FEASIBILITY OF THERMAL ANALYSIS OF CONSTRUCTIVE SYSTEMS USING THE AHP-GAUSSIAN METHOD

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ABSTRACT

The low energy efficiency of buildings highlights the need for materials that bring advances in this area. Therefore, this work aims to analyze the thermal viability of walls in EPS core panels in Brazilian bioclimatic zones. For this, the software EnergyPlus 9.4 was used to analyze and compare this material with that of ceramic blocks, and the AHP-Gaussian method for decision-making on the most viable systems. Several scenarios were simulated, and the results indicated that in hot zones, even for low solar absorptance, the masonry presented better performance, with the EPS presenting 39.95% more thermal load consumption. On the other hand, in cold areas, EPS core panels were among the best solutions, depending on their characteristics. Finally, the study identifies the feasibility and impacts of the analyzed systems on energy efficiency, performance, and thermal comfort of affordable housing and the benefits of the AHP-Gaussian method in decision-making in studies in this area.

Keywords: Thermal comfort. Thermal performance. AHP-Gaussian. Computational simulation.

1. Introduction

Several studies have analyzed the influence of materials on energy efficiency, aiming to obtain buildings energetically efficiently. These studies can be made using computational simulation. When this methodology is utilized, several parameters are considered. As a consequence, the decision-making about the best combinations of construction techniques, materials, and thermal properties may become complex. For this reason, the adoption of multicriteria decision-making methods, not yet used in this area, becomes relevant.

2. Literature Review

Among the multicriteria decision-making methods, there is the AHP-Gaussian, developed by Santos, Costa and Gomes (2021) for selecting the best options of warships for the Brazilian Navy, which has already been used in other works, such as the evaluation of

hospital acquisitions (SILVA, GOMES and SANTOS, 2021) and the selection of a large cargo aircraft model for the Brazilian Air Force (SOARES, SANTOS and GOMES, 2022).

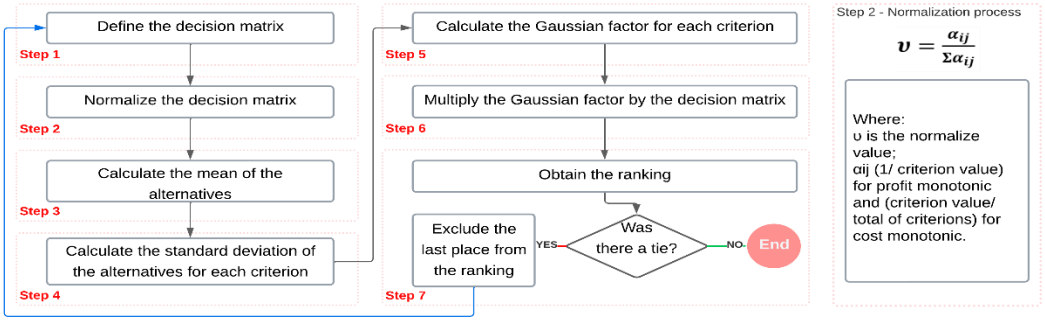
3. Hypotheses/Objectives

This work aims to analyze the applicability of the AHP-Gaussian method for assisting decision-making in thermoenergetics simulations, analyzing the viability of the application of EPS core panels in the different Brazilian bioclimatic zones (BZ).

4. Research Design/Methodology

The research started with the execution of the computer simulations and identification of the thermal performance level and percentage of hours in thermal discomfort, followed by the application of the AHP-Gaussian Method, illustrated in Figure 1.

Figure 1 - Flowchart of the steps of the AHP-Gaussian method.



The criterions analyzed for each of the eight bioclimatic zones were the maximum (TomaxUH) and minimum (TominUH) operative temperature, the percentage of occupancy hours within the acceptable operative temperature range (PHFTUH), the annual sum of the thermal load values (CgTTUH), and the discomfort hours. All these criteria were analyzed for different scenarios, varying the solar absorptance, ventilation system, and shading, totalizing 112 computational simulations, being unfeasible the individual analyses between the results.

5. Data/Model Analysis

In addition to the results exposed in the appendices, it could be observed that:
• For places with high thermal amplitude, the EPS core panels present greater advantages;
• In hot zones, EPS-D, even with shading, should be avoided;
• Shading of openings should be prioritized in social housing in hot zones, having reduced OTmax by up to 0.51°C and increased the hours in comfort by 13.86%.

6. Limitations

The limitation of the use of AHP-Gaussian for analyses of thermoenergetics simulations is the impossibility of using parameters that presents negative values.

7. Conclusions

This study highlights the benefits of multicriteria decision methods in analyses of thermoenergetics simulations, reducing time and effort, allowing informed decisions, and the development of studies considering more parameters.

8. Key References

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9. Appendices

Figure 2 – AHP-G Values

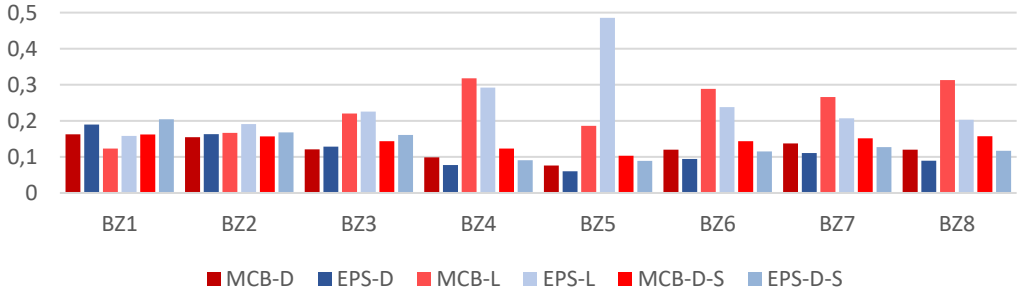
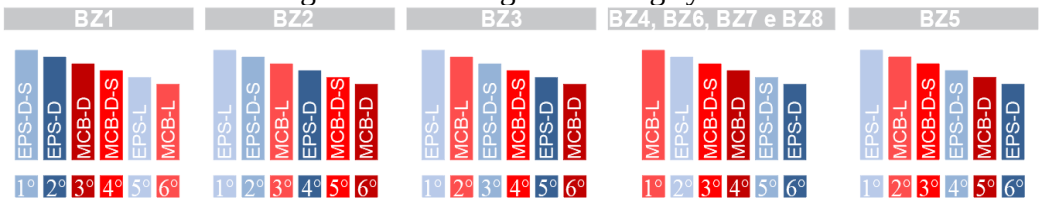


Figure 3 - Ranking of building systems.



Source: the authors (2022).