Assessing and enhancing EN 16883:2017

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Abstract. This paper describes the work undertaken within the international project IEA SHC Task 59 Renovating Historic Buildings Towards Zero Energy to produce a handbook for the planning of energy retrofits in historic buildings. The handbook is an attempt to increase use and usability of the European standard EN 16883:2017 - Conservation of cultural heritage - Guidelines for improving the energy performance of historic buildings. The standard provides a decision roadmap for how energy efficiency measures can be identified that both respect the heritage values of the building and improves the energy performance. It also provides general information about energy efficiency in historic buildings. There has been a lot of interest in this standard from researchers in the field of energy efficiency in historic buildings, but it has not been widely used in practice. The first part of the paper summarises an assessment of the use, or lack thereof, of the standard. The assessment is based on nine European case studies that identify how the European standard can be complemented with additional resources, examples and guidance. In the second part the work with a handbook complementing the standard is outlined, and recommendations to future revisions of the standard are suggested.

Keywords – conservation; cultural heritage; European standard; standardization; heritage

1. Introduction

A novel European standard to support the planning of energy retrofits in historic buildings was introduced in 2017: EN 16883:2017 *Conservation of cultural heritage. Guidelines for improving the energy performance of historic buildings* [1]. The standard acknowledges the challenges and opportunities connected with improving the energy performance in historic buildings, and the aim is to facilitate a systematic interdisciplinary planning process that will identify solutions on a case-by-case basis.

Guidelines, in various forms, have played, and continue to play, an important role for the application of research results outside of the academic community. When designing guidelines, standard makers face a fundamental dilemma: they have to present generic answers to problems which tend to vary from case to case [2]. Practitioners often have expectations of simple and general guidance even though the problems tend to be complex. During the last years, guidelines and standards in the conservation field have moved away from universal recommendations to process oriented standards which aim to support the decision process in each individual case [3]. EN 16883:2017 is an example of a procedural standard. Such procedural guidelines are promising as they are more flexible and allow for individual variation in the end results. However their application might place higher demands on the end user in terms of resources and competence[3,4]. Generally, little attention is given to if and how standards and guidelines

actually are used in practice [3]. It is an under-researched area given the efforts put into the production of standards.

Buildings with heritage and architectural values have an important role in the transition to a sustainable energy system [5]. When looking at the building stock as a whole, considering the urgency to mitigate climate change in combination with the relatively slow replacement rate of existing buildings with new ones, it is apparent that the energy performance of existing buildings have to be in focus [6]. Retrofitting existing buildings to improve their energy performance will affect their function but also their heritage and architectural values. As a significant share of existing buildings have such values, it is important to consider the balance between energy performance and preservation in policy making [7].

The conventional policy solution of exempting officially designated buildings ("listed buildings") from demands on energy performance has substantial drawbacks. There is in practice no distinct separation between buildings with and without heritage significance, and having heritage values does not imply a lack of energy efficiency potential per se [5]. Exempting historic buildings is therefore problematic in two ways. Firstly, there is often a possibility to identify energy efficiency measures that are acceptable from a preservation point of view even in officially designated buildings. Such measures will remain unidentified if energy efficiency is not considered important in the renovation process. Secondly, there are energy efficiency measures that should be avoided, or be better adapted, in non-designated buildings because of their impact on heritage and architectural values. In this case, it is important that heritage values and architectural quality of mundane buildings are considered in the planning process. In both cases, it is also the case that standard energy saving measures can be problematic to use, nevertheless the energy performance can be improved considerably if the right package of solutions for the specific building is identified.

This paper is the result of work performed within the IEA SHC Task 59 Renovating Historic Buildings Towards Zero Energy. A part of the project has been dedicated to the study of procedures for how experts can work together to maintain the heritage values of historic buildings, and at the same time make them more energy efficient. The newly launched European standard EN 16883:2017 was from the outset of the project considered a key standard to be evaluated, both for its novel approach and for the uncertainties about how it would be used in practice. The evaluation is useful for deciding if and how the standard can be applied and advertised, and for identifying what kind of complementary resources and activities that are needed. Furthermore, the evaluation can be of interest for both researchers and policymakers to improve the design and development of future guidelines and standards, including a revision of EN 16883.

The paper has three aims:

- To evaluate the use of EN 16883:2017 based on case studies and expert elicitation
- To present the work with a "Handbook for the planning of energy retrofit in historic buildings" undertaken by IEA SHC Task 59
- To give suggestions for future updates of EN 16883:2017.

The full evaluation will be published in a project report, it is only possible here to give a summary of the findings due to the limited format.

2. An assessment of EN 16883:2017 in use

The European standard EN 16883:2017 Conservation of cultural heritage. Guidelines for improving the energy performance of historic buildings is meant to be used by building owners, authorities and professionals involved in the conservation and refurbishment of historic buildings. The aim is to facilitate the selection of appropriate measures in the planning stage. The guidelines are applicable "to a wide range of buildings where special considerations are needed in order to find a sustainable balance

between the use of the building, its energy performance and its conservation". Rather than specifying general solutions beforehand, EN 16883:2017 provides a procedure to facilitate the best decision for each individual building. The standard is divided into the following chapters:

1. Scope
2. Normative references
3. Terms and definitions
4. General consideration
5. Overview of the procedure
6. Initiating the planning process
7. Building survey and assessment
8. Specifying the objectives
9. Deciding if improvement of energy performance is needed
10. Assessment and selection of measures for improving energy performance
11. Implementation, documentation and evaluation of improvement measures

The standard includes general information about energy efficient renovation of historic buildings to be considered, as well as an informative annex with examples of checklists for building information and an example of an assessment table to be used in the selection of measures.

The balancing of preservation aspects and energy efficiency is a key challenge in the sustainable management of built heritage. There is a need to get a better fundamental understanding of the processes, barriers and constraints involved in the planning of energy retrofits in historic buildings, and what role standards and guidelines can have in decision making.

The following research questions have guided the evaluation:

- What have been perceived as strengths and weaknesses with the overall approach of the standard?
- How have users interpreted the standard, and how have existing work processes been modified?
- What complementary material, or resources, are users missing?

2.1. Methodology

The ambition from the outset of the project was to evaluate how EN 16883:2017 is used in real projects where practitioners in an independent way interpret and apply the standard. The professional networks of the 24 partners of IEA SHC Task 59 in 13 countries was used to promote the standard and it was asked if organizations were interested in trying it out. The search for projects where the standard is used started in 2017 and was going on until June 2020.It turned out to be difficult to find these kinds of case studies, and in addition to the evaluation of projects where practitioners have used the standard, experiences from researchers/experts that have applied the standard in research projects have been gathered.

2.1.1. Case studies

Three case studies have been studied throughout the planning process. The recruitment of these projects was done in the following way: Firstly, emails were sent through the researcher's professional networks to building owners/managers, architects, energy experts and heritage experts. These emails were both sent to organizations and individuals. The emails briefly introduced the scope of the standard and informed that there was an interest in evaluating the use of the standard. After initial contact through email the researchers met with the project partners to introduce the standard and the aim of the research. The researchers tried to be careful not to interpret the standard for the adopters in order not to influence the adopter´s own interpretations.

After this initial meeting the projects have been free to use the standard to the extent, and in what way, they have found plausible. It has been stressed that there is no pressure for them to use the standard, and that a reluctance to use it is just as interesting in terms of the evaluation process.

The projects were of different scale and complexity. They have been followed through interviews and participant observation on meetings during and after the pre-concept phase.

Case study A

A small project regarding the upgrade of energy performance of an urban religious building in Norway. One energy consultant, with a special interest in historic buildings, used the standard to identify and select energy efficiency measures.

Case study B

A medium-sized project involving an urban 18th century industrial building in Sweden. The building, which is owned by the municipality, was in a poor state and the aim for the project has been to renovate it as a cultural center. The building department at the municipality, which had little experience with historic buildings, consulted the standard to come up with a proposal for energy efficiency measures.

Case study C

A large and complex project involving the refurbishment of an urban monumental building in Norway. The building is publicly owned and is considered to be of very high heritage value. The standard has been used by an interdisciplinary team to identify and select a package of energy efficiency measures, which has been proposed to be integrated with the planned comprehensive renovation of the whole building.

2.1.2. Expert elicitation from research projects

EN 16883:2017 has attracted considerable interest among researchers active in the field of energy efficiency in historic buildings. There has been contact with researchers involved in 6 different research projects (RP1-6, see table 1), where the standard has been tested in one or more buildings. Firstly, available published results of the studies were collected. An online survey where the involved researchers/experts were invited to contribute with their thoughts about the standard was then conducted. Based on the results of the survey, a workshop with representatives from the RP:s was held online June 2020 with the aim to condense and consolidate the overall results.

The involved projects have varied in both scope and scale, which is to be expected given the nature of the standard. On one side of the spectrum, a modified version of the standard has been used by a multidisciplinary team in several buildings (RP6), and on the other side it has been used meticulously by one person in only one building (RP2). A special case is RP 5, where the application of a modified version of the standard has been demanded by the regional authorities to get building permits for renovations in historic buildings [8]. Several hundreds of applications have followed this procedure.

Table 1: List of cases/projects where the standard has been used. CS= Case Study, RP = Research Project.

ABB.	COUNTRY	DESCRIPTION	CONTACT PERSON/REFERENCE
CSA	Norway	A small project of an energy upgrade of an urban religious building. One energy expert involved together with heritage authorities and owners/users.	Gustaf Leijonhufvud, Uppsala university
CSB	Sweden	Whole building renovation of an 18th century urban industrial building in a poor state. Medium-sized project. Planning team with little pre-experience of renovating historic buildings.	Gustaf Leijonhufvud, Uppsala university
CSC	Norway	Major renovation of a complex monumental building. Interdisciplinary team involved.	Gustaf Leijonhufvud, Uppsala university
RP1	Italy	EN 16883:2017, MiBact guidelines and ASHRAE 34P were tested in three buildings in Sicily and Lombardia. These were rural buildings of medium complexity. Interdisciplinary team involved.	Alessia Buda, Politecnico di Milano. [4]
RP2	Italy	EN 16883:2017 was tested in one listed, ancient building in Genova. Restoration and reuse project with residential and office use oriented towards the realisation of a NZEB pilot case. Interdisciplinary team involved.	Giovanna Franco, University of Genova
RP3	Turkey	EN 16883:2017 was used to select packages of energy efficiency measures in 22 pre- and early-republican residential buildings in İzmir.	Zeynep Durmus Arsan, Izmir Institute of Technology [9]
RP4	Turkey	A preliminary version of EN 16883:2017 was tested on a building in Izmir. A detailed building energy simulation tool was used to determine the impacts of energy efficient retrofits.	Gulden G.Akkurt, Izmir Institute of Technology [10]
RP 5	Belgium	An energy audit scheme based on EN 16883:2017 has been used by the Flanders Heritage Agency. Under some circumstances, it has been mandatory to use it in order to get permit for renovation projects.	Nathalie Vernimme. Flanders heritage agency [8]
RP 6	France	An early version of the standard was developed and used by a multidisciplinary team to compare packages of energy efficiency measures for seven representative historic buildings in the region of Alsace.	Elodie Héberlé, Cerema [11]

2.2. Results of the evaluation

a) What have been perceived as strengths and weaknesses with the overall approach of the standard?
Overall strengths:

- Offers a systematic approach that can open up for other interventions than what team members immediately think of
- The systematic approach advocated for the selection of measures resonates with common sense
- The voluntary and informative elements (many positive users have been "inspired" by the standard rather than strictly followed it)
- The general interdisciplinary approach
- The focus on the potential for energy efficiency also in protected buildings
- Gives attention to heritage aspects early on in the planning process also in the case of non-protected buildings

Overall weaknesses of the standard:

- Confusion about what is mandatory or not
- Uncertainty about how different parts are supposed to be carried out
- Presupposes a large project (e.g. a multi-disciplinary planning team)
- In larger projects, the required parts will to some extent be covered by existing procedures and there is a risk of redundancy
- In smaller projects, the list of what is required can be overwhelming and of questionable benefit.
- Lack of examples
- The focus on the individual building implies missed opportunities of communal solutions and infrastructure
- the iterative character of the planning procedure is not emphasized enough

b) How have users interpreted the standard, and how have existing work processes been modified?

The standard, as a standalone document, is neither sufficient to convince decision-makers about the benefits of its use, nor self-explanatory for the majority of new users. Here, there is clear difference between the research projects and the case studies. The research projects have been led by researchers that from the outset were familiar with the basic ideas of the standard, as well as the potential benefits from applying these ideas. They have also focused more on the details of the standard. In the case studies a major obstacle in the beginning of the process has been for the decision-makers to interpret what the standard is about (its core ideas) and what the potential benefits would be. Despite this reluctance to use the standard, it is evident from the case studies that users of the standard generally have perceived it as relevant and based on sound ideas.

A recurring problem is that users have had difficulties in interpreting what is required and not in the standard. This seems to have at least two explanations. Firstly, it has to do with how refurbishment processes are structured. It is only rarely that refurbishment is made with improved energy performance as the main objective. Rather, energy efficiency is one of many objectives that have to be considered. The logic of the planning process is therefore based mainly on other aspects, and the suggested workflow of the standard has to be integrated with existing planning practices and conventions. This implies that the user of the standard has to select elements of the standard and translate them into working practices that fit with the existing ones. Secondly, it is not clear in the text of the standard what is required in order to follow the standard. The language is sometimes ambiguous, and aspects that obviously are unnecessary or impossible to fulfil can be perceived as mandatory.
An aspect that has been put forward as a strength of the standard is the focus on the potential for energy efficiency also in officially protected buildings. A perceived common problem is that energy efficiency

is overlooked in protected buildings. In addition, the early involvement of heritage aspects in the planning process is perceived as a success factor, and this is emphasized by the standard. This is not surprising, as this was one important rationale behind the development of the standard.

c) What complementary material, or resources, are users missing?

Complementary, and easily accessible, information is needed to support potential adopters of the standard. Such information should provide users with:

- Examples of how the steps in the standard can be carried out
- Example of how the standard can be integrated with existing standards and procedures
- Examples of energy retrofits and energy efficiency measures
- Examples showing the benefit of following the standard
- Resources, literature and tools supplementing the steps in the standard

3. A handbook for the planning of energy retrofit in historic buildings

Based on the discussions within the IEA SHC Task 59 project, as well as the evaluation of how EN 16883:2017 is used in practice, the idea of a handbook complementing the standard developed. It was decided that a handbook should be:

- Follow the standard in spirit but not directly refer to the different sections in the standard. It should be possible to use the handbook as a standalone guideline and as a complement to the standard.
- Provide readers with real and hypothetical examples of best practice in energy retrofit of historic buildings
- Provide readers with real and hypothetical examples of how different steps of the planning process can be carried out in practice
- Give general background information about the different parts of the planning process, and provide links to more detailed information, resources and literature.
- Provide integration to other parts of the IEA SHC resources being developed, such as the Best practice database for energy retrofit in historic buildings (www.hiberatlas.com) and a tool for the selection of energy efficiency measures.

The handbook is currently being developed and the chosen format is to publish it as a written handbook in English published by the Swedish Institute for Standards.

4. The future of EN 16883:2017

Regarding the standard itself, it is suggested that the following recommendations should be considered for its next revision:

- Focus on the generic procedure for decision-making. This procedure, which is the core of the standard, should not be concealed by other information. Differentiate clearly between the core of the standard and proposed methodologies/general information.
- Emphasize the iterative nature of the planning process. It is important that users understand that the setting of objectives and the assessment of packages is a matter of negotiation which might require several iterations.
- Make it clear what is required in order to follow the standard (if anything). The jurisdiction of the standard is unclear to users. An alternative would be to emphasize the voluntary aspects, and only require users to follow the generic decision-making procedure (without specifying what is mandatory in each step).
- Adapt the standard so it easily can be used for a stock of buildings, or categories of buildings.

Lastly, to spread the use of the standard in a long-term perspective it is important that it is used in training and education for professionals in the field.

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