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Escuela Académico Profesional de Ingeniería Civil

Tesis

Analysis of the Mechanical Properties of Adobe with Chillihua Fibre and Recycled LDPE for Sustainable Construction in the Andes

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Abstract In the Andean regions of Peru, Andean house construction in Peru relies heavily on adobe as the main material, characterized by an entrenched self-construction system. This method faces significant challenges in terms of durability and structural strength, especially in areas exposed to flooding and seismic movements, due to the inherent low mechanical properties of adobe. In response to these limitations, research has explored the improvement of the mechanical properties of adobe by incorporating readily available fibers, such as chillihua fiber (CF), a plant that grows in the high Andean zone. At the same time, efforts have been made to reduce environmental pollution by reusing plastic waste, such as low-density polyethylene (LDPE), due to its slow decomposition process. This research work evaluates the mechanical properties of adobe modified by incorporating CF fiber and recycled LDPE in the Andean region of Huancayo. Evaluations of the physical properties of the soil in situ were carried out to verify its suitability, followed by tests of granulometry, moisture content and plasticity index (PI). Subsequently, compressive strength and absorption strength tests were developed to evaluate the mechanical properties of the stabilized adobes. The study was divided into control and experimental groups with varying concentrations of CF fiber and recycled LDPE (0%, 1%, 2%, 3%, 4%, 5% and 6%). The results

showed that adobes stabilized with CF and recycled LDPE exhibit significant improvement in their compressive, indirect tensile, flexural and absorption strength, increasing load-bearing capacity and improving water absorption resistance. These improvements potentially contribute positively to the durability and structural stability of buildings with a variation of the cost of a conventional wall per m² versus a stabilized wall of only 6.86%.

Keywords Chillihua Fibre, LDPE Fibre, Compressive Strength, Absorption Strength, Adobe, Durability

1. Introduction

Adobe, according to the report of the National Institute of Statistics and Informatics (INEI) in 2017, is the predominant material in the construction of approximately 2,148,494 houses in the Andean and high Andean region of Peru [1]. Adobe is the result of deep-rooted self-construction systems. This traditional material is manufactured in situ by mixing soils with potable water and vegetable fiber, such as ichu, and is used to construct one- or two-story buildings with tin, tile or calamine roofs