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Integration between GBC Historic Building® and BIM: the methodological innovation for conservation project workflow

Integrazione fra BIM e GBC Historic Building®: l'innovazione metodologica nel sistema di progettazione e verifica di interventi conservativi

The development of design with the support of BIM software represents ideas and forms that result from interdisciplinary integration. The combination of different instrumentation allows the architectural surfaces modeling to develop a 3D model similar to the real architectural characteristics. Through this you can create a database of information collected in situ. The complexity of the data, discretized into a single shared database, sets a level of attention to the conservative project according to the GBC Historic Building® rating system.
The use of BIM software in relation to the assessment system allows designers to formulate measurable innovations in the project phase, in the construction phase, and in the entire building life cycle.

Lo sviluppo della progettazione all'interno di software BIM rappresenta idee e forme che derivano da integrazioni interdisciplinari. L'unione fra diverse sorgenti di dati permette la modellazione diversificata delle unità tecnologiche sviluppando un modello simile al comportamento reale dell'architettura, creando un database di informazioni direttamente raccolte in situ. La complessità dei dati, discretizzati in un unico database condiviso, definisce un livello di attenzione all'intervento di natura conservativa misurabile secondo il sistema di rating GBC Historic Building®. Il protocollo, in relazione all'uso del BIM, nella filiera progettuale, consente ai tecnici di formulare innovazioni quantificabili e riconosciute sia negli aspetti progettuali, sia nelle fasi di lavoro e cantierizzazione, sia nel ciclo di vita dell'edificio.

keywords: *BIM, GBC Historic BUILDING®, Modeling, Preservation*
parole chiave: *BIM, GBC Historic Building®, Modellazione, Conservazione*

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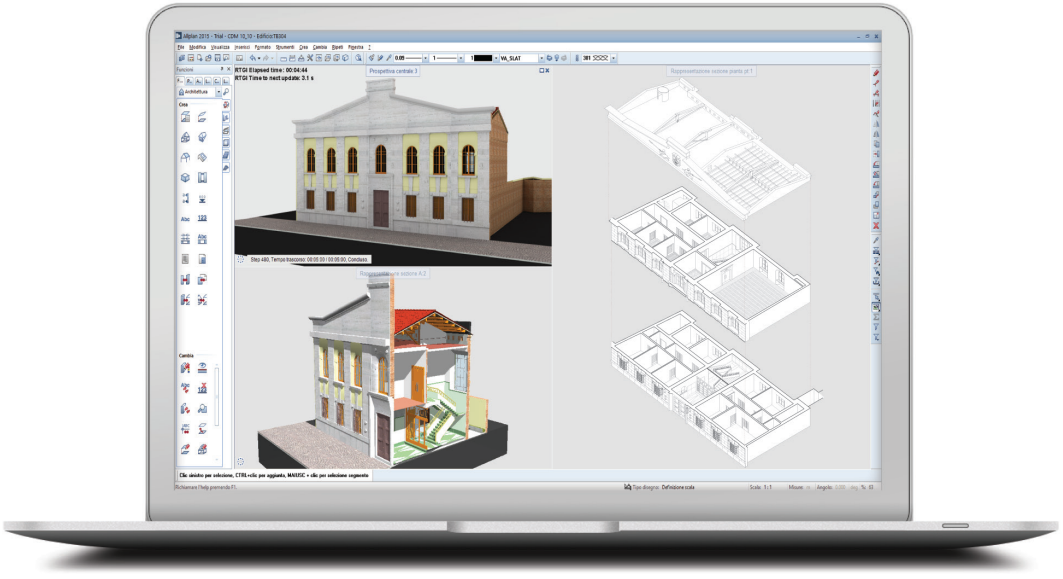


1. The three-dimensional design via BIM allows multiple view of the model building via the Real Time Rendering engines. It's perceived the level of the project definition v(considering LOD levels 300-500).
At this stage we identify the interference between systems designed and existing systems to reduce conflicts and variants.

INTRODUCTION

The Association Green Building Council Italy has promoted the dissemination of a new rating system called GBC Historic BUILDING® conjugating two aspects (difficult to combine) restoration and sustainable energy. The GBC wants the energy efficiency and adjustment of historic building performance is a form of protection used in restoration.
The use of the protocol, using BIM software for the design, enabling several technicians to perform measurable choices. This to be able to verify the overall sustainability of the intervention, according to the protocol.
The protocol can be used only on "historic buildings" which are "material testimony of civilization" [1].
The historical heritage was due in the last historical period, for Europe is conventionally 1945.
The historical building, in addition to the temporal requirement, must ensure the historical requirement: preserving at least 70% of the original technical elements, excluding the additions, the plants and window frames.
GBC Historic BUILDING® is divided into credits for eight subject areas (VS: Historical value; SS: Site Sustainability; GA: Water Management; EA: Energy and Atmosphere; MR: Materials and Resources; QI: Indoor Environmental Quality; IP: Innovation in Design; PR: Regional Priority). The decision-making process for define the restauration project needs analysis "aesthetic-witness" and "energy and environment" to preserve the real object and the potential wealth. The purpose of the protocol is to identify the overall of sustainability level of the intervention and the project, not only a sum of the individual specialist contributions.
For BIM users it is easier to simulate the behavior of the building in the design phase and monitor the level of quality by planning ceck list of protocol.

DEFINITION OF BIM MODEL

The representation is the ability to understand better the meaning of things; this, as defined by Husserl [2], it can be considered the innovative assumption operated by BIM systems. The choice of Bim ensures the understanding and management of the construction process, improving collaboration, interoperability and management. The definition of representation (EIKASIA) enunciated by Platone in the Republica [3], becomes one of the possibilities offered by BIM. It 'important that the design idea defines the characteristics of the technological elements in reference to the levels of development of the model (LOD Level Of Development 100-500 [4]). The LOD are the level of reliability of the collected information, but do not measure the amount of information and accuracy.
The CAD systems can not run sustainability analysis in the first stages of project development. Analyzes performance of the building, are therefore performed after the first phase of the project: the lack of continuous interaction during the design process make it inefficient. BIM modelling allows, during the preparation of preliminary designs, verification of standards and credits to be achieved in order to reach the certification class, checking step by step the restoration performance. The information collected and stored inside the BIM files are born by the inclusion of all collected diagnostic data. The modeling of the architectural work, provides for the integration of different types of non-destructive data (thermography, videoscopic investigations, transmittance measurements, etc.) and destructive data (verification of walls, compression

ISSN 1828-5961

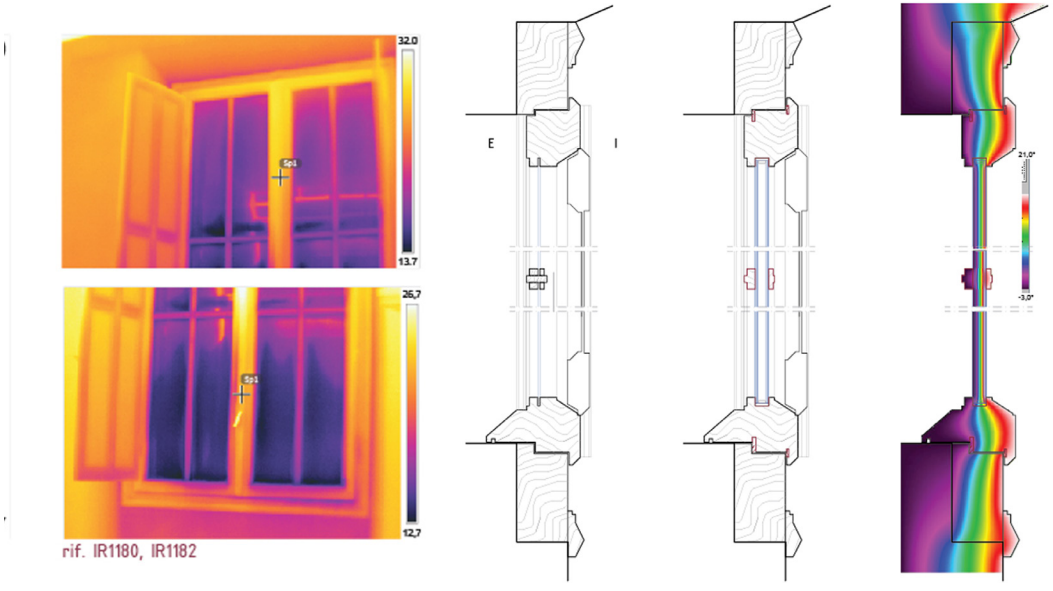
2. The 3D survey becomes the metric base recommended for BIM, it can also be used for display / remote verification of the acquired data. The technician, in real time, may carry out checks of the definition of detail of the model.

testing, material characterization tests, mineralogical and petro-graphical analysis, etc.) to define structural models and plant. Work in BIM environment allows a more efficient design process while reducing project overlap and thus the timing of the design and changes during construction. The Bim systems ensure the right integration of architectural, structural and plant engineering desi to reduce the interpolation data of the different workflows. The BIM model not only manages the geometry, but also the integration of decision-making processes of the feasibility, design, regulatory, contractual conditions, execution and testing, and everything that revolves around the project in progress.
Control over credits is facilitated because it is possible to verify the correspondence of the project to the standards of the GBC protocol, placing the project in the final certification class.
It must be observed that the figurative aspects linked the planning and design are separated by the choices on the technical elements.

GBC HISTORIC BUILDING® PROTOCOL

The sustainable design process aimed at the conservation and safeguarding of cultural heritage can not be separated from its aesthetic value and testimonial.
Until 2014 the methods for certification of sustainability level for the interventions of recovery of the historical heritage (before 1945), did not use specific requirements could consider the aspects related the historic value.
Protocol GBC Historic BUILDING® has solved this problem by developing a new rating system for conservation action based on LEED certification systems (New Construction and Renovation, 2009) identifying compliance paths for the fulfillment of requirements of the building historicity . This system can be used to analyze the project impact in the entire life of the building.
The three-dimensional model created from the integration of many sources: indirect (eg. historical data to evaluate the transformations) and direct sources.
The combination allows to evaluate both data to check the accuracy of archival information and increase its analysis and survey operations.
The morphometric survey operations, thermography and endoscopy are useful to detect the presence of discontinuities in the walls (columns exhaust, doors, windows, walled niches, building irregularities, chimneys) and to highlight the crack pattern of physical degradation classifying each lesion in relation to the kinetic mechanism associated with the state deformation (misalignments, bulges / depressions).
These activities allow simulations of possible evolutions of the structural problems of the building.
To build a BIM model similar to the real behavior of the historic model will need the survey data relating to the connections and between vertical and horizontal closures, including closures and partitions or closures and structural elements.
The model will contain detected data relating to the mechanical characteristics, shape, type, texture, offset of the joints.

ISSN 1828-5961



3. The BIM model allows, through specific plug-in, a project status check of the technical elements.
The analyzes of the frame (photographic, metric and thermographic) found several defects. In the planning stage it was considered a frame that retained the figurative form, but that would improve energy performance. The insert of a double-glazing, the redefinition of other elements has enabled a design verification of the thermal behavior directly into the BIM model.

The three-dimensional survey becomes a database composed of coordinates space, color data (photograph and given reflectance).
The representation of 3d Survey in BIM platform highlights that the complexity of the forms requires a free modelling, because the walls, for historic structures, have irregular shapes and sections, difficult to parameterized.
Is possible to insert qualitative elements that identify the material consistency of the surfaces (macroscopic and microscopic detection) arising from the building inspection and diagnostic data for both indoor and outdoor environments.
A further phase of modeling is related to existing integrated plant (working and / or non-working). We are identifying the main plants (both pre-industrial and contemporary) for the identification of the historical-aesthetic and functional value for conservation purposes.
The project will fulfill the requirement of the overall energy reduction (Heating, cooling, lighting, process energy) and simulate their work schedules, identification of processes, risk situations, coordination, optimization of resources, the planning of supply contracts and reduction of storage on site.
This level of attention is aimed at reducing pollution of the construction activity (sedimentation of water, contamination in sewer or on the ground, dust generation, acoustic comfort and health of the adjacent areas the construction site) mitigating environmental damage.

CONCLUSIONS

The design process that uses BIMbased systems for conservation work, which measurable sustainability level (through GBC Historic BUILDING®), brings many benefits in economic terms, timing and management.
Obvious how quickly the process shares information among the actors: the project proposals can be immediately analyzed, identifying errors and / or improved and innovative solutions.
Careful planning and a meticulous use of BIM, allows to predict the environmental performance of the project, maximizing the value of specialist contributions whose information, integrating them into the design workflow.
The information on the performance requirements can be used during the entire life cycle through a “facility management”, through the provision of integrated services, in order to make easy the management phase.
The management phase is especially interesting for the government architecture, where management and maintenance is not effectively organized for the conservation and protection of historical heritage.
At the end of the process, verified the “acquired” credits (in different subject areas) and after verification, the association Green Building Council provide the certification and execution level. The ranking checking the project in the LEED system as a basic, silver, gold or platinum level.

ISSN 1828-5961

4.Checklist of GBC Historic BUILDING® protocol.
You can evaluate the design coherence (through credits) in the eight thematic areas. The structure of the protocol, requires attention in the research of qualitative and quantitative information.
The use of this protocol pays off in the realization and in the execution of the intervention, as well as in the maintenance and operational stages.

NOTES

[1] Cf. definition of "Cultural Heritage" provided by *Franceschini* Commission, 1967

[2] HUSSERL EDMUND, *La crisi delle scienze europee e la fenomenologia trascendentale*, *Il saggiatore*, 2008

[3] PLATONE. *Repubblica*. edited by M. VEGETTI,. Milan, Rizzoli, 2006, book VI, 509d-511e

[4] Cfr. BIMForum LOD Specification 2015 Draft

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