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HBIM as an active tool for the study of on-paper architecture: the case of the unbuilt project for a maritime school in Cagliari

Simone Cera¹ [0009-0007-4976-5687], Raffaele Argiolas¹ [0000-0002-6652-7660] and Vincenzo Bagnolo¹ [0000-0002-7297-9196]

¹ DICAAR, Università degli Studi di Cagliari, Italy
simone.cera@unica.it

Abstract.

The research stands in continuity with the processes of valorization and communication of the architectural heritage of the twentieth century, already undertaken during the last years through the use of the digital medium.

The digitization of archives, conducted through the development of models derived from the critical reading of architectural drawings, has led to the need to define new approaches to the translation of geometric and semantic components. Indeed, such translations develop from a complex process of interpretation capable of communicating a whole series of unseen values and significances that have remained latent. Digital models today must therefore be able to preserve and convey such complexity.

This research proposes a workflow focused on the use of typical HBIM processes and tools, declined for the particular case of on-paper architectures, as active tools of study and interpretive reinterpretation.

The case study is the model project for a Marinara Professional School, designed by architects Salvatore Rattu and Bruno Viridis, for the city of Cagliari during the early second half of the twentieth century.

The digital reconfiguration in the HBIM environment allowed the opening to new paths of semantic redefinition of the drawings, facilitating the decomposition, documentation and communication of values related to the architecture of the twentieth century.

Keywords: On paper architectures, Digital Archives, HBIM, Salvatore Rattu, Bruno Viridis, Architectural visualisation, 20th century architecture

1 INTRODUCTION

The gradual increase in attention to the valorisation of paper archives of architecture through their digitisation has shifted the interest of the scientific community towards the potential offered by ICT (Information and Communication Technologies) in the areas of documentation and communication of 20th century heritage.

The important steps forward in research on tools and methodologies for the acquisition and preservation of drawings in digitised archives [1] have led to the creation of

important digital portals, such as the “Archivi degli Architetti” [2] platform promoted by the DGA (Direzione generale per gli Archivi) and the project called “Il Disegno negli Archivi di Architettura” [3] promoted by the UID (Unione Italiana per il Disegno).

Digitised archives, however, have so far represented a purely quantitative expansion of documents made available remotely, ignoring the advantages that ICTs can provide in terms of both "physical accessibility" to the documentary heritage and "cognitive accessibility" with regard to the latent information inherent in the documents.

The digital medium alone, supporting traditional archival tools, does not therefore seem sufficient to guarantee an effective digital translation of knowledge [4].

The scientific debate is therefore progressively shifting away from overcoming the physical boundaries of consultation towards new exploratory possibilities related to communication and knowledge processes [5, 6, 7, 8].

Various experiments in digital reconfiguration, conducted through standard 3D modelling streams, have resulted in the generation of digital models capable of containing and communicating only geometric and dimensional information; these models are the result of different levels of critical interpretation, but are therefore unable to keep track of semantic attributes. The result is a mere digital transposition of archive documents, characterised by an ineffective communication of the intrinsic and potential values of architecture archives, which, besides constituting an important heritage of memories, are also "a source of rethinking, revisiting and knowledge leading to the understanding and transmission of a project culture" [9].

The state of the art shows us how, during the last few years, some authors have tried to overcome these limits through different tools and workflows that contemplate the analysis and communication of architectures that no longer exist, have been transformed over time or remain on paper [10, 11, 12, 13].

Limits that are unacceptable today, especially in relation to the central role that archives are called upon to play in educating a new and broader public about historical and cultural heritage awareness.

With these premises, the research investigates which tools and processes, declined for the digital reconfiguration of architectures on paper, could represent that interpretative means that from paper is able to support the understanding of the project.

Specifically, the discussion aims to explore, outline and test one of the possible workflows in the HBIM (Heritage/Historical Building Information Modeling) environment.

The experimentation was conducted on the case study of the model project for a professional and maritime school (Fig. 1), designed by architects Salvatore Rattu and Bruno Viridis, for the city of Cagliari during the early second half of the 20th century.

The material at our disposal consists of a total of 14 tables containing plans, perspective views, elevations, sections and some construction details. Completing the collection is also a typed note by the authors containing some hints on the materials and type of structures, as well as doubts and possible future developments of the project. It is precisely this detail that suggests that the project was not only never realised, but seems to have remained unfinished even on paper.

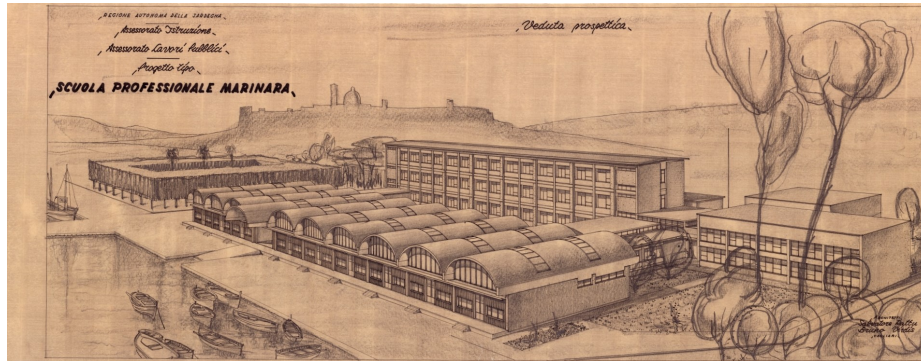


Fig. 1. Perspective view as part of the original drawings of the project for a professional and maritime school for Cagliari. Chalk and graphite on glossy paper. Authors: Architects Salvatore Rattu and Bruno Virdis.

2 HBIM FOR ON-PAPER ARCHITECTURE

The development of HBIM models is based on a process of reconstruction of the architectural artefact through reverse engineering, which starts from the survey of the existing and the analysis of historical and archival sources [14].

An as-built model thus derives from a cognitive approach and critical interpretation of the artefact; the model is therefore not intended as an output, but as a useful, intelligent and interoperable tool for understanding and managing the built pat-itage. Through the application of the methodology and tools typical of HBIM, there are therefore important advantages in understanding the architectural heritage [15].

The same logic can be adopted with paper-based architectures, through a conceptually similar, but conceptually different approach; the 'as-built' approach must undergo a reconfiguration in order to adapt to the 'as-drawn' one. This approach is characterised by a more complex process of critical interpretation of the paper document; a hermeneutic approach to reading that admits the existence of different levels of uncertainty.

Some recent research shows us how exploring the potential of HBIM tools and workflows, applied to the particular case of archive drawings and unbuilt architecture, can offer advantages not only in terms of understanding, reading and analysing projects, but also in the direction of communicating a whole series of unseen values linked to paper archives of architecture [16, 17, 18].

3 THE STUDY THROUGH THE HBIM MODEL

The digital translation process was developed through a workflow in an HBIM environment (Fig. 2), with the help of Autodesk Revit 2024 software. The disunity found between the drawings and the heterogeneity of the information resulting from inconsistencies, gaps and unresolved gestures led to a reading difficulty that accompanied us in translating the latent meanings of the work.

The peculiarity of BIM models to be both a geometric model and an information database at the same time, helped us to segment, catalogue and store the different categories of information in a single environment.

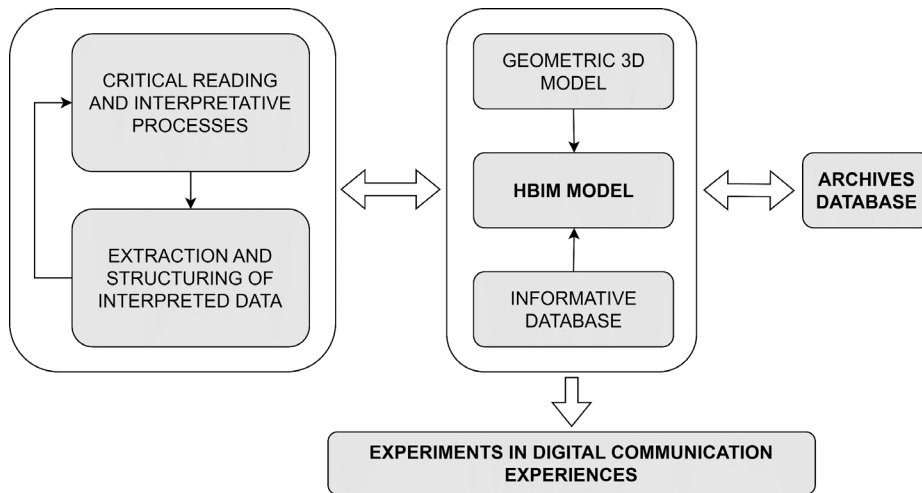


Fig. 2. The workflow tested in the course of the present discussion.

Developing the work into 3 autonomous study models, structured according to an appropriate network of relationships, allowed an initial semantic breakdown of the main elements (Fig. 3).

The coordination model was used for the study and graphic analysis of the archive drawings. The comparative reading and redrawing of the project made it possible to identify what we called minimum modelling units.

The decomposition into the seven units was guided both by the identification of the functional programme and by relating the different linguistic treatments to the structural solutions chosen by the authors.

Through the rationalisation of the structural scheme, we arrived at the definition of the parametric reference elements for the development and control of the subsequent study models, such as grids, levels, volumes and reference planes (Fig. 4).

The development of the structural and architectural models allowed us to understand and verify design and technical solutions represented by the authors. This led to the classification of the structural and architectural elements by means of parametric object model-relation.

Each of the 7 identified units is composed of 2 types of elements: the elements common to all units and the invariant elements 'typical' of each individual unit. The common elements such as columns, beam systems, flat floors and wall packages were modelled through the system families. For typical elements of each individual unit, such as vaulted systems and fixtures, modelling through loadable parametric families was chosen instead. It was decided not to use local modelling because no unique objects were identified that could be referred to the individual project.

Finally, each element was assigned a semantic attribute, thus creating a bond of relations between the elements and the unit to which it refers.

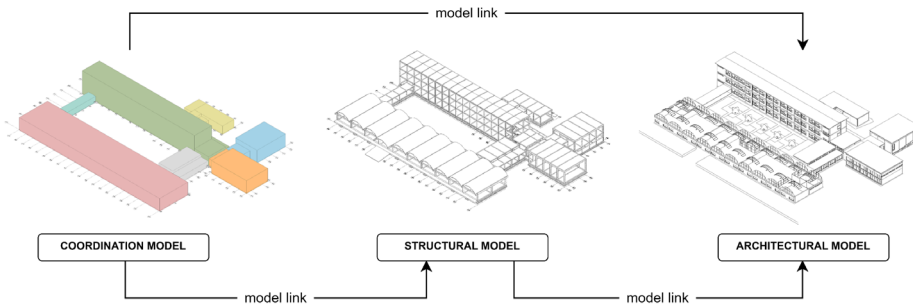


Fig. 3. Structure for linking information between models.

On the other hand, the reading of the functional plan and the hierarchy of the spaces was returned through the insertion of appropriate parameters associated with the reference premises, thus permitting their subsequent graphic visualisation (Fig. 5).

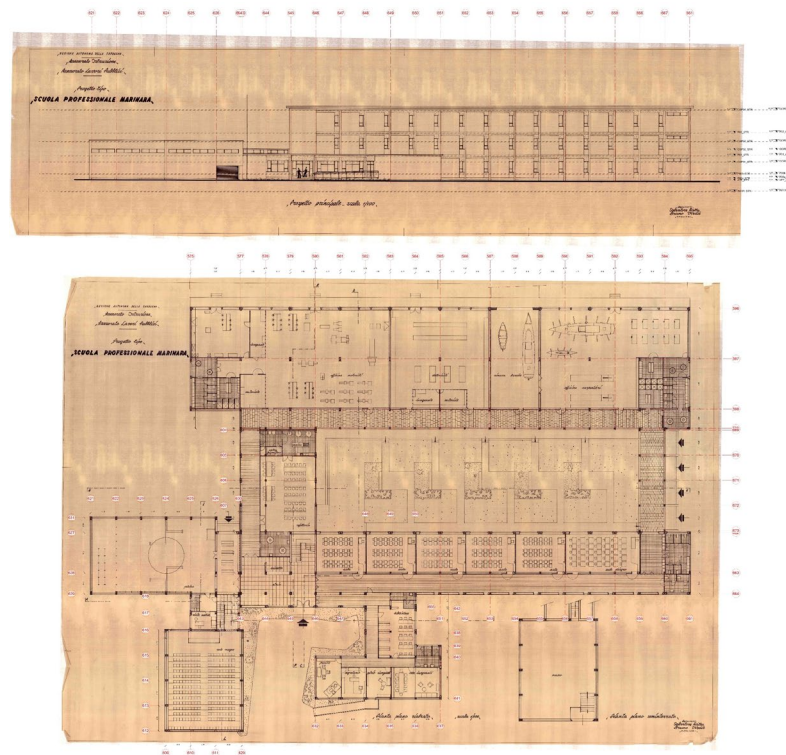


Fig. 4. Plan and elevation study for the rationalisation of the structural grid.

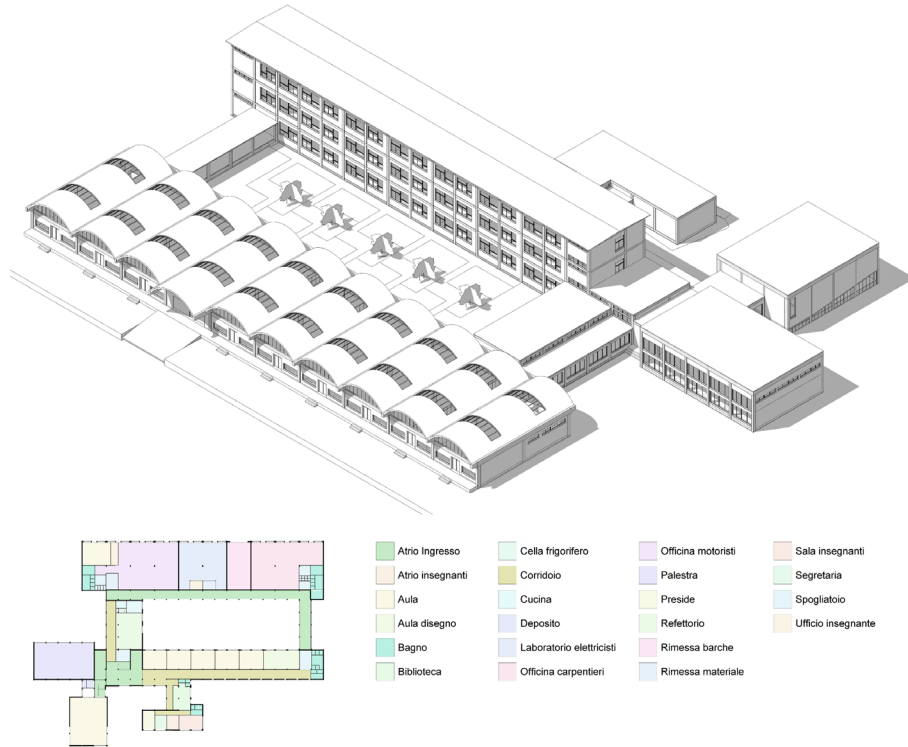


Fig. 5. Axonometric view of the architectural model complete with information from the coordination and structural model. The graphic work also includes a schematic plan view of the functional programme on the ground floor.

Thanks to the authors' notes, it was also possible to trace the type of structural systems. An example is that of the "S.A.P." type brickwork vaults. Here the modelling was conducted by nested loadable families.

The macro-category 'vault' in fact contains within it the sub-categories 'chain' and 'skylight', composed in turn by further sub-categories concerning the material and frame components. This not only helped us rationalise the structural mesh, but also allowed us to model geometries that were more consistent with the design intentions, allowing us to compile structural material attributes for each category.

Generally speaking, each semantic attribute category is defined by a project parameter linked to the instance, which is in turn defined by a shared parameter.

This choice proved to be particularly useful for two main reasons, one related to the possibility of querying the realised model and the other related to the potential it can offer in the study of a large sample of projects.

The shared parameter definitions are in fact stored in a .txt file, which is actually independent of the generated models. This file is nothing more than a container of information and attributes that can be shared and used with several project models and parameter families. The use of shared parameters makes it possible to show in Revit schedules and annotations different categories of families from the 3 different models, as long as they have parameters in common.

Each unit can thus also be queried individually and, thanks to this expedient, it was possible to generate a series of multi-category tables and schedules capable of returning the 7 units in an "assembly box".

But if it is true that the definition of appropriate shared parameters is useful in the realisation of certain analyses on the individual project, it is even more useful in the particular case of an application referable to a group of projects.

The experimentation of the present discussion is in fact part of a broader research concerning the study of a large digitised collection of projects in the possession of the Department of Engineering and Architecture of the University of Cagliari.

The workflow and the model developed in this way, therefore, form the basis for the development of a repeatable methodology applicable to the study of paper collections of 20th century architecture projects.

4 CONCLUSIONS

The digital reconfiguration in the HBIM environment has opened up new paths of knowledge and semantic redefinition of the drawings, favouring the decomposition, documentation and communication of the values linked to 20th-century architecture.

Modelling by parametric objects, in addition to allowing us to render spatialities that cannot be explored by simply reading archive drawings, has enabled us to generate codified elements capable of preserving the components of the architect's interpretative reading. Generating relationship constraints between the parameterised objects and the semantic data associated with them allowed us to make the model a useful interactive and interrogable tool.

Modelling by loadable parametric families and defining appropriate shared parameters also allowed us to catalogue the main components of the language of on-paper architectures. The model thus becomes a reading tool that can be implemented through subsequent experimentation on other works and reusable on other models.

Extending the methodology to different case studies would thus not only allow for the understanding of individual projects, but would also reveal a whole series of unprecedented values linked to the culture of twentieth-century design in Sardinia, placing the archives of architectural drawings at the centre.

The model thus developed also lends itself to implementation in advanced consultation and communication systems, with a view to defining new digital spaces capable of broadening the experience of potential users through customised digital communication experiments, in the direction of an archive that increasingly assumes the role of a digital museum.

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