

## Goals

There are two goals for this report. The first goal is to design and simulate a VAV system for the third floor space in the CSUF. The second goal is to use the simulated VAV system to analyze the affects of a green roof. The specific benefits of the green roof that are analyzed include water quantity control, water quality control, energy consumption, the LEED point system, structural support, and costs.

A VAV system was chosen to be the basis for the design because the designated space in CSUF is already designed for one. There are two mechanical rooms available that have cold water and electrical hook-ups available for air handling units. VAV systems are also very common, so the results of this report could be compared to other existing conditions on another project.

Green roofs are a growing technology, but there is not much information about the energy savings and benefits associated to them. Every benefit and cost of a green roof is directly related to the size of a green roof. The goal of this report is to record each benefit, or cost, associated with a green roof as a “benefit amount/square foot of green roof.” By looking at differently sized green roofs, an optimum size for the green roof can be found.

## Procedure

To design and simulate the VAV system, Trane’s Trace program was used. The same design conditions as the CSUF were used, and the same equipment that was used throughout the rest of the building was used in the space as well. The space conditions of a library were used, and the amount of outdoor air supplied to the space was determined in accordance with ASHRAE Std. 62.1.2004. To simulate the green roof, the R-value of the soil was added to the R-value of the roof that Trace simulated. The manufacturer, Hydrotech, estimated their roof had an insulation value of R5 per inch of soil, which brought the roofs total R-value up to around R31. Other studies have shown similar results, calculating the R-value of soil to be from 17-38 (Sonne).

After the VAV system was designed to the existing conditions, it became the basis of comparison to the modified design conditions. To calculate the change in benefits compared to the area of green roof, the green roof was slowly reduced in size by increments of about 5%.

The existing green roof for the CSUF covers 66% of the total roof area. In each non design condition, the size of the green roof was reduced to first 60%, and then by 5% for each additional run, all the way down to 30%. Including the design, there are eight different designs in which each benefit was analyzed. The space was simulated for the summertime only, because past research has found that the green roof is less effective for heating loads than cooling loads, usually by a significant amount (Liu).

Since only the library was being simulated, the area for the library and not the entire roof was used in the TRANE simulations. The sections of the roof that were not simulated are occupied by the atrium skylight and stairwells. Each of these spaces are sealed off from the library, so the results of the calculations should remain the same.