

## ABSTRACT

Name: Tang, Xin. Degree: Master of Science in Engineering, Purdue University, December 2015. Thesis Title: Winter Green Roof Performance Analysis. Major Professor: Ming Qu.

Green roof, also known as eco-roof, is a vegetative layer grown on a building roof. Due to the lots of environment benefits of green roofs, they have become increasingly popular in recent years. A lot of researches have been conducted to evaluate the performance and benefits of the green roofs by experiments and modeling analysis. However, few studies for energy performance of green roofs in winter can be found in the literature. This study, therefore, aims to bridge this gap to provide the evaluation of energy performance for the green roofs in winter by using through experiments and modeling. The test bed for the study is the green roof on Schleman Hall, Purdue University. It is facilitated with a data logger and various sensors for measuring soil temperature, soil water content, etc. The experiment conducted focuses on the thermal performance of the green roof in winter and how the phase change of water in the growth medium of the green roof influences the thermal performance. A transient numerical thermal model for the green roof was developed to predict the energy performance of the green roof through the various processes during winter such as freezing and thawing process. The model was validated by the experimental data and used for predict the thermal performance at other various winter conditions. The results from the predictive model show that (i) the green roof can reduce the heat flux through the roof compared to the traditional roof; (ii) the phase change of the water in the grow medium can reduce the temperature fluctuation in the soil as well as reduce the total heat flux through the roof.

The study provides new insight into the impact of the phase change of water in the green roof on the thermal performance, as well as the winter thermal characteristics of green roof.