Roof Slab Insulation Syatem for Tropical Climatic Conditions

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Due to rapid urbanisation, land prices have escalated significantly and multi-storey buildings with flat roof slabs have gained significant interest. Flat roof slabs have many advantages such as land recovery, cyclonic resistance, the possibility of future vertical extension and utilising as an extra working space. Since the insulated roof slabs can reduce the energy consumption, an effective insulation system was decided to develop. Ultimately, a structurally sound, thermally effective and durable system was developed with locally available materials with the capability of withstanding 4MT point load. Actual scale model testing showed that the new system performs well in thermal aspects as under actual conditions. Further, a peak cooling reduction of 20% was achieved through numerical modelling. The new material invention process proved that a confined air gap with bamboo strips have a similar thermal performance as polystyrene. Also, vegetation layers on these systems can enhance the thermal conditions. Further, Life cycle cost analysis indicated an additional 5% of the initial cost is paid back within seven years.

Kasun Nandapala, a Civil Engineering graduate as well as a PhD holder from the University of Moratuwa, Sri Lanka, acts as Civil and Structural Engineer, Lecturer in Civil Engineering and a Researcher, in the fields of Building Information Modelling, Sustainable Development, Building Materials, Structural Engineering and Architectural Modelling.

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DEDICATION

This book is dedicated to each and every teacher, lecturers or any academics who do a great job in teaching and research fields delivering a remarkable service to the students.

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1 Introduction

1.1 General Overview

Greenhouse gas emission has increased rapidly for a couple of centuries now, causing the major issue that the current world is facing, Global Warming. Now, the world has begun to feel the degree of this threat, and the concern of researchers has been increased on the ways and means to mitigate it.

Meanwhile, climate change has become an inevitable consequence of global warming, increasing the intensity and severity of natural disasters, particularly cyclones (Halwatura & Jayasinghe, 2007, 2008; Isobe, 2013). Hence, the degree of damages caused by them is increased significantly. One of the best ways of

minimising this impact is to make the structures robust, as it increases the durability.

In the process, the use of roof slabs has been identified as a good strategy (Halwatura, Mallawarachchi, & Jayasinghe, 2007). Its suitability is further emphasised as it possesses many additional advantages like low maintenance cost, ability to create greener environments and the possibility of using as a working space. (Halwatura & Jayasinghe, 2009).

However, this has made its way to the issue of the higher energy requirement for thermal comfort (Halwatura & Jayasinghe, 2008). Roof slabs act as heated bodies, and emit long-wave radiation to the underneath spaces, leading to discomfort. The roof contributes to about 70% of total heat gain (Vijaykumar, Srinivasan, & Dhandapani, 2007), and in the case of a concrete slab, it is even more.

Consequently, in Malaysia, which is a tropical country and of which most of the residences are multi-storied buildings and high rises with roof slabs, 75% of the population relies on air conditioning (Al-Obaidi, Ismail, & Abdul Rahman, 2014). This is not a good statistic at all and is an issue to be addressed soon.

In this context, passive techniques have begun to play a major role in modern designs. They are the techniques that are used in the design phase itself so that the structures use a minimum amount of energy in their operational phase, particularly for thermal comfort. Insulation of the building envelope is such a popular technique. Since ’roof’ is the major contributor to internal heat gain, insulating that is very common in practice, and proven to be effective (Vijaykumar et al., 2007).