Central Shared Use Facility: Thesis Proposal

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Option: Mechanical

Executive Summary:

The Central Shared Use Facility is a central building located on the White Oaks Campus in Silver Spring Maryland. It is the connection point for both existing and future buildings. The building houses a library, gym, auditorium, kitchen, offices, and a future data center. The CSUF was designed to be LEED Rated.

Mechanical Analysis:

The green roof on this building is designed to help reduce the amount of rainwater runoff, reduce the heat island effect, help to obtain a LEED rating, and reduce the cooling load required by the building. However, all of these benefits are directly related to the size of the green roof.

Each benefit will be looked at separately, and written as a "benefit amount/square foot of green roof." By looking at different sized green roofs, 40-90% of the total roof area, an optimum sized roof can be found that will be the most beneficial. These benefits will be compared to costs of the roof found in the Breadth Analysis.

Breadth Analysis:

An analysis of the Central Shared Use Facilities green roof will provide an understanding of other the structural and construction management discipline. Green roofs are great architectural features, but the increased structural requirements and costs associated with them usually outweigh the benefits. This thesis will determine exactly how much extra a green roof costs by look looking at:

1. The extra strength of structure required to support their weight
2. The extra amount of money required to construct one
3. The extra amount of time spent constructing one
4. The energy savings they create

The extra costs will be compared to the benefits of the green roof, including the value of 1 LEED point, and the architectural feature.

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Existing Conditions:

The Central Shared Use Facility (CSUF) is located in Silver Spring, Maryland, on the FDA's White Oaks Campus. Being a central building, it will be connected to the surrounding buildings by bridges and tunnels. The building has many different functions which can be seen by the diversity of the types of spaces in the building. The lower levels consist of offices, storage, and a future data center. The first floor houses a gym, cafeteria, kitchen, and a doctor's office. The second and third floors contain more offices, conference rooms, auditoriums, and libraries. This wide assortment of spaces requires the mechanical system to be flexible and accommodate the different needs of the building.

The mechanical system for the building consists of 9 Air Handling Units (AHU), and future plans for 2 more. Two AHU are located on the roof, and supply outdoor air to the other AHU. The other AHU are located in the area that they supply. One supplies the basement, two others supply the first floor, two more supply the second floor, and the last two supply the north and south stairwells. The future AHU will supply the third floor. Each air handler has a cooling coil supplied with chilled water from a Central Utility Plant (CUP). There are no heating coils in any of the AHU, but instead found in each VAV box throughout the building; supplied with hot water from the CUP. The central lobby/atrium is also heated with finned tube radiation units located by the glass facade wall.

Mechanical Analysis: The Green Roof

A green roof system can provide benefits such as providing a drainage system for rainwater, reducing the heat island effect, and reducing the cooling loads of a building. They are also credited in the LEED rating system. All of these benefits are directly proportional to the size of the green roof. The cost of a green roof is much more expensive per unit area compared to that of a normal flat roof. Since all these benefits and drawbacks are proportional to the size of the roof, there may be an optimum size of a green roof. For example, covering 60% of the roof with a green roof may be just as beneficial as covering 90% of the roof.

To analyze the size requirements for a roof, each benefit must be looked at separately. The benefits being studied will include rainwater retention, the heat island effect, the LEED rating system, and the cooling load reduction. The point of the analysis will conclude that each of these benefits is directly related to the size of the green roof system, and hopefully finding a size of the green roof that provides maximum benefits for minimum costs.

The first benefits looked at will be the rainwater retention properties of a green roof. This should be simple to analyze because there are only a few factors that need to be taken into account. The first is the amount of rainfall a year, which can be found from weather data of the area. The second is the volume of dirt found in the green roof system. Each cubic inch of dirt can hold so much water. Local codes dictate how much rainwater must be controlled, either through storage or drainage systems. By looking at the required codes, and the amount of water a cubic foot of dirt can hold, it should be easy to find the most beneficial size for a green roof.

Another easy benefit to analyze is the LEED point system. A green roof of a certain percentage of the total roof is worth so many points. This is a straightforward analysis.

The two remaining benefits include the effect of the heat island, and the cooling load cost benefits. The green roof may have to be simulated to analyze these two benefits. If there is no way to analyze or calculate how beneficial a green roof is, perhaps the solution could be found by other sources, such as papers published on the subject or case studies of similar buildings. Of the two, the cooling load benefits will be the hardest to calculate, because most manufactures do not even sell a green roof for this purpose. Since green roofs are common in Europe, there should be similar buildings that are comparable to the CSUF to help analyze the benefits.

After all of the benefits are looked at, there should be a clear relation between each benefit and the area of green roof required. Then, by looking at all the benefits together, there may be an optimum size for a green roof. The final analysis will include sizes ranging from 40% of the total roof area to 90% of the total roof area. I am only guessing that this range will be sufficient to view the changes in the benefits.

Breadth Analysis – Structural and Construction Costs:

The first breadth topic will deal with the structural system of the building. The CSUF is supported by steel columns of varying sizes. If the building did not have a green roof, I predict that smaller columns could be used or perhaps less columns. If smaller columns could be used, the fist costs of the structural system would be reduced. If the amount of columns could be reduced, there would be a cost benefit, and the amount of useable area throughout the building would be increased. However, the architecture of the building might change if the columns become differently spaced. If that is the case, this area of savings would have to be ignored, because there would be no way in analyzing the benefits for a building with a completely different layout.

As mentioned above, the required size of the beams will be dependant on the area and depth of the green roof. Therefore, when looking at the benefits by increasing the size of the green roof up to 90%, the size of the beams will also be taken into account.

The second breadth topic will deal with the cost benefits created by a differently sized green roof. By reducing the size of the green roof, the cost should drop. A few factors that will be looked at include the costs of the structural systems, the first costs, construction costs, and time costs.

The costs for the structural system should be easily calculated because the steel columns will be reduced in size, and that’s about it. The buildings first costs will be calculated by determining how much less soil and green roof components are needed with the smaller systems. The construction costs may be a little harder to calculate, but they should be reduced because it should be much easier to install a normal flat roof compared to a green roof. This reduced installation time may also be able to effect the overall schedule of the building, perhaps allowing a faster build time. Maintenance costs may be another factor looked at.

Estimated Timetable:

Week and Date	Work
1 – 1/09/06	Reworked Proposal, narrowed down topic to just green roofs
2 – 1/16/06	Find local codes to determine storm water runoff restrictions. Find local weather data. Find needed area for LEED point. Examine simulation methods for cooling load and heat island analysis
3 – 1/23/06	Begin Storm Water Runoff analysis, find current amount, reduced amounts, what to do with extra water after reductions (need new storage system?)
4 – 1/30/06	Finish Storm Water Runoff analysis. Conclude LEED Point Value.
5 – 2/06/06	Begin Simulation for heat island and cooling loads, or if not possible research for case study or lit review
6 – 2/13/06	Continue Simulation or Case Study/Lit Review
7 – 2/20/06	Finish Simulation or Case Study/Lit Review
8 – 2/27/06	Analyze Structural System, and reduction sizes for smaller green roof
9 – 3/06/06	Spring Break – catch up to schedule
10 – 3/13/06	Tally the total costs for the system not mentioned above
11 – 3/20/06	Write new construction schedule if found to change. Finish other areas if not done so before. Address problems not found in analysis that were not taken into account in this report. Start Final Report
12 – 3/27/06	Start Final Report
13 – 4/03/06	Final Report Due April 5th, Wednesday
14 – 4/11/06 3:20pm	Final Presentations