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Curriculum for the
Master's Programme Civil Engineering
at the Faculty of Engineering Sciences at the University of Innsbruck

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§ 1 Categorisation of programme

According to §54 para. 1 of the Universities Act of 2002, the Master's Programme Civil Engineering at the University of Innsbruck is grouped among the engineering sciences.

§ 2 Qualification profile

The degree awarded by this programme, the "Diplomingenieur" (diploma in engineering), is internationally comparable with a master's degree.

The Master's Programme Civil Engineering is closely related to the Master's Programme Environmental Engineering, also offered by the University of Innsbruck, and focuses on the conventional constructive subjects, the areas modelling and simulation, building materials, construction operations, and project management.

(1) Specialised skills

The field of civil engineering ranges from feasibility studies, planning, structural design and calculations for construction and operations to the preservation and renovation of structures. Graduates of the Master's Programme Civil Engineering possess the necessary knowledge and skills to develop and implement methodologically sound solutions for technical tasks in the areas of concrete and brick construction, wood construction, metal construction, composite construction and materials technology. The programme is based on in-depth knowledge of the fundamental subjects of mechanics, strength of materials and numerical analysis. Moreover, graduates possess advanced knowledge of construction operations and the processes of project management and development. They are able to correctly apply their highly specialized knowledge, incorporating the latest findings in various areas of civil engineering, as the basis for innovative solutions and discourse with colleagues. Graduates possess the necessary competence and critical awareness to perform demanding tasks in civil engineering projects.

(2) Scientific training

Graduates are able to apply the scientific methods and findings of civil engineering. Moreover, they possess specialized problem-solving skills in the areas of research and innovation that allow them to acquire further knowledge, to develop new methods and to combine knowledge from various fields. Building upon scientific principles and methods, students are trained in analytic and interdisciplinary thinking and in deductive approaches to the tasks of civil engineering.

As a result of the following skills, graduates are able to apply scientific methods and findings in the field and to acquire further knowledge independently:

a) Advanced understanding of civil engineering issues based on in-depth fundamental knowledge
b) Professional competence in the application of fundamental knowledge in the core areas of the practical subjects
c) The ability to develop solutions for complex engineering tasks independently
d) The application of modern IT, management and presentation methods

The Master's Programme Civil Engineering qualifies students to pursue advanced studies in engineering.

(3) Wide-ranging skills

Graduates possess problem-solving skills based on sound scientific theories and methods. They are familiar with the management of complex, unpredictable working contexts that require new strategic approaches. Thanks to the diverse foreign language resources of the University of Innsbruck, funded stays abroad during the degree programme, and the incorporation of technical literature in English, graduates also possess foreign language skills, an area that has become increasingly important. The required subject-specific internship, an important part of the curriculum, provides practical skills that help graduates when entering the workforce. The civil engineering programme prepares graduates to solve complex problems in engineering through interdisciplinary teamwork. They are thus qualified to successfully fill leadership positions in projects.

(4) Professional prospects

Graduates of the civil engineering programme are capable of working in planning, building and operations in companies of various sizes and in capacities involving planning, projection, analysis, advising and implementation. They can also pursue professional activities in construction companies, public agencies and organizations, interest groups, media and in teaching and research institutions.

(5) Consecutive degree structure

The Master's Programme Civil Engineering provides in-depth, pre-professional training for students who have completed a bachelor's degree in a relevant field, e.g. the Bachelor's Programme Civil and Environmental Engineering at the University of Innsbruck. Graduates are able to pursue further academic training.

§ 3 Scope and duration

The Master's Programme Civil Engineering covers 120 ECTS credit points (henceforth ECTS-Credits); this corresponds to a duration of four semesters. One ECTS-Credit is equivalent to a work-load of 25 hours.

§ 4 Admission

(1) Admission to the Master's Programme Civil Engineering requires a completed bachelor's degree in an appropriate subject or completion of a comparable programme of study in an appropriate subject at a recognized national or international post-secondary educational institution.

(2) The completed Bachelor's Programme Civil and Environmental Engineering at the University of Innsbruck is always sufficient for this purpose. In accordance with the provisions of the Universities Act, the Rectorate is responsible for determining whether a given programme of study from an Austrian or international institution is considered equivalent for admission to the master's programme.

(3) If equivalence has been established in principle but with certain qualifications missing for full equivalence, the Rectorate may require that supplemental examinations be completed during the course of the master's programme.

§ 5 Courses and numbers of participants

(1) Courses without continuous assessment:

1. Lectures (VO) are courses in which subject matter is primarily conveyed in lecture format. They introduce students to research, methods and schools of thought of a given subject.

   Maximum number of participants: none

(2) Continuous assessment courses:

1. **Practical courses** (UE) are concerned with concrete scientific issues within a given subject.

   Maximum number of participants: generally 30, for laboratory and equipment-based courses 15.

2. **Seminars** (SE) are for in-depth treatment of issues, structured around presentations and discussion of student contributions.

   Maximum number of participants: generally 30

3. **Lectures with practical emphasis** (VU) are concerned with the practical treatment of scientific issues raised during lectures.

   Maximum number of participants: no maximum for the lecture part, generally 30 for the practical part, 15 for laboratory and equipment-based courses

4. **Practical training courses** (PR) are for the practical introduction and treatment of concrete issues in a field; they are designed to complement pre-professional and/or scientific training.

   Maximum number of participants: generally 15

5. **Excursions** (EX) are for the demonstration and in-depth treatment of material outside the premises of the university.

   Maximum number of participants: none

§ 6 Procedures for the allocation of places in courses with a limited number of participants

In courses with a limited number of participants, course places are allocated as follows:

1. Students for whom non-admission would demonstrably result in a prolonged duration of studies are given priority.
2. If the criterion in 1 does not suffice for the regulation of course admission, priority should be given first to students for whom this is a mandatory module and second to those for whom this is an elective module.
3. If the criteria in 1 and 2 do not suffice for the regulation of course admission, remaining course places are allocated by random draw.

§ 7 Structure of the programme

(1) The Master's Programme Civil Engineering comprises compulsory modules covering altogether 17.5 ECTS-Credits and elective modules covering altogether 82.5 ECTS-Credits. In addition, a master's thesis corresponding to 20 ECTS-Credits must be written. The elective modules are divided into three content areas, each of which is divided into three proficiency levels. In order to complete the programme of study, students are required to complete modules from all three content areas and at least one module per proficiency level.

(2) The Master's Programme Civil Engineering consists of the content areas "Materials, Operations, and Project Management" (referred to in the following as BBP – from German "Baustoffe, Baubetrieb und Projektmanagement"), "Constructive Engineering" (referred to in the following as KIB – from German "Konstruktiver Ingenieurbau") and "Modelling and Simulation" (referred to in the following as MOS).

1. The content area BBP contains the following elective modules:
   a. Proficiency level 1: BBP 1-1, BBP 1-2, BBP 1-3, BBP 1-4
   b. Proficiency level 2: BBP 2-1, BBP 2-2, BBP 2-3, BBP 2-4
   c. Proficiency level 3: BBP 3-1, BBP 3-2, BBP 3-3, BBP 3-4, BBP 3-5
2. The content area KIB contains the following elective modules:
   a. Proficiency level 1: KIB 1-1, KIB 1-2, KIB 1-3
   b. Proficiency level 2: KIB 2-1, KIB 2-2, KIB 2-3, KIB 2-4
   c. Proficiency level 3: KIB 3-1, KIB 3-2, KIB 3-3, KIB 3-4, KIB 3-5, KIB 3-6, KIB 3-7, KIB 3-8
3. The content area MOS contains the following elective modules:
   a. Proficiency level 1: MOS 1-1, MOS 1-2, MOS 1-3
   b. Proficiency level 2: MOS 2-1, MOS 2-2, MOS 2-3, MOS 2-4
   c. Proficiency level 3: MOS 3-1, MOS 3-2, MOS 3-3, MOS 3-4, MOS 3-5

§ 8 Compulsory and elective modules

(1) The following compulsory modules covering altogether 17.5 ECTS-Credits, are to be completed:

1.	Compulsory Module: Interdisciplinary Skills	h	ECTS-Credits
	Courses amounting to 7.5 ECTS-Credits are to be chosen according to available spaces from the curricula of diploma or master's programmes at the University of Innsbruck. Especially recommended are courses that deal with gender aspects and findings from women's and gender studies.		7.5
	Total		**7.5**
	Learning Outcomes: This module expands the range of the study programme and provides additional qualifications. Students acquire qualifications that allow them to engage in scientific discourse beyond the boundaries of their own field, constructively, responsibly and with sensitivity to gender issues.		
	Prerequisites: the prerequisites of the respective curricula are to be fulfilled.		

2.	Compulsory Module: Preparation of the Master's Thesis	h	ECTS-Credits
	Agreement on the topic, the scope and the form of the Master's Thesis on the basis of a brief summary of the contents (abstract) as well as agreement on the work processes and the study progress. Planning of an appropriate time frame for the completion of the Master's Thesis.	-	7.5
	Total	**-**	**7**
	Learning Outcomes: After successful completion of this module, the students will be able to write a brief summary of the content of the planned Master's Thesis (abstract), to outline an anticipated schedule and to conclude a written Master's Thesis agreement.		
	Prerequisites: none		

3.	Compulsory Module: Master's Thesis Defence	h	ECTS-Credits
	The oral defence of the master's thesis, held in front of an examination board, concludes the program of study.		2.5
	Total		**2.5**
	Learning Outcomes: To reflect on the master's thesis within the scope of the whole programme, focusing on theoretical understanding, methodology, the communication of results, and presentation abilities.		
	Prerequisites: successful completion of all other mandatory and elective modules and the master's thesis		

(2) Elective modules amounting to 82.5 ECTS-Credits are to be completed as follows; modules are to be selected from the elective module catalogue according to para. 3.

1. Elective modules amounting to 30 ECTS-Credits from proficiency level 1 are to be completed; proficiency level 1 contains the following elective modules:
   a. BBP 1-1, BBP 1-2, BBP 1-3, BBP 1-4
   b. KIB 1-1, KIB 1-2, KIB 1-3
   c. MOS 1-1, MOS 1-2, MOS 1-3

2. Elective modules amounting to 30 ECTS-Credits from proficiency level 2 are to be completed; proficiency level 2 contains the following elective modules:
   a. BBP 2-1, BBP 2-2, BBP 2-3, BBP 2-4
   b. KIB 2-1, KIB 2-2, KIB 2-3, KIB 2-4
   c. MOS 2-1, MOS 2-2, MOS 2-3, MOS 2-4
3. Elective modules amounting to 22.5 ECTS-Credits from proficiency level 3 are to be completed; proficiency level 3 contains the following elective modules:
   a. BBP 3-1, BBP 3-2, BBP 3-3, BBP 3-4, BBP 3-5
   b. KIB 3-1, KIB 3-2, KIB 3-3, KIB 3-4, KIB 3-5, KIB 3-6, KIB 3-7. KIB 3-8
   c. MOS 3-1, MOS 3-2, MOS 3-3, MOS 3-4, MOS 3-5

(3) Elective module catalogue

1. Proficiency level 1 elective modules:

1.	**Elective Module BBP 1-1: Building Materials, Construction Economics and Project Management 1-1**	**h**	**ECTS-Credits**
a.	**VU Concrete Technology 1** Fundamentals of concrete technology and its applications: cement and cement hydration, aggregates, mix composition of cement, fresh cement, hardened cement, special cement, standardization;	2	2.5
b.	**VU Material Testing and Measurement Technology** Material characteristics and experimental use (destructive and non-destructive methods), introduction to measurement technology;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students become familiar with and are able to apply concrete technology. They are proficient in standard measurement methods and techniques to determine material characteristics.		
	Prerequisites: none		

2.	**Elective Module BBP 1-2: Building Materials, Construction Economics and Project Management 1-2**	**h**	**ECTS-Credits**
a.	**VU Fibrous and Cellular Materials** Micromechanics of the materials: characterization and modelling of microstructure and processes of materials with regard to production and usage and the effects on macroscopic behavior of material	2	2.5
b.	**VU Modelling in Material Technology** Modelling and simulation of material behavior: fundamentals, computerized implementation and numerical computation methods for simulation-based prediction of material behavior; examination of special loads (impact, fires, etc.);	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students are able to model material characteristics and processes with regard to material structure, production, usage and special loads. Students are familiar with simulation methods and their use for the prediction and optimization of material behavior.		
	Prerequisites: none		

3.	Elective Module BBP 1-3: Building Materials, Construction Economics and Project Management 1-3	h	ECTS-Credits
a.	**VU Construction Operations and Business 2** In-depth treatment of methods for operations and business activities, such as formwork technology, deep excavation, etc.; contractual processes, awarding construction and service contracts, contract management;	2	2.5
b.	**SE Corporate Management** Legal fundamentals (corporate law), organizational theory; management of planning and construction companies and construction sites; focus on leadership abilities; personnel management; marketing, business creation, etc.;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students acquire complementary skills in operations and business for successful management of construction projects. They have in-depth knowledge of operational, contractual, business-related and social aspects of construction operations and processes. They possess skills to create and manage companies and are familiar with personnel management and legal considerations.		
	Prerequisites: none		

4.	Elective Module BBP 1-4: Building Materials, Construction Economics and Project Management 1-4	h	ECTS-Credits
a.	**SE Sustainable Project Planning and Smart Design** Smart Design – interaction between object structures, people and environment; requirements for integral, holistic, sustainable concepts, LCC determination, building certification, variation studies concerned with economic and LCC aspects.	2	2.5
b.	**SE BIM – 5D-Planning and Building Modelling** The integration of construction processes into a BIM (building information modelling) system; organizational challenges of sequential and integral project planning; effects of BIM on the construction process; practical application using BIM software.	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students understand project planning from the perspective of sustainability and planning (modelling) and can deal with planning issues independently. They can solve planning problems using procedural and modelling approaches.		
	Prerequisites: none		

5.	Elective Module KIB 1-1: Structural Engineering 1-1	h	ECTS-Credits
a.	**VU Concrete Construction 2** Fundamentals of calculation, dimensioning and construction of pre-stressed elements, and practical applications; structural details;	2	2.5
b.	**VU Design and Production** Essential principles for the design of supporting structures; application in realistic examples;	2	2.5
	Total	**4**	**5**

	Learning Outcomes: Students possess in-depth knowledge of concrete construction, especially pre-stressed concrete construction, and are proficient in the fundamentals of calculation, dimensioning and construction of pre-stressed elements. They are able to use this knowledge to find practical solutions to problems. Moreover, students possess knowledge that enables them to design supporting structures for buildings using a wide range of materials.
	Prerequisites: none

6.	**Elective Module KIB 1-2 Structural Engineering 1-2**	**h**	**ECTS-Credits**
a.	**VU Steel Construction – Advanced** Stability in metal construction (torsional buckling, plate bulging), warping torsion, thin-walled elements and sheets, silos and shell constructions;	2	2.5
b.	**VU Fundamentals of Composite Construction** Fundamentals of composite construction, verification methods and dimensioning of composite components according to current regulations; illustration of construction options and details using drawings; completed examples;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess in-depth knowledge of stability issues in metal construction. They are familiar with warping torsion and have basic knowledge of composite construction. They are able to apply their knowledge to practical tasks in silo, shell, and composite construction.		
	Prerequisites: none		

7.	**Elective Module KIB 1-3: Structural Engineering 1-3**	**h**	**ECTS-Credits**
a.	**VU Wood Construction 2** Composite theory for designs based on cross-sections; design, preliminary measurements and verification of timber elements, beams, beam framework systems and connection nodes; the verification process, from load determination to verification of connectors, is illustrated in a project example that students work on independently;	2	2.5
b.	**VU Building Construction 2 – Structural Engineering** Fundamentals of preventive fire protection and determination of fire resistance in load-bearing wooden, steel and concrete elements; structural focus on the intersections of supporting structures, building envelopes and building services in new construction and renovation; structural node details in concrete construction;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess in-depth knowledge of wood construction and are able to apply this knowledge systematically in structural calculations. They are familiar with the structural fundamentals of building construction, especially at the intersections of supporting structures, building envelopes and building services, and know the fundamentals of fire protection; they are able to apply their skills in practice.		
	Prerequisites: none		

8.	Elective Module MOS 1-1: Modelling and Simulation 1-1	h	ECTS-Credits
a.	**VU Construction Dynamics and Earthquake Engineering 1** Time-domain and frequency-domain methods of linear single-mass and multi-mass oscillators; force and displacement excitation; damping; response spectra; modal analysis; vibration damping; vibration isolation; vibration reduction;	2	2.5
b.	**UE Structural Measurement** Fundamentals of structural measurement; experimental determination of the natural frequency and damping of a cantilever and a small-scale frame structure; free and forced oscillation; vibration damper adjustment;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess advanced knowledge of the principal methods of dynamic calculation in structures and can apply earthquake-specific measuring techniques (e.g. response spectrum). They understand the dynamic behavior of supporting structures and are able to choose calculation methods appropriate to the task at hand.		
	Prerequisites: none		

9.	Elective Module MOS 1-2: Modelling and Simulation 1-2	h	ECTS-Credits
a.	**VO FEM – Linear Strength Analysis** Introduction to the finite element method (heat conduction, moisture transfer, structural mechanics);	2	2.5
b.	**UE FEM – Linear Strength Analysis** Complementing the lecture, practical examples are demonstrated using finite element methods; students are shown how to do such tasks independently and to interpret the results of numerical calculations;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students are proficient in the theoretical principles of the finite element method (FEM) and can apply the FEM for linear calculation of the load-bearing capacity of structures and to solve problems relating to heat conduction and moisture transfer.		
	Prerequisites: none		

10.	Elective Module MOS 1-3: Modelling and Simulation 1-3	h	ECTS-Credits
a.	**VO Numerical Mathematics** Fundamentals of numerical mathematics: numerical representation on the computer, numerical differentiation and integration, interpolation and approximation, systems of linear equations, solving non-linear equations, differential equations;	2	2.5
b.	**UE Numerical Mathematics** Practical session accompanying the lecture: in-depth discussion of the material, solving equations, practical engineering examples with computer support;	2	2.5
	Total	**4**	**5**

	Learning Outcomes: Students are proficient in the fundamentals of numerical mathematics and are able to apply the methods of numerical mathematics to solve problems in engineering.
	Prerequisites: none

2. Proficiency level 2 elective modules:

1.	**Elective Module BBP 2-1: Building Materials, Construction Economics and Project Management 2-1**	**h**	**ECTS-Credits**
a.	**VU Concrete Technology 2** Special types of concrete and their applications in civil and infrastructure engineering; special applications in new construction and renovation;	2	2.5
b.	**VU Materials for Infrastructure Engineering** Performance-oriented and ecological design of materials: experimental characterization (fatigue, aging, etc.), tool optimization methods (mix design, use of fibers, hydrophobing, polymer modification, etc.), special materials used in infrastructure engineering, hydraulic engineering and power plant engineering;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess in-depth knowledge of the use of special building materials for civil and infrastructure engineering. They are proficient in the methods of experimental characterization and optimization of material properties.		
	Prerequisites: none		

2.	**Elective Module BBP 2-2: Building Materials, Construction Economics and Project Management 2-2**	**h**	**ECTS-Credits**
a.	**VU Tunnel Construction** "New Austrian Tunneling" method, conventional tunneling; near-surface tunneling, shafts and caverns; site facilities, logistics and safety management in tunneling; labor contract norm ÖN B2203; equipment selection, driving speed, conventional and machine tunneling, supporting elements and site facilities;	2	2.5
b.	**SE Construction Scheduling and Coordination** Introduction to scheduling and planning of construction projects – in theory and in practice; common computer programmes for representation in Gantt charts, time-distance diagrams, network diagrams, cycle graphs; tasks of the planning and site coordinator according to Austrian law (BauKG: Bauarbeitenkoordinationsgesetz).	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess specific skills for the practical implementation of tunneling projects as principals, contractors or advisors; they are able to plan sample projects independently and assess the risks of planning and construction work.		
	Prerequisites: none		

3.	Elective Module BBP 2-3: Building Materials, Construction Economics and Project Management 2-3	h	ECTS-Credits
a.	**VU Legal Issues in Project Implementation** Treatment of legally relevant questions in project implementation, based on concrete cases (projects completed or in progress); strategies and methods of dealing with legal issues in construction projects;	2	2.5
b.	**SE Planning and Building Abroad** Difference between construction in Austria and other countries; specific strategies and methods for successful planning and construction abroad;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess skills for successful project implementation, including non-technical topics such as legal issues and intercultural management.		
	Prerequisites: none		

4.	Elective Module BBP 2-4: Building Materials, Construction Economics and Project Management 2-4	h	ECTS-Credits
a.	**SE Project Development and Redevelopment in the Life Cycle** Fundamentals of project development, project pipeline, determination of initial return, master planning; redevelopment of existing structures, economic considerations in view of the life cycle, variation studies; the development of building construction projects is analyzed from technical and economic standpoints using examples and half-day and full-day excursions.	2	2.5
b.	**SE Interdisciplinary Aspects of Fire Protection** Requirements for structural and organizational fire protection (OIB 2, TRVBs, local requirements, etc.), fire protection approaches and their consequences for project and construction planning; practice with sample projects;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students have in-depth knowledge of the project pipeline and processes before the actual beginning of the construction process. They have a solid understanding of zoning and rezoning for sustainable profit. They are familiar with interdisciplinary aspects of safety and sustainability (fire protection!) in project planning and development.		
	Prerequisites: none		

5.	Elective Module KIB 2-1: Structural Engineering 2-1	h	ECTS-Credits
a.	**VU Wood Construction Details** Design and dimensioning of details for various wood construction projects (houses, commercial buildings, bridges); connecting elements for a precise and tight fit of prefabricated wooden elements, with consideration of structural, physical and manufacturing aspects; system solutions and connectors (details) for various building methods;	2	2.5

b.	**PR Wood Construction Internship and CNC Manufacturing** Connection details and supporting structure drafting with CAD programmes and manufacture of 1:1 models with computerized joinery machinery; assembly of wooden structures as part of workshops and, where applicable, as part of student competitions; laboratory investigations of wooden structures after assembly;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess in-depth knowledge and skills in the design and construction of wooden elements, including connection details, with consideration of structural, physical and manufacturing aspects as well as computerized technologies such as CAD and CNC.		
	Prerequisites: none		

6.	**Elective Module KIB 2-2: Structural Engineering 2-2**	**h**	**ECTS-Credits**
	VU Bridge Construction Fundamentals of bridge construction, load assumption, structural analysis; design, dimensioning and construction of bridges with solid components; practical applications;	4	5
	Total	**4**	**5**
	Learning Outcomes: Students possess fundamental skills in calculation, dimensioning and construction of bridges as well as in-depth knowledge of solid bridge building; they are able to apply their skills to practical tasks.		
	Prerequisites: none		

7.	**Elective Module KIB 2-3: Structural Engineering 2-3**	**h**	**ECTS-Credits**
a.	**VU Glass, Facades and Fastening Technology** Introduction to glass and facade construction, including fastening technology, measurements, structural solutions and standards;	2	2.5
b.	**SE Special Focus: Metal Construction** Content from the areas: fatigue, fracture mechanics, dynamics, plant construction, crane construction, centering;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students have basic knowledge of glass and facade construction engineering and are familiar with the functions and selection criteria of fastening elements. They have in-depth knowledge of metal construction, in terms of life span calculations and fracture mechanics, and of special elements in plant construction. Students are able to apply their knowledge to practical situations.		
	Prerequisites: none		

8.	Elective Module KIB 2-4: Structural Engineering 2-4	h	ECTS-Credits
a.	**VU Plausibility Checks for Electronic Calculations** Methods and procedures to quickly check the plausibility of numerical results from complex structural design software;	2	2.5
b.	**VU FEM in Metal Construction** Application of linear and non-linear FEM in metal construction, e.g. contact tasks, dimensioning of pre-stress screws, plastic design, various dynamic and thermal analyses, CFD calculation in combination with mechanical structural analysis (e.g. y-pipes in steel hydraulic engineering), control procedures for numerical calculations;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students have the special knowledge required to apply FEM correctly in steel construction. They are familiar with methods to check the plausibility of electronic calculations using simple procedures, including their application in practical situations.		
	Prerequisites: none		

9.	Elective Module MOS 2-1: Modelling and Simulation 2-1	h	ECTS-Credits
a.	**VU Construction Dynamics and Earthquake Engineering 2** Modelling the behavior of inelastic supporting structures during earthquakes; modern earthquake detection techniques; incremental dynamic analysis; pushover analysis; behavior-based earthquake engineering; multipoint motion;	2	2.5
b.	**UE Project in Construction Dynamics and Earthquake Engineering** Realization of a practical project from construction dynamics or earthquake engineering;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students are familiar with the methods of dynamic calculation in building construction and earthquake engineering. They are proficient in the process of analyzing dynamic engineering tasks – from data collection and modelling, numerical and measurement-based analysis, to the interpretation and evaluation of results.		
	Prerequisites: none		

10.	Elective Module MOS 2-2: Modelling and Simulation 2-2	h	ECTS-Credits
a.	**VO FEM – Non-Linear Strength Analysis** Load analysis of supporting structures of steel, concrete and reinforced concrete using the finite element method; non-linear numerical material models for steel and concrete using the theory of plasticity and the damage theory; incremental-iterative procedure;	2	2.5
b.	**UE FEM – Non-Linear Strength Analysis** Demonstration of practical tasks using non-linear strength analysis with a finite element programme (load calculations); students are shown how to complete such tasks and interpret the results of numerical calculations;	2	2.5
	Total	**4**	**5**

	Learning Outcomes: Students are proficient in the theoretical principles of non-linear finite element methods (FEM) and are able to apply FEM for numerical simulation of the load-bearing capabilities of structures to the point of failure.
	Prerequisites: none

11.	**Elective Module MOS 2-3: Modelling and Simulation 2-3**	**h**	**ECTS-Credits**
a.	**VU Plane Load-Bearing Structures** Theoretical principles for calculations of plane load-bearing structures, especially shells; students are instructed in performing such tasks independently.	2	2.5
b.	**VU Structural Analysis – Advanced** Analysis of beam framework structures using the direct stiffness method; influence lines for various displacement and load forces; structural modelling;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students are proficient in the theoretical fundamentals and familiar with the application of procedures for structural calculations of beam, slab and shell structures.		
	Prerequisites: none		

12.	**Elective Module MOS 2-4: Modelling and Simulation 2-4**	**h**	**ECTS-Credits**
a.	**VU Higher Analysis** In-depth treatment of multidimensional analysis, partial differential equations, Fourier series, discrete Fourier transformation, calculus of variations, variation principles in FEM;	2	2.5
b.	**VU Mathematical Optimization** Linear and convex optimization, combinatorial optimization, non-linear optimization, optimal control of dynamic systems, inverse problems, data adjustment;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess in-depth knowledge and practical skills in the use of concepts of higher analysis and optimization procedures in the technical sciences.		
	Prerequisites: none		

3. Proficiency level 3 elective modules:

1.	**Elective Module BBP 3-1: Building Materials, Construction Economics and Project Management 3-1**	**h**	**ECTS-Credits**
a.	**VU Durability of Materials** Description of damage mechanisms in materials, damage types and assessment of structural damage, evaluation and monitoring of structural condition, standardization and state-of-the-art technology;	2	2.5

b.	**VU Materials Analysis** Methods to determine material composition and damage analysis: preparing samples, wet chemical analysis, instrumental analysis (spectroscopic methods, x-ray-based analytics, thermal analysis), microscopy (optical, scanning electron microscopy);	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess in-depth knowledge of various damage mechanisms of materials and are able to assess building damage and condition competently. They have the knowledge and abilities to apply analytic methods to determine material composition and analyze damage.		
	Prerequisites: none		

2.	**Elective Module BBP 3-2: Building Materials, Construction Economics and Project Management 3-2**	**h**	**ECTS-Credits**
	VU OR and Risk Analysis Procedures and principles of risk management; project risk management; risk assessment and decision making processes; fundamentals of probability theory; decision tree method; simulation technique, fuzzy logic; interpretation of findings;	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Building on the theoretical principles of OR, students have the ability to analyze building processes independently and assess them in terms of feasibility.		
	Prerequisites: none		

3.	**Elective Module BBP 3-3: Building Materials, Construction Economics and Project Management 3-3**	**h**	**ECTS-Credits**
	EX Link to Practice Interdisciplinary project visits with introductions by the project leaders.	1	2.5
	Total	**1**	**2.5**
	Learning Outcomes: Students are familiar with various construction site situations in different phases of projects. After visiting a project, students are able to evaluate it according to quality standards, time parameters and the technologies applied.		
	Prerequisites: none		

4.	**Elective Module BBP 3-4: Building Materials, Construction Economics and Project Management 3-4**	**h**	**ECTS-Credits**
	VU BBP-AK 1 Course covers alternating topics in materials technology (e.g. materials science internship).	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students possess advanced knowledge and skills in various areas of materials technology. They can approach complex problems in various areas of materials technology independently and with appropriate methodology in order to develop innovative solutions.		

	Prerequisites: none

5.	Elective Module BBP 3-5: Building Materials, Construction Economics and Project Management 3-5	h	ECTS-Credits
	VU BBP-AK 2 Course covers alternating topics in operations and project management (e.g. building cybernetics, mediation abilities).	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students possess advanced knowledge and skills in various areas of building operations and project management. They can approach complex problems in various areas of materials technology independently and with appropriate methodology in order to develop innovative solutions.		
	Prerequisites: none		

6.	Elective Module KIB 3-1: Structural Engineering 3-1	h	ECTS-Credits
a.	**VU Structural Development** Fundamentals of structural development in timber engineering for hall and bridge structures; selected support systems for efficient main and additional supporting structures; stabilization and bracing of supporting structures; independent work on a structural development assignment (design, details, dimensioning); manual creation of a scale model in the modelling laboratory;	2	2.5
b.	**VU Connectors and Fasteners** Calculation methods for selected connectors for wooden and wood-concrete composite constructions, with consideration of resilience for new construction and strengthening of old buildings; statistical principles to determine material parameters; fundamentals of FE modelling for orthotropic wood materials and plywood elements, determination of the spring stiffness of connection nodes; reinforcement measures for supports, notches, openings and transverse stress;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students can design wooden structure systems methodically correctly, including connection details and connectors for old and new buildings.		
	Prerequisite): none		

7.	Elective Module KIB 3-2: Structural Engineering 3-2	h	ECTS-Credits
a.	**VU Special Constructions** Design, calculation and construction of special structures, e.g. avalanche and stone fall galleries, white tank constructions, containers and high-rise buildings;	2	2.5
b.	**VU Strengthening and Repairing Concrete Structures** Status assessment methods; concepts for strengthening and repairing existing structures; examples;	2	2.5
	Total	**4**	**5**

	Learning Outcomes: Students are familiar with the design, calculation, construction and realization of special structures and with concepts for strengthening and repairing existing structures. They are able to apply their knowledge to practical tasks.
	Prerequisites: none

8.	**Elective Module KIB 3-3: Structural Engineering 3-3**	**h**	**ECTS-Credits**
a.	**VU External Prestressing and Unbonded Prestressing** Characteristics of unbonded prestressing and external prestressing; calculation and dimensioning of such constructions; structural details;	2	2.5
b.	**VU Hybrid Constructions** Terminology (use of various materials in one structure according to their advantages); examples: composite construction combining components of various materials; calculations and dimensioning of such structures; structural details;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess in-depth knowledge of current developments in prestressed concrete construction and in hybrid construction; they are able to apply this knowledge to practical tasks.		
	Prerequisites: none		

9.	**Elective Module KIB 3-4: Structural Engineering 3-4**	**h**	**ECTS-Credits**
	VU Steel Bridges Fundamentals of the planning and realization of steel bridges; calculations and dimensioning of main and secondary supporting structures, with special consideration of stability; construction and realization of special structures; details for fatigue resistance; bridge equipment (bearings, expansion joints) and bridge maintenance;	2	2.5
	Total	**2**	**2.5**
	Objective: Students are proficient in the fundamentals of planning, calculations and construction of steel bridges; they are able to apply their knowledge to practical tasks.		
	Prerequisites: none		

10.	**Elective Module KIB 3-5: Structural Engineering 3-5**	**h**	**ECTS-Credits**
	VU Cable Car Construction Overview of cable car and people mover systems, transportation services; cable car directive and standards, including Eurocodes; design principles for planning cable car systems; technical calculations; motors and brakes; structural elements and practical examples;	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students are proficient in the basics of cable car system planning and are able to apply their knowledge to practical examples.		

	Prerequisites: none

11.	Elective Module KIB 3-6: Structural Engineering 3-6	h	ECTS-Credits
	SE Engineering Internship Experience In this seminar, students report on and discuss experiences from their technical internship, which covered a minimum of 160 working hours.	1	2.5
	Total	**1**	**2.5**
	Learning Outcomes: Students have practical working experience and are able to apply their theoretical knowledge in practice.		
	Prerequisites: Participation in this seminar requires proof of completion of an appropriate technical internship of 160 working hours after completion of the bachelor's programme.		

12.	Elective Module KIB 3-7: Structural Engineering 3-7	h	ECTS-Credits
	VU KIB-AK 1 Course covers alternating topics in constructive engineering, especially relating to solid construction (e.g. high-performance concrete).	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students possess advanced knowledge and skills in various areas of constructive engineering. They can approach complex problems independently and with correct methodology in order to develop innovative solutions.		
	Prerequisites: none		

13.	Elective Module KIB 3-8: Structural Engineering 3-8	h	ECTS-Credits
	VU KIB-AK 2 Course covers alternating topics in constructive engineering, especially relating to steel and composite construction (e.g. composite bridge construction).	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students possess advanced knowledge and skills in various areas of constructive engineering. They can approach complex problems independently and with correct methodology in order to develop innovative solutions.		
	Prerequisites: none		

14.	Elective Module MOS 3-1: Modelling and Simulation 3-1	h	ECTS-Credits
	UE FEM Project Students are instructed in solving non-linear strength and multi-field problems independently, performing calculations of plane load-bearing structures and interpreting the results of such calculations;	2	2.5
	Total	**2**	**2.5**

	Learning Outcomes: Students possess the ability to solve non-linear strength and multi-field problems independently, to perform calculations of plane load-bearing structures and to interpret the results of such calculations
	Prerequisites: none

15.	Elective Module MOS 3-2: Modelling and Simulation 3-2	h	ECTS-Credits
	VU Advanced CAD 3-D modelling and visualization of load-bearing structures, buildings or details using a CAD programme; in-depth understanding of the use of CAD for planning and implementation; programming scripts and macros, graphic programming (e.g. Grasshopper).	2	2.5
	Total	**2**	**2.5**
	Objective: Students have advanced knowledge in the use of a CAD package. They possess abilities in graphic programming and can apply them in parametric construction, details and planning.		
	Prerequisites: none		

16.	Elective Module MOS 3-3: Modelling and Simulation 3-3	h	ECTS-Credits
	VU Programming Language 2 In-depth knowledge and practical abilities in programming languages such as Fortran, C++ and MATLAB;	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students have in-depth knowledge and practical abilities in programming languages such as Fortran, C++ and MATLAB		
	Prerequisites: none		

17.	Elective Module MOS 3-4: Modelling and Simulation 3-4	h	ECTS-Credits
	VU MOS-AK 1 Course covers alternating topics in the numerical modelling of structural strength problems (e.g. multi-field problems).	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students possess advanced knowledge and skills in various areas of numerical modelling and simulation. They can approach complex problems independently and with correct methodology in order to develop innovative solutions.		
	Prerequisites: none		

18.	Elective Module MOS 3-5: Structural Engineering 3-5	h	ECTS-Credits
	VU MOS-AK 2 Course covers alternating topics in numerical modelling (e.g. numerical analysis of FEM).	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students possess advanced knowledge and skills in various areas of numerical modelling. They can approach complex problems independently and with correct methodology in order to develop innovative solutions.		
	Prerequisites: none		

(4) A selection of modules from the advanced courses of the Master's Programme in Environmental Engineering is possible as per the specifications of para. 5. The Master's Programme in Environmental Engineering is structured the same as the Master's Programme in Civil Engineering as per § 7 and features the content areas Energy-Efficient Building (referred to in the following as EEG – from German "Energieeffiziente Gebäude"), "Geotechnics, Surveying and Hydraulic Engineering" (referred to in the following as GVW – from German "Geotechnik, Vermessung und Wasserbau"), and "Environmental Engineering and Traffic" (referred to in the following as UVW – from German "Umwelttechnik und Verkehrswesen").

1. The content area EEG contains the following elective modules:
   a. Proficiency level 1: EEG 1-1, EEG 1-2
   b. Proficiency level 2: EEG 2-1, EEG 2-2, EEG 2-3, EEG 2-4
   c. Proficiency level 3: EEG 3-1, EEG 3-2, EEG 3-3, EEG 3-4, EEG 3-5, EEG 3-6
2. The content area GVW contains the following elective modules:
   a. Proficiency level 1: GVW 1-1, GVW 1-2, GVW 1-3, GVW 1-4
   b. Proficiency level 2: GVW 2-1, GVW 2-2, GVW 2-3, GVW 2-4
   c. Proficiency level 3: GVW 3-1, GVW 3-2, GVW 3-3, GVW 3-4, GVW 3-5, GVW 3-6, GVW 3-7
3. The content area UVW contains the following elective modules:
   a. Proficiency level 1: UVW 1-1, UVW 1-2, UVW 1-3, UVW 1-4
   b. Proficiency level 2: UVW 2-1, UVW 2-2, UVW 2-3, UVW 2-4
   c. Proficiency level 3: UVW 3-1, UVW 3-2, UVW 3-3, UVW 3-4, UVW 3-5

(5) A content area of the Master's Programme in Civil Engineering amounting to a maximum of 20 ECTS-Credits can be replaced by a content area of the Master's Programme in Environmental Engineering of the same number of credits (exchange of a content area). At least one module per proficiency level is to be completed in the content area of the Master's Programme in Environmental Engineering. The Director of Studies is to be informed in writing of an exchange of a content area in the first semester until the end of the extended registration period. The exchange of an elective module following a first examination attempt is not permitted.

§ 9 Master's thesis

(1) In the Master's Programme Civil Engineering a Master's Thesis corresponding 20 ECTS-Credits must be written. The Master's Thesis is a scientific paper that serves as proof of the ability to deal with a scientific topic independently and appropriately with regards to content and methodology.

(2) The topic of the master's thesis is to be selected from the completed elective modules of the content areas.

(3) If both master's programmes are being pursued (Civil Engineering and Environmental Engineering), the topic of the master's thesis may not be selected twice from the same content area.

(4) Students are to inform the Director of Studies of their choice of topic and supervisor in writing. Prerequisites are fulfillment of all conditions as per § 64 para. 5, UA 2002, and successful completion of proficiency level 1 of the module of the content area from which the topic of the master's thesis is taken.

(5) Students are entitled to propose the topic of the master's thesis or to choose from a list of topics.

(6) Students are entitled to write the master's thesis in English if the supervisor agrees.

§ 10 Examinations

(1) Modules, with the exception of the compulsory module "Master's Thesis Defence" and "Master's Thesis Defence" are evaluated by course examinations. Course examinations are:

1. Examinations that assess the knowledge and skills covered in an individual course in which assessment is based on a single examination at the end of the course. The course instructor is to determine and announce the method of examination (written and/or oral) before the course begins.
2. Courses with continuous assessment in which assessment is based on regular written and/or oral contribution by participants. The assessment criteria are to be determined and announced by the instructor before the course begins.

(2) The compulsory module "Preparation of the Master's Thesis" is evaluated by the supervisor of the Master's Thesis based on an abstract. Positive evaluation reads "successful completed", negative evaluation "unsuccessful completed".

(3) Assessment of the module "Defence of the Master's Thesis" is performed as an oral exam in front of an examination board consisting of three examiners.

§ 11 Academic degree

Graduates of the Master's Programme Civil Engineering are awarded the academic degree "Diplomingenieurin" (female) or "Diplomingenieur" (male), abbreviated as "Dipl.-Ing." Or "DI".

§ 12 Coming into force

(1) This curriculum is effective as of 1 October 2014 and applies to all students who begin their degree programme as of winter semester 2014/15.

(2) The changes of the curriculum acc. to the version of the University of Innsbruck Bulletin of 28 June 2019, Issue 67, No. 594 come into effect on 1 October 2019 and are to be applied to all students.