

STRUCTURAL ENGINEERING

INFORMATION BOOKLET 2020-2021

UBASE

The official course and examination regulations are always decisive: Teaching and Examination Regulations (TER), the annex to the TER named Implementation Regulations, and Rules and guidelines Board of Examiners MSc CE and AES (BoE MSc). These can be found on the TU Delft website at Educational Rules and Regulations (<https://www.tudelft.nl/en/student/faculties/ceg-student-portal/education/education-information/educational-rules-and-regulations/>).

Updates made to this information booklet will be communicated through the U-BASE website (www.U-BASE.org).

PREFACE

This booklet is published by the United Building and Structural Engineering Student Association of the faculty of Civil Engineering of the Delft University of Technology. The booklet is meant as a guiding document for (future) Master students Structural Engineering at this faculty.

With this guiding document an overview is given of the possibilities within the Master Track. At the same time it helps the student to choose courses and make a planning for the Master's phase. In addition to this information booklet it is advised to visit the website of Structural Engineering, <https://www.tudelft.nl/onderwijs/opleidingen/masters/ce/msc-civil-engineering/msc-programme/track-structural-engineering/> (or google "TU Delft MSc Track Structural Engineering") Here you can find more information about the courses, specializations and so on.

Furthermore have a look at <https://studiegids.tudelft.nl>. Here you can find more detailed information about the courses. Course evaluations from previous years are available in the Brightspace Course "Evaluations TUD". We recommend you to enroll and check on your preferred courses to plan your study load accordingly.



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1. INTRODUCTION

Structures such as bridges, high-rise buildings, tunnels and storm surge barriers clearly may not collapse or fall over. They may not deflect or vibrate in excess. Often, they need to last for more than 100 years without much maintenance. In the MSc Structural Engineering track you will learn to calculate and design whether a structure is safe; whether it will buckle; whether its strength will be sufficient and many other aspects relevant to the design of our built environment.

Essential to this are physical models of structures, materials and loading. You will learn to formulate these models, to test them and to apply them. Simple models are used for hand calculations to quickly make decisions in meetings with owners, architects, contractors and local governments. Complicated models are used for computer simulations to accurately determine whether a structure will comply with the design specifications. Examples are the stresses that will occur in a concrete dam of an artificial lake or the damage that will occur in a high-rise building due to a strong earthquake.

This booklet is a guide for students interested or participating in the Structural Engineering master track.

Chapter 1 gives a short introduction into the background of Structural Engineering and an overview of future possibilities. Chapter 2 is a practical chapter with relevant information about the curriculum of the Structural Engineering track. The specializations within Structural Engineering are discussed in Chapter 3, including curricular demands. Possibilities to compliment your MSc Program with specialized elective courses, the Honours programme and the Joint Interdisciplinary Project (JIP) are included in Chapter 4. The practicalities surrounding the Master thesis, which concludes the Master's education, are found in Chapter 5. Finally, Chapter 6 presents the student organization related to the Structural Engineering track at this faculty: U-BASE.



2nd
in QS subject ranking
Civil Engineering



40%
International students



350
Students in total



98%
Job within 6 months



20%
Work abroad



70%
Graduation assignment
with external party

The Structural Engineering track provides students with in-depth knowledge of the fundamental behavior of civil engineering materials and structures. Used daily, the safe, sound and durable design, construction and maintenance of these structures is imperative for human well-being and society. Students learn to formulate and test physical models of loads, materials and structures. They test complex structure models for endurance under stresses that might occur. Additionally, students learn to test and apply hand calculations for quick decision-making and to use computer simulations to determine whether a structure will comply with design specifications. Research is fundamental to the educational program. Well-equipped laboratories enable testing from nanoscale materials to full-scale structures and their components.

Degree	Master of Science
Starts	September
Type	Full-time
Credits	120 ECTS, 24 months
Language	English
Application Deadline	1st of April
Tuition Fee	€18.750 (non EU) €2.143 (EU)
Scholarships	scholarships.tudelft.nl
International Student Ratio	40%



2. THE STRUCTURAL ENG. TRACK

GENERAL PROGRAMME CIVIL ENGINEERING MASTER

First Year	Second Year
Track Specific Courses (Total of 56 ECTS) <ul style="list-style-type: none">• Common block (32 ECTS)• Specialization specific courses (24 ECTS)	Special Subjects (choose one) <ul style="list-style-type: none">• Additional graduation Work, research project (10 ECTS)• Elective Courses (10 ECTS)• Internship (10ECTS)• Multidisciplinary Project, Civil Eng. Consultancy Project (10ECTS)
Compulsory Ethics Course (Choose One) <ul style="list-style-type: none">• Philosophy, Technology Assessment and Ethics for CT (WM0312CIE)• Climate Change: Science & Ethics (CIE4510)• Ethics of transportation (WMI302TU)• Ethics of technological risk (WM0376TU)• Water ethics (TPM003A)	Elective Courses (10 ECTS) Master thesis (40 ECTS)

Fig. 2.1. General Programme Civil Engineering MSc.

1 ECTS corresponds to 28 credit hours, according to the European Credit Transfer System. One academic year equals 60 ECTS. The total number of ECTS in the MSc Track Structural Engineering is 120 ECTS

The official documents on regulations for exams and graduation give a general scheme applicable for all Master tracks. This may be found summarized in the extract of Article 3 of the Implementation Regulations of the TER. The program overview can also be found on <https://studiegids.tudelft.nl>.

All tracks of the Civil Engineering master program have one course in common. This is the course on Philosophy, Technology Assessment and Ethics for CT (WM0312CIE), or its equivalent courses (CIE4510, WMI302TU, WM0376TU or TPM003A). Then there is an obligatory part for all Structural Engineering specializations, part b. Due to the large skill set every structural engineer needs this obligatory part consists of 32 ECTS of common courses to all Structural Engineering tracks.

In order to graduate on the specialization of your preference, students must follow the specialization-related courses before the end of their MSc programme. The reason for these specializations is to facilitate a transparent academic profile within all the possibilities. It gives an identity in relation with your graduation and future possibilities within the study program which aids the students as well as external professionals. The specifics of these specializations can be found in the Chapter 3 “Specializations”.



Fig. 2.2. The different Master Track Specializations in Structural Engineering

Several different possibilities are available to complete a personalized MSc Program. Aside from the core courses for each specialization within Structural Engineering, students may choose to realize a Honours Program. The possibility for electives allows the student to dive deeper into personal interest and development of higher technical knowledge.

Students may choose a double track within one MSc-programme. Both tracks are mentioned in the diploma. For both tracks all requirements set for both specialization-linked courses must be met. Additionally, 20 ECTS should be added in the form of Electives. The subject of both tracks specialization must be addressed in the graduation work. Contact both track coordinators for more information.



Photo Credits: Judith Kavelaars. *Hungerford Bridge*, London. 2019.

Course Code	Course Name	ECTS	1st Year				2nd Year			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
a. At least 4 credits in one of the following courses (choose 1)		total: 4								
WM0312CIE	Philosophy, Tech. Assessment and Ethics for C.E.	4								
CIE4510-20	Climate Change: Science and Ethics	4								
WM0376TU	Ethics of Technological Risks	5								
WMI302TU	Ethics of Transportation	5								
TPM003A	Water Ethics	5								
b. 56 credits belonging to the chosen track		total: 56								
b.1. 32 credits belong to the compulsory block Structural Engineering										
CIE4100	Materials and Ecological Engineering	4								
CIE4110	Timber Structures and Wood Technology	4								
CIE4115	Steel Structures 2	4								
CIE4121	Steel Structures 3	4								
CIE4140	Structural Dynamics	4								
CIE4160	Prestressed Concrete	4								
CIE4180	Plates and Slabs	4								
CIE4190	Analysis of Slender Structures	4								
b.2. 24 credits belonging to the chosen specialization ...as described in the chapter 3 "Specializations"										
		24								

Add. available education periodRecommended period

Fig. 2.3 The composition of the Structural Engineering MSc Track.

14 The Structural Engineering Track

Article 3 - The composition

I. The study program tracks are compiled in the following way:

a. At least 4 credits (Choose 1 out of 5):

- Philosophy, Technology Assessment and Ethics for CT (WM0312CIE)
- Climate Change: Science & Ethics (CIE4510-20)
- Ethics of transportation (WMI302TU)
- Ethics of technological risk (WM0376TU)
- Water ethics (TPM003A)

b. 56 credits: track-linked subjects belonging to the chosen track.

The track-linked subjects may be subdivided into those that are general track-linked subjects (the common compulsory block) and those that belong to a specialization as stipulated in Articles 5 to 12 or a free specialization. Track-linked credits, exceeding 56 credits, will be considered as credits achieved for electives mentioned under c.

c. 20 ECTS as follows:

• Part 1: 10 credits. All subjects from the Civil Engineering MSc programme which may include only one of the following subjects:

- CIE5050-09 Additional Graduation Work, Research project
- CIE4040-09 Internship
- CIE4061-09 Multidisciplinary project, Civil Engineering Consultancy project²

• Part 2, part 2: 10 credits electives from:

- Other subjects from all MSc programmes hosted by the faculty CEG with the exception of the three mentioned subjects above under part 1
- All subjects offered in conjunction with other MSc degree courses at a Dutch University or at an international university with an exchange contract with TUD
- The specialisation subjects included in the table 'Track linked BSc electives' ('keuzelijst specialisatievakken') as intended in Article 3 of the annex for the Bachelor's degree course in Civil Engineering at Delft University of Technology, as far as they are considered to be convergence subjects (CIE course codes, see list at end of annex),
- Interfaculty Master's-level electives at Delft University of Technology with a "WM-code" to a maximum of 6 credits, however language, skills subjects and MOOCs are not allowed within the examination programme. Language, skills subjects and MOOCs can only be part of the extracurricular paragraph of the diploma supplement,

Any deviations to this composition requires the approval of the Board of Examiners on forehand. For this a motivated request is needed.

[...]

d. 40 credits: a track-linked Master Thesis Project (CIE5060-09).

The Master Thesis Project consists of a final project, a thesis, a summary of the thesis and a final presentation. The project is subject to a strict planning and time table; specific dates and deadlines need to be set for the evaluation(s) and the final presentation of the project. The planning will be monitored by the graduation coordinator.

In article 21, as well as in the Rules and Guidelines laid down by the board of examiners, further stipulations have been laid down in relation to the Internship, the Multidisciplinary Project, Civil Engineering Consultancy project, the Additional Graduation Work and the Master Thesis Project.

²Instead of CIE4061-09 Multidisciplinary project, Civil Engineering Consultancy project, a student may take a Joint Interdisciplinary Project (15ECTS). Please note that 5 ECTS is part of the extracurricular paragraph of the diploma supplement.

Source: TER Annex - Implementation Regulations. Article 3 - The composition

SPECIAL SUBJECTS: INTERNSHIPS

One of the optional subjects in the MSc programme is the internship. The internship lasts for at least 7 weeks and is awarded 10 ECTS as standard. The aim is that in the course of your internship you become familiar with the technical, social and organizational aspects of civil engineering as a practical profession. All information can be found at the internship office at room 2.73 of Civil Engineering or by e-mailing: internship-CEG@tudelft.nl.

SPECIAL SUBJECTS: THE MULTIDISCIPLINARY PROJECT

Solve an actual and recent civil engineering problem in a multidisciplinary team. Integrate several studies and designs into a coherent entity, based on knowledge, understanding and skills acquired in the preceding years. Attention will be on quality control and the evaluation of the design process. Knowledge and skills obtained during the BSc projects will be used in this project. The course is divided into three phases: phase 1: work plan; phase 2: preliminary design and studies; phase 3: process evaluation with respect to interdisciplinary aspects; final report.

For more information regarding the multidisciplinary project visit <https://studiegids.tudelft.nl/> under course code CIE4061-09.

SPECIAL SUBJECTS: ADDITIONAL GRADUATION WORK

The additional graduation work lasts for at least 8 weeks and is awarded 10 ECTS as standard. The additional graduation may or may not be linked to the MSc Thesis (CIE5060-09) and can be done after completion. For more information please visit <https://studiegids.tudelft.nl/> and look for the course code CIE5050-09.

THE FREE STUDY PROGRAM

Students are free to compile examination programmes that are rounded off with a final exam. Such a programme needs prior approval by the board of examiners and it must consist entirely or mainly of subjects given in conjunction with the degree course but it can be complemented with subjects provided by or given in other courses. For more information, reach out to the graduation coordinator.



3. SPECIALIZATIONS

In this chapter the different requirements are discussed for each one of the specializations that conform the Structural Engineering track. As shown previously in Fig. 2, all Structural Engineering students have the possibility to carry out 24 ECTS on courses related to their specialization.

b. 56 credits belonging to the chosen track

total: 56

b2. 24 credits belonging to the chosen specialization

...as described in the chapter 3 “Specializations”

24

Extract from Figure 2. Space allocated for Specialization-Related Courses.

As said before, 6 specializations conform the Structural Engineering track; these include: (1) Structural Mechanics, (2) Concrete Structures (3) Steel, Timber and Composite Structures, (4) Materials and Environment (5) Hydraulic Structures and (6) Road and Railway Engineering. These specializations will be discussed in this chapter. For each specialization a short description is given. Following that, an overview of the specialization-related courses is given.

The specializations Structural Mechanics, Hydraulic Structures and Railway Engineering offer a comprehensive list of suggested electives that may more adequately address the possibilities in these tracks. These recommended electives may be found in the chapter “Recommended Electives, Annotations and Honours”. Be aware that some of the courses covered in the Specialization may have already been covered in the BSc phase. In such case an exception may be granted with the approval of the teaching faculty and the graduation coordinator to be changed for any of recommended electives.

STRUCTURAL MECHANICS

Course Code	Course Name	ECTS	1st Year				2nd Year				
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
b2. Specialization-related courses			total: 24								
CIE4130	Probabilistic Design and Risk Management	4		■					■		
CIE4143	Shell Analysis, Theory and Application	4				■					■
CIE4150	Plastic analysis of Structures	4			■					■	
CIE5123	Introduction to the Finite Element Method	4			■					■	
CIE5145	Random Vibrations	4				■					■
CIE5148	Computational Modeling of Structures	4	■					■			

Add. available education period
 Recommended period

Fig. 3.1. Structural Mechanics specialization courses.

The basis of every structural analysis is applied mechanics. This is used to calculate structures ever since the formulation of the Newtonian Laws of Physics 300 years ago, and complimented by the Rational Mechanics of Flexible Elastic Bodies, as Loehnard Euler once mathematically described to his epistolar partner Daniel Bernoulli. Now, the formulation of ever-more complex problems is complimented by the formulation of the Finite Element Method to discretize the physical world into a numerical model.

In the graduation project you will develop tools for other engineers to design structures, for example computational calculation methods, rules of thumb or design charts. In your carrier you can develop yourself further as the one who solves structural problems for which others do not know a solution.

CONCRETE STRUCTURES

Course Code	Course Name	ECTS	1st Year				2nd Year						
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4			
b2. Specialization-related courses			total: 24										
CIE4170	Construction Technology of Civil Engineering Structures	4				■							■
CIE4281	Building Structures 2	4		■						■			
CIE5110	Concrete - Science and Technology	4		■						■			
CIE5127	Concrete Bridges	4			■						■		
CIE5130	Capita Selecta Concrete Structures	4				■							■
CIE5148	Computational Modeling of Structures	4	■					■					

Add. available education period
 Recommended period

Fig. 3.2. Concrete Structures specialization courses.

Reinforced Concrete is the most use construction material. Architects and contractors appreciate this material because of the freedom in design, the low costs, the strength and the durability. However, designing a reinforced concrete structure is a specialization in itself. For example every reinforced structure has small cracks that cannot be seen by the naked eye. These cracks are necessary for activating the reinforcement but when they become too large the concrete is no longer water proof and the reinforcement will corrode.

In the Concrete Structures specialization you learn to make the right decisions for obtaining an optimal design. Despite that the material is being used for over 100 years, in the last years many innovations occurred in material, construction and applications to which this specialization gives much attention.

STEEL, TIMBER AND COMPOSITE STRUCTURES

Course Code	Course Name	ECTS	1st Year				2nd Year				
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
b2. Specialization-related courses			total: 24								
CIE4125	Structural Design - Case Study Steel, Timber or FRP	3				■	■	■	■		
CIE5122	Capita Selecta Steel and Aluminum Structures	4		■				■			
CIE5124	Biobased Structures and Materials	4				■					■
CIE5125	Steel Bridges	4				■					■
CIE5126-20	Fatigue	3			■				■		
CIE5128	Fiber-Reinforced Polymer (FRP) Structures	3	■					■			
CIE5131	Fire Safety Design	3			■				■		

Add. available education period
 Recommended period

Fig. 3.3. Steel, Timber and Composite Structures specialization courses.

You encounter structures made of steel, wood, aluminium and fibre-reinforced plastic everywhere you go. Think for example of applications in high-rise and low-rise buildings, in factory buildings, towers, masts, locks, weirs, bridges and viaducts. You will find out how to design and execute these constructions, as well as carry out the necessary calculations, within the Steel, Timber and Composite Structures specialization.

MATERIALS & ENVIRONMENT

Course Code	Course Name	ECTS	1st Year				2nd Year				
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
b2. Specialization-related courses			total: 24								
CIE4030	Methodology of Scientific Research	3				■					■
CIE4240-19	Forensic Structural Engineering	3	■				■				
CIE5100	Repair and Maintenance of Construction Materials	4			■					■	
CIE5102	Forensic Building Materials Engineering	3				■					■
CIE5110	Concrete - Science and Technology	4		■					■		
CIE5130	Capita Selecta Concrete Structures	4				■					■
CIE5146	Micromechanics and Computational Modeling of Materials	3			■					■	

Add. available education period
 Recommended period

Fig. 3.4. Materials and Environment specialization courses.

If you aim to design constructions, you have to be very much aware of the properties of the materials you plan to use. For example, what is the load bearing capacity of a prefab concrete driven pile? When does metal fatigue occur in aluminium? How can you make strong joints with wood? What is the minimum life span of the various building materials? You will learn the answers to these and other questions within the Materials Science specialization.

HYDRAULIC STRUCTURES

Course Code	Course Name	ECTS	1st Year				2nd Year				
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
b2. Specialization-related courses			total: 24								
CIE3310-09	Open Channel Flow	4			■					■	
CIE3330	Hydraulic Structures I	4			■					■	
CIE4130	Probabilistic Design and Risk Management	4		■					■		
CIE4170	Construction Technology of Civil Engineering Structures	4				■					■
CIE4310	Bed, Bank and Shore Protection	4		■					■		
CIE4345	River Dynamics I	4	■					■			

Add. available education period
 Recommended period

Fig. 3.5. Hydraulic Structures specialization courses.

Note: CIE3310-09 or CIE3330 may be changed for further elective space as suggested in the “Recommended Electives” chapter if these courses or their equivalent had already been taken in the Bachelor’s Phase.

Hydraulic structures are always part of larger systems, such as flood defense systems or navigation systems, that play an important role in providing safety and prosperity to vulnerable delta regions. Hydraulic structures therefore have to be designed, built and maintained in an integral way. The group’s research and education is concerned with various types of hydraulic structures and systems, such as tunnels, quay walls, locks, dikes and storm surge barriers. To understand the behavior of these structures it is important that hydraulic, geotechnical and structural aspects are addressed in coherence.

ROAD AND RAILWAY ENGINEERING

Course Code	Course Name	ECTS	1st Year				2nd Year				
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
b2. Specialization-related courses			total: 24								
CIE4860	Structural Pavement Design	6				■					■
CIE4870	Structural Design of Railway Track	4			■					■	
CIE4880	Road Paving Materials, Laboratory Experiment included	7		■	■				■	■	
CIE5850	Road Construction	3	■				■				
CIE5871	Capita Selecta Railway and Road Structures	4				■					■

Add. available education period
 Recommended period

Fig. 3.6. Road and Railway Engineering specialization courses.

Note: for those interested in Railway Engineering there is a possibility to replace the above-mentioned courses by the Recommended Electives of the Chair of Railway Engineering (Chapter 4, page 30).

Infrastructural facilities such as roads, airfields, port areas, railways and tramways are essential for the proper functioning of our modern society. The structures required for these facilities are complex because they consist of multiple layers or components which together – over a long period – need to withstand increasingly heavy traffic loads. In the case of roads, airfields and port areas this involves asphalt, concrete or small elements, a solid foundation and a sand foundation. In the case of railways the basic structure is, in principle, rails connected by sleepers (or ties), a ballast foundation and a sand foundation, while tramways are mostly embedded in a road structure. The structures are built on the natural soil; in large parts of the Netherlands this is extremely weak, thus leading to a range of complications. In the Road and Railway Engineering specialisation you learn to design and maintain such structures.



4. RECOMMENDED ELECTIVES, HONOURS AND JIP

RECOMMENDED ELECTIVES FROM THE CHAIR OF INTEGRAL DESIGN MANAGEMENT

IDM focuses on integrated design and project management of major infrastructural projects from the viewpoint that a comprehensive review of the life cycle of a structure should generate maximum benefit for all the stakeholders concerned at the minimum price (including to society). The chair of Integral Design Management has recommended the following courses as electives to complement the study course of Structural Engineering with comprehensive technical and analytical techniques for the management of the built environment.

Course Code	Course Name	ECTS	1st Year				2nd Year				
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
CIE448I	Systems Engineering & Management	4			■					■	
CIE438I	Engineering Asset Management	4	■					■			
CIE4120	Information Systems for Construction	4	■					■			

Add. available education period
 Recommended period

Fig. 4.1. Recommended Electives IDM.

These courses are also part of the Integral Design Management annotation. More information about annotations can be found on: u-base.org/education/annotations.

RECOMMENDED ELECTIVES FROM THE CHAIR OF HYDRAULIC ENGINEERING

Course Code	Course Name	ECTS	1st Year				2nd Year				
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
CIE4305	Coastal Dynamics I	6			■					■	
CIE4325	Ocean Waves	6	■				■				
CIE5304	Waterpower Engineering	3				■					■
CIE5310	Probabilistic Design in Hydraulic Engineering	3				■					■
CIE5313-18	Hydraulic Structures 2	4				■					■
CIE5314-19	Flood Defenses	4				■					■

Add. available education period
 Recommended period

Fig. 4.2 Recommended Electives Hydraulic Eng.

The Hydraulic Engineering group focuses on research and education related to hydraulic engineering systems, such as flood defenses, storm surges, barriers, tunnels and locks. In the specific case of the hydraulic structures specialization, the following courses may be undertaken as electives instead of courses that have been previously accredited by the student during their BSc phase.

RECOMMENDED ELECTIVES FROM THE CHAIR OF STRUCTURAL MECHANICS

Course Code	Course Name	ECTS	1st Year				2nd Year					
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
CIE3109-09	Structural Mechanics 4	4			■						■	
CIE5144	Stability of Structures	3				■						■
CIE5142	Computational Methods in Non-Linear Solid Mechanics	3	■					■				
CIE5260	Structural Response to Earthquakes	4	■					■				
CIE4353	Continuum Mechanics	3	■	■				■	■			

Add. available education period
 Recommended period

Fig. 4.3 Recommended Electives Structural Mechanics; CIE4353 takes place in Q1+Q2.

The chair of Structural Mechanics focuses on modeling of civil and building engineering structures, comprising the generation and evaluation of FEM models. The challenge is to confront the behavior of lab tests and real world structures through a thorough understanding of the finite element analysis. As complement to the specialization of Structural Mechanics and as an offer for all SE specializations, the chair of Structural Mechanics offers the courses mentioned above.

RECOMMENDED ELECTIVES FROM THE CHAIR OF RAILWAY ENGINEERING

Railways are complex systems that include rolling stock, infrastructure and operations. The chair of Railway Engineering recommends the following courses as electives to complement any chosen specialization:

Course Code	Course Name	ECTS	1st Year				2nd Year				
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
CIE4874	Elements of Railway Engineering	4		■				■			
CIE5826	Railway operations and Control	4			■				■		
CIE4873	Wheel-Rail Interface	4				■					■
CIE4871	Design and Maintenance of Railway Vehicles	4				■					■
CIE5875	Railway Asset Management	4	■				■				

Add. available education period
 Recommended period

Figure 4.4. Recommended electives Railway Engineering.

Keeping in mind that the grand total of ECTS for the specialization-related courses should be at least 24 ECTS, any compulsory course of the Road and Railway Engineering Specialization may be replaced by the above-mentioned courses with the approval of the graduation coordinator.

These courses are also part of the Railway Systems annotation. More information about annotations can be found on: www.u-base.org/education/annotations.

RECOMMENDED ELECTIVES FROM THE CHAIR OF DYNAMICS OF STRUCTURES

There is a significant increase in demand of graduates with an in-depth understanding of the dynamic behavior of structures. As complement to all SE specializations, the chair of Dynamics of Structures offers the courses mentioned below. All courses are a follow-up on the course CIE4140 Structural Dynamics. It is highly recommended to take at least 4 out of 5 electives, as the content of the courses is linked.

Course Code	Course Name	ECTS	1st Year				2nd Year				
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
CIE4260	Measurements and Analysis of Vibrations	4				■					■
CIE5145	Random Vibrations	4				■					■
CIE5260	Structural Response to Earthquakes	4	■				■				
CIE5340-18	Soil Dynamics	4				■					■
CIE4320	Vibration-based Monitoring and Identification	4	■				■				

Add. available education period
 Recommended period

Fig. 4.5. Recommended Electives Dynamics of Structures.

These courses are also part of the Dynamics of Structures annotation. More information about annotations can be found on: www.u-base.org/education/annotations.

HONOURS PROGRAMME MASTER

Motivated Students who have proven good academic performance (above a 7.5 GPA in their BSc and average 7.5 GPA in their first semester of their MSc with no fails) may apply to the Honours Programme. The Honours Programme includes 20 ECTS on top of the regular MSc track and a research proposal approved by a Scientific Staff Member and the Graduation Coordinator is presued. The research proposal must be sent to the Honours Coordinator .

The content of the Honours Programme must be thematically consistent, complemented by the course “Critical Reflection on Technology”. The programme has to be completed during the course of the Student’s MSc programme. No results may be lower than 6.0. Students who have successfully completed the programme will receive a special certificate from the university.

Course Code	Course Name	ECTS	1st Year				2nd Year			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
a. Individual elective courses										
	free elective courses approved by the Honours Coordinator	15								
b. Collective interdepartmental course										
UD2010	Critical reflection on technology	5								
			Add. available education period				Recommended period			

Fig. 4.6. Honours Programme MSc UD2010 takes place either in Q2+Q3 or Q3+Q4.

JOINT INTERDISCIPLINARY PROJECT

The course is for the second year MSc students from the faculties of Aerospace Engineering; Civil Engineering and Geosciences; Mechanical, Maritime and Materials Engineering; Technology, Policy and Management. during the JIP you will work together with students of other faculties and with staff of a company. The full-time projects are focused on integrated design or research assignments in addition to value adding, societal acceptance and engineering ethics. For the MSc. Civil Engineering, 10 ECTS are credited as elective space and 5 ECTS are credited as extracurricular. Application is required for all interested students in the form of a Motivation Letter, CV and 1st year MSc transcript. More information in: www.jointinterdisciplinaryproject.nl.

Course Code	Course Name	ECTS	1st Year				2nd Year					
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
	Joint Interdisciplinary Project	15	█				█					
			Add. available education period		█	Recommended period						█

Fig. 4.11. Joint interdisciplinary Project.



5. GRADUATION

The Master's thesis finalizes the Master's study at the university. During the graduation period not only the graduation work itself is important, but also the organization of the graduation as whole. The organization of the Master's thesis is considered an important part of the graduation and is the sole responsibility of the student.

This chapter tries to give an overview of all the steps that need to be taken within the graduation period. The buildup of the chapter is related to the graduation scheme shown in Figure 5.1. In addition, students are advised to consult the CIE-0 form, which provides information on the graduation procedure (<https://www.tudelft.nl/en/student/faculties/ceg-student-portal/education/master/forms-master/>).

CHAIRMAN GRADUATION COMMITTEE

For your graduation committee you will need a chair that has accredited the University Teaching Qualifications (UTQ's). For students Structural Engineering any (associate/assistant) professor of the CEG faculty will suffice.

START OF THE MASTER'S THESIS PROJECT

The first step in starting on the final project is to e-mail the graduation-coordinator. For Structural Engineering this is either C. Kasbergen or F. di Maio. Their mail address is SE-track@tudelft.nl. Together, the official part of the graduation will be set-up. This is the left hand column in Figure 5.1. One can start the MSc thesis as soon as the BSc diploma and 65 ECTS in the MSc. are gained.

FINDING A SUBJECT

At the same time a graduation subject needs to be found. It is a good idea to discuss this with a number of teachers and professors, where own input is very much appreciated. The graduation subject needs to be approved in concordance with the graduation professor.

A graduation subject at Structural Engineering can be:

- Defined by the research interest of the student in collaboration with the faculty.
- Defined by the research interest of a third-party company.
- Defined by the research interest of the faculty in the Engineering Structures and 3MD chairs.

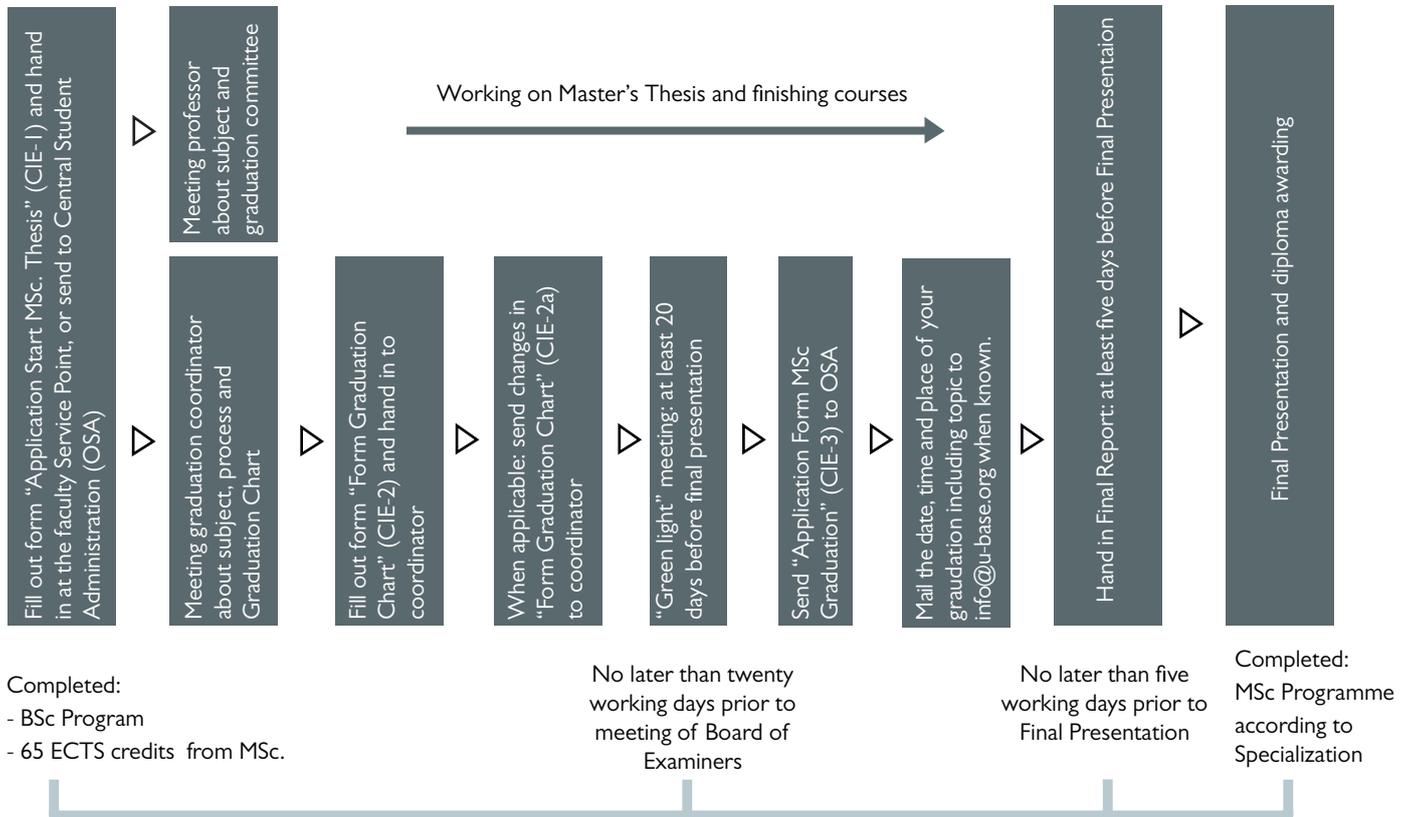
The department of Engineering Structures has made public a Master Thesis database as a Brightspace Course. This database showcases the currently available projects from the groups of Bio-based structures and Materials; Concrete Structures; Dynamics of Structures; Pavement Engineering; Railway Engineering; Resources and Recycling; and Steel, Timber and Composite Structures.

Thesis projects may be research oriented or design oriented. In reality a combination of the two is most common.

To help the student to find a graduation subject it is also advised to look at previous subjects. All the completed Master's thesis projects can be found on <https://repository.tudelft.nl/> (look for structural engineering subjects). Other important resources are PhD. students, fellow students and the permanent MSc thesis poster exposition on the first floor of the main building (facing lecture room G).

GRADUATION PROJECT AT COMPANY

Companies also often have interesting challenges for graduating students. In these cases it is also normal to have a person from the company to take place in the graduation committee. This has to be approved by the graduation professor and the board of examination. Also, an extra form has to be filled in to perform a graduation project at a company, which can be found at: <https://www.tudelft.nl/en/student/faculties/ceg-student-portal/education/master/forms-master/>.



For information only. No rights may be inferred from this diagram. The official Course and Examinations Regulations and Board of Examiners Rules and Guidelines take precedence at all times.

Figure 5.1: Flow chart for graduation at Structural Engineering

GRADUATION COMMITTEE

The chairman of the graduation committee is the graduation professor. The committee itself depends completely on the subject, but must consist of at least three committee members from the TU Delft University, divided over at least two different sections of the Structural Engineering department. Furthermore. One or two members from outside the university can be added. The composition of the committee is a combined task of the graduation professor and the student.

All forms mentioned in Figure 5.1 can be found on the faculty website (<https://www.tudelft.nl/en/student/faculties/ceg-student-portal/education/master/forms-master/>). The following forms are available:

- “Application Start MSc. Thesis” (CIE-1) (Aanvraag Aanvang Afstudeerwerk)
- “Form Graduation Chart” (CIE-2) (‘Aanvraag Afstudeerkaart)
- “Form Changes Graduation Chart” (CIE-2a)
- “Application Form MSc Graduation” (CIE-3) (Aanvraag MSc Examen)

COURSE OF THE GRADUATION PROJECT

The **Kick-off Meeting** is the first official meeting of the complete graduation committee. At this meeting the student presents a detailed work plan for the entire project. The work plan is a result of preliminary research by the student into the chosen subject and is put down in concordance with the graduation professor.

Typically, the Start Meeting is followed by two **Interim Meetings** to monitor the progress of the project. The time between the meetings is approximately 2 to 3 months. Additional meetings can be set up when necessary. Obviously there is regular contact with the individual committee members between meetings.

At the **Green-Light Meeting** a green light is given to proceed to finishing the project. The date for the Final Presentation is set here as well. The **Judgement Meeting** takes place directly before the Final Presentation. At this meeting the student is absent and the committee will judge the project as a whole. After the **Final Presentation** the final mark is established, and the MSc-diploma is awarded.

A graduation project usually takes 9 months. Make a clear planning in advance and keep track of your progress!

FINALIZING THE MASTER'S THESIS

In order to graduate a number of aspects need to be taken into account. Firstly there is a number of deliverables and secondly the official judgement criteria that are used by the graduation committee.

Deliverables

The following deliverables are obligatory:

- Hard copy of the final report for each committee member
- Upload full report to repository in .doc or .pdf format

Judgement criteria

The Master's Thesis is judged on the following five aspects:

A. Scientific approach (25%)

- Theoretical profundity
- State of the art description and literature study
- Scientific argumentation (hypothesis testing)
- Quality of experimental work or design
- Creativity: new ideas

B. Quality of result/product (25%)

- Scientific reflection and judgment
- Utilization of result/product
- Extension/generation of method
- Quality of abstract
- Amount of work

C. Behavioral competencies (20%)

- Initiative and/or own contribution
- Responsibility
- Communicative skills
- Independency

D. Quality of written presentation (15%)

- Structure and consistency
- Acknowledgment of sources/quotations
- English proficiency

E. Quality of oral presentation and defense (15%)

- Speaker quality
- Clarity and structure of presentation
- Quality of presentation material
- Answering of questions





6. U-BASE

U-BASE is the United Building and Structural Engineering Association for students at the Faculty of Civil Engineering and Geosciences at TU Delft.

The main objective of U-BASE is to stimulate relations between students, the university and the building industry by organizing several activities:

- Excursions to companies and interesting building projects
- One European and one overseas Study Tour per year. In the past years we have visited Moscow & St Petersburg, Shanghai, New York, Hong Kong, Chicago, Tokyo, Singapore, Macao, Shenzhen, Guangzhou, Osaka, Kyoto and Kuala Lumpur !
- Biennial Symposium with participation of professionally renowned architects and engineers such as Keith Boswell, Bart Leclercq, Eran Chen, Jacob van Rijs.
- Workshops, guest lectures, conference visits.
- Publication of the magazine U-Profiel
- Evaluations of courses in collaboration with the faculty staff for the improvement of the overall MSc programme.

For more information on U-BASE and their activities, come for a cup of coffee at room Stevin II, I.35 or visit www.U-BASE.org.

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APPENDIX A: CONTACT INFORMATION

Contact		Telephone	E-mail	Room
Track Coordinator Structural Engineering	Dr. O. (Oguzhan) Copuroglu	+31 15 278 1827	SE-track@tudelft.nl / O.Copuroglu@tudelft.nl	6.03
Section Applied Mechanics	Prof. dr. ir. L.J (Bert) Sluijs	+31 15 278 2728	L.J.Sluijs@tudelft.nl	6.49
Section Materials and Environment	Prof. dr. ir. E. (Erik) Schlangen	+31 15 278 6535	Erik.Schlangen@tudelft.nl	6.21
Section IDM	Prof. dr. ir. A.R.M. (Rogier) Wolfert	+31 15 278 6636	A.R.M.Wolfert@tudelft.nl	6.66
Section Steel and Composite Structures	Prof. dr. M. (Milan) Veljkovic	+31 15 278 5816	M.Veljkovic@tudelft.nl	2.52
Section Biobased Structures and Materials	Prof.dr.ir. J.W.G. (Jan-Willem) van de Kuilen	+49 89 2180 6462/ +31 15 278 2322	J.W.G.vandeKuilen@tudelft.nl	S2 2.56
Section Concrete Structures	Dr. ir. M. (Mladena) Luković / Dr. ir. Y. (Yuguang) Yang	+31 15 278 2320/ +31 15 278 2277	M.lukovic@tudelft.nl / Yuguang.Yang@tudelft.nl	S2 1.04/ S2 2.05
Section Dynamics of Structures	Prof. dr. A. (Andrei) Metrikine	+31 15 278 4749	A.Metrikine@tudelft.nl	3.38
Section Pavement Engineering	Prof. dr. ir. S.M.J.G. (Sandra) Erkens	+31 15 278 5949	S.M.J.G.Erkens@tudelft.nl	S2 2.25
Section Railway Engineering	Prof. dr. ir. R.P.B.J. (Rolf)Dollevoet	+31 15 278 2365	R.P.B.J.Dollevoet@tudelft.nl	S2 2.28
Section Resources and Recycling	Prof. dr. P. (Peter) Rem	+31 15 278 3617	P.C.Rem@tudelft.nl	S2 2.08
Graduation Coordinators Structural Engineering	Ir. C. (Cor) Kasbergen / Dr. F. (Francesco) di Maio	+31 15 278 2729/ +31 15 278 8148	SE-track@tudelft.nl / C.Kasbergen@tudelft.nl / F.Dimaio@tudelft.nl	S2 2.36/ S2 1.07
Internship office		+31 15 278 1174	stagebureau-citg@tudelft.nl	4.25
International Office		+31 15 278 1174/4733	exchange-citg@tudelft.nl	2.73
Multidisciplinary Project		+31 15 278 4800	studentoffice-esa-ceg@tudelft.nl	2.73
Education and Student Affairs		+31 15 278 8012	contactcentre-esa@tudelft.nl	Jaffalaan 9A
U-BASE		+31 15 278 3042	info@U-BASE.org	S2 1.35

Figure A.1: Relevant contacts in Structural Engineering. S2 in the room number stands for the offices in the Stevin 2 Laboratory.

UBASE