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On a Post-occupancy Evaluation Study of Effects of Occupant Behavior on Indoor Environment Quality in College Buildings in Chongqing

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Abstract

Some field studies of the effect of college buildings environment parameters on environmental and study satisfaction were conducted in Chongqing of China. A post-occupancy evaluation (POE) approach was used to analyze the survey results of building occupant satisfaction and the measured indoor environment quality. Occupants completed a questionnaire related to environmental satisfaction. Meanwhile, a long-term objective measurement was proceeding to characterize the immediate environment experienced by the occupants. This study analyzed the subjective and objective measurements of indoor environment quality (IEQ) from four parts: thermal environment, indoor air quality (CO₂), visual and acoustic environment. The data collection for these studies was based on full consideration of user's energy consumption habits and environmental control behavior in using HVACs. This offered the opportunity to compare the study results at the user side demand level, with the goal of identifying parameters consistent in affecting occupant satisfaction.

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1. Introduction

In the process of global urbanization, energy consumption associated with the use and maintenance of buildings has become the main obstacle to urban sustainable development. The prediction of the energy consumption of urban built environment and the understanding of its impacts are important for the decision-making of urban development and city planning [1]. Post occupancy evaluation (POE) is a system of procedures and methodologies for the evaluation of built environments. POE pays a special attention to the actual usage of built-environment and users' opinions and requirements. Through data collection and comparison between aims and actual usage, POE can obtain valuable feedbacks for architects and planners [2]. Although extensive research has investigated the benefits of green buildings, very little is known about user perception and satisfaction. Most of the studies involving users in

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green buildings are in the form of post-occupancy evaluations that gather satisfaction scores and qualitative feedback from building occupants [3].

A retrospective post-occupancy evaluation survey of 44 occupants in two Leadership in Energy and Environmental Design (LEED) Platinum buildings on a US college campus is reported. The Internet survey covered a range of indoor environment and ergonomics issues. Results show that working in these buildings were a generally positive experience for their health, performance and satisfaction [4]. Two large and detailed field studies of the effect of office environment parameters on aspects of environmental and job satisfaction were conducted. Satisfaction with acoustics and privacy was most strongly affected by workstation size and office type; satisfaction with lighting was most strongly affected by window access and glare conditions; and satisfaction with ventilation and temperature was most strongly affected by pollutant concentration. Occupants of green buildings rated all aspects of environmental satisfaction more highly. Finally, job satisfaction was most strongly affected by pollutant concentration and office type [5]. Green campus building standards are significantly impacting modern construction practices. The resulting structures are more energy efficient, but their impact on occupant health or satisfaction has not been widely studied [6].

When energy saving consciousness is gradually enhanced in colleges and universities, the campus buildings begin to transform from energy saving campus to green campus. Since 1 April 2013, the implementation of the green campus evaluation standard (CSUS/GBC 04-2013) has become the first evaluation standard for green campus in China. To investigate a range of indoor environment and ergonomic issues in campus buildings, this paper has taken retrospective post-occupancy evaluation survey of hundreds of occupants in a college campus buildings in Chongqing in China.

2. Methods

Chongqing University of science and technology covers an area of 2200 mu, has total construction area of 600000 square meters, with existing school staff 1527 people and over 20000 students. Three years of campus power consumption are shown in table 1.

Table 1. Three years of campus power consumption

Year	Energy used (104kW·h)	Electricity bill (104Yuan)	Energy used per people per year[kW·h/(a·P)]
2014	1588	842	738.6
2015	1605	851	746.5
2016	2037	1100	947.4

Survey found that energy saving consciousness of teachers and students is not enough, energy management system is insufficient.

By investigation to energy using behavior of students and the campus building indoor environment quality, the college students' life style and energy using habits in different campus buildings have been obtained by statistical analysis, which is also good to improve college students' cognition to the campus energy saving and engagement. In view of the campus building indoor environment quality survey, this paper adopts the method of in-situ test, while adopts the combination of interviews and questionnaire survey method to study the campus students' energy consumption habits. The survey, a total of more than 500 questionnaires were received, including 484 effective questionnaire, effective rate was 96.8%.

Survey content includes the residence time in different buildings, energy-using equipment type and running time, standby mode, air conditioning set mode, windows switch mode and indoor environment quality comprehensive evaluation, as well as indoor air temperature and humidity, CO₂ concentration, noise, illuminating quality, etc.

3. Results& discussion

3.1 Computer type and duration of use

Computers are the mainly studying tools for college students, nearly each person has one computer. According to college students' computer type, running time and standby mode on weekdays and weekend, survey statistics have been done as shown in table 2.

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