

EXECUTIVE SUMMARY

The Carl R. Darnall Army Medical Center Replacement is topic of this senior thesis report. Various systems were explored in order to determine ways to save energy consumption, initial and life cycle costs, and building space. The alterations will be made to the top two floors of the patient bed tower because of the massiveness of the entire building.

The designed system comprises of a chilled water and hot water systems from a central utility plant located off site. The proposed plan for this thesis topic is to eliminate the need for the central utility plant for the system. Besides using the central utility plant for space for the new equipment, this new system will be its own loop.

The new systems will be modeled based on ventilation requirements from ASHRAE 170-2013 and ASHRAE 62.1-2013 instead of UFC 4-510 which require stringent minimum ventilation airflow rates. By reducing the minimum ventilation air, the two DOAS units were reduced by two thirds the air flow. The chilled water coil was changed to a DX coil to provide cold air, and a gas fired heat exchanger was added to provide heat.

The first proposed system is a variable refrigerant flow system paired with a dedicated outdoor air system. The VRF system comprises of 16 outdoor units and over 200 VRF indoor units. The floors were arranged into 16 zones in order to create small systems with safe amounts of refrigerant in the loop. The VRF system saves over 37% in energy costs compared to the baseline design, but it has higher initial costs.

The second proposed system is a water source heat pump system paired with a dedicated outdoor air system. The WSHP system comprises of one loop with 200 indoor units, a 510 MBH gas fired water boiler, and a 230 ton cooling tower connected to it to maintain a water loop temperature between 60°F and 90°F. The WSHP system saves over 19% in energy costs and it has a shorter payback period than the VRF system.

Construction Breadth

Since the mechanical system is reducing in size, the IBS floors were changed to large plenums, so the cost savings was analyzed to justify changing the systems. Removing the IBS floors also saved time by eliminating the assembly of the floor, but it lost time in the ease of installing mechanical equipment.

Structural Breadth

By reducing the size of the DOAS units, the load on the roof decreases, so the roof was analyzed in order to prove it can withstand the decrease. The reinforcement was reduced in size because the new design does not account for anti-terrorism force protection or progressive collapse resistance.