

Info booklet September 2026
Structural & Materials Track
& Structural Engineering Track

Msc Civil Engineering
TU Delft

UBASE

Preface

This booklet was created to provide further information about Structural & Materials and Structural Engineering tracks for first years Civil Engineering Masters students, aiming to assist on their track selection. General information about each module is given alongside student experiences. The experiences were written by students that took the respective modules and units in the academic year of 2022-2023, 2023-2024 & 2024-2025

It is important to note that this is not an official booklet of the university. The official brochure from TU Delft can be found on the website: https://filelist.tudelft.nl/TUDelft/Onderwijs/Opleidingen/Master/MSc_Civil_Engineering/MSc-CE.pdf

Also, since 2022-2023 was the first year of the new master programs, the courses referred herein are subject to adjustments for the next academic years. If there is any question regarding the booklet, please contact one of the U-BASE board members. For further information about the courses, contact the track coordinators Oguzhan Copuroglu (Previously Construction Materials, now Structural & Materials) or Roel Schipper and Marko Pavlovic (Structural Engineering).

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Introduction Structural & Materials Track
(Previously named "Construction Materials")

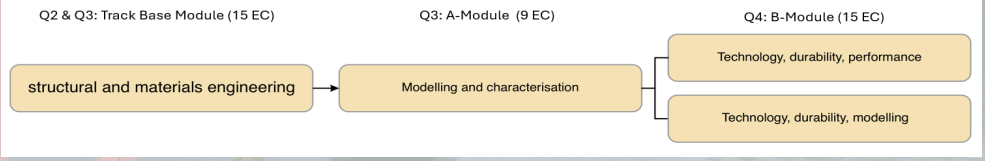
The Construction Materials Engineering education was offered as a specialisation of Structural Engineering in the old masters program, but now became a dedicated track of its own. The new track Structural and Materials Engineering shares numerous subjects with Structural Engineering, while focusing on engineering materials and structural elements rather than structural systems. The track stands on two main pillars, namely Materials science and Structural Mechanics. In this track, you will learn the behaviour of the materials and how to relate the microstructure and micro properties of the materials to the large structures. Hence, you will understand the reasoning behind design codes, instead of just using them. By choosing this track, you will become an expert in a wide range of different materials and technologies used for constructions, in experimental techniques and equipment, and in numerical modelling.

Moreover, this track consists of several laboratory sessions, where you will be able to put in practice what you have learned in the lectures. Last year, the track welcomed 8 students, which created a nice environment for the students who have enjoyed close attention from the teaching teams. The classes were often 2-ways, where student interaction and discussions were encouraged, and we learned a lot from each other as well. Hence, most classes felt more like a conversation rather than formal lectures.

The track specific modules are listed below, per quarter.

Q1	No track specific modules
Q2	Structural & Materials Track Base
Q3	Structural & Materials Track Base and A-module: Modelling and Characterisation
Q4	One of the following B-modules: - B1- Technology, Durability, and Performance - B2- Technology, Durability, and Modelling

Flowchart of modules S&ME:



Structural & Materials - Track Base: Structural / Material Engineering (CIEM1000)

Base-1: Sustainable Construction Members and Systems

In this unit, the focus lies on loads and sustainability aspects of structural design and design and analysis of steel, timber and concrete members. It covers the topics of identification and quantification of loads on structures, design of steel and timber cross-sections and members, analysis and verification of response of prestressed concrete members exposed to forces and the application of the principles of sustainability and circularity in civil engineering structures.

The content of Unit 1 is divided into six themes offered in Q2 and Q3 with a workload of 5EC and 3EC, respectively. In Q2, loads and sustainability aspects of structural design and design and analysis of steel and timber members are covered. In Q3, the design and analysis of prestressed concrete systems and connections in steel and timber structures are covered.

The Unit is shared with the SE track.

Base-2: Science and Selection of Construction Materials

In this unit, you will learn fundamental principles of comparing different material properties and selecting the most appropriate material for each application through interactive workshops using Granta Edupack. Moreover, since the database in Edupack does not only have materials often used in Civil Engineering, you will develop a great understanding of why certain materials are not used in practice despite showing good properties. Hence, you learn to select materials by evaluating specific properties, but also having the general performance of the material in mind.

Base-3: Fracture Mechanics

In the Fracture Mechanics unit, the failure modes of different materials are evaluated, understanding how a crack propagates through the material. From this unit, you will learn to relate the microstructure of the material to its micro properties and how that affects the macro properties, predicting the failure of the element.

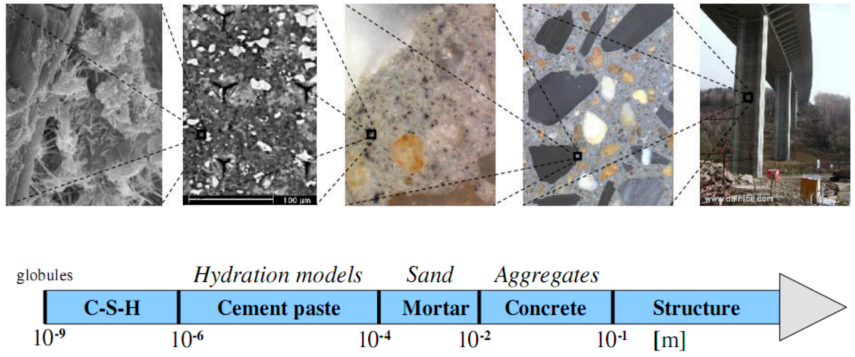


Figure 1: Multiscale features of concrete structures

Student experience (when it was called construction materials, different unit numbering)

The base track module was divided into 4 topics which I believe indeed are required for you to be expert in construction materials. In unit 1, I learned a lot about a wide range of materials. I only had pre knowledge of concrete but I did not feel lost at any time, as each material was introduced from its basic concepts. Unit 3 was also very surprising for me as I did not expect the large amount of materials that can be chosen for a project. It was really nice that in the exercises, we were encouraged to choose and compare unconventional materials with concrete and metals for example. Also, during one class in Unit 1, the lecturer was going to oversee one experiment right after the end of the lecture, and due to the small class size and more personal interaction, the class was invited to join and watch the experiment, which was very interesting and helped us to learn more about the topic.

Student experience (when it was called construction materials)

The base was a bit overwhelming at first, with subjects I didn't spend a lot of time on in my Bachelor's and a lot of different teachers. However, as time rolled along, I got the hang of the rhythm and got to appreciate how every teacher is telling about advancements in their own field, meaning that not a lot of other people in the world know about it, nevermind get lectures on it. That is pretty cool.

Student experience (Last year)

The Base model had a lot of interesting lectures and really helped me gain useful knowledge and skills for courses that come later in the track. Unit 1 sometimes felt a bit overwhelming with its large amounts of topics that ran alongside each other, but with a bit of effort, it was easy to keep up. Unit 2 sometimes felt a bit superficial, because a lot of different materials and topics were introduced, but for none we really went in depth. However, in the later quarters understood why this unit was structured this way. It really helped to have a basic understanding of all the different topics, when we finally went deeper into the behaviour and characteristics of most materials. Unit 3 was really interesting, it taught us different approaches to predict when and how a material will crack, and how this relates to the materials microstructural properties.

Structural & Materials - A Module: Measuring and Characterisation (CIEM1110)

A-1: Numerical Modelling of Construction Materials

In this Unit, many numerical modelling tools are introduced, such as FEM in python notebooks, Diana software, and Lattice models. The theory behind each modelling tool is explained, and workshops are given for students to grasp how to model materials with these tools. Also, one group project is done with each tool learned, so students work together to understand and make the necessary adjustments to correctly model the material of interest.

A-2: Experimental Characterization of Construction Materials

In this unit, you learn about several analytical techniques used for experimental characterization of construction materials, from microstructure to destructive and non-destructive techniques. During the lectures, the concepts behind each equipment and experiment are described, alongside the outputs and an explanation on how to interpret the data obtained.

Student experience

This module was very interesting, as in unit 2 you learn about experiment devices and how they work, which also gives you insight on potential problems, and where uncertainty may arise from them. This module was also very good due to the connection between units. Each group of students had to write three different reports. For each case report, an experiment was performed and interpreted alongside a modelling tool to validate the data obtained. Then a comparison between experimental and numerical tests was performed.

Student experience

The general idea of the module is very nice: for different material properties you compare lab tests with computer models simulating those properties. It was sometimes hard with planning all of it, since lectures should ideally line up with the lab tests, but this was not always the case. Still, if you're interested in learning how the microscale properties affect the macroscale properties of a material, this module is a step in that direction.

Student experience (Last year)

I would say this module was mostly great. The units worked really well together, and it really helped to apply the theory from the lectures in the workshops and report. Most students struggled a bit with some content of unit 1. The finite element modelling in python was difficult and the exam content was not really in line with the material that was taught. All the other content was appreciated by the students.

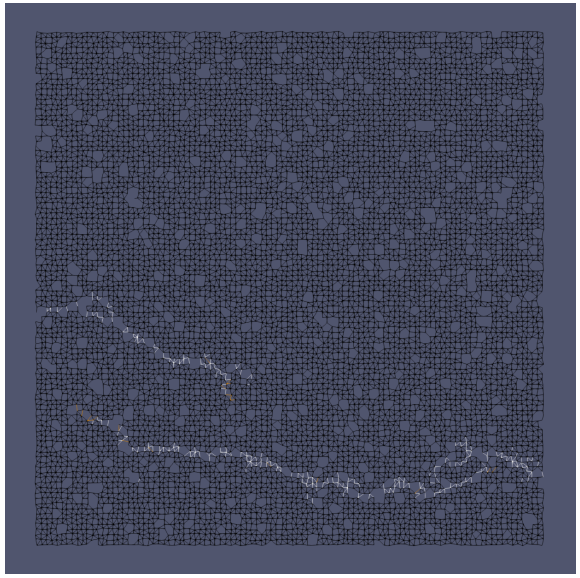


Figure 2: Crack propagation of mortar samples with different porosities using lattice modelling

Structural & Materials - B1 Module: Technology, Durability and Performance (CIEM1230)

Module B1 focuses on the development and behaviour of construction materials under different environmental and loading conditions. It includes three parts: construction materials technology, degradation mechanisms and durability, and imposed deformations. You will study how materials are produced and applied, how they degrade over time, and how they respond to external influences such as temperature and moisture.



Figure 3: GECOR equipment that will be used during the durability module to measure corrosion properties of reinforced concrete in the field

Structural & Materials - B2 Module: Technology, Durability and Modelling (CIEM1240)

Module B2 focuses on the development, durability, and modelling of construction materials. It includes three parts: construction materials technology, degradation mechanisms and durability, and constitutive modelling. You will study how materials are produced and applied, how they degrade over time, and how their behaviour can be described and predicted using multiple modelling approaches.

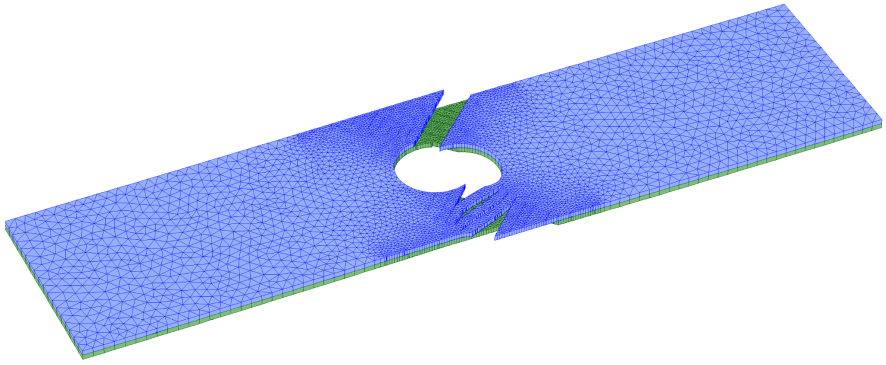


Figure 4: 2-Ply polymer modeled with XFEM modelling technique that will be taught in the numerical modelling unit

Student experience B1 (Last year)

The units 1, construction materials technology, and 2, durability are shared between students following both the B1 and B2 modules. Both of these units were great. They really tie together all the previous material that was taught in the track and helped students to combine this knowledge to solve real world problems. The construction materials technology unit really goes in depth for both concrete and asphalt as a material. It teaches you all about their properties and how to characterize them. It also teaches you about potential issues that can arise when you use these materials, and how to use your new gained knowledge to solve these issues. Moreover, it also touches upon the most recent advances in the research field of concrete and asphalt industry.

Unit 3 teaches you to analyse and predict the influence of eigenstresses in materials on the behaviour of structural elements and components, and to explain how environmental effects and different gradients on material level and structural level impose deformations and stresses. Some students felt the unit could have been organized a bit better as they felt a lot of the material was not relevant to pass the oral examination, even though it was interesting.

Student experience B2 (Last year)

Unit 1 and 2 were also received positively by the students following B2. Unit 3, the numerical modelling unit of B2 is a shared unit with students following the module B1: Applied Mechanics of Structures of the Structural Engineering Track. The unit consists of 2 parts, small strain modelling and large strain modelling. The small strain part was received very well. Personally, It really made me understand the finite element modelling framework, filling in some knowledge gaps that earlier courses about modelling had left me with. The large strain part was quite difficult. For me, I only fully understood the concepts at the end of the course, when a workshop was given, where all the knowledge was applied step by step as you would in a real world modelling problem. Overall, the unit was very nice, but if you don't enjoy modelling and learning about the concepts behind it, this unit is probably not for you.

Introduction Structural Engineering Track

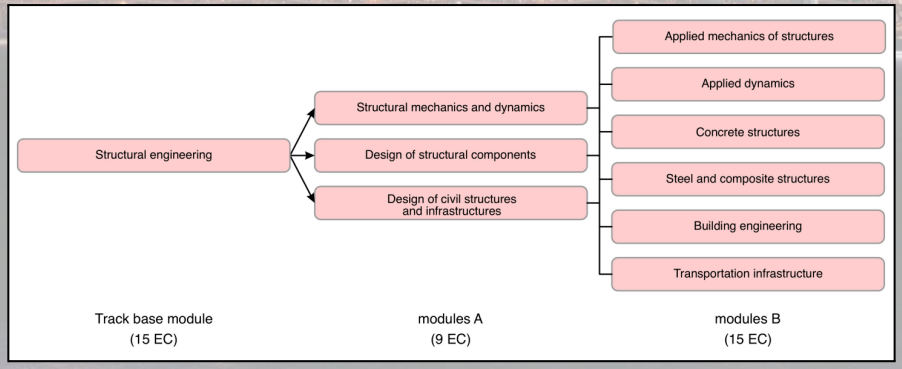
Structures such as bridges, high-rise buildings, tunnels, and storm surge barriers clearly should not collapse or fall over. They may not deflect or vibrate in excess. Moreover, often they need to last for more than 100 years without much maintenance. In the MSc Structural Engineering track you will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

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 early design stages to prepare for 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. An example is the stresses that will occur a high-rise building due to a strong earthquake.

The track specific modules are listed below, per quarter.

Q1	No track specific modules
Q2	Structural Engineering Track Base
Q3	Structural Engineering Track Base and One of the following A-modules: - A1- Structural Mechanics and Dynamics - A2- Design of Structural Components - A3- Design of Civil Structures and Infrastructures
Q4	One of the following B-modules: - B1- Applied Mechanics of Structures - B2- Applied Dynamics of Structures - B3- Concrete Structures - B4- Steel and Composite Structures - B5- Building Engineering

Flowchart of modules SE:



Structural Engineering - Track Base: Structural Engineering (CIEM5000)

Designing skills are important for all structural engineers, and in this module the goal is that students embrace principles and good "feeling" of structural design with "traditional" construction systems and materials.

Base-1: Sustainable Construction Members and Systems

In this unit, the focus lies on loads and sustainability aspects of structural design and design and analysis of steel, timber and concrete members. It covers the topics of identification and quantification of loads on structures, design of steel and timber cross-sections and members, analysis and verification of response of prestressed concrete members exposed to forces and the application of the principles of sustainability and circularity in civil engineering structures.

The content of Unit 1 is divided into six themes offered in Q2 and Q3 with a workload of 5EC and 3EC, respectively. In Q2, loads and sustainability aspects of structural design and design and analysis of steel and timber members are covered. In Q3, the design and analysis of prestressed concrete systems and connections in steel and timber structures are covered.

Base-2: Mechanics of Slender Structures

Unit 2 treats the mechanics of slender structures (Rod, Cable, Beam & Plate). Both the Statics & Dynamic parts of these slender elements are taught. In Q2, simple cases are treated in which analytical solutions of single elements are possible. The goal is to explain physics and the basics of the methods. In Q3, the focus is shifted towards design-type assignments in which students apply the solution methods in more complex systems consisting of combined one-dimensional structural elements and plates together with complex boundary/interface conditions.

Student experience

The Base-1 unit of Q2 and Q3 were very interesting; I got to learn more about designing with steel, timber and pre-stressed concrete materials. The classes were also made interesting with formative assignments and in a few lectures, the professors would bring the material to the classroom to better understand the lectures. The Base-2 unit of Q2 was mainly solving analytical problems. The unit was very informative and the professors did a great job in helping us understand the unit with lots of example problems and formative assignments. In Q3, the unit was assessed based on 3 assignments. In the assignments, we would numerically solve complex problems using software like maple, python and a FEM software (ABAQUS/ DIANA/ ANSYS).

Structural Engineering - A1 Module: Structural Mechanics and Dynamics (CIEM5110)

This module provides students with in-depth knowledge and understanding in Structural Mechanics and Dynamics, providing theoretical and relevant application cases for structural engineers.

A1-1: Stability of structures

In this unit, you will learn to analyse and explain the criteria for the stability of structure for static and dynamic loads. A range of instabilities for the conceptual design are considered, like, buckling of building columns, flutter and galloping of bridges and power lines, plastic collapse of frames (linear & non-linear analysis) and vortex-induced vibrations.

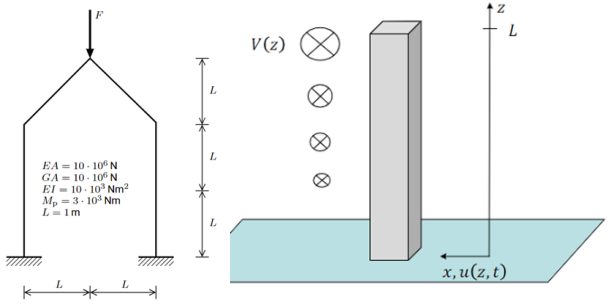


Figure 6: Example exercise

A1-2: Finite Element Method

In this unit, the learning line of MUDE is continued. You will receive a theoretical background into the finite element formulations for structural analysis, with which you would perform the FEM analysis on frame structures to analyse their force distribution and their static and dynamic responses.

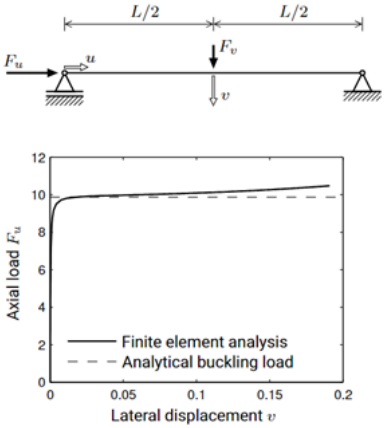


Figure 7: Nonlinear Elastic Analysis: Euler Beam

A1-3: Measurement and Analysis of Vibrations

In this unit, students will develop on the contents learned in MUDE about Signal Processing. Students will be taught to analyse and interpret measured signals for characterising dynamic systems and to assess the uncertainty. The unit is assessed based on group work, which involves laboratory set-ups to quantify and interpret the uncertainties in the vibration analysis. There are weekly assignments provided to receive better understanding into the unit.

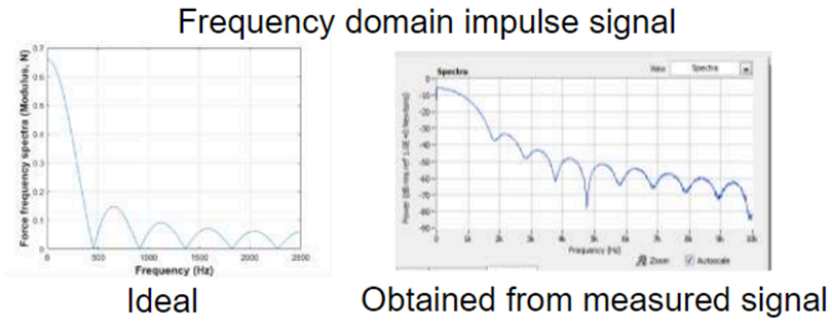


Figure 8: Example of a measured signal

Student experience

The U-1 has 2 subparts: Static Instability and Dynamic Instability. The unit starts with how Instability which happens during a load is different from the response of structure to the same load. Static Instability deals with various types of buckling (Euler buckling, Torsional buckling and Lateral buckling (LTB)). I learnt the fundamentals behind various analyses such as Geometrically Linear/Non-linear Elastic/Plastic analysis, Buckling analysis. Static stability uses the Energy approach to derive the EOM and then the buckling load. I also learnt how structures may not necessarily fail after reaching static instability. There are quite some mathematical derivations involved including finding the higher order approximations using Taylor series which forms the basis for finding the Post buckling state. Dynamic Instability deals with Galloping, flutter, gyroscopic systems and Parametric instabilities. This feels like the continuation of the Slender structures. I learnt the fundamental difference between Static and Dynamic Instability, which can be explained after solving the EOM and finding the eigenvalues. We start any problem with the EOM & Boundary/Interface conditions. If you like Prof. Metrikine's lectures, then you're going to love this unit. You simplify the real life structures into equivalent 1-D structures and apply the concepts of Instability to find what parameters can cause instability. The professor brought us the real equipment where you can see both linear and non-linear effects on the parametric instability.

The U-2 deals with FEM. This is a continuation of the FEM topic from MUDE and this forms the foundation for the B1 module. We started with some recap of MUDE (not much). Then we dive into deriving the weak form of a Timoshenko beam element, followed by the weak form of a more general 3-D element. The derivation from strong form to weak form involves quite some mathematics and vector algebra, which is also important for the exam. Another great thing about this unit is that the professors made available an online textbook (similar to MUDE) whose content at times is even better than the lectures! The unit also links to the U1, where you learn the different types of analysis (Geometrically Linear/Nonlinear Elastic/Plastic) analytically. This unit extends on the same topics but using FEM. Bridging this link is a really essential learning element. Another important aspect is the PYJIVE, an in house Python

code which has all the implementation of FEM required to solve some basic to even complex problems. Your coding skills come handy when you use it during weekly workshops. Personally, I am not very good at Python but this module offers a lot of scope into developing your python skills as well.

The U-3 is where you practically implement the concept of mode shapes and natural frequencies. The workload is a bit on the heavier side, and the assignments involve some amount of coding, but the professor provides a lot of hints on how to implement it in Python. The study material from the professor contains a lot of material but most of it is optional and can come handy if you want to further your journey with Signal processing. Mathematics involves some understanding of complex numbers. At the end, we performed an experiment where we hit a rail beam with a hammer to measure its mode shapes and natural frequencies. You get to see the practical importance of finding the dynamic properties of a system and this unit forms the foundation for the SHM course. This is a photo of me taking revenge on the rail beam. There was a separate lecture at the end where they also connected this unit to U2: FEM, where you model the experiment using PYJIVE.



Structural Engineering - A2 Module: Design of Structural Components (CIEM5120)

A2-1: Prefabricated and composite structures

The focus of this unit is to learn designing on components in 4 different themes: steel, concrete, timber and railway. It will consist of home assignments for all the themes except railway, that includes hand calculations for example Steel composites, Unbounded prestress concrete and CLT timber structures, also each assignments have different deadlines for submission which is of 20% grade of the module, and 35% for the written exam.

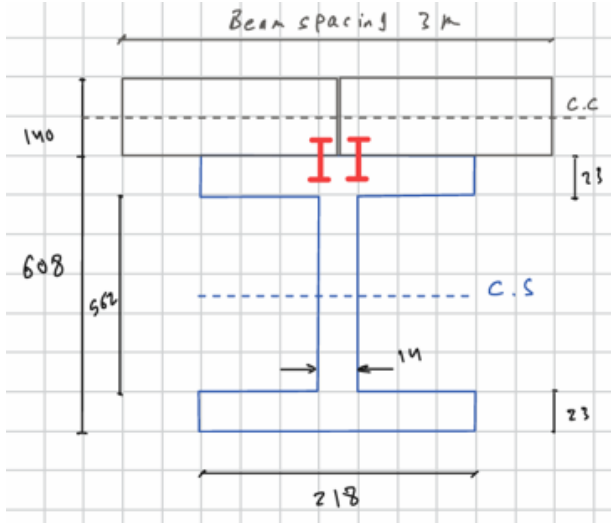


Figure 9: Example of Steel Composite structure

A2-2: Design with innovative materials

The unit's lectures are led by field experts and instructors covering topics such as high-performance steel and concrete, recycled materials, structural glass, digital manufacturing, and pavement and railway engineering. Students then choose a topic to explore in greater depth, producing a research paper as the final output. This unit consists of 45% of the grade.

Student experience

Our group did the research on Vibration mitigations of Tram line 19, which involved various mitigation methods comparisons having to do some dynamic analysis hand calculations and finally suggest the best mitigation method in our results, I felt it to be interesting as involved writing a research article rather than just a report, which could also help me in writing journal papers in the future.

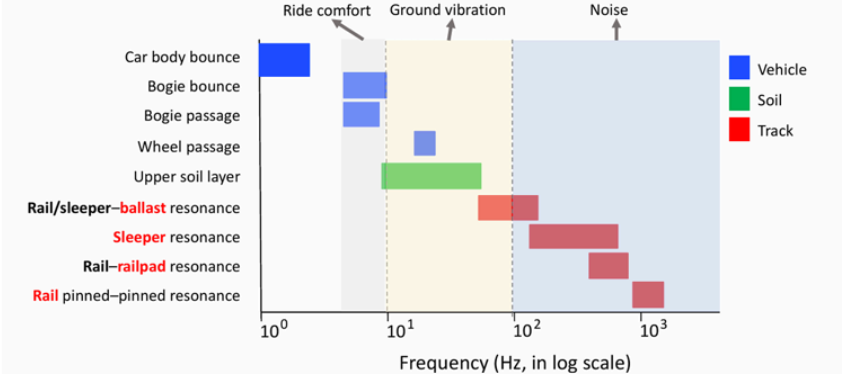


Figure 10: Figure made by students for the research paper on structural glass

Structural Engineering - A3 Module: Design of Civil Structures and Infrastructure (CIEM5130)

A3-1: General design principles of (infra)structural systems

This unit's lectures focus on the design principles of five main themes: buildings, bridges, railways, pavement and circularity. These lectures take place during the first four weeks. For instance, for bridge design, you will gain insight into various bridge types, their components and loading types. Moreover, the initial two weeks include six workshops that offer useful skills such as parametric design, visual presentation and setting up a clear calculation. For example, the parametric design workshop introduces you to the practical use of the software Grasshopper.

A3-2: Specific design aspects of building, bridges, rail and road structural systems

Once you have acquired knowledge about the design principles of the themes in unit 1 and have worked on their structural system in the design assignment of unit 3, you may come across a subject that you would like to research in more detail. In this particular unit, you are encouraged to select a topic within your chosen theme and write a research paper about it. It will help you dive deeper into a topic of your choosing with the guidance of an expert in the field, whilst learning the procedure of writing about research.

Student experience

Within the theme of railways, I researched the feasibility of plastic railway sleepers on a ballasted track. I looked into the benefits and drawbacks of plastic sleepers and the uncertainties surrounding the long-term performance of plastic sleepers. The research paper should also contain a simple model. For this, I used a beam on an elastic foundation model to compare the stiffness behaviour of plastic sleepers with concrete sleepers. It was nice to be able to choose my own topic and to write the paper in the form of a research paper.

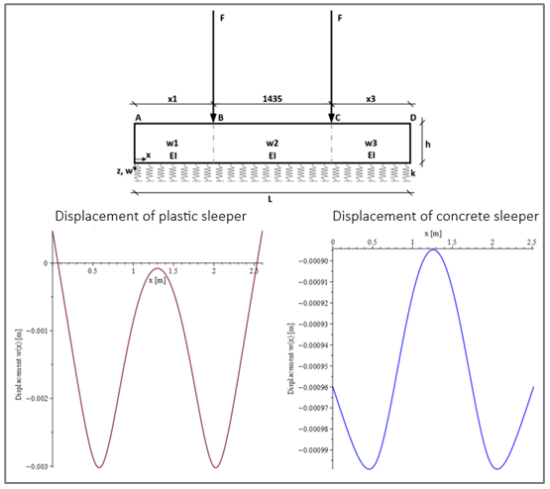


Figure 11: Beam on an elastic foundation for railway sleepers

A3-3: Design Challenge

In this unit, students will be participating in a group design assignment. Each group had to design an airport consisting of a new railway track, overpass, actual building and the pavement design for both car and plane roads. Each group member chooses their preferred element, while keeping in mind the circularity part.

Student experience

The design challenge consisted of the preliminary design of an airport. The airport contains a terminal (building aspect), a railway track, an overpass and a run- and highway for the pavement design. Regarding the railway, I looked into the track that leads to the terminal. For example, I calculated the number of passengers to be expected to make use of the railway station at the terminal. Also, various track structures were considered to choose the most suitable one for the project and amongst others I calculated the minimum rail displacements.

Structural Engineering - B1 Module: Applied Mechanics of Structures (CIEM5210)

B1-1: Computational modelling of structures

This unit focuses on the application of the Finite Element Modelling package DIANA to structural engineering. It teaches very practically how to work with DIANA, but also FEM packages in general. Topics covered include linear elasticity, material nonlinearity (crack modeling and plasticity), geometric nonlinearity and concepts like convergence and mesh dependency. The unit consists partly of lectures on Finite Element Modelling, but mostly of seminars where you work on informal assignments and can ask questions. In these assignments, you will replicate a real experiment in DIANA and compare the results. Towards the end of the quarter, you work on a final assignment, on which you have to write a report. After submitting this report, you have to do an oral exam which focuses both on your final report and the information given in the lectures. Assessment is done partly on your report and partly on your oral exam.

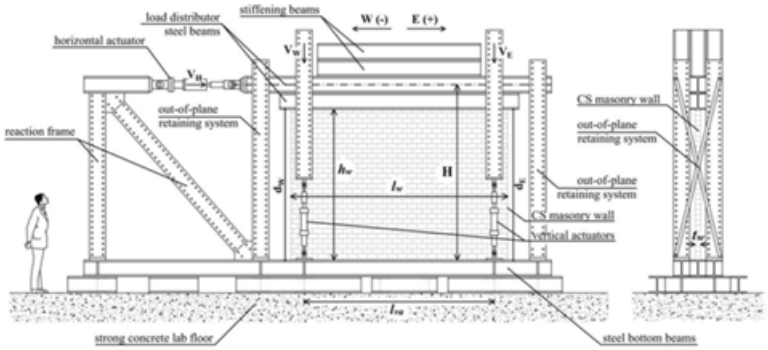


Figure 12: Exemplary masonry wall from the final assessment

B1-2: Advanced constitutive modelling (same as CM B1-3)

This unit focuses on the modelling of the constitutive behaviour of materials. It consists of two parts, given by two different lecturers. The first part goes deeper into the mathematical theory behind finite element modelling and shows how different non-linear models work. This theory is applied in the first unit of the module. The second part focuses on how to mathematically describe different material models like hyperelastic, elasto-plastic, viscous, visco-elastic and thermo-elastic. Both parts are assessed separately in the form of oral exams.

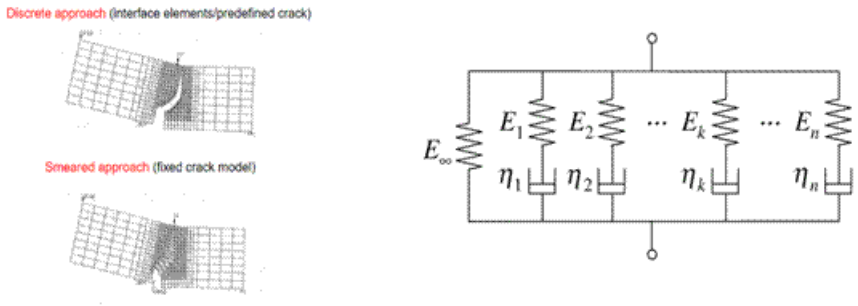


Figure 13: Discrete/smeared modelling of crack interface

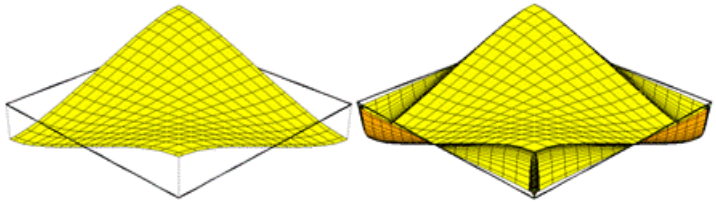


Figure 14: Two different Finite Element methods applied to a plate. (torsion moment shown).

For this unit, prior knowledge from the Structural Mechanics and Dynamics module is useful, but not necessary.

B1-3: Advanced mechanics of structures

This unit consists of two parts: an elastic part and a plastic part. The elastic part focuses on torsion as well as on elastic analysis of plates. The plastic part consists of different kinds of plastic behaviour like the Bauschinger effect, yielding contours, upper bound and lower bound theorem and force interaction. For the topic of torsion and plates Finite Element results will be discussed. The lecturer, Pierre Hoogenboom, manages his own website where you can preview the covered material more closely. This unit is assessed with an open book written exam.

Student experience

I liked this course a lot. It wasn't a very heavy workload. Sometimes you have to read and sometimes there are some exercises to do. The lectures of Unit 1 are very nice, but sometimes the content overlaps with Unit 2. For Unit 2, the content you learned in A1 module really helps. If you did not follow the A1 module, you might have to do some homework to catch up. There was a guest lecture from an expert in the medical field who used FEM for predicting a heart attack to learn its applications. For unit 3, a suggestion is to start working on sample exams early. There was also a cool competition for Unit 3 which allowed you to gain extra points in the exam which was fun. It's a very nice course that provides a lot of knowledge that most engineers won't know about.

Structural Engineering - B2 Module: Applied Dynamics of Structures (CIEM5220)

In the B2 module, you will learn structural response to various dynamic loads. The module is divided into three units, the unit 1 earthquake, the unit 2 wind and waves, and the unit 3 moving load. In 2025-2026, assessment consisted of an overall exam (25%) and assignments (75%).

B2-1: Structural response to earthquakes

In this unit, you will learn the different methods of dynamic analysis for simple and more complicated structures with ground motion as a source of excitation. This includes the methods mentioned in the Eurocode as well as soil structure interaction. In the graded assignment, you will apply your knowledge in an analytical as well as a numerical approach using a FE-software. In 2025-2026, there were two assignments. In the first assignment, we analysed the dynamic behaviour of a wind turbine subjected to various dynamic loads, such as waves and earthquakes. In the second assignment, we performed seismic analysis of a structure of our choice using several different analysis methods.

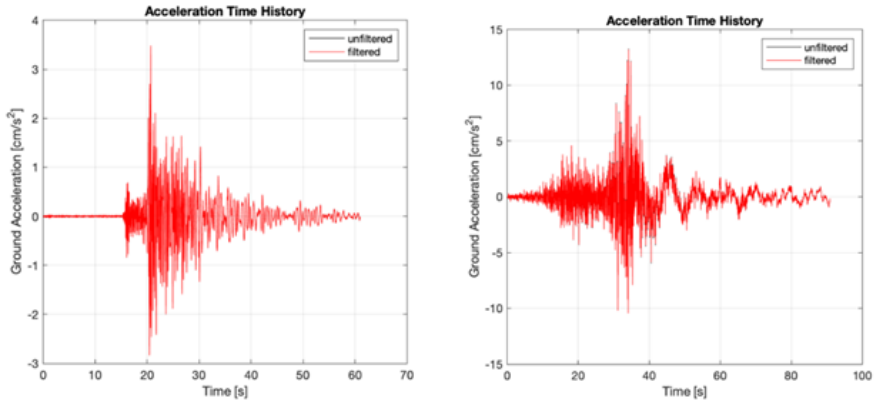


Figure 15: Example graphs showing acceleration of the ground over time

B2-2: Structures subjected to wind and waves

This unit focuses on an assignment, while the lectures and literature provide the necessary information. In the assignment, you analyse the dynamic behaviour of an offshore wind turbine subject to randomly generated wind and wave time signals. The analysis will be computed numerically by building your own dynamic FEM model.

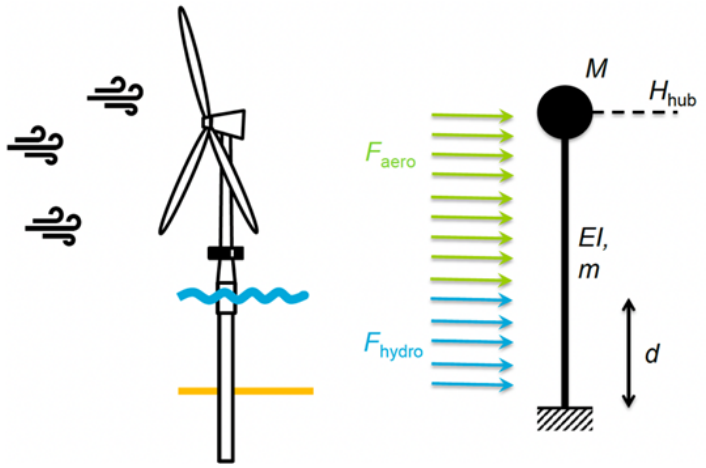


Figure 16: Example model for windturbine

B2-3: Structures under moving loads

This unit is split into two approaches. The first one focused on showing the dynamic effects on simple beam structures subject to moving loads using an analytical approach. The second one focuses on numerical modelling methods and more complex systems using Ansys and MATLAB code. In the graded assignment, you analyse several systems' dynamics analytically and do the same thing numerically for the high-speed case (Hyperloop).

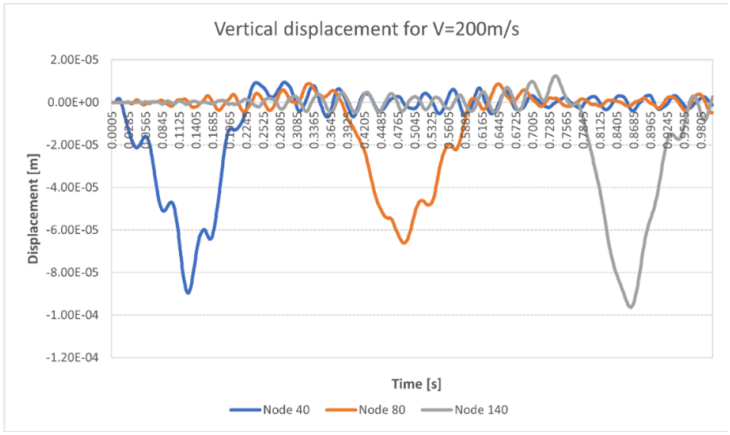


Figure 17: Example figure vertical displacement for certain speed

B2 common block: Random vibrations

During the second week of the quarter, the focus shifted to analysing random vibrations caused by unknown excitations. The approach of this subject is purely analytical and based on the probability theory and propagation of inputs through the system. As opposed to the "standard" approach, we are here no longer interested in one solution but rather a response spectrum, as the real excitation is unknown.

Student experience

During the module, we got a lot of information about the different courses. The teachers really try to let you think about the different subjects and after a nice start, the tempo increases a bit. The projects were fun to do and there was plenty of support. Although they are a lot of work, I found it nice to work together and get it done. The presentations were very educational, and the questions sometimes were

even fun. Because of the projects, I had forgotten a bit about the exam, but in the end it was a nice quarter.

Structural Engineering - B3 Module: Concrete Structures (CIEM5230)

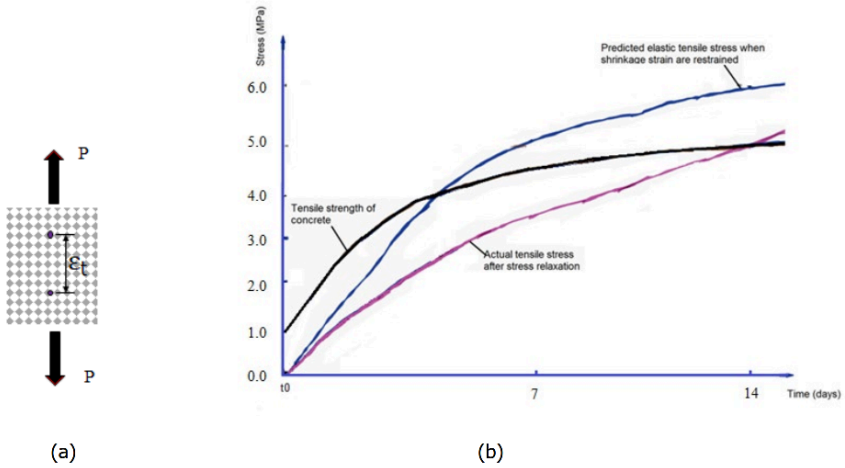
The lectures of this module are given by teachers who are all experts in the field of concrete. All different kinds of topics are discussed in this module, from finite element modelling of concrete structures to concrete bridges and advanced mechanics. But also the more fundamental theory about the concrete science and technology and concrete structures under special loadings are explained.

B3-1: Advanced Modelling of Concrete Structures

This unit focuses on the mechanics which are used for designing concrete structures. Topics such as the plasticity theory, stress fields and fracture mechanics are examples of typical concrete mechanics. You will learn how certain rules in the Eurocode are established, such as the shear force capacity of reinforced and prestressed concrete elements. Lectures in combination with a few examples using software will prepare you for the written exam which is given in combination with unit 2.

B3-2: Concrete science and technology

The second unit of the module will go more in depth on the material science aspect of concrete. The constituents of concrete and the chemistry behind hydration will be taught as well as the microstructure of concrete, creep and strain. Innovative and more sustainable types of concrete will also be touched upon in the lectures and the assessment is done by a written exam in combination with unit 1.



(a) (b)

Figure 18: Example exercise: explain influence of shrinkage and creep on concrete cracking potential when concrete is under restraint.

B3-3: Numerical Modelling of Concrete Structures

Numerical modelling of structures is the only unit which runs throughout both halves of the quarter. This unit will teach you how to go from a physical problem, which is schematized by a mechanical model, to a finite element model. Discretizing the physical problem has to be done thoughtfully. Each week consists of lectures about the application of finite element modelling and a workshop to apply this knowledge to some examples. This unit is assessed by modelling a structure from a paper at the end of quarter and an oral exam in which your assignment is discussed as well as your knowledge about numerical modelling.

B3-4: Concrete structures under special loadings

Unit 4 of the module is all about special loadings such as imposed deformation caused by thermal expansion or loading caused by explosions and collisions. Early age concrete will be presented briefly, which will teach you how to mitigate excessive early age cracking. Moreover, the construction and loadings of silos will be discussed as well as reservoirs filled with liquids such as water or LNG. Two case studies about silos and an oral exam on imposed deformation will form your final grade.

B3-5: Concrete bridges

The last unit, concrete bridges, is all about the different types of concrete bridges used in the Netherlands. You learn which type of concrete bridges are viable for which spans and rule of thumbs to dimension all these types of bridges. The standard elements of concrete bridges will be discussed and it is explained how the loading on bridges is determined. Completion of three assignments is required for entering an oral exam at the end of the quarter, on which your final grade is based.

Student experience

The quarter is divided in two parts, where the first part focuses on concrete science and technology and advanced concrete mechanics. Where concrete mechanics is given in a flipped classroom type, which was executed very well. Concrete science and technology is given in a more classical teaching style. Both units are combined in one exam which was given in week 5. After week 5 the focus shifts to concrete bridges and concrete structures under special loadings. For both units multiple assignments were given and an oral exam is conducted in week 10. During the entire quarter we had workshops and lectures about finite element modelling of concrete structures, where small assignments were conducted in the first half of the quarter, and one bigger assignment is conducted in the second half. This bigger assignment is also the preparation for the oral exam which is conducted in week 10.

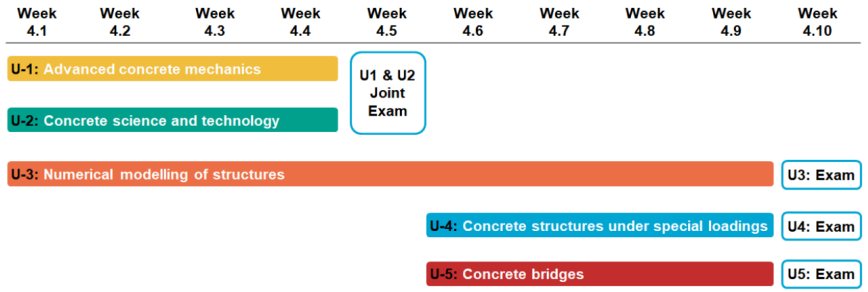


Figure 19: weekly schedule B3 module

Structural Engineering - B4 Module: Steel and Composite Structures (CIEM5240)

B4-1: Strength and durability of steel and composite structures and joints

This unit consisted of Fatigue assessment and fracture mechanics with Finite Element modelling in ABAQUS, Joint design and fatigue rank among the most critical design considerations in structural steel, regardless of application. Together with modelling innovations and their significance, these three topics form the foundation of steel structure design understanding applicable across today's engineering practice. Although the unit runs the full quarter, the lectures are thoughtfully structured to present theory clearly before moving into thorough practice sessions on numerical applications. Topics are never taught concurrently, which keeps the material manageable and easy to follow. Exams are largely numerical and application-based, mirroring the style of the assignments. The modelling component also featured lectures from professors and PhD researchers on real-world applications, which made it both engaging and enjoyable.

B4-2: Heavy-duty steel and composite structures

This Unit consists of the topics Bridges (60%) and Energy (40%). As the name suggests, this unit covers some of the specific applications of steel. The Bridges the design and analysis of steel and hybrid bridges, including some modelling aspects. Delivery for this unit is mixed-mode, combining pre-recorded video lectures with in-person sessions. Study hours are clearly split between lectures and numerical discussion sessions, giving a solid sense of what to expect in both exams and assignments. Exams combined theory and application-based questions, which felt tricky at times given how unfamiliar the mixed lecture format was at first; still, staying on top of the reading material made a real difference. Since this unit ran in parallel with the first, it became much easier to see how the various topics interact within the overall design of these structures. Frequent lab visits also accompanied the lectures, lightening the workload some weeks while bringing the theory to life.

The energy unit consists of supporting structures for renewable energy especially offshore wind turbines that rely on steel substructures that must withstand near-constant cyclic loading from wind and waves, making fatigue design central to their performance. Jacket/truss structures use welded tubular joints (K-, X-, Y-, KT-joints) that concentrate stress at the weld toe and demand specialized fatigue design methods, while monopiles — the more common foundation for shallower waters rely on a transition piece (grouted or bolted) to transfer large overturning moments from tower to pile, with fatigue, corrosion, and scour as key concerns. Together, these structures apply the unit's core themes of joint design, fatigue, and modelling to a case where cyclic loading defines the design with one of the assignments involved in the design of tubular structures completely.

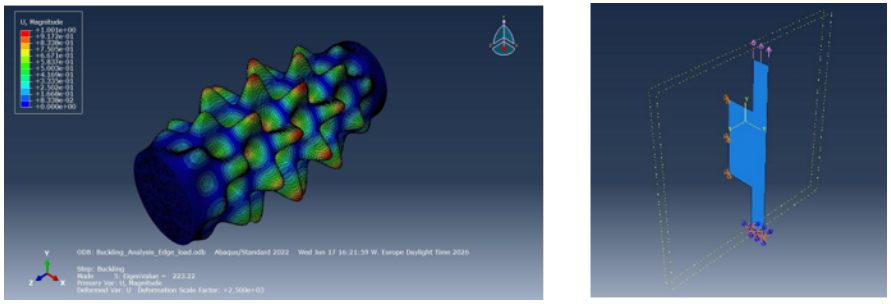


Figure 20: Wind turbine buckling and connection analysis.

B4-3: Lightweight steel and composite structures

This unit focuses on Composites, covering design using innovative fibre-reinforced polymeric composites. Following the format of previous units, Composites lectures are delivered in mixed-mode, featuring input from industry leaders and researchers. Though a relatively new subject, it's easy to grasp and comes with a solid repository of reading materials. A good number of solved examples and assignments help reinforce the theoretical concepts covered. Exams are relatively straightforward as a result, though with a greater emphasis on application compared to Unit 1. The guest lectures and pre-recorded videos alongside the lectures were genuinely enjoyable and great for networking.

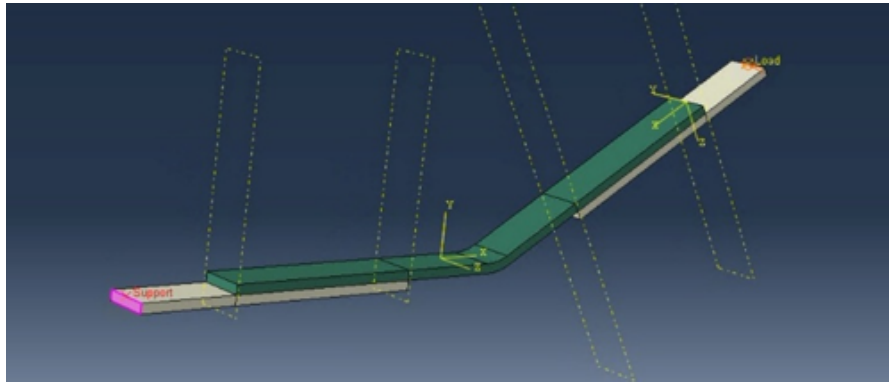


Figure 21: FRP connection modelling

Student experience

I really enjoyed this module both how it was put together and how it was taught, there were 3 assignments 20% each and 40% written exam. What we learned here isn't just theoretical; you can see it directly applied in major infrastructure companies and research organisations today, and the lectures and assignments were clearly designed with that in mind. That's honestly what made it click for me. It felt like we were being shown not just the "what" but the "why," and how it connects to real industry problems. One thing I really appreciated was how flexible the teaching style was; the professors adjusted how they delivered content depending on what worked for us as a group. Since the class wasn't huge, lectures felt more like conversations than lectures, which made it so much easier to ask questions and get them answered. The graded group assignments were genuinely useful too; they carried enough weight that we had to stay on top of things throughout the quarter, which took a lot of pressure off exam time and doubled as solid exam prep. I also liked that the units ran alongside each other rather than one after another, because it meant concepts from one topic kept showing up and reinforcing what we were learning in another. All in all, it was an enjoyable quarter, and I came away having learned a lot.

Structural Engineering - B5 Module: Building Engineering (CIEM5250)

Building Engineering will focus on the engineering of buildings as complex systems in which many facets need to be aligned in an integrated interdisciplinary design process. The three units are taught through lectures and workshops and the knowledge is then applied to an overarching design challenge. Furthermore, the knowledge is tested through one (closed book) exam per unit.

B5-1: Architecture, Building Physics and Façades

This unit will provide you with specific building-related background knowledge that is not directly structural engineering: contemporary and 19th-century western architectural styles, façade design/detailing, building physics (heat transport, durability) as well as building services (energy, daylight and shadow, ventilation).

B5-2: Building Structures, Construction Methods and Foundations

You will learn about the flow of forces and stability in various typologies of buildings. The use and re-use of various building materials and structures will be addressed, as well as the interaction with the subsoil via foundation and construction pit. Working on a design exercise of a realistic building allows students to experience the consequences (limitations, options, and uncertainties) of available design and construction methods and receive feedback from professional building engineers. The theory is accompanied by a site visit and guest lectures.



Figure 22: Biomorphic design

B5-3: Design of Spatial Structures

This is an advanced course in the field of special and spatial building structures, their design process, structural mechanics, behaviour and performance, computational modelling, combined with practical use of design and analysis tools for structural engineering. Topics include structures in nature, biomimetics, plates, shells and vaults, membrane and pneumatic structures, cable-nets, tensegrity, (space) frames, grid structures and domes, adaptive and deployable structures. You will learn to do graphic statics and hands-on workshops for making membrane and shell models.

Student experience

The main aspect that I liked about the module is that the project was no longer a simplified version of reality, but rather we got to see the whole process of designing a building, in a way that is very close to real life work. Also, it was nice to derail a bit from engineering and see the architectural side through the design of the facade. It was a challenge, but a fun one. We got a Rhino model and from there we designed a flat combining public spaces and student houses. We had to think about the fire safety, window to wall ratio, heat exchange in the building, etc. It was really fun since the module forced everyone to rewrite the way in which they see things, you get a new perspective on design.



Figure 23: Workshop on shell and membrane models

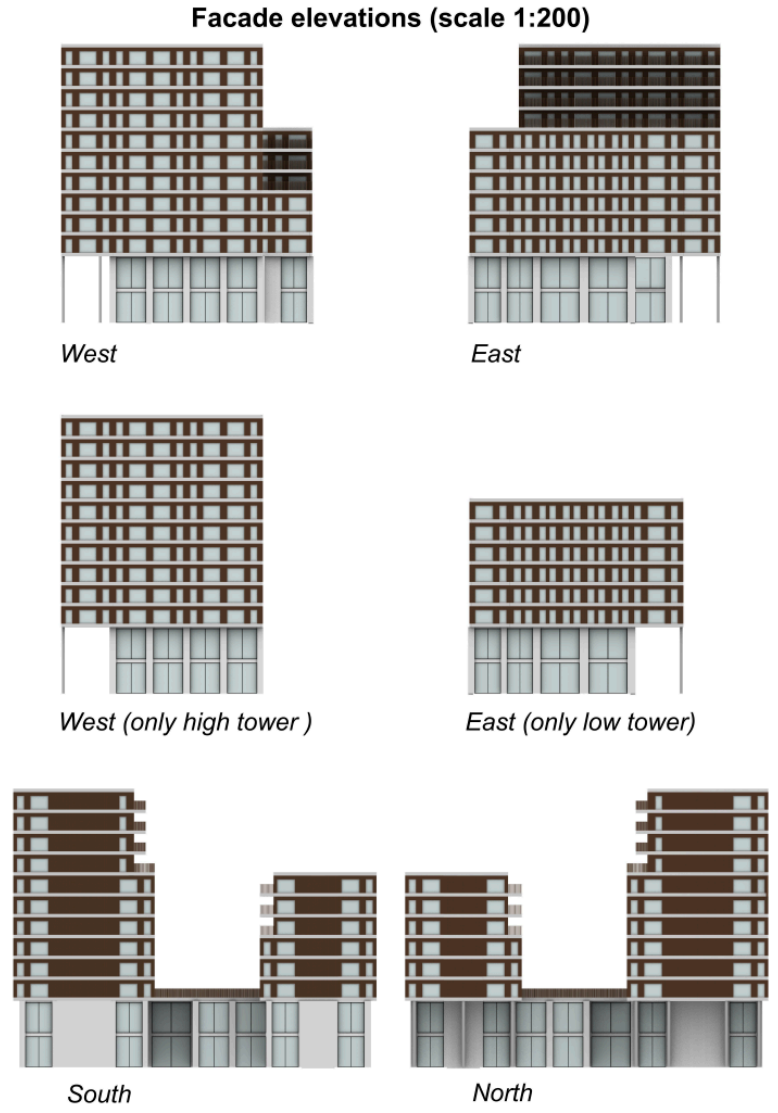


Figure 23: Example finished project poster

U-BASE Study Association

Whilst you're putting in your best efforts to obtain your degree, it is important to not only be occupied with studies and frequently take time off to relax. By becoming a member of U-BASE, you will be given the opportunity to partake in many fun activities among fellow students.

U-BASE is an abbreviation for "United Building and Structural Engineering Association" and it is the student association for master students of Structural & Materials and Structural Engineering at the Civil Engineering faculty of the Delft University of Technology. U-BASE was established in September 2015 and was the result of a merger between three former MSc study associations, namely: U-dispuut, CST-dispuut and Betondispuut. At U-BASE we aim to make your time as an MSc student unforgettable. We are here to bring you in contact with your fellow students so that studying is easier, but mainly so you will make a lot of new friends. Also, bringing students and teachers closer together and improving education is one of our goals. And finally bringing students and companies together for future job opportunities is important to us.

We offer our members a wide range of activities throughout the year. To bring students and companies together we organise excursions, lunch lectures and a yearly recruitment dinner. U-BASE also organises social activities throughout the year, a short U-BASE trip in fall and an international trip during summer break. In order to bring students and teachers closer together, we organise Coffee and Cake Breaks where they can exchange information about courses, exams, graduation or research. Also, course evaluation and improvement are one of our core activities regarding education.

Committees

Committees form the heart of U-BASE. As a member, you're given the opportunity to join a wide range of committees. A committee is a group of students that helps out the association by creating fun and interesting content and activities for other students to participate in. During the Committee Interest Drinks (Wednesday 4th of October), an overview of all committees U-BASE contains will be given. After these drinks, we hope you have a general impression and can make a well-informed choice on whether to join a committee of your liking. Already interested about joining a committee? Have a look at our website: https://u-base.org/about-us/committees/current-committees for more information!

The BASE

Our office (called 'BASE') can be found in the Stevinlab II (room S2.1.35) of the Civil Engineering faculty. Here, students can relax between lectures and meet up with their fellow students. Upcoming events and company information are also shared here. Our door is always open for students, teachers, and companies to come by for a visit. So if you are interested in becoming a member or have any questions in general, don't hesitate to come by and say hi!



Other Useful Links

U-BASE website : https://www.u-BASE.org/

Study guide (offers information about each module) :
https://www.studiegids.tudelft.nl/

Teaching and Examination Regulations (TER) and Rules and Guidelines Board of Examiners (R&G) :
https://www.tudelft.nl/studenten/faculteiten/citg-studentenportal/onderwijs/onderwijsinformatie/educational-rules-and-regulations

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