

## DEVELOPMENT OF A MODULAR ROOF TILE FOR SLOPED GREEN ROOFS IN THE TROPICS

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Converting existing sloped roofs to green roofs in Sri Lanka poses challenges due to limited options and costly modifications. This research aims to overcome these barriers by developing a modular roof tile system that enables a smooth and cost-effective transition to green roofs. The proposed system allows for easy replacement of current roofing materials with green roof tiles, minimising the need for major modifications to the existing roof support system. By considering the tropical climate conditions of Sri Lanka, this research fills the gap in green roof studies primarily conducted in temperate regions. The study focuses on determining optimal dimensions and profiles for modular roof tiles through structural analysis and computer simulations.

The methodology employed in the research study was as follows. Initially, a literature review was conducted to gather information on green roofs, research gaps, and roof structure details specific to Sri Lanka. Then examined existing roofing systems in Sri Lanka to understand their characteristics and installation methods. Suitable dimensions for the proposed green roof tile were decided based on the literature review, the study of roofing systems in Sri Lanka, and a laboriousness study. Suitable dimensions were identified as 900mm x 1200mm x 25 mm. Then suitable profiles were selected for the green roof tile based on existing roof tiles and relevant literature. Finite element modelling was utilised to analyse the structural behaviour of the proposed roof tile profiles and identify the most suitable profile for optimal performance. Three initial shapes of corrugations were considered first to determine the best shape. Based on the comparative study of the three different corrugation shapes, it was determined that circular corrugation exhibited the highest reduction in maximum displacement per unit length increased through the introduction of corrugation. To explore the design variations within this profile, the rise and pitch of the circular corrugation were systematically varied, resulting in a total of nine different profiles. During the comparative study of the nine profiles, a specific criterion was applied to select the most suitable profile. Only the profiles that exhibited a displacement of less than or equal to 5mm were considered for further evaluation. Among these profiles, the focus was on identifying the one that demonstrated the highest reduction in maximum displacement per unit length increased through the introduction of corrugation compared to the base profile. After careful analysis and assessment, profile with a rise of 10mm and a pitch of 200mm emerged as the optimal choice, exhibiting a significant reduction in displacement, and fulfilling the established criteria. Thus, this profile was selected as the preferred profile for the proposed green roof tile system. The recommended profile demonstrates significant displacement reduction per unit length increased through the introduction of corrugation and offers favourable characteristics for accommodating the growing medium.

The findings will contribute to promoting sustainable construction practices by providing cost-effective solutions for converting existing sloped roofs to green roofs in Sri Lanka.

**Keywords: modular roof tile system; green roof conversion; cost-effective, sloped roofs; Sri Lanka; tropical climate**

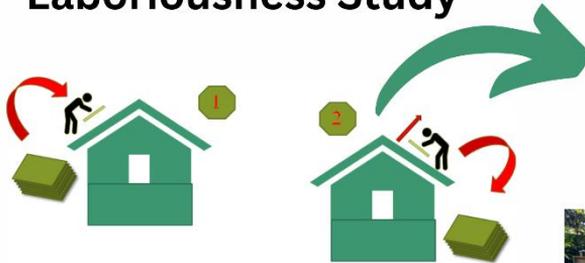
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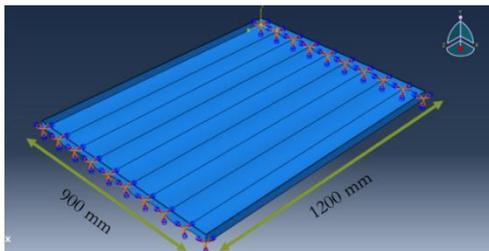


## Laboriousness Study

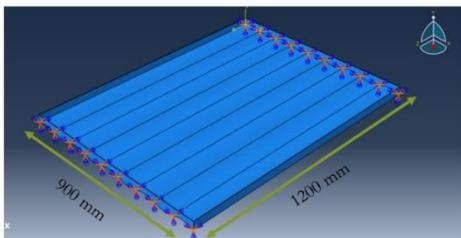


1. Time to take the tiles to the roof and to install the tiles.
2. Time to remove the tiles from the roof to bring the tiles back to the floor and stack them.

## Finalised dimension



## Finalised design



## Corrugated shapes considered:

