



M3.5 Report on the Key Performance Indicators

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1 Introduction

Complex façade systems include a large variety of technologies in terms of both single components and whole system assembly. Norms and standards are still not able to provide a unified and comprehensive framework for such complexities, often also due the lack of available product on the market. Nevertheless, the question about "how to characterise a complex façade component or system" is of extremely practical interest, especially in the field of complex fenestration system. In this sector, in fact, innovation is progressing rapidly, and the curtain wall technology has only limited capability to integrate such complex components. As a results, designers, building owners, and public body have to face daily the following problems: (i) "to what extent existing standardised indicators apply to non-standard system" (to comply with regulations) and (ii) "which new/modified indicators should be used to correctly report the façade performance".

Hence, this report presents synthetically the FACEcamp work done on the topic of the Key Performance Indicators (KPIs) for complex façades. More information can be gathered contacting Eurac Research, Institute for Renewable Energy.

2 Objectives

The work described in this report aimed at mapping and evaluating the (KPIs) for complex façade systems, starting from norms and standard definitions, as well as from the scientific literature. This study has been divided in two parts. Firstly, the mapping of the KPIs available has been completed and make freely available in an open online database (<u>http://kpidb.eurac.edu</u>). Secondly, a new set of KPIs for advanced and complex facades has been defined and then applied to a number of relatively similar cases (same purpose, similar level of complexity, different technology) to evaluate the usability of this new set of indicators to assess the performances of dynamic façade systems.

3 Mapping of KPIs

3.1 Methodology

The following text has been extracted with minor changes from the Booklet Building Performance Simulation and Characterisation of Adaptive Facades – Adaptive Facade Network, Fabio Favoino, Roel C.G.M. Loonen, Maxime Doya, Francesco Goia, Chiara Bedon, Francesco Babich (<u>http://tu1403.eu/wp-content/uploads/Vol-3-2_for-web-Open-Access_9789463661119.pdf</u>) as the robust work performed within FACAcamp was used to contributing to this publication.

KPIs are defined as a quantifiable measure used to evaluate the performances of a given thing. Thus, by definition, each KPI has its unit of measurement, a scale, and therefore enables to make a quantitative assessment and comparison of the performances of a certain building or its portion. It is worth highlighting that a KPI is not a feature of a material, such as its density or thermal conductivity, but it usually refers to a system.

The KPI has to be representative for a single specific characteristic of the system under investigation. This peculiarity is very useful when talking about specific technologies, because it helps to easily identify the technology main features and how good the system is performing on that aspect. On the other hand, innovative façade systems and components need new or at least modified KPIs being able to describe their features and their goodness in that.

For such complex system, the traditional façade KPIs are not anymore representative of the actual system performance. New or modified KPIs are needed to characterize the adaptivity of adaptive façade as well as their performance in terms of traditional KPIs.

In order to make the comparison possible, each KPI must be clearly defined so that everyone then calculates it exactly in the same way and using the same units. Thus, a comprehensive repository of



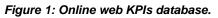


the KPIs used in the built environment has been developed. It includes, for each KPI, at least its univocal definition, its units of measurement, and how it is calculated.

3.2 Result

The tool is a website that can be accessed via the internet from anywhere using computers, tablets or smartphones (http://kpidb.eurac.edu/). It has been designed to be easily usable and accessible, it includes a large number of KPIs, and many research projects and partners have supported its development.





The website contains three main tabs, namely "home", "database", and "projects and partners" (Figure 1). As its name suggests, in the "home" tab there is an introduction to explain the main aim of this tool, what KPIs are, and how the contents included into the KPI database have been selected. The second tab, "database", is where the user can search into the database to find out the exact meaning of a given KPI, or to identify what KPIs they should be using for this or that purpose. The third and last tab, namely "projects and partners", provides an overview of the research projects that are link to this website and that supported, at different levels, its implementation. Lastly, at the bottom of the page, there are some general information about contact details, registration, how to cite this tool, and the license agreement.

At the top of the "Database" page, there is the possibility to look for a certain KPI using keywords. These could be the name of the KPIs as well as other relevant works. The remaining part of the page is dedicated to the filters that can be selected to interrogate the database. When the user starts to set the first filters, such as "building" in the "macro scale" filter, then the subsequent filters became active according to this initial choice. In other words, a nested selection procedure was chosen to guide the user in the use of the database.

The filters cover several areas such as intended use of building, type of system or components, target group (who is more likely to use a certain KPI), and some general themes (e.g. thermal comfort, economy, energy, etc.). The basic idea is that this filtering process led to the identification of the most appropriate KPI, or set of KPIs, for a given purpose for a specific user.

The output of the query is a table that summarizes all the KPIs that match the selected filters. Unregistered users have access to a limited number of results per query, while this restriction does not apply to the registered ones. Moreover, after having completed the registration and login, the



users can also vote the KPIs, add comments, and suggest new KPIs. However, these will not be displayed and accessible to everyone until when the website's administrators approve them.

4 KPI evaluation

This part of the work is synthetically reported in the following paragraphs. The details are freely readable in the publication of Bianco L. et al, Towards New Metrics for the Characterisation of the Dynamic Performance of Adaptive Façade Systems, Journal of Façade Design and Engineering, Vol. 6, Nr 3, 2018 (<u>https://journals.open.tudelft.nl/jfde/article/view/2564/2854</u>).

4.1 Methodology

This work focused on the technological group called "adaptive facade". The work first consisted in the definition of specific performance metrics devised into the four different adaptive façade projects. A description of the adaptive façade system is given, then the definitions and characteristics of all metrics are provided, together with the quantification of the specific metric for the related adaptive façade system. Finally, similarities and differences between the different metrics are contrasted, identifying their main benefits, the specific adaptive technology they refer to, and how they can capture the dynamic effect of the adaptive system.

4.2 Result

Using a combination of experiments and simulations, different indicators for different adaptive opaque façades were identified. The main difference between the presented metrics, and the standard way to evaluate the performance of façades such as U-value, G-value, and so on, is that the presented metrics cannot be calculated directly from physical characteristics of the materials adopted in a typical façade multi-layer system / construction, and do not have an immediate direct physical meaning. Instead, these metrics are derived from either experimental or numerical datasets.

5 Conclusions

Complex façade systems needed a dedicated set of Key Performance Indicators to be characterised becoming comparable, and the work conducted within FACEcamp enabled to move some step forward. However, there is still a relevant gap between technologies' complexity and reference methodologies and related KPIs. FACEcamp KPIs database (<u>http://kpidb.eurac.edu/</u>) is the main step, reached with project, towards the creation of an agreed methodological framework able to support the comparison of different complex façade technologies.





FACEcamp partners

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SÜDTIROL ALTO ADIGE	IDM IDM Suedtirol - Alto Adige	Partner
universität innsbruck	UIBK Universität Innsbruck, Arbeitsbereich Energieeffizientes Bauen	Partner
HELLA Jalousien. Markisen. Rollläden.	HELLA HELLA Sonnen- und Wetterschutztechnik GmbH	Partner
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FRENER REIFER	F&R, FRENER & REIFER SrL	Partner

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