

Mechanical

It is clear that there are many benefits associated with green roofs, but the most notable benefits are related to storm water management and other civil engineering concerns. Green roofs are marketed to reduce runoff and increase the runoff quality. Manufacturers are aware that the green roofs can reduce a building's cooling load; however, there is no easy way to predict the amount of energy saved.

Numerous studies have predicted energy savings, but the results vary. The energy savings calculated by TRACE are much smaller compared to energy savings reported by existing buildings. The program does not recognize that the increased insulation is from a green roof and cannot model it properly. I think more research is needed before a green roof can be accurately modeled to predict the energy savings associated with them. There has been some consistency between every study, including this simulation, and that is that there will be a reduction in the cooling load. In today's energy depleting market, I think it is important that every energy conservation method should be utilized in design.

The main reason the CSUF was designed with a green roof is because it is known that green roofs reduce the energy consumption of the building. Even though the exact amount is unknown, and cannot be known until the project is built, the government is willing to spend the extra money to cut down on energy consumption. Today's energy crisis will only become worse in the future, and the government is already spending extra money to help reduce energy.

Structural

The green roof adds a significant amount of weight to the roof structure. In general, a green roof can require the column dimensions to double. As seen above, no direct relation exists between the size of the green roof and the number of columns that would need to be resized.

As discussed in the mechanical analysis, the structural difference of this project cannot be compared with any other project. The number of columns in need of resizing depends on the structural system and location of the green roof.

Cost

The first cost of a green roof is more expensive mostly because the material and labor costs are so much higher compared to that of a built-up roof. The cost for additional structural support and savings for mechanical systems and drainage are almost equal. This means that as green roofs become more popular in the US and they are manufactured easier, the extra first cost of a green roof will be significantly less.

It has been reported that the maintenance cost of a green roof is much lower than that of a built-up roof. (Liu) Although my assumptions estimated they are probably around the same, the differences between the lifetime costs of the green roof help payback the additional first cost. The operating cost savings will also increase as the price of energy increases. This was a main concern for the owner of the CSUF and is one of the reasons why a green roof was required. There are also tax breaks credited to building owners with a LEED certified building. The green roof on the CSUF is worth at least 2 credits and possibly more depending on the rest of the project.

Architectural Aspects

Although not discussed in the report, green roofs offer great architectural value. The CSUF is in the center of the FDA's campus and will be surrounded by many taller buildings. The aesthetics of a building may not seem important in an energy use or cost analysis, but the aesthetics of the building will determine whether the building is built or not.

Application of the results

I do not think these results can be compared with other green roof projects, or can be used to analyze how a green roof will affect a future building. Most of the variables in the analysis are project specific; however, the following facts are common to green roofs.

- Currently, the industry allows a green roof to take the place of a water quality filtration system.
- Green roofs can reduce the amount of rainwater runoff, and reduce the temperature gradient through the roof. Consequently, two LEED points can be earned by just building a green roof.
- The structure required to support a green roof is significantly larger and more expensive compared to that of a normal roof.
- The cooling load of a building can be decreased, but the amount is hard to determine. This reduced cooling load means there will be a reduced energy usage during the summer months.

The fact that a green roof can produce energy savings means that there is some value in the technology. This report analyzed for a VAV system, but other systems such as a DOAS system can utilize the reduced cooling load. A DOAS system with a reduced cooling load means the radiant cooling panels could be reduced in size. Since these panels are the most controversial design aspect of the system, a reduction in their size would be beneficial.

Conclusion

Green roof technology is new to the United States, and there is not a lot of information on how it can help conserve energy. Right now, the industry is taking advantage of the lack of information. For instance, the design for the Central Shared Use Facility did not include any water quality control filters. This is because there was a green roof covering the entire roof except where skylights and mechanical equipment was located. Even though 34% of the designed roof is impervious, it was assumed that the water that hit the impervious area would just absorb into the green roof and become cleaned that way. This is not true, because a 6" barrier exists between the edge of the green roof and any obstacles.

The CSUF benefits the most from the designed green roof of 66%. This design has the highest upfront cost, but the most energy savings. There does not seem to be a most economical/beneficial size of a green roof in terms of percent covering of a roof. The most beneficial green roof design must be determined by the amount of money an owner can spend on its first cost. If the owner can spend to make the entire roof green, then that design will result in the most savings. If an owner can only cover 30% of his roof, there will still be energy savings although at a reduced rate.