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Sustainability and Maintainability of High Rise Vertical Greenery Systems (VGS): its Lessons and Assessment Scoresheet

Sheila Conejos[1] and Michael Y.L. Chew[2]

[1] School of Science and Technology, Singapore University of Social Sciences,
sheilaconejos@suss.edu.sg
[2] Department of Building, National University of Singapore

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1 Introduction

Vertical Greenery Systems (VGS) applied on building has proven economic, environmental and social benefits (Chew and Conejos, 2016; Perini *et al.,* 2017) which made it one of the widely accepted green building design strategies to support sustainable development. However, incorporating vertical greenery systems into innovative facades generates maintainability challenges as highlighted in Chew and Conejos (2016) which reports evidenced based issues and defects in Singapore that were categorized into technical and environmental defects. The aim of this paper is to develop the Design for Maintainability (DfM) assessment scoresheet which will be beneficial in assessing and avoiding potential VGS defects leading to its maximum performance, longevity and sustainability. The research study has undertaken mixed methods. a) Qualitative Approach which uses eleven (11) selected instrumental case studies conducted in Singapore which are physically accessible for field observation surveys and a wealth of recent data is on hand. The five green maintainability factors are used qualitatively in assessing the case studies' vertical greenery systems green maintainability potential via field observation survey and interview with expert and supported by stakeholders' via walkthrough interviews. While b) Quantitative Approach was used to provide an assessment scoresheet, where a survey was conducted among practitioners and experts involved in designing and installing green facades, then using the Analytical Hierarchy Process (AHP) to analyze the data.

In previous research studies, the Design for Maintainability (DfM) guidelines (Chew *et al.* 2019) and checklist (Conejos, *et al.* 2019) for vertical greenery systems has been established. In this study, the checklist is further developed into a graded scoring system which will assess the vertical greenery systems' total performance according to the five green maintainability factors. The DfM scoresheet for high rise vertical greenery systems, highlights fourteen (14) design criteria with corresponding DfM good practice measures/guidelines and corresponding percentage scores with a total score of 100% when summed up. This research study has established a list of best practice guidelines and measures with weighted scoring system for evaluating the maximum performance and efficient maintainability of VGS applications on facades while minimizing cost, risks, negative environmental impacts and consumption of matter/energy. The paper's contribution lies in promoting the importance of integrating maintainability of high-rise VGS facades in tropical conditions during design inception.

ORCID

Sheila Conejos: https://orcid.org/0000-0001-6430-7042
Michael Y.L. Chew: https://orcid.org/0000-0002-3190-4315

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