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MAJOR: Mechanical Engineering

WOODWARD RESOURCE CENTER

COMPANY PROFILE:

The Woodward Resource Center (WRC) is an Intermediate care facility in Woodward, Iowa. Established in 1917, the facility houses individuals with physical and intellectual disabilities, while also treating those with other related disabilities. WRC works to prepare and support both children and adults to live in the community of their choice while also providing care and shelter to those who cannot take care of themselves. Their mission is to "provide high quality programs and services that protect and improve the health and resiliency of individuals, families, and communities."

PROJECT BACKGROUND

The Woodward Resource Center is undergoing a process of decentralizing their heating, ventilation, and air conditioning (HVAC) cycling system from a primary power plant. The intern was tasked with creating and implementing a plan for recommendations by conducting a thermographic assessment of campus structures and targeted equipment, aiming to improve energy efficiency and reduce utility costs. The project objective is to increase energy efficiency of the campus structures and provide supporting data for a comprehensive decentralization project at the Woodward Resource Center campus. The intern performed heat transfer calculations and established feasible options for the facility to implement for this process.

INCENTIVES TO CHANGE

The WRC is committed to improving their energy efficiency. The main method being used to cycle heating and cooling through the WRC's power plant is inefficient and expensive to maintain. Large amounts of resources are lost in the heating cycle as the system is prone to leaks and damage. Furthermore, many of the buildings and cottages at WRC are outdated and need updating. The facility intends on putting an emphasis on resolving air leakages and improving quality of building envelopes to ensure the most efficient outcome during this transition.

RESULTS

Install Thermal Curtains

Through thermographic surveying and performing calculations, the intern noticed significant heat infiltration being caused by the numerous amounts of windows in several buildings. One of the most significant was the Administration building: several long corridors of uninsulated windows contributed to high temperatures inside the building. Air conditioning (AC) units would run in rooms on either end of the building, however, would not be able to properly condition the space due to the high heat infiltration from the windows. Not only did the extensive number of windows cause unbalanced temperatures within the building, but also overworked the AC systems, contributing to more energy consumption during hotter temperatures. The intern proposes the implementation of thermal polyester curtains that will be able to block the sunlight from entering the corridors and therefore shield the interior of the building from excessive heat. This addition would allow for the interior temperature and air to be better controlled. Furthermore, thermal curtains are adjustable and will be able to be moved or folded in the case that the windows need to be open.

Replacement Windows

Studying the building structures, the intern noticed several older windows still in use with some of the buildings at WRC. The facility is currently in the process of replacing these windows, however the progress is affected by budget considerations.

Through research and calculating heat loss from several of the types of windows on campus, it was shown that the oldest, single pane windows have the least amount of thermal resistance as compared to others. Although the replacement process is already in progress, it is proposed that WRC prioritize window replacement for the decentralization process. Several buildings have many old or outdated windows and ideally, the campus will eventually replace all the old windows with newer double pane windows. Since this process is slow, it is recommended to prioritize window replacement in the Administration building, Birches (office building), and Linden Court (Woodward Academy) first, as these buildings contribute the most to overall heat loss. The replacement of these windows with newer ones will provide more overall thermal resistance to the envelops of each building, and therefore use less energy to heat or cool the interior spaces.

Added Insulation

Performing heat transfer calculations revealed a significant portion of overall heat loss was the result of poorly insulated walls in the cottages on campus. Further thermographic surveying showed that much of the insulation in the walls has collapsed due to water infiltration. The current insulation, being only fiberglass, does not provide enough internal protection to the building from heat infiltration or heat loss. This is detrimental to these buildings especially during extreme hot or cold weather. Because of the poor heat resistance, the campus needs to consume more energy to maintain the internal temperature of the cottages. To address this issue, the intern recommended installing an extra layer of insulation along with the already existing material. The specific insulation recommended for this change is extruded polystyrene foam which specifically has a high thermal resistance value and is also moisture resistant. As recommended, extruded polystyrene foam insulation would be installed on top of the already existing fiberglass insulation, being imbedded in the layers of material used in this wall. This added insulation would then provide more thermal resistance to the cottages, giving these buildings better protection against extreme hot and cold conditions.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
INSTALL THERMAL CURTAINS	$5,458	9,801 therms	RECOMMENDED
REPLACEMENT WINDOWS	$5,112	9,181 therms	IN PROGRESS
ADDED INSULATION	$4,531	8,137 therms	RECOMMENDED