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PROCESSING OF NON-EXISTENT ARCHITECTURAL HERITAGE FOR AI VISUALIZATION, A CASE STUDY OF THE CHAPEL OF SAINT PETKA IN BRESTAČ

Abstract

This study focuses on collecting data on non-existent architectural heritage and transforming it into structured input for AI visualization, based on the case study of the Chapel of Saint Petka in Brestač, which was demolished after the Second World War and the early communist period. Archival documents, cartographic sources, and interviews with witnesses were combined to create digital input suitable for virtual reconstruction. AI-supported virtual reconstruction enables precise visualization, preservation of cultural identity, and the creation of a permanent digital record, providing methodological insights for future research and heritage conservation.

Keywords: architectural heritage, virtual reconstruction, cultural identity

ОБРАДА ПОДАТАКА НЕПОСТОЈЕЋЕГ АРХИТЕКТОНСКОГ НАСЛЕЂА ЗА АИ ВИЗУЕЛИЗАЦИЈУ, СТУДИЈА СЛУЧАЈА КАПЕЛА СВЕТЕ ПЕТКЕ У БРЕСТАЧУ

Сажетак

Рад се бави прикупљањем података о непостојећем архитектонском наслеђу и њиховом трансформисању у структурисане улазне податке за АИ визуелизацију, на студији случаја капеле Свете Петке у Брестачу која је срушена након Другог светског рата и почетку комунистичког периода. Архивска документа, картографски извори и интервјуи са сведоцима комбиновани су како би се креирали дигитални улазни подаци погодни за виртуелну реконструкцију. Виртуелна реконструкција уз подршку АИ омогућава прецизну визуализацију, очување културног идентитета и ствара трајан дигитални запис, пружајући методолошке увиде за будућа истраживања и очување наслеђа.

Кључне речи: архитектонско наслеђе, виртуелна реконструкција, културни идентитет

1. INTRODUCTION

Through digital visualization and virtual reconstruction, architectural heritage acquires a new role as a carrier of knowledge and cultural memory, even in cases where material traces and historical sources are limited or entirely absent [1]. This paper presents a case study of the Chapel of Saint Petka in Brestač, a structure demolished immediately after the Second World War and the early communist period, with the aim of transforming the collected data on non-existent architectural heritage into high-quality input parameters suitable for visualization and analysis using artificial intelligence (AI). The Chapel of Saint Petka held an important role in the spiritual and cultural life of the local community, serving as a place of gathering, prayer, and the preservation of tradition. Its physical destruction following the Second World War and the beginning of the communist era, represents an irreplaceable loss for the collective memory of the inhabitants of Brestač. Wartime conflicts and socio-political changes had both direct and indirect impacts on the degradation and disappearance of this architectural heritage, interrupting the continuity of local customs and cultural practices. Therefore, digital reconstruction and visualization through AI tools offer the possibility to preserve its form, spatial identity, and cultural role in a permanent, accessible format. This approach allows future generations to understand the significance of this lost architectural heritage while simultaneously highlighting the consequences of social and wartime conflicts on material culture and collective memory. The integration of artificial intelligence into virtual restoration processes enhances the automation, accuracy, and interpretative capacity of architectural heritage reconstruction, enabling intelligent and immersive preservation of cultural values beyond physical conservation [2]. The historical context and the role of the chapel in the local community underscore the importance of a careful approach to data collection and systematization, including archival documents, cartographic sources, technical drawings, and testimonies from residents. The primary challenge addressed by this case study is the need for comprehensive and precise methods that enable the use of digital and AI tools for reconstructing structures for which only partial data has survived, as many archival documents were destroyed during the Second World War as well as in the early period of communism.

The methodology of this study combines multiple analytical approaches. The first step involves the collection and critical analysis of archival documents, cartographic materials, technical drawings, and other written sources. The second step consists of a systematic typological analysis of similar structures to identify architectural patterns and potential that can be applied in reconstruction. The third step relies on interviews with living witnesses, which allows for the supplementation of missing information and the acquisition of descriptive data not available in written sources. Interviewing living witnesses also complement the research process by demonstrating correlations with archival documents and cartographic evidence, thereby confirming the existence of the structure. Once processed, the collected data are structured into a digital format suitable for AI modeling and visualization. This process involves transforming qualitative historical information obtained from archival documents, cartographic sources, and witness testimonies into clearly defined architectural parameters such as approximate dimensions, spatial proportions, roof form, facade characteristics, and construction materials. These parameters are then organized into structured descriptive inputs that can be interpreted by generative AI visualization systems. The study demonstrates how digital tools and AI models facilitate the creation of visualizations of non-existent structures. In this research, AI-assisted architectural visualization was conducted using the online generative platform Gendo AI [3], a browser-based tool designed for architectural rendering and conceptual visualization. The platform enables the generation of architectural images based on textual prompts, sketches, or reference images, translating descriptive architectural information into visual outputs. Key steps include the organization of documentation, the creation of AI input parameters, the application of generative algorithms, and the production of final visualizations. The reconstruction workflow therefore consists of several stages: (1) collection and verification of historical documentation, (2) extraction of architectural characteristics from archival and oral sources, (3) transformation of these characteristics into structured descriptive prompts suitable for AI input, (4) generation of AI-based visual reconstructions using generative algorithms, and (5) critical evaluation of generated visualizations through comparison with available historical evidence. These steps enable the systematic organization of data and its integration into digital tools, which simplifies the analysis and reconstruction of architectural elements that no longer exist.

A review of relevant literature indicates that digital approaches and AI modeling significantly contribute to the preservation and reconstruction of lost architectural heritage. Research combining systematic analysis and visualization allows for interactive representations of structures, as well as experimental evaluation of different reconstruction scenarios. Nevertheless, challenges remain, including incomplete or contradictory sources, technical complexity, and potential interpretive errors. The Chapel of Saint Petka, as a structure with limited documentation, provides a valuable opportunity to critically examine these challenges, offering insights into the advantages and limitations of using AI tools in digital reconstruction and heritage preservation.

The aim of this study is to develop a methodological framework that integrates data collection, analytical processing, and AI visualization applications to create a comprehensive approach for reconstructing non-existent structures. Such approaches not only contribute to scholarly research and heritage preservation but also provide practical tools for architects, urban planners, and digital curators in producing realistic, functional, and aesthetically representative digital reconstructions. This study also emphasizes the importance of digital reconstructions to preserve cultural heritage that would otherwise be irretrievably lost, providing a permanent record that can serve as a resource for future research.

2. COLLECTION AND SYSTEMATIZATION OF DATA ON NON-EXISTENT ARCHITECTURAL HERITAGE – A CASE STUDY OF THE CHAPEL OF SAINT PETKA IN BRESTAČ

2.1. ANALYSIS OF CARTOGRAPHIC SOURCES

Cartographic sources play a crucial role in the study of non-existent architectural structures, for which reliable data are often difficult to obtain due to their destruction over time. These sources serve as key evidence of the former existence of such structures and provide credible and verifiable information. Their particular importance lies in the ability to precisely determine the original location of the non-existent structure, its footprint dimensions, and overall volumetric characteristics. Furthermore, certain cartographic records may also include information related to the construction materials used, thereby contributing to a more comprehensive understanding of the architectural characteristics of the lost building.

The earliest cartographic sources identified so far for the case study of the Chapel of Saint Petka in Brestač are military maps produced by the Habsburg Monarchy from the nineteenth century, as illustrated in Figure 1. The maps clearly indicate the presence of the building, which is explicitly marked and labeled as a chapel. Based on the date of the map production, corresponding to the second half of the nineteenth century, it is possible to determine the approximate period during which the building existed. This is particularly significant as it enables the establishment of analogies and comparisons with structures from the same period that have been preserved to the present day.

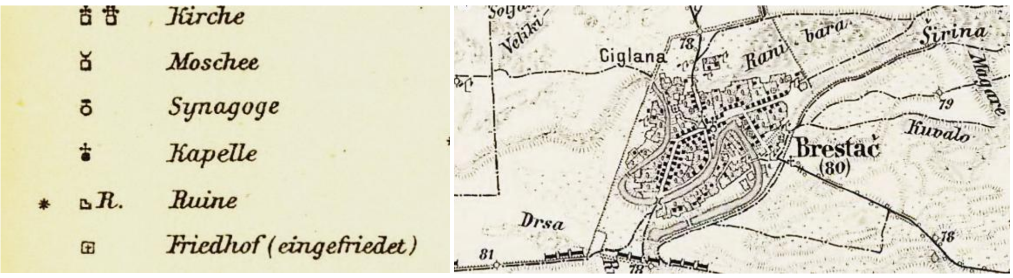

Figure 1. Left: Legend, right: Habsburg military map [14].

Another significant cartographic source is an excerpt from the cadastral records, in which the building remains recorded in the historical land registers, even though a different structure was later erected on the same site. These data are particularly valuable as they testify to the former existence of the building and preserve its spatial position, which is especially important in cases where material remains no longer exist. Through the “GeoSerbia” platform, it is also possible to determine the approximate dimensions of the Chapel of Saint Petka, providing a clearer understanding of its appearance and significance within the broader spatial context, as illustrated in Figure 2. This cartographic source clearly indicates that the cultural center was constructed directly above the Chapel of Saint Petka in Brestač. This intervention represents a clear manifestation of a shift in the socio-political system, as the cultural center functioned as a space for the dissemination of communist ideology and propaganda within the framework of the new political order. Its placement over the pre-existing sacred structure symbolically and functionally reflects the suppression of religious content and the imposition of a new ideological narrative.

This example clearly illustrates how changes in the political context directly affect the subsequent development of sacred buildings, their function, and their level of preservation, as well as society's attitude toward cultural and architectural heritage. Such interventions reveal a disruption of the continuity of sacred space and the transformation of its meaning in accordance with the dominant ideological values of a given period.

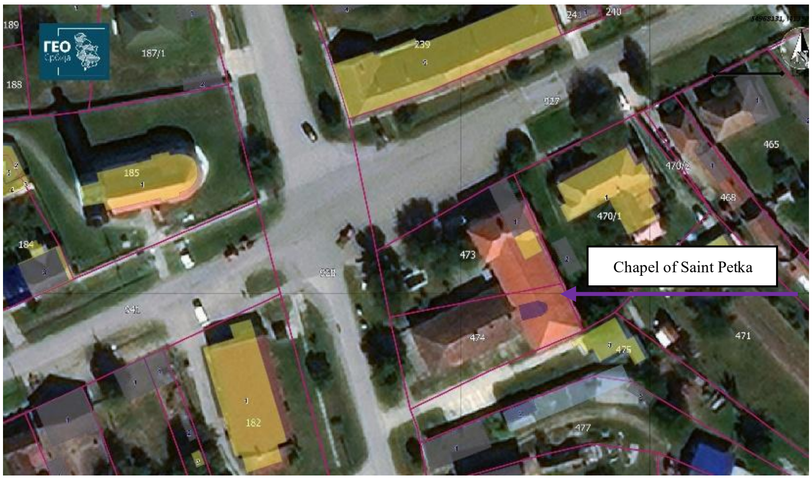

Figure 2. Cadastral record [15].

2.2. DOCUMENTARY SOURCES

Written sources related to the case study of the Chapel of Saint Petka in Brestač have been preserved only to a limited extent, which significantly complicates the process of collecting relevant research material. The archival sources that provide the most reliable information about the building are church chronicles. Although most of them have been destroyed, the preserved records indicate that the chapel was an endowment of the Radivojević family and that it was dedicated to Saint Petka [4]. The chapel was situated approximately 80 meters southeast of the existing Church of Saint Archangels Michael and Gabriel, which is consistent with the information provided by the cartographic sources. The chapel was demolished after the Second World War by the communist authorities, in order to construct a cultural center on the same site, which still exists today [4]. This is of great importance for establishing analogies with existing structures of the same type. The chapel was a sacred religious building intended for the performance of religious rites. All chapels dedicated to Saint Petka are commonly referred to as "vodice," as they were traditionally built in close proximity to water sources [5]. Which was also the case here, since a well was located next to the chapel. The exact date of construction remains unknown; however, cartographic evidence confirms the existence of the chapel during the nineteenth century. The scarcity of written sources highlights the paramount significance of architectural and material evidence in the rigorous reconstruction of the historical, social, and cultural context of sacred sites. The Chapel of Saint Petka transcends its material form, serving as a tangible manifestation of the community's religious practices, collective identity, and cultural memory. The systematic documentation, preservation, and scholarly analysis of such architectural heritage are indispensable for elucidating the broader historical landscape, as these structures provide critical insight into vernacular building traditions, patterns of ritual and devotional life, and the dynamic interplay between sacred and secular authorities across temporal frameworks. The intentional destruction, alteration, or neglect of such heritage constitutes not merely a loss of physical fabric, but a profound disruption of cultural continuity, interpretive capacity, and the evidentiary basis necessary for future interdisciplinary research in architectural history, heritage studies, and cultural anthropology.

2.3. TYPOLOGICAL ANALOGIES WITH EXISTING CHAPELS

Chapels dedicated to Saint Petka in the region of Vojvodina are, in most cases, single-nave buildings with a simple layout consisting of a single space without a transept. Their overall plan is therefore modest and uncomplicated. They are typically covered with a gable roof made of clay tiles or metal sheets. A belfry structure (preslica) is positioned on the roof, usually above the entrance or opposite it. The belfry generally does not contain a bell, and a cross is placed at its top. The form and roofing materials, as well as the position of the belfry, are standardized within the local architectural tradition and convey the fundamental functional and symbolic elements of these chapels. The Chapel of Saint Petka in Beška represents a well-preserved example of this type of architectural heritage. The building is white in color and measures approximately 7 × 4 meters [5]. Its single-nave structure consists of one space without additional annexes. Above the entrance, there is an elevated structure with a cross at its top, representing a typical belfry element. The roof is gabled and terminates in an apse on the eastern side as seen in Figure 3.

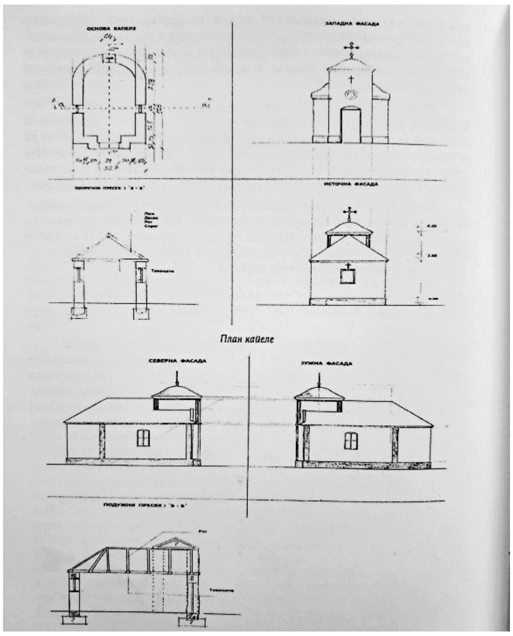

Figure 3. The Chapel of Saint Petka in Beška
(Predrag Puzić, Nebeskih visina zlatni krst. Narodna biblioteka Pećinci. 2017.)

The creation of analogies with buildings of similar construction periods, forms, and functions is of paramount importance in the study and reconstruction of non-existent architectural heritage. Such existing structures serve as benchmarks and reference points for comparison, enabling the identification of shared characteristics and regularities in architectural and decorative elements. Analogous buildings provide valuable information regarding construction materials, building techniques, the shape of elements such as walls, roofs, openings, and decorative details, as well as the spatial organization and functional aspects of the structure.

These comparisons allow researchers to make informed inferences about the appearance and structure of a non-existent building, even in cases where archival data is limited. Furthermore, the analysis of analogous structures contributes to a more precise understanding of cultural context, architectural style, and local building traditions, as well as a deeper comprehension of transitional or unique features that reflect the historical, social, or religious particularities of the period.

2.4. COLLECTION OF ORAL TESTIMONIES FROM LIVING WITNESSES

The chapel was demolished after the Second World War and the beginning of the communist era, yet its existence is still attested by living witnesses who remember it. According to their accounts, the chapel served as a place of regular gatherings for many people. Consequently, a small baptismal basin was constructed in the central part of the building, containing water brought from the surrounding well; it also functioned as a baptismal font. Also, water was placed in the basin at the center of the church on the day before the feast of Saint Petka, thereby sanctifying it. On the following day, during the annual liturgy held in celebration of Saint Petka, the water was distributed to the congregation. The faithful would keep the water in their homes throughout the year, as it was believed to possess healing properties and to promote the health and well-being of the family. Inside the chapel, small protrusions and recesses in the walls held the icons; these were not hung on the walls, and there were no frescoes. Living witnesses attest to the exceptional significance of the Chapel of Saint Petka for the local community, emphasizing that it was deeply regarded and regarded as a sacred site. The chapel was frequently visited, and the faithful regularly offered gifts such as towels, icons, and other sacred items, demonstrating their devotion and reverence. The chapel's spiritual importance was further enhanced by the presence of a nearby well, which was believed to possess healing properties. While the well attracted additional visitors from surrounding villages, it was the chapel itself that remained the central focus of religious practice and communal devotion. These aspects indicate that the chapel functioned as more than a physical structure; it served as a central locus of spirituality, religious practice, and cultural identity for the community. Since the church was an endowment of the Radivojević family, it was meticulously maintained daily by family members, who regularly cleaned the interior, secured it in the evenings, and, on the feast day, welcomed the congregation. They also prepared the traditional celebration cake (slavski kolač) and a festive table. This daily care and ritual preparation highlight the crucial role of the family in preserving the sacred space, ensuring the continuity of religious practices, and sustaining the cultural and spiritual heritage associated with the chapel. The interior walls were unplastered, revealing that the building was constructed of brick. The eastern part of the structure was semicircular. The floor consisted of old hexagonal bricks, and the chapel floor was set two steps below the surrounding terrain. The entrance was located on the western side, facing the street, although the chapel was slightly recessed relative to the street. The wooden door was brown, with a small canopy above it. There were small windows on the north and south sides, one on each side. The roof was gabled, covered with old black Biberschwanz roof tiles, with an elevated section topped by a cross. The belfry (preslica) was positioned above the entrance on the western side. Most interviewees recall that the chapel was light brown or yellow, while some remember a greenish hue, which may indicate the presence of moisture, as witnesses also report that the building appeared old shortly before its demolition. The walls were plastered, with a plinth and decorative elements around the doors and windows. Women from Brestač frequently contributed to the chapel by decorating it with white towels adorned with red patterns, which were placed around the entrance and on the windows. These eyewitness accounts are consistent with cartographic sources, which confirm the precise location of the building. Certain witnesses indicate that the Chapel of Saint Petka in Brestač was identical or, to a significant extent, similar to the Chapel of Saint Petka in Beška. These statements constitute a highly relevant point of departure for further analogical and comparative research of related sacred structures. Their significance lies particularly in the possibility of conducting a detailed architectural analysis of individual elements, such as spatial organization, ground plan configuration, structural system, facade treatment, roof structure, as well as characteristic details including openings, materiality, and decorative features. This approach allows for a more precise identification of typological similarities and differences and supports the reconstruction of the building’s appearance and architectural characteristics, thereby contributing to a deeper understanding of its spatial, functional, and symbolic role within the local and broader cultural-historical context.

Based on the systematically organized testimonies of eight eyewitnesses, the collected data were further analyzed and presented through graphical diagrams as seen in Figure 4. Pie charts were employed to illustrate the degree of consistency in the descriptions of architectural form, materials, and interior organization of the chapel. This visual analysis enabled the identification of dominant architectural characteristics, as well as elements with minor discrepancies in individual recollections, which is particularly important for the process of digital reconstruction and architectural interpretation. Based on testimonies of witnesses, sketches were also produced according to their statements, as shown in Figure 5.

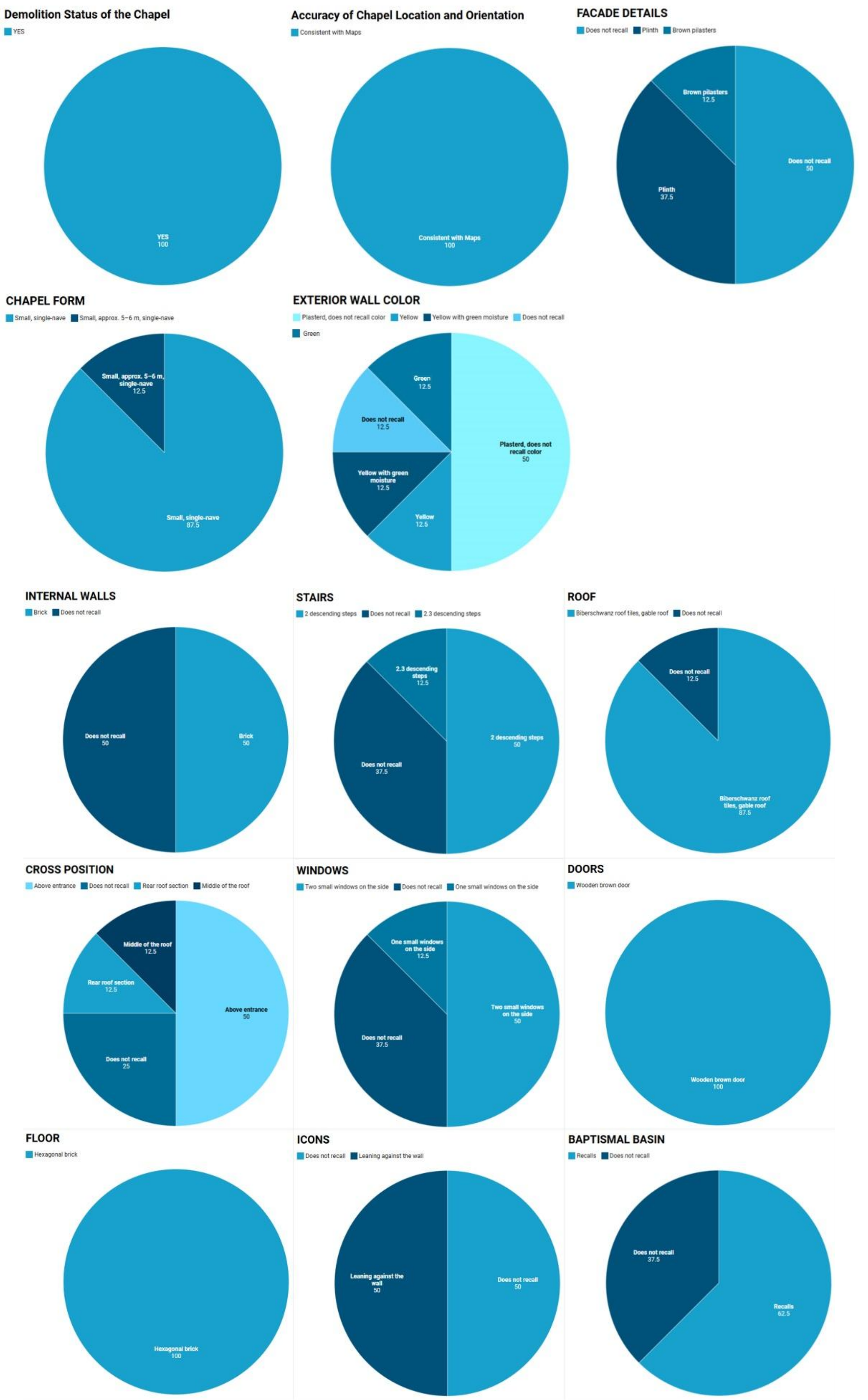

Figure 4. *Pie chart showing the responses of living witnesses (diagram by author, created using online AI-based tools)*

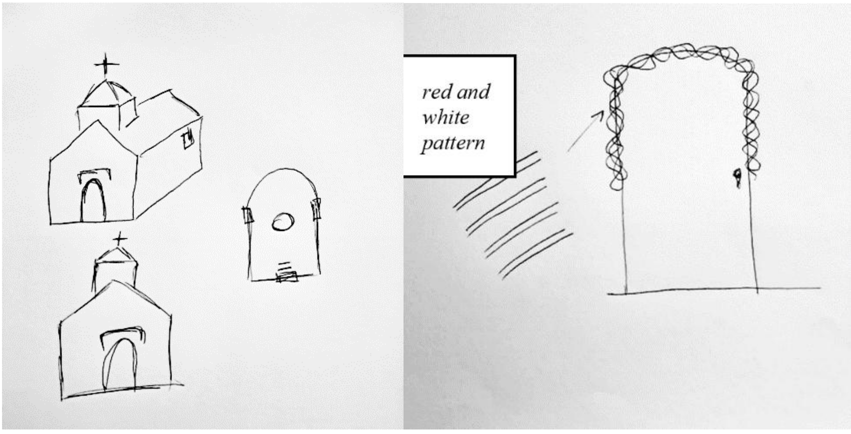

Figure 5. Sketches of the chapel based on the instructions of living witnesses (drawing by author).

3. INPUT DATA FOR ARTIFICIAL INTELLIGENCE: TYPOLOGY AND QUALITY CRITERIA

3.1. PHOTOGRAPHIC MATERIALS

Artificial intelligence enables accurate and efficient visual inspection of cultural heritage objects, supporting their preservation through enhanced image processing and analysis [6]. In the context of artificial intelligence applications, photographs serve as a critical type of input data for various analytical and visualization processes, including modeling, virtual reconstruction, and architectural simulation. When using historical cartographic sources, such as archival photographs, plans, or technical drawings, proper processing, standardization, and digital preparation of these materials allow the extraction of precise base measurements and other spatial parameters, even in the absence of actual photographs or surviving physical evidence. This approach is particularly relevant for studies of non-existent architectural heritage, where reconstruction relies solely on archival documentation and witness testimonies. Advances in AI, particularly computer vision and semantic web technologies, enable the extraction and semantic enrichment of cultural heritage images, allowing both concrete and abstract cultural information to be systematically analysed and utilized [7]. Applying methodologies for data quality assessment, digital correction, and standardization is therefore essential for effective AI-supported virtual reconstruction and digital visualization. These methods not only enhance technical accuracy but also provide a systematic framework for documenting and preserving architectural heritage in a digital format, contributing to research in architecture, cultural heritage, and digital technologies.

3.2. TEXTUAL MATERIALS

Responsible prompt engineering involves strategically crafting and managing AI prompts to balance technical precision with ethical and societal considerations, providing a structured framework that enhances how AI systems are instructed and aligned with broader values [8]. Input data for modeling and visualization within artificial intelligence systems can be represented in various formats, including textual descriptions. The quality and structure of textual inputs have a direct impact on the accuracy, reliability, and controllability of the outputs generated by AI models. The preparation of textual input involves a detailed and systematic specification of all elements, spatial characteristics, and visual properties expected in the final model. In this context, an increasingly common approach is the distinction between positive and negative prompts as a method for achieving greater control over the generative process. Effective prompt design significantly affects how well large language models respond, and having AI literacy, especially skills in creating clear and well-organized instructions, is crucial for obtaining accurate and high-quality outputs from generative AI [9]. Prompt engineering directs models toward desired behaviors using specific input instructions, enabling effective performance across tasks without altering the model itself [10]. By applying such a systematic approach to textual input formulation, a higher level of precision, reliability, and reproducibility of results can be achieved, which is particularly important in the context of virtual reconstruction of lost or non-existent architectural heritage. Well-defined input data allows AI-based tools to generate credible visualizations based on limited and fragmentary sources, thereby enhancing both the scientific value and methodological robustness of the research.

3.3. SKETCHES AND 3D MODEL

Incorporating image processing techniques allows the model to interpret the input sketches more effectively, producing outputs that are both visually consistent and semantically meaningful [11]. The integration of sketches and 3D models into AI represents a fundamental step in the digital reconstruction and visualization of architectural heritage. Sketches, as precise architectural drawings, must closely reflect the actual proportions and dimensions of the object, as they often serve as the only available or valid documentation for structures that no longer exist or are partially destroyed. Due to their significance, sketches must be carefully handled: it is important to correct imperfections, divide complex forms into simpler elements, and adapt them for digital processing. This approach allows for more accurate and reliable visual results in AI environments and ensures that sketches serve as a trustworthy foundation for further processing. 3D models play a crucial role as the basis for AI visualization, enabling the construction of a digital space onto which textures, materials, and details can be subsequently added. They can be created in various programs such as AutoCAD, SketchUp, Rhino ,Archicad , Revit or some similar, and it is important that they remain basic, accurately dimensioned, and free of unnecessary details. This approach allows for flexible manipulation of the model, combining it with textual instructions and sketches, which significantly enhances the quality and fidelity of the final AI-generated visualization. Well-defined and basic 3D models serve as the starting point for more complex AI interventions, enabling realistic representation of architectural objects and their effective digital reconstruction.

3.4. LIMITATIONS AND UNCERTAINTIES OF AI-BASED RECONSTRUCTION

Artificial intelligence offers significant potential for the virtual reconstruction of architectural heritage; however, inherent limitations arise when historical documentation is incomplete or fragmented, leading to uncertainty in the generated outputs [2]. Generative AI models may introduce stylistic biases and inaccuracies if the underlying data are limited, inconsistent, or lack validated architectural parameters, which can affect the reliability of visualizations and their interpretability as historical evidence [12]. Consequently, distinguishing between elements supported by primary documentation and those derived through interpretation or AI inference is essential for methodological transparency in digital heritage research [13]. Careful documentation of source material, explicit reporting of assumptions, and acknowledgment of interpretative decisions significantly improve the credibility and scholarly value of AI-based reconstructions. Even when AI outputs are visually convincing, the results should be treated as plausible analytical hypotheses rather than definitive historical reconstructions. The reliability of each reconstructed element depends heavily on the quality and completeness of input data, and any gaps in historical evidence must be explicitly acknowledged. Therefore, in this study, reconstructed features that are supported primarily by witness testimonies or partial archival sources are clearly distinguished from fully documented architectural elements, enhancing both scientific rigor and methodological transparency.

4. TRANSFORMATION OF DATA ON NON-EXISTENT ARCHITECTURAL HERITAGE INTO INPUT DATA FOR AI VISUALIZATION

4.1. CREATION OF THE BASE MODEL AND TEXT

The Chapel of Saint Petka in Brestač is a single nave building with a rectangular base and a semicircular apse on the eastern side. The structure is covered by Biberschwanz roof tiles, with a belfry (preslica) topped by a cross. The entrance is located on the western side, and there is one small window on each lateral side. The aim of this description is to enhance the historical and visual authenticity of the 3D model, providing accurate basic geometric and material characteristics of the building without introducing decorative elements. Original proportions are measured from the cartographic sources. The first step involves creating a basic 3D model, made in Archicad, representing the primary geometry and spatial organization of the structure, without decorative details. This model establishes correct proportions, orientation, and volume, serving as the framework for AI processing. The 3D model is combined with a structured textual prompt defining key attributes such as materials, color, roof type, openings, and stylistic features. To guide the AI further, analogous reference images of the Chapel of Saint Petka in Beška are used, which share similar proportions, construction techniques, and historical context. Integrating the base model, textual input, and reference imagery provides contextual guidance, improving the AI's interpretation of architectural elements and ensuring a reliable foundational visualization. This base generation then supports further refinement, sketch overlays, and iterative adjustments based on archival and eyewitness data, producing a historically grounded digital reconstruction.

4.2. INCORPORATION OF CREDIBLE ELEMENTS

Historical and archival sources provide additional information about the structural characteristics of the chapel. The walls are constructed of brick and plastered on facades in light yellow tones with greenish moisture, while the roof is covered with black or dark brown tiles, reflecting the age of the structure and the conditions under which it was maintained over time. These details allow for a more precise understanding of the chapel's material composition and visual authenticity. The aim of this description is to enhance the historical and visual accuracy of the 3D model, providing precise material and structural characteristics of the building without adding decorative elements. This information serves as a foundation for creating a basic model, which can later be supplemented with additional details based on other historical and architectural sources. Sketches play a crucial role at this stage, as the process of sketching enables the clear definition of elements to be added to the model, including their details, position, and form. When combined with accompanying textual descriptions and reference images, sketches contribute to a more precise understanding of the proposed interventions and to the preservation of the authenticity of architectural expression. They are particularly significant in the context of architectural heritage, as they allow for a critical examination of the historical layers of a structure and the careful introduction of new elements without compromising their cultural and historical value. Furthermore, sketches can be used to highlight parts of the building that are to be removed, modified, or spatially repositioned, thereby ensuring greater credibility of interpretation, clearer communication of design intentions, and a more reliable foundation for subsequent digital reconstruction and visualization. Basic visual decorations are added to the chapel's facade and roof, including the belfry (preslica) with a cross, a small canopy above the entrance. The AI model uses the basic 3D model along with the additional information from the previous step to ensure the accurate positioning and proportions of these decorative elements. The aim of this description is to provide detailed adjustments to the facade and roof without altering the building's fundamental structural and spatial layout.

4.3. INTERIOR MODELING

The interior of the chapel is modeled using the same methodological steps applied to the exterior, with particular emphasis on the accuracy of spatial organization and the preservation of authentic architectural and decorative elements. The basic interior space consists of a single room with a central basin, while the floor level inside the chapel is lowered by two steps in relation to the surrounding terrain and finished with old hexagonal bricks. Wall niches were used to accommodate icons, representing an important indicator of Orthodox sacred tradition. The interior modeling process includes the incorporation of precise architectural elements, such as walls, floor structure, and niches, as well as decorative details and textures, including icons, characteristic color schemes, and appropriate materials. Special importance is placed on the use of accurate and historically grounded data, as interior details most clearly reflect the sacred character of the building and its confessional affiliation. Through the careful reconstruction of the interior, it is possible to clearly emphasize the identity of the Orthodox sacred space, since symbolism, liturgical function, and the spiritual significance of the building are primarily expressed through interior organization, decorative elements, and materialization. The aim of this process is to create a comprehensive interior model that is both visually convincing and historically authentic, based on archival material, historical sources, and relevant reference data, thereby contributing to the preservation and interpretation of architectural heritage.

4.4. IMPLEMENTATION PROCEDURE EXTERIROR

The application of AI in the digital reconstruction of non-existent structures consists of multiple key stages, with the possibility of targeted adjustments to achieve the desired outcomes. AI-generated results often require guidance and fine-tuning to ensure accuracy and alignment with historical and architectural sources. The AI tool employed in this study is an online-based artificial intelligence platform. This cloud-accessible tool enables real-time processing and visualization, allowing the integration of 3D models, textual prompts, and reference images without the need for local high-performance hardware [3].

Step 1: Base Model (Figure 6) + Text + Analogous Reference (Figure 3) → Base Generation (Figure 7)

PROMPT: Orthodox chapel, single-nave, rectangular footprint with a 7x4 meter plan, east semicircular apse, brick walls plastered in light yellow-beige, partially exposed brick and damp patches, two-pitched roof clad in dark brown/black tiles, west facade featuring double wooden doors in brown with a small simple-framed overhang, a small cross above the entrance, two small rectangular windows on the north and south walls, rural setting with 19th-century architectural simplicity and a plain exterior, exterior photography, natural soft daylight highlighting weathered textures and age, no glass, no metal, no modern elements, no Gothic or Baroque styles

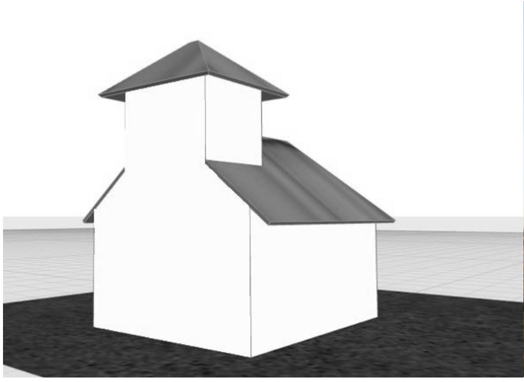

Figure 6. Left: Base 3D model (drawing by author).

Figure 7. Right: First result for 1 facade (drawing by author in Gendo AI studio).

Step 2: First result (Figure 7) + Text→ Model Refinement (Figure 8)
PROMPT: Building with a tower, tower window removed, small side facade window relocated to the rear and reduced in size, facade less damaged and tinted toward a warmer yellow hue while preserving moisture marks and the plinth, roof retained with overall shape unchanged, above the entrance a small wooden canopy, exterior photography, photorealistic architectural realism, soft warm daylight, weathered texture, wood grain, yellow plaster, moisture stains, plinth, wooden canopy, roof, Orthodox cross atop the tower, exterior photography, photorealistic architectural realism, soft warm daylight, weathered texture, wood grain, yellow plaster, moisture stains, plinth, wooden canopy, roof.

Figure 8. Left: Second result for 1 facade (drawing by author in Gendo AI studio).

Figure 9. Right: Reference sketch (drawing by author).

Step 3: Second result (Figure 8) + Sketch References (Figure 9) + Text→ Detail Enhancement (Figure 10)
PROMPT: Towering building, exterior preserved with surroundings and lighting unchanged, facade unaltered with no ornaments or windows on the tower, doors area featuring a white-and-red towel wrapped beneath the canopy as in the reference image, roof kept intact, minor facade wear with minimal damp and minimal brick exposure, cross preserved on the facade, exterior photography, photorealistic architectural photography, sunlit daylight, environment unchanged, perspective: exterior photography, style: photorealistic architectural photography, modern daylight realism.

Figure 10. Third result for 1 façade (drawing by author in Gendo AI studio).

Step 4: Third result (Figure 10) + Revised Prompt → Final Result for 1 facade (Figure 11)
PROMPT: Tower facade matching the lower-floor facade exactly, surroundings, overall form and all detailing preserved with no arches and no added elements, exterior photography with natural daylight, architectural consistency and seamless replication, photorealistic, architectural photography, modern designer architecture, no new features, one-to-one facade transfer, tower context, ground-floor mimicry, precise symmetry, clean lines, material texture, neutral palette.

Figure 11. Final result for 1 façade (drawing by author in Gendo AI studio).

The final model (Figure 11) is used as a reference image to generate a different viewing angle of the object. The base model is rendered from a new perspective, enabling more precise visualization of details, spatial relationships, and the three-dimensional structure of the building.
Step 1: Base Model (Figure 12) + Reference (Figure 11) → Initial Output (Figure 13)
PROMPT: Facade of the building shown from the angle of the rear side, with the same roof and the same position of windows as in the reference image, angle of the rear part of the object and same environment, sunny daylight, natural lighting, photorealistic architectural photograph, modern design, exterior, 5–8 visual keywords: facade, brick, glass, texture, shadows, light, modern architecture, exterior

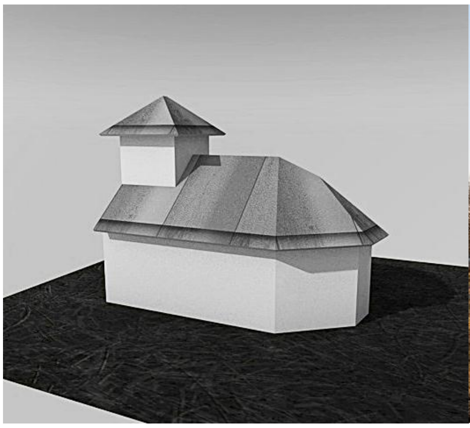

Figure 12. Left: Base 3D model (drawing by author).

Figure 13. Right First result for 2 façade (drawing by author in Gendo AI studio).

Step 2: First result for 2 facade (Figure 13) + Text → Refined Final Result (Figure 14)
PROMPT: An old building with a tiled roof and a church tower, Orthodox cross mounted on the tower and a window added on the left wall at the same position as in the reference image, all other elements kept as in the reference, exterior facade lighting preserved, exterior photography, photorealistic architectural photography, soft golden daylight with subtle shadows, weathered textures, clay tiles, stone facade, morning light, high fidelity

Figure 14. Final result for 2 façade (drawing by author in Gendo AI studio).

4.5. IMPLEMENTATION PROCEDURE INTERIOR

The principle is the same as for the exterior: the base model is used as a foundation, which is then combined with textual descriptions to create the interior.
Step 1: Base Model (Figure 15)+ Text → Base Generation (Figure 16)
PROMPT: Interior of a small Orthodox chapel, brick walls and a floor laid with hexagonal bricks, two small side windows, soft natural light filters in, casting warm shadows across rugged masonry and creating a calm, contemplative atmosphere; photorealistic architectural photography, straightforward, minimal adornment that highlights materiality and spatial clarity in a sacred interior.

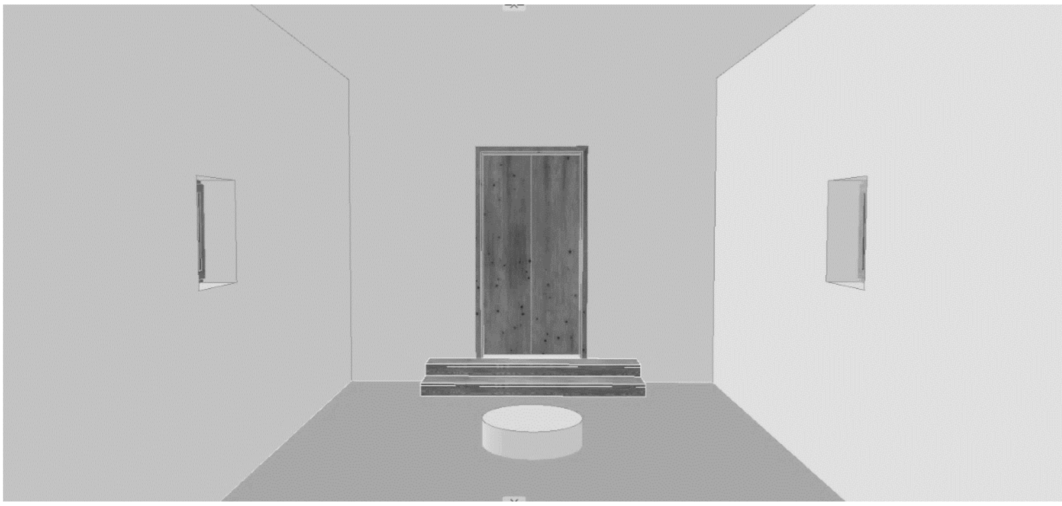

Figure 15. Up: Base 3D model (drawing by author)

Figure 16. Down: First result for interior (drawing by author in Gendo AI studio).

Step 2: First result for interior (Figure 16) + Text→ Model Refinement (Figure 17)
PROMPT: Central pillar in the middle, with minimal height increase and water inside it; side walls consist of protrusions on which Orthodox icons are stacked, doors, windows, materials and colors remain the same, everything else the same, perspective of exterior photograph; style: architectural photograph, photorealistic, natural lighting; extra keywords: central pillar, water structure, protruding walls, Orthodox icons, stone texture, warm tones, sunlight, architectural scene

Figure 17. Final result for 1 interior (drawing by author in Gendo AI studio).

5. VALIDATION / WITNESS CONFIRMATION

Living witnesses confirm the authenticity of the reconstructed model of the Chapel of Saint Petka across multiple aspects of its appearance. They note that the exterior of the chapel, including the position and shape of the windows, the facade color, and roof details, correspond closely with the recollections of the local community. Additionally, witnesses recognize elements of the interior, such as the central pillar and the arrangement and presence of Orthodox icons, as accurately represented in the results obtained through virtual reconstruction. This confirms that combining witness testimony with AI-assisted visualization is an effective approach for reconstructing non-existent architectural heritage while ensuring historical accuracy.

6. CONCLUSION

The case study of the Chapel of Saint Petka in Brestač clearly demonstrates the significance of systematically collecting and transforming data on non-existent architectural heritage for AI-driven visualization. By integrating cartographic and documentary sources, sketches, technical drawings, and oral testimonies from living witnesses, reliable and measurable input data can be generated, forming the foundation for accurate digital reconstruction. Such an approach, combining traditional research methodologies with contemporary digital tools, enables precise visualization, preservation of cultural identity, and the creation of a permanent digital record, providing methodological insights for future research and heritage conservation.

Well-defined steps in the data collection and processing workflow, from archival and cartographic analysis to the development of sketches and basic 3D models, facilitate controlled and reliable implementation within AI environments. Sketches and 3D models, as fundamental elements of digital reconstruction, serve as a critical base for creative and authentic visualization, allowing flexible manipulation, integration with textual inputs, and further processing within AI systems.

This methodology not only preserves the historical and cultural identity of lost structures but also opens avenues for contemporary creative interventions, interactive analysis, and experimental reconstruction scenarios. The integration of AI technologies into digital restoration processes proves to be an effective strategy for sustainable visualization of non-existent architectural heritage, providing architects, urban planners, and digital curators with a reliable tool for producing accurate and functionally precise digital models.

Future research may focus on extending these methodologies to other lost or damaged structures from the historical period following the Second World War and the early communist era, with the aim of systematically preserving cultural and architectural heritage that no longer exists in physical form. Studies could investigate the combination of archival documentation, oral testimonies, and typological analogies to generate reliable digital reconstructions and restoration scenarios. Moreover, standards for AI-assisted reconstruction can be developed, enabling conservation-oriented utilization of digital models as well as experimental evaluation of alternative architectural interpretations. This approach offers the potential not only to safeguard knowledge of lost structures but also to provide educational and cultural content accessible to broader audiences, ensuring a permanent digital record and resources for future generations of researchers and professionals in architecture and heritage studies.

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