Vorlesungsverzeichnis

M.Sc. Natural hazards and risk in structural engineering

SoSe 2024

Stand 23.04.2024

M.Sc. Natural hazards and risk in structural engineering

Applied mathematics and stochastics for risk assessment

Disaster management and mitigation strategies

Earthquake engineering and structural design

202002 Earthquake engineering and structural design (L + E + P)

J. Schwarz, L. Abrahamczyk, C. Kaufmann, S. Beinersdorf Veranst. SWS: 6
Vorlesung

1-Gruppe Mo, wöch., 17:00 - 18:30, Marienstraße 7 B - Projektraum 301, NHRE - Group I
1-Gruppe Mo, wöch., 17:00 - 18:30, Marienstraße 7 B - Seminarraum 205, NHRE - Group I
2-Gruppe Do, wöch., 17:00 - 18:30, Marienstraße 7 B - Projektraum 301, NHRE - Group II
2-Gruppe Do, wöch., 17:00 - 18:30, Marienstraße 7 B - Seminarraum 205, NHRE - Group II
Do, wöch., 13:30 - 15:00, Marienstraße 13 C - Hörsaal C, Lecture will start 11.04.2024
Do, wöch., 15:15 - 16:45, Marienstraße 13 C - Hörsaal C, Lecture * Dates by arrangement

Beschreibung

Students are trained and qualified in tasks of earthquake engineering, natural hazard and risk determining parameters. Students will be able to process input data, to realize design decision for structures of different building type and risk potential, to apply modern building codes and design concepts, to develop earthquake resistant structures and to evaluate structural design.

Earthquake engineering

Seismic Code development and generations; simplified analysis methods; design of structures and regularity criteria for earthquake resistance; performance and experience-based design concepts; rules for engineered buildings (R/C, steel, masonry) and non-engineered buildings; interaction effects between structure and soil, equipment and filling media; special and high risk structures

Structures in Earthquake Regions

Description of National code development; recent code situation; determination of seismic forces for an idealized RC frame system; comparison of different international code levels

Design of RC frames with masonry infill walls in earthquake regions: Application of modern software tools

Training of modelling and calculation with different software tools; interpretation of structural systems in terms of earthquake resistance design (ERD); design and analysis of structural systems for given and modified building layouts; comparison of the results with outcome of damage surveys. Tools: ETABS, SAP2000

Voraussetzungen

recomended module "Primary Hazards and Risks" NHRE

Leistungsnachweis

1 written exam

”Earthquake engineering” / 180 min (67%) / **SuSe** + WiSe

1 Project report + Project presentation

”Structures in Earthquake Regions/Design of RC frames” /

(33%) / **SuSe**

Finite element methods and structural dynamics

Geo- and hydrotechnical engineering

202003 Geo- and hydrotechnical engineering - Part: "Flood hazard and vulnerability assessment" (L + E)

H. Maiwald, S. Beinersdorf Veranst. SWS: 3
Vorlesung
Di, wöch., 15:15 - 16:45, Marienstraße 13 C - Hörsaal C
Do, wöch., 11:00 - 12:30, Marienstraße 13 C - Hörsaal C, Dates by arrangement

Beschreibung

The students should be able to apply the strategies and methods to arbitrary engineering problems in the given fields. To fix the theoretical background the student has to apply the methods independently at given tasks during several projects.

Flood Hazard and Vulnerability Assessment

Flood Management; Fundamentals of flood defence; Management of low-lying areas; Design of river dikes, channels and dams; Design concepts for the defence of structural objects and buildings; Forecasting, management and maintenance in flood defence; Hydrology, hydraulic calculations, flood routing; Characteristics of tsunami action, forces and loads on structures; Structural damage and loss prediction, damage scenarios; Re-interpretation of recent events.

Bemerkung

Vorlesungen in englischer Sprache "Flood hazard and vulnerability assessment"

Leistungsnachweis

1 written exam

”Flood Hazard and Vulnerability Assessment” / 90 min (50%)

/ **SuSe** + WiSe

906014 Geo- and hydrotechnical engineering - Part: "Geotechnical Engineering" (L + E)

P. Staubach, C. Rodríguez Lugo Veranst. SWS: 3
Vorlesung
Mi, wöch., 09:15 - 10:45, Marienstraße 7 B - Seminarraum 103
Fr, wöch., 15:15 - 16:45, Marienstraße 13 C - Hörsaal C, Dates by arrangement

Beschreibung

The objective of this module is focused on deepening the basics of soils mechanics, the fundamentals of analysis in applications for static and dynamic analysis as well as the basics of soil-structure interaction analysis. The students should be able to apply the strategies and methods to arbitrary engineering problems in the given fields. To fix the theoretical background the student has to apply the methods independently at given tasks during several projects.

Geotechnical Engineering

Classification and identification of soils; Description of soil state; Water in the soil; Hydraulic conductivity and seepage flow; Distribution of vertical stress in the soil; Stress-strain relationships; Settlement analysis; Consolidation theory; Shear strength; Earth pressure; Basics of Soil Dynamics (wave propagation, laboratory and field testing, soil-structure interaction under dynamic loading); Soil Liquefaction (phenomenon, consequences, estimation of liquefaction risk, prevention)

Leistungsnachweis

1 written exam

”Geotechnical Engineering” / 90 min (50%) / **SuSe** + WiSe

Geographical Information Systems (GIS) and building stock survey

Life-lines engineering

Primary hazards and risks

Structural engineering

205013, 205033 Structural engineering - Steel structures (L)

M. Kraus, S. Ibañez Sánchez Veranst. SWS: 3

Vorlesung

Mo, wöch., 13:30 - 15:00, Marienstraße 7 B - Seminarraum 103
Di, wöch., 17:00 - 18:30, Marienstraße 13 C - Hörsaal C

Beschreibung

Students will be familiar with the history of structures and structural forms, with building materials and building methods. They will understand the concepts of structural engineering design, including safety concepts, loads and structural design codes. They will be able to convert a structural concept into a mechanical model to determine internal demand and to design and detail the components of the structure, with an emphasis on reinforced concrete and post-tensioned concrete structures as well as steel and steel-concrete composite structures.

Structural Engineering – Advanced systems (summer semester):

Design of steel and steel-concrete composite structures; Post-tensioned concrete structures – design and detailing; Design of steel connections and detailing

Voraussetzungen

B.Sc.

Leistungsnachweis

2 written exams

”Reinforced and post-tensioned concrete structures” / 90 min (50%) / **WiSe** + SuSe --> WiSe!

”Steel structures” / 90 min (50%) / **SuSe** + WiSe

Structural parameter survey and evaluation

204018 Structural parameter survey and evaluation (L + E + P)

G. Morgenthal, V. Rodehorst, B. Rüffer, T. Gebhardt, S. Rau, M. Schönlein Veranst. SWS: 4.5

Vorlesung

Fr, wöch., 09:15 - 12:30, Marienstraße 13 C - Hörsaal C
Fr, wöch., 13:30 - 15:00, Marienstraße 13 C - Hörsaal C

Beschreibung

The students will be familiar with methods to determine properties of structural systems by means of modern measurement techniques. They will be familiar with the concepts, the application and the limitations of these techniques. They understand the data obtained and the methods to condition, analyse and interpret the data to extract information about structures and structural members and components. They will be able to apply the concepts to develop measurement setups and analysis procedures to problems encountered in structural engineering.

Signal Analysis

Trigonometric polynomials (TP); amplitude-phase and complex representation; approximation of arbitrary periodic functions by TP using method of least squares, calculation of Fourier coefficients and error estimation; Fourier series. Discussion of spectra and Fourier transform and its basic properties; Convolution and its properties and applications; random variables and central limit theorem; applications of Fourier transforms such as filtering of signals and solving differential equations

Sensor-based Monitoring and System Analysis

Types and principles of sensors; important sensor properties; data acquisition techniques; spectral and stochastic analysis of sensor data; properties of structural systems important in experimental testing and structural health monitoring; relevant limit states; structural analysis, modelling and model calibration; applications to static and dynamic response, load determination, physically nonlinear structural behaviour and optimization of sensor system setups

Geo-spatial Monitoring

Preparation and planning of three-dimensional measurement tasks; application of tacheometry, satellite-based positioning (GNSS), terrestrial laser scanning and photogrammetry for monitoring; image-based sensor orientation and surface reconstruction; spatial transformations, georeferencing, distance measures, pointcloud registration and geometric deformation analyses

Voraussetzungen

Primary hazards and risks

Applied mathmathics

Leistungsnachweis

1 written exam

”Structural parameter survey and evaluation ”/ 120 min

(100%) / **SuSe** + WiSe

Special Project

Elective compulsory modules

2401012 Applied Finite element methods (Lecture)

T. Rabczuk, C. Könke Veranst. SWS: 2
Vorlesung
Mo, wöch., 07:30 - 09:00, Marienstraße 7 B - Seminarraum 205

2401012 Applied Finite element methods (Exercise)

T. Rabczuk, A. Habtemariam, J. Lopez Zermeño, F. Tartaglione Garcia Veranst. SWS: 1
Seminar
Mi, wöch., 13:30 - 15:00, Marienstraße 7 B - Seminarraum 205, Tutorium
Fr, wöch., 07:30 - 09:00, Marienstraße 7 B - Projektraum 302, Exercise

303001 Advanced Building Information Modelling

C. Koch, J. Krischler, J. Taraben Veranst. SWS: 4
Vorlesung
Mi, wöch., 11:00 - 12:30, Coudraystraße 13 B - Pool Fak. B 007, Exercise
Mi, wöch., 11:00 - 12:30, Marienstraße 7 B - Student Design Studio – SDS 303, Exercise
Mi, wöch., 11:00 - 12:30, Coudraystraße 11 C - Pool-Raum 101, Exercise
Do, wöch., 09:15 - 10:45, Marienstraße 13 C - Hörsaal A, Lecture

engl. Beschreibung/ Kurzkommentar

Advanced Building Information Modelling

Content: Advanced geometric and parametric modelling, Interoperability and collaboration concepts (IFC, IDM, BEP), Advanced use cases (e.g. clash detection, as-built model-ing), BIM programming (incl. visual programming)

Target qualifications: This module introduces advanced concepts of Building Information Modelling (BIM) to provide students with advanced knowledge in order to understand, analyze and discuss scientific research approaches related to BIM. Within the frame of the mod-ule project (coursework) the students will choose a topic from a pre-defined list or come up with their own topic. Based on that they will do detailed research, imple-ment a representative concept in a software prototype and discuss findings and limi-tations. Also the students acquire skills of scientific working and presentation.

Bemerkung

NHRE: Possible as Elective Compulsory as from Intake 2022

Voraussetzungen

Recommended require-ments for participation: Basic knowledge of Computer-Aided Design, BIM concepts, and object-oriented programming

Leistungsnachweis

written report, presentation

204031 Computational and Experimental Wind Engineering (L, E, P)

G. Morgenthal, S. Chawdhury, G. Tondo Veranst. SWS: 6
Vorlesung
Di, wöch., 09:15 - 10:45, Marienstraße 7 B - Projektraum 301
Di, wöch., 09:15 - 10:45, Marienstraße 7 B - Seminarraum 106
Mi, wöch., 11:00 - 12:30, Marienstraße 7 B - Seminarraum 205

Mi, wöch., 11:00 - 12:30, Marienstraße 7 B - Projektraum 302

Beschreibung

The course aims to introduce the students to the fundamentals and state-of-the-art methods of wind engineering and different aerodynamic
phenomena that are relevant to the design of long-span cable-supported bridges. To characterize and quantify aerodynamic and
aeroelastic effects, students will understand the concepts of computational fluid dynamics (CFD) simulations and experimental wind tunnel
tests, along with their advantages and limitations. Students will be able to model complex bridge structures using Finite Element Analysis
methods and simulate dynamic response due to wind. Different combinations of analytical, numerical and experimental analysis
approaches are employed to investigate dynamic wind excitations with a focus on identifying serviceability issues and ultimate limit
scenarios of the structure.
Participating students are tasked with practical bridge design-oriented challenges and work in groups to address them. Group organization
and goal-oriented work are an important aspect to the project work. Results are reported periodically in presentations. Results are to be
summarized in a report following scientific writing standards and presented orally.

Bemerkung

Literature review on aerodynamic phenomena in long-span bridges; Fundamentals of computational wind engineering; Aerodynamic loads;
Self-excited or motion-induced forces; Aerodynamic instabilities; Finite Element modelling and dynamic simulation of long-span bridges
(arches, cable-stayed bridges, suspension bridges); Model Validation; Analytical and semi-analytical aerodynamic models; 2D and pseudo-
3D CFD simulations; Developing experimental scaled models; Experimental wind tunnel testing; Comparison of results from different
methods; Strategies for vibration mitigation; Aerodynamic optimization; Scientific writing and design-focused reporting.

Leistungsnachweis

1 Intermediate presentation
”Theoretical background and work update (20%)” / SuSe

1 Final presentation
”Presentation of final outcome (30%)” / SuSe

1 Final report
”Computational and Experimental Wind Engineering for Long-
span Bridge Design” (50%) / SuSe

301016 Complex dynamics

B. Rüffer Veranst. SWS: 4
Vorlesung
Do, wöch., 07:30 - 10:45, Marienstraße 7 B - Seminarraum 206, Will start at 04.04.2024 9:00 am!

Beschreibung

After the course the students will be able to analyse mathematical models that describe dynamic behaviour, as they occur in engineering (e.g. mechanical coupling of building structures), in biology and in physics, but also in multi-agent systems in computer science, or as opinion dynamics in psychology. Based on examples from different disciplines, students learn to build simplified models that allow to answer questions on their long-term behaviour.

Students will be able to apply methods of feedback design that help shape the dynamics of a given system, along with the relevant stability concepts. As several topics lend themselves for computer simulation, students of this course will develop a proficiency to both implement and analyse mathematical models using computational tools and software.

Bemerkung

Examples of complex dynamics. Models for dynamical systems in continuous and discrete time. Computer simulation. Control and Feedback. Stability, stabilization, and Lyapunov functions. Coupled systems: Disturbance or Cooperation? Networks of systems. Consensus. Synchronization.

The topics will be presented in a lecture, deepened by exercises. Some of the exercise include computer programming and simulation.

Voraussetzungen

B.Sc., knowledge in Matlab or Python

Leistungsnachweis

1 written exam

”Complex dynamics”

120 min (100%) / **SuSe** + WiSe

401009 Experimental structural dynamics and Structural monitoring (P)

T. Most, R. Das, M. Ansari, F. Tartaglione Garcia, S. Marwitz Veranst. SWS: 4
Projekt
Mi, wöch., 13:30 - 18:30, Marienstraße 7 B - Projektraum 301

Beschreibung

The students obtain deepened knowledge in structural dynamics, structural dynamic analysis, data processing, dynamic test equipment and its handling. They learn to analyse the dynamic behaviour of a structure utilizing both numerical and experimental state-of-the-art methods. Furthermore, the students have to develop strategies and concepts of investigation. The work in small groups enhances the social competence of the students.

Operational modal analysis, sensor types, sensor positioning, data analysis and assessment, assessment of structural changes, structural modelling, model updating

Bemerkung

14 students from NHRE only

Voraussetzungen

Structural dynamics

Leistungsnachweis

1 Project report + intermediate and final presentations

„ Experimental structural dynamics”

(100%) / **SuSe**

451002 Introduction to Optimization (L+E)

T. Lahmer Veranst. SWS: 3

Integrierte Vorlesung

Mo, wöch., 09:15 - 10:45, Marienstraße 13 C - Hörsaal D, Lecture
Di, wöch., 07:30 - 09:00, Marienstraße 7 B - Projektraum 301, Exercise Dates by arrangement

Beschreibung

In engineering science, we are often faced with problems having potential for optimization. We learn how to formulate this in mathematical terms, and we will study techniques how to improve the situations, generally by involving numerical models. We will discuss classical optimization problems in the field of linear and nonlinear optimization, e.g. optimization of the use of resources, routing problems, calibration problems and structural optimization. In particular in structural optimization we learn techniques like dimensioning, shape and topology optimization. Optimized structures are discussed also in the context of additive manufacturing techniques.

Bemerkung

Introduction to Optimization (summer semester):

Definitions, Classification of Optimization Problems,

Linear Problems, Simplex Method, Nonlinear Problems: Constrained and unconstrained continuous problems, descent methods and variants. (Robust) Structural Optimization (including Shape and Topology Optimization)

Voraussetzungen

B.Sc.

Leistungsnachweis

1 written or oral exam (depending on the number of participants)

”Introduction to Optimization” (3 credits) / **SuSe** + WiSe

202004 Multi-hazard and risk assessment (L + E)

J. Schwarz, S. Beinersdorf, H. Maiwald, N. Hadidian Moghaddam, P. Hasan Veranst. SWS: 4

Vorlesung

Di, Einzel, 13:30 - 15:00, Marienstraße 7 B - Seminarraum 102, 14.05.2024 - 14.05.2024
Di, Einzel, 13:30 - 15:00, Marienstraße 7 B - Seminarraum 102, 28.05.2024 - 28.05.2024
Mo, Einzel, 15:15 - 16:45, Marienstraße 13 C - Hörsaal C, 10.06.2024 - 10.06.2024
Mo, Einzel, 15:15 - 16:45, Marienstraße 13 C - Hörsaal C, 17.06.2024 - 17.06.2024
Di, Einzel, 13:30 - 15:00, Marienstraße 7 B - Seminarraum 102, 25.06.2024 - 25.06.2024
Mo, wöch., 15:15 - 16:45, Marienstraße 7 B - Seminarraum 205
Di, wöch., 13:30 - 15:00, Marienstraße 13 C - Hörsaal C

Beschreibung

The students will be familiar with the probability of natural hazard and risk determining parameters. They will be able to recognize procedures of single and multi-hazard assessment and to process input data and to apply tools to study areas. Students will be introduced in further advanced geotechnologies and existing or on-going research as well as global projects conducted by GFZ.

Hazard Assessment and Applications

Primary input and output parameters for EQ (and other natural) hazard; Earthquake statistics and occurrence probability; Methodology of seismic hazard assessment; Seismicity models; Examples of seismic hazard and risk

studies; Synopses of natural hazards; procedures and developments in multi-hazard assessment; Case studies of multi-hazard, vulnerability, and risk considerations.

Workshop

”Natural Hazards and Advanced Geotechnologies” during excursion to GFZ Potsdam

Compilation of EQ hazard-related data

Treatment of long-term seismicity data files; elaboration of earthquake data to get harmonized input for PSHA; earthquake catalogues; creation of shakemaps; data pre-processing; Hazard Description for the Project regions

Bemerkung

In this course 17 students can take part. **It is compulsory for the DAAD-scholarship holders of NHRE intake 2023.** There will be an introduction to the module at April 8th, where everybody interested can participate.

If you are interested to take part in the course, please write a **proposal** why you are interested and what are the major problems in your country related to multi-hazard that you identified yourself. Please **submit this to silke.beinersdorf@uni-weimar.de until April 5th, 2024**. We will inform you about the decision until April 8th, 2024.

The excursion to Berlin and Potsdam will take place this semester. **As soon as you are accepted, you will be enroled to the moodle-room.**

Voraussetzungen

recommended module "Primary Hazards and Risks" (NHRE)

completion of the module "Geographical information systems (GIS) and building stock survey" (NHRE) or basic knowledge of GIS-Systems is also recommended

Leistungsnachweis

1 written exam

”Multi-Hazard and risk assessment ”/ 90 min

(50%) / **SuSe** + WiSe

1 Project report (SYMULTHAN)

(50%) / **SuSe**

205007 Modelling of steel structures and numerical simulation (L + E)

M. Kraus, S. Ibañez Sánchez, S. Mämpel Veranst. SWS: 4

Vorlesung

1-Gruppe Mo, wöch., 11:00 - 12:30, Marienstraße 7 B - Projektraum 301, Exercise
1-Gruppe Mi, wöch., 07:30 - 09:00, Marienstraße 7 B - Projektraum 301, Exercise
2-Gruppe Mo, wöch., 11:00 - 12:30, Marienstraße 7 B - Projektraum 302, Exercise
2-Gruppe Mi, wöch., 07:30 - 09:00, Marienstraße 7 B - Projektraum 302, Exercise
Mo, wöch., 11:00 - 12:30, Marienstraße 13 C - Hörsaal D, Lecture
Mi, wöch., 07:30 - 09:00, Marienstraße 13 C - Hörsaal C, Lecture

Beschreibung

The students will be familiar with skills and expertise in the field of nonlinear structural analyses. Extensive knowledge of theoretical basics and modern modelling methods including numerical representations are the aim of the course. The students will acquire skills in handling advanced tools for the analysis and the design of structures.

Design of steel structures using finite element methods; basics of the design; modelling of structures and loads; nonlinear material behaviour, numerical analyses of steel-members and structures regarding geometric and physical nonlinearities; stability behaviour of members including flexural and lateral torsional buckling

Leistungsnachweis

1 Project report

”Modelling of steel structures and numerical simulation” (0%) / **SuSe**

1 written exam

”Modelling of steel structures and numerical simulation”/ 120 min (100%) / **SuSe** + WiSe

301017 Mathematics for data science

B. Rüffer, M. Schönlein Veranst. SWS: 4
Vorlesung
Mo, wöch., 09:15 - 12:30, Coudraystraße 13 B - Seminarraum 210
Mo, wöch., 09:15 - 12:30, Coudraystraße 13 A - Hörsaal 2

Beschreibung

After the course the students will be familiar with the fundamental concepts of data science. The participants can analyse given data sets with respect to dimensionality reduction and clustering. They also know the basic structure of neural networks and support vector machines to solve classification tasks. The participants know relevant methods from linear algebra and optimization and can apply these techniques. This embraces the design of appropriate algorithms and the implementation of different numerical methods to solve the corresponding problems.

Bemerkung

Examples of complex dynamics. Models for dynamical systems in continuous and discrete time. Computer simulation. Control and Feedback. Stability, stabilization, and Lyapunov functions. Coupled systems: Disturbance or Cooperation? Networks of systems. Consensus. Synchronization.

The topics will be presented in a lecture, deepened by exercises. Some of the exercise include computer programming and simulation.

Voraussetzungen

B. Sc.; Analysis and Linear Algebra at Bachelor level, knowledge of Matlab or Python

Leistungsnachweis

1 written exam

”Complex dynamics”

120 min (100%) / **SuSe** + WiSe

451006 Optimization in Applications (P)

T. Lahmer Veranst. SWS: 3
Projektmodul/Projekt

Beschreibung

In engineering science, we are often faced with problems having potential for optimization. We learn how to formulate this in mathematical terms, and we will study techniques how to improve the situations, generally by involving numerical models. We will discuss classical optimization problems in the field of linear and nonlinear optimization, e.g. optimization of the use of resources, routing problems, calibration problems and structural optimization. In particular in structural optimization we learn techniques like dimensioning, shape and topology optimization. Optimized structures are discussed also in the context of additive manufacturing techniques.

Bemerkung

Optimization in Applications (summer semester):

Optimization in Applications is generally a project assigned to the students including own programming and modelling. E.g. innovative optimization strategies are to be implemented in Matlab, Python or similar. Alternatively, engineering models could be subjected to optimization software.

Leistungsnachweis

1 project ”Optimization in Applications” (3 credits) / **SuSe** + WiSe

451007 Stochastic Simulation Techniques and Structural Reliability (L+E)

T. Lahmer Veranst. SWS: 3

Integrierte Vorlesung

Di, wöch., 11:00 - 12:30, Schwanseestraße 143 - Lintpool 2.17, Lecture
Di, wöch., 11:00 - 12:30, Marienstraße 13 C - Hörsaal D, Lecture
Fr, wöch., 07:30 - 09:00, Marienstraße 7 B - Projektraum 301, Exercise dates by arrangement

Beschreibung

Soils, rocks and materials like concrete are in the natural state among the most variable of all engineering materials. Engineers need to deal with this variability and make decisions in situations of little data, i.e. under high uncertainties. The course aims in providing the students with techniques state of the art in risk assessment (structural reliability) and stochastic simulation.
The course topics comprise
- (a very brief review) of probability theory
- discrete and continuous random processes and fields
- estimation of statistical parameters
- stochastic simulation techniques (Monte Carlo Samplings)
- reliability-based design
- sensitivity analysis
- structural safety
- Risk assessment and stochastic modelling in practice

Bemerkung

The lecture consists of weekly lectures by Prof. Tom Lahmer (Bauhaus University Weimar) throughout the semester and an intensive practical training (Blockkurs) on applications by Dr. Thomas Most (DYNARDO, Weimar)
Please indicate your interest in the course via an E-Mail to Prof. Tom Lahmer (tom.lahmer@uni-weimar.de) by briefly citing the title of the lecture and providing your name until **April 1st, 2023** as this will make the organization of rooms, course material, etc. much easier.

Possible combinations with other lectures acc. to the NHRE-Modulguide.

Voraussetzungen

Basic knowledge in probability theory

Leistungsnachweis

1 written or oral exam (depending on the number of participants)

”Stochastic Simulation Techniques and Structural Reliability” / (50%) / **SuSe** + WiSe

451011 Stochastic Simulation Techniques and Structural Reliability (P)

T. Lahmer Veranst. SWS: 3
Projektmodul/Projekt

Beschreibung

The course topics comprise

- (a very brief review) of probability theory
- discrete and continuous random processes and fields
- estimation of statistical parameters
- stochastic simulation techniques (Monte Carlo Simulation)
- reliability-based design
- sensitivity analysis
- structural reliability (FORM, FOSM, Subset Simulation, …)
- Risk assessment and stochastic modelling in practice

The project (extra 3 credits) involves own programming of stochastic simulation algorithms, e.g. generators of random fields, methods to assess structural reliability, and combination of stochastic simulation techniques with engineering models.

Bemerkung

Possible combinations with other lectures acc. to the NHRE-Moduleguide.

Voraussetzungen

Basic knowledge in probability theory

Leistungsnachweis

1 written or oral exam (depending on the number of participants)

”Stochastic Simulation Techniques and Structural Reliability” / (50%) / **SuSe** + WiSe

Elective Modules

Seit Wintersemester 2018/19 besteht an der Bauhaus-Universität Weimar ein zusätzliches Angebot an fächerübergreifenden Lehrveranstaltungen im Rahmen der Bauhaus.Module. **Studierende des NHRE können Bauhaus.Module aus dem Bereich Master belegen.** Inwiefern diese Module des **Wahlbereichs** ersetzen können, muss individuell mit der Fachstudienberatung geklärt werden. Das Angebot der Bauhaus.Module findet sich unterweimar.de/bauhausmodule.

Bemerkung:

– nur Masterkurse der BUW

– besonders engl. Kurse

Wunsch nach Einteilung der BM im bison nach Sprachen

252001 Experimental seismic assessment of steel members

A. Athanasiou Veranst. SWS: 4

Vorlesung

Di, wöch., 09:15 - 12:30, Marienstraße 7 B - Seminarraum 205

Beschreibung

The students will : familiarize with ductile braced frame systems; design steel braced frames for seismic hazard, following modern building codes; reflect on underlying code concepts; be actively involved in the experiments; become familiar with standardized testing protocols for steel braces; collect, analyze and interpret test data; explore the seismic behavior of steel braces in the full range of elastic-inelastic response, identify yielding and collapse mechanisms; create numerical models for seismic simulations; assess the strengths and weaknesses of alternative numerical models for accurate prediction of the experimental response; conclude on the produced qualitative and quantitative data in a final report.

Bemerkung

As engineers, we have to resort to testing and analytical methods in order to establish with some confidence the strength and deformation capacities of conventional and new structural elements under seismic excitation, and thus quantify collapse safety in a reliable manner. In this class, students are exposed to state-of-practice design, testing and numerical tools for steel braced frames under seismic excitation. Students are motivated to do practice-oriented research, and build new knowledge on the basis of what they already know. They are organized in learning groups of 3 or 4 and work weekly towards a paper reporting and reflecting on quantitative and qualitative task.

Leistungsnachweis

180hs, thereof 60hs Attendance time, 60hs Self-study time, 60hs Report-preparation time

1 Final report (100%) / **SuSe**

303002 Simulation Methods in Engineering

C. Koch, M. Artus Veranst. SWS: 4

Vorlesung

Fr, wöch., 09:15 - 10:45, Marienstraße 13 C - Hörsaal A
Fr, wöch., 13:30 - 15:00, Marienstraße 7 B - Projektraum 301
Fr, wöch., 13:30 - 15:00, Marienstraße 7 B - Projektraum 302

engl. Beschreibung/ Kurzkommentar

Simulation Methods in Engineering

Content:

- System analysis and modelling
- System dynamics
- Discrete event simulation
- Multi-agent simulation
- Input data and stochastic simulation
- Simulation based optimization
- Introduction to the software AnyLogic

Target qualifications:

This module provides students with comprehensive knowledge about computer based simulation concepts to address practical challenges in engineering. Modern simulation and optimization software is introduced within tutorials. The module project (coursework) offers an opportunity to students to work in groups on current problems in the context of civil and environmental engineering (e.g. production logistics, pedestrian simulation, pollutant dispersion). Using object-oriented simula-tion software the students will analyze, model and simulate different

engineering systems. The programming is carried out using Java. Also the students acquire team working and presentation skills.

Voraussetzungen

Recommended require-ments for participation: Basic knowledge of programming

Leistungsnachweis

Short group report, group presentation, written exam

104001 Multiscale Analysis of Engineering Materials

L. Göbel Veranst. SWS: 4

Vorlesung

Fr, wöch., 09:15 - 12:30, Coudraystraße 11 A - Seminarraum 215, 05.04.2024 - 12.07.2024

Beschreibung

Qualifikationsziele: Die Studierenden lernen experimentelle and analytische Methoden für die Charakterisierung von Baustoffen auf verschiedenen Ebenen kennen. Zunächst definieren und beschreiben die Studierenden die Mehrphasigkeit und Mehrskaligkeit ausgewählter Baustoffe. In Praktikumsversuchen, die unter fachlicher Anleitung durchgeführt werden, untersuchen sie die mikromechanischen Eigenschaften von ausgewählten Baustoffen und lernen dabei zum Beispiel die Methode der Nanoindentation und die dynamisch-mechanische Analyse kennen. Anschließend erfahren die Studierenden, wie diese experimentellen Daten in analytischen Ansätzen für die computer-basierte Abbildung der mechanischen Eigenschaften verwendet werden. Die Studierenden erlernen die Implementierung einfacher semi-analytischer Mehrskalenmodelle in MATLAB. Zudem lernen sie die thermodynamische Modellierung mittels GEMS kennen. Am Ende der Veranstaltung sind die Studierenden in der Lage, elastische Eigenschaften von Zementsteinen vorherzusagen.

Lehrinhalte: Mehrphasige Darstellungen von Baustoffen, repräsentative Volumenelemente, mikromechanische Versuchsmethoden (Nanoindentation, dynamisch-mechanische Analyse), Einführung in die Kontinuumsmikromechanik, Homogenisierungsverfahren, thermodynamische Modellierung

Course aim: The students learn experimental and analytical methods to characterize building materials at different levels. The students start to define and describe the multiphase and multiscale nature of selected building materials. The students then conduct selected micromechanical experiments in practical tests under expert guidance and learn, for example, about the method of nanoindentation and dynamic-mechanical analysis. Students then learn how these experimental data are used in analytical approaches for computer-based modelling of mechanical properties. Students learn how to implement simple semi-analytical multiscale models in MATLAB. They also learn about thermodynamic modelling using GEMS. At the end of the course, students will be able to predict the elastic properties of hardened cement pastes.
Course content: Multiphase representations of building materials, representative volume elements, micromechanical test methods (nanoindentation, dynamic-mechanical analysis), introduction to continuum micromechanics, homogenisation methods, thermodynamic modeling

Voraussetzungen

empfohlene Voraussetzungen / *recommended requirements*: Baustoffkunde, Mechanik I, Mechanik II (Festigkeitslehre)

Leistungsnachweis

Schriftliche Klausur: 90 Minuten (70 %)

Bewertung der Protokolle und Computerübung (30 %)

202012 Experimental testing based on impact and resistance: wind, fire and earthquake

L. Abrahamczyk Veranst. SWS: 4
Vorlesung
Mi, wöch., 15:15 - 18:30, hybrid format (Lectures online)

Beschreibung

Students will be familiar with principles of the design and setup, as well as evaluation and interpretation of experimental testing in structural engineering, by attending the experiments in a virtual environment. The students will be encouraged to apply their theoretical knowledge and competences for solving complex practical tasks, and thus, to build their own ”mental models”. It will be focused on the special and diverse demands in the elaboration of repeatable and destructive testing. Students will be familiar with instrumental methods and instrumentation requirements to provide structure related parameters and characteristic e.g. force-displacement relationships in support of analytical studies. Students should be able to decide upon appropriate test configuration for particular problems and to formulate the right questions in preparation of experimental studies. Students will be trained in distant group work.

Bemerkung

Lectures: (hybrid format)
Theoretical background about experimental testing based on impact and resistance with focus on wind, fire and earthquake;
testing facilities and technical equipment; demands on specimens and scaling requirements; arrangement of sensors;
application of equivalent impact/action (e.g. forces) in pseudo static and dynamic testing; physical interpretation and presentation of experimental data;

Project:
Training of modelling and analysis methods; study of code requirements and their application to different structural systems;
evaluation of structural performance for wind and seismic action; Tools: Matlab or Python; SAP2000

Workshop / Excursion (presence):
Training in and practicing presentation skills; visit of construction sites; networking;
Date: from 24th to 31st of March 2023
Place: Weimar and Bochum

Leistungsnachweis

Project presentation (oral), 50%
Project report, 50%

204032 Konstruktiver Entwurf eines IKI-Experimentalbaus

G. Morgenthal, L. Abrahamczyk, B. Bode
Projekt
Fr, Einzel, 13:30 - 15:00, Marienstraße 7 B - Seminarraum 105, Informationsveranstaltung, 12.04.2024 - 12.04.2024
Fr, Einzel, 13:00 - 15:00, Marienstraße 7 B - Seminarraum 105, Auftaktveranstaltung, 19.04.2024 - 19.04.2024
Fr, wöch., 13:30 - 15:00, Marienstraße 7 B - Seminarraum 104, ab 26.04.2024

Beschreibung

Auf Basis eines architektonischen Vorentwurfs soll der konstruktive Entwurf und die Herstellungsplanung für einen auf dem Campus der Bauhaus-Universität zu errichtenden Experimentalbau des Instituts für Konstruktiven

Ingenieurbau (IKI) umgesetzt werden. Das Konzept sieht eine auf der Geometrie eines Kuboktaeders basierende Gebäudehülle vor, für die auf der Basis zu definierender Nutzungs- und Einwirkungsszenarien ein gestalterisch ansprechendes, statisch-konstruktiv sinnvolles und wirtschaftlich umsetzbares Tragwerk zu entwickeln und zu planen ist.

Leistungsnachweis

Entwurfsarbeit und Präsentation

302014 Indoor Environmental Modeling

C. Völker, H. Alsaad, J. Arnold Veranst. SWS: 4
Integrierte Vorlesung
Mo, wöch., 13:30 - 16:45, Coudraystraße 13 B - Pool Fak. B 007

Beschreibung

Das Modul führt in die Untersuchung und Bewertung des Raumklimas ein, wobei der Schwerpunkt auf den Simulations- und Validierungsaspekten dieses Themas liegt. Die Studierenden lernen die Grundlagen des Raumklimas, die Methoden der raumklimatischen Modellierung und die für die Validierung der Simulationen notwendigen empirischen Messungen kennen. Dieses Modul beinhaltet einen Gruppenbeleg, in dem die Studierenden zunächst empirische Messungen in den Labors der Professur Bauphysik durchführen und diese Experimente anschließend mit Hilfe der Strömungssimulation modellieren. Die Simulationen werden anhand der Messungen validiert. Durch diese Aufgaben lernen die Studierenden die notwendigen Fähigkeiten für wissenschaftliche Forschung, fortgeschrittene Simulationswerkzeuge, wissenschaftliches Schreiben, Präsentation und Teamarbeit.

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The module introduces the investigation and assessment of the indoor environment with focus on the simulation and validation aspects of this topic. The students will learn the fundamentals of the indoor environment, the methods of indoor environmental simulations, and the empirical measurements required for the validation of the simulations. This module involves a group project in which the students begin with conducting empirical measurements at the laboratories of the Chair of Building Physics and move on to modelling these experiments using CFD. The simulations will be validated using the measurements. Through these tasks, the students will learn the necessary skills needed for scientific research, advanced simulation tools, scientific writing, presentation, and teamwork.

Bemerkung

Die Veranstaltung ist auf eine **Gesamt-Teilnehmerzahl von 12** begrenzt.

Voraussetzungen

Es ist kein Abschluss in einer vorhergehenden Lehrveranstaltung notwendig.

Kenntnisse in den Grundlagen der numerischen Analyse, FEM, FVM oder ähnlichem werden für die Teilnahme vorausgesetzt.

Leistungsnachweis

Beleg, Präsentation und mündliche Prüfung

Prüfungen