A22: Identifying the barriers that limit the spreading of interior insulation as a solution to improve the energy efficiency of the existing building stock

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This abstract has undergone single blind review by the ICMB25 Conference Scientific Committee.

About the conference
The following abstract is from the 3rd International Conference on Moisture in Buildings (https://ukcmb.org/icmb25) held in UM Guimarães, Portugal, on the 23-24 Oct 2025. All abstracts published here underwent single blind review by the Conference Scientific Committee.

Abstract: Internal wall insulation is crucial for reducing CO_2 emissions in historic buildings where external interventions are undesirable. Despite its importance, adoption remains limited. The InRenova project aims to understand and remove the barriers to this limited diffusion. An online survey targeting key stakeholders explored participants' experiences with internal insulation, challenges, materials and techniques used, and design tools. The survey revealed substantial barriers, including concerns about moisture-related damages, technical complexities in the practical implementation, and a lack of validated examples. It revealed also that although dynamic hygrothermal simulations are perceived as essential for designing effective solutions, their application remains limited. Finally, participants showed little knowledge of existing guidelines, highlighting the need for better dissemination of scientific results targeting designers.

Keywords: Interior Insulation, Retrofit of Existing Buildings, Moisture related damages in buildings

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1. Introduction/Background

Thermal insulation of the building envelope is a key measure for reducing the energy consumption of the existing building stock [1]. Internal wall insulation is particularly important for the renovation of listed buildings, historic centres, and buildings with architectural value where external interventions are not an option [2]. Although important and technologically feasible in various contexts, the adoption of internal insulation remains limited. The EFRE-funded project InRenova aims to address this gap by identifying the barriers to internal insulation's adoption and implementing actions to make it more accessible. In order to best guide the actions proposed, an online questionnaire was developed with the main objective of gathering information on the main barriers and challenges that professionals encounter when using internal insulation for the renovation of existing buildings, to understand their perception of this technique, to identify which calculation tools they use and to gather their input on what a technical guideline or tool on internal insulation should include in order to be really useful.

2. Methodology

The survey was mainly addressed to construction professionals, architects and engineers, but also to researchers, craftsmen, restorers and other experts with experience in the renovation of existing buildings and the application of internal insulation techniques. The questionnaire was opened to the entire Italian territory, as well as to neighboring countries, such as Austria and Switzerland. It was organized into five sections: 1. *Socio-demographic questions* 2. *Internal Insulation: personal experience* 3. *Internal Insulation: follow-up* 4. *Use of calculation tools* 5. *Guidelines and support tools.*

The questionnaire was implemented and distributed using the SurveyMonkey platform; the collection of responses took place between 30 October 2024 and 31 December 2024.

3. Results and Discussion

The results in this section are organized in subsections following the 5 parts into which the questionnaire was divided.

3.1. Socio-demographic questions

In total, 612 responses were received, of which 337 were complete and 275 were partial, demonstrating significant interest in the topic. Most participants belong to two main categories: architects (48%) and engineers (44%), who represent the most relevant group for this survey as they are the key decision-makers in the internal insulation process. Regarding geographical distribution, most respondents are Italian, with a minority percentage from other countries (2.77%).

3.2. . Internal Insulation: personal experience

This first set of questions focused on respondents' personal experiences with internal insulation, including the evaluation of advantages and disadvantages of this solution in the decision making process, the chosen materials and thicknesses, and the main difficulties encountered from design to implementation.

The most common arguments in favour of internal insulation are typically related to the need to preserve the building's facade or practical considerations such as lack of external space or the need to renovate only part of the building. This aligns with expectations since, from a physical-building perspective, external insulation is in most of the cases preferable. The main arguments against internal insulation are limited space within the building and concerns about moisture damage. This latter point is particularly interesting as it demonstrates the significant potential for developing tools and guidelines to support the planning and implementation process of internal insulation, making it more reliable and removing this source of concern.

The most common materials used for internal insulation are found to be mineral wool, followed by synthetic panels (EPS, XPS), mineral-based capillary active insulation panels, plant-based capillary active insulation panels, and insulating plasters. Other insulation materials were selected by less than 20% of respondents. Insulation thicknesses are typically less than 12 cm. Only a minor part of respondents reported cases with insulation thicknesses greater than 12 cm.

The main difficulties in the design process (from selection to implementation) were encountered during the implementation phase (existing building conditions, presence of thermal bridges, etc.), followed by a lack of information about the building's condition (internal and external climatic conditions, initial humidity) and information about existing building materials. Finally, many reported a lack of exemplary cases to draw inspiration from.

3.3. Internal Insulation: follow-up

In this section, the questions aimed to understand the level of satisfaction after the installation of internal insulation and the monitoring of its performance over time. The most significant finding from this set of questions is that respondents typically do not verify the performance of the internal insulation solution with any monitoring tools or dedicated inspections (90%). It was then specifically asked if there had ever been situations where owners were dissatisfied with an internal insulation intervention. The majority of respondents (about 55%) indicated that this had never occurred, and 26% said it had occurred only rarely. However, about 12% of respondents reported that such critical situations had occurred sometimes, and about 5% often. The dominant cause of dissatisfaction is the formation of surface mold (selected by 50% of the respondents).

3.4. Use of calculation tools

In this section, respondents were asked about how hygrothermal performance of walls is calculated and what barriers hinder the use of hygrothermal simulation tools. One of the key aspects that emerged is that only about 19% of the respondents use dynamic hygrothermal simulations to design internal insulation measures. Instead, the majority (around 55%) rely on stationary methods based on the Glaser approach and/or on previous experience, either by choosing solutions proposed by the manufacturer who guarantees their effectiveness or by choosing thicknesses that they feel have a margin of safety.
It is important to note that despite the relatively low number of respondents who use dynamic hygrothermal simulations for the design of interior insulation solutions, 35% of respondents consider these to be indispensable for every interior insulation project, while 38% believe they are often useful. The main difficulty in using these tools is the complexity/lack of expertise (in 52% of cases), followed by the high cost of the calculation tools (37%). The complexity in using the dynamic tools is mainly attributed to the difficulty in finding the parameters of the building's existing materials and to results interpretation.

3.5. Guidelines and support tools

In this final section, the survey aimed to understand how a new guideline on internal insulation should be structured, and what other tools could support the design of internal insulation.
A surprising finding is that about 90% of respondents are not aware of any guidelines. This indicates a low penetration in Italy of guidelines developed in the context of European projects or European associations [3 ,4 ,5] and highlights the need to translate, disseminate, and adapt these guidelines.
Regarding what to include in the guideline, there emerged a need for practical and simple tools that allow for design without complex simulation and evaluation tools as well as for interpretation criteria when using simulations. Finally, the necessity for specific instructions on how to practically implement internal insulation was emphasized.
Although considered interesting, less attention was given to aspects such as the evaluation of energy savings from internal insulation solutions or the economic convenience of a particular intervention. Similarly, aspects related to post-installation control measures were deemed less important than the other aspects mentioned above.

4. Conclusions

The survey involved 612 participants, exceeding initial expectations and demonstrating a clear interest in the use of internal insulation in the renovation of existing buildings. To date, this technique seems to be used more out of necessity, such as preserving external facades or the impossibility of external interventions, rather than as a design choice. The main obstacles identified include difficulties related to installation, such as the evaluation of the initial state of the building or uncertainty about how to resolve technical details, particularly thermal bridges. Also, the concern about the onset of possible moisture damage emerged as a key barrier to the application of internal insulation solution.
Another crucial aspect that emerged from the questionnaire concerns the calculation methods. Most professionals rely on simple tools based on the Glaser method, which has significant limitations in identifying moisture-related risks. Although dynamic hygrothermal simulations are recognized as essential for effective design, their use is limited by the complexity of the tools, high costs, and the lack of data on materials and the conditions of existing walls, particularly in historic buildings.
Another relevant finding is that almost 90% of respondents are unaware of specific guidelines on the use of internal insulation. Therefore, it is important to increase the dissemination of scientific results targeting designers. Additionally, translating documents into local languages could facilitate the effective dissemination of existing guidelines.
The survey also highlighted that interventions with internal insulation thicknesses greater than 12 cm are not widespread, suggesting that the potential for energy savings is not yet fully exploited. Raising awareness among professionals about the possibilities offered by interventions with greater thicknesses is therefore essential to improve the energy efficiency of buildings. The need for concrete application examples, clearly emerged from the questionnaire, confirms the value of initiatives such as best practice databases for energy renovations [7, 8], which, given the specificity of existing buildings and especially historic ones, provide a considerable source of inspiration and could instill confidence in a design solution that has not yet been applied to its full potential.

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