

## Executive Summary

HITT Contracting Headquarters is a four story, 135,000 square foot office building located next to the Capital Beltway in Falls Church, Virginia. The building consists of a variety of spaces including office, conference rooms, server space, café, fitness center and covered, under-building parking. The current mechanical system was designed to achieve a LEED silver rating and utilizes unitary rooftop units with DX cooling and electric resistance heating. The existing system is environmentally conscious and relatively efficient, but improvements could be made through a system redesign. It should be noted that economic and design constraints that were placed upon the design team were not taken into account in this report, as this report is not meant to discredit the existing system.

Three main studies were conducted for this report:

- Centralized redesign of mechanical system
- Sustainability study involving rainfall capturing
- Structural impact analysis studying the effects of the new systems

Before describing the new centralized system, this report overviews the existing system. This new centralized plant was designed with efficient systems including: absorption refrigeration and heating through the use of a chiller-heater, waterside free cooling, primary-secondary pumping, and cooling towers for heat rejection. The primary goal of the redesign was to improve efficiency of the system with a lesser focus on economic first costs. It was found that the new system had a simple payback of seventeen years when compared to the existing system and reduced annual energy usage by approximately ten percent. The new system also diversifies the building energy sources by using both natural gas and electricity; the existing system only uses electricity.

The sustainability study described in this report was implemented to provide additional water for non-potable uses from rainwater that would normally be treated as a waste and expelled from the building. A tank was sized to capture rainwater from the roof and to provide the full amount of water for the toilet systems 25 percent of the time, with supplemental volumes the rest of the year. An economic analysis concluded that the new rainwater capturing system would have a simple payback of approximately 20 years. As in the mechanical redesign, economic payback was not the primary concern of the study. Offsetting of potable water use was the main goal of the study.

A structural impact analysis was also performed to account for the new loads that the mechanical redesign and sustainability study created. The study achieved its goals of redesigning the structural system to the new loads and calculating the cost difference. Cooling towers were added and unitary rooftop units were replaced with air handling units. Minor

changes to the roof structure were observed, including a net reduction in the amount of reinforcing steel. The cost change between the existing and new was a minimal savings of \$614.51.

The redesign of HITT Contracting Headquarters increases the overall system first cost while reducing the annual operating costs of the building from \$2.52 per square foot to \$2.38 per square foot. The overall energy usage and amount of potable water consumed by the toilet system were also reduced greatly by the new system. These modifications would be best for long term solutions for the building when considering a life cycle of over 20 years.