Energy-optimized Buildings: Keeping a Cool Head at the Workplace

Students Participate in Setting up New Indoor Climate Chamber LOBSTER – Study Confirms Effect of Ceiling Fans

Working in a comfortable air-conditioned room at high temperatures: Architects of Karlsruhe Institute of Technology (KIT) built the new climate chamber LOBSTER to study what this may be like. The study focused on comfort and user behavior at office workplaces in energy-optimized buildings. KIT students were also involved in setting up the test chamber. A first study covered the effect of ceiling fans under summer conditions. The result: The fan enhances comfort only, if it has a cooling effect and users feel that their control power over the fan is effective.

LOBSTER means “Laboratory of Occupant Behavior, Satisfaction, Thermal Comfort, and Environmental Research”. The climate chamber was set up under the direction of Dr. Marcel Schweiker of the Building Science Division (fbta) of KIT’s Department of Architecture and funded by the Federal Ministry for Economic Affairs (BMWi) under the Energy-optimized Building (EnOB) program. Research in LOBSTER mainly covers thermal and visual comfort, i.e. comfort relating to natural and artificial lighting, at office workplaces as well as user behavior, user satisfaction, and energy-efficient building...
concepts. From the very beginning, the climate chamber was part of education in architecture. Students were involved in the planning and implementation phase. Within the framework of student projects, the wood frame construction, front, sliding wall in the vestibule, and the staircase of the building on KIT Campus West were developed.

The eye-catcher of the building is the front wall. It is made of aluminium composite plates. These plates were milled in a computer-supported manner and look like a QR code. LOBSTER can be rotated to simulate various building orientations or to reach a maximum heat input by tracking the position of the sun. The building is based on a ring mount made of steel beams and rests on eight wheel blocks. Rotation of the building is controlled via a touch screen. Due to this rotation, the staircase designed by students is a freely suspended stainless steel construction that can be adapted to various ground conditions and heights by height-adjustable feet.

LOBSTER is used to study thermal comfort under controlled conditions taking the outdoor climate into account. Under the “passive cooling” project, fbta scientists studied to what an extent comfort under summer conditions is modified by a ceiling fan. 21 test persons worked in LOBSTER for three days each. On the three days, the conditions were identical, except for the operation of a ceiling fan. On the first day, the test persons were not allowed to switch it on, while on the second day, they were. On the third day, users were allowed to use the fan as they wished. However, the fan was adjusted such that it hardly had any cooling effect. The fan worked, but airflow was directed upwards. In the course of the day, temperature in the room was increased constantly: In the morning, it was one degree below the adaptive comfort temperature. In the evening, it was three degrees above. “This comfort temperature is calculated from the external temperatures of the past days to which the body has adapted. In a typical summer in Karlsruhe, this temperature ranges between 23°C in the early summer and 27°C or more at the end of the summer,” Marcel Schweiker explains. The range between three degrees below and three degrees above this temperature is referred to as comfort zone. During the study performed in autumn 2013, the average room temperature was 26.4°C.

The result of the study: On the days, on which the participants were allowed to use the fan effectively, they rated the conditions at their office workplace much better than on the other days. “There clearly is no placebo effect: The possibility of switching on and off the fan alone is not sufficient to increase comfort,” Schweiker says. “Comfort is achieved only when the fan has a cooling effect and the feel-
ing of controlling the fan is positive.” According to the study, a simple ceiling fan can considerably reduce the number of hours outside of the comfort zone in the building. Compared to air conditioning systems, costs for the installation and operation of fans are much lower.


More information on LOBSTER: http://lobster-fbta.de

The fbta is looking for participants in further studies. Click here for information: http://fbta.arch.kit.edu/508.php

Karlsruhe Institute of Technology (KIT) is one of Europe’s leading energy research establishments. Research, education, and innovation at KIT foster the energy turnaround and reorganization of the energy system in Germany. For this, KIT links excellent competences in engineering and science with know-how in economics, the humanities, and social science as well as law. The activities of the KIT Energy Center are organized in seven topics: Energy conversion, renewable energies, energy storage and distribution, efficient energy use, fusion technology, nuclear power and safety, and energy systems analysis. Clear priorities lie in the areas of energy efficiency and renewable energies, energy storage technologies and grids, electric mobility, and enhanced international cooperation in research.

Karlsruhe Institute of Technology (KIT) is a public corporation according to the legislation of the state of Baden-Württemberg. It fulfills the mission of a university and the mission of a national research center of the Helmholtz Association. Research activities focus on energy, the natural and built environment as well as on society and technology and cover the whole range extending from fundamental aspects to application. With about 9400 employees, including more than 6000 staff members in the science and education sector, and 24500 students, KIT is one of the biggest research and education institutions in Europe. Work of KIT is based on the knowledge triangle of research, teaching, and innovation.
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