IMPRESS BIM Methodology and Software Tools (iBIMm) for Façade Retrofitting Using Prefabricated Concrete Panels

Adalberto Guerra Cabrera, Integrated Environmental Solutions Ltd., Glasgow, UK
Dimitrios Ntimos, Integrated Environmental Solutions Ltd., Glasgow, UK
Nick Purshouse, Integrated Environmental Solutions Ltd., Glasgow, UK
Shirley Gallagher, Temperature Limited T/A Sirus AirCone, Cork, Ireland

ABSTRACT

IMPRESS is a H2020 funded project that has developed prefabricated façade panels to reduce building energy demand. In order to accelerate and optimise the retrofit process, IMPRESS has developed an iterative design methodology (IDM), which incorporates all stages of the design-construct-install-operate process and aims to bring energy efficiency as early as possible in the design process. Three software tools have been developed for this purpose: (1) an online decision support software (DSS), to inform decision-making on which panel type is suitable for the building; (2) an interoperable data exchange server (IDES) to allow exchange of information related to the design, construction, installation and operation of the facade; and (3) an online management platform (OMP) for coordination through all stages. The merger of the design methodology and software tools is called IMPRESS BIM methodology (iBIMm) which enables design teams to make informed decisions based on building information models and provides a platform to monitor its performance during the operation stage.

KEYWORDS

BIM, Decision Support, Energy Efficiency, IES-VE, Interoperability, Iterative Design, Methodology, Operational Phase, Retrofitting

1. INTRODUCTION

As it stands, the design and construction process of energy-efficient retrofitting with prefabricated panels is inefficient (Bystedt et al., 2016). This leaves the end-user with a sub-optimal solution for both cost and energy efficiency and in many cases the final as-built product does not meet the initial as-designed concept and performance.

As stated in Garmston, Fox, Pan, and Wilde (2013):

Poorly-insulated existing buildings contribute significantly to the energy use of the built environment. In the UK, the existing building stock is replaced at a rate of less than 2% a year; thus, many of today’s buildings will still be in use in 2060.

DOI: 10.4018/IJ3DIM.2017100104

This article published as an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0/) which permits unrestricted use, distribution, and production in any medium, provided the author of the original work and original publication source are properly credited.
Façade retrofitting can impact positively in the life cycle impact on the existing building stock not only in the UK (Allder, 2006), but also in Europe (Biseniece et al., 2017; Loussos, Konstantinou, van den Dobbelsteen, & Bokel, 2015). Different research studies have demonstrated that these types of retrofitting generates not only environmental (Lassandro & Di Turi, 2017), but also financial (Pombo, Allacker, Rivela, & Neila, 2016; Terés-Zubiaga, Campos-Celador, González-Pino, & Escudero-Revilla, 2015) and social benefits (Camprubí, Malmusi, Mehdipanah, Roshanak Palència, & Molnar, 2016).

Although there exists motivation by public bodies to improve energy efficiency in buildings, there are barriers. For the specific case of the United Kingdom, insufficient research, difficulty to decide which retrofitting solution is best and performance gaps are some of the identified challenges (National Platform for Construction, 2013).

Based on the current needs for energy efficient retrofitting, the present document focuses on describing the creation of an iterative design methodology, using the current industry approaches as a starting point, as well as the required software, in order to create the new methodology. This methodology shall overcome existing documented challenges and focus on the collaboration and communication relevant project stakeholders in order to improve the quality of the façade retrofitting projects.

In the first section, the iterative design methodology (IDM) is described. A brief description of current industry design methodologies is provided together with their respective limitations. Once these are identified, the IDM is presented including each of the steps.

The second section explains the integration with BIM technologies that enable the IDM. Documented limitations of the use of BIM for renovation projects are presented and these are tackled through different strategies and software developed for this project.

The three following sections explain the three pieces of IMPRESS software. The decision support software (DSS) uses open source data and the IES-VE to generate a concept model for early calculations on the potential energy savings that could be achieved by the façade retrofitting process. The Online Management Platform (OMP) is a web based interactive project management and collaboration tool designed to ensure correct use and easy uptake of the iterative design methodology. Finally, the Interoperable Data Exchange Server (IDES) is used to store all information relating to the design, construction, installation and operation of a façade retrofitting project.

One demo site in Italy and two case studies are being used to test and validate the IDM together with the IMPRESS software solutions and its integration.

Finally, conclusions on the newly designed IDM and IMPRESS software are provided including future research areas.

2. ITERATIVE DESIGN METHODOLOGY

The development of the iterative design methodology (IDM) is the result of adapting existing state-of-the-art design methodologies and feedback from project’s stakeholders to the retrofitting projects with prefabricated panels.

For the case of the design methodologies, several were examined and the most relevant were considered for greater critique. These are: Integrated Project Delivery (IPD), Integrated Design Process (IDP), Integrated Energy Efficient Design (EED) and Integrated Energy-Efficient building design process (IEBDP).

The Integrated Project Delivery (IPD):

Integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to reduce waste and optimize efficiency through all phases of design, fabrication and construction. IPD principles can be applied to a variety of contractual arrangements and IPD teams will usually include members well beyond the basic triad of owner, architect, and contractor. At a minimum, though, an integrated project includes highly effective
Enhancing Construction Processes Using Building Information Modelling on Mobile Devices
[www.igi-global.com/article/enhancing-construction-processes-using-building-information-modelling-on-mobile-devices/99616?camid=4v1a](www.igi-global.com/article/enhancing-construction-processes-using-building-information-modelling-on-mobile-devices/99616?camid=4v1a)

Leveraging the Science of Geographic Information Systems
[www.igi-global.com/article/leveraging-science-geographic-information-systems/53193?camid=4v1a](www.igi-global.com/article/leveraging-science-geographic-information-systems/53193?camid=4v1a)