Executive Summary

Energy efficiency, green design, LEED ratings – these words are commonly used in the building industry. New projects are increasingly designed to be environmentally conscious, and the definition of an energy conscious building is reaching new heights of expectation and complexity. While new building designs are staying abreast of the energy savings demands, some older and existing buildings are suffering. Many of these buildings have been designed with a lower first cost economic goal while annual energy costs have been given less priority. As energy rates continue to increase, there will be an increasing market for an energy performance overhaul of less efficient existing buildings. This report contains a detailed analysis of an existing building with several problems, and proposes a solution that will help to alleviate those issues.

Several studies have been performed to assist in this analysis. To evaluate the existing moisture problems, an on site study of the existing wall conditions has been performed and has been supplemented by research with the LBNL WUFI 4 program. The selected dehumidification system has been modeled in EES equation solver program to show the system performance characteristics. After the selection and design of the dehumidification system, the building energy performance was modeled using the Trane Trace 700 energy modeling software. Finally, over 70 parametric runs with different controls options were completed to find the most optimal combination of equipment and different schedules. A life cycle cost analysis determined the payback period of the selected system, and compared it to the costs of the current configuration.

To supplement the mechanical systems analysis, a variety of other building systems had to be checked for coordination with the moisture problems and redesign. Therefore, calculations have been performed to confirm that the structural and electrical systems can support the additional loads required by the renovation. A construction analysis of the costs involved with the renovation, as well as an analysis of the direct and indirect costs of the moisture problems has been performed to assist with the mechanical life cycle cost analysis. Finally, an acoustical study of the auditorium space was performed to determine the acoustical response of the space to various space relative humidity levels.

The culmination of these studies has resulted in a recommendation for replacing the current modular air handling units with a modular version of series active desiccant wheels produced by the same manufacturer. Control of these units will be supplemented by carbon dioxide sensors and humidity sensors to regulate air handler operation through demand control ventilation. In addition, the air handlers will be upgraded from a dry bulb based economizer cycle to an enthalpy based economizer cycle. Building equipment schedules have been finalized to a load following operation during peak hours and a 100% purge cycle overnight. These changes have resulted in a 30% total energy use reduction and a 30% reduction in total emissions produced. This building is an excellent example of energy inefficiency in existing buildings. Often simple procedures can cause large energy savings at minimal cost. Undoubtedly the building industry will be asked to perform more of these analyses in the future.