the main elements of railway infrastructure and rolling stock, their functions and main features as well as the basics of track power supply and railway asset management will be explained.

### **Railway Operations and Control**

The focus in this course is on the interaction between the various elements of railway systems (rolling stock, tracks, signalling, etc.) and on the fundamentals of railway safety, which have a major impact on the design and performance of railway operations. Important in this course is the collaboration between the technical and organisational systems when it comes to analysis operations and control.

## Operations Electives

### **Planning & Operations of Public Transport**

Understanding the multi-level structure and development of public transport systems are necessary to design public transport networks and timetables. This course gives knowledge and insight in the function of strategic, tactical and real-time operations of public transport systems.

### **Railway Traffic Management**

A big challenge in railway traffic planning is to design a good timetable, in which all trains can run conflict-free over the network. To let this timetable work, traffic real-time management is needed. This course is dedicated to planning and real-time management of railway traffic, to avoid disturbances.

### **Transport Safety**

This course deals with the structure and development of the concept of safety and risk control with respect to railway and aerospace systems. The course presents a systematic approach towards safety in different modes of transportation with the main focus on rail, integrated in traffic design and management.

## Engineering Electives

### **Structural Design of Railway Track**

This course will provide deeper knowledge on the static and dynamic behaviour of railway tracks; hands-on experience with analytical, engineering and numerical methods like Finite Element and Multi-body based software. Finally, gained knowledge is applied to solve a given real-life railway track related problem.

### **Design & Maintenance of Railway Vehicles**

The design and maintenance of vehicles have a direct impact on comfort of passengers, health conditions of tracks and vehicles, but also on operational safety. The course focuses on the vehicle dynamics; vibration, derailment and stability are discussed in relation to the railway track through wheel-rail contact.

### **Wheel-Rail Interface**

This course concerns the theoretical and the practical aspects of wheel-rail interface. The course starts with everyday observations in the railway system that clarify what wheel-rail interface is, why it is so important and where the challenges lie in Railway Engineering.

### **Railway Assets: Performance by Design**

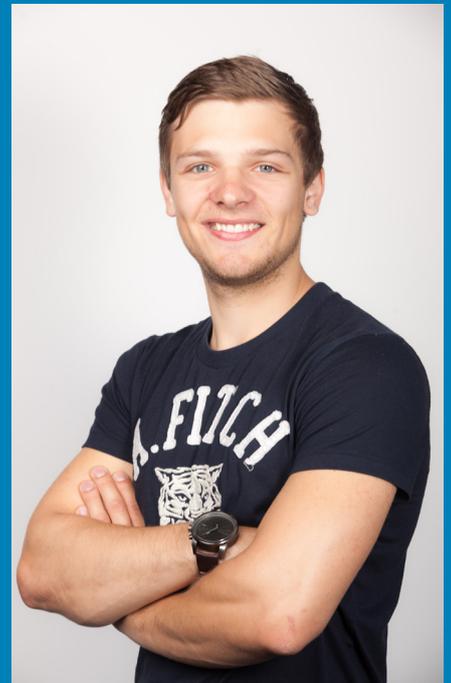
Increasing demands on railways introduce a critical design challenge: from static design with functional specifications towards life-cycle performance based design. This course develops the engineering basis of such a design, with a focus on the interface between dynamics and material behaviour.

### **Capita Selecta**

The main objective of this course is to bring students into contact with professionals from the railway industry that are involved in big infrastructural projects. The course consists of a series of guest lectures and discussions reflecting different topics and area's of expertise.

### **Railway Asset Management**

Railway assets (infrastructure and rolling stock), have a long life expectation if well managed. By avoiding premature termination of assets, the life span of railway systems can be extended. The goal of this course is systematic and in-depth training on asset management, to reach best performance.



## **Bojan Bogojević**

Civil Engineering (The Netherlands)

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Hello! My name is Bojan Bogojević (Serbian roots), finishing a Bachelor's degree in Civil Engineering at the TU Delft.

As a child I always had a strong interest for vehicles: buses, trucks, airplanes and also trains. Because of this strong interest, in 2015 I realised one of my dreams: to be a coach driver. Due my age of 19 years at that time, I was the youngest coach driver in The Netherlands.

Recently, I decided to do the minor 'Bend and Break', including a course about railway transition zones (e.g. between a bridge and regular track). Due to sloppy soil in The Netherlands, regular track is lowering all the time while bridges are well-founded. This results in a height difference, which causes big problems. During this course I learned that railways are complex dynamic systems, which was new and very interesting to me since civil structures are mostly static.

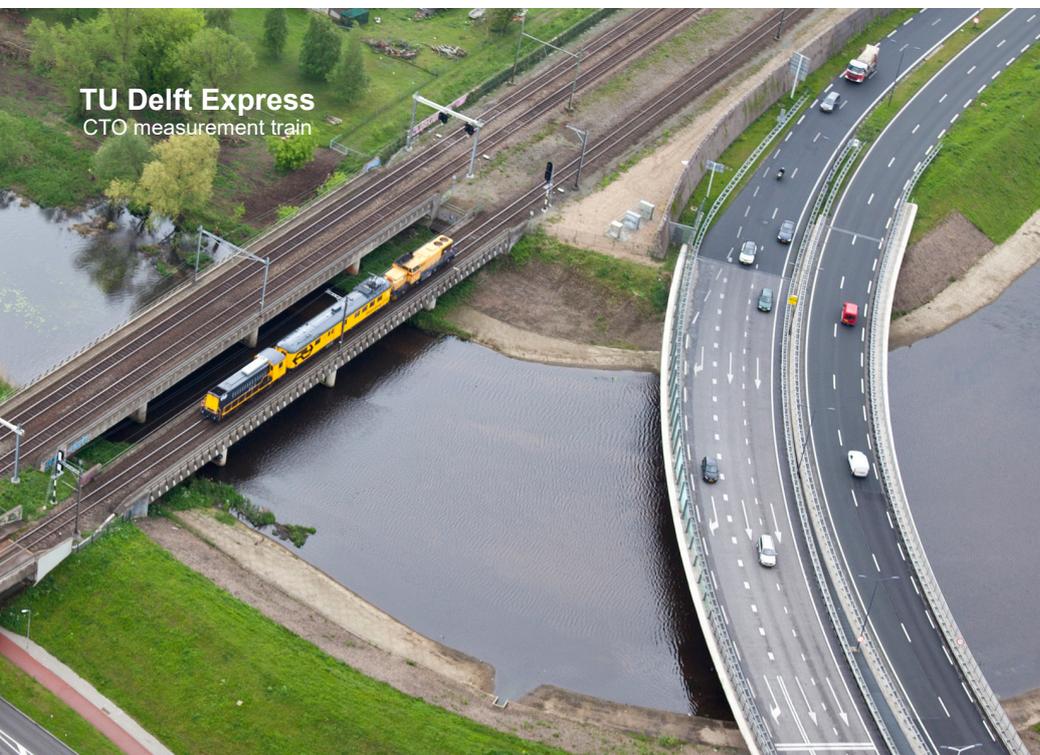
After the minor course, I became strongly interested in Railway Engineering. Since I already succeeded the railway course in the Bachelor, I decided to apply as a student-assistant for the railway department.

I got in touch with the TU Delft measurement train (CTO), assisting researchers with various tasks concerning different ways of monitoring tracks. Think about placing new sensors, executing measurements (while driving of course) and data processing. From this, I gain a lot of knowledge about railway systems, but also about measuring and data processing in general.

Because of the university having its own train, it is easily accessible for students. In this way, fundamental theories can be transformed into a hands-on experience, which I experienced as very important.

Next year I will start my Master's in Rail. The new rail annotation is a great way to broaden my knowledge and learn more about this complex field of expertise.

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**TU Delft Express**  
CTO measurement train

## Objective, MSc integration and admission requirements

### Objective of the Annotation

The primarily goal of the annotation Railway Systems is to create MSc programmes that cover both Railway Engineering and Railway Operations. Railways are complex, combining multidisciplinary aspects from subsystems of infrastructure, operations, management, safety and policy. The railway infrastructure (track, power supply, rolling stock, safety and signalling) should facilitate the desired railway operations (train services, traffic density, heterogeneity, synchronisation, speed) based on the transportation demands. Future railway engineers should have an integral knowledge on the whole system and interactions between subsystems.

### Cooperation with the industry

The railway sector has a big demand for scientifically educated engineers with a broad knowledge of the whole railway system. With this rail annotation, new railway engineers can easily find employment in the diverse railway sector; fields like railway administrator, railway operators, urban rail transit, engineering and consultancy, contractors and within the government. Various railway related companies are closely involved in the setup of our education, so we make sure our lectures, projects and cases reflect reality.

### Leading in the world

The railway engineering group at TU Delft is internationally renowned for its research and has strong connections with universities all over the world. A team of forty specialists continuously researches railway infrastructure and rolling stock, to improve the train, tram and metro networks of today and tomorrow. Innovations come from combining knowledge, experience and collaboration and at TU Delft this comes together.

### Integration within the MSc Curricula

The annotation Railway Systems can be integrated within various MSc programmes. In consultation with our academic staff it is also possible to personalise your curriculum and follow our courses and annotation within Master degrees from other faculties.

The rail annotation is currently embedded primarily in four MSc programmes:

- MSc Civil Engineering track Structural Engineering (CEG/SE)
- MSc Civil Engineering track Transport & Planning (CEG/TP)
- MSc Transport, Infrastructure and Logistics (TIL)
- MSc TU Delft Flex (Faculties CEG, 3mE) flexible track (consult railway staff)

Students will be qualified for this annotation if they successfully have accomplished the following requirements:

- Compulsory courses (8 ECTS)
- Elective courses (14 ECTS or more)
- Graduation thesis (30-40 ECTS)

The graduation project and thesis must have a close relation to the field of railways.

### MSc Road and Rail

For students following the Road and Rail specialization within the MSc-track Structural Engineering (CEG) all Railway Engineering electives, mentioned in the centre fold of this brochure, will become part of the set curriculum. This track is focussed on the essential technical aspects of railway infrastructure, vehicles and the different interfaces. Combined with the two compulsory annotation courses, students can also obtain the certificate Railway Systems.

### General TU Delft admission

If you hold a Dutch BSc degree (WO) closely related to the Master's programme, you will be admitted directly. However, if your undergraduate programme is not, you will be required to take additional courses in what is called a bridging programme. This may be a standard programme or it may be tailored to your specific situation.

An HBO Bachelor's degree does not qualify for direct admission to a TU Delft Master's programme. You must first complete a supplementary programme to bring your knowledge to the required level. You can do this during your HBO programme by completing a bridging minor, or through a bridging programme upon completion of your HBO degree.

Applications through Studielink:  
[www.tudelft.studielink.nl](http://www.tudelft.studielink.nl)

### International applicants

To be considered for admission to an MSc programme you will need to meet TU Delft's general admission requirements.

1. A University Bachelor's degree (or proof that you have nearly completed a Bachelor's programme) in a main subject closely related to the MSc programme to which you are applying, with good grades on the key courses.
2. A BSc Cumulative Grade Point Average (CGPA) of at least 75% of the scale maximum.
3. Proof of English language proficiency.

For more information about the application procedure, requirements and studying at TU Delft, visit: [www.admissions.tudelft.nl](http://www.admissions.tudelft.nl)

### For further information

For more details, complete requirements, deadlines and contact information, visit: [www.rail.tudelft.nl](http://www.rail.tudelft.nl)

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