STRUCTURAL ENGINEERING

INFORMATION BOOKLET 2017-2018

UBASE

NB the official course and examination regulations are always decisive: Teaching and Examination Regulations (TER), Implementation Regulations (IR), and Rules and guidelines Board of Examiners MSc CE and AES (BoE MSc). These can be found on the TU Delft website at Regulations: TER, Rules and Guidelines.

PREFACE

This booklet is published by the Building Engineering 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: http://www.tudelft.nl/en/study/master-of-science/master-programmes/civil-engineering/msc-programme/tracks/structural-engineering/. Here you can find more information about the courses, specializations and so on.

Furthermore have a look at www.studyguide.tudelft.nl here you can find more detailed information about the courses.

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INTRODUCTION

Structures such as bridges, high-rise buildings, tunnels and storm surge barriers clearly may not collapse or fall over. They may not deflect too much or vibrate annoyingly. Moreover, often they need to last for more than 100 years without much maintenance. In the MSc Structural Engineering track you will learn to calculate which deflections we can expect, whether a structure will buckle, whether its strength will be sufficient, etcetera.

Essential to this are physical models of structures, of materials and of 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. The practicalities surrounding the Master thesis, which concludes the Master's education, are found in Chapter 4. In Chapter 5 an important institution related to the Structural Engineering track at this faculty is introduced: The U-BASE student association.

Diploma	Master of Science Civil Engineering Track: Structural Engineering
Credits	120 ECTS, 24 months
Starts in	September
Language of instruction	English
% International students	35%

1. GENERAL INFORMATION

Structural engineering is a subfield of engineering. Structural engineers design load-bearing structures, like buildings, roads, bridges, tunnels, and storm surge barriers, to endure the environmental conditions in which they are built. For instance, a high-rise office building in northern Russia must have a roof that can bear the weight of heavy snow, and a stadium in Japan must be able to withstand earthquakes. Load-bearing structures must withstand time, stress and the pressures of human use; not collapse, deflect or vibrate, and last for hundreds of years with minimum maintenance.

The Structural Engineering track teaches students to formulate and test physical models of structures, materials and loads. Students test complex structure models for endurance under stresses that might occur. For instance, the impact of a strong earthquake on a high-rise building, or a concrete dam in the creation of an artificial lake. Students learn to test and apply hand calculations for quick decision-making in meetings with owners, architects, contractors and local governments and are trained to use computer simulations to determine whether a structure will comply with design specifications.

FIRST YEAR			
Compulsary and Specialisation courses (56 EC)			Climate Change: Science and Ethics (4 EC) *or* Philosophy, Technology Assesment and Ethics for Civil Engineers (4 EC)
SECOND YEAR			
Only elective courses (20 EC)	*or*	Choose 2 out of 4 (20 EC): - Internship *or* Multidisciplinairy Project (10 EC) - Additional Graduation Work (10 EC) - Electives (10 EC)	MSc Thesis (40 EC) *1 EC = 28 hrs study, according to the European Credit Transfer System (ECTS) ▪ One academic year = 60 EC ▪ Total number of credits in the MSc track Structural Engineering = 120 EC.*

ARTICLE 3 – THE COMPOSITION

1.The study programme tracks are compiled in the following way:

a. 4 credits: the subject Philosophy, Technology Assessment and Ethics for CT (WM0312CIE) or the subject Climate Change: Science & Ethics (CIE4510). Geoscience and Remote Sensing students do CIE4613 (5 credits), Climate Change: Science and Ethics, instead.

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 and those that belong to a specialisation as stipulated in Articles 5 to 11.
Track-linked credits, exceeding 56 credits, will be considered as credits achieved for electives mentioned under c.

c. 20 credits as follows:

- 20 credits electives. The student has to choose 10 credits offered in conjunction with the degree course. For the other credits the student may choose:
  - All subjects offered in conjunction with the degree course,
  - All subjects offered in conjunction with other Master's degree courses at a Dutch university,
  - The specialisation subjects included in the list "keuzelijst specialisatievakken" as intended in Article 3 of the Implementation Regulations for the Bachelor's degree course in Civil Engineering at Delft University of Technology, as far as they are considered to be convergence subjects,
  - Interfacultary Master's-level electives at Delft University of Technology with a "WM-code" to a maximum of 6 credits. Before any other subjects can be studied the approval of the board of examiners is required.

OR

- Two of the possibilities listed below:
  - 10 credits: Internship (CIE4040-09)or Multidisciplinary Project (CIE4061-09) (choose one out of two)
  - 10 credits: electives. What is determined above for the other electives is similarly applicable.
  - 10 credits: Additional Master Thesis Project (CIE5050-09). The Additional Master Thesis Project may or may not be related to the Master Thesis Project mentioned under d but it must, in any case, be separately distinguished. The student can only start an Additional Master Thesis Project if 45 credits of the track linked courses are completed.

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.

FIGURE 2.1: IMPLEMENTATION REGULATION SE

2. GENERAL PROGRAM

2.1 GENERAL PROGRAMME CIVIL ENGINEERING MASTER

The official documents on regulations for exams and graduation give a general scheme applicable for all Master tracks. This scheme is given in Figure 2.1. This is presented in a convenient arrangement in Figure 2.2.
N.B. The program overview can also be found on www.studyguide.tudelft.nl.

In the scheme it is visible that all tracks of the Civil Engineering master programme have one course in common. This is the course on Ethics (WM0312CIE), or its equivalent CIE4510.
Then there is an obligatory part for all Structural engineering specialisations, part b1. Due to the large skillset every structural engineer needs this obligatory part consists of 32 ECTS.

Then there is also an obligatory part dependent on which specialization is chosen (part b2). Within the Structural Engineering Master Track 6 different specialisations can be chosen:

- Structural Mechanics
- Concrete Structures
- Steel and Timber Construction
- Materials & Environment
- Road and Railway Engineering
- Hydraulic Structures

The reason for these specialisations is to facilitate a transparent choice 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 specialisations can be found in Chapter 3.

	CREDITS		COURSE CODE	COURSE NAME	ECTS	EDUCATION PERIOD
a.	4 ECTS		**Compulsory for all students**			P1 P2 P3 P4
			WM0312CIE	Ethics	4	
			CIE4501	Climate Change: Science & Ethics	4	
b1.	32 ECTS		**Compulsory for all Structural Engineering students**			
			CIE4100	Materials and Ecological Engineering	4	
			CIE4110	Timber and Timber Structures 1	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	
b2.	24 ECTS		**Specialisation linked courses, see Chapter 3**			
c.	20 ECTS		**Choose 2 out of 3 below**			
		c1.	CIE4040-09 or CIE4061-09	Internship or Multidisciplinary Project *	10	
		c2.		Additional Electives	10	
		c3.	CIE5050-09	Additional Graduation Work	10	
			Or			
		c4.		Only elective courses	20	
d.	40 ECTS		CIE5060-09	MSc Thesis (specialisation linked)	40	
Sum:	120 ECTS					

**NOTE: Students are not allowed to both do CIE4040-09 (Internship) and CIE4061-09 (Multidisciplinary Project) for ECTS.*
NOTE: Students who have not done CT3150 or CTB3335 (Concrete Structures 2) in the Bachelor's phase, will have to do CIE3150 as a compulsory elective subject.
NOTE: Students who have not done CT3109 or CTB3330 (Structural Mechanics 4) in the Bachelor's phase, are strongly advised to take CIE3109-09 as an elective subject.
NOTE: If required by intake, foreign students have to follow CIE4145-09 (Dynamics, Slender Struct. and Introduction to Continuum Mechanics) as a compulsory elective. 4 ECTS in P1.

FIGURE 2.2: OVERVIEW SE TRACK BUILDUP

2.2 ANNOTATIONS

In addition to the general program of Structural Engineering and its specializations, it is possible to acquire an annotation. An annotation implies a number of ECTS and a graduation topic in a certain direchtion and is added on your diploma. The possible annotations are: Dynamics of Structures, Railway Systems, Integral Design and Management (contact: Dr. van Nederveen), Technology in Sustainable Development (tudelft.nl/tido), Entrepeneurship (dce.tudelft.nl), Urban Planning and Engineering, Infrastructure Planning and Environmental Engineering, Hydro Geotechnics or Offshore Geotechnics. More info about these can be found in the IR (implementation regulations) Msc CE 2017-2018.

2.3 INTERNSHIP

One of the optional subjects in the MSc programme is the internship. The internship lasts for at least 8 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 at www.citg.tudelft.nl/stagebureau.

2.4 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: inception plan; phase 2: preliminary design and studies; phase 3: process evaluation with respect to interdisciplinary aspects; final report.
For more information regarding the Multi-disciplinary project see the studyguide under course code CIE4061-09

2.5 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.

3. SPECIALIZATIONS

3.1 INTRODUCTION

As mentioned in Chapter 2, the Structural Engineering track offers 6 different specialisations:

- Structural Mechanics
- Concrete Structures
- Steel and Timber Construction
- Materials & Environment
- Road and Railway Engineering
- Hydraulic Structures

These specialisations will be discussed in this chapter. For each specialization a short description is given and following that an overview of the specialization linked courses is given.

3.2 STRUCTURAL MECHANICS

The basis of every structural analysis is applied mechanics. This is used to calculate structures ever since Isaac Newton discovered his laws, 300 years ago. In the Structural Mechanics specialisation there is much attention for applied mechanics.

In the graduation project you will develop tools for other engineers to design structures, for example a calculation method for computers, 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.

CREDITS	COURSE CODE	COURSE NAME	ECTS	EDUCATION PERIOD			
				P1	P2	P3	P4
24 ECTS	**Specialisation linked courses**						
	CIE4130	Probabilistic Design	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	■			

STRUCTURAL MECHANICS LINKED COURSES

3.3 CONCRETE STRUCTURES

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.

CREDITS	COURSE CODE	COURSE NAME	ECTS	EDUCATION PERIOD
24 ECTS	**Specialisation linked courses**			P1 P2 P3 P4
	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	

CONCRETE STRUCTURES LINKED COURSES

3.4 STEEL AND TIMBER CONSTRUCTION

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 and Timber Structures specialisation.

CREDITS	COURSE CODE	COURSE NAME	ECTS	EDUCATION PERIOD
24 ECTS	**Specialisation linked courses**			P1 P2 P3 P4
	CIE4125	Structural design - Case study Steel, Timber or FRP	3	
	CIE5122	Capita Selecta Steel and Auminium Structures	4	
	CIE5124	Timber and Timber Structures 2	4	
	CIE5125	Steel Bridges	4	
	CIE5126	Fatigue	3	
	CIE5128	Fibre-reinforced Polymer (FRP) Structures	3	
	CIE5131	Fire Safety Design	3	

STEEL AND TIMBER CONSTRUCTION LINKED COURSES

3.5 MATERIALS & ENVIRONMENT

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 specialisation.

CREDITS	COURSE CODE	COURSE NAME	ECTS	EDUCATION PERIOD			
				P1	P2	P3	P4
24 ECTS	**Specialisation linked courses**						
	CIE4030	Structural design - Case study Steel, Timber or FRP	3				■
	CIE5100	Repair and Maintenance of Construction Materials	4		■		
	CIE5102	Forensic Building Materials Engineering	3			■	
	CIE5110	Concrete - Science and Technology	4	■			
	CIE5126	Fatigue	3			■	
	CIE5130	Capita Selecta Concrete Structures	4		■		
	CIE5146	Micromechanics and Computational Modeling of Building Materials	3		■		

MATERIALS & ENVIRONMENT LINKED COURSES

3.6 ROAD AND RAILWAY ENGINEERING

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 not only how to design the aforementioned structures but also how they should be constructed and maintained.

CREDITS	COURSE CODE	COURSE NAME	ECTS	EDUCATION PERIOD
24 ECTS	**Specialisation linked courses**			P1 P2 P3 P4
	CIE4860	Structural Pavement Design	6	
	CIE4870	Structural Design of Railway Track	4	
	CIE4880	Road Paving Materials incl. Laboratory Experiment	7	
	CIE5850	Road Construction	3	
	CIE5871	Capita Selecta Railway and Road Structures	4	

ROAD AND RAILWAY ENGINEERING LINKED COURSES

HYDRAULIC STRUCTURES

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.

CREDITS	COURSE CODE	COURSE NAME	ECTS	EDUCATION PERIOD
24 ECTS	**Specialisation linked courses**			P1 P2 P3 P4
	CIE3310-09*	Open Channel Flow	4	
	CIE3330*	Hydraulic Structures 1	4	
	CIE4130	Probabilistic Design	4	
	CIE4170	Construction Technology of Civil Engineering Structures	4	
	CIE4310	Bed, Bank and Shore Protection	4	
	CIE4345*	River Engineering	4	

** Only if CT3310-09; CT3330; CT3340 or CIE4345MI respectively has not been completed in the Bachelor's phase (see also IR)*

HYDRAULIC STRUCTURES LINKED COURSES

4. GRADUATION

4.1 INTRODUCTION

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 4.1. In addition, students are advised to consult the CIE-0 form, which provides information on the graduation procedure (studenten.tudelft.nl).

4.2 CHAIRMAN GRADUATION COMMITTEE

For your graduation committee you will need a chair of your committee. For students Structural Engineering any (associate/assistant) professor of the CeG faculty will suffice.

4.3 START OF THE MASTER'S THESIS PROJECT

The first step in starting on the final project is to visit the graduation-coordinator. For Structural Engineering this is L.J.M. Houben, r. 2.27 Stevin II. Together the official part of the graduation will be set-up, this is the left hand column in Figure 4.1. 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:

- Research focussed
- Design focussed

In reality a combination of the two is most common.

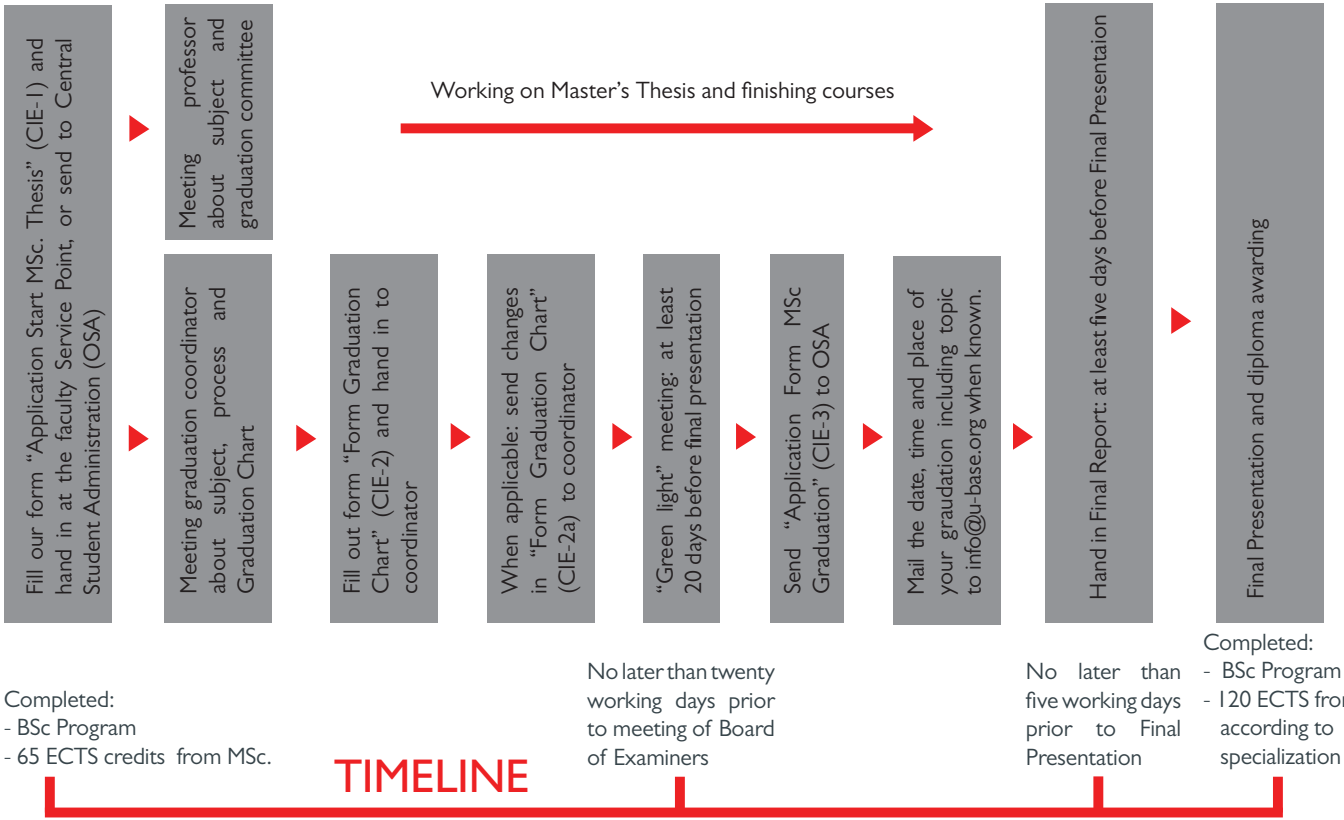
To help the student to find a graduation subject it is also advised to look at previous subjects. All the Master's theses of projects can be found on https://repository.tudelft.nl/ (look for structural engeneering subjects). Other important resources are PhD. students, fellow students and the permanent 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.

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 persons from the 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.



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.

4.1: FLOW CHART FOR GRADUATION AT STRUCTURAL ENGINEERING

FORMS
All forms mentioned in Figure 4.1 can be found on the faculty website (studenten.tudelft.nl, go to CiTG, Forms). 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)

4.4 COURSE OF THE GRADUATION PROJECT

The Start 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 2/3 months. Additional meetings can be set up when necessary. Obviously there is regular contact with the individual committee members between meetings.

At the Final 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.

4.5 FINALIZING THE MASTER'S THESIS

In order to graduate a number of aspects need to 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 judgement
- Utilisation of result/product

• Extension/generation of method
• Quality of abstract
• Amount of work

C. Behavioural competencies (20%)
• Initiative and/or own contribution
• Responsibility
• Communicative skills
• Independency

D. Quality of written presentation (15%)
• Structure and consistency
• Acknowledgement of sources/quotations
• English proficiency

E. Quality of oral presentation and defence (15%)
• Speaker quality
• Clarity and structure of presentation
• Quality of presentation material
• Answering of questions

5. RELATED INSTITUTIONS

U-BASE ASSOCIATION

U-BASE Association is the student association of Building Engineering and Structural Engineering.

The main objective of U-BASE is to introduce students to the business environment of civil engineering and the building and structural engineering practice in particular. To achieve this, we create and stimulate relations between students, the university and the building industry by organizing several activities:

- Excursions to companies and interesting building projects several times a year;
- Study tours abroad: the last few years we visited Moscow & St Petersburg, Shanghai, New York, Hong Kong, Chicago, Tokyo, Singapore & Kuala Lumpur;
- Symposia, workshops and guest lectures;
- By publishing a magazine the “U-Profiel”.

For more information on U-BASE visit us for a cup of coffee at room 1.35 Stevin II or go to:
www.u-base.org.

UBASE

United Building and Structural Engineering Association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