Abstract

The decision to carry out this research was moved from particular needs and questions affecting the actual architectural heritage and building archaeology panorama, especially as far as the documentation and preservation of Cultural Heritage assets are concerned. In this regard, a particular methodology called Building Information Modelling (BIM) is changing and revolutionising the way to produce and preserve documentation and in general information. BIM methodology has been developed especially for AEC industry (Architecture Engineering Construction), then for architectural design and technical installations and it allows to collect and include information inside 3D models also establishing relations (such as geometric and semantic) and between objects and related information. Despite BIM advantages, this methodology is not widely used for Cultural Heritage assets and it could be considered still an ongoing research field, also due to the limitations resulting of commercial BIM solutions, developed and designed to support AEC industry management and for this reason they could rarely adapt their workflows (from modelling tools to semantic dimension) and methods to Heritage assets.

Analysing its peculiarities, BIM, and in particular HBIM (Historic Building Information Modelling) could become the proper methodology as far as the Cultural Heritage assets documentation and preservation, providing the integration of different kind of information through semantic relations. Indeed, the inclusion of historical information on HBIM platform produces and involves advantages for managing, monitoring and valorisation processes, as well as benefits for the purpose of investigating historical evolution of historic architecture. Through the BIM methodology becomes possible to increase the documentation phase and to comprehend information stored inside the model in order to have a complete panorama of the analysed context by establishing and managing custom datasheet, database and ad-hoc queries, ensuring in this way the quality and preservation of data.

In this regard, stratigraphic information are particular features to be included inside an HBIM platform especially since stratigraphy is a unique historical information that rarely can be found on archives or other resources. In this sense, stratigraphy and its analysis, widely used and implemented in archaeological excavations has become a fundamental tool also for historical buildings and then for *building*

archaeology purposes. By using this analysis on the stratification, a complete identification map of *layers* or *units* can be extract for the purpose of understanding the transformation and evolution of the stratification. As far as building archaeology is concerned, this *reading map* is a fundamental analysis not only for comprehending the historical evolution of the construction site (analysing constructive and destructive actions on wall surfaces) as well as for the comparison operations between the structure of an historical building with its mechanical behaviours taking into account the specific events that have changed the building static asset.

For these reasons, stratigraphy is a type of information to be preserved and documented in the best way possible and BIM methodology could be the right solution, because stratigraphic units, as well as pathologies and surface features can be modelled as wall components and connected to the parametric model of the surveyed building.

Acting in this way it is also possible to obtain a complete framework as far as the historical evolution of the analysed historic architecture through stratigraphic analysis (if visible) is concerned, collecting and increasing the amount of knowledge concerning the evolution of the building inside the HBIM platform. Moreover, the inclusion of stratigraphy involves benefits for risk and vulnerability comprehension, attaching to the parametric model constructive and destructive actions concerning historical buildings.

Performing this kind of integration, the resulted limitations of traditional stratigraphic studies (in general paper-based analysis often disconnected from the architectural context and from other resources) can be avoided, ensuring a good data collection and protection. For this reason, BIM methodology could be the right solution for building archaeology and architecture history studies.

Despite these advantages, this type of historic implementation could be considered an ongoing research field, especially since the HBIM operative steps differs from a classical BIM workflow and the integration of not common information inside a BIM platform depends also on testing experimental and not conventional procedures and workflows as well as not common software: in fact, inside this project, the decision to carry out an HBIM platform by using a particular scan-to-BIM process via NURBS modelling by also using an open source BIM solution (and this workflow could be named *scan-to-openBIM via NURBS*) has followed exactly this thought. The decision of NURBS modelling – by using Rhinoceros software – has been adopted in order to reach a high LOD (level of detail) as well as high GOG (Grade Of Generation) as far as the 3D model is concerned, avoiding the objective modelling limitations of BIM software. In this regard, actual BIM

solutions offer modelling tools based on predefined and limited architectural libraries editable parametrically, but in this sense, Cultural Heritage assets requires to be comprehended, simplified and modelled manually depending on specific needs as well as their features and peculiarities are concerned.
Moreover, the decision to develop a custom HBIM platform by using open source solutions – by compiling and customizing FreeCAD software – it has been taken for the purpose of having the complete access and control to the source code, libraries, tools and then to the entire software, adapting and modifying the software workflow and in general the instrument analysis to specific Cultural Heritage assets and research needs. Then, this work is essentially based on analysis and experimentations of not common commercial (Rhinoceros) and open source (FreeCAD) software applied to a custom HBIM workflow for the purpose of verifying their flexibility, stability and reliability, creating a dynamic open source HBIM platform focusing on the integration of stratigraphic analysis as historical information.