CASE STUDY OF
KRESGE FOUNDATION OFFICE COMPLEX
TROY, MICHIGAN

Executive Summary: August 2010
ACKNOWLEDGEMENTS

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The Center for the Built Environment (CBE) was established in May 1997 at the University of California, Berkeley, to provide timely unbiased information on promising new building technologies and design strategies. The Center’s work is supported by the National Science Foundation and CBE’s Industry Partners, a consortium of corporations and organizations committed to improving the design and operation of commercial buildings.

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**EXECUTIVE SUMMARY**

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|               | X            |   |     |    |
| Life cycle costs |               |   |     |    |

**BUILDING PERFORMANCE SUMMARY**

This report measures the Kresge Office Complex's (Complex) performance and was informed by the ASHRAE Performance Measurement Protocols (PMP.) The United States Green Building Council is a co-author of the protocols; yet they differ from the LEED-NC version 2.1 rating system under which the building was certified. PMP evaluates performance using measured data while LEED accepts simulations or expected performance. For that reason, this report gives precedence to measured data. The report does however, include a number of references to LEED since the Complex was awarded a Platinum rating.

The chart on the left displays the Complex's performance via occupant responses, utility bills and environmental measurements. The building meets or exceeds standards in 10 of 15 metrics. Meeting the standard means the building is operating at or above the threshold set in the standard. If no specific threshold is provided, the Complex's results are compared to its peers using datasets suggested in PMP. Please note that thermal comfort results are based on winter measurements only. Summer measurements have not yet been performed.

From the occupants' perspective, the building is a high performer. The building received ratings in the top quartile of the Center for the Built Environment (CBE) database in 5 of 7 categories. Eighty-nine percent of occupants are satisfied with the building overall. Eighty percent are very satisfied with the building. Seventy-two percent of occupants are satisfied with their personal workspace. As is common among buildings in the CBE database, occupants in enclosed private offices are happier with their workspaces than their counterparts in shared or open office configurations are.

All of the indoor environmental quality factors received positive ratings from occupants. More specifically, all IEQ factors have a mean score above zero, or in the satisfied range. Occupants also report satisfaction with the underfloor air distribution system when compared to a standard overhead system. They are also largely satisfied with the thermal comfort and air quality the system provides, although they rarely adjust the settings themselves. Air quality is probably also supported by the low-VOC finishes and cleaners used in the Complex.

Although the building met the PMP measured acoustic metrics, occupants reported frustration with sound privacy, even in private offices. Occupants may require more space for collaboration so that noise.
can be moved away from workers requiring focused concentration. Despite this issue, occupants felt the building supports them in their work.

The building's proactive operators are a major reason for the building's success from a human perspective. Occupants report a high level of satisfaction with the availability and timeliness of building management staff among several other criteria.

The building's resource efficiency meets standards in some areas, but misses in others. Potable water usage is 21% less than an average US office building. Excluding the extra water used for irrigation --as estimated by using winter water use data-- the baseline usage is approximately 65% lower than baseline standards. Unfortunately, it is using more water than was predicted by LEED, 179% per occupant predictions on an annual basis.

Based on 12-months of energy data, CBE calculates the building's energystar score as 33. To achieve an energystar rating, a building must score 75 or greater. The building's energy use intensity is 264.2kbtu/sq. Ft/yr. This is 19% higher than the national average of 222 kbtu/sq ft/yr. The building's energy use is however, below what was predicted by the calibrated energy model developed in 2009.

The following changes might reduce energy use. Occupants are not using lighting or thermal controls to reduce light levels and manage localized temperatures; instead, lights are left on even when there is plenty of day lighting and a number of portable heaters were observed, which themselves affect energy use. An employee manual or training that incorporates information about these systems might be useful. It is also possible that excess energy is being used to move and cool more outside air than is needed. CBE suggests accurate and frequent CO2 measurements to determine the correct amount of outside air. Outside air intakes should also be set away from building exhaust. Additional energy could be saved by sealing all leaks in the air distribution system, replacing localized reheat units with more efficient warm-up methods, and replacing return fans with relief fans. Each of these measures should be weighed against occupant comfort, productivity and costs.

The Complex site is compliant with LEED Water Efficiency Credit 1.1 but was not compliant with credit 1.2 up to and including 2009. Difficulty in establishing the plant design incurred potable water use. It is expected however, that the site will be compliant during 2010.

Site investigation found that 75% of intended species were present on the site in mid May 2010. Volunteer species made up 36.7% of all plants species found. While intended species are considered dominant, this condition cannot be expected to persist without continued hand weeding, occasional controlled burns and other measures. The site is however contributing to local biodiversity, far exceeding LEED requirements in this regard.

The building's annual operations costs are about $26,000 higher per year than a conventional building. Most of this premium is due to site measures. The building's annualized periodic cost however, is most likely $0.30/sq ft, or $8,000 per year lower than a conventional building due to reduced replacement costs. The calibrated energy model prepared by Arup, dated January 19, 2009 indicates an estimated energy cost saving of $34,908. This is more than the $24,259 estimated in the model prepared during design. Water costs are very low, with the anticipated annual savings in the range of $1,300 per year. The cumulative cost premium for the building, including fee and overhead is in the range of $1,200,000 to $1,300,000. Of this, roughly $900,000 is attributable to energy use reduction. A 20-year return on investment is likely if current economic conditions persist.
DESIGN PROCESS

The Complex began with an integrated design process that included the architect and engineers. This process included a charrette, site observations and discussions with Kresge management. The Foundation also commissioned occupancy and programmatic needs projections, which were used to understand the spatial needs of the organization. From these data, the following design goals were developed:

- Sustainability
- Integrating the historic building with the new building and site
- No “in-your-face design”
- Building a great workplace

Whether the foundation should stay at the current site and whether the modern building should be retrofitted or demolished were also given special consideration. Ultimately, a decision was made to demolish the existing modern building to reduce project costs and alleviate problems with a large west facing curtain wall that negatively affected comfort and energy consumption.

While the building's performance is strong, several design process opportunities could have resulted in even better performance. For example, it appears that occupancy projections may have led to greater than predicted water use and low acoustic scores. The implications of these decisions are explained in their respective sections.

Further, while an integrated design process was used, our investigations suggest that an operations perspective was missing from the process. This perspective is important to develop workable operations schedules and procedures that promote both occupant comfort and system optimization rather than one at the expense of the other. It may also have reduced or prevented excessive system maintenance labor.

A pre-design occupant survey or focus group might have also been useful. While observations reveal what people do and are a good way to learn about supporting or discouraging current activities, they are not well-suited to discovering the ideal activities that would most improve workers' output or morale. This kind of information requires a survey, or interviews. It is admittedly challenging to know which questions to ask, and how to transform the resultant data into environmental conditions. Yet without this information, opportunities to support occupants' most important needs may be missed, while others are given precedent unnecessarily. At the same time, most occupant needs have cost and energy implications. This information would have better enabled the design team to avoid giving precedent to occupant needs that offer only a limited benefit while incurring significant increases in cost or energy use; additionally, it highlights those areas where occupants can and will meet their own needs if given the opportunity.

OPERATIONS

Not all green buildings are appreciated by their occupants. The CBE database includes many disparaging comments about buildings with a mere symbolic adherence to resource-efficiency and human comfort. Responses from Complex occupants are not among these, as occupants largely appreciate working in the building. They especially enjoy the natural light and connection to nature. They feel that this green building addresses critical health concerns through improved air quality while decreasing negative environmental impacts through energy efficiency and materials selection. This
overwhelmingly positive response was received despite some apparent design, construction and operational issues.

Throughout our investigation--surveying the occupants and operations team, visiting the building and conducting interviews--it became clear that there are challenges yet to be addressed. The research team found floor diffusers that had been covered to prevent air movement, individual heaters or fans at many desks, and most occupants using ear phones to block sound. Components related to thermal comfort and acoustic quality were frequently altered by building operators to optimize workspaces. Operators have also had to adjust many systems or manually override settings to bring the building in line with occupant needs. In addition, in most private offices there was unusable space between the desks and the wall. In spite of the very high satisfaction levels, these issues represent design opportunities that were not exploited.

The functional issues mentioned here are not unique to the Complex. They represent common challenges in designing, building and operating resource-efficient buildings. While high environmental performance can be achieved through aggressive operations, it often affects resource use and building system performance negatively. In the sections that follow, we offer suggestions that will promote a good environment without compromising system performance within the Complex.

Figure 2 – Occupant modification in private office.