Abstract:

The focus of this thesis will be on the hydrological and thermal behavior of the green roof installed on the Jacob Javits Convention Center in 2014. This monitoring project began in 2013. A total of 99 rain events have been studied. The roof is capable of fully retaining light and medium storms yielding less than 12.7 mm of precipitation with an antecedent dry period of over 50 hours. A statistical analysis was performed to determine a relationship between antecedent dry periods and soil storage. A relationship was found to estimate the increase in lysimeter mass for heavy storms exceeding 12.7 mm of rainfall with an R^2 value of 0.6. A similar analysis was used to develop an equation to approximate runoff using storm data and antecedent dry conditions with an R^2 value of 0.73. These findings indicate that that Jacob Javits Green Roof is retaining more water each year as the green roof establishes in place. Mathematical models, combined with daylong, infrared surveys demonstrate the insulating effects the green roof has on the interior structure of the convention center during both extreme winter and summer temperatures. A one dimensional heat conduction model was developed to approximate the temperature stratification through the green roof layers within 15% accuracy. Laboratory and experimental setups demonstrate the cooling effects of a sedum surface compared to other surfaces exposed to heating, finding the green roof surface was 25-28% cooler than a black roof surface and 8-9% cooler than a white roof. The white roof reached a peak temperature of 41.5 degrees Celsius, the black surface reached a maximum of 51.4 degrees Celsius, and the sedum surface reached a peak temperature of 37.1 degrees Celsius, using a significant amount of incoming radiation to carry out evapotranspirative plant processes. An analysis of actual evapotranspiration using lysimeter mass and reference evapotranspiration, using the Penman-Montieth equation, suggests a moisture threshold where the sedum begins conserving water, decreasing overall evapotranspiration volume. Lower AET rates are observed when plants are physically constrained by moisture availability, while the RET does not exhibit the same pattern because of the assumption of unlimited soil moisture.