POST-OCCUPANCY PRESIDIO: HOW LIGHTING AND ENERGY DESIGN GOALS COMPARE TO PERFORMANCE FOR THE THOREAU CENTER FOR SUSTAINABILITY

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ABSTRACT

The National Park Service was intent on creating a model "green" development at the decommissioned Presidio military base in San Francisco. Two local firms, Community Equity Builders and Tanner Leddy Maytum Stacy (TLMS) Architects forged a partnership which led to one of the first successful historic rehabilitation since the base conversion. Their efforts transformed the turn-of-the-century Letterman Hospital into the Thoreau Center for Sustainability where energy and resource conservation are at the forefront of the building design and operation. The building complex, now occupied for over two years, has been well-documented as a green building and historic rehabilitation project but without the benefits of a post-occupancy evaluation. This study examines the occupied building in three important areas -- daylighting, electric lighting, and thermal comfort -- in order to assess the actual building environmental performance. Results of the first phase of the post-occupancy study, a lighting and thermal comfort user survey, are presented in this paper.

1.0 INTRODUCTION

Adaptability of older buildings to new uses is a key tenant of both environmental sustainability and historic rehabilitation. The Secretary of the Interior's Standards for Rehabilitation and the National Park Service's recent Guidelines for Sustainable Design illustrate the national commitment to viewing the existing building stock as a natural resource to be redeveloped.

Many historic buildings, designed before electric lighting and air-conditioning, possessed the traits we now associate with environmental sustainability. These buildings are necessarily climate-adapted, using operable windows for natural ventilation, high ceilings for air stratification, and large windows for daylighting, and make excellent candidates for reuse.

The project which is the subject of this paper is one such example. The reuse of the historic Letterman Hospital at the San Francisco Presidio into offices for non-profit agencies concerned with sustainability demonstrates how a building can maintain its historical and contextual presence while judiciously preserving and reusing interior spaces.

2.0 PHYSICAL CONTEXT

The Thoreau Center for Sustainability is a building complex located on the eastern side of the Presidio in a geographical area called the Letterman Complex. In spite of a building conditions assessment survey that indicated the buildings in this area were too costly to renovate and hence a low priority for reuse, the site was selected by a developer-architect team in response to the National Park Service's "Request for Proposals." In keeping with the National Park Service philosophy, the project was to demonstrate principles of environmental sustainability in the building fabric, systems and operations. A team comprised of the Community Equity Builders and TLMS Architects were awarded the contract. Three buildings renovated in Phase One are the subject of this post-occupancy study.

3.0 PURPOSE OF THE STUDY

Although the Thoreau Center for Sustainability has been documented elsewhere as a flagship "green" building (AIA 1997; Parks 1997), it has not been evaluated for actual building environmental performance. Simulation models to predict energy and electric lighting performance were conducted under contract with Lawrence Berkeley Laboratory and a private lighting consultant, respectively. Since lighting and thermal design were clearly a design priority, this study will provide comparisons between design intentions and predictions as compared to actual performance. The first phase of the study which concentrates on post-occupancy user satisfaction in three areas -- daylighting, electric lighting, and thermal comfort -- is presented here.

4.0 METHODOLOGY

Representatives of the building design and consulting teams were interviewed to establish their statement of design priorities for the project. Field visits were made to the buildings on several occasions to photograph building features, document physical configurations such as use patterns, measure instantaneous interior and exterior illuminance for daylight evaluation, and place data loggers for thermal measurement of interior dry bulb temperature and relative humidity.

After completing the first phase of building analysis, a user occupant survey was prepared and submitted to the design team and building tenant managers for approval. The survey was made available in two forms: hard copy and World-Wide Web format. The latter format was made available at the request of one of the building tenants who is an Internet service provider although, when the hard copy versions arrived, all but one respondent chose the hard copy version.

Occupants of eight areas in the building, referred to as Buildings 1012, 1013, and 1014, were surveyed for their observations reagrding the suitability of the building design relative to their actual use patterns and preferences.

5.0 SURVEY

Occupants of the building completed a survey which consisted of thirty-four questions with several sub-items to be answered depending on earlier responses.

5.1 Demographics

The first section of the survey covered demographics such as (1) age, (2) gender, (3) environmental concerns, (4) location of work area, (5) work schedule, and (6) and time spent at different work activities. The second and third sections focused on daylighting and electric lighting, respectively, concerns such as the quantity and quality of light. The fourth section asked questions about glare and other aspects where lighting might affect productivity or use of a space. The fifth section asked questions relating to thermal comfort by referring to air temperature, movement, and humidity, as well as the ability to control or change thermal conditions. There were opportunities for expanded comment on the form. The results of the survey are presented in Table 1.

TABLE 1: RESPONDENT DEMOGRAPHICS

AGE	under 40 years old	75%
	between 40 and 59	25%
GENDER	male	45%
	female	55%
JOB TITLE	administrator	30%
	staff	55%
	clerical	10%
	other/no response	5%
CONCERN	energy conservation	92%
	building aesthetics	66%
	environmental impacts of buildings	77%
	comfort in buildings	96%
WORK AREA	upper floor	64%
	ground floor	28%
	no response	8%
WALLS	full height (to ceiling)	21%
	partial height	62%
	no partitions	17%
SCHEDULE	work between 8am-6pm	92%

The demographics indicate a young work force, mainly consisting of a staff (e.g., accountants, computer programmers, researchers, writers) that is relatively gender-balanced. The respondents indicated the greatest concern for comfort in buildings although energy conservation was a close secondary concern. Surprisingly, environmental impacts of buildings ranked a more distant third and building aesthetics (not surprising for architects!), was only a priority for two-thirds of the occupants. Most of the respondents are located on the upper floor of the buildings and have work spaces that are enclosed with partial height partitions which is the predominate design solution in Building 1013.

Interestingly, almost all respondents indicated that they work between 8am-5pm or 9am-6pm. No one indicated

that they work past 6pm (although deadlines certainly must make this happen from time to time).

When surveyed for how they spend their time, respondents indicated that 55% of them spend 50% or more of their time at their desks working at the computer. For 15%, it was 80% or more. Since only five respondents were from the Internet service provider, this number would be expected to be somewhat higher. In the building walk-through, 85 computers were counted for all building occupants. The total population is about 135 workers.

The high percentage of time spent working at a computer in buildings that are daylight is one of the study areas that merits further investigation. Also, the high frequency of staff working during daylight hours also suggests a design strategy that maximizes daylight use and minimizing electric lighting wherever possible.

5.2 Daylighting Features

Like most pre-1920s institutional buildings, the former hospital spaces provided excellent daylight in their existing configuration. The E-shaped building creates some self-shading, not needed in the San Francisco climate, and daylight obstructions for some first floor occupants. Applying the rule of thumb recommendation from Stein and Reynolds confirms that the building is sufficiently thin for daylighting interior zones; that is, 2.5 x window head height equals the midpoint of the floor plan.

The width of the building suggested dividing the space into five zones: east perimeter, east interior, center circulation, west interior, west perimeter zone. In order to maintain access to daylight and views for the interior zone, glass partition walls were used between interior and perimeter zones.

Given that the existing building configuration was primed for daylighting, what was the necessary design response to maximize this opportunity since too much light can also be a liability? Glass partitions that are not full height are excellent for daylight but interfer with acoustical (and visual) privacy. Is this satisfactory? Borrowed light depends on a "friendly" neighbor who is willing to adjust the shades so that all persons in that daylight zone are able to receive adequate light. Are they willing to cooperate? The survey begins to answer some of these questions although raises others demanding further investigation.

5.2.1 Daylighting User Response

The survey questions asked the occupants about the desirability, control, quantity, and quality of daylight. The majority commented on finding the window location desirable most of the time, except on the occasions when there was too much light or if their work involved intensive computer use. Only 13% of the respondents where unable to control the daylight in their work area. Those who did control the daylight, 62% say that they adjust the devices "daily" and an equal number either adjust them "weekly or monthly" or "never." It is difficult to determine if the users are accurately recording their use patterns. A better test would be an automated method of recording shade movement (such as time elapsed photography or data loggers) correlated with concurrent weather data.

As for the quality of light, 77% found the light to be pleasant, 15% found the light to be annoying, and the remainder either commented on how the light could be both at the same time or did not respond.

There were minimal written recommendations for improvements to the daylight in the spaces.

5.3 Electric Lighting Features

The electric lighting in the buildings followed two approaches: integrated or general purpose. Integrated electric lighting refers to the electric lighting fixtures that were custom designed as part of an interiors package with cabinetry and built-in partitions. General purpose lighting strategies were applied to those spaces where tenants made their own interior improvements and were simply provided a basic finished shell by the architects.
In all electric lighting design, however, the effort to produce a glare-free environment was successful. The integrated electric lighting scheme used indirect T-8 fluorescent fixtures installed on a partial height partition walls between the perimeter and interior workspaces to provide ambient light. The lighting designer indicated that individuals were encouraged to purchase task lights for use at their work stations since he was asked about recommended task lights.

In the general purpose lighted spaces, pendant mounted indirect fixtures also using T-8 technology were installed in a pattern placing them parallel to the longer daylit exterior wall in the two perimeter bays. These light fixtures provide general illumination only and increase the need for task lighting at the work surface. On the other hand, taking cursory measurements, these spaces had the highest light levels since built-in partitions were not installed to limit daylight.

Although daylight sensors were preferred, budgetary consideration allowed only occupancy sensors to be installed in the final project and not in all locations.

5.3.1 Electric Light User Response

The survey on electric light asked the user questions about quantity and quality as well. Seventy-five percent of the respondents felt that they received about the right amount of light in their work space. Approximately 4% felt that they received too little light and 20% felt they received too much light. One percent did not respond.

When asked about task lighting such as desk lamps, 21% said that they did have one and, of these, 30% use halogen lamps and 50% use fluorescent lamps. Twenty percent did not reply or said that they did not know the lamp type.

The recent concern over the energy consumption of halogen lamps suggests getting information to users to make more energy efficient choices. It is possible however, that the users mistook a fluorescent lamp for a halogen lamp not being familiar with the technology. This matter warrants further investigation.

As for improvements, there were several requests for daylight sensors that would reduce electric light when daylight is sufficient.

5.4 Other Lighting Considerations

Issues of glare were asked separate from the lighting categories since they apply to both daylight and electric lighting. Occupants were asked if they ever saw reflections on their computer screens. The replies were: 9% never, 15% rarely, 47% sometimes, 15% often, and 15% always. In most cases, the reflection was attributed to the window. In very few cases was the electric lighting the culprit.

Similarly, occupants were asked about reflections off the work surface. In this case, it is clear that reflections off horizontal work surfaces are not a problem given this response: 36% never, 38% rarely, 21% sometimes, and 5% did not respond.

As for lighting and productivity, occupants were asked about associated elements such as (1) access to views, (2) fresh air, (3) daylight, (4) electric lighting, and (5) architectural design. Overall all areas were considered to have a positive effect on the occupants.

5.5 Thermal Comfort Features

The San Francisco climate is predominantly overcast year round. Large windows increase daylighting opportunities but also create large areas of heat loss. Balancing the requirements of daylighting and thermal comfort, especially in a historic building, is a significant design challenge.

The historic building exterior limited what the design team was able to provide in order to improve thermal comfort for the building occupants. The original clear, single glazed, wood frame, double hung sash were maintained and no shading devices were added to the building exterior. Interior white venetian blinds were added at various times for most windows. Storm sash were not added to the exterior. The original hydronic heating system was upgraded for greater energy efficiency.

5.5.1 Thermal Comfort Response

Forty three percent of the respondents find the building to be too cold in the winter and 36% thought that it was too hot in the summer. When asked how they adjusted for thermal conditions, 92% said that they modified their clothing, 72% said that they opened or closed doors or windows. Twenty one percent said that they used a space heater to improve the interior climate and 17% said that they use a fan. Thirty-eight percent considered the spaces drafty, although several noted that this might be related to the open windows. Forty-three percent thought that the air in the spaces was too still and 15% thought that the spaces were occasionally too humid.

Only 9% of the respondents did not have an operable window nearby and 28% thought that their ventilation could be improved by changing the configuration of their space. There were no additional written comments or recommendations for improving thermal comfort.

6.0 NEXT STEPS

This first phase of this study is nearing completion pending the return of additional surveys. Besides the cursory physical measurements taken on early exploratory visits to the building, more detailed and accurate measurements will be made. Thermal data from data loggers placed previously will be processed. Electrical power data was recently made available from an electrical consulting firm which will be used to analyze power consumption of lighting loads. In addition, the survey results have raised new questions.

The ultimate aim of this study is to add to the existing documentation on the Thoreau Center for Sustainability as a successful, adaptive reuse that combines appropriate responses to historic and environmental sensitivities not only as a design concept but also as a validated post-occupancy building. The building case study will then serve, with thorough visual and supporting data documentation, as a instructional model for architecture students to fully comprehend design intentions *and* actual building performance. Very few buildings are fully documented and presented in this way.

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