

The building studied in this report is a 3 story, 126,000 sf office building. At the center of the Food and Drug Administrations campus in Silver Spring Maryland, the building houses a gym, cafeteria, data center, auditoriums, and libraries. The third floor has been left bare during the first design and construction phase, but the space has been reserved for a 26,000 sf library. The purpose of this thesis is to design a VAV system for the future library, and use the system to analyze how the green roof will affect the space, and how much extra costs are associated with the green roof.

To help design and simulate the VAV system, the existing space conditions were used to model the future library in Trane’s TRACE program. After the initial VAV system was designed, the simulated green roof was slowly reduced in size and the system was re-simulated in order to see how the size of the green roof affected the design. At design, the green roof covered 66% of the roof. The off-design conditions analyzed were green roofs that covered 60, 55, 50, 45, 40, 35, and 30% of the total roof area. As the green roof was taken away, a conventional concrete roof was added in its place. Energy savings, rainwater reduction, and first costs were the main categories evaluated for this thesis.

Table 1 - Summary

Green Roof (%)	Total Cooling Load (ton)	Runoff Reduction (%)	Additional First Cost (\$)	Estimated Annual Energy Savings (\$)
66	105.9	48	202,184	25,825
60	109.2	45	183,804	23,477
55	112.0	42	168,487	21,521
50	114.8	39	153,170	19,564
45	117.7	36	137,853	17,608
40	120.5	33	122,536	15,652
35	123.6	30	107,219	13,695
30	126.4	27	91,902	11,739

Based on the results above, it is clear that the designed green roof covering 66% of the total roof is the most valuable design for the owner. The additional first cost to the project is compensated by the energy savings and extended lifetime of the roof. There was no most beneficial size for the green roof, but it was determined that the bigger the green roof, the bigger the energy savings. Therefore, if an owner can pay for the additional first costs of a green roof (about \$12/sf) the owner should cover as much of the roof as possible.

Even though the maintenance costs and energy savings cannot be predicted very accurately, it is important in today’s society to conserve as much energy as possible. By building a green roof on the CSUF, the government is insuring that the energy consumption will be lower, no matter how much extra money they need to spend.