HBIM APPROACH FOR HERITAGE PROTECTION: FIRST EXPERIENCES FOR A DEDICATED TRAINING

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ABSTRACT:

The BIM (Building Information Modelling) approach has been extensively studied in the case of new buildings and existing heritage (where it gained the term HBIM where H refers to Historic or Heritage). Numerous researchers have studied its applicability to cultural heritage conservation design, focusing on Scan2BIM processes, ontologies, semantic segmentation, and parametric modeling. But to ensure the applicability of the HBIM approach in the heritage sector, it is also necessary to verify that the various actors in the sector are ready to use it. The legislation foresees a growing adoption of this system in all areas of Architecture Engineering and Construction (AEC) sector. Nevertheless, it is necessary to understand if the National administration entities are prone to implement it in their own processes.
This article deals precisely with the training and research experience carried out in collaboration with the Superintendence of Aosta (the government department responsible for monuments, the environment, and historical buildings preservation) to understand whether the State preservation institution can actually use this system in its activities and, if so, to understand which actions need to be undertaken to ensure full interoperability in the heritage preservation sector as well. The activities carried out included a training course (update) designed with a specific scenario in mind: the HBIM model as a means of transferring the restoration project to the Superintendence, as a way for evaluating the model, and as a place for expressing opinions and comments. The training included a simulation involving a conservation design on the Tour De Pailleron of Aosta.

1. INTRODUCTION

The BIM (Building Information Modelling) approach to the construction sector is now well-established, both in its theoretical configuration (Bruno and Roncella, 2019) and through practical experiences supported by regulations pushing for adopting such systems. In Italy, according to what is happening internationally, DM n. 560 of December 1st, 2017 (modified by DM n. 312 of August 2nd 2022) in fact, contemplates the mandatory use of BIM for public interventions, establishing a road map based on the total amount of public works from 2022 onward. This Decree, however, sets 2025 as the date from which all public works must be carried out according to a BIM approach, regardless of the total amount. This logic includes all interventions, not only new construction but also renovation and restorations, which comprise an important percentage of the Italian construction sector. The obligation affects not only designers and owners but also the public administration. The law also entails the need, stipulated in the legislation, to adopt a staff training plan, to establish a plan for acquiring or maintaining hardware and software tools, and adopt an organizational act. Moreover, Public administration includes the heritage protection sector - the Superintendence- which will be required to intervene in projects through a BIM methodology.

In this context, the Superintendence of Aosta, Università degli studi di Brescia, and Politecnico di Milano have undertaken training activities. The Superintendence first trained some of its officials through a second-level HBIM master from Politecnico di Milano (Adami and Fregonese, 2020) and then organized an introductory training course for all its officials.
The training course has been set into two activities: one related to an update course and the second, a simulation of a process involving the Supertindence
Currently, the Superintendence of Aosta operates according to a traditional method. Projects concerning its own heritage, are managed by an internal supervisor who entrusts external professionals with specific tasks. Each professional draws up the project independently and shares specific project choices during meetings in mutual collaboration. The RUP (Single Project Manager, in Italian *Responsabile Unico del Procedimento*) plays an important role: he must coordinate all meetings and activities by verifying the documentation's correctness. The project is contracted and followed during the construction phases by external technicians, in some cases the same who carried out the project. The technicians collect the data of the work and process it to draw up the project accounting, propose variants if necessary, and close the working site. Every decision is taken in agreement with the RUP.

In the case of a building owned by a private individual, the latter chooses the designers, who, in addition to discussing the project with the owner, present the project to the Superintendence in order to agree on the operating procedures in the context of the conservation of the monument. The officials provide an opinion to which the designers and the company must adhere during the work. The method requires a

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great deal of cooperation and willingness by all parts involved, especially in the definition of guiding principles, but still remains substantial autonomy in the operational modalities of design and site management.
Actually the first part of the training activity (update course) has finished, while the simulation is still ongoing. The simulation, in fact, concerns the first case of the Superintendence work: one monument of its heritage has been assigned to an architect to develop the conservation design. At the end of the simulation, the Superintendence will try to receive the design in BIM format and give its own opinions with the same tools (this last part is scheduled by the end of 2023).

The paper is structured with a presentation of the training activities (section 2) both concerning the update course and the simulation experience. Some more details are given for the simulation project. Section 3 describes the results of the two activities and underlines positive and negative observations about them. The last section, conclusions, envisages the next steps of the simulation.

2. THE TRAINING OF THE SUPERINTENDENCE

This section describes which aspects were discussed in the training course developed for the Superintendence. It included an experimental activity, that is still being finalized, in addition to a classical training part.

The first part of the course was organized to convey the main features of the BIM approach, including process interoperability, model and process scalability, and process management in its different phases. The purpose, from the beginning, was not geometric and informational modelling but rather the ability to interact and use the BIM model. This choice was made according to the most probable scenario of BIM usage within the Superintendence offices. In fact, they would be engaged not so much in design activity but rather in verifying submitted projects and issuing opinions and prescriptions.
Secondly, it was agreed with the Superintendence to develop, after the basic training topics, a simulation in which officials are faced with a project to be evaluated that has been implemented and delivered through BIM mode. This approach was considered the best way to assess the supposed scenario and discover the "pros and cons" of the process.

2.1 The training course: contents and goals

The course was structured with the target audience in mind, which was made up of technicians already involved in the monument heritage sector, albeit in different positions and roles (e.g., architect, archaeologist, archivist, etc.). For this reason, the introduction to BIM first dealt with parametric modelling as an equal synthesis of geometry and information modelling. The themes that characterize BIM were then addressed, starting with a comparison with prior knowledge in the construction sector. For example, the traditional concept of the scale of representation then moved to the concept of LOD (Level of Detail) up to the more recent LOIN (Level Of Information Need) introduced by ISO 19650-1. In this way, previous knowledge was transferred to the new BIM approach, sometimes emphasizing the similarities and at other times highlighting the differences.
The course also included an in-depth study of regulations to learn about specific national and international (e.g., European Community) laws and distinguish mandatory regulations from guidelines. The in-depth study of regulations also made it possible to reflect on the necessity and urgency of this training activity.
The activity of the State Property Office (*Demanio dello Stato* in Italian) in the BIM field was then analyzed by reading specially produced materials and case studies (Demanio dello Stato, 2023). The State Property Department, in fact, in addition to being one of the first bodies to push toward the digitization of its heritage, has provided a whole series of guidelines, standards, and infrastructures (e.g., a specific Common Data Environment) to favor the BIM approach to project activities. The similarity between what could be the scenario envisaged for the Superintendence and the existing activity of the State Property Department also became evident.

2.2 A first test bed: the Tour De Pailleron

As anticipated, it was necessary to find a case study suitable for applying what had been previously taught on a theoretical level. With this in mind, a project for the restoration of a building was prepared by the research teams involved, as if it was carried out by a professional appointed by the Superintendence.
The building for the practical simulation was proposed by the Superintendence. It was the Tour De Pailleron (Fig. 1), which is one of the Aosta monuments managed directly by the Superintendence, with an evident need for conservation and reuse as also previously studied in some master thesis (Dufour, 2021; Papandrea, 2021). The Tour De Pailleron (Fazari, 2019) is one of the towers of the Roman of Aosta (Figure 1). This tower, belonging to the Aosta of Roman times, was also the subject of restoration work carried out in the early 20th century by Alfredo D'Andrade (Cerri et al., 1981)

Figure 1: The building selected for the practical simulation inside the training activity, Tour De Pailleron, Aosta, north-west view.

The planned activities followed those typical of the conservation and reuse project. In particular, there was an archival documentation search, a geometric survey, an analysis of materials and the state of conservation, a surface conservation project, and an architectural project for reuse. All the phases were performed as if done by a small architecture studio, therefore a relatively smaller scale than that of large commissions and engineering societies. The experimentation started from the geometric survey, carried out by the MantovaLab of Politecnico di Milano. It was chosen to outsource, with respect to the Superintendence, this activity because it is normally done by a professional.

2.2.1 Data acquisition: archive and survey sources: The first activities done were the geometric survey and the collection of information about the monument. Both historical and current archives were consulted o reconstruct previous interventions on the monument. In particular, we visited the

State Archives of Turin, the archives of the Turin Superintendence (which in the past was in charge also of Aosta region), the State Archives of Aosta, the archives of the Aosta Municipality, and the archives of the Aosta Valley Superintendence.
Various types of information are stored in these institutions: graphic, photographic, and written documents, both analogic and digital. The contents illustrate the history of the building and the history of the restoration works, starting with the earliest, where Alfredo D'andrade, among others, was the person in charge of the project that saved the Roman tower. Going into detail, it was possible to reconstruct the state of conservation just before the current one, the transformations of the monument use as a barn, and the portions added to reproduce the conformation of the tower (Fig. 2). Other documents illustrate the creation of the public park around the tower, the property issues, the management of the green areas up to the present day, and proposals for the reuse and enhancement of the tower.
In addition to the documents provided by these institutions, there are also paper publications as well as digital resources stored in the municipal library and online (http://cordela.regione.vda.it/index.html).

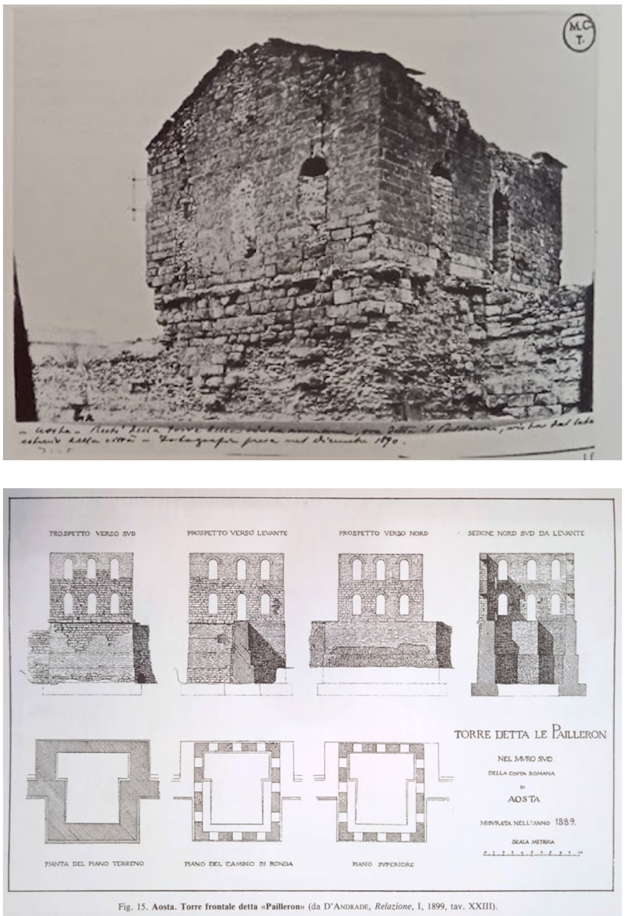

Figure 2: Top: picture of the Tour De Pailleron, before the intervention of the XIX century. (Courtesy of Superintendence of Aosta Archive); Bottom: a survey of the tower, from the report of D'Andrade, 1899 (TavXXIII).

All the archival documents were systematized by creating reference databases in order to allow easy data management, retrieval, and comparison. The database organization took into account, from the beginning, its future interaction with an HBIM model, and the conceived use of the model itself. Therefore, the data itself dictated the characteristics of the model, in which the collected information was linked and georeferenced. Since we are not talking about a data collection-only system, the database was assumed to be able to operate actively on the HBIM model.

The survey was carried out through the established practice of integrating terrestrial laser scanner survey (by using Leica RTC360) terrestrial photogrammetry and drone photogrammetry (by using Dji Mavic 2 Pro) on a common topographic reference system.
The topographical network formed the backbone of the entire survey. It allowed the data to be georeferenced in a single reference system, even though acquisitions were made at different times. Furthermore, the topographic measurements allowed the topographic survey to be linked to the topographic network used by the Superintendence for the rest of its monuments.
The laser scans were carried out at a medium resolution (6mm at 10 m) and were structured into internal and external ones, in order to cover all the building's surfaces.
Photogrammetry was used to survey the fronts from the ground, to obtain orthophotos useful in the mapping phase of materials and degradation. Furthermore, by drone, it was possible to measure the masonry ridges that had not been measured by laser scanner because they were not accessible.
The data was then processed according to established practices, using the Cyclone Register 360 software for laser scanner data and Agisoft Metashape for photogrammetry.
The integrated survey's outcomes (Figure 3) were used as the source for the modelling and the design project: point cloud as the basis for the 3D geometric modelling (using Autodesk Recap) and orthophotos as support for material and decay analysis.

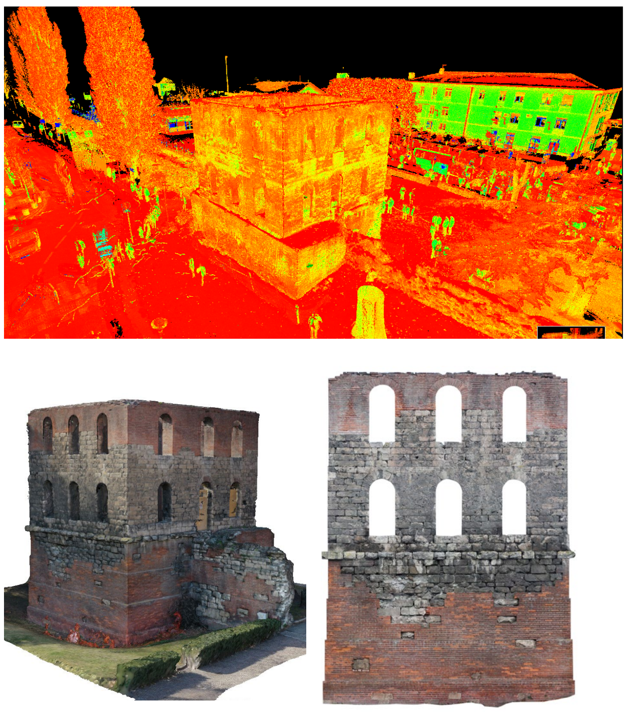

Figure 3: the survey results of the Tour De Pailleron: laser scanner point cloud (top), photogrammetric mesh model (bottom-left), orthophotos (bottom-right)

The scans were organized into three large groups (interior, exterior and park context) for easier use in the Revit environment, with each group being the result of decimating the original clouds into a single cloud (for each group) with a 3 mm spacing, considered suitable for the conservation project.
The orthophotos were calculated with a final Ground Sample Distance (GSD) of 5 mm, thus suitable for the traditional 1:50 representation scale.

2.2.2 The architectural design: conservation and reuse: The architectural design phase was developed in parallel, starting from a single topographic datum, for the realization of the preservation project and the project for the reuse of the tower, by using the BIM Authoring Tool Autodesk Revit.
The first operation regarded the as-built model. Working on a monumental artifact required great care in recording the history of the building itself, not only through documents but also through the materials and techniques used. The tower is composed of different types of walls: the lower part is still characterized by the original Roman walls made of rough stone and cladded only externally with squared stone; the upper part, on the other hand, underwent restoration towards the end of the XIX century and is characterized by walls composed of three layers, a central one made of brick and two others of brick and/or stone cladding, irregularly divided. This information, recorded in the model, is of fundamental importance to the Superintendence to have an as-built model that accurately depicts the stratification of the materials that make up the walls.
After setting up the layers, the first step was modeling the walls with the wall thicknesses detected in the point cloud. This process began by using generic walls with different thicknesses corresponding to reality: each new wall was created by juxtaposing two or more walls, with the aim of composing the stratigraphy described above. All the walls created were renamed by modifying the acronyms of the nomenclature according to the characteristics of each element. Given the irregular division between stone and brick along the surface of the internal and external cladding walls, a single wall was initially modelled and then cut following the division line between stone and brick using the edit profile command. This approach allows to use of the parametric features as an added element concerning the specificity of the as-built situation (Scala et al., 2023).

The conservation project includes a series of operations that, even in an HBIM model, must be included and prepared to ensure the correct execution of the conservation intervention.
In particular, the mapping of materials and degradation pathologies was carried out. Regarding the mapping of materials, the graphicization is closely linked to the element on which it is drawn and becomes a *parameter* of the same element. It is therefore important to choose how to draw the element itself already at this stage. For example, in the case of the Tour De Pailleron, it was decided to give importance to the individual stone ashlars, by modelling them individually. In contrast, the brick face was considered as a single wall without detailing the individual bricks.
We paid particular attention to the representation of the degradations. Various attempts were made to find the best solution for its representation. The bibliography provided a number of modalities already developed (Brruku and Cigliutti, 2019) in other fields. These were tested until one was chosen for each pathology: the use of *Metric Generic Model Adaptive families* (on Autodesk Revit). With a *family* built from the metric generic model adaptive, a degradation type was created through a volume thickness of 1 mm that was applied to the surface of the three-dimensional elements. The advantage of these type of *families* is the possibility of creating three-dimensional surfaces that can also fit non-planar surfaces, such as vaults and arches. The creation of a metric generic model adaptive element consisting of adaptive points allows for a more accurate perimeter of the degradation. The *family* had to be configured with a suitable number of adaptive points for the degradation perimeter to be identified. The choice of spline or broken line depends on how the contour of the degradation area is to be represented (spline for curved contour and broken line for segmented contour). With this mode, it was possible to represent the totality of degradation.
The use of the *metric generic model adaptive* allowed the visualization of degradation in all two- and three-dimensional views of the model, as well as the characterization of the visualization through the assignment of ad hoc materials. The use of this *family*, however, does not allow the direct quantification of the surface, so it was necessary to use the Dynamo application contained in Revit to create a script to determine the surface of the elements.
An analytical sheet was then created for each element, linked to the model, in which the specific characteristics of the pathologies present and the consequent operative intervention steps were described.
The design of valuable interventions to solve conservation problems followed the methodologies already used in professional practice (Figure 4) but was made more dynamic and accessible thanks to the possibility of querying and searching the database linked to the BIM. In this way, the informative content t is directly related to the graphic system, providing the possibility of continuous interaction.

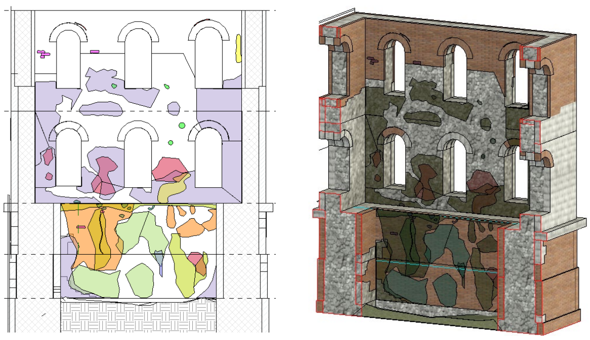

Figure 4: Decay analysis in 2D (left) and 3D (right), both in Autodesk Revit

The recovery project (Figure 5), on the other hand, was developed foreseeing a new hypothetical function for the building, compatible with its features and location near the train station. The new assumed function was a coffee shop or an info point for tourists and citizens. At the same time, an attempt was made to keep the history of this monument alive by exploiting and enhancing the pre-existing buildings and dedicating a space to the dissemination of the history of Aosta, its walls, and the Tour De Pailleron itself.
The project was developed exclusively through Autodesk Revit software and the construction details were also studied and linked to the BIM model as external links available to the end user. All design choices were made carefully by exploiting the current configuration of the Tour De Pailleron, such as the position of the pontoon holes, the reinforcement wall at the basement level, and the conformation of the ridges of the summit walls. This design was facilitated by the as-built model, based on the point cloud, which allowed a detailed design.

The model was structured by paying attention not only to the geometric aspect but also by carefully designing the nomenclature of its elements and developing ad hoc *families* for certain elements.
Each element has been named with a concise and unambiguous coding that allows it to be identified according to its main functions and characteristics. This was useful for classifying and differentiating elements with the same function. This process allows for a simple understanding of the entire model for any operator who has to use it.
The State Property Department prepared very detailed guidelines for the management of the project on its assets and, in these, a very exhaustive part concerns the coding and nomenclature of the elements (Demanio Tender, 2023).
The blind application of this codification, although very detailed, appears unhelpful and excessively articulated when applied to less complex situations such as our case study. This is one of the reasons why rather than attributing predetermined codes unrelated to the specific case, it seems more useful to prepare guidelines that allow to apply a logical method (consistent with the guidelines) that can define a unique way of attributing coding.
With such a method, the creation of coding can be adapted to the needs of the model, avoiding excessive complications of predetermined tables. They can be developed for the architectural elements, the degradation but also for the archival documents with the purpose to favor access to elements, not only in a graphic way but also through informative abacus and lists (figure 5).

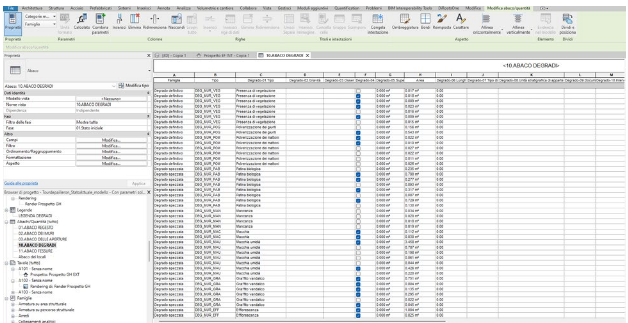

Figure 5: Abacus of the elements of the conservation project, with details about the suggested intervention and preservation activities. Each element is identified by a specific code.

For example, the logical system used in the case study identified a unique code *XXX_YYY_000_Abcdfghilmopqrstuvz999* for each element. In this case, XXX represents the type function of the element and consists of the first three letters of the word characterizing the element. The letters YYY represent the sub-type of the type function consisting of the first three letters of the word characterizing the element function. The 000 represents the sequence number assigned to the sub-type, while the text Abcdfghilmopqrstuvz represents a brief description of the element. Finally, the three numbers 999 represent the significant dimension (thickness for walls and floors, width height for windows, section for pillars, etc.) in centimeters of the element.
Similarly, with regard to the coding of the levels, it was decided to proceed according to a logical scheme arising from the simplification of the system proposed by the State Property Office. For example, level 01.01... contains the description of the level (Ground floor, First floor, etc.) and the number identifying the level in hierarchical form. The first number identifies the main levels or floors (ground floor, first floor, second floor, etc.); the second is the secondary level intermediate between the main levels; the third is the tertiary level between the secondary levels, and so on.
With this coding mode, it is always possible to insert a possible level within others, being able to recognize their hierarchy without the need to recode all levels again.
For example, the element with the code WAL_LBE_127_StoneWall220 where WAL means wall, LBE is for Load Bearing, 127 is the number of walls, StoneWall220 means a wall made of stone, with a total thickness of 220 mm.
A similar code was used for the elements of degradation, and for example, it became XXX_YYY_ZZZ where (XXX means degradation or cracks, YYY is the support, and ZZZ is the specific type of degradation. Here the example is DEG_WAL_CDU which represents a degradation (DEG) of Coherent Dust (CDU) on a wall (WAL).

For the new design project (Figure 6) double access was studied, one to the south-east, near the station, by means of an external steel staircase, and a wheelchair access to the north-east, permitted by the development of a ramp that runs inside the public garden that juxtaposes the tower and the walls.
The existing interior of the building is without floors and at full-height. In the basement, the one without openings, there is a double wall for the entire height, which generates a C-shaped kerb along the entire south side and to half of the east and west sides. It was decided to use this wall to partially support the flooring of the first level: an L-shaped steel profile is installed along the inner profile on which the floor support beams will rest. In the other part, where there is no kerb, there are pontoon holes, probably already used in the past to support the beams of an attic. They are helpful for supporting the remaining beams of the new flooring. All the beams are made of steel, while the floor above is made of precast concrete slabs in order to further lighten the weight on the structure and minimize thicknesses.
The floor between the first and second levels also works in the same way, with the difference that there is no kerb, but the pontoon holes run the full length of the east and west sides. Structurally, the roof also functions in the same way, but a trapezoidal sheet metal will be placed above the rafters to support concrete screed and insulation, above which a waterproof and a protective sheathings will be placed. A water collection channel will be placed at the sides.
A self-supporting structure, positioned within the C-shaped kerb already present inside the tower, has been designed to overcome the height differences. This structure consists of a small lift around which run a C-shaped staircase.
The first floor, the entrance floor, is dedicated to an info point space furnished with counters, shelves, and a few tables. Between the staircase and the wall behind, there is a corridor-like space with a width of 1.20 meters dedicated to displaying posters and panels telling the history of the tower, the ancient walls and the city of Aosta. The lower floor is devoted entirely to toilets, including an accessible bathroom, and a storage area that can be used by both the bar and the info-point. Going up to the second floor is a simple café area and several tables, from which it is possible to admire the city of Aosta and the mountain landscape from above.
As concerning the design modelling, the structural elements were generated through the use of *standard parametric families* in Revit, without the need for further modifications. Many architectural details (masonry beam node of the first floor, roof beam node of the second floor, self-supporting system of the lift) were designed by means of detail drawings also drawn up in Autocad 2D and attached to the model, in order to provide all the necessary information for the evaluation by the Superintendence.

This contribution has been peer-reviewed.
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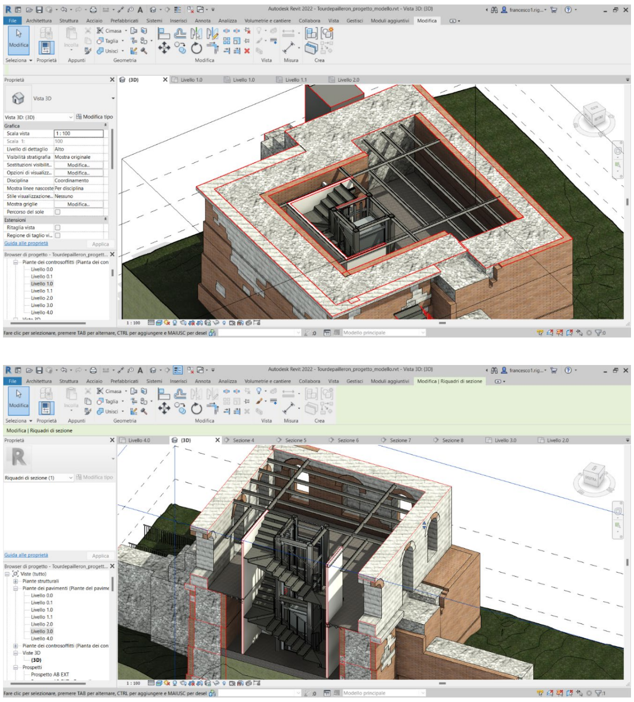

Figure 6: screenshots of the design in Revit. Horizontal section with details of the HE beams (top); axonometric view with vertical connection system, stairs, and elevator (bottom)

3. RESULTS AND DISCUSSION

3.1 First activity: the training course

The course was aimed at officials from two sectors of the Superintendence of Aosta, specifically those belonging to the Archaeological Heritage and Monumental Heritage Restoration Department and those from the Landscape and Architectural Heritage Department (about 30 people in total). The course was organized over 4 days and proposed a successive sequence of activities. The speakers were of various types: university lecturers, technicians, and private operators working with public bodies.

The first meeting aimed to provide basic knowledge of the Building Information Modelling (BIM) system to the construction sector. It describes the current State of adoption of the BIM approach in Italy and Europe, the regulatory aspects (compulsory and non-compulsory), what are the future prospects, illustrating examples of public tenders in BIM mode, proving that BIM approach implementation is now an unstoppable process.

The second meeting focused on the presentation of the information model: the basic choices necessary to set up correctly the geometric and information modelling, and to respond to the information plan. This step is essential in a conservation project where (as illustrated in the previous sections) the choice of the detail of the element to be modelled has important implications for the entire design process.

In the logic of the process, the figures of the BIM-Specialist and the BIM-Manager were introduced: they are increasingly important and present in the AEC sector, and their training in the field of conservation can determine a considerable implementation of the quality of operations. In fact, knowledge of the processes for conservation can change the model's approach in different directions.

The last two meetings dealt with the management of information in the model, structural data and analysis, collaboration and data-sharing systems.

Already at the end of the first two meetings, some reflections emerged. An important aspect is the cheduled time, in consideration of the learning curve of the BIM authoring software and the use, in the initial phase, of both systems (traditional and BIM) to ensure the correct and complete transition to the new method. Another annotation was referred to the management of the data in the delivery of documentation about the project. It was decided to proceed with the elaboration of a project concerning the Tour De Pailleron, in order to study how to manage it.

Finally, more practical aspects were addressed. In particular, the compulsory regulations require not only an update of employers skills, but also new equipment and infrastructural adaptation concerning hardware, software, network and everything necessary to guarantee data management and transmission.

In addition, the possibility of integrating BIM models with Superintendence archives to be shared with professionals emerged. This is a complex issue which can foster data access and data sharing. But it also poses technical and privacy problems (e.g., the data are the property of the Superintendence), which have yet to be addressed. These last issues requires the intervention of other disciplines, such as informatics, archives management and jurisprudence.

3.2 Second activity: HBIM design simulation

Following the course and while waiting for the Superintendence to respond to the simulated project with its own opinion, the simulation made it possible to identify some critical issues or problems to be solved.

First of all, it emerged how useful it would be to prepare specific guidelines for restoration projects that would guide the designers and the bodies evaluating the projects.

Guidelines, and not procedural manuals, are proposed because it is appropriate to leave a margin of freedom in the management of the procedure. Although we deal with BIM models, which by their nature are rigid, the restoration project nevertheless maintains a degree of necessary adaptation to the building under study.

For this purpose, the national reference is the State Property Department, which has undertaken digitization of its assets by defining a protocol for the information management of the entire lifecycle of the building, favouring and optimizing collaboration between all the professionals involved in each phase of the lifecycle.

According to these specifications, the BIM model must collect and organize the geometric, alphanumeric, and documentary information that is collected and/or created and/or updated during the execution of the service itself. In this way, the application of the BIM methodology guarantees the planning and management of all activities related to the sharing and delivery of the model.

The State Property Department defines the Information Specifications required for the performance of the Service subject to a tender. These Specifications are structured according to a logical flow from the framing of the Service to the production and sharing specifications of the information content.

In this context, as experimented during this first part of the simulation, the nomenclature used by the State Property Department seems to be very rigid, although its appropriateness is evident, especially from the perspective of the management of a very vast and diverse heritage. The coding presented here, however, is an interesting system to manage data in an orderly

manner, while ensuring the immediate "understanding" of the object.
Since the historical objects investigated with the BIM procedure have peculiarities and characteristics that are difficult to duplicate, it is believed that an approach of this type can allow a more precise and specific management of the object, making the procedures and results more efficient without disregarding the objectives of the complex system.
Among the observations that emerged, it is also possible to note that there is a need to reason about open formats for data interchange. In the preparation phase of the test, educational versions were used to enable the exchange and verification of data. However, the Superintendence is currently not equipped with a CDE nor with the proprietary software with which the model was drafted. Therefore, it is deemed necessary to rely on IFC interchange formats so as not to bind the end user and to allow access to the project in any case.
As far as the reuse project is concerned, the comments mainly concern the advantages of the BIM system in the field of design. In particular, the advantages come from the possibility of using standardized elements, of which there are already BIM models ready to be used, and already defined both geometrically and informatively. This system, however, also allows the elements to be modified, thus enabling the preparation of ad hoc solutions depending on the state of the building and the needs of respect and protection of the building..
Finally, particularly interesting is, the possibility of integrating technological details into the project, described through 2D drawings. This allows a complete understanding of the project.
However, the learning curve of BIM authoring is quite complex, especially if the learner was previously trained only with traditional digital systems (both 2D and 3D). The BIM logic, in fact, of a parametric nature, requires an initial effort, especially in the modelling part.

3.3 Ongoing test for BIM implementation within the Superintendence

All these observations and experiences convinced the Superintendence to continue the BIM experimentation on another building of its own heritage: the Arch of Augustus in Aosta, On this occasion, moreover, the Superintendence will not have only the role of a conservation institution but will act as the designer of the intervention. The Arch of Augustus was already studied using an HBIM approach in the past (Adami and Scala, 2021). In the continuation of the work, the Superintendence will design directy the conservation project in HBIM.. The public body will develop the BIM with the support of the Università degli studi di BresciaThe contract entitled "Realization of a research project for the study and elaboration of an informative HBIM model of the Arch of Augustus in Aosta" provides for:
1. Historical research and cataloging of the data stored in the historical and current archives of the Aosta Valley Department of the Superintendence for Cultural Assets and Activities;
2. Elaboration of an HBIM model adapted to the information found in the first research phase;
3. Experimental tests for the insertion of data regarding the material elements and regarding the degradations found on the Arch of Augustus;
4. Inclusion in the model of information for the conservative restoration intervention for the purpose of data extraction for the quantification of the restoration cost;
5. Extraction of graphic tables, tables and economic documents for the purpose of drawing up the project for the conservation and restoration of the Arch of Augustus in Aosta.

This process has generated working tables that meet monthly to proceed with the comparative preparation of the model.

4. CONCLUSIONS

The BIM approach to the conservation and restoration site has been discussed and tested in many types of research. Numerous experiments have investigated the possibility of using BIM for conservation projects, focusing on the scan2BIM process, ontology management, and segmentation. Despite the limitations of the BIM systems, which were designed for new buildings, an interesting case history has been established to use the BIM (or HBIM) approach in the context of conservation projects. But it is necessary to explore, however, the relationship between the designer and the other actors involved in the building process. In this research, we began investigating the interface between the designer and the heritage protection institution, the Superintendence. The objective of the research is, in fact, to understand how the protection bodies can use the characteristics of the BIM approach to their advantage in order to optimize the process and also be ready for the future adoption of BIM for all public interventions (and therefore also those concerning cultural and architectural heritage).
The research, which has not yet been completed, envisages for the next steps a direct confrontation with the officials of the Superintendence in order to develop guidelines to be proposed to the designers and, at the same time, to become aware of the themes/techniques to be explored within their own structure.

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