Appendix 1
Module descriptions

module no.	**module name**	**responsible lecturer**
BIWO-01	Building Materials	Prof. Mechtcherine
contents and qualifications	The module covers the microstructure and chemical composition of building materials, physical and mechanical properties of construction materials (timber, steel, concrete, masonry), the durability of construction materials, materials for strengthening and repair (polymers, polymer-modified mortars/concretes, fibre-reinforced polymer-based composites, shotcrete), cement-bound high-performance composites for new structures and rehabilitation (self-compacting concrete, fibre-reinforced concrete, textile-reinforced concrete, ultra high-strength concrete), modelling and numerical simulation of freshly poured, concrete-like materials (including the numerical simulation of mixing, carrying, pouring and compacting), theoretical modelling of the deformation and cracking behaviour of cement-based building materials, fracture mechanics of concrete, numerical simulation of the crack development due to thermal and moisture changes. On completion of the module students will be able to assess the microstructure and the properties of construction and repair materials and also apply the methods for their modelling and numerical simulation.	
types of teaching and learning	4 SWS* lecture and 2 SWS tutorial and also self-study	
prerequisites for participation		
usability	The module is a required module in the Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS. It is a prerequisite for the required elective modules BIWE-01, BIWE-02, BIWE-03, BIWE-08, BIWE-10 and BIWE-11.	
requirements for being awarded credits	Students earn credits after having passed the module exam. The module exam consists of a written exam (180 min.).	
credits and grades	Students can earn 8 credits through the module. The module grade is equivalent to the grade given for the written exam.	
availability of the module	The module is offered in the winter semester.	
workload	total workload 240 hours	
duration of the module	1 semester	

module no.	**module name**	**responsible lecturer**
BIWO-02	Continuum Mechanics, Tensor Analysis	Prof. Löhnert
contents and qualifications	The module focuses on the fundamental concepts of continuum mechanics and the related variational principles. content of the module: Tensor Algebra, Tensor Analysis, Kinematics, Master Equations, Material Theory and Variational Principles. On completion of the module students will have an understanding of the fundamentals of continuum mechanics and also the necessary skills to apply the tensor analysis.	
types of teaching and learning	4 SWS* lecture and 2 SWS tutorial and also self-study	
prerequisites for participation		
usability	The module is a required module in Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS. It is a prerequisite for the required elective modules BIWE-02, BIWE-08, BIWE-09 and BIWE-14.	
requirements for being awarded credits	Students can earn credit points after having passed the module exam. The module exam consists of a written exam (90 minutes) and an ungraded assigned paper with a total of 60 hours.	
credits and grades	Students can earn 8 credits through the module. The module grade is equivalent to the grade earned for the written exam if the assigned paper rated 'pass'. Otherwise, the module grade is the weighted average of the grade for the written exam and grade 5 for the assigned paper (§ 10 par. 1 sentence 5 PO); the weighting factors applied to the written exam and the assigned paper are two and one, respectively.	
availability of the module	The module is offered in the winter semester.	
workload	total workload 240 hours	
duration of the module	1 semester	

module no.	module name	responsible lecturer
BIWO-03	Energy Methods, FEM	Prof. Kaliske
contents and qualifications	content of the module: calculus of variations, principle of minimum potential energy, Ritz and Galerkin approximate methods, energy stability criteria and their application, Hamilton's principle, Lagrange equations, application to steady-state/transient vibrations, principle of minimum complementary energy, displacement forms of FEM, general variational principles and hybrid finite elements, geometrically nonlinear FEM, physically nonlinear FEM and numerical simulation of crack formation. On completion of the module students will be able to apply the energy methods, the foundation for the finite element method and also the linear and nonlinear finite element method.	
types of teaching and learning	4 SWS* lecture and 2 SWS tutorial and also self-study	
prerequisites for participation		
usability	The module is a required module in Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS. It is a prerequisite for the required elective modules BIWE-02, BIWE-03, BIWE-09 and BIWE-13.	
requirements for being awarded credits	Students earn credits after having passed the module exam. The module exam consists of a written exam (120 minutes) and an ungraded assigned paper with a total of 40 hours.	
credits and grades	Students can earn 8 credits through the module. The module grade is equivalent to the grade earned for the written exam if the assigned paper rated 'pass'. Otherwise, the module grade is the weighted average of the grade for the written exam and grade 5 for the assigned paper (§ 10 par. 1 sentence 5 PO); the weighting factors applied to the written exam and the assigned paper are two and one, respectively.	
availability of the module	The module is offered in the winter semester.	
workload	total workload 240 hours	
duration of the module	1 semester	
module reading list	Chandrupatla, Belegundu: Introduction to Finite Elements in Engineering, Prentice-Hall Zienkiewicz, Taylor: The Finite Element Method, Butterworth-Heinemann	

module no.	module name	responsible lecturer
BIWO-04	Numerical Methods	Prof. Reuter
contents and qualifications	content of the module: engineering design and analysis of algorithms for the numerical solution of continuous mathematical problems, direct methods that give the exact solution to a problem in a finite number of steps and for an infinite computer accuracy, iterative methods to compute approximations that converge to the exact solution of a problem, linear algebra and analytical geometry, solutions for linear and nonlinear equations, equation systems, extremum and eigenvalue problems, numerical integration, interpolation, regression and implementation of the algorithms in software solutions. On completion of the module students are able to apply basic and advanced numerical methods to solve engineering and scientific issues of civil engineering. Students will have the necessary programming knowledge to implement the numerical methods.	
types of teaching and learning	2 SWS* lecture and 2 SWS tutorial and also self-study	
prerequisites for participation		
usability	The module is a required module in Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS. It is a prerequisite for the required elective module BIWE-12.	
requirements for being awarded credits	Students can earn credit points after having passed the module exam. The module exam consists of a written exam (90 minutes) and an ungraded assigned paper with a total of 30 hours.	
credits and grades	Students can earn 4 credit points through the module. The module grade is equivalent to the grade earned for the written exam if the assigned paper rated 'pass'. Otherwise, the module grade is the weighted average of the grade for the written exam and grade 5 for the assigned paper (§ 10 par. 1 sentence 5 PO); the weighting factors applied to the written exam and the assigned paper are two and one, respectively.	
availability of the module	The module is offered in the winter semester.	
workload	total workload 120 hours	
duration of the module	1 semester	

module no.	**module name**	**responsible lecturer**
BIWO-05	Mentoring Programme on Academic Competence	Prof. Kaliske
contents and qualifications	content of the module: programme design, didactics, solving subject-related problems and general academic competence. Students learn how to early identify and overcome barriers to learning and they know the methods to prevent dropping out; moreover, they are able to complete studies within standard period of study and they acquire the competence to use scientific methods.	
types of teaching and learning	2 SWS mentoring and also self-study	
prerequisites for participation		
usability	The module is a required module in Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS. It is a prerequisite for the required elective modules BIWE-01 to BIWE-14.	
requirements for being awarded credits	Students can earn credit points after having passed the module exam. The module exam is an ungraded final report of mentoring sessions.	
credits and grades	Students can earn 2 credits through the module. The module is rated as passed or failed.	
availability of the module	The module is offered in the winter semester.	
workload	total workload 60 hours	
duration of the module	1 semester	

module no.	**module name**	**responsible lecturer**
BIWO-06	Mentoring Programme on Methods Competence	Prof. Kaliske
contents and qualifications	content of the module: methods competence, general academic skills and skills for solving subject-related problems. Students know how to early identify and overcome barriers to learning; moreover, they are able to complete the subject-related tasks assigned to them within reasonable time and to identify and evaluate own mistakes. Moreover, they acquired interdisciplinary methods competence.	
types of teaching and learning	2 SWS mentoring and also self-study	
prerequisites for participation		
usability	The module is a required module in Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS. It is a prerequisite for the required modules BIWO-07 and BIWO-08.	
requirements for being awarded credits	Students can earn credit points after having passed the module exam. The module exam is an ungraded final report of mentoring sessions.	
credits and grades	Students can earn 2 credits through the module. The module is rated as passed or failed.	
availability of the module	The module is offered each summer semester.	
workload	total workload 60 hours	
duration of the module	1 semester	

module no.	module name	responsible lecturer
BIWO-07	Applications Computer-Oriented Engineering Methods	Prof. Kaliske
contents and qualifications	content of the module: current research topics in civil engineering, materials science and computer-assisted mechanics. On completion of the module students will be able employ computer-assisted modelling in structural analysis, in general, or, in particular, in structural strengthening.	
types of teaching and learning	4 SWS lecture and also self-study	
prerequisites for participation	The competencies covered in module BIWO-06 are essential for this module.	
usability	The module is a required module in Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS.	
requirements for being awarded credits	Students can earn credit points after having passed the module exam. The module exam consists of a written exam (120 min.).	
credits and grades	Students can earn 6 credit points through the module. The module grade is equivalent to the grade given for the written exam.	
availability of the module	The module is offered in the winter semester.	
workload	total workload 180 hours	
duration of the module	1 semester	

module no.	**module name**	**responsible lecturer**
BIWO-08	Application-Oriented Research Project	Prof. Kaliske
contents and qualifications	content of the module: definite tasks of civil engineering, materials science and computer-assisted mechanics, in particular tasks that require interdisciplinary solutions. On completion of the module students are able to use their knowledge, abilities and skills independently, individually or in a team to solve practical tasks, to document all portions of their work in a logical and consistent manner and to present their results for discussion. Moreover, they can carry out interdisciplinary work in a team and work out concepts for development, implementation and presentation.	
types of teaching and learning	project and seminar (including self-study) with a total of 560 hours; of which not more than 4 SWS are for the seminar	
prerequisites for participation	The competencies covered in module BIWO-06 are essential for this module.	
usability	The module is a required module in Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS.	
requirements for being awarded credits	Students can earn credit points after having passed the module exam. The module exam consists of a project of 4 weeks duration.	
credits and grades	Students can earn 24 credits through the module. The module grade is equivalent to the grade given for the project.	
availability of the module	The module is offered in the winter semester.	
workload	total workload 720 hours	
duration of the module	1 semester	

module no.	module name	responsible lecturer
BIWE-01	Structural Analysis of Reinforced Concrete Structures	Prof. Curbach
contents and qualifications	content of the module: maintenance principles for bridges and buildings, e.g., inspection, testing, examination and condition assessment of existing reinforced concrete structures, load testing and monitoring of steel-reinforced structures, calculation of the load-bearing capacity and reserve strength of existing buildings and bridges using special computation methods, strengthening methods for massive structures and their calculation (shotcrete, steel lamellae, CFRP lamellas, textile-reinforced concrete, external prestressing). On completion of the module students are able to assess the load-bearing capacity of existing structures and to derive and calculate the necessary repair and strengthening measures.	
types of teaching and learning	2 SWS* lecture and 1 SWS tutorial and also self-study	
prerequisites for participation	The competencies covered in modules BIWO-01 and BIWO-05 are prerequisite to this module.	
usability	The module is one of the required elective modules in the Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS of which students must choose seven.	
requirements for being awarded credits	Students earn credits after having passed the module exam. The module exam consists of a written exam (90 min.).	
credits and grades	Students can earn 4 credit points through the module. The module grade is equivalent to the grade given for the written exam.	
availability of the module	The module is offered each summer semester.	
workload	total workload 120 hours	
duration of the module	1 semester	
module reading list	Eurocode 2: Design of Concrete Structures Fib bulletin 14: Externally bonded FRP-reinforcement for RC structures Fib bulletin 17: Management, maintenance and strengthening of concrete structures	

module no.	module name	responsible lecturer
BIWE-02	Calculation and Structural Analysis of Masonry Structures	Prof. Jäger
contents and qualifications	content of the module: materials of masonry construction, types of masonry walls and their properties, load-bearing and deformation characteristics and also material laws for the description, modelling and calculation of masonry structures and problems (engineering methods, numerical methods, static stress, dynamic impacts), design models, verification concepts and methods (semi-probabilistic safety concept, reliability of failure and verification of the safety index, existing structures, in-situ testing), advanced problems of structural masonry (stability problems, load-factor method, failure mechanism, behaviour and verification under earthquake loads, fire action), codes, standards and verification methods in international comparison, experimental methods (testing of materials and building elements, scaled models, static and dynamic loading) and their application, assessment and strengthening of existing buildings and structures (principles, building pathology, analyses, evaluation and enhancement of load bearing capacity). On completion of the module students will be able to solve standard tasks as well as special engineering problems and to answer questions of masonry structures in the field of professional engineering and the domain of research and development. They will also be able to assess existing masonry structures, to evaluate the damages and to evaluate and enhance the load bearing capacity.	
types of teaching and learning	2 SWS* lecture and 1 SWS tutorial and also self-study	
prerequisites for participation	The competencies covered in modules BIWO-01, BIWO-02, BIWO-03 and BIWO-05 are prerequisite to this module.	
usability	The module is one of the required elective modules in the Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS of which students must choose seven.	
requirements for earning for being awarded credits	Students earn credits after having passed the module exam. The module exam consists of a written exam (120 min.).	
credits and grades	Students can earn 4 credit points through the module. The module grade is equivalent to the grade given for the written exam.	
availability of the module	The module is offered each summer semester.	
workload	total workload 120 hours	
duration of the module	1 semester	
module reading list	Jäger, W. et al. : Structural Masonry. Manuscript. TU Dresden 2009 Jäger, W.: Historic Masonry. WITpress Southampton 2009	

module no.	module name	responsible lecturer
BIWE-03	Timber and Lightweight Structures	Prof. Stroetmann
contents and qualifications	content of the module: mechanical and Physical Fundamentals von timber and its derivatives and their consequences for use in construction, situation of resources and transformation processes of the raw wood for timber structures, wood modification, timber joints and structural behaviour, composite structures with concrete, fibres and textiles, selected examples of wooden structures demonstrating the current state of timber construction technology and its specific aspects, historical timber structures, reconstruction and rehabilitation, stability, fatigue and operational strength of steel structures, cable structures – cable types and connectors (concept and detailed design and calculation), structural systems made of textile membranes and foils combined with structural steel elements. On completion of the module students will be well prepared for concept design, detailed design and calculation of timber and lightweight structures.	
types of teaching and learning	2 SWS* lecture and 1 SWS tutorial and also self-study	
prerequisites for participation	The competencies covered in modules BIWO-01, BIWO-03 and BIWO-05 are prerequisite to this module.	
usability	The module is one of the required elective modules in the Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS of which students must choose seven.	
requirements for earning for being awarded credits	Students earn credits after having passed the module exam. The module exam consists of a written exam (150 min.).	
credits and grades	Students can earn 4 credit points through the module. The module grade is equivalent to the grade given for the written exam.	
availability of the module	The module is offered each summer semester.	
workload	total workload 120 hours	
duration of the module	1 semester	

module no.	module name	responsible lecturer
BIWE-05	Glass Structures	Prof. Weller
contents and qualifications	content of the module: aspects of façade engineering, mechanical and physical fundamentals of annealed and tempered glass, safety concepts for structural glass, design and construction using glass, numerical simulation of glass as a construction material, numerical simulation of mechanically fixed and adhesively bonded structures and also all-glass structures, analytical methods and modelling. On completion of the module students will be well prepared for the structural use of glass and also the safety concept and the structural analysis following building codes and ordinances.	
types of teaching and learning	2 SWS* lecture and 1 SWS tutorial and also self-study	
prerequisites for participation	The competencies covered in module BIWO-05 are essential for this module.	
usability	The module is one of the required elective modules in the Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS of which students must choose seven.	
requirements for earning for being awarded credits	Students can earn credit points after having passed the module exam. The module exam consists of a written exam (90 min.).	
credits and grades	Students can earn 4 credit points through the module. The module grade is equivalent to the grade given for the written exam.	
availability of the module	The module is offered each summer semester.	
workload	total workload 120 hours	
duration of the module	1 semester	
module reading list	The Institution of Structural Engineers: Structural use of glass in buildings. ISBN 1 874 266 5147 Schittich et al: Glass construction manual. ISBN 3 764 381 221	

module no.	module name	responsible lecturer
BIWE-06	Computational Methods for Reinforced Concrete Structures	Prof. Häußler-Combe
contents and qualifications	content of the module: particular numerical methods that are suited to calculate the behaviour of reinforced concrete structures This includes the modelling of cracking and bond, particular nonlinear computation methods, the structural behaviour of cracked reinforced concrete bars, finite elements for reinforced concrete beams, numerical methods for strut and tie models, multiaxial material laws for concrete, finite elements for reinforced concrete plates and finite elements for reinforced concrete slabs On completion of the module students know the special mechanisms of the load-bearing behaviour of reinforced concrete and are able to apply the relevant numerical methods.	
types of teaching and learning	2 SWS* lecture and 1 SWS tutorial and also self-study	
prerequisites for participation	The competencies covered in module BIWO-05 are essential for this module.	
usability	The module is one of the required elective modules in the Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS of which students must choose seven.	
requirements for being awarded credits	Students earn credits after having passed the module exam. The module exam consists of an assigned paper including the defence of the paper with a total of 40 hours.	
credits and grades	Students can earn 4 credit points through the module. The module grade is equivalent to the grade given for the assessment.	
availability of the module	The module is offered each summer semester.	
workload	total workload 120 hours	
duration of the module	1 semester	

module no.	module name	responsible lecturer
BIWE-07	Building Physics	Prof. Grunewald
contents and qualifications	content of the module: indoor climate (human comfort and indoor air quality, pollutants, environmental and indoor climate loads, user behaviour, thermal protection in the summer and in hot climates), coupled heat, air and moisture transfer processes in building envelope systems (hygrothermal analysis of structural details, aspects of durability, damage potentials and protective measures, protection of built heritage and the built environment), integration in building physics simulation – energy & hygrothermal performance (development of building physics models of buildings, passive and active measures to store energy and moisture in structural components, energy optimisation of buildings with respect to their environment). On completion of the module students are able to apply internationally available and the Institute's software models to solve the tasks stated above.	
types of teaching and learning	2 SWS* lecture and 1 SWS tutorial and also self-study	
prerequisites for participation	The competencies covered in module BIWO-05 are essential for this module.	
usability	The module is one of the required elective modules in the Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS of which students must choose seven.	
requirements for being awarded credits	Students earn credits after having passed the module exam. The module exam consists of a written exam (180 min.).	
credits and grades	Students can earn 4 credit points through the module. The module grade is equivalent to the grade given for the written exam.	
availability of the module	The module is offered each summer semester.	
workload	total workload 120 hours	
duration of the module	1 semester	
module reading list	for program downloads and literature visit http://www.bauklimatik-dresden.de/ http://www.eere.energy.gov/buildings/energyplus/ http://www.designbuilder.co.uk/	

module no.	module name	responsible lecturer
BIWE-08	Multiscale Methods	Prof. Löhnert
contents and qualifications	content of the module: multiscale modelling of composites and materials with defects and cracks, representative volume elements and unit cells, scale transitions/bridging using homogenisation and localisation, hierarchical and simultaneous multiscale methods, averaging techniques, Voigt/Reuss approximations and Hashin/Shtrikman bounds, micromechanical solution by Eshelby, Effective Field Theory and Effective Medium Theory (self-consistent method), numerical homogenisation with homogenous, periodical and mixed boundary conditions. On completion of the module students will be able to use analytical and numerical multiscale modelling of composites and materials with defects and cracks.	
types of teaching and learning	2 SWS* lecture and 1 SWS tutorial and also self-study	
prerequisites for participation	The competencies covered in modules BIWO-01, BIWO-02 and BIWO-05 are prerequisite to this module.	
usability	The module is one of the required elective modules in the Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS of which students must choose seven.	
requirements for being awarded credits	Students earn credits after having passed the module exam. The module exam consists of a written exam (90 minutes) and an ungraded assigned paper with a total of 40 hours.	
credits and grades	Students can earn 4 credit points through the module. The module grade is equivalent to the grade earned for the written exam if the assigned paper rated 'pass'. Otherwise, the module grade is the weighted average of the grade for the written exam and grade 5 for the assigned paper (§ 10 par. 1 sentence 5 PO); the weighting factors applied to the written exam and the assigned paper are two and one, respectively.	
availability of the module	The module is offered each summer semester.	
workload	total workload 120 hours	
duration of the module	1 semester	

module no.	module name	responsible lecturer
BIWE-09	Computational Dynamics	Prof. Graf
contents and qualifications	content of the module: computational structural dynamic analysis, such as single-degree-of-freedom system in the time and frequency domain, multi-degree-of-freedom systems, natural vibrations, modal analysis, modal superposition, damping models, displacement method and linear dynamics, element formulations, transformation relations, substructuring and condensation techniques, numerical simulation in the time domain, central difference method, analysis of time integration methods, continuous systems, applications, earthquake analysis and impact problems. On completion of the module students will be able to solve dynamic problems of load-bearing structures by applying advanced computational methods.	
types of teaching and learning	2 SWS* lecture and 1 SWS tutorial and also self-study	
prerequisites for participation	The competencies covered in modules BIWO-02, BIWO-03 and BIWO-05 are prerequisite to this module.	
usability	The module is one of the required elective modules in the Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS of which students must choose seven.	
requirements for being awarded credits	Students earn credits after having passed the module exam. The module exam consists of a written exam (120 min.).	
credits and grades	Students can earn 4 credit points through the module. The module grade is equivalent to the grade given for the written exam.	
availability of the module	The module is offered each summer semester.	
workload	total workload 120 hours	
duration of the module	1 semester	
module reading list	Clough, Penzien: Dynamics of Structures, McGraw-Hill Argyris, Mlejnek: Dynamics of Structures, North-Holland Meskouris: Structural Dynamics, Ernst & Sohn	

module no.	module name	responsible lecturer
BIWE-10	Modelling of Pavement Structures for Dimensioning and Forecast Calculations	Prof. Wellner
contents and qualifications	content of the module: fundamentals of road loads (climate, traffic loads), modelling of loads (temperature variations, models to calculate essential temperature conditions as climate data, comparison with data measured in the field, modelling of tire-pavement interaction, modelling of vehicle parameters, comparison with field measurements), materials modelling (granular materials, asphalt, concrete), modelling of the layered compound, structure of the numerical simulation model – material description, element approaches, structural model, multiphysics (numerical, multiphysics structural analysis, validation using lab tests and large-scale tests). On completion of the module students will be able to use analytical and numerical methods for modelling and simulating pavement behaviour.	
types of teaching and learning	2 SWS* lecture and 1 SWS tutorial and also self-study	
prerequisites for participation	The competencies covered in modules BIWO-01 and BIWO-05 are prerequisite to this module.	
usability	The module is one of the required elective modules in the Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS of which students must choose seven.	
requirements for being awarded for being awarded credits	Students earn credits after having passed the module exam. The module exam consists of a written exam (120 minutes) and an ungraded assigned paper with a total of 40 hours.	
credits and grades	Students can earn 4 credit points through the module. The module grade is equivalent to the grade earned for the written exam if the assigned paper rated 'pass'. Otherwise, the module grade is the weighted average of the grade for the written exam and grade 5 for the assigned paper (§ 10 par. 1 sentence 5 PO); the weighting factors applied to the written exam and the assigned paper are two and one, respectively.	
availability of the module	The module is offered each summer semester.	
workload	total workload 120 hours	
duration of the module	1 semester	
module reading list	Highways, The Location, Design, Edited by C. A. O'Flaherty, 2002, ISBN 0 7506 5090 7	

	Design and Performance of Road Pavements, D. and P. Croney, ISBN 0 07 014451 6

module no.	module name	responsible lecturer
BIWE-11	Cable-Stayed Bridges	Prof. Dr.-Ing. Stroetmann
contents and qualifications	content of the module: forces acting on cable-stayed bridges, dimensioning, dynamics, details, manufacture and installation of cable stays, calculation of cable-stayed, reinforced concrete and steel bridges taking into account the nonlinear theory and the aerodynamic stability of the cables, stiffening girder and pylons, design and construction of cable-stayed bridges, practical examples of concrete, composite and hybrid cable-stayed bridges, design and dimensioning of cable-stayed bridges to Eurocode, design loads in bridge construction, stiffening girders and decks in reinforced concrete, steel and steel compound bridges and also selected bridge construction details. Students know the basics of planning, concept and detailed design and the calculation of cable-stayed bridges. Upon the successful completion of the module students are able to apply the fundamentals of concept and detailed design and calculation of cable-stayed bridges. Moreover, they will know the processes of manufacturing and assembly for installing these bridges.	
types of teaching and learning	2 SWS* lecture and 1 SWS tutorial and also self-study	
prerequisites for participation	The competencies covered in modules BIWO-01 and BIWO-05 are prerequisite to this module.	
usability	The module is one of the required elective modules in the Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS of which students must choose seven.	
requirements for being awarded for being awarded credits	Students can earn credit points after having passed the module exam. The module exam consists of a written exam (90 min.).	
credits and grades	Students can earn 4 credit points through the module. The module grade is equivalent to the grade given for the written exam.	
availability of the module	The module is offered each summer semester.	
workload	total workload 120 hours	
duration of the module	1 semester	
module reading list	Svensson, H.: Cable-Stayed Bridges - 40 years of experience worldwide. Published by Ernst & Sohn, Berlin 2012	

module no.	module name	responsible lecturer
BIWE-12	Safety Concepts	Prof. Kaliske
contents and qualifications	content of the module: safety of load-bearing structures, forecast and risk assessment, limit states and failure structures, concepts for the description of uncertainty and safety, level 3 analysis (stochastic concepts for the assessment of structural safety, integral formulas for the probability of failure, system and element failure, series and parallel systems), level 2 analysis (approximation methods for the computation of the probability of failure, safety index, first order/ second order reliability method), level 1 analysis (semi-probabilistic safety concepts, partial safety factors, application of standards), time series and load processes, model-based and model-free analytical methods. On completion of the module students are able to apply advanced computational methods in order to assess the safety of load-bearing structures.	
types of teaching and learning	2 SWS* lecture and 1 SWS tutorial and also self-study	
prerequisites for participation	The competencies covered in modules BIWO-04 and BIWO-05 are prerequisite to this module.	
usability	The module is one of the required elective modules in the Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS of which students must choose seven.	
requirements for being awarded for being awarded credits	Students earn credits after having passed the module exam. The module exam consists of a written exam (90 minutes) and an ungraded assigned paper with a total of 40 hours.	
credits and grades	Students can earn 4 credit points through the module. The module grade is equivalent to the grade earned for the written exam if the assigned paper rated 'pass'. Otherwise, the module grade is the weighted average of the grade for the written exam and grade 5 for the assigned paper (§ 10 par. 1 sentence 5 PO); the weighting factors applied to the written exam and the assigned paper are two and one, respectively.	
availability of the module	The module is offered each summer semester.	
workload	total workload 120 hours	
duration of the module	1 semester	

module no.	module name	responsible lecturer
BIWE-13	BIM-Based Virtual Engineering Laboratory	Prof. Menzel
contents and qualifications	content of the module: relational and object-oriented data structures of building information modelling (BIM), multi-models and link models, filtering of engineering information, visualisation methods for engineering information, integration of numerical tools (web services), grid/cloud access (web services), optimisation and system identification strategies in grid/cloud, modelling strategies for holistic engineering problems. On completion of the module students can take a holistic approach to complex engineering problems. They take a more holistic approach to problem modelling and break them into sub-problems in order to identify suitable software tools and their interaction thus establishing and using the most appropriate integrated information and simulation system for analysis, optimisation for different aspects and system identification, e.g., for structural health monitoring.	
types of teaching and learning	2 SWS* lecture and 1 SWS tutorial and also self-study	
prerequisites for participation	The competencies covered in modules BIWO-03 and BIWO-05 are prerequisite to this module.	
usability	The module is one of the required elective modules in the Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS of which students must choose seven.	
requirements for earning for being awarded credits	Students earn credits after having passed the module exam. The module exam consists of a written exam (90 min.).	
credits and grades	Students can earn 4 credit points through the module. The module grade is equivalent to the grade given for the written exam.	
availability of the module	The module is offered each summer semester.	
workload	total workload 120 hours	
duration of the module	1 semester	
module reading list	Chuck Eastman: BIM Handbook, Wiley, 2011	

module no.	module name	responsible lecturer
BIWE-14	Material Models for Soils	Prof. Herle
contents and qualifications	content of the module: essential aspects of soil mechanics, linear and nonlinear elasticity, perfect plasticity, boundary stress conditions, critical states, Cam clay models and hypoplasticity. On completion of the module students will be able to use material models for soils for advanced geotechnical analyses.	
types of teaching and learning	2 SWS* lecture and 1 SWS tutorial and also self-study	
prerequisites for participation	The competencies covered in modules BIWO-02 and BIWO-05 are prerequisite to this module.	
usability	The module is one of the required elective modules in the Master's programme Advanced Computational and Civil Engineering Structural Studies – ACCESS of which students must choose seven.	
prerequisites for earning credits	Students earn credits after having passed the module exam. The module exam consists of a written exam (90 minutes) and an ungraded assigned paper with a total of 30 hours.	
credits and grades	Students can earn 4 credit points through the module. The module grade is equivalent to the grade earned for the written exam if the assigned paper rated 'pass'. Otherwise, the module grade is the weighted average of the grade for the written exam and grade 5 for the assigned paper (§ 10 par. 1 sentence 5 PO); the weighting factors applied to the written exam and the assigned paper are two and one, respectively.	
frequency of the module	The module is offered each summer semester.	
workload	total workload 120 hours	
duration of the module	1 semester	
module reading list	D. Muir Wood: Geotechnical Modelling D. Muir Wood: Soil Behaviour and Critical State Soil Mechanics	