Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 132 (2017) 496–501

Energy Procedia

www.elsevier.com/locate/procedia

11th Nordic Symposium on Building Physics, NSB2017, 11-14 June 2017, Trondheim, Norway

Advanced transparent facades: market available products and associated challenges in building performance simulation

Ellika Taveres-Cachat[a,b*], Steinar Grynning[b], Oddvar Almas[a], Francesco Goia[a]

[a]NTNU, Høgskoleringen 5, Trondheim 7034, Norway
[b]Sintef Byggforsk, Høgskoleringen 7b,Trondheim 7034, Norway

Abstract

The starting point of this study is to provide a non-exhaustive overview of relevant transparent advanced facade technologies available on the market and suited to Nordic climates. A corresponding literature review is carried out to assess the existing modelling capabilities in building performance simulation for each type of product, highlighting the main challenges associated with its modelling. Overall, most of the difficulties identified are linked to the inherent dynamicity of advanced facades, the interdependent physical domains they cover, the limitations of the software, and the skills necessary to recognize and implement the best-suited model among the multitude of options available.

Peer-review under responsibility of the organizing committee of the 11th Nordic Symposium on Building Physics.

Keywords: Translucent advanced facades; Translucent advanced facades; Building Performance Simulation; Review;

1. Introduction

Current research [1] suggests that building envelopes hold a key stake in meeting sustainability and carbon reduction emissions targets set by legislation across countries. In particular, advanced facades are, according to the International Energy Agency (IEA), the most promising component in building design with the highest impact on building performance [2]. Advanced facades, in this study, refer to a wide range of systems and technologies that allow for dynamic response of the building shell. They are particularly attractive since they have the ability to actively and / or selectively manage the energy flow and heat transfer between the building and its external environment leading to potentially significant reduction in heating and cooling loads. Unlike traditional energy saving strategies, which

* Corresponding author. Tel.: +47-403-886-52; fax: +47-735-953-10.
E-mail address: ellika.cachat@ntnu.no

1876-6102
Peer-review under responsibility of the organizing committee of the 11th Nordic Symposium on Building Physics
10.1016/j.egypro.2017.09.685

rely on passive measures, such as increasing insulation thickness or optimizing window area, they can provide higher levels of indoor comfort [3,4] without significant additional energy consumption from other building systems like HVAC or lighting [5,6]. This is especially important since, as users, we are concerned with designing indoor spaces where our fluctuating comfort needs are met, while maintaining low energy requirements. Constant innovations in material science have led to the development of a myriad of systems and technologies for advanced facades. However, because of the fast pace of product innovation, a knowledge gap has been created between the progress of technologies and the tools available to building designers to model them sufficiently accurately in relation to the whole building's performance. The resulting situation is a bottom-up approach where modelling possibilities in building performance simulation (BPS) follow instead of drive innovation [3]. The lack of adequate modelling approaches additionally leads to difficulties in predicting the performance of the systems in use and thereby at times limiting their real-world uptake or optimization in the design process. Loonen et al [7] describe four main physical domains that advanced building envelopes influence and that must be taken into account when predicting the behavior of such facades. These domains are Thermal (T), Optical (O), Airflow (A) and Electrical (E). This study provides a general overview of the most relevant transparent advanced facade technologies available on the market; then proceeds to carry out a preliminary assessment of the types of challenges associated with the modelling of these technologies in given available BPS software alternatives. The aim of the study is therefore to give insight into which types of existing technologies can be simulated and which aspects may challenge the level of accuracy in the models.

2. Methods

The first part of the study involved the task of mapping existing technologies of transparent advanced facades [8]. This was carried out through an extensive review of webpages, catalogues and product description brochures of well-known manufacturers as well as documentation provided at exhibitions on the topic. In order to complete this search, an additional terminology based search for relevant products and systems was run through online search engines using the key words: *advanced facades; adaptive facades; dynamic facades; smart facades; intelligent facades; innovative facades; multifunctional facades; solar facades*. Due to the limited scope of this study, the work encompassed only the relevant and market-ready transparent/translucent advanced facade components. The choice to exclude opaque components was made on the basis that transparent facades are intrinsically more complicated and present broader challenges in modelling [9]. Based on the results, a classification of the different technologies is suggested alongside examples of products from manufacturers and a description of the most relevant characteristics. The findings from this initial research work were coupled to a scholarly literature review with the goal of identifying and analyzing existing modelling options in building simulation tools. This work builds upon existing reviews of building simulation tools capabilities [10] and was carried out by reviewing journal articles on the topic of modelling and using keywords related to the specific technologies identified in the first part of the study.

3. Results

3.1. State of the art – innovative technologies and systems classifications

The findings from the technology mapping are shown in Table 1. The technologies are sorted according to a proposed two-tiered categorization system. The main product categories are based on the nature of the component and the technology implemented. Each one is described with an outline of its main characteristics with an explanation of the acronyms below table 1. The specific sub-categories of products are listed in the table along with examples of products available on the market.