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Multicriterion assessment of existing buildings in reSBToolCZ

Stepan Mancik *Czech Technical University in Prague, Prague, Czech Republic* stepan.mancik@fsv.cvut.cz

Jan Ruzicka *Czech Technical University in Prague, Prague, Czech Republic* jan.ruzicka@fsv.cvut.cz

Multicriterion assessments of buildings, placing an emphasis on their environmental profiles, are becoming increasingly important in building practice. It is generally known that the greatest deal of energy savings in the building sector is achieved through improving the existing building stock. New buildings represent just a small part of the existing building stock. The key question with existing buildings is, what approach should be adopted towards existing buildings which can look very different depending on their construction, typology, building style and also the value of their historical and cultural quality. The assessment methodology reSBToolCZ for building renovations for residential purposes is based on SBToolCZ which was implemented according to Czech conditions and requirements. It considers current standards, legislation and approaches in cultural heritage protection of existing buildings and also the possibilities of their improving from the point of view of sustainability and environmental quality. ReSBToolCZ also includes historical monuments in the assessment, taking into account their historical quality so that they are not disadvantaged in comparison with buildings without any cultural or historical quality. The development of the methodology was finished and the assessment tool and benchmarks settings will be verified through case studies.

Introduction

SBToolCZ (www.sbtool.cz) is a Czech methodology (Vonka et al., 2011) for the evaluation of complex quality of buildings and is based on international methodology SBTool (www.iisbe.org) developed by iiSBE – International Initiative for a Sustainable Built Environment. ReSBToolCZ for existing residential buildings and their renovation is an assessment method which evaluates building and location qualities with reference to sustainable development and cultural-historical values. Analogically as in the SBToolCZ for new residential buildings, a building's impact on the environment is assessed as well as socio-cultural aspects, functional and technical quality, economics and management and also the location of the building (for a complete criteria summary see chapter 8).

Several international methodologies exist which also deal with existing buildings (such as LEED, BREEAM, CASBEE, etc.) but they evaluate the scale of running efficiency of the building and its possible improvement. So they work more like a facility management tool. Its result is a list of recommended constructional interventions that would improve the overall performance of the building according to the methodology setup.

In order to be able to clearly define the essence and aims of the assessment tool for existing buildings, it is necessary first to define the specific terms that are involved:

- Reconstruction = intervention into an existing building that means fundamental changes in its construction. The fundamental part of the building is changed ,and in case of need, also its purpose.
- Renovation = is such an intervention into an existing building when particular building structures are changed (for example in order to reduce energy demand of the building or to fix damaged structures) in a way that the essence of the building is preserved.
- BAT (Best Available Techniques) = currently best available technologies used for example for refurbishing a building structure.

Classification of existing buildings

The key issue of complex assessments of reconstruction or renovation of buildings is above all in the diversity of the existing building stock.

If it was possible to classify existing buildings then it would be also possible to assign specific ways of renovation or reconstruction in terms of sustainable development criteria for each category of buildings.

It is necessary to realize that during the assessment, buildings just several years old are evaluated at the same time as buildings several centuries old, buildings with a minimal cultural-historical significance and on the other hand buildings whose cultural-historical significance is immense. Buildings can naturally have different purposes. The criteria of the classification of buildings can be different according to the following parameters:

- Age
- Style
- Typology
- Structure or material
- Cultural-historical value etc.

These classification groups can overlap each other and classifying a building into one specific group can be complicated if the building is on the edge of two groups.

If it was decided to divide the assessment method according to these groups or their combinations then it would lead into a confusing state of heterogeneous approaches which would have to be divided between each other. Such a method and classification of buildings into specific subgroups could be problematic and it would be possible to confront it very easily.

The result from the above mentioned facts is that the categorization of existing buildings is not objective and transparent and it does not lead to satisfying results. An assessment method should be implemented in a way that it would not depend on classifying buildings but it would assess existing buildings in one transparent way according to their environmental, social, cultural and economic qualities.

Cultural-historical aspect of existing building

The main aspect that, in contrast to new buildings, affects renovations of existing buildings is their cultural-historical value. It has a fundamental influence on potential renovations and also on the scale of improvements of the overall building profile. It is obvious that it is necessary to approach to a building with cultural-historical value and a building with minor cultural-historical significance (Figure 1) differently.

Figure 1. Listed building after renovation (left) and renovated object without historical protection (right).

Assessment methods that nowadays exist for evaluating existing buildings do not consider their cultural-historical value.

From the point of view of the building structure, it is obvious that the cultural-historical value respectively of its preservation during renovation or reconstruction significantly limits achieving the best environmental performance quality.

Example 1 – Historical building: A very important aspect of an environmentally effective building is among others; reducing heating energy consumption. This could be achieved by improving the thermal insulation parameters of external walls or dividing into heated and non-heated rooms. However, a lot of buildings cannot be equipped with ETICS (External Thermal Insulation Compound System) considering their valuable historical façades or they can be just partially insulated. In such buildings it is often impossible to install new windows with the best thermal insulation parameters etc. These kinds of buildings would never reach the best evaluation in SBToolCZ because of their cultural-historical quality.

In some ways, the demands on sustainable buildings and the necessity of handing them down to future generations; through the system of cultural references (Council of Europe, 1985) oppose each other. On the other hand, it is evident that the preservation of our cultural heritage, its maintenance and protection for future generations should be consistent with the principles of sustainable buildings.

Cultural-historical value in the Czech Republic

The protection of cultural heritage in the Czech Republic is defined by the Architectural Heritage Protection Law (Czech National Parliament, 1987) - as amended by further regulations. The Czech Republic has undertaken in respect to meet the standards set out in the Convention for the Protection of the Architectural Heritage of Europe (Council of Europe, 1985) issued by the Council of Europe in 1985. These documents are the fundamental pillars of architectural protection in the Czech Republic.

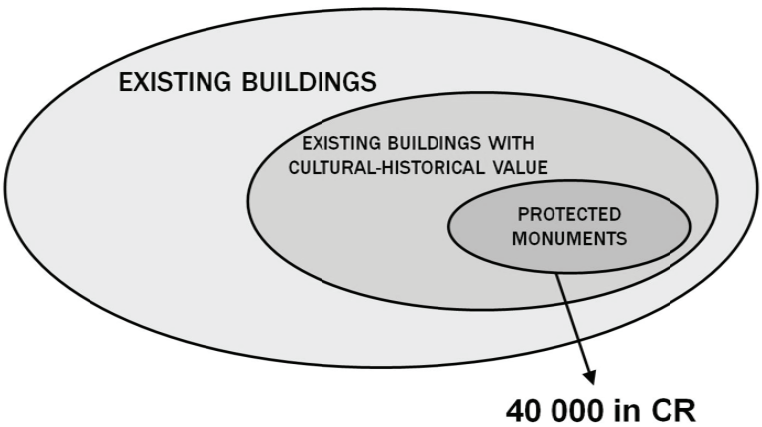

Figure 2. Diagram of existing buildings in the Czech Republic and their cultural-historical importance. There are over 40,000 recognized and protected historical monuments in the Czech Republic (National Heritage Institute, 2011).

On the basis of this law, the National Heritage Institute was established. It is an institution that administers a complex service of heritage protection (evidence of monuments, methodology of renovations, expert supervising over the maintenance, analyses etc.) and fulfills the objectives of the [aw.

Existing buildings can be illustratively divided according to the above mentioned documents into 4 categories that define their cultural-historical protection:

A. Buildings without recognized cultural-historical significance;

B. Buildings culturally valuable but not protected by law; buildings in the protection perimeter

C. Buildings in a reservation or a zone

D. Architectural monument

G. [illegible]

Every building is unique and represents a specific case and therefore requires an individual approach to its renovation as well as to its assessment.

Cultural-historical quality of every building that is to be renovated or reconstructed should be assessed by a responsible person, in this case by an authorized architect. For buildings that fall into groups C and D, the scale of the constructional intervention and its way are determined by the requirements and instructions of the authority in the field of architectural heritage protection which is the

National Heritage Institute. This institute should be a partner for the investor while searching the conception of renovation of delicate buildings. This also presumes a wider perception of reconstruction and renovation of the existing building stock not only in the context of heritage protection but also in the context of sustainable buildings.

For groups B, C and D and potentially valuable buildings from group A, it is clear that the assessment method reSBToolCZ fully respects the priorities of cultural heritage protection of those buildings that represents such values, and tries to define within the protection definition such construction interventions that improve its quality in terms of sustainable development. Buildings that do not represent such a value (group A) are not limited by the protection and can be improved any way.

Aims of the assessment method for evaluation of existing buildings

In the light of the above mentioned facts, two main goals were implemented for the proposal of the multicriterion assessment method for existing buildings:

- Assessing the complex quality of new buildings and renovated/reconstructed buildings in a way that the resulting quality of both will be comparable
- Systematically taking into account the cultural-historical qualities of buildings

This kind of assessment method will allow an evaluation of all existing buildings without the necessity of their classification into some groups, no matter what historical quality they represent. At the same time it will be able to mutually compare the complex quality of existing and new buildings. In this connection, it is necessary to keep in mind the possibility that a number of existing buildings have neither cultural-historical quality nor the potential of environmental improvement can be replaced by new buildings that have at least one of these qualities.

Such buildings will be assessed with the reSBToolCZ method as well but the benchmarks in the criteria will not be affected by cultural-historical values. So there will not be any relative setup of the benchmarks (by improvement potential) and the buildings will be assessed practically the same way as new buildings. It is necessary to take into account also the possibility that sometimes the best solution for the existing building is demolition.

Example 2 – Embodied energy and emissions: The assessed building will not be found historically valuable and will be assessed by the reSBToolCZ method with the criteria setup as for a new building (that means without implementing the principle of relative setup by improvement potential). Then in the criteria which deals with the embodied parameters of materials used in the building, an existing building will have a better position because the original materials in the buildings will not be counted into the assessment. Only those materials added to the construction during renovation/reconstruction will be counted.

Example 3 – BAT historical building vs. new building: If the renovation/reconstruction of an existing building was designed as a BAT construction in compliance with the principles of cultural-historical protection then the building gets the best marks even though the absolute quality of the renovated/reconstructed building in technical and environmental parameters are lower than those of a new building of a similar scale.

Example 4 – BAT historical building vs. standard renovation: Two existing buildings of different historical quality are assessed. Both are designed in the BAT standard in compliance with the principles of cultural-historical protection. These two buildings get the best evaluation in reSBToolCZ even though their environmental qualities are different (Figure 3).

Example 5 – reSBToolCZ as a part of investment decision making process: The renovation/reconstruction of an existing building is designed in the BAT standard and the building reaches a certain evaluation level. At the same time there is a proposal of a new building. It is possible to achieve a better evaluation with the new building. On the basis of comparison of these two assessments; the investor can decide if he wants to renovate/reconstruct the existing building or demolish it and replace it with a new one in better quality.

Figure 3. Listed building after BAT renovation and renovated building without historical protection with parameters as a new building.

Basic principles of reSBToolCZ assessment method

The cultural-historical value of buildings that takes into account valuable historical elements, constructions, details or crafts to certain extent limits the possibilities of achieving the best environmental quality. It "disadvantages" such buildings in terms of the SBTool criteria, even though in many cases, the protection of the historical value is much more important. This protection can be called cultural sustainability.

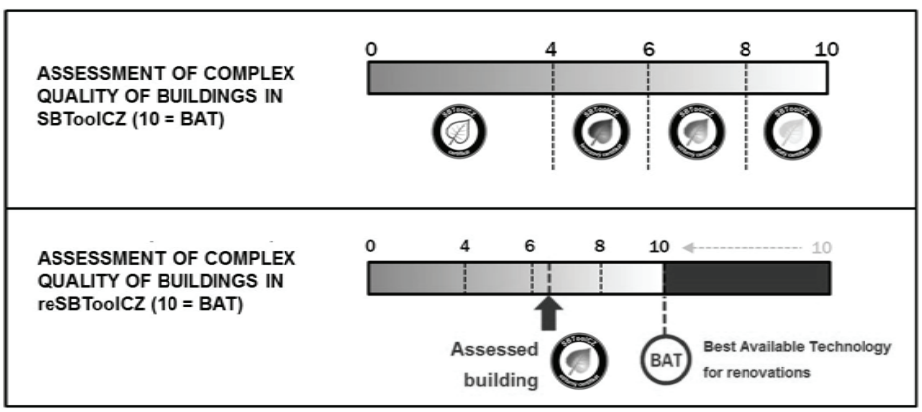

Figure 4. Comparison of assessment of buildings with and without cultural-historical value. The scale shows the evaluation in reSBToolCZ assessment method.

The criteria for assessing existing residential buildings and the evaluation system come from the existing methodology for new residential objects (Example 5). Only some definitions and benchmarks are slightly modified.

The basic principle of reSBToolCZ assessment is the relative setup of those criteria and benchmarks that are directly influenced by the cultural-historical values of the building. The setup is always made individually depending on cultural-historical significance. In these criteria, the BAT standard is defined and creates the highest outline of the benchmarks. The quality of designed renovation/reconstruction is assessed in the interval <original state; BAT>. This approach helps to avoid the categorization of existing buildings and further complications during their classification.

Division of criteria according to the matter of benchmark setting

The proposed method of multicriterion assessment of existing buildings divides the criteria into the following groups according to benchmark settings:

A. Criteria with identical settings as for new buildings

B. Criteria with benchmarks modified by the improvement potential

C. Criteria modified for existing buildings

Criteria with identical settings as for new buildings

Those criteria that do not have any direct connection to the cultural-historical value of the building belong in this group. These criteria and their settings do not differ from those for new buildings. The reason is either the possibility of achieving the best available evaluation even for existing buildings or the relative benchmark setup cannot be applied in this case because of the qualitative nature of the criteria (for example those criteria that deal with the internal quality of buildings and their impact on people). In this group, there are the two following cases:

- Benchmarks are the same as those for new buildings because renovation/reconstruction can reach the best quality defined in the criteria. These criteria are represented by the social group. It is clear that internal environment of building has the same impact on a human being no matter if it is historical building or not. This aspect of building quality cannot be relativized and it is important to keep the current setting that comes from valid regulations and laws.
- Embodied energy and emissions that are already built in the existing building are not included into the assessment. Only the materials that are added during the construction within the renovation process are calculated. This automatically means a better position for existing buildings compared to new buildings. The usage of the existing buildings means a reduction of the consumption of new materials and built-up areas which are some of the basic principles of a sustainable building. At the same time, the higher design and economical complexity of the renovation is compensated (Example 6).

Example 6 – Small renovation vs. major reconstruction: The main structural part is made as a reinforced concrete shell with light suspended façade. Two variants of renovation/reconstruction are designed:

a) The minimalistic variant where the façade is thermally insulated. The consumption of materials in comparison with a newly built object is very low and the existing building will reach the best evaluation in this criteria. On the other hand running costs will be just partially reduced and this solution will not improve the quality of the internal environment.

b) A complex reconstruction occurs where the entire façade is changed for a new one. This means that the embodied emissions and energy rise significantly. On the other hand this step reduces the running costs for heating, air-conditioning etc. so the building achieves the best evaluation in other criteria.

Criteria with benchmarks modified by improvement potential

The criteria where it is necessary to take into account cultural-historical values are implemented relatively according to the building quality. This relative set up of benchmarks is called the improvement potential. This represents the scale of possible improvement in terms of the criteria influenced by the cultural historical value (Figure 4).

Benchmark settings are relative which means that they are always set up ad hoc building from to building according to the evaluation of original state and definition of the BAT solution for the building. Then the proposed solution lies in the interval between the original state and the *BAT <original state; BAT>*. The difference between these two points is called the improvement potential (Figure 4).

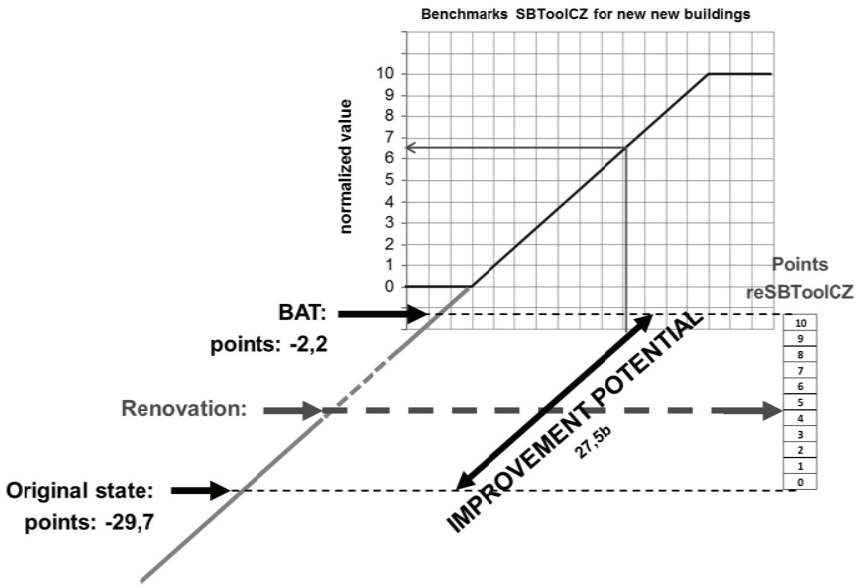

Figure 5. Benchmark setting with the help of improvement potential. Graph shows the layout of benchmarks for new buildings. reSBToolCZ point evaluation of original state, BAT and designed renovation can be seen on the stretched normalization line.

Valuable facades or decorative interiors that influence the building's envelope are common matters of architectural protection. That is why all the criteria from the environment that are connected to the façade belong to this group. Furthermore, "User Comfort" from the social group belongs here too.

Example 7 – BAT renovation of historical valuable building: The aim is to refurbish an object with a valuable decorative façade. The thermal insulation capacity of the external walls is of a low level. The only possible intervention to the façade is a partial change of the glazing or partial internal thermal insulation. These acquisitions define for this building the BAT standard form for improving the façade and criteria connected with it.

Criteria modified for existing buildings

The last criteria are those which are necessary to be redefined because the setting for them is not appropriate for the existing buildings.

For example from the group of environmental, criterion E.11 Land use belongs here. The assessment of handling demolished waste material will be newly implemented.

Summary and comparison of criteria for new and existing residential buildings

In the Table 1 the criteria of reSBToolCZ are summarized together with a comparison with the criteria for new buildings (Vonka et al., 2011).

Table 1. Comparison of the criteria in existing methodology for new residential buildings and reSBToolCZ.

SBToolCZ for new buildings		reSBToolCZ
	Environmental criteria	
E.01	Global warming potential	Improvement potential
E.02	Acidification potential	Improvement potential
E.03	Eutrophication potential	Improvement potential
E.04	Ozone depletion potential	Identical with new b.
E.05	Photochemical ozone creation potential	Identical with new b.
E.06	Use of greenery on building site	Identical with new b.
E.07	Use of greenery on roofs and facades	Improvement potential
E.08	Potable water identical with new buildings	Identical with new b.
E.09	Primary energy consumption	Improvement potential
E.10	Use of construction material	Identical with new b.
E.11	Land use	Modified for existing b.
E.12	Outcome of rainwater	Identical with new b.
	Social criteria	
S.01	Lighting comfort	Identical with new b.
S.02	Acoustic comfort	Identical with new b.
S.03	Thermal comfort in summer	Identical with new b.
S.04	Thermal comfort in winter	Identical with new b.
S.05	Health safety of materials	Identical with new b.
S.06	User comfort	Improvement potential
S.07	Accessibility for disabled	Identical with new b.
S.08	Building security	Identical with new b.
S.09	Adaptability	Identical with new b.
S.10	Space Efficiency	Identical with new b.
S.11	Use of exterior building	Identical with new b.
	Economics and Management	
C.01	Operation cost analysis	Identical with new b.
C.02	Provision of operation plans	Identical with new b.
C.03	Operation autonomy	Identical with new b.
C.04	Sorted waste management	Identical with new b.
	Locality	
L.01	Biodiversity	Identical with new b.
L.02	Provision of place for free time	Identical with new b.
L.03	Key amenities - provision and proximity	Identical with new b.
L.04	Public transport accessibility	Identical with new b.
L.05	Site security	Identical with new b.
L.06	Natural risk	Identical with new b.

Conclusions

The aim of the proposed assessment method is not a polemic about the level and procedures of architectural protection of historical buildings. In good faith the thesis accepts that the way of current protection of cultural heritage is carried out in the best available format. The proposed assessment method uses these preservation techniques. Interventions into the reconstruction of a building must be in compliance with these principles. On the other hand, it is probably necessary to extend the view of cultural heritage protection to wider social demands and take it in as an inseparable part of a sustainable building.

From the point of multicriterion assessment of existing buildings, reSBToolCZ is a completely new method and differs from all existing methodologies. Fairness of this approach is obvious when we look at the absolute number of historical monuments in the Czech Republic. Nowadays, there are more than 40,000 (National Heritage Institute, 2011). Buildings that represent a certain cultural historical value but are not protected by law though are not included in the National Heritage Institute's overall estimate.

The assessment method reSBToolCZ and its benchmark settings are currently being tested in several case studies.

References

Ad-hoc Industrial Advisory Group (2009). Energy-efficient Buildings (EeB) PPP, Research priorities for the definition of a Multiannual Roadmap and longer term Strategy. *European Economic Recovery Plan*. Brussels: European Commission.

Council of Europe (1985). *Convention for the protection of the architectural heritage of Europe.* Grenada.

Czech National Parliament (1987). *Protection of cultural heritage law.* Prague.

Faculty of Civil Engineering (2011). *About SBToolCZ*. Available at www.sbtool.cz.

National Heritage Institute (2011). MonumNet. *MonumNet*. Available at http://monumnet.npu.cz/monumnet.php.

Vonka, M. et al. (2011). *Methodics SBToolCZ – Manual for assessment of new residential buildings in design phase*. Prague: Faculty of Civil Engineering.

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