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Concept of Building Evaluation Methodology for Gap Estimation between Designed and Achieved energy savings

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Abstract

Nowadays, despite the plethora of existing standards and calculation methodologies, i.e. procedures assessing a building's energy efficiency, it is unfortunately common to monitor significant differences between designed and achieved energy savings in practice. This is a problem that in extremis may lead to contractual and even legal claims, but in any case sheds doubt on the whole energy efficiency approach and finally presents one of the barriers for investments in energy efficiency projects. It should therefore be addressed and in order to achieve this, one has to understand the problem: Numerous and often intertwined factors lead to the aforementioned discrepancy, based on the differences in methodological approaches and standards adopted as well as the boundary conditions they use, they will all be discussed in the paper.

Furthermore, a novel building evaluation methodology will be presented; its conceptual approach addresses the different influences addressed and taken into account, as they can significantly affect the level of achieved energy savings in buildings. In that sense, the main purpose of the proposed methodology is to evaluate in advance, the difference rate between designed and achieved energy savings. This approach can be a useful decision tool in the phase where energy efficiency projects are rated and evaluated for possible investments.

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Keywords: buildings, energy efficiency, energy savings.

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1. Introduction

It is a well-known fact that buildings are responsible for the large part of overall final energy consumption as well as for the approximately same amount of carbon dioxide emissions, [1]. Therefore, the investment potential in buildings is high as the general EU policy is focused on restraining overall energy consumption in buildings and by that reducing harmful emission into the environment [2]. Furthermore, an increase in the share of renewables is also an EU general long term target towards 2050, where it will be challenging to implement them on a desired large scale. Namely, according to the available renewable energy technologies on the market nowadays, it is not a problem to successfully implement them in the case of single building units, as in family houses or in relatively small building residential facilities. However, there is an issue when implementing renewables in the case of condominium building facilities at a sufficient level as we have certain technical constrains. In the case of condominium building facilities, we are generally limited with space for the sufficient implementation of renewables, so the realistic question is whether we can even achieve the desired share of renewables in the case of the considered building facilities. Even though we can have excellent climate characteristics on specific geographical locations, we unfortunately have limited capabilities when implementing renewables for the mentioned building facilities, i.e. limited on-site energy production from renewables. One solution in solving the previous issue is to realize large scale renewable energy plants (electricity, thermal) that will produce a larger share of primary energy demands for certain building facilities (district energy plants based on renewables). However, we need to be clear that in the previously considered case, we are faced with a high investment cost, possible technical limitations and finally with questionable economic viability.

The EU has set a clear target for nZEB which is challenging in the sense of market available energy efficient products, technologies and design issues (guidance plans [3] were provided as each EU member state country should prepare their specific guidance for nZEB). Designers need to be prepared and additionally educated in order to be able to cover the increased design related work load regarding nZEB and finally provide quality projects that will ensure the desired nZEB standards. Hence, to reach nZEB standards, we need to prepare professionals (designers), companies involved in project realization, i.e. a whole chain needs to be prepared in the energy renovation of building facilities. In relation to the previous issue, the PROF/TRAC project [4] was kick started in March of 2015 in order to develop a European Training and Qualification Platform on nZEB design and construction. It is indicative that all professions are included in this project as well as all major, well-known and influential professional associations. There is a clear and serious signal that we need to change the current design paradigm if we want to reach nZEB standards on a large scale. A design paradigm change entails a close and intertwined cooperation between all professions from initial project consideration until its final realization. The current design approach that usually happens is provided in the way that architects set a defined baseline for specific building facilities in advance and all other professions need to integrate their specific part into it. In the previous case, it is hard to build in the most efficient project solution that will lead to nZEB standards (we have a predefined base and basically have limited designer flexibility). Hence, as already mentioned, a close and smooth cooperation between all professions is crucial if we want to achieve nZEB standards and should be the general approach.

One of the crucial problems related to energy efficiency projects in buildings is the validation procedure of achieved energy savings, i.e. there are a lot of examples in practice where we have a significant difference between designed and achieved energy savings. Namely, current designer procedures include a variety of input data where the final output (designed energy savings) is sensitive to the input values and there can be a significant value range in magnitude for the designed energy savings in the final outcome. Furthermore, estimated (designed) energy savings are an important factor for the decision of possible investment in specific building facilities (especially in the case when dealing with investment scenarios such as a combination of grants and other financial instruments). Hence, it would be useful to have a tool where we would be able to at least estimate a possible gap between achieved and designed energy savings. The previous kind of approach would also be a useful tool in detecting potential weak