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Adobe with Eucalyptus Fibers Optimizing the Mechanical and Thermal Properties in Houses in Galindo

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ABSTRACT

Various legends of the past designed adobe constructions to safeguard their health according to the climate and rainfall in Galindo, which is why adobes with eucalyptus fibers were investigated and to see their incidence on the mechanical and thermal properties, the Formulation of the problem is how the elaboration of adobe using eucalyptus fibers will optimize the mechanical and thermal properties in the construction of houses in Galindo?, the sampling is of the classification of the soil and its natural average natural moisture content, the techniques and instruments , with its procedures in the methods of innovation, its characteristics in thermal insulation, Results with the thermal behavior by convection of adobe solids, presented two mechanisms of heat transfer; by convection and conduction, in both the physical properties were water absorption that kept the dosage of vegetable fiber constant, determining that they can make use of the material by replacing the clay brick.

KEYWORDS: Adobe, eucalyptus fibers, Mechanical and thermal properties.

Introduction

On different theoretical bases of eucalyptus fibers in the elaboration of adobe, their mechanical properties, according to Mescco & Zapana (2023), including the philosophical framework, technological framework, legal framework where the Standard E-080 (2017), shows us the proportion between the thickness and the free

height of the wall, with NTP 331.017 1978 - Masonry Units. After many legends of the past, the individual has enjoyed adobe constructions to safeguard his health according to the climate and rainfall in Galindo, where architecture provided many benefits to families taking care of their economy, likewise over time some cement and partition factories were implemented, different international and national works were found where the objective was to optimize the mechanical and thermal properties in the brick production using eucalyptus fibers for housing, La Torre Ortega, Á. L. (2022) and his hypothesis of the use of eucalyptus fiber optimized the mechanical and thermal properties in the elaboration of adobe housing in Galindo, according to Gonzales (2019).

In his article Albornoz (2014) argues for housing well-being and improvement of thermal insulation in social housing research, type five, where he investigated and identified the first problem in the homes studied in terms of thermal well-being, the combination of thermal insulation means a lower consumption of heating fuel: 86.53 kg of liquefied gas (LPG) and 98.74 LT of kerosene annually, Considering especially in colder times, highlighting the thermal benefits that imply in the improvement of the characteristics, in the construction of the cabinet the thermal severity is eloquently developed, this compresses the flow of heat, in warm phases, due to insufficient insulation, the walls of a type five house, its thermal mass, absorbing energy during the day and being released at night, By reducing heat transfer to the interior of the building, the specific objective of Cárdenas (2015) from Mexico in his article "Thermal behavior of architectural spaces in construction with adobe", is to calculate the density-dependent thermal properties, he concludes that it is clear from the results of thermal conductivity that walls of lower density have a better thermal conductivity (< p=>q) in cold climates and that the thermal conductivity of the building is not the same as that of the building. The density of the material does not directly affect the thermal conductivity, the authors also state that the thermal resistance and the transmission of light are equivalent because the thickness of the wall is the same, and for the formulation of the General Problem, it was presented How will the elaboration of adobe using eucalyptus fibers optimize the mechanical and thermal properties in the construction of houses in Galindo? and as specifics, will the use of eucalyptus fibers improve the mechanical properties for the elaboration of adobe in the construction of houses in Galindo? and Will the use of eucalyptus fibers increase the thermal properties for the elaboration of adobe in the construction of houses in Galindo?

For a better understanding in his research, Vega (2020) on the "Improvement of the mechanical properties of compacted adobe", where he presented that dense adobe shows excellent mechanical particularities of everyday adobe, taking into account that with studies and verifications the improvement of its property, they observed its behavior in bending, compression and absorption tests of samples, using the 8% cement stabilized adobe, compacted wall construction with 1:2-1: 5-volume symmetrical soil-cement mortar, and finally the resistance of the adobe to the cement content of 2%~8% is determined, after 28 days of maintenance, the adhesion of the mortar is the best. 1:2 and 1:3 for their joint of compacted adobe showed Carrasco & Sinti, (2019), in the perfection of mechanical properties. (p. 5)

In their study Guerrero & Lora (2023), they focused on the seismic strengthening of

adobe walls using different reinforcement materials and different reinforcement schemes through the near-surface assembly (NSM) technique. In Six Adobe Wall Panels (1900 × 1200 × 200 mm), Villar, I. R. (2021), were tested almost statically and comprised one unreinforced wall and five specimens reinforced with strips of reinforced mortar, bamboo plywood, and wood, respectively. The reinforcement procedure involved the insertion of the reinforcement materials into the symmetrically cut grooves on both sides of the walls with Aliaga, & Gonzales (2020), and their Offering of maguey fiber fabrics that improve the strength of adobe walls, with Escobar (2014), for confined masonry walls with the results were described in terms of energy dissipation, lateral strength, ultimate displacement, degradation of stiffness, ductility and maximum tolerance of maximum soil accelerations, whose test results indicated that the tensile strength, elastic modulus and scheme of the reinforcement materials had a significant impact on the seismic behavior and failure mode of the specimens, Its reinforced mortar strips significantly improved the seismic behavior of the adobe walls. Reyes, (2016), showed that the reinforcement of the walls with bamboo wood had achieved satisfactory results in terms of ductility, energy dissipation and PGA. Finally, the masonry calculation formula was modified to establish the formula for estimating the lateral strength of the adobe wall. Palomino Huatuco, E. (2023).

In Comparison of cellular and prismatic mechanical properties of earth blocks, Castañola (2018), compacted stabilized with cement and pozzolana geopolymers", Utility and scarcity of soil, as a more resistant, economical and rational reconstruction material in developing countries, with a more methodical construction using compacted earth blocks. (BTC) according to Gonzales, & Humareda (2022).

In his research, Chuquillanqui (2019) argues that the consequence of the incorporation of polypropylene fibers in the improvement of the physical and mechanical properties of clay. The author shows how the aggregation of polypropylene fibers, and incurs in the improvement of their properties, in the construction of houses, with the aim of determining the effect on the physical and mechanical properties, with a scientific method, it was concluded that the addition of polypropylene fibers improved the properties of the adobe components, such as the curvature, dimensional instability, rigidity and compression permeability, permeability and absorption capacity of the residential buildings of the National Group.

Justification of the research, with Gonzales (2019), in the economic aspect: the construction of adobe houses with the addition of eucalyptus fibers represents a lower cost because they have all the resources in the area for the elaboration of new specimens, with benefits: the conservation of temperature in adobe houses built with the addition of eucalyptus fiber will bring a health benefit and improve the quality of the inhabitants by reducing the quality of life of the inhabitants. the infant mortality rate and bronchial diseases in adults and children. Babé, (2020, p. 2), in technical: Current research involves understanding the thermal behavior of Eucalyptus, which will help improve the thermal conditions of the house and thus increase the comfort of the occupants at low temperatures. Solórzano, (2015), in Mexico and in the environment: the aggregate used in the production of adobe is environmentally friendly, since it does not create any type of pollution in the creation of new adobe, since it is purely natural, renewable and clean. Gómez (2018), showed the limitations

of special research, in Peru we cope with meteorological phenomena such as frost and cold, that is, a drop in temperature, a climatic problem that increasingly affects the Andean region, likewise, the multidisciplinary program resistance to frost aims to reduce the vulnerability of people to frost and cold phenomena, temporal, the time element means that the survey within social programs, collecting data in state agencies for evaluation exceed the times generated, another limitation is the economic factor, since this research work is self-financed with own resources, with Yzaga, A. (2023).

General objective, To optimize the mechanical and thermal properties in the elaboration of adobe using eucalyptus fibers for housing in Galindo, the specific, To improve the mechanical properties in the elaboration of adobe using eucalyptus fibers for housing in Galindo, To analyze eucalyptus fibers in the thermal properties in the elaboration of adobe for the construction of houses in Galindo, we can comment that in the use of eucalyptus fiber, the mechanical and thermal properties in the elaboration of adobe housing in Galindo will be evaluated.

1. Methodology

Its quantitative, descriptive, basic and applied approach, according to Lozada (2014), was a quantitative approach (Hernández - Sampieri & Mendoza Torres, 2018). It was instrumental in design, aimed at analyzing the physical properties of the instrument and the study of its reliability and validity according to Gómez, et al., (2021), with Yépez - Alvarez, et al., (2022). With evidence of validity in questionnaires and samples.

1.1. Participants

Population and sample were considered according to the authors Dávila et al., (2018). I indicate the Social Progress Index and then define the population as a general panorama of study in the Laredo district (2017 census, INE1), based on the object of study for which specific characteristics are observed; 140 adobes were made, Anchaya (2022). Addition of eucalyptus in soil coding sampling in table 1.

Table 1. Natural average moisture content

Average	**Total**	**%**
W (%)	8	%

Source: Own elaboration

1.2. Instruments

Particle size test sieve (Peruvian Technical Standard 339.128. 1999) Quantification by sieving of a specific soil distribution retained in sieve no. 200: instrument, balance, oven, mechanical sieve, stopwatch, thermometer and strainer. Moisture content test, with Nazar, (2022), showed us that this test, sent to Adobe, must determine its moisture content expressed as a percentage (%) (Peru Technical Standard 339.127.1998), the test conditions are: equipment, yards, oven and balance, where the program first, analyzed the particle size, moisture content and Attberg limits of the soil used to verify

compliance with Adobe's manufacturing requirements. Proposal for a structural reinforcement technique According to Escobar & Rivera (2021). Where there are different ways of obtaining information, and since the results are standardized (Standard E.080), the most commonly used technique to obtain information is direct visual observation. Therefore, we conduct testing and laboratory testing on the engineering school grounds. We use technical pages to collect data to better control your data. Gonzales, & Reátegui, (2019).

1.3. Procedure

Mar, (2019), in the procedures and methods of the study, data obtained from the laboratory were validated with data from previous studies to visualize the differences that existed between the control and experimental groups. An explanatory analysis will be carried out, since the objective of this study is to understand the negative effects of adobe on the thermodynamic behavior of nature, for its analysis and data processing laboratory tests of the samples were used. Carrillo & García (2018).

1.4. Innovation

Innovation, in this study is based on the addition of eucalyptus fibers to modify the physical and mechanical properties of adobe, Monrroy (2020), and its effect on thermal behavior using the properties of eucalyptus fibers, a resource of the region; in addition, we will use the Fanger software to determine thermal comfort in homes stabilized with eucalyptus fibers.

1.5. Characteristics

Characteristics depending on thermal insulation; according to Astudillo, F. (2009), for thermal insulation, it is necessary to know the physical properties of the material, such as the color of the surface, since darker colors absorb solar radiation better. In a climate of low temperatures, it is necessary to insulate the walls of the greenhouse, especially the south-facing walls, to achieve thermal insulation both inside the environment and outside the walls. The amount of heat accumulated in the home reduces temperature, Garzón, B. (2021).

2. Results

On-site evaluation of the properties of Adobe components by Gonzales (2019), in the materials laboratory and during sample manufacturing; allows us to understand and evaluate these properties through Adobe's physical, mechanical, and thermal testing. The field studies were carried out empirically through the excavation of pits and the selection of materials according to Annexes 01 and 02 of the E.080 standard, with Quijano (2023), which were transported to the soil and materials laboratory. Tested by soil classification, the average natural moisture content of W (%) is 8% with Atterberg limits. Checking with the Soil Classification, the natural moisture content of W (%) average 8%, with Atterberg Limits

Table 2. Soil classification, the natural moisture content of W (%) average 8%, with Atterberg Limits

Liquid	Stocking	Plastic Limit	Plasticity index

Limit			
27.85	%	21.2	6.65

Source: Own elaboration

Granulometric analysis by sieving: according to the ASTM D422 standard it will allow us to determine the quantitative distribution of soil particles; For the test, 6 kg of material is used, of which the dry part will be weighed, in addition, the part retained in the 200 sieve (0.074 mm) will be washed until the running water remains, crystalline for subsequent weighing and then sent to the oven for drying. Guerrero & Purisaca (2023).

Description of the stratigraphic section: Results of the in situ sampling; In the area, dry roots of wild plants were observed with some plastic debris and remains of dark brown furniture compacted at a depth of 0.20 meters and containing silty clay. Based on the results of laboratory tests, the properties of the soil can be defined, according to SUCS, the percentage of material passing through sieve no. 200, is greater than 50% and the soil type is CL - ML (low to medium plastic silty clay, fine sand, less fine gravel, medium consistency)

Manufacture of the specimens: All specimens are made in Galindo

First, the adobe samples were made without the addition of eucalyptus fibers; Soil was extracted from the pit, from which stones and other large foreign bodies were separated. Then we begin to gradually moisten the clay until it absorbs the amount of water molecules necessary to continue walking, until it acquires a plastic consistency; then it is left (curing process) and then it is ready to be placed in the mold. Before that, the mold should be moistened and placed in sand so that the mold can be easily removed. When making adobe, the mud is poured into the mold in two stages, the first half, then vibrated, the mold is completed, and then carefully removed, because it deforms easily, according to E.080 standard, the sample is dried at room temperature, out of direct sunlight (use plastic to protect the samples) for 28 days. Second, adobe samples were made by adding eucalyptus fibers; Soil was extracted from the pit, from which stones and other large foreign bodies were separated. Then we begin to gradually moisten the clay until it absorbs the water molecules necessary to continue treading and adding eucalyptus fibers until a plastic consistency is obtained; Then leave it for 24 hours (curing process) and you can put it in the mold. Before that, the mold should be moistened and placed in sand so that the mold can be easily removed. When making adobe, the clay is poured into the mold in two steps, the first half, then vibrated to complete the mold, and then carefully removed, because it is easy to deform, according to E.080 standard, the sample is dried, at room temperature, protect from direct sunlight (use plastic to protect the samples).

Evaluation of the mechanical and physical properties of adobe, with Escalante et al., (2020).

Compressive strength test of the eucalyptus fiberless adobe unit an average of 20.41.

The flexural strength test of the adobe unit with eucalyptus fiber is 20.44

Battery compression test

The Protected Hot Plate Meter (APCG) is a test method for the determination of steady-state color transfer in flat samples developed in accordance with the recommendations of ASTM C-177. In the procedure of evaluating the thermal properties of adobe, to determine the electrical conductivity of adobe, we first weigh, then measure the thickness of several samples of each type of adobe, and then mount on a heating surface with a protective cover (APCG); Get the data according to the following method.

First, the sample is prepared taking into account that its thickness must be constant and the surface must be uniform and flat, so that the heat transfer is uniform when in contact with the heating surface.

Secondly; test material is trimmed and filled with 1-inch thick extruded polyethylene (XPS) to ensure its insulating properties

Third; covering it completely with plastic to decrease the absorption of moisture from the environment.

Room; Some samples were installed between the hot plate and the cold plate, and it was checked whether the surface of the hot plate and cold plate should be cleaned, whether the water supply should be stopped, and if there is no temperature sensor on the device, cold plate.

Fifth: At the end of the sample setup, put the thermocouple into the protected hot plate setting and connect the water power supply to the cold plate, also prepare the ice bath and submerge the reference thermocouple.

Sixth; heat is supplied to the measuring area and to the guard by means of sources, taking into account that the temperature difference must be ± 0.003 °C by adjusting the values of voltages and currents.

The seventh; The measuring system must maintain a steady state over time, which requires adjusting the temperature of the cold plate, the voltage and current values of the measuring area, and the protective device, which will be displayed graphically.

In the program, data acquisition is a program that periodically calculates the temperature of hot and cold plates and acquires data every minute when energy is applied to the measurement area.

The data is used to calculate the temperature of the measurement section, the guard section, the temperature difference between them and the current data will be used to calculate the temperature and ambient humidity, in addition to this we will calculate the thermal expansion of the measurement area of the hot plate and then the thermal conductivity is calculated.

The connective thermal behavior of solid adobe can have two heat transfer mechanisms; by convection and conduction

The convection heat transfer mechanism was carried out at the Soil and Materials Mechanics Laboratory, of the Cesar Vallejo University, where the following equipment was used: concrete kiln and thermometer, to determine the thermal behavior of concrete Costantini & Francisca (2022), in a certain period of time.

3. Discussion

Carhuanambo (2016) in his book "Mechanical and physical properties of crushed adobe with chip and sawdust aggregate" recommends increasing the proportion of eucalyptus chips and sawdust by 1.5%, 3.0% and 4.5%, in terms of compression, according to Rojas (2023), adobe improved its mechanical properties in both cases, increasing compressive strength by 5% and flexural strength by 10%, maintaining the physical properties of resistance to water absorption.

The suggested prerequisites are not fully met, as Adobe tests with different percentages of tile addition show a minimum compressive and flexural strength of 28.04 kg/cm2 and 19.38 kg/cm2, respectively, this gave the lowest compressive and flexural strengths of 13.64 kg/cm2 and 9.81 kg/cm2, respectively, which violated the assumptions and did not change the physical properties in both cases. Fernández and Quispe, (2019).

Mechanical results for Adobe elements by Carvalho, M., et al., (2016) and 20.41 kg/cm2 for Carrasco and Sinti (2019) without medium eucalyptus fibers. In compressive strength and flexural strength they were 5.81 kg/cm2, while the adobe unit containing medium eucalyptus fibers had a compressive strength of 20.44 kg/cm2 and a flexural strength of 8.43 kg/cm2, and given the low modulus of elasticity obtained in the compression test of the masonry, The fibers surpassed adobe without the addition of other types of materials. Likewise, the new production plant complies with the Peruvian technical standard E.080, which concludes that this material can replace clay brick.

4. Conclusions

Adobe has improved its mechanical properties in both cases, increasing compressive strength by 5% and bending strength by 10%, maintaining the physical properties of resistance to water absorption, with these experimental evaluations we can verify the constructive changes to achieve thermal comfort in a home according to

According to the results obtained in the detailed tests, adobe with eucalyptus fibers behaves better than adobe without the addition of other types of materials, considering the low modulus of elasticity obtained in the compression tests of masonry.

In addition, the new facility complies with the Peruvian technical standard E.080, which states that the material must be used instead of clay bricks.

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