ISSN 1647-0621 (print) ISSN 2182-2743 (on line)
www.ijsc.greenlines-institute.org

International Journal of Sustainable Construction
Vol. 2, No. 1, December 2014, pp. 7-17

Certified sustainability for heritage buildings: development of the new rating system GBC Historic Building™

Paola Boarin[1] — *Architettura>Energia Research Centre, Department of Architecture, University of Ferrara, Ferrara, Italy* — paola.boarin@unife.it

Daniele Guglielmino[2] — *Green Building Council Italia, Rovereto, Italy* — daniele@danieleguglielmino.it

Marco Zuppiroli[3] — *Labo.R.A. Laboratory, Department of Architecture, University of Ferrara, Ferrara, Italy* — marco.zuppiroli@unife.it

The identification of historical value must be an integrated part of a sustainable building process aimed at the preservation and enhancement of its all previous expressions with the ultimate goal of identification, enhancement and transmission of the cultural heritage to the future generations. Green Building Council Italia is moving within this cultural context with the main goal, developed through an interdisciplinary working group, of the establishment of a voluntary certification protocol aimed at evaluating the sustainability level of restoration, refurbishment and partial integration in pre-industrial buildings. The paper presents the new rating system *GBC Historic Building*™ starting from the identification of the protocol's field of application and moving to the new topic "Historic Value", introduced with the goal of improving the building's sustainability level without compromising its cultural value. The paper also shows the innovations added throughout the new protocol and the contribution of the first registered case study.

Introduction

Existing buildings with historic and testimonial value represent a significant asset in Italy (Fabbri, Zuppiroli and Ambrogio, 2012, p.139). The improvement of existing building's performance, by deep renovation or operational strategies, is also a priority set by the European Community through the directives on energy efficiency (2012/27/EU). The actions of refurbishment and restoration of buildings with historical value have also to consider the need to preserve the related architectural and cultural aspects that characterize them. In order to achieve these goals, appropriate tools capable of leading operators in the building industry are needed.

The rating systems evaluating buildings level of sustainability are intended to respond to the needs by defining requirements to be met, suggesting approaches and computational models to demonstrate the achievement. The main contents addressed by these rating systems deal with sustainability of the sites, water efficiency, energy saving and performance optimization, indoor environmental quality, materials, waste management, both during construction and operation phases, and reduction of environmental loads.

To conjugate restoration/refurbishment actions for maintaining historic buildings and their related cultural and historical meanings still constitutes an open challenge. The Italian Green Building Council (GBC Italia) is now working to promote a dialogue between two areas that have always been highly diversified so far: the sustainability criteria of LEED® and the knowledge of the world of restoration, for which Italy plays roles of excellence in the international scenario.

A new rating system: *GBC Historic Building*™

GBC Historic Building™ is a new rating system for the voluntary certification of the sustainability level of conservation, requalification and partial integration of historic buildings, respecting and protecting their cultural value.

The choice of basing the development of the *GBC Historic Building*™ on the structure of LEED® (Leadership in Energy and Environmental Design) is related to the systemic approach that this internationally diffused rating system offers. The LEED® system approaches the building in a transversal way, developing thematic correlations between different aspects, which are framed within macro-areas. It is a set of rating systems for design, construction, operation and maintenance of green buildings.

In 2010, the Italian Green Building Council developed a local version of one LEED® rating system for New Construction and Major Renovation named LEED® Italia (GBC Italia, 2010). Although LEED® Italia is applicable to interventions of deep renovation of historic buildings, it does not include specific issues linked to the valorisation of historical and cultural aspects that the built environment might have. The new rating system is based on the type of building involved among the family of the existing products of GBC Italia for new construction (in particular the LEED® *Italia 2009 New Construction and Major Renovation and GBC Home* (GBC Italia, 2011)), progressively merge into a single product called *GBC Historic Building*™ (Fig. 1). The first one is used for residential building with more than four floors above ground or for commercial buildings, the second is only for low rise residential building (four floor above ground or lees). Basing on these two protocols, the final output of the process is a unique, specific and dedicated tool that covers all potential cases of restoration and refurbishment (Fig. 2).

Figure 1. Existing GBC Italia's rating systems as basis of the new protocol.

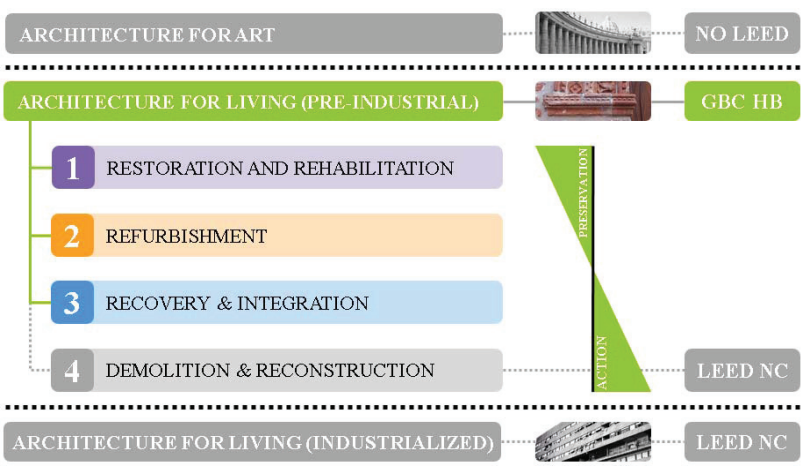

Figure 2. Design activities and type of buildings involved in the new protocol's field of application.

When to use *GBC Historic Building*™

GBC Historic Building™ is applicable to "historic buildings", meaning construction that are worthy of consideration as "material witness having the force of civilization" (Commissione d'indagine per la tutela e la valorizzazione del patrimonio storico, archeo-logico, artistico e del paesaggio, 1967). In this regard, the buildings that may fall within the scope of *GBC Historic Building*™ must be traceable within the last concluded historical cycle that, for the European zone, coincides with the industrialization of construction process and, therefore, must be built before 1945. These buildings have a pre-industrial building process (in terms of phases, tasks and operators), pre-industrial materials and construction techniques (spontaneous and local) and technical elements made through a pre-industrial processes (Dalla Negra, 2013).

The existing building (before refurbishment) must have been built before 1945 (or after 1945 if a pre-industrial building process is detached and there are historical and cultural recognized features) for a portion of at least 70% of the existing technical elements (measured in square meters of the front surface calculated without considering voids as windows and doors). If the building was built before 1945 for a portion of between 50% and 70% of the existing technical elements, the project team has the possibility to choose whether to use the protocol *GBC Historic Building*™ or, depending on the intended use of the building, LEED® *Italia 2009 New Construction and Major Renovation or GBC Home* (Fig. 3).

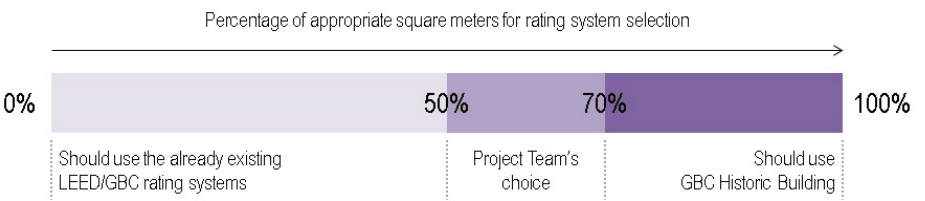

Figure 3. Guidance for rating system selection, basing on the square meters of the existing building surfaces.

Buildings object of the protocol application shall be subject to restoration, rehabilitation or recovery (also with partial integrations), which must implicate a major renovations, defined as actions that involve significant elements of HVAC systems and the renewal or functional reorganization of interior spaces, evaluating the possibility of the building envelope's performance improvement, consistent with the preservation of the existing building's typological and construction features.

In compliance with all the LEED®/GBC rating system, all aspects concerning architectural language (design choices) are not considered for the purposes of certification and, in case of buildings under protection or listed, they shall remain as exclusive domain of the governing bodies. In fact, the ultimate goal of the protocol is the definition of the level of sustainability of the intervention process, in the respect and protection of cultural and historical value, and not the verification of cultural interest of the object itself (Boarin and Zuppiroli, 2012, p.XXIV).

Existing building as historic building: a new tool

In order to verify whether the existing building can fall within the scope of *GBC Historic Building*™, a fact sheet called "Historic Building Identity Card" (HBIC) has been drafted. This tool contains qualitative and quantitative evidence of all the existing technical elements and information about which of these were made at a different historical stage from the current one (pre-industrial). The HBIC is given to the project team before the certification in order to verify if the building fits the protocol's fields of application and it is a key moment for an initial understanding of the building in its technical elements and historic value.

The HBIC consists in an Excel-based format divided into three parts to be filled with information about the existing building before refurbishment (Fig. 4). The qualitative data refer to the characteristics of the technical elements with historical nature that have cultural interest.

The first part of the sheet must contain all essential information that can help identifying the basic characteristics of the building, such as:

- climate zone, with indication of geographical coordinates;
- period/year of construction, with reference to the construction period of the original core (dating of additional transformations can be placed under item "historical overview" and, more specifically, under "time sequence list of building interventions");
- surrounding environmental setting, describing the type of context in which the building is located (isolated in a rural setting, in an urban setting; belonging to a medieval, renaissance urban fabric, etc.);

- consistency of the building (average height of the attics, total covered surface, overall gross volume, etc.).

The sheet also requires additional information concerning "urban parameters" and "regulatory constraints (degree of protection)" with special reference to the intervention categories provided by the technical implementation rules in accordance with current urban planning and any other active protection constraints on the building subject of the certification. After completing the basic information, a brief "historical overview" is required for identifying any important change stages that could have caused alterations to the original structure. Specifically, a summary list is required of construction interventions for which documentation is available.

In the second part of the sheet, basing on the UNI 8290-1 standard (UNI, 1981), the "Technological Unit Classes" described under "Technological Units" are identified. For each of these, identification of the "Technical characteristics" of the examined element is required. The description of the technical element must be sufficiently precise so that its typology can be qualified (for instance, masonry equipment with mixed facing with presence of different materials, in support of the decorative elements, with or without surface finish treatments). Subsequently, the origin of information must be clarified ("found/not found"). The description of the technical characteristics may in fact result from both past documentation and documents drafted during preliminary investigations. In case of no direct information, data to be put in the HBIC must come from studies and hypotheses concerning buildings with similar construction and typology. Lastly, the "percentage of historical/non-historical structure" must be identified for all technological units for which the technical characteristics have been indicated. The percentage of tech-nological units (e.g. external walls) should be approximately determined, which, as it is historical, is likely to be of interest in heritage terms. The percentage of technological units of an industrial nature is determined by difference, as, in contrast, it may not be of any interest.

Characterization of technological unit can be further specified by finding and tracking the "decorative architectural elements" (where present).

Once completed, the third part of the tool offers a preliminary assessment of the building, summing automatically the total amount of the existing technical elements that are present in the building (basing on the square meters of existing building's surfaces) and showing the final percentage that must be compared with the rating system selection scheme.

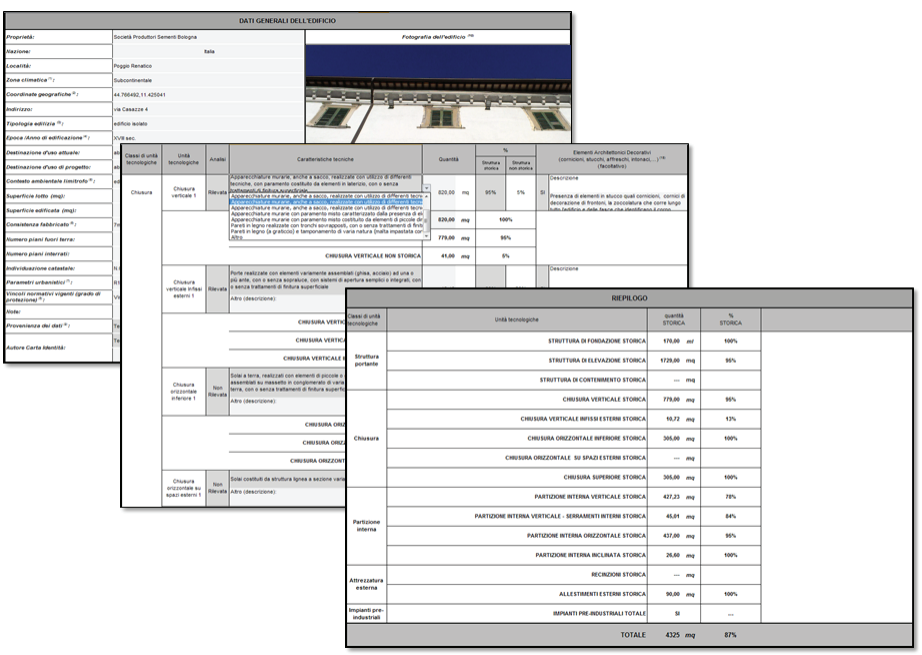

Figure 4. Screenshots of the "Historic Building Identity Card". Up: first part of the tool collecting general information of the building. Middle: second part of the tool collecting information about Technological Units, their features and measures (m2). Down: third part of the tool assessing the final percentage of historic building with cultural interest in order to verify protocol's requirements on fields of application.

Structure and main contents of *GBC Bistoric Building*™

In order to verify critical aspects of LEED® *2009 Italia New Construction and Major Renovation and GBC Home* in case of application to the historic heritage, a gap analysis process has been done through the application of the existing protocol[4] to three preliminary case studies[5], defining the following aspects:

- relevance and applicability of the existing rating systems (analyzing Minimum Program Requirements, prerequisites, credits and certification templates) in case of different levels of the conservative processes, in order to define strengths, weaknesses, opportunities and threats;
- possible modifications and integrations of the existing structure and contents, according to the seven themes that characterize the well-established LEED®/GBC protocols.

This analysis highlights that existing LEED® topics do not include specific issues concerning historic heritage renovation so that it was decided to add a brand new topic specific of the sustainable intervention in the conservation field, called "Historic Value" (HV).

The following paragraphs show all prerequisites and credits of each topic, highlighting points' allocation, exemplary performance credits and building phase in which all credits must be reviewed (design phase or construction phase review).

It is to be noticed that credits and weights are referred to the first part of the new rating system (related to *LEED® Italia 2009 New Construction and Major Renovation*) and that distribution of points among credits may vary basing on Technical Advisory Group "Historic Building" (TAG HB) further analysis and following the pilot period of application.

Topic Historic Value (HV)

The protocol lays its foundations on the transposition of the concept of sustainability to the conservative world. The restoration is sustainable because as "methodological moment in which the work of art is appreciated in its material form and in its historical and aesthetic duality, with a view to transmitting it to the future" (Brandi, 1963), it allows future generations to recognize the same cultural values that we recognize today (WCED, 1987). In particular, credits pertaining to the topic "Historic Value", through the identification of specific research methodologies and specific operational principles, seek to ensure that everything is recognized as "evidence having the force of civilization" and it is preserved for future generations, encouraging therefore high level of sustainability by taking advantage of the positive qualities of pre-industrial buildings.

Topic "Historic Value" pays close attention to the different stages of the restoration process, such as:

- the preliminary investigative stage. It is a mandatory step, without which it would be impossible to draft the project correctly and to estimate the executive intervention. It starts from a direct study of the building along with a background history research, followed by degradation analysis (with an interpretation of their causes);
- the project stage. It is the moment during which a detailed presentation of the building's critical issues are given and the intervention proposal is developed by taking into account needed performances and requirements and the conservation issues of the building itself;
- the construction stage. It is the key point of the intervention and it is the most delicate as almost every operation is irreversible and because the building always shows new "discoveries" when the initial demolition or removal begin. Naturally, the restoration site, which always includes conflicts with the initial project, requires wide experience and deep knowledge regarding materials and traditional construction systems.

Table 1. Credits overview of topic "Historic Value".

Prerequisite/ Credit	Title	Points		Exemplary Performance	Design/ Construction
Prerequisite 1	Fundamental history structure report	Mandatory		-	D
Credit 1.1	Fundamental history structure report: energy analysis	1	3	-	D
Credit 1.2	Fundamental history structure report: analysis on materials and decay	-	2	-	D
Credit 1.3	Fundamental history structure report: analysis on structures and structural monitoring	2	3	-	D
Credit 2	Restoration process reversibility	1	2	Yes	D
Credit 3.1	Compatibility of final-use function and benefits	1	2	Yes	D
Credit 3.2	Chemical and physical compatibility of mortars for restoration	-	2	-	C
Credit 3.3	Structural compatibility	-	2	-	C
Credit 4	Sustainable restoration site	-	1	Yes	C
Credit 5	Scheduled maintenance plan	-	2	-	C
Credit 6	Specialist in restoration of buildings and sites	-	1	-	D

Sustainable Sites (SS)

This topic concerns the environmental aspects related to the place where the historical building is situated, with particular reference to the relationship between the building itself, the surrounding environment and the potential impacts that the building is capable of generating both in construction phase and in management phase or during its life. The objective of this area is the mitigation of damages resulting from a previous careless planning, which over time have generated negative effects on natural ecosystems and social systems in different ways.

The redevelopment of a building and its new functions can be an important opportunity to revive degraded urban sectors, introducing practices of sustainable design and management. It is important to stress the importance of a redevelopment compatible with the environmental context in which it is integrated, in order to prevent overload phenomena for infrastructure systems, resulting in increased pollution.

Table 2. Credits overview of topic "Sustainable Sites".

Prerequisite/ Credit	Title	Points		Exemplary Performance	Design/ Construction
Prerequisite 1	Construction activity pollution prevention	Mandatory		-	C
Credit 1	Brownfield redevelopment	-	2	-	D
Credit 2.1	Alternative transportation: public transportation access	-	1	Yes	D
Credit 2.2	Alternative transportation: bicycle storage and changing rooms	-	1	Yes	D
Credit 2.3	Alternative transportation: low-emitting and fuel-efficient vehicles	-	1	Yes	D
Credit 2.4	Alternative transportation: parking capacity	-	1	Yes	D
Credit 3	Site development: open spaces recovery	-	2	Yes	D
Credit 4	Stormwater design: quantity and quality control	-	2	-	D
Credit 5	Heat island effect: non-roof and roof	-	2	Yes	C
Credit 6	Light Pollution Reduction	-	1	-	D

Water Efficiency (WE)

In traditional architecture, the topic of water management has been subject to variations related to the climatic zone the building belongs, defining collection devices and efficient management with great historical and cultural value, integrated with the building itself or placed in the immediate surrounding areas. Through the credits of this topic, in addition to the reduction of water consumption for civilian use, it is possible to enhance the contribution of pre-industrial devices for stormwater collection and management, through their restoration or renovation as well as improve the efficiency of fountains and other water amenities present in outdoor spaces.

Table 3. Credits overview of topic "Water Efficiency".

Prerequisite/ Credit	Title	Points		Exemplary Performance	Design/ Construction
Prerequisite 1	Water use reduction	Mandatory		-	D
Credit 1	Water-efficient landscaping	1	3	-	D
Credit 2	Water use reduction	1	3	Yes	D
Credit 3	Water metering	-	2	Yes	D

Energy & Atmosphere (EA)

One of the innovative aspects of GBC Historic Building™ is the consideration that energy efficiency and retrofit process represent a means of protection of the historical building and not necessarily a change in the building's original material consistency (Boarin, Dotor and Onecha, 2014, p.13). This principle allows to overcome the logic that "excludes any work on properties falling under the regulations laying down the code of the cultural heritage and landscape, in cases in which a compliance with the requirements would unacceptably alter their character or appearance with particular reference to historical or artistic character"

(2010/31/EU). Topic "Energy and Atmosphere" includes the principle of building performance improvement compared to a reference condition, rather than an adaption to performance levels set and rigid (Ambrogio and Zuppiroli, 2013, p.101-104). In fact, in historical architecture, any improvement, although modest, is an important step in the direction of reducing energy consumption, reduced emissions of greenhouse gases and increasing comfort for occupants.

Table 4. Credits overview of topic "Energy & Atmosphere".

Prerequisite/ Credit	Title	Points		Exemplary Performance	Design/ Construction
Prerequisite 1	Fundamental commissioning of building energy systems	Mandatory		-	C
Prerequisite 2	Minimum energy performance	Mandatory		-	D
Prerequisite 3	Fundamental refrigerant management	Mandatory		-	D
Credit 1	Optimize energy performance	1	17	Yes	D
Credit 2	Renewable energies	1	6	Yes	C
Credit 3	Enhanced commissioning	-	2	Yes	C
Credit 4	Enhanced refrigerant management	-	1	-	D
Credit 5	Measurement and verification	-	3	-	C

Materials & Resources (MR)

The restoration and upgrading processes are sustainable because reusing existing buildings is an important task for saving natural resources and virgin materials, as well as limiting use of soil that allows restraining the progressive extension of the cities' boundaries. Area "Materials and Resources" has the objective of ensuring that the project intervention is raised in continuity with the existing building, while preserving the material consistency as much as possible. In case of integration or partial replacement of technical elements, the topic aims at ensuring that materials have compatible characteristics if compared with the existing building.

Table 5. Credits overview of topic "Materials & Resources".

Prerequisite/ Credit	Title	Points		Exemplary Performance	Design/ Construction
Prerequisite 1	Storage and collection of recyclables	Mandatory		-	D
Prerequisite 2	Fundamental demolition and construction waste management	Mandatory		-	C
Prerequisite 3	Building reuse	Mandatory		-	C
Credit 1	Building reuse: maintain existing technical elements and finishing	-	4	-	C
Credit 2	Demolition and construction waste management	1	2	-	C
Credit 3	Materials reuse	1	2	Yes	C
Credit 4	Products environmental optimization	2	4	Yes	C
Credit 5	Regional materials	1	2	Yes	C

Indoor Environmental Quality (IEQ)

The achievement of high standards of comfort for the occupants inside historic buildings can sometimes be very complex, due to the presence of decorations or to high artistic value of the building that does not allow any substantial interventions on the technical elements. For this reason, the topic is structured into two possible paths: on one hand the goal of conservation and preservation of historic architecture, on the other the fulfilment of occupants' conditions of comfort and indoor air quality. This dual approach allows user to respect the historic environment by protecting surfaces and high-quality materials and, at the same time, to achieve the highest levels of comfort and indoor air quality attainable, taking advantage of the potential offered by the boundary conditions.

Table 6. Credits overview of topic "Indoor Environmental Quality".

Prerequisite/ Credit	Title	Points		Exemplary Performance	Design/ Construction
Prerequisite 1	Minimum Indoor Air Quality Performance	Mandatory		-	D
Prerequisite 2	Environmental Tobacco Smoke (ETS) Control	Mandatory		-	D
Credit 1	Environmental air monitoring	-	2	-	D
Credit 2	External air minimum ratio evaluation	-	2	-	D
Credit 3.1	Construction Indoor Air Quality Management Plan - During Construction	-	1	-	C
Credit 3.2	Construction Indoor Air Quality Management Plan - Before Occupancy	-	1	-	C
Credit 4.1	Low-Emitting Materials: Adhesives and Sealants, concrete materials and wood finishing	-	1	-	C
Credit 4.2	Low-Emitting Materials - Paints and Coatings	-	1	-	C
Credit 4.3	Low-Emitting Materials - Flooring Systems	-	1	-	C
Credit 4.4	Low-Emitting Materials - Composite Wood and Agrifiber Product	-	1	-	C
Credit 5	Indoor Chemical and Pollutant Source Control	-	1	-	D
Credit 6.1	Controllability of Systems - Lighting	-	1	-	D
Credit 6.2	Controllability of Systems - Thermal Comfort	-	1	-	D
Credit 7.1	Thermal Comfort - Design	-	1	-	D
Credit 7.2	Thermal Comfort - Verification	-	2	-	D

Innovation in Design (ID)

The objective of this topic is to identify design solutions that are distinguished by the characteristics of innovation and high environment performance developed during the preservation process. Rewarded aspects are excellence in design in case of performance that greatly exceed those required by the protocol itself or the particular characteristics of the project which, although not related to any prerequisite or credit, guarantee documented benefits in terms of sustainability.

Table 7. Credits overview of topic "Innovation in Design".

Prerequisite/ Credit	Title	Points		Exemplary Performance	Design/ Construction
Credit 1	Innovation in Design	1	5	-	P/D
Credit 2	GBC Accredited Professional	-	1	-	C

Regional Priority (RP)

Some environmental characteristics are unique and specific to the locality in which the building is situated. In order to encourage design teams to focus on the aspects of regionalism, GBC Italia identifies up to six credits for each different local contexts of the Italian territory, having equivalent or similar environmental characteristics.

Table 8. Credits overview of topic "Regional Priority".

Prerequisite/ Credit	Title	Points		Exemplary Performance	Design/ Construction
Credit 1	Regional Priority	1	4	-	-

Weightings and certification

About credits weightings

LEED® protocols are structured on the basis of a maximum achievable score of 110 points (100 points as sum of the scores assigned to the credit of thematic areas SS, GA, EA, MR, IQ to which are added a further 10 points allocated to areas thematic IP and PR). The addition of new points specifically dedicated to the topic "Historic Value" makes a revision of the scores assigned to each existing credit needed, basing on the assessments conducted previously through the gap analysis. All aspects of the historic building that can be evaluated with existing credits, even in case of their partial applicability, are introduced through their integration or modification, so that the higher part of the existing issues are preserved. New credits

will use points coming from non-applicable existing credits to be removed in the new rating system because they do not satisfy its new field of application in terms of intent and/or requirements.
New protocol weightings compared to existing ones are shown in Fig. 5.

	LEED ITALIA NC	%	GBC HB	%
Historic Value	0	-	20	18,2%
Sustainable Sites	26	23,6	13	11,8%
Water Efficiency	10	9,1	8	7,3%
Energy and Atmosphere	35	31,8	29	26,4%
Materials and Resources	14	12,7	14	12,7%
Indoor Environmental Quality	15	13,6	16	14,5%
Innovation in Design	6	5,5	6	5,5%
Regional Priority	4	3,6	4	3,6%
TOTAL SCORE	110	100%	110	100%

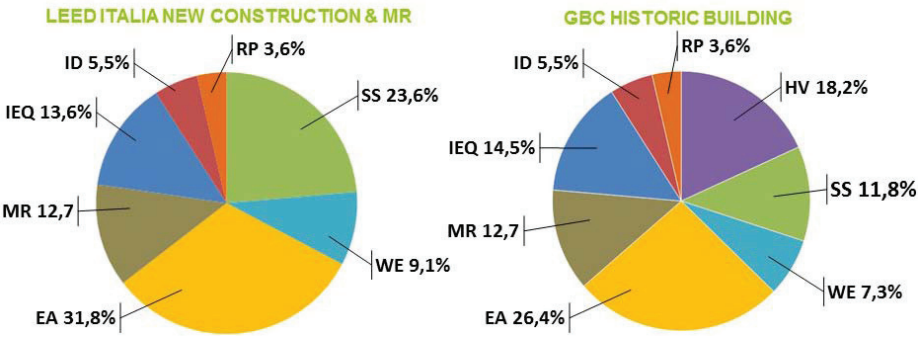

Figure 5. Distribution of points and weights for each topic in *LEED® Italia 2009 New Construction and Major Renovation* e in *GBC Historic Building*™.

About certification process

The certification process is based on the verification of conformity by a third party body. For the purposes of certification, each prerequisite and credit of the protocol has a dedicated form, useful to describe and show compliance between requirements and design/construction. This form is filled in by design/construction team and contains a list of the information required by the third party body, in order to make it able to carry out verification. External documents may be attached to the forms, if required. These documents may include drawings, calculations or any other document that may be useful to show the requested compliance.

Two separated paths are available to achieve certification. As a LEED® system, *GBC Historic Building*™ certification allows a spitted review (two different phases of review first after design and second after construction) and combined review (only one phase, after construction).

At the end of the certification path, if all prerequisites (mandatory, with no points to be earned) and a minimum number of credits (volunteers, each corresponding to scores) are achieved, the certification is reached. The sum of the achieved points defines the level of certification attainable by the project, basing on the following scale:

- "Certified": 40 to 49 points earned;
- "Silver": 50 to 59 points earned;
- "Gold": 60 to 79 points earned;
- "Platinum": 80 to 110 points earned.

Supporting rating system validation: learning from case studies

The Role of case studies as a tool to develop the rating system

Case studies represent an effective tool to support the development of the rating system. A case study is based on restoration/refurbishment of buildings that fall within the scope of the rating system and is used

to test the contents of the individual prerequisites and credits. In particular, the case study aims at verifying:

- "Historic Building Identity Card" (contents and type of data requested);
- performance calculation (where requested);
- performance documentation;
- benchmark used within the requirements.

The case study needs to fulfill all prerequisites and at least six credits chosen by the Owner. It does not achieve any certification level related to the rating system, but it receives a written declaration that recognizes its value for the purpose of the rating system development.

The first case study: a rural building in Guarene

Since the time of sharing the protocol short version internally with associates, GBC Italia began to record numerous expression of interest to the application of case studies from designers and entities operating within the historic property interventions. Among these, a case has already been selected and formalized by GBC Italia and began the process of verification. It is a building of rural spontaneous housing built in the late nineteenth century in Guarene, in the Province of Cuneo (Italy), that provides the opportunity to test the new protocol for interventions in "minor" manufactured housing that make up the large part of the historical and documentary nationwide.

The building has been built with a pre-industrial building process (local knowledge and operators), technologies (humid for walls and dry for floors and roofs) and materials (such as adobe bricks and bricks made locally) that are expression of a traditional building culture to be preserved (Fig. 6). With the support of TAG HB, GBC Italia is evaluating the case study documentation both of project and construction phases, including on-site inspections, and identifying critical aspects or necessary additions for the new protocol evaluation (Boarin, 2014, p.3).

Figure 6. The rural building in Guarene (Italy) is the first registered case study of *GBC Historic Building*™.

Conclusions

GBC Historic Building™ is a new Italian protocol that responds to both a market and environmental requirements to reduce resources' impact demanded by the valuable architectural heritage. Important efforts are oriented to heritage valorisation, without compromising the environmental sustainability of historic buildings that, in a holistic vision, should also perform as high efficiency constructions (Celeste and Morin, 2009). Thus, a systemic approach is the only way to intervene in the historical heritage that can guarantee the maintenance of its cultural value and LEED®-based systems have the possibility to guide the building process towards the achievement of goals linked to social, economic and environmental aspects at the same time. The increasingly urgent need to adapt historic buildings to new uses and functions must necessarily be subject to the logic of sustainability that require the achievement of transparent standards and, therefore, of a certified quality.

Endnotes

[1] Chair of the Technical Advisory Group "Historic Building" for GBC Italia. Corresponding Author.

[2] Technical Development for GBC Italia.

[3] Scientific Referee of TAG "Historic Building" for GBC Italia.

[4] The gap analysis has been done basing on *LEED® Italia 2009 New Construction and Major Renovation*.

[5] Preliminary case studies have been chosen among those with available information about existing building (in terms of measures, features, documents about history, etc.), detailed project features and about building sites. They have been built in different historic periods and they are placed in different climatic areas.

References

Ambrogio, K. & Zuppiroli, M. (2013) *Energia e restauro. Il miglioramento dell'efficienza energetica in sistemi aggregati di edilizia pre-industriale, tra istanze conservative e prestazionali*, Franco Angeli, Milano.

Boarin, P. & Zuppiroli, M. (2012) Sustainability and restoration. A recovered combination, *Paesaggio Urbano* 4. p.XXII-XXIV.

Boarin, P. (2014) Sostenibilità nell'intervento sul patrimonio storico. Il ruolo dei casi studio per lo sviluppo del protocollo *GBC Historic Building*™, Recuperoeconservazione, *DeLettera* 111, p.1-5, Available at http://recuperoeconservazione.it/cms/it4-magazine.asp?pag=articoli.asp&idCopertina=21 [Accessed 14 December 2014].

Boarin, P., Dotor, A. & Onecha, B. (2014) A new sustainability for restoration of the historic heritage with high cultural values. The case study of Sant Manuel pavilion of Hospital de Sant Pau in Barcelona, Recuperoeconservazione, *DeLettera* 112, p.1-13, Available at http://recuperoeconservazione.it/cgibin/news_allegato/79_1_art22_boarin_rec112.pdf [Accessed 14 December 2014].

Brandi, C. (1963) *Teoria del restauro*, Einaudi, Torino.

Celeste, G. & Morin, E. (2009) *Cultura e natura nella teoria della complessità*. Saonara (PD): Il prato.

Commessione D'indagine per la Tutela e la Valorizzazione del Patrimonio Storico, Archeologico, Artistico e del Paesaggio (1967) *Per la salvezza dei beni culturali in Italia: atti e documenti della Commissione d'indagine per la tutela e la valorizzazione del patrimonio storico, archeologico, artistico e del paesaggio*, Vol.3, Colombo, Roma.

Fabbri, K., Zuppiroli, M. & Ambrogio, K. (2012) Heritage buildings and energy performance: Mapping with GIS tools, *Energy and Buildings* 48, p.137-145.

GBC Italia (2010) *LEED 2009 Italia Nuove Costruzioni e Ristrutturazioni*, Reference guide, Rovereto (TN): Green Building Council Italia.

GBC Italia (2011) *GBC Home*, Reference guide, Rovereto (TN): Green Building Council Italia.

UNI (1981) *Edilizia residenziale, Sistema tecnológico, Classificazione e terminologia*, Norma UNI 8290-1, Ente Nazionale Italiano di Unificazione, Milano.

World Commission on Environment and Development - WCED (1987) *Report of the World Commission on Environment and Development: Our Common Future*, p.16, Available at http://www.un-documents.net/our-common-future.pdf [Accessed 14 December 2014].