CO_2 AND SURFACE TEMPERATURE REDUCTION ON BUILDING SURFACE USING GREEN WALLS

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A project report submitted in partial fulfillment of the
requirements for the award of the degree of
Master of Engineering (Civil – Environmental Management)

Faculty of Civil Engineering
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JULY 2010

ABSTRACT

Global warming due to the increase of greenhouse gaseous (GHG) emissions is an issue that plagues worldwide. It causes higher atmospheric temperatures, intensive precipitation, excessive solar radiation and increases air pollution. Consequently, it leads to the increment of energy consumption of ventilation and air-conditioner in buildings in order to maintain the desirable temperature. The use of green walls has been selected as the eco-friendly approach to reduce the temperature in buildings as well as to reduce the CO_2 from the ambient environment. In Malaysia, the successfulness of the green wall technology has not been thoroughly studied by the Malaysian researchers, particularly on the thermal reduction and GHG reduction. Therefore, the study evaluates the effectiveness of the green walls for outdoor ambient environment improvement and surface temperature reduction on building walls in the urban setting. Focusing on ambient air quality, this study quantify amount of carbon dioxide, carbon monoxide, surface and ambient temperature and relative humidity influenced by the green walls based on field data. Result shows that with the green wall technology, surface temperature of buildings is reduced and the ambient environment can be improved. The study also concluded that greenery can be extend to the façade of buildings to enhance air quality and thermal comfort.

ABSTRAK

Isu pemanasan dunia yang berpunca daripada peningkatan gas rumah hijau di dalam udara telah menarik perhatian dunia. Fenomena ini telah menyebabkan peningkatan suhu atmosfera, curajan hujan tidak sekata, radiasi solar yang terlampau dan menyumbang kepada pencemaran udara. Seterusnya membawa kepada peningkatan penggunaan tenaga melalui penggunaan ventilasi dan penyaman udara di dalam bangunan bagi mengekalkan suhu selesa. Dinding hijau telah dipilih sebagai satu langkah mesra alam bagi mengurangkan suhu di dalam bangunan dan kandungan karbon dioksida di dalam udara. Di Malaysia, tidak banyak kajian mengenai keberkesanan dinding hijau dalam mengurangkan suhu dan gas rumah hijau di udara. Oleh itu, kajian ini dilakukan bagi mengkaji keberkesanan dinding hijau dlaam meningkatkan kualiti udara dan megurangkan suhu permukaan dinding bangunan di kawasan bandar. Oleh yang demikian, kajian ini mengenalpasti jumlah perubahan karbon dioksida, karbon monoksida, suhu permukaan dan udara dan kelembapan udara yang dipengaruhi oleh kewujudan dinding hijau. Kajian menunjukkan dinding hijau dapat mengurangkan suhu permukaan dan kualiti udara juga dapat ditingkatkan. Kajian ini juga merumuskan tumbuhan dan kawasan hijau gunakan di atas dinding bangunan untuk meningkatkan kualiti udara dan mengekalkan suhu keselesaan.

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°C	-	Degree Celsius
CO	-	Carbon Monoxide
CO_2	-	Carbon Dioxide
NO_2	-	Nitrogen Dioxide
ppm	-	Parts per million
RH	-	Relative Humidity
GHG	-	Greenhouse gaseous

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Throughout history greening of outside walls and roofs of buildings has taken place. Reasons for doing so were the increase of insulation (keep cool in summer and keep cold out in winter), improved aesthetics, improved indoor and outdoor climate, reduce the greenhouse gases such as Carbon Dioxide (CO2), Carbon Monoxide (CO) and Nitrogen Dioxide (NO2) as well as increasing ecological values by creating habitats for birds and insects.

Throughout the years, replacement of vegetated surfaces with paved and impervious surfaces in the urban area have caused the temperature in the area to increase comparing to the surrounding rural area. This is because the paved surfaces absorbs, retain, and reradiate more solar energy than grasses and trees. The ambient temperature in urban area can be as much as 6°C warmer than the air in rural areas.

Vegetation can make positive contributions to energy efficiency through a variety of means. Simple shading by trees, climbing plants or a green roof can help stop a building from over-heating and can so reduce cooling loads by up to 30%, though always in climates warmer than the UK. The main benefit of shading is in reducing solar gain through windows, rather than through walls. Conversely, a layer of vegetation can also reduce heat loss from buildings, and it has been found that protecting a house from wind reduced the 'wind chill factor' by 75% and reduced the heating demand by 25% (Facer,2007).

Malaysia is experiencing rapid economic growth especially in the last 2 or 3 decades (Ahmad Fuad Embi,2002). Developments on urban areas have changed the surface profile of our cities. The skyline of a city are now complimented with tall buildings, condominiums, skyscrapers and the surface area are covered with paved, roads and long stretch of highways which absorb, contain and reradiate more heat comparing to the past years. With these rapid developments and change of of our surface profile, along come the environmental problems such as, drought, flash floods, pollutions and landslides.

1.2 Problem statement

Malaysia is experiencing rapid economic growth these past few decades. Along with the development, alteration of land surface profile and land clearing is inevitable, to make way for building of tall skyscrapers for new residential areas, elevated highways and more buildings in the urban areas. Thus causing increment of impervious surface that absorb more heat and causing temperature in the urban area to rise. Thus, causing the urban heat island effect. Environmental problems also increases where flash floods, air and water pollutions make headlines every year.

1.3 Aims and Objectives of the Study

The objective of the study is to determine the potential of green walls technology in surface temperature reduction on buildings and to determine the degree of air pollution that can be reduced by green walls through analysing amount of Carbon Dioxide (CO_2), Carbon Monoxide (CO) and Nitrogen Dioxide (NO_2) filtered by the plants.

1.4 Scope of Study

The study area is at Johor Bahru which is experiencing rapid growth and urbanization in Malaysia. Sutera Mall in Taman Sutera, Johor Bahru has been choosen as the case study as it has green wall technology installed at the façade of the building. The parameters considered for this study are based on two major categories, which are; thermal aspect which include temperature (°C) and relative humidity (RH) and air quality which consist of reading of Carbon Dioxide (CO_2) Carbon Monoxide (CO) and Nitrogen Dioxide (NO_2).

1.5 Significance of Study

Developing countries like Malaysia are aware of the impact of rapid construction of 'concrete jungle' to our environment. A guideline has been done on a better way of designing and constructing buildings which is through the environmental friendly, the Green Building (Faridah Shafii, 2008). Green building refers to the quality and characteristics of the actual structure created using the principles and methodologies of sustainable construction (Charles J. Kibert, 2008). It is approved by many researchers to reduce the effect of urban heat island and the global warming for instance.

Incorporating nature into the design is one of the elements in the Green Building. Thus, the use of green walls can be one of the major parts in the green building system. Green walls help to reduce the environmental impact of development through reduction of heat radiated from the surface of the building and help to create a sustainable community. When trees planted at the surrounding area of the building help in reducing the ambient temperature, with limited land and spaces, fewer or no trees can be planted. With the green walls technology, space is not an issue, where greenery can be extended on the surface of the buildings.

Nevertheless, the benefits of this technology have not been thoroughly studied yet by the Malaysian researchers particularly on how much thermal and pollution can be reduced by implementing green walls technology. This is the primary reason why sampling, measurement and analysis were needed to be carried out.

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