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Towards Nearly Zero-Energy Buildings through analyzing reasons for degradation of facades

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Abstract

Nearly Zero-Energy Buildings offer one way to reduce energy use in the built environment and thus contribute to mitigating global climate change. This paper is focused on analyzing the reasons for degradation of External Insulation Composite system facades in order to develop sustainable and cost-effective solutions for dwelling stock renovation. While several reasons for degradation of the facades have been studied in depth, the impact of building technology and site management have received undeservedly little attention. This paper systemizes the factors affecting facade quality and proposes a research plan for on-site surveillance in order to measure the weight of different degradation factors.

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Keywords: Nearly Zero-Energy Buildings, degradation of facades, thin-layer rendering systems, ETICS

1. Intoduction

Thin-layer rendering on the exterior facade is one possibility to protect a wall against external effects. In European countries the External Thermal Insulation Composite System (ETICS) is widely used and the quality of its construction significantly affect the inner climate of the building. As the quality of renovated facades depends on a wide range of factors, it is essential to understand the importance of each factor influencing the performance of facades such as:

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- Holistic design and calculations (thermal insulation, moisture-diffusion, ventilation system, building services);
- External effects (weathering, pollution, direction of the facade, climate in general);
- Moisture and biologic growth (mortar composition, weather effects);
- Compatibility of used materials within the system;
- On-site construction technology (fixation, application of render).

These factors affect the degradation and further maintenance costs of the building. The research by Böhmer and Simon shows that 66% of buildings which do not meet the required energy efficiency level have shortcomings during the construction phase (Böhmer and Simon, 2011). This proportion highlights the significance of improving the construction process. By understanding and avoiding on-site deficiencies, it is expected that facade performance may be improved.

2. Problem recognition

The deterioration of the ETICS is influenced by numerous factors reducing facades' lifetime. Many people have studied the reasons of degradation and made useful suggestions based on their research outcomes. However, there are still unsolved problems and there is a lot of space for improvement. The aim of this paper is to systemize these reasons for deterioration based on the literature and identify the knowledge gaps where further research input is needed. The degradation factors for ETICS are divided by degradation reasons into three main groups:

- Holistic design and defects caused by moisture;
- Composition of render mortars and use of substrates;
- On-site application of ETICS.

2.1 Holistic design and defects caused by moisture

The physics of the building, indoor climate and holistic design have to be integrated in the design stage to satisfy the goal of users and owners to reduce the maintenance and energy costs of the building during its operation (Mitterer et al., 2012). The research by H. Böhmer and J. Simon reveals the distribution of common design deficiencies as shown in Fig. 1 (Böhmer and Simon, 2011).

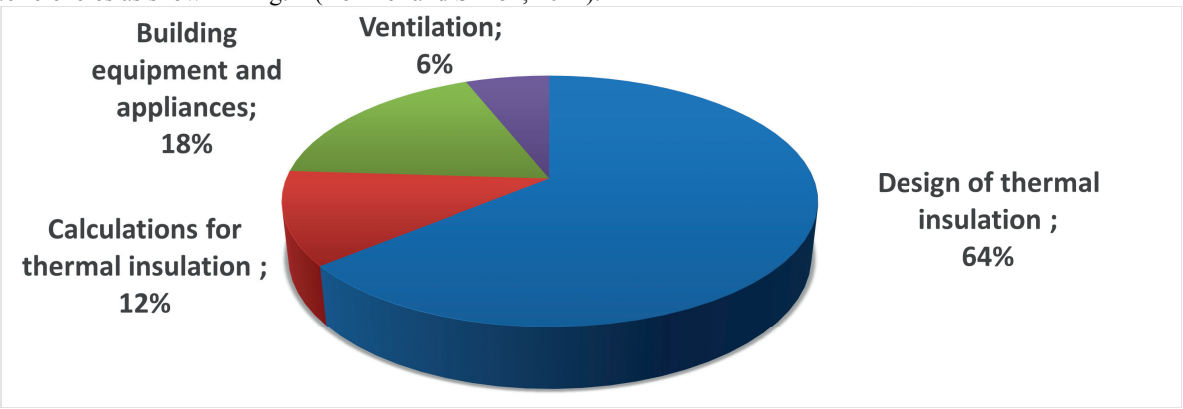

Fig. 1 Distribution of shortcomings during design process

It is important to avoid thermal bridges as these lead to moisture and freezing defects (Böhmer and Simon, 2011). The moisture movement through the exterior wall should be minimized with an airtight interior layer to avoid moist convections damage (Künzel, 2010). The external rendering layer should control and manage rainwater to provide durability and prevent cracking of the exterior layer (Lstiburek, 2007).