Is mass a prerequisite for stability? Are all concrete structures heavy as a beached whale? Can structures temporarily adapt to changing conditions? Or are we bound to design for the worst case? Knowing the solution prevents us from finding new answers. Novel solutions are found by continuously transgressing boundaries.

DARING EVERYTHING.
WITHOUT RISKING ANYTHING.
EFFICIENCY IS FINE.

Good lightweight design brings about a cascade of advantages. The most important one: Complex tasks are solved elegantly. According to Antoine de Saint-Exupéry perfection is achieved not when there is nothing left to add, but when there is nothing left to remove. Elegance in design is hence measured by minimising the input to achieve maximum output.

The practical use in this approach is evident: Economical and ecological advantages go hand in hand with short construction times. In other words: Design and efficiency are siblings. Fundamentally connected. You cannot have one without the other.

INNOVATION IS A LIGHTWEIGHT.

Lightweight design is more than a generic term for structural optimisation and material efficiency. Complex architecture leads to new challenges regarding building technology and physics that go beyond mere structural considerations in a functional design.

Today, the potential in lightweight design may be seen in functional integration. Here, two aspects must be focused upon: the development of new materials and the continuous enhancement of our simulation techniques to step closer to physical reality, which permits us to reduce conservative assumptions.

A maximum of structural and functional integration is achieved when interdisciplinary and interactivity are at the basis of the design processes.
INSIDE STRUCTURE.

str.ucture has specialised in developing lightweight solutions through integral and interdisciplinary thinking. The aim is to systematically align material and structure and thereby enable functional integration. As a result our solutions are both light and efficient.

In our understanding of systematic lightweight design, communication is a must – between disciplines and with the client. Consequentially, transparency and openness characterise the work of str.ucture. In short: Lightweight design is more than a design approach, it is a mindset.

str.ucture was founded in 2012 by Michael Herrmann, Julian Lienhard, Alexander Michalski and Stefan Schöne, originating from Studio LD that was already well established in the sector of lightweight design. Changing the company’s name to str.ucture GmbH is a result of broadening our expertise to all fields of building structures in which we can apply the principles of lightweight design. The Stuttgart-based company operates internationally.
PROFESSIONALISM IS THE CORE.

Optimised processes and good communication with the client are the foundations of an excellent solution. We are set to achieve this with our expert staff and technological equipment.

Our IT infrastructure is geared to coping with complex CAD design and simulation tasks. In addition we program software tools for specific applications in-house. Regarding data exchange we provide maximum compatibility.

Our successful project management relies on simple principles: We consider our clients to be our partners and we work highly focussed and professionally.
Consulting, planning and project management: structured offers you solution-oriented service packages, ensuring competent and efficient support in the implementation of your lightweight design project.
INDIVIDUAL SOLUTIONS FOR CHALLENGING CONSTRUCTION PROJECTS.

Make use of our lightweight know-how in all classic fields of structural design. Benefit from our proven expertise in the construction of highly efficient building structures, as well as in the development and application of innovative materials for lightweight structures.

Our solutions are sustainable through energy efficiency and reduction of material use.

OUR CORE COMPETENCIES

• Integration of parametric design principles
• Membrane structures
• Modern steel structures
• Energy-efficient timber structures
• Modern concrete structures
• Numeric optimisation
• Form finding
• Wind engineering

Furthermore, structure considerably contributes to innovative developments in lightweight design:

• Functionally graded concrete: This building material enables a continuous adaptation of mechanical behaviour throughout a cross-section – adapted to the requirements of a structural element. Up to 50% reduction in weight and a significant improvement of the carbon footprint become possible.

• Bending-active structures: Active elastic bending is used for complex curved beam and surface structures that base their geometry on the elastic deformation of initially straight or planar elements. Bending-active structures have an inexhaustible potential for structural integration and heterogeneity by accumulating different load-bearing strategies in hybrid systems.

• Biomimetics: Flectofin® is a market-ready product that is able to underline the potential of biological findings to inspire novel technical solutions. Flectofin® is a multi-functional hingeless flapping mechanism applicable, for example, as an adaptable shading solution for complexly curved glass facades.

• Fluid-Structure-Interaction Simulation: A numerical simulation methodology which is suitable for highly elastic membrane structures, i.e. applications where the structural response of wide-span membrane structures is affected by added mass and added damping effects of the surrounding air. This methodology, incorporating all kinds of physical effects, was developed and industrialised by structure especially for lightweight structures. It has been validated at a real-scale test of a 29 m umbrella prototype.
CONVERTIBLE MEMBRANE ROOF, BUCHS, SWITZERLAND, 2014.

The foldable membrane roof spans over a 50 m long pedestrian road in the center of Buchs, Switzerland. In deployed state the membrane takes on an undulating shape, pronounced by sharp ridges and valleys. The retracted membrane is collected under a parking bridge at the northern end and presents itself as the entrance arch of the road. During deployment of the roof it is pre-stressed in both directions to generate its final wind stable state. Wind tunnel tests were used as part of the structural analysis. The membrane is made of pure PTFE to serve the highest structural and visual standards.

Client: Alliva AG
Architects: Kugel Architekten
Planning period: 2014
Construction work: structural design, form finding, detailed design, cutting pattern, membrane installation
Completion: 2014
NORWAY PAVILION, EXPO 2010, SHANGHAI.

The supporting structure of the pavilion consists of 15 tree elements. These laminated timber constructions are spanned by a PTFE membrane. The membrane covers an area of 2,500 m². The maximum span is 11 m.

Client: Sweco AB, Knippers Helbig GmbH
Architects: Helen & Hard
Contract type: subcontract Knippers Helbig GmbH
Construction work: structural design, form finding, membrane installation
Completion: 2010
Few building materials offer the flexibility and adaptability of timber. Apparent advantages regarding sustainability have recently accelerated novel developments of timber as a construction material in functionally activated and integrally insulated building envelopes.

- Timber structures enable the integration of insulation in the construction layer. The result is a system-based lightweight design at ‘plus energy’ standard.
- Timber structures enable complex geometries. Innovative production methods help to realise double-curved geometries quite easily.

For years structure has been contributing to the development of lightweight timber structures. We are actively involved in furthering material- and process developments to provide our projects with new solutions.

**EFFICIENCY HOUSE PLUS WITH E-MOBILITY OF THE GERMAN FEDERAL GOVERNMENT, 2011**

In the future, single-family homes will produce more energy than they consume. This energy plus will ensure the necessary mobility of its residents. The house is planned under the premise of complete recyclability.

*Architect: Werner Sobek*
*Construction work: structural design by structure engineer Michael Herrmann as freelancer with Werner Sobek Stuttgart GmbH*
*Planning period: 2010–2011*
*Completion: 2011*

**STO FAIR PANEL VHF FOR THE BAU 2015**

Substructure for a double-curved fair facade. A global 3D model including design, calculations and production data allows the rapid evaluation and adaptation to customer requirements.

*Architect: FAT LAB | Forschung Architektur Technik*
*Construction work: structural design*
*Planning period: 2014*
*Completion: 2015*
Innovations are strong drivers of success. Therefore str.ucture is actively involved in diverse research projects. We use the knowledge thus gained to concretely increase the performance in our projects.

TRANSGRESSING RULES. WITHOUT BREAKING THEM
PIONEERING WORK – SIMULATION METHODS, CONSTRUCTION ELEMENTS AND LIGHTWEIGHT MATERIALS.

How do advances come about? One of the biggest challenges is to be inquisitive and bold in the right places. Targeted research requires complex imagination, creativity and comprehensive know-how.

Photogrammetric measurement system

Position of strain gauges

Experimental validation of fluid-structure simulation

Wind test Ehingen
FACADE SHADING SYSTEM FLECTOFIN®.

Within the scope of the research project "Flexible surface structures", sponsored by the German Federal Ministry of Education and Research (BMBF), convertible systems based on elastic structural deformations were developed at the German Institute of Building Structures and Structural Design (ITKE) of the University of Stuttgart.

For this purpose, an interdisciplinary research team was working with references from nature. Flectofin® was derived from the pollination mechanism of the bird-of-paradise flower (Strelitzia reginae). The continuously formable folding mechanism is used for convertible shading systems.

The particularity is that all mechanical components required for complex forming are combined in only one locally differentiated unit, thus dispensing with the need for delicate joints or complicated element joining.


Scientists: Julian Lienhard (ITKE), Simon Schleicher (ITKE), Simon Poppinga (PBG), Tom Masselter (PBG), Lena Müller (ITV), Julian Sartori (ITV)

Input of Julian Lienhard, str.ucture enginee: project application and head of the project, form finding and structural design with finite elements simulation
CAN MORE, WEIGHS LESS – FUNCTIONALLY GRADED CONCRETE IS GREATLY DIFFERENT.

Functionally graded concrete is an excellent example of structural and functional integration. Its inner material properties are modified so that they are optimally adapted to different requirements. By changing its porosity the concrete’s strength, thermal conductivity and density can be varied and adjusted exactly to specific necessities.

The result is a more efficient use of materials, reduced resource and energy consumption as well as a much smaller carbon footprint. An additional advantage: Functionally graded concrete is a mono-material product – this considerably facilitates its return to the building material cycle. Conventional thermal insulation systems composed of different materials are difficult to recycle.

RESEARCH PROJECTS:
“Gradient material in construction” and “weight-optimised development of functionally graded element covers” research initiative for future construction of BMVDI
“Optimal structures of functionally graded concrete structures” within the DFG priority program 1542 “Lightweight construction with concrete”

Heads of the institutes: Prof. Werner Sobek (ILEK), Prof. Oliver Sawodny (ISYS), Prof. Hans-Wolf Reinhardt (IWB), Prof. Harald Garrecht (IWB)

Scientists: Michael Herrmann (ILEK), Jan Mittelstädt (ILEK), Claudia Wolf (ILEK), Walter Haase (ILEK), Mark Wörner (ISYS), Sören Sippel (IWB)

Input of Julian Lienhard, structure engineer: project application and head of the projects, development of construction and calculation methods as well as experiments with components
YOU WANT MORE?
NO PROBLEM AT ALL:

WWW.STR-UCTURE.COM

PICTURE CREDITS
S.  4 (1) Stephan Töngi
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S.  15 AL-Rash
S.  15 Bernd Götz
S.  17 Patrick Nash
S.  25 (2) Boris Miklautsch
START YOUR NEXT PROJECT WITH STRUCTURE.

Lightweight design means sustainability through focusing on the essentials; lightweight design requires efficiency, anticipation and flexibility. Whether concrete building task or lightweight-oriented design processes, whether architects or industrial companies: Benefit from our expertise to achieve your goals – we are looking forward to hearing from you.

LIGHTER IS MORE EFFICIENT IS MORE ECONOMICAL.