Chapter 32
Energy Simulations as a Tool in Integrated Design Process

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ABSTRACT

In the integrated building modelling, all aspects have the same importance. It means that the architect, construction, and HVAC engineers create a building with interactions. BIM guarantees permanent information about important indicators generated parallel during the whole design process. Sophisticated simulation gives opportunity to observe important factors, for example, thermal comfort, ventilation quality, energy performance of building, operating and investments costs. For effective design process, selection of the appropriate team of people should be done carefully. It is particularly important to have a proper approach to modernisation of buildings. Without careful analysis of the concept and cooperation at various stages, it is not possible to complex retrofit of the building, which is aimed not only at reducing the energy use but also at maintain the desired thermal comfort.

INTRODUCTION

Increasing demands of the energy performance of buildings bring a new approach to the design process. Architects, constructors, HVAC engineers, lighting engineers, energy consultants, contractors and future users must cooperate with each other from the beginning until the end of the process. Communication between them requires understanding each other and new tools that would facilitate exchanging information. Although appropriate modern software can greatly improve the exchange of data, it is also necessary to develop appropriate standards. New building construction and especially modernization to the nZEB standard requires attention to details and accurate design concept development.

BACKGROUND

The Recast of the Directive on the Energy Performance of Buildings (Directive 2010/31/EU) came into force on 9 June 2010. EU member states should until 9 June 2012, publish the relevant laws and ad-

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ministrative regulations necessary to implement its provisions. All activities aim to improve the energy performance of buildings and its elements. All new public building constructed after 31.12.2018 and all others after 31.12.2020 must be nearly zero energy buildings. Such high requirements are very difficult to meet using standard design methods and standard technical solutions.

In response to market demand the concept of integrated design has been developed. In traditional approach the construction, architects and engineering market is very much focused on the regional and local level. The work of individual specialists is followed in a line. For example, HVAC engineering has no influence on architectural concepts. This approach from the beginning imposes the use of some standard solutions. Other specialists are further forced to adapt the concept. In this solution, it is almost impossible to design a building with very low energy demand for heating, cooling, lighting, domestic hot water and electricity, with good thermal comfort conditions and characterised by comparable to standard ones, construction costs.

The combination of the three objectives mentioned above: low energy consumption, good thermal comfort conditions and low construction costs, represents an integrated design process (ID), sometimes also called IED (Integrated Energy Design). This approach has been developed in many countries independently therefore,, the state of the art for ID in the participating countries is very different. In some countries, GHG emissions or energy embodied in construction materials are taken into account during the assessment (The Research Centre on Zero Emission Buildings 2017).

In response to The Recast of the Directive on the Energy Performance of Buildings in June 2012 a project MaTrID *Market Transformation Towards Nearly Zero Energy Buildings Through Widespread Use of Integrated Energy Design* was lunched. The project was finished in December 2014 and was co-funded by the Intelligent Energy Europe Program of the European Union. The aim of the project was to support the implementation of Nearly Zero Energy Buildings by 2020. Special attention was given to the beginning of the process that is the concept phase. The more workload is placed at the beginning the greater is the possibility of using unconventional solutions. It is also possible to get better final results meaning lower energy use for heating, cooling, lighting, domestic hot water and electricity with lower investment cost while still maintaining the thermal comfort inside the building. Of course, such approach lengthens the design phase but the execution phase itself is more efficient. With the use of right tools, appropriate solutions can be chosen while still meeting all the established criteria.

Widely used tools are simulation programs which allow performing an hourly or even sub-hourly analysis of building variables. Software aimed at analysing energy demand and thermal comfort should already be applied at the conceptual stage. Any change made during the project for example, in the building purpose, its construction, or its external envelope and HVAC systems should be analysed it terms of its impact on energy consumption, thermal comfort conditions and construction costs. In the standard design process, the improvement of the energy standard might turn out to be inefficient, especially if the construction process has already begun. The possibility of achieving good results is decreasing as work progresses, at the same time, the costs increases. For these reasons, integrated design is a right approach when designing buildings with nZEB standard.

Integrated Design

Integrated design is a way to lead the investment process in a way, where the main goal is to improve the project team collaboration (Integrated Design 2012-2014). The members of each project team shall comprise the specialists from all stages of the construction process that are architects, HVAC designers,