Thesis Proposal

Mechanical Project Proposal

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New Castle Center for Delaware Hospice, Inc.

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Mechanical Option

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Introduction of the Building

New Castle Center for Delaware Hospice is a two story building at 65,000 SF. DE Hospice is a medical building with long term patients and administration building for the hospice's support and services to the patient and the patient's family. (Throughout the report New Castle Center for Delaware Hospice may show as DE Hospice to shorten the name). The DE Hospice is divided into two buildings connected by a Lobby area. Building A is a one story building with the main entrance and patient area facilities for the DE Hospice. The support services and administration are in the two story building B. Building A has patient rooms open to an outside patio and a courtyard for the inner patient rooms. DE Hospice has aluminum curtain wall systems with manufactured stone for the lower part of the exterior wall for the first floor and manufactured stone for some exterior walls. The manufactured stone is also used chimney on the East side of building B. The building is topped with asphalt shingles on the gable roof and cupolas. Windows are cladwood windows with louvers for shading.

Mechanical System Overview

The DE Hospice has a geothermal based mechanical cooling and heating system. The geothermal wells are under the east parking lot and in to the mechanical room in the basement. Then it is piped up to the attic where heat pumps and energy recovery units are. The water to water geothermal heat pump exchanges the energy from 20% glycol source to the R410A refrigerant in the heat pumps that are supplied by the water to water geothermal heat pump. The refrigerant goes to heat pump units throughout the attic and the three ventilation heat pumps. The mechanical system does use two energy recover units that are located in the attic with the heat pumps. There are eight mechanical rooms in the attic. One mechanical room in the attic is not in line with an energy recovery unit or ventilation heat pump unit, it receives outside air directly to a regular heat pump. (see ASHRAE Standard 62.1-2007 section 6 and appendix for more information on the mechanical ventilation)

Mechanical Redesign Overview

The redesign of DE Hospice mechanical system will look at changing a full ground source heat pump system to a hybrid ground source heat pump system. By changing the mechanical system to a hybrid system the system will become more cost effective. In the HyGSHP (hybrid ground source heat pump system) will include cooling tower, boiler, reducing the size of ground heat exchanger, reducing size of pumps, finding an optimal control over new system and solar shingles to keep Leed rating. Hybrid system does not sacrifice environmental benefits because the boiler and cooling tower operates a part-load.

Alternatives Considered

When considering alternatives for redesign the main goal was to look at geothermal heat pump design options .Below is a list of option that were considered for the DE Hospice building for redesign.

- Chilled Beam

- Using two large heat pumps instead of many small heat pumps

- Drilling the geothermal wells at an angle

- Hybrid ground source heat pump system

- Solar shingles

- PV panels

Hybrid ground source heat pump was chosen base on the benefit of lowing first cost of the mechanical system. In lowing the first cost of the mechanical system will allow to add other equipment to the build and having an integrated mechanical system with solar shingles.

Cooling Tower

The Cooling Tower will reduce size of GSHP and first cost. In adding this equipment location placement will be research to find if or how to locate the tower on top of building. Placing

tower on the roof will add to the structural of the roof as well as design of the roof. There is a concern with moister from the tower and gable roof style.

Boiler

The boiler can be added to the basement with the ground heat exchanger's pumps. Frist cost and GSHP will be reducing with adding a boiler to the mechanical system. With the boiler the electrical per heat can be replaced with heated fluid from the boiler.

Pumping and Piping

The pumps will be resized for the HyGSHP and be sized for a part-load performance. The piping will have more equipment to connect together.

Controls

All equipment for HyGSHP will perform at a part-load and have controls design for operation at part-load. Cooling tower and boiler will have the ability to bypass the ground heat exchanger when it is more effective.

Solar Shingles

To reduce energy coming from the grid and low insulation cost installing solar shingles will be added to counter act cooling tower and boiler.

Proposed Redesign

The HyGSHP will reduce first cost for the mechanical system without reducing environmental benefits. GSHP reduces energy consumption in building greatly, but it comes with a high first cost of installing the ground heat exchanger. The cooling tower and boiler allows to meet a portion of the peak heating and cooling load. With a reduced peak load a smaller and less expensive ground heat exchanger can be installed.

Breadth Topics

Electrical

Changing size of equipment and adding more equipment with solar shingle will change the electrical design. With all the new equipment changes to the building should cause the panel to be changed and add more of them. The electrical new wiring and panels will be design in accords with NEC 2008. The pay back and energy produced for the solar shingle will be calculated and compared to a conventional PV panels.

Structural

The cooling tower will add weight to the roof structure and may require more room for it. The roof may need to be lifted, which will affect the structure of the roof. The current Structural material is wood. The cooling tower will have ducts of outside air to it and exhaust air though a membrane lined chimney. In having the cooling tower in the attic it will hide and chimney will better control indoor air quality. Load on the attic structure will calculated to either change size of matter and/or change the shape or size of the attic.

Tools and Methods

Trane Trace 700 will be used for energy modeling of the alternative mechanical system to keep consistent with the original built energy model. HyGCHP software will be used with Trane Trace 700 to allow comparision of the HyGSHP with the original GSHP. Trane Trace 700 with excel will also be used for operation cost of HyGSHP. Excel will also be used to find the life cycle of the system. Frist cost of the equipment will be determined by manufacturer and R.S Means.

Executive Summary

The redesign of DE Hospice mechanical system will look at changing a full ground source heat pump system to a hybrid ground source heat pump system with solar shingles. The changes that will be analysis will be the first cost of mechanical system, energy consumption by equipment, energy annual cost, controls of the mechanical system, LEED Accreditation, life cycle cost and geothermal heat pump resized.

Preliminary Research

Scott Hackel. " Hybrid Ground-Source Heat Pump Installations: Experiences, Improvements and Tools." Energy Center of Wisconsin. June 30, 2011

"2007 ASHRAE Handbook: HVAC Applications." 2007. American Society of Heating, Refrigeration, and Air-Conditioning Engineers

Carol Marriott. "3 Simple Approaches to Energy Efficency: Optimal Air, Energy Recovery, Geothermal" ASHRAE Journal July (2006): pp 44-50

Al Barfield. "Hybrid Geothermal Heat Pump for BeachFront Hotel" ASHRAE Journal Sept. (2006): pp 49-55

Tentative Schedule

Project Name	Start	Days	End	9-Jan	13-Jan	20-Jan	27-Jan	3-Feb	10-Feb
Thesis Redesign	**9-Jan**	**95**	**14-Apr**				**mile-stone**		
Research									
Mechanical Equipment	9-Jan	7	16-Jan						
Electrical Equipment	10-Feb	6	16-Feb						
Structural System	27-Feb	6	5-Mar						
Modeling									
HyGCHP	16-Jan	5	21-Jan						
Energy (Trace)	17-Jan	10	27-Jan						
Electrical	14-Feb	9	23-Feb						
Structural	4-Mar	16	20-Mar						
Analyze									
Energy	28-Jan	7	4-Feb						
Cost	1-Feb	7	8-Feb						
Life Cycle	6-Feb	7	13-Feb						
Electrical	21-Feb	7	28-Feb						
Structural	18-Mar	7	25-Mar						
Report									
Final Thesis Report	26-Mar	3	29-Mar						
Presention	29-Mar	6	4-Apr						
Spring Break	**3-Mar**	**7**	**10-Mar**						

13-Feb	18-Feb	25-Feb	28-Feb	7-Mar	14-Mar	21-Mar	26-Mar	4-Apr	9-Apr
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