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Case Study in Durrës, Albania: Temperature and moisture differences between a non-thermally insulated wall system and an external thermal insulation composite wall system (ETICS).

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ABSTRACT: *Thermal insulation is a fundamental part of building design, being influenced by increasing demands for energy generation, usage, and conservation. Different typologies of buildings are adapting at a fast pace to an effective thermal insulation method, which as a result, has enhanced the thermal performance and reduced energy use. Advances in technology have led to the development of high-performance insulation materials, not only improving indoor comfort, but also the durability and moisture and fire resistance of these structures.*

This research provides a comparative analysis of thermal and moisture performance of two types of masonry wall systems. The buildings investigated are in the Spitalla area of Durrës, Albania and share identical climate conditions. The two wall typologies that were examined were: an uninsulated wall consisting of a 25 cm brick layer with plaster, and an external thermal composite system, referred commonly as ETICS. Thermal and moisture measurements were performed at multiple points of each wall with the help of specialized instruments.

The objective of this study is to experimentally assess the thermal performance of masonry walls with and without ETICS ***implementation****. Furthermore, this study aims to highlight how construction techniques and architectural design influence temperature fluctuations and humidity in building envelopes.*

KEYWORDS: *masonry wall, thermal insulation, ETICS, moisture, specialized instruments, moisture.*

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I. INTRODUCTION

Buildings require significant amounts of energy to maintain indoor thermal comfort throughout the year, including in Albania. Heating and cooling loads can be reduced through various approaches, the most important being the appropriate design and construction of the building envelope. Proper use of thermal insulation not only decreases the demand for heating and cooling systems but also reduces annual energy costs. The degree of energy savings achieved through insulation depends on building type, climatic conditions, and the insulating material used.

A central question therefore arises: what type and thickness of insulation should be applied? A well- insulated building operates with increased energy efficiency, enabling occupants to maintain comfortable indoor temperatures with lower costs in both winter and summer. When exterior temperatures are extreme, indoor temperature fluctuations are minimized, promoting thermal comfort.

In contrast, insufficient insulation leads to substantial energy losses and higher economic costs. Moreover, areas where thermal bridges occur tend to be colder than surrounding surfaces, increasing the likelihood of condensation. This may cause structural damage or foster mold growth, which poses health risks. These considerations underline the essential role of thermal insulation materials in the construction industry.

II. EXTERNAL THERMAL INSULATION COMPOSITE SYSTEM (ETICS)

External thermal insulation composite systems, abbreviated as ETICS, include a variety of insulation layers, designed to improve the energy efficiency of buildings or aesthetics with various surface finish options, build cost-effective low carbon structures, etc. Because of its positive impact, this multilayer insulation solution has found a vast application in recent years, including Albania.

In this research, two buildings with different construction methods have been taken into consideration: building A which has a plain wall design of a 25 cm brick ***breadth*** and a plaster layer (that indicates the building has no use of insulation material to the exterior) and building B that has an exterior insulation finishing system, known widely as ETIC system.

This system offers numerous benefits in building design, such as:

- Reduction of heat transfer, which directly impacts the decrease of energy consumption and utility expenses.
- Flexibility in creating aesthetically pleasing facades.
- High durability to weathering, cracking and impact damage, increasing the lifespan of the building envelope.
- Multiple insulation options and materials.

Fig.1 shows the section view of a basic ETICS facade installation on a solid wall. This type of system is intended to work as a whole system, with each part being essential to overall effectiveness. A qualified applicator is required for its installation to operate as intended. The following elements make up an ETICS system:[4]

- Adhesive – Connects the insulation board with the outside wall surface.
- Insulation Board – Composed of mineral wool or polystyrene and attached to the external wall surface.
- Mechanical Fastener – Fixes the Insulation Board to the exterior wall surface.
- Base Coat – Placed on the top of the insulation and strengthened with glass fiber mesh.
- Finish Coat – Applied on the top of the base coat, ensuring a long-lasting and impervious finish.

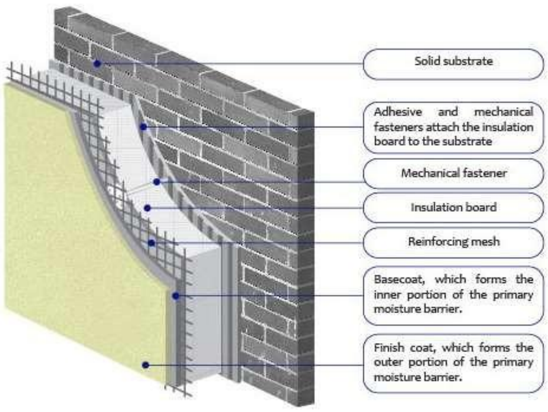

Fig. 1. Section view of a simple ETICS facade installation

The “TESTO 606-2 Digital Humidity and Temperature meter” was utilized to assess the temperature and moisture levels in both external and internal walls. Both buildings are single-story villas, with data taken at intervals of roughly 100 cm along the perimeter walls, both externally and interior. The measurements were conducted on 15 January 2026 at the Spitallë area in Durrës, Albania. [2]

Fig. 2. TESTO 606-2 material temperature and moisture measuring instrument

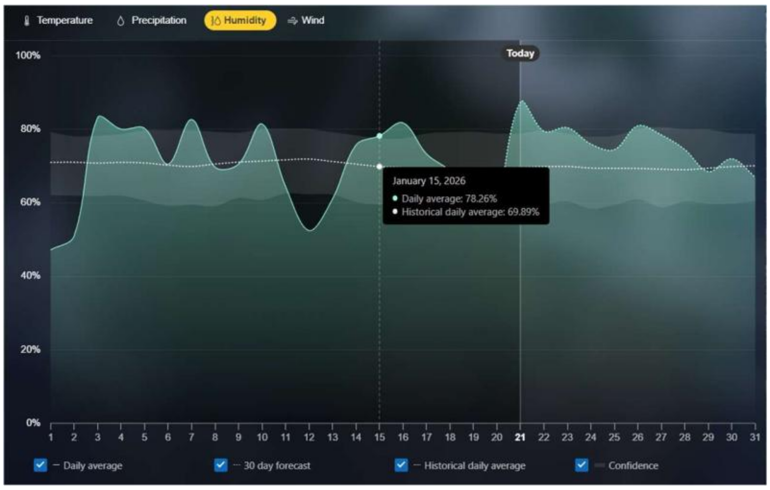

Fig. 3. Daily humidity line chart, annotated for January 15, 2026, in Spitallë, Durrës, Albania. Source: Msn Weather website.

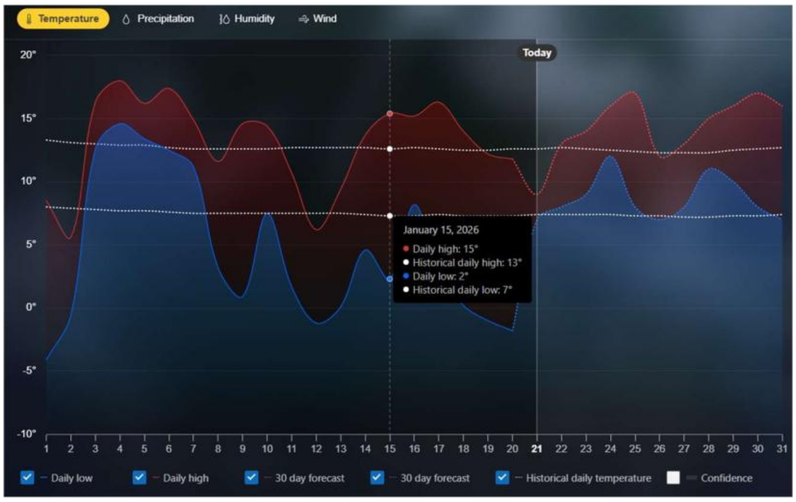

Fig. 4. Daily temperature line chart, annotated for January 15, 2026, in Spitallë, Durrës, Albania. Source: Msn Weather website.

The temperature ranged from a minimum of 12.8°C to a maximum of 13.8°C. The buildings under consideration are fewer than 5 m apart.

Building A – It is built without insulation, merely with a wall system consisting of 25-cm brick breadth and plaster. It was built earlier than Building B.

Building B – Includes a multi-layered exterior wall system that integrates insulation and water-resisting materials.

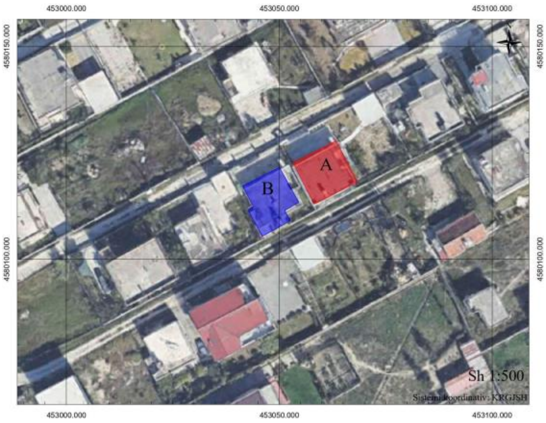

Fig. 5. Location of building A and B using Google Earth software.

Fig. 6. Photo of buildings A and B before performing the measurements.

Fig. 7. Photograph taken of the exterior wall of Building A

Fig. 8. Photograph taken of the exterior wall of Building B

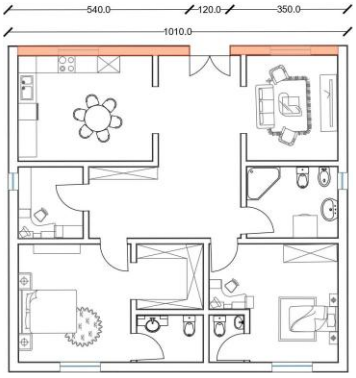

Fig. 9. Architectural floor plan of building A

It is represented with a pale pink tint on the perimeter wall where the data was collected.

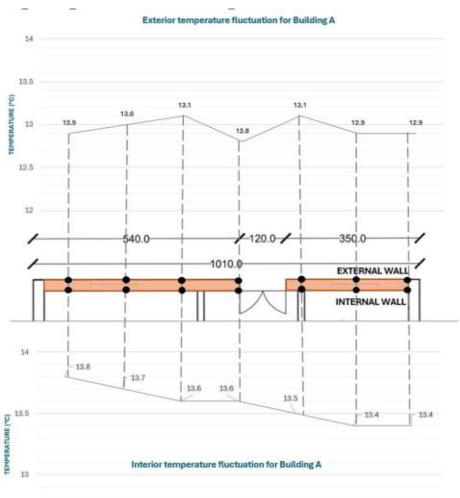

Fig. 10. Interior and exterior temperature fluctuation graph for building A (without thermal insulation)

The graph illustrates the exterior and interior temperature fluctuations along the perimeter wall of Building A. Measurements are made at several positions along the wall, with distances between each sampling location recorded. The exterior temperature shows fluctuations ranging approximately from 12.8°C to 13.1°C, while the interior varies by 13.8°C-13.4°C. External temperature is influenced by environmental factors like solar radiation, wind exposure, etc. [3] It is obvious that a lack of thermal insulation, specifically the ETICS system, results in energy loss and affects the similarity of the outside and inside temperatures of the perimeter wall.

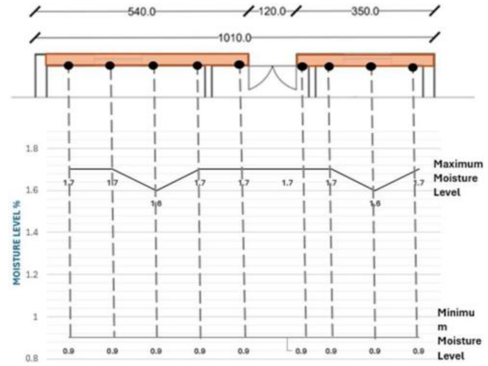

Fig. 11. Interior moisture level graph for building A (without thermal insulation)

As can be seen, the maximum moisture percentage that may be reached in this climate is 1.7, and the minimum is 0.9. Even though these are acceptable limitations, in severe circumstances, moisture has caused structural damage such as cracking, swelling, and loss of building strength.[4] When this parameter exceeds 5, there is a chance of mold formation; however, the likelihood is modest.

Fig. 12. The internal face of the external wall, Building A

Fig. 13. Architectural floor plan of building B

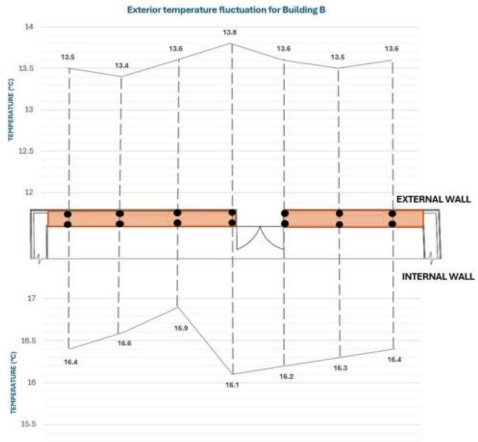

Fig. 14. Interior and exterior temperature fluctuation graph for building B (installed ETICS system)

The temperature inside is higher than outside due to insulation. The temperature fluctuation graph illustrates this, with the external temperature ranging from 13.4°C to 13.6°C and the internal temperature ranging from 16.2°C to 16.9°C.

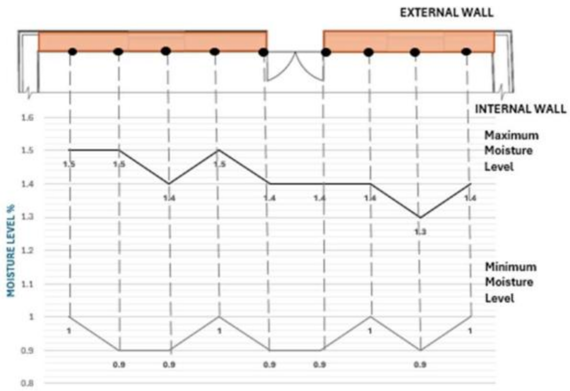

Fig. 15. Interior moisture level graph for building B (installed ETICS system

III. CONCLUSION

The primary objective of this study was to compare the difference between a thermally insulated wall, considering as an example a solid wall having installed an exterior thermal insulation composite system, and a non-thermally insulated wall. This cutting-edge technology continues to show that its advantages are significant not just locally but globally, making it one of the most widely used advancements nowadays. This system has expanded to Albania as well, being present in almost every modern or renovated construction due to its insulation solution. It is considered the perfect combination of cost-effectiveness, energy efficiency, and environmental sustainability. In most cases, more than 60% of heat and cooling transfer is maintained, and this can be observed from the temperature difference on the interior face of each wall system. This value approximates a delta value of 3-4°C.

With a delta value of 2%, the humidity level differs slightly between the two types of wall systems. In extreme cases, this can be harmful in both human health and building durability.

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