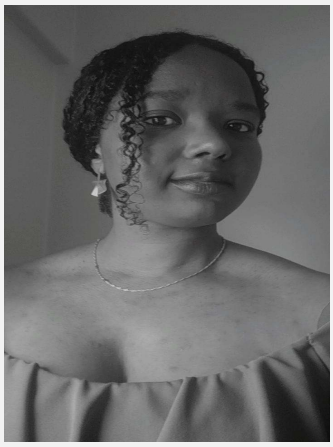
CERIS : Civil Engineering Research and Innovation for Sustainability

# Thermal rehabilitation of buildings using solar passive techniques



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## Summary

Most of Portuguese residential building stock was built prior to the first Thermal Regulation and is obsolete in terms of thermal comfort. As a result, most of the Portuguese dwellings have poor energy performance. This statement is particularly true regarding their performance during the heating season. One of the main reasons for the poor performance of Portuguese façades are structural thermal bridges at façades, which are areas where thermal energy is significantly lost during the heating season. Additionally, the literature review also showed that:

- Portugal has a great solar potential in the European context, which could be leveraged to enhance the thermal performance its residential building stock.
- The number of case studies based on solar passive techniques in Portugal are scarsed.
- There is a lack of case studies on the assessment and correction of thermal bridges related to the use of solar retrofit strategies in Portugal.

The review studies on Trombe walls also led to the research hypotheses that, by adding an external transparent skin (glazing), it is possible to:

- Reduce the thermal bridge effect.
- Enhance the indoor thermal comfort of residential buildings.

As a result, to correct structural thermal bridge areas, by taking advantage of Portuguese climate (Mediterranean climate) and by enhancing the thermal performance of residential buildings, a novel Trombe, named Solar Bridge Retrofit Solution (SBRS), was proposed. This novel approach of a Trombe wall systems targets structural thermal bridge areas of the façade (concrete colums and surroounding masonry wall) and aims to recreate a positive balance of thermal energy to the indoor environment during the heating season. Instead of having higher winter heat losses through the concrete columns than solar heat gains, the proposed system aims to reverse this equation.

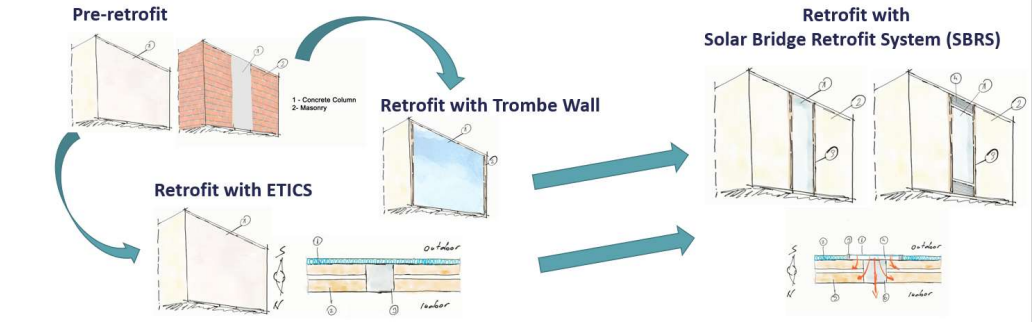
Experimental results, from monitoring campaigns on SBRS, have shown that:

- The intended thermal balanced was achieved (due to the air space between the external transparent skin and the wall, the concrete column worked has a heat gain mechanism).
- Double-glazing performs better han single-glazing configuration during winter.
- During summer it is prefereable to consider vents on the external transparent skin.

Numerical approach is bing devised and will be validated with experimental results. The numerial study will allow to study the proposed solution on an annual basis and with different configurations, so more conclusions could be made.

## Keywords

Solar passive technology, building retrofit, façade design, mediterranean climate.




*Façade design: from existing façade and retrofit solutions to a novel façade design with SBRS.*