FBTBaU

FACHBEREICHSTAG
BAUINGENIEURWESEN UND UMWELTINGENIEURWESEN
German Association of Departments of Civil Engineering and Environmental Engineering at Universities of Applied Sciences (GADCEE)

Reference Frame

Knowledge, skills and competences in core studies

Bachelor‘s program „Umweltingenieurwesen-Bau“

at Universities of Applied Sciences
(Hochschulen für angewandte Wissenschaften – HAW)

Umweltingenieurwesen-Bau

environmental engineering construction

Basics of structural engineering and engineering design
Comprehensive contents • Environmental management
Material cycle and resource management
Mathematical and natural-scientific basics • Methodical basics
Mobility spatial planning • Process and plant engineering
Sustainability sciences • Water engineering

**German Association of Departments
of Civil Engineering and
Environmental Engineering
at Universities of Applied Sciences**

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Introduction

The Bologna Process for the Europeanisation of Higher Education, launched in 1998, has also led to a differentiation of study programmes at universities. For example, in the departments and faculties of universities of applied sciences (HAW), in addition to the classically broad Bachelor‘s degree programmes in civil engineering, there is an increasing number of Bachelor‘s degree programmes dedicated specifically to solving problems relating to the environmental compatibility and sustainability of buildings and, in doing so, integrating essential core contents of civil engineering.

In 2018, the Civil Engineering Department Conference was renamed the Civil Engineering and Environmental Engineering Department Conference (FBT BaU). It currently represents 42 departments and faculties at universities of applied sciences in Germany nationwide and thus has the task of representing the interests of the courses of study in civil engineering as well as the interests of the construction-related courses of study in environmental engineering vis-à-vis politics and society, coordinating the further development of these courses of study and agreeing a frame of reference for teaching and research as well as for examinations. It is thus an important element in ensuring the quality of higher education at universities of applied sciences in Germany.

At its plenary meeting in Biberach in autumn 2017, the Fachbereichstag also agreed on the core contents of Bachelor‘s degree programmes in „Environmental Engineering and Construction“ at Universities of Applied Sciences (HAW) and recommended them for application.

A common European education area and labour market requires a transparent presentation of educational and professional standards, also in the field of environmental engineering. At universities, this is done by describing the modules (subjects) of a course of study in which, in addition to the acquired knowledge, the skills and competences after completion of a module or after completion of the course of study are explained.

The Executive Board of the
Departmental Conference Civil Engineering and
Environmental Engineering

Content

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Reference Frame of Environmental Engineering Construction at Universities of Applied Sciencesn

After the departments and faculties of civil engineering and at universities of applied sciences agreed on common „standards“ for university education in civil engineering at their plenary meeting in Leipzig in autumn 2013, the Departmental Conference of Civil Engineering and Environmental Engineering (FBT BaU) has now developed a reference framework for university education for construction-related bachelor‘s degree courses in environmental engineering (hereinafter referred to as „environmental engineering and construction“). Here the frame of reference is explained and it is shown how the quality of the training is to be described.

Core contents of the Bachelor‘s programme

The increasing discussions on the protection of natural habitats, the built environment and the climate as well as the conservation of natural resources and the evaluation of sustainability have prompted the departments and faculties of civil engineering to supplement or adapt their courses. This has led to the creation of new Bachelor‘s programmes whose graduates can examine and evaluate the impact of construction projects on the environment. This requires special approaches to problem solving which, in comparison to the classical civil engineering degree, require in-depth knowledge, skills and competences. This concerns, for example, the increasing complexity of approval procedures, operational processes in transport, water management, waste management, the recycling of building materials, the conservation of resources, etc.

The study of environmental engineering and construction differs from the classical environmental sciences (natural science oriented courses, e.g. geoecology) and environmental technology (process and apparatus engineering oriented courses, e.g. process engineering) by dealing with the built environment and its social relevance.

The Fachbereichstag Bauingenieurwesen und Umweltingenieurwesen (Civil Engineering and Environmental Engineering Department Day) has dealt with the question of which knowledge, skills and competences every student should acquire, regardless of his or her specialisation, in order to be prepared for later specialisations in professional life on the basis of a broad education and to plan, build and operate buildings comprehensively in a team with other engineering disciplines, taking all interests into consideration. The corresponding contents were referred to as „Core contents - knowledge, skills and competences - Bachelor‘s degree programmes in environmental engineering and construction“. These were discussed by the departments and faculties with courses of study in civil engineering and environmental engineering, the merger of which is formed by the Department Day in Civil Engineering and Environmental Engineering, and adopted at the 2017 plenary meeting in Biberach.

Core study

The workload of students is measured in ECTS credit points. One ECTS point corresponds to a workload of 30 hours. Each semester 30 ECTS points are awarded, a 6-semester bachelor‘s programme comprises 180 ECTS points, a 7-semester programme 210 ECTS points.

The core study course in environmental engineering construction was defined by the Departmental Conference of Civil Engineering and Environmental Engineering with 120 ECTS points. This corresponds to 67% of the total Bachelor‘s study course for a 6-semester curriculum and 57% for a 7-semester curriculum. The core course is basically the same for all students of environmental engineering construction (compulsory modules). Building on this, various specialisations are possible during the course, such as environmental aspects, sustainable mobility or resource efficiency. The remaining 33% and 43%, respectively, can be used for profile formation (elective subjects) or specialisation (elective subjects).

A 7-semester programme is recommended in order to integrate sufficient practical phases into the programme.

Knowledge, skills and competences

Before the Bologna reform, study programmes were designed and described as „input-oriented“. The focus was on teaching content and study objectives. The content of the courses describes the lecture material, which is mostly taught in lectures. The perspective has changed since Bologna (2003). The focus has shifted to learning and training outcomes, and the examination of the programme has become „outcome-oriented“ on the basis of the Qualifications Framework for German Higher Education Qualifications. Therefore, competence orientation is indispensable for the accreditation of study programmes today.

To simplify matters, a distinction is made between knowledge (theoretical and factual knowledge), skills (ability to apply knowledge) and competences (ability to solve problems independently).

A variety of didactic forms are available for imparting competences in engineering degree programmes: classical lectures, activating forms of learning, group work, practical exercises involving laboratory equipment, project work to bring together individual disciplines in a topic-oriented approach, etc. The teaching of the competences in engineering degree programmes is also possible. Engineering education is strongly linked to practice, especially at universities of applied sciences. The teaching of theoretical contents is intensively accompanied by preliminary internships, practical study semesters, laboratory internships and practical projects. The learning process can thus be constantly adjusted to the requirements of the profession. Engineering competences develop as a deeper understanding of the specialist science, systematically structuring and networking individual facts.

The final qualification comprises knowledge, skills and action competences that are required for the profession of environmental engineer.

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Study shares

The core programme was divided into ten module groups: „Mathematical and scientific basics“, „Sustainability sciences“, „Methodological basics“, „Civil engineering basics and structural engineering“, „Water management“, „Material cycle and resource management“, „Mobility, spatial planning“, „Process and plant engineering“, „Environmental management“, „General contents“.

The degree programmes have a share of at least 75% in mathematics, engineering and natural sciences (MINT). From our point of view, graduates therefore always meet the requirements placed on an engineer.

The study shares of the 120 ECTS credit points of the core course were developed by the Technical Committee Water-Soil-Environment of the Department Day Civil Engineering and Environmental Engineering and coordinated with the other technical committees (basic principles, structural engineering, traffic engineering, construction operation). The module groups are in turn divided into modules.

The exact designation of the modules and their grouping can vary between the universities and degree programmes. However, the knowledge, skills and competences acquired (see following section) are uniform. In this way, the module groups as a whole ensure comprehensive training in all fundamental areas of environmental engineering and construction.

Classification in the European Qualifications Framework

The European Qualifications Framework (EQF) defines vocational qualifications at eight levels, with levels 6 and 7 being essential for Bachelor‘s and Master‘s programmes. Classification into one level is based on the description of the learning outcome for the entire training, which in turn is defined by the learning outcomes of the individual modules.

In the following, the central terms knowledge, skills and competence are defined and their assignment to level 6 (Bachelor‘s education) of the EQF is explained.

Knowledge	The result of processing information through learning. Knowledge refers to the totality of facts, principles, theories and practice in the described field of work. • Theoretical and/or factual knowledge Level 6 (Bachelor): Advanced knowledge • in the described field of work using a critical understanding of theories and principles.
Skills	The ability to apply knowledge to perform tasks and solve problems. • Cognitive skills: logical, intuitive and creative thinking; • practical skills: Skill and use of methods, materials, tools and instruments. Level 6 (Bachelor): Advanced skills, • who demonstrate mastery of the subject as well as innovative ability, and • which are necessary to solve complex and unforeseeable problems in the described work area.
Competences	The proven ability to use knowledge, skills and personal, social and methodological abilities in work situations and for professional and/or personal development in the sense of assuming responsibility and independence. Level 6 (Bachelor): • Management of complex technical or professional activities or projects • Assumption of decision-making responsibility in unforeseeable work contexts • Taking responsibility for the professional development of individuals and groups

The knowledge, skills and competences at level 6 described here are formed from the sum of the subject-specific and social competences of the individual modules and are not fully attained until completion of the course of study.

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Module groups in the core area

A bachelor‘s degree in environmental engineering and construction at universities of applied sciences comprises six or seven semesters of study. Each semester, students achieve a workload of 30 ECTS credit points, whereby one credit point stands for 30 hours of student work. In total, students earn 180 or 210 ECTS credit points in the Bachelor‘s programme.

The core content comprises 120 ECTS credit points (ECTS-LP). In consultation with the specialist committees, the following distribution of the ECTS-LP among the module groups was agreed:

No	Module group	Range of modules	Minimum proportion of studies [ECTS-LP]
1	Mathematical and natural-scientific basics	Mathematics, Physics, Biology, Chemistry, Geology, Hydrogeology, Soil Science	20
2	Sustainability sciences	Environment, Society, Climate, Ecology	10
3	Methodical basics	Computer science/geoinformatics, CAD, Geoinformation system, Surveying, Engineering skills	10
4	Basics of structural engineering and engineering design	Building materials, building physics, constructive engineering, technical mechanics, geotechnics	20
5	Water engineering	Hydrology, hydromechanics, water management, urban water management, hydraulic engineering	15
6	Material cycle and resource management	Recycling management, building material recycling, contaminated sites	10
7	Mobility, spatial planning	Urban and regional planning, traffic planning, public transport, road construction	15
8	Process and plant engineering	Mechanical and electrical engineering, measurement and control control technology, process engineering, renewable energy, air pollution control	10
9	Environmental management	Environmental and construction contract law, project management, economics	10
10	Comprehensive contents	For instance Project work, technical vocabulary Foreign languages, occupational safety	
		Total core area	**120**

The recommended core contents were divided into module groups analogous to the core contents of Civil Engineering, in order on the one hand to make clear the strong construction reference and on the other hand to illustrate the differences between the study courses. The listed module contents of each individual module group (see below) can be individually combined to modules by the universities, whereby their designations can deviate from the terms selected here.

However, the knowledge, skills and competences acquired in each case (see following section) are specified. In this way, the requirements as a whole ensure comprehensive training in all fundamental areas of environmental engineering and construction.

The General Assembly of the Departmental Day of Civil Engineering and Environmental Engineering recommends that its members provide 120 ECTS credit points for the core course of study in the following composition for bachelor courses in environmental engineering and construction.

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Module group: Mathematical and natural-scientific basics (20 ECTS)

	Mathematics
Knowledge	• Vector algebra, matrices, linear systems of equations • Analytical geometry • Elementary functions of a variable and their properties • Differential and integral calculus • Ordinary differential equations • Statistical methods
Skills	• Applying techniques, methods, and procedures for task classes • Solving mathematical problems
Competences	• Think and argue logically • Understand and apply symbolic notations • Reproduce mathematical modelling • Techniques, methods and procedures independently and for solution deploy efficiently • Verify results

	Physics
Knowledge	• Kinematics/dynamics of mass point and rigid body for translation and rotation • Mechanics of deformable body • Thermodynamics - basic terms and main clauses • Changes of state and circular processes • Phase transformations and heat transfer mechanisms • Energy balances • Electricity and magnetism • Fundamentals of radiation protection • Introduction to error calculation
Skills	• Translation of the physical correlations into thought models • Calculation of the physical facts
Competences	• Development and application of physically based models and Formulas for the description of engineering-scientific contexts

	Chemistry
Knowledge	• General and inorganic chemistry of particular environmental relevance items • Inorganic chemistry using simple reaction mechanisms and particularly environmentally relevant organic compounds • Law of mass action • Solubility product • Acids and bases • Buffer systems • Qualitative analysis
Skills	• Application of basic analytical methods
Competences	• Independent recognition of environmental-chemical correlations • Description of chemical processes • Use of working techniques in environmental chemistry

Module group: Mathematical and natural-scientific basics (20 ECTS)

	Biology
Knowledge	• Botany/zoology (environmental interrelationships, indicators) • Microbiology (bacteria, fungi, algae, viruses) biotechnology • Biological processes in biogas plants, biomass, sewage treatment plants • Waste water constituents and their elimination • Aerobic and anaerobic degradation and metabolic reaction • Biological processes in raw or drinking water, waste and corrosion
Skills	• Application of biological principles in environmental technology biotechnology • Selection of the relevant biotechnological processes
Competences	• Recognition of functional correlations • Benefits of analytical methods (specific microscopy and bacteriology) biotechnology • Understanding biological processes in environmental technology • Application of biotechnological processes in the field of waste water and wastewater treatment. Waste treatment • Determining the cause of faults

	Geology, Hydrogeology, Soil Science
Knowledge	Geology/Hydrogeology • Structure and material composition of the earth • Exogenous-dynamic processes and their products (erosion, transport, etc.) landscape formation, sedimentation, diagenesis and metamorphosis) • Endogenous dynamic processes and their products (vulcanogenic and tectonic processes and their environmental relevance) • Hydrogeological basics soil science • Rocks and minerals as the basis for soil formation • Ground address and classification • Weathering and weathering products • Organic matter and soil biology, physics, chemistry • Soil development, systematics and distribution
Skills	• Evaluation and interpretation of geological and hydrogeological data cards • Evaluation and interpretation of soil maps
Competences	Geology/Hydrogeology • Assessment of soil and rock types • Hydrogeological expertise on groundwater resources • Assessment of soil and rock properties with regard to on environmental risks to soil and groundwater as objects of protection soil science • Understanding of information on soils and substrates • Independent addressing and evaluation of soils

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Modul group: Sustainability sciences (10 ECTS)

	Environment
Knowledge	Environmental testing/environmental impact assessment • Structure, procedures and methods of the UP (screening, scoping, participation) • Presentation and preparation of the environmental impact study • Evaluation procedures and methods • Quantitative assessment procedures for environmental aspects • Measures to reduce or solve problems
Skills	Environmental testing/environmental impact assessment • Knowledge of the objects of protection • Preparation of an environmental impact study
Competences	Environmental testing/environmental impact assessment • Consideration of the ecological, economic, social and cultural protected interests • Strategies for sustainable environmental development

	Society
Knowledge	Participation/participation procedures/public relations work • Function and benefits of participation • Legal foundations of participation • Participants and stakeholders and their role in the planning process • Methods and procedures of participation • Mediation and moderation of planning processes • Evaluation of planning processes
Skills	Participation/participation procedures/public relations work • Preparation and execution of public meetings • Preparation of information and documentation documents for public meetings
Competences	Participation/participation procedures/public relations work • Strategic planning of participation processes • Moderating public appearances

	Climate
Knowledge	• Fundamentals of Meteorology • Structure and composition of the atmosphere • Definition of climate • Climatic factors • Climate system • Climate elements • Climate and land use change • Earth Risk Management • Climate modelling - possibilities and limits
Skills	• Creation and evaluation of time series of climatic parameters
Competences	• Assessment and evaluation of climate analyses

Modul group: Sustainability sciences (10 ECTS)

	Ecology
Knowledge	Ecology • Individuals and populations • Biocoenosis and biotope • Food relationships, energy flow, abiotic and biotic factors • Terrestrial ecology • Limnology Life Cycle Assessment/LCA • Definition of objective and scope of investigation • Life Cycle Inventory • Impact assessment • Evaluation
Skills	Ecology • Selection of ecological assessment factors • Preparation of ecological assessments Life Cycle Assessment/LCA • Preparation of life cycle assessments
Competences	Ecology • Understanding of the ecological interrelationships in the natural environment ecological balance • Application of product-related environmental and sustainability assessments

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Module group: Methodical basics (10 ECTS)

	Computer science/geoinformatics
Knowledge	• Higher applications in spreadsheets (incl. VBA scripts) • Functionality of a higher programming language (f. einf. Tasks) • Application of surface interpolations • Visualization of data (diagrams, area evaluations)
Skills	• Use of a script language (VBA) • Formulation of calculations as algorithms and transfer in one programming language • Use of a compiler to create an application program • Use of environment-related, comprehensive software products one programming language
Competences	• Use of a high-level language for implementation automated calculations and data conversions • Visualization of data and results

	CAD
Knowledge	• Geometric basic constructions • Axonometry and perspective • Introduction to Technical Drawing/Construction Drawing • Basics of program operation, display control • Drawing aids (coordinates, ortho and polar mode, etc.) • CAD-specific drawing techniques • Plan creation with CAD
Skills	• Development of the spatial imagination • Recognition of drawing contents and their contexts • Knowledge of the structure and functioning of a modern CAD program
Competences	• Ability to structure drawing tasks • Ability to draw technical drawings independently • Solution of simple construction tasks

	Geo-information system
Knowledge	• Structure, functionality and possible applications • Simple application for solving spatial problems • Introduction to spatial and environment-related planning and Analysis processes in companies and technical authorities • Environmental Information Act and GIS
Skills	• Basics and terms • Components of a GIS (acquisition, analysis, visualization) • Referencing data and maps, changing the reference system • Introduction and operation of a desktop GIS • Modelling of spatial information • GIS scripting
Competences	• Independent use of GIS in planning and monitoring environmental measures

Module group: Methodical basics (10 ECTS)

	Surveying
Knowledge	• Units of measurement, reference surfaces, coordinate systems, Position and height fixed points • Function and working methods for position and height determination • Use of GPS incl. correction procedures • Remote sensing/aerial photo evaluation
Skills	• Create, update and use maps and plans, and other basic geoinformation • Height measurement and trigonometric height determination (single points surface levelling), and creating longitudinal and transverse profiles • Distance measurement (optical/electro-optical) • Angle measurement (theodolite) • Position measurement (incl. use of an electro-optical total station) • Use of a GPS (real time or post-correction) • Area, volume and mass calculation • Creation of longitudinal and cross profiles • Ability to carry out, award and inspect surveying and testing projects technical tasks within the scope of engineering planning and construction
Competences	• Independent use of various surveying instruments and practical application of corresponding methods for measuring and staking

	Engineering Skills
Knowledge	• Application of standard software • Preparation of protocols, reports, scientific papers inclusive research • Conception, implementation and evaluation of a measurement series (lab/field)
Skills	• Application MS-Office
Competences	• Preparation of reports and scientific papers • Independent execution and evaluation of measurement series

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Module group: Basics of structural engineering and engineering design (20 ECTS)

	Technical mechanics
Knowledge	• Forces, torques and their interrelations or decomposition • Equilibrium of building structures (mathematical and graphical) • Static modelling • Cutting principle • Support reactions and internal forces of statically determined systems • Differential equation of the internal forces • Practical cross-sections, centre of gravity, area moments • Stresses, distortions, material laws • Basics of the safety concept
Skills	• Differentiation between statically determined systems and kinematic systems and statically indeterminate systems • Calculation of support reactions and internal forces static certain systems • Representation of state lines for internal forces • Calculation of stresses for bending, normal force and shear force for flat, statically determined systems
Competences	• Determination of forces, moments and independent assessment of equilibrium situations of simple statically determined systems • Design and evaluation of simple supporting structures

	Building materials
Knowledge	• Basics of construction chemistry • Raw material science and manufacturing processes of the most important building materials • Ecological aspects of building materials • Building material characteristics with regard to structure, strength, deformation, Humidity and temperature behaviour • Material testing procedure • Relevant requirements and testing standards
Skills	• Assessment of the basic suitability of building materials for concrete applications building tasks • Application of the relevant requirements and testing standards • Taking measures specific to the building material during the construction phase • Recognition of the causes of structural damage • Creation of a tear-off register
Competences	• Well-founded basic knowledge for extensive answering of the specific questions concerning the processing of Building materials for planning and existing buildings

Module group: Basics of structural engineering and engineering design (20 ECTS)

	Building physics
Knowledge	• Objectives of structural thermal insulation: environmental and climatic effects, Comfort and hygiene • Basics of thermal insulation: Heat storage, heat conduction, thermal bridges, radiation • Moisture protection; basics, formation of condensation water • Noise protection: Fundamentals of sound generation, propagation and -perception • Fire protection (if not covered by other compartments): Protection objectives fire progression
Skills	• Application of building physics methods • Understanding of building physics connections • Energetic balancing • Level calculation • Assignment of building material properties • Calculation of component properties • Methods of building physics evaluation and assessment of constructions
Competences	• Derivation of building physics requirements for constructions • Basic understanding of proof management - Energy-saving thermal insulation (simplified proofs) - Hygienic thermal insulation, air tightness and room climate • Evaluation of elementary room acoustics, building acoustics, protection against outside noise

	Geotechnics
Knowledge	• Investigation and determination of soil and rock physics Features & Benefits - Classifying parameters (particle size, particle size distribution, water content) organic fraction, state form, consistency limits, grain density, etc.) - Storage density and compaction properties - Deformation behavior - Water permeability • Soil and rock classification for construction purposes • Geotechnical site investigations incl. evaluation methods and graphic representation • Drilling, sounding and geophysical methods • Evaluation methods and graphic representation • Simple soil mechanical calculations • Geotechnical construction methods
Skills	• Determination and evaluation of the soil condition and the -characteristics (field and laboratory) • Development of a subsurface model (stratification with variation) of condition and characteristics)
Competences	• Understanding the Characteristics of Soil and Rock • Linking of subsoil characteristics with environmental questions

Module group: Basics of structural engineering and engineering design (20 ECTS)

	Constructive engineering
Knowledge	• Load assumptions for buildings, load-bearing elements and structural systems • Load transfer to the subsoil • Introduction to the structural design of individual components of a Building and its assembly • Aspects of strength theory (pre-dimensioning of components) • Masonry construction, timber construction, steel and reinforced concrete construction
Skills	• Selection of load assumptions • Determination of the load-bearing system • Calculation of forces and moments on simple components • Design of simple components
Competences	• Evaluation of different construction principles in the body shop • Understanding of the relationship between structural engineering, static conditions, material properties and design • Selection of the appropriate manufacturing processes • Approximate dimensioning of the main load-bearing elements

Module group: Water engineering (15 ECTS)

	Hydrology, water management
Knowledge	• Fundamentals of Hydrology • Fundamentals of Hydrology • Fundamentals of quantity- and quality-related water management • European and national legal bases • Organisation of water management in Germany • management of water resources/river basin management
Skills	• Basic calculations for - Water cycle, water balance - Hydrometry - Hydrography statistics - Individual processes of the precipitation runoff process - Assessment of retention measures • Formulation of flood protection requirements • Evaluation of measures according to guidelines
Competences	• Recognition of the connections in hydrological processes, • Determination of characteristic values (runoff, water and air flow) (e.g. for the protection against flooding), in particular for flood protection • Preparation of water balances

	Hydromechanics
Knowledge	• Substance characteristics • Hydrostatic and hydrodynamic basic equations • Basics of pipe hydraulics • Fundamentals of channel hydraulics • Basics of building hydraulics • Groundwater hydraulics
Skills	• Determination of the hydrostatic load in the form of pressures and Forces for any surfaces • Determination of uplift and verification of swimming stability • Application of hydraulic mass, force and energy balances • Application of stationary channel hydraulics for verification the hydraulic performance • Dimensioning and hydraulic verification for simple Installations in watercourses
Competences	• Understanding of the physical correlations • Independent processing of simple hydraulic questions

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Module group: Water engineering (15 ECTS)

	Urban water management
Knowledge	Water supply • Legal framework (EU Directive, Drinking Water Directive DIN 2000) • Requirements for drinking and process water • Water catchment and treatment • Water distribution systems Water disposal • Types, quantities and characteristics of waste water • Plants and structures for local drainage • Rainwater management and wastewater avoidance • Waste water and sludge treatment processes • Rehabilitation procedure for the sewage network
Skills	Water supply • Targeted use of standards and regulations • Selection of the necessary and appropriate processing procedures • Dimensioning of elements of the treatment processes • Compilation of process combinations water disposal • Development of concepts for the drainage and treatment of Waste water and rainwater • Application of the measurement rules • Planning and dimensioning of plants in wastewater technology • Condition assessment of wastewater systems
Competences	Water supply • Ability to master the basics of selection and design technical process for the selective modification of raw waters • Professional competence for planning, operation and monitoring of Plants and apparatus for water treatment water disposal • Understanding of the interdisciplinary and ecological tasks of the Urban water management and its methods • Participation in the planning, construction and operation of wastewater technology plants • Preparation of rehabilitation concepts for the sewage network

	Hydraulic engineering
Knowledge	• Fundamentals of near-natural watercourse development • Fundamentals of hydraulic structures Hydropower, dams, storage structures, shipping, flood protection
Skills	• Basic hydraulic calculations for - Drains and water level, also in natural cross-sections - The design of the water cross section and ground plan - The relevant hydraulic structures • Constructive design of simple structures
Competences	• Planning and dimensioning of hydraulic engineering measures, including under consideration of ecological framework conditions • Ability to carry out hydraulic engineering works

Module group: Material cycle and resource management (10 ECTS)

	Recycling management
Knowledge	• Legal and waste management framework conditions • Waste classification, waste generation and composition • Disposal concepts in municipal waste management • Avoidance possibilities • Waste collection and transport • Fundamentals of separate collection of recyclable materials • Process and plant concepts for the - Processing and recycling of packaging waste, used plastics and old electrical appliances - Mechanical-biological residue treatment (MBA) • Provision of substitute fuels, composting of biowaste • Thermal treatment/energetic use of waste • Processes and plant concepts for recycling, processing and disposal and recycling of residues and building materials • Objectives and methods of residual waste pretreatment • Landfilling of residual materials (aftercare and replanning)
Skills	• Mastery of the basics of waste management • Assessment of waste generation and composition • Preparation of disposal concepts • Selection and evaluation of treatment procedures • Planning, design and operation of waste treatment plants • Quality assurance for the recovered recyclables/products
Competences	• Preparation of the basic principles of waste management • Mastery of the methods of waste analysis • Planning of disposal concepts, waste collection and transport, collection of recyclable materials and pretreatment of residual waste) • Development, assessment and implementation of process concepts • Design and calculation of waste treatment and recycling facilities

	Building material recycling
Knowledge	• Finishing materials in the building industry • Secondary raw materials from industrial processes • Technical requirements for secondary raw materials • Requirements for the environmental compatibility of building materials • Possibilities of substituting primary raw materials • Examination methods (laboratory, in-situ, non-destructive) • Construction waste management
Skills	• Evaluation of building materials with regard to their reusability • Preparation and execution of simple building material tests
Competences	• Detection of composite materials; • Contributing to the use of recyclable building materials

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Module group: Material cycle and resource management (10 ECTS)

	Contaminated sites
Knowledge	• Fundamentals of remediation of contaminated sites and soil, legal framework • Recording, investigation and evaluation of contaminated sites and contaminated soils • Methods of soil treatment, hydraulic and pneumatic remediation methods • Occupational safety measures • Preparation of the initial status report (Ausgangszustandsbericht - AZB)
Skills	• Description of the soil-groundwater path of action • Planning of remediation measures)
Competences	• Independent implementation of - Hazard assessments of contaminated sites - Soil remediations - Remediation planning of contaminated sites - Planning of initial status reports

Module group: Mobility, spatial planning (15 ECTS)

	Urban and regional planning
Knowledge	• Basic knowledge and practical working methods of urban development and urban development • Basic knowledge of the integration of transport planning into urban development processes • Legal basis • Land use, development and specialist planning, planning procedures and participation procedures • Functions in the city, buildings and construction methods • Transport and urban development • Interaction between urban land-use planning and traffic systems • Urban ecology
Skills	• Independent development and planning of problem solutions Analyses and specific solution tasks for standard tasks in the urban and regional transport
Competences	• Collaboration in urban and regional planning with planning agencies or specialist offices • Discussion and communication of planning objectives in the context of experts and citizens

	Traffic planning
Knowledge	• Fields of work and tasks of transport planning • Causes and structural foundations of mobility • Traffic surveys (methods, preparation of data, findings) • Basics of traffic modelling • Conception of urban transport networks • Parking space planning • Traffic safety
Skills	• Development of solution concepts for standard transport planning tasks • Development of infrastructure measures in the road and rail network • Preparation of drafts for dimensioning and design
Competences	• Collaboration in traffic planning with building contractors or specialist offices • Discussion and communication of planning objectives in the context of experts and citizens

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Module group: Mobility, spatial planning (15 ECTS)

	Public transport
Knowledge	• Legal bases • Organisation development and financing of public transport modes • Rail-bound transport infrastructure (vehicles, passenger transport facilities, freight traffic facilities, safety guarantee) • Road-bound transport systems (planning, construction and operation of for buses, coaches and taxis) • Connection points (boarding and transfer points, transhipment points) • Offer planning (network and line formation, timetable design, roster construction, operating procedures) • Cooperation (tariff cooperation, tariff community, transport association, merger)
Skills	• Creation of simple driving dynamics calculations and routes • Planning and dimensioning of simple systems (rail) • Planning, construction and operation of facilities (road) • Solution of elementary tasks of offer planning and network and line formation
Competences	• Collaboration in the planning of building load bearers or specialist offices • Discussion and communication of planning objectives in the context of technical people and citizens

	Road construction
Knowledge	• Legal bases • Fundamentals of road design, construction and operation • Driving dynamics and driving geometry fundamentals • Cross-section design as well as line layout and routing • Planning and design of nodes with or without the same plan • Road construction, road building methods, production and recycling • Requirements for roads on bridges and in tunnels • Construction technology (production of road pavements) • Operation and maintenance, maintenance and quality management • Aspects of road safety
Skills	• Development of solution concepts for standard tasks in traffic route planning • Development of functional and environmentally sound infrastructure measures on the road network • Preparation of drafts for dimensioning and design
Competences	• Collaboration in the planning, design and operation of roads for building contractors, specialist offices and construction companies • discussion and communication of planning objectives in the context of experts and citizens • Finding a solution to conflicting goals

Module group: Process and plant engineering (10 ECTS)

	Mechanical and electrical engineering
Knowledge	• Basics of power electrics • Electrical machines (synchronous/asynchronous and DC machines) • Generators (synchronous/asynchronous or DC machines) • Force or torque transmission • Gearbox • Inverter • Electrical networks • Combined heat and power (CHP) plants
Skills	• Selection and dimensioning of electrical machine technology • Assessment and application of power transmission procedures • Planning and design of inverters • Planning and application for feeds into the local grid
Competences	• Basic works for the planning of the use of electrical Machine technology in environmental engineering plants (e.g. renewable energy plants) energy use, technical facilities such as sewage treatment plants or waste treatment plants systems)

	Measurement and control control technology
Knowledge	• Fundamentals of measurement technology: basic terms, measurement errors, units of mea-surement Measured value processing, selected measuring methods (temperature, flow, mechanical sizes) • Function of technical measuring equipment, control systems and control loops • Overview of the components required for process control systems and their use • MSR equipment and its marking, explosion protection
Skills	• Structure of measuring procedures with the corresponding sensor technology • Data acquisition and processing • Construction of the control technology by means of switching systems, implementation digital controls • Structure of the control engineering (control loop elements, model formation, elementary time behavior, system structures, continuous and discontinuous Controllers, selection and use of controllers, setting rules, stability, control performance)
Competences	• Simple design and dimensioning/programming Measuring, control and programming and control devices

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Module group: Process and plant engineering (10 ECTS)

	Process engineering
Knowledge	• Basics for the description of processes and plants • Mastery of simple calculation methods for mechanical, thermal and chemical or biological processes • Integrated environmental protection technologies • Near process pollutant separation
Skills	• Process description of processes (flow diagrams, mass and energy balances, thermodynamic equilibrium relations, heat and mass transport equations) • Mechanical and thermal unit processes (grading, sorting.) Crushing, heat transfer, adsorption and desorption, extraction, crystallization, drying) • Classification and description of chemical and biological reaction apparatuses
Competences	• Design and dimensioning of individual process technologies simple processes

	Renewable energy
Knowledge	• Basic data on the national energy industry • Possibilities and limits to the substitution potentials renewable energy sources • Overview of different usage techniques
Skills	• Assessment of the potentials of different uses - Solar thermal systems - Photovoltaic systems - Wind energy converter - Geothermal utilisation - Air heat utilisation - Hydropower - Biomass
Competences	• Assessment of selection, areas of application and economic efficiency of different plant technologies

	Air pollution control
Knowledge	• Knowledge of the legal requirements for air pollution control and their Implementation (Federal Immission Control Act, TA Luft, TA Lärm) • Knowledge of the Regulation on installations subject to authorisation • Understanding the tasks of immission control officers • Understanding the tasks of immission control officers
Skills	• Determination and evaluation of sound immissions (origin, Assessment and measurement) • Combustion calculations for solid, liquid and gaseous fuels • Immission and emission measurements for air pollutants • Procedure and contents of approval procedures
Competences	• Methodological competence in predicting gaseous emissions • Ability to plan and carry out immissions and emission measurements • Development of plant-specific questions on air pollution control and noise pollution • Preparation of application documents

Module group: Environmental management (10 ECTS)

	Environmental and construction contract law
Knowledge	• Public and private building law • Federal Building Act and State Building Regulations • Environmental legislation, European and German law • Environmental Impact Assessment Act • VOB, part A and part B (Award of construction contracts) • BGB • Criminal code • Public participation
Skills	• Application of the relevant legal regulations for a building project • Establishment of a public participation procedure
Competences	• Estimate the interaction between a construction project and the legal requirements and with the interests of third parties in an Cooperation between the parties involved must be established

	Project management
Knowledge	• Definition, application possibilities, goals, methods and Principles of project management - Project organisation - Project phases - Structural analysis - Specification - Scheduling, cost and capacity planning - network technique
Skills	• Tasks of the project manager - Team leadership - Planning - Implementation - Monitoring and control of projects
Competences	• Dealing with the objectives, main tasks and methods of the Project management during planning, implementation, monitoring and project management • Understanding the tasks and competencies of a project manager

	Economics
Knowledge	• Basics of business administration and economics (definitions, principles, factors of production, goods) • Company processes and goals • Divisions and their tasks • Types and legal forms of enterprises • Basic concepts of the operational accounting, operational economic figures, balance sheet, profit and loss account • Cost and performance calculation, break-even analysis, Price determination, investment calculation • Economic importance of environmental measures
Skills	• Linking of technical and economic factors
Competences	• Understanding the instruments of the external and internal accounting • Recognition of economic effects

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Members of FBT BaU - Faculties and departments of Universities of Applied Sciences in Germany with Bachelor‘s degree programmes in civil engineering and of the environmental engineering construction - (status: October 2018)

University of Ap. Sc.	Faculty/Department	Course of studies	Place of study
Fachhochschule Aachen	Bauingenieurwesen	Bauingenieurwesen Dual, B.Eng.; Bauingenieurwesen, B.Eng.	Aachen
Hochschule Augsburg	Architektur und Bauwesen	Bauingenieurwesen, B.Eng.;	Augsburg
Beuth-Hochschule für Technik Berlin	Bauingenieur- und Geoinformationswesen	Bauingenieurwesen, B.Eng.; Umweltingenieurwesen – Bau, B.Eng.	Berlin
Hochschule für Technik und Wirtschaft (HTW) Berlin	Ingenieurwissenschaften - Technik und Leben	Bauingenieurwesen, B.Sc.	Berlin (Campus Wilhelmi-nenhof)
Hochschule Biberach	Bauingenieurwesen	Bauingenieurwesen, B.Eng.	Biberach an der Riß
Hochschule Bochum	Bauingenieurwesen; Bau- und Umweltingenieurwesen	Bauingenieurwesen, B.Sc; Umweltingenieurwesen, B.Sc;	Bochum
Hochschule Bremen	Architektur, Bau und Umwelt	Bauingenieurwesen, B.Sc.; Internationaler Studiengang Umwelttechnik, B.Sc.	Bremen
Hochschule 21, gemeinnützige GmbH, Staatlich anerkannte private Fachhochschule	Bauingenieurwesen Dual	Bauingenieurwesen DUAL, B.Eng.	Buxtehude
Hochschule Coburg	Design	Bauingenieurwesen - Allgemeines Bauingenieurwesen, B.Eng.;	Coburg
Hochschule Darmstadt	Bauingenieurwesen	Bauingenieurwesen, B.Eng.; Umweltingenieurwesen, B.Eng.	Darmstadt
Technische Hochschule Deggendorf	Bauingenieurwesen und Umwelttechnik	Bauingenieurwesen, B.Eng.; Umweltingenieurwesen, B.Eng.	Deggendorf
Hochschule Ostwestfalen-Lippe	Bauingenieurwesen	Bauingenieurwesen, B.Eng; Bauingenieurwesen DUAL, B.Eng.	Detmold
Hochschule für Technik und Wirtschaft Dresden	Bauingenieurwesen / Architektur	Bauingenieurwesen, Dipl.-Ing. (FH); Kooperatives Studium Bauingenieur-wesen, Dipl.-Ing. (FH)	Dresden
Fachhochschule Erfurt	Bauingenieurwesen und Konservierung/Restaurierung	Bauingenieurwesen, B.Eng.; Bauingenieurwesen (dual), B.Eng.	Erfurt
Frankfurt University of Applied Sciences	Architektur. Bauingenieur-wesen. Geomatik	Bauingenieurwesen, B.Eng.; Bauingenieurwesen dual, B.Eng.	Frankfurt am Main
Technische Hochschule Mittelhessen, Campus Gießen	Bauwesen	Bauingenieurwesen, B.Eng.	Gießen

University of Ap. Sc.	Faculty/Department	Course of studies	Place of study
Hochschule für Angewandte Wissenschaft und Kunst Hildesheim/ Holzminden/Göttingen	Bauen und Erhalten	Bauingenieurwesen, B.Eng.	Hildesheim
Hochschule Kaiserslautern	Bauen und Gestalten	Bauingenieurwesen, B.Eng.	Kaiserslautern
Hochschule Karlsruhe Technik und Wirtschaft	Architektur und Bauwesen	Bauingenieurwesen, B.Eng.; Bauingenieurwesen (trinational), B.Eng.; Umweltingenieurwesen (Bau), B.Eng.	Karlsruhe
Hochschule Koblenz	bauen-kunst-werkstoffe - Bauwesen	Bauingenieurwesen, B.Eng.; Bauingenieurwesen Dual, B.Eng.; Wasserbau/Bauingenieurwesen (dual), B.Eng.	Koblenz
Technische Hochschule Köln	Bauingenieurwesen und Umwelttechnik	Bauingenieurwesen, B.Eng.; Bauingenieurwesen Dual, B.Eng.	Köln
Hochschule Konstanz Technik, Wirtschaft und Gestaltung	Bauingenieurwesen	Bauingenieurwesen, B.Eng.; Umwelttechnik und Ressourcenmanagement, B.Eng.	Konstanz
Hochschule für Technik, Wirtschaft und Kultur Leipzig	Bauwesen	Bauingenieurwesen, B.Eng.	Leipzig
Technische Hochschule Lübeck	Bauwesen	Bauingenieurwesen, B.Eng.	Lübeck
H² Hochschule Magdeburg - Stendal	Wasser, Umwelt, Bau und Sicherheit	Bauingenieurwesen, B.Eng.; Recycling und Entsorgungsmanagement, B.Eng.	Magdeburg
Hochschule Mainz	Technik	Bauingenieurwesen, B.Eng.; Internationales Bauingenieurwesen, B.Eng.	Mainz
Fachhochschule Bielefeld	Campus Minden	Bauingenieurwesen, B.Eng.; Infrastrukturmanagement, B.Eng.	Minden
Hochschule für angewandte Wissenschaften München	Bauingenieurwesen	Bauingenieurwesen, B.Eng.; Bauingenieurwesen dual, B.Eng.	München
Fachhochschule Münster	Bauingenieurwesen	Bauingenieurwesen, B.Eng.	Münster
Hochschule Ruhr West Mülheim an der Ruhr	Bauingenieurwesen	Bauingenieurwesen, B.Sc.	Mülheim an der Ruhr
Technische Hochschule Nürnberg Georg Simon Ohm	Bauingenieurwesen	Bauingenieurwesen, B.Eng.	Nürnberg
Jade Hochschule	Bauwesen Geoinformation Gesundheitstechnologie	Bauingenieurwesen, B.Eng.	Oldenburg
Hochschule Osnabrück	Agrarwissenschaft und Landschaftsarchitektur	Baubetriebswirtschaft Dual, B.Eng.	Osnabrück

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University of Ap. Sc.	Faculty/Department	Course of studies	Place of study
Fachhochschule Potsdam	Bauingenieurwesen	Bauingenieurwesen, B.Eng.; Siedlungswasserwirtschaft (Dual), B.Eng.	Potsdam
OTH Ostbayerische Technische Hochschule Regensburg	Bauingenieurwesen	Bauingenieurwesen, B.Eng.	Regensburg
Hochschule für Technik und Wirtschaft des Saarlandes	Architektur und Bauingenieurwesen	Bauingenieurwesen, B.Eng.	Saarbrücken
Hochschule für Technik Stuttgart	Bauingenieurwesen	Bauingenieurwesen, B.Eng.	Stuttgart
Ostfalia Hochschule für angewandte Wissenschaften	Bau-Wasser-Boden	Bauingenieurwesen, B.Eng.; Bauingenieurwesen im Praxisverbund, B.Eng.; Wasser- und Bodenmanagement, B.Eng.	Suderburg
Hochschule Trier	Bauen + Leben	Bauingenieurwesen, B.Eng.	Trier
Hochschule RheinMain	Architektur und Bauingenieurwesen	Bauingenieurwesen, B.Eng.	Wiesbaden
Hochschule Wismar University of Applied Sciences Technology, Business and Design	Ingenieurwissenschaften - Bauingenieurwesen	Bauingenieurwesen, B.Eng.	Wismar
Hochschule für angewandte Wissenschaften Würzburg - Schweinfurt	Architektur & Bauingenieurwesen	Bauingenieurwesen, B.Eng.	Würzburg