Does building energy standard make a difference? Results from post occupancy evaluation in office buildings in Germany

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Introduction

With approx. 40% of the German primary energy consumption, buildings are of special interest in the context of sustainability. As an important work environment office buildings are a worthwhile challenge for designing buildings with low energy consumption. The research initiative *EnOB* (funded by the German Federal Ministry of Economics and Technology, *BMWi*) targets the monitoring of new technology concepts and materials, which address energy relevant environmental parameters such as heating, cooling, indoor air quality or daylight. In parallel, excellent workplace conditions with high comfort are expected. So far little is known about the perspective of the occupants in energy-optimised buildings. The question at hand in the presented project is to which extent the occupants accept their ambient environmental conditions in comparison to occupants in conventional buildings. The assumption is that the building energy standard has an influence on comfort parameters and the overall rating of the workplace.

Method

The sample consists of 23 energy-optimised buildings and 15 conventional buildings. Surveys have been carried out in winter (N=1,969) and summer (N=1,814) from 2004 to 2011 based on a questionnaire which derives from the *Occupant Indoor Environmental Quality (IEQ) Survey*^{TM} of the Center for the Built Environment, UC Berkeley.

Occupants were asked to rate their degree of satisfaction with comfort parameters and control options on a five-point-scale from 1 to 5 (very dissatisfied – dissatisfied – neither/nor – satisfied – very satisfied). In order to assess effects of the building context on occupants' voting *Hierarchical Linear Modeling* has been applied considering 2-level-models. The benefit of this method is that individual and contextual characteristics (e.g. energy standard) can be considered simultaneously and ecological fallacy can be avoided. Occupants in the buildings are understood as units of the individual level (level 1), buildings are in the context level (level 2). As the dependent variable the overall rating of the workplace was chosen. The independent individual variables include ratings for temperature, control of temperature, indoor air quality, daylight and acoustics. On the context level the energy standard was chosen (energy-optimised versus conventional).

Results

All independent individual variables had significant influence on the overall rating of the workplace. Additionally, a main effect for the context was found: occupants' ratings were more positive in energy-optimised buildings. In contrast to the expected high comfort, for most of the energy relevant comfort parameters the occupants' votes in energy-optimised buildings showed lower scores than in conventional buildings. Whereas in summer the daylight concepts seemed to enhance visual comfort in energy-optimised buildings especially the indoor air quality in winter has to be improved.

Discussion

In comparison to the conventional buildings the energy-optimised buildings are comparatively new and presumably provide a more attractive office layout and more comfortable building features which might affect the overall rating. The gap between the predicted high comfort in energy optimised buildings and the occupants' feedback can probably be attributed to a complex bundle of aspects such as designing, construction,

maintenance and user expectations. Additionally, occupant behaviour might not fit with the energy concept.

References

Preiser, W. F. & Vischer J. C. (Eds.) (2005). *Assessing Building Performance.* Oxford: Elsevier.

Raudenbush, S. W. & Bryk, A. S. (2002). Hierarchical Linear Models (2nd ed.). Thousand Oaks: Sage Publications.

Wagner, A., Gossauer, E., Moosmann, C., Gropp, T. & Leonhart, R. (2007). Thermal comfort and workplace occupant satisfaction - Results of field studies in German low energy office buildings. *Energy and Building*, 39, 758-769.