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## Cooling Potentials and CO<sub>2</sub> Uptake of *Ipomoea Pes-caprae* Installed on the Flat Roof of a Single Storey Residential Building in Malaysia

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### Abstract

This paper emphasizes on the cooling effect of green roof in improving indoor comfort of Malaysian homes. The amount of CO<sub>2</sub> uptake by the chosen green roof plant is also highlighted in this paper. This study used an experimental procedure in which the measurements of temperatures, solar radiation, indoor humidity and carbon uptake of a selected green roof plant (*Ipomoea pes-caprae*) were conducted on the case study building.

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*Keywords:* global warming; green roof; *ipomoea pes caprae*; CO<sub>2</sub> uptake

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### 1. Introduction

Global warming is a world calamity. This projected phenomenon could lead to extreme and unpredictable weather conditions such as, intense precipitation, sea level rise due to melting of ice, and increased indoor discomfort conditions. Many scholars said that, global warming is caused by human activities, which contributed to the massive increase of greenhouse gas due to burning of fossil fuels and

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deforestation (Ahmad, 2007; Houghton, 2004; Kaur, 2008; Maslin, 2004; Yusoff, 2007a, 2008). Carbon dioxide (CO<sub>2</sub>) is the most important greenhouse gases that are increasing in the atmosphere. It contributed about 70% of the enhanced greenhouse effect (Houghton, 2004). If this extra greenhouse gases continuously generated, the thicker thermal blanket will develop and the earth's atmosphere will keep too much heat. The increases amount of heat-trapping gases in the atmosphere, due to the human societies, increasingly adopt the sophisticated and mechanised lifestyles, has enhanced the warming capability of the natural greenhouse effect (Yusoff, 2007b). A range of projected buildings related CO<sub>2</sub> emissions (including through the use of electricity) is from 8.6 GtCO<sub>2</sub> in 2004 to 11.4 and 15.6 GtCO<sub>2</sub> emissions in 2030 (Levine et al., 2007). Therefore, to reduce the CO<sub>2</sub> emission and improve thermal performance in a building, the energy consumption and embodied energy in buildings should be reduced. According to IPCC Fourth Assessment Report, use of technologies, culture, occupant behaviour, and consumer choice were considered as the main determinants of energy use in buildings and play a fundamental role in determining CO<sub>2</sub> emissions (Levine et al., 2007). Therefore, to reduce energy usage and CO<sub>2</sub> emission also to improve thermal performance in a building, the application of passive element in building is necessary. Many studies have proved that the greening nature of the roof may provide a positive impact towards mitigating the impacts of global warming. It also can assure an improvement in indoor comfort inside the buildings. However, in the Malaysian context, study to examine the green roof's cooling potential and its contribution towards reducing the atmospheric carbon dioxide is extremely scanty. Therefore, this paper focus on the study of green roofs' effect in improving indoor comfort of Malaysian homes and how much the atmospheric CO<sub>2</sub> can be sequestered by a chosen plant installed on the roof. The comparison of outdoor and indoor environmental data from green roof (potted plant installed on the flat roof) and expose reference roof (bare roof) has used to evaluate the green roof's cooling potentials. Furthermore, we have estimated the amount of carbon sequestered by this plant. After comparing a few plants, *Ipomoea pes-caprae* or beach morning glory was chosen as green roof plant due to its ability to uptake higher carbon dioxide.

By definition, green roof is roof consists of vegetation planted on usually water proved membrane and growing medium (Anon, 2007; Dunnett and Kingsbury, 2004). Over the years, many researchers have proved that green roof could give rise to enormous environmental benefits to the buildings and its occupants. Specifically, Eomorfopoulou and Aravatinos (1998) has shown in their studies that large surfaces covered with vegetation could contribute to the improvement of thermal performance of building. This notion was supported by Niachou *et al.* (2001) with an experimental result concluded that the surface temperature of non-insulated building without green roof were varied from 42-48°C, while the surface temperature of the green roof upon non-insulated building were much lower with the range of 28-40°C. These result shown a large temperature differences between both roofs. In 2001, Onmura *et al* from Japan confirmed that the amount of heat coming into the room during summer could be significantly reduced by a roof lawn garden. They observed the reduction of roof slab surface temperature of around 60-30°C during the measurement and estimated from there a 50% in heat flux. In Singapore, Wong *et al.* (2007) concluded that green roof tends to experience lower surface temperature than the exposed roof surface, of which over 60% of heat gain was prevented in areas covered well by vegetation. Spala *et al.* (2008) found that green roof installed on the office building in Athens significantly contributes to energy saving especially in summer and estimated a remarkable reduction of building cooling load. In Malaysia, a study by Rumana & Mohd Hamdan (2009) showed an impressive result. Outdoor surface temperature reduction of up to 19.8°C was observed on the green roof. While, the reduction of indoor ceiling surface temperature was up to 3°C compared to the bare roof. All the above studies were concentrated on the cooling effect of green roof. There are very few studies that emphasized the effect of green roof's plant in reducing the atmospheric carbon dioxide. Therefore, as mentioned earlier, one of the purposes of this paper is to highlight the CO<sub>2</sub> uptake by selected green roof plant in a single storey residential building.

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