FRAUNHOFER INSTITUTE FOR BUILDING PHYSICS IBP

PRESS RELEASE

Research for »Living spaces of the future«

The Fraunhofer Institute for Building Physics IBP at BAU 2019

Since 2014, the construction industry has been constantly growing. For 2018, the main association of the German construction industry has raised its annual forecast regarding the total sales revenues in the construction sector, adjusting it from a nominal four to six percent. At the same time, the construction industry continues to face new challenges: Along with progressing urbanization, steadily increasing digitalization in the construction sector, dwindling resources, tightened requirements on the energy performance of buildings or indoor environments induce profound changes in all areas of society and call for industry, politics and research to provide new solutions. At the international construction trade fair BAU 2019, taking place January 14 through 19 in Munich, Germany, Fraunhofer IBP presents innovative products and system solutions in the areas of digitalization, new sustainability, user-friendly residential buildings and resilient city districts, welcoming visitors at its special exhibition »Living spaces of the future: Digital – sustainable – smart« (hall C2, stand 528).

Innovation Cube

In the two-storey *Innovation Cube* located at the centre of the 300 square meter stand of the Fraunhofer Building Innovation Alliance, Fraunhofer IBP presents four exhibits, which demonstrate innovative and compelling solutions.

The »**Augmented Reality Experience Lab**« turns virtual construction into a palpable experience for users. Here, designers, planners, builders, product manufacturers and potential users can encounter the digital twin of their designs, thanks to a new dimension of 3D technology. The »AR Experience Lab« adds several other sensory perceptions to the optical dimension of virtual reality: indoor air temperature, thermal radiation, humidity and air flow are included and turned into a palpable experience for users. Further, other parameters such as outdoor temperature, the building construction and the technical building services can also be part of the simulation. Virtual sampling, which - as early as in the planning stage - allows combining different building components (e.g. façade or window units, building products or installation situations or various combinations thereof) and reflecting their interaction will enable architects, planners and builders to make more reliable decisions when choosing a system. At the BAU 2019 construction trade fair, visitors have the opportunity to navigate through a virtual building (wearing a 3D VR headset) and experience first simulations of acoustics and lighting.

For people who spend much time in indoor environments, daylight and good lighting are of great importance. Good lighting is not only crucial for physical health, but also considerably affects human well-being and our physical performance. This is why Fraunhofer IBP scientists are doing intensive research into this area. At the trade fair stand, they present a solution for energy and cost-efficient **façade-integrated combination of daylight and LED lighting**, which improves indoor space lighting. Fraunhofer IBP presents a two-component façade exhibit with a ceiling, which demonstrates artificial LED light emission using transparent glass and a new technology for redirecting sunlight. This solution is based on two novel micro-optical structures, which may be functionally combined and can be produced cost-efficiently. It involves light-redirecting structures, which are applied to transparent supporting structures and have been optimized in order to redirect daylight deep into interior spaces without causing glare. The function of this façade element is simulated by an externally mounted light source, which simulates incident sunlight. In addition, light-emitting structures are applied. These are installed at the surface of transparent supporting structures, emitting light from LEDs exclusively to one direction (edge lighting). The element remains transparent (top view) and can be combined with glazing or light-redirecting structures to form façade components. These components are then transparent for daylight or capable of redirecting light. If interior spaces need more light (due to lack of daylight) this solution allows adding artificial light from the façade. The light-emitting component can also be integrated into other space-forming transparent elements such as partition screens or luminaires. For these applications, the researchers present a **task luminaire with micro-structures**. Light from LEDs is emitted precisely downwards or upwards into the task area. The transparent light-emitting glass surfaces of the luminaire may be refined by adding screen printing designs, without any deterioration of the quality of illumination.

Not a transparent material, but a material that offers plenty of economic and environmental benefits is **Typhaboard**. Cattail (also known as typha, by its Latin name) is a robust wetland plant. Thanks to its biological structure, it is possible to produce construction materials from typha, which are distinguished by their combination of unique properties in terms of thermal insulation and load-bearing properties. Based on these natural properties, architect Werner Theuerkorn and Fraunhofer IBP collaborated in developing a magnesite-bonded construction material, which combines all the positive qualities of the typha plant: it is resistant to mould growth, features good thermal insulating properties, high static load capacity and its production requires only low energy input. As it consists only of the natural plant material and a mineral bonding agent, it is particularly sustainable. This environmentally friendly building product has been applied to an internal wall of the Innovation Cube.

Every year, more than one million of water damages are reported to insurance companies in Germany. Infrared heating plates and plastic sheeting tents, which are commonly used in professional wall and floor drying, usually consume large amounts of energy. With the new drying system **Fast Dry Technologies™ (EDF principle =**

energy-efficient, open to diffusion, flexible), which was developed by scientists at Fraunhofer IBP in Stuttgart, there is now an alternative solution available which directly emits heat to the affected areas. For this purpose, the drying system (sized 1000 x 500 mm), which consists of some fire-proof, vapour permeable insulating material and an electric heating system, is applied directly onto the wet internal wall surface. This procedure also works well on curved surfaces or circular walls. A sensor controls the temperature of the heating system. If the temperature is increased, an even drying process gets started. The water-vapour permeable insulation layer at the rear face minimizes heat losses and allows moisture to permeate unhindered. In laboratory tests of wet walls made of vertically perforated bricks, which were performed under the same boundary conditions, it was found that more than 80 percent of energy could be saved compared to IR-heating panels, while the drying time remained the same. A prototype of this innovative drying system will be presented at the trade show.

Small and medium-sized enterprises go digital

Since its foundation in March 2018 the SME 4.0 Competence Centre "Design and Construction" (Mittelstand 4.0-Kompetenzzentrum) has been hosted by Fraunhofer IBP. Small and medium-sized enterprises, which are characteristic of the German construction and real-estate industry, are going to receive a variety of supporting measures within the next three years, in order to actively promote digitalization and successfully use it for their business models. Twelve strong partners in 5 regional sub-centres support SMEs in the building industry and associated trades by providing demonstrators, implementation projects, qualification measures and workshops. All these efforts are aimed at closing the gap between digital solutions and their practical and successful application.

To this end, training environments are established with the aim of creating, testing, and providing complete process chains to relevant users. In this context, every target group will receive specific instructions, as different trades, building sites, building operation, design/ planning and project financing require different solutions in order to successfully implement digitalization.
Several demonstrators such as the »AR Experience Lab«, the BIM2FM Showcase or the so-called "Elbedome" (a 360° immersive VR Lab) are going to be presented at the trade show stand.

Construction waste turned into functional construction materials and components

Following the demolition of buildings and infrastructure, in Germany alone about five million tons of fine-grained construction waste are coming up every year. This waste is dumped onto landfill sites or is used in construction. Since many raw materials, among them also sand and gravel, will not be available in unlimited amounts, this is going to be a real problem. In the scope of the project »BauCycle«, the Fraunhofer Institutes for Building Physics IBP, for Material Flow and Logistics IML, for Optronics, System Technologies and Image Exploitation IOSB and for Environmental, Safety and Energy Technology UMSICHT are facing the challenge to recycle construction waste, to generate sustainable materials from the mineral mixture and to point out some application possibilities for building construction. An example for these efforts is **porous concrete**, a light-weight building material with good thermal insulation properties. It is well suited for building two-storey houses but can also be used as an insulating material in indoor applications. Tests found that mixtures of concrete and sand-lime bricks can also be re-used after recycling, providing some suitable secondary raw material for the production of porous concrete while featuring competitive, comparable strength properties. Another insight derived from this project: **Geopolymers** can be produced from bricks and recycled concrete. This cement-free construction material, whose properties in terms of material strength and acid resistance are similar to concrete, is distinguished by its excellent carbon footprint. In addition to presenting samples of various mixtures of porous concrete, the expert team will exhibit geopolymer façade panels at the BAU 2019 trade show, along with the prototype of a sound-absorbing panel with an open pore structure, which was made from granulates.

Improved planning security thanks to functional façade mock-ups

The building envelope is the central interface with the external world. In addition, modern façades have to perform different functions (such as weather protection, energy efficiency, providing thermal comfort in indoor environments, ventilation, daylight supply, glare control, generation of thermal and electrical energy), thus posing major challenges to architects, planners and the specialist departments involved (e.g. mechanical engineering, metal construction, lightweight construction, glazing etc.). In many cases, planning is merely based on assumptions, experience and calculations. To improve planning security and ensure safe execution of the façade construction, Fraunhofer IBP provides functional façade mock-up tests for planners, builders and manufacturers. This includes tests of the interaction among various components before construction actually starts. These tests help to avoid possible expensive retrofits during building operation – after all, 15 to 25 percent of the average construction costs of large-scale building projects account for façade costs alone.

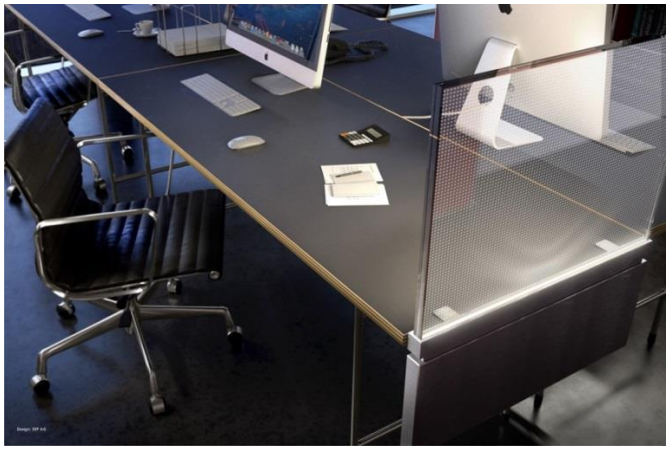
Using Fraunhofer IBP test facilities (such as the modular test facility for energy performance and indoor environments, VERU), IBP scientists are able to carry out individual sampling tests under real-life conditions. Visitors of the trade show can view an element of an exhaust-air façade (ACT Façade). The team of experts will gladly give advice regarding testing possibilities and current façade technologies.

Building physics of urban surfaces

According to a statement published by the German Foundation for World Population in Hanover, three out of four people in Germany are living in cities; this share is expected to rise to 83 percent by 2050. The cities of the future need to change in order to cope with progressing urbanization and increasing menaces and hazards caused by climatic disasters. In this context, urban surfaces play an important role. These surfaces exert substantial influence on the occupants' quality of life and the quality of the environment. For instance, 'green' (i.e. planted) façades improve the urban climate and the air quality. Hydro-active surfaces will act as a buffer for rainwater, releasing it after a certain delay, thus equally reducing heat and rain flooding. At the same time, there are indivisible interdependencies between use and design of urban surfaces and other areas of action, such as resource and energy efficiency, climatic resilience, mobility and productivity of urban structures. In the scope of the *BUOLUS* research project (Building physics design of urban surfaces for sustainable quality of urban living and environments), which is coordinated by Fraunhofer IBP, municipal and scientific institutions have joined with urban planners and developers, building companies and manufacturers of construction materials in order to evaluate the impact potential of urban surfaces present in districts or settlements, infrastructure, green spaces and buildings under aspects of building physics. This potential is to be tapped and extended using technological options; eventually, it will be tried and tested in practice.

The objective is to investigate new options, procedures, systems or materials designed to improve the resilience of cities. In this context, the project is strongly geared to the actual requirements of municipalities, their current issues and pressing problems. At the Munich trade fair, members of the Fraunhofer IBP staff will present a model of their project and introduce future-oriented approaches for cities and mega-cities.

Installation of ISOshade elements from iconic skin GmbH in the VERU at Fraunhofer IBP
© iconic skin GmbH



TALED luminaires provide efficient task lighting.
© SSP AG

Demonstrator for experiencing virtual and real impacts of products using an innovative combination of simulation and construction systems.
© Fraunhofer IBP

Building physics is one of the keys to a successful building project. The **Fraunhofer Institute for Building Physics IBP** focuses its work on research, development, testing, demonstration and consulting in the various fields of building physics. These include noise control and sound insulation in buildings, the optimization of auditoria acoustics and solutions for improving energy efficiency and optimizing lighting technology. Fraunhofer IBP's work also covers issues of climate control and the indoor environment, hygiene and health protection, building material emissions, weatherproofing and protection against heat and moisture, preservation of building structures and the conservation of historic monuments.

Further contact
Tanja Fleck | Phone +49 8024 643-626 | tanja.fleck@ibp.fraunhofer.de | Fraunhofer Institute for Building Physics IBP, Holzkirchen branch | www.ibp.fraunhofer.de