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HBIM Methodology to Achieve a Balance between Protection and Habitability: The Case Study of the Monastery of Santa Clara in Belalcazar, Spain

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Abstract: The different technical and legal tools intended for heritage protection have augmented the possibilities to acknowledge important monumental complexes. However, a contrast lies in the artistic contexts in which, due to the consolidation of their programmatic typology, such monuments require habitation, unlike more conventional monuments. This article collects the results of an accurate investigation conducted by the authors, whose main objective was to obtain a tool that allows consistent measurement of different indicators in which both the protection of the elements, and the capacity for habitation, are safeguarded. To this aim, we contextualized the research at the Monastery of Santa Clara de la Columna in Belalcázar (Córdoba), a monastery with the highest heritage protection in Spain, and which, in turn, accommodates a religious community. The results have allowed us, for the first time in Andalucia, to define objective habitability parameters, within protected heritage contexts.

Keywords: BIM; HBIM; heritage; conservation; protection; habitability; monastery; Belalcázar

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1. Introduction

Since the beginning of the application of laws dedicated to the conservation of heritage, they have produced uneven effects that were possibly caused by an excess of zeal. Such is the case of heritage crystallization [1], in which material configurations of built fenclaves and fragments of cities have been congealed, perhaps ignoring the living reality of the existing heritage. In developing this material protection of movable or immovable elements, important and sophisticated procedures and tools have been created. These have resulted in profound knowledge and testing of construction phases, materials employed, epochs, historical sequences, etc.

With such procedures, we have been able to intervene by restoring, adding value, and consolidating the most important phases of certain architectures, whilst being obliged to eliminate any element that would cause deterioration. The processes of expelling daily life from the protected architectures may have ensured material conservation, but has also harmed the wealth of uses that were provided in these spaces.

Digital modeling is a tool generated for the conservation and study of heritage and historical structures. Its development was principally based its potential to obtain an exact three-dimensional and constructive level of precision, while forgetting to explore the qualities of the architectural heritage, from a critical and contemporary perspective. Heritage Building Information Modeling (HBIM) offers the possibility to implement other factors capable of inducing a more comprehensive assessment of the architectural heritage, such as the habitability of spaces.

Our aim with this manuscript is to present sustaining guidelines and a discussion on protection and habitability through HBIM modeling; thus, the article presents the research carried out in the search for parameterizations that allow the objective study of heritage, together with the development of its daily life. As a first objective, we took, for reference, a monastery of significant heritage value which, at present, is obliged to separate its uses due to the impossibility of inhabiting the protected areas (see Figure 1).

Figure 1. Aerial photo of the monastic complex, 2021.

2. Case Study

The choice of the Monastery of Santa Clara de la Columna in Belalcázar (Córdoba) for this research was not casual, and was due basically to two reasons: the site constitutes a heritage complex with the need to be inhabited, in which severe protection is also necessary. Both realities accrue in an architecture that demands this double analysis, and serve as a field of experimentation for study, development, and adjustment of this new mode of parameterization of inhabited heritage architectures.

The Monastery of Santa Clara de la Columna, declared an Asset of Cultural Interest in 1982, constitutes one of the main monastic complexes in southern Spain, and one of the fundamental pillars of the historical and artistic heritage of the Pedroches Valley. It was founded for Franciscan Friars by Elvira de Zúñiga, widow of Alfonso de Sotomayor, in 1476 [2]. After spending a short time there, two of her daughters decided to take up the habits of the Seraphic Order and began to live in a house near the cloister. This group of women (not yet constituted as Poor Clare nuns) began to grow, and they saw the need to erect a new place for the Friars so that they could stay in that place. It was in 1490 when the construction of the cloister of the Five Martyrs of Morocco (Maghreb) was finished for the Friars, and that the Poor Clare sisters stayed in the premises they had previously occupied. From that moment (21 March 1490) onwards, the monastery has been inhabited, without interruption, by the Poor Clare Sisters (see Figure 2).

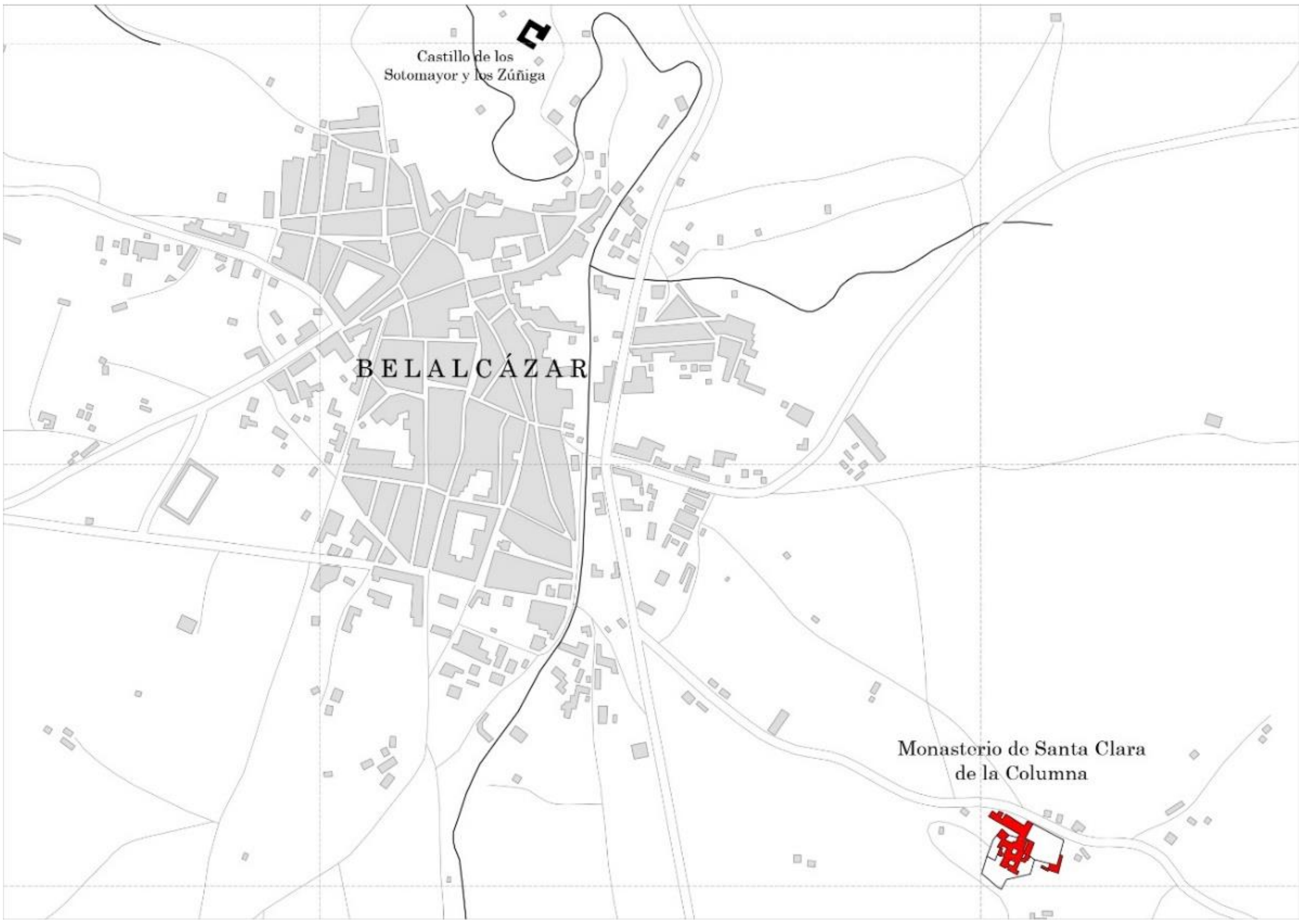

Figure 2. Location plan of the monastic complex, 2021.

The monastic complex is located on the outskirts of Belalcázar, in the so-called Villeta de Santa Clara, an area outside the municipality, rich in large orchards and irrigated from different water sources and supply points. This is how the Chronicler of the Province of Los Ángeles describes it: "The convent was founded in the eastern part of the town, half a quarter of a league, next to the bank of a stream in a small or unhealthy valley, building at the same time some principal houses for the Countess" [3]. Madoz also reveals its remoteness from the town: "a quarter of a league from the town" [4].

Given its continuous occupation since its foundation, the monastery has undergone important transformations, both of a liturgical and residential nature, configuring a complex structure of architectures from various eras that currently co-exist, giving use to the needs of the community of Poor Clare Sisters that actually inhabits the structures.

In recent years, important conservation work has been carried out, with various projects undertaken, the first in 1998, then 2002 and 2007, by the Cultural Delegation of the Junta de Andalucía, and the latest, in 2014 and 2018, promoted by the same community. In 2019, given the need to continue conservation actions, a preliminary investigation of the architectural structures and the housing needs of the monastery were proposed as, until then, there had not been any systematic work undertaken [5] (see Figures 3 and 4).

Figure 3. View of the galleries of the monastery's cloisters, 2020.

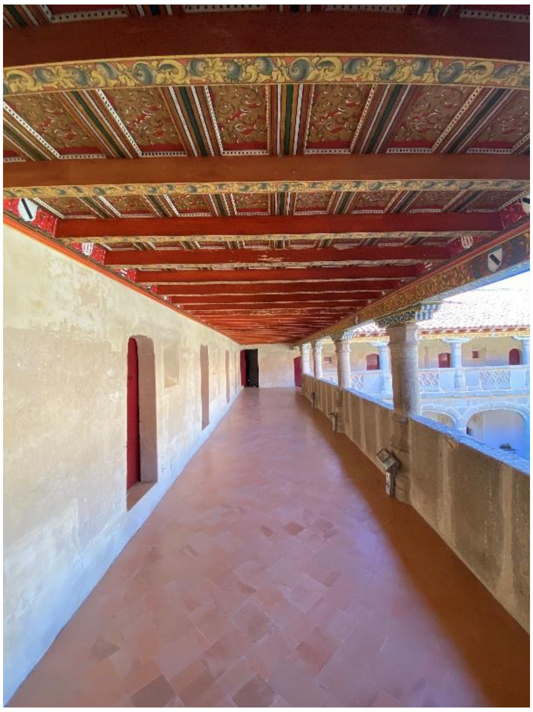

Figure 4. Photo of the galleries of the monastery's cloisters, 2020.

The reduction in the number of the religious community has led to the fact that they are currently living in a section of the monastery that has few heritage values, and the most artistic part has been relegated to visits and tourist use. This double reality led us to develop the research explained in this article. The fundamental objective of the research was to find a tool that would offer variables, which in turn could determine the degree of protection of this architecture while being entirely compatible with the residential use. Such a tool is the HBIM methodology, as we will demonstrate.

The dual nature of the studied monastery is not unusual and there are numerous protected buildings (palaces, convents, churches, houses, etc.), that are part of this reality. Any inhabited heritage building has the same characteristics and, as a general rule, almost all of them tend to be important heritage pieces. The specific case of monasteries is unique. The decrease in the number of vocations associated with religious life, together with the strengthening of laws and regulations for the conservation of protected architectures, has caused the people who inhabit these unique spaces to retreat to secondary and unprotected areas. This new zoning is due to the fact that it was decided to abandon areas with a wealth of heritage, in exchange for staying in secondary spaces, but with options to be adapted to the basic comforts and needs. Something as basic as the location of a lift, which guarantees accessibility for the elderly, is often not easily manageable within these heritage contexts.

At present, and due to the complexity of inhabiting a heritage site, the religious community has delimited a private area, clearly segregated from a public area (see Figure 5).

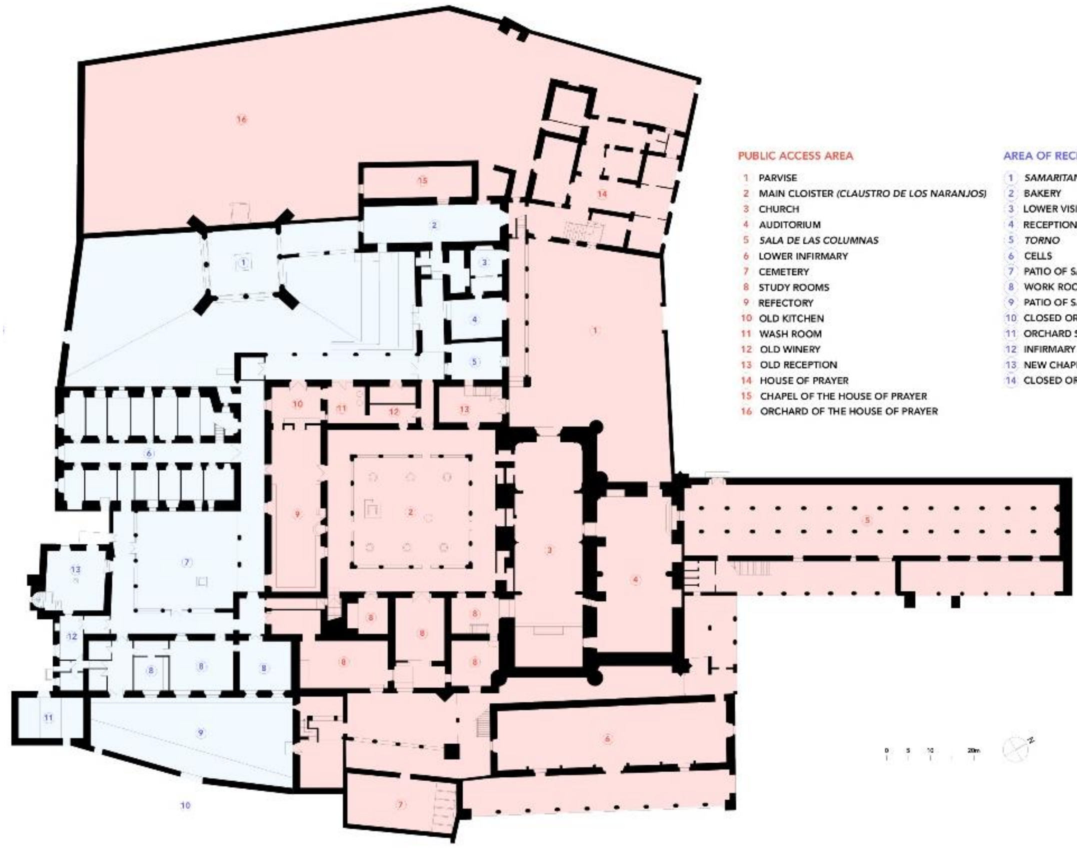

Figure 5. Monastery plan segregated by uses, 2021.

In the private area, the basic questions of living have been reorganized, with a certain quality of life, while in the public area (for tourist visits) no activity can be carried out, due to the restricted uses allowed. This segregation prevents actions as obvious as eating in the refectory from taking place on a regular basis.

What was initially a segregation of uses and routes has ended up being built into clearly defined physical segregation. It was due to this double convergent reality, in a single heritage space, that the objective of this research arose, to find a tool that can make all these realities converge and coexist in both directions (see Figure 6).

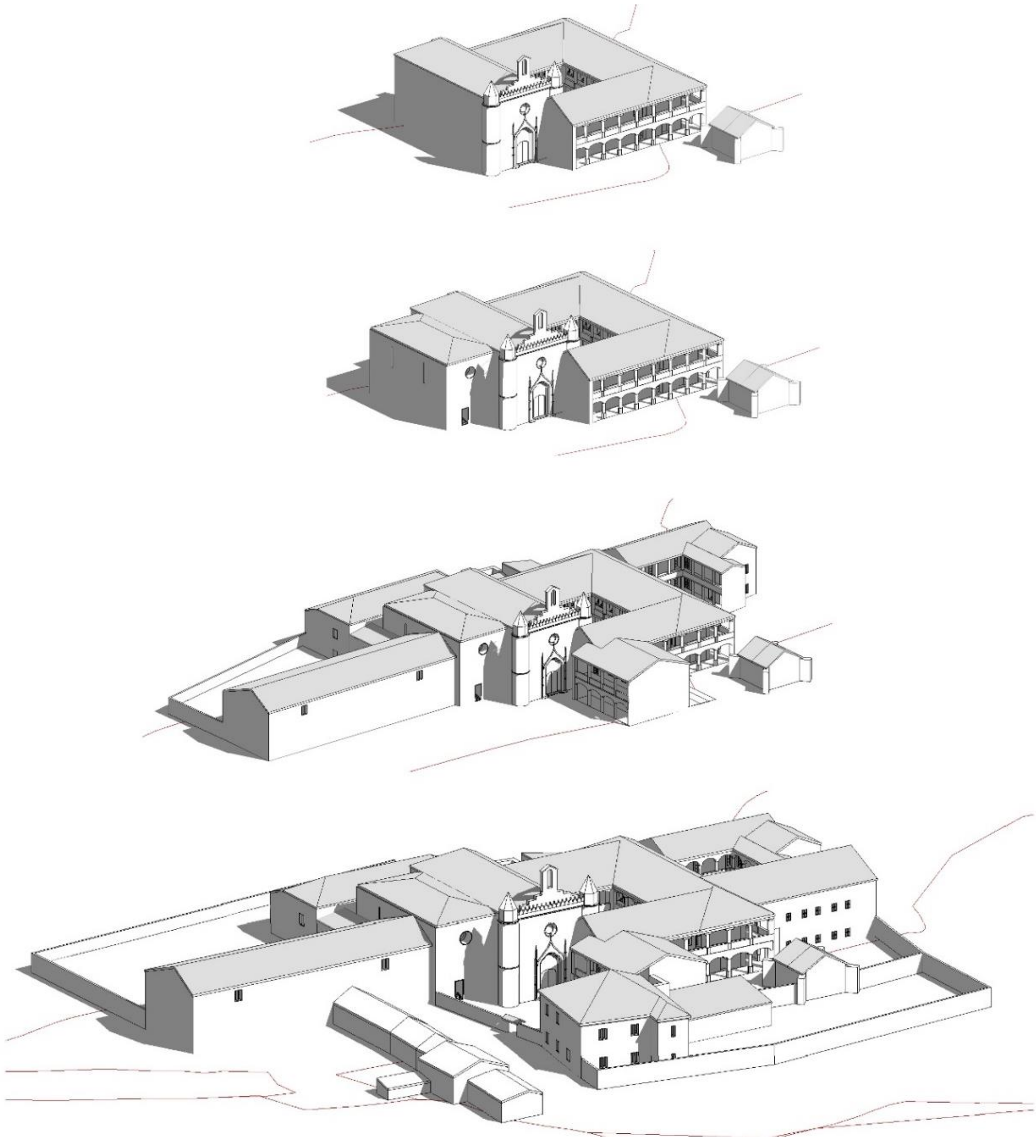

Figure 6. Architectural evolution of the monastic complex, 2021.

3. Distinguishing between BIM and HBIM

The protection of the architectural heritage presents a technical dimension, for the physical preservation of historical structures, and a social dimension, as heritage must be disseminated within society to guarantee its protection [6]. Today, the approach to this issue transcends the more traditional heritage framework. It belongs to a very recent, and constantly evolving, research forum, with daily repercussions in areas which transcend architecture, the information age, and visual culture [7].

According to the Rilievo Charter [8], in the year 2000, surveying was declared fundamental. The knowledge and digitization of this process is approached from the heritage project, by means of Computer Aided Design. This is where the drawing offers a procedure that should not only be valued for its results, but as a tool with which to record intentions that are developed in the transversal nature of architectural facts. The multiple resources offered by graphic representation allow for diverse translations between the work, in its architecture and materialization (furniture or property), and reflections through the intentionality of the model, the selection of information, and the different and new dimensions collected from the elements [9].

The Building Information Modeling (BIM) tool is defined as a shared digital graphic representation system of the physical and functional characteristics of any constructed object that constitutes a reliable basis for decision-making [10]. BIM processes are already established for new buildings; however, this is not the case in most existing buildings that are not yet maintained, renovated, or deconstructed with BIM [11]. This happens despite the fact that the main use of the tool is based on the most extensive quality of integrating and organizing all the factors in a single file. The effective use allows the definition of the architectural evolution, from the ideation phase, its development, and its execution, to the end of its life cycle. Once the 2D levels are exceeded, the BIM stands out among other formats, for entering beyond the geometric and constructive 3D, by associating other hypergeometric dimensions as follows: 4D to include temporal sequences; 5D in reference to the incorporation of costs; 6D to indicate the association with certain environmental behaviors; and, 7D to finally collect the maintenance schedules (see Figure 2). The addition of qualitative and quantitative technical information on the objects included in the model, and their relationships that are established inside and outside, through links to external documents, characterize the potential of its use, according to the heritage information systems and the already collected documents [12].

The complexity that these models are able to reach implies a demand for a terminology of their functional parts. The Level of Development (LOD) categorizes the model, according to the level of precision and reliability associated with the said BIM file. This definition is subdivided into sequences, regarding its development level: LOD100, LOD200, LOD300, LOD400, and LOD500, according to the American Institute of Architects [13]. Such a hierarchy, which allows graphic realities to be quickly classified, is translated to the heritage world as level of knowledge (LOK). This arises from the level of knowledge that is achieved and collected in the model, from a contemporary perspective. The said parallelism occurs indirectly, as the graphic accuracy is determined by the documentation and its discrimination within the survey process, according to the significant value in the protection. In the same way, the LOK depends on the information available and, later, on its reflection in the modeling. This approach always maintains graphic accuracy and defines gradations which, according to their ascending improvement, perpetuate the depth of the definition and the formal and historical knowledge of the property [14].

Despite the rapid evolution and BIM standards, challenging research opportunities arise from process automation and the adaptation of BIM to the requirements of existing buildings [15]. The reasons why many buildings are not managed or maintained properly, are lack of knowledge, experience, and resources, and dependence on other stakeholders [16]. Recent research has focused on the methodology of the tool beyond the outcome. In this way, the objective is understood as the process of interpreting the survey, and therefore, the asset itself, including qualities such as the potential of the BIM system as a research tool, conservation activities, and managing dissemination [17].

The transition between the collection of data and its BIM graphic expression, as a consequence of the digital capture process, diverges within various protocols. Photogrammetry is one of the methods that has experienced more progress, due to the recent appearance of dimensional data collection on surface morphology (derived from other capture systems). The 3D scanner, or the advanced photogrammetry software itself, collects colors and textures. All are based on the co-ordination between the photographs, and their translation into geometric information through restitution or rectification [15]. Such computer applications translate the clouds of points generated on surfaces in a highly faithful manner, but Angulo Fornos [18] indicated the lack of information about their unmanageability, a fundamental aspect in historical structures. Hence, a recurring stance is to carry out a manual treatment through classification, hierarchical organization, and simplification. The former subsequently allows the model to be focused on the most intrinsic and representative references, compared to the so-called semi-automatic approaches in which the whole generation prevails through algorithms. These are applied globally, always maintaining the prior reflection phase for the discretization and revision of certain aspects, compared to those directly automated.

Apollonio, Gaiani and Sun [19] highlight that the aspects that concern current research are those that influence the adaptation of the BIM methodology to the specific characteristics of historical architecture. This is based on the level of knowledge that can be incorporated, and the semantic structures available for historical heritage. Some authors point out the analysis of the historical building, and the generation of knowledge that a digital model should incorporate, considering geometric precision as a characteristic of the said model, which can evolve, according to its level of knowledge and development. They highlight the quality of the tool to allow for progressive improvement, based on the analysis and acquisition of information during the evolution of the architecture [20].

Consequently, it is essential to reflect on the level of detail and the simplification of models useful for conservational projects [21]. Both aspects are related to the possibility of modifying the parameters of the shape of the architectural elements; in particular, historical objects that are often irregular or isotropic. Regarding HBIM, it has been illustrated how a library of interactive parametric objects can be built, subject to the variability in the historical dimension of architectural patterns [22]. This inclusion in the methodology provides architects, engineers, and archaeologists, among other agents involved, with concepts and tools that require a different and additional vision, taking into account aspects that are not normally addressed in new building projects [23].

One of the aspects of greatest interest for this research is the use of parameters when defining heritage architecture. Its quality as an informational structure [23] allows direct association of information to elements, spaces, etc., and, in turn, the ability to generate tables, or repositories of internal or external information. All this includes not only the type of data associated with the locations, which the BIM tool supports, but also historic plans, documentary files, images, URL information, etc. Through this association of data, Castellano Roman [22] gathered conclusions about the spatiality of the Cartuja de Jerez, with regard to its heritage potential, in levels of protection, state of conservation, urgency of intervention, vulnerability and accessibility for visitors.

Architecture (materials, systems, elements, spaces, complexes, images, etc.) establishes relationships between technique and society, for the creation of a human co-habitability [24]. In the specific case of heritage, its valuation and protection are additions to its architectural reality, and, therefore, the interest that sparks its maintenance would be unsatisfactory if its condition if enrichment of human life were not ratified [25]. Today, habitability is understood with a broader scope of the quantitative and qualitative spectrum, determined by the adequacy of each of the territorial scales [26].

As evinced in these approaches, the definition of habitability includes work to determine the factors and variables that allow establishing standards of residential wellbeing, with a transverse reading criterion in relation to the environment and the community [27]. The decisive approach to the habitability of the spaces is abandoned in heritage cases, passing to a second level in favor of protection, so that the qualities related to comfort and health are subordinated to conservation and protection, provoking divergences and contradictions according to the requirements applied to other buildings. All this is reflected, in turn, in the HBIM models, in which this important aspect is not fully developed.

The implementation of HBIM still requires a methodological debate, and practical experience, to apply this documentation to a broader process of conservation and the maintenance of heritage [28]. Taking these challenges into account, HBIM libraries require a broad and shared exploration of the objects, the production of data, and their interpretation [28]. Finally, there is a knowledge gap between the automation and adaptation of BIM technology to existing buildings, as studies do not always take into account social and cultural needs, which is a fundamental requirement for heritage projects [29].

4. Materials and Methods

There are few examples of heritage architectural types still inhabited today in the manner for which they were conceived. Religious architecture is one of these types and, in addition, the monastery combines this double perspective: liturgical use and residential use. In relation to the investigation, two processes were developed, taking into account the double objective: the protection and habitability of the monastery.

The final aim of the surveys conditions the general approach, so the strategy chosen was to support actions that are as general and transversal as possible in relation to obtaining a balance between protection and habitability. In order to achieve this, a model was generated following the BIM methodology applied to heritage architecture and, after parallel research on the subject, the necessary parameters will be implemented.

4.1. HBIM Model

As mentioned, in this case it is assumed that the scope of the objectives set in this investigation necessarily implies the generation of a three-dimensional digital model via HBIM of the object of study. First, an architectural analysis was carried out for the creation of the model, defining its constructive elements and its heritage qualities, for its later parameterization. This model was manual, putting into practice the knowledge acquired, after the reflection and proper ranking of the enclave, according to its qualities and the architectural evolution of the building itself and its constructive methods (see Figure 6).

The precision of this characterization and its progressive use over time is based on additions and updates, which allow a directly progressive increase in knowledge and reflection on the property (see Figure 7).

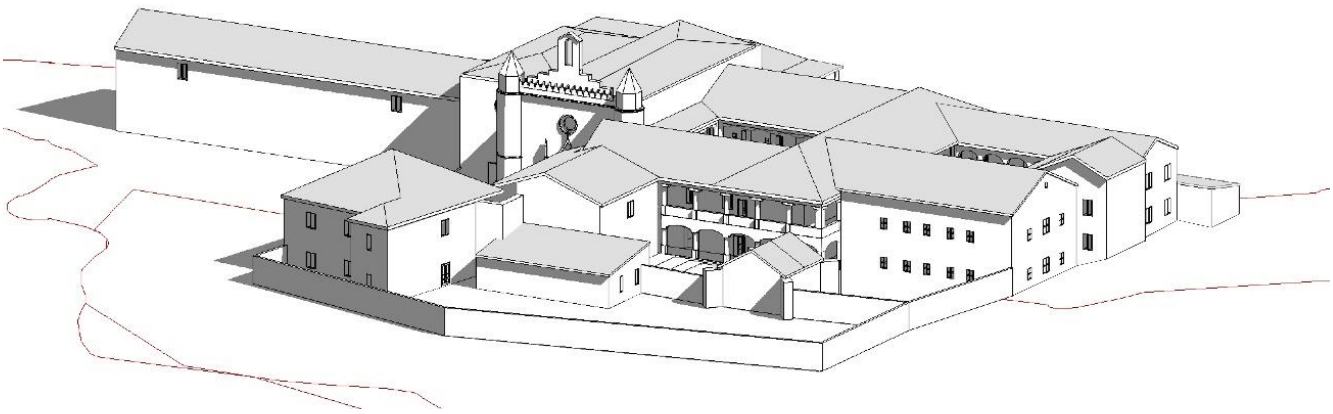

Figure 7. Perspective sketch of the current state of the monastery, 2021.

Although the different branches, with which it was modeled through the software, offer a series of parameters that can be perfectly compatible with the heritage information in the manner of building realities, the tool permits the duplication and modification of the existing parameters in its library for the alteration or addition of information. These allowed characterization of the historical structures, with respect to qualities, not only geometric, but also in relation to thermal, acoustic, ventilation properties, etc. The procedure directly affects the behavior of the element, with respect to the spatiality that surrounds it, allowing incorporation and measurement through habitability parameters.

The room branch is used to model the cells. It should be noted that, in general, this category needs to be inscribed within another one. When creating a room, it is necessary to define a space previously delimited by walls, floor, roof, etc., and other building structures that allow the prediction of the subsequent behavior of the space. In this way, a new object element is generated with geometrical information, such as surface, free height, and volume, therefore enabling parameter association by adding new data in relation to other parts of the model.

4.2. Parameterization

An essential part of the survey process focuses on determining the factors and variables that affect the said habitability of the spaces, for their parametric translation, when graphically representing this coexistence within the tool. Thus, we are able to objectify the practice of these two realities: the heritage and the habitable. To this aim, in the second process, and as a conclusion of the study regarding the potential factors that inform the habitability of the heritage, the following parameters are proposed for its control and measurement in heritage cases. The aim is to implement what is collected in the research, providing a new perspective to the knowledge of the field of HBIM, applied to architectural heritage. Its novel use is built into the case study, the Monastery of Santa Clara de la Columna. Although the data, which numerically and graphically translate this reality, respond to the detailed parametric definition of the usable building, this production of parameters can be applied for other architectural heritage assets.

In order to set comfort standards, by virtue of the habitability concept, the following parameters were determined, responding to the indications on how to improve the performance of the health systems developed by the World Health Organization. These include the functional provision and adequate development of the physical, social, and mental health conditions, safety, hygiene, comfort, and privacy [30]. At the same time, the current regulations were taken into account regarding the requirements of the inhabitable spaces of the Technical Building Code of Spain; among these we outline: identification, dimension, temperature, acoustics, ventilation, facilities, daylighting, artificial lighting, accessibility, and privacy. The said information is defined in the model as a result of the study of compliance with the said requirements.

The creation of parameters within the tool was undertaken using the option offered for the shared parameters, so that the parameters created can be applied to all linked areas and projects. Within this dialogue, we proceeded by providing information such as naming the parameter in a recognizable and rational way, and using terms from existing literature and architectural concepts and also employed in the bibliography and legislation.

The definition of parameters within the HBIM model allowed modeling of the basic building structures: walls, floors, roofs, doors, windows, stairs, etc. These elements were programmed with the explained advanced editing options that characterize an unlimited number of contents, in addition to an equally unrestricted repertoire of graphic solutions for display. For example, the model includes all the construction systems in its material definition, and its heritage status, regarding interventions, state of conservation, damage, etc. (see Figure 8).

The understanding gained from the physical and social comfort of the inhabitable spaces of the monastery, on which the implementation of these parameters was focused, enables the digital definition to specify a contemporary evaluation of the monastery cells, with respect to their use and domesticity. That is, the spaces associated with the definition parameters collected above were modeled, and their information was completed, evaluating the benefits that they fulfil or, to the contrary, that lack a positive assessment, regarding habitability (see Figure 9).

In the case of a heritage building, the object parameters of the HBIM model are organized, facilitating their ordering, based on the disciplines that would establish more conventional datasets—historical, archaeological, etc.—or according to conventionally recognized areas of protection: identification, research, protection, conservation, and dissemination. Within each of these groups, subgroups facilitate the ordering of parameters, with the aim of improving the management of purely multidisciplinary information. In all the structures, the information system can create a semantic data mapping that can be actively applied, and is extractible, in the form of plans' documentation, reports, tables, etc., using a single data input system [31]. In the current survey, having generated the historical structures characterized with their constructive parameters intrinsic to the model, to facilitate the discussion on the convergence of protection and habitability and their heritage parameters, this is added to the definition of the consequent spaces of such volumes, by means of habitability parameters defined as a result of the study of the relationship established by the construction, and its current state (see Figures 10 and 11).

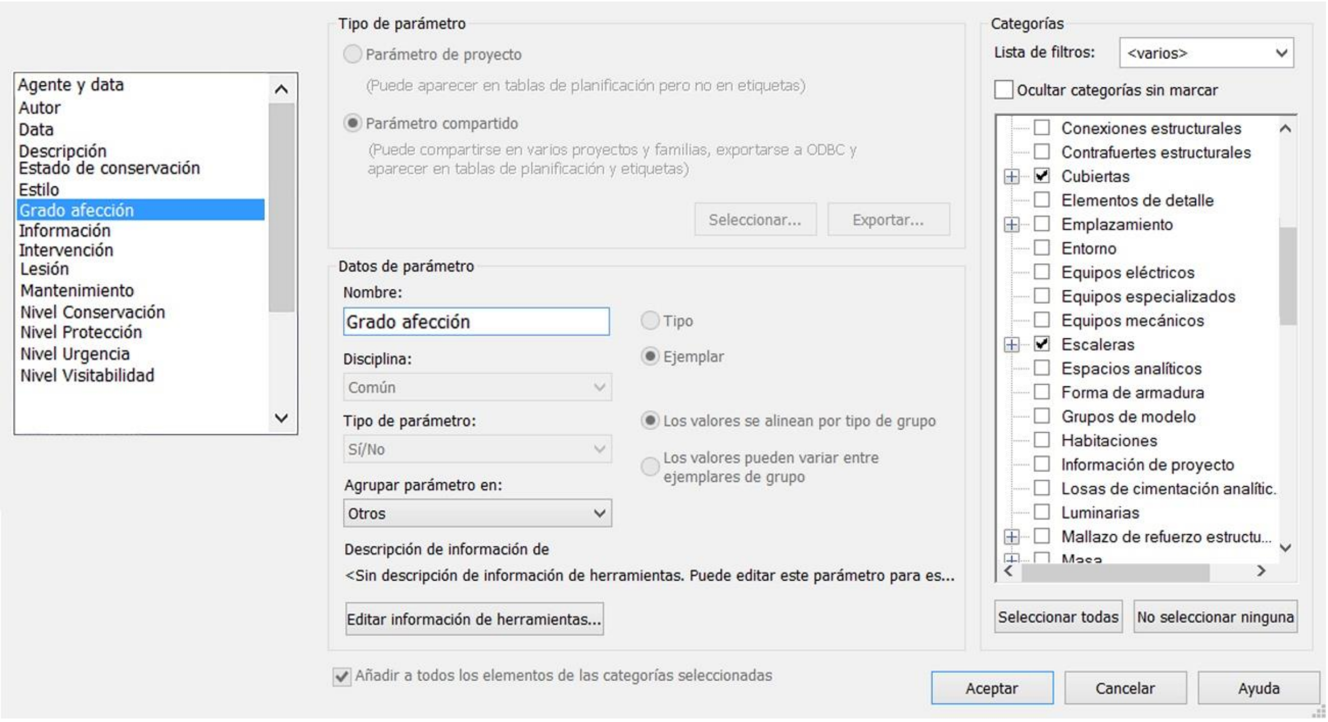

Figure 8. Heritage parameters, 2021.

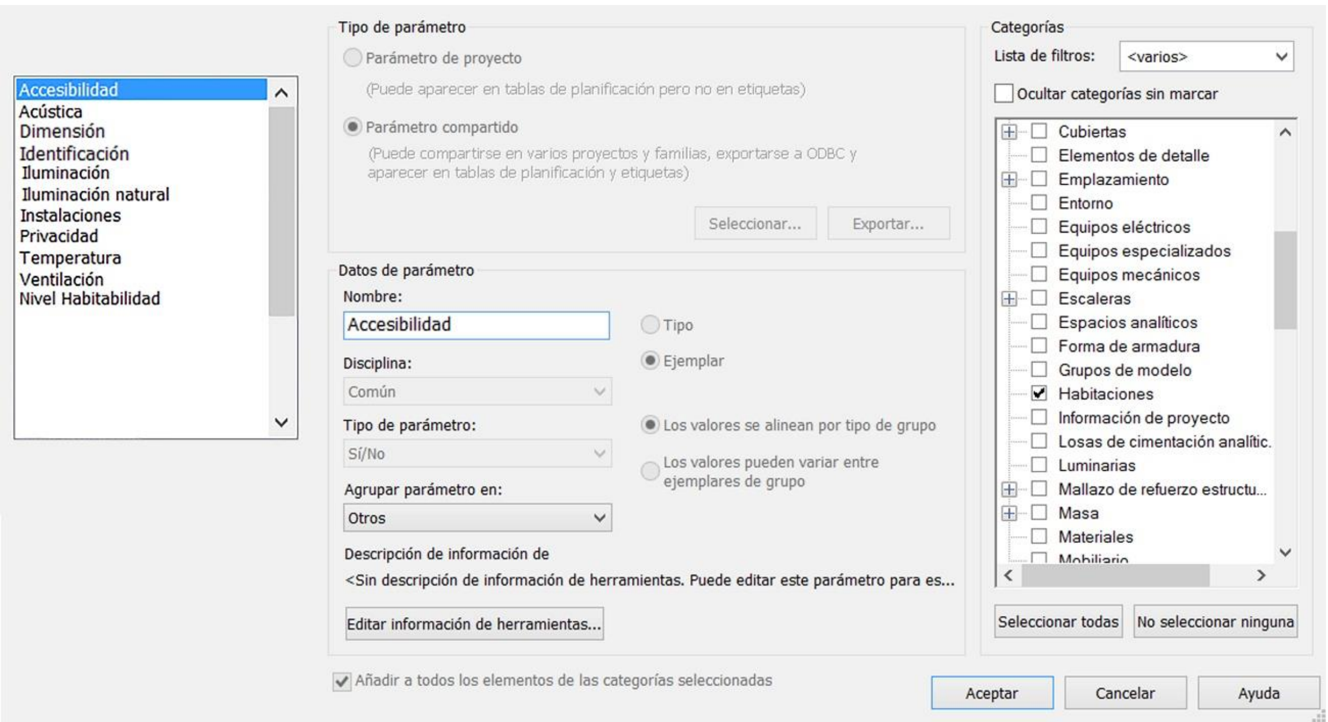

Figure 9. Habitability parameters, 2021.

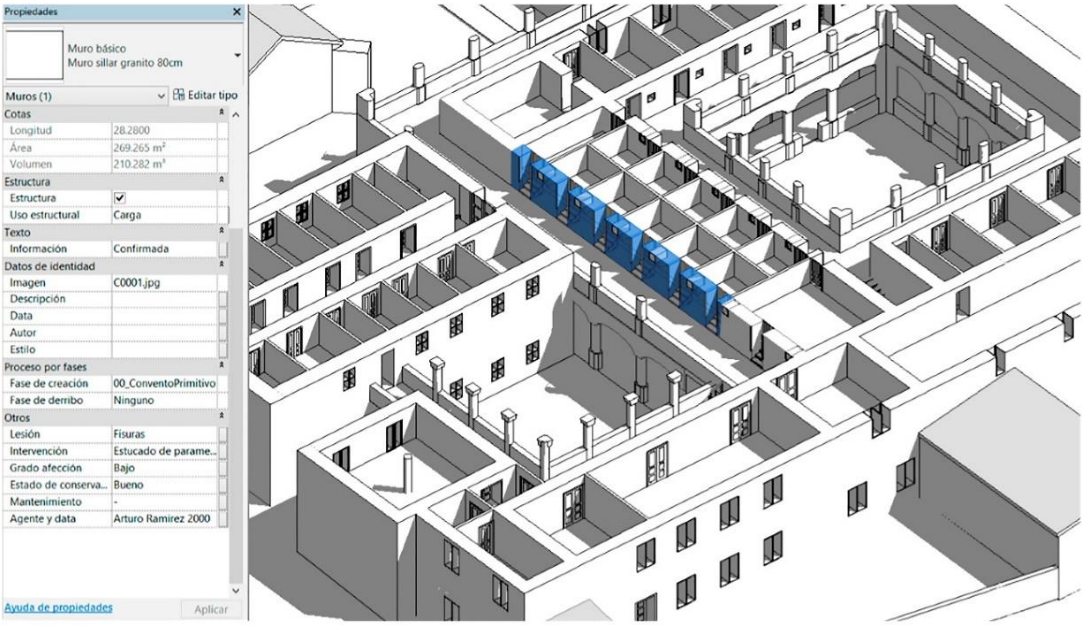

Figure 10. Study of the wall characteristics of the monastery, 2021.

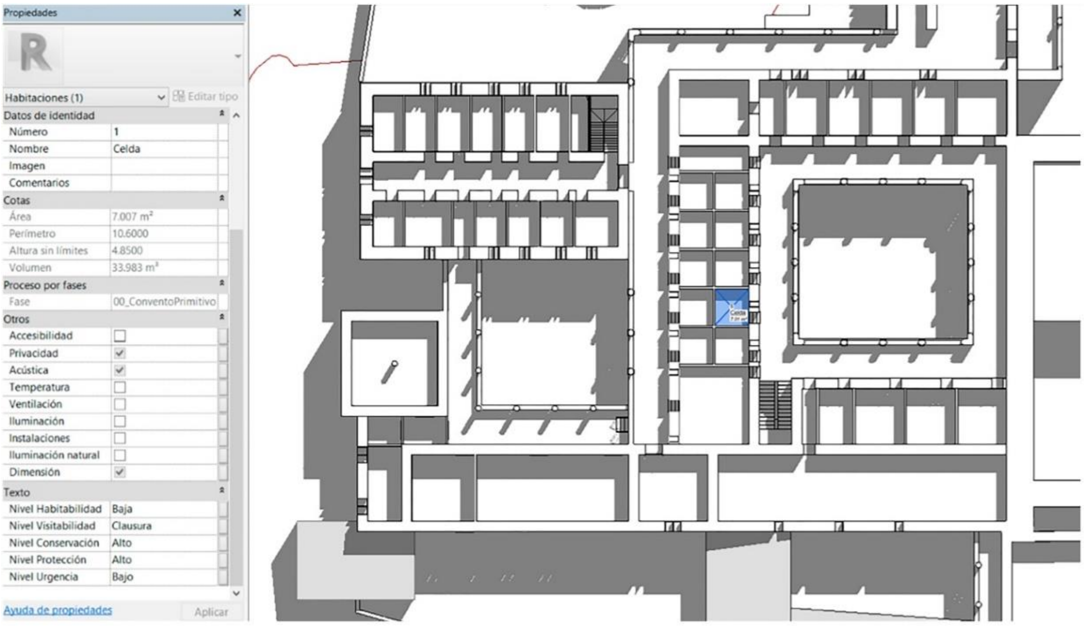

Figure 11. Study of the habitable spaces of the monastic complex, 2021.

Within the process of surveying the case study, a structure of parameters associated with the different elements of the graphic model was designed, allowing the recording of their heritage information. In the deployment of the group of parameters, these were sub- divided into elements and spaces enabling the definition of both realities in a parallel manner. This allows for the heritage work to be evaluated in a comprehensive manner, not only from the point of view of construction, but also architecturally. It includes aspects intrinsic to the behavior of the property and, therefore, its comprehensive assessment, which was the objective of the reflection on the contemporaneity of its management. The modeling, therefore, was not only of the volume, but also of the resulting voids, which are ultimately the spaces that give essence to the architecture. This detailing was made possible after an analysis of its elements, from their materiality to their building systems, which led to the objectification of the definition of the spaces [32]. The incorporation of these parameters clarified the spatial realities, allowing for observation of the performance of the protection within its four bases: identification, protection, conservation, and dissemination. The effect is not only to safeguard the knowledge gained from the said heritage, but also to incorporate new visions of housing behavior, gained by contemporary analysis through the use of the HBIM model. In turn, all the information collected is available in the form of the properties of the elements and spaces of the model, and, at the same time, linked in the form of text files and tables, whose modification reverts to the modeling, and vice versa.

4.3. Visualization and Levels

Creating parameters does not directly enable their visualization. The association and definition of parameters to elements and spaces is reflected in these realities, within their properties, but not in their representation in any of the displays. Hence, a display-style configuration system needs bespoke modeling, through filters, according to the reflected parameters. Such filters are created in accordance with the relationship that is established between a parameter and its definition, in a way by which the graphic display style can be created according not only to the parameter, but also according to its different definitions, facilitating comparison.

As a final result of this process, different floor plans were created that respond to the visualizations achieved, in line with the criteria of the parameters. Its behavior is similar to what would be known as thematic plans, where the graphic representation of the modeled architecture of the buildings appears, and the information that has been transferred and filtered is indicated with a color legend to facilitate viewing (see Figure 12).

These parameter criteria respond to a reflection provoked by the observation of the behavior of the resulting spaces once the modeling and parameterization are completed. During the visualization, it was found that, although it is possible to look at the parameters individually, for example, accessibility according to each space, it is convenient to have a conclusion as a quick comprehension mode of the output. [15] Therefore, leaving unchanged the triple criteria of low, medium, and high, each space is granted a simultaneous level of protection and habitability.

Protection

- Low: spaces that have no recognized legal protection.
- Medium: spaces that have recognized legal protection but allow changes in their construction system.
- High: spaces that have recognized legal protection but do not allow changes to their building features.
- Maximum: spaces that have the maximum recognized legal protection and therefore are not considered residential but only a public area for visitors due to their heritage values.

Habitability

- Low: basic habitability parameters such as accessibility are not met.
- Medium: basic habitability parameters are fulfilled but not in their entirety.
- High: all habitability parameters are met, although there may be exceptions depending on specific facilities.

Through this method, it was possible to analyze, measure, and reflect both realities in the model in a comprehensive manner, allowing the drawing of comparisons between the spaces and avoiding former shortcomings. These thematic frames are grouped into views related to the heritage rating of the spaces, and the synopsis of the habitability factors. The level of protection results from a heritage reading of the current situation, including custody and the requirements demanded for the formal conservation of the value of the spaces and their level of habitability. These are the result of the factors, intrinsic to the comfort of their inhabitants, provided by the qualities of the diverse elements that constitute the construction systems and the final space.

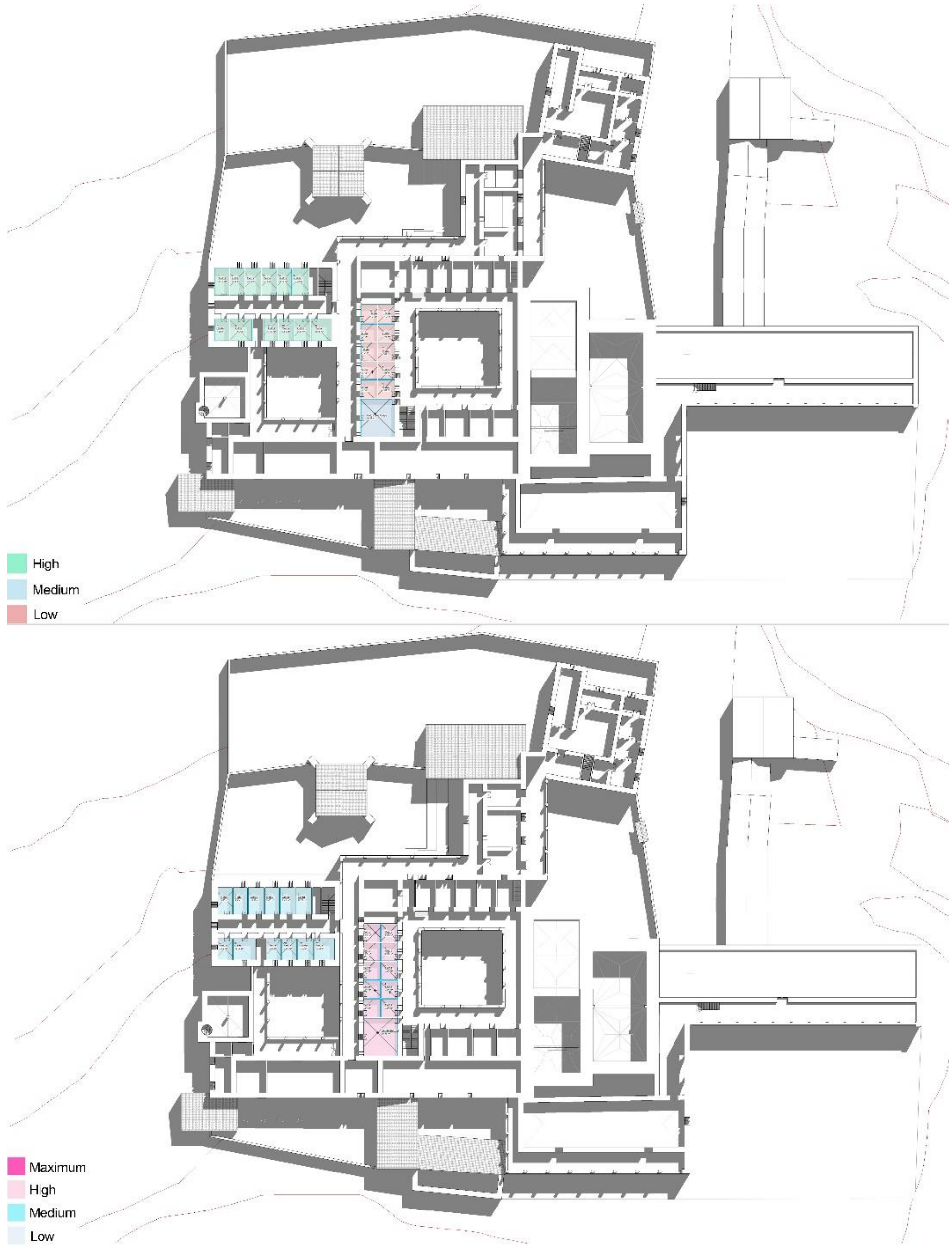

Figure 12. Levels of habitability and patrimonial protection after the study, 2021.

5. Results and Discussion

The HBIM model of the Santa Clara de la Columna Monastery, developed with a LOK-300, provides relevant alphanumeric and graphical output, suitable for reflection on the coexistence between heritage and habitat.

As a fundamental reason for the development of the survey, the parameterization allows the advancement of basic three-dimensional graphic modeling. This is achieved through generic elements, and an information structure oriented towards its multidisciplinary analysis and its realities, in a comprehensive manner, by establishing the general guidelines of its representational planning. Its precision depends on the purpose of the creator of that model, the result being an interactive model based on common languages of resources and current intellectual mechanisms, ascribed not only to the more traditional graphic representation. We firmly believe that this should reduce previous shortcomings of BIM models.

Regarding the protection of spaces, to achieve an analytical and contemporary reflection on habitability, the survey was produced from the detailed definition of the physical realities, the materials, construction systems, and their current state; to the association of evaluation data for the assets, such as potential damage and habitability requirements. The relevance of these concepts lies in the fact that they broaden the scope of the evaluation of the qualitative aspects of buildings, both in the variety of problems to be considered, and in the scales of analysis and intervention. These allow for the objectification and, therefore, the holistic technical and contemporary aims of this study, for purposes such as research, and the prospective intervention or improvement in the management of their protection [33].

The level of habitability, resulting from all the stated evaluation processes, is a tool to inform the related institutions and agents about the reality of the habitational conditions in relation to the preservation schemes. The use of this tool would allow resources to be directed, more efficiently, over the circumstances of each program, incorporating a further complete and objective perspective of the problems. [34] The main areas of application, within the relevant schedule, are:

1. Preliminary evaluation tool, for targeting intervention and maintenance projects;
2. Instruments to establish specific requirements associated with the objectives of each program, demanding certain compliance with the performance levels;
3. Finally, as a tool for studying and reflecting on domesticity (capabilities for habitation), being a synchronic factor in the historical development of heritage properties.

The last point responds to the first application possibility of this research tool, which again affects the contemporary analysis of the heritage [34], from the addition of the habitability factor, to its global vision, in order to promote the transversality and integrity of the acquired knowledge [35].

6. Conclusions and Future Aims

The information provided through the implementation of habitability factors allows for improvement of contemporary sustainability protection as the determining approach to the relationship, in this case, of the nuns with their own spaces. These spaces are abandoned in heritage cases, and adopt a secondary status in favor of preservation, so that the issues related to comfort and health are subordinated to the conservation and protection of the premises. This causes increasing divergence and contradictions, with respect to the requirements applied to other buildings.

The BIM model, with active parameter management, involves the simplification, at least initially, of the geometry by virtue of prior analysis. However, it provides the potential for the variability and gradation that this tool presents, allowing the information to be classified objectively and rationally, according to specific aspects that focus on the survey results.

As it can be observed, there is a parallel scenario, i.e., those spaces with less protection due to the valuation of assets, which revert to more permissive requirements, favoring habitability in turn. This is why the protection of heritage should not be understood only as a legal issue that must be accomplished once the damage has occurred; rather, it should be understood as a preventive strategy to safeguard the heritage values of the monument for the future.

This approach to the sustainable development of cultural heritage requires not only protection against shortcomings in adverse environmental conditions and intentional damage, but also constant attention to multidisciplinary factors, and the permanent renewal of the perspective of action. Any approach that solely considers the more formal past runs the risk of converting heritage into a rigid and frozen entity, which would become deprived of its actual relevance for the present and the future of its inhabitants.

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