

# Sustainable and Circular Upright Extensions for Timber Pile Foundation

Exploring Bio-based Material Combinations for Eco-Friendly Foundation Solutions

Abdi Abdulle  
Werner Muller, Wilner Acosta Martinez, Neha John, Marianna A.  
**Project/Research Group:** BBF  
**Contact information:** aam.abdulle@avans.nl  
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## Introduction

This project explores innovative bio-based material combinations for sustainable timber pile foundation extensions. The research investigates eco-friendly materials to develop structurally sound and environmentally responsible solutions. Focusing on material selection and analysis, the aim is to contribute to more sustainable practices in foundation engineering.



Application of upright pile extensions (in Dutch "opslagers") (image by Rioned)

## Methodology

- Creating a benchmark from current materials used for as upright extensions.
- Literature review of potential biobased materials.
- AHP was used to assign weighted scores to materials. Properties were ranked by importance, and each material was scored against them. A final weighted score was calculated to identify the most sustainable and effective option.

## Promising Bio-Based Materials

- CLT ( Cross laminated timber ) with Bio-based adhesives
- Hardwood
- Hempcrete
- Bio-based Wood Plastic Composites
- Alderwood
- Beech wood
- Bio-based peach kernel shell concrete
- Glulam with Bio-based adhesives
- Willow
- Parallel Strand Lumber (PSL) with bio-based binders
- Lignin – Enhanced Natural Fiber composites
- Bacterial Bio-cement
- Bamboo reinforced Composites
- Laminated Veneer Lumber

## Current Materials and Challenges

Traditionally, upright extensions have been made from concrete or steel. While effective, these materials present several challenges:

- Environmental Impact
- Corrosion
- Thermal bridging
- End-of-life consideration



Timber piles and concrete extension piles

## Results

The MCA scoring system evaluates pile extension materials on 18 criteria, including strength, durability, environmental impact, and cost. Scores range from 1 (poor) to 5 (excellent), with weighted priorities for key factors like compressive strength and rot resistance. Top materials, such as Lignin-Enhanced Natural Fiber Composites and PSL with Bio-based Binders, excel in strength, rot resistance, and sustainability, offering optimal performance and eco-friendliness



MCA Results Graph

## References

1. Ravenshorst, G. J. P., van Dalen, J. H., Mirra, M., Steiger, R., & van de Kuilen, J. W. G. (2021). Connection of timber foundation piles to concrete extension piles. In Proceedings of the 2021 International Network on Timber Engineering Research (INTER) Meeting. Article 54-07-11.