SUSTAINABLE CAPSTONE PROJECTS [SCAP]
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Heat transfer Analysis of a Mini house

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INTRODUCTION

Heat transfer is the process by which thermal energy flows from regions of higher temperature to regions of lower temperature until thermal equilibrium is achieved. Understanding heat transfer is crucial for optimizing energy efficiency, enhancing thermal comfort, improving system performance, and ensuring safety. It also plays a vital role in promoting sustainability, guiding material selection, fostering innovation, and improving industrial processes.

This project aims to analyze the heat transfer properties of a mini-house constructed with double-wall wooden structures. The focus is on evaluating how heat flows through the house's walls, roof, and floor, with particular attention given to the double-wall design. This design includes an air gap or insulation layer that helps reduce heat transfer, ultimately enhancing the building's energy efficiency and thermal comfort.

FINAL PRODUCT

We conducted the heat transfer analysis using three main components: the first component is the material to be tested, the second component is the insulation layer, and the third component is the environment in which the material is placed. The analysis works by simulating heat flow through the material, observing the impact of the insulation layer, and evaluating the temperature changes in the surrounding environment. The results are obtained by running simulations and analyzing how the insulation improves energy efficiency and reduces heat loss.

RESULTS AND DISCUSSION

Results and Discussion

Thermal Performance:

- Single-layer wood allowed higher heat transfer (Q=1.61W).
- Adding styrofoam reduced heat transfer (Q=1.49W), demonstrating improved insulation.

Energy Efficiency:

- The addition of styrofoam significantly reduced internal heat gain, enhancing thermal comfort.

Practical Applications:

- This experiment demonstrates how combining wood and styrofoam can be used to improve energy efficiency in real-world construction.

The thermal simulation demonstrated that using styrofoam as an insulating material enhances energy efficiency and heat loss control, making it a viable and cost-effective option for industrial applications. The project strengthened our understanding of heat transfer principles and provided practical skills in thermal simulation, paving the way for future thermal optimization efforts in industries focused on energy efficiency and thermal management.

MATERIALS USED IN CONSTRUCTION

1. **Construction Materials Wood: Used as the primary structural material for the walls.White Styrofoam: Placed between the layers of wood for improved thermal insulation. The styrofoam was cut manually and with a laser cutting machine.**
2. **Tools and Testing Equipment Hot Glue: Used to bond the wood and styrofoam layers together. Thermometer: Used to measure both internal and external temperatures**
3. **.3. Mini-House DimensionsLength: 28cmWidth: 24cm Height: 18cm Wall Thickness:Single-layer wood: 1.2cmCombined wood + styrofoam: 2.2 cm**

REFERENCES

Books:"Introduction to Heat Transfer" by Incropera and DeWitt."Fundamentals of Heat and Mass Transfer" by Incropera and DeWitt.Standards:ASHRAE Handbook - Fundamentals: ASHRAE Link.