



Multi-Objective Optimization of Bioclimatic Modular CEB Housing for the Sahelian Climate

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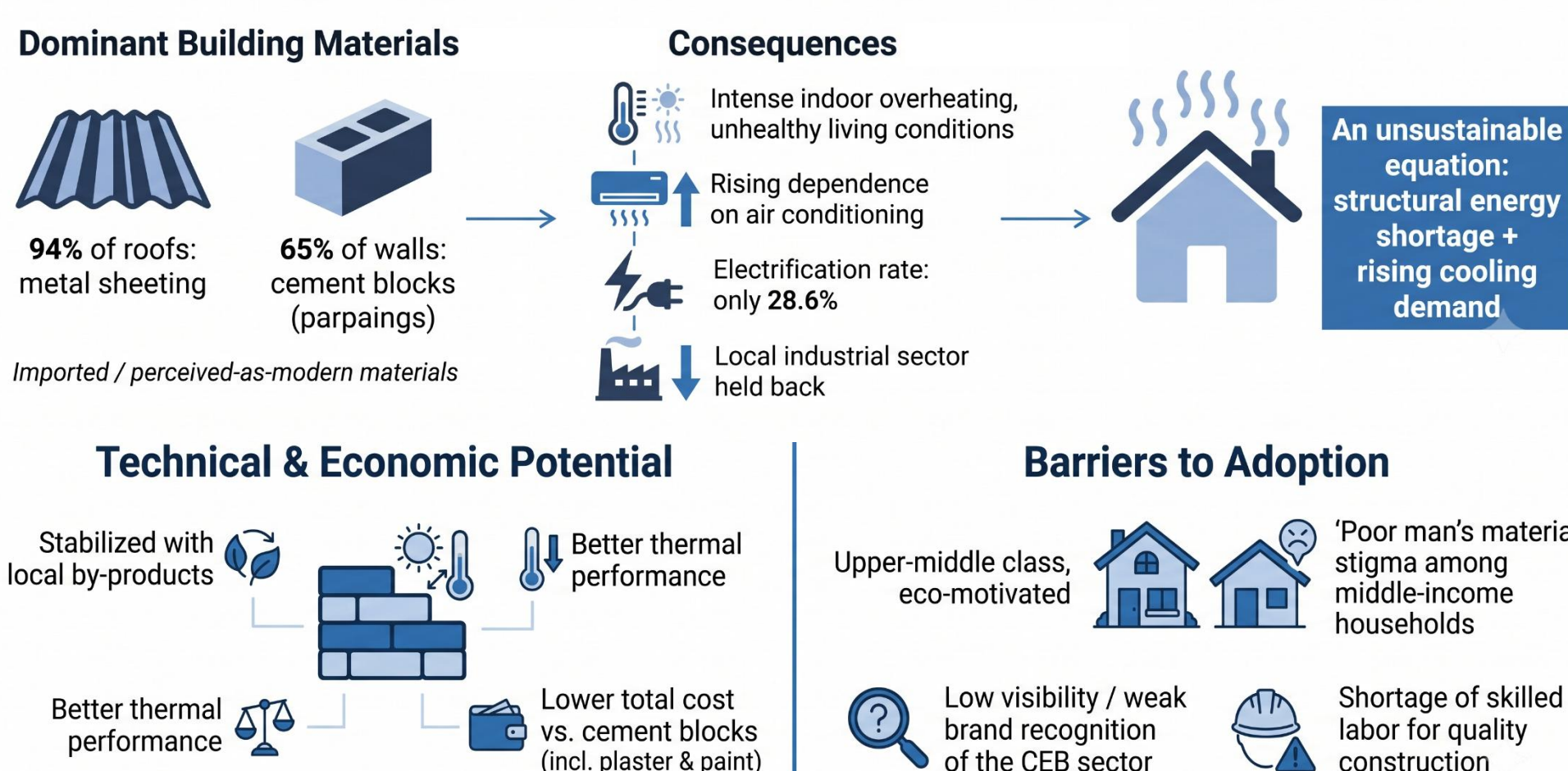
ABSTRACT

In Burkina Faso, most homes are built with cement blocks and metal roofing, materials poorly suited to the hot, dry Sahelian climate and prone to severe overheating. This PhD develops a design and optimization method for bioclimatic, modular Compressed Earth Block housing in Ouagadougou, coupling EnergyPlus simulation with the NSGA-II algorithm to reduce discomfort, cost, and emissions.

KEYWORDS

Compressed earth block; Bioclimatic modular housing; Thermal comfort; Multi-objective optimization; NSGA-II

PROBLEM



OBJECTIVE / HYPOTHESIS

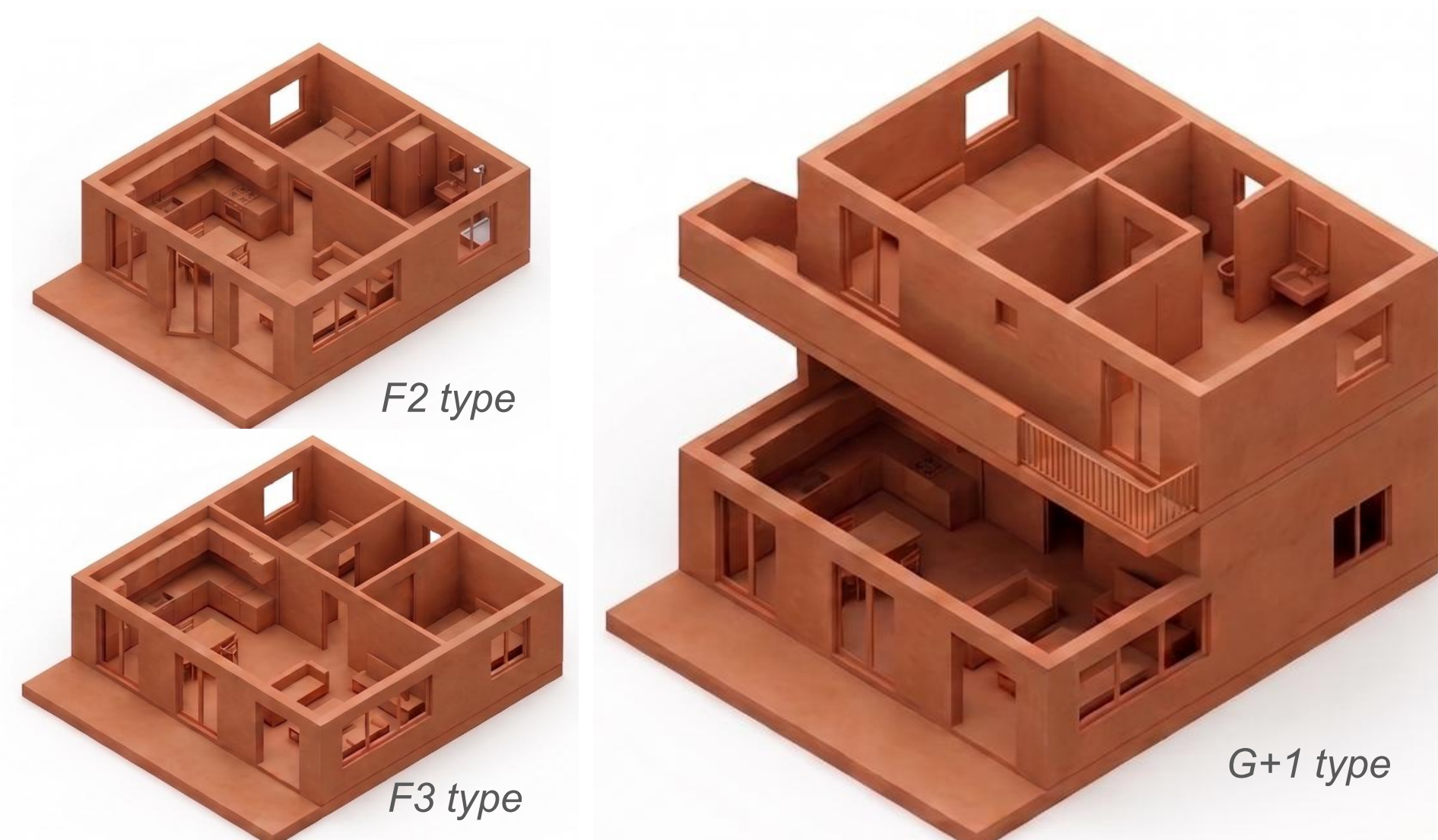
This research develops a design and optimization method for bioclimatic, modular CEB housing adapted to the Sahelian climate. We hypothesize that optimizing orientation and wall composition can reduce discomfort, cost, and emissions.

AUDIENCE

Training institutions, construction professionals, and middle-income households in Burkina Faso will benefit directly.

RESEARCH QUESTION

How can CEB housing be optimized for thermal comfort, cost, and emissions across F2, F3, and G+1 housing typologies in the Sahelian climate?



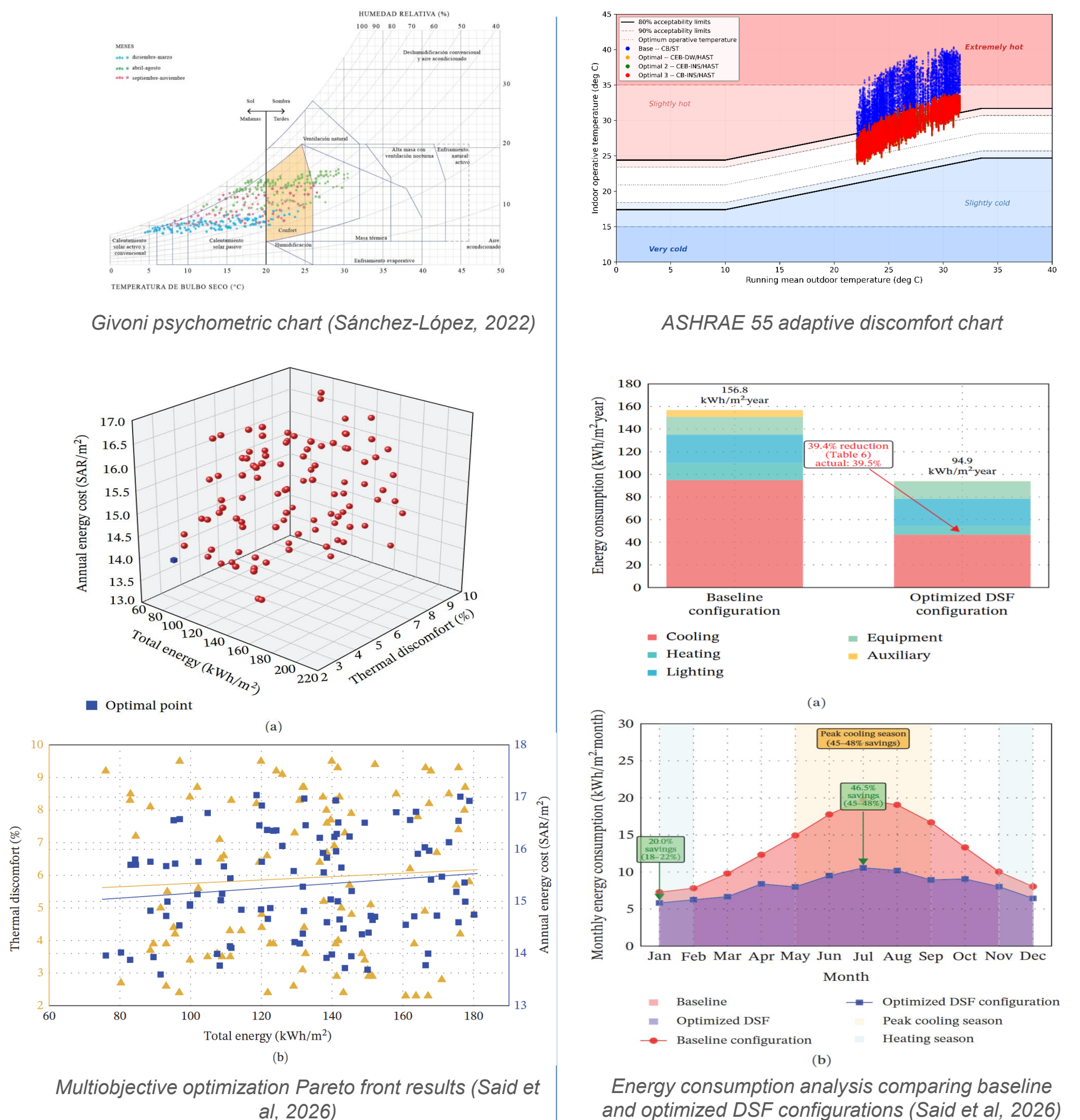
ORIGINALITY

This research is the first to combine dynamic thermal simulation, NSGA-II optimization, and compressed earth block's thermal properties to design bioclimatic, modular Sahelian housing, filling a clear gap for CEB construction in Burkina Faso. Using EnergyPlus (via DesignBuilder and jEPlus+EA), it identifies Pareto-optimal trade-offs between discomfort, cost, and emissions across key design variables,

METHODOLOGY

Six work packages: (1) literature review and housing stock characterization; (2) twelve months of in-situ comfort monitoring; (3) optimization framework combining EnergyPlus and NSGA-II; (4) application to three housing typologies; (5) validation of social acceptance; (6) integration of results into design guidelines.

EXPECTED RESULTS



CONCLUSION

This research offers the scientific community a validated methodology for hot, dry climates, gives architects and masons ready-to-use design rules for comfortable passive houses, and provides local authorities an evidence base for housing policy,

RESOURCES

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