

# Insulated Wood Walls Using Coconut Fiber

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## Extended Abstract

The wood walls are a very efficient structural system given their low weight and high resistance to vertical loads, earthquake, and wind loads [1]. Solid wood gives the shape to the wall, the panels are its covering and are nailed or screwed to the solid wood sections. In the cavities formed between the wood elements and the panel, a thermal insulator must be added to guarantee comfort in the building. Unfortunately, almost all insulators used today (mineral wool, expanded polystyrene, polyurethane) are not biodegradable and require the use of vapor barriers (polyethylene sheets, aluminum sheets, etc.) that increase the cost of the wall, deteriorate quickly and are relatively unfriendly to the environment. For this reason, it is necessary to find an ecological insulating material that allows a good thermal behavior of the wood wall.

Coconut fiber is a material extracted from the mesocarp tissue of the coconut tree, composed of cellulose, hemicellulose, and lignin [2]. It is a hygroscopic natural fiber, has a high mechanical tensile resistance of 131-220 MPa, a modulus of elasticity between 4 and 6 GPa and has low density ranging between 1.15 and 1.46 g/cm<sup>3</sup> [3]. It has a high natural durability (it is not affected by rodents and insects and does not suffer the action of fungi when it dries). In addition, it has been used in the construction as reinforcement in concrete elements [2], manufacture of fiber cement boards [4] and floor-cement blocks [5], demonstrating a reduction in the thermal conductivity of these elements.

In this research it is proposed to use coconut fiber to replace conventional insulators in wooden structures. Ten walls of 2.44 m x 2.44 m were manufactured from two segments of 1.22 m x 2.44 m with vertical and horizontal elements of 2" x 4" of Pinus Radiata and OSB boards 15 mm thick nailed, on both sides of the wall, to the solid wood. Subsequently, the cavities between the wood elements were filled with dry and clean coconut fiber, with an average density of 640 kg / m<sup>3</sup>. The average thermal conductivity of the insulated wood walls using coconut fiber was estimated in the laboratory according to ASTM C177-13 [6] and ASTM C518-15 [7]. Considering various climatic conditions and experimental estimated thermal conductivities, a heat transfer FEM simulation was performed to analyze the thermal load of the walls insulated with coconut fiber and compared with uninsulated walls and walls of other typical materials. Coconut fiber is a good alternative to use of traditional insulation materials.

## References

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