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Influence of soil water content on thermal performance of green roofs

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5 CONCLUSIONS AND RECOMMENDATIONS

Meteorological conditions such as rainfall influence the amount of volumetric water content (VWC) that is present in soil. In this study it was hypothesised that VWC affects the thermal performance of green roofs. In turn, the aim of this study was to understand the effect of VWC on the thermal performance of green roofs, with the overall objective of determining the effectiveness of green roofs under various climatic conditions. For the purpose of this study, thermal performance was defined as the ability of a green roof to lower T_{ave} (the average temperature incident on a roof surface) and A (the amplitude of daily temperature variations).

Based on a review of soil physics, it was expected that an increase in VWC would lead to:

- an increase in C_v, and hence a decrease in T_{ave} and A;
- an increase in K_q, and hence an increase in T_{ave} and A; and
- an increase in heat lost through evapotranspiration, and hence a decrease in T_{ave}.

The objective of this study was therefore to determine how VWC affects the thermal performance of green roofs through studying its effects on C_v, K_q and evapotranspiration; and to study how the latter factors compare i.e. out of the three, which is the dominant factor affecting thermal performance of green roofs?

It was found that ΔT_{ave} (Figure 4-24) and A (Figure 4-25) remained relatively constant with an increase in VWC under both the vegetated (Box 1) and non-vegetated (Box 2) green roof experimental boxes (see Figure 3-1). This unexpected result could be due to the small range of VWC represented in the results; and warrants the need for more data. It was noted that under the same outdoor weather conditions, Box 1 tended to retain a higher VWC than Box 2. This could be due to the root system of the plants. Also, at the same VWC ΔT_{ave} and ΔA in Box 1 was higher than in Box 2. This could either be due to shading of the vegetation canopy or evapotranspiration; however, the findings of this study support the latter.

In order to gain a better understanding of the relevant influence of shading, evapotranspiration and insulation effects on thermal performance, a series of vertical temperature profiles for Box 1 and Box 2 throughout a typical summer day was plotted

(Fugure 4-6 to Figure 4-13). It was concluded that for this day, shading played a minimal role, while evapotranspiration tended to be the dominant influence on thermal performance.

When considering the effects of VWC on the thermal properties of soil, it was shown that C_v increases with VWC; and that K_q appears constant with increasing VWC. K_q values obtained were not reliable because of the discrepancies in the D_q values (section 3.4.2); and the results of this study were inconclusive. In terms of C_v, ΔT_{ave} and ΔA do not increase as significantly with VWC as C_v does. This could imply that C_v is not the dominant factor determining thermal performance.

From the above considerations, and the discussion in section 4.4, it appears that evapotranspiration is the dominant factor determining thermal performance. Evapotranspiration increases with VWC, implying that climatic factors do play a role in the effectiveness of green roofs. Specifically, green roofs in high summer rainfall regions will be more effective than those in low summer rainfall regions.

These results are only limited to one plant type, and results will vary with other types of vegetation. The study was also only limited to summer, and should be expanded to include the winter months. The results for K_q are not clear because of the discrepancies in the method used to calculate D_q. The dual heat pulse technique can be used but different research methods for D_q need to be employed where there are budgetary concerns. As mentioned, more data is required to confirm the observations of this study, and it is suggested that rainfall data be collected in addition to temperature and VWC.