Making the EPBD-CEN package software proof

– The development of the ICT calculation tool under Mandate 480

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The complexity of the EPBD calculation (e.g. nZEB), the interaction between the building and the technical building systems make the use of software necessary. The absence of software tools has been identified as one of the limitations for the correct usage of EPBD standards and for the right implementation of EPBD requirements. Therefore the whole package of the EPBD-CEN standards has to be software proof.

These challenges have clearly been identified and addressed at the beginning of the development of the second generation of EPBD-CEN standards under mandate 480.

A dedicated team is in charge of developing a software tool that will demonstrate the validity and the possibility of a holistic computation based on this second generation of standards.

In the present paper, the first actions of the team are described.

More and more areas of the energy consumption of buildings are covered by the EPDB standards. The complexity of the calculation (e.g. nZEB), the interaction between the building and the technical building systems make the use of software necessary. The absence of software tools has been identified as one of the limitations for the correct usage of EPBD standards and for the right implementation of EPBD requirements.

Daily work in the building energy efficiency will be based on software. This has been recalled and emphasized by the EUPPD (European Union Public Procurement Directive) voted by the European Parliament in January 2014: The building information modelling (BIM) should be used as much as possible in the building sector. In this context, ensuring the using of the standards in software, and especially BIM software, is essential. European funded projects already work on the integration of calculation tools in the BIM. The EPBD-CEN standards must be part of them as a common scheme for assessing the building energy performance.

Therefore the whole package of the EPBD-CEN standards has to be software proof.

Making the EPBD-CEN standards software proof – the task and the team

These challenges has been clearly identified and addressed at the beginning of the development of the second generation of CEN standards under mandate

480. Standards developed under mandate M480 should pay attention to unambiguous expression of the overall energy performance of buildings and their systems, including clearly specified options for different applications to be defined at national or regional level.

CEN has proposed that a dedicated team supports the TC's writing the standards to check the unambiguous expression of the standards as well as their interaction. This team is also in charge of developing a software tool that will demonstrate the validity and the possibility of a holistic computation based on this second generation of standards.

The team is composed by CSTB (Centre Scientifique et Technique du Bâtiment), who is also the team leader, TNO (Netherlands Organisation for Applied Scientific Research) and Beelas. The team is involved in the development of the standards in Phase I and Phase II of the mandate 480. The software team is working in close cooperation with the experts developing the standards.

It has to be underlined that the task of the software tool team is not to develop a commercial software tool neither even a kernel. The task of the software team is to check:

- the consistency between the standards (from the point of view of inputs and outputs and of the calculation sequence);
- the unambiguous and detailed description of algorithms.

Content of work

The set of standards includes two types of standards:

- **Phase 1 / Mandate 480**: The overarching standard, prEN15603 specifies a general framework for the assessment of overall energy use of a building and the calculation of energy performance assessments in terms of primary energy or other energy related metrics.
- **Phase 2/ mandate 480**: The underlying standards in the EPBD-CEN set provide methodologies that may be used to calculate the energy use of services within a building (heating, cooling, domestic hot water, ventilation and lighting) and produce results that are used here in combination to show overall energy use.

Phase 1

In phase I, the skeleton of the demonstration tool has been built and a quality procedure has been developed. As a first step a modular structure has been proposed for the standards. It was shown that this modular structure is implementable in a software computing kernel. Among the modules that have been implemented, prEN15603 plays the central role of the overarching structure. The first task of the software tool team has been to check on prEN15603 software-proofness. PrEN15603 is fully parameterized by Annex A and B making policy factors and choices transparent and visible. These factors are primary energy factors, CO_2 emission, energy cost, or conventions to take into account exported and redelivered energy and definitions (e.g. renewable energy ratio, perimeters, and floor areas). Other inputs of prEN15603 come from the underlying standards. prEN 15603 has been integrated in the software testing tool together with some test versions of the underlying standards.

The framework of the modular structure is depicted in **Figure 1**.

Phase 2

The underlying standards, developed under phase II, are organized in a modular way so that each functionality is a module, identified as such in the detailed modular structure of EPBD –CEN package (see **Figure 2**).

A module is defined by variable inputs and outputs. This structure allows easy replacement of modules by some other coming, for example, from national/regional computations. In Phase II, the testing software tool is designed to show that this "plug-and-play" procedure is indeed reality.

EPBD-CEN standards propose several calculation options. In the proposed holistic approach computation are performed per time step (e.g. hourly, monthly, seasonally, bin). The exchange of information between the standards is per time step. A software tool is more required when the calculation is complex. Therefore the tool focuses on the hourly calculation time step.

Specific effort was put to anticipate the integration into a BIM structure. Coupling with the widely recognized format for energy simulation GbXML has been developed. It can be easily coupled to the standard IFC format, as well as other proprietary ones. This coupling allows a simple integration in the existing software environments.

Conclusions

The integration of a software team in the process of developing the standards is new. The more and more performing buildings (e.g. nZEB's) make necessary the

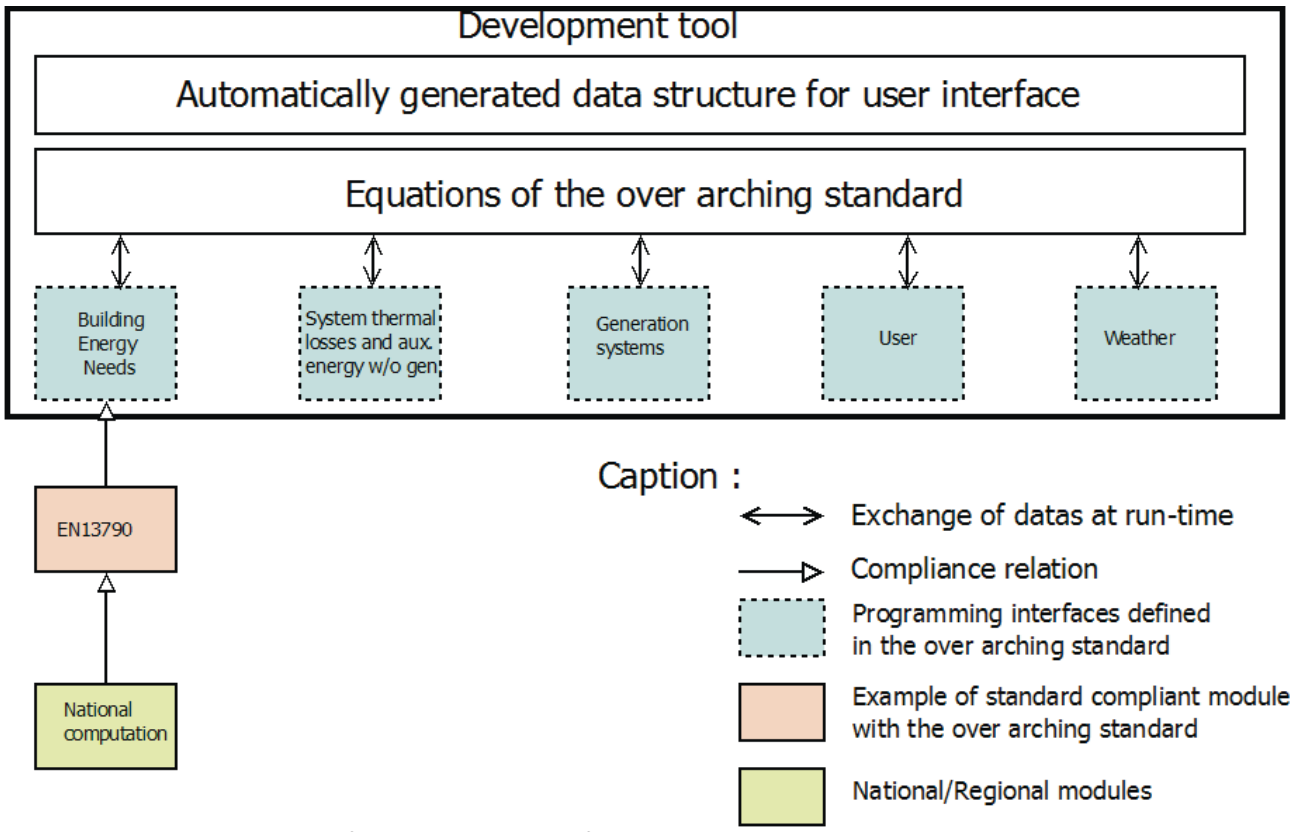

Figure 1. Proposed structure of the development software.

Overarching			Building (as such)			Technical Building Systems										
	Description	Standards		Description	Standards		Description	Heating	Cooling	Ventilation	Humidifi.	Dehumidifi.	DHW	Lighting	Build.control	Electr prod.
sub	M1		sub	M2		sub		M3	M4	M5	M6	M7	M8	M9	M10	M11
1	General		1	General		1	General									
2	Common definitions		2	Building Energy Needs		2	Needs									
3	Applications		3	Indoor Conditions		3	Maximum Load / Power									
4	Perform. Expression		4	Performance Expression		4	Perform. Expression									
5	Building Boundaries		5	Heat Transmission		5	Emission & control									
6	Building Occupancy		6	Infiltration, Ventilation		6	Distribution & control									
7	Aggregation of Energy		7	Internal Heat Gains		7	Storage & control									
8	Building Partitioning		8	Solar Heat Gains		8	Generation									
9	Calculated Perform.		9	Building Dynamics		9	Operating conditions									
10	Measured Perform.		10	Measured Performance		10	Measured Performance									
11	Inspection		11	Inspection		11	Inspection									
12	Indoor Comfort		12			12	BMS									
13	External Conditions															
14	Economic Calculation															

Standards under development

Figure 2. Detailed modular structure of EPBD –CEN package M480.

use of more and more performing tools. Therefore the EPBD-CEN package should be able to be integrated in modern software tools. The cooperation between the software tool team and standard writers will help to increase applicability and use of the EPBD-CEN package. ■