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The "Fraunhofer CityLaboratory" at BAU 2017: Creating living spaces for people

Recent years have seen a striking rise in the challenges faced by the building sector: Residential space shortages, increasing digitalization and the need for energy efficiency – all call for interdisciplinary and creative solutions from industry, politics and science. Based on current building trends, the 14 member institutes of the Fraunhofer Building Innovation Alliance develop application oriented system solutions and innovations. Their activities focus on the human element and the need for comfortable, healthy and safe living space. From January 16 to 21, 2017, the Fraunhofer Building Innovation Alliance will present sustainable product and system solutions for the focus areas "Resource Efficiency and Energy Management", "Intelligent Facades", "Safety and Comfort" and "Digital Planning, Building and Operating" in the 245 square meter special show "Fraunhofer CityLaboratory – Creating living spaces for people" at the BAU 2017 trade fair (Hall C2, stand 538).

The challenge of digitalization

The building industry is faced with the international task of mastering constantly increasing specialization and the growing complexity of construction projects, with their mutual dependencies and interactions. Typical of the German construction sector is the collaboration of multiple small and medium-sized enterprises (SMEs): Each new construction project requires them to reorganize and thus realign their various business processes with one another. Architects and planners are increasingly using Building Information Modeling (BIM) to optimize collaboration and minimize error rates. Here they work with a central digital data model throughout the entire lifecycle of the building. Sustainable increases in cost and time efficiency result from improved coordination of all those involved and the avoidance of redundant, parallel data input. Based on a "digital twin", additional factors such as indoor climate, acoustics and energy consumption can be simulated as early as in the building's planning phase. But in spite of these and other highly promising advantages, the application of BIM in the construction sector continues to face obstacles, among other things in the form of investment costs, employee qualifications and legal uncertainties. The **Fraunhofer Institute for Industrial Engineering IAO** and the **Fraunhofer Institute for Building Physics IBP** are working to drive the progress of digitalization in Germany in the BIMiD (BIM Reference Project in Germany) initiative, funded by the German Federal Ministry for Economic Affairs and Energy. They gather experience and formulate recommendations for the future based on reference projects. An essential benefit to the user is the application of special virtual reality technologies that make it possible to

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render the respective planning phases transparent and self-explanatory, even for laymen.

In order to pave the way for BIM in small and medium-sized companies, the **Fraunhofer Institute for Factory Operation and Automation IFF** integrates conventional planning tools such as MS Project and Excel in BIM software as a part of the BAU ZEIT project. The project is supported by the information and communications technologies funding initiative "KMU-innovativ: Informations- und Kommunikationstechnologie" (IKT) of the German Federal Ministry of Education and Research. In the topic area "Digital Planning, Building and Operating", visitors to the BAU trade fair will find a clear illustration of how BIM can work in practical application and how Fraunhofer building research is moving digitalization ahead.

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Increase efficiency, conserve resources and energy

With the objective of cutting heating costs and thus saving energy, scientists at the **Fraunhofer Institute for Chemical Technology ICT** are researching what are referred to as phase change materials (PCM). By changing their aggregate states from solid to fluid and back again, these storage materials can store and release large amounts of heat. In the past they have been added in microencapsulated form to plaster and wall paints, for example. The disadvantage to this approach was that at some point all the microcapsules have changed state and no additional heat can be absorbed. Fraunhofer ICT has developed a process enabling the integration of larger amounts of PCM in foamed panels. This increases the thermal mass of the panels without changing thickness. At BAU 2017 the researchers will use two climate chambers to demonstrate the degree to which different amounts of PCM can compensate for temperature fluctuations.

Leveraging the potentials of energy savings is not only interesting for ecological reasons, it can also significantly reduce costs. Working together with partners from industry, researchers at the **Fraunhofer Institute for Microelectronic Circuits and Systems IMS** have developed a high-tech ampere meter that uses special NILM algorithms (Non-Intrusive Load Monitoring) to break down overall power consumption according to individual devices. The meter is installed at a central point (entry point) and so that installation and management of numerous other meters (Sub-metering) is no longer necessary. Based on the visualization of the various consumption levels, the user receives a real-time depiction of which device is operating at what time, as well as information on defective devices that could possibly increase electricity consumption. In particular, NILM makes it possible to optimize energy consumption in industrial and commercial applications with savings of up to 12 percent. In the topic area "Resource Efficiency and Energy Management" Fraunhofer IMS will use a prototype to show how the power consumption of a refrigerator, coffee maker and lamps can be measured and visualized using the SmartMeter.

FRAUNHOFER BUILDING INNOVATION ALLIANCE**All-round talents: Facades**

Facades play a central role in the energy optimization of buildings. In addition to passive energy savings with composite thermal insulation systems (ETICS), the active production and efficient exploitation of energy are growing in importance. The building envelope has a key effect on the comfort of the building users because of its impact on the indoor climate. The following are only two examples of the wide spectrum of Fraunhofer construction research represented at the special exhibit:

In order to meet the wide range of requirements placed on building envelopes, in the collaborative research project "TABSOLAR" the **Fraunhofer Institute for Solar Energy Systems ISE** developed components based on ultra-high-performance concrete (UHPC) containing circulating fluid. These multifunctional low-temperature components have mechanical functions (e.g. as load-bearing walls), are thermally active (circulating fluid), thermally passive (thermal insulation) and have design functionality and can be used as walls, ceilings or floors. The "TABSOLAR II" project, supported by the German Federal Ministry for Economic Affairs and Energy, is currently developing three product families ("Premium", "Economy", "Design") with various efficiency levels, costs and design possibilities. At BAU 2017 the scientists will present a sample installation of a solar-thermal facade made of UHPC as well as samples from the various product families.

The **Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT** is focusing on a different area with the development of a modular system made of mineral components that allow planting vegetation on a substrate basis. This is in reaction to the growing demand for residential space and the corresponding necessary redensification in metropolitan areas at the expense of urban green spaces. Fraunhofer UMSICHT has turned to vertical green spaces in order to retain and improve the important contribution plants make to air quality, microclimates and noise control in metropolitan spaces. In parallel to the development of vegetation on facades, investigations are also underway on the ability of various plant types to trap respirable dust and on the system's acoustical and climatic impacts. The special Fraunhofer Building Innovation Alliance exhibit will include a construction element for vertical vegetation and will illustrate its functionality.

Creating safe and comfortable living space

Climate change, terrorism and social conflicts are contributing to the rising level of potential hazards in our living space. This is also forcing planners to pay more and more attention to the issue of civil safety. The necessary structural risk assessment is usually a very tedious process involving the evaluation of many individual expert opinions and assessments. The development of the software product VITRUV by the **Fraunhofer Institute for High-Speed Dynamics, Ernst-Mach-Institut, EMI**, supported by the EU, has simplified this process. VITRUV makes it possible to analyze entire sections of a

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city in structural terms as early as the draft phase in order to identify weak points with regard to safety aspects. Here all three working phases of urban planning are covered: In the conceptual phase VITRUV conducts an empirical risk analysis based on historical data; in the subsequent planning phase susceptibility and weak points in the risk areas are identified; and specific measures for minimizing risk can be proposed in final detail planning. The software product can also optimize existing infrastructures in terms of resilience and robustness against disturbances. Here VITRUV identifies and quantifies not only the effects of various threat scenarios, but also determines how effective and expensive the necessary reinforcement measures would be.

In topic area "Safety and Comfort" the **Fraunhofer Institute for Wood Research, Wilhelm-Klauditz-Institut WKI** will show that it is indeed possible to combine comfort with practicality. Researchers at the Institute have developed wood foams whose open-pored structure make them a suitable alternative to synthetic insulation materials made of polymer foams. The new materials consist exclusively of renewable resources and can be manufactured in densities between 40 – 230 kg/m³. In addition to good thermal insulation they also exhibit high acoustical absorption properties. The strength of the foam comes from the bonding forces inherent in wood, so that synthetic adhesives are no longer necessary and no health issues result from emissions.

Expert forum: From vision to practice

Together with the Bundesarbeitskreis Altbaurenewerung e.V. (German association for the renovation of existing buildings or BAKA) and the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), once again this year the Fraunhofer Building Innovation Alliance will be handling the program for the expert forum held in Hall B0. During the entire BAU 2017, fair visitors can learn from a variety of expert presentations on the theme "From Vision to Practice".

The complete program (only German) is available at
http://www.bau.fraunhofer.de/de/presse_news/veranstaltungen/bau-2017.html

Images of all the exhibits can be downloaded at
www.ibp.fraunhofer.de/de/Presse_und_Medien/Presseinformationen.html

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The Fraunhofer Building Innovation Alliance is the central contact point for the construction industry when it comes to application-oriented system solutions and innovations.

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The **Fraunhofer Building Innovation Alliance** clusters resources and competences of 14 Fraunhofer research institutions relating to building construction, thus providing the market with a single, central contact for integral system solutions in the areas of design and construction. The extensive portfolio addresses both medium-sized enterprises and large construction companies. The Fraunhofer Building Innovation Alliance sees itself as an indicator and Initiator of new and innovative topics relating to building research, assuming the function of an interface between economy, research and politics. Clients' inquiries are centrally collected in the head office, from where they are forwarded to a member institute specializing in the respective issue. International contacts and partnerships enable Fraunhofer to advise companies with global operations.

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