Thesis Proposal for Berks Classroom and Lab Building

Berks Classroom and Lab Building - Berks Campus Reading, PA

Authored by Julia Broskey - Mechanical Option
Prepared for Dr. William P. Bahnfleth PE
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1. Executive Summary

This proposal is to outline work for Spring 2012 semester in compliance with the A E department's thesis requirements. Outlined below is the depth work, tools for analysis, and the two breadth topics.

The mechanical depth work will include the design of a ground source heat pump and its impact on the sizes of the RTU's.

The tools used for this analysis will included Trane Trace, or equivalent program, RS Means, a scheduling software and for the electrical redesign NEC 2009.

There are two breadth topics to be considered as well. The two breadth topics are a construction management breadth and a electrical breadth. The construction management breadth will included a cost analysis of all work redesigned and the impact on the schedule for construction. These numbers will be reported as just the cost for the redesign and not the full building and the schedule will be represented as the amount of days difference.

Included with this proposal is a work plan devised to anticipate work complete throughout the semester. This includes milestones for both breadths and the mechanical depth work. This proposal and work plan are subject to revision upon return to classes in January.

2. Introduction

Burks Classroom and Lab Building is located on Penn State's Burks Campus, located near Reading, Pennsylvania in Berks County. Penn State Burks sits among rolling hill and tree-lined pathways. The campus has a rich history, considering it was not always part of the Penn State system. The campus started as Wyomissing Polytechnic Institute (WPI) and became part of the Penn State System in 1958. In 1972 it moved to the Spring Township location and added residence halls in 1990. Even though there is rich history with the campus Penn State did not have to follow any historical requirements.

Burks Classroom and Lab Building is 62,188 square feet with all three levels above ground the occupancy for the building is designated as Group B – Business. The building was started in April 2010 and is scheduled to be completed in either August or September of 2011. The delivery method was design-bid-build. As with the new buildings at Penn State, Burks Classroom and Lab Building is designed using LEED certification and after completion is anticipated to achieve a LEED Silver rating under LEED 2.2.

The design team is as follows:

Owner: The Pennsylvania State University Berks Campus

General Contractor: Alvin H Butz, Inc.

Construction Cost Estimator: Becker & Frondorf

Building Architect: RMJM Hiller

Engineers:

Structural: Greenman-Pedersen, Inc.

MEP: H.F. Lenz Company

Civil: Gannett Fleming Engineers

Lighting Consultant: Illumination Arts, LLC

Acoustical Consultant: Shen Milsom Wilke, Inc.

They used multiple codes in the design of Burks Classroom and Lab Building; the codes are mostly 2006 with one exception being 2003. The code are as follows: International Building Code, International Mechanical Code, International Plumbing Code, International Energy Conservation Code, International Code Council Electrical Code, International Fire Code, and Accessibility Code ICC/ANSI 117.1 2003. There were some zoning requirements which included a Land Development Permit (LDP) from Springs Township and an NPDES permit was required from Burks County Conservation District (BCCD).

The building façade of the first floor is consists of two different types of façade, the first and closest to grade are Architectural precast concrete panels backed with an airspace rigid insulation air space and finally a masonry wall. The second part of the first floor façade has an aluminum curtain wall system in place of the architectural precast concrete panels, the two airspaces and rigid insulation. Above the first floor the façade changes again to have an exterior finish of terracotta rain screen backed by rigid insulation backed by cold formed metal framing (CMFM).

The roof system consists of metal decking covered by rigid composite insulation and a Kee membrane. KEE stands for ketone ethylene ester and is gaining popularity in Southern California because of its great waterproofing protection and lightweight design. The KEE membrane is a single-ply, lightweight vinyl and is extremely easy to install. The install for most types of the KEE membrane requires the contractors to use a simple hot air bonding technique; this creates a seamless molecular bond between each sheet of the

membrane. This makes the membrane easy to repair and remains highly flexible with age, making it easy to uncover the substructure for repairs if needed.

Considering the Burks Classroom and Lab Building is designed to achieve a LEED Silver rating at completion. The building utilizes a gray water system; this system is designed to supply the restrooms within the building with water for their water closets and urinals. Other things considered for LEED rating was using materials that are made within a 500 mile radius from the site.

3. System Description

The building utilizes a VAV system that has an air side and hydronic side to it.

AIR SIDE:

On the air side there are three roof top air handling units (AHUs) that range from 26 tons to 70 tons.

HYDRONIC SIDE:

The water side consists of two gas fired boilers with a 6.2 gallon capacity and an output of 850 MBH. The building utilizes four Split system air conditioning units with rated capacities of either 1 or 1.5 tons. There are supplemental heaters located in two vestibules, two corridors and a stair well to help regulate the temperature of these spaces.

ZONE CONDITIONING:

The spaces are supplied air from Variable Air Volume Boxes (VAV Boxes). The server room is served by a computer room air conditioning unit (CRAC).

3.1. Design Objectives and Requirements

The objective of the HVAC system in the Berks Classroom and Lab Building are to properly ventilate the building and maintain comfortable temperatures and humidity levels for the occupancy and the surrounding temperatures. There are three roof top air handling units that serve 87 VAV boxes these roof top units are supplemented by 5 cabinet unit heaters and 3 horizontal unit heaters.

There are 2 main types of spaces in the building including office spaces and classroom spaces. Additional spaces include a café, kitchen, and conference spaces.

3.2. EQUIPMENT SUMMARY

The equipment for the Berks Classroom and Lab Building include three AHU's(RTU), eight additional heaters(UHT&CUH), a computer room air conditioning unit(CRAC), four split system air condition units(ACU), five hot water pumps(HWP) and two boilers(BLR). The roof top units are variable air volume systems and for this summary the VAV boxes will not be included but will be summarized with the AHUs. (RMJM Miller, 2009).

TABLE 1: ROOF TOP UNITS AND AC UNITS SUMMARY

Unit	System Supply (CFM)	% OA Min	Coil Capacities (MBH)	
			Heating	Cooling
RTU-1	20,500	16.6	414.8	799.6
RTU-2	14,000	39.4	366.8	471.4
RTU-3	10,725	29	324.4	318,4
ACU-1	-	-	-	12
ACU-2	-	-	-	18
ACU-3	-	-	-	18
ACU-4	-	-	-	18
CRAC-1	885/800	-	-	32.8

TABLE 2: HEATER SUMMARY

Unit	System Supply	Heating Capacity (MBH)
UHTM118	460	18.2
UHT109	460	18.2
UHTP110	460	18.2
CUHF105	430	24.9
CUHQ104	335	19.5
CUHF101	430	24.9
CUHZ101	630	40.5
CUHQ304	230	12.9

TABLE 3: SUMMARY OF BOILERS

Boiler	Input MBH	Output MBH	Water Content GPM
BLR-1	1,000	850	6.2
BLR-2	1,000	850	6.2

TABLE 4: HOT WATER PUMP SUMMARY

Pump	Operation	Motor (HP)	GPM
HWP-1	Duty	1	85
HWP-2	Standby	1	85
HWP-3	Duty	1	85
HWP-4	Duty	.5	170
HWP-5	Standby	.5	170

4. Discussion of Systems

The system in the building has both an air side and a water side. The RTUs supply air to VAV boxes that are controlled by thermostats located within the area they serve.

The supply fans will turn on when the thermostats reach a temperature below the set point of the zone. This set point will vary based on occupancy, and seasonal temperatures, the summer being the cooling season and the winter being the heating season.

The boilers provide the VAV boxes and RTUs with hot water to either heat or reheat the air as needed by each zone. They also provide the building with domestic hot water.

5. Proposed Alternative System

The proposed alternative system for the Berks Classroom and Lab Building will consist of implementing a ground source heat pump to the building. The building already uses a grey water system to supply water to the toilers and urinals within the building.

5.1. Ground Source Heat Pump

A ground source heat pump would potentially lower the load on the buildings two boilers. The heat pump would consist of loops that run into the surrounding ground that is constant temperature at about 55 °F. The water would then enter the building's boilers to be heated to the appropriate temperature required by both the

domestic water system and the HVAC system. Pending the result of the analysis a reduction in RTUs, and boilers may be considered.

6. Tools for Analysis

The tools for analysis for this project will include Trane Trace or equivalent program, RS Mean, scheduling software,

7. Breadth Proposals

7.1. Breadth One: Construction Management Breadth

This breadth will include a cost and schedule study of the ground source heat pump. This will be represented in a plus or minus figure not a full cost of the building. The items to be included are the ground source heat pump and installation, the change in RTUs and or boilers and the electrical redesign needed, as well as a cost comparison with comparable systems within the state of Pennsylvania or similar climates.

7.2. Breadth Two: Electrical Design

This analysis will consist of redesigning the electrical system impacted by the implementation of the ground source heat pump and its impact to the RTUs and boilers.

8. Work Plan

1 Mechanical Depth Work
- 1.1 Research System – Semester break – 1/9/12
- 1.2 Design new system – 1/9/12 – 1/23/12
- 1.3 Construct new energy models – 1/9/12 – 1/23/12
- 1.4 Run energy models – 1/23/12 – 1/30/12
- 1.5 Analyze results – 1/30/12 – 2/13/12

2 Construction Management Breadth
- 2.1 Inquire about construction schedule – semester break – 1/9/12
- 2.2 Construct estimate – 1/23/12 – 2/13/12
- 2.3 Construct new schedule – 2/20/12 – 3/5/12

3 Electrical Redesign
- 3.1 Calculate Electrical loads – 3/5/12 – 3/19/12
- 3.2 Size components – 3/19/12 – 3/26/12

4 Final Report – 01/09/12 – 4/4/12

5 Presentation – 01/09/12 -4/9/12

9. BIBLIOGRAPHY

RMJM Miller. (2009, July 17). Working Drawings for Berks Classroom and Lab Building. *Bid Documents* . Princeton, New Jersey, USA.