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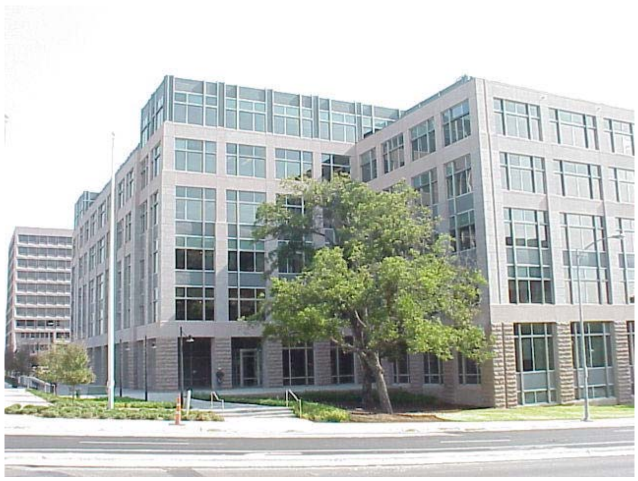
Lessons Learned from Continuous Commissioning® of the Robert E. Johnson State Office Building, Austin, TX



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EXECUTIVE SUMMARY

The Robert E. Johnson State Office building is a 5-story, 303,389 square foot office building built in 2000 located in downtown Austin, TX. The original building design included a number of energy conservation measures that were incorporated into the final construction. During the investigation of the building, four energy conservation measures were identified, three of which deal with conventional HVAC systems. The fourth is related to the currently unutilized daylighting system which was one of the energy conservation measures of the original building design. Utilizing this system would lead to approximately 18.5% annual lighting energy savings or 5.6% annual whole building energy savings based on a DOE-2 simulation analysis.

Three main lessons were learned from the experience with the Robert E. Johnson building:

- The traditional design-construction-operation team must include the energy conservation analysis team
- The entire building process should be reorganized to assure that complete information is provided and passed on from the energy conservation analysis team
- High performance buildings should be continuously monitored and analyzed to ensure that the building is operated efficiently in the long term.

DISCLAIMER

ACKNOWLEDGEMENTS

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Lessons Learned from Continuous Commissioning®[1] of the Robert E. Johnson State Office Building, Austin, TX

The Robert E. Johnson State Office building is a 5-story, 303,389 square foot office building built in 2000 located in downtown Austin, TX. The building houses state legislative support staff such as House Committees, Legislative Council, State Auditor, the Legislative Reference Library, the Senate Print Shop and the Sunset Commission. Overall there are two types of spaces in the building: open plan office spaces and individual offices. The building also includes a computer center and a print shop. The building envelope is over 50% glazing consisting of two types of low-e glass with deciduous trees lining a significant portion of the south façade up to the third level. The original building design included a number of energy conservation measures that were incorporated into the building. These include an energy efficient HVAC system (dual-duct variable-air-volume), high efficiency chillers (0.5 kW/ton measured), T-8 fluorescent lamps with electronic ballasts, motion sensors for lighting control, low-e window glazing, a daylighting system, an enthalpy heat recovery system for the print shop, a run-around dehumidification and preconditioning system, low head pumping in oversized cooling towers, variable speed pumping in the chilled water loop, and a high albedo roof among other measures.

During the course of the investigation of the Robert E. Johnson building, four primary energy saving opportunities were identified including a reduction in the terminal box minimum airflow, a reduction in the undocumented exhaust air (duct air loss), implementation of design control algorithms and implementation of the daylighting design features. The terminal box minimum airflows, reduction of duct air losses, and design control algorithms are three measures that are not unique to high performance buildings in that they involve systems common to many commercial buildings; however, the daylighting system and related design features are not as common in the commercial building stock. The daylighting system consists of specially designed light shelves on the south side of the building that were installed to project the daylight into the interior offices and dimmable ballasts were installed in 15-18% of the offices to dim artificial lighting when the natural lighting is sufficient. Unfortunately, the daylighting system was found to be circumvented by interior blinds which were installed on all glazed surfaces. The blinds were installed at the request of the occupants who indicated they were unable to use their computers when the sunlight was shining into the space. The choice of office furniture also contributes to the problem by restricting access to the blind controls and further reducing the chances that the daylighting system could be used. In addition to the blinds, some of the light sensors necessary for controlling the artificial lighting were improperly located, incorrectly wired, removed from the lighting circuit and inconsistent with as-built documents. A DOE-2 energy simulation was used to estimate the savings potential of implementing the daylighting system and found that annual lighting electricity use could be reduced by 18.5% which equals a 5.6% reduction in whole building energy use. The estimated savings from implementing all three of

[1] Continuous Commissioning is a registered trademark of the Texas Engineering Experiment Station of the Texas A&M University System.

these measures together is 19.3% of annual whole building energy consumption (Song 2006).

The savings given above from implementing the daylighting system could be considered potential commissioning savings, but it also illustrates a more fundamental problem related to high efficiency buildings. Problems such as this are the result of a disconnect between the designers of the energy conservation measures and the contractors and occupants. A number of observations concerning the design, construction and operation of high performance buildings were made through the experience with the Robert E. Johnson building (Sylvester et al 2002).

First of all, the traditional design-construction-operation team must include the analysis team that is responsible for analyzing the energy conservation features of the building. To ensure that all features are installed and working properly and that any questions about the design intent can be easily answered communication between the team members should continue from design through the first few years of occupancy.

Further, the entire process should be reorganized to assure that complete information is provided and passed on that will allow for proper design, construction, maintenance, documentation and analysis of the energy efficient measures. This information could be disseminated in numerous was including operations manuals, training for maintenance staff, or both. Special attention should be given to the documentation of the original design intent that was part of any simulations performed as well as the details of these simulations. This will also help ensure that energy efficient measures in the building are properly implemented and help achieve the energy consumption goals of the designers.

Finally, the Robert E. Johnson building and other high performance buildings should be continuously monitored and analyzed to ensure that the building is as efficient as possible in the long term. As we have seen, energy efficiency measures set forth in design can be circumvented in numerous ways over time leading to sub-optimal performance of the building. While this is true of nearly all buildings, the sometimes complex and unique features of high performance buildings which can greatly affect the building's performance make the need for monitoring even greater.

REFERENCES

Song, S. 2006. Development of New Methodologies for Evaluating the Energy Performance of New Commercial Buildings. PhD Dissertation, Department of Architecture, Texas A&M University, College Station.

Sylvester, K., Song, S., Haberl, J. S., and Turner, W. D. 2002. Sustainability Assessment of the Robert E. Johnson State Office Building. Prepared for The Texas State Energy Conservation Office and the General Service Commission of Texas under inter-agency agreement, *Energy Systems Laboratory Report No. ESL-TR-02-01-02*.