Bio-Based Textile Reinforcements for Water-Based Waterproofing Membranes for Flat and Walkable Roofs

Augusta Silva[1], Luani Costa[1], José Morgado[1], Filipe Rodrigues[1], Miguel Rocha[2], Luís Silva[3], Sandra Ventura[4], Agostinho Afonso[4], João Abreu[4]

[1] CITEVE - Technological Centre for Textile and Clothing of Portugal, VN Famalicão, Portugal
[2] CeNTI - Centre for Nanotechnology and Smart Materials, VN Famalicão, Portugal
[3] Weber Saint-Gobain, Aveiro, Portugal
[4] Têxteis Penedo, Guimarães, Portugal

The **i4Roofs project** tackles the growing demand for sustainable, resilient, and smart building solutions by developing an advanced roofing system that combines a high-performance, water-based polymeric membrane, sustainable textile reinforcement structures, embedded electronics, and intelligent monitoring.

Designed for flat and walkable roofs, the system addresses key challenges related to cracking and subsequent water infiltration. Within this integrated system, the present work focuses on textile reinforcement structures based on natural fibres, including flax (linen) and hemp, and recycled polypropylene, designed to improve the mechanical performance, durability, and sustainability of waterproofing membranes.

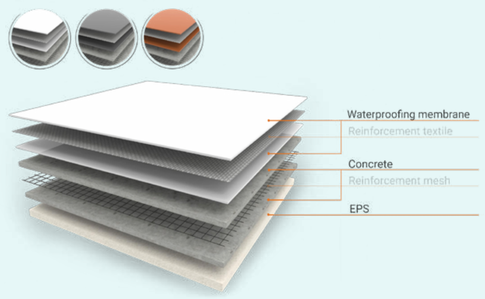
The developed reinforcement structures demonstrate high tear resistance, with good retention of this property after prolonged exposure to a water-based polyurethane membrane under accelerated ageing conditions.

The correlation between laboratory-induced ageing and *in situ* exposure contributes to a better understanding of long-term performance and supports the development of more durable and sustainable waterproofing solutions for modern buildings.

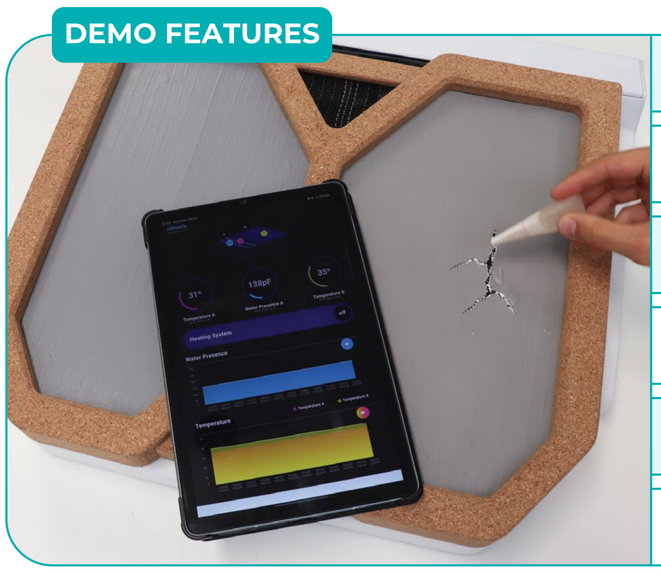
MOTIVATION

i4Roofs merges a water-based waterproofing membrane with sustainable textile reinforcement and embedded sensors to enhance durability, environmental sustainability, and structural performance. Cracking and water infiltration remain challenges, while conventional reinforcement structures largely rely on synthetic fibres. Natural and recycled fibres provide a more sustainable reinforcement alternative, improving membrane mechanical performance and cracking resistance, while integrated sensors support real-time monitoring.





DEMO FEATURES



- Solar Reflectance
- Temperature Monitoring
- Embedded Heating System
- Sustainable Textile Reinforcement
- Water Detection
- Data Communication

FINAL REMARKS



Membrane: Scaling up sustainable pigment production for industrial membrane application.

Textile Reinforcement: Characterizing mechanical behavior with/without membrane and optimizing recycled/natural fiber structures for passable roofs.

Heating System: Optimization of the heating system construction during the weaving process.

Sensors: Enhancing the performance of position and pressure sensors for improved accuracy.

Architecture & Digital Twin: Collecting data and developing ML algorithms for defect prediction; preparing real-environment testing.

SUSTAINABLE TEXTILE REINFORCEMENT STRUCTURES

Woven fabric structure with a small mesh pattern, allowing the optimal membrane transfer through the structure, promoting its adhesion with the textile reinforcement layer.



100% Linen



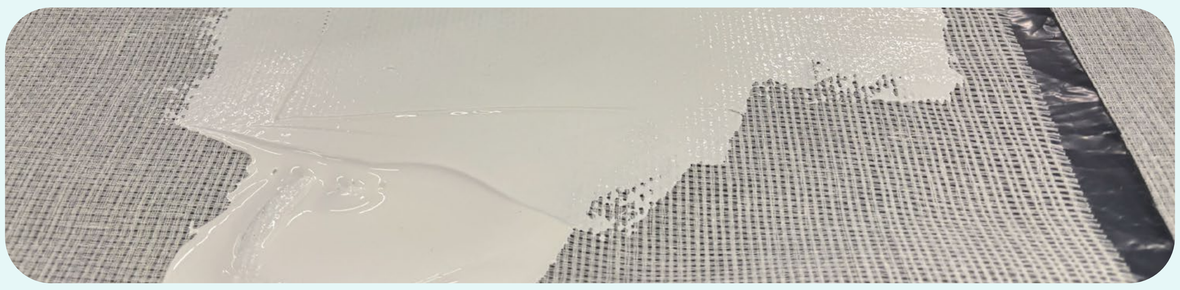
50% Linen
50% Hemp



100% Recycled polypropylene

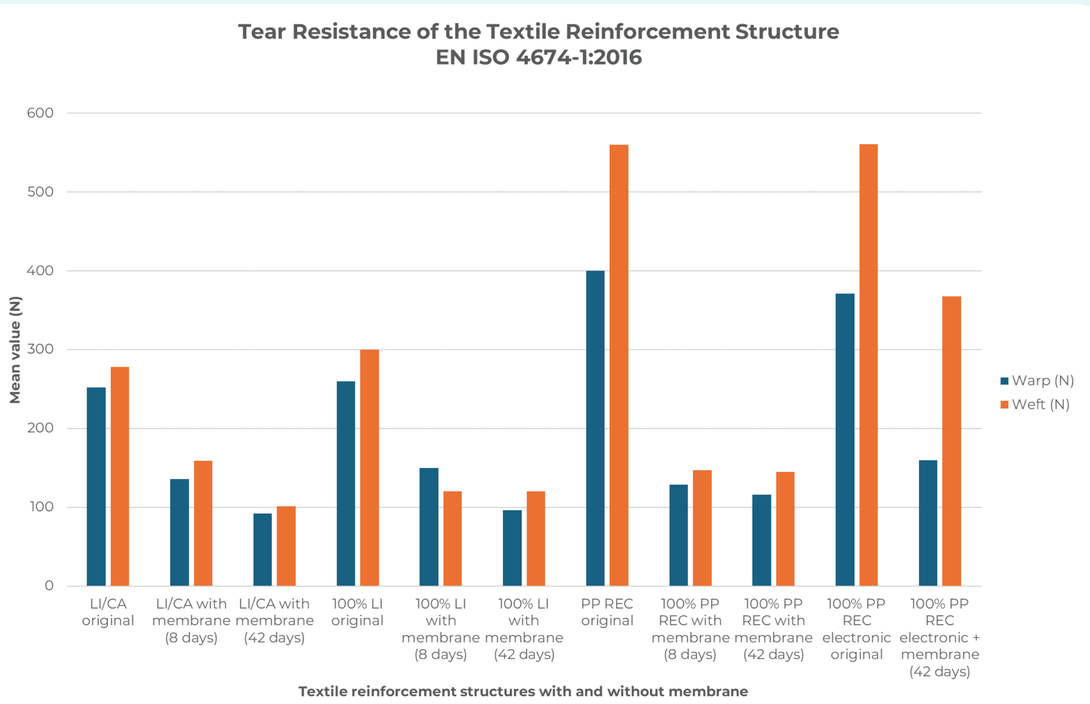


Recycled polypropylene with embedded electronics (heating and sensors)



Waterproofing membrane with sustainable textile reinforcement

MECHANICAL VALIDATION OF REINFORCEMENT STRUCTURES



SOLUTIONS AND PROTOTYPES

i4Roofs system combines sustainability, mechanical performance and smart functionality, providing an innovative solution for waterproofing walkable roofs. The textile reinforcement structures based on linen, hemp and recycled polypropylene exhibited high tear resistance.

Good retention of this property was observed after prolonged exposure to the water-based polyurethane membrane under accelerated ageing conditions. The results highlight the potential of natural and recycled fibres as sustainable reinforcement solutions for water-based waterproofing membranes. The correlation between laboratory ageing and in situ exposure supports a better understanding of long-term performance and durability.

ILLIANCE

Partners

SAINT-GOBAIN · TÊXTEIS PENEDO, S.A. · citeve TEXTILE TECHNOLOGY · centi Centre for Nanotechnology and Advanced Materials

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