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## BIM-Based Energy Analysis Using Edilclima EC770 Plug-In, Case Study Archimede Library EEB Project

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### Abstract

In the recent years, energy efficiency issues as well as Building Information Modelling (BIM) have been the greatest and most challenging paradigms for the Architecture Engineering and Construction (AECO) industry in the context of Smart Cities. Digital models are used to analyse the existing building stock to promote a better management and retrofitting actions. Data modelling is the first step to pursue an integrated approach for the building lifecycle allowing simulations and analysis for different purposes through the interoperability process. This study aims to investigate the potential and the limitations of a BIM-based energy analysis by means of an Italian commonly used software for energy diagnosis and certificates, according to the quasi-steady method specified in the UNI/TS 11300-1:2008. The case study is a library with municipal offices in Settimo Torinese (Italy), which is the demonstrator of the ongoing Zero Energy Buildings in Smart Urban Districts (EEB) national cluster, which has the main scope to create a data management infrastructure able to integrate heterogeneous networks. The energy rate is evaluated from a simplified Revit architectural model, where the most significant components of the building in terms of energy are defined with a proper Level of Detail/Development (LOD) to easily set the energy model through the EC770 plug-in. In this way, the acquisition of geometrical data is allowed by the interoperability among software, speeding up the redundant preliminary phases of the simulation concerning the description of the building envelope.

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The graphical interface needs to be improved to facilitate the general understanding of the building components provided by the BIM model. Shared parameters, schedules and families have also been implemented to maximize the information exchange as the process is still imperfect.

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However, the critical comparison of methodology and results has shown that the use of BIM in energy modelling practices can strengthen the reliability, consistency, and usability of energy data for a cost-effective building simulation.

## 1. Introduction

According to the European Directive 2010/31/CE (EPBD recast), improving the energy performance of the existing building stock is one of the highest priorities over the next several decades. To achieve this ambitious goal, many researches are under development as integrated and standardised methodologies, while tools to monitor and assess real building energy performance are still missing. At the same time, the digitalization process of public buildings involving BIM method represents a significant opportunity for the Administrations to monitor and control the Public Real Estate. The EEB Project pursues the objective of increasing energy efficiency of existing buildings through the pervasive use of non-invasive technologies for the real-time monitoring and control. As a part of the data management infrastructure, Building Information Modelling is used to generate and manage building information during the operational phase in order to achieve a baseline model for the energy and facility management objectives. The aim of this study is to explore the role that BIM plays in energy modeling practices and the issues that should be considered to make the process of data sharing effective. According to Patti et al. and Ronzino et al. [1,2], the energy analysis integrated in the construction process is moving from the building to the urban and district level, integrating digital models with the Information and Communication Technologies (ICT).

## 2. Methodology

Tests described in this paper have been performed on the Archimede Library, located in the central Piazza Campidoglio in Settimo Torinese (Italy), in the former “Paramatti” industrial area. It is a recent building designed to be an innovative cultural centre with a thousand of daily users and a place for testing new technologies. The building looks like a compact curved shape spreading over 6.000 m<sup>2</sup> on four floors above ground and includes a public library and municipal offices. The north facade is made by concrete blocks, while the others by a coating terracotta slabs acting as a ventilated wall with sunshades protecting openings.

### 2.1. Building Information Model

A preliminary on-site survey is aimed at verifying the “as is” documentation, cataloguing space and assets with regard to their typology and number and getting detailed measurements of a specific component, such as window frames. Autodesk Revit has been chosen for its ability to interoperate with other software through specific plug-in. According to the main scope of the research, the BIM model created includes an accurate building envelope’s characterization in terms of correct stratigraphy and transparent components’ properties as well as facility management information (i.e. room type, responsible structure, occupants). Thus, it becomes a significant repository of graphical and alphanumeric information useful to make several analyses and generate innumerable output mutually consistent. The concept of Level of Detail and of Development (LOD) has been applied in defining the model components, as described by the American Institute of Architects. For this study, LOD300 [3] is used to achieve a proper description of the building in terms of both graphic specifications and attached data. The same modelling standards and additional parameters implemented in this model have been used to analyse other public buildings involved in the project. In this way, a coherent system is established to obtain comparable data bringing a great value to the Public Heritage’s knowledge and management.

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