Technische Universität Braunschweig
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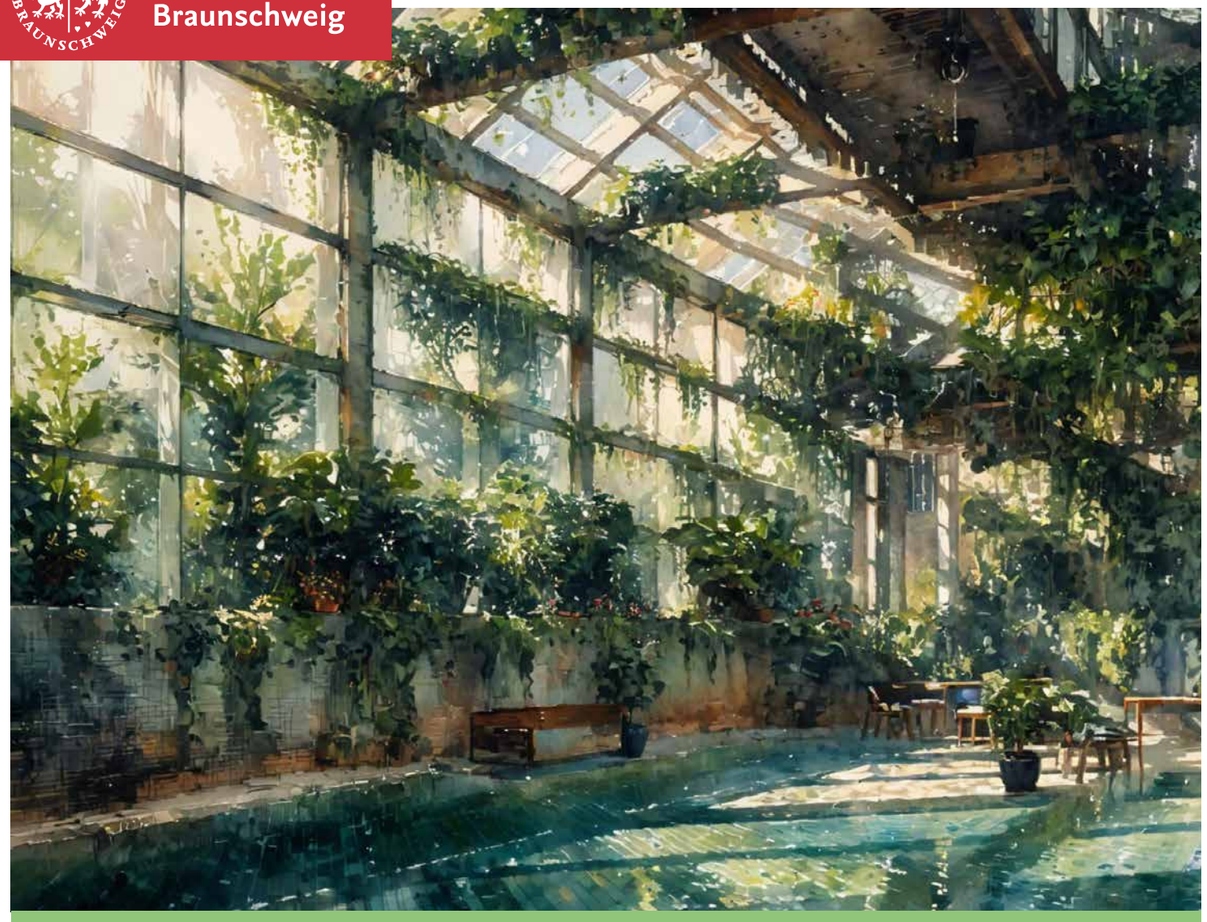
Technische Universität Braunschweig

Faculty
of Architecture, Civil Engineering
and Environmental Sciences



RESEARCH AND TEACHING

Faculty of Architecture, Civil Engineering and Environmental Sciences

Foreword of the Dean

Dear national and international partners,
prospective students, and funding bodies,

In the face of today's complex global challenges, collaborative and interdisciplinary efforts are more essential than ever to drive sustainable development and ensure long-term quality of life. At the Faculty of Architecture, Civil Engineering and Environmental Sciences at TU Braunschweig, we bring together diverse perspectives from key disciplines to tackle pressing social, environmental, and technological issues—and to shape sustainable living spaces, lifestyles, and land use for the future.

Our Faculty is composed of two departments: the Department of Architecture and the Department of Civil Engineering and Environmental Sciences, each organized into several institutes of varying size and fields of expertise. Together, we pursue integrated solutions for a more resilient, livable, and equitable world. With this booklet, we invite you to explore our research and teaching activities and meet the people behind them. Each professor is featured in a two-page profile that outlines their academic mission, research and teaching focus, laboratory infrastructure, key publications, a brief CV, and contact details.

You will find that our Faculty is deeply committed to sustainability, innovation, resilience, and social responsibility across technical, scientific, and creative disciplines. We are particularly focused on developing solutions to adapt to the impacts of climate change—on coasts, cities, and both aquatic and terrestrial ecosystems. Our initiatives include implementing circular economy principles in water management, advancing sustainable urban development and mobility, preserving biodiversity, developing nature-based solutions, and enhancing the durability and sustainability of roads, steel structures, and fire-safe buildings. We promote the use of low-carbon building materials, recyclable structures, and additive manufacturing (3D printing), and leverage digital fabrication and robotics for sustainable construction. Our research includes the development of advanced numerical models, digital twins, and machine learning tools.

In teaching, we aim to inspire our students to address complex problems with curiosity and critical thinking. Our curriculum fosters system-oriented understanding, inclusive values, and social awareness, preparing students and early-career scientists for both academic and non-academic careers—at national and international levels. We offer numerous opportunities for bachelor's and master's theses, as well as student assistant roles within our research projects.

We also see ourselves as facilitators of international cooperation and knowledge exchange, roles that have become increasingly important in today's interconnected world. We actively seek partnerships with universities, research institutions, industries, and public stakeholders to advance shared goals in education, research, and innovation.

This booklet also includes a brief portrait of TU Braunschweig, with general information about the university's research and teaching profile, a short history, and an overview of the 13 degree programs offered by our Faculty.

We hope this publication captures your interest—and we warmly invite you to connect with us.
Sincerely,

Professor Dr. sc. Antje Schwalb

Dean of the Faculty of Architecture,
Civil Engineering and Environmental Sciences
Technische Universität Braunschweig

Technische Universität Braunschweig

Faculty of Architecture, Civil Engineering and Environmental Sciences

Architecture

Civil Engineering and Environmental Sciences

Short Portrait Technische Universität Braunschweig

Carolo-Wilhelmina

Technische Universität Braunschweig Carolo-Wilhelmina is the academic focal point of Braunschweig, the City of Science, which in turn is at the heart of one of Europe's most active research regions. With more than 20,000 students and 3,500 staff members, we are the largest Institute of Technology in Northern Germany. Our campus is the ideal size for a university: our vast spectrum of teaching and research activities enjoy the use of state-of-the-art facilities while offering an intimate atmosphere at the same time. The Central Campus is located on the banks of the Oker River, walking distance from Braunschweig's city centre.

Our core disciplines include a comprehensive engineering branch and a strong natural sciences branch, closely linked with business sciences, social sciences, humanities and educational sciences. Our strategic research fields are mobility, infections and active agents, city of the future and metrology, which are interlinked through numerous overarching topics.

The name Carolo-Wilhelmina stems from the founding fathers of Technische Universität Braunschweig, Dukes Carl and Wilhelm von Braunschweig-Lüneburg. In 1745, Carl founded the Collegium Carolinum, thus becoming the first in Germany to lay the foundations for a technical university. Among the first students was mathematician Carl Friedrich Gauß.

Nec aspera terrent. Adversities shall not deter us – this motto of the founders of our university still serves as our maxim.

Taken from: Short Profile, TU Braunschweig 2018

With its 250,000 residents, Braunschweig is the largest city between Hanover and Berlin, making it the region's focal point, both throughout history and the present. Today, the Lion City is characterized by its rich history, its continuous development as a dynamic economic and commercial hub, its diverse and attractive cultural life, and its many-faceted research and science landscape.

Active research region

Braunschweig is not only one of the most active research regions in Europe; according to European Union statistics, it is also one of Europe's top investment regions in terms of spending on research and development. German economics magazine »Wirtschaftswoche« has also placed Braunschweig at the top of a ranking of business-friendly cities. TU Braunschweig plays a substantial part in this as it serves as a vital engine for the region. Our students are able to take part in projects at the facilities of our cooperation partners, for example at the Helmholtz Centres and Fraunhofer Institutes, and at federal research facilities and museums. Here they gain hands-on experience in biotechnology and environmental technology, automotive technology, aerospace technology, information and communications technology, measurement technology and microelectronics, as well as in humanities and education.

Transfers: What does it take to turn a good idea into a successful business concept? Technology transfers help to bring our research results to the economy, give support to business founders, and protect inventions through patenting. Under the roof of the Innovationsgesellschaft iTUBS (TU Braunschweig's innovation company), various specialized technology transfer centres aim to provide access to TU Braunschweig's research potential for commercial use, including for small and mid-sized enterprises.

Transparency and solid foundations: As a technical university, we seek open exchanges with the economy and society. In doing so, we also retain our independence. We feel an obligation towards a public, scientific and ethical discourse about the work that we do and uphold the rules of good scientific practice.

RESEARCH AND TEACHING AT TU BRAUNSCHWEIG

Study at the cutting edge of science: Our courses are guided by our research and impart broad, in-depth fundamentals, as well as offering diverse possibilities for individual specialisation. We let our students experience what it is like to put their own thoughts and results into practice, to research and develop projects on their own. For this reason we try to shape our degree courses around up-to-date research topics from an early stage.

Take interdisciplinary courses such as Environmental Science or Biochemical and Pharmaceutical Engineering, Transportation Engineering, Sustainable Energy Engineering and Biotechnology, or classic subjects from the fields of engineering, natural sciences, humanities and social sciences: our curriculum aims to interlink the various individual fields of study. Many courses of study are developed and realised in conjunction with neighbouring research institutes, such as the Metrology and Analytics course that is unique in Germany and is offered in cooperation with the German metrology institute PTB.

Master's degree: Our goal is that our bachelor's graduates continue to study at the master's level. Here the focus is even stronger: all our master's programmes are research-oriented and provide the necessary skill sets for management positions and international careers in research, development and business management.

Awards for exceptional teaching: We strive to continuously improve the quality of our teaching through student participation and by encouraging innovation in teaching. The best courses are awarded the »LehrLeo« teaching prize.

Open University: We open up new possibilities by offering students the chance to study without the »Abitur« certificate. We also practice knowledge transfers through research-oriented further education, especially in the field of mobility.

One point of contact for all your informational needs: matriculation, course guidance and CareerService – the Study Service Centre provides all the information and guidance you may need.

Technische Universität Braunschweig is part of the TU9 group of leading Institutes of Technology in Germany, and for each of its core disciplines, the engineering subjects, it ranks among the top 9 universities in Germany.

International

Our profile is international: TU Braunschweig is a cosmopolitan university. We cooperate closely with universities in the European Union, the USA, Canada, South America, China and Japan. Through the ERASMUS programme, we have student exchange partnerships with more than 200 universities in Europe.

One third of all our students spend part of their studies outside of Germany.
Dual degrees with US, French, Brazilian and Chinese universities qualify our graduates for the international job market. Student exchange, research projects and internships in foreign countries allow them to gain invaluable international experience. The various language courses on offer at our Language Centre prepare them for their stay abroad and for future careers in international environments.

International students are an important part of our academic community. Our campus is truly diverse: 3,000 students from more than 100 countries are currently studying and researching at TU Braunschweig. The excellent support provided by the International Office, the City of Braunschweig and the Peer Student Programme ensure that international students feel at home at our university.

In terms of research, our international orientation is just as self-evident. A considerable number of international scientists teach and conduct research at TU Braunschweig.

TU BRAUNSCHWEIG HISTORY

1745: The Collegium Carolinum is established, a new type of educational institution between secondary school and university, where mathematical/technical subjects are taught alongside humanities and fine arts.

1878: The polytechnical school is renamed Herzogliche Technische Hochschule Carolo-Wilhelmina (TH).

1900: The TH is accredited to award doctorates.

1933: Political alignment of the TH: the institution loses nearly 20% of its academic staff during the early period of the Nazi regime.

1945: Despite 70% of the institution being destroyed, the TH resumes lectures. It is the first German technical university to do so.

1968: After the establishment of a department for humanities and social sciences, the TH is renamed Technische Universität or TU Braunschweig (Institute of Technology).

1995: Under the slogan »Project Future«, TU Braunschweig celebrates its 250th anniversary.

2003: Establishment of the Centre for Humanities and Social Sciences at the Northern campus.

2006: Creation of TU9, an association of the nine leading German Institutes of Technology.

2007: Braunschweig is named the »City of Science 2007«.

2007: Foundation of the Automotive Research Centre Niedersachsen (NFF).

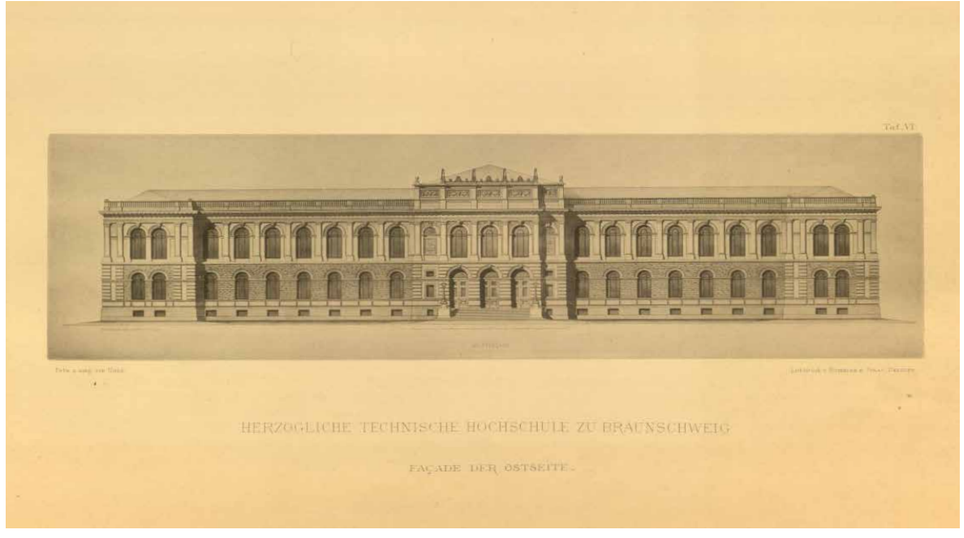
2009: Foundation of the Aeronautics Research Centre Niedersachsen (NFL).

2009: Creation of the Braunschweig Integrated Centre of Systems Biology (BRICS).

2016: Completion of the Open Hybrid LabFactory research campus.

2017: Relocation to the new Centre for Pharmaceutical Process Engineering (PVZ).

2017: Record high of 20.116 students



TU Braunschweig Figures

Study programmes:
- 34 bachelor's programmess and state examination courses (for undergraduates)
- 41 master's programmes

Students:
16,809 in the 2022/23 winter semester, including:
- 7,009 female
- 3,294 international students
- from 119 countries
- 2937 in faculty 3, 1.278 female

Graduates:
- 3,353

Doctorates:
- 303

Staff:
3,834 university employees (1,624 female, 2,110 male), including externally funded employees:
- 242 professors
- 2,088 academic staff
- 1,415 technical and administrative staff
- 89 trainees
- plus 416 adjunct lecturers
- plus 1,946 student assistants

Budget:
393 million € of overall budget, including:
- 123,6 million € in external funding

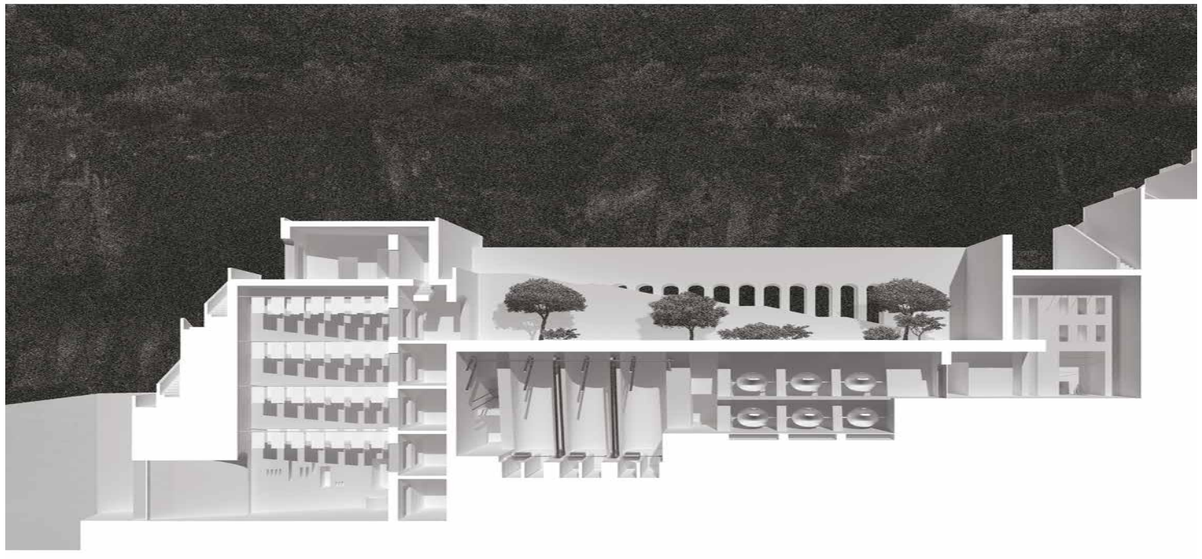
Faculty of Architecture, Civil Engineering and Environmental Sciences

Our degree programmes:

- **Architecture, BSc/MSc**
- **Civil Engineering, BSc/MSc**
- **Industrial and Civil Engineering, BSc/MSc**
- **Environmental Engineering, BSc/MSc**
- **Environmental Sciences, BSc/MSc**
- **Computational Sciences in Engineering, MSc**
- **Transportation Engineering, BSc/MSc**

As with all our degree programmes, graduates have the opportunity to pursue a doctorate.

Leonard Clemens



Architecture (BSc. and MSc.)

The Bachelor's degree programme in Architecture provides a foundational education over six semesters and offers a comprehensive overview of the architectural profession. The curriculum is structured around six areas of competence:

- Cultural and historical knowledge
- Representation and design
- Design and construction
- City and landscape
- Architectural design
- Professionalisation

TThe Master's programme in Architecture offers students exceptional freedom to organise their studies according to their personal and professional interests. Master's students choose their design projects and work as well as their other subjects according to their interests. Students explore architecture both within Germany and across the globe. Past international study trips have included destinations such as Italy, Iceland, Japan, Brazil or India, offering rich opportunities for on-site design work and cultural exchange.

New media play an essential role in contemporary architecture. From the very beginning of the programme, our students engage with both digital tools and analogue techniques. They have access to a wide range of state-of-the-art facilities, including model-making workshops; laser cutters, 3D printers and virtual reality labs—ensuring they are well-equipped to explore innovative design methods and workflows.

The Architecture Pavilion of TU Braunschweig serves as the central venue for a wide variety of events throughout the academic year. It hosts project presentations, regular exhibitions, semester kick-off events, and the graduation ceremony, making it a vibrant hub for academic and creative exchange within the architecture programme.

TU Braunschweig is home to one of the most renowned schools of architecture in Germany. The so-called "Braunschweig School" is particularly known for its strong emphasis on architectural design. Students learn to design architectural forms and spaces in both a constructive and functional manner. In addition to regular coursework, the lecture series "Architectural Positions" —featuring presentations by outstanding international architects—forms an integral part of the programme. These bi-weekly lectures provide valuable insight into contemporary architectural practice and thought.

A distinctive feature of the architecture programme at Braunschweig is the availability of large drawing rooms with several hundred workstations. These spaces foster a collaborative environment where students support one another during intensive project phases and offer feedback on drafts and exercises. This peer-to-peer exchange of ideas, knowledge, and techniques enriches the academic experience and complements formal university teaching. The strong sense of community and shared creativity is often cited as one of the most rewarding aspects of the programme. It is not uncommon for architectural firms to be founded as a result of the collaborations that begin in these drawing rooms.

Civil Engineering (BSc. and MSc.)

The Civil Engineering degree programme at TU Braunschweig is distinguished by its broad and interdisciplinary structure. The study plan stipulates that subjects from each area of the engineering specialisations must be taken. The Bachelor's programme in Civil Engineering includes the following core fields:

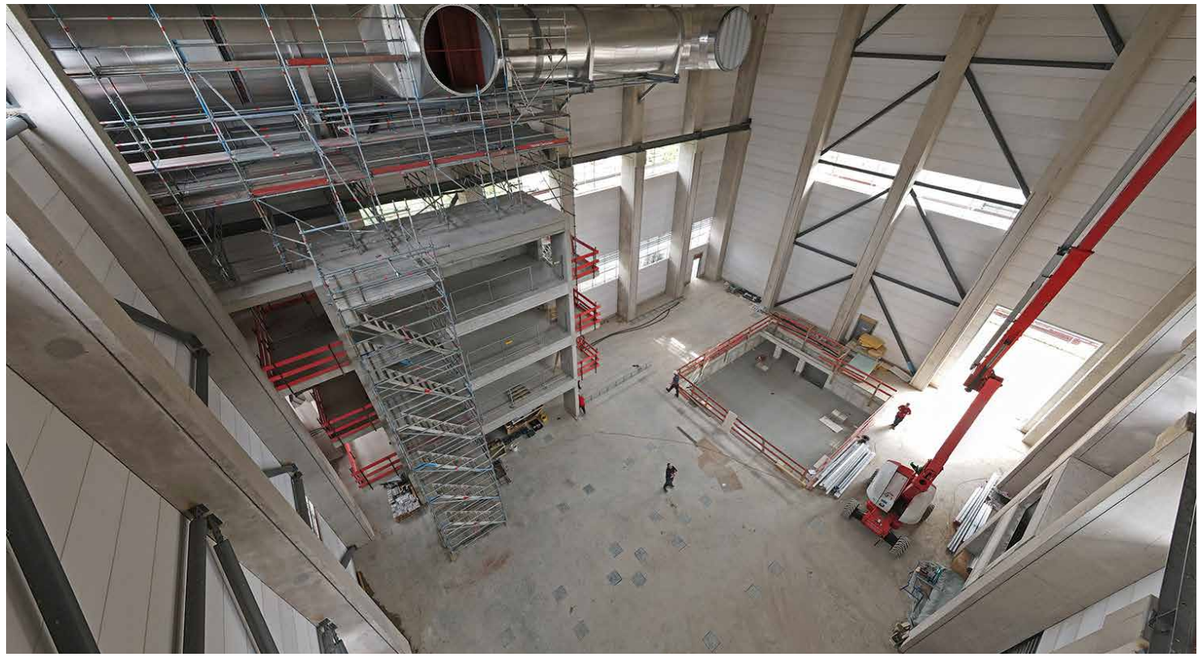
- Cultural and historical knowledge
- Representation and design
- Mathematical-scientific basics, including the modules engineering mathematics and technical mechanics.
- Engineering fundamentals, this area includes the modules building construction, building materials science, building economics, building statics, geotechnics, etc.
- Engineering science specialisation in the areas of structural engineering, water and environment, transport and infrastructure, computational engineering
- Cross-curricular content, including courses outside of civil engineering, e.g. languages and general business studies
- Bachelor thesis

The Civil Engineering programme at TU Braunschweig follows the "Braunschweig Model", which offers students a broad-based foundational education during the Bachelor's programme. In the Master's programme, students can then choose to specialise deeply in a single subject area or pursue a more generalist path, gaining foundational knowledge across multiple specialisations.

This flexible structure equips graduates with the skills needed for a wide range of professional careers in civil engineering.

In the Master's programme, students can choose from 22 specialisation subjects. Those seeking a broad education often select three diverse subjects, reflecting the demand from companies and engineering firms for versatile professionals with a wide-ranging skill set. Alternatively, students interested in a specific field can specialise in three thematically related subjects—such as solid construction, steel construction, and statics—allowing them to develop deep expertise within their chosen area. They can choose from the following specialisation subjects:

Waste management | Construction and project management | Building materials technology | Building preservation | Fire protection | Geotechnics | Timber construction | Hydrology, Water Management and Water Protection | Coastal Engineering and Maritime Engineering | Infrastructure and real estate management | Engineering Geodesy | Engineering Mechanics | Solid Construction | Public Transport | Computer-aided Modelling | Urban Water Management | Guided traffic | Steel construction | Statics | Road engineering | Traffic and urban planning | Hydraulic engineering



Industrial and Civil Engineering (BSc. and MSc.)

"Construction" has long since ceased to be limited to constructing buildings, roads, bridges, underground railway lines and railway tracks, or ensuring water supply and sewage disposal. Buildings, industrial plants, railway stations, airport terminals, traffic routes, etc. are now offered as "complete packages" - from planning and construction to commissioning and use.

Turnkey construction, leasing models, building management and public-private partnerships additionally require dealing with questions of financing, sale, operation and maintenance of buildings. Buildings and facilities are managed by construction companies for the entire duration of their existence. This requires professionals who have both the basic knowledge of civil engineering and business administration.

The Bachelor's degree programme in Industrial Engineering/Construction combines the classical contents of civil engineering, such as planning, dimensioning and operation, with knowledge from the field of economics, including the handling of financial resources and the management methods of a controlling system. Over the course of four semesters, our students gain scientific and methodological expertise that prepares them for challenging professional roles.

The Master's programme is divided into specialisations in civil engineering and economics, alongside an integration area that brings these disciplines together.

At TU Braunschweig, students gain a comprehensive understanding of both civil engineering and economics. They benefit from a broad spectrum of civil engineering courses covering areas such as structural engineering, hydraulic engineering, and lane-guided traffic systems. Simultaneously, students study the basics of business administration and civil law alongside industrial engineering peers. To further support this interdisciplinary approach, a professorship in infrastructure planning and management has been established, specifically tailored to the needs of industrial engineering students.

Even during their studies, our students benefit from the interdisciplinary nature of their future careers by attending lectures and practical exercises across various disciplines.

Environmental Engineering (BSc. and MSc.)

The daily news underscores the growing demand for environmental engineers in the job market. Challenges such as natural disasters and climate change, the management of endangered nuclear waste repositories, disrupted ecosystems, and the scarcity of raw materials amid a rising global population all highlight the critical importance of environmental engineering.

The solutions to these problems must be sustainable and aimed at protecting and preserving our planet. Environmental engineers are concerned with:

- Transport and Infrastructure
- Supply Locks, dams and wind and hydroelectric power plants
- Renewable energy sources (sun, wind, water, biomass)
- flood protection
- Reduction of emissions, immissions and noise
- Drinking water supply and wastewater treatment
- Sewage treatment plants
- Landfills and contaminated sites
- recycling

In the bachelor's degree programme in Environmental Engineering, we teach students the professional and sustainable management of vital resources resources such as energy, water, soil, building materials.

Building on the foundational knowledge gained in the Bachelor's programme, students n the Master's programme can deepen their expertise in line with their individual interests- preparing them to enter the workforce as highly qualified specialists.

The following specialisations are available in the Master's programme in Environmental Engineering:

- Soil conservation and geotechnics
- Energy Engineering
- Environmental Sustainability and Life Cycle Engineering
- Public Transport
- Environmental Monitoring
- Environment- and resource-friendly construction
- Transport and Infrastructure
- Supply and waste management

Environmental Sciences (BSc. and MSc.)

Environmental scientists work closely with engineers to combat the ongoing degradation, pollution and depletion of the natural foundations of life for humans, fauna and flora. Their expertise allows them to anticipate and assess potential environmental problems resulting from human activity, contributing to the development of effective, forward-looking solutions.

The Environmental Sciences degree programme is ideal for those interested in understanding the complex interrelationships within ecosystems and the dynamic interaction between humans and nature.

At TU Braunschweig, the Environmental Sciences degree programme offers a focused and supportive learning environment rather than a mass enrolement experience. With an intake of around 50 first-year students each year, the programme ensures small group sizes, close interaction with faculty, and excellent academic support. A particular highlight of the programme is its wide-ranging curriculum in the modelling of processes and interrelationships within ecosystems—offering students in-depth insights into environmental systems analysis.

Furthermore, TU Braunschweig is distinguished by its extensive research and experimental facilities, as well as its strong partnerships with institutions such as the Federal Research Institute for Rural Areas, Forests and Fisheries, and the Federal Research Institute for Cultivated Plants. These collaborations offer students valuable opportunities to engage in practice-oriented projects and theses grounded in real-world challenges.
The bachelor's programme equips students with the knowledge and skills needed to develop sustainable solutions to environmental challenges in the areas of soil, water and atmosphere. It lays a strong foundation for either direct entry into the workforce or continuation into a relevant Master's programme.

Building on the foundational knowledge from the Bachelor's degree and tailored to individual interests, students can further specialise in the Master's programme by choosing from the following focus areas:

- Applied hydrology and water management
- Atmosphere and boundary layer processes
- Biodiversity
- Soil and land use management
- Pollutant monitoring and modelling
- Environmental (geo)chemistry and ecotoxicology

Transportation Engineering (BSc. and MSc.)

Transport Engineering studies at TU Braunschweig cover tall major transport systems, including road, rail and air. This field offers exciting challenges and diverse career opportunities-ranging from urban and regional planning, the design and construction of vehicles and transport infrastructure, to the development of innovative traffic management and control methods.

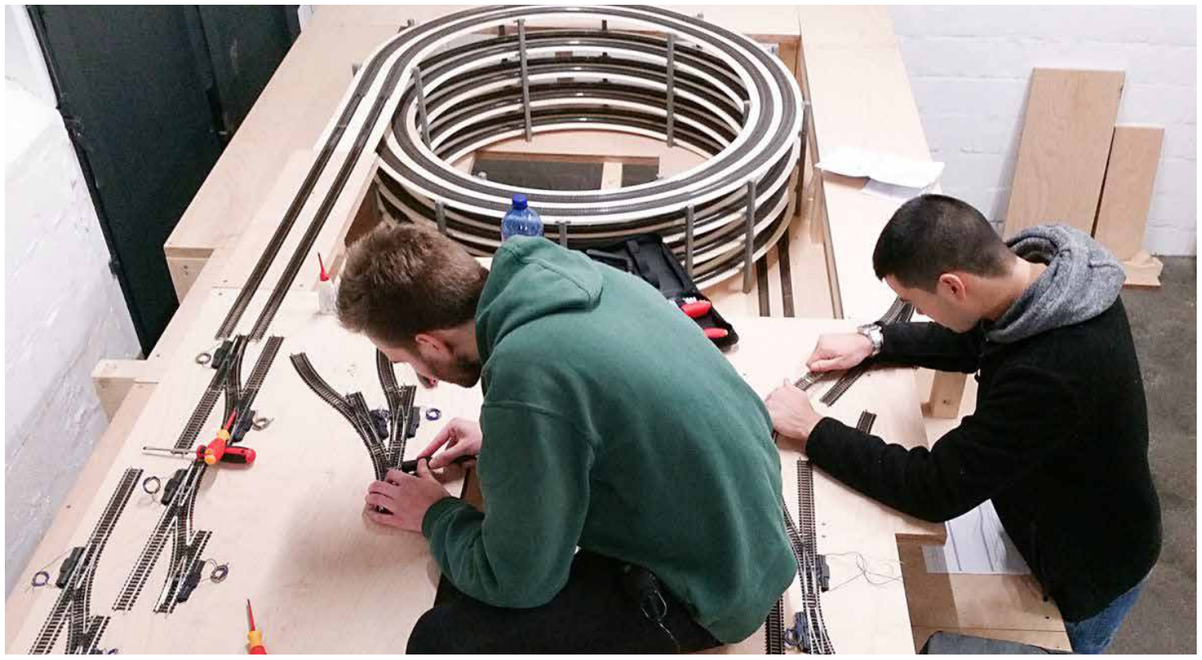
The Bachelor's degree programme in Traffic Engineering includes:

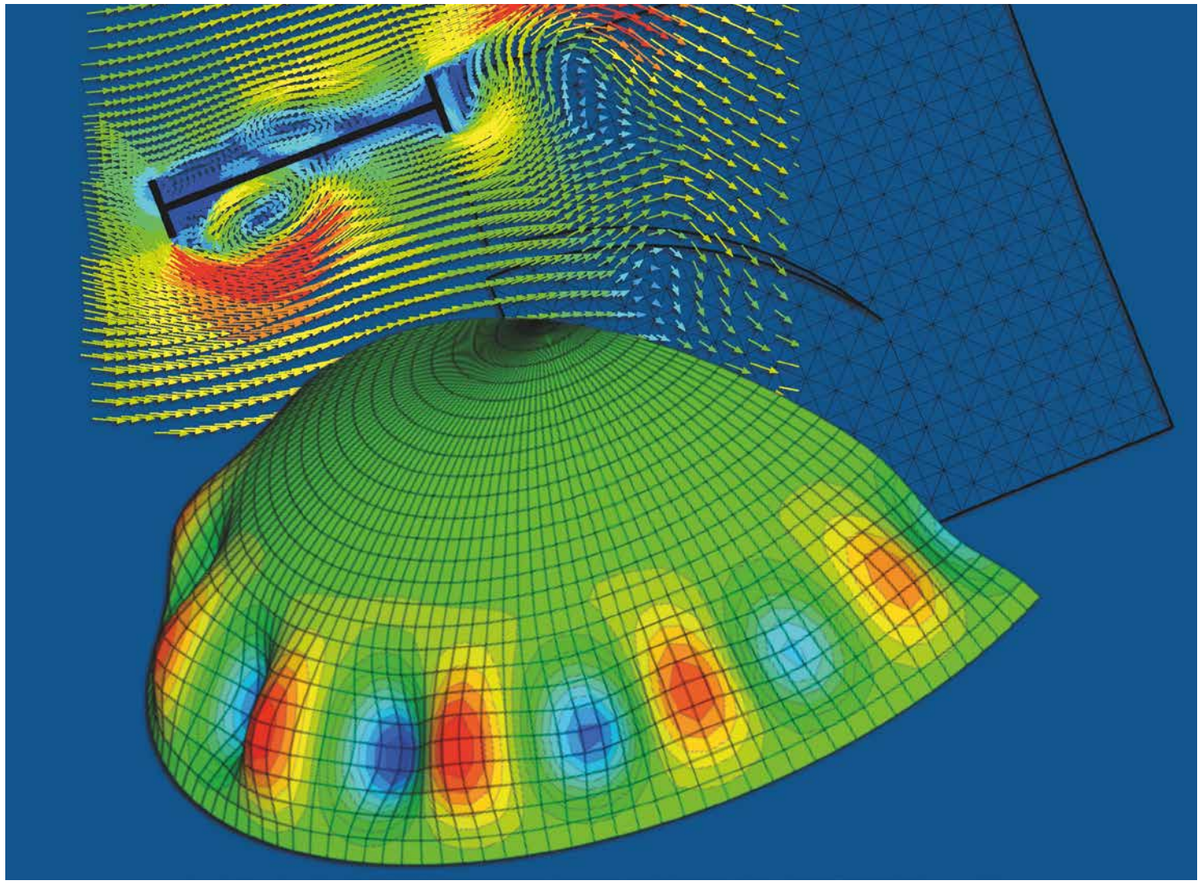
- Mathematical basics and computer science with the modules Engineering Mathematics and Programming.
- Engineering fundamentals such as technical mechanics, control engineering and electrical engineering
- Fundamentals of transport science, including modules on railway construction, road construction, public transport and transport and urban planning
- Economics and Social Sciences
- Architecture and economics, including the modules Production & Logistics, Economics and Mobility, Space & Architecture, among others
- Professionalisation: which includes, among others, the module CAD and the specialised internship

TU Braunschweig offers an ideal setting for the interdisciplinary Transport Engineering degree programme. The region is recognised as a hub of transport expertise, with a strong economic presence of transport-related companies as well as key public institutions such as the German Federal Aviation Office, the German Aerospace Center (DLR), and the Braunschweig Research Airport. This unique environment provides students with excellent opportunities for practical experience, networking, and career development in the transport sector..

In addition, TU Braunschweig offers:

- An interdisciplinary degree programme (intersections of mechanical engineering, civil engineering and economics).
- An opportunity for a double degree: through exchange programmes with the Université de Technologie de Compiègne (UTC) you can obtain a French Diplôme d'Ingénieur in addition to the German Master's degree
- A strong network with companies in the region





Computational Sciences in Engineering (MSc)

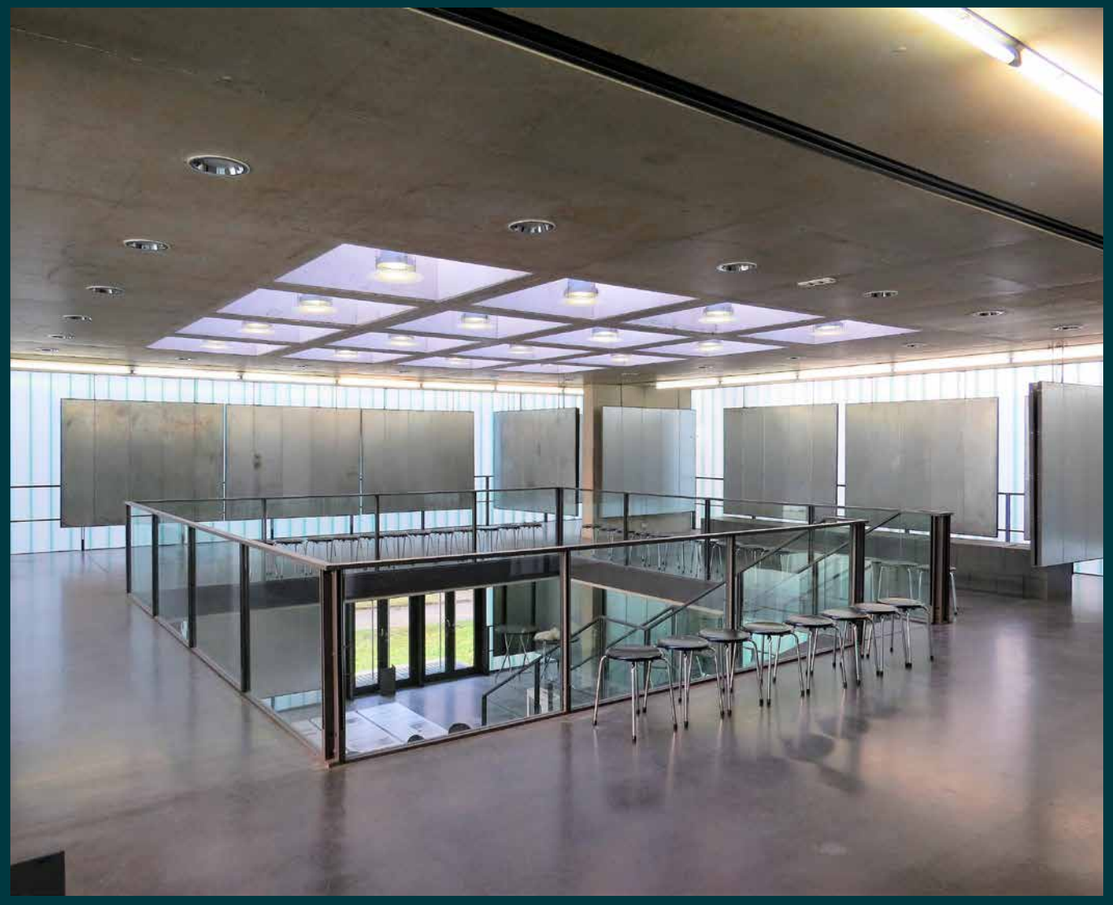
Computational Sciences in Engineering (CSE) is an interdisciplinary, research-oriented Master’s programme taught in English at TU Braunschweig.

The CSE Master's programme combines engineering sciences, mathematics and applied computer sciences. Students develop mathematical models to represent physical processes encountered across various engineering disciplines. They solve specific problems regarding physical modelling, mathematical formulation as well as numerical simulation and performing and evaluating complex numerical analyses of engineering processes. Three engineering tracks - Solid and Structural Mechanics, Fluid Mechanics and Information Technology - allow students to tailor their studies to their interests and career goals.

Thanks to the international focus of the CSE programme, our students study in a vibrant, multicultural environment.

CSE graduates are able to apply this knowledge both in developing new approaches and in improving existing technologies. They are able to plan and work on sub-projects in increasingly interdisciplinary project teams and successfully present the results.

The CSE master’s programme prepares graduates to pursue independent research, enabling them to continue with doctoral studies in civil, mechanical or electrical engineering, as well as in mathematics.



Architecture

IAD | Institute of Architectural Design

Mission Statement

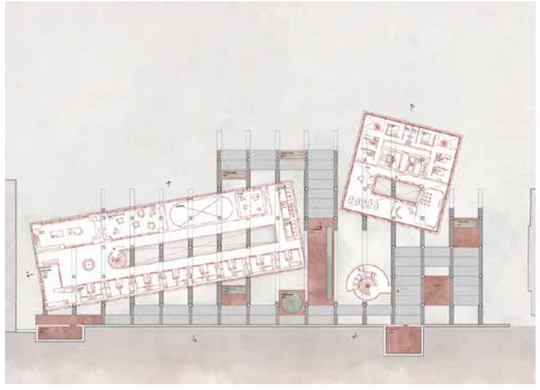
We are particularly interested in those structural-spatial elements and phenomena that allow a building to accommodate different programmes without losing its independent spatial expression and character.

RESEARCH

Design-Based Research
The built space forms the framework in which a society is articulated, reflected and further developed. Conversely, social developments also influence the manifestation of space and built structures. This includes the discourse on the conscious and moderate use of limited natural resources as well as the preservation of cultural continuity. Other influencing factors include constant technological and social change, which, under the auspices of digitalisation, climate change, or migration, seem to be accelerating. These aspects are also in tension with each other. From this, two design focal points emerge within our research and teaching: on the one hand, the further development and reinterpretation of existing buildings and the social influences associated with them. On the other hand, the understanding of architecture as a space of possibilities in which social change can continuously take place. We are particularly interested in those structural-spatial elements and phenomena that allow a building to accommodate different programmes without losing its independent spatial expression and character.

Lecture Series
IAD curates the Department of Architecture's lecture series ‚Architekturpositionen', featuring both renowned architects and emerging talents. Professionals present their thinking and acting as architects, the design strategies, work and applied research of their offices. Thus, students not only get to know exciting architectural projects and gain insights into their realization. They also learn what professionalism means in the field of architecture. Lecturers and tutors can match their teaching and research with architectural practice. With about five guest lectures per semester, since 2012 we have welcomed more than 100 architects, most recently De Zwarte Hond, Conen Sigl, b 720, Riegler Riewe, Bruther.

Continuation and Transformation
Student projects by Antonia Buschmann/Frederike Hage, Edwald Dederer, Hyeyeon Jeong/Reidar Mester



IAD | Bernhard Ax + Dr.-Ing. Simon Banakar (provisional)

Researcher's Career

Bernhard Ax
- since 2023 Head of Institute of Architectural Design IAD at TU Braunschweig together with Dr.-Ing. Simon Banakar
- 2012-2023 Assistant professor at IAD, Prof. Volker Staab
- 1997-2012 Assistant professor at IAD, Prof. Michael Szyszkowitz
- 1992-1997 Architect in Cologne, Munich and Hannover
- 1992 Diploma in Architecture at Hannover University
- 1984-1992 Architecture studies in Siegen, Hannover and London

Dr.-Ing. Simon Banakar
- since 2023 Head of Institute of Architectural Design IAD at TU Braunschweig together with Bernhard Ax
- 2018/2022-2023 Assistant professor at IAD, Prof. Volker Staab
- 2023 Design-based doctorate (PEP Program), TU Berlin
- since 2013 Staab Architekten GmbH
- 2013 Diploma with distinction, TU Braunschweig
- 2009–2010 Guest studies at ETH Zurich (DAAD Free Mover Scholarship)

TEACHING

Programmatic Approach
IAD is primarily concerned with the design of buildings. The focus is on the search for design strategies that take into consideration the complex boundary conditions of architecture and contemporary techniques, while still keeping an emphasis on conceptual sharpness in the design process. The inner logic of an architectural construct as well as the processing of contextual influences and social issues play an essential role. The discourse is determined by the question of the relevance of an architectural form.
In the Bachelor's programme, implications of architectural design such as idea, context, programme, structure and atmosphere are addressed in exercises and projects of increasing complexity. In the master studios, we are looking for an architecture that is open to different uses but specific in terms of the spatial quality, expression and atmosphere of a building and its relationship to its context. In particular over the last two years, we have focused on the continuation and transformation of existing buildings as a basis for new dedications and future uses.

Publications

- Ongoing IAD-Publication: Development and reinterpretation of existing buildings - Teaching and student work 2023-2025
- Zukunft Kirchen Raum. Szenarien für die Bartholomäuskirche, in Gunnar Schulz-Lehnfeld (Hg.): Die Bartholomäuskirche in Braunschweig. Bauforschung, Denkmalpflege, Perspektiven. Berlin 2025, p. 135-169
- Robust structures, autonomy and formation of space in horizontal spatial structures, Doctoral thesis, Technical University of Berlin, DepositOnce, 2023. DOI: 10.14279/depositonce-17493

Contact
Technische Universität Braunschweig
IAD | Institute of Architectural Design
[Institut für Entwerfen und Raumkomposition]
Pockelsstr. 3, 11. OG
38106 Braunschweig
Phone: +49 531 391-3531
iad@tu-bs.de
www.iad-bs.de

IAK | Institute for Architecture-Related Art

Mission Statement

Artistic work as we understand it is process oriented and never primarily determined by its use. Our goal is to foster dialogue and collaborative models of working. We work 1:1 with many different, often recycled materials, establishing knowledge about methods of artistic design and form-finding. We encourage critical thinking and questioning of predefined structures via artistic reflection.

RESEARCH

Public Space
How do we define public space and what rights and obligations follow as a consequence of our perception? Public space in the cities today is beset by a growing number of cars and the expanding infrastructure to support the automobile lifestyle, by the permanent pressure to consume and the increasing surveillance of public or semi-public spaces. Through artistic work - interventions, installations, site specific constructions as well as performative and collaborative works - we seek to deepen our knowledge of public space and instigate new alternative models of co-habitation and collective appropriation.

Mobility
We believe that mobility begins in our heads and by experimenting with shifting views and standpoints, we aim to expand the willingness for creative thinking. While walking (or biking) heightens the sensitivity towards our surroundings, driving a car does not. Therefore we work to design and construct new structures and vehicles for non-motorised transportation by reconstructing and recycling materials gained from automobile waste with the aim to strengthen sustainable forms of mobility.

Resources
We explore the artistic and constructional qualities of a variety of materials. It is our firm conviction that it is not necessary to buy material to work with, but that there are significant resources to be gained from what is generally considered to be trash and of no use to others. Most working materials we obtain from our immediate surrounding. Through our daily artistic practice as well as in more extensive collaborative works, we develop the manual skills needed to work with many different materials, learning how to reuse and recycle. The possibilities lying within the material inspire the design and the acquisition of the work material becomes part of the exploration process.

Waste land
Free and unused space is an invaluable resource in times of growing cities and an increasing world population. We understand waste land or uninvested land as a creative resource and explore possibilities for creating new shared space through site specific work. Urban waste land is mostly a symptom of economic crises and transformation processes. At the IAK we value the yet undefined space as possible exit point of a cultural refreshment of a city. Because of unclear ownership, uninvested spaces are open to informal use and as green areas it has the potential to become areas of urban retreat, often being land left to nature and with spontaneous wild growth; spots where nature has re-defined space.

IAK | Prof. Folke Köbberling

Researcher's Career

- Full Professor for Architecture-Related Art, TU Braunschweig
- Visiting Professor, University of Applied Arts, Vienna/Austria
- Visiting Professor, Art Center College of Design, Pasadena/USA
- Lecturer, University of Fine Arts UDK, Berlin
- Associated Professor, Leibniz Universität, Hannover
- Member of the Commission for Art in Public Space, Lower Austria
- Working grant, Canada Council, Vancouver/Canada
- Artist in residence, Villa Serpentara/ Akademie der Künste, Olevano/Ital
- Working grant, Stiftung Kunstfonds Bonn

Co-operations since 2017

- Felix-Nussbaum-Haus, Osnabrück
- ALBA Braunschweig GmbH
- KHiB - Bergen National Academy of the Arts, Bergen, Norway (now UiB, Bergen)

TEACHING

A design process, be it in art or architecture, typically begins with a layout, a concept, a sketch or a design from which a form is developed. At the IAK design takes a starting point in the material, its qualities and possibilities, while form develops as a consequence of the practical and manual work process. We teach and work as site specific as possible. The surrounding forest, the city of Braunschweig, the museums and cultural institutions nearby, the resources at hand, provide a basis for our investigative and experimental practices. In art, in making art, the process is a goal in itself, much more than a predefined result. The useful often hides within the erroneous and is to be found on detours or by coincidence. It is our goal to train perception to a heightened sensitivity towards our urban and natural surroundings and their visual and creative potentials.
Most steps of the artistic practice taught at the IAK are collaborative, making communicative skills and knowledge about art practice an essential element of our teaching. We strongly believe in the possibility of sound but critical thinking deriving from artistic practice and we encourage dialogue and verbalised reflection as an integrated part of our daily teaching. Lectures and workshops by renowned artists and art practitioners complement the practical and theoretical courses offered by Professor Folke Köbberling and her team.

Publications

- Köbberling, Folke: Full Stop, Edition Metzel, München 2017
- The Games Are Open, Folke Köbberling and Martin Kaltwasser. Texts by Barbara Holub and Barbara Cole. Edited by Lorna Brown, Vancouver 2016
- Kaltwasser, Martin/Köbberling, Folke (ed.): Hold it! The Art & Architecture of Public Space: Bricolage Resistance Resources Aesthetics, jovis Verlag, Berlin 2009
- Kaltwasser, Martin/Köbberling, Folke (ed.): Ressource Stadt - City as a Resource. One man's trash is another man's treasure, jovis Verlag, Berlin 2006
- Becker, Jochen/Burbaum, Claudia/Kaltwasser, Martin/Köbberling, Folke /Lanz, Stephan/Reichard, Katja: learning from *, NGBK (ed.) b_books, vice versa, Berlin 2003
- Köbberling, Folke: Tagesfiliale Köbberling Elektronik, Goldrausch Künstlerinnenprojekt, Berlin 2003

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IB | Institute of Building History

Mission Statement

Historic Buildings document the achievements, failures, challenges and transformations within our societies: how people lived, where they were governed, how they practised their religious beliefs, by what they wished to be remembered by, etc. To understand and to preserve these sources is our responsibility as a society and the institute's mission.

RESEARCH

Thanks to a diverse team of researchers with a wide spectrum of interests, the IB is active in various projects within the field of building history and building archaeology.

Building Archaeology of the Ancient and Medieval World
We explore the architecture of the ancient and medieval world, gaining knowledge through building archaeology, interdisciplinary cooperation, and cultural exchange. Architectural remains are scrutinized and documented by surveying, drawing, describing, etc. Only this enables assessment, virtual reconstruction, interpretation and protection.
In cooperation with the WWU Münster, the IB is involved in the archaeological exploration of Doliche, a Roman city in southeastern Turkey, particularly of its centrally located temple. In Egypt and Spain we cooperate with the German Archaeological Institute: In the investigation of the Monastery of Deir Anba Hadra near Aswan we focus on the refectory as the space of common meals; in the mosque-cathedral in Cordoba, where decorated roof timbers of the earlier building phases are preserved, we endeavour to virtually reconstruct one of the oldest roofs in Europe.

Projects in Lower Saxony
The exploration of significant buildings in Lower Saxony is a contribution to local history and heritage conservation by the IB. The region was a hub of economic growth from the 12th century mainly due to mining in the Harz Mountains. In Hildesheim one of the few preserved stone arch bridges from the 12th century was documented during a rescue excavation, virtually reconstructed and interpretated as a main source for the historic urban development. In Lucklum, a historic knight's estate, the central Manor House is being documented in every detail and studied in its development from its foundation to the 19th century – a precondition for its preservation. Brunswick Cathedral holds one of the very rare preserved construction machines from the middle ages, a 20 m high rotating crane mast dated to the 13th century. It is being investigated with the aim to better understand the history of the church and medieval construction sites in general.

Epistemic History
The history of knowledge and science is a rich field for building historians, competent to establish how historic architects operated.
Ancient Egyptian working drawings are hard to find and not easy to document, but are preserved in considerable number – the IB is involved in new findings in the Philae temple near Aswan. Notable research on the work and methods of Michelangelo Buoanarotti has been undertaken at the institute until 2025. It also holds a rich archive of photos and plans acquired from the 1960s to 1980s. Their preservation and digitization is a challenge and responsibility.

This page: Sketching a temple in Paestum – excursions and field trips enable to study historic buildings hands-on. (U. Fauerbach/TU Braunschweig)

Opposite page: An IB-research-team documenting a recently excavated medieval bridge in Hildesheim. (Y. Timm/TU Braunschweig)

IB | Prof. Dr. phil. Ulrike Fauerbach

Researcher's Academic Career

- Since 2021: Full Professor of Building History
- 2016–2021: Professor of the History of Architecture and Construction, University of Applied Science OTH Regensburg
- 2013–2015 Senior Research Fellow, Eidgenössische Technische Hochschule Zürich
- 2006–2012 Senior Research Fellow, German Archaeological Institute Cairo
- 2006 Scholarship at the Max Planck Institute for the History of Science, Berlin
- 2005 Doctoral degree from the University of Bamberg on The Great Pylon of the Horus Temple in Edfu, Egypt
- Member of the DFG Research Training Group Kunstwissenschaft–Bauforschung–Denkmalpflege (University of Bamberg/ TU Berlin). The thesis was awarded the Hans-Löwel-Preis

Funding
DAAD, DFG, Niedersachsen Nieders. Ministerium für Wissenschaft und Kultur, Thyssen-Stiftung a.o.

TEACHING

We teach students how to analyse historic architecture in its manifold context of cultural and social history, technical development, theoretical outlook, climate, and topography. A rough overview is given in a two-term lecture course that presents examples from the Neolithic to the end of the 19th century, focusing on the Mediterranean and Central Europe. The experience of hands-on material studies can be gained in an intensive workshop week by surveying and researching historic buildings on site, as well as by studying written and visual sources. On these foundations, which are laid during the first two semesters, students can then choose from a range of topics for in-depth studies of building history. These could comprise a survey of a medieval village church, researching publications on Ancient temples, recording the building construction of an industrial building from the early modern era, etc. During the course, students interpret their research results and convey the gained knowledge to others by e.g. writing a paper, re-editing a Wikipedia entry, making an architectural model, and so forth.
These achievements will enable students to help preserve the built heritage and to transfer their analysis to the architectural discourse.

Publications

- Fauerbach, Ulrike, in print. „Planen ohne Papier. Antike Werkrisse in Ägypten". In Pflegen. Reaktivieren. Retten – Beiträge der Bautechnikgeschichte zu einer Kultur des Weiternutzens. Tagungsband der siebten Jahrestagung der Gesellschaft für Bautechnikgeschichte vom 15.–17. Mai in Braunschweig, herausgegeben von Christoph Rauhut, Christiane Weber, Michael Bastgen, Mike Sieder, und Sabine Kuban. Petersberg: Imhof.
- Schulz-Lehnfeld, Gunnar, Ulrike Fauerbach, und David Wendland, in print. „Der mittelalterliche Drehkran im Nordturm des Braunschweiger Doms – Bauforschung zur Konstruktion, Funktionsweise und Nutzung mittelalterlicher Hebezeuge", in: ibid.
- Michaelis, Ruben, in print. „Erhalt aus ästhetischer Perspektive Zur Transformation der Dachwerke der Moscheekathedrale von Córdoba", in: ibid.,
- Schulz-Lehnfeld, Gunnar, Gymnasium Andreanum Hildesheim. Bild oder Substanz? Was bleibt, was zählt? In: Birnbaum, Jens; Gebler, Tina; Krekeler, Achim (Hg.): Pass-Stücke. Bauen im historischen Kontext. Berlin 2024, S. 148–157.
- Fauerbach, Ulrike/Andreas Putz, ‚« Bauforschung » Today: Current Tendencies in Building Archaeology in Germany', in: Archéologie du bâti. Aujourd'hui et demain, ed. by Chr. Sapin, S. Bully, M. Bizri, und F. Henrion. Dijon 2022. https://books.openedition.org/artehis/26352.
- von Kienlin, Alexander; Schulz-Lehnfeld, Gunnar: Die Koldewey Summerschool 2019. Bauhistorische Untersuchungen an der Gutskirche in Lucklum. In: von Kienlin, Alexander: Sur le Grand Tour - Reisende Architekten als Protagonisten des europäischen Gedankens. Dresden 2023, S. 251–255.

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Bet Tfila - Research Unit for Jewish Architecture

Mission Statement

The Bet Tfila – Research Unit for Jewish Architecture – is dedicated to researching and communicating Jewish cultural, especially built heritage, in Europe and beyond. Through our international and interdisciplinary projects, Bet Tfila scholars contribute to the development of social awareness of Jewish heritage, thus combating anti-Semitism, by conducting and publishing its in-depth research on selected topics.

RESEARCH

The built heritage of Jewish communities in Europe is viewed controversially. As the architecture of a minority, it is often overlooked, misunderstood and thus endangered, both in the past and today. Our work at the Bet Tfila – Research Unit is aimed at documenting, researching, critically assessing and communicating this heritage in all its facets. As Jewish communities were highly mobile and globally connected from antiquity on, this work must be considered in a wider international context. Beyond the aspects of architectural history, the social, cultural and political significance of Jewish built heritage needs to be considered: what constitutes Jewish architecture? who designs it, who builds it? What is the significance of architecture for Jewish communities, how is it received by non-Jewish societies? What is the role of destroyed and preserved Jewish buildings within the discourses surrounding the memory of the Holocaust, from both Jewish and non-Jewish perspectives? How do societies, bereft of their Jewish citizens, deal with the "orphaned" heritage, how do contemporary Jewish communities position themselves in relation to it?

Since the foundation of the Bet Tfila – Research Unit in 2000, its groups at the TU Braunschweig and at the Center for Jewish Art of the Hebrew University of Jerusalem have been working in interdisciplinary and international project cooperations. Within the DFG priority program "Jewish Cultural Heritage", which began its work in 2022, we are represented by two projects and also by Ulrich Knufinke in the coordinating program committee. Doctoral and postdoctoral researchers work on the documentation of Jewish buildings: Zuzanna Światowy's project deals with former synagogues in Poland, their protection, re-use and reception by Jews and non-Jewish society. In a further project, Mirko Przystawik explores architecture and text as constituting "sites" of Jewish self-understanding and cultural heritage. Katrin Keßler examines Jewish cemeteries with regard to anti-Semitism and their role in memorial culture.

The Bet Tfila – Research Unit publishes its research results in two scientific series, as well as in books and numerous articles. Since 2007, we have organised a series of international congresses on Jewish Architecture with our partner institutions, most recently in 2022 on "Jewish Topographies" with contributions from all over the world.
We address the interested public with our lectures at the TU Braunschweig and in more than 20 exhibitions of our collection of wooden models of reconstructed synagogues.

Photos:

This page: Model of the villa of Galka Scheyer, LA art collector and socialite, built by students after scrutinizing hundreds of photos (M. Przystawik, 2022)

Opposite page: Synagogue in Lengnau/Switzerland (U. Knufinke, 2017)

Bet Tfila | Prof. Dr. phil. Ulrike Fauerbach

Formation of the Research Unit

- 2000: Foundation of the Bet Tfila – Research Unit for Jewish Architecture at the TU Braunschweig and the Center for Jewish Art in Jerusalem; Directors: Harmen H. Thies (Braunschweig), Aliza Cohen-Mushlin (Jerusalem)
- Since 2007: five International Congresses on Jewish Architecture
- 2014: new director: Alexander von Kienlin
- 2015: foundation of the Jewish Cultural Heritage Network
- Since 2021: new director: Ulrike Fauerbach, scientific director: Ulrich Knufinke
- 2021: DFG priority program "Jewish Cultural Heritage", Ulrich Knufinke member of the program committee

Funding
German Research Foundation (DFG), Federal Ministry of Education and Research (BMBF), Lower Saxony Ministry of Science and Culture (MWK), Alfried Krupp von Bohlen und Halbach-Stiftung, German Israeli Foundation and others

TEACHING

The Bet Tfila – Research Unit regularly offers seminars for Bachelor and Master students to provide an insight into Jewish cultural heritage and also enable participants to learn building documentation, the critical analysis of historical sources as well as to become well-versed concerning reconstructions of destroyed buildings. The topics and tasks of the courses are related to ongoing research projects, so that students acquire in-depth knowledge of scholarly work and experience how their results contribute to scientific knowledge.

Currently, the Bet Tfila – Research Unit is establishing an interdisciplinary, cross-university "Jewish Cultural Heritage Studies Network" in cooperation with other institutions. It will offer our students a wide range of courses from various disciplines to a broad methodological and thematic spectrum. We understand Jewish heritage as exemplary for having both material and immaterial aspects which are inseparable from each other and can only have a future as a living legacy.

Publications

- Keßler, Katrin, Andreas Brämer, Ulrich Knufinke and Miriam Rürup (eds.): Wandernde Objekte des Jüdischen. Braunschweig 2022.
- Berghahn, Cord Friedrich, Mirko Przystawik, Ulrich Knufinke and Katrin Keßler (eds.): Israel Jacobson (1768-1828). Studien zu Leben, Werk und Wirkung. Göttingen 2022.
- Keßler, Katrin, Sarah M. Ross, Barbara Staudinger and Lea Weik (eds.): Jewish Life and Culture in Germany after 1945. Sacred Spaces, Objects and Musical Traditions. Berlin, Boston 2022.
- Keßler Katrin (ed.): Galka Scheyer – A Jewish Woman in International Art Business, Petersberg 2022.
- Brämer, Andreas, Katrin Keßler, Ulrich Knufinke and Mirko Przystawik (eds.): Jewish Architects – Jewish Architecture?, Petersberg 2021.
- Keßler, Katrin; Ulrich Knufinke, Alexander von Kienlin and Annette Weber (eds.): Synagogue and Museum, Petersberg 2018.
- Brämer, Andreas, Mirko Przystawik and Harmen H. Thies (eds.): Reform Judaism and Architecture, Petersberg 2016.
- Keßler, Katrin and Alexander von Kienlin (eds.): Jewish Architecture – New Sources and Approaches, Petersberg 2015.

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IBEA | Institute for Building Climatology and Energy of Architecture

Mission Statement

The IBEA teaches and researches at the interface of passive and active building components in architecture. The aim of our applied building research is to develop strategies for districts and buildings that create sustainable living space with robust construction methods, simple low-tech systems and holistic approaches.

RESEARCH

Energy systems
Buildings and their functionality and operational performance are closely linked to the energy and supply infrastructure systems they are embedded in. Therefore, one of the Institute's research focuses and interest lies on the analysis, design and optimization of energy systems in buildings as well as on urban levels. With rising shares of renewable energies, also innovative storage opportunities like hydrogen become more important and are investigated to meet the challenges of volatility and decentralization. Ultimately questions of appropriate sustainability metrics in the building sector and their development are subject of research.

Low Tech / High Tech
The low-tech approach is a response to the increasing demands on building and comfort for users in recent decades, which have often been met with complex and component-rich building technology. While the term low-tech is often misunderstood as no-tech one of the institutes main interests is to research not only how much technology a building and its users need but also how active and passive compounds can collaborate to archive holistic building strategies for durable and sustainable buildings.

Materials
The building physics of a building is often considered separately from the materials used, since it is not uncommon for energy considerations to use only one characteristic value in the form of thermal conductivity to assess the thermal quality. However, by exploiting the passive potential of alternative natural building materials, it is possible to achieve not only thermal improvements but also optimization in the area of indoor humidity in combination with reduced climate effectiveness. In this context, layer-reduced constructions respective the effort of refinement of the materials used, are in the focus of minimizing ecological burdens and furthermore increasing resource and energy efficiency, as well as the possibility of reuse and recycling .

Living Lab
The real laboratory as an experiment enables the interaction between planners, builders and users with the object of investigation and links social and scientific learning and reflection processes. We do not collect specific knowledge under abstract laboratory conditions, but abstract knowledge under specific conditions of use. Thereby we consider the conception and production as well as the monitoring/ measurement as part of the Living Lab and as a source for insights and knowledge.

At the IBEA institute we installed various self-constructed clay walls equipped with different water-based systems for heating and cooling our rooms. The passive contribution to the preservation of the indoor climate by means of clay building materials is measured.

Photos:
Left page: Till Zihlmann
Right page: IB Hausladen / BBSR (Portrait), Ines Aubert

IBEA | Prof. Dipl.-Ing. Elisabeth Endres, BDA

Researcher's Career

- Since 2019 Full Professor and Head of Institute for Building Climatology and Energy of Architecture (IBEA)
- Curator of the German Pavillon at Biennale 2025
- Member of Managing board at Hausladen Engineering LTD
- Member of the Advisory Board of HafenCity GmbH, LDR Berlin and Climate Advisory Board of the State Capital Munich
- EuroTec Fellow at DTU Kopenhagen, Center for Indoor Environment and Energy
- Teaching Fellow at Universidad Técnica Federico Santa Maria, Chile
- Scientific Assistant at Institute of Building Technology and Climate Responsive Design, TU Munich
- Scientific Assistant at Institute of Building Climatology and Building Services, TU Munich
- Member of DGNB, BDA, Bundesstiftung Baukultur, Aktiv+ e.V.
- Study of architecture at TU Kaiserslautern and TU Munich

Funding
BBSR Forschungsförderung ZukunftBau, Bingo Umweltstiftung, DBU, FNR, GEWOFAG, RECUN, BMWK, MWK Niedersachsen, Volkswagen Foundation

TEACHING

Increasing requirements on building performance for the energy efficiency and the development of methods brings a high complexity in the processes of planning and construction as well as for the users in operation. Therefore, the research area of the institute analyses the development of general solutions in architecture and urban planning that need to be carried out in order to achieve the necessary climate targets by implementation of recyclable constructions and the reducing of technical complexity.

Our aim is to teach the students the basics of building physics and technical building equipment as well as holistic thinking for integral planning in order to apply them in drafts and student research projects. Some of the research questions are explored through the use of digital tools as well as through 1:1 experiments in the institute's laboratory and in the urban context in collaboration with students. The range of courses can be taken up by students of architecture and environmental engineering.

Publications

- N. Borgmann, E. Endres, G.G. Kiefer, D. Santucci, Der Deutsche Pavillon STRESSTEST, 2025
- C. Hutter, A. Eberle, H. Wöhrle, L. Neubert, G. Hausladen, E. Endres, S. Klinski, Kühle Gebäude im Sommer - Anforderungen und Methoden des sommerlichen Wärmeschutzes - 5.6.3 Diskussion, Kirchheim: Umweltbundesamt, 2023
- B. Breitenhuber, P. Bruno, E. Endres, A. Klinge, J. Mehnert, J. Mönig T. Pörschke, E. Roswag-Klinge, Gesundes, zukunftsfähiges Wohnen in Holz, Ziegel und Lehm, (DBU) 37391/01, 2023
- Endres, E., "Hightech versus Lowtech oder einfach robust? ", in: Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR) im Bundesamt für Bauwesen und Raumordnung (BBR) (ed.), Lowtech im Gebäudebereich, ISBN 978-3-87994-300-5, 2020.
- Endres, E., Franke, L., Sen Dong, M., Neubert, L., "Parameters to design Low-Tech Strategies", in: PowerSkin Conference Proceedings, TU Delft/TUM (ed.), ISBN 978-94-6366-125-6, 2019.
- Santucci, D., Tucci, F., Endres, E., Hausladen, G., "Smart urban districts: Dynamic energy systems for synergic interactions between building and city", in TECHNE - Journal of Technology for Architecture and Environment, (1), 92-102, 2018.
- Endres, E., Santucci, D., Tucci, F., Battisti, A., "Energie: Bedrohung oder Chance für die Europäische Stadtlandschaft? Energia: occasione o minaccia per il paesaggio urbano europeo? ", TUM (ed.) ISBN: 9783941370685, 2015.

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IBEA Gender.Ing. | Gendered and intersectional aspects of technology and space

Mission Statement

Technology and space, though seemingly "neutral" and "for all", are socially constructed and inherently intertwined with cultural understandings of gender roles and relations. We work at the intersection of Social Sciences, especially Gender Studies, and various fields of Engineering with the overall aim to disclose, discuss and deepen our knowledge on the interdependencies of society and its inequalities on the one hand and spatial structures, technical artefacts as well as engineering, design and planning processes on the other. Ultimately, we aim to contribute to a more reflective and less discriminatory academia and society.

RESEARCH

Gender-sensitive planning and the reconciliation of care work and paid work
Everybody cares and is cared for – the spatial structures of our cities, however, are not designed to meet the needs of people giving or receiving care. Many have their origins in a fordist functional separation of space that does not accommodate the highly complex and time-consuming everyday geographies of care. Within this field, we are especially interested in researching the possibilities and impossibilities of reconciling paid employment and care in newly planned suburban residential areas. We advocate for new ways of collaborating between institutions on a variety of scales and sectors with the aim to foster gender equality and develop partnerships that prioritise and strategically include care into spatial planning and urban/regional economics. We are part of a DFG-funded research cluster on "New Suburbanisms" coordinated at the University of Kassel.

Spatial and environmental justice
Environmental and resource protection, adaptation to climate change and social as well as gender justice are closely intertwined. Environmental impacts are unevenly distributed, as are recreational opportunities, especially in densely populated areas. In a research project completed in 2021 on the significance of residential green spaces for families and children during the Covid 19 pandemic, we have shown that attractively designed and stimulating open spaces strengthen children and, to a certain extent, balance out their parents' financial and time resources. In the future, we plan to investigate more broadly the impact of the design and distribution of infrastructure on society and its most vulnerable groups.

Communication and participation processes in engineering, architecture and urban planning
Communication between engineers and the users of their products is important in all areas of engineering – from building equipment to renewable energies, from public transport to apps and digital devices – and improves the acceptance and usability of engineering products. In recent years, participatory processes such as citizen science have gained significance. Still, certain groups of people – those with care responsibilities, but also children and young people, people with disabilities, with limited language skills or from non-academic backgrounds – are often underrepresented in these processes. Researching and evaluating gender-sensitive and intersectionally informed means of communication and participation that contribute to the quality of engineering research are therefore particularly important to us.

IBEA | Prof. Dr. Henriette Bertram

Researcher's Career

- Assistant Professor for gendered and intersectional aspects of technology and space at TU Braunschweig
- Post-Doc researcher and coordinator of research cluster "New Suburbanisms", Universität Kassel
- Lecturer in Social Sciences, Georg-August-Universität Göttingen
- PhD in Urban Planning at Universität Kassel
- Researcher and lecturer at the Chairs of Urban and Regional Economics and Urban Renewal and Planning Theory at Universität Kassel
- Erasmus exchange programme, Universidad Complutense de Madrid
- Degree in Cultural Sciences, Europa-Universität Frankfurt (Oder)
- Voluntary Service at Centre for Global Education, Belfast

Funding
DFG, British Academy/Alexander von Humboldt Foundation, Federal State of Hesse

TEACHING

In teaching, we aim to encourage students to think independently and to develop their own questions about the interrelatedness of society and the respective engineering fields. Learning content is geared towards specific real-life, social or design-related issues that complement students' professional skills and has a relevance for their personal development as well as their future employment. We emphasise the practise of writing in order to develop ideas, strengthen argumentation skills and focused communication. Our teaching is based on students' prior knowledge and their degree background and informed by our own and other scholars' recent research. A recurring teaching format is the seminar "Gendered aspects of technology and engineering" that is open to students of all engineering degree programmes. We work closely with Faculties 4 (Mechanical Engineering) and 5 (Electrical Engineering, Information Technology, Physics) of TU Braunschweig.

Publications

- Bertram, Henriette (2024, forthcoming): Gendersensible Planung in aktuellen Stadterweiterungsprojekten – Vereinbarkeit von Erwerbs- und Sorgearbeit jetzt auch in Suburbia? In: Altrock, Uwe/Bertram, Henriette/Krüger, Arvid (Eds.): Stadterweiterung in Zeiten der Reurbanisierung – Neue Suburbanität? Transcript.
- Bertram, Henriette (2023): Planning Gender-Inclusive Cities: Tactical and Strategic Support for the Reconciliation of Paid Work and Care Work. In: Čamprag, Nebojša/Uğur, Lauren/Suri, Anshika (Eds.): Rethinking Urban Transformations. A New Paradigm for Inclusive Cities; pp. 169-186.
- Bertram, Henriette/Hennecke, Stefanie/Münderlein, Daniel/Niesen, Johanna (2022): Children's outdoor play and leisure time during the first weeks of the Covid-19 pandemic. In: Sharp, Briony; Finkel, Rebecca; Dashper, Katherine (Hrsg.): Transformations and Transgressions: Explorations of 'Restricted' Leisure during COVID-19. London: Routledge.
- Bertram, Henriette/Hennecke, Stefanie/Million, Angela/Niesen, Johanna: Basteln, Matschen, Toben während der „Corona-Krise": Die Bedeutung von wohnungsnahem Freiraum für Kinder und Familien während der Frühphase der Pandemie. In: sub\urban Zeitschrift für kritische Stadtforschung.
- Bertram, Henriette (2017): Schattenorte in Belfast. Stadterneuerung nach dem Karfreitagsabkommen. Bielefeld: Transcript.

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IDAS | Institute for Design and Architectural Strategies

Mission Statement

Architectural Design is creative exploration. It requires the observation and evaluation of the environment and its history in order to develop strategies for mastering current and future challenges. It requires the empathatic understanding of the collective as well as the courage of the individual to develop architectural strategies in the search for alternative ecological, functional, formal, technical, artistic and cultural possibilities.

RESEARCH

Hortitecture
This term refers to the exploration of synergies between architecture and plant material in order to understand their impact on the environment and architectural design. We have established a network of international experts, including architects, artists, biologists, and ecologists, and have hosted a series of symposia at the Technical University of Braunschweig. We aim through these multidisciplinary exchanges, we aim to encourage critical reflection, enhance knowledge transfer, and expand expertise in implementing these synergies into architectural design.

Reet reloaded
Thatch construction, which utilizes the reed plant as a primary element, has a long history in any region where this plant grows near shallow water. This has resulted in a strong interdependence between architecture and ecology in these areas. Our research explores new ways to interpret and utilize this traditional material, examining its formal and technical capabilities, cultural-historical significance, and ecological potential. We have organized workshops to design case study architecture for slow tourism, for example, compostable cabins in the dunes.

Existing building as the resource
architectural design is no longer based on „tabula rasa thinking“ of modernism, rather it is challenged by impacts of the climate crisis and the abundance of sealed surfaces created by buildings and infrastructure. The role of architects is to balance the problems and potentials of existing buildings. The strategies here are varied: existing building structures are expanded, reconnected and reprogrammed through addition, superimposition, displacement and penetration. Our challenge as architects - beyond design and supervision of construction as a service - is to present ideas that activate and connect program and people. Pro-active moderation requires a high level of architectural expertise and the sensitivity to understand buildings as a cultural and material resource.

Building Knowledge
Schools are vital institutions for any society, serving not only as places for knowledge transfer, but also for experimentation and communication. School buildings significantly influence students' perceptions of the built and natural world. In an era of digital transformation, it becomes increasingly important to have physical spaces that provide sensory experiences and foster social interaction and communication. Our design studios focus on the creative exploration of school buildings, in collaboration with the Department of School Pedagogy and General Didactics. School buildings initiate the relationship to architecture - they shape the life of future generations.

IDAS | Prof. Almut Grüntuch-Ernst

Researcher's Career

- Member of the Academy of Arts Berlin since 2016
- Professor at TU Braunschweig, Head of the Institute of Design and Architectural Strategies since 2011
- Consultant to the City of Munich 2010-15
- Commissioner of the German Contribution for the Venice Biennale, 2006
- Grüntuch Ernst Architects, Berlin - office with Armand Grüntuch since 1991
- Assistant teacher at Hochschule der Künste, Berlin 1993-97
- Architectural Association, London (DAAD-Scholarship) 1989-90
- Internship Alsop & Lyall, London 1988-89
- Architecture and Urban Development at Universität Stuttgart 1985-91

TEACHING

A wide spectrum of design studios addresses future challenges that permeate the entire teaching and research program. Our aim is to engage students in the complex and contradictory nature of future challenges while enabling them to use architectural design as a method of materializing a project and actively promoting optimism. We base the studio work on observations and video documentations, lectures, readings and references in order to discuss criteria for the design work. We organize workshops, invite interdisciplinary experts and build up a direct connection with possible future clients in order to enable students to present ideas and projects beyond the academic framework. We have established an international network with partnering universities for the purpose of collaborative studio work in order to address global challenges and understand intercultural perspectives.

Publications

- Grüntuch-Ernst, Almut; Grüntuch, Armand (Hg.): Wilmina; DISTANZ, Berlin 2022
- Grüntuch Ernst Architects - Based in Berlin, Protagonisti Series of Books,Editions de l'Arca International, Monaco 2019
- Grüntuch-Ernst, Almut; IDAS TU Braunschweig (Hg.): Hortitecture – The Power of Architecture and Plants, Jovis, Berlin 2018
- Ruby, Ilka; Ruby, Andreas (Hg.): Grüntuch Ernst Architekten – Dialoge/Dialogues, DISTANZ, Berlin 2013
- Grüntuch-Ernst, Almut; Grüntuch, Armand (Hg.): Arch+ 180 – Convertible City, Exhibition catalogue for the German pavilion - Venice Biennale 2006, ARCH+, Berlin 2006
- Feireiss, Kristin; Commerell, Hans-Jürgen (Hg.): Grüntuch Ernst Architekten – Urban Upgrade, Strategies of urban densification, Exhibition catalogue, Aedes, Berlin 2006
- Feireiss, Kristin (Hg.): Grüntuch Ernst Architects – Points of Access, Prestel Verlag 2004

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IEB | Institute of Building Design

Mission Statement

Designing is a constant tightrope walk between intuition and knowledge, a creative process ranging from integral consideration to individual interpretation. Reducing it to a rational planning process and limiting it to the comprehensible is bound to fail, since designing is always an artistic process as well.

RESEARCH

IEB
We are a group of people who are on the road together. On the road to discover something new time and again. It is the secret of the arts to always start all over again and again. We do have many questions and a few answers. But most of all, we experience, how teaching at TU Braunschweig is a source of great joy and energy in our daily lives. The joy in architecture is our reason for gatherings and festivities. Through conversations, workshops, travels, guest lectures and moments that speak into our lives, we provide space for creativity. We are learning from each other.
We love people!

Symposia
We consider architecture as an interdisciplinary art, which thrives not only through its own insights, but rather by the collective gain of knowledge through the exchange of new perspectives. Within the framework of symposia as „convivial gatherings“, we want to face the responsibility of our work together. We aim to learn from each other, and with each other.

Research
We are concerned with the creation of new, innovative and demand-oriented housing models as a contemporary response to social developments. The shift away from the classic family model toward more single-person households due to demographic change, but also changing lifestyles, confront us with new challenges.
How did we use to live? How are we living now? How do we want to live in the future? Is it possible to integrate architectural research and practice? What are contemporary typological solutions that address changing living situations? Our seminars, in-depth studies and research projects focus on questions like these.

Travels
To really understand and study architecture, traveling is essential. Excursions and field trips are an important additional part of the design courses. We consider ourselves to be architectural nomads. Always in search of our roots. We may study architecture at universities. We certainly acquire knowledge there, but being an architect is above all a question of seeing and imagining. It is a matter of attentively searching and „nomadically“ going through life.

IEB | Prof. Dan Schürch

Researcher's Career

- Architect FH / REG A; Member SIA, BSA, BDA NRW and Architekten-kammer Hamburg
- since 2020 Full Professor at TU Braunschweig, Head of the Institute for Building Design (IEB)
- since 2007 Duplex Architekten, Zu-rich / Düsseldorf / Hamburg / Paris
- 2007-2009 Research Assistant with Prof. Markus Peter, in the field of construction and design, at ETHZ
- 2001-2007 Work with Marcel Meili, Markus Peter Architekten, Zurich
- 2000 Internship at DRFTWD, Amsterdam
- 1997-2001 Architectural Studies at Technikum Winterthur
- 1992-1996 Apprenticeship as a Structural Draughtsman at H.R. Berger, Zurich

TEACHING

Drafting means searching, thinking and making. With the aim to discover something new by working on models and sketches, processes are triggered and things become visible that, without visual support, would remain hidden. In our work at the Institute for Design and Building Design we focus in the drafting of buildings which ever typology it might be. Beginning in the third semester, the spectrum extends through initial design exercises, standing drafts and various design formats to the master's thesis.

Lectures
Complementary to our design courses, we offer various additional learning opportunities. These are e.g. lectures that complement the teaching and take place in an informal setting, both in terms of time and location.
These so called „Learning Lunches“ take place during the lunch break in a relaxed atmosphere. In collaboration with invited guest lecturers from a variety of disciplines, a wide range of topics are addressed throughout each semester.

Publications

- innen nah am fenster tag, Editor: Anne Kaestle, Dan Schürch, Graficdesign: Ludovic Balland, Typography Cabinet, Basel, 164 pages, 16 x 24 cm, Own publishing house, 2015, ISBN 978-3-86859-454-6
- Duplex Architects – Rethinking Housing, Editor: Ludovic Balland, Nele Dechmann, Authors: Hubertus Adam, Marc Angélil, Nele Dechmann, Anne Kaestle, Andreas Ruby, Caspar Schärer, Dan Schürch, Philip Ursprung, Niklas Maak, Günther Vogt, Language: English, German, 416 pages, 23 x 30 cm, Park Books, 2021. ISBN D 978-3-03860-229-3, ISBN EN 978-3-03860-230-9

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IEX | Institute for Experimental Architecture

Mission Statement

The Institute for Experimental Architecture sees itself as a laboratory where students can explore and apply new ideas and experimental approaches to design tasks in order to find solutions to today's social, spatiotemporal, economic and environmental problems and challenges.

RESEARCH

Introduction in Designing:
In the first year of study, five supervised exercises lasting several weeks are worked on. Under the headings of manifesto, composition, genius loci, spatial sequence and light spaces, these initially focus on partial aspects of design. These are finally brought together in a small building design. In this way, students are introduced to the complex field of design from different angles. By working on and presenting the exercises, they will also learn initial drawing, model building and presentation techniques.

Introduction in Drawing:
In the form of weekly lectures and exercises, students are introduced to the basic skills of freehand drawing, sketching, and descriptive geometry, in addition to the theoretical and historical foundations of drawing in architecture. Techniques of building and architectural analysis are practiced, which can be used to break down a building into its architectural elements. Using the drawing and representation techniques practiced, analytical, interpretive drawings can be produced. Through repetition and analog production in different modes of representation and scales, students train their two- and three-dimensional imagination.

Lecture Series:
The lecture series "Architektonisches Denken im 20. und 21. Jahrhundert" introduces important persons, works and positions of architectural production of the last 125 years. It is a compulsory part of Introduction in Designing. During the lecture, the students draw along the photographs and drawings shown in the form of speedsketches.

IEX | Prof. Berthold Penkhues

Researcher's Career

- Member: Architektenkammer Hessen AKH, Nr. 10508 since 1989, Bund Deutscher Architekten, BDA, Deutscher Werkbund, DWB
- Since 1994 Full-Professor, Technische Universität Braunschweig, Director IEX Institute for Experimental Architecture
- 1989 –1994 Assistant Prof., University Kassel, Department of Architecture
- Since 1989 PENKHUES ARCHITECTS, Kassel
- 1986 – 1989, Design- Architect Frank O. Gehry, Los Angeles
- 1985 DAAD scholarship for the US of America
- 1985 California Fellowship (Scholarship from the State of California)
- 1984 - 1986 University of California, Los Angeles, UCLA, Master of Architecture, M Arch
- 1980 Internship Office Prof. Josef Kleihues, Dülmen/Rorup, Germany
- 1976 – 1984 University Kassel: Diplom- Ingenieur in Architecture, Dipl.-Ing. 1981, Diplom- Ingenieur in Urban Design, Dipl.-Ing. 1984

TEACHING

We understand architecture in its genesis, its direct experience and in its theoretical reception as manifoldly determined and determining. Accordingly, design logic does not exist for us as a rigid set of rules, but as a complex system in the field of tension between technical knowledge, historical contexts, sociological factors, personal experiences and aesthetic intentions. In the concrete formulation of our task, we therefore distance ourselves from a pure "theory of form". Rather, the development of individually defined approaches to architectural work is the focus of our teaching. Starting from simple observations up to detailed analyses of everyday or special phenomena, the students develop a personal positioning in space and time, which are to be connected with the functional requirements and aesthetic objectives and to be communicated with adequate means of expression.

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GTAS | Institute for History and Theory of Architecture and the City

Mission Statement

In the face of epochal urban transformations and growing socio-spatial inequalities, architecture – as a field, discipline, and profession – will need to reconfigure long-established and habitual ways of doing, practices, mechanisms as well as operations. Tackling this directly through the development of transformative narratives is at the core of our work.

RESEARCH

The Institute for History and Theory of Architecture and the City investigates, analyses, and documents the political-economic conditions and ethical demands placed on architecture and architects in the context of climate breakdown.

We regard the making visible and thus the understanding of decision-making structures as an essential, if not indispensable, instrument for negotiable, transformative and emancipatory (re)productions of space.

This is important because other ways of doing only become conceivable when questions of privilege, interest or power are exposed, and their distinct layers revealed. The much-discussed right to the city, for example, can only be realised when the very systems that produce architectural projects and objects become the focus of investigation.

This critical-reflective point of departure for the Institute is anchored in teaching and research through the exploration of historical lines of flight. It is situated in interdisciplinary discussions and the identification of trans-local concerns, so that contemporary issues such as migration, housing, and agency are framed and embedded in broader debates.

We position ourselves and our approaches firmly against the modernist fragmentation and abstraction of knowledge. In doing so, we are concerned with drawing attention to and investigating complex machines or apparitions of practices and the subsequent configuration of other trajectories and imaginaries.

This side: Extracurricular lecture series; Design: A Gesture Of, 2025.

Playing 'Lift Me Up' – a student project that develops a critical understanding of vacant shops and properties in Braunschweig; Design: Marlon Dina, Jonas Fangmann und Büsra Topallar, 2021.

Opposite side: Engaging with ecological and social conditions of making cities; Field trip to Marseille, 2022.

Photo credits: GTAS (3), Simone Bednarek (portrait)

GTAS | Prof. Dr. Tatjana Schneider

Researcher's Career

- 2022-24: Vice President for International and Regional Relations, TU Braunschweig
- since 2018: Full Professor for Architectural Theory, TU Braunschweig
- 2004–2018: Senior Lecturer, The University of Sheffield
- Guest Professor Hafencity University, Hamburg; Adjunct Faculty: IUAV, Venice; Nanjing University; CEPT University, Ahmedabad
- Co-Founder of the Workers' Cooperative Glasgow Letters on Architecture and Space (G.L.A.S), the research Cluster AGENCY, the Partisan Design Network (PDN), the research collective MOULD, A4F Braunschweig and member of the Hochschulnetzwerk "Gemeinsam für die Bauwende"

Funding
AHRC, BMBF, BMI, British Academy, British Council, DAAD, DFG, ESRC / Horizon 2020, Kulturstiftung des Bundes, MWK

TEACHING

The guiding idea of our teaching formats is to reveal the complexity and 'messiness' of the spaces in which and for which architects design, through the collaboration of diverse professional competencies and associated methodological approaches.

We believe it is essential to navigate this complexity and make it visible as a dense network of practices, imaginaries, privileges, interests, and power relations in order to prepare for sustainable and lasting change. In doing so, it is important for us not only to make references to current events and social developments but also their path dependencies. We also question hegemonic constructs and their validity, to find out where seemingly universally valid judgments and evaluations come from, how and by whom they are produced, and what – often less apparent – alternatives already exist. The approaches are always processual, research-based, and problem-oriented, and are thus intended to contribute to the reconfiguration as well as ethical expansion of the profession and discipline of architecture.

Publications

- MOULD (Anthony Powis, Tatjana Schneider, Christina Serifi, Jeremy Till and Becca Voelcker). *Architecture Is Climate*. Barcelona: dpr-barcelona, 2025
- Baxi, Kadambari, Isabel Glogar, Gabu Heindl, Bernadette Krejs, and Tatjana Schneider, eds. *Changing Spatial Practices: Alliances, Activism, and Networks*. Vol. 4. Dimensions. Journal of Architectural Knowledge. Transcript Verlag, 2024.
- Bader, Markus, George Kafka, Tatjana Schneider, and Rosario Talevi, eds. *Making Futures*. Leipzig: Spector Books, 2022.
- Feireiss, Lukas, Tatjana Schneider, and TheGreenEyl. *Living the City. Of Cities, People and Stories*. Leipzig: Spector Books, 2020.
- Schneider, Tatjana. „Agency". In *connectedness. An Incomplete Encyclopedia of the Anthropocene*, edited by Marianne Krogh, 36–39. Copenhagen: Strandberg, 2020.
- Schneider, Tatjana. „Plädoyer für das Durcheinander". In *Architekturkultur*, edited by Alexander Gutzmer and Stefan Höglmaier, 116–31. München: Callwey, 2019.
- Awan, Nishat, Tatjana Schneider, and Jeremy Till. *Spatial Agency. Other Ways of Doing Architecture*. London & New York: Routledge, 2011.
- Kossak, Florian, Doina Petrescu, Renata Tyszczuk, Tatjana Schneider and Stephen Walker, eds. *Agency. Working With Uncertain Architectures*. London: Routledge, 2009.
- Schneider, Tatjana, and Jeremy Till. *Flexible Housing*. London: Architectural Press, 2007.

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SAIB | Collection for Architecture and Civil Engineering

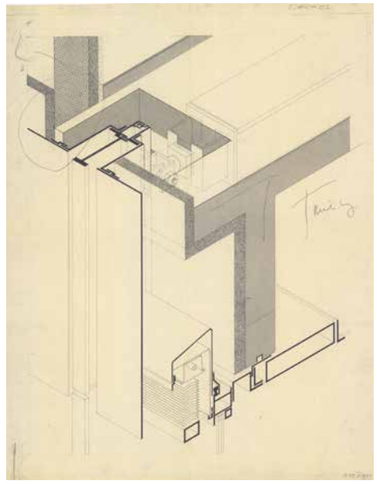
Mission Statement

The Collection for Architecture and Civil Engineering at TU Braunschweig (SAIB) is part of the Technische Universität Braunschweig University Archive and is dedicated to collecting and archiving materials from former university members in order to enable university historiography and create a basis for diverse forms of spatial research.

RESEARCH AND TEACHING

The SAIB's task is to collect and archive materials relating to the work of architects and civil engineers who worked as teachers or students at the Technical University of Braunschweig. The core of the collection, which was founded in 2008, consists of the estates of university teachers from the so-called Braunschweig School of Post-War Modernism, i.e. men such as Friedrich Wilhelm Kraemer, Dieter Oesterlen, Walter Henn, Manfred Lehmbruck and Zdenko Strizic. Here you will find, for example, teaching materials, scripts, drawings, slide collections and travel albums that provide insights into the lives and work of these personalities. These materials reveal areas of interest, demonstrate how knowledge of certain building materials was developed and imparted, and highlight the interconnections between industry, the use of fossil-engergy-intensive building materials and the university.

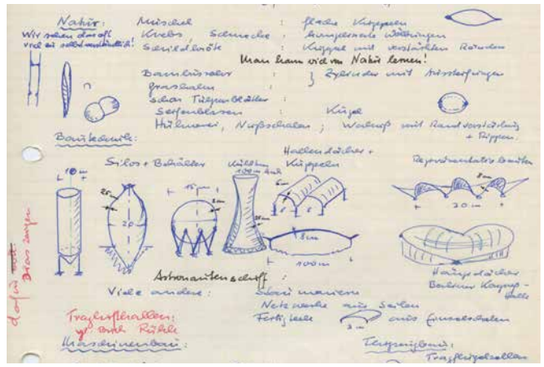
This core collection is continuously supplemented by the estates of subsequent generations of university teachers and expanded by student works. These works document how discourses have developed and shifted. We can also see how students reacted to their teachers' ideas, and how fierce resistance formed against individual university teachers and their teaching content and formats. The diversity of university history is revealed in all its breadth. As well as materials from university staff, there are estates from architecture and planning offices founded and run by Braunschweig graduates. Together, these provide a comprehensive picture of the development of the disciplines of architecture and engineering.



SAIB | Prof. Dr. Tatjana Schneider

Formation of the Research Unit

- 2018: New director: Prof. Dr. Tatjana Schneider, Managing Director: Dr. Arne Herbote
- 2015: Exhibition 'Findbuch Braunschweiger Schule. Architekturdiplom 1945 – 2015'
- 2011: Membership in the Federation of German-speaking Architecture Collections
- 2008: Founding of the Collection for Architecture and Civil Engineering at TU Braunschweig (SAIB) by the GTAS under the direction of Prof. Dr. Karin Wilhelm



The Institute for History and Theory of Architecture and the City (GTAS) is responsible for the scientific processing and management of the SAIB's holdings within the Faculty of Architecture, Civil Engineering and Environmental Sciences. It processes those holdings—which can be searched using the Arcinsys archive information system—for archival purposes, thus making them available to the professional public. The SAIB is also a member of the Federation of German-speaking Architecture Collections.

The SAIB therefore encompasses more than just material stored in boxes and plan cabinets; it is also a space for reflection. Events, exhibitions and publications make its holdings accessible to a wider public. Students use the collection for seminars and other coursework, and the GTAS Institute regularly incorporates the SAIB's holdings into seminars for undergraduate and postgraduate students.

Left side:
1: Walter Henn, Friedrich-Deckel-Werk administration building, Munich, isometric view of the façade construction, around 1961 (UABS G055 IV/1.373)
2: Student newspaper 'Der Rote Mauerziegel' (The Red Brick), front page, 1970 (UABS G074 III/2)
3: Susanne Dexling, Vertical Passage on Heligoland, thesis supervised by Prof. Gerhard Wagner, 1986 (UABS G123_14-10)

This side:
1: Heinz Duddeck, Lecture "Shell Theory I", Manuscript, 1967 (UABS G069 I/329)
2: Pysall, Jensen, Stahrenberg & Partner, Oberstufenzentrum Berlin-Wedding, 1971-1977 (UABS G124)

Publications

- Herbote, Arne. 'Von architekturgeschichtlichen Annäherungen an ein Institutsgebäude und seine Nutzer*innen'. In Erbschaften: Dokumentation einer Seminarreihe 2019-2022, IAK Institut für Architekturbezogene Kunst, Technische Universität Braunschweig, edited by Alice Goudsmit and Gergely László. Technische Universität, IAK Institut für Architekturbezogene Kunst, 2022.
- Herbote, Arne, Martin Peschken, Christian von Wissel, and Institut für Geschichte und Theorie der Architektur und Stadt, eds. Fund-Stücke: Reflexionen über Objekte der Sammlung für Architektur und Ingenieurbau der TU Braunschweig (saib). Veröffentlichungen der Universitätsbibliothek und des Universitätsarchivs Braunschweig: Brunsvicensien der Universitätsbibliothek Braunschweig. Universitätbibliothek TU Braunschweig, 2018. https://doi.org/10.24355/dbbs.084-201809041305-0.
- Peschken, Martin, Arne Herbote, Anikó Merten, and Christian von Wissel, eds. Findbuch Braunschweiger Schule: Architekturdiplom 1945 - 2015. 2. überarbeitete Auflage. Technische Universität Braunschweig, Institut für Geschichte und Theorie der Architektur und Stadt (GTAS), 2015. https://doi.org/10.24355/dbbs.084-201602031325-0.
- SAIB materials have been published in dissertations and other publications.

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IKE | Institute of Construction Design, Industrial and Healthcare Building

Mission Statement

The IKE regards itself as a think tank that places emphasis on the exploration and implementation of innovative methods, technologies and theories in architecture at all scales. Dedicated research groups along with a network of specialists exchange ideas on building the framework for the interdisciplinary research activities of the institute, focusing on the fields of industrial and healthcare building.

RESEARCH

Industrial Building
Head of research: Michael Bucherer
The IIKE holds core expertise in investigating typological and constructive aspects of industrial and functional building, as well as industrial construction. Recently, focus has been placed on the increasingly complex requirements and influential factors of industrial building. In several research projects, the institute has successfully collaborated on research partnerships with specialists from the fields of plant design, city planning, business management and building services engineering, as well as key players from the private sector. In this way the institute is able to offer expert advice to the industry.

Urban Factory: This interdisciplinary research project investigates the symbiosis of cities and industrial production under the aspect of resource efficiency. It aims to develop an innovative, interactive knowledge base that can be used by all key players involved in maximizing integration potentials.
OI BAU: The initiation of planning requirements for complex building projects is analyzed and tools are developed that determine the decisions in the early phases of design.

Architecture for Health
Head of research: Dr. Wolfgang Sunder, Jan Holzhausen
The biggest challenge in the health sector is to achieve a balance between the best possible medical care and associated costs. The aspect of hospital construction has been identified to play a key role in establishing an equilibrium. The transfer of highly efficient planning and construction methods utilized in everything from industrial buildings to health care buildings is another research focus of the institute.
In various research projects related to this matter, the IIKE has researched ways to optimize the planning process, to develop new building structures and to provide a higher level of infection protection in hospitals. Successful collaborations with hospital operators and healthcare companies have been established in the process, working jointly on various innovative research projects, research contracts and reports.

HYBAU: The aim of this research project is to optimize construction types, from materials to methods in construction, as well as functional processes, in order to create a safer hospital environment under the aspect of hygiene.
KARMIN: Investigations on the influence of architecture and design on the occurrence of infections, design and construction of a two-bed room in the normal care as a prototype.
HYFLY: Effective strategies to control and manage pathways of pathogens in aviation, development of infection-safe mastering and acute planning of airports.
EKOS: Development of a new concept of an insolation unit to ensure the medical care of life-threatening diseases in hospitals.
BIPROC: Development of a classification system for structural infection prevention based on new epidemiological studies.

This side: Pandemic Research Center, design: Reuven Zweigel 2017

Opposite side: ME Transit, Erin Nies 2017

IKE | Prof. Carsten Roth

Researcher's Career

- Member of the Freie Akademie der Künste in Hamburg
- Visiting professor for Design at the Universität Kassel
- Leader of his own studio in Hamburg
- Fulbright scholarship at Virginia Polytechnic Institute in Blacksburg and Alexandria/USA
- Study of architecture at the Academy of Fine arts in Vienna
- Study of architecture at Technische Universität Braunschweig

Funding
BBSR, BMBF, BMWI

TEACHING

As one of three institutes at German architecture faculties that engage in industrial building, the Institute for Industrial Building and Constructive Design (IIKE) of university professor Mag. Arch. M. Arch. Carsten Roth holds core expertise regarding urbanistic, typological and structural key aspects of industrial building and industrial site development.

The institute places emphasis on the exploration and implementation of innovative methods, technologies and materials in industrial building and the prefabrication in building construction. The transfer of highly efficient planning and construction methods utilized in industrial building to health care buildings is another research focus.

For both, research and teaching, the institute maintains long-standing cooperations with partners in the industry. Research partnerships in the fields of plant design, city planning, business management and building services engineering enable the IIKE to develop and execute various research projects based on interdisciplinary collaboration.

Publications

- Roth C, Dombrowski U, Fisch N, Holzhausen J, Knöfler P, Riechel C, Sunder W: Zukunft.Klinik.Bau. Strategische Planung von Krankenhäusern. Springer Vieweg Verlag Wiesbaden, 1. Auflage 2015, 212 Seiten
- BBSR Zukunft Bauen: Forschung für die Praxis, Band 13, Bauliche Hygiene im Klinikbau, Bonn, Februar 2018, S.54-69
- Roth C, Dombrowski U, Sunder W, Riechel C (2013): Zukunftsfähige Gebäudestrukturen und Planungsorganisation von Krankenhäusern. In: Das Krankenhaus 2013, 2, S. 170-174
- Sunder W, Holzhausen J, Dreßler I, Stiller A (2016): Bauliche Hygiene: Mit Architektur und Design gegen multiresistente Erreger. In: das Krankenhaus 108 (12), S. 1130–1132
- Juraschek M, Bucherer M, Schnabel F, Hoffschröer H, Vossen B, Kreuz F, Thiede S, Herrmann C (2018): Urban Factories and Their Potential Contribution to the Sustainable Development of Cities. In: The 25th CIRP Conference on Life Cycle Engineering, Procedia CIRP, 69, S. 72–77

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IKE | Institute of Construction Design, Industrial and Healthcare Building

Mission Statement

The Institute sees itself as a central teaching and research institution for Healthcare Building in Germany. An interdisciplinary team of experts from the fields of architecture, design and medicine is facing the complex challenges of sustainable hospital construction. In past and current research projects focused on hospitals, concepts and structural recommendations and have been put into practice in the form of mock-ups or demonstrators.

RESEARCH

LAB: Patient Room of the Future
The aim of the research and study LAB is to develop innovative solutions in all relevant areas of the patient room, such as construction, equipment, materials/surfaces, hygiene/cleaning, communication, digitalization and lighting. A patient room demonstrator for future studies has been set up on the grounds of Braunschweig Hospital and has been in operation since 2022.

Knowledge Platform www.PlanGesund.info
Since 2024 www.plangesund.info offers basic and specialist knowledge on structural health, well-being and infection protection. This includes target group-specific recommendations for practical action, numerous interactive planning tools and best practice examples to enable evidence-based decisions. A large number of experts from the fields of architecture, design, ventilation technology, hygiene and material sciences are involved.

Infection, Prevention, Control and the Built Environment
Structural and technical measures can reduce the risk of transmission of infectious pathogens in buildings. This can reduce the number of illnesses - both among patients and staff. Solution strategies for controlling the spread of infections in open and closed building systems are being developed in a series of research projects. In hospital, the operating theatre, emergency room and intensive care unit were analysed (Projects: Intensive care unit of the future, Enhance, InnoBRI, SAVE, EKOS).

Healthcare Architecture in low- and middle-income countries
The institute supports the planning and construction of healthcare facilities in developing countries. There is a long-standing partnership with the Rwandan Ministry of Health (MoH). A number of projects in this field have been realized in the past. The National Isolation Centre (Project: EFFO CoE) in Kigali is particularly outstanding.
The Institute has partnerships with the World Health Organization (WHO) and Médecins Sans Frontières (MSF).

This side: Research and study LAB Patient Room of the Future, IKE/ Tom Bauer
Knowledge Platform www.PlanGesund.info, IKE/ Nordsonne

Opposite side: Bezirkskrankenhaus Baraka, DR Kongo, IKE/ P. Knaus

IKE | Prof. Dr.-Ing. Wolfgang Sunder

Researcher's Career

- Since 2024: Professor for Health Care Building at the Institute of Construction Design, Industrial and Healthcare Building, TU Braunschweig
- 2010-2023 Research assistant at the Institute of Industrial Building and Construction Design, TU Braunschweig
- 2018: PhD on IPC and Health Care Building, Prof. Christine Nickl-Weller, Technical University of Berlin
- Since 2018: Partner smeta, Hamburg
- Since 2010: Partner APP-Architects, Hamburg
- 2001-2004: Architect at Zaha Hadid Architects, London
- 2007: Master of Architecture, ETH Zurich
- 2001: Diploma in Architecture, msa Münster
- Member of Architekten für Krankenhausbau und Gesundheitswesen e.V. (AKG), Berlin
- Member of Infection Control Africa Network (ICAN), South Africa

Funding
BBSR, BMWK, BMG, BMBF, MWK, BIZ, Innovationsausschuss, Nieders. Vorab. der VolkswagenStiftung

TEACHING

If you look back at the history of Healthcare Architecture, it becomes clear that no other building has had to face so many social and medical changes. Numerous factors, from medicine and hygiene to politics and society, have led to major changes. New hospital buildings can be outdated by the time they are completed.
When working on student design tasks and seminars, relevant health topics and social issues are addressed. This takes place in an interdisciplinary exchange with hospital operators, planners, companies and other disciplines (e.g. medicine, sociology).
Research and teaching are closely interlinked. Students are continuously involved in research projects and thus have the opportunity to work on health-related topics. The results of teaching make a significant contribution to the research projects. At the same time, new architectural findings from the research projects are passed on to our students.

Publications

- Sunder W, Scheithauer S, Karch A, Kuhlmann A, Kucheryava N, Hernández Mejía G, Bartz A, Bludau A, Schreiner P (2024): Optimierte Patientenversorgung durch innovative Baukonzepte zur Reduktion nosokomialer Infektionsübertragungen, Gemeinsamer Bundesausschuss, Berlin
- Fucini G, Geffers C, Schwab F, Behnke M, Moellmann J, Sunder W, Gastmeier P (2023): Die bauliche Struktur der deutschen Intensivstationen aus dem Blickwinkel der Infektionsprävention, Medizinische Klinik - Intensivmedizin und Notfallmedizin, Volume 119, Seiten 27–38
- Sunder, W., Moellmann, J., Zeise, O., & Jurk, L. A. (2021). Das Patientenzimmer - Planung und Gestaltung. Birkhäuser, Basel
- Sunder W (2019): Hygiene Bauen – Planungsempfehlungen für die Intensivstation, den Operationsbereich und die Notfallaufnahme. In: Prölß J et al: Pflegemanagement. Medizinisch Wissenschaftliche Verlagsgesellschaft.
- Sunder W, Holzhausen J, Gastmeier P, Haselbeck A, Dreßler I (2018): Bauliche Hygiene im Klinikbau. Planungsempfehlungen für die bauliche Infektionsprävention in den Bereichen der Operation, Notfall- und Intensivmedizin. Bonn (Zukunft Bauen – Forschung für die Praxis, Band 13), 76 Seiten

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IKON | Institute for Construction

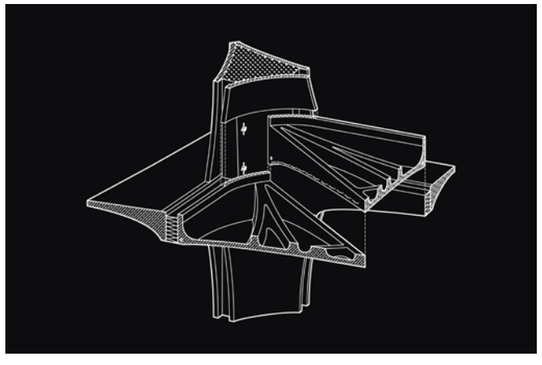
Mission Statement

Building construction examines all architectural actions from the perspective of their moment of realization. It is evident that without innovations in architectural construction the buildings of the future will remain impossible to create. This is the point where practice, learning and research have to collectively reposition themselves in order to recalibrate structural design processes. In the shift from the doable to the desirable, already in the development process the solution lies in cooperatively combining the experimental, the fundamental and the digital with ecological ideals so that a meaningful whole emerges.

RESEARCH

Designing in a contemporary manner means using the criteria of planetary boundaries as a basis for the conception of an architectural project. We have to understand the complex processes behind the production of a construction and their effects on our environment. At the Institute of Construction / IKON, we address research topics dealing with new methods for responsible design and their influence on our architectural language.

Constructive Disobedience
Constructive Disobedience focuses on methods for constructive experimentation and knowledge production through singular and particular architectural projects. A conference in September 2022 invited architects, engineers, manufacturers and craftspeople to present a specific insight into their constructive experiments and to engage in exchange. The aim is to find instructions for action - dispositivi - on how we can enable constructive experimentation from the core of the profession, understand it methodically, establish it as design research and thus bring it into recognition academically and on the building site.



Birch Bark Building Material
The temporary pavilion in Weimar - realized by Prof. Blocksdorf in 2021 - serves as an epistemic artefact for the investigation of the physical properties of birch bark as a building material. Monitoring results allow the development of new construction typologies with bark materials. Birch bark performs functions such as moisture regulation, sealing or weather protection.

Breathable Constructions
Breathable Constructions aim to explore the potential of the hygrothermal properties of ecological building materials. Based on an analysis of the building stock in Germany, strategies for the transformation and supplementation are developed and constructive alternatives to conventional construction methods are identified. The interaction of structural and building climate parameters is the focus of the considerations.

Explorative Teaching & Additive Manufacturing
Explorative teaching breaks with common and standardized design teaching methods. It promotes the interaction of technology and design and transfers individual technical inventions into a coherent architectural construct. In cooperation with the Institute of Structural Design, ITE, design methods on additive manufacturing were investigated and led to the production of collaborative demonstrators for the AMC TRR 277 research project. Explorative teaching will be integrated in upcoming design studios, searching for a new symbiosis of ecological materials and digital fabrication.

Picture Credits
This Side:
ME / AMtoARC / Leon Kremer / Thilo Schlinker / TU Braunschweig

Opposite Site:
above: Portrait: © HB / A
below / A+K: © Ruben Beilby/TU Braunschweig

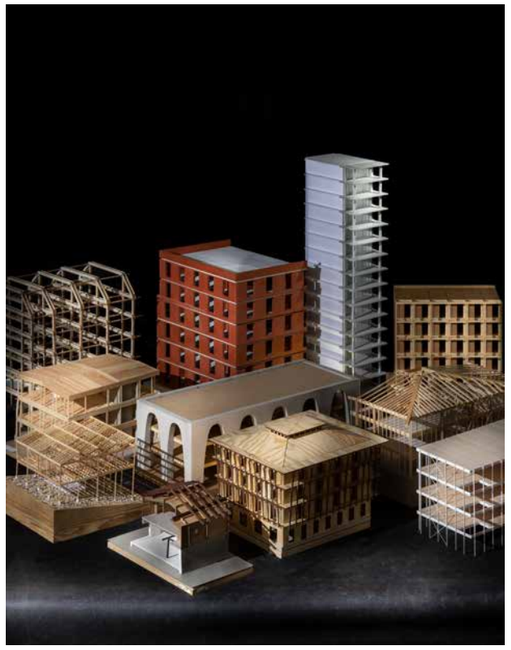
IKON | Prof. Dr.-Ing. Helga Blocksdorf

Researcher's Career

- since 2021 Full Professor and Director of the Institute for Construction / IKON
- 2022 International Conference Constructive Disobedience at TU Braunschweig in collaboration with Katharina Benjamin and Matthias Ballestrem
- 2021 Guest Professor for Constructive Design at Bauhaus-University Weimar
- since 2019 PHD-candidate
- program for design-based doctorates (PEP) at Technische Universität Berlin
- 2013 Founder of Helga Blocksdorf / Architektur, Berlin
- 2007 - 2012 Scientific Assistant at the Chair for Design and Construction, Prof. Ute Frank, TU Berlin

TEACHING

IKON prepares the knowledge base for the materialization of a responsible architecture. In "Building Construction I & II", "Architecture & Construction" and "Constructive Project", methods, concepts and skills for constructive design are taught in the first 5 semesters of the Bachelor program. Master's programs, on the other hand, focus on developing new perspectives on architectural solutions, such as explorative design. The studios intend to transform the classical design method in favor of a material- and fabrication-oriented approach that leads to true sustainable architectural conceptions.



Publications

- Blocksdorf, H.; Ballestrem, M.; Benjamin, K., (2025). Constructive disobedience: an experimental methodology in architecture, Basel
- Blocksdorf, H.; Dörfler K.; Hack N. (Hrsg.), (2023). From Additive Manufacturing to Architecture, TU Braunschweig.
- Blocksdorf, H.; Barckhausen, S.; Beilby, R. (Hrsg.), (2023). PERSONÆ - Konstruktive Charaktere im analytischen Licht zeitgenössischer Entwurfskriterien, TU Braunschweig, Institut für Baukonstruktion.
- Blocksdorf, H. (2023). Kommentar in Ballestrem, M. (Hrsg.); Gasperoni, L. (Hrsg.), Epistemic Artefacts – a Dialogical Reflection on Design Research in Architecture, AADR, Spurbuchverlag. B
- Blocksdorf, H., Barckhausen, S., Beilby, R. (Hrsg.), (2021). IN SITU EX SITU – eine grafische Analyse zwischen Konstruktionsprozess und Ausdrucksform, TU Braunschweig, Institut für Baukonstruktion.
- Blocksdorf, H. (Hrsg.) (2021). Winter 20/21 – Über die Textilität von Brettsperrholz, Bauhaus-Universität Weimar, Fachgebiet für Konstruktives Entwerfen.
- Blocksdorf, H. (Hrsg.) (2012). adreizehn 2008-10, TU Berlin, Fachgebiet Entwerfen und Baukonstruktion.
- Blocksdorf, H. (Hrsg.) (2011). EKLAT - Entwerfen und Konstruieren in Lehre, Anwendung und Theorie, TU Berlin, Fachgebiet Entwerfen und Baukonstruktion.
- Blocksdorf, H. (Hrsg.) (2008). adreizehn 2007-08, TU Berlin, Fachgebiet Entwerfen und Baukonstruktion.

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ILA | Institute of Landscape Architecture

Mission Statement

Landscape architecture is a unique non-verbal communication medium for conducting dialogues about our built and natural environment. Designing characteristic places capable of endowing identities is one of the central duties of (landscape) architecture intending to offer viable and aesthetically appealing places in which people can live. We have to discuss new points of reference and models for tomorrow's open spaces.

RESEARCH

Recombinations: Developing landscape hybrids with an antithetical leitmotif as an expression of total creation which is linked to the idea of nature – this is the main focus of our landscape architectural work. We do research on the hybridization of space and atmosphere and develop interfaces between productive and reproductive spaces.

Sustainable Chile: We maintain partnerships with Chilean universities to discuss and develop tools and approaches for sustainable urban developments in South American contexts at all urban scales from object to citywide concepts.

Urban Biodiversity: The flora and fauna of Central European cities has long received little attention; nature was sought after outside the cities, in the countryside or in distant regions of the world. We focus on urban contexts and develop structures for wildlife architectures and analyze requirements for evolving habitat structures.

City of the Future: Whether it be climate change, social inequality or scarcity of resources – the challenges facing our society are great. We are part of the new strategic research project at our university discussing and developing principles and models of sustainable urban development.

Landscape for Architects: The design of landscapes requires a holistic approach but also in- depth specialist knowledge. In teaching and publications, however, the perspective of the generalist and concrete aspects of design are often neglected. "Landscape for Architects" is a design manual that is as comprehensive as it is practical and as holistic in its concept as it is lucid in detail. It presents a series of "questions" illustrated by abstract schematic drawings along with "answers" in the form of analytical drawings of case studies that aim to inspire creative reflection and exploration in the reader's own design process.

This side: Landscape for Architects – The 5 trilingual volumes – Building, Landscape, Park, Qualities, Use – together compromise more than 1000 pages.

Opposite side: Exhibition view „Eins.Getrennt.Vereint" St. Thomas-Church, Berlin.

ILA | Prof. Gabriele G. Kiefer

Researcher's Career

- Curator of the German Pavillon at Biennale 2025
- 2015-2013, Dean of the Faculty of Architecture at the TU Braunschweig
- 2013-2008, Member of urban advisory council City of Salzburg
- since 2012, Jury member for the Villa Massimo-Scholarships
- since 2008, Teaching in Valdivia and Santiago de Chile, Chile
- since 2002, Professor at the Technical University of Braunschweig, Institute of Landscape Architecture
- since 1990, internatonal juries and lectures activities
- 1989, Foundation of planning office BÜRO KIEFER
- 1992-1987, research associate at the TU Berlin , Department of landscape architecture
- 1987-1979, Studies at the Technical University of Berlin, Department of landscape architecture

Funding
DAAD, BUND, City of Braunschweig, BS | Energy, local municipalities

TEACHING

Most of our environment - landscape and city - consists of open space. Open or public space shape the image and atmosphere of a city just as much as its high-rise buildings. The clear boundary between the building and the outside space, between inside and outside, is becoming increasingly blurred. This interlocking creates hybrid spaces; the landscape is no longer just the space around the building, but the building increasingly becomes part of the landscape. In recent years, landscape architecture has increasingly turned out to be the engine of urban development. Today, no architectural and urban planning project can be carried out without open space planning. In order to sensitize architecture students to this, the focus of our teaching is not only on design projects but also on the analysis of existing projects. Knowledge of open space planning and the timeline of urban developments is therefore a necessary component of architectural teaching.

Publications

- Borgmann, N., Endres, E., Kiefer, G., Santucci, D. (Hrsg.): STRESSTEST - DER DEUTSCHE PAVILLON - 19. Architekturbiennale von Venedig; DISTANZ Verlag; 2025
- Endres, E., Kiefer, G., Köbberling, F., Schneider, T.: Reallabor Hagenmarkt; TU Braunschweig; 2022
- Kiefer, G., Neubauer A.: Landscape for Architects I Landschaft für Architekten I Paisaje para arquitectos; Birkhäuser; 2020
- Kiefer, G.: Armut, Ästhetik und Stadt.Architektur In: Grüne Reihe 117; Erich Fleischer Verlag (Hrsg.); 2017
- Kiefer, G.: Strategies for Optimizing Urban Resources - (Bio) Diversity of Public Space In: ISG Magazin; Internationales Städteforum in Graz (Hrsg.); 2016
- Kiefer, G.: Die Kehrseite der Schönheit – Die Vorstadt Salzburgs ist einer Kulturstadt nicht würdig In: ‚Frei Raum Szene Salzburg' Tagungsband, Magistrat Stadt Salzburg (Hrsg.); 2010
- Kiefer, G.: Wie Phönix aus der Asche In: Learning from Duisburg Nord; TU München, Prof. Udo Weilacher (Hrsg.); 2009
- Kiefer, G.: Stilisierte Leere und Möglichkeiten In: Architekturforum Zürich (Hrsg.): Garten des Poeten G59; 2009
- Kiefer, G.; Schröder, T. (Hrsg.): Büro Kiefer – Recombinations; Ulmer Verlag; 2005

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IMDR | Institute for Methodologies of Design and Representation

Mission Statement

The IMDR explores how aesthetic understanding emerges from attentive observation, material interaction, and the transformation of spatial conditions. We approach design not as the execution of predetermined ideas but as a process of inquiry — one that reveals structures, relations, and potentials within the world around us. Through research-led teaching, iterative experimentation, and dialogue across disciplines, the institute investigates how architects learn to see, interpret, and act. Our work aims to cultivate a reflective design practice capable of engaging with cultural, technological, and societal transformations in meaningful ways.

RESEARCH

Teaching and research at IMDR are closely intertwined. Methods introduced in the foundational studios evolve into research questions, and insights gained through research flow directly back into teaching formats. As a newly formed institute, IMDR is shaping its profile through this reciprocal dynamic: the content is conceptually clear and robust, while its institutional anchoring and expansion are currently underway. This phase of development allows for a focused consolidation of methods, themes, and collaborations that will define the institute's long-term trajectory.

Aesthetic Knowledge Production
Aesthetic knowledge arises in the moment when perception meets material, when attention turns into insight and observation becomes form. At IMDR, we explore how such knowledge emerges through careful looking, spatial analysis, and the transformation of everyday situations. Rather than treating aesthetics as an add-on to design, we understand it as a mode of inquiry that reveals the structural, temporal, and relational qualities of the world. Through iterative experiments and close engagement with phenomena, we study how meaning is produced before it becomes a design proposal. Our research contributes to a contemporary understanding of how architects and designers think, perceive, and act within complex cultural conditions.

Phenomena, Systems, and Emergence
We investigate how spatial and formal systems develop from the phenomena that surround us. Instead of beginning with defined concepts, our approach asks how rules, structures, and patterns arise through making, testing, and reflecting. These self-forming logics often expose unexpected coherences that blur the boundaries between intuition and method. By analysing these emergent behaviours, from material tendencies to spatial sequences, we aim to develop tools that support designers in engaging with uncertainty and complexity. This work fosters a deeper literacy of the hidden orders and dynamic processes that shape our environment.

Design Methodologies and Iterative Processes
Our research studies how design concepts emerge through processes rather than prescriptions. We focus on generative methods that unfold over time: rule formation, system-building, intuitive decisions, and condition-driven transformations. These open-ended approaches highlight the productive role of uncertainty and the value of step-by-step discoveries. Instead of following linear design models, we emphasise processes that respond to what is found, perceived, or revealed. This research contributes to a contemporary methodology of design that is adaptive, reflective, and grounded in the realities of material and spatial experience.

Cultural Participation and Public Engagement
Design is shaped by, and shapes, its cultural and social context. We explore how architectural thinking can support inclusive forms of engagement, shared learning, and low-threshold access to aesthetic experience. Through collaborative projects, exhibitions, and public formats, we investigate how knowledge can move beyond academic settings and into everyday life. These activities create opportunities for communities to encounter spatial ideas, contribute their perspectives, and participate in shaping their environments. Our research strengthens the role of design as a cultural practice that invites dialogue, reflection, and collective imagination.

Portrait: Athenea Diapouli-Hariman 2023
This side: FoundationCourse Work in Progress - 2021

IMDR | Prof. Dipl.-Ing. Fahim Mohammadi, M.Arch., M.Eng.

Researcher's Career

- Full Professor (W3); Founding Head, Institute for Methodologies of Design and Representation (IMDR), TU Braunschweig, since 2025
- Full Professor (W2), Design Foundations and Experimental Design, Stuttgart State Academy of Art and Design (ABK), 2015–2025
- Vice Rector for International affairs, ABK-Stuttgart, 2024-2025
- Senator (elected), ABK-Stuttgart, tenures 2019–2023 & 2023–2027
- Member of the Representative Board (elected), ELIA – European League of Institutes of the Arts, since 2022
- Member / Chair of Steering Group, ELIA Academies, since 2019
- Deputy Head & Academic Associate, Institute for Experimental Design, TU Braunschweig, 2011–2015
- M.Eng. (Membrane Structures), Anhalt University of Applied Sciences; M.Arch (DesignResearchLab), Architectural Association London; Dipl.-Ing. (Architecture), TU Braunschweig
- Board Member, Mia Seeger Foundation, 2018-2020

Funding
MWK Baden-Württemberg;
EnBW Cultural Funding; ZfkT-Centre for Cultural Participation BW

TEACHING

Perception and Phenomena
Teaching at the IMDR begins with cultivating an ability to look closely. Students observe everyday spatial situations and learn to recognise the structural, material, and temporal conditions that shape them. This work shifts attention from what things are to how they behave: how patterns emerge, how boundaries dissolve, and how relationships become visible. Observation becomes an investigative tool that reveals the underlying orders of the world, rather than its surface appearances. Through this practice, students develop the perceptual acuity needed to approach architectural problems with clarity, sensitivity, and conceptual depth.
In later semesters, studios and seminars allow students to deepen this perceptual approach, drawing on the interdisciplinary expertise of the IMDR team to develop both architectural proposals and experimental design formats. This enables students to refine their own ways of observing, analysing, and transforming spatial conditions within increasingly complex and conceptually demanding contexts.

Representation as Inquiry
Teaching begins with the mastery of drawing as a precise, manual craft. In the first semester, students work with sketching, plan, section, three-view projection, and axonometry, constructing each drawing by hand from fundamental geometries. This careful practice develops accuracy, spatial understanding, and an awareness of how lines produce relations. In the second semester, the notion of drawing expands: students explore what a drawing can do beyond depiction: how it can record, interpret, abstract, or even speculate. Through this shift, representation becomes a way of thinking, where the act of drawing generates insight, reveals structures, and opens possibilities that were not visible at the outset. In the advanced stages of the programme, studios and seminars extend this representational inquiry, enabling students to develop their own visual and conceptual languages through the combined perspectives of the institute's interdisciplinary team.

Publications

- Mohammadi, F.; Roggan, R. (forthcoming). Unschärfen – Aesthetic Perspectives on Indeterminacy and Quantum-Like Phenomena in Art and Architecture. With an introduction by Michael Lüthy. Braunschweig / Stuttgart.
- Mohammadi, F. (2024). UNLOCKED – Gaming Opens Culture; funded by the Centre for Cultural Participation Baden-Württemberg (ZfKT). Stuttgart.
- Mohammadi, F. (2023). UNFOLD – Cartographies of the Aesthetic. Stuttgart.
- Mohammadi, F. (2023). "incubator – an interdisciplinary foundation class." In: Langreuter, A. C. (ed.), More than the Sum of its Parts. Stuttgart, 72–89.
- Mohammadi, F. (ed.) (2022). IK007–00–000. Stuttgart.
- Mohammadi, F. (2021). "Five Phases of an Aesthetic Approach in Foundational Studies." In: Hermann, A.; Bader, N. (eds.), Exhibiting Lessons – On Showing Pedagogy. Siegen: universi, 251–261.
- Mohammadi, F. (ed.) (2021). Hybrid Intervention Vol. 2. Stuttgart.
- Mohammadi, F. (ed.) (2020). Hybrid Intervention Vol. 1. Stuttgart.
- Mohammadi, F. (2019). "Material Knows No Discipline." In: Textiles Panorama. Stuttgart: EnBW, 20–21.
- Mohammadi, F. (2018). "On Seeing, Playing, and Making." In: Inkubator – Forms of Aesthetic Play. Stuttgart, 4–11.

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ISE | Institute of Urban Design

Mission Statement

Urban Design as we understand it is a balancing act between idealism and pragmatism, creativity and structure, future visions, and current needs. It is also a long-term process with a huge social, environmental, economic, and energetic impact. We therefore aim to create visions and designs für sustainable future cities.

RESEARCH

In our research projects we work together with cooperating municipalities and institutes as well as students to create visions and concepts for future-oriented urban design. Our focus lies on transformative research and experiment which closely relate to the local urban design practice and its challenges. In the past years ISE conducted transformative research projects on several urban areas, particularly on such aspects as design scenarios, energetic strategies, and participatory processes. Among our past projects is for instance the research on transformation of the TU campus in terms of sustainability and resilience, conducted in a cooperation with several institutes of the TU as well as external partners and founded by the Ministry of Economy and Energy (EnEff Campus). In cooperation with the municipality of Wolfsburg and with the support of the German Federal Environmental Foundation we explored urban transformation ideas of the local community and published a catalogue of urban transformation strategies (Zukunftsraum Wolfsburg).

In cooperation with the city of Braunschweig we contributed to the strategic development and participatory design of the area of the former industrial railway zone (BAHNSTADT). Another cooperation with the city of Braunschweig is the co-creative planning process for a new mixed-use area at and around the so-called Campus North (Campus Nord): Since 2016 we coordinate and codesign the experimental project “CoLiving Campus”, aiming to offer an urban platform for local innovation and to build bridges between science and the city.

ISE | Prof. Uwe Brederlau

Researcher’s Career

- CEO, Institute of Urban Design
- Chair, Johannes Göderitz Foundation
- Member of the Deutsche Akademie für Städtebau und Landesplanung (DASL)
- Member of the Deutscher Werkbund (DWB)
- Office BREDERLAU + HOLIK, Architecture and Urban Design, Braunschweig
- Full Professor for Urban Design since 2000
- Assistant Professor at the Institut für Städtebau, Wohnungswesen und Landesplanung, Leibniz Universität Hannover
- Office of Urban Design and Architecture, 1993-2010, Hannover
- Meisterschüler at the Hochschule für Bildende Künste (HBK) Braunschweig
- Study of Architecture at the Leibniz Universität Hannover

Funding
BMWi, DBU, BMBF

TEACHING

We aim to share our passion for urban design with architecture students because we understand buildings as parts of a large interconnected system that interact with their built, social, and natural environment. In his lectures, Prof. Brederlau discusses theoretical and historic background of urban design with bachelor students. We also run software and method-focused workshops in order to offer our students tools for a successful design process, starting from early semesters. In our design courses we work on development scenarios for urban areas and often cooperate with city municipalities in order to explore practice-oriented challenges. Through cooperation with urban design institutes from different universities and cities we take part in a student competition that allows a broader discourse and exchange for students in their advanced bachelor and master semesters (Johannes-Göderitz-Preis). In seminars we explore urban interventions, critical urbanism as well as planning instruments and methods. We regularly document the output of the design courses and seminars in digital and printed publications, which are partially available on our website as well in the institute and the university library.

Publications

- Brederlau, U., ISE - Institut für Städtebau und Entwurfsmethodik (Hrsg.) (2020): Grenzen des Bauens Folgen der Massenproduktion von Stadt und die Alternativen: Seminar 2019-20.
- Brederlau, U. Holik, F., Jureit, A., Lubahn, S., (Hrsg.) (2019): Zukunftsraum Wolfsburg. Strategien zur Umsetzung der Energiewende im städtischen Kontext.
- Brederlau, U-, ISE - Institut Für Städtebau Und Entwurfsmethodik (Hrsg.) (2018): CoLiving Campus – Johannes-Göderitz-Preis 2018.
- Brederlau, U., Jureit, A., Lubahn, S., Nestler, J. (2015): CAMPUS+STADT: Analysen, Strategien und Szenarien für die stadträumliche Entwicklung der Technischen Universität Braunschweig.

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ISU | Institute for Sustainable Urbanism

Mission Statement

‘Sustainable Urbanism.’ These two words represent the biggest challenge and the biggest hope of our generation. ISU explores, teaches, co-designs, engineers, and promotes all strata of sustainable development in the context of worldwide urbanisation. ISU is a think tank, design and research laboratory committed to promoting science and scholarship in an international, inter- and transdisciplinary setting.

RESEARCH

The Institute for Sustainable Urbanism (ISU) is researching and developing tools and strategies for more sustainable cities and communities. Its progressive ideas in linking architecture, urban design and planning to a multitude of other disciplines, such as environmental science, traffic engineering, politial science, psychology and data sciences, within the context of a common ground – sustainable cities and urban regions – has generated new holistic approaches towards a more science-based urban design. Extending the limits of its own discipline, ISU engages in multidisciplinary joint projects, gaining scientific and data-based knowledge of the complexity of the urban world and redefines the understanding how the structure, design and shape of the built environment is key towards sustainable urbanism.
With the Urban Digital Lab (ISU-uLAB) ISU builds up a state of the art competence center for multidisciplinary urban research. It uses the digital realm to transgress the disciplinary limits of architecture, urban design, and planning in its pursuit to transform and develop future cities.

ISU projects typically evolve around central research themes:
Space as Resource: Space is a valuable and limited resource that must be properly managed and used efficiently to optimal effect, just like other resources of limited supply. As we face what the United Nations call the Urban Age, this idea will become increasingly true and imperative.

City in Society: Cities are where people are and people meet. At the heart of good urban design is public space, accessible and open to multiple users and uses, connecting individuals, functions, and spaces, but increasingly also formats of democratic participation in developing cities and urban regions. Urban design, both formal and process-oriented, has a role in supporting sustainable lifestyles, such as by understanding users’ needs, providing environmentally friendly forms of mobility, or by enabling innovative recreational or economic activities.

Impossible Sites: Large, global-scale trends affect the local, urban-scale conditions. What was previously considered an uninhabitable or un-occupiable site, can, through a tilt in macropolitical, economic, environmental, or sociological forces, become again possible, and vice versa.
These forces produce particular observable and measureable phenomena that affect neighborhoods at the local scale, highlighting the inherent contradictions and excesses of globalisation and its neoliberal forces.

Urban-Rural Relations: Where the city stops, the country does not begin. Cities must be considered in a broader context, encompassing their larger footprints. Thus today cities must be managed in a context larger than their compact urban cores and downtown areas, but rather in terms of their hinterlands, water- and waste-sheds, their reaches of networks of transportation and human resources. Likewise, villages are not just remote, rural places, but also providers and consumers of various forms of urban capital. These new dynamics involve processes of proximity and distance between the city and the countryside.

ISU | Prof. Dr.-Ing. Vanessa M. Carlow

Researcher’s Career

- Architect and Planner, MAA, BDA
- since 2012: Full Professor; Head of the Institute for Sustainable Urbanism (ISU)
- since 2015: Co-speaker of ‘Future City’ research cluster of TU Braunschweig
- since 2014: CEO of Research Institute for Sustainable Urbanism RISU
- Visiting Professor: Cornell University, Architecture Art Planning AAP, Ithaca, USA (2017); Stuckeman School of Architecture, Pennsylvania State University, USA (2013)
- 2012: PhD at Royal Danish Academy of Fine Arts Copenhagen, Centre for Planning
- 2012: Founder of COBE Berlin GmbH
- 2005: Co-founder of COBE, Copenhagen, Denkmark
- 2003-2004: MA Urban Management at Erasmus University Rotterdam, University Copenhagen, Ca Foscari Venice, Antwerp University, Auton. University Barcelona
- 1995-2002: Study of architecture and urban design, Berlin & Delft

Funding: BMBF, AA, MWK, DAAD, public and local authorities, Alexander von Humboldt Foundation, Robert Bosch Foundation, VW Foundation, et al.

TEACHING

Architects and urban designers – in collaboration with specialists from a multitude of other disciplines – balance their individual creativity with manifold impacting interests to shape our built environment. In an ever more complex world, our profession needs to reflect on design strategies, considering other disciplines’ knowledge and perspectives, to develop sustainable future cities and liveable spaces for all.

An in-depth exploration of specific questions and current discourses is necessary in order to train students’ perception and understanding of complex processes embedded in urban development. In order to prepare students for the challenges of sustainable urban development, ISU has developed a series of innovative teaching formats that pursue a cooperative, multidisciplinary approach.

ISU follows the concept of integrating practice-oriented methods and cooperation into teaching. In the sense of problem-oriented teaching, we bring our students into contact with real-world questions, places and actors to foster a two-directional transfer of knowledge. ISU is using digital media and tools in pursuing the strong interdisciplinary integration of teaching and research.

Publications

- Carlow VM, Schmidt V, Neumann D, Mumm O. 2019 (forthcoming). Projektakademie Ländlicher Raum – ein kooperativer, inter- und transdisziplinärer Ansatz in der Städtebaulehre. In: Kauffeld S, Othmer J (eds.). Innovative Lehre. Heidelberg: Springer.
- Carlow VM. 2018 (forthcoming). Stadt für Alle. In: Pahl KA, Reuther I, Stubbe P, Tietz J (eds.). Potenzial Großsiedlung – Zukunftsbilder für die Neue Vahr. Berlin: Jovis, 118-133.
- Carlow VM. 2017. The transformation of the London Green Belt. In: Voigts E, Pleßke N. (eds.) 2017. Transforming Cities. Heidelberg: Winter a&e
- Carlow VM. 2017. Perspektiven einer wissensbasierten, kooperativen und offenen Stadtentwicklungspolitik. In: Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR) im BBR (ed.). 2017. Stadt im Fokus – 10 Jahre Nationale Stadtentwicklungspolitik. Bonn: BBSR.
- Neumann D, Sedrez M, Carlow VM. 2016. Scenarios for sustainable development of Lower Saxony. Metapolis. In: Schröder J, Carta M, Ferretti M, Lino B (eds.). 2016. Territories. Rural-Urban Strategies. Berlin: Jovis, 258-265.
- Carlow VM, ISU (ed.). 2016. Ruralism. The Future of Villages and Small Towns in an Urbanizing World. Berlin: Jovis.
- Carlow VM. 2016. LIMITS. Space as Resource. Berlin: Jovis.
- Carlow VM. 2015. Space as a resource: West Berlin’s impossible sites. In: Sustainable Development and Planning. WIT Press/ Computational Mechanics, 251–261.
- Carlow VM, Hong YW. 2015. Adapting design tools to produce site-specific solutions: three Projects. In: Wang F, Prominski M (eds.). Urbanization and Locality: Strengthening Identity and Sustainability by Site-specific Planning and Design. Heidelberg: Springer, 359-383.

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ITE | Institute of Structural Design

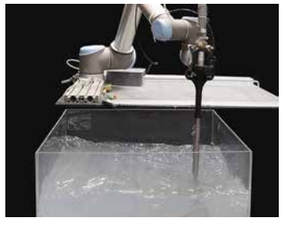
ITE | Prof. Dr. Norman Hack

Researcher's Career

- Since 2022: Professor for Digital Construction at the Institute of Structural Design, TU Braunschweig
- 2018-2022: Junior professor for Digital Building Fabrication at the Institute of Structural Design, TU Braunschweig
- 2018: PhD with distinction, Chair of Architecture and Digital Fabrication (Gramazio Kohler Research), ETH Zurich
- 2012-2014 Research assistant, Future Cities Laboratory, Singapore-ETH Centre for Global Environmental Sustainability, Singapore
- 2012: Master of Architecture with distinction, Architectural Association (AA), London
- 2009-2010: Architect in the Digital Technologies Group at Herzog & de Meuron, Basel
- 2009: Diploma in Architecture with distinction, Vienna Technical University, Vienna

TEACHING

Architects must reconsider their approach to design, planning, and construction in response to the global climate crisis. Construction alone contributes to 8% of the world's CO_2 emissions and consumes 35% of all materials used worldwide. Digital construction processes can help address these challenges by integrating interdisciplinary knowledge and facilitating seamless digital information flow from design to execution. Robotic manufacturing and additive manufacturing, in particular, have the potential to contribute to these efforts. The professorship in Digital Construction focuses on reducing resource consumption by adopting a circular approach facilitated through digital design and fabrication processes. The research-driven learning approach emphasizes comprehensive digital skills for navigating future architectural contexts. Physical experimentation on a 1:1 scale and interdisciplinary collaboration are key components of this approach, which emphasizes a practice-oriented, material, and design-oriented approach to teaching.



Shotcrete 3D printing for material-efficient reinforced concrete componentsfor its design and potential and material efficiency

Publications

- N. Hack, H. Kloft, Shotcrete 3D Printing Technology for the Fabrication of Slender Fully Reinforced Freeform Concrete Elements with High Surface Quality: A Real-Scale Demonstrator, 2nd RILEM International Conference on Concrete and Digital Fabrication, Eindhoven, 2020
- N. Hack, I. Dressler, L. Brohmann, S. Gantner, D. Lowke, H. Kloft, Injection 3D Concrete Printing: Basic Principles and Case Studies, Materials. (2020)
- N. Hack, K. Dörfler, A.N. Walzer, T. Wangler, J. Mata-Falcón, N. Kumar, J. Buchli, W. Kaufmann, R.J. Flatt, F. Gramazio, M. Kohler, Structural Stay-In-Place Formwork for Robotic In Situ Fabrication of Non-Standard Concrete Structures: A Real Scale Architectural Demonstrator, Automation in Construction. 115, 202
- I. Mai, L. Brohmann, N. Freund, S. Gantner, H.Kloft, D. Lowke, N. Hack, Large Particle 3D Concrete Printing—A Green and Viable Solution. Materials 2021, Vol. 14, Page 6125, 14(20), 6125 (2021)
- Y. Xiao, N.Khader, A. Vandenberg, D. Lowke, H. Kloft, N. Hack, Injection 3D Concrete Printing (I3DCP) Combined with Vector-Based 3D Graphic Statics. RILEM Bookseries, 37, 43–49 (2022)

Awards

2018: ETH Medal for outstanding Doctoral Theses
2017: Concrete Innovation Award 2017, Tromsø
2016: SwissTechnology Award 2016, Basel
2014: Best Paper Award CAADRIA 2014, Kyoto
2011: Europan 11, Winner for Skien and Porsgrunn
2010: DAAD Scholarship for Architectural Association, London

ITE | Prof. Dr.-Ing. Harald Kloft

Researcher's Career

- Since 2020: Spokesperson of the DFG-funded Collaborative Research Centre TRR 277 Additive Manufacturing in Construction (AMC)
- 2015-2017: Dean of the Faculty of Architecture, Civil Engineering and Environmental Sciences, TU Braunschweig
- Since 2011: University Professorship for Structural Design and Head of the Institute of Structural Design (ITE), Faculty of Architecture, Civil Engineering and Environmental Sciences, TU Braunschweig
- 2007-2009: University Professorship for Structural Design, Faculty of Architecture, TU Graz
- 2002-2011: University Professor for Structural Design and Construction, Faculty A/RU/BI, TU Kaiserslautern
- 2002-2019: Co-Founder and Managing Director of the engineering practice "Office for Structural Design" (osd), Frankfurt a. M
- Distinction 'Deutscher Ingenieurbaupreis 2016', Award for the ETA-Fabrik project (osd)
- Balthasar-Neumann-Prize' 2014, Award for the LAV-Archive Nordrhein-Westfalen (osd)

TEACHING

Structures are an essential part of all architecture. The up-to-date digital technologies in planning and manufacturing create new possibilities in the design of structures as well as in the range of materials and construction techniques. However, the basic knowledge of structural design and engineering theories remain valid, regardless of the technologies used. More than ever, the design of resource-minimised structures that can be utilised for a long time and whose components can ideally be de-constructed and re-used later is an important contribution to environmental sustainability and climate protection. At the Institute of Structural Design (ITE), the basics of load-bearing structures (TWL) as well as the materials-based design and construction principles (TWE) are taught in the bachelor's degree programme. In the so-called "Konstruktives Projekt", the structural design is addressed as an integral part of the architectural design. Here, the philosophy is that the structural design is a separate, but not an independent design task: a structural system cannot be designed without an architectural context! In addition to the obligatory courses, the material-oriented design of structures is taught in research-related seminars and design projects in the Bachelor's and Master's degree programmes.

Variety of structural design models within the teaching course TWE

Publications

- H. Kloft, L. P. Schmitz, C. Müller, V. Laghi, N. Babovic, "Experimental Application of Robotic Wire-and-Arc Additive Manufacturing Technique for Strengthening the I-Beam Profiles", in: buildings, 2023, 13, 366
- M. Eschenbach, A.-K. Wagner, L. Ledderose, T. Böhret, D. Wohlfeld, M. Gille-Sepehri, C. Kuhn, H. Kloft, O. Tessmann, "Matter as Met: Towards a Computational Workflow for Architectural Design with Reused Concrete Components," in: Towards Radical Regeneration – Design Modelling Symposium Berlin 2022 (C. Gengnagel, O. Baverel, G. Betti, M. Popescu, M. Ramsgaard Thomsen, J. Wurm (Ed.), Springer International Publishing, pp.442-455
- D. Lowke, A. Vandenberg, A. Pierre, A. Thomas, H. Kloft, N. Hack, "Injection 3D concrete printing in a carrier liquid - Underlying physics and applications to lightweight space frame structures," Cement and Concrete Composites, 2021, 104169, ISSN 0958-9465
- V. Mechtcherine, R. Buswell, H. Kloft, F. P. Bos, N. Hack, R. Wolfs, J. Sanjayane, B. Nematollahi, E. Ivaniuk, T. Neef, "Integrating reinforcement in digital fabrication with concrete: A review and classification framework," Cement and Concrete Composites, 2021, 103964
- A. Baghdadi, M. Heristchian, H. Kloft, "Connections placement optimization approach toward new prefabricated building systems," Engineering Structures, 2021, 111648
- M. Schweiker, E. Endres, J. Gosslar, N. Hack, L. Hildebrand, M. Creutz, A. Klinge, H. Kloft, U. Knaack, J. Mehnert, E. Roswag-Klinge, "Ten questions concerning the potential of digital production and new technologies for contemporary earthen constructions," in: Building and Environment, 2021, 108240
- H. Kloft, H.-W. Krauss, N. Hack, E. Herrmann, S. Neudecker, P. Varady, D. Lowke, "Influence of process parameters on the interlayer bond strength of concrete elements additive manufactured by Shotcrete 3D Printing (SC3DP)," in: Cement and Concrete Research, no. 134, 2020
- H. Kloft, J. Oechsler, F. Loccarini, J. Gosslar, C. Delille, Robotische Fabrikation von Bauteilen aus Stampflehm, in: Deutsche BauZeitschrift. (2019) Nr. 7/8, S. 54-59

ITE | Institute of Structural Design

Mission Statement

Our goal is to explore the latest digital design and construction technologies, including additive manufacturing, robotics and augmented reality to create a more sustainable and circular built environment. By reducing material consumption and waste, we aim to enable sustainable building practices while exploring the impact of these technologies on architectural and structural design.

RESEARCH

Using digital tools our research investigates three core aspects of sustainable construction: reduce, reuse, and recycle. We aim to develop innovative computational design and fabrication methods to reduce material consumption, increase efficiency, and minimize the environmental impact of the construction industry.

Reduce

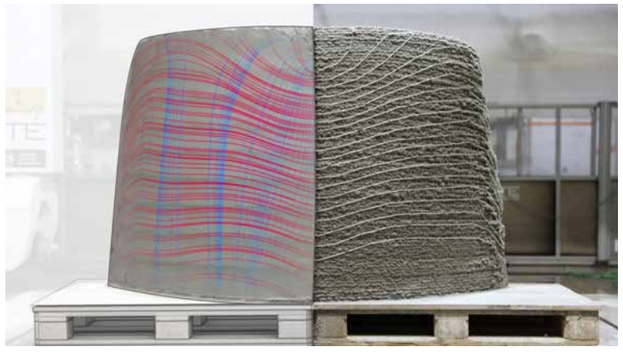
The "Reduce" focus area of research involves exploring data-driven and rule-based architectural design techniques, as well as artificial intelligence and evolutionary computation. The primary goal is to investigate new ways to design structures and buildings that use minimal building materials while still providing greater design flexibility. This area of research is supported by the development and testing of additive manufacturing techniques for construction on a 1:1 scale.

Reuse

The "Reuse" focus area aims on designing buildings for a circular economy, where components can be disassembled and reused. The architecture is designed for disassembly using durable and robust materials with reversible connections.

The research also includes digital pre-fabrication of components, mobile robotics, and augmented reality for in-situ assembly. We investigate hybrid structural systems and the use of salvaged as well as custom-printed parts. The research topics include integrative computational design frameworks, lightweight construction systems, digital fabrication of reusable components, robotic and augmented assembly strategies, structural and reversible connections, and digital databases.

Reduce: Through structural optimization and automated placement of fibre reinforcement the thickness of concrete elements can be significantly reduced



Reuse: Reinforced large-scale concrete components are digitally manufactured in a combinded process of SC3DP core printing, vertical cover layer printing and precise surface finishing by CNC milling

ITE | Institute of Structural Design

Team

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Yonca Taube, Cecilia S. Ahumada, Meike Bährens

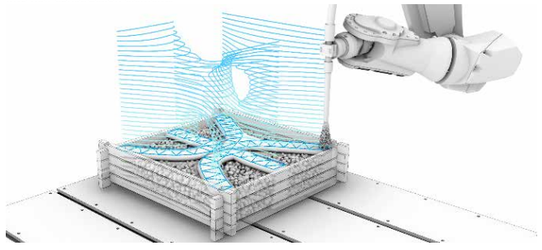
Researchers
Fatemeh Amiri, Neira Babovic, Abtin Baghdadi, Robin Dörrie, Stefan Gantner, Joschua Gosslar, Carsten Jantzen, Sven Jonischkies, Noor Khader, Gabriela Kienbaum, Mareike Krake, Lukas Ledderose, Jeldrik Mainka, Ankiet Patel, Philipp Rennen, Bartlomiej Sawicki, Benedict Sonntag, Janna Vollrath, Yinan Xiao, Jan-Phillip Zöllner

Additive Manufacturing with earthen materials
left: Sprayed Earth Additive Manufacturing; right: Robotic Rammed Earth

Recycle

The "Recycle" focus area aims to reduce the construction industry's waste production by upcycling construction waste into higher-grade construction products through digital fabrication. This research stream explores two strategies: additive manufacturing using materials like concrete, clay, plastic, metal, and glass, and robotic upcycling of building elements like bricks and timber using subtractive robotic fabrication techniques. Research topics include the development of new, higher-grade construction products, innovative fabrication techniques and process chains, and 3D scanning methods for precise geometric inspection. The focus area is closely linked to the other two focus areas, and primarily concerns materials and fabrication processeses.

Recycle: Large Particle 3D Printing: Using recycled aggregates and construction debris for upcycling into new construction elements



Recycle: Cutting of dry joint for reversible connections, applicable for salvaged as well as for newly printed structural elements

Research Projects (exclusive TRR 277 AMC projects)

- Rammed earth concrete: Combined, additive manufacturing of rammed earth and rammed concrete; Funding: BMBF
- ReMin - Joint project: Fertigteil2Punkto - Real-digital processchains for the extraction of installed concrete components forfurther use as finished components; Funding: BMBF
- WE! - GOLEHM: Mobile, robotic rammed earth: from laboratory to construction site production; Funding: BMBF
- Beyond 3D printing - A novel spatial printing technology for lightweight spaceframe concrete structures; Funding: VolkswagenStiftung
- Potential of additive manufacturing and performance in comparison to conventional in reinforced concrete construction; Funding: DBV - Deutscher Beton- und Bautechnik-Verein E.V.
- Next-generation additive manufacturing for material-efficient multi-storey buildings; Funding: BMBF
- Future Urban Coastlines – Individualized and Eco-Integrated Coastal Protection using Digital Technologies; Funding: DFG
- Large Particle 3D Concrete Printing Using Recycled Concrete Aggregates; Funding: BBSR
- Robot-supported production of recyclable wax formwork for sustainable geopolymer concrete components; Funding: BMBF

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AMC | Collaborative Research Center TRR 277 Additive Manufacturing in Construction

Mission Statement

The Collaborative Research Center Transregio 277 Additive Manufacturing in Construction (AMC) aims with its basic research to significantly shape the digitalization of construction. Within the levels of components, processes and materials, the AMC researches resource- and energy-efficient as well as sustainable, recyclable and digital construction. Through innovative 3D printing methods, materials, processes and optimized design are completely rethought.

RESEARCH

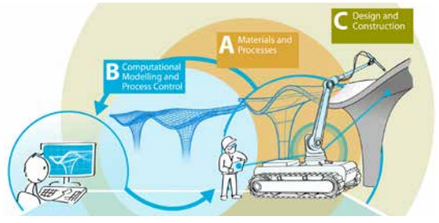
The AMC TRR 277 aims to examine Additive Manufacturing (AM) (3D printing) as a novel digital manufacturing technology for the construction industry in an interdisciplinary, cross-location research project. The two universities TU Braunschweig and TU Munich, pursue the novel manufacturing approach for the construction industry. Additive manufacturing can develop into a key technology for the digitalization of the construction industry. Complex research questions on materials, process engineering, control, modelling, design and construction are being investigated holistically by scientists from the fields of architecture, civil and mechanical engineering.

In Additive Manufacturing, the production of building components is achieved solely by a digitally controlled layer-by-layer material application, without mould making or forming processes. This approach represents a paradigm shift to the manual construction processes, which are characterised by traditional, predominantly craft-based techniques. As a result, productivity in the construction industry has stagnated for decades. In addition, these manual techniques foster a rather simple component design and thus inefficient use of materials.

Against the background of the enormous demand for resources in the construction industry, this methods of constructing contributes significantly to global CO_2 emissions.

The objective of the AMC is to explore the fundamentals for implementing Additive Manufacturing in Construction (AMC). Automated additive material application enables the construction of buildings with a high degree of design freedom and a resource-efficient use of materials. In order to fully exploit this potential, structural design, material behaviour and manufacturing processes must be fundamentally rethought and, above all, must interact.

Focus Areas A,B and C of the AMC and how they interact



TRR 277 AMC Summer School, Herrsching am Ammersee 2022

AMC | Collaborative Research Center TRR277 Additive Manufacturing in Construction

Funding
Funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – since 2020 – Project number 414265976.

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Prof. Dr. Kathrin Dörfler

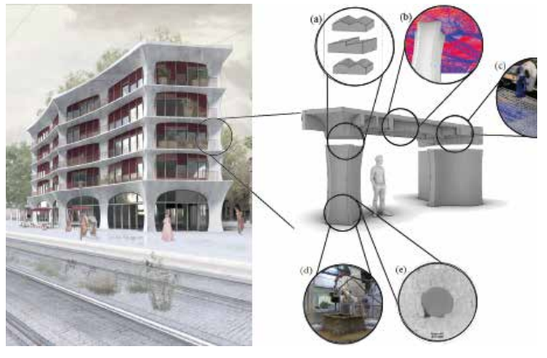
General Manager
Jeldrik Mainka

Administration
Cecilia S. Ahumada, Hastia Asadi, Meike Bährens, Yonca Taube, Janna Vollrath

RESEARCH BASED TEACHING

Additive manufacturing (AM) is an essential technology for the future of construction. To train and prepare students for the digitalized construction industry, topics of the TRR 277 AMC are incorporated into three teaching formats.
Firstly, the seminar “Applied Additive Manufacturing in Construction“, offered to students of architecture and civil engineering provided by ITE and iBMB consists of a theoretical and practical part, and teaches a fundamental knowledge of various additive manufacturing processes, materials development, testing and their practical application.
Secondly, the design course "From Additive Manufacturing to Architecture," investigated the impact of AM-methods as a design generator. In a joint design studio offered by TUM Professors Dörfler and Nagler as well as TUBS Professors Blocksdorf (IKON), Hack and Kloft (ITE) students develop AM-based housing projects in an urban context.
Thirdly, "Computational Design and Digital Fabrication," a cross-university seminar between TU Braunschweig, TU Munich and TU Delft included hybrid lectures in computational form finding, excursion to TU Delft and one-week robotic fabrication workshop at TU Braunschweig.

Shelltonics demonstrator: AM-section of building construction



AMC Focus Areas

- Focus Area A ‘Materials and Processes’ centres on the investigation of various materials and processes combinations for 3D-Printing. AM technologies include Particle-bed 3D printing techniques include selective cement activation (SCA), selective paste intrusion (SPI) for concrete, and selective laser melting (SLM) for steel which are being investigated. In terms of deposition techniques, extrusion 3D printing and shotcrete 3D printing for concrete, as well as wire and arc additive manufacturing (WAAM) for steel are being investigated.
- Focus Area B ‘Computational Modelling and Control’ considers the assigned digital feedback obtained by computational modelling and process control of all AM processes. The aim of focus area B is the development of novel models and efficient discretisation schemes for numerical simulation of material–process interactions relevant to additive manufacturing processes in construction.
- Focus Area C ‘Design and Construction‘ addresses the implementation of additive manufacturing in the process chain of design and construction. The interaction between digital models and physical objects connects the focus areas A and C. This focus area provides feedback to the A projects by investigating novel design techniques and structural optimisation as well as any information about building information modelling (BIM).

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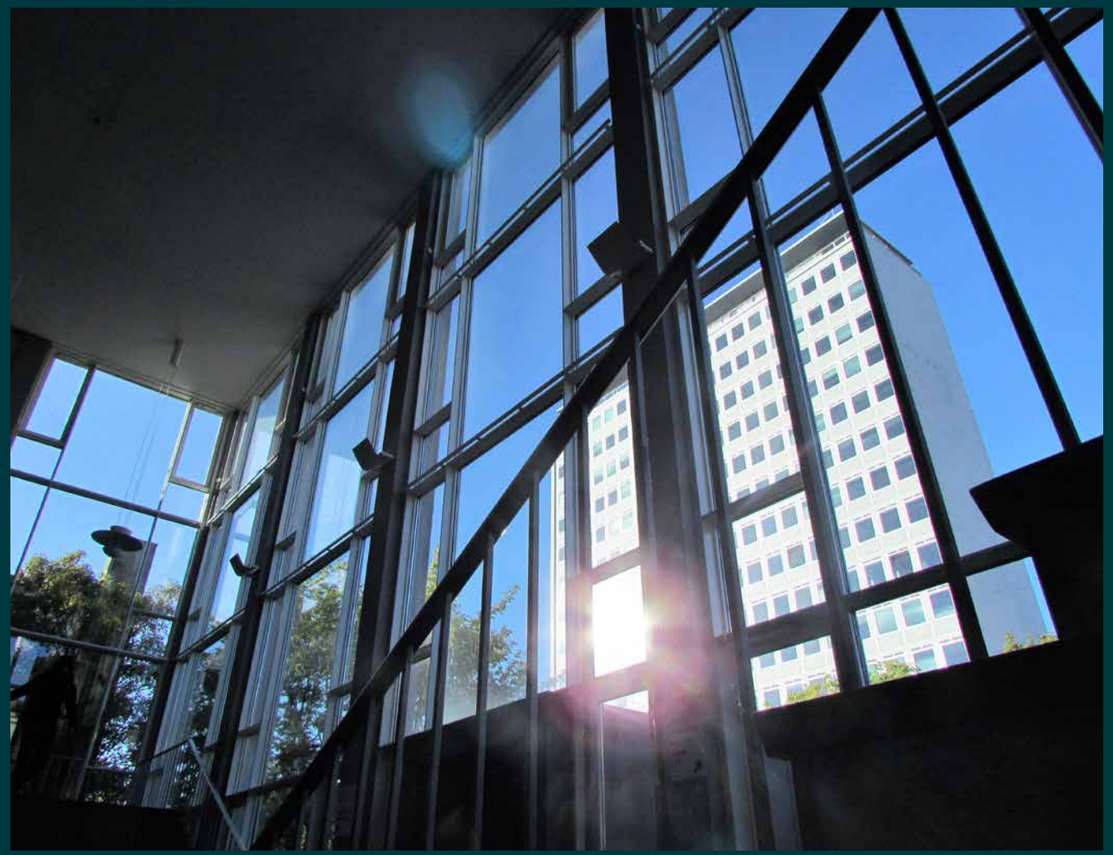


Civil Engineering and Environmental Sciences

IAM | Institute of Applied Mechanics

Mission Statement

We develop reliable and efficient computational methods that bridge the gap between length scales from nanometers to meters for solving multi-physics problems in conjunction with both 3D imaging and in-situ testing. Our activities span a broad range of applications, from porous media like concrete, rock, and soil, to cutting-edge energy storage materials.

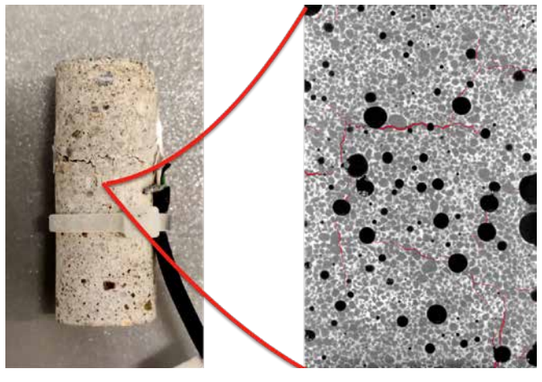
RESEARCH

At our institute, we are dedicated to developing advanced multi-physics models that enable us to describe and predict complex material properties. Our research is focused on developing strategies for solving multi-scale problems using cutting-edge techniques such as Computational Homogenization with Numerical Model Reduction. To support the accuracy of our models, we develop innovative setups for lab-experiments and combine 3D imaging using X-Ray Computed Tomography with in-situ testing.

Our applications of interest span a wide range of fields, from studying

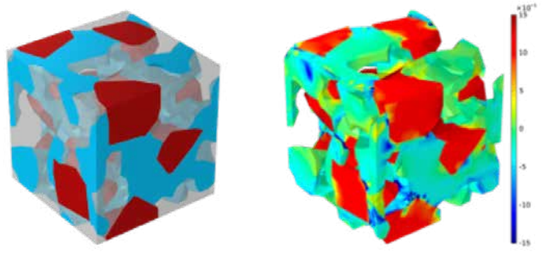
- transport and degradation processes in porous media such as concrete, porous rock, and soil, to
- process simulation of ShotCrete 3D Printing (SC3DP), as well as
- simulating coupled processes in batteries across multiple length scales.

Together with our collaboration partners, we are constantly exploring new avenues of research to tackle the most pressing challenges in engineering sciences, and our goal is to develop innovative solutions that will have a lasting impact on future research and industrial applications.



left: Crack propagation in concrete mortar after applying 16 freezing-thawing cycles.

below: Synthetic microstructure of a Li-ion battery cathode and volumetric expansion of LFP particles during battery charging.



IAM | Prof. Dr.-Ing. Ralf Jänicke

Researcher's Career

- Full professor in Applied Mechanics, TU Braunschweig, Germany
- Assoc. Prof. in Solid and Structural Mechanics, Chalmers University of Technology, Sweden
- Habiliation in Mechanics, Ruhr-Universität Bochum, Germany
- Elected as Junior Fellow of the North Rhine-Westphalian Academy of Sciences, Humanities, and the Arts
- Visiting Scholar, Chalmers University of Technology, Sweden
- Researcher at Institute of Computational Engineering, Ruhr-Universität Bochum, Germany
- Dr.-Ing. Saarland University, Germany
- Dipl.-Ing. In Materials Science, Saarland University, Germany

Funding: DFG, State Lower Saxony (MWK)

TEACHING

We aim to equip our students with the knowledge and skills necessary to succeed as engineers and researchers in their respective fields.

Our institute provides a diverse selection of courses tailored to Bachelor's and Master's level students in Civil and Environmental Engineering, Industrial Engineering, and the international Master's program in Computational Sciences in Engineering (CSE). Our course offerings include engineering mechanics, solid mechanics, computational mechanics, and related topics.

At the Bachelor's level, our courses serve as a foundation for future engineers. Students learn about engineering mechanics, including equilibrium principles, statics of rigid bodies, elastostatics, dynamics of rigid bodies, as well as concepts of computational methods and discretization techniques.

At the Master's level, we offer courses on both linear and nonlinear solid mechanics, providing students with an in-depth understanding of how to describe mechanical material behavior within a consistent mathematical framework. Additionally, we provide advanced courses on the Finite Element Method that equip our students to tackle nonlinear and coupled material behavior, multi-scale problems, and fracture propagation. To ensure a hands-on learning experience, all courses include computer labs.

Publications

- Tu, V., Larsson, F., Runesson, K., & Jänicke, R. (2023). Variationally consistent homogenization of electrochemical ion transport in a porous structural battery electrolyte. European Journal of Mechanics-A/Solids, 98, 104901.
- Ekre, F., Larsson, F., Runesson, K., & Jänicke, R. (2022). Numerical Model Reduction with error estimation for computational homogenization of non-linear consolidation. Computer Methods in Applied Mechanics and Engineering, 389, 114334.
- Bharali, R., Larsson, F., & Jänicke, R. (2021). Computational homogenisation of phase-field fracture. European Journal of Mechanics-A/Solids, 88, 104247.
- Pollmann, N., Larsson, F., Runesson, K., Lundgren, K., Zandi, K., & Jänicke, R. (2021). Modeling and computational homogenization of chloride diffusion in three-phase meso-scale concrete. Construction and Building Materials, 271, 121558.
- Kaessmair, S., Runesson, K., Steinmann, P., Jänicke, R., & Larsson, F. (2021). Variationally consistent computational homogenization of chemomechanical problems with stabilized weakly periodic boundary conditions. International Journal for Numerical Methods in Engineering, 122(22), 6429-6454.
- Jänicke, R., Larsson, F., & Runesson, K. (2020). A poro-viscoelastic substitute model of fine-scale poroelasticity obtained from homogenization and numerical model reduction. Computational Mechanics, 65(4), 1063-1083.

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IAM| Institute of Applied Mechanics | **Division Data-driven modeling of mechanical systems**

Mission Statement

Modeling + Numerics + Machine Learning
Engineers develop physical models to design, monitor and control infrastructures and products. Complex models can only be solved numerically with the aid of computers. Tailored machine learning approaches help us to link the information from experiments, sensing and simulations to build next generation models: digital twins.

RESEARCH

Inverse problems and parameter identification

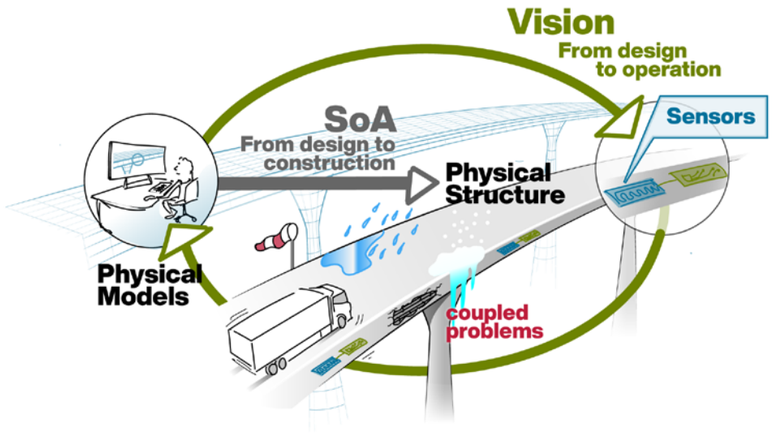
Engineers often have to deal with incomplete observations. Given such incomplete information, what is the stress field inside a steel girder? How does the flow field inside a river look like? Inverse modeling and parameter identification are our strategies to relate sparse information to what remains hidden to the human eye. If the computational model that has been used to design a product, process or infrastructure, becomes outdated due to ageing or damage effects, efficient model updating strategies need to be employed.

Additive manufacturing & multi-physics

Increased flexibility for designers is what made additive manufacturing popular. This flexibility is mostly due to the large amount of process parameters, which make process planning a complicated endeavor. With sophisticated computational methods we aim to increase this flexibility beyond what is known today, e.g. towards functionally graded materials.

Multi-scale modeling

It is understood that the composition and structure at smaller scales determines the material behavior on the component scale that is relevant for designers. We develop data-driven models to exploit this understanding and to optimize material structures in virtual design loops.



IAM | Prof. Dr.-Ing. Henning Wessels

Researcher's Career

- Professor (W2) for Data-driven mechanics at the Institute of Applied Mechanics
- Assistant Professor at the Institute for Computational Modeling in Civil Engineering
- Awarded a Feodor-Lynen fellowhship of the Alexander-von-Humboldt foundation for a research stay at Brown University (not realized due to the pandemic)
- Scientific assistant (PhD and Postdoc) at the Institute for Continuum Mechanics at Leibniz University Hannover
- Fulbright Fellow and Visiting Scholar at UC Berkeley
- M.Sc. and B.Sc. in Mechanical Engineering from Leibniz University Hannover
- Internship at Robert Bosch GmbH
- Erasmus at Aristotle University, Thessaloniki

Funding
DFG, BMBF, BMUV,
State of Lower Saxony (MWK)

TEACHING

As in research, our courses cover the intersection of modeling, numerics and machine learning. Since data in engineering is usually limited, we learn how machine learning algorithms can be enriched with physical models. Given some observational data, students will be confronted with the questions: What is useful to learn? What is save to learn? How about the physics? What is the range of applicability of a trained model?

- Few problems in engineering or applied mathematics have an analytical solution and a numerical solution strategy is required. **Numerical engineering methods** provides an overview of basic numerical methods for tasks like integration, solving differential equations, root finding in non-linear equations, solving systems of equations or doing frequency analysis.
- **Algorithms and Programming** teaches concepts that enable students to understand existing and especially to draft own R&D software. The course covers an introduction to Python, Object Oriented Programming, Data structures as well as selected algorithms.
- Material modelling comprises two tasks: specifying the functions which appear in the model, and finding the numerical values of their parameters. **Data-driven material modeling** aims to automate these tasks using machine learning and statistical methods. In particular, we will review the concepts of material modelling and and discuss model discovery through the lens of regression.
- Inverse problems arise in the context of parameter identification from full-field or monitoring data. Especially monitoring imposes severe time constraints for their solution. **Advanced data-driven modeling** discusses data-driven methods such as physics-informed neural networks to enable fast inference.

Publications

- U. Römer, S. Hartmann, J.-A. Tröger, D. Anton, H. Wessels, M. Flaschel and L. de Lorenzis. "Reduced and All-at-Once Approaches for Model Calibration and Discovery in Computational Solid Mechanics". In Applied Mechanics Review (2025). 10.1115/1.4066118
- V. Narouie, H. Wessels, F. Cirak and U. Römer. "Mechanical state estimation with a Polynomial-Chaos-Based Statistical Finite Element Method." Computer Methods in Applied Mechanics and Engineering 441 (2025). 10.1016/j.cma.2025.117970
- A. Henkes, L. Herrmann, H. Wessels and S. Kollmannsberger. "Generative Adversarial Networks Enable Outlier Detection and Property Monitoring for Additive Manufacturing of Complex Structures". In Engineering Applications of Artificial Intelligence (2024). 10.1016/j.engappai.2024.108993
- A. Henkes, J. K. Eshraghian, and H. Wessels. "Spiking neural networks for nonlinear regression". In: Royal Society Open Science 11.5 (2024). 10.1098/rsos.231606
- A. Henkes, H. Wessels and R. Mahnken. "Physics informed neural networks for continuum micromechanics". In: Computer Methods in Applied Mechanics and Engineering 393 (2022). https://doi.org/10.1016/j.cma.2022.114790
- H. Wessels, C. Weißenfels and P. Wriggers. "The neural particle method - an updated Lagrangian physics informed neural network for computational fluid dynamics". In: Computer Methods in Applied Mechanics and Engineering 368 (2020). 10.1016/j.cma.2020.113127

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IBB | Institute of Construction Engineering and Management

Mission Statement

Through excellent research, innovative teaching and tailor-made training, the IBB plays a leading role in shaping the sustainable and digital transformation of the construction industry. Therefore, we develop and impart knowledge, structures, methods and processes to plan, implement, evaluate and improve construction production systems in a sustainable manner.

RESEARCH

Additive Manufacturing in Construction (AMC):
Additive manufacturing in construction is leading to fundamental changes in the value chain. The use of additive concrete production experience ("concrete 3D printing") promises not only an increasing productivity through the rationalization of human work, but also more resource-efficient construction through the elimination of formwork and targeted use of materials, as well as improvements in safety on construction sites.

Cologne railway overpasses:
In a multi-stage research project, IBB is taking over the scientific support of a pilot project of Deutsche Bahn to examine the economic viability of the rail partnership model ("PM Schiene"). Due to the specific project characteristics, the economic feasibility study itself also represents a "pilot project" in order to establish a conceptual template for the future assessment of alternative project management models.

PartnerIng:
A confrontational project culture is a typical feature in the processing of construction contracts. Elements to promote partnership (partnership elements) are an integral part of collaborative delivery methods. The aim of the BMWSB-funded research project PartnerIng is to develop a guideline for the integration of collaboration-promoting elements in order to promote the implementation of construction projects based on partnership in the interest of all parties involved.

Zero Waste Construction Logistics:
The aim of the BMWSB-funded research project is initially to quantify the extent of (avoidable) residual materials and waste quantities on the one hand and packaging and load carriers on the other hand through field studies and to process the results in a life cycle assessment. Based on this, priorities for avoidance strategies are determined and alternative scheduling, packaging and transport as well as processing and assembly concepts are identified. This is intended to ensure resource- and climate-friendly material flows on construction sites in the future.

This side: Cologne Railway
Jeldrik Mainka/ TRR277 AMC/TU Braunschweig
Zero Waste Construction
Jan Niklas Lünig/IBB/TU Braunschweig

Other side: Jan Thormälen/IBB/
TU Braunschweig

IBB | Prof. Dr.-Ing. Patrick Schwerdtner

Researcher's Career

- Full Professor for Construction Engineering and Management, TU Braunschweig
- Partner of CEM Partner Beratungsgesellschaft mbH
- Head of Tender Division Major Projects, Bilfinger Hochbau GmbH, Frankfurt
- Head of Contract Management, Bilfinger Hochbau GmbH
- PhD, TU Braunschweig
- Construction Manager, Bilfinger Hochbau GmbH, Frankfurt
- Dipl.-Ing. in Civil Engineering, TU Braunschweig
- Master of Science in Civil Engineering, Georgia Institute of Technology, Atlanta

Funding
BMUB, BBSR, EFRE, Industry

TEACHING

The IBB imparts knowledge in Bachelor's and Master's programmes of Civil Engineering and Industrial Engineering with a specialisation in Civil Engineering as well as for interested students in the fields of Architecture and Environmental Engineering. The teaching concept of the IBB covers the phases of planning, organizing, process planning and execution of any construction project from a technological, economic and legal perspective. In addition to traditional methods and basic knowledge new technologies are integrated in the lectures, seminars and workshops (e.g. Building Information Modeling, Lean Construction, Industrial Production and Alternative Delivery Methods). IBB has committed itself to convey skills and expertise that go beyond the requirements of later daily business and allow graduates to assert themselves in a constantly changing professional environment. Therefore, the design and execution of a construction project is considered as a production system with an network of linked stakeholders and required production factors.

Publications

- Lünig, J.; Seiß, S.; Schwerdtner, P.; Melzner, J.: Reducing construction quality costs through ontology-based inspection planning. In: Advanced Engineering Informatics, Volume 68, Part B, November 2025, S. 1-16.
- Behrens, S. N.; Schwerdtner, P.: Gemeinsam zum Ziel: Die Bausteine partnerschaftlicher Zusammenarbeit in Bauprojekten. In: Sundermeier, Matthias ; Meinen, Heiko (Hrsg.): Bauwirtschaft 1/2025, 10. Jahrgang 2025. Hürth : Werner Verlag (2025), S. 14–20.
- Placzek, G.; Schwerdtner, P.: A Global Snapshot of 3D-Printed Buildings: Uncovering Robotic-Oriented Fabrication Strategies. In: Buildings 2024, 14(11), 3410.
- Greune, S.; Schwerdtner, P.; Schütte, J.: Möglichkeiten für die präventive Regelung einer Preisgleitung aus baubetrieblicher Sicht. In: Institut für Bauwirtschaft und Baubetrieb (Hrsg.) : Preis- und Lieferrisiken durch höhere Gewalt - Präventive und reaktive Lösungen : Beiträge zum Braunschweiger Baubetriebsseminar vom 3. März 2023. (2023), Heft 68, S. 36 - 59.
- Placzek, G.; Schwerdtner, P.: Vorüberlegungen bei der Anwendung robotischer Systeme - eine baubetriebliche Untersuchung für den Beton-3D-Druck. Bauingenieur 97 (2022), Heft 12, S. 423-433.
- Placzek, G.; Barking, L.; Schwerdtner, P.: Entwicklung eines Level-of-Logistics-Konzepts zur Beschreibung des Fachmodells "Baulogistik". In: Bauwirtschaft. Berlin : Werner Verlag (2022), Heft 1, S. 1-11.

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DCS | Digital Construction Site

Mission Statement

The Digital Construction Site (DCS) pioneers the transformation towards Construction Industry 4.0 through disruptive innovation and interdisciplinary collaboration. While the construction industry adapts Lean Construction Management principles and leverage parametrized BIM models, these approaches alone are insufficient. To achieve truly efficient construction processes, entirely new procedures and technologies based on data-driven processes and networks are essential. The 2,800-square-meter research facility represents a paradigm shift from laboratory conditions to real construction site environments.

RESEARCH

Integrated Digital Manufacturing
The six-meter-high multifunctional 3D printing portal, developed jointly with COBOD, represents a global innovation. Automated concrete mixing plants, mobile robotic systems, and comprehensive object tracking networks create seamless digital process chains from planning through manufacturing, enabling resource-optimised construction through targeted material placement.

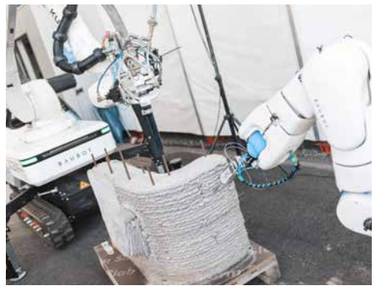
Additive Manufacturing in Construction (AMC)
As a partner in the Collaborative Research Centre TRR 277, we transition research from laboratory to real construction site conditions. This opens entirely new research dimensions, particularly in sustainability applications investigated within the second phase of the research programme of AMC.

European Innovation Networks
Through the Horizon Europe project "Next Level AM", the DCS acts as an additional outside laboratory. The objective, implemented together with European research partners Mesh AG (Switzerland), Rupp Gebäudedruck (Germany), and COBOD (Denmark): implementing shotcrete 3D printing with automated reinforcement production for multistorey building construction directly on construction sites.

Data-Driven Process Optimization
The Digital Engineering Centre consolidates all process data through Virtual and Augmented Reality interfaces, enabling real-time monitoring and control. Advanced sensor systems document construction progress, environmental influences, and deviations from digital planning, facilitating precise steering and comprehensive analysis.

Interdisciplinary Research Infrastructure
Five professors from the Institute of Construction Management, Institute of Structural Design, Institute of Building Materials, and Institute of Geodesy and Photogrammetry collaborate to address fundamental questions in digitized construction, creating comprehensive research approaches that transcend traditional disciplinary boundaries.

This side: 3 pictures: Combining traditional processes with new technologies \ TU Braunschweig
Other side: Large scale 3D-Gantry-Printer \ Researching under real construction site conditions \ TU Braunschweig



IBB | ITE | IGP | IBMB

Participating institutes
The DCS is a joint project of institutes within the Faculty of Architecture, Civil Engineering and Environmental Sciences. Funded by the EU & Lower Saxony in response to the COVID-19 pandemic.

EUROPÄISCHE UNION
Europäischer Fonds für regionale Entwicklung

EUROPA FÜR NIEDERSACHSEN

- **Institute for Construction Engineering and Management** (IBB)
  Univ.-Prof. Dr.-Ing. Patrick Schwerdtner
  https://www.tu-braunschweig.de/en/ibb
- **Institute for structural design** (ITE)
  Prof. Dr.-Ing. Harald Kloft
  Prof. Dr. Norman Hack
  https://www.tu-braunschweig.de/ite
- **Institute of Geodesy and Photogrammetry** (IGP)
  Prof. Dr.-Ing. Markus Gerke
  https://www.tu-braunschweig.de/en/igp
- **Institute of Building Materials, Concrete Construction and Fire Safety** (iBMB)
  Dr.-Ing. Thorsten Leusmann
  https://www.tu-braunschweig.de/en/ibmb/divisions

TEACHING

Students and researchers gain practical experience with cutting-edge technologies including large-format 3D printing, automated concrete production, robotic construction systems, and immersive planning environments. This hands-on approach prepares future construction professionals for industry transformation while generating practical research results directly trans-ferable to construction projects.

Professional Development Integration
Through partnerships with regional construction companies, federal institutes, and international research organizations, the DCS serves as a dynamic hub for knowledge transfer. Companies can test and validate new technologies on-site, accelerating the adoption of digital construction methods.

Research Focus Areas

- **Digital Process Integration & Stakeholder Connectivity**
  The DCS facilitates comprehensive digital networking of construction processes and stake-holders through advanced tracking systems, automated material handling, and centralized control systems. Research on DCS focuses on creating seamless data flows between planning, production, execution, and quality control phases.
- **Resource Efficiency & Sustainable Construction**
  Through precision-controlled 3D concrete printing, automated mixing systems, and waste re-duction technologies, we investigate methods to minimize CO_2 emissions and construction waste. The large-format concrete 3D printer enables complex geometries while reducing material consumption by up to 60% compared to conventional methods.
- **Enhanced Safety & Health Protection**
  Mobile robotic systems and automated processes reduce human exposure to hazardous construction environments. Advanced tracking technologies and digital monitoring systems provide realtime safety assessments and predictive risk management.
- **Productivity Enhancement & Construction Time Reduction**
  Digital fabrication methods enable rapid prototyping and production of complex building components. Components that traditionally required weeks to produce can now be manufactured within hours through the integrated 3D printing and automated mixing systems.

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IBHolz | Institute of Building Construction and Timber Structures

Mission Statement

The Institute of Building Construction and Timber Structures focuses on the investigation of spatial and planar structures from current and historical constructions. More challenges regard material behaviour, simulation of building physics and the preservation of existing structures.

RESEARCH

Research topics:

- Fatigue in Timber Structures
- Timber Adhesive Bonding
- Historic Timber Structures
- Building Conservation
- Roof Stacking
- Multi-Storey Timber Construction
- Renewable Resources
- Timber Frame Construction

Guide for Roof Stacking

This project is funded by the Forschungsinitiative ZukunftBau and aims for an extended addition of storeys to existing buildings in metropolitan areas by decreasing design efforts. Therefore a guideline is to be developed that provides the most important facts and parameters for designing and evaluating a Roof Stacking measure.

Development of a Loadbearing Theory for Timber Frame Constructions

In this project the development of an advanced shear field girder method in the plastic state of timber panel constructions is proposed. The advanced shear field girder method distinguishes from the basic model by considering joints in the ribs between all sheathing boards instead of continuous ribs. Hence, the model is reduced to a rigid body model with elastic-plastic bond and offers simple equations to measure the stress in the plastic state.

Fatigue Behaviour of Notches and Self-Tapping Fully Threaded Screws

This cooperation-project with the University of Stuttgart investigates the fatigue behaviour of notches and self-tapping fully threaded screws against the background of application as a connection in timber-concrete composite beams. Thus a safe and economic application regarding the relevant effects on fatigue is permitted. Especially shearing, extraction and the combination of both are reviewed and rules for dimensioning are deducted.

Investigation of the requirements and functional connection of components of ETICS

In this cooperation-project with Fraunhofer WKI the main physical properties of all components of an ETICS are determined and simulated in a numeric model. The numeric model shall be used to evolve single components according to the needed requirements.

IBHolz | Prof. Dr.-Ing. Mike Sieder

Researcher's Career

- Professor at TU Braunschweig, head of the Institute of Building Construction and Timber Stuctures
- Honorary professor at the TU München
- Interim professor at the Chair of Timber Structures and Building Construction, TU München
- Head of engineering of a company in the field of membrane structures and lightweight construction
- Authorised signatory and head of the department 'Building Physics' at the testing laboratory MFPA für das Bauwesen Leipzig GmbH
- Graduation: Dr.-Ing., Ruhr-Universität Bochum
- Scientific assistant at the Chair of Building Construction, Timber Structures and Building Physics, Ruhr-Universität Bochum
- Studies in civil engineering, Bauhaus-Universität Weimar

Funding
DFG, AiF, ZukunftBau (BBSR), DBU

TEACHING

The institute participates in the education of Industrial, Civil and Environmental engineers. In the bachelor's programme lectures on the subjects Building Construction, Form and Construction, Masonry Constructions, Building Physics and Timber Construction are held. In the master's programme, the focus on wooden constructions is consolidated with the subjects Timber Components and their Connections, Timber Structures, Design of Timber Structures, Prefabricated Timber Panel Constructions, CAD for Timber Structures, FEM for Timber Structures, Preservation of Wooden Buildings and Timber Adhesive Bonding. Following the contents of main lectures are listed. Other courses are part of modules contained in the main lectures, as specified in the underlying table.

BUILDING CONSTRUCTION I and II

Basic knowledge of the load-bearing capacity, serviceability and durability of constructions. Representations of structures. Technical terms and terminology. Dependence of form and construction, and influence on design.

MASONRY CONSTRUCTIONS

Behavior of masonry as construction material.
Verification of masonry constructions according to EC 6.

BUILDING PHYSICS

Basic knowledge of thermal insulation, moisture protection and sound insulation.

TIMBER CONSTRUCTION I

Design, calculation and evidence of simple timber constructions. For example a single-family house.

TIMBER COMPONENTS AND THEIR CONNECTIONS

Basic understanding of timber properties and their evidence: durability, load-bearing capacity and serviceability.

DESIGN OF TIMBER STRUCTURES

Design, calculation and evidence of small timber structures with increasing difficulty and complexity.

Publications and Patents

- Kessel, M. H.; Sieder, M.; Anheier, D.; Janßen, P. (2018): Floor panels with free edges - Extension of the shear field girder. In: G. Dill-Langer (Hrsg.), Timber: Bonds, Connections and Structures. Materialprüfungsanstalt (MPA) der Universität Stuttgart, pp. 271-288
- Sieder, M.; Niebuhr, P. (2018): Fatigue behaviour of CLT under in-plane shear loading. In: Brandner, R.; Tomasi, T.; Moosbrugger, T.; Serrano, E.; Dietsch. P. (Hrsg.): Properties, testing and design of cross laminated timber: A state-of-the-art report by COST Action FP1402 / WG 2, Shaker
- Sieder, M.; Niebuhr, P. (2017): Der Ermüdungsnachweis im Holzbau nach DIN EN 1995-2 Anhang A. In: Stahlbau, Holzbau und Verbundbau – Festschrift zum 60. Geburtstag von Univ.-Prof. Dr.-Ing. Ulrike Kuhlmann, pp. 333-340, Verlag Ernst & Sohn, Berlin
- Kessel, M. H.; Sieder, M.; Colling, F.; Janßen, P.: Erarbeitung eines Rechenverfahrens zur Berücksichtigung von freien Stößen bei der Bemessung von Deckenscheiben in Holztafelbauart (erweiterte Schubfeldtheorie). Abschlussbericht PraxisRegelnBau Nr. PRB-4.1 (2017), Initiative Praxisgerechte Regelwerke im Bauwesen e.V., Berlin (2017)
- Brandner, R.; Dietsch, P.; Dröscher, J.; Schulte-Wrede, M.; Sieder, M. (2017): Cross Laminated Timber (CLT) Diaphragms under Shear: Test Configuration, Properties and Design, Construction and Building Materials 147 (2017), pp. 312-327, Elsevier B.V., Amsterdam
- Kreuzinger, H.; Sieder, M.: Einfaches Prüfverfahren zur Bewertung der Schubfestigkeit von Kreuzlagenholz/ Brettsperrholz. In: Bautechnik 90 (2013) No. 5, pp. 314-316, Ernst & Sohn, Berlin

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iBMB | Institute of Building Materials, Concrete Construction and Fire Safety
Division of Concrete Construction

Mission Statement

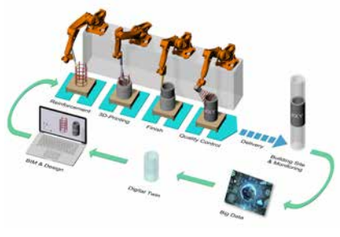
The research at the Division of Concrete Construction aims at various aspects of construction, design, maintenance and strengthening of plain concrete as well as reinforced and prestressed concrete structures.

RESEARCH

Automated construction
The research focus “Automated Construction” addresses the construction of the future. Automating processes using digitalisation and robotics throughout the construction industry’s value chain has enormous potential to make construction more efficient and higher quality, as well as compensating for the shortage of skilled workers. In this context, robots should interact with their human counterparts to provide profitable support. The research focuses on intelligent, data-based assistance systems, as well as the fundamental transformation of production approaches through automation.

Sustainable Construction
The research focus “Sustainable Construction” addresses the environmental impact of construction and investigates CO_2- and resource-efficient construction methods in solid construction. This involves investigating innovative ecological concretes and reinforcement types, as well as researching the use of high-performance materials to produce extremely thin-walled, material-efficient, durable structures with a very long service life. Additionally, this research area encompasses studies on structures for renewable energy generation and the development of more precise load and calculation models to facilitate the resource-efficient design and construction of components. The aim is to make an important contribution to climate protection and the preservation of our planet.

Modular Construction
The research focus “Modular Construction” addresses faster and more efficient construction using prefabricated modules. The central concept involves the use of reinforced concrete modules, which are manufactured in large quantities to a very high standard in a stationary, weather-independent prefabrication plant. These modules are then assembled on the construction site like a puzzle to form supporting structures and buildings. Alongside the modularisation and manufacture of the modules, the research also focuses on how they are joined together. This research focus interacts closely with the research focuses “Automated Construction” and “Sustainable Construction” and is primarily intended to enable faster, more efficient, and higher-quality construction.



iBMB | Univ.-Prof. Dr.-Ing. Vincent Oettel

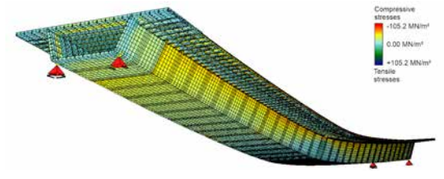
Researcher’s Career

- Executive Director, Civil Engineering Materials Testing Institute (MPA BS) Braunschweig
- Full Professor for Concrete Construction, TU Braunschweig
- Director, Test Center Support Structures Hannover (TTH)
- Full Professor for Concrete Construction, Leibniz University Hannover
- Project Engineer, G + S Planungsgesellschaft mbH
- Deputy Head, iBMB, TU Braunschweig
- Doctorate, Civil Engineering, TU Braunschweig
- Research Assistant, iBMB, TU Braunschweig
- Structural Engineer, SEH Engineering GmbH
- Study, Civil Engineering, TU Braunschweig, degree: Dipl.-Ing.
- Study, Civil Engineering, HAWK Hildesheim, degree: Dipl.-Ing. (FH)

Funding
DFG, BMWi, DAfStb

TEACHING

Bachelor
The aim of the bachelor courses is to prepare students to work as a structural engineer. Therefore, students get to know basic principles of the design and construction of reinforced concrete members, regarding the design for bending, shear and torsion at ultimate limit state as well as the control of cracking and deflection at serviceability limit state. Based on these principles, students gain the ability to design basic reinforced concrete elements like beams, slabs and columns. The bachelor courses are finalized in the bachelor's thesis, focusing the design and construction of a supporting structure of a high-rise building.



Master
The master's courses build upon the knowledge gained during the bachelor's courses. Thus, further aspects of concrete construction are discussed, such as sophisticated buildings like concrete bridges, industrial buildings, and hydraulic engineering structures, as well as advanced construction techniques like prestressed concrete. The lectures also cover advanced design and detailing aspects, as well as innovations and applications in concrete construction, such as automated construction. Another focus is sustainability, including the structural assessment and rehabilitation of existing structures, resource conservation, CO_2 emission reduction and life cycle analysis. Finally, student research projects and master's thesis deal with various topics, focusing either on advanced design and construction methods, or on current developments and research topics in concrete construction.

Publications

- Wilkening, M.; Voß, S.; Schmidt, B.; Oettel, V. (2025) Untersuchungen zur Rauigkeit und Tragfähigkeit von Verbundfugen zwischen normalfestem Beton und UHFB. Beton- und Stahlbetonbau 120, Sonderheft, S. 27-39. https://doi.org/10.1002/best.202400084
- Wilkening, M.; Buitelaar, P.; Oettel, V. (2025) Nachhaltigkeitsbetrachtungen zur Verstärkung und Instandsetzung von Brücken mit UHFB-Aufbeton. Beton- und Stahlbetonbau 120, Sonderheft, S. 40-53. https://doi.org/10.1002/best.202400089
- Voß, S.; Schmidt, B.; Oettel, V. (2025) Fatigue resistance of concrete: influence of time-dependent scattering of compressive strength. Materials and Structures 58 (3). https://doi.org/10.1617/s11527-024-02517-5
- Joachim, L.; Oettel, V. (2024) Experimental Investigations on the Application of Natural Plant Fibers in Ultra-High-Performance Concrete. Materials, 17(14), 3519. https://doi.org/10.3390/ma17143519
- Wilkening, M.; Joachim, L.; Oettel, V. (2024) Investigations on the fatigue loading of thin-walled and resource-efficient UHPFRC segmental bridges. Engineering Structures 306, 117858. https://doi.org/10.1016/j.engstruct.2024.117858
- Oettel, V.; Joachim, L.; Schmidt, B. (2023) Calculation approach of multi keyed dry joints for sustainable modular precast element constructions made of UHPFRC. Construction and Building Materials 370, 130687. https://doi.org/10.1016/j.conbuildmat.2023.130687

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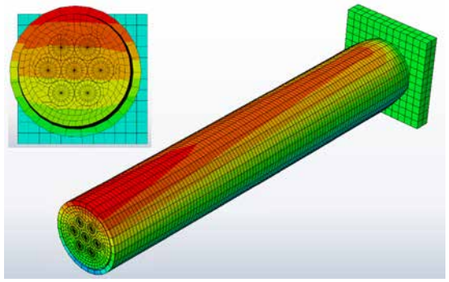
iBMB | Institute of Building Materials, Concrete Construction and Fire Safety **Division of Fire Safety**

Mission Statement

The focus of our work is the development of fire-safe buildings. Therefore we combine experimental research as well as numerical modelling in the fields of structural fire engineering and fire dynamics.

RESEARCH

Fire Safety of Components and Structures
In order to exploit the advantages in terms of load-bearing capacity and material efficiency of components made of high-strength building materials, they must be designed to be fire-safe. For components made from combustible renewable raw materials, it is important to develop reliable design concepts. Additionally the fire-related load-bearing behavior of global structures is also being investigated. The aim is to understand the interactions between different components in fire situation and to develop realistic simulation models that can depict the system behavior. In the area of façades, research activities focus on the development and testing of safe façade systems that meet both design and energy requirements.



Fire dynamics
Understanding fire dynamics is an important prerequisite for the design of fire-resistant buildings. Essential fire-describing variables are the heat release rate and the release rates of fire gases, which are explored depending on different fire scenarios. This also includes the investigation of fire and smoke propagation as well as special fire phenomena. The thermal decomposition (pyrolysis) of fuels essentially determines the early fire phase and the fire behavior of building materials. Based on experimentally determined input data, numerical models are developed to represent the processes, which are validated in real tests.

Fire Safety Analyses
Risk analyses and probabilistic methods are used to develop safety concepts that form the basis for customized fire protection strategies. Important components here are egress analyses and fire safety systems, the effectiveness and reliability of which must be taken into account.

iBMB | Prof. Dr.-Ing. Jochen Zehfuß

Researcher's Career

- Professor of Fire Safety, iBMB, TU Braunschweig
- Spokesman of Fire Research Center (ZeBra)
- Board Member of the Materials Testing Institute (MPA) Braunschweig
- Convenor of DIN Standard Committee for Fire Safety Engineering
- Member of CEN Committee for Structural Fire Engineering (EN 1991-1-2, EN 1992-1-2)
- Member of Executive Committee German Fire Protection Association (GFPA)
- Design Review Engineer for Fire Protection
- PhD at TU Braunschweig, Department of Civil Engineering
- Research Assistant at Institute of Building Materials, Concrete Structures and Fire Safety, TU Braunschweig
- Study of Civil Engineering at TU Braunschweig, degree Dipl.-Ing.

Funding
DFG, BMBFTR, BMWE, IGF, BMEL, DIBt, industry

TEACHING

We teach the basic knowledge of Fire Safety for the bachelor education in civil engineering, architecture and environmental engineering. For master in civil engineering we offer advanced courses in the field of Fire Safety and Structural Reliability:

Fundamentals of Fire Protection
Prescriptive Fire Safety Design and Passive Fire Protection
Based Fire Fighting and Active Fire Protection

Fire Safety Engineering Methods for Fire and Egress Simulations
Fire Dynamics and Human Behavior
Application of Models for Fire and Egress Simulations

Structural Fire Engineering
Fire Design of Components and Structures
Application of Models for Fire Design of Components and Structures

Special Subjects of Fire Safety
Fire Protection of Existing Buildings
Disaster Control
Fire Safety Design of Special Buildings

Structural Reliability
Reliability
Evaluation of Reliability of Existing Buildings
Risk Analysis

ZeBra
As the main user of the Center of Fire Research (ZeBra), the Division of Fire Safety is able to conduct and analyze fire test of various sizes.

Publications

- Firan, M.; Zehfuß, J. et al. (2025): Experiments and simulations on hot-dip galvanized composite beams made of high- and higher strength steel in case of fire. In: Fire Safety Journal. https://doi.org
- Brunkhorst, S.; Zehfuß, J. et al. (2024): TIMpuls - Large-scale timber compartment fire tests. In: Fire Safety Journal, https://doi.org
- Zehfuß, J.; Sander, L. et al. (2023): Fire design approach for modern vehicles with combustion or electrical engine. In: Civil Engineering design. DOI: 10.1002/cend.202300011
- Voigt, S.; Straubig, F.; Kwade, A.; Zehfuß, J.; Knaust, C. (2023): An empirical model for lithium-ion battery fires for CFD applications. In: Fire Safety Journal. doi.org/10.1016/j.firesaf.2022.103725
- Gernay, T.; Zehfuß, J.; Brunkhorst, S.; Robert, F. et al. (2022): Experimental investigation of structural failure during the cooling phase of a fire: timber columns. In: Fire and Materials. DOI:10.1002/fam.3110
- Wichmann, H.; Kolb, M.; Bulutcu, D.; Kolb, T.; Zehfuß, J. (2022): Analytical determination of compounds released during pyrolysis, smouldering, and combustion experiments with insulation materials from renewable resources. In: Fire and Materials. http://doi.org/10.1002/fam.3064
- Lyzwa, J.; Zehfuß, J. (2021): Experimental investigations of ultra-high performance concrete exposed to natural fires. In: Fire Safety Journal Volume 125, ISSN 0379-7112, https://doi.org
- McNamee, R.; Zehfuß, J.; Bartlett, A.; Heidari, M.; Robert, F.; Bisby, L. (2020): Enclosure Fire Dynamics with a Combustible Ceiling. In: Fire and Materials, September 2020, https://doi.org/10.1002/fam.2904

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ZeBra | Center of Fire Research

ZeBra | Prof. Dr.-Ing. Jochen Zehfuß

Mission Statement

ZeBra drives innovation in fire safety through interdisciplinary research and state-of-the-art experimentation, from laboratory to real scale. By integrating experimental data and advanced numerical models, robust predictions of fire dynamics are enabled to support the development of sustainable buildings, new materials, and future energy technologies.

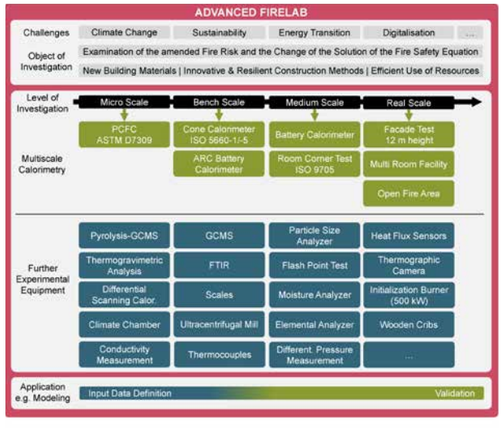
Advanced FireLab

The Center of Fire Research (ZeBra) at TU Braunschweig is dedicated to advancing fire safety in an era of rapid technological and societal change. With the increasing use of innovative materials, renewable resources, digital fabrication methods, and energy systems such as batteries and electric vehicles, there is a growing need to understand and predict fire dynamics reliably. ZeBra addresses this challenge through interdisciplinary research that bridges fundamental science and practical application, enabling the development of safe and sustainable buildings and products.

The heart of ZeBra is the Advanced FireLab, a unique experimental facility that provides unparalleled opportunities for investigating fire behavior across scales. It offers the capability to study thermophysical and chemical properties of materials at the laboratory level and to analyse fire dynamics and emissions in medium and full-scale fire scenarios. The facility is equipped with six state-of-the-art calorimeters, covering a broad range of fire sizes up to 20 MW heat release rates. These include a micro combustion and a cone calorimeter for material testing, a room corner test for building products, as well as large-scale calorimeters with movable hoods for facade or real structure and products of the energy transition fire investigations.

The Advanced FireLab also incorporates a dedicated battery calorimeter for investigating energy storage systems and their interaction with fire. Complementary laboratory equipment enables detailed analysis of combustion gases and particulates using advanced techniques such as TGA-DSC coupled with GC/MS. This multi-scale, multi-disciplinary approach provides critical data for developing and validating numerical models, supporting robust predictions of fire growth, spread, and associated hazards.

By combining cutting-edge experimentation with computational advances, ZeBra creates the scientific foundation for future-oriented fire safety solutions, ensuring resilience in the built environment and contributing to global sustainability goals.



Knowledge Transfer

ZeBra ensures effective knowledge transfer from cutting-edge fire research into practice. Through active participation in national and international expert committees, research findings directly influence standards, regulations, and building codes. Collaboration with industry partners supports the development of innovative fire safety solutions, while interdisciplinary expertise facilitates the translation of scientific insights into practical applications. This approach strengthens resilience in the built environment and enhances the integration of sustainable technologies without compromising safety.

Research Projects

- Within the HOBRATEC project (2021-2024), firefighting techniques for timber buildings were developed and tested through large-scale facade fire experiments at ZeBra, addressing key research questions on suppression and concealed fire spread.
- In the BEGIN-HVS project (2023-2025), large-scale fire experiments at ZeBra provided essential data to develop strategies, models, and guidelines for managing warehouse fires involving high-voltage storage systems.
- Through the ALREKO project (2023-2025), solutions were explored to ensure safe evacuation in densified urban buildings where additional storeys often prevent providing two independent escape routes, by strengthening single stairwells as rescue paths.
- In the FIRESAFE-CLT project (2025-2027), bio-based flame retardants are being developed for use in adhesives and coatings to improve the fire behavior and environmental properties of CLT and tested in multiscale experiments at ZeBra to determine the tensile shear strength of the adhesive bond.
- In the CFD-SAFE project (2025-2028) the effect of sprinklers on fire spread will be investigated and a validated, high-performance and predictive model will be developed which can be used in CFD simulations in fire protection verifications for buildings, tunnels and underground parking garages.

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iBMB | Institute for Building Materials, Solid Construction and Fire Safety **| Division of Organic and Wood-Based Construction Materials**

Mission Statement

We are devoted to developing an designing future environmentally-friendly construction and building materials and structures with lower carbon footprint from construction and building demolition and agricultural wastes.

RESEARCH

Application of Construction and Agricultural Wastes in Infrastructure: Our group is one of the leading german institutes to utilize agricultural waste, i.e. plant-based natural fibres and their reinforced polymer composites, for infrastructure application. Our research covers material characterisation, structural design and numerical simulation of natural fibre reinforced composite materials and the application of these materials to replace synthetic fibre reinforced composite materials. Currently we are also focusing on reuse and recycle of construction and building demolition wastes.

Design and Modeling of Hybrid Structures in Infrastructure: We design, model and characterize hybrid structures combining fibre reinforced polymer (FRP) composite materials with conventional construction and building materials such as steel, concrete and timber to be light-weight and environmentally-friendly structures with high performance.

Crashworthiness Design of Composite Structures for Automotive Engineering: We develop, design and model crashworthy structures with lightweight and high strength composite materials for automotive engineering application. Currently we are using composite materials such as glass, basalt and flax FRP composites.

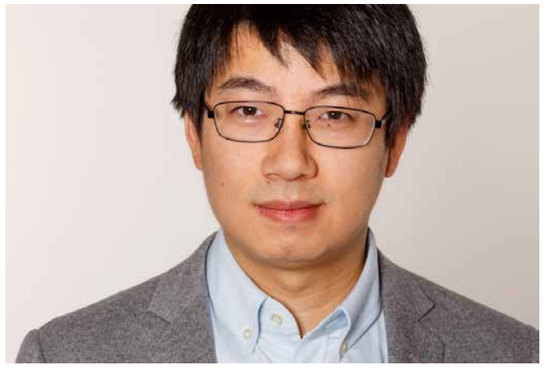
Ageing Investigation of Construction and Building Materials: We focus on the durability and ageing investigation of conventional and novel construction and building materials such as natural fibre, natural fibre reinforced polymer and natural fibre reinforced cementitious composites, concrete and recycled aggregate concrete. Currently we are studying the long-term durability of natural fibre and their fibre reinforced polymer and cementitious composites subjected to various accelerated environmental weathering conditions.

iBMB | Professor Dr. Libo Yan

Researcher's Career

- Assistant Professor of Department of Organic and Wood-based Construction Materials, iBMB, TU Braunschweig
- PhD in Civil Engineering, University of Auckland, New Zealand
- Master of Science in Structural Engineering from Cardiff University, United Kingdom
- Bachelor of Engineering in Civil Engineering from Chongqing University, China
- Recipient of several international/ national awards, such as International Institute for FRP in Construction (IIFC) Best PhD Thesis Award (2016), Vice-Chancellor's Prize for Best Doctoral Thesis (2014) from University of Auckland, Chinese Government Award for Outstanding Self-financed Student Abroad from China Scholarship Council (2014)

Funding
BMBF, BMEL, DFG



Publications and Patents

- Huang L, Zhang C, Yan L, Kasal B. Flexural Behavior of U-shape FRP Profile-RC Composite Beams with Inner GFRP Tube Confinement at Concrete Compression Zone. Composite Structures 2018; 184: 674-687.
- Yan LB, Wang B, Kasal B. Can Plant-Based Natural Flax Replace Basalt and E-Glass for Fiber-Reinforced Polymer Tubular Energy Absorbers? A Comparative Study on Quasi-Static Axial Crushing. Frontiers in Materials 2018; 4, 42. https://doi.org/10.3389/fmats.2017.00042
- Yan B, Huang L, Yan LB, Gao C, Kasal B. Behavior of flax FRP tube encased recycled aggregate concrete with clay brick aggregate. Construction and Building Materials (Elesvier) 2017;136:265-276.
- Huang L, Xun X, Yan LB, Kasal B. Impact behavior of concrete columns confined by both GFRP tube and steel spiral reinforcement. Construction and Building Materials 2017; 131:438-448
- Yan LB, Kasal B, Huang L. A review of recent research on the use of cellulosic fibres, their fibre fabric reinforced cementitious, geo-polymer and polymer composites in civil engineering. Composites Part B: Engineering (Elesvier) 2016;92:94-132.

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IfEV | Institute of Railway Systems Engineering and Traffic Safety

Mission Statement

In many parts of the world, there is a growing demand for rail transportation. Our mission is to provide excellent expertise in railway operations and signalling to support the revitalisation and modernisation of railway systems wordwide. A key element of this is international knowledge transfer.

RESEARCH

Centralisation: A main challenge is the change from rail traffic control by locally staffed control stations to operation control centres with a very high degree of centralisation. Beside new control technologies, there is a need for new operating rules and procedures that are designed for highly centralised control. A key element of this are efficient procedures for degraded-mode operations.

Interoperability: For historical reasons, the national railway systems differ significantly in their control systems, operating rules, and procedures. An important step to overcome these differences is international knowledge transfer and comparative analysis of technologies and procedures.

Human Factors: Safe and efficient operation is closely connected with the design of user interfaces in control centres and locomotive cabs. So, human factors in these areas have become a key element of our research. Typical research questions are the evaluation of situation awareness and the optimum design of the user interfaces for safe and efficient rail traffic control.

Digitalisation and Automation: These two megatrends will have a major impact on the way railway operation is controlled. In our research, we concentrate on the operational constraints that must be handled to implement digital control and driverless train operations.

This Side: Train driving simulator in the Virtual Railway Operations Laboratory (Picture: Pachl)

Other Side: Cutout from a train control user interface in the Virtual Railway Operations Laboratory

IfEV | Prof. Dr.-Ing. Jörn Pachl

Researcher's Career

- University professor and head of the Institute of Railway Systems Engineering and Traffic Safety
- Dr.-Ing. at TU Braunschweig, external candidate
- Project manager at German Railways
- Research assistant at the Institute of Traffic Safety at the Dresden College of Transportation
- Study of Transportation Engineering at the Dresden College of Transportation, degree Dipl.-Ing.

Funding
Industry, government authorities, DAAD

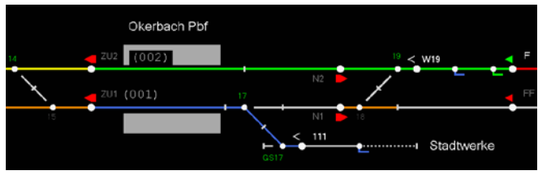
TEACHING

Railway Operations: Our lectures on railway operations cover the evaluation of operational capacity, computer-based scheduling of train operations, and the procedures of dispatching and train control.

Railway Signalling: The signalling lectures concentrate on the signalling principles, i.e., the operational functions of signalling systems. This includes block systems, interlocking systems, automatic train protection, and level crossing control.

Laboratory Session: A key teaching facility is the Virtual Railway Operations Laboratory. In this laboratory, railway traffic is simulated in a virtual network controlled by distributed control stations. The control stations are equipped with user interfaces as used in real control centres. Several networks including samples from foreign railways and light rail systems can be simulated. In addition to the network control simulation, the laboratory also has a locomotive cab simulator, which is based on a real locomotive interior.

International Teaching: Due to the big share of international students we offer specific lectures on international railway operations. In addition, external lectures are provided as a visiting professor or invited lecturer in several countries inside and outside Europe.



Publications

- Pachl, J.: Systemtechnik des Schienenverkehrs - Bahnbetrieb planen, steuern und sichern. 11th ed., Springer Vieweg, Wiesbaden 2022
- Pachl, J.: Railway Operation and Control. 3rd ed., VTD Rail Publishing, Mountlake Terrace (USA) 2014
- Pachl, J.: Railway Operation Processes. in: Theeg, G.; Vlasenko, S. (editors): Railway Signalling & Interlocking – International Compendium. 2nd ed., PMC Media, Bingen 2017, pp. 39-60
- Hansen, I. A.; Pachl, J. (editors): Railway Timetabling & Operations. 2nd ed., Eurailpress Hamburg 2014
- Pachl, J.: Besonderheiten ausländischer Eisenbahnbetriebsverfahren: Grundbegriffe – Stellwerksfunktionen – Signalsysteme. Springer essentials, Springer Vieweg, Wiesbaden 2016

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IGeo | Institute of Geosystems and Bioindication

Mission Statement

Sustainable use of our environment, especially of water resources, depends on understanding long-term interactions between climate, landscapes, and humans. We examine regional expressions of global climate change and human impact through time, focusing on aquatic ecosystems and the dynamic processes that shape and transform them.

RESEARCH

Using Bioindicators to Assess Water Quality:
We assess human impact on water quality of aquatic systems in urban and remote areas by combining biological indicators ("bioindication")—such as diatoms, ostracods, and chironomids—with chemical, physical, and nutrient parameters from surface waters and sediments.

Regional Impacts of Global Climate Change and Human Activity:
We use lake sediments from climatically sensitive regions to investigate how climate change has altered regional hydrological cycles and water availability. We also assess the effects of land use on aquatic systems. Current projects apply this approach in high-altitude regions of Nepal and Tibet, as well as at lakes in Southern Germany, Italy, Saudi Arabia, and the Americas. In the Canadian Arctic, we are currently investigating the legacy effects of oil and gas exploration conducted between the 1970s and 1990s on thawing permafrost environments.

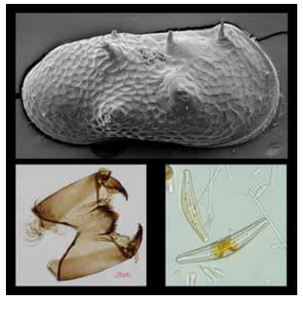
Reconstruction of Long-Term Environmental Change:
We collaborate within the interdisciplinary network of several international scientific drilling projects (ICDP), to recover long sediment cores from large lakes, extending back several hundred thousand years. These records allow us to trace environmental evolution, identify patterns of natural climate variability and extremes, and explore the drivers of changes in biodiversity and human activity.

Our team has recently expanded into paleogenetics, enabling access to environmental information in contexts where no microfossil remains are preserved. In the project "Climate Change and Early Humans in the North", we combine paleogenetic, sedimentological, and biological methods in an interdisciplinary approach to study environmental change during the time of Neanderthals in Europe.

Our research contributes to the development of concepts for environmental management and protection—particularly in the context of future climate change and sustainable land use.

Photo 1: Pond situated next to the Inuvik-Tuktoyaktuk Highway, Mackenzie Delta area in Canada's Northwest Territories
Photo 2: Emma Cameron getting ready to take a sediment core through 1.2 m of lake ice at -40°C.
Photo 3: Bioindicators: Ostracod valve, chironomid head capsule and diatoms from lake sediments.
Photo 4: Sediment coring using the Hipercorig platform on Lake Constance, Germany.
Photos: E. Cameron/TU Braunschweig, A. Schwarz, A. Schwalb





IGeo | Prof. Dr. sc. Antje Schwalb

Researcher's Career

- Chair Board of Trustees Federal Institute for Geosciences and Natural Resources (BGR)
- Member Selection Committee Alexander von Humboldt Foundation
- Member DFG Senate, Review Board Geology/Paleontology
- Professor for Geology and Geosystems, TU Braunschweig
- Dr. sc. habil., Universität Göttingen
- BMBF Junior Group Leader, Universität Heidelberg
- Scientific Coordinator, Helmholtz Centre Potsdam, GFZ
- DFG Research Fellow and Research Associate, Universität Göttingen
- Swiss NSF Research Fellow, University of Minnesota, and U.S. Geological Survey (USA)
- Dr. sc., Université de Neuchâtel (CH)
- Dipl.-Geol., Universität Göttingen

Funding
DFG, BMBF, State Lower Saxony/ Volkswagen Foundation, DAAD, Karl-Heinz Frenzen-Stiftung

TEACHING

Our interdisciplinary team offers lectures, seminars, and hands-on field and lab training in Geosciences, Biology, and Ecology for Bachelor's and Master's programs in Environmental Sciences, Environmental Engineering, and Civil Engineering. We focus on processes, feedbacks, and interactions within the complex Earth system—atmosphere, biosphere, hydrosphere, and lithosphere—using Earth's history to understand the full range of natural climate variability.
Students can specialize in (paleo-)climate and biodiversity research, (paleo-)limnology, bioindication, water quality assessment, paleogenetics, and GIS. Our program emphasizes systems thinking, process comprehension, and critical analysis. Students gain a solid foundation for assessing human impact and developing environmental management strategies. Considering future climate and ecosystem change, they design concepts for water protection and nature conservation. We offer thesis topics in both applied and basic research, including field and lab work, with opportunities for collaboration with local authorities and national or international research institutions.

Publications

- Bauersachs, T., Russell, J.M., Evans, T.W., Schwalb, A., Schwark, L., 2021. A heterocyte glycolipid-based calibration to reconstruct past continental climate change. Nature Communications 12:2406, DOI: 10.1038/s41467-021-22739-3
- Büngener L., Schäffer S.-M., Schwarz A., Schwalb A., 2024. Microplastics in a small river: Occurrence and influencing factors along the river Oker, Northern Germany. Journal of Contaminant Hydrology, 264, 10.1016/j.jconhyd.2024.104366
- Liang, S., Taghavi- Bayat, A. Steffen, P., Wahrig, B., Schwalb, A., 2025. What is a good grassland? Contrasting perspectives on greening of the Tibetan Plateau. Regional Environmental Change 25, 40, https://doi.org/10.1007/s10113-024-02346-w
- Martínez-Abarca, R., Pérez, L., Bauersachs, T., Schenk, F., Kutterolf, S., Brenner, M., Guilderson, T., Correa-Metrio, A., Anselmetti, F.S., Brown, R., Ariztegui, D., Macario-Gonzalez, L., Cruz-Silva. E., Beltran-Martinez, J.C., Bush, M., Stockhecke, M., Curtis, J., Schwalb, A., 2024. Precipitation variability and environmental change across late Quaternary glacial-interglacial cycles in lowland Central America: Insights from Lake Petén Itzá (Guatemala) sediments. Quaternary Science Reviews 344, https://doi.org/10.1016/j.quascirev.2024.108985.
- Rigterink, S., Krahn, K. J., Kotrys, B., Urban, B., Heiri, O., Turner, F., Pannes, A. & Schwalb, A., 2024. Summer temperatures from the Middle Pleistocene site Schöningen 13 II, northern Germany, determined from subfossil chironomid assemblages. Boreas. https://doi.org/10.1111/bor.12658. ISSN 0300-9483.

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IGG | Institute of Geomechanics and Geotechnical Engineering

Mission Statement

In geotechnical engineering, a discipline of civil engineering, we work with soil and rock in their various manifestations. All those natural geomaterials represent the building ground and building material whose geomechanics and hydraulics we have to capture accurately for the safe construction of infrastructure from high rise buildings to tunnels.

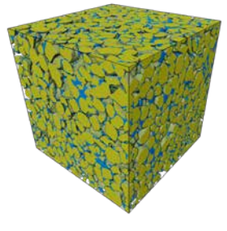
RESEARCH

Fundamental research
In fundamental research, in the field of experimental soil mechanics and geotechnical engineering, we investigate various mechanical and hydraulic processes in all kinds of geomaterials by means of lab and field experiments in order to determine soil and rock parameters. These parameters are used in engineering models to describe the material behaviour, e. g., for foundation design. In our research, we focus on different length scales from the microscopic, i. e., the grain or pore scale, up to the macroscale, i. e., the size of construction sites. One of many experimental methods applied at IGG is computed tomography (CT) which allows to obtain 3D images of soil specimens with high spatial resolutions. This technique is currently applied to investigate the hydro-mechanical coupling in granular soils as well as plant-root soil interaction, a topic in collaboration with plant biology and other institutes at TU Braunschweig. Key questions concern the mechanical reinforcement of soils and changes in soil hydraulic behaviour caused by plant roots. This topic is very related to the field of bio-inspired geotechnical engineering, also known as bionics, where we learn fundamental principles by studying nature's designs to develop innovative geotechnical construction techniques. Furthermore, experiments are linked to numerical simulations, where computer models are developed and applied to model the investigated processes, on the microscopic and large field scale.

Applied research
In applied industry-related research, the IGG focuses on soil-structure interaction in the fields of onshore and offshore renewable wind energy as well as tunnelling. We investigate the interaction of steel monopiles or other foundation systems such as anchors and soil in large scale model tests. The geotechnical model structures, such as monopiles, are instrumented with different sensors in order to measure the soil reactions as well as pile dynamics during impact or vibratory driving of the pile. Further interesting fields are repowering of existing pile foundations as well as decommissioning of pile foundations at the end of their life time. The IGG collaborates with hydraulic engineering at the LWI to include the hydrodynamic loading of offshore structures by waves and currents in wave flume experiments, e. g., at the Large Wave Flume of the Coastal Research Center (Forschungszentrum Küste, FZK) in Hannover. In the field of mechanised tunnelling with tunnel boring machines we are studying the wear of cutting tools and the clogging phenomenon caused by adhesion in sticky clayey soils.

This side: Segmented CT data of partially saturated sand (Picture: Marius Milatz), Investigation of plant roots in soils by means of X-ray computed tomography (CT), Extraction of a monopile in the IGG test stand (Pictures: IGG),

Other side: Portrait (Kristina Rottig/TU Braunschweig)
Cutting wheel of an open gripper tunnel boring machine for driving an exploratory tunnel for the Brenner Base Tunnel (IGG)



IGG | Prof. Dr.-Ing. habil. Marius Milatz

Researcher's Career

- Full Professor and Head of the Institute of Geomechanics and Geotechnical Engineering at Technische Universität Braunschweig
- Habilitation (Dr.-Ing. habil.) at TU Hamburg
- PostDoc at TU Hamburg
- Doctoral degree Dr.-Ing. at TU Hamburg
- Research assistant at the Institute of Geotechnical Engineering and Construction Management at TU Hamburg
- Studies in civil and environmental engineering (Dipl.-Ing.) at TU Hamburg-Harburg

Funding
DFG, Industry projects: BMWE, BMFTR, Other: DAAD, Humboldt-Foundation (IGG as host institution)

TEACHING

Teaching at IGG aims at a thorough basic education of civil, environmental and industrial engineers in the field of soil and rock mechanics as well as geotechnical engineering. This includes basic knowledge about the physical properties and behaviours of geomaterials but also practical skills and methods for the modelling and safe design of geotechnical structures. The teaching also accounts for new opportunities in engineering work given by digitalisation, i. e., the application of computer programs for engineering design as well as development of computer code to solve geotechnical problems and to analyse and visualise their solutions. The B Sc and M Sc classes taught by IGG follow a bottom-up approach: from the fundamentals to more details and special applications. In their Bachelor's and Master's theses, students can choose between theoretical and experimental topics from current research and applied topics also in cooperation with industry.

Bachelor level:
- Soil mechanics
- Foundation engineering
- Tunnel construction
- Seminar series in foundation engineering and tunnel construction

Master level:
- Theoretical and experimental soil and rock mechanics
- Laboratory practical training in soil mechanics
- Numerical methods in geotechnical engineering
- Geotechnical field instrumentation
- Foundation and rock engineering
- Soil dynamics
- Subsurface excavation construction
- Field trip in tunnel construction
- Deep geological repositories

Publications

- Milatz, M., I. Sarhangi-Fard, J. Heinzel, M. Wiebicke and E. Daumlechner (2025): Experimental investigation of the pull-out resistance of simplified root system architecture models in dry sand. In: Proc. of 5th European Conference on Unsaturated Soils (EUNSAT), Lisbon, Portugal. DOI: 10.1051/e3sconf/202564206003
- Toffoli, C. M., M. Milatz, J. P. Moosmann, T. Jentschke, F. Beckmann and J. Grabe (2025): Synchrotron-radiation computed tomography of the water drop penetration time test on hydrophobic soils. In: Journal of Rock Mechanics and Geotechnical Engineering. DOI: 10.1016/j.jrmge.2025.06.003
- Schröder, M., D. A. Dao, C. Levesque, J. Patterson and M. Milatz (2025): Influence of sodium chloride solutions on compressibility of resconstituted illite. In: Proceedings of 5th International Symposium on Frontiers in Offshore Geotechnics (ISFOG) 2025 in Nantes/France, International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE), No. 133, DOI: 10.53243/ISFOG2025-131
- Milatz, M. (2024): Die digitale Bodenprobe: Zur Messung granulometrischer und bodenmechanischer Eigenschaften von Sanden mittels Computertomografie. In: Tagungsband zum Symposium "Messen in der Geotechnik". Hrsg. von J. Stahlmann, Mitteilung des Instituts für Geomechanik und Geotechnik der TU Braunschweig, Heft 116, S. 59–74. Weblink

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IGÖ | Institute of Geoecology
Division of Soil Science

Mission Statement

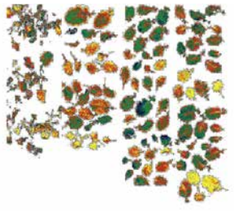
Our research focuses on analyzing soil development in the context of land use change and urbanization. The aim is to support the conservation of natural ecosystem services in the landscape and urban environment. A particular focus is on experimental research and modelling of biogeochemical reactions and transport processes in natural, semi-natural and anthropogenically influenced soils.

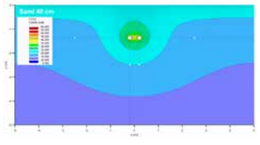
RESEARCH

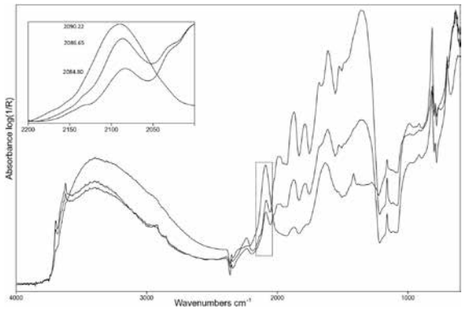
Biogeochemical Approaches for Sustainable Soil Management and Functional Ecosystem Services: Our main interest is to increase soil water holding capacity and enable long-term nutrient supply. In connection with this, we explore ways to create carbon sinks in soils, offering significant potential for climate neutrality. The enrichment and stabilization of carbon in anthropogenically influenced soils also have co-benefits: pollutant retention, activation of soil life (pollutant metabolism), and increased water storage capacity. Within this thematic area, understanding and targeted optimization of the soil-microbiome-plant system are additional research priorities. We focus on locally adapted species contributing to the stabilization and metabolism of pollutants, enhancing the functional adaptability of flora to biotic and abiotic environments, that improve the remediation of challenging ecosystems.

Non-Invasive Methods for Soil Mapping and Assessment: We apply non-invasive, rapid, and cost-effective methods to capture information on the spatial variability of physical, chemical, and mineralogical properties of anthropogenically influenced soils, which significantly advance the management of functions and dynamics. Our use of drones with optical spectroscopy or Sentinel data is based on detecting, mapping, and monitoring pollutant concentrations and other trace metals in the soil.

Soil Hydrological Process Research and Transport Simulation: The temporally limited availability of water in natural and urban ecosystems necessitates the storage of water in technical infrastructure and porous media. The latter must be designed or optimized to maximize the storage of plant-available water. Linked to this are questions of efficient irrigation, as increased conflicts over the scarce resource of water are expected in the future.







IGÖ | Prof. Dr.-Ing. Magdalena Sut-Lohmann

Researcher's Career

- Full Professor for Soil Science
- Visiting Professor, Institute of Soil Science, Wrocław University of Environmental & Life Sciences
- Visiting Professor, Chemical Department, Gdansk University of Technology
- Post-Doc, Geopedology and Landscape Development, Brandenburg University of Technology
- Habilitation, Soil Restoration, Brandenburg University of Technology
- Dr.-Ing., Soil Chemistry; Brandenburg University of Technology
- Study of Environmental Protection, Brandenburg University of Technology and Gdansk University of Technology

Funding
DFG, BMBF, Industry, DAAD, Alexander von Humboldt Foundation

TEACHING

Introduction to Soil Science: This lecture provides knowledge on the formation, ecological properties, and essential functions of soils. Fundamental knowledge is imparted on the relationship between parent material and soil formation, the inorganic and organic components of soil, soil as a habitat, soil structure, soil water balance, factors and processes of soil development, soil as an ion exchanger and nutrient reservoir, as well as the soil classification and distribution.

Soil Degradation and Conservation: Specific aim of this course is to expand basic knowledge in soil science regarding soil protection. Course teaches legal and technical foundations of soil conservation and evaluate measures for the use of soils regarding soil protection. Selected issues in soil science and applied soil protection, as well as associated ecological problems, are reflected upon.

Urban Soils: This course gives an overview of the specific characteristics of urban soils, various parent materials, technogenic substrates, soil formation processes, and resulting physical, chemical, and biological properties. Topics such as sealing, contamination, parent substrates, and soil functions including urban agriculture, among others, are discussed in more detail.

Laboratory and Field Courses: Specific laboratory and field courses provide practical training in measurement methods to characterize soil chemical, physical and hydraulic properties.

Publications

- Sut-Lohmann, M., Ramezany, S., Kästner, F. and Raab, T. (2021). Feasibility of pXRF to evaluate chosen heavy metals in soil highly influenced by municipal waste disposal - a Former Sewage Farm Monitoring Study, Land Degradation and Development, 1-13, https://doi.org/10.1002/ldr.4147.
- Sut-Lohmann, M., Ramezany, S., Kästner, F., Raab, T. and Heinrich, M. (2021). Using modified Tessier sequential extraction to specify potentially toxic metals at a former sewage farm, Journal of Environmental Management, 304, 114229, https://doi.org/10.1016/j.jenvman.2021.114229.
- Kästner, F., Sut-Lohmann, M., Ramezany, S., Raab, T., Feilhauer, H. and Chabrillat, S. (2022). Estimating heavy metal concentrations in Technosols with reflectance spectroscopy, Geoderma, 406. https://doi.org/10.1016/j.geoderma.2021.115512.
- Sut-Lohmann, M., Grimm, M., Raab, T. and Heinrich, M. (2023). Feasibility of Brassica juncea as a hyperaccumulator in phytomining of chosen potentially toxic elements, International Journal of Environmental Research, open access.
- Chojnacka, A., Sut-Lohmann, M., Jonczak, J., Banasiewicz, J., Detman, A. and Sikora, A. (2024). An evaluation of long-term contaminated soil from a manufactured gas plant for in situ biodegradation potential and as a source of ferrocyanide-degrading bacteria. Water, Air and Soil Pollution, 235, https://doi.org/10.1007/s11270-024-07157-7.

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IGÖ | Institute of Geoecology | **Division of Climatology and Environmental Meteorology**

Mission Statement

Our group uses measurements and modelling to explore exchange processes of energy and mass between urban and non-built surfaces and the atmosphere. We study relationships between urban particle emission and meteorological influence to assess exposure variability of humans towards pollutants.

RESEARCH

Surface-atmosphere exchange and boundary layer processes: The atmospheric boundary layer is characterised by important exchange processes of energy, mass and pollutants between the surface and the atmosphere. These fluxes influence climate, the state of ecosystems or human well-being. We use the state-of-the-art eddy covariance technique to quantify exchange fluxes. The work in our group focuses on urban environments, but takes place also in natural ecosystems. Currently, we are studying exchange processes of heat, water and CO_2 between the urban atmosphere and green roofs as well as at a mountainous peatland site.

Urban Climatology: The climate of urban areas is significantly modified in comparison to nonbuilt urban surroundings. The urban heat island is the most well known phenomenon of urban climate effects. We are interested in studying modifications of near-surface climate processes in urban environments and in analysing the relationship with urban structure and morphology. Our research addresses basic aspects of urban climatology but also looks into applied questions, e.g. benefits and urban ecosystem services of green infrastructure (cf. Figure).

Air quality and Aerosol research: Pollutants that are emitted into the atmosphere from different sources react and/or transform during atmospheric transport and residence. Due to a large number of sources especially in urban areas, the exposure towards particles is characterised by a large spatio-temporal variation. We assess particle exposure by using state-of-the-art measurement and modelling approaches to resolve particle concentration variability on the local urban scale. A current work models the transformation of particle number size distributions during atmospheric transport from roadside into the urban background.

IGÖ | Prof. Dr. Stephan Weber

Researcher's Career

- Dean of studies Geoecology/ Environmental Sciences (2013-2017)
- Full professor Climatology and Environmental Meteorology, TU Braunschweig
- Post-Doc, Applied Climatology and Landscape Ecology, University of Duisburg-Essen
- Dr. rer. nat. at the University of Duisburg-Essen
- PhD student, Applied Climatology and Landscape Ecology, University of Duisburg-Essen
- Diploma Thesis at Royal Netherlands Institute for Sea Research, Texel, Netherlands
- Study of Physical Geography and Climatology, Ruhr University Bochum

Funding
DFG, BMBF, State lower Saxony (MWK), industry

Publications

- Heusinger J., Weber S. (2015). Comparative microclimate and dewfall measurements at an urban green roof versus bitumen roof. Building and Environment, 92: 713-723.
- von Bismarck-Osten C., Birmili W., Ketzel M., Weber S. (2015). Statistical modelling of aerosol particle number size distributions in urban and rural environments – a multi-site study. Urban Climate, 11: 51-66.
- Birmili, W., Sun, J., Weinhold, K., Merkel, M., Rasch, F., Wiedensohler, A., Bastian, S., Löschau, G., Schladitz, A., Quass, U., Kuhlbusch, T.A.J., Kaminski, H., Cyrys, J., Gu, J., Kusch, T., Flentje, H., Meinhardt, F., Schwerin, A., Bath, O., Ries, L., Gerwig, H., Wirtz, K., Weber, S. (2015). Atmospheric aerosol measurements in the German Ultrafine Aerosol Network (GUAN) - Part III: Black Carbon mass and particle number concentrations 2009-2014, Gefahrstoffe – Reinhaltung der Luft 11/12, 479-488
- Ruths M., von Bismarck-Osten C., Weber S. (2014). Measuring and modelling the local-scale spatiotemporal variation of urban particle number size distributions and black carbon. Atmospheric Environment, 96: 37-49
- Hussein T., Mølgaard B., Hannuniemi H., Martikainen J., Järvi L., Wegner T., Ripamonti G., Weber S., Vesala T., Hämeri K. (2014). Finger-Prints of Urban Particle Number Size Distribution in Helsinki – Finland: Local versus Regional Characteristics. Boreal Environment Research, 19: 1-20

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IGÖ | Institute of Geoecology | **Landscape Ecology and Environmental Systems Analysis**

Mission Statement

Our main interest is in freshwater biodiversity. Freshwater ecosystems are the most endangered ecosystems worldwide. Most freshwaters are stressed by human activity, such as habitat alteration and pollution, and increasingly also by climate change. We investigate how such pressures impact the species richness and ecological interactions between species and how freshwater communities may be changed with ongoing global change.

RESEARCH

We study how anthropogenic and natural environmental factors are governing freshwater macroinvertebrate communities. A focal group are dragonflies (Odonata), which are commonly used as sentinel organisms for indicating environmental changes.

Urban freshwaters. In cities most freshwater habitats are modified for various human use. Doing long-term monitoring at several running waters in Braunschweig we found that anyhow the freshwater biodiversity generally increased and many species recovered (Fig. 1). We examine which factors and treatments cause differences in species richness and water quality. We evaluate how to improve environmental conditions for freshwater conditions, e.g., how can management of water courses be adapted to increase species richness. We also explore methods of habitat restoration to recover natural freshwater communities. Monitoring permits us to recognise how climate change, by drying and warming, threatens to undo previously positive results of conservation and management efforts. Finally, we also explore methods for the conservation management of ponds. While doing field work mainly in Braunschweig we also analyse data sets from several cities in Central Europe to compare which conditions and concepts are most suited to improve biodiversity in urban areas.

C**hanging interactions in a changing climate.** Climate change affects organisms in several ways, e.g., via life cycle alterations generated by increasing temperatures. Indirect are more difficult to detect and may have massive consequences at the level of biological communities. Since warming affects all organisms differently each may vary in its reaction to a temperature increase, and, thus, formerly matching interactions between species become unmatching. This may disturb food webs and cause massive declines in species otherwise unharmed by climate change. We use dragonflies as proxies to study effects of rising temperature on the single species responses and the species interactions triggered by these responses, i.e., predation and competition between pairs and groups of species. We also consider the additional effects of range expanding species (caused by warming) invading the natural communities and usually react positive to warming. Our studies are mainly experimental but we also apply mechanistic mathematical models to explore several possible combinations of conditions.

Fig. 1: This dragonfly species, Ophiogomphus cecilia, one of our long-term study objects, was formerly threatened by extinction due to bad habitat quality of rivers, but improved during the last two decades from increased environmental quality of rivers in many parts Germany, and also in Braunschweig.

Fig. 2: Students sampling on a section of a stream in Braunschweig after revitalization.

IGÖ | Prof. Dr. Frank Suhling

Researcher's Career

- President Worldwide Dragonfly Association 2017-2019
- apl. Professorship, TU Braunschweig, Institute of Geoecology
- Global Red List Coordinator for International Union for the Conservation of Nature (IUCN), Dragonfly Specialist Group
- Habilitation TU Braunschweig, Institute of Geoecology
- Dr. rer. nat. TU Braunschweig, Institute of Zoology
- Study of Biology, TU Braunschweig

Funding
DFG, BMBF, DBU, Industry

TEACHING

Fundamentals of Ecology. Ecology is the science of the interactions between organisms and their biotic and abiotic environment, and of the material and energy balance of the biosphere and its ecosystems. This lecture considers the habitat requirements and adaptations of organisms, the different mechanisms and pattern of population biology, the interactions among organisms, and the consequences for the functioning of biological communities and whole ecosystems.

Water Quality Assessment. The course teaches methods of water quality assessment using indicator organisms such as diatoms, aquatic plants, macroinvertebrates and fish. This includes procedures and background of the assessment, especially considering the EU Water Framework Directive. Through a field course students gain practical experience, especially concerning the identification of the relevant organisms.

Biodiversity and Biodiversity Conservation. Biological diversity means the variability among living organisms, which includes diversity within species, between species and of ecosystems. Biodiversity is a core program at Master level. We teach the fundamentals of biodiversity and biogeography, such as the mechanisms and theories as well as the effects of diversity on ecological functions and ecosystem services. A module on conservation treats the current decline and threats to biodiversity, the strategies to combat the biodiversity crisis, and introduces into practical conservation issues at the level of local administrations in Germany. Field courses and excursions introduce students into the existing biodiversity.

Publications

- Goertzen D, Schneider A-K, Eggers TO, Suhling F (2022): Temporal changes of biodiversity in urban running waters – results of a twelve-year monitoring study. Basic and Applied Ecology 58: 74-87.
- Hogreve J, Suhling F (2022): Development of two common dragonfly species with diverging occupancy trends. Journal of Insect Conservation 26: 571–581.
- Goertzen D, Suhling F (2019): Urbanization versus other land use: diverging effects on dragonfly communities in Germany. Diversity and Distributions 25: 38-47.
- Suhling F, Suhling I, Richter O (2015): Temperature response of growth of larval dragonflies – an overview. International Journal of Odonatology 18: 15–30.
- Suhling I, Suhling F (2013): Thermal adaptation affects interactions between a range-expanding and a native odonate species. Freshwater Biology 58: 705-714.
- Clausnitzer V, Dijkstra KD-B, Koch R, Boudot JP, Darwall W, Kipping J, Samraoui B, Samways M, Simaika J, Suhling F (2012): Focus on African freshwaters: hotspots of dragonfly diversity and conservation concerns. Frontiers in Ecology and the Environment 10: 129-134.
- Braune E, Richter O, Söndgerath D, Suhling F (2008) Voltinism flexibility of a riverine dragonfly along thermal gradients. Global Change Biology 14: 470-482.

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IGÖ | Institute of Geoecology
Division of Environmental Geochemistry

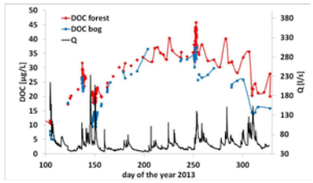
Mission Statement

Estimating anthropogenic contributions to biogeochemical cycling of trace elements and pollutants is based on profound knowledge of biogeochemical processes and interactions in terrestrial and marine ecosystems to predict future changes of fluxes of trace elements and pollutants.

RESEARCH

Biogeochemical Cycles: We investigate coupling of trace element and organic matter cycling in terrestrial and marine ecosystems on a micro- to landscape scale. Main emphasis is the understanding of processes of trace element organic matter interactions and their coupling to hydrological and climatic drivers, which both control fluxes of trace element, pollutants and carbon in ecosystems.

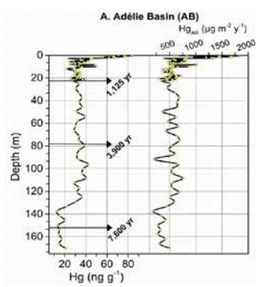
Currently, we study the release of dissolved organic matter and related contaminants from forest ecosystem under drought-stress.



Mercury and Primary Production in the Oceans:
We investigate the interaction between algae blooms and the biogeochemical cycling of Hg in the oceans. We are specifically interested in the interaction between sinking algal material in highly productive areas and the scavenging of mercury in the water column and its export to deep sea sediments. We have participated in a POLARSTERN cruise to the Southern Atlantic where we took water and sediment samples and marine snow down to a depth of more than 7000 m.

Geochemical Archives and Formation of Environmental Signals: We conduct several projects on the formation of environmental signals based on biogeochemical proxies. We are interested in understanding what geochemical signals indicate and how they are preserved in geo-archives such as peat bogs and lake sediments.

Mercury Speciation and Risk Assessment:
We apply these mercury speciation methods in combination with geochemical modelling to mercury contaminated industrial sites worldwide for risk assessment and remediation strategies.



IGÖ | Prof. Dr. Harald Biester

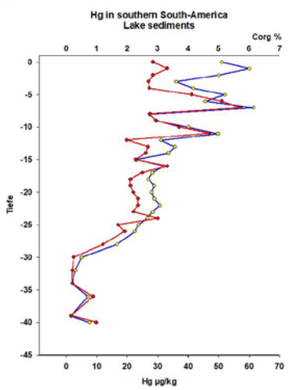
Researcher's Career

- Professor for Environmental Geochemistry
- Assistant Professor, Environmental Geochemistry, University of Heidelberg
- Post-Doc, Environmental Geochemistry, University of Heidelberg
- Habilitation, Geology, Mineralogy, University of Heidelberg
- Dr. rer. nat., University of Heidelberg
- Study of Geology, University of Heidelberg and University of Freiburg

Funding
Mostly DFG, Industry, State Lower Saxony

TEACHING

Teaching covers fundamentals in Environmental Geochemistry including Geochemical Modelling, Biogeochemical Cycling and the Fate of Inorganic Pollutants in the environment as well as Analytical Methods.



Publications

- McLagan, D. S., Schwab, L., Wiederhold, J. G., Chen, L., Pietrucha, J., Kraemer, S. M., and Biester, H. (2022) Demystifying mercury geochemistry in contaminated soil–groundwater systems with complementary mercury stable isotope, concentration, and speciation analyses, Environ. Sci. Process. Impacts, DOI: 10.1039/D1EM00368B.
- Pérez-Rodríguez, M., Biester, H. (2022) Sensitivity of river catchments to discharge-controlled dissolved carbon export: a study of eight catchments in southern Patagonia Biogeochemistry 160 (2), 177-197
- Kaal, J., Pérez-Rodríguez, M., Biester, H. (2022) Molecular Probing of DOM Indicates a Key Role of Spruce-Derived Lignin in the DOM and Metal Cycles of a Headwater Catchment: Can Spruce Forest Dieback Exacerbate Future Trends. Environmental Science & Technology 56 (4), 2747-2759.
- McLagan, D. S., Osterwalder, S., and Biester, H. (2021) Temporal and spatial assessment of gaseous elemental mercury concentrations and emissions at contaminated sites using active and passive measurements, Environ. Res. Commun., 3(5), p.051004.
- Zaferani, S., Biester, H. (2021) Mercury Accumulation in Marine Sediments–A Comparison of an Upwelling Area and Two Large River Mouths. Frontiers in Marine Science 8, 732720.
- Zaferani, S., Pérez-Rodríguez, M., Biester, H. (2018) Diatom ooze - A large marine mercury sink. Science 361 (6404), 797-800.

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IGÖ | Institute of Geoecology
Biodiversity of Agricultural Landscapes

Mission Statement

Understanding how biodiversity is developing in agricultural landscapes, which are the causal factors for the development, which management options exist, and which effects alternative options would have is the basis for developing concepts for sustainable land use.

RESEARCH

Landscape and land-use change
Our research focus is on the relationships between agricultural production, land use systems, landscape structure and biodiversity. We investigate where, which and how abundantly plants and animals occur in open agricultural landscapes, which functional role they play there and how this biological diversity (biodiversity) responds to the type and intensity of agricultural land use and other influencing factors. We analyse changes of biodiversity in agricultural landscapes and apply landscape-ecological methods to gain basic and applied knowledge about the importance and functioning of biodiversity in agroecosystems. Our research covers spatial scales ranging from the field and farm to the national scale.

Ecosystem services and agroecology
We study various functional groups of species, pollinating insects and natural biocontrol agents in particular, on multiple spatial scales in order to better understand the complex relationships between agricultural production, ecosystem functions and services. For this purpose, we use field-ecology, experimental and modelling approaches. The knowledge gained from our studies helps to point out perspectives and strategies for the sustainable use of biodiversity in cropping systems, while maintaining agricultural productivity for provisioning of food and renewable resources.

Monitoring and indicators
Our work aims at developing, improving and testing of scientific monitoring and assessment methods of biodiversity change in agricultural landscapes. To monitor drivers, pressures, state, impact and response (DPSIR) in relation to biodiversity change we rely on scientifically sound and representative indicators and appropriate monitoring programmes. Our objective is to help in developing and testing indicators and monitoring techniques which are adequately robust and sensitive for deriving meaningful information about the development of biodiversity in agricultural landscapes.

IGÖ | Prof. Dr. Jens Dauber

Researcher's Career

- Professor for Biodiversity in Agricultural Landscapes, TU Braunschweig
- Head of Institute, Thünen-Institute of Biodiversity, Johann Heinrich von Thünen Institute, Braunschweig
- Senior research officer, Thünen-Institute of Biodiversity, Johann Heinrich von Thünen Institute, Braunschweig
- Research fellow and scientific project manager, School of Natural Sciences, Botany, Trinity College Dublin, Ireland
- Research fellow, Institute of Integrative and Comparative Biology, Faculty of Biological Sciences, University of Leeds, UK
- Dr. rer. nat. habil., Justus-Liebig-University Giessen, Department of Animal Ecology
- Dr. rer. nat., Justus-Liebig-University Giessen, Department of Animal Ecology
- Study of Biology, Johannes-Gutenberg University Mainz

Funding
EU Horizon2020, BLE, FNR, DBU, Rentenbank

TEACHING

We teach the basic knowledge of agroecology, biodiversity conservation and sustainable use of biodiversity in agricultural systems:

Introduction to agroecology
Origin of agriculture
Development of agricultural landscapes
Agroecosystems
Agroecology as a science, a movement and a practice
Biotic interactions in agroecosystems

Biodiversity of agricultural landscapes
The biodiversity concept
Farmland biodiversity monitoring
Ecosystem services
Strategies of biodiversity conservation in farmland

Publications and Patents

- Pérez-Sánchez AJ, Zopf D, Klimek S, Dauber J (2018) Differential responses of ant assemblages (Hymenoptera: Formicidae) to long-term grassland management in Central Germany. Myrmecological News 27, 13-23.
- Jerrentrup JS, Dauber J, Strohbach MW, Mecke S, Mitschke A, Ludwig J, Klimek S (2017) Impact of recent changes in agricultural land use on farmland bird trends. Agriculture, Ecosystems and Environment 239, 334-341.
- Lomba A, Strohbach M, Jerrentrup JS, Dauber J, Klimek S, McCracken D (2017) Making the best of both worlds: can high-resolution agricultural administrative data support the assessment of High Nature Value farmlands across Europe? Ecological Indicators 72, 118-130.
- Dauber J, Miyake S (2016) To integrate or to segregate food crop and energy crop cultivation at the landscape scale? - Perspectives on biodiversity conservation in agriculture in Europe. Energy, Sustainability and Society, 6:25.
- Müller AL, Dauber J (2016) Hoverflies (Diptera: Syrphidae) benefit from a cultivation of the bioenergy crop Silphium perfoliatum L. (Asteraceae) depending on larval feeding type, landscape composition and crop management. Agricultural and Forest Entomology 18, 419-431.
- Strohbach MW, Kohler ML, Dauber J, Klimek S (2015) High Nature Value farming: From indication to conservation. Ecological Indicators 57, 557-563.
- Dauber J, Cass S, Gabriel D, Harte K, Aström S, O'Rourke E, Stout JC (2015) Yield-biodiversity trade-off in patchy fields of Miscanthus x giganteus. Global Change Biology - Bioenergy 7, 455-467.

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IGÖ | Institute of Geoecology
Theoretical Ecohydrology

Mission Statement

We develop and apply tools for in silico experiments to explore the interactions among plants, flow processes, and the hydrological cycle, advancing system and process understanding.

RESEARCH

TModel development
We co-develop two models:
1. SERGHEI: a high-performance ecohydrological model that simulates flow and transport processes at the surface and in the subsurface in an integrated manner. While SERGHEI can run on personal computers, it is specifically designed for supercomputing clusters. We develop the model's vegetation dynamics module.
2. SurEau-Ecos: a mechanistic plant hydraulic model that simulates plant water dynamics and plant response with a focus on drought conditions. Our contribution focuses on improving the representation of soil water dynamics within the model.

Terrestrial ecohydrology
Our research focuses on plant–water relations in terrestrial systems, including urban environments. We aim to understand (and predict) ecohydrological signatures, such as soil moisture and transpiration, within these systems. Water availability, particularly soil moisture and groundwater, influences vegetation health and growth, while vegetation modulates soil moisture and groundwater replenishment through root water uptake and subsequent transpiration. We apply the models we develop to test hypotheses about this bidirectional interaction. Additionally, our models enable upscaling of plot-scale observations to the ecosystem scale, providing a bridge between ground-based measurements and remote sensing data.

Wildfire dynamics
Wildfires are a crucial part of the Earth system and have shaped ecosystems since the emergence of terrestrial plants. While many ecosystems rely on wildfire to sustain themselves, wildfires pose a significant threat to anthropogenic biomes, destroying property and—in the worst cases—causing loss of life. Understanding wildfire propagation dynamics is crucial for developing effective management and intervention strategies. The challenge lies in the fact that wildfire spread is governed by multiple physical and chemical processes across multiple spatial and temporal scales. We contribute to the development of a wildfire propagation model that aims to disentangle these multiscale processes and their effects on wildfire dynamics, in order to predict key parameters for fire management, such as burned area and the fire front speed.

IGÖ | Prof. Dr. Ilhan Özgen

Researcher's Career

- Juniorprofessor of Modelling Urban Environmental Interfaces, Technische Universität Braunschweig
- Postdoctoral Scholar, Earth & Environmental Sciences Area, Lawrence Berkeley National Laboratory, USA
- Visiting Scientist, RIKEN Advanced Institute for Computational Science, Japan
- Dr.-Ing., Technische Universität Berlin, Germany
- Dipl.-Ing., Technische Universität Berlin, Germany

Funding
DFG

TEACHING

We teach basic and advanced courses in the field of (eco) hydrology.

Plant Hydraulics
Plant physiology
Water flow through the soil–plant–atmosphere continuum
Computational plant hydraulics

Urban Ecohydrology
Urbanisation
Hydrosociology
Blue–green infrastructure
Urban green

Hydrometrie
In cooperation with HydRiv (LWI)
Methods for measuring discharge and water level
Water level–discharge relationship

Wasser- und Stofftransport in Böden
In cooperation with the Division of Soil Science (IGÖ)
Richards(on) equation
Root water uptake
Transport processes

Ecohydrological Modelling of Catchments
In cooperation with HydRiv (LWI)
Fundamentals of ecohydrological modelling
Catchments as dynamical systems
Forest hydrology

Publications

- Navas-Montilla, A., Reisch, C., Diaz, P., Özgen-Xian, I. (2025) Modeling wildfire dynamics through a physics-based approach incorporating fuel moisture and landscape heterogeneity, Environmental Modelling & Software, 191, 106511. doi: 10.1016/j.envsoft.2025.106511
- Li, Z., Rickert, G., Zheng, N., Zhang, Z., Özgen-Xian, I., Caviedes-Voullième, D. (2025) SERGHEI v2.0: introducing a performance-portable, high-performance, three-dimensional variably saturated subsurface flow solver (SERGHEI-RE), Geoscientific Model Development, 18, 547–562. doi: 10.5194/gmd-18-547-2025
- Reisch, C., Navas-Montilla, A., Özgen-Xian, I. (2024) Analytical and numerical insights into wildfire dynamics: Exploring the advection–diffusion–reaction model, Computers & Mathematics with Applications, 158, 179–198. doi: 10.1016/j.camwa.2024.01.024
- Li, Z., Caviedes-Voullième, D., Özgen-Xian, I., Jiang, S., Zheng, N. (2023) A comparison of numerical schemes for the GPU-accelerated simulation of variably-saturated groundwater flow, Environmental Modelling & Software, 171, 105900. doi: 10.1016/j.envsoft.2023.105900
- Özgen-Xian, I., Molins, S., a.o. (2023) Understanding the hydrological response of a headwater-dominated catchment by analysis of distributed surface–subsurface interactions, Scientific Reports, 13, 4669. doi: 10.1038/s41598-023-31925-w
- Caviedes-Voulliéme, D., Morales-Hernández, M., Norman, M. R., Özgen-Xian, I. (2023) SERGHEI (SERGHEI-SWE) v1.0: a performance-portable high-performance parallel-computing shallow-water solver for hydrology and environmental hydraulics, Geoscientific Model Development, 16, 977–1008. doi: 10.5194/gmd-16-977-2023

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IGP | Institute of Geodesy and Photogrammetry

Mission Statement

We are performing research and education in the broad field of geodesy, which is the science of measurement and representation of the earth. In particular, we are active in engineering geodesy, remote sensing, photogrammetry and geoinformatics. Research questions range from the country or even continent level - such as quantification of land subsidence - to the individual (man-made) object, like digital building documentation.

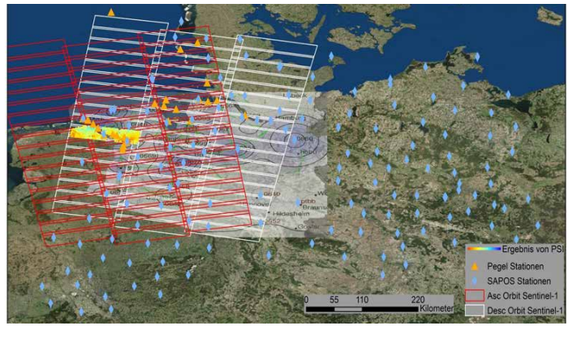
RESEARCH

Engineering Geodesy: The determination and modeling of dynamic processes in large temporal and geometric resolution is one of the core tasks in engineering geodesy. We are deriving such models for instance for bridge constructions using state-of-the-art measuring technology and statistic tools.

SAR Remote Sensing: Modern methods of satellite-based Synthetic Aperture Radar (SAR) allow determining motions on the earth's surface within millimeter-range. In combination with other geodetic techniques such as levelling or GNSS we are modeling phenomena, which are interesting for many scientific fields. For instance, in a BMBF-funded project we evaluated land rise/subsidence along the North and Baltic Sea. In the DFG-funded graduate project 'Geo-ecosystems in transition on the Tibetan Plateau (TransTiP)' we contribute to a better understanding of soil dynamics along the Nam Co by employing and further developing SAR data processing. We also developed a new method for miminizing the influence of troposphere to measurements.

Photogrammetry and Lasercanning:
To efficiently and accurately capture and model as-built (man-made) objects by developing techniques in the domains of photogrammetry and laserscanning is another research field. This might range from the representation of entire settlement areas or buildings to individual parts in civil or mechanical engineering. This is in particular interesting within the digital construction processes, which are in the focus of current research. One category of devices, so-called drones (or Unmanned Aerial Vehicles, UAV), have gained substantial attention in the last decade. We are also working with those instruments, for instance to retrieve reliable geometric and thematic information. In other projects we develop and employ state-of-the-art deep learning technology in remote sensing.

Geoinformatics:
Geospatial object modeling, representation and querying in databases is done within the geoinformatics domain. One project was concerned with the modeling of fine dust distribution in large cities, where the 3D-environment plays a crucial role. The involvement of citizens and laymen into decision processes using modern, interactive geospatial technology is also part of this work.



Left side: Footprints of satellite images, GNSS and gauge stations in Northern Germany.

Right side:: To create geometric (three-dimensional) models out of image sequences is one of the tasks of Photogrammetry. The images in this case were taken by a UAV.

IGP | Prof. Dr.-Ing. Markus Gerke

Researcher's Career

- Full Professor for Spatial Information at the Institute of Geodesy and Photogrammetry, TU Braunschweig
- Assistant Professor for Image Sequence Analysis, University of Twente, Enschede, The Netherlands
- Carl-Pulfrich-Award
- Dr.-Ing., Leibniz University Hannover, Germany
- Dipl.-Ing. Geodesy, Leibniz University Hannover, Germany

Funding
DFG, EU, BMBF, BMDV, DAAD

TEACHING

Our teaching portfolio covers in BSc level all basic knowledge of geodesy, including earth shape modeling, map projections, traditional surveying, geo-monitoring, remote sensing, photogrammetry, laserscanning and geoinformatics. In individual projects towards the end of the bachelor´s programme, students may work on some more concrete problems, e.g. related to questions occurring in civil or environmental engineering. In the master´s programme, we are offering advanced courses for all our sub-disciplines, including extended projects in selected fields. In those we aim to concentrate on the interdisciplinary nature of geodesy: all projects are connected to research problems in civil, environmental or mechanical engineering. Bachelor or master theses are constantly offered for interested students, as well.

Publications

- Mehdi Maboudi, Jan Backhaus, Inka Mai, Yahya Ghassoun, Yogesh Khedar, Dirk Lowke, Björn Riedel, Ulf Bestmann & Markus Gerke, Very high resolution bridge deformation monitoring using UAV-based photogrammetry. 2025. https://doi.org/10.1007/s13349-025-01001-0
- Pius Kipng'etich Kirui, Bjorn Riedel & Markus Gerke, Determination of present-day crustal deformation along the Kenyan rift system using InSAR. 2025. https://doi.org/10.1186/s40623-024-02133-1
- Rob Wolfs, Derk Bos, Jean-François Caron, Markus Gerke, Romain Mesnil, Richard Buswell, Nicolas Ducoulombier, Norman Hack a.o., On-line and in-line quality assessment across all scale levels of 3D concrete printing. 2024. https://doi.org/10.1016/j.cemconres.2024.107646
- Pedro Achanccaray, Markus Gerke, Leonhard Wesche, Sebastian Hoyer, Klaus Thiele, Ulrich Knufinke & Christina Krafczyk. 2023. https://doi.org/10.1007/s41064-023-00237-z
- Kirui P, Riedel B, Gerke M. 2022. Multi-temporal InSAR tropospheric delay modelling using Tikhonov regularization for Sentinel-1 C-band data. 2022. ISPRS Open Journal of Photogrammetry and Remote Sensing (6). https://doi.org/10.1016/j.ophoto.2022.100020
- Reinosch E, Gerke M, Riedel B, Schwalb A, Ye Q, Buckel J. 2021. Rock Glacier Inventory of the Western Nyainqêntanglha Range, Tibetan Plateau, Supported by InSAR Time Series and Automated Classification. Permafrost Periglac. 32 (4), 657–672. https://doi.org/10.1002/ppp.2117
- Gerke M. 2018. Developments in UAV-Photogrammetry. Journal of Digital Landscape Architecture (3) (open access):262-272 http://dx.doi.org/10.14627/537642028

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IIM | Institute for Infrastructure and Real Estate Management

Mission Statement

To meet the increasing demands of our fast moving modern society efficient management of infrastructure and real estate is needed within the whole lifecycle. Especially the aspects of sustainable development, operation, maintenance and financing become more important.

RESEARCH

Infrastructure Management: Assessment of PPP infrastructure project conditions focusing on possibilities of participation of SME enterprises. The examination was instructed by the Zentralverband Deutsches Baugewerbe (ZDB) at the current design of PPP projects in federal highway construction and is characterized by high project volumes and long maturities, which are perceived by construction SMEs as restricting competition.

Member of the Advisory Board of the Federal Ministry of Transport and Digital Infrastructure (BMVI) for the assessment report 'Alternative business and financing models in federal highway construction'. Aim of the assessment is to examine what suitable development opportunities are available for the financing of federal highway PPP projects.

Expert for the Commission 'Construction and Maintenance of the Transport Network' of the Conference of State Ministers of Transport, headed by Kurt Bodewig. The commission investigates potential financing and organisational models for the construction and operation of federal highways.

Real Estate Management: Evaluation of PPP real estate projects focusing on the operation phase. The examination is requested by the Hauptverband der Deutschen Bauindustrie to analyse the operative performance of PPP real estate projects which have been in use for a minimum of 2 years. The intended assessment criteria are:

- use costs
- performance quality
- innovations
- the change management / contract management
- dispute settlement
- PPP pulses
- the involvement of SMEs

IIM | Prof. Dr.-Ing. Tanja Kessel

Researcher's Career

- Head of Chair of Infrastructure and Real Estate Management
- Member of the Executive Board and General Partner PSPC GmbH
- Partner and CEO of PSPC GmbH
- Dr.-Ing. at the TU Berlin
- Study of Civil Engineering, TU Berlin
- Study of Civil Engineering, Loyola Marymount University, Los Angeles

Funding
BMVI, BMUB, BBSR, ZDB, HDB, Industry

Publications

- Kessel, Tanja, Kessel, Martti: Übertragung von Immobilienvermögen unter Berücksichtigung des Erbschafts- und Schenkungsgesetzes (ErbStG), Festschrift für Prof. Dieter Jacob, pp. 77 ff. (2015)
- Gottschling, Ines, Kessel, Tanja: Wirtschaftlichkeitsuntersuchungen bei öffentlichen Hochbaumaßnahmen in: Immobilien- und Bauwirtschaft aktuell – Entwicklungen und Tendenzen, Festschrift für Prof. Bernd Kochendörfer, pp. 47 ff. (2015)
- Kessel, Tanja, Völker, Wiebke: Nutzerverhalten ist wesentlich, Energieeffiziente Bauwerksbewirtschaftung, Behörden Spiegel Juni 2014, pp. 42
- Kohnke, Tanja, Riebeling, Klaus: PPP und Freibäder – zwei Praxismodelle, in: Knop, Detlef (Hrsg.), Public Private Partnership – Jahrbuch 2007, pp. 78-81 (2007)
- Kohnke, Tanja, Schauer, Werner: 3. Fallstudie PPP-Expresspaket der Stadt Köln in: Littwin, Frank/Schöne, Franz-Josef (Hrsg.), Public Private Partnership im öffentlichen Hochbau, Verlag W. Kohlhammer, pp. 416-422 (2006)

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IPTP | Institute of Public Transport Planning

Mission Statement

Providing mobility to all, regardless of socio-economic status and physical condition, is the social role and overarching aim of public transport. At IPTP we specialise in all fields of public transport design at the operational, tactical and strategic planning levels, considering economic, environmental, social equity and health effects of public transport.

RESEARCH

Our topics of research at IPTP cover three main areas of application, (i) the planning and operations of public transport systems for all type of public transport services (bus-based and rail based, fixed-route and flexible services), (ii) the analysis of demand and quality of service for users, and (ii) financial and regulation aspects, which are relevant to authorities. Given the interdependences of public transport with other modes such as cars, cycling and walking, multimodal frameworks are also developed at out institute. Specific topics of research and application include:

- Public transport service design, including optimisation of networks and service levels.
- Environmental externalities, decarbonisation and life-cycle assessment.
- Health benefits of walking and cycling as complementary modes to public transport.
- Public transport pricing optimisation and social effects.
- Public transport demand estimation, using both macroscopic and microscopic models.
- Impacts of extreme weather on public transport systems, particularly considering infrastructure adaptation and resilience
- Quality of service, including the effects of reliability and passenger crowding.
- New technologies: the effects of vehicle automation on the future of public transport.
- Shared modes (e.g., bike-sharing, car-sharing) and their relationship to public transport.
- Ride-pooling and flexible forms of public transport, considering service optimisation, economic analysis and demand effects.

Images: Alejandro Tirachini (this side) / Kristin Rottig

IPTP | Prof. Dr. Alejandro Tirachini

Researcher's Career

- Professor and head of IPTP (launched in September 2025) at TU Braunschweig
- Part-time Professor at U. de Chile
- Previously Visiting Professor and Humboldt Fellow at the TU Munich (2019-2020) and Associate Professor at U. of Twente (2023-2025).
- PhD, Institute of Transport and Logistics Studies (ITLS), U. of Sydney (2012)
- Civil Engineer and MSc in Transport Engineering, U. de Chile (2007)

Funding
ANID (Chile), Humboldt Stiftung (Germany), World Bank

TEACHING

We teach in the fields of public transport planning and operations, including all forms of public transport. Some of our courses are:

- Grundlagen spurgeführter Verkehr und ÖPNV
- Angebotsplanung und Transportstrategien
- Eisenbahnbetriebswissenschaft und Verkehrsinformatik
- Public Transport Planning
- Public Transport Operations

Publications

Selected journal papers

- Ho, C. Q., & Tirachini, A., 2024. Mobility-as-a-Service and the role of multimodality in the sustainability of urban mobility in developing and developed countries. Transport Policy, 145, 161-176.
- Hörcher, D., Tirachini, A., 2021. A review of public transport economics. Economics of Transportation 25, 100196
- Tirachini, A., Antoniou, C., 2020. The economics of automated public transport: Effects on operator cost, travel time, fare and subsidy. Economics of Transportation, 21, 100151.
- Tirachini, A., Cats, O., 2020. COVID-19 and public transportation: current assessment, prospects and research needs. Journal of Public Transportation 22 (1)
- Tirachini, A., Hensher, D. A., Rose, J.M., 2014. Multimodal pricing and optimal design of urban transport: the interplay between traffic congestion and bus crowding. Transportation Research Part B, 61: 33-54
- Tirachini, A., Hensher, D. A., Rose, J. M., 2013. Crowding in public transport systems: effects on users, operation and implications for the estimation of demand. Transportation Research Part A 53: 36-52.

Edited Book

- Tirachini, A., Hörcher, D., Verhoef, E. (Editors), 2023. Handbook on Transport Pricing and Financing. ISBN: 978 1 80037 554 3, Edward Elgar Publishing.

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IRMB | Institute for Computational Modeling in Civil Engineering

Mission Statement

Our mission is to develop efficient and accurate numerical models for transport problems in the natural and urban environment. Our approach is focused on the application of scalable kinetic methods describing matter as an ensemble of particles, rather than either individual molecules or a continuum.

RESEARCH

Our research focus is the development of kinetic methods for transport problems and a deepening of our theoretical understanding of such methods. Unlike continuum models, kinetic methods respect the molecular nature of matter. Unlike atomistic models they do not deal with individual particles but with their statistic. They hence inherit some properties of atomist models while keeping the efficiency of continuum models. Our contribution to the theory of kinetic methods include the development of advanced statistical approaches based on cumulants and the development of efficient and versatile asymptotic analysis methods. With this we are able to automatically derive the equivalent continuum partial differential equation corresponding to a given kinetic method. This helped us to drastically increase the efficiency of our numerical simulations.

Kinetic methods are as parallel as nature, such that our algorithms run efficiently on modern many core computers such as GPUs. This enables us to apply our methods to complicated time dependent flow problems across many scales. Applications include fluids with complex rheology, (i.e. liquid cement), urban boundary layer flows, dispersion of pollutants, shallow water flows, reacting flows (i.e. fire) and classical lift and drag computations. Our work is made accessible to the scientific community through our open source software VirtualFluids (https://git.rz.tu-bs.de/irmb/VirtualFluids).

Images: © IRMB

IRMB | Prof. Dr. rer. nat. Martin Geier

Researcher's Career

- Head of IRMB
- GIAN lecturer and visiting professor at Indian Institute of Technology Madras
- Visiting professor at Indian Institute of Technology Kharagpur
- W1 Professor for theory of kinetic methods
- Post Doc at Kyoto University
- Dr. rer. nat. Albert-Ludwigs University Freiburg
- Diploma in Microsystems Engineering, Albert-Ludwigs University Freiburg

Funding:
DFG, Federal Ministry of Transport, GIAN, DAAD, JSPS

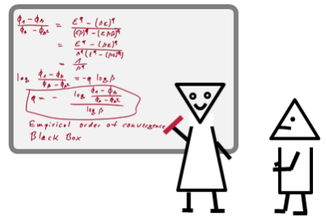
TEACHING

Our teaching ranges from topics in computer science, computer aided design, building information modeling, research software engineering, computational fluid dynamics and numerical modeling.

On bachelor level we offer the compulsory Introduction to Programming and elective lectures Introduction to CAD, Numerical Methods in C++ and Modeling and Simulation of Transportation Systems.

On master level we offer Digital Building Modeling, Computational Fluid Dynamics and High Performance Computing, Modeling and Numerical Methods of Flow Problems, Mathematical and Geometrical Modeling, Applied CFD Software Engineering, Mathematical and Geometrical Modeling and Introduction to Lattice Boltzmann Methods.

With a large range of hands on computer-lab based subjects, iRMB incorporates advanced students into the teaching process. We actively promote the creative contribution from our student assistants and offer an excellent learning-by-teaching working environment.



Publications

- M. Geier, K. Kutscher, M. Schönherr, A. Wellmann, S. Peters, H. Alihussein, J. Linxweiler, M. Krfczyk, „VirtualFluids – open source parallel LBM solver“, Computer Pysics Communications, 2025.
- M. Geier, K. Kutscher, M. Krafczyk, “A direct effective viscosity approach for modeling and simulating Bingham Fluids with the cumulant lattice Boltzmann method”, Open Journal of Fluid Dynamics, 11 (01), 34, 2021.
- M. Geier, A. Pasquali, M. Schönherr, “Parametrization of the cumulant lattice Boltzmann method for fourth order accurate diffusion Part I: derivation and validation“, Journal of Computational Physics, vol. 348, no. 1 pp. 862-888, 2017.
- M. Geier, M. Schönherr, “Esoteric Twist: An Efficient in-Place Streaming Algorithm for the Lattice Boltzmann Method on Massively Parallel Hardware”, Computation, vol. 5 no. 2, 2017.
- M. Geier, M. Schönherr, A. Pasquali, M. Krafczyk, “The Cumulant Lattice Boltzmann Equation in three dimensions: theory and validation”, Computers and Mathematics with Applications, vol. 70, issue 4, p. 507, 2015.
- M. Geier, A. Fakhari, T. Lee, “Conservative phase-field lattice Boltzmann equation for interface tracking”, Physical Review E 91, p. 063309, 2015.

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ISBS | Braunschweig Pavement Engineering Centre

Mission Statement

The major requirements of modern road pavements are safety, functionality and sustainability. Our research work focuses on these requirements, emphasizing the increase in durability of asphalt pavements by means of structural optimisation for making the design, selection of materials and construction, rehabilitation & recycling techniques as fully perfect and effective as possible.

RESEARCH

Laboratory testing of road building materials:
We run a well-equipped laboratory for testing asphalt materials, in particular for identifying the characteristics of the individual components (aggregate and bitumen) as well as of the composed mixtures. We use the latest test methods and are developing new performance-based methods. Thus, new recipes can be optimized, and asphalt quality can be assured.

Modeling behavior of road materials and pavement structures: With help of the results from laboratory testing and by means of computer simulation of road pavement behavior under controlled climate conditions and under repeated loading, we predict short- and long-term performance of road materials and pavement structures. Our objective is to support the development and optimisation of new road building materials and new methods for pavement design and road construction, rehabilitation & recycling techniques, considering the actual growth in heavy vehicle traffic, new trends in the automobile and tire industries, the effects of climate, as well as the changing availability of bitumen and the strong need for re-using reclaimed asphalts.

Developing tools for systematic pavement management:
We are developing methods for pavement condition assessment and evaluation, as well as for systematic road maintenance. A major research focus is dedicated to improving the performance prediction functions within Pavement Management Systems (PMS) by considering the individual properties of the actual pavement materials and structures.

ISBS | Prof. Dipl.-Ing. Dr. techn. Michael P. Wistuba

Researcher's Career

- Full Professor of Pavement Engineering, TU Braunschweig
- Head of Braunschweig Pavement Engineering Centre
- Board member of the accredited testing laboratory for road-building materials according to the German guidelines RAPStra, Braunschweig
- Steering group member of the European Asphalt Technology Association (EATA)
- Scientific board member of Deutsches Asphaltinstitut (DAI)
- Scientific board member of the Swiss Expert Association for Road and Transport Engineering (VSS)
- Board member of Christian Doppler Laboratory for performance based optimization of flexible road pavements, TU Wien, 2003-2008
- Post-Doc research associate at Ecole polytechnique fédérale de Lausanne (EPFL, Switzerland), 2002-2003
- Ph.D. in Civil Engineering, TU Wien
- Research Associate at TU Wien, 1988-2008
- Diploma in Civil Engineering, TU Wien, 1989

Funding
EU, BMVBS, BASt, AiF, FFG, DAAD, Lower Saxony, industry

Publications

- Cannone-Falchetto, A., Moon, K. H. & Wistuba, M. 2014. Microstructural Analysis and Rheological Modeling of Asphalt Mixtures Containing Recycled Asphalt Materials. Materials, Int. Journal, MDPI editions, Special Issue Recycled Materials vol. 7, pp. 6254-6280, open access publication, doi:10.3390/ma7096254, ISSN 1996-1944, www.mdpi.com/journal/materials.
- Cannone Falchetto, A., Wistuba, M. & Marasteanu, M. Size effect in asphalt mixture at low temperature: Type I and Type II. Proc., Association of Asphalt Paving Technologists Annual Meeting, March 13-16, 2016, Indianapolis.
- Büchler, S., Wistuba, M. & Cannone-Falchetto, A. 2015. Evaluation of crack propagation in asphalt mixture through photoelasticity. Proc., 8th Int. RILEM SIB Symposium, Testing and Characterization of Sustainable & Innovative Bituminous Materials, October 7-9, 2015, Ancona, Italy.
- Isailović, I., Cannone-Falchetto, A. & Wistuba, M. 2015. Energy Dissipation in Asphalt Mixtures Observed in Different Cyclic Stress-Controlled Fatigue Tests. Proc., 8th Int. RILEM SIB Symposium, Testing and Characterization of Sustainable & Innovative Bituminous Materials, October 7-9, 2015, Ancona, Italy.
- Wistuba, M., Weninger-Vycudil, A., Ringleb, A., Mladenovic, G. & Litzka, J. 2013. 'InteMat4PMS' – Integration of material-science based performance models into life-cycle-analysis processed in the frame of pavement management systems. Final report, No 832708, ERAnet-Road II.

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ISD | Institute of Structural Analysis

Mission Statement

Research and teaching aim at modeling the stess-deformation behavior of civil engineering structures. Limit states concerning instabilities and failure as well as coupled multi-field processes are in focus, employing adequate numerical methods as finite element or discrete element analysis.

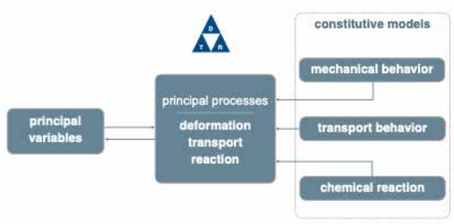
RESEARCH

Material Modeling:
Inelastic material behavior concerning plastic and viscoplastic deformations as well as damage up to failure is modeled in context of continuum mechanics and thermodynamics of irreversible processes. Numerical analyses are performed with adequate tools, e.g. FEM and DEM. Nonlocal damage behavior is modeled employing gradient enhanced formulations in FEM.

Multicomponent materials as concrete, UHPFRC, soil, waste, asphalt or wood are modeled, anisotropies are taken into account to describe elastic, inelastic and transport behavior. In many fields of engineering it is important to predict the failure of components as exact as possible. Especially statements concerning the time of failure, the location and the ultimate loading are of great interest. Therefore, life-cycle management systems are to be established for effective maintenance and to prevent failure.

Model parameters are to be determined from experimental data. Numerical optimization strategies are employed, which identify iteratively the best set of parameters for a given model. Thereby the target function influences significantly the quality of the results. Hybrid strategies combine the excellent global search characteristics of stochastic evolution strategies with the high rate of convergence of deterministic gradient and simplex methods.

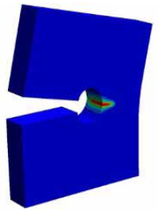
Coupled Multi-field Processes:
Multiphysics phenomena including material mechanics, transport processes focusing on thermal and hydraulical transport mechanisms, chemical reactions as well as biological processes are modeled to analyse complex structures. In porous media, like concrete, asphalt, soil or waste, the different physical-mechanical, biological-chemical or transport processes interact strongly with each other. Research aims at efficient algorithms for numerical analysis of thermo-hygro-mechanical-chemical coupled processes in volume coupled multifield systems. Significant couplings are to be considered in the related constitutive models.

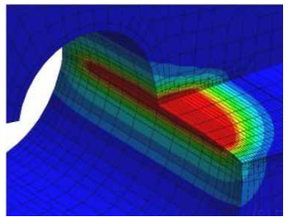


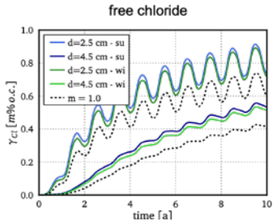
above: Solution strategy for coupled multi-field processes.

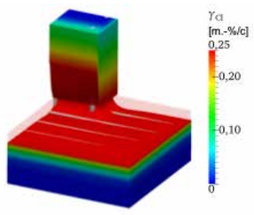
left: Steel CT-specimen, creep damage distribution. Optical enlargement of damage distribution.

below: Chloride concentration at the column base of a parking deck.









ISD | Prof. Dr.-Ing. Ursula Kowalsky

Researcher's Career

- Deputy Head of Institute
- Deputy speaker of RTG 2075
- Adjunct Professor for "Structural Analysis"
- Academic Director of Institute of Structural Analysis
- Dean of Studies (CSE)
- Course Director of the international Master's programme "Computational Sciences in Engineering" (CSE)
- Senior Researcher at Institute of Structural Analysis
- Dr.-Ing. TU Braunschweig
- Dipl.-Ing. TU Braunschweig

Funding:
DFG, DAAD

TEACHING

Limit Load Analysis:
- steel and reinforced concrete structures
- limit loads of frames
- M-N interaction
- theories of 1st and 2nd order
- deformations at limit state

Modeling of Discrete Structures:
- advanced beam and arch models
- cable networks
- girder grids
- soil-structure interaction
- cross bracing of tall buildings

Introduction to Finite Element Methods:
- principle of virtual displacements
- weighted residuals
- bars, beams, membrane and bending structures
- heat conduction
- quadrilateral and triangular elements
- isoparametric concept
- numerical integration
- error indication and estimation

Advanced Finite Element Methods:
- advanced element formulations
- mixed and hybrid formulations
- geometrically nonlinear structural behavior
- physically nonlinear material and structural behavior

Publications

- R. G. Venkateswaran, U. Kowalsky, D. Dinkler. A modified bond model for describing isotropic linear elastic material behaviour with the discrete element method, Computational Particle Mechanics, 2021. [DOI]
- Reinstädler, S.; Kowalsky, U.; Dinkler, D.: Analysis of landslides employing a space-time single-phase level-set method. Comput. Methods Appl. Mech. Engrg. 347, pp. 639-662, 2019.
- Lanwer, J.-P.; Oettel, V.; Empelmann, M.; Höper, S.; Kowalsky, U.; Dinkler, D.: Bond behavior of micro steel fibers embedded in ultra-high performance concrete subjected to monotonic and cyclic loading. Structural Concrete 20, Heft 4, S. 1243-1253 (2019).
- F. Cramer, U. Kowalsky, and D. Dinkler. Coupled chemical and mechanical processes in concrete structures with respect to aging. Coupled systems mechanics, 3:53-71, March 2014. [DOI]
- U. Kowalsky, S. Bente, and D. Dinkler. Modeling of coupled THMC processes in porous media. Coupled systems mechanics, 3:27-52, March 2014. [DOI]
- U. Kowalsky, J. Meyer, S. Heinrich, and D. Dinkler. A nonlocal damage model for mild steel under inelastic cyclic straining. Computational Materials Science, 63:28-34, 2012. [DOI]
- K. Schuster, U. Kowalsky, and D. Dinkler. System identification and structural health monitoring using piezoceramic actuators. Mechanics of Advanced Materials and Structures, 18(7):540-547, 2011. [DOI]
- U. Kowalsky, T. Zümendorf, and D. Dinkler. Random Fluctuations of Material Behaviour in FE-Damage-Analysis. Computational Material Science, 39:8-16, 2007. [DOI]

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IVS | Institute of Transportation and Urban Engineering

Mission Statement

Mobility is one of the fundamental human needs, and a prerequisite for individual development and the success and growth of every society. Through cutting-edge modelling, data integration, and infrastructure design, IVS is shaping the future of safe, efficient, and sustainable mobility systems.

RESEARCH

Data Analytics
Data is the foundation for understanding mobility behaviour, traffic flow, and validating traffic models. Expanding datasets, such as floating car data, allow reconstruction of vehicle trajectories, offering precise insights into traffic dynamics. At IVS, raw data is analysed to generate value-added information, such as the capacity of road facilities under real operating conditions.

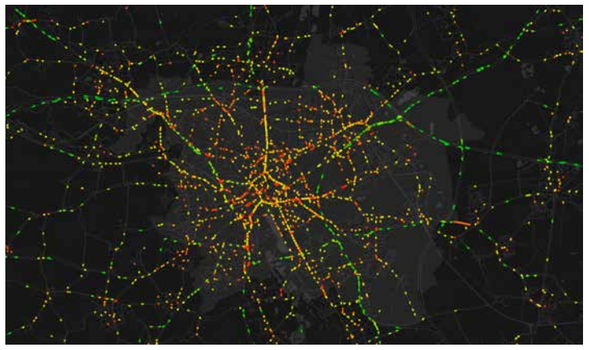
Data-Driven Traffic Modelling
Assessing transport developments demands robust models, yet providing accurate input data and calibration remains challenging. IVS integrates observed data into models, identifies auto-calibration parameters, and estimates origin-destination patterns by combining traffic counts with surveys.

Agent-Based Models
Designing mobility services requires understanding their impact on demand. Agent-based simulations model individual user choices, accurately capturing service changes like pricing or availability. IVS advances these models to test innovative transport scenarios.

Complex Traffic Scenario Modelling
Efficiency and safety depend on the interaction of pedestrians, cyclists, and vehicles. Future systems—especially with autonomous vehicles—require mixed-traffic modelling across shared and separate spaces. IVS has pioneered methods for such modelling and is expanding them for higher complexity.

Infrastructure for Mixed Traffic
Evolving road space calls for designs that ensure safety, functionality, and urban quality. IVS develops infrastructure concepts enabling different transport modes to coexist, adapting existing networks to new demands.

(De)Centralised Traffic Management
Effective traffic management blends central strategies with decentralised user freedom. Central controls reflect societal goals like speed limits, while decentralised measures optimise vehicle behaviour. IVS explores coordination between network-wide traffic light control and local optimisation by autonomous vehicles.



IVS | Univ.-Prof. Dr.-Ing. Bernhard Friedrich

Researcher's Career

- Full Professor for Transportation and Urban Engineering, TU Braunschweig
- Co-Founder of mouver data analytics, Hannover
- Spokesperson of DFG-Research Training Group "SocialCars"
- Member of Braunschweigische Wissenschaftliche Gesellschaft
- Member of the German National Academy of Science and Engineering
- Full Professor for Transport, Road Infrastructure and Urban Planning, Leibniz University Hannover 2000-2007
- Co-Founder and Managing Director of TRANSVER Consultancy, Munich
- Dr.-Ing. at TU München
- Research Assistant at the Chair of Traffic Planning and Control, TU München
- Dipl.-Ing. In Civil Engineering, TU München

Funding
DFG, EU, BMBF, BMV, BMWI, BASt, DAAD

TEACHING

Our core educational objective is to equip students with a balanced integration of theoretical expertise and practical competence in urban and regional planning, traffic planning, traffic engineering, and environmental protection. This goal is realised through a broad spectrum of teaching formats. We offer a bachelor's programme in transport planning and urban development, alongside master's-level courses addressing key areas such as traffic demand modelling, traffic flow simulation, traffic control and management, and urban design. The curriculum is further enriched by practice-oriented seminars.

In the bachelor's programme, students gain foundational knowledge of the planning process, relevant legislation, and the models and methods applied in the design of multimodal road networks and facilities.

The master's specialisation provides an in-depth understanding of the models and analytical methods essential for the planning and impact assessment of road transport infrastructure. Both theoretical foundations and practical applications are addressed, with students engaging in project-based work and sample plans to bridge academic learning with real-world practice.

Publications

- Yao S., Zhou Y., Friedrich B., Ahn S. (2024): Planning trajectories for connected and automated vehicle platoon on curved roads: A two-dimensional cooperative approach. Transportation Research Part C: Emerging Technologies, 165. DOI: 10.1016/j.trc.2024.104718
- Tzouras P.G., Batista M., Kepaptsoglou K., Vlahogianni E.I., Friedrich B. (2023): Can we all coexist? An empirical analysis of drivers' and pedestrians' behavior in four different shared space road environments. Cities, 141, art. no. 104477. DOI: 10.1016/j.cities.2023.104477
- Bienzeisler L., Lelke T., Wage O., Huck L.-M., Friedrich B. (2022): Uncertainty and Variability Analysis of Agent-Based Transport Models. Transportation Research Procedia, 62, pp. 719 – 726. DOI: 10.1016/j.trpro.2022.02.089
- Fourati W., Friedrich B. (2021): A method for using crowd-sourced trajectories to construct control-independent fundamental diagrams at signalized links. Transportation Research Part C: Emerging Technologies, 130. DOI: 10.1016/j.trc.2021.103270
- Czioska P., Kutadinata R., Trifunović A., Winter S., Sester M., Friedrich B. (2019): Real-world meeting points for shared demand-responsive transportation systems. Public Transport, 11 (2), pp. 341 – 377. DOI: 10.1007/s12469-019-00207-y
- Rinke N., Schiermeyer C., Pascucci F., Berkhahn V., Friedrich B. (2017): A multi-layer social force approach to model interactions in shared spaces using collision prediction. Transportation Research Procedia, 25, pp. 1249 – 1267. DOI: 10.1016/j.trpro.2017.05.144
- Feuchtinger-Wehner Denkmünze 2002 der Forschungsgesellschaft Straßen- und Verkehrswesen
- BMW Scientific Award 1999

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ISWW | Institute of Sanitary and Environmental Engineering

Mission Statement

Developing the wastewater sector towards a circular economy: water reuse, resource recovery, production of renewable bio-energy while removing pathogens and pollutants by applying multi-barrier concepts. Resource oriented sanitation concepts (NASS), resource economy and materials flow management, transformation-concepts for the wastewater sector.

RESEARCH

Environmental Process Technology
The ISWW develops and investigates process technologies and process chains for the treatment and processing of water, wastewater and sewage sludge, for the recovery of nutrients and for regenerative bio-energy production in municipal and industrial sectors.

Water Reuse in Hydroponic Systems
The ISWW has been leading the inter- and transdisciplinary BMBF projects HypoWave and HypoWave+, where an innovative concept for a resource-efficient water reuse in hydroponic systems for regional vegetable production is being developed and implemented on a large scale for the first time. Key objectives include the development of new water sources for agricultural irrigation, the appropriate treatment of the irrigation water, the use of nutrients from the wastewater sector and the production of high-quality agricultural products.

Phosphor-Recycling and Management
Municipal wastewater is one of the most important collectors of the essential and finite resource phosphorus within our economic system. However, until now phosphate contained in wastewater has not been returned to the economic cycle but disposed of with sewage sludge. The ISWW is head of the joint research project P-Net, in which phosphate is recovered as secondary raw material fertilizer at wastewater treatment plants and - starting from the region Braunschweig-Gifhorn - a regional network for phosphorus recycling and management is to be established.

Renewable Bio-Energy
In numerous projects, the ISWW has been investigating the generation of regenerative energy based on organic residues from the wastewater sector. This includes the production of biogas from wastewater, sewage sludge and renewable raw materials, the increase of substrate availability by using disintegration processes as well as the development of bioelectrochemical systems such as microbial fuel cells and microbial electrolysis cells.

Removal of Organic Micropollutants
Wastewater frequently contains organic trace substances such as pharmaceutical residues which are often only insufficiently degraded during the wastewater treatment process. The ISWW is working on innovative processes such as activated carbon biofiltration, which are highly successful in removing trace substances from wastewater treatment plant effluents and irrigation water.

ISWW | Prof. Dr.-Ing. habil. Thomas Dockhorn

Researcher's Career

- Director of ISWW
- Prof. at TU Braunschweig
- Habilitation on Resource-Economy and Materials flow Management at TU Braunschweig
- Dr.-Ing. in Sanitary Engineering at TU Braunschweig
- Study of Biology at TU Braunschweig

Funding:
BMBF, BMELV, BMU, DBU, Industry, Municipalities

TEACHING

Sanitary Engineering is an integral part of the BSc and MSc courses in Civil and Environmental Engineering. In addition, students from up to 20 different study programs take part in our classes in the course of interdisciplinary qualification.

Besides our fundamental lectures where students acquire all the basic and specialized knowledge required for the understanding and dimensioning of wastewater and sludge treatment systems, we also offer interactive seminars where students can apply their acquired knowledge by working in teams on case studies in national and international contexts.

We also supervise numerous BSc and MSc theses, most of which are offered as practical research work in our various projects investigating exciting and current research topics.

Publications

- Gebhardt, T., Dockhorn, T., Pieper, S., Beckett, M., Germer, J.,Netter, T., Lampe, C., Mohr, M., Heinze, J., Gromadecki, F. (2025): Advanced water treatment for water reuse in a hydroponic system – Experiences from the first full-scale implementation in Germany. Water Reuse jwrd2025025, https://doi.org/10.2166/wrd.2025.025
- Winker, M., Beckett, M.,Dockhorn, T., Domurath, N., Gebhardt, T., Germer, J., Kerber, H., Lampe, C., Mohr, M., Pieper, S., Rohrbach, M., Schramm, E. (2025): Integrated Quality Management for Hydroponic Water Reuse – A Dual-Objective Approach. Water Reuse (2025) 15 (3): 491–508, https://doi.org/10.2166/wrd.2025.033
- M. Beckett, M. Mohr, M. Winker, M. Rohrbach, A. Schwarzer, T. Gebhardt, T. Dockhorn (2025): A critical assessment of the applicability of EU regulation 741/2020 for the development of a risk management plan for hydroponic water reuse. Water Reuse (2025) 15 (3): 475–490. https://doi.org/10.2166/wrd.2025.032
- Kolb, A., Gebhardt, T., Dockhorn, T. (2025): Struvite precipitation from centrate– Identifying the best conditions between effectiveness and resource efficiency. Resources 2025, 14, 56 https://doi.org/10.3390/resources14040056
- Xu, X., Dockhorn, T. (2025): Evaluation of anaerobic sludge digestion in combination with thermal alkaline process as pre- and post-treatment: impacts on energy, economic, and CO2 footprint balances. Bioresource Technology, Volume 441, February 2026, 133564, https://doi.org/10.1016/j.biortech.2025.133564
- Xu, X., T., Dockhorn, T. (2025): Disintegration of digested sludge with the thermal alkaline process to enhance the biogas production. Water Science & Technology Vol 92 No 3, 441, https://doi.org/10.2166/wst.2025.109

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LWI | Leichtweiß-Institute for Hydraulic Engineering and Water Resources (LWI)
Division Waste and Resource Management

Mission Statement

We are committed to protecting nature and conserving resources, and address the requirements on modern waste management posed by climate change, the energy transition, resource security, and sustainability. This includes waste management strategies in emerging countries, (micro-)plastic prevention strategies, applicability of secondary construction materials and stability of waste organic carbon.

RESEARCH

Waste management
Poor solid waste management causes air, water and soil pollution and marine litter, and contributes to climate change. Non-existent collection systems and uncontrolled dumping, wide-spread in poorer societies, harm human health and the environment and put people's livelihood at risk. Our research focuses on the adaptation of international best practice waste management techniques (avoidance, collection, recycling, treatment, landfilling) to the local boundary conditions and needs. Further focus is placed on capacity building by developing tools to train municipalities, the private and informal sector. The practical knowledge of waste handling is brought to the educational sector.

Microplastics in the aquatic environment
Globally, millions of tons of microplastic enter the environment each year. Microplastics affect all levels of life and have been detected in thousands of aquatic and terrestrial species, including the human body. Our research focuses on the prevention of microplastic marine litter, the occurrence of microplastics in the aquatic environment and the development of standard methods for the quantification of microplastics in environmental samples. Furthermore, innovative methods for the elimination of microplastics and micropollutants from wastewater are being investigated.

Landfill in situ stabilization
Landfills pose a long-term risk to soil, ground- and surface waters are a relevant source of the potent greenhouse gas methane. Therefore, post-closure landfill aftercare including monitoring is strictly regulated in Europe. Novel approaches to aftercare include accelerated stabilization of wastes under controlled conditions within in the time frame of current liability using in-situ techniques such as aeration and/or (re-) infiltration of water or leachate, decreasing a landfill's emission potential. With our partners in the Netherlands, we investigate landfill response to in situ stabilization on full scale, including the development of landfill settlement, leachate and gas quality.

Secondary construction materials
Climate change induced sea level rise necessitates strengthening of coastal defenses. Clayey marsh sediment, traditionally used for dike construction in north-western Europe, is a non-renewable resource. We research the feasibility of using of fine-grained dredged sediment, one of the largest single waste streams in port cities, as alternative earthen construction material. This spares natural soil resources and enables a beneficial, sustainable and more economical sediment management. Prerequisite is the transformation of a saturated, unconsolidated and unstructured material into a drained, consolidated, structured, biogeochemically stable and environmentally compliant soil, meeting the required soil mechanical properties. We research the involved processes and predict long-term product behaviour as part of the waste-to-resource concept.

LWI | Prof. Dr. rer. nat. habil. Julia Gebert

Researcher's Career

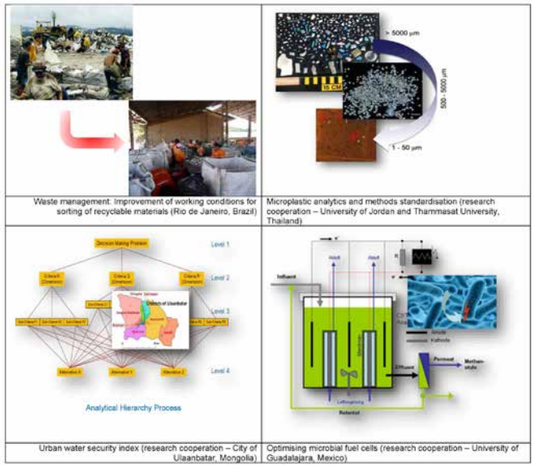
- 2024 Full Professor Waste and Resource Management, TU Braunschweig
- Co-founder of MUDNET academic platform and foundation
- 2017 Associate Professor Geo-Engineering Delft University of Technology (TU Delft)
- 2014 Head of Environmental Services Unit at Hamburg Port Authority AöR
- 2013 Habilitation and venia legendi Soil Science at University of Hamburg
- 2011 Deputy head of Environmental Services Unit at Hamburg Port Authority AöR
- 2004 Dr. rer. nat. University of Hamburg
- 1998 Dipl.-Biol. University of Hamburg
- Member of International Waste Working Group (IWWG), German Society for Waste Management (DGAW), European Sediment Network SedNet, German port Engineering Society, German Soil Science Society, German Federal Soil Association

Funding:
NWO, BMBF, SDS, various industrial stakeholders

TEACHING

The teaching of the Waste and Resource Management Division covers the areas of waste, recycling (circular economy), landfill technology, mechanical and thermal waste treatment, use of biomass in anaerobic processes to produce methane, life cycle assessment, water-energy-nexus, waste management, and water security.

A freely accessible e-learning platform "tech4waste" was developed, providing comprehensive information and teaching materials as Open Educational Resources (OER) that can be used by universities and stakeholders worldwide. Since 2009, an international graduate programme (Professional Master in Urban and Environmental Engineering) has been offered in cooperation with the Department of Civil and Environmental Engineering at PUC-Rio, Brazil.



Publications

- Yi, S., Meza, N., Gebert, J. (2025): Application of the nitrogen-to-argon ratio to understand nitrogen transformation pathways in landfills under in-situ stabilization. Waste Manage 194, 13-23. https://doi.org/10.1016/j.wasman.2024.12.042
- van den Brink, J.M., Scharff, H., Steinert, B., Melchior, S., Hrachowitz, M., Heimovaara, T.J., Gebert, J. (2024): Long-term observations on the hydraulic performance of a combined capillary barrier-methane oxidation landfill cover system. Waste Manage 187, 109-118. https://doi.org/10.1016/j.wasman.2024.07.002
- Zander, F., Comans, R. N. J., Gebert, J. (2023): Linking patterns of physical and chemical organic matter fractions to its lability in sediments of the tidal Elbe river. App Geochem 156, 105760. https://doi.org/10.1016/j.apgeochem.2023.105760
- Flores-Estrella, R.A., Alcaraz-Gonzalez, V., Haarstrick, A. (2022): A catalytic effectiveness factor for a microbial electrolysis cell biofilm model. Energies 2022, 15, 4179. https://doi.org/10.3390/en15114179
- Tuan Ta, A., Babel, S., Haarstrick, A. (2020): Microplastics Contamination in a High Population Density Area of the Chao Phraya River, Bangkok. J Eng Technol Sci, 52, 534-545. DOI: 10.5614/j.eng.technol.sci.2020.52.4.6
- Gebert, J., de Jong, T., Beaven, R., Rhees-White, T., Lammen, H. (2022): Spatial variability of leachate tables, leachate composition and hydraulic conductivity in a landfill stabilized by in situ aeration. Detritus 19. https://doi.org/10.31025/2611-4135/2022.15189
- Gebert, J., Huber-Humer, M., Cabral, A. (2022): Design of microbial methane oxidation systems for landfills. Front Environ Sci 10. https://doi.org/10.3389/fenvs.2022.907562

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LWI | Leichtweiß-Institute for Hydraulic Engineering and Water Resources (LWI) **| Division of Hydraulic Engineering and River Morphology**

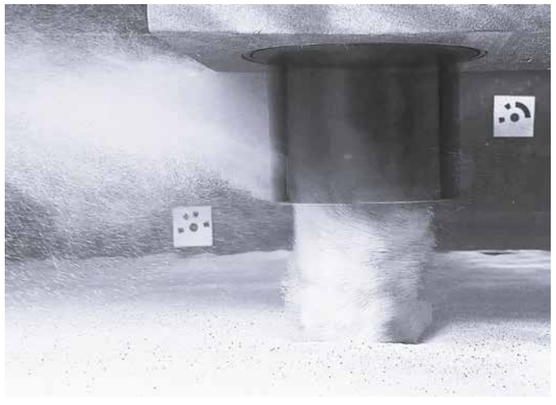
Mission Statement

We investigate natural and anthropogenic flow and transport processes in riverine environments. Combining theoretical and experimental approaches, we address knowledge gaps at water-biota and water-sediment interfaces to advance sustainable river management and provide solutions to challenges in morphodynamics and flood risk mitigation.

RESEARCH

The research conducted at our institute addresses key challenges in sustainable river management by integrating morphodynamics, flood protection, and ecological requirements. These often competing demands define the complex framework in which modern hydraulic engineers operate. Our aim is to develop scientifically sound tools to reconcile such conflicts. Central to this work is the assessment of physical processes governing interactions among water flow, vegetation, morphology, hydraulic structures, and ecology.

Our research is predominantly experimental, combining field studies with investigations in the LWI hydraulic laboratory. The laboratory offers uniquely equipped hydraulic flumes of varying scales and state-of-the-art instrumentation, enabling both fundamental studies, such as turbulent flow over rough beds, and applied projects using custom-built scale models to address practical problems. A further focus lies on advancing innovative experimental methods.



Voith–Schneider Propeller induced vortex with suspended sand and transport of the suspended material in the wake flow field
Source: C. Schwartpaul (LWI)

Near bed velocity measurements with a 3D-Laser-DopplerAnemometer in a flume study on flow-vegetation interaction
Source: J. Aliaga-Villagrán (LWI)

LWI | Prof. Dr.-Ing. Jochen Aberle

Researcher's Career

- Full Professor for Hydraulic Engineering and River Morphology at LWI
- Full Professor for Hydraulic Engineering at Norwegian University of Science and Technology (NTNU), Trondheim, Norway
- Head of Hydraulic Laboratory, LWI, TU Braunschweig
- Research Associate, LWI, TU Braunschweig
- Postdoctoral Researcher, National Institute of Water and Atmospheric Research Ltd. (NIWA), Christchurch, New Zealand
- Dr.-Ing., University of Karlsruhe (TH)
- Dipl.-Ing. Civil Engineering, University of Karlsruhe (TH)

Funding
BAW, BMDV, BMBF, DBU, DFG, EU, State of Lower Saxony, Industry

TEACHING

Our teaching addresses three core areas essential for hydraulic engineers: classical hydraulic engineering, computational fluid dynamics, and environmental hydraulics. Classical hydraulic engineering provides the foundation for maintaining and modernizing hydraulic structures. Computational fluid dynamics has become indispensable for simulating flow and transport processes in both research and practice. Environmental hydraulics equips engineers with insights into complex natural processes and supports transdisciplinary collaboration. A key element of our teaching is the application of theoretical knowledge in practical exercises. Recently, we have expanded our portfolio with a new module on project management in waterway engineering.

Publications

- Artini, G., Francalanci, S., Solari, L. & Aberle, J. (2025). "Effects of leafy flexible vegetation and bedforms on turbulent flow and sediment transport." J. Geophys. Res.: Earth Surf., 130, e2024JF007920, https://doi.org/10.1029/2024JF007920
- Pasquino, V., Cesare Lama, G.F., Peruzzi, C., Chirico, G.B., Aberle, J. (2025). "Assessing bed shear stress effects on flow resistance of vegetated channel beds by means of Leaf Area Index (LAI)." J. Hydrol., 653, 132518., doi:10.1016/j.jhydrol.2024.132518
- Aliaga, J. & Aberle, J. (2024). "Bed shear stress and near-bed flow through sparse arrays of rigid emergent vegetation." Water Resour. Res., 60, e2023WR035879, https://doi.org/10.1029/2023WR035879
- Branß, T., Aberle, J. & Hentschel, B. (2023). "Impacts on alternate bar geometry and dynamics in a trained sand bed river." Frontiers in Water, doi:10.3389/frwa.2022.1091872
- Aberle, J., Branß, T., Eikenberg, R., Henry, P.-Y. & Olsen, N.R.B. (2022). "Directional dependency of flow resistance in an unlined rock blasted hydropower tunnel." J. Hydraul. Res., 60(3), 504-513, doi:10.1080/00221686.2021.2001596

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LWI | Leichtweiß-Institute for Hydraulic Engineering and Water Resources (LWI) **| Division of Hydrology and River Basin Management (HydRiv)**

Mission Statement

Our research focuses on the integrated consideration of water quantity and water quality for surface and groundwater in the context of hydrological extremes and associated risks. We seek to deepen our understanding of the interactions between hydrological processes and human interventions. For this goal, we develop methods, simulation models and tools for the sustainable and flexible management of future water resources systems.

RESEARCH

Global change - with aspects of climate change, demographic change, changes in land use, globalisation of markets and other transformations - poses unprecedented challenges for sustainable development. From a water management perspective, for instance, hotter and drier summers and more frequent heavy rainfall increase the pressure on natural water resources and exacerbate the risk of hydrological extremes. In addition, due to the contamination of the groundwater, rivers and lakes, and the ongoing environmental degradation, the ecological condition of water bodies and the production and supply of drinking water are increasingly impaired.

Research at HydRiv contributes to addressing these urgent and societal relevant challenges. Our research mission is motivated by three key objectives:

- Increase knowledge about the complex inter-dependencies, feedbacks, and use conflicts in hydrological human-environment systems,
- Adapt water infrastructures and optimise their interconnected management to ensure their long-term performance,
- Develop methods and tools for monitoring, modelling, and the integrated management of water resources systems and assessing risks associated with hydrological extremes.

We work on the analysis, monitoring and modelling of hydrological processes in catchment areas and their interaction with human interventions. We are particularly interested in low mountain and lowland regions as well as coastal lowland areas.

Our research work focuses on

- Integrated modelling systems for river basin management and risk analysis of hydrological extremes under the influence of global change,
- Forecasting and warning systems for floods, low water and water pollution
- Simulation models for the control and optimisation of water resources systems,
- System-oriented monitoring through continuous and event-based observation campaigns and the integration of 'new' data sources.

We apply and develop explorative data analysis, numerical an data-driven modelling techniques for **system analyses** to gain a deeper understanding of interactions and chains of effects, especially in areas with different hydrological characteristics and land use structures, such as urban and rural areas or surface and groundwater bodies.

We are working on concepts for **system-oriented monitoring** to close data gaps and optimise the collection of information on relevant variables and characteristics in meso-scale observation areas. Topics are i) the integration of new data sources (e.g. IoT sensors, crowd-sourced data, and ground-, air-, and space-based sensors) with data from established observation networks and measurement campaigns and ii) the use of data science methods for data management and exploration, scientific analysis and more efficient use of information in decision contexts.

We **advance modelling and predictive capabilities** by further developing algorithms and modelling approaches for integrated river basin management, forecasting and control of water resources systems. To this end, we develop hybrid approaches that combine numerical models with machine learning methods.
We conduct our research activities both at the fundamental level and in application-related settings.

LWI | Prof. Dr.-Ing. Dr. rer. nat. habil. Kai Schröter

Researcher's Career

- Full Professor for Hydrology and River Basin Management at TU Braunschweig, Germany
- Senior Scientist at Section Hydrology, Helmholtz Centre Potsdam German Research Centre for Geosciences GFZ, Potsdam, Germany
- Private Lecturer at University of Potsdam, Faculty of Science, Potsdam, Germany
- Research Asssociate at Center for Disaster Management and Risk Reduction Technology (CEDIM)
- Project Engineer and Project Manager at BWS GmbH, Hamburg, Germany
- Research Associate at Section Engineering Hydrology and Water Resources Management, Darmstadt, Germany
- Dr. rer. nat. habil. in Hydrology at University of Potsdam
- Dr.-Ing. in Engineering Hydrology at TU Darmstadt
- Dipl.-Ing, Civil Engineering at TU Darmstadt

Funding
EU, Climate KIC, BMBF, DFG, Helmholtz Association, Industry

TEACHING

Our teaching topics cover the broad spectrum of hydrology and river basin management, water quality management, and hydrogeology. Content on hydrological and hydraulic modelling as well as water quality and eco-hydrology complement the teaching offer. Further courses impart specific knowledge on data science and geospatial methods as well as on measurement techniques for water quantity and quality, including practical methods of fieldwork. The focus is on methodological knowledge for data acquisition, data analysis, mathematical process modelling and subsequent computer-based processing with complex simulation models.

Practical applications are a central element and are oriented towards the acquisition of competencies to meet current challenges for hydrology and water management:

- the development of sustainable adaptation options to cope with increasingly frequent and intense heat, drought, flood and heavy rainfall events
- the long-term safeguarding of the quantity and quality of water resources and water bodies in the face of increasing demands
- the adaptation of water infrastructures and their flexible management taking into account divergent user interests, in order to ensure their long-term performance.

Publications

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- Kreibich, H., Van Loon, A.F., Schröter, K., Ward, P.J., Mazzoleni, M., Sairam, N., et al. 2022. 'The Challenge of Unprecedented Floods and Droughts in Risk Management'. Nature 608 (7921): 80–86. https://doi.org/10.1038/s41586-022-04917-5.
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- Steinhausen, M., Paprotny, D., Dottori, F., Sairam, N., Mentaschi, L., Alfieri, L., Lüdtke, S., Kreibich, H., Schröter, K.. 2022. 'Drivers of Future Fluvial Flood Risk Change for Residential Buildings in Europe'. Global Environmental Change 76 (September): 102559. https://doi.org/10.1016/j.gloenvcha.2022.102559.
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LWI | Leichtweiß-Institute for Hydraulic Engineering and Water Resources (LWI) **| Division of Hydromechanics, Coastal and Ocean Engineering**

Mission Statement

The world faces climate change, extreme coastal hazards, rapid urban expansion at coasts and the increasing demand on natural marine resources. Our research activities are directed towards understanding and prediction of hydro- and morphodynamic processes in both natural and built environments. We develop sustainable, innovative, nature-friendly solutions and strategies for coastal management and protection as well as marine food and energy resources.

RESEARCH

The research activities, related to coastal, ocean and harbour engineering, are characterized by a mix of fundamental, application- and industry-oriented approaches. Methodologically, we conduct field (in situ) studies, laboratory experiments, numerical modelling and theoretical approaches. The division is equipped with modern, small- to large-scale experimental facilities for investigation of 2D and 3D problems such as coastal hydro- and morphodynamics, structural integrity analysis and stability considerations, testing ecohydraulics as well as extreme hydraulic conditions. The division is a member of the Coastal Research Center, Hannover, Germany, and we operate one of the largest wave-current flumes worldwide. Our research activities can be subdivided into the following research areas:

Marine Technology, Renewable Energy, Marine Constructions and Aquaculture
A massive development of marine infrastructure for wind and ocean energy harvesting as well as marine aquaculture is currently taking place. The main challenges related to this development are economic and environmental issues as well as increasing their efficiency and life span. The most promising solutions represent offshore platforms combining multiple functions such as energy extraction, aquaculture, transport and leisure activities. Our current research interests cover testing of novel aquaculture systems, flow-biota-interaction, marine renewable energy.

Coastal Protection Structures, Morphodynamics and Ecohydraulics
Design of appropriate means of coastal protection against erosion and flooding is based on understanding of local hydrodynamic and morphodynamic processes determining wave loading and sediment budget. Nowadays, environment-friendly, nature-based and sustainable solutions such as beach nourishment, green dikes, coastal vegetation and submerged breakwaters are preferable as compared to the hard means of coastal protection commonly used in the past (e.g. sea walls, revetments, sea dikes). New hybrid solutions combining green and grey coastal protections are currently investigated in respect to their functionality, stability and effect on the environment as well as wave-vegetation-interaction. In parallel, development of numerical tools for a better prediction of wave-soil-structure interaction is taking place.

Natural Hazards
Coastal zones are exposed to different types of natural hazards such as extreme storm surges and tsunami. Thus, a better understanding of their physics and interaction with the built environment is required to develop resilient communities and appropriate risk management strategy. Our current research topics are related to extreme flow condition interacting with the natural and built environment, including transport of water-borne debris and coarse sediment, loading on structures and resulting structure damage.

Waterway and Port Engineering
Both growing marine traffic and increasing size of the vessels pose challenges for the planning of waterway and port infrastructure. Design of port facilities is very often supported by physical and/or numerical modelling in respect to wave loading, wave overtopping and the overall structure stability. In addition, a better understanding of the hydromechanics behind waves induced by vessels is indispensable for appropriate design of port and waterway infrastructure. Our current research topics encompass issues related to ship-induced waves and design of port and marine facilities.

LWI | Prof. Dr.-Ing. habil. Nils Goseberg

Researcher's Career

- Full Professor Coastal and Ocean Engineering at TU Braunschweig, Germany
- Managing Director of Coastal Research Center, Hannover (Forschungszentrum Küste, FZK)
- Habilitation Thesis (venia legendi) at Leibniz Universität Hannover, Germany
- Dr.-Ing. Coastal Engineering at Leibniz Universität Hannover
- Elected fellow "The Braunschweig Scientific Society"
- AXA Investment Management Award 2024 edition
- European Research Council (ERC), Consolidator Grant 2023
- Henriette Herz-Scout 2022 – 2025, Alexander von Humboldt Foundation

Funding
European Union, DFG, DAAD, BMBF, BMBi, KFKI, Volkswagen Stiftung, Industry

TEACHING

Our main educational aim is to equip the students with a well-balanced combination of theoretical knowledge and practical experience in the field of Hydromechanics and Coastal Engineering. We are offering a variety of theoretical and practical courses for the bachelor as well as the master students of Civil Engineering and Environmental Engineering.

In the bachelor's course *Hydromechanics*, the basic laws and concepts of hydrostatics and -dynamics are introduced. For the master students, we offer numerous courses within the specialization "Coastal and Offshore Engineering": The course *Basic Coastal Engineering* provides fundamental knowledge of the characteristics, transformation, and prediction of water waves in coastal areas (sea states, storm surges, tides). In *Coastal Dynamics and Engineering Design*, the students are taught the basics of coastal sediment transport as well as estimating wave-induced loads on structures and designing coastal protection measures. The master curriculum is supplemented by a variety of other seminars, excursions, practical courses, and lectures such as *Tsunami Engineering*, dealing with more specialized subjects of coastal and offshore engineering. Our students have the chance to do physical experiments in the LWI laboratory *(Practical Course)*, to develop and conduct field studies at the German coast *(Ecohydraulic Processes)*, set up and run numerical models *(Numerical Modeling of Coastal Processes)*, and various excursions and field trips.

Field trip to the North Sea coast, Norderney, 2022. (Photo: B. Bratz)

Publications

- V. Kosmalla, O. Lojek, L. Ahrenbeck, B. Mehrtens, C. Schweiger, D. Schürenkamp, and N. Goseberg. "Vegetation effects on dune erosion under wave collision: Influence of planting density, biomass distribution and arrangement in scaled experiments". In: Coastal Engineering 204 (2026), p. 104899
- C. G. David, J. Kremer, M. Ashwini, H. Kloft, and N. Goseberg. "Digital Fabrication of Hybrid Nature-based Solutions as New Opportunity for Coastal Climate Change Adaptation". In: Cambridge Prisms: Coastal Futures 3.e24 (2025), pp. 1–35
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- Krautwald, C., Häfen, H. von, Niebuhr, P., Vögele, K., Schürenkamp, D., Sieder, M., & Goseberg, N. (2022). Large-scale physical modeling of broken solitary waves impacting elevated coastal structures. Coastal Engineering Journal, 64(1), 169–189.
- J. Stolle, N. Goseberg, I. Nistor, and E. Petriu. "Debris impact forces on flexible structures in extreme hydrodynamic conditions". In: Journal of Fluids and Structures 84 (2019), pp. 391–407.
- G. David, V. Röber, N. Goseberg, and T. Schlurmann. "Generation and Propagation of Ship-borne Waves - Solutions from a Boussinesq-type Model". In: Coastal Engineering 127 (2017), pp. 170–187.

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Stahlbau | Institute of Steel Structures

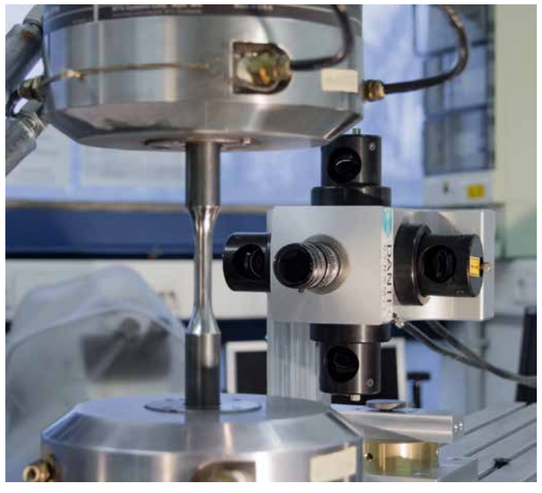
Mission Statement

Steel plays an increasingly important role for light-weight and wide-spanning civil engineering structures with advantages in economy and sustainability. Our work includes fundamental research as well as application-oriented research – also in fields connected to steel construction as wind engineering and building preservation.

RESEARCH

Remaining Service Life of Steel Structures.
For existing bridges and crane structures, quantification of the expected remaining service life time is of great importance. Up to now, no in-situ method is available to identify the pre-crack material aging. Several approaches are investigated within this project.

Material Properties under very high strain velocity.
High speed loading like explosions impose severe damage to structures. Design methods are to be developed to ensure safe evacuation of buildings after such events. The current project classifies typical construction steel due to its properties under high speed loading to predict structural robustness.



Design of silo structures with eccentric discharging.
Today's design of silo structures is not in all cases done with safe load assumptions. A numerical model for eccentric discharging behavior of silo content is developed. With this information, an engineering model for relevant loading of the silo structure is to be developed.

Material and process analysis.
As a subproject in the framework of the DFG Research Training Group "GRK 2075 - Modelling the constitutional evolution of building materials and structures with respect to aging", the fatigue behaviour of bolts with large diameters is examined. The aim of this project is the quantification of the residual stress state resulting from the deep-rolling process of the thread, as determined by x-ray or neutron diffraction at HZ-Berlin, as well as DIC-mesurements and complex material testing.

Three dimensional full-scale wind measurements on a 344 m high guyed mast.
Until now, wind speed and wind direction have been described using line like arrangement of wind sensors vertically or horizontally. A new extended wind measuring system based on 48 3d-ultrasonic anemometers is installed along the guys of the mast. From these measurements, improved models are developed to describe the structure of the atmospheric boundary layer.

Stahlbau | Prof. Dr. sc. tech. Klaus Thiele

Researcher's Career

- Head of Institute of Steel Structures, TU Braunschweig
- Acting Head of Institute of Preservation of Buildings and Structure
- Full Professor of Steel Structures, TU Braunschweig
- Head of Design and Construction Office at Max Bögl Stahl- und Anlagenbau GmbH&Co. KG, Neumarkt
- Dr. sc. techn. at IBK, ETH Zürich
- M.E.Sc. at Boundary Layer Wind Tunnel Laboratory, University of Western Ontario, London, Canada
- Dipl.-Ing., Civil Engineering, TH Darmstadt

Funding
DFG, AiF, DAAD, Industry

TEACHING

We pursue an education that is ambitious in creating theoretical background and training practical skills. Cooperation with industry and engineering offices reinforces the practical relevance in teaching. A close connection to the research at the institute ensures to meet the scientific claim of our teaching.

For Bachelor´s programmes, the basic course 'Stahlbau 1' introduces a general view on steel construction principles, the design of members, bolts and weldings, and an elementary view on stability issues. The advanced course 'Stahlbau 2' consolidates the concepts of modeling of systems, loads and material and introduces composite construction.

'Stahlbau 2' received the LehrLEO prize 2018 for the best lecture at TU Braunschweig.

The Steel construction specialisation in master's programmes contains three main courses: At the beginning, the fundamentals of steel design are deepened for lateral torsional buckling, plate buckling, warping torsion and fatigue, a practical training in the lab is included. Secondly, during a design course students practice the steel structure development. The ability to tackle engineering tasks independently, to develop constructions alone or in groups and to convey them to others plays an important role. In a third course, special topics as lightweight steel structures, steel cable structures, wind engineering and dynamics are offered.

We offer study projects as design and construction work. For Master students, we also offer scientific projects that are supported by lectures on scientific writing.

Publications and Patents

- Gusella, F., Orlando, M., Vignoli, A., Thiele, K.: Flexural capacity of steel rack connections via the component method. Open Construction and Building Technology Journal (2018)
- Höbbel, T., Thiele, K., Clobes, M.: Wind turbulence parameters from three dimensional full-scale measurements at 344 m high guyed mast site Gartow 2. Journal of Wind Engineering and Industrial Aerodynamics (2018), S. 341–350
- Ritter, K., Thiele, K.: Zur frühen Detektion von Ermüdungsrissen mithilfe der Speckle-Interferometrie. 21. DASt-Forschungskolloquium (2018), S. 134–139
- Scholl, N., Minuth-Hadi, F., Thiele, K.: Modelling the Strain Rate Dependent Hardening of Constructional Steel using semi-empirical models. Journal of Constructional Steel Research (June 2018), S. 414–424
- Stengel, D., Thiele, K., Clobes, M., Mehdianpour M.: Aerodynamic damping of nonlinear movement of conductor cables in wind tunnel tests, numerical simulations and full scale measurements. Journal of Wind Engineering & Industrial Aerodynamics (October 2017), S. 47–53
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Imprint

Published by
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Version V22 | 20|11|2025