Preface

The module handbook is the document in which important additional information about the studies is described. The general rules from the examination regulation (s. https://www.sle.kit.edu/imstudium/master-engineering-structures.php, in German) and the structure of the program are specified by the curriculum (Part I). The main function of the Module Handbook is the compilation of the module descriptions (Part II) and the learning controls (Part III).

In addition to the module handbook information about the execution of the single courses is collected within the course catalog (online). Information about the examinations is provided by the self-service function for students. This information is also announced by postings and web pages of the institutes.
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- Basics of Prestressed Concrete - T-BGU-100019
- Bracing and Stability in Reinforced Concrete - T-BGU-100018
- Brownfield Sites - Investigation, Evaluation, Rehabilitation - T-BGU-100089
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- Building Preservation of Steel and Timber Structures - T-BGU-100027
- Building Technology - T-BGU-100040
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- Contact Mechanics - T-BGU-109947
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- Dynamics of Structures - T-BGU-100077
Part I
Curriculum

1 Curriculum

In the section ‘Curriculum’ rules in addition to the examination regulation (ER/SPO) and the amendments to this are declared. These can be found on

(2013 KIT 029 Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudienengang Funktionaler und konstruktiver Ingenieurbau – Engineering Structures, vom 30.08.2013; in German)

(2014 KIT 019 Satzung zur Umsetzung des Übereinkommens über die Anerkennung von Qualifikationen im Hochschulbereich der Europäischen Region vom 11. April 1997 gemäß §§ 32 Abs. 2, 4 und 36a LHG in den Studien- und Prüfungsordnungen am KIT, vom 28.03.2014; in German)

1.1 Objectives of the master degree program

The graduates of the master degree program ‘Funktionaler und Konstruktiver Ingenieurbau - Engineering Structures’ at Karlsruhe Institute of Technology (KIT) augmented their scientific qualifications in the fields construction engineering, building material technology and geotechnics obtained in the bachelor degree program by profound and in-depth knowledge oriented towards the national and international demand in science and practice.

The graduates can collect, analyze, interpret and evaluate relevant information from different sources problem-oriented and take positions and make decisions based on this. They are able to extend their knowledge and skills by themselves and to configure further learning processes. They learned to discuss knowledge from their own fields of expertise with colleagues, to present them to an academic audience or to explain them in a non-technical way, to take exposed responsibility within a team, to lead a team and collaborators and to mobilize the skills of others or to motivate others respectively.

They can develop ideas and solutions for principle or also unusual problems, conduct research and demonstration projects mostly self-reliantly, to work out and on scientific problems by themselves and conduct the critical analysis, development and synthesis of novel and complex ideas.
1.2 Structure of the master degree program

The master degree program ‘Funktionaler und Konstruktiver Ingenieurbau - Engineering Structures’ comprises 120 credit points (CP). It is subdivided into a **Compulsory Block** (30 CP), a **Compulsory Elective Block** (42 CP), an **Elective Block** including **Key Competencies** (18 CP) and the preparation of the **Master Thesis** (30 CP).

In accordance to the different characteristics of the professional profile the following study profiles are defined:

I Construction Engineering  
II Modelling and Simulation in Construction Engineering  
III Building Preservation, Building Materials and Building Physics  
IV Geotechnics

The focus of the respective profile on a specific field is defined by the assigned modules (s. Tab. 1-4). For every profile five specific **compulsory modules** are defined as Compulsory Block. The Compulsory Elective Block is characterized by the module catalog of each profile with the **compulsory elective modules**. All modules in the master degree program are integrated into these study profiles and comprise 6 CP. Several modules are assigned to several profiles.
1.2.1 Profile 'Construction Engineering' (P1)

The graduates of the qualification profile 'Construction Engineering' can apply their scientifically sound knowledge about material behavior, particularly of concrete, steel and timber, to the dimensioning and constructive design of all kinds of structures and structural component connections. They are able to use and develop further the available models (analytical and numerical solution methods as well as their error analysis).

Table 1: Modules in Profile Construction Engineering

<table>
<thead>
<tr>
<th>Code (engi)</th>
<th>Name</th>
<th>Module</th>
<th>CP</th>
<th>Name (Language)</th>
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<th>Type</th>
<th>HpW / SWS</th>
<th>LC Type</th>
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<td>M102: Bracing and Stability in Reinforced Concrete (p. 33)</td>
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<td>wE</td>
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<td>ngA wE</td>
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* compulsory elective modules

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<td>M702: Earthworks and Foundation Engineering (#) (p. 57)</td>
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*) Practical course Dynamics of Structure recommended as supplementary additional accomplishment
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<td>L/E</td>
<td>2/2</td>
<td>ngA oE</td>
<td>2 4</td>
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<td>FE-Applications in Practical Engineering (G)</td>
<td>L/E</td>
<td>2/2</td>
<td>oE</td>
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### Table 1: Modules in Profile Construction Engineering (continued)

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<th>Code (engi)</th>
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<th>Type</th>
<th>HpW / SWS</th>
<th>LC Type</th>
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<tr>
<td>M404:</td>
<td>Shell Structures and Stability of Structures (p. 97)</td>
<td>6</td>
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<td>ngA 5) 2</td>
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<td></td>
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<td></td>
<td>oE 6</td>
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<td>Numerical Methods in Structural Analysis (p. 88)</td>
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<td>oE 6</td>
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<td>oE 6</td>
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<td>oE 6</td>
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<td>M707:</td>
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<td>Foundations and Retaining Structures (G)</td>
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**Explanations to Table 1:**

**General:**
- **LC:** learning control
- **CP:** credit point
- **HpW:** hours per week
- **W / S:** winter term / summer term
- **G / E:** language German / English

1.) The registration for module M202, M301 and M702 or M715 (alternatively) is also mandatory in Profile Construction Engineering and compulsory elective modules can only be exchanged for those in agreement with the mentor.

2.) Starting the module in summer term (S) is recommended.

3.) Module must not be selected together with module M715.

4.) Module must not be selected together with module M702 or module M707 and not as supplementary module.

**Type of course:**
- **L:** lecture
- **L/E:** lecture and exercise, separate or integrated

**Type of learning control:**
- **wE:** written examination
- **oE:** oral examination
- **EoT:** examination of other type
- **ngA:** not graded accomplishment
- **ngA 5):** not graded accomplishment as prerequisite for admission to examination

---

Engineering Structures (M.Sc.), ER/SPO 2013
Module handbook Summer term 2019, as at 03/27/2019
1.2.2 Profile 'Modelling and Simulation in Construction Engineering' (P2)

The graduates of the qualification profile 'Modelling and Simulation in Construction Engineering' are scientifically sound able to develop theoretical-numerical modeling and simulation techniques for complex and innovative problems in construction engineering and to apply these. This comprises extensive knowledge about modern simulation techniques (particularly finite element methods) for the numerical analysis of engineering problems which includes a mechanic/static description of non-linear material behavior in construction, the complex static and dynamic load-bearing behavior of structures as well as structural-physical processes.

Table 2: Modules in Profile Modelling and Simulation in Construction Engineering

<table>
<thead>
<tr>
<th>Code (engi)</th>
<th>Name</th>
<th>Course</th>
<th>Type</th>
<th>Cp</th>
<th>Name (Language)</th>
<th>Type</th>
<th>HpW / SWS</th>
<th>LC Type</th>
<th>Cp</th>
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<tr>
<td>M101:</td>
<td>Design and Construction of Components in Reinforced Concrete (p. 54)</td>
<td>6</td>
<td>Design and Construction of Components in Reinforced Concrete (G)</td>
<td>L/E</td>
<td>2/2</td>
<td>ngA wE</td>
<td>2</td>
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</tr>
<tr>
<td>M401:</td>
<td>Non-linear Analysis of Beam Structures (p. 85)</td>
<td>6</td>
<td>Non-linear Analysis of Beam Structures (G)</td>
<td>L/E</td>
<td>2/2</td>
<td>wE</td>
<td>6</td>
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<tr>
<td>M601:</td>
<td>Surface Structures and Dynamics of Structures (p. 107)</td>
<td>6</td>
<td>Surface Structures (G)</td>
<td>L</td>
<td>2</td>
<td>ngA wE</td>
<td>1</td>
<td>2</td>
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</tr>
<tr>
<td></td>
<td>Dynamics of Structures*) (G)</td>
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<td>Dynamics of Structures*) (G)</td>
<td>L</td>
<td>2</td>
<td>ngA wE</td>
<td>1</td>
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<td>M501:</td>
<td>Basics of Finite Elements (p. 28)</td>
<td>6</td>
<td>Basics of Finite Elements (G)</td>
<td>L/E</td>
<td>2/2</td>
<td>ngA oE</td>
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<td>M402:</td>
<td>Computational Analysis of Structures (p. 40)</td>
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<td>Computational Analysis of Structures (G)</td>
<td>L/E</td>
<td>2/2</td>
<td>ngA 4) oE</td>
<td>2</td>
<td>4</td>
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</table>

sum compulsory modules | 30 |
compulsory elective modules | 16 |

*) Practical course Dynamics of Structure recommended as supplementary additional accomplishment
### Table 2: Modules in Profile Modelling and Simulation in Construction Engineering (continued)

<table>
<thead>
<tr>
<th>Code (engi)</th>
<th>Name</th>
<th>CP</th>
<th>Course</th>
<th>Type</th>
<th>HpW / SWS</th>
<th>LC Type</th>
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<td>M404:</td>
<td>Shell Structures and Stability of Structures (p. 97)</td>
<td>6</td>
<td>Shell Structures (G)</td>
<td>L/E</td>
<td>1/1</td>
<td>oE 4</td>
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<tr>
<td></td>
<td>Stability of Structures (G)</td>
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<td>ngA 4)</td>
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<td>2/2</td>
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<td>M406:</td>
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<td>L/E</td>
<td>2/2</td>
<td>oE 6</td>
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<td>M502:</td>
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<td>Fracture and Damage Mechanics (G)</td>
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<td>2/2</td>
<td>oE 6</td>
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<td>M503:</td>
<td>Material Models in Solid Mechanics (p. 77)</td>
<td>6</td>
<td>Material Models in Solid Mechanics (G)</td>
<td>L/E</td>
<td>2/2</td>
<td>oE 6</td>
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<td>M507:</td>
<td>Continuum Mechanics of Heterogeneous Solids1, 2) (p. 50)</td>
<td>6</td>
<td>Continuum Mechanics (G)</td>
<td>L</td>
<td>2</td>
<td>oE 3</td>
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|            | Micromechanics of Heterogeneous Solids (G) | | | | | ngA | 4)
| M513:      | Numerical Structural Dynamics (p. 92) | 6 | Numerical Structural Dynamics (G) | L/E | 4 | oE 6 | |
| M514:      | Modelling in Solid Mechanics (p. 82) | 6 | Modelling in Solid Mechanics (G) | L/E | 4 | oE 6 | |
| M515:      | Contact Mechanics3) (p. 45) | 6 | Contact Mechanics (G) | L/E | 2/2 | oE 6 | |
| sum compulsory elective modules | | 102 | | | | 30 | 38 |

**Explanations to Table 2:**

**General:**
- LC: learning control
- CP: credit point
- HpW: hours per week
- W / S: winter term / summer term
- G / E: language German / English

**Type of Course:**
- L: lecture
- L/E: lecture and exercise, separate or integrated

**Type of Learning Control:**
- wE: written examination
- oE: oral examination
- EoT: examination of other type
- ngA: not graded accomplishment
  - ngA 4): not graded accomplishment as examination prerequisite

1) Starting the module in winter term (W) is recommended.
2) Module must not be selected together with module M704.
3) Module is newly offered as from winter term 2019/20.
1.2.3 Profile 'Building Preservation, Building Materials and Building Physics' (P3)

The graduates of the qualification profile 'Building Preservation, Building Materials and Building Physics' can apply their scientifically sound knowledge about material behavior, particularly of concrete, steel and timber, to problems of building preservation. Based on their extensive knowledge of the relevant causes and procedures of damaging processes at concrete, masonry, steel and timber constructions as well as deepened knowledge of the theoretical principles of structural-physical processes they are able to work independently on concept of preservation, strengthening and reinforcement as well as restoration proposals considering energetic and building technology related, structural-physical and building materials related conditions as well as relevant regulations.

Table 3: Modules in Profile Building Preservation, Building Materials and Building Physics

<table>
<thead>
<tr>
<th>Code (engi)</th>
<th>Module</th>
<th>CP</th>
<th>Name (Language)</th>
<th>Course Type</th>
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<td>M109:</td>
<td>Building Preservation of Concrete and Masonry Constructions (p. 36)</td>
<td>6</td>
<td>Protection, Rehabilitation and Reinforcement of Concrete and Masonry Constructions (G)</td>
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<td>ngA oE</td>
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<td>Preservation of Steel Structures (G)</td>
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<td>Preservation of Timber Structures (G)</td>
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<td>Design and Construction of Components in Reinforced Concrete #) (p. 54)</td>
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<td>Design and Construction of Components in Reinforced Concrete (G)</td>
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<td>ngA wE</td>
<td>1  2</td>
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<td>Dynamics of Structures*) (G)</td>
<td>L</td>
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*) Practical course Dynamics of Structure recommended as supplementary additional accomplishment
### Table 3: Modules in Profile Building Preservation, Building Materials and Building Physics (continued)

<table>
<thead>
<tr>
<th>Code (engi)</th>
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<th>Type</th>
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<td>Computational Analysis of Structures (G)</td>
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<td>ngA</td>
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<td>M401:</td>
<td>Non-linear Analysis of Beam Structures (p. 85)</td>
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<td>Non-linear Analysis of Beam Structures (G)</td>
<td>L/E</td>
<td>2/2</td>
<td>wE</td>
<td>6</td>
</tr>
<tr>
<td>M503:</td>
<td>Material Models in Solid Mechanics (p. 77)</td>
<td>6</td>
<td>Material Models in Solid Mechanics (G)</td>
<td>L/E</td>
<td>2/2</td>
<td>oE</td>
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<td>M501:</td>
<td>Basics of Finite Elements (p. 28)</td>
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<td>Basics of Finite Elements (G)</td>
<td>L/E</td>
<td>2/2</td>
<td>oE</td>
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<td>M111:</td>
<td>Building Physics II (p. 35)</td>
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<td>Practical Noise Control (G)</td>
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<td>EoT</td>
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<td>M108:</td>
<td>Durability and Service Life Design (p. 56)</td>
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<td>Corrosion Processes and Life Time (G)</td>
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<td>oE</td>
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<td>M112:</td>
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<td>Measuring Techniques in Civil Engineering (G)</td>
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<td>oE</td>
<td>6</td>
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<td></td>
<td>Materials Testing in the Field of Concrete (G)</td>
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<tr>
<td>M205:</td>
<td>Glass, Plastic and Cable Structures (p. 69)</td>
<td>6</td>
<td>Glass, Plastic and Cable Structures (G)</td>
<td>L/E</td>
<td>3/1</td>
<td>oE</td>
<td>6</td>
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<tr>
<td>M801:</td>
<td>Upgrading of Existing Buildings and Energetic Refurbishment (p. 116)</td>
<td>6</td>
<td>Upgrading of Existing Buildings (G)</td>
<td>L/E</td>
<td>3</td>
<td>EoT</td>
<td>1.5 4.5</td>
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<td>Energetic Refurbishment (G)</td>
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</tbody>
</table>

**Explanations to Table 3:**

**General:**
- **LC:** learning control
- **CP:** credit point
- **HpW:** hours per week
- **W / S:** winter term / summer term
- **G / E:** language German / English

**Type of course:**
- **L:** lecture
- **L/E:** lecture and exercise, separate or integrated

**Type of learning control:**
- **wE:** written examination
- **oE:** oral examination
- **ngA:** not graded accomplishment
- **ngA 2:** not graded accomplishment as examination prerequisite

**Notes:**
- The registration for module M101 and M302 is also mandatory in Profile Building Preservation, Building Materials and Building Physics and compulsory elective modules can only be exchanged for those in agreement with the mentor.
- Module newly offered as from summer term 2019 within this profile.
1.2.4 Profile 'Geotechnics' (P4)

The graduates of the qualification profile 'Geotechnics' can apply their scientifically sound knowledge about the mechanic-hydraulic behavior of soil and hard rock and the mathematical and physical precise description of material laws, including numerical tools, to planning decisions, dimensioning and constructive design of geotechnical structures in foundation engineering and tunneling. They are able to select critically and evaluate the relevant construction methods of special underground engineering as well as the often used construction materials (concrete, steel, foundation improving materials and geosynthetics) under consideration of relevant regulations, construction management organization, economics and long-term performance with orientation to problem solutions.

Table 4: Modules in Profile Geotechnics

<table>
<thead>
<tr>
<th>Code (engi)</th>
<th>Module</th>
<th>CP</th>
<th>Name (Language)</th>
<th>Course</th>
<th>Type</th>
<th>HpW / SWS</th>
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</tr>
<tr>
<td>M701: Theoretical Soil Mechanics (p. 111)</td>
<td>6</td>
<td>Theoretical Soil Mechanics (G)</td>
<td>L/E</td>
<td>4</td>
<td>wE</td>
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</tr>
<tr>
<td>M702: Earthworks and Foundation Engineering³ (#) (p. 57)</td>
<td>6</td>
<td>Foundation Types (G)</td>
<td>L/E</td>
<td>2</td>
<td>ngA wE</td>
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<tr>
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<td></td>
<td>Basics in Earthworks and Embankment Dams (G)</td>
<td>L/E</td>
<td>2</td>
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<td>M703: Rock Mechanics and Tunnelling (p. 95)</td>
<td>6</td>
<td>Basics in Rock Mechanics (G)</td>
<td>L/E</td>
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<td>L/E</td>
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<td>M704: Basics in Numerical Modelling¹ (p. 30)</td>
<td>6</td>
<td>Continuum Mechanics (G)</td>
<td>L</td>
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<td>oE</td>
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<td></td>
<td>3</td>
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<tr>
<td>M101: Design and Construction of Components in Reinforced Concrete (p. 54)</td>
<td>6</td>
<td>Design and Construction of Components in Reinforced Concrete (G)</td>
<td>L/E</td>
<td>2/2</td>
<td>ngA wE</td>
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compulsory elective modules

<table>
<thead>
<tr>
<th>Code (engi)</th>
<th>Module</th>
<th>CP</th>
<th>Name (Language)</th>
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<th>HpW / SWS</th>
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<tr>
<td>M705: Special Issues of Soil Mechanics (p. 100)</td>
<td>6</td>
<td>Unsaturated, Viscous and Cyclic Soil Behaviour - Theory and Element Tests (G)</td>
<td>L/E</td>
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<td>oE</td>
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<td>Soil Dynamics (G)</td>
<td>L/E</td>
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<tr>
<td>M706: Ground Investigation (p. 71)</td>
<td>6</td>
<td>Soil Mechanical Laboratory Exercises (G)</td>
<td>E</td>
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<td>M707: Applied Geotechnics (p. 26)</td>
<td>6</td>
<td>Foundations and Retaining Structures (G)</td>
<td>L/E</td>
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<td>M708: Ground Water and Earth Dams (p. 72)</td>
<td>6</td>
<td>Geotechnical Ground Water Problems (G)</td>
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<td>oE</td>
<td>6</td>
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<td>Embankment Dams (Advanced) (G)</td>
<td>L/E</td>
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### Table 4: Modules in Profile Geotechnics (continued)

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<tr>
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<tbody>
<tr>
<td>M709: Rock Engineering and Underground Construction (p. 93)</td>
<td>6</td>
<td>Aboveground Rock Engineering (G)</td>
<td>L/E</td>
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<td>Tunnel Construction in Soils and in Existence (G)</td>
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<tr>
<td>M710: Numerical Modelling in Geotechnics (p. 90)</td>
<td>6</td>
<td>Exercises in Numerical Modelling (G)</td>
<td>E</td>
<td>2</td>
<td>wE</td>
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<tr>
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<td>FEM Applications in Geotechnical Modelling (G)</td>
<td>L/E</td>
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<td></td>
</tr>
<tr>
<td>M711: Geotechnical Testing and Measuring Technology (p. 67)</td>
<td>6</td>
<td>Rock Testing (G)</td>
<td>L</td>
<td>1</td>
<td>oE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Testing in Dam and Wastefill Engineering (G)</td>
<td>L</td>
<td>1</td>
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<tr>
<td></td>
<td></td>
<td>Geotechnical Measuring Technology (G)</td>
<td>L/E</td>
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<tr>
<td>M712: Special Underground Engineering (p. 101)</td>
<td>6</td>
<td>Ground Improvement, Grouting and Soil Freezing (G)</td>
<td>L/E</td>
<td>2</td>
<td>oE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anchoring, Piling and Slurry Wall Technology (G)</td>
<td>L/E</td>
<td>2</td>
<td>oE</td>
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<tr>
<td>M713: Environmental Geotechnics (p. 59)</td>
<td>6</td>
<td>Landfills (G)</td>
<td>L/E</td>
<td>2</td>
<td>oE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brownfield Sites – Investigation, Evaluation, Rehabilitation (G)</td>
<td>L</td>
<td>2</td>
<td>oE</td>
</tr>
<tr>
<td>M714: Coupled Geomechanical Processes (p. 52)</td>
<td>6</td>
<td>Special Issues in Rock Mechanics (G)</td>
<td>L/E</td>
<td>2</td>
<td>oE</td>
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<tr>
<td></td>
<td></td>
<td>Coupled Phenomena in Geomechanics (G)</td>
<td>L/E</td>
<td>2</td>
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<tr>
<td><strong>sum compulsory elective modules</strong></td>
<td><strong>60</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**sum compulsory elective modules**: 60

**explanations to Table 4:**

- **general:**
  - LC: learning control
  - CP: credit point
  - HpW: hours per week
  - W / S: winter term / summer term
  - G / E: language German / English
  - Module must not be selected together with module M507.

- **type of course:**
  - L: lecture
  - L/E: lecture and exercise, separate or integrated
  - E: exercise

- **type of learning control:**
  - E: written examination
  - oE: oral examination
  - ngA: not graded accomplishment
1.3 Mentoring, module selection, individual curriculum

The selection options within the study require that each student compiles an individual curriculum. This comprises the selection of one of the four profiles with the respective modules and the selection of the modules within the Supplementary Studies (supplementary modules). This selection has to be supervised by a mentor chosen by the student. The mentor has to be a professor of the KIT-Department Civil Engineering, Geo and Environmental Sciences and to be involved with one module in one of the selected profile.

By selection of the profile the five compulsory modules are determined. Within the compulsory elective block of the selected profile seven compulsory elective modules have to be taken from the respective module catalog (s. Tab. 1-4).

Within the elective block two additional specialized modules have to be selected freely from the master degree program ‘Funktionaler und Konstruktiver Ingenieurbau - Engineering Structures’ or any related one respectively.

The module Key Competencies (S. 75, comp. also ER/SPO § 14) is composed by the student herself or himself respectively with an extent of 6 CP from the respective offering of the KIT House of Competence (HoC) or the Centre for Cultural and General Studies (ZAK). In special cases the examination committee can accept further suitable courses as key competencies which are not included in the offers of HoC and ZAK as mentioned above. The module Key Competencies is completed without grade. After consultation with the lecturer a grade can be reported but is not included in the general grade.

For the selection of modules in the profiles and in the supplementary studies the form for module selection available on the web page of the Examination Committee Master, https://www.tmb.kit.edu/PAM.php, has to be completed, to be signed by student and mentor and to be transferred by the mentor to the study program coordinator (s. p. 22) to be stored in the Campus Management System. The module selection shall be stored there in time to register for the exams in the first semester of the master degree program (comp. ER/SPO § 19 Par. 4), so that the management of the examinations (registration, deregistration if applicable, result booking etc.) can be processed smoothly. The individual curriculum can be viewed any time via the portal Campus Management for Students, https://campus.studium.kit.edu.

The selection of the modules have to be made with care. On the one hand, the assignment of the modules to the respective part of the program, Profile Study or Supplementary Study respectively, will be transferred to the master degree certificate. On the other hand, changes of the module selection has to be agreed by the selected mentor and should be limited to exceptional cases, e.g. if a compulsory elective module is not offered at short notice. As far as the respective module is not yet begun, changes of the module selection are generally possible.

1.4 Beginning and completion of a module

Every module and every examination is allowed to be credited only once (comp. ER/SPO § 7 Par. 5). The binding decision whether a module is selected is made by the student at the time of registering for the corresponding examination, also partial examination (comp. ER/SPO § 5 Par. 2). The student can reset this binding selection by deregistration in time. After attendance of the examination, especially of a partial examination, a module cannot be replaced by another one any more. By request to the examination committee the assignment can be changed.

A module is completed if the general examination of the module has been passed (grade min. 4.0). In case that the module examination consists of several partial examinations, it holds: The module is completed if all partial examinations are passed (grade min. 4.0) so that the minimum requirement of credits of this module have been met.

1.5 Registration, deregistration, repetition of examinations

The registration to examinations, also to not graded accomplishments and examination prerequisites, takes place online via the portal Campus Management for Students, https://campus.studium.kit.edu. The following functions can be accessed there after login:

- register to and deregister from examinations
- retrieve examination results
- print transcript of records

A successful online registration covers the admission to the examination. A confirmation for this is provided by the portal Campus Management for Students and can serve as proof for a made registration in case of doubts. If there occurs a problem with an attempt of an online registration the study program coordinator (s. p. 22) has to be informed as soon as possible in addition to the examiner. In case of an oral examination the online registration is to be combined directly with the negotiation of an examination date with the examiner.

A registered examination is either to be taken or a deregistration has to be made in advance to the deadline of deregistration. In particular, this is valid if e.g. the date of on oral examination is shifted to the next semester because the management of the examinations has to be made in terms of the semester. The rules for the deregistration from an examination are given by the ER/SPO § 9 Par. 1.
Principally, a failed examination can be repeated once, latest by the end of the examination period of the next but one semester to this examination (comp. ER/SPO § 8). If failing a written repeat examination an oral repeat examination can be taken. This is part of the repeat examination and will not be evaluated independently. After an oral repeat examination the overall grade of the repeat examination is determined, either grade 4.0 (passed) or grade 5.0 (failed).

If the repeat examination (including an oral repeat examination) will be failed as well, the examination claim is lost. A potential request for a second repetition has to be made without delay after loosing the examination claim. Requests for a second repetition of an examination require the approval of the examination committee. A counseling interview is mandatory.

In addition, every student has the opportunity to take immediately an additional oral examination after the attendance at the first written examination after the announcement of the results. Further information is available in the examination regulation (ER/SPO, http://www.sle.kit.edu/imstudium/master-engineering-structures.php) and from the Examination Committee Master or the ‘Fachschaft’ (student council) (s. p. 22).

1.6 Students with disability or chronic disease

Students with disability or chronic disease have the opportunity, by request to the examination committee, to get preferred access to participation limited courses, to adapt the order of taking certain courses to their requirements, or to take examinations of single modules in individually arranged form or period. The student has to present the respective attests.

The examination committee defines in agreement with the examiner the details for the respective examination and informs the student in time.

1.7 Crediting and recognition of already obtained accomplishments

Already obtained accomplishments can by recognized generally under the conditions of the ER/SPO (s. Änderungssatzung from 28.03.2014 Artikel 45 § 18, in German). The recognition has to be made with the respective recognition form of the Examination Committee Master (https://www.tmb.kit.edu/PAM.php). There, it has to be stated unambiguously at which place in the curriculum the recognized accomplishment has to be credited.

If the accomplishments are mainly identical with modules from the curriculum (name, objectives, content) this is confirmed on the form by the respective lecturer.

If the accomplishments are not identical with modules from the curriculum they can be recognized as well, if the obtained competences contribute to achieve the qualification goals of the study program. These are included into the individual curriculum in agreement with the mentor. The recognition is made by the Examination Committee Master. Usually, modules in extent of 12 CP at maximum can be credited as supplementary modules in this way. Additional credit points get lapsed.

The recognition of accomplishments obtained outside of the higher education system is made also with the respective recognition form of the Examination Committee Master (https://www.tmb.kit.edu/PAM.php). A recognition is possible if the obtained competences contribute to achieve the qualification goals of the study program. The Examination Committee Master examines in which extent the obtained knowledge and skills can be recognized and which parts of the higher education study can be replaced by them. It is allowed to replace not more than 50 % of the higher education study. These are included in the individual curriculum in agreement with the mentor.

The recognition form has to be submitted to the Examination Committee Master which transfers it for booking the accomplishments. Further information about recognitions can be found on the web page of the Examination Committee Master (https://www.tmb.kit.edu/PAM.php).

1.8 Admission, preparation and completion of the master thesis

The Master Thesis has to be prepared usually in semester 4 (p. 84, comp. also ER/SPO § 12). The topic of the master thesis has to be assigned by a professor of the Department of Civil Engineering. The wishes of the students may be respected when formulating the topic. In case that the master thesis shall be prepared outside of KIT the leaflet ‘Merkblatt - Externe Abschlussarbeiten’ (http://www.haa.kit.edu/downloads/KIT_ALLGEMEIN_Merkblatt_Externe_Abschlussarbeiten.pdf) has to be considered.

Those are admitted to the master thesis who has passed successfully modules of extent of minimum 42 CP within the master program ‘Funktionaler und Konstruktiver Ingenieurbau – Engineering Structures’. Obtained results in the module Key Competencies cannot be counted for this purpose. The application for admission has to be made online via the portal Campus Management for Students three months after passing the last module examination at latest. The admission to the master thesis is made by the study program coordinator (s. p. 22) after approval of the prerequisites, e.g. by submitting an up to date transcript of records. The registration for the master thesis is made at the ‘Studierendenservice’ (students’
service) with the form http://www.sle.kit.edu/downloads/Sonstige/Pruefungszulassung-Abschlussarbeit.pdf.
The duration of preparation is six months. The master thesis can be written in English. It has to be completed by a presentation that is considered in the grading within one month after submission. It is very much recommended to have gained already all technical and soft skills required for the preparation of the topic of the master thesis before beginning the thesis project.

1.9 Additional accomplishments

An additional accomplishment is a voluntarily taken examination, which is not considered in the overall grade (comp. ER/SPO § 13). In total, additional accomplishments can be taken in extent of 30 CP at maximum from the entire offer of KIT.

An additional accomplishment has to be admitted as such by the Study Program Service of the department (‘Studienangservice Bau-Geo-Umwelt’; s. p. 22) with the examination form available there. It cannot be credited subsequently as compulsory or compulsory elective module. The respective examination form has to be delivered to the examiner as registration and for the transfer of the obtained grade within the registration period.

All taken additional accomplishments are listed in the transcript of records. If a module is completed by the taken additional accomplishments this module can be included in the master degree certificate as additional module on request by the student at the Study Program Service (‘Studiengangservice Bau-Geo-Umwelt’, s. p. 22). By this, three modules at maximum with an extent of at least 6 CP can be included in the master degree certificate. This applies also to additional accomplishments which were recognized by the examination committee.
2 Further information

2.1 About the module handbook . . .

The module handbook is the relevant document in which the structure of the program is described and therefore it provides assistance for the orientation during the study. It describes the modules belonging to the program and contains information about:

- the structure of the modules,
- the extent of the modules (in CP),
- the interdependencies of the modules,
- the learning outcomes of the modules,
- the type of assessment and examinations,
- the computation of the grade of the module and
- the placement of the module in the course of study.

Each module consists of one or more interrelated courses, which are completed by one or more examinations. The extent of each module is characterized by 6 CP, which will be credited after the successful completion of the module. The module handbook provides the necessary information that the students can customize content and time schedule of the interdisciplinary study according to personal needs, interest and job perspective.

In addition to the module handbook the course catalog and the institutes (web pages) provide important information. These are updated every semester concerning variable course details (e.g. time and location of the course) as well as short-term modifications.

2.2 About module examinations, examination committee . . .

The module examinations can be taken as a general examination or as several partial examinations. If the module examination is offered as a general examination, the entire content of the module will be reviewed in a single examination. If the module examination consists of partial examinations, the content of each course will be reviewed in corresponding partial examinations. Then the module examination can be taken over several semesters. Also not graded accomplishments can be part of the module examination, e.g. as examination prerequisites.

The Examination Committee Master (https://www.tmb.kit.edu/PAM.php) is responsible for all legal questions in the context of examinations. For instance, all requests on second repetition, extension of deadlines or recognitions are submitted to this. It decides about their approval.

2.3 About changes in module offer . . .

The offer of modules changes in the course of the semesters. Modules can be discontinued or added or the module examination may change. If possible, such changes are announced in the module handbook with sufficient time in advance, at latest at the beginning of the semester as from they are valid (s. p. 23).

Usually, it is valid that students started a module (s. selection and completion of a module) can complete this in that form as started. The respective examinations are provided onwards over a certain time period usually at least one semester after time of change. In general, a consultation with the examiner is recommended in such a case.
2.4 Contact persons

Dean of Study Affairs:
Prof. Dr. Peter Vortisch
Institute for Transport Studies, Bldg. 10.30, R. 305
consultation: on appointment
Phone: 0721/608-42255
Email: peter.vortisch@kit.edu

Study Program Coordination:
PD Dr. Ulf Mohrlok
Department of Civil Engineering, Geo and Environmental Sciences, Bldg. 10.81, R. 329
consultation: on appointment
Phone: 0721/608-46517
Email: ulf.mohrlok@kit.edu

Examination Committee Master:
Prof. Dr.-Ing. Kunibert Lennerts (chairperson)
Dr. Gunnar Adams (person in charge)
Institute of Technology and Management in Construction, Bldg. 50.31, R. 005 (ground floor)
consultation: Fr. 14.00 – 15.00 h
Phone: 0721/608-46008
Email: pam@bgu.kit.edu
Web: https://www.tmb.kit.edu/PAM.php

Students’ Advisory Service:
Dr.-Ing. Harald Schneider
Institute of Technology and Management in Construction, Bldg. 50.31, R. 008 (ground floor)
consultation: on appointment
Phone: 0721/608-43881
Email: harald.schneider@kit.edu

Study Program Service ("Studiengangservice Bau-Geo-Umwelt"): 
Department of Civil Engineering, Geo and Environmental Sciences, Bldg. 10.81, R. 312
Email: studiengangservice@bgu.kit.edu
Web: http://www.bgu.kit.edu/studiengangservice.php

Fachschaft:
Students in Civil Engineering
Bldg. 10.81 (Altes Bauing. Geb.), R. 317.1 (3rd floor)
consultation: s. http://www.fs-bau.kit.edu
Phone: 0721/608-43895
Email: fsbau@lists.kit.edu
Web: http://www.fs-bau.kit.edu

2.5 Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>English</th>
<th>German</th>
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<tr>
<td>LP/CP</td>
<td>credit points</td>
<td>Leistungspunkte</td>
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<td>course</td>
<td>Lehrveranstaltung</td>
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<td>P</td>
<td>practical training</td>
<td>Praktikum</td>
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<tr>
<td>S</td>
<td>seminar / summer term</td>
<td>Seminar / Sommersemester</td>
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<td>Semester</td>
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<td>Studien- und Prüfungsordnung</td>
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<td>L/V</td>
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<td>Vorlesung</td>
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<tr>
<td>W</td>
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<td>Wintersemester</td>
</tr>
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</table>
3 Current changes

In the following, the important changes are listed as from summer term 2019. Although this process was done with great care, other/minor changes may exist.

modules not offered any more as from summer term 2019:

- Contact Mechanics - Fundamentals and Basics [engiM510-KONTMECH-BASICS]
- Contact Mechanics - Computational Algorithms in a geometrically exact Form [engiM511-KONTMECH-ALGOR]

modules offered newly as from winter term 2019/20:

- Contact Mechanics [engiM515-KONTMECH], replaces modules
- Contact Mechanics - Fundamentals and Basics [engiM510-KONTMECH-BASICS] and Contact Mechanics - Computational Algorithms in a geometrically exact Form [engiM511-KONTMECH-ALGOR]
- Glass, Plastic and Cable Structures [engiM205-GlaKunSe], additionally selectable in the Profile Building Preservation, Building Materials and Building Physics
- Upgrading of Existing Buildings and Energetic Refurbishment [engiM801-], newly selectable in the Profile Building Preservation, Building Materials and Building Physics and as additional specialized module in the elective block

changed examinations and not graded accomplishments as from summer term 2019:

- All not graded accomplishments are assigned with credit points. Therefore, the credit points of the examinations are adapted.

  Basics of Finite Elements [engiM501-GRUNDFE]:
  The not graded accomplishment 'Homework Basics of Finite Elements' is additional part of the module.

  Building Physics II [engiM111-BAUPH-II]:
  The partial examination 'Homework Practical Noise Control' consists of an examination of other type and is additional part of the module.
Part II

Modules

Module: Anchorage in Concrete (engiM106-BEFTech) [M-BGU-100001]

Responsibility: Lothar Stempniewski
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering

<table>
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<tr>
<td>6</td>
<td>Each summer term</td>
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Compulsory

Identifier: ‘Teilleistung’ CP Responsibility

T-BGU-100022 Anchorage in Concrete (S. 118) 6 Lothar Stempniewski

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013 - term paper (internal) - ‘Teilleistung’ T-BGU-100021 with oral examination according to § 4 Par. 2 No. 2 details about the learning control see at the ‘Teilleistung’

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students can explain the importance of the use of the appropriate anchorage system. Hence, they are able to select it for the specific case and to apply it in an appropriate way.

Content
The anchorage systems relevant for the application in concrete and their load bearing behavior are presented. Furthermore, the importance of appropriate selection and economical design of the systems is explained.

Recommendations
none

Remarks
The term paper is part of the module and is managed internally at the institute.

Literature
Eliehausen, Mallée: ‘Befestigungstechnik im Beton- und Mauerwerksbau’

Workload
contact hours (1 Hpq = 1 h x 15 weeks):
- Anchorage in Concrete I lecture, exercise: 30 h
- Anchorage in Concrete II lecture, exercise: 30 h

independent study:
- preparation and follow-up lectures, exercises Anchorage in Concrete I: 20 h
- preparation and follow-up lectures, exercises Anchorage in Concrete II: 20 h
- preparation of term paper (internal): 20 h
- examination preparation: 60 h

total: 180 h
Module: Applied Dynamics of Structures (engiM105-BAUDYN) [M-BGU-100038]

Responsibility: Lothar Stempniewski

Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften

Curricular Embedding: Compulsory Elective

Contained in: Profile / Construction Engineering

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Compulsory

Identifier 'Teilleistung' CP Responsibility

T-BGU-100021 Applied Dynamics of Structures (S. 121) 6 Lothar Stempniewski

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013

- 'Teilleistung' T-BGU-100021 with oral examination according to § 4 Par. 2 No. 2
details about the learning control see at the ‘Teilleistung’

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students can transfer their basic knowledge of the modules ‘Dynamics’ and ‘Surface Structures and Dynamics of Structures’ to the field of earthquake engineering. By that, the students can evaluate the dynamic behavior of structures in practical application. Based on material science and the modules ‘Geology in Civil Engineering’ and ‘Bracing and Stability in Reinforced Concrete’ the students can describe the basic seismological relationships regarding soil-building-interaction. The students can design basically design structures by impact of earthquake loads.

Content
- basics of dynamics of structures
- man-made excited, machinery excited, wind excited vibrations and counteractions
- basics in earthquake engineering
- presentation of practical relevant calculation methods
- modeling, calculation, designing, and construction of buildings

Recommendations
none

Remarks
none

Literature

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- Applied Dynamics of Structures lecture, exercise: 30 h
- Earthquake Engineering lecture, exercise: 30 h

independent study:
- preparation and follow-up lectures, exercises Applied Dynamics of Structures: 30 h
- preparation and follow-up lectures, exercises Earthquake Engineering: 30 h
- examination preparation: 60 h

total: 180 h
Module: Applied Geotechnics (engiM707-ANGEOTEC) [M-BGU-100072]

Responsibility: Theodoros Triantafyllidis
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering
Profile / Geotechnics

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Compulsory

Identifier ‘Teilleistung’ CP Responsibility
T-BGU-100073 Applied Geotechnics (S. 122) 6 Peter Kudella

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100073 with written examination according to § 4 Par. 2 No. 1
details about the learning control see at the ‘Teilleistung’

Grade of the Module
grade of the module is grade of the exam

Prerequisites
This module must not be selected together with the module Geotechnical Constructions [engiM715-GEOKONSTR].

Modeled Conditions
The following conditions must be met:
- The module [M-BGU-101674] Geotechnical Constructions must not have been started.

Qualification Goals
The students make a self-dependent reasonable design decisions for pile foundations and excavations with regard to geological engineering, site managing and economical boundary conditions. They can assess the interaction of building, foundation and subsoil and can establish simple mechanical models by themself and use numerical tools customary in practice as well. They can describe and use relevant guidelines and can link constructional experience, dimensioning rules and standardization to theoretical knowledge about soil mechanical laws.

Content
see German version

Recommendations
module Earthworks and Foundation Engineering [engiM702-ERDGB]

Remarks
none

Literature
Workload
contact hours (1 HpW = 1 h x 15 weeks):
- Foundations and Retaining Structures lecture/exercise: 30 h
- Special Foundation Engineering and Design lecture/exercise: 30 h
- field trips: 10 h

independent study:
- preparation and follow-up lecture/exercises Foundations and Retaining Structures: 25 h
- preparation and follow-up lecture/exercises Special Foundation Engineering and Design: 25 h
- examination preparation: 60 h

total: 180 h
Module: Basics of Finite Elements (engiM501-GRUNDFE) [M-BGU-100052]

Responsibility: Peter Betsch

Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften

Curricular Embedding: Compulsory Elective

Contained in: Profile / Modeling and Simulation in Construction Engineering
Profile / Building Preservation, Building Materials and Building Physics

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Compulsory

Identifier | ‘Teilleistung’ | CP | Responsibility |
---|---|---|---|
T-BGU-109908 | Homework ‘Basics of Finite Elements’ (S. 159) | 1 | Peter Betsch |
T-BGU-100047 | Basics of Finite Elements (S. 124) | 5 | Peter Betsch |

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-109908 with not graded accomplishment according to § 4 Par. 3
- ‘Teilleistung’ T-BGU-100027 with oral examination according to § 4 Par. 2 No. 2

details about the learning controls see at the respective ‘Teilleistung’

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students can describe the structure and the functionality of FE codes. They can formulate the basics of variational principles of FEM as well as the Lagrangian element family of different order of projection for one-dimensional, planar and spatial problems in the fields of linear strength of materials and heat transport. They know, that it is an approximate solution method for boundary value problems, and they are aware of its limits. They can get familiar quickly with commercial FE codes and can use them reasonably.

Content
The theoretical principles as well as the numerical implementation of Finite Element Methods are covered. The major terms are discussed such as weak form of the boundary value problem, test function, projection function, continuity requirements, domain discretization, Galerkin approximation, stiffness matrix, assembly,iso-parametric concept, numerical integration and accuracy of finite element approximation.

Recommendations
none

Remarks
none

Literature
Workload

contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 60 h

independent study:
- preparation and follow-up lectures, exercises: 45 h
- processing exercises sheets: 30 h
- examination preparation: 45 h

total: 180 h
Module: Basics of Numeric Modeling (engiM704-NUMGRUND) [M-BGU-100070]

Responsibility: Theodoros Triantafyllidis
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Geotechnics

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<td>T-BGU-106196</td>
<td>Continuum Mechanics (S. 138)</td>
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<td>Marlon Franke</td>
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<td>T-BGU-106197</td>
<td>Numerics in Geotechnics (S. 173)</td>
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<td>Andrzej Niemunis</td>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-106196 with oral examination according to § 4 Par. 2 No. 2
- 'Teilleistung' T-BGU-106197 with oral examination according to § 4 Par. 2 No. 2
Details about the learning controls see at the respective 'Teilleistung'

Grade of the Module
grade of the module is CP weighted average of grades of the partial exams

Prerequisites
This module must not be selected together with the module Continuum Mechanics of Heterogeneous Solids [engiM507-KONTIMECH].

Modeled Conditions
The following conditions must be met:
- The module [M-BGU-100064] Continuum Mechanics of Heterogeneous Solids must not have been started.

Qualification Goals
The students are familiar with the general concepts of continuum mechanics and their application to engineering, specifically geotechnical, problems. They know operational methods for the discretization of the typical differential equations. They are able to comprehend the modelling of geomechanical boundary value problems using Finite Difference and Finite Element Methods and to work independently on standard problems. They can assess the failure potential of numerical calculations, select commercial FE-codes reasonably and test and evaluate FE results critically.

Content
see German version

Recommendations
course 'Introduction to Continuum Mechanics' (6200607) or similar basic knowledge

Remarks
none

Literature
Workload

contact hours (1 HpW = 1 h x 15 weeks):

- Continuum Mechanics lecture: 30 h
- Numerics in Geotechnics lecture: 30 h

independent study:

- preparation and follow-up lectures Continuum Mechanics: 15 h
- preparation and follow-up lectures Numerics in Geotechnics: 15 h
- exercises with available software: 30 h
- examination preparation Numerics in Geotechnics (partial exam): 30 h

Total: 180 h
Module: Basics of Prestressed Concrete (engiM103-GDLSAPANBB) [M-BGU-100036]

Responsibility: Lothar Stempniewski

Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften

Curricular Embedding: Compulsory Elective

Contained in: Profile / Construction Engineering

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Compulsory

Identifier ‘Teilleistung’ CP Responsibility
T-BGU-100019 Basics of Prestressed Concrete (S. 125) 6 Lothar Stempniewski

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100019 with written examination according to § 4 Par. 2 No. 1
details about the learning control see at the ‘Teilleistung’

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students know the basics and can reconstruct the functional principle of prestressed concrete. The students can explain the already obtained knowledge in the subjects ‘Strength of Materials’, ‘Structural Analysis’ and ‘Design and Construction of Components in Reinforced Concrete’ and can transfer these to the methods in prestressed concrete. The students are able to conduct design of buildings in structural engineering safely and economically by reference to current standards.

Content
- Types and systems for prestressing
- loss of prestressing forces
- proof in ultimate limit state and in serviceability limit state

Recommendations
module Design and Construction of Components in Reinforced Concrete [engiM101-BEMISTB]

Remarks
none

Literature
lecture notes

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 60 h
independent study:
- preparation and follow-up lectures, exercises: 45 h
- examination preparation: 75 h
total: 180 h
Module: Bracing and Stability in Reinforced Concrete (engiM102-STABISTB) [M-BGU-100003]

Responsibility: Lothar Stempniewski
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering
Profile / Modeling and Simulation in Construction Engineering
Profile / Building Preservation, Building Materials and Building Physics

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Compulsory

Identifier ‘Teilleistung’ CP Responsibility
T-BGU-100018 Bracing and Stability in Reinforced Concrete (S. 126) 6 Lothar Stempniewski

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100018 with written examination according to § 4 Par. 2 No. 1
  details about the learning control see at the ‘Teilleistung’

Grade of the Module
grade of the module is grade of the exam

Prerequisites none

Qualification Goals
Based on the module ‘Basics in Reinforced Concrete’, ‘Design and Construction of Components in Reinforced Concrete’ and cross-cutting modules such as ‘Structural Analysis’ the students can transfer and apply the methods from the module ‘Non-linear Analysis of Beam Structures’ to the subject of reinforced concrete with respect to bracing and stability of buildings. Furthermore, the students can analyse and solve problems in special issues of reinforced concrete. Given problems can be assigned to the respective design problems, be conducted subsequently and the current standards can be applied.

Content
- bracing and stability of buildings
- design of columns
- fire protection, fatigue, determination of stress resultants

Recommendations
course Basics of Reinforced Concrete I (6200601).module Design and Construction of Components in Reinforced Concrete [engiM101-BEMISTB]

Remarks none

Literature lecture notes

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 60 h
independent study:
- preparation and follow-up lectures, exercises: 45 h
- examination preparation: 75 h
total: 180 h
**Module: Building Physics I (engiM110-BAUPH-I) [M-BGU-100059]**

**Responsibility:** Engin Kotan  
**Institution:** KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften  
**Curricular Embedding:** Compulsory Elective  
**Contained in:**  
- Profile / Construction Engineering  
- Profile / Building Preservation, Building Materials and Building Physics

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<td>Engin Kotan</td>
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<td>Building Technology (S. 130)</td>
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<td>Stefan Wirth</td>
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<td>Engin Kotan, Stefan Wirth</td>
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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**
- ‘Teilleistung’ T-BGU-100177 with not graded accomplishment according to § 4 Par. 3  
- ‘Teilleistung’ T-BGU-100039 with oral examination according to § 4 Par. 2 No. 2  
- ‘Teilleistung’ T-BGU-100040 with oral examination according to § 4 Par. 2 No. 2

**Grade of the Module**
Grade of the module is average of grades of the partial exams

**Prerequisites**
none

**Qualification Goals**
see German version

**Content**
see German version

**Recommendations**
none

**Remarks**
none

**Workload**
contact hours (1 HpW = 1 h x 15 weeks):
- Applied Building Physics lecture: 30 h  
- Building Technology lecture: 30 h  

independent study:
- preparation and follow-up lectures Applied Building Physics: 10 h  
- preparation of student research project ‘Building Physics I’ (not graded accomplishment): 40 h  
- examination preparation Applied Building Physics (partial exam): 30 h  
- preparation and follow-up lectures Building Technology: 10 h  
- examination preparation Building Technology (partial exam): 30 h  

total: 180 h
Module: Building Physics II (engiM111-BAUPH-II) [M-BGU-100060]

Responsibility: Engin Kotan
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering
Profile / Building Preservation, Building Materials and Building Physics

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<td>Practical Noise Control (S. 175)</td>
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<td>T-BGU-100042</td>
<td>Practical Fire Protection (S. 174)</td>
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<td>Hermann Schröder</td>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-109946 with examination of other type according to § 4 Par. 2 No. 3
- ‘Teilleistung’ T-BGU-108024 with oral examination according to § 4 Par. 2 No. 2
- ‘Teilleistung’ T-BGU-100042 with oral examination according to § 4 Par. 2 No. 2

details about the learning controls see at the respective ‘Teilleistung’

Grade of the Module
grade of the module is CP weighted average of grades of the partial exams

Prerequisites
none

Qualification Goals
see German version

Content
see German version

Recommendations
none

Remarks
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- Practical Noise Control lecture: 30 h
- Practical Fire Protection lecture: 30 h

independent study:
- preparation and follow-up lectures Practical Noise Control: 15 h
- preparation of Homeworks ‘Practical Noise Control’ (partial exam): 20 h
- examination preparation Practical Noise Control (partial exam): 25 h
- preparation and follow-up lectures Practical Fire Protection: 30 h
- examination preparation Practical Fire Protection (partial exam): 30 h

total: 180 h

Engineering Structures (M.Sc.), ER/SPO 2013
Module handbook Summer term 2019, as at 03/27/2019
Module: Building Preservation of Concrete and Masonry Constructions (engiM109-BBM) [M-BGU-100058]

Responsibility: Engin Kotan
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering
Profile / Building Preservation, Building Materials and Building Physics

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Compulsory

Identifier | 'Teilleistung' | CP | Responsibility
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T-BGU-100175 | Student Research Project 'Building Preservation of Concrete and Masonry Constructions' (S. 188) | 1 | Engin Kotan
T-BGU-100038 | Building Preservation of Concrete and Masonry Constructions (S. 128) | 5 | Engin Kotan

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-100175 with not graded accomplishment according to § 4 Par. 3
- 'Teilleistung' T-BGU-100038 with oral examination according to § 4 Par. 2 No. 2
details about the learning controls see at the respective 'Teilleistung'

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
After successful completion of the module the students have detailed knowledge about the relevant causes and processes of degradation in concrete and masonry constructions. Thus they are able to take appropriate measures to enhance the durability of solid buildings and to plan and execute effective measures to repair damaged concrete and masonry constructions. Moreover the students have also the knowledge about the main aspects and basic techniques of building reinforcement.

Content
This course provides fundamental knowledge of the possibilities to preserve concrete and masonry constructions. Besides an introduction into the characteristics of masonry, plaster, concrete and reinforced concrete structures, various damage patterns and their origins are discussed. Based on the knowledge of the essential damage processes, efficient measures for the increase of the durability are described, which include material and constructional precautions as well as additional preventive measures. Furthermore the course focuses on the repair of already damaged concrete and masonry constructions. In this connection different research methods for the analysis of damages are presented and various possibilities are shown to predict the time-development of these damages. Finally repair materials as well as procedures are described which are necessary for the realization of a durable repair measure. A further main part of the course covers the different possibilities of an additional reinforcement of concrete and masonry constructions. Applicable materials and their characteristics in design and construction are introduced and discussed. In the accompanying exercises the subject matter shall independently be developed and the practical realization will be practised by means of several design problems.

Recommendations
none

Remarks
none
Literature
Hand-outs and (selection):

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- Protection, Rehabilitation and Reinforcement of Concrete and Masonry Constructions lecture, exercise: 45 h
- Building Analysis lecture: 15 h

independent study:
- preparation and follow-up lectures, exercises Protection, Rehabilitation and Reinforcement of Concrete and Masonry Constructions: 25 h
- preparation and follow-up lectures Building Analysis: 15 h
- preparation of student research project “Building Preservation of Concrete and Masonry Constructions”: 40 h
- examination preparation: 40 h

total: 180 h
Module: Building Preservation of Steel and Timber Structures (engiM603-BSH) [M-BGU-100043]

Responsibility: Matthias Frese
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering
Profile / Building Preservation, Building Materials and Building Physics

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Compulsory

Identifier 'Teilleistung' CP Responsibility
T-BGU-100027 Building Preservation of Steel and Timber Structures (S. 129) 6 Matthias Frese, Thomas Ummenhofer

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-100027 with written examination according to § 4 Par. 2 No. 1
  details about the learning control see at the 'Teilleistung'

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students can explain the procedure of investigation and evaluation of old building fabric. They can describe the characteristics of old steel and cast productions made of iron materials as well as the timber quality (in-situ strength grading of timber). They are able to name typical defects of steel and timber structures. They conduct realistic static computations of old constructions and determine the remaining lifetime. They can explain methods for repairing and strengthening of steel and timber structures on the base of concepts conserving cultural heritage and taking into consideration carpentry and engineered solutions.

Content
- historical overview
- properties of old steels, cast materials and old, built-in timber
- investigation of structures and building parts
- damage-mechanisms in steel and timber structures
- investigation of bearing capacity and remaining lifetime
- restoration and strengthening procedures

Recommendations
participation in module Timber Structures [engiMM301-HB]

Remarks
none

Literature
lecture accompanying documents
Workload

contact hours (1 HpW = 1 h x 15 weeks):
- Preservation of Steel Structures lecture: 30 h
- Preservation of Timber Structures lecture/exercise: 30 h

independent study:
- preparation and follow-up lectures Preservation of Steel Structures: 30 h
- preparation and follow-up lectures/exercises Preservation of Timber Structures: 30 h
- examination preparation: 60 h

total: 180 h
Module: Computational Analysis of Structures (engiM402-CTWM) [M-BGU-100047]

Responsibility: Werner Wagner
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering
Profile / Modeling and Simulation in Construction Engineering
Profile / Building Preservation, Building Materials and Building Physics

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Compulsory

Identifier | ‘Teilleistung’ | CP | Responsibility |
---|---|---|---|
T-BGU-100174 | Student Research Project ‘Computational Analysis of Structures’ (S. 189) | 2 | Werner Wagner |
T-BGU-100031 | Computational Analysis of Structures (S. 131) | 4 | Werner Wagner |

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100174 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- ‘Teilleistung’ T-BGU-100031 with oral examination according to § 4 Par. 2 No. 2

details about the learning controls see at the respective ‘Teilleistung’

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students can formulate and apply the essential principles for the computational modeling of structures (FE models for beam and surface structures, modeling of practical problems, error analysis) as basis for design and construction.

Content
- numerical simulation of 2D/3D beams, surface structures
- modeling of 2D/3D beams, surface structures
- exactness and improvement of the solutions
- folded plates
- rotational shells
- adaptive mesh generation
- stationary heat conduction 2D/3D and further problems of building physics
- commercial software for design and construction

Recommendations
module Surface Structures and Dynamics of Structures [engiM601-FTW-BD]

Remarks
none

Literature
lecture notes ‘Computergestützte Tragwerksmodellierung’
Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 60 h

independent study:
- preparation and follow-up lectures, exercises: 30 h
- preparation of student research project (exam prerequisite): 50 h
- examination preparation: 40 h

total: 180 h
Module: Concrete Construction Technology (engiM107-BETONTECH)  
[M-BGU-100056]

Responsibility: Frank Dehn
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering  
Profile / Modeling and Simulation in Construction Engineering
Profile / Building Preservation, Building Materials and Building Physics

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Compulsory

Identifier | ‘Teilleistung’ | CP | Responsibility
---|---|---|---
T-BGU-100036 | Concrete Construction Technology (S. 133) | 6 | Frank Dehn

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100036 with oral examination according to § 4 Par. 2 No. 2
  details about the learning control see at the ‘Teilleistung’

Grade of the Module
grade of the module is grade of the exam
Prerequisites
none

Qualification Goals
see German version
Content
see German version
Recommendations
none
Remarks
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- Concrete Technology lecture/exercise: 45 h
- Deformation and Fracture Processes lecture: 15 h

independent study:
- preparation and follow-up lecture/exercises Concrete Technology: 45 h
- preparation and follow-up lectures Deformation and Fracture Processes: 15 h
- examination preparation: 60 h

total: 180 h
Module: Construction of Steel and Composite Bridges (engIM203-STAHLBRÜ)  
[M-BGU-100040]

Responsibility: Thomas Ummenhofer
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering

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Compulsory

Identifier 'Teilleistung' CP Responsibility
T-BGU-100024 Construction of Steel and Composite Bridges (S. 134) 6 Thomas Ummenhofer

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013  
- ‘Teilleistung’ T-BGU-100024 with written examination according to § 4 Par. 2 No. 1  
details about the learning control see at the ‘Teilleistung’

Grade of the Module  
grade of the module is grade of the exam

Prerequisites  
none

Qualification Goals  
The students can evaluate steel and steel composite bridges with respect to design, construction, production, conduct design calculations and design constructive details.

Content  
- historical development
- design basics
- construction types for main beams
- bridge bearings
- assembly process
- design examples

Recommendations  
course Basics in Steel Structures (6200504), module Steel and Composite Structures [engIM201-STAHLBAU]

Remarks  
none

Literature  
lecture accompanying documents
Workload
contact hours (1 HpW = 1 h x 15 weeks):
  • lecture, exercise: 60 h
independent study:
  • preparation and follow-up lectures, exercises: 45 h
  • examination preparation: 75 h
total: 180 h
Module: Contact Mechanics (engiM515-KONTMECH) [M-BGU-104916]

Responsibility: Marlon Franke
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Modeling and Simulation in Construction Engineering

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Compulsory

Identifier 'Teilleistung'

T-BGU-109947 Contact Mechanics (S. 135) 6 Marlon Franke

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-109947 with oral examination according to § 4 Par. 2 No. 2 details about the learning control see at the 'Teilleistung'

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Modeled Conditions
The following conditions must be met:

1. The module [M-BGU-100336] Contact Mechanics - Fundamentals and Basics must not have been started.
2. The module [M-BGU-100337] Contact Mechanics - Computational Algorithms in a Geometrically Exact Form must not have been started.

Qualification Goals
The students gain the ability to name the basics for the numerical simulation of contact problems. They can transfer these capabilities to the discussion of deformable bodies in contact. The students can describe the handling of general interface problems, non-smooth dynamics and inequality constraints. The students are able to apply formulations of interfaces based on collocation methods and recent integral formulations.

Content
The continuum mechanical description of deformable bodies (continua) with second-order condition is imparted. The formulation of contact conditions and friction laws is discussed. Further, methods for claiming of constraints is discussed. The contact contribution is emphasised particularly by the subsequent numerical implementation.

Recommendations
course Introduction to Continuum Mechanics (6200607),module Basics of Finite Elements [engiM501-GRUNDFE]

Remarks
This module is offered newly as from winter term 2019/20.

Literature
[1] Laursen: Computational Contact and Impact Mechanics
Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 60 h

independent study:
- preparation and follow-up lectures, exercises: 45 h
- examination preparation: 75 h

total: 180 h
Module: Contact Mechanics - Computational Algorithms in a Geometrically Exact Form (engiM511-KONTMECH-ALGOR) [M-BGU-100337]

Responsibility: Alexander Konyukhov
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Modeling and Simulation in Construction Engineering

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Compulsory

Identifier | 'Teilleistung' CP Responsibility
---|---|---
T-BGU-100618 | Contact Mechanics - Computational Algorithms in a Geometrically Exact Form (S. 136) 6 Alexander Konyukhov

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100618 with oral examination according to § 4 Par. 2 No. 2 details about the learning control see at the ‘Teilleistung’

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students are able to select appropriately a coordinate system for the geometric exact contact formulation and contact interaction. The students can describe the principles of applied differential geometry, contact kinematics, formulation of the weak form and the linearization in covariant coordinates. The students can present formulations for 1D, 2D and 3D. The students are able to apply finite element discretization and to integrate numerical algorithms for their implementation.

Content
- continuum formulation of a contact problem (Signorini’s problem): weak and strong formulation
- necessary information from the differential geometry of curves and surfaces
- curvilinear coordinate systems necessary for the various contact types
- geometry and kinematics for arbitrary two body contact problem in a covariant form
- abstract form of formulations in computational mechanics.
- weak formulation in a covariant form
- various methods of enforcement contact constraints in a covariant and in operator form
- consistent linearization in a covariant form: normal and tangential parts
- various discretization techniques of both the weak form and its linearization: residual and tangent matrix
- a set of analytical solution used for verification of the implemented contact algorithms (Hertz solution, contact patch tests for non-frictional and frictional cases
- modelling of frictional contact: elastoplastic analogy, return-mapping scheme
- a possible way of generalization of Coulomb friction law

Recommendations
course Introduction to Continuum Mechanics (6200607),module Basics of Finite Elements [engiM501-GRUNDFE]

Remarks
IMPORTANT:
The module will not be offered anymore as from winter term 2019/20.

Literature

Engineering Structures (M.Sc.), ER/SPO 2013
Module handbook Summer term 2019, as at 03/27/2019

47

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 60 h
independent study:
  - preparation and follow-up lectures, exercises: 45 h
  - examination preparation: 75 h
total: 180 h
Module: Contact Mechanics - Fundamentals and Basics (engiM510-KONTMECH-BASICS) [M-BGU-100336]

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<td>T-BGU-100617</td>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100617 with oral examination according to § 4 Par. 2 No. 2
details about the learning control see at the ‘Teilleistung’

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students gain the ability to name the basics for the numerical simulation of contact problems. They can transfer these capabilities to the discussion of deformable bodies in contact. The students can describe the handling of general interface problems, non-smooth dynamics and inequality constraints. The students are able to apply formulations of interfaces based on collocation methods and recent integral formulations.

Content
The continuum mechanical description of deformable bodies (continua) with second-order condition is imparted. The formulation of contact conditions and friction laws is discussed. Further, methods for claiming of constraints is discussed. The contact contribution is emphasised particularly by the subsequent numerical implementation.

Recommendations
course Introduction to Continuum Mechanics (6200607), module Basics of Finite Elements [engiM501-GRUNDFE]

Remarks
IMPORTANT:
The module will not be offered anymore as from summer term 2019.

Literature
[1] Laursen: Computational Contact and Impact Mechanics

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 60 h
- independent study:
  - preparation and follow-up lectures, exercises: 45 h
  - examination preparation: 75 h
- total: 180 h
Module: Continuum Mechanics of Heterogeneous Solids (engiM507-KONTIMECH) [M-BGU-100064]

Responsibility: Thomas Seelig
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Modeling and Simulation in Construction Engineering

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<td>T-BGU-108879</td>
<td>Micromechanics of Heterogeneous Solids (S. 167)</td>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-106196 with oral examination according to § 4 Par. 2 No. 2
- ‘Teilleistung’ T-BGU-108879 with oral examination according to § 4 Par. 2 No. 2
details about the learning controls see at the respective ‘Teilleistung’

Grade of the Module
grade of the module is CP weighted average of grades of the partial exams

Prerequisites
This module must not be selected together with the module Basics of Numeric Modeling [engiM704-NUMGRUND].

Modeled Conditions
The following conditions must be met:
- The module [M-BGU-100070] Basics of Numeric Modeling must not have been started.

Qualification Goals
see German version

Content
see German version

Recommendations
none

Remarks
none

Literature
Seelig, T.: Kontinuumsmechanik. Skript zur Vorlesung
Literatur Mechanik heterogener Festkörper:

**Workload**

contact hours (1 HpW = 1 h x 15 weeks):
- Continuum Mechanics lecture: 30 h
- Mechanics of Heterogeneous Solids lecture: 30 h

independent study:
- preparation and follow-up lectures Continuum Mechanics: 30 h
- preparation and follow-up lectures Mechanics of Heterogeneous Solids: 30 h
- examination preparation Continuum Mechanics: 30 h
- examination preparation Mechanics of Heterogeneous Solids: 30 h

total: 180 h
Module: Coupled Geomechanic Processes (engiM714-GEKOPPRO)  
[M-BGU-100077]

Responsibility: Theodoros Triantafyllidis  
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften  
Curricular Embedding: Compulsory Elective  
Contained in: Profile / Geotechnics

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Compulsory

Identifier ‘Teilleistung’ CP Responsibility
T-BGU-100085 Coupled Geomechanic Processes (S. 139) 6 Theodoros Triantafyllidis

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100085 with oral examination according to § 4 Par. 2 No. 2

details about the learning control see at the ‘Teilleistung’

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students can explain supplementary knowledge about strength and deformation properties of rocks as well as of rock testing in-situ and in laboratory. They recognize and evaluate the basic physical and chemical alteration parameters of geomaterials. They are able to describe the involved hydromechanical, chemomechanical, thermomechanical and biomechanical processes and to express mathematically their interdependence with mechanical properties.

Content
The module takes into account unconsolidated and hard rock as multiphase systems, in which mechanical processes take place coupled with hydraulic, chemical, biological and thermal processes and their material behavior being therefore typically time-dependent. Phenomena of swelling, shrinking, creeping, fracture hydraulics and rock dynamics, moisture conditions, solute transport, internal erosion, climatic influence of precipitation and freeze-thaw changes as well as influences of bacteria and flora.

Recommendations
module Rock Engineering and Tunneling [engiM703-FMTUB]

Remarks
none

Literature
**Workload**

contact hours (1 HpW = 1 h x 15 weeks):
- Special Issues in Rock Mechanics lecture/exercise: 30 h
- Coupled Phenomena in Geomechanics lecture/exercise: 30 h

independent study:
- preparation and follow-up lecture/exercises Special Issues in Rock Mechanics: 30 h
- preparation and follow-up lecture/exercises Coupled Phenomena in Geomechanics: 30 h
- examination preparation: 60 h

total: 180 h
Module: Design and Construction of Components in Reinforced Concrete (engiM101-BEMISTB) [M-BGU-100033]

Responsibility: Lothar Stempniewski

Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften

Curricular Embedding: Compulsory Elective

Contained in: Profile / Construction Engineering
Profile / Modeling and Simulation in Construction Engineering
Profile / Building Preservation, Building Materials and Building Physics
Profile / Geotechnics

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Compulsory

Identifier | ‘Teilleistung’ | CP | Responsibility |
---|---|---|---|
T-BGU-100170 | Student Research Project ‘Reinforced Concrete’ (S. 193) | 2 | Lothar Stempniewski |
T-BGU-100015 | Design and Construction of Components in Reinforced Concrete (S. 141) | 4 | Lothar Stempniewski |

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100170 with not graded accomplishment according to § 4 Par. 3
- ‘Teilleistung’ T-BGU-100015 with written examination according to § 4 Par. 2 No. 1

details about the learning controls see at the respective ‘Teilleistung’

Grade of the Module
grade of module is grade of the exam

Prerequisites
none

Qualification Goals
Based on the module ‘Basics in Reinforced Concrete’ and cross-cutting modules such as ‘Structural Analysis’ the students can recognize complex subjects of reinforced concrete and apply their methods. They can assign given problems to the respective design problems, conduct these subsequently and apply the current standards. Furthermore, the students can interpretate the results of a design and evaluate them with respect to their correctness and profitability.

Content
Design and Construction of Components, Design for bending and Torsion, Biaxial Bending, Punching, Truss Analogy

Recommendations
courses Basics of Reinforced Concrete I+II (6200509, 6200601)

Remarks
none

Literature
lecture notes

Engineering Structures (M.Sc.), ER/SPO 2013 Module handbook Summer term 2019, as at 03/27/2019
Workload

contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 60 h

independent study:
- preparation and follow-up lectures, exercises: 30 h
- preparation of student research project: 60 h
- examination preparation: 30 h

total: 180 h
# Module: Durability and Service Life Design (engiM108-DAUERLEB) [M-BGU-100057]

**Responsibility:** Michael Vogel  
**Institution:** KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften  
**Curricular Embedding:** Compulsory Elective  
**Contained in:** Profile / Construction Engineering, Profile / Building Preservation, Building Materials and Building Physics

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### Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100037 with oral examination according to § 4 Par. 2 No. 2
- details about the learning control see at the ‘Teilleistung’

### Grade of the Module
- grade of the module is grade of the exam

### Prerequisites
- none

### Qualification Goals
- see German version

### Content
- see German version

### Recommendations
- course Building Chemistry (6200108)

### Remarks
- none

### Workload
- contact hours (1 HpW = 1 h x 15 weeks):
  - Corrosion Processes and Life Time lecture/exercise: 45 h
  - Analytic Methods lecture: 15 h
- independent study:
  - preparation and follow-up lecture/exercises Corrosion Processes and Life Time: 45 h
  - preparation and follow-up lectures Analytic Methods: 15 h
  - examination preparation: 60 h
- total: 180 h
Module: Earthworks and Foundation Engineering (engiM702-ERDGB) [M-BGU-100068]

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### Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100178 with not graded accomplishment according to § 4 Par. 3
- ‘Teilleistung’ T-BGU-100068 with written examination according to § 4 Par. 2 No. 1

details about the learning controls see at the respective ‘Teilleistung’

### Grade of the Module

grade of the module is grade of the exam

### Prerequisites

This module must not be selected together with the module Geotechnical Constructions [engiM715-GEOKONSTR].

### Modeled Conditions

The following conditions must be met:

1. The module [M-BGU-101674] Geotechnical Constructions must not have been started.

### Qualification Goals

With regard to geotechnical constructions the students are able to select and apply appropriate methods for exploration, modelling, dimensioning, realization and control in the case of complex requirements on average. They can apply this knowledge to earthworks and embankment engineering, can identify all geotechnically relevant problems occurring with dams and can apply self-reliantly design and dimensioning rules in outline. They gained geotechnical competence in solving problems for all kind of constructions in and with unconsolidated rocks, also with respect to the managerial organization, expense budgeting, use of documents and presentation of results.

### Content

The module deepens the safety concepts in earthworks and foundation engineering and the project design for foundation problems by means of several examples (foundations on soft soil, variants of construction pit supporting system, stabilization and drainage of embankments, slope stabilization, retaining structure, underpinning) and explains the observation method. Basics of earthworks and foundation engineering are presented such as building materials for dams, design requirements, construction of dams, sealing and stability of filled dams. Further basics are computation of seepage and the evaluation of erosion, suffosion, piping, colmatation and joint erosion.

### Recommendations

basic knowledge of Soil Mechanics and Foundation Engineering;
compilation and submission of student research project as examination preparation until examination date

Engineering Structures (M.Sc.), ER/SPO 2013
Module handbook Summer term 2019, as at 03/27/2019
Remarks
none

Literature
[1] Witt. K.J. (2008), Grundbau-Taschenbuch, Teil 1,

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- Foundation Types lecture/exercise: 30 h
- Basics in Earthworks and Embankment Dams lecture/exercise: 30 h
independent study:
- preparation and follow-up lecture/exercises Foundation Types: 10 h
- preparation and follow-up lecture/exercises Basics in Earthworks and Embankment Dams: 10 h
- preparation of student research project: 60 h
- examination preparation: 40 h

total: 180 h
Module: Environmental Geotechnics (engiM713-UMGEOTEC) [M-BGU-100079]

Responsibility: Theodoros Triantafyllidis
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Geotechnics

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Identifier 'Teilleistung' CP Responsibility

| T-BGU-100084 | Landfills (S. 162) | 3 | Andreas Bieberstein |
| T-BGU-100089 | Brownfield Sites - Investigation, Evaluation, Rehabilitation (S. 127) | 3 | Andreas Bieberstein |

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-100084 with oral examination according to § 4 Par. 2 No. 2
- 'Teilleistung' T-BGU-100089 with oral examination according to § 4 Par. 2 No. 2

details about the learning control see at the 'Teilleistung'

Grade of the Module
grade of the module is CP weighted average of grades of the partial exams

Prerequisites
none

Qualification Goals
Knowledge of the legal requirements regarding the depositing of waste. Presentation of the geotechnical concerns in the construction of landfill sites depending on the particular landfill classification, landfill elements, their relevant requirements and necessary certifications. Knowledge of the permitted limits for brown-fields. Interdisciplinary cross-linking of chemical, mineralogical, biological, hydraulic and geotechnical aspects of the treatment of brown-fields. Knowledge of the relevant procedures of decontamination, their limitations and risks.

Content
Waste-situation and waste catalogue, Requirements from the authorities, legal basis, Planning landfill sites, Multi-barrier system, Construction elements, Hydraulic analysis, Technical equipment for gas treatment of landfills, Statical analysis, Serviceability analysis, Construction, Special design solutions, strengthening of landfills. Introduction to the problematic of brownfields, Investigation and location assessment of brownfields, Harmful substances and their behavior in the environment, Environmental-chemical and mineralogical aspects of the accumulation of harmful substances in soil, Natural attenuation and active microbiological decontamination procedures, Reactive walls and electro-kinetic decontamination procedures, Soil washing, combustion, pyrolysis, immobilization and compression, Geotechnical aspects of the containment of industrial waste landfills, Hydraulic and pneumatic decontamination procedures, Case-studies, Excursion.

Recommendations
none

Remarks
none

Literature
DGGT, GDA-Empfehlungen – Geotechnik der Deponien und Altlasten, Ernst und Sohn, Berlin
Drescher (1997), Deponiebau, Ernst und Sohn, Berlin
Reiersloh, D und Reinhard, M. (2010): Altlastenratgeber für die Praxis, Vulkan-V. Essen
Workload
contact hours (1 HpW = 1 h x 15 weeks):
• Landfills lecture/exercise: 30 h
• Brownfield Sites - Investigation, Evaluation, Rehabilitation lecture: 30 h
• Excursion: 10 h

independent study:
• preparation and follow-up lecture/exercises Landfills: 25 h
• examination preparation Landfills (partial exam): 30 h
• preparation and follow-up lectures Brownfield Sites - Investigation, Evaluation, Rehabilitation: 25 h
• examination preparation Brownfield Sites - Investigation, Evaluation, Rehabilitation (partial exam): 30 h

total: 180 h
Module: FE-Applications in Practical Engineering (engiM403-FE-PRAXIS) [M-BGU-100048]

Responsibility: Werner Wagner
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering
Profile / Modeling and Simulation in Construction Engineering

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Compulsory

Identifier 'Teilleistung' CP Responsibility
T-BGU-100032 FE-Applications in Practical Engineering (S. 146) 6 Werner Wagner

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung’ T-BGU-100032 with oral examination according to § 4 Par. 2 No. 2
details about the learning control see at the 'Teilleistung’

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students can conduct and check computer aided modeling of structures by using commercial FE-codes (beams, surface structures) for practical civil engineering projects.

Content
- application of different commercial software for the modeling of beam- and surface structures
- structural analysis and design
- discussion of approximation behaviour of numerical methods at examples
- analytical comparative calculations
- software comparisons
- control options.

Recommendations
module Computational Analysis of Structures [engiM402-CTWM]

Remarks
none

Literature
lecture notes Computational Analysis of Structures

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 60 h
independent study:
- preparation and follow-up lectures, exercises: 45 h
- examination preparation: 75 h
total: 180 h
Module: Finite Elements in Solid Mechanics (engiM512-FEFKM) [M-BGU-100578]

Responsibility: Peter Betsch
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Modeling and Simulation in Construction Engineering

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100998 with oral examination according to § 4 Par. 2 No. 2 details about the learning control see at the ‘Teilleistung’

Grade of the Module
grade of the module is grade of the exam
Prerequisites
none

Qualification Goals
see German version
Content
see German version
Recommendations
module Basics in Finite Elements [engiM501-GRUNDFE]
Remarks
none
Workload
contact hours (1 Hpw = 1 h x 15 weeks):
- lectures, exercises: 60 h
independent study:
- preparation and follow-up: 45 h
- working on programming exercises: 30 h
- examination preparation and examination: 45 h
total: 180 h
Module: Fracture and Damage Mechanics (engiM502-BRUCHMECH) [M-BGU-100053]

Responsibility: Thomas Seelig
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering
Profile / Modeling and Simulation in Construction Engineering

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-100087 with oral examination according to § 4 Par. 2 No. 2
details about the learning control see at the 'Teilleistung'

Grade of the Module
grade of the module is grade of the exam
Prerequisites
none

Qualification Goals
The students are able to apply the basic principles and methods of fracture and damage mechanics as used for the analysis of fissured structures and the description of complex material behavior. They can establish relationships between continuum mechanical descriptions and material specific aspects.

Content
- phenomenology and mechanisms of fracture
- linear elastic fracture mechanics (crack tip fields, K-concept, energy balance, J-integral, small scale yielding)
- elastic plastic fracture mechanics (Dugdale model, HRR-field, J-controlled crack growth)
- dynamic fracture mechanics (dynamic loading, fast running cracks)
- micromechanics of heterogeneous solids (defects and eigenstrain, RVE-concept, homogenization)
- damage mechanics (mechanisms of brittle and ductile damage, micromechanical and phenomenological models, softening and localization)

Recommendations
course Introduction to Continuum Mechanics (6200607)

Remarks
none

Literature

**Workload**

contact hours ($1\text{ HpW} = 1\text{ h} \times 15\text{ weeks}$):
- lecture, exercise: 60 h

independent study:
- preparation and follow-up lectures, exercises: 60 h
- examination preparation: 60 h

total: 180 h
Module: Geotechnical Constructions (engiM715-GEOKONSTR) [M-BGU-101674]

Responsibility: Theodoros Triantafyllidis

Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften

Curricular Embedding: Compulsory Elective

Contained in: Profile / Construction Engineering

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Compulsory

Identifier 'Teilleistung' CP Responsibility

T-BGU-103224 Geotechnical Constructions (S. 149) 6 Theodoros Triantafyllidis

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013

- 'Teilleistung' T-BGU-103224 with written examination according to § 4 Par. 2 No. 1 details about the learning control see at the 'Teilleistung'

Grade of the Module

grade of the module is grade of the exam

Prerequisites

This module must not be selected together with the modules Earthworks and Foundation Engineering [engiM702-ERDGB] or Applied Geotechnics [engiM707-ANGEOTEC].

Modeled Conditions

The following conditions must be met:

1. The module [M-BGU-100068] Earthworks and Foundation Engineering must not have been started.
2. The module [M-BGU-100072] Applied Geotechnics must not have been started.

Qualification Goals

see German version

Content

see German version

Recommendations

basic knowledge of Soil Mechanics and Foundation Engineering

Remarks

The module can be selected exclusively in the compulsory elective block of the profile ‘Construction Engineering’.

Literature

Workload

contact hours (1 HpW = 1 h x 15 weeks):
- Foundation Types lecture/exercise: 30 h
- Foundations and Retaining Structures lecture/exercise: 30 h
- field trips: 10 h

independent study:
- preparation and follow-up lecture/exercises Foundation Types: 25 h
- preparation and follow-up lecture/exercises Foundations and Retaining Structures: 25 h
- examination preparation: 60 h

total: 180 h
Module: Geotechnical Testing and Measuring Technology (bauiM5S07-VERSMESS) [M-BGU-100076]

Responsibility: Theodoros Triantafyllidis
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Geotechnics

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Compulsory

Identifier | ‘Teilleistung’ | CP | Responsibility |
-----------|----------------|----|----------------|
T-BGU-100075 | Geotechnical Testing and Measuring Technology (S. 151) | 6 | Theodoros Triantafyllidis |

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100075 with oral examination according to § 4 Par. 2 No. 2
  details about the learning control see at the ‘Teilleistung’

Grade of the Module
none

Prerequisites
none

Qualification Goals
The students can classify the procedures and methods for subsoil exploration and testing techniques even those surpassing standard procedures. They are able to select reasonably appropriate combinations of techniques based on the specific application conditions and prerequisites. They can explain basic knowledge in geophysics, measurement technologies and the functioning principles of sensors and data acquisition. As a result of this they can select equipment reasonably with respect to resolution, accuracy, long term stability and interpretation. They have own experiences with the handling of sensor application, wiring, data acquisition, control elements, measuring and analysis procedures.

Content
The module deepens aspects of geotechnical experiments. Specific experiments from rock mechanics and dam and embarkment construction as well as the test of rheologic properties are presented. The students obtain also insight into geophysical exploratory methods. Further, basics with respect to the selection of appropriate sensors measuring physical, dynamic and electrical quantities, optical methods, correlation measurement techniques, influences of errors, data transfer, data acquisition as well as controlling concepts. The setup and test of a measurement chain for field measurements is practiced.

Recommendations
none

Remarks
none
Workload
contact hours (1 HpW = 1 h x 15 weeks):
- Rock Testing lecture: 15 h
- Testing in Dam and Wastefill Engineering lecture: 15 h
- Geotechnical Measuring Technology lecture/exercise: 30 h
- preparation and follow-up of experiments in the laboratory, own repeating experiments: 25 h

independent study:
- preparation and follow-up lecture Rock Testing: 10 h
- preparation and follow-up lecture Testing in Dam and Wastefill Engineering: 10 h
- preparation and follow-up lecture/exercise Geotechnical Measuring Technology: 15 h
- examination preparation: 60 h

total: 180 h
Module: Glass, Plastic and Cable Structures (engiM205-GlaKunSe) [M-BGU-100041]

**Responsibility:** Daniel Ruff  
**Institution:** KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften  
**Curricular Embedding:** Compulsory Elective  
**Contained in:** Profile / Construction Engineering  
Profile / Building Preservation, Building Materials and Building Physics

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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**  
- ‘Teilleistung’ T-BGU-100025 with oral examination according to § 4 Par. 2 No. 2  
details about the learning control see at the ‘Teilleistung’

**Grade of the Module**  
grade of the module is grade of the exam

**Prerequisites**  
one

**Qualification Goals**  
The students can describe the historical evolution of glass materials, the material characteristics of currently used glass products in construction engineering as well as structural behavior of products of glass and glass-steel structures considering the specific properties of stainless steels. They are able to conduct proofs of load-carrying capacity according to current technical standards (e.g. DIN 18008).  
The students can explain the manufacturing, characteristics, processing capacities and applications of plastics in construction engineering. In addition, the students can describe the principles of construction and design of adhesive bonds.  
The students can describe the assembly, production and characteristics of high-strength tension members (steel cables, cords, tension bar members), the associated end-connections and their application in construction engineering. They are able to conduct simple proofs of structural safety for high-strength tension members according to Eurocode for predominantly statically stressed structures. In addition, they can explain the assembly of large structures with cables (stadium roofs, suspension bridges).

**Content**  
- glass in civil engineering  
- stainless steels, upgrading products  
- construction details, design of glass structures  
- plastics in civil engineering, adhesive bonds, construction details  
- design of wires, cables, cords  
- tension bar systems  
- end-connections, buffles  
- static structural behavior  
- dynamic structural behavior  
- design of structures with high-strength tension members  
- construction details of high-strength tension members  
- assembly of cable structures

**Recommendations**  
course Basics in Steel Structures (6200504)
Remarks
none

Literature
lecture accompanying documents

Workload
contact hours (1 HpW = 1 h x 15 weeks):
  - lecture, exercise: 60 h
independent study:
  - preparation and follow-up lectures, exercises: 45 h
  - examination preparation: 75 h
total: 180 h
Module: Ground Investigation (engiM706-BERKUND) [M-BGU-100071]

Responsibility: Theodoros Triantafyllidis
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Geotechnics

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Compulsory

Identifier 'Teilleistung' CP Responsibility
T-BGU-100072  Ground Investigation (S. 155)  6 Theodoros Triantafyllidis

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-100072 with oral examination according to § 4 Par. 2 No. 2
  details about the learning control see at the 'Teilleistung'

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students can conduct the standard experiments common in soil mechanics by themself, define appropriate experimental conditions, analyse and control the experiments purposefully and derive constructionally conclusions. They are familiar with the common field experiments in unconsolidated rocks, they can plan, control, analyse and interpret these. They conducted experiments exemplarily by themselves.

Content
The module covers standard tests in soil mechanics, starting with indexing experiments, determination of shear parameters and water permeability through to different triaxial tests. The different types of explorations, measurement of density and stiffness as well as determination of interface structures in rocks are demonstrated in field experiments. It is discussed which requirements the types of experiments define for exploratory drilling and sample quality, which laboratory and field experiment or experimental conditions respectively are required for the evaluation of the ground and foundation and how drillings can be converted to monitoring wells.

Recommendations
none

Remarks
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- Soil Mechanical Laboratory Exercises: 30 h
- Geomechanical Field Exercise: 30 h
- preparation and follow-up of experiments in the laboratory, own repeating experiments: 30 h
independent study:
- preparation and follow-up Soil Mechanical Laboratory Exercises: 15 h
- preparation and follow-up Geomechanical Field Exercise: 15 h
- examination preparation: 60 h

total: 180 h
Module: Ground Water and Earth Dams (engiM708-GWDAMM) [M-BGU-100073]

Responsibility: Theodoros Triantafyllidis
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Geotechnics

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Compulsory

Identifier ‘Teilleistung’ CP Responsibility
T-BGU-100091 Ground Water and Earth Dams (S. 156) 6 Andreas Bieberstein

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100091 with oral examination according to § 4 Par. 2 No. 2
details about the learning control see at the ‘Teilleistung’

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students can describe the deepened knowledge about different geotechnical groundwater problems. They can dimension dewatering under very different boundary conditions and demonstrate geohydraulic relationships by example calculations. They are able to develop own solution approaches for dam construction problems, to evaluate construction techniques and to conduct the requested geotechnical proofs.

Content
The module discusses the investigation of the groundwater conditions in laboratory and field. Geohydraulic fundamentals are extended with respect to anisotropy, saturation fronts, air permeability and groundwater drawdown under specific boundary conditions. The construction of flow nets is applied to seepage problems and the underseepage of dams. The hydrologic hydraulic and geotechnical design of dams is deepened. Hereby, the design of artificial sealings and filters is linked to the geo-mechanical proofs such as sliding, spread and uplift stability, deformation and earthquake design. Buried auxiliary structures, dams designed for overtopping as well as metrological monitoring of dams are mentioned, too.

Recommendations
module Earthworks and Foundation Engineering [engiM702-ERDGB]

Remarks
none

Literature
Workload
contact hours (1 HpW = 1 h x 15 weeks):
  • Geotechnical Ground Water Problems lecture/exercise: 30 h
  • Embankment Dams (Advanced) lecture/exercise: 30 h
  • field trips: 10 h
independent study:
  • preparation and follow-up lecture/exercises Geotechnical Ground Water Problems: 25 h
  • preparation and follow-up lecture/exercises Embankment Dams (Advanced): 25 h
  • examination preparation: 60 h
total: 180 h
Module: Hollow Section Structures (engiM204-HOHLPROFIL) [M-BGU-100004]

Responsibility: Stefan Herion
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering

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Compulsory

Identifier | 'Teilleistung' | CP | Responsibility
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T-BGU-100086 | Hollow Section Structures (S. 158) | 6 | Stefan Herion

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-100086 with oral examination according to § 4 Par. 2 No. 2
  details about the learning control see at the 'Teilleistung'

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students can design and construct predominantly static and non predominantly static stressed constructions made of hollow sections considering their connections.

Content
- appliance in steel- and bridge engineering
- joint constructions
- fatigue behavior
- calculation examples

Recommendations
course Basics in Steel Structures (6200504)

Remarks
none

Literature
lecture notes: ‘Hohlprofilkonstruktionen’, Karlsruher Institut für Technologie (KIT), Versuchsanstalt für Stahl, Holz und Steine

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 60 h
independent study:
- preparation and follow-up lectures, exercises: 45 h
- examination preparation: 75 h
total: 180 h
Module: Key Competencies [M-BGU-100100]

Responsibility:

Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory
Contained in: Key Competencies

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Schlüesselqualifikationen
Compulsory Elective; You must choose at least 6 credits.

Identifier ‘Teilleistung’ CP Responsibility
T-BGU-106765 Introduction to Matlab (S. 161) 3 Uwe Ehret
T-BGU-100133 Wildcard (S. 207) 1

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
according to elected courses, freely be chosen from the course catalogue for Interdisciplinary Qualifications of HoC and ZAK

Grade of the Module
not graded

Prerequisites
none

Qualification Goals
Learning outcomes can be divided into three main complementary categories:

1. Contextual Knowledge
   - Students are aware of the cultural context of their position and are in a position to consider the views and interests of others (beyond the boundaries of subject, culture, and language).
   - They have enhanced their ability to participate properly and appropriately in academic or public discussions.

2. Practical Focus
   - Students have gained an insight into the routines of professional life.
   - They have further developed their capability to learn.
   - They have improved their scope of action by extending their knowledge of foreign languages.
   - They are able to relate their field of experience to basic aspects of business administration and law.

3. Basic Competences
   - The students autonomously acquire new knowledge in a planned, specific, and methodologically founded manner and use it for solving tasks and problems.
   - They can evaluate own work.
   - They possess efficient work techniques, can set priorities, take decisions, and assume responsibility.

Content
With the key competences, the House of Competence (HoC) and the Centre for Cultural and General Studies (ZAK) offer a wide range of courses, which are bundled thematically for better orientation. The contents are explained in detail in the descriptions of the courses on the internet pages of HoC (http://www.hoc.kit.edu/lehrangebot.php) and ZAK (http://www.zak.kit.edu/english/general_studies.php).

Recommendations
none

Remarks
The mentor can recognize, if applicable in consultation with the Examination Committee, further suitable courses as interdisciplinary qualifications which are not listed in the mentioned offers of HoC and ZAK. Language courses of the
'Sprachzentrum' (SpZ) are usually recognized. Further information about the selection of Interdisciplinary Qualifications see Sect. 1.3.

**Workload**
see course description of HoC, and lecture descriptions of ZAK
Module: Material Models in Solid Mechanics (engiM503-MATTHEO) 
[M-BGU-100054]

Responsibility: Thomas Seelig
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Modeling and Simulation in Construction Engineering
Profile / Building Preservation, Building Materials and Building Physics

Credit Points: 6
Recurrence Frequency: Each summer term
Duration: 1 term
Language: German
Version: 1

Compulsory

Identifier 'Teilleistung' CP Responsibility
T-BGU-100044 Material Models in Solid Mechanics (S. 164) 6 Thomas Seelig

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-100044 with oral examination according to § 4 Par. 2 No. 2
details about the learning control see at the 'Teilleistung'

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students know the phenomena of inelastic material behavior as well as the continuum mechanical methods for their theoretical description and they can explain them.

Content
- general purpose of material theories and constitutive laws
- elasticity (isotropic / anisotropic material models)
- phenomenology of inelastic material behavior (residual deformation, rate-dependence / creep, plastic incompressibility / dilatancy, pressure-dependence / independence, damage)
- concepts of constitutive modeling (internal variables, yield condition, flow rule, hardening laws, incremental constitutive equations)
- material theories: viscoelasticity, plasticity, viscoplasticity
- applications (metals, geomaterials, concrete, thermoplastic polymers, wood)

Recommendations
course Introduction to Continuum Mechanics (6200607)

Remarks
none

Literature
Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 60 h

independent study:
- preparation and follow-up lectures, exercises: 60 h
- examination preparation: 60 h

total: 180 h
Module: Material Science, Welding and Fatigue (engiM202-SCHWEISSEN) [M-BGU-100039]

Responsibility: Peter Knödel

Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften

Curricular Embedding: Compulsory Elective

Contained in: Profile / Construction Engineering
Profile / Modeling and Simulation in Construction Engineering
Profile / Building Preservation, Building Materials and Building Physics

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Compulsory

Identifier ‘Teilleistung’ CP Responsibility

T-BGU-100023 Material Science, Welding and Fatigue (S. 165) 6 Peter Knödel

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100023 with written examination according to § 4 Par. 2 No. 1
details about the learning control see at the ‘Teilleistung’

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students can
- assess the usability of different steel materials for different requirements,
- design constructionally weld joints and define requirements for their production and quality assurance,
- differentiate the usability of different welding techniques,
- design and construct steel components stressed by fatigue,
- evaluate failures of steel components.

Content
- materials: denotation of steels, physical and technological properties
- fatigue: influencing parameters, calculation concepts
- welding technology: welding techniques, welding instructions
- quality management: building law, implementation categories, competences
- fracture toughness: linear fracture mechanics
- designing of welded constructions: internal stresses, welding distortion
- material testing: non-destructive testing, material and weld joint failures

Recommendations
courses Theory of Building Materials (6200206), Basics in Steel Structures (6200504)

Remarks
none

Literature
lecture accompanying documents
DIN EN 1993-1-10: Bemessung und Konstruktion von Stahlbauten - Teil 1-10: Stahlsortenauswahl im Hinblick auf Bruchzähigkeit und Eigenschaften in Dickenrichtung
DIN EN 1090: Ausführung von Stahltragwerken und Aluminiumtragwerken
Workload
contact hours (1 HpW = 1 h x 15 weeks):
  • lecture/exercise: 60 h
independent study:
  • preparation and follow-up lecture/exercises: 60 h
  • examination preparation: 60 h
total: 180 h
Module: Materials Testing and Measuring Techniques (engiM112-MATPRÜF) [M-BGU-100061]

Responsibility: Nico Herrmann

Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften

Curricular Embedding: Compulsory Elective

Contained in: Profile / Construction Engineering
Profile / Modeling and Simulation in Construction Engineering
Profile / Building Preservation, Building Materials and Building Physics

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Compulsory

Identifier ‘Teilleistung’ CP Responsibility

T-BGU-100043 Materials Testing and Measuring Techniques (S. 166) 6 Nico Herrmann

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100043 with oral examination according to § 4 Par. 2 No. 2
details about the learning control see at the ‘Teilleistung’

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students can explain the basic knowledge of materials testing in the field of construction materials and concrete structures connected with the application in engineering constructions (e.g. bridges, power plants, etc.). They can name the basics of measuring techniques and are able to record the relevant measuring parameters for high-level material testing. The students develop self-reliantly a measurement concept, which they apply and evaluate.

Content
- introduction to different measurement techniques and their principles
- material testing of construction materials and elements
- basics in testing techniques and concepts
- examples from current research projects

Recommendations
none

Remarks
maximum number of participants: 12

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- Measuring Techniques in Civil Engineering lecture, exercise: 30 h
- Materials Testing in the Field of Concrete lecture: 30 h

independent study:
- preparation and follow-up lectures, exercises Measuring Techniques in Civil Engineering: 30 h
- preparation and follow-up lectures Materials Testing in the Field of Concrete: 30 h
- examination preparation: 60 h

total: 180 h
Module: Modeling in Solid Mechanics (engiM514-MODFEST) [M-BGU-101673]

Responsibility: Peter Betsch
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Modeling and Simulation in Construction Engineering

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Compulsory

Identifier 'Teilleistung' CP Responsibility
T-BGU-103223 Modeling Techniques in Solid Mechanics (S. 168) 6 Alexander Konyukhov

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-103223 with oral examination according to § 4 Par. 2 No. 2 details about the learning control see at the 'Teilleistung'

Grade of the Module
grade of the module is grade of the exam

Prerequisites

Qualification Goals
The students can explain and classify various numerical analysis of engineering structures based on geometrical models of different dimensionality bars, beams, shells and solids. They know the derivation of finite element models from the geometrical point of view together with corresponding hypothesis of deformation. They know, that this procedure is a model reduction and a continuous transformation from 3D continuum to the shell, beams and bar models. They can assign and use different computational methods and the corresponding set of finite elements for practical engineering problems.

Content
One- and multidimensional bodies are presented by differential geometry: provision of line and surface descriptions on the one hand and of selected curvilinear coordinate system for the description of three-dimensional solid bodies on the other hand. The kinematics of deformation is imparted in all cases with the associated forces on the one hand and the appropriate Dirichlet and Neumann boundary conditions on the other hand.

Available computational methods are explained: static methods with a-posteriori error estimation and mesh refinement; eigen value analyses and modal methods as well as their applications, e.g. with respect to stability problems; dynamic computations in implicit and explicit formulations; harmonic methods with application of resonance phenomena.

All models are illustrated with FEM software, including practical programming in ANSYS APDL.

Recommendations
course Introduction to Continuum Mechanics (6200607);
module Basics of Finite Elements [engiM501-GRUNDFE]

Remarks
none

Literature

**Workload**

Contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 60 h

Independent study:
- preparation and follow-up lectures, exercises: 45 h
- examination preparation: 75 h

Total: 180 h
Module: Module Master Thesis (engiMSC-THESIS) [M-BGU-100080]

Responsibility: Peter Vortisch
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory
Contained in: Master Thesis

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
thesis and final presentation according to § 12 ER/SPO

Grade of the Module
The grade of the module results from the evaluation of the Master Thesis and the final presentation.

Prerequisites
Modules in extent of minimum 42 CP has to be passed in order to be admitted to the Master Thesis according to ER/SPO § 12 Par. 1. Results obtained in the module Key Competences [engiMW0-SQUAL] cannot be counted for this purpose.

Qualification Goals
The student is able to investigate independently a complex problem within a particular research field of his choice in limited time, following scientific methods. He can search autonomously for literature, can find own approaches, can evaluate his results and can classify them according to the state of the art. He is further able to present clearly the essential matter and results in his master thesis and in a comprehensive presentation.

Content
The Master Thesis is an independent written report and comprises the theoretical or experimental work on a complex problem within a particular field of civil engineering with scientific methods. The topic of the master thesis derives from the students choice of a particular field. The student and can make proposals for the topic.

Recommendations
All technical skills and soft skills required for working on the selected topic and the preparation of the thesis should be attained.

Remarks
none

Workload
- working on thesis project: 720 h
- thesis writing: 150 h.
- preparation of presentation: 30 h

total: 900 h
**Module: Non-linear Analysis of Beam Structures (engiM401-NILI-STAB)**

**[M-BGU-100046]**

**Responsibility:** Werner Wagner

**Institution:** KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften

**Curricular Embedding:** Compulsory Elective

**Contained in:**
- Profile / Construction Engineering
- Profile / Modeling and Simulation in Construction Engineering
- Profile / Building Preservation, Building Materials and Building Physics

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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**
- ‘Teilleistung’ T-BGU-100030 with written examination according to § 4 Par. 2 No. 1
  details about the learning control see at the ‘Teilleistung’

**Grade of the Module**
grade of the module is grade of the exam

**Prerequisites**
none

**Qualification Goals**
The students can formulate and apply the main essential principles of the nonlinear analysis of beam structures (ultimate load design, II. Order theory, extensions and error analysis) as the basis for design and construction. They are able to compare and combine different methods.

**Content**
- material nonlinearity: basics of ultimate load design, plastic hinge 1st order theory
- incremental and direct calculation of the ultimate load, limit value theorems
- geometrical nonlinearity: equilibrium of 2nd order theory
- displacement methods
- predeformation
- iteration procedures
- stability problems
- combination of geometrical and material nonlinearity

**Recommendations**
courses Structural Analysis I+II (6200401, 6200501)

**Remarks**
none

**Literature**
lecture notes ‘Nichtlineare Modellierung von Stabtragwerken’
Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 60 h
independent study:
- preparation and follow-up lectures, exercises: 45 h
- examination preparation: 75 h
total: 180 h
Module: Non-linear Analysis of Surface Structures (engiM406-NILI-FTW) [M-BGU-100051]

Responsibility: Werner Wagner
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering
Profile / Modeling and Simulation in Construction Engineering

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Compulsory

Identifier ‘Teilleistung’ CP Responsibility
T-BGU-100035 Non-linear Analysis of Surface Structures (S. 170) 6 Werner Wagner

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100035 with oral examination according to § 4 Par. 2 No. 2
details about the learning control see at the ‘Teilleistung’

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students can classify and apply the essential principles of nonlinear analysis of surface structures. Hence, they are able to conduct even difficult static computations and use the required tools therefore methodically in an appropriate manner.

Content
- geometric nonlinear models of surface structures
- nonlinear material models for thin structures
- analytical and numerical surface structure analysis
- introduction to the modeling of shell structures
- application of stability and dynamic problems
- modeling of laminated structures
- practical examples

Recommendations
course Surface Structures (6214701), module Computational Analysis of Structures [engiM402-CTWM]

Remarks
none

Literature
lecture notes

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 60 h
independent study:
- preparation and follow-up lectures, exercises: 60 h
- examination preparation: 60 h
total: 180 h
Module: Numerical Methods in Structural Analysis (engiM405-FEM-BS)  
[M-BGU-100050]

Responsibility: Werner Wagner
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering  
Profile / Modeling and Simulation in Construction Engineering

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Compulsory

Identifier 'Teilleistung' CP Responsibility
T-BGU-100034 Numerical Methods in Structural Analysis (S. 171) 6 Ingo Münch, Werner Wagner

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-100034 with oral examination according to § 4 Par. 2 No. 2
  details about the learning control see at the 'Teilleistung'

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students will can develop finite element programs for beam and surface structures on the basis of methods from structural analysis and can integrate the numerical methods.

Content
- development of a program for truss structures with VBA
- input and output of data
- element stiffness matrices, transformation, solving of equations
- calculation of stress resultants
- programming force density method for cable structures
- iterative procedures for designing
- visualization of results
- FEM for surface structures
- numerical integration for surface structures
- discussion of FEM with approximation with low order interpolation functions
- elimination of numerical stiffness effects using specific integration and interpolation techniques

Recommendations
module Computational Analysis of Structures [engiM402-CTWM]

Remarks
none

Literature
lecture notes Computational Analysis of Structures
Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 60 h
independent study:
- preparation and follow-up lectures, exercises: 60 h
- examination preparation: 60 h
total: 180 h
Module: Numerical Modelling in Geotechnics (engiM710-NUMMOD) [M-BGU-100075]

Responsibility: Theodoros Triantafyllidis
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Geotechnics

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Compulsory

Identifier: 'Teilleistung’ CP Responsibility
T-BGU-100107 Numerical Modelling in Geotechnics (S. 172) 6 Andrzej Niemunis

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung’ T-BGU-100107 with oral examination according to § 4 Par. 2 No. 2
details about the learning control see at the 'Teilleistung’

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students can develop numerical solutions for typical geotechnical boundary value problems by themself and implement them by programming with FORTRAN95. They got to know FE applications in several fields of geotechnics (foundation, rock and tunnel construction, dam construction), got practical experience with the FE code ABAQUS (TM) and applied this for the modeling of example problems. They are able to interpret and evaluate critically results of numerical simulations.

Content
- beam on elastic half-space
- slope stability with layer procedure according to Bishop
- 2D and 3D pile rafts with lateral bedding
- FE-modeling of spatially correlated fluctuations of soil parameters
- FE settlement prediction with nonlinearity for small strains
- introduction to the FE-program ABAQUS: definition of joints and elements, assignment of material laws, definition of initial and boundary conditions
- examples of FE-applications in tunnel engineering
- numerical FE-modeling of a deep pit excavation under consideration of the construction sequence
- numerical FE-modeling of seepage through a zoned dam with partial saturation (different load cases)
- linear dynamics using ABAQUS

Recommendations
module Basics of Numeric Modelling [engiM704-NUMGRUND]

Remarks
none

Literature
Workload
contact hours (1 HpW = 1 h x 15 weeks):
- Exercises in Numerical Modelling: 30 h
- FEM Applications in Geotechnical Modelling lecture: 30 h
independent study:
- preparation and follow-up Exercises in Numerical Modelling: 15 h
- preparation and follow-up lectures FEM Applications in Geotechnical Modelling: 15 h
- exercises with available software: 30 h
- examination preparation: 60 h

total: 180 h
Module: Numerical Structural Dynamics (engiM513-NUMSTRDYN) [M-BGU-100579]

Responsibility: Peter Betsch
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Modeling and Simulation in Construction Engineering

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Compulsory

Identifier ‘Teilleistung’ CP Responsibility
T-BGU-100999 Computational Structural Dynamics (S. 132) 6 Peter Betsch

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100999 with oral examination according to § 4 Par. 2 No. 2
details about the learning control see at the ‘Teilleistung’

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
see German version

Content
see German version

Recommendations
module Basics in Finite Elements [engiM501-GRUNDFE]

Remarks
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lectures, exercises: 60 h
independent study:
- preparation and follow-up: 45 h
- working on programming exercises: 30 h
- examination preparation and examination: 45 h
total: 180 h
Module: Rock Engineering and Underground Construction (engiM709-FELSHOHL) [M-BGU-100074]

Responsibility: Theodoros Triantafyllidis
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Geotechnics

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Compulsory

Identifier 'Teilleistung' CP Responsibility

T-BGU-100074 Rock Engineering and Underground Construction (S. 176) 6 Peter Kudella

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-100074 with written examination according to § 4 Par. 2 No. 1
details about the learning control see at the 'Teilleistung'

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students are familiar with planning, construction and design of safety systems for embankments and hillsides in bedrock. They can identify critical failure mechanisms, conduct respective stability analyses and design anchoring. They know setup and function of tunnel boring machines and tunneling techniques by own perception and can select appropriate tunnel boring technologies. They can transfer deepened knowledge about strength and deformation properties of bedrock and the precursory and accompanied exploration to the rehabilitation of existing tunnels.

Content
see German version

Recommendations
module Rock Engineering and Tunneling [engiM703-FMTUB]

Remarks
none

Literature
Workload
contact hours (1 HpW = 1 h x 15 weeks):
- Aboveground Rock Engineering lecture/exercise: 30 h
- Tunnel Construction in Soils and in Existence lecture/exercise: 30 h
- field trips: 10 h
independent study:
- preparation and follow-up lecture/exercises Aboveground Rock Engineering: 25 h
- preparation and follow-up lecture/exercises Tunnel Construction in Soils and in Existence: 25 h
- examination preparation: 60 h

total: 180 h
Module: Rock Mechanics and Tunneling (engiM703-FMTUB) [M-BGU-100069]

Responsibility: Theodoros Triantafyllidis
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Geotechnics

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<tr>
<td>T-BGU-100069</td>
<td>Rock Mechanics and Tunneling (S. 178)</td>
<td>5</td>
<td>Carlos Grandas Tavera, Theodoros Triantafyllidis</td>
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<td>T-BGU-100179</td>
<td>Student Research Project ‘Rock Mechanics and Tunneling’ (S. 194)</td>
<td>1</td>
<td>Carlos Grandas Tavera, Theodoros Triantafyllidis</td>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100179 with not graded accomplishment according to § 4 Par. 3
- ‘Teilleistung’ T-BGU-100069 with written examination according to § 4 Par. 2 No. 1

details about the learning controls see at the respective ‘Teilleistung’

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students understand the essential strength and deformation properties of rock and master the basic analytical methods to solve boundary value problems of surface and underground rock excavation. They can select basic construction methods and constructions in underground tunnel construction and apply self-reliantly the methods of rock mechanics and static calculation and safety assessments. With regard to the assessment of variants, costs, construction operation and safety aspects they gained geotechnical competence in solving problems for all kinds of constructions in and with solid rocks.

Content
see German version

Recommendations
basic knowledge of Engineering Geology;
compilation and submission of student research project as examination preparation until examination date

Remarks
none

Literature
[8] Müller, L. 1978: Der Felsbau, Bd. 3 Tunnelbau
Workload
contact hours (1 HpW = 1 h x 15 weeks):
- Basics in Rock Mechanics lecture/exercise: 30 h
- Basics in Tunnel Construction lecture/exercise: 30 h

independent study:
- preparation and follow-up lecture/exercises Basics in Rock Mechanics: 20 h
- preparation and follow-up lecture/exercises Basics in Tunnel Construction: 20 h
- preparation of student research project: 20 h
- examination preparation: 60 h

total: 180 h
Module: Shell Structures and Stability of Structures (engiM404-STABISHELL) [M-BGU-100049]

Responsibility: Werner Wagner
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering
Profile / Modeling and Simulation in Construction Engineering

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<td>T-BGU-100254</td>
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<td>Ingo Münch, Werner Wagner</td>
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<td>T-BGU-100033</td>
<td>Shell Structures and Stability of Structures (S. 180)</td>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-100254 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-BGU-100033 with oral examination according to § 4 Par. 2 No. 2

details about the learning controls see at the respective 'Teilleistung'

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students can formulate and apply analytical and computational modeling of shell structures and of stability problems.

Content
- shell structures in nature and technique
- membrane and bending theory of rotational shells
- analytical solutions for rotational shells
- force value method for rotational shells,
- FE-modeling of shell structures
- basics of stability theory for structures
- analytical solutions for stability endangered structures
- sensitivity and imperfections for beam and surface structures
- numerical models for path following
- bifurcation
- buckling of shells
- practical examples

Recommendations
course Surface Structures (6214701)

Remarks
none

Literature
lecture notes Schalentragwerke
lecture notes Stabilität der Tragwerke
Workload

contact hours (1 HpW = 1 h x 15 weeks):
  • Shell Structures lecture, exercise: 30 h
  • Stability of Structures lecture, exercise: 30 h

independent study:
  • preparation and follow-up lectures, exercises Shell Structures: 15 h
  • preparation and follow-up lectures, exercises Stability of Structures: 15 h
  • preparation of student research project (exam prerequisite): 50 h
  • examination preparation: 40 h

total: 180 h
Module: Solid Construction Bridges (engiM104-MASSBRUE) [M-BGU-100037]

Responsibility: Lothar Stempniewski

Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften

Curricular Embedding: Compulsory Elective

Contained in: Profile / Construction Engineering

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Compulsory

Identifier 'Teilleistung' CP Responsibility

T-BGU-100020 Solid Construction Bridges (S. 181) 6 Lothar Stempniewski

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-100020 with written examination according to § 4 Par. 2 No. 1

details about the learning control see at the 'Teilleistung'

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
Based on the module ‘Basics of Prestressed Concrete’ the students can explain the peculiarity of bridge constructions. In addition, they can describe the principle procedure of the design of solid construction bridges and can conduct these. Hence, the students can describe the differences to classical structural engineering and the introduction to current standards.

Content
- construction methods, production and impacts
- proof in ultimate limit state and in serviceability limit state
- types of supports

Recommendations
module Basics of Prestressed Concrete [engiM103-GDLSPANNB]

Remarks
none

Literature
lecture notes

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 60 h

independent study:
- preparation and follow-up lectures, exercises: 45 h
- examination preparation: 75 h

total: 180 h
Module: Special Issues of Soil Mechanics (engiM705-SPEZBM) [M-BGU-100005]

Responsibility: Theodoros Triantafyllidis

Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften

Curricular Embedding: Compulsory Elective

Contained in: Profile / Geotechnics

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<td>Special Issues of Soil Mechanics (S. 182)</td>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-100071 with oral examination according to § 4 Par. 2 No. 2 details about the learning control see at the 'Teilleistung'

Grade of the Module
grade of the module is grade of the exams

Prerequisites
none

Qualification Goals
The students master a wide range of mechanical, hydraulic and numerical tools for the processing of specific soil mechanical problems. They can comprehend the cross-linking of hydraulic, mechanical and chemical processes under partial saturation. They can use the dynamic and cyclic laboratory techniques and apply material laws operationally for the calculation and calibration of experiments. They can describe and evaluate constructionally vibrations and waves in elastic continua and real soils in the range of strains from small shakes up to earthquakes.

Content
see German version

Recommendations
module Theoretical Soil Mechanics [engiM705-THEOBM]

Remarks
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- Unsaturated, Viscous and Cyclic Soil Behaviour - Theory and Element Tests lecture/exercise: 30 h
- Soil Dynamics lecture/exercise: 30 h

independent study:
- preparation and follow-up lecture/exercises Soil Dynamics: 15 h
- exercises with available software: 30 h
- examination preparation: 60 h

total: 180 h
Module: Special Underground Engineering (engiM712-SPEZTIEF) [M-BGU-100078]

Responsibility: Theodoros Triantafyllidis
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Geotechnics

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<td>T-BGU-100080</td>
<td>Ground Improvement, Grouting and Soil Freezing</td>
<td>3</td>
<td>Wolfgang Orth</td>
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<td>T-BGU-100079</td>
<td>Anchoring, Piling and Slurry Wall Technology</td>
<td>3</td>
<td>Theodoros Triantafyllidis</td>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100080 with oral examination according to § 4 Par. 2 No. 2
- ‘Teilleistung’ T-BGU-100079 with oral examination according to § 4 Par. 2 No. 2
details about the learning controls see at the respective ‘Teilleistung’

Grade of the Module
grade of the module is CP weighted average of grades of the partial exams

Prerequisites
none

Qualification Goals
The students can name performance, ranges of application, necessary preliminary investigations and accompanying controls (monitoring) for special underground engineering technologies. They can select self-reliantly appropriate technologies for certain construction problems, describe and dimensioning the steps of the procedure, motivate required preinvestigations, specify parameters for the realization and define the type of controls of execution. They can describe the principles of the observation method and the construction measurement technology and the controls for quality assurance.

Content
The module goes into specific construction techniques of special underground engineering and discusses questions of application limitation, of designing and proofs of safety, requirements for equipement, execution controls and advices for avoiding errors and minimizing risks:
- soil freezing techniques
- injection techniques
- soil improvement techniques
- implementation of slurry and seal walls
- drilling and anchor techniques for grouted anchors
- execution of piles

Recommendations
none

Remarks
none

Literature
[1] Triantafyllidis, Th. (1990), Planung und Bauausführung im Spezialtiefbau, Teil 1, Ernst & S.
Workload

contact hours (1 HpW = 1 h x 15 weeks):
- Ground Improvement, Grouting and Soil Freezing lecture/exercise: 30 h
- Anchoring, Piling and Slurry Wall Technology lecture/exercise: 30 h
- field trips: 10 h

independent study:
- preparation and follow-up lecture/exercises Ground Improvement, Grouting and Soil Freezing: 25 h
- examination preparation Ground Improvement, Grouting and Soil Freezing (partial exam): 30 h
- preparation and follow-up lecture/exercises Anchoring, Piling and Slurry Wall Technology: 25 h
- examination preparation Anchoring, Piling and Slurry Wall Technology (partial exam): 30 h

total: 180 h
Module: Steel and Composite Structures (engiM201-STAHLBAU) [M-BGU-100034]

Responsibility: Thomas Ummenhofer
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering
Profile / Modeling and Simulation in Construction Engineering
Profile / Building Preservation, Building Materials and Building Physics

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<td>T-BGU-100016</td>
<td>Steel and Composite Structures (S. 184)</td>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-100171 with not graded accomplishment according to § 4 Par. 3
- 'Teilleistung' T-BGU-100016 with written examination according to § 4 Par. 2 No. 1
details about the learning controls see at the respective 'Teilleistung'

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students can design and construct structures in steel and steel composite construction method. Further, they can calculate structures and building components made of thin-walled, cold formed steelwork components. They are able to proof fire protection in steel constructions and to design torsion-loaded components of any cross section.

Content
- basics of steel composite structures
- light-weight steel construction
- fire protection in steel constructions
- the theory of torsion

Recommendations
lecture Basics in Steel Structures (6200504)

Remarks
none

Literature
Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 60 h

independent study:
- preparation and follow-up lectures, exercises: 25 h
- preparation of student research project: 45 h
- examination preparation: 50 h

total: 180 h
Module: Structures in Steel and Timber (engiM602-TSH) [M-BGU-100042]

Responsibility: Thomas Ummenhofer
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering

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<td>Structures in Steel (S. 185)</td>
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<td>Structures in Timber (S. 186)</td>
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<td>Matthias Frese</td>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-106798 with examination of other type according to § 4 Par. 2 No. 3
- ‘Teilleistung’ T-BGU-106799 with oral examination according to § 4 Par. 2 No. 2

details about the learning controls see at the respective ‘Teilleistung’

Grade of the Module
grade of the module is CP weighted average of grades of the partial exams

Prerequisites
none

Qualification Goals
The students can name typical supporting structures for building construction (for steel and timber) and the construction and connecting elements required for production. They can describe, model correctly and outline analytically the supporting effect of constructions and their single elements. They can identify assets and drawbacks of constructions, and they are able to develop design options under given conditions, to assess these and based on this to opt for reasonable design and construction solutions. The students can describe the most important damages and their reasons. They are able to prevent damages during constructing and designing supporting structures by creativity, accuracy and complex cross-linked thinking. By that they are able to design reliable and permanent constructions.

Content
- structure design and constructive detail design in structural and bridge engineering
- classification of damages independent of building materials
- definitions of the sphere, in which damages and failures occur
- damages and failures that are typical for timber structures

Recommendations
course Basics in Steel Structures (6200504), modules Steel and Composite Structures [engiM201-STAHLBAU], Timber Structures [engiM301-HB]

Remarks
none

Literature
lecture accompanying documents
Workload

contact hours (1 HpW = 1 h x 15 weeks):
- Structures in Steel lectures, exercises and discussions: 15 h
- Structures in Timber lecture/exercise: 30 h

independent study:
- preparation of design project Structures in Steel, preparation of final presentation (partial exam): 80 h
- preparation and follow-up lecture/exercises Structures in Timber: 45 h
- examination preparation Structures in Timber (partial exam): 15 h

total: 185 h
Module: Surface Structures and Dynamics of Structures (engiM601-FTW-BD) [M-BGU-100035]

Responsibility: Werner Wagner
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering
Profile / Modeling and Simulation in Construction Engineering
Profile / Building Preservation, Building Materials and Building Physics

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<td>T-BGU-107819</td>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
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- ‘Teilleistung’ T-BGU-107819 with not graded accomplishment according to § 4 Par. 3
- ‘Teilleistung’ T-BGU-100017 with written examination according to § 4 Par. 2 No. 1
- ‘Teilleistung’ T-BGU-100077 with written examination according to § 4 Par. 2 No. 1

Details about the learning controls see at the respective ‘Teilleistung’

Grade of the Module
The grade of the module is CP weighted average of grades of the partial exams

Prerequisites
none

Qualification Goals
The students gain the ability to write up and apply the essential principles for surface structures (theory, models, analytical and numerical solution procedures and error analysis) as basis for design and construction. They are further able to analyze the vibration behavior of structures in the context of mechanical modeling. The students can apply concepts for the avoidance of vibrations and the reduction of vibrations to a tolerable extent and can describe fundamental vibration phenomena by means of small scale building models.

Content
Surface Structures:
- panel structures models and basic equations
- PDE and BCs for panel structures and analytical solutions
- FEM for panel structures (general/rot. symmetry)
- practical related solutions for panel structures with truss models
- plate structures models and basic equations
- PDE and simplifications for plate structures
- analytical solutions for plate structures, incl. serial solutions
- FEM for plate structures (general/rot. symmetry)
- practical related solutions for plate structures
- elastic foundation, temperature load and influence surfaces
• introduction to shell structures

Dynamics of Structures:
Vibratory structural-mechanical constructions with finite degrees of freedom are considered. The vibration analysis is based on linearized equations of motion and their solutions. Non-damped and damped free oscillations caused by different kinds of excitations are discussed. This includes measures avoiding and reducing vibrations of structures.

Recommendations
lectures in Structural Analysis I+II (6200401, 6200501);
laboratory course Dynamics of Structures (6215905) in addition to the lecture Dynamics of Structures (6215701)

Remarks
none

Literature
Surface Structures:
lecture notes Flächentragwerke
Dynamics of Structures:
lecture notes: P. Vielsack: Grundlagen der Baudynamik

Workload
contact hours (1 HpW = 1 h x 15 weeks):
• Surface Structures lecture: 30 h
• Dynamics of Structures lecture: 30 h
independent study:
• preparation and follow-up lectures Surface Structures: 15 h
• preparation of student research project ‘Surface Structures’ (not graded accomplishment): 20 h
• examination preparation Surface Structures (partial exam): 25 h
• preparation and follow-up lectures Dynamics of Structures: 15 h
• preparation of student research project ‘Dynamics of Structures’ (not graded accomplishment): 20 h
• examination preparation Dynamics of Structures (partial exam): 25 h
total: 180 h
Module: Tank Construction (engiM206-BEHBAU) [M-BGU-100580]

Responsibility: Peter Knödel
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering
Profile / Modeling and Simulation in Construction Engineering

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<td>Term Paper Tank Construction (S. 201)</td>
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<td>Tank Construction (S. 200)</td>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-101001 with examination of other type according to § 4 Par. 2 No. 3
- 'Teilleistung' T-BGU-101000 with oral examination according to § 4 Par. 2 No. 2
details about the learning controls see at the respective 'Teilleistung'

Grade of the Module
grade of the module is CP weighted average of grades of the partial exams

Prerequisites
none

Qualification Goals
The students can design and construct tank and silo structures and they can assess the influences on the structural behavior of shell structures:
- They can apply scientific methods for the system analysis of tanks.
- They can develop problem solutions beyond the application of the regulations for tank constructions.
- They have the ability to work interdisciplinarily at the interface to plant engineering and construction.
- They can compile complex technical facts and impart them to a plenary assembly.

Content
- classification of tank and silo types
- application related material selection
- actions on storage structures: characteristics of wind loads (e.g. flow around cylinders), filling, internal pressure, earthquakes and explosions
- structural behavior of shell structure
- strength and stability check by linear and non-linear calculations under comparison of handouts with FE models
- design and construction
- specific problems

Recommendations
The contents of the lecture Basics in Steel Structures (6200504) are required. Contents of the modules Surface Structures and Dynamics of Structures [engiM601-FTW-BD] as well as Steel and Composite Structures [engiM201-STABISTB] are recommended.

Remarks
none

Literature
lecture notes
DIN EN 1993-4-1: Bemessung und Konstruktion von Stahlbauten - Teil 4-1: Silos.

Workload

contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 45 h
- discussion on term paper: 15 h

independent study:
- preparation and follow-up lectures, exercises: 20 h
- preparation of term paper (partial exam): 80 h
- examination preparation (partial exam): 20 h

total: 180 h
Module: Theoretical Soil Mechanics (engiM701-THEOBM) [M-BGU-100067]

Responsibility: Theodoros Triantafyllidis
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Geotechnics

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Compulsory

Identifier 'Teilleistung' CP Responsibility
T-BGU-100067 Theoretical Soil Mechanics (S. 203) 6 Theodoros Triantafyllidis

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-100067 with written examination according to § 4 Par. 2 No. 1
details about the learning control see at the 'Teilleistung'

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students obtained a scientific based understanding of the essential behavior of soil under monotonic and cyclic load with and without effects of time regarding large and small deformations. They are able to describe relations in soil mechanics mathematically and physically correctly. They can understand the tensorial terminology of modern geotechnical literature and can apply computing programs to comprehend element tests. They recognize self-reliantly relevant mechanisms of boundary value problems and can specify the limitations of simple engineering models.

Content
advanced theoretical basics of soil behavior:
- geotechnical invariants of stress and strain
- failure criteria according to Coulomb, Matsuoka-Nakai etc.
- contractancy and dilatancy
- critical density
- failure criteria according to Krey-Tiedemann
- soil behavior under partial saturation
- collapse theorems and their application (Kinematic Element Analysis)
- elasticity in soil mechanics (isotropic and anisotropic)
- elastoplasticity with volumetric hardening using the example of the Cam-Clay-Model
- soil behavior under cyclic loading
- one-dimensional viscoplasticity

Recommendations
fundamentals in soil mechanics and continuum mechanics, module Basics of Numerical Modelling [engiM701-THEOBM]

Remarks
none

Literature
Niemunis (2009): Über die Anwendung der Kontinuumstheorie auf bodenmechanische Probleme (download)
Workload
contact hours (1 HpW = 1 h × 15 weeks):
- lecture/exercise: 60 h
independent study:
- preparation and follow-up lecture/exercises: 30 h
- working with available software: 30 h
- examination preparation: 60 h
total: 180 h
Module: Timber and Wood-Based Materials (engiM302-HHW) [M-BGU-100045]

Responsibility: Hans Joachim Blaß

Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften

Curricular Embedding: Compulsory Elective

Contained in: Profile / Construction Engineering, Profile / Building Preservation, Building Materials and Building Physics

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Compulsory

Identifier | ‘Teilleistung’ | CP | Responsibility
---|---|---|---
T-BGU-100029 | Timber and Wood-Based Materials (S. 204) | 6 | Hans Joachim Blaß, Carmen Sandhaas

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- ‘Teilleistung’ T-BGU-100029 with oral examination according to § 4 Par. 2 No. 2
  details about the learning control see at the ‘Teilleistung’

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students can utilize the building material timber and its derived products in civil engineering appropriately and are aware of possible problems caused by the hygroscopic, anisotropic, heterogeneous and biological properties of wood. They developed methods to handle the variable properties of timber in construction practice. The students can develop different timber-based materials target-oriented by themselves based on wood-anatomic, wood-physical and biological knowledge. Their questionable and critical cogitation is educated with respect to well realized, robust and reliable details of timber construction and the students can transfer problems from civil engineering to other context. Based on their material understanding the students can analyse and evaluate the material-specific quality of construction details.

Another competence after completing the module is the ability to read, analyse and comprehend coherently and critically English-language technical texts. A short scientific presentation is developed and presented in English as teamwork.

Content
- wood anatomy
- wood characteristics
- wood physics
- durability
- drying and strength grading of wood
- solid timber
- engineered wood products
- glued laminated timber
- wood-based panels

Recommendations
module Timber Structures [engiM301-HB]

Remarks
none
Literature
lecture notes „Holz und Holzwerkstoffe“, Lehrstuhl für Holzbau und Baukonstruktionen, Karlsruher Institut für Technologie (in German)

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture/exercise: 60 h
independent study:
- preparation and follow-up lecture/exercises, preparation of scientific presentation: 60 h
- examination preparation: 60 h
total: 180 h
Module: Timber Structures (engiM301-HB) [M-BGU-100044]

Responsibility: Hans Joachim Blaß
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Construction Engineering

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Identifier 'Teilleistung' CP Responsibility
T-BGU-100028 Timber Structures (S. 205) 6 Hans Joachim Blaß

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-100028 with written examination according to § 4 Par. 2 No. 1
details about the learning control see at the 'Teilleistung'

Grade of the Module
grade of the module is grade of the exam

Prerequisites
none

Qualification Goals
The students are able to design composite glued or mechanically jointed components as well as special connection details. They have knowledge about detailing for durability and fire resistance of timber. The students are qualified to design timber structures.

Content
- elements: mechanically jointed beams, stressed skin panels, purlins
- joints: moment resisting connections, multiple-shear joints with dowel-type fasteners, joist hangers and framing anchors, reinforced connections
- construction details: tension perpendicular to the grain in joints, notched beam and holes in glulam beams, fire resistance, detailing for durability, durability - preservative treatment

Recommendations
none

Remarks
none

Literature
Blaß, H.J.; Görlacher, R.; Steck, G. (Ed.) Holzbauwerke STEP 1 - Bemessung und Baustoffe. Fachverlag Holz, Düsseldorf, 1995 (ISSN-Nr. 04462114)

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 60 h
independent study:
- preparation and follow-up lectures, exercises: 45 h
- examination preparation: 75 h
total: 180 h

Engineering Structures (M.Sc.), ER/SPO 2013
Module handbook Summer term 2019, as at 03/27/2019
Module: Upgrading of Existing Buildings and Energetic Refurbishment (engiM801-)
[M-BGU-100108]

Responsibility: Kunibert Lennerts
Institution: KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Curricular Embedding: Compulsory Elective
Contained in: Profile / Building Preservation, Building Materials and Building Physics

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
- 'Teilleistung' T-BGU-100621 with examination of other type according to § 4 Par. 2 No. 3
- 'Teilleistung' T-BGU-108001 with written examination according to § 4 Par. 2 No. 1
details about the learning controls see at the respective 'Teilleistung'

Grade of the Module
grade of the module is CP weighted average of grades of the partial exams

Prerequisites
none

Qualification Goals
Students understand the economic, ecological and cultural significance of the building stock and to describe the specific tasks for a civil engineer in this field of activity. You can explain the advantages and disadvantages of different maintenance strategies and maintenance budgets can be calculated for real estate stocks. You know the basics of a technical due diligence and the basics of building information modeling. In addition, students may constitute the legal framework for energy rehabilitation measures and can use the methods of the energy performance of buildings apply.

Content
- durability and wear of components
- determination of component lifetimes
- budgeting of maintenance costs
- condition assessment & action planning
- monument and Historic Monuments
- building Information Modeling (BIM)
- policy development and historical development of the energy savings
- forms of energy and calculation of energy use
- energy efficiency of buildings by Energy Saving Ordinance
- renewables

Recommendations
none

Remarks
none
Workload
contact hours (1 HpW = 1 h x 15 weeks):
- Upgrading of Existing Buildings lecture, exercise: 45 h
- Energetic Refurbishment lecture: 15 h

independent study:
- preparation and follow-up lectures/exercises Upgrading of Existing Buildings: 30 h
- preparation and follow-up lectures Energetic Refurbishment: 15 h
- preparation of term paper (partial examination): 25 h
- examination preparation (partial examination): 50 h

total: 180 h
Part III
'Teilleistungen'

'Teilleistung': Anchorage in Concrete [T-BGU-100022]

Responsibility: Lothar Stempniewski
Contained in: [M-BGU-100001] Anchorage in Concrete

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 20 min.

Prerequisites
none

Recommendations
none

Remarks
none
Course Excerpt: Anchoring, Piling and Slurry Wall Technology (SS 2019)

Aim
The students know performance, ranges of application, necessary preliminary investigations and accompanying controls (monitoring) for anchoring, piling and slurry walls. They can select self-reliantly required pre-investigations, specify parameters for the realization, perform static proofs and define the type of controls of execution. They are familiar with the principles of the observation method and the construction measurement technology and the controls for quality assurance.

Content
- Slurry walls: Application ranges of diaphragm and slurry walls, guide walls, trench excavation, internal and external stability of open slurry trenches, corner trenches, support fluids, suspension clays and their testing, joints and joint constructions, reinforcement and concreting of diaphragm walls, FE simulation of construction.
- Anchoring: Ground anchor types, standards, certifications, recommendations, function and constructions, corrosion protection, anchor drilling and mounting, dimensioning and load capacity, group effects, checks due to DIN 1537, supervision, use in aggressive environment
- Piling: cast concrete caissons, borehole support, machinery, drilling technology and tools, distinctive features, pile reinforcement and concreting

Literature
Triantafyllidis, Th. (1990), Planung und Bauausführung im Spezialtiefbau, Teil 1, Ernst & S.
Seitz, J. & Schmidt, H.-G. (2000), Bohrpfähle Ernst & S.
'Teilleistung': Applied Building Physics [T-BGU-100039]

Responsibility: Engin Kotan

Contained in: [M-BGU-100059] Building Physics I

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 20 min.

Prerequisites
none

Recommendations
none

Remarks
none
### 'Teilleistung': Applied Dynamics of Structures [T-BGU-100021]

**Responsibility:** Lothar Stempniewski  
**Contained in:** [M-BGU-100038] Applied Dynamics of Structures

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#### Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 30 min.

**Prerequisites**

- none

**Recommendations**

- none

**Remarks**

- none
Course: Foundations and Retaining Structures (SS 2019)

Aim
The students know the construction technologies for pile foundations and deep excavations. They make self-dependent reasonable design decisions with regard to geological engineering, site managing and economical boundary conditions. They can evaluate the interaction of building, foundation and subsoil and perform design and proof of ultimate limit state by themselves. They know and use relevant guidelines and link constructional experience, dimensioning rules and standardization to theoretical knowledge about soil mechanics.

Content
- pile types
- load bearing resistance and deformations of individual piles in axial and lateral direction
- negative skin friction
- elastic subgrade reaction and plastic flow resistance
- load bearing resistance and settlement of pile groups
- recommendations EA-Pfähle and pile tests
- pile raft design
- stress trapezoid, ground reaction and elastic halfspace method for slab foundations
- gravity walls, cantilever retaining walls, stone cages, space lattice walls, underpinning
- trench sheeting, timber sheeting
- soldier pile walls, sheetpile walls, diaphragm walls
- anchoring and struts
- dig-and-cast construction method
- bottom sealing and immersed troughs, grouted slabs, jetgrout slabs, underwater concrete
- uplift piles and anchors

Literature
Seitz, J. & Schmidt, H.-G. (2000), Bohrpfähle Ernst & S.
Triantafyllidis, Th. (1990), Planung und Bauausführung im Spezialtiefbau, Teil 1, Ernst & S.
V Course Excerpt: Special Foundation Engineering and Design (SS 2019)

Aim
The students overlook geotechnical constructions for slope stabilization, geotextiles, caissons and other specialized technologies and know their relevant design rules and proofs of stability. For proofs of ultimate limit state and serviceability limit state they can establish simple mechanical models by themselves and use customary numerical tools as well. They know and use relevant guidelines.

Content
- static and dynamic pile testing
- combined pile-raft foundations
- caisson foundations
- soil reinforcement, geosynthetics and EBGEO recommendations
- soil nailing
- recommendations EAB: load approaches, special shapes of excavations, excavations next to buildings, excavations in rock and soft soils
- buried structures
- numerical design and deformation prediction using elastic-beam models
- numerical design and deformation prediction using elastoplastic FE-models, recommendations for modelling, 3D-FEM in examples
- recommendations EAU

Literature
EAB (2012), Deutsche Ges. f. Geotechnik, 5. Aufl., Ernst & S.
'Teilleistung': Basics of Finite Elements [T-BGU-100047]

Responsibility: Peter Betsch

Contained in: [M-BGU-100052] Basics of Finite Elements

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 30 min.

Prerequisites
none

Recommendations
none

Remarks
none
### Teilleistung: Basics of Prestressed Concrete [T-BGU-100019]

**Responsibility:** Lothar Stempniewski  
**Contained in:** [M-BGU-100036] Basics of Prestressed Concrete

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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**  
written exam, 90 min.

**Prerequisites**  
none

**Recommendations**  
none

**Remarks**  
none
'Teilleistung': Bracing and Stability in Reinforced Concrete [T-BGU-100018]

Responsibility: Lothar Stempniewski
Contained in: [M-BGU-100003] Bracing and Stability in Reinforced Concrete

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
written exam, 90 min.
Prerequisites
none

Recommendations
none

Remarks
none
'Teilleistung': Brownfield Sites - Investigation, Evaluation, Rehabilitation

Responsibility: Andreas Bieberstein

Contained in: [M-BGU-100079] Environmental Geotechnics

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013

oral exam, appr. 20 min.

Prerequisites

none

Recommendations

none

Remarks

none

Course Excerpt: Brownfield Sites - Investigation, Evaluation, Rehabilitation (WS 18/19)

Aim

The students are able to interlink interdisciplinary the chemical, mineralogical, biological, hydraulic and geotechnical aspects dealing with brownfields. They can choose reasonably between the relevant remediation technologies and assess their limits of applications and risks.

Content

· introduction to the problematic of brownfields investigation and location assessment of brownfields
· harmful substances and their behavior in the environment
· environmental-chemical and mineralogical aspects of the accumulation of harmful substances in soil
· natural attenuation and active microbiological decontamination procedures
· reactive walls and electro-kinetic decontamination procedures
· soil washing, combustion, pyrolysis
· immobilization and compression, geotechnical aspects of the containment of industrial waste landfills
· hydraulic and pneumatic decontamination procedures
· sustainability aspects for brownfield rehabilitation
· case-studies, excursion

Literature

Reiersloh, D und Reinhard, M. (2010): Altlastenratgeber für die Praxis, Vulkan-V. Essen
"Teilleistung": Building Preservation of Concrete and Masonry Constructions

[ T-BGU-100038 ]

Responsibility: Engin Kotan

Contained in: [ M-BGU-100058 ] Building Preservation of Concrete and Masonry Constructions

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 30 min.

Prerequisites
none

Recommendations
none

Remarks
none
"Teilleistung": Building Preservation of Steel and Timber Structures
[T-BGU-100027]

Responsibility: Matthias Frese, Thomas Ummenhofer

Contained in: [M-BGU-100043] Building Preservation of Steel and Timber Structures

Credit Points: 6
Language: German
Recurrence Frequency: Each term
Type of Learning Control: written examination
Version: 1

Courses

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
written exam, 90 min. (45 min. for each course)

Prerequisites
none

Recommendations
none

Remarks
none
### Teilleistung: Building Technology [T-BGU-100040]

- **Responsibility:** Stefan Wirth
- **Contained in:** [M-BGU-100059] Building Physics I

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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**
oral exam, appr. 20 min.

**Prerequisites**
none

**Recommendations**
none

**Remarks**
none
'Teilleistung': Computational Analysis of Structures [T-BGU-100031]

Responsibility: Werner Wagner

Credit Points: 4
Language: German
Recurrence Frequency: Each term
Type of Learning Control: oral examination
Version: 3

Courses

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 30 min.

Prerequisites
Student research project “Computational Analysis of Structures” has to be passed.

Modeled Conditions
The following conditions must be met:

- The course [T-BGU-100174] Student Research Project ‘Computational Analysis of Structures’ must have been passed.

Recommendations
none

Remarks
none
'Teilleistung': Computational Structural Dynamics [T-BGU-100999]

Responsibility: Peter Betsch
Contained in: [M-BGU-100579] Numerical Structural Dynamics

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 30 min.

Prerequisites
none

Recommendations
none

Remarks
none
'Teilleistung': Concrete Construction Technology [T-BGU-100036]

Responsibility: Frank Dehn
Contained in: [M-BGU-100056] Concrete Construction Technology

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 30 min.

Prerequisites
none

Recommendations
none

Remarks
none
### 'Teilleistung': Construction of Steel and Composite Bridges [T-BGU-100024]

#### Responsibility:
Thomas Ummenhofer

#### Contained in:
[M-BGU-100040] Construction of Steel and Composite Bridges

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#### Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, 60 min.

#### Prerequisites
none

#### Recommendations
none

#### Remarks
none
### 'Teilleistung': Contact Mechanics [T-BGU-109947]

**Responsibility:** Marlon Franke  
**Contained in:** [M-BGU-104916] Contact Mechanics

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- **Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**  
  oral exam, appr. 30 min.

**Prerequisites**  
none

**Recommendations**  
none

**Remarks**  
none
### 'Teilleistung': Contact Mechanics - Computational Algorithms in a Geometrically Exact Form [T-BGU-100618]

**Responsibility:** Alexander Konyukhov  
**Contained in:** [M-BGU-100337] Contact Mechanics - Computational Algorithms in a Geometrically Exact Form

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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**

oral exam, appr. 30 min.

**Prerequisites**  
none

**Recommendations**  
none

**Remarks**  
none
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 30 min.

Prerequisites
none

Recommendations
none

Remarks
none
'Teilleistung': Continuum Mechanics [T-BGU-106196]

Responsibility: Marlon Franke

Courses

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 30 min.

Prerequisites
none

Recommendations
none

Remarks
none
'Teilleistung': Coupled Geomechanic Processes [T-BGU-100085]

Responsibility: Theodoros Triantafyllidis

Contained in: [M-BGU-100077] Coupled Geomechanic Processes

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<td>Special Issues in Rock Mechanics</td>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 40 min.

Prerequisites
none

Recommendations
none

Remarks
none

Course Excerpt: Coupled Phenomena in Geomechanics (WS 18/19)

Aim
The students recognize and evaluate the basic physical and chemical alteration parameters of geomaterials. They are able to describe the involved hydromechanical, chemomechanical, thermomechanical and biomechanical processes and to express mathematically their interdependence with mechanical properties.

Content
- hydromechanical phenomena: effect of wetting, internal erosion, liquefaction, hydraulic fracturing
- chemomechanical phenomena: dissolution, precipitation, swelling, solute transport
- thermomechanical phenomena: heat production and transport, effect on mechanical properties, coupling to hydraulic effects
- biomechanical phenomena: effect of bacteria and flora

Course Excerpt: Special Issues in Rock Mechanics (WS 18/19)

Aim
The students have deepened and supplementary knowledge about time-varying strength and deformation properties of rocks. They apply this knowledge on preliminary rock investigation, survey of construction progress and monitoring of structures in rock.

Content
- time-dependent material phenomena: swelling, creep
- scale effects
- rock as multi-phase system (Biot theory)
- rock and fissure hydraulics, permeability,
- rock dynamics and basics of blasting techniques,
- rock drilling, cutting performance and bit consumption
- numerical methods in rock mechanics
Literature
### 'Teilleistung': Design and Construction of Components in Reinforced Concrete

**[T-BGU-100015]**

**Responsibility:** Lothar Stempniewski  
**Contained in:** [M-BGU-100033] Design and Construction of Components in Reinforced Concrete

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#### Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013

written exam, 90 min.

**Prerequisites**  
none

**Recommendations**  
none

**Remarks**  
none
### 'Teilleistung': Durability and Service Life Design [T-BGU-100037]

**Responsibility:** Michael Vogel  
**Contained in:** [M-BGU-100057] Durability and Service Life Design

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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**

oral exam, appr. 30 min.

**Prerequisites**

none

**Recommendations**

none

**Remarks**

none
'Teilleistung': Dynamics of Structures [T-BGU-100077]

**Responsibility:** Peter Betsch  
**Contained in:** [M-BGU-100035] Surface Structures and Dynamics of Structures

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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**  
written exam, 60 min.

**Prerequisites**  
none

**Recommendations**  
none

**Remarks**  
none
**Course Excerpt: Basics in Earthworks and Embankment Dams (WS 18/19)**

**Aim**
The students are able to select and apply appropriate methods for exploration, modelling, dimensioning, realization and control for earthworks and dam construction. They can identify all geotechnically relevant problems occurring with dams and can apply design and dimensioning rules in outline self-reliantly.

**Content**
- cross section and longitudinal section of filled dams
- requirements for zonation
- sealing
- combined effects dam/subsoil
- construction methods for seepage cutoff
- building materials for dams with requirements and characteristics
- construction of dams
- seepage and flow nets
- flow cases with known and unknown boundaries
- erosion, suffosion, piping, colmatation and joint erosion
- dam stability

**Literature**
Striegler (1998), Dammbau in Theorie und Praxis, Verlag für Bauwesen Berlin
Kutzner (1996), Erd- und Steinschüttdämme für Stauanlagen, Enke Verlag Stuttgart

**Course Excerpt: Foundation Types (WS 18/19)**

**Aim**
The students are able to select and apply appropriate methods for exploration, modelling, dimensioning, realization and control for geotechnical constructions of average complexity. They gained competence in solving geotechnical problems,
also with respect to the managerial organization, expense budgeting, use of documents and presentation of results.

Content
- safety concepts in earthworks and foundation engineering
- project design for foundation problems
- frame constructions on partially soft soil, bridge abutment and embankments on soft soil
- types of retaining constructions for a cut-and-cover metro tunnel
- ground anchors
- quay wall structures with tied-back sheetpiles
- stabilization and drainage of embankments
- retaining constructions with structural slope stabilisation
- underpinning and supporting
- observational method

Literature
Witt. K.J. (2008), Grundbau-Taschenbuch, Teil 1,
U. Smoltczyk, U. (2001), Grundbau-Taschenbuch, Teil 2-3,
'Teilleistung': FE-Applications in Practical Engineering [T-BGU-100032]

Responsibility: Werner Wagner

Contained in: [M-BGU-100048] FE-Applications in Practical Engineering

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 30 min.

Prerequisites
none

Recommendations
none

Remarks
none
## 'Teilleistung': Finite Elements in Solid Mechanics [T-BGU-100998]

**Responsibility:** Peter Betsch  
**Contained in:** [M-BGU-100578] Finite Elements in Solid Mechanics

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### Courses

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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**  
oral exam, appr. 30 min.

**Prerequisites**  
none

**Recommendations**  
none

**Remarks**  
none
### 'Teilleistung': Fracture and Damage Mechanics [T-BGU-100087]

**Responsibility:** Thomas Seelig  
**Contained in:** [M-BGU-100053] Fracture and Damage Mechanics

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013  
oral exam, appr. 45 min.

**Prerequisites**  
none

**Recommendations**  
none

**Remarks**  
none

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Engineering Structures (M.Sc.), ER/SPO 2013  
Module handbook Summer term 2019, as at 03/27/2019
'Teilleistung': Geotechnical Constructions [T-BGU-103224]

Responsibility: Theodoros Triantafyllidis

Courses

<table>
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<td>Foundation Types</td>
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<td>Foundations and Retaining Structures</td>
<td>Vorlesung / Übung</td>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
written exam, 90 min.

Prerequisites
This exam must not be selected if one of the modules Earthworks and Foundation Engineering [engiM702-ERDGB] or Applied Geotechnics [engiM707-ANGEOTEC] is selected.

Modeled Conditions
The following conditions must be met:

1. The module [M-BGU-100068] Earthworks and Foundation Engineering must not have been started.
2. The module [M-BGU-100128] Earthworks and Foundation Engineering (without Student Research Project) must not have been started.
3. The module [M-BGU-100072] Applied Geotechnics must not have been started.

Recommendations
none

Remarks
none

Course Excerpt: Foundations and Retaining Structures (SS 2019)

Aim
The students know the construction technologies for pile foundations and deep excavations. They make self-dependent reasonable design decisions with regard to geological engineering, site managing and economical boundary conditions. They can evaluate the interaction of building, foundation and subsoil and perform design and proof of ultimate limit state by themselves. They know and use relevant guidelines and link constructional experience, dimensioning rules and standardization to theoretical knowledge about soil mechanics.

Content
- pile types
- load bearing resistance and deformations of individual piles in axial and lateral direction
- negative skin friction
- elastic subgrade reaction and plastic flow resistance
- load bearing resistance and settlement of pile groups
- recommendations EA-Pfähle and pile tests
- pile raft design
- stress trapezoid, ground reaction and elastic halfspace method for slab foundations
- gravity walls, cantilever retaining walls, stone cages, space lattice walls, underpinning
- trench sheeting, timber sheeting
- soldier pile walls, sheetpile walls, diaphragm walls
- anchoring and struts
- dig-and-cast construction method
- bottom sealing and immersed troughs, grouted slabs, jetgrout slabs, underwater concrete
- uplift piles and anchors

**Literature**
Seitz, J. & Schmidt, H.-G. (2000), Bohrpfähle Ernst & S.
Triantafyllidis, Th. (1990), Planung und Bauausführung im Spezialtiebauen, Teil 1, Ernst & S.
Weißenbach, A. (2001), Baugruben, Teil 1-3, Wiley

**Course Excerpt: Foundation Types (WS 18/19)**

**Aim**
The students are able to select and apply appropriate methods for exploration, modelling, dimensioning, realization and control for geotechnical constructions of average complexity. They gained competence in solving geotechnical problems, also with respect to the managerial organization, expense budgeting, use of documents and presentation of results.

**Content**
- safety concepts in earthworks and foundation engineering
- project design for foundation problems
- frame constructions on partially soft soil, bridge abutment and embankments on soft soil
- types of retaining constructions for a cut-and-cover metro tunnel
- ground anchors
- quay wall structures with tied-back sheetpiles
- stabilization and drainage of embankments
- retaining constructions with structural slope stabilisation
- underpinning and supporting
- observational method

**Literature**
Witt, K.J. (2008), Grundbau-Taschenbuch, Teil 1,
U. Smoltczyk, U. (2001), Grundbau-Taschenbuch, Teil 2-3,
Teilleistung': Geotechnical Testing and Measuring Technology [T-BGU-100075]

Responsibility: Theodoros Triantafyllidis

Credit Points: 6
Language: German
Recurrence: Each term
Type of Learning Control: oral examination
Version: 1

Courses

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<td>6251910</td>
<td>Testing in Dam and Wastefill Engineering</td>
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<td>Geotechnical Measuring Technology</td>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013

oral exam, appr. 40 min.

Prerequisites
none

Recommendations
none

Remarks
none

Course Excerpt: Testing in Dam and Wastefill Engineering (WS 18/19)

Aim
The students have basic knowledge in geophysics and overview the procedures and methods for subsoil exploration and testing techniques in dam and wastefill engineering. They are familiar with their specific application conditions and prerequisites and can select reasonably appropriate combinations of techniques.

Content
· investigation of groundwater situation
· geophysical exploration
· overview of lab and field tests for compressibility, shear resistance, permeability, filter tests
· dispersivity of soils
· rheological properties of suspensions
· testing of densification and deformability

Course Excerpt: Rock Testing (WS 18/19)

Aim
The students overview masterfully the procedures and methods for subsoil exploration and testing techniques in rock engineering and tunneling. They can select reasonably appropriate combinations of techniques.

Content
· presentation of national and international standards for testing procedures
· basic measuring techniques in rock
· structure and function of testing devices
· selection and preparation of samples
· test execution: uniaxial and triaxial compression test, uniaxial and triaxial creep test, relaxation test, direct shear test, Brazilian test, swelling test, point load test, large-scale triaxial test, further index tests


Course Excerpt: Geotechnical Measuring Technology (WS 18/19)

Aim
The students have basic knowledge in measurement technologies and the functioning principles of sensors and data acquisition. They have own experiences with the handling of sensor application, wiring, data acquisition, control elements, measuring and analysis procedures. As a result of this they can select equipment reasonably with respect to resolution, accuracy, long term stability and interpretation.

Content
- measurement of physical quantities: displacement, strain, velocity, acceleration, force, pressure, stress tensor, time, temperature, flow, moisture
- introduction to their measuring methods, sensors and limitations
- measuring electrical quantities: methods and devices, signal filtering
- optical measurements and correlation techniques using the example of the Particle-Image-Velocimetry (PIV)
- development and analysis of a measurement chain from a physical quantity to a final reading
- influence of measurement on observed processes, influences of errors, noise e.g.
- comparison of direct and compensating methods
- transmission of analogue and digital data, smart sensors
- description of dynamic measurement categories: time domain, frequency domain, state space,
- control technology: concepts and application
- examples of measurements on construction site and in situ: anchor tests, measurement of settlement and inclination, stress measurement and borehole measurements in rock
- measurements in relation to the observational method (DIN1054)
- training: electrical measuring, data acquisition, influence of noise, mounting of DMS to strain gauges, setup and test of a measurement chain for field measurements (anchor test or cone penetration test), density measurement
Course Excerpt: (WS 18/19)

Content

- Glas im Bauwesen
- nichtrostende Stähle, Veredelungsprodukte
- Konstruktionsdetails Glas, Bemessung von Bauprodukten aus Glas
- Kunststoffe im Bauwesen, Klebverbindungen, Konstruktionsdetails Kunststoffe
- Stahldrähte für Seile, Seile, Paralleldrahtbündel
- Zugstabsysteme
- Endverbindungen, Umlenkungen
- statisches Tragverhalten
- dynamisches Tragverhalten
- Bemessung von Tragwerken mit hochfesten Zuggliedern
- Konstruktionsdetails hochfeste Zugglieder
- Montage von Seiltragwerken

Literature

- vorlesungsbegleitende Unterlagen
Course Excerpt: Ground Improvement, Grouting and Soil Freezing (SS 2019)

Aim
The students know performance, ranges of application, necessary preliminary investigations and accompanying controls (monitoring) for special underground engineering technologies of subsoil improvement and sealing. They can select required pre-investigations, specify parameters for the realization and define the type of controls of execution.

Content
- soil freezing: brine and nitrogen cooling, frost spreading under artificial and natural influence, frost heave and thaw settlement, mechanical behaviour of frozen soils, mechanical and thermal calculation of simple frost bodies (underpinning and tunnel ring), monitoring
- grouting technology: execution and application boundaries of injections, monitoring, pore and gap injection, soil fracturing, jet grouting, theory of the injections, characteristics of suspensions and solutions, permeability and strength of injected soils
- soil improvement: application areas, obtainable effects, monitoring, deep vibro compaction, vibro replacement compaction, dynamic (heavy) compaction

Literature
Kutzner, Ch. (1991), Injektionen im Baugrund, F. Enke
"Teilleistung": Ground Investigation [T-BGU-100072]

**Responsibility:** Theodoros Triantafyllidis

**Contained in:** [M-BGU-100071] Ground Investigation

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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**

oral exam, appr. 40 min.

**Prerequisites**

none

**Recommendations**

none

**Remarks**

none
T 'Teilleistung': Ground Water and Earth Dams [T-BGU-100091]

Responsibility: Andreas Bieberstein
Contained in: [M-BGU-100073] Ground Water and Earth Dams

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<td>Geotechnical Ground Water Problems</td>
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<td>SS 2019</td>
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<td>Embankment Dams (Advanced)</td>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 40 min.

Prerequisites
none

Recommendations
none

Remarks
none

Course Excerpt: Geotechnical Ground Water Problems (SS 2019)

Aim
The students have deepened knowledge about different geotechnical groundwater problems. They can dimension dewatering measures under various boundary conditions and demonstrate geohydraulic relationships by example calculations.

Content
- basics of groundwater conditions
- investigation and monitoring of the groundwater conditions
- types and application possibilities of sounding equipment and measuring procedures
- permeability tests in the laboratory and in-situ
- air permeability of soils
- saturation and propagation of saturation fronts
- permeability anisotropy
- dewatering technologies, time scale of dewatering
- dewatering along rivers
- quantitative relations for drainage ditches and dewatering wells
- dewatering effects
- seepage through dams and flow nets, load cases, underseepage of dams.

Literature

Course Excerpt: Embankment Dams (Advanced) (SS 2019)

Aim
The students are able to develop their own solution approaches for earth dam design problems, to evaluate the relevant construction techniques and to conduct the requested geotechnical proofs.
Content

- hydrologic and hydraulic design of dams
- regulations for dams and embankments
- design of freeboard
- slope stability concepts
- proof of sliding stability
- uplift stability
- stress distribution in the dam base
- spread stability
- settlements
- hydraulic stability
- seepage and flow nets
- determination of the phreatic line
- erosion criteria, methods to prove inner erosion stability
- filters and drains
- subsoil sealing
- deformation of embankments
- safety against flaws
- earthquake design
- monitoring of dams
- buried auxiliary structures
- artificial sealings
- dams and embankments designed for overtopping

Literature

### 'Teilleistung': Hollow Section Structures [T-BGU-100086]

**Responsibility:** Stefan Herion  
**Contained in:** [M-BGU-100004] Hollow Section Structures

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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**  
oral exam, appr. 30 min.

**Prerequisites**  
none

**Recommendations**  
none

**Remarks**  
none
### 'Teilleistung': Homework 'Basics of Finite Elements' [T-BGU-109908]

**Responsibility:** Peter Betsch  
**Contained in:** [M-BGU-100052] Basics of Finite Elements

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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**

Processing of two exercise sheets

**Prerequisites**

none
'Teilleistung': Homework 'Practical Noise Control' [T-BGU-109946]

Responsibility: Reiner Grigo
Contained in: [M-BGU-100060] Building Physics II

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
2 short reports, appr. 5 pages each

Prerequisites
none

Recommendations
none

Remarks
none
Teilleistung: Introduction to Matlab [T-BGU-106765]

Responsibility: Uwe Ehret

Contained in: [M-BGU-100100] Key Competencies

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<td>Introduction to Matlab</td>
<td>Vorlesung (VÜ) / Übung 2</td>
<td>Uwe Ehret, Jan Wienhöfer</td>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
implementation of a Matlab code with report, appr. 1 page

Prerequisites
none

Recommendations
none

Remarks
none

Course Excerpt: Introduction to Matlab (WS 18/19)

Aim
Students are familiar with common programming rules and the working environment and basic syntax of Matlab. They are capable of independently formulating and coding simple programs for data analysis and visualization as well as simulation of dynamical systems with Matlab. Students have thus gained the competence to independently solve computer-based modeling tasks in advanced courses. Students are able to solve problems and to present the related results in teamwork.

Content
- Universal programming basics: Programming strategies, program structures, control structures, operators and variables, functions and objects, matrix calculations
- Basics of Matlab: History, installation, graphical user interface, tool boxes, using help
- Matlab programming basics: syntax, debugging, reading and writing of files, data visualization

Workload
Attendance time: 30 h
Preparation/follow-up: 10 h
Homework: 30 h
Take-home exam: 20 h
Course Excerpt: Landfills (WS 18/19)

Aim
The students know the legal guidelines regarding the disposal of wastes and the permitted threshold value for brownfields. They overview the geotechnical concerns in the construction of landfill sites depending on the particular landfill classification, landfill elements, their relevant requirements and necessary certifications.

Content
- waste-situation and waste catalogue
- requirements from the authorities, legal basis
- planning landfill sites
- multi-barrier system
- construction elements
- hydraulic analysis
- technical equipment for gas treatment of landfills
- static analysis
- serviceability analysis
- construction
- special design solutions
- strengthening of landfills

Literature
DGGT, GDA-Empfehlungen – Geotechnik der Deponien und Altlasten, Ernst und Sohn, Berlin
Drescher (1997), Deponiebau, Ernst und Sohn, Berlin
### 'Teilleistung': Master Thesis [T-BGU-100093]

**Responsibility:** Peter Vortisch  
**Contained in:** [M-BGU-100080] Module Master Thesis

<table>
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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**
- duration appr. 6 months
- presentation within one month after submission of the thesis

**Prerequisites**
defined for the module Master Thesis

**Recommendations**
see module

**Remarks**
one

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Engineering Structures (M.Sc.), ER/SPO 2013  
Module handbook Summer term 2019, as at 03/27/2019
'Teilleistung': Material Models in Solid Mechanics [T-BGU-100044]

Responsibility: Thomas Seelig

<table>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 45 min.

Prerequisites
none

Recommendations
none

Remarks
none
Course Excerpt: (SS 2019)

Content
- materials: denotation of steels, physical and technological properties
- fatigue: influencing parameters, calculation concepts
- welding technology: welding techniques, welding instructions
- quality management: building law, implementation categories, competences
- fracture toughness: linear fracture mechanics
- design of welded constructions: internal stresses, welding distortion
- material testing: non-destructive testing, material and weld joint failures

Literature
- lecture notes
- DIN EN 1993-1-10: Design of steel structures- Part1-10: Material toughness and through-thickness properties
- DIN EN 1090: Execution of steel structures and aluminium structures
### 'Teilleistung': Materials Testing and Measuring Techniques [T-BGU-100043]

**Responsibility:** Nico Herrmann  
**Contained in:** [M-BGU-100061] Materials Testing and Measuring Techniques

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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**  
oral exam, appr. 30 min.

**Prerequisites**  
none

**Recommendations**  
none

**Remarks**  
none
### 'Teilleistung': Micromechanics of Heterogeneous Solids [T-BGU-108879]

**Responsibility:** Ingo Schmidt  
**Contained in:** [M-BGU-100064] Continuum Mechanics of Heterogeneous Solids

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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**

oral exam, appr. 20 min.

**Prerequisites**

none

**Recommendations**

none

**Remarks**

none
"Teilleistung": Modeling Techniques in Solid Mechanics [T-BGU-103223]

Responsibility: Alexander Konyukhov

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 30 min.

Prerequisites

Recommendations
none

Remarks
none
## 'Teilleistung': Non-linear Analysis of Beam Structures [T-BGU-100030]

**Responsibility:** Ingo Münch, Werner Wagner  
**Contained in:** [M-BGU-100046] Non-linear Analysis of Beam Structures

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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**  
written exam, 90 min.

**Prerequisites**  
none

**Recommendations**  
none

**Remarks**  
none
### 'Teilleistung': Non-linear Analysis of Surface Structures [T-BGU-100035]

**Responsibility:** Werner Wagner  
**Contained in:** [M-BGU-100051] Non-linear Analysis of Surface Structures

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#### Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 3 min.

#### Prerequisites
none

#### Recommendations
none

#### Remarks
none
'Teilleistung': Numerical Methods in Structural Analysis [T-BGU-100034]

Responsibility: Ingo Münch, Werner Wagner
Contained in: [M-BGU-100050] Numerical Methods in Structural Analysis

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 30 min.

Prerequisites
none

Recommendations
none

Remarks
none
Course Excerpt: FEM Applications in Geotechnical Modelling (SS 2019)

Aim
The students got to know FE applications in several fields of geotechnics (foundation, rock and tunnel construction, dam construction), got practical experience with the FE code ABAQUS (TM) and applied this for the modelling of example problems.

Content
- introduction to the FE-program ABAQUS: definition of joints and elements, assignment of material laws, definition of initial and boundary conditions
- examples of FE-applications in tunnel engineering
- numerical FE-modeling of a deep pit excavation under consideration of the construction sequence
- numerical FE-modeling of seepage through a zoned dam with partial saturation (different load cases)
- linear dynamics using ABAQUS

Literature
Hibbit, Karlsson, Sorensen: ABAQUS for geotechnical problems
Hibbit, Karlsson, Sorensen (1997): Contact in ABAQUS/Standard
Course Excerpt: Numerics in Geotechnics (WS 18/19)

**Aim**
The students know operational methods for the discretization of the typical differential equations. They are able to comprehend the modelling of geomechanical boundary value problems using Finite Difference and Finite Element Methods and to work independently on standard problems. They can assess the errors possible with numerical calculations, select commercial FE-codes reasonably and test and evaluate numerical results critically.

**Content**
- time dependent and time-independent numerical problems in soil mechanics
- finite difference method: implicit and explicit solution of time-dependent ordinary differential equations, stability of the FD-scheme
- partial differential equations (consolidation, waves): numerical methods, stability, errors
- finite elements: weak form, discretization, boundary conditions according to Neumann and Dirichlet
- sample finite element computation for stationary two dimensional seepage flow
- finite element computation for static equilibrium (2D)
- locking, reduced integration, static condensation
- weak form of the consolidation equation and GN-time integration
- material non-linearity
- return-mapping and equilibrium iteration
- geometrical non-linearity, follower loads, simplified integration schemes
- introduction to the boundary-element-method.

**Literature**
Presss, W., e.a. (1992), Numerical Recipies, Cambridge Univ. Press
Hughes, T.J.R. (2000): The FEM, Linear Static and Dynamic FE Analysis. Dover
Bathe, K.-J. (200): Finite-Elemente-Methoden. Springer
'Teilleistung': Practical Fire Protection [T-BGU-100042]

Responsibility: Hermann Schröder

Contained in: [M-BGU-100060] Building Physics II

Credit Points: 3
Language: German
Recurrence Frequency: Each term
Type of Learning Control: oral examination
Version: 1

Courses

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 20 min.

Prerequisites
none

Recommendations
none

Remarks
none
'Teilleistung': Practical Noise Control [T-BGU-108024]

Responsibility: Reiner Grigo
Contained in: [M-BGU-100060] Building Physics II

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 20 min.

Prerequisites
none

Recommendations
none

Remarks
none
Teilleistung: Rock Engineering and Underground Construction [T-BGU-100074]

Responsibility: Peter Kudella
Contained in: [M-BGU-100074] Rock Engineering and Underground Construction

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<td>Tunnel Construction in Soils and in Existence</td>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
written exam, 90 min.

Prerequisites
none

Recommendations
none

Remarks
none

Course Excerpt: Aboveground Rock Engineering (WS 18/19)

Aim
The students are familiar with planning, construction and design of safety systems for embankments and hillsides in bedrock. They can identify critical failure mechanisms, conduct respective stability analyses and design anchoring.

Content
- types of rock slopes and failure mechanisms
- survey, analysis and interpretation of structural interface data
- computational procedures for sliding of rock embankments: graphical (stereonet projection)
- analytical computational procedures
- safety definitions
- different failure mechanisms, block overturning
- rockfall protection methods and design, geocompatible slope design
- block and slope stabilization, retaining walls, anchors, monitoring systems
- rock excavation, slope construction, blasting technology

Literature

Course Excerpt: Tunnel Construction in Soils and in Existence (WS 18/19)

Aim
The students know setup and function of tunnel boring machines and tunneling techniques by own perception and can select appropriate tunnel boring technologies. They can transfer deepened knowledge about strength and deformation properties of bedrock and the precursory and accompanied exploration to the rehabilitation of existing tunnels.

Content
- tunnel sealing
· tunnel lining
· tunnel security (fire protection, escape concept)
· rehabilitation of existing tunnels, safety analysis of existing tunnels (exploration, rehabilitation, restoration, renewal)
· tunnelling shield machines, compressed air, hydro and earth pressure support, pipe and frame
· jacking, microtunneling and steered horizontal borings
· earth static analysis and deformation prediction for surface-near tunneling in loose ground
· settlement compensation

**Literature**
'Teilleistung': Rock Mechanics and Tunneling [T-BGU-100069]

Responsibility: Carlos Grandas Tavera, Theodoros Triantafyllidis

Courses

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
written exam, 90 min.

Prerequisites
none

Recommendations
preparation of the student research project for examination preparation

Remarks
none

Course Excerpt: Basics in Tunnel Construction (SS 2019)

Aim
The students can select basic construction methods and constructions in underground tunnel construction and apply self-reliantly the methods and static calculation and safety assessments in rock mechanics. With regard to the assessment of variants, costs, construction operation and safety aspects they gained geotechnical competence in solving problems.

Content
- tunneling by excavator, drilling and blasting, driving by TBM
- tunnel driving classification
- measuring technologies in tunnel construction
- rock exploration and classification
- rock pressure and in-situ stress measurement
- introduction to tunnel constructions (types and purposes)
- tunnel construction methods: historic, full-circle and segmental, calotte, roof and wall mining
- safety measures and sequence
- collaps mechanisms of bedrock
- stresses and deformations around a tunnel: primary stresses, convergence, plastification, crack stresses, ground reaction line method

Literature
Maidl, B. 1997: Tunnelbau im Sprengvortrieb
Müller, L. 1978: Der Felsbau, Bd. 3 Tunnelbau

Course Excerpt: Basics in Rock Mechanics (SS 2019)

Aim
The students understand the essential strength and deformation properties of rock and can deduce the behavior of the discontinuum. They apply the basic analytical methods to solve boundary value problems of surface and underground
rock excavation.

Content

- basics of petrography
- rocks and rock mass classification
- rock pressure
- genesis and tropy
- stress-strain-behaviour
- shear strength, compressive strength and tensile strength of compact and jointed rock
- shear resistance of discontinuities
- basics and methods to determine compressibility parameters for rocks and rock mass
- in situ and laboratory testing
- circular tunnels in isotropic and biaxial primary stress fields (elastic)
- circular tunnels in elastoplastic ground
- elliptical cross sections
- shaft problem

Literature

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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**
oral exam, appr. 40 min.

**Prerequisites**
Student research project “Shell Structures and Stability of Structures” has to be passed.

**Modeled Conditions**
The following conditions must be met:

- The course [T-BGU-100254] *Student Research Project ‘Shell Structures and Stability of Structures’* must have been passed.

**Recommendations**
none

**Remarks**
none
"Teilleistung": Solid Construction Bridges [T-BGU-100020]

Responsibility: Lothar Stempniewski
Contained in: [M-BGU-100037] Solid Construction Bridges

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
written exam, 90 min.

Prerequisites
none

Recommendations
none

Remarks
none
'Teilleistung': Special Issues of Soil Mechanics [T-BGU-100071]

Responsibility: Theodoros Triantafyllidis

Contained in: [M-BGU-100005] Special Issues of Soil Mechanics

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<td>Unsaturated, Viscous and Cyclic Soil Behaviour - Theory and Element Tests</td>
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<td>WS 18/19</td>
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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 40 min.

Prerequisites
none

Recommendations
none

Remarks
none

Course Excerpt: Unsaturated, Viscous and Cyclic Soil Behaviour - Theory and Element Tests (WS 18/19)

Aim
The students master a wide range of mechanical, hydraulic and numerical tools for the processing of specific soil mechanical problems. They can comprehend the cross-linking of hydraulic, mechanical and chemical processes under partial saturation. They can use the dynamic and cyclic laboratory techniques and apply material laws operationally for the calculation and calibration of experiments.

Content
- Hypoplastic constitutive laws (1D, 3D): advantages, limitations, identification of parameters, intergranular strain
- visco-hypoplasticity
- application: creeping embankments with shead dowelling
- natural soils in comparison to idealized models
- phenomena of shear localization
- sounding, soil penetration and contact problems
- typical stress-strain-relations for various soils (sand, gravel, silt, clay) for monotonous drained and undrained loading
- soils under high-cycle-loading, strain accumulation, accumulation model
- soils under undrained cyclic loading, soil liquefaction, debris flow
- hydraulic and mechanic Characteristics of partly saturated soils
- recalculation of different element tests

Course Excerpt: Soil Dynamics (WS 18/19)

Aim
The students can describe vibrations and waves in elastic continua and real soils in the range of strains from small shakes up to earthquakes and evaluate them from an engineering viewpoint. They can design, overview and interprete the relevant dynamic laboratory tests.
Content
- vibrations of systems with one degree of freedom, linear and non-linear (time and frequency domain)
- wave propagation in full and half space, also layered
- vibrations of rigid foundations (linear elastic, substructure method)
- wave propagation: linear and linearised using adapted stiffness, numerical methods
- behaviour of soils under cyclic and dynamic loading: particle models, continuum models
- laboratory tests: resonant column test (RC), cyclic triaxial test
- wave propagation in real soils (influence of hysteretic material damping and increase of stiffness with depth)
- effects related to saturated soil (cyclic mobility, liquefaction)
- 1D-wave propagation for earthquake loading: linearised model using program Shake including adapted
- stiffness, nonlinear using Hypoplasticity
- settlements caused by dynamic loading and transient loss of stiffness

Literature
W. Haupt, Bodendynamik: Grundlagen und Anwendung, Vieweg+Teubner Verlag, 1986
### 'Teilleistung': Steel and Composite Structures [T-BGU-100016]

**Responsibility:** Thomas Ummenhofer  
**Contained in:** [M-BGU-100034] Steel and Composite Structures

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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**

written exam, 90 min.

**Prerequisites**
none

**Recommendations**
none

**Remarks**
none
### 'Teilleistung': Structures in Steel [T-BGU-106798]

**Responsibility:** Thomas Ummenhofer  
**Contained in:** [M-BGU-100042] Structures in Steel and Timber

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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**

Project work with final presentation, presentation and colloquium appr. 30 min.

**Prerequisites**

None

**Recommendations**

None

**Remarks**

None
'Teilleistung': Structures in Timber [T-BGU-106799]

Responsibility: Matthias Frese
Contained in: [M-BGU-100042] Structures in Steel and Timber

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral examination, appr. 30 min.

Prerequisites
none

Recommendations
none

Remarks
none
Responsibility: Engin Kotan, Stefan Wirth
Contained in: [M-BGU-100059] Building Physics I

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
student research paper, 15-20 pages;
definition of a project available from lecturer

Prerequisites
none

Recommendations
none

Remarks
none
'Teilleistung': Student Research Project 'Building Preservation of Concrete and Masonry Constructions' [T-BGU-100175]

Responsibility: Engin Kotan

Contained in: [M-BGU-100058] Building Preservation of Concrete and Masonry Constructions

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013

student research paper, 15-20 pages; definition of a project available from lecturer

Prerequisites
none

Recommendations
none

Remarks
none
Teilleistung': Student Research Project 'Computational Analysis of Structures' [T-BGU-100174]

Responsibility: Werner Wagner

Contained in: [M-BGU-100047] Computational Analysis of Structures

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013

student research project, appr. 15 pages
definition of a project available from lecturer

Prerequisites

none

Recommendations

none

Remarks

none
'Teilleistung': Student Research Project 'Dynamics of Structures' [T-BGU-107819]

Responsibility: Peter Betsch
Contained in: [M-BGU-100035] Surface Structures and Dynamics of Structures

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013

term paper;
definition of a project available from lecturer

Prerequisites
none

Recommendations
none

Remarks
none
T: 'Teilleistung': Student Research Project 'Earthworks and Foundation Engineering' [T-BGU-100178]

Responsibility: Theodoros Triantafyllidis

Contained in: [M-BGU-100068] Earthworks and Foundation Engineering

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013

report appr. 45 pages;
definition of a project available from lecturer

Prerequisites

none

Recommendations

none

Remarks

none

Course Excerpt: Basics in Earthworks and Embankment Dams (WS 18/19)

Aim

The students are able to select and apply appropriate methods for exploration, modelling, dimensioning, realization and control for earthworks and dam construction. They can identify all geotechnically relevant problems occurring with dams and can apply design and dimensioning rules in outline self-reliantly.

Content

- cross section and longitudinal section of filled dams
- requirements for zonation
- sealing
- combined effects dam/subsoil
- construction methods for seepage cuttoff
- building materials for dams with requirements and characteristics
- construction of dams
- seepage and flow nets
- flow cases with known and unknown boundaries
- erosion, suffosion, piping, colmatation and joint erosion
- dam stability

Literature

Striegler (1998), Dammbau in Theorie und Praxis, Verlag für Bauwesen Berlin
Kutzner (1996), Erd- und Steinschüttdämmen für Stauanlagen, Enke Verlag Stuttgart

Course Excerpt: Foundation Types (WS 18/19)
Aim
The students are able to select and apply appropriate methods for exploration, modelling, dimensioning, realization and control for geotechnical constructions of average complexity. They gained competence in solving geotechnical problems, also with respect to the managerial organization, expense budgeting, use of documents and presentation of results.

Content
· safety concepts in earthworks and foundation engineering
· project design for foundation problems
· frame constructions on partially soft soil, bridge abutment and embankments on soft soil
· types of retaining constructions for a cut-and-cover metro tunnel
· ground anchors
· quay wall structures with tied-back sheetpiles
· stabilization and drainage of embankments
· retaining constructions with structural slope stabilisation
· underpinning and supporting
· observational method

Literature
Witt. K.J. (2008), Grundbau-Taschenbuch, Teil 1,
U. Smoltczyk, U. (2001), Grundbau-Taschenbuch, Teil 2-3,


'Teilleistung': Student Research Project 'Reinforced Concrete' [T-BGU-100170]

Responsibility: Lothar Stempniewski
Contained in: [M-BGU-100033] Design and Construction of Components in Reinforced Concrete

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013

term paper;
definition of a project available from lecturer

Prerequisites

none

Recommendations

none

Remarks

none
Course Excerpt: Basics in Tunnel Construction (SS 2019)

**Aim**
The students can select basic construction methods and constructions in underground tunnel construction and apply self-reliantly the methods and static calculation and safety assessments in rock mechanics. With regard to the assessment of variants, costs, construction operation and safety aspects they gained geotechnical competence in solving problems.

**Content**
- tunneling by excavator, drilling and blasting, driving by TBM
- tunnel driving classification
- measuring technologies in tunnel construction
- rock exploration and classification
- rock pressure and in-situ stress measurement
- introduction to tunnel constructions (types and purposes)
- tunnel construction methods: historic, full-circle and segmental, calotte, roof and wall mining
- safety measures and sequence
- collapses mechanisms of bedrock
- stresses and deformations around a tunnel: primary stresses, convergence, plastification, crack stresses, ground reaction line method

**Literature**
Maidl, B. 1997: Tunnelbau im Sprengvortrieb
Müller, L. 1978: Der Felsbau, Bd. 3 Tunnelbau
Aim
The students understand the essential strength and deformation properties of rock and can deduce the behavior of the discontinuum. They apply the basic analytical methods to solve boundary value problems of surface and underground rock excavation.

Content
- basics of petrography
- rocks and rock mass classification
- rock pressure
- genity and tropy
- stress-strain-behaviour
- shear strength, compressive strength and tensile strength of compact and jointed rock
- shear resistance of discontinuities
- basics and methods to determine compressibility parameters for rocks and rock mass
- in situ and laboratory testing
- circular tunnels in isotropic and biaxial primary stress fields (elastic)
- circular tunnels in elastoplastic ground
- elliptical cross sections
- shaft problem

Literature
Teilleistung: Student Research Project 'Shell Structures and Stability of Structures' [T-BGU-100254]

Responsibility: Ingo Münch, Werner Wagner

Contained in: [M-BGU-100049] Shell Structures and Stability of Structures

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013

student research project, appr. 15 pages
definition of a project available from lecturer

Prerequisites
none

Recommendations
none

Remarks
none
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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**

term paper;
definition of a project available from lecturer

**Prerequisites**
none

**Recommendations**
none

**Remarks**
none
'Teilleistung': Student Research Project 'Surface Structures' [T-BGU-107818]

Responsibility: Werner Wagner
Contained in: [M-BGU-100035] Surface Structures and Dynamics of Structures

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
term paper;
definition of a project available from lecturer

Prerequisites
none

Recommendations
none

Remarks
none
### 'Teilleistung': Surface Structures [T-BGU-100017]

**Responsibility:** Werner Wagner  
**Contained in:** [M-BGU-100035] Surface Structures and Dynamics of Structures

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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**

- written exam, 60 min.

**Prerequisites**

- none

**Recommendations**

- none

**Remarks**

- none
'Teilleistung': Tank Construction [T-BGU-101000]

Responsibility: Peter Knödel

Contained in: [M-BGU-100580] Tank Construction

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
oral exam, appr. 20 min.

Prerequisites
none

Recommendations
none

Remarks
none

Course Excerpt: Tank Construction (WS 18/19)

Content
- classification of tank types
- impacts: characteristic of loads by wind, filing, internal pressre, earth quake and deonation
- characteristics of shell structures
- proof of strength and stability with linear an non-linear calculation
- design and construction
- specific problems

Literature
- lecture note
- DIN EN 1993-4-1: Design of steel structures – Part 4-1: Silos
- DIN EN 1993-4-2: Design of steel structures – Part 4-2: Tanks
'Teilleistung': Term Paper Tank Construction [T-BGU-101001]

Responsibility: Peter Knödel
Contained in: [M-BGU-100580] Tank Construction

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
term paper with presentation, appr. 20 pages

Prerequisites
none

Recommendations
none

Remarks
none

Course Excerpt: Tank Construction (WS 18/19)

Content
- classification of tank types
- impacts: characteristic of loads by wind, filing, internal pressure, earth quake and deonation
- characteristics of shell structures
- proof of strength and stability with linear an non-linear calculation
- design and construction
- specific problems

Literature
- lecture note
- DIN EN 1993-4-1: Design of steel structures – Part 4-1: Silos
- DIN EN 1993-4-2: Design of steel structures – Part 4-2: Tanks
Teilleistung: Term Paper Upgrading of Existing Buildings and Energetic Refurbishment [T-BGU-100621]

Responsibility: Kunibert Lennerts

Contained in: [M-BGU-100108] Upgrading of Existing Buildings and Energetic Refurbishment

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Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013

term paper, appr. 10 pages, and presentation, appr. 10 min.

Prerequisites

none

Recommendations

none

Remarks

none
Course Excerpt: Theoretical Soil Mechanics (SS 2019)

Aim
The students obtained a scientific based understanding of the essential behaviour of soil under monotonic and cyclic load with and without effects of time. They are able to describe relations in soil mechanics mathematically and physically correctly. They can understand the tensorial terminology of modern geotechnical literature and can apply computing programs to comprehend element tests. They recognize self-reliantly relevant mechanisms of boundary value problems and can specify the limitations of simple engineering models.

Content
- geotechnical invariants of stress and strain
- failure criteria according to Coulomb, Matsuoka-Nakai etc.
- contractancy and dilatancy
- critical density
- failure criteria according to Krey-Tiedemann
- soil behaviour under partial saturation
- collapse theorems and their application (Kinematic Element Analysis)
- elasticity in soil mechanics (isotropic and anisotropic)
- acoustic tensor
- elastoplasticity with volumetric hardening using the example of the Cam-Clay-Model
- soil behaviour under cyclic loading
- one-dimensional viscoplasticity

Literature
Niemunis (2009): Über die Anwendung der Kontinuumstheorie auf bodenmechanische Probleme (download)
**Course Excerpt: Timber and wood-based materials (SS 2019)**

**Aim**


**Content**

Holzanatomie  
Holzmerkmale  
Physik des Holzes  
Dauerhaftigkeit  
Schnittholztrocknung  
Festigkeitssortierung  
Vollholz  
Brettschichtholz  
Brettsperrholz  
plattenförmige Holzwerkstoffe
'Teilleistung': Timber Structures [T-BGU-100028]

Responsibility:  Hans Joachim Blaß
Contained in:  [M-BGU-100044] Timber Structures

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---|-------------|---------|------|-----------|-----------|
SS 2019 | 6213801 | Vorlesung (V) | 2 | Hans Joachim Blaß |
SS 2019 | 6213802 | Übung (Ü) | 2 | Hans Joachim Blaß, Mitarbeiter/innen |

Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013
written exam, 90 min.

Prerequisites
none

Recommendations
none

Remarks
none
**Teilleistung**: Upgrading of Existing Buildings and Energetic Refurbishment  
*T-BGU-108001*

**Responsibility:** Kunibert Lennerts  
**Contained in:** [M-BGU-100108] Upgrading of Existing Buildings and Energetic Refurbishment

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**Learning Control(s), according ER/SPO Engineering Structures (M.Sc.) 2013**

written exam, 70 min.

**Prerequisites**

none

**Recommendations**

none

**Remarks**

none
Teilleistung': Wildcard [T-BGU-100133]

Responsibility:
Contained in: [M-BGU-100100] Key Competencies

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Engineering Structures (M.Sc.), ER/SPO 2013
Module handbook Summer term 2019, as at 03/27/2019
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