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DOCUMENTATION OF HISTORIC STRUCTURES FOR THE ASSESSMENT OF HERITAGE CHARACTERISTICS

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Correct identification of heritage characteristics is a prerequisite for the conservation of historic structures. This study summarizes the developments in image-based documentation techniques and explores a way of combining them with conventional documentation techniques for architectural conservation. The processes of architectural photogrammetry and pictorial photography help the architect-conservator examine the many details of architectural heritage, making the assessment of heritage characteristics easier. Nevertheless, site observations and historical research are indispensable tools that support the evaluation process. A 19th century Ottoman church in western Turkey has been documented by combining the above techniques. Scaled drawings, a 3D model, maps on rectified image mosaics, and image albums make it possible to perceive the spatial qualities and conception of the original construction techniques, together with their alterations. The assessment results are presented in thematic tables with links to visual documents, and the heritage values and conservation problems of the church are clarified. Finally, this study illustrates one example of a successful heritage assessment leading to a conservation design.

INTRODUCTION

The process of documenting historic structures has always been important for architectural conservation, but it gained significance especially after the second World War (Jokilehto, 2002). The need for reliable information sources for heritage conservation is underlined in the 1994 Nara Document on Authenticity drafted by the International Council on Monuments and Sites (ICOMOS, 1999). Digitization of documentary material and formation of digital archives have become the goals of national and international cultural heritage services because digitization offers ease of data storage and management (Heritage Turkey, 2005; ICCROM, 2005). On the other hand, historic structures are constantly subject to alteration during their existence. The assessment of these alterations and the structures' original characteristics is indispensable for the definition of intervention decisions (see Chan and Xiong, 2007; Sibley, 2007).

This study considers the developments in image-based techniques, including rectification and architectural photogrammetry, looking for ways they could be utilized in assessing architectural heritage characteristics. It is not an aim of this study to further develop these techniques or to discuss or compare their accuracy with respect to the criteria of time and user labor. This study's purpose is to challenge information-users — in this case, architect-conservators — to understand the scope of contemporary achievements in image-based documentation techniques and to seek ways of utilizing them in the process of documenting architectural conservation. Image-based documentation techniques have positive impacts on the level of thinking of the architect-conservator. This study further suggests that photogrammetric data acquisition and processing help the architect focus on the many details of the historic structure since the process necessitates a thorough examination of building photographs and constructional relations. The importance of continuing to use conventional pictorial photographs and 2D drawings, together with contemporary rectified image mosaics and 3D models, in the discussion of the details of the conservation problem is also underlined. Moreover, this study points out the need to define the themes for assessing heritage characteristics and searches for a systematic way of presenting the visual and written data.

The aim of this study is to present documentation guidelines for assessing a structure's architectural heritage characteristics, with all the traces of its historical timeline, by balancing the developments in contemporary image-based techniques and conventional techniques for heritage documentation. The conclusion addresses some critiques of the guidelines. The following tools were used in the study: a prismless total station (a Zeiss Rec Elta with an accuracy of ±10 mm), a Nikon D70 SLR camera with a resolution of 3,008 x 2,000 pixels and equipped with a 28 mm AF Nikkor lens calibrated by a professional photogrammetry firm, a Pictran Release 4.0 digital monoscopic workstation, AutoCAD 2004, Adobe Photoshop 7.0 image-editing software, and Microsoft Access 2002 for Windows XP.

Methodology

The methodology used in this study is illustrated in Figure 1. First, we selected a historical building, Ildiri Church in Izmir, Turkey, as the structure to be documented. We measured the point clouds with Pictran and transferred them in DXF format into AutoCAD. Then, we produced a 3D model and 2D scaled elevations in 1/50 scale. Next, we rectified the images of the building facades in Pictran and mapped the heritage characteristics on the rectified image mosaic of each facade in 1/50 scale (Hamamcioglu-Turan and Akbaylar, 2007). Finally, we evaluated the visual data along with past research results so the original characteristics and alterations within the historical timeline of the architectural heritage site could be clarified. We considered the following factors in the assessment of the architectural heritage site: spatial components, architectural elements, construction techniques, and damages. Definite characteristics attached to each factor set make up the column headings of the assessment tables (Tables 1-4). The column headings "Element Name" and "ID" (*i.e.*, building element ID) are kept constant for all tables; however, only building elements that are relevant to the theme of each specific table appear in that table. Building elements are taken as the core of the assessment.

An excessive number of publications on the significance of image-based documentation techniques have appeared in the last decade. The meetings organized by the International Scientific Committee for Documentation of Cultural Heritage (CIPA, 2010) are especially significant since they bring the information providers and users together. Among the studies dealing with the application of architectural photogrammetry to heritage documentation, the review by Hanke and Grussenmeyer (2002) is notable since it comprehensively discusses the advantages and disadvantages of contemporary photogrammetric techniques for architec-

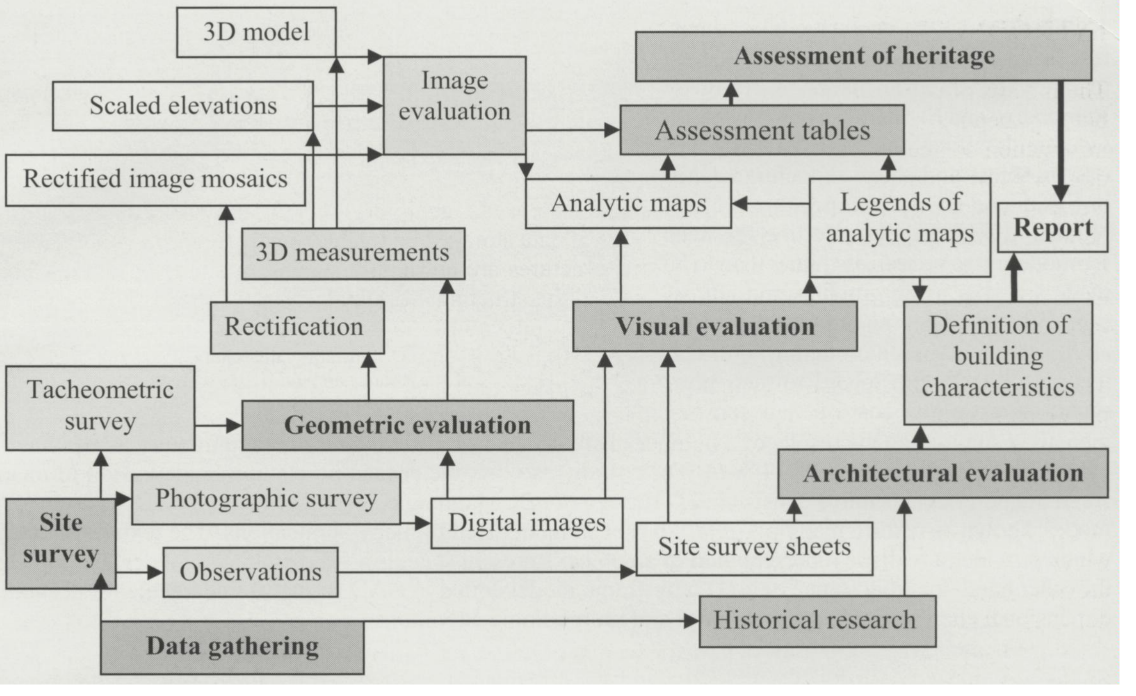

FIGURE 1. Flow diagram illustrating the types of work and their relations.

tural heritage documentation. Their study emphasizes monoscopic multi-image evaluation, which any architect with some computer skills could easily use (*ibid.*). The study by Arias, *et al.* (2007) stands out for its clear expression and simplified description of the photogrammetric process. However, the structures they selected for the case study of the monoscopic multi-image evaluation had a simple geometry with no extensive deformation. Regardless, the validity of photogrammetric documentation is undeniable in projects where the building forms are irregular. Warden and Woodcock (2005) were very careful in the selection of structures for their case study. The irregular geometries of their case study structures were associated with the difficulties they had in getting direct access with a tape, not to mention exposure to field conditions for long periods of time. Swallow and his team (Swallow, *et al.*, 2004) underline the importance of precise photogrammetric documentation when structural failures of historic buildings are considered. They also provide examples of applications made with stereo digital photogrammetry.

From the viewpoint of visualization of digital photogrammetric data, conventional elevation drawings are still valid. However, since the beginning of the 1990s, many trials have been carried out both on wire-frame models constructed with regard to accurate 3D measurements made with photogrammetry and on orthophotos and rectified image mosaics, which are end-products of the rectification of the photogrammetric process. Rectification is an image-evaluation process in which the perspective of a slightly tilted photograph of a planer surface is controlled with the aid of software and a number of points on the surface whose coordinates are known (Swallow, *et al.*, 2004; Wolf and Dewitt, 2000). Architectural representations are prepared to address different concerns, such as perceptual and conceptual anxieties (Gurer and Yucel, 2005). Perceptual anxieties include the intellectual and aesthetic concerns of the architect, marked by both design ideas and emotions prior to an architectural creation. Conceptual anxieties include concerns about the systematic deciphering of various architectural relations, such as circulation, topography, and space organization, that orient the architect to specific design inputs. Whereas orthophotos and rectified image mosaics help the architect concentrate on the various aspects of the conservation design, 3D models play a role in the perception of the spatial qualities of architectural representations, including their earlier precedents, their perspective, and axonometric drawings (Perez-Gomez and Pelletier, 2000). The former's role has similarities with conventional plans, sections, elevations, and related analytic visualizations. Rectified image mosaics are very simple to construct and sufficient for a scaled presentation of analytic data, such as mapping stone damages (Hamamcioglu-Turan and Akbaylar, 2007; Swallow, *et al.*, 2004; Wolf and Dewitt, 2000). Orthophotos are more precise than rectified image mosaics, but they require more time and technical knowledge to process (Kavanagh and Bird, 2000; Wolf and Dewitt, 2000).

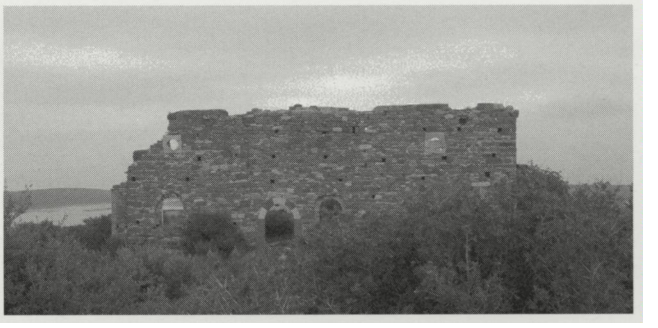

FIGURE 2. Photo illustrating the southern exterior wall of the church and Ildiri Bay behind.

A realistic and accurate 3D model is important since it is a concrete product of interest to many information users. A study by Remondino and El-Hakim (2006), who provided a classification of the current methods of object and scene modeling, stands out because of its comprehensive approach, in which they underline the need for modeling to be realistic rather than to be made artificial using graphics and animation software. They also discuss the suitability of image-based modeling for architectural objects with regard to their portability and the low cost of their sensors; then, they summarize the results of a number of studies that propose digital photogrammetry as an image-based geometry recovering tool (*ibid.*). Their study also lists the critical points in the conversion of measured 3D point clouds into a consistent 3D surface (*ibid.*). Mapping color images onto the 3D surfaces of a model, known as texture mapping (*ibid.*), has been recognized in many applications. The textured model, which provides a realistic representation of an object's present state, is a valid architectural design tool. On the other hand, the importance of a 3D wire-frame model edited in CAD format is undeniable for accurate dimensional characterization of structural and morphologic alterations.

THE STRUCTURE

The structure chosen for this case study is the Ildiri (Erythrai) Church (Figure 2) at the acropolis of the archaeological site of Erythrai on the western coast of Turkey. Erythrai was one of the important cities in antique Ionia (Akurgal, 1993a, 1993b; Bean, 1989). During the Byzantine period, it was demolished extensively (Akurgal, 1993b; Bayburtluoglu, 1975). During the Emirates and Ottoman periods, it was known as a coastal village with a dense Greek population (Akurgal, 1993a, 1993b; Budun, 2003). The village of Ildiri presents a potential for tourism because of its archaeological and natural values. Ildiri was declared a first-degree archaeological site in 1981 (Ministry of Culture of Turkey, 1981), and the outstanding perceptual value of the acropolis on the Ildiri plane was underlined. The church was declared a cultural heritage site in 1992 (*ibid.*, 1992).

The building is in a largely ruined state; its superstructure and the western wall are almost completely lost. The original floor is hidden underneath the debris of the demolished building elements. Presently, there are only three walls to document: the northern (13.85 m), eastern (11.35 m), and southern (17.25 m) walls. This makes six facades, three exterior and three interior. The exterior surfaces are exposed without plastering, so the surfaces to be recorded are characterized by rubble stone, brick, and mortar in random bond. The interior surfaces are plastered. Nevertheless, many traces of details in connection with these walls, such as vaults, arches, cornices, pilasters, niches, and windows, have to be documented so that a sound reconstruction hypothesis followed by an appropriate conservation treatment may be defined.

GUIDELINES FOR DOCUMENTATION AND ASSESSMENT

There are two sets of guidelines to be followed. The first set describes the strategy for preparing the visual and written documents, and the second set describes the strategy for assessing the heritage characteristics with reference to these documents.

Preparing the Documents

First, a preliminary site trip is recommended to shoot as many details and general photographs as possible and to make observations. General shots of each building surface — in this case, the exterior and interior facades of the northern, eastern, and southern walls — are printed so the positions of the control points can be noted. Survey sheets comprehending the related prints are prepared in A3 format for each building surface to be documented. At the second site trip, photographs are taken considering the principles of

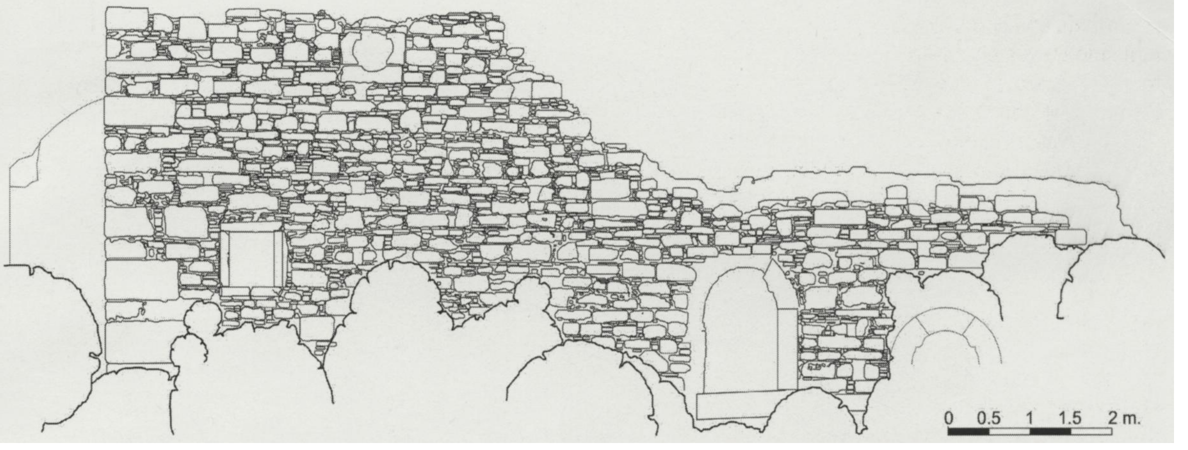

FIGURE 3. Scaled drawing illustrating the exterior facade of the northern wall.

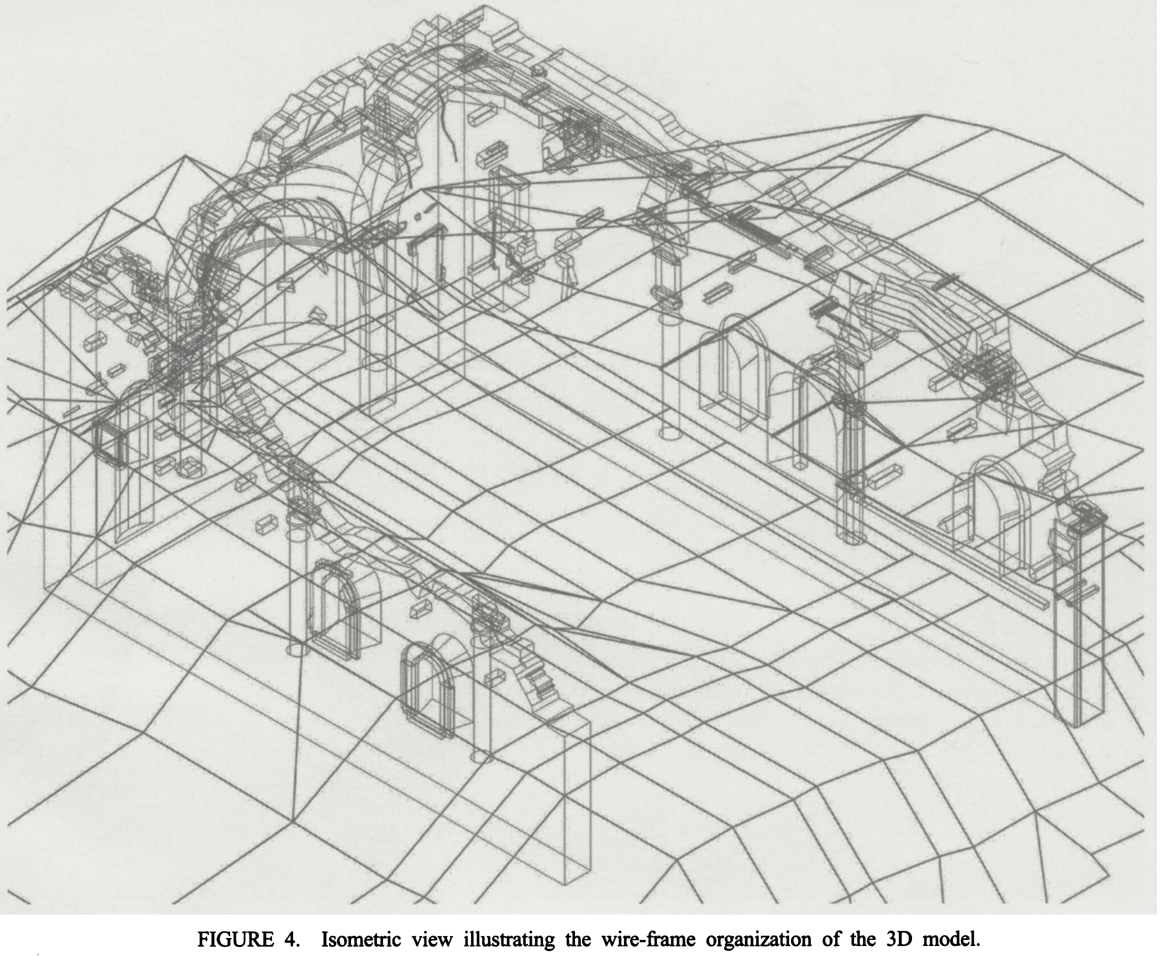

FIGURE 4. Isometric view illustrating the wire-frame organization of the 3D model.

monoscopic multi-image evaluation (Arias, *et al.*, 2007; Hanke and Grussenmeyer, 2002), and the tachometric work is completed.

The data gathered at the close of site work are evaluated in the photogrammetric software to obtain 3D measurements and rectified images. The measurements are transferred to CAD in order to produce conventional elevations (Figure 3) and then the 3D model. In this study, dense 3D measurements were made in order

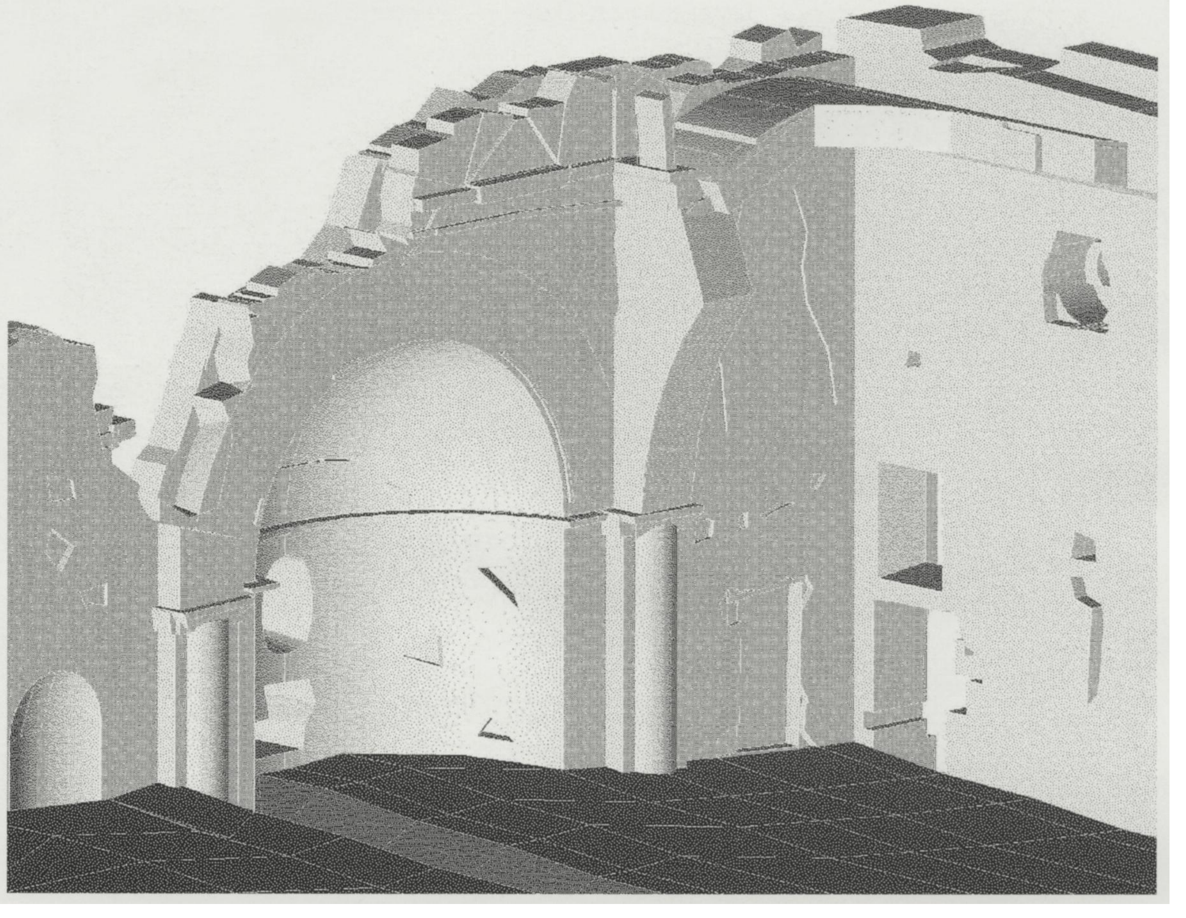

FIGURE 5. Perspective view illustrating the detail of the 3D model surfaces in the southeastern interior corner.

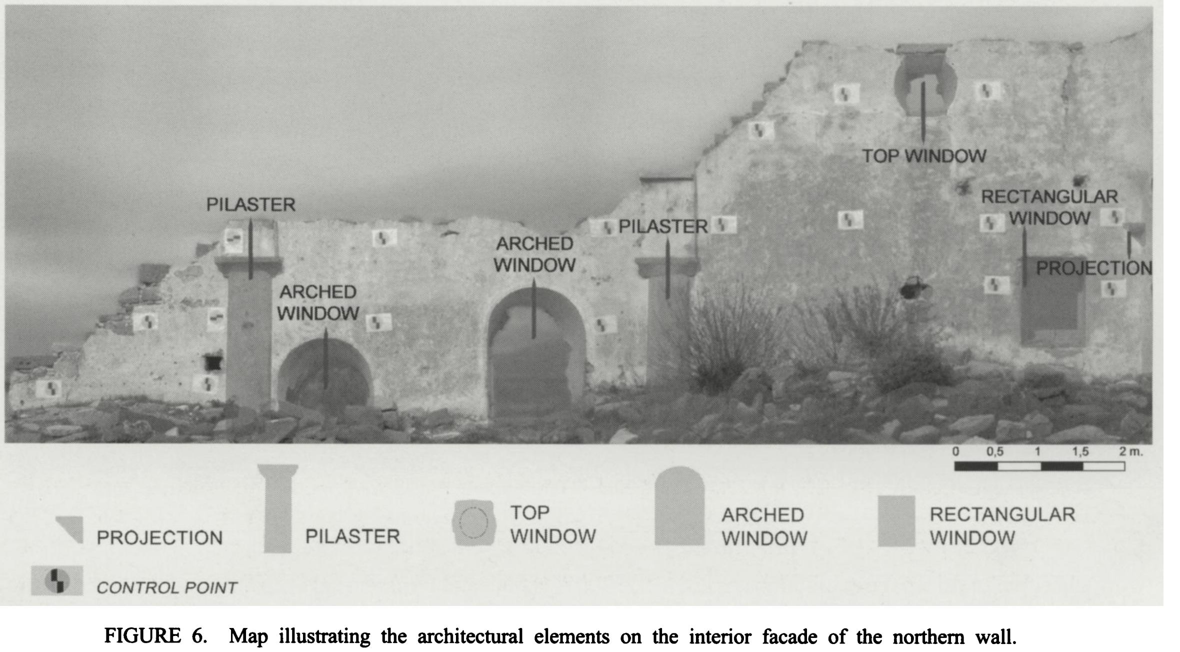

FIGURE 6. Map illustrating the architectural elements on the interior facade of the northern wall.

to reconstruct a realistic representation of the present state of the heritage site (Remondino and El-Hakim, 2006) (Figures 4-5).

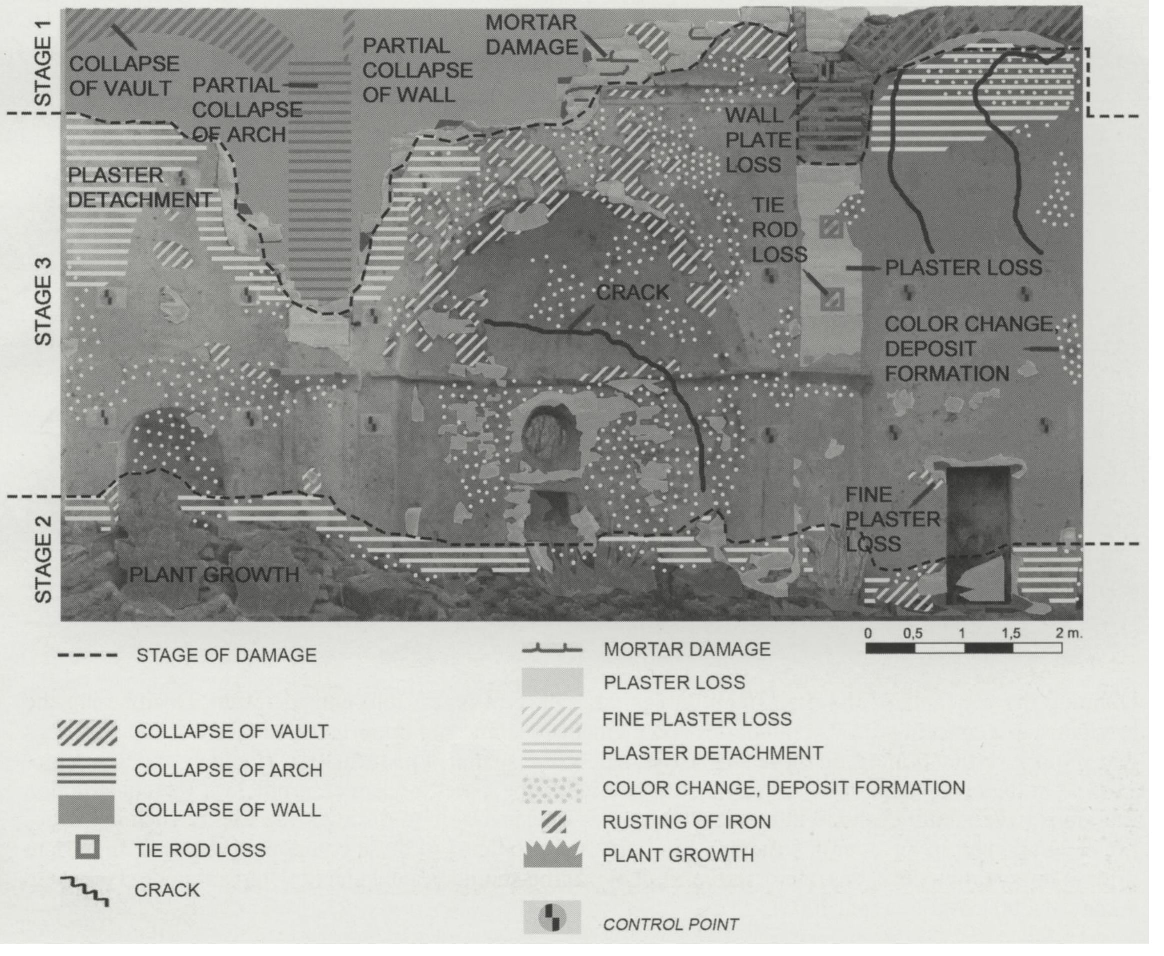

FIGURE 7. Map illustrating the structural failures, material deterioration, and damage stages on the interior facade of the eastern wall.

Consequently, the images rectified with the photogrammetric software are transferred to image-evaluation software to form rectified image mosaics. These are further evaluated to form maps illustrating the heritage characteristics (Figures 6-7). Themes such as architectural elements and damages are defined. Each theme is assessed, the results are tabulated, and the items are marked with their graphic codes. Mapping of each thematic information set is made on a rectified image mosaic of each facade in the image-evaluation software (Hamamcioglu-Turan and Akbaylar, 2007).

Alongside the production of visual documents, research is carried out on the historical building itself, Ottoman churches in the 19th century generally (specific to this case study), and local construction techniques, and a report is prepared.

Presenting the Documents

Subsequent to documentation, assessment tables are developed for evaluating the characteristics of the architectural heritage site. Microsoft Access, an extensively used, easily programmable, and user-friendly database-management system (Alves and Vaz, 2007), allows the tables to be structured with appropriate links to the visual documents. Thus, both visual and written documents on the architectural heritage site can be stored in a single digital file and associated with each other by keeping the ID numbers of the building elements constant in each table. The 144 building elements are distributed according to type as follows: four spatial, 40 architectural, 39 load-bearing/masonry, 19 load-bearing/iron or timber, one constructional, 40 finishing, and one disordered.

TABLE 1. Spatial components.

ID	Element Name	Characteristics of Space	Alteration of Space	Recommendations
1	Church building as an element of the archaeological and natural site	Landmark in its cultural landscape	Monumental character ruined with loss of vaults and wall pieces	Definition of conservation, presentation, and management strategy
2	Narthex	Elevated entrance hall leading to holy prayer hall	Almost totally lost; pilaster at right corner provides a clue about its presence	Removal of debris, observation and documentation of floor, and collection of reusable building material
3	Naos	Axial organization	Space extends to the sky with loss of superstructure; axial perception reduced	Removal of debris, observation and documentation of floor, and collection of reusable building material
4	Apse	Specialized subspace in prayer hall; termination spot of building axis	Increase in light intensity with loss of roof; difficult to identify spatial boundary between apse and naos; floor hidden below debris	Removal of debris, observation and documentation of floor, and collection of reusable building material

Note. A photo and 3D model were documented for each element ID. Two additional columns, "Photo" and "Graphic," have been deleted from the table for space reasons. The authors encourage those using assessment tables in their documentation to include these columns for tracking purposes.

Defining the concepts of the assessment tables takes several issues into consideration. Deciphering the original space concept with its boundaries and elements becomes an important issue for historic buildings that require re-functioning or those that have undergone spatial transformation (Feilden and Jokilehto, 1993). On the other hand, how a historic structure works becomes a research problem if the construction traditions have totally changed in a place. Then, it is indispensable to discover the role of each constructional component in the overall structure. Similarly, the problems of these components become important prior to intervention decisions. Here, the concept of staging should be considered (Hamamcioglu-Turan and Akbaylar, 2007; Warke, *et al.*, 2003).

The contents of each table are described below.

Table of spatial components
Table 1 analyzes the monument itself as an architectural object in its cultural landscape and its spatial components. Spatial components are those that have different functions and spatial qualities. The views of the 3D model and the pictorial photographs are relevant for discussing the concepts of this table.

Table of architectural elements
The architectural elements (40) are those that contribute to spatial quality with their aesthetic and/or functional characteristics (Table 2). The maps of architectural elements and the pictorial photographs are relevant for discussing the concepts of this table.

Table of construction techniques
The construction techniques of all of the building elements except the spatial ones (140) are analyzed in Table 3. Load-bearing elements are those that maintain the structural integrity of the monument. The elements made of stone, brick, and mortar and the elements made of iron and timber are discussed separately. A constructional element is one that contributes to the construction of the monument. Architectural elements are defined above. Finishing elements are those that protect the structural and architectural elements and contribute to the structural integrity and/or aesthetic quality of the building. Disordered elements are those that have lost their identity by losing their positions and roles in the building system. The views of the 3D model, the scaled elevations, and the pictorial photographs are relevant for discussing the concepts of this table.

Table of damages
The damages to the superstructure and the northern, eastern, and southern walls are analyzed in separate tables. For space reasons, only the table for the eastern wall (Table 4) has been included in this paper.

TABLE 2. Characteristics of architectural elements.

ID	Element Name	Morphologic Characteristics	Alteration
64	Water spout	U-profile channel	--
65	Cornice – eastern wall	Emphasizing beginning of vault; Neoclassical style	Partially lost
66	Cornice – apse	Emphasizing beginning of semi-dome; linear	--
67	Cornice – southern wall	Emphasizing beginning of vault; Neoclassical style	Partially lost
68	Casing – top window, northern wall	Emphasizing opening at exterior	Partially lost
69	Casing – rectangular window, northern wall	Emphasizing opening at exterior	--
70	Casing – arched window, northern wall, central section	Emphasizing opening at exterior	Partially lost
71	Casing – arched window, northern wall, western section	Emphasizing opening at exterior	--
72	Casing – apse window	Emphasizing opening at exterior	--
73	Casing – top window, southern wall, western section	Emphasizing opening at exterior	--
74	Casing – arched window, southern wall, western section	Emphasizing opening at exterior	Totally lost
75	Casing – arched door	Emphasizing opening at exterior	--
76	Casing – arched window, southern wall, central section	Emphasizing opening at exterior	Totally lost
77	Casing – top window, southern wall, eastern section	Emphasizing opening at exterior	--
78	Casing – rectangular window, southern wall	Emphasizing opening at exterior	Partially lost
79	Casing – rectangular door	Emphasizing opening at exterior	Totally lost
80	Projection for oil lamp – northeastern corner	Triangular in plan	--
81	Projection for oil lamp – southeastern corner	Rectangular in plan	--
82	Arched niche	Semicircular in plan; semi-domed	--
83	Square niche	Rectangular in plan; square facade	Partially lost
84	Rectangular niche	Rectangular in plan; rectangular facade	Partially lost
85	Pilaster – northern aisle, western section	Semicircular in plan; cubical capital	--
86	Pilaster – northern aisle, eastern section	Semicircular in plan; cubical capital	--
87	Pilaster – central aisle, northern section	Combined in plan; cubical capital	--
88	Pilaster – central aisle, southern section	Combined in plan; cubical capital	--
89	Pilaster – southern aisle, eastern section	Semicircular in plan; cubical capital	--
90	Pilaster – southern aisle, western section	Semicircular in plan; cubical capital	--
91	Pilaster – southwestern corner	Rectangular in plan; cubical capital	--

TABLE 2 continued. Characteristics of architectural elements.

ID	Element Name	Morphologic Characteristics	Alteration
92	Top window – northern wall	Union of cylinder with two rectangular prisms	--
93	Top window – southern wall, eastern section	Union of cylinder with two rectangular prisms	--
94	Top window – southern wall, western section	Union of cylinder with two rectangular prisms	--
95	Apse window	Elliptical section diminishing in size from interior to exterior	--
96	Arched window – northern wall, central section	Trapezoidal plan; vault diminishing in size from interior to exterior	--
97	Arched window – northern wall, western section	Trapezoidal plan; vault diminishing in size from interior to exterior	--
98	Arched window – southern wall, western section	Trapezoidal plan; vault diminishing in size from interior to exterior	--
99	Arched window – southern wall, central section	Trapezoidal plan; vault diminishing in size from interior to exterior	--
100	Rectangular window – northern wall	Rectangular plan and facade	Partially lost
101	Rectangular window – southern wall	Rectangular plan and facade	--
102	Arched door	Trapezoidal plan; vault diminishing in size from interior to exterior	Partially lost
103	Rectangular door	Rectangular plan and facade; elevated 20 cm	Partially lost

Note. A photo and map of architectural elements were documented for each element ID. Two additional columns, "Photo" and "Graphic," have been deleted from the table for space reasons. The authors encourage those using assessment tables in their documentation to include these columns for tracking purposes.

TABLE 3. Characteristics of construction techniques.

ID	Element Name	Element Type*	Construction Technique	Element Role
5	Superstructure – northern aisle	LB	--	Enclose naos
6	Superstructure – central aisle, western and central sections	LB	--	Enclose naos
7	Vault – central aisle, eastern section	LB	Rubble stone, brick, and mortar in random bond; 30 cm	Enclose naos
8	Vault – southern aisle, eastern section	LB	Rubble stone, brick, and mortar in random bond; 30 cm	Enclose naos
9	Vault – southern aisle, central section	LB	Rubble stone, brick, and mortar in random bond; 30 cm	Enclose naos
10	Vault – southern aisle, western section	LB	Rubble stone, brick, and mortar in random bond; 30 cm	Enclose naos
11	Arch – northern aisle, western section	LB	Rubble stone, brick, and mortar in random bond; cut stone surface	Bear load of vaults
12	Arch – northern aisle, eastern section	LB	Rubble stone, brick, and mortar in random bond; cut stone surface	Bear load of vaults
13	Arch – central aisle, northern section	LB	Rubble stone, brick, and mortar in random bond; cut stone surface	Bear load of vaults
14	Arch – central aisle, southern section	LB	Rubble stone, brick, and mortar in random bond; cut stone surface	Bear load of vaults

TABLE 3 continued. Characteristics of construction techniques.

ID	Element Name	Element Type*	Construction Technique	Element Role
15	Arch – southern aisle, eastern section	LB	Rubble stone, brick, and mortar in random bond; cut stone surface	Bear load of vaults
16	Arch – southern aisle, western section	LB	Rubble stone, brick, and mortar in random bond; cut stone surface	Bear load of vaults
17	Northern wall – top section	LB	Rubble stone, brick, and mortar in random bond; 70 cm	Bear load of superstructure; enclose naos
18	Northern wall – middle section	LB	Rubble stone, brick, and mortar in random bond; 70 cm	Bear load of superstructure; enclose naos
19	Northern wall – bottom section	LB	Rubble stone, brick, and mortar in random bond; 70 cm	Bear load of superstructure; enclose naos
20	Northeastern wall corner	LB	Cut stone, rubble stone, brick, and mortar in random bond	Bind perpendicular walls tightly to each other
21	Eastern wall – top section	LB	Rubble stone, brick, and mortar in random bond; 70 cm	Bear load of superstructure; enclose naos
22	Eastern wall – middle section	LB	Rubble stone, brick, and mortar in random bond; 70 cm	Bear load of superstructure; enclose naos
23	Eastern wall – bottom section	LB	Rubble stone, brick, and mortar in random bond; 70 cm	Bear load of superstructure; enclose naos
24	Southeastern wall corner	LB	Cut stone, rubble stone, brick, and mortar in random bond	Bind perpendicular walls tightly to each other
25	Southern wall – top section	LB	Rubble stone, brick, and mortar in random bond; 70 cm	Bear load of superstructure; enclose naos
26	Southern wall – middle section	LB	Rubble stone, brick, and mortar in random bond; 70 cm	Bear load of superstructure; enclose naos
27	Southern wall – bottom section	LB	Rubble stone, brick, and mortar in random bond; 70 cm	Bear load of superstructure; enclose naos
28	Southwestern wall corner	LB	Cut stone, rubble stone, brick, and mortar in random bond	Bind perpendicular walls tightly to each other
29	Lintel – top window, northern wall	LB	Gray cut stone; 20 cm thick	Span window opening
30	Lintel – rectangular window, northern wall	LB	Gray cut stone; 20 cm thick	Span window opening
31	Lintel – apse window	LB	Gray cut stone; bottom carved to form a partial cone	Span window opening
32	Lintel – square niche	LB	Gray cut stone; 20 cm thick	Span niche opening
33	Lintel – rectangular niche	LB	Gray cut stone; 20 cm thick	Span niche opening
34	Lintel – top window, southern wall, eastern section	LB	Gray cut stone; 20 cm thick	Span window opening
35	Lintel – rectangular door	LB	Gray cut stone; 20 cm thick	Span door opening
36	Lintel – top window, southern wall, western section	LB	Gray cut stone; 20 cm thick	Span window opening
37	Semi-dome – apse	LB	Rubble stone, brick, and mortar in random bond	Enclose apse
38	Semi-dome – niche	LB	Plastered	Span niche opening
39	Vault – arched window, northern wall, western section	LB	Rubble stone, brick, and mortar in random bond	Span window opening
40	Vault – arched window, northern wall, central section	LB	Rubble stone, brick, and mortar in random bond	Span window opening

TABLE 3 continued. Characteristics of construction techniques.

ID	Element Name	Element Type*	Construction Technique	Element Role
41	Vault – arched window, northern wall, eastern section	LB	Rubble stone, brick, and mortar in random bond	Span window opening
42	Vault – arched door	LB	Rubble stone, brick, and mortar in random bond	Span door opening
43	Vault – arched window, southern wall, central section	LB	Rubble stone, brick, and mortar in random bond	Span window opening
44	Tie-rod arch – central aisle, southern section, top	LB	Iron; 2.5 cm in diameter	Take thrust of arch
45	Tie-rod arch – central aisle, southern section, bottom	LB	Iron; 2.5 cm in diameter	Take thrust of arch
46	Tie-rod arch – southern aisle, eastern section, top	LB	Iron; 2.5 cm in diameter	Take thrust of arch
47	Tie-rod arch – southern aisle, eastern section, bottom	LB	Iron; 2.5 cm in diameter	Take thrust of arch
48	Tie-rod arch – southern aisle, western section, top	LB	Iron; 2.5 cm in diameter	Take thrust of arch
49	Tie-rod arch – southern aisle, western section, bottom	LB	Iron; 2.5 cm in diameter	Take thrust of arch
50	Tie-rod anchor – eastern wall, southern section	LB	Iron; 80 cm high	Give stability to arch by making tie rod fast to wall
51	Tie-rod anchor – southern wall, western section	LB	Iron; 80 cm high	Give stability to arch by making tie rod fast to wall
52	Tie-rod anchor – southern wall, eastern section	LB	Iron; 80 cm high	Give stability to arch by making tie rod fast to wall
53	Wall reinforcement – northern wall, eastern corner	LB	Iron; 3 cm thick; L profile	Bind northern and eastern walls together
54	Wall reinforcement – eastern wall, southern corner	LB	Iron; 3 cm thick; L profile	Bind southern and eastern walls together
55	Wall reinforcement – eastern wall, northern corner	LB	Iron; 3 cm thick; L profile	Bind northern and eastern walls together
56	Wall reinforcement – southern wall, eastern corner	LB	Iron; 3 cm thick; L profile	Bind southern and eastern walls together
57	Nail group – southern wall, western top window	LB	Iron; 1 cm in diameter	Hold casing stones
58	Nail group – southern wall, eastern top window	LB	Iron; 1 cm in diameter	Hold casing stones
59	Wall plate – apse wall	LB	Timber; 10 cm x 10 cm	Bind apse and eastern wall together
60	Wall plate – southern aisle, wall piece above eastern arch	LB	Timber; 10 cm in diameter	Bind apse and eastern wall together
61	Wall plate – southern wall, western section, interior	LB	Timber; 10 cm x 10 cm; 80 cm above ground	Homogenize loads in random bond wall system
62	Wall plates – southwestern wall corner	LB	Timber; 2 elements each 8 cm in diameter; 1 m above ground	Bind southern and western walls together
63	Scaffolding hole system	C	4 rows in each wall; 2.5 m distance; 15 cm x 15 cm x 70 cm	Support portable scaffold during construction
64	Water spout	A	Cut stone; 20 cm x 15 cm	Throw rain water out on roof

TABLE 3 continued. Characteristics of construction techniques.

ID	Element Name	Element Type*	Construction Technique	Element Role
65	Cornice – eastern wall	A	Stone and brick projection reinforced with nails; plastered	Add aesthetic value
66	Cornice – apse	A	Stone and brick projection reinforced with nails; plastered	Add aesthetic value
67	Cornice – southern wall	A	Stone and brick projection reinforced with nails; plastered	Add aesthetic value
68	Casing – top window, northern wall	A	Frame with cut stones; 20 cm wide; 10 cm deep	Add aesthetic value
69	Casing – rectangular window, northern wall	A	Frame with cut stones; 20 cm wide; 10 cm deep	Add aesthetic value
70	Casing – arched window, northern wall, central section	A	Frame with cut stones; 20 cm wide; 10 cm deep	Add aesthetic value
71	Casing – arched window, northern wall, western section	A	Frame with cut stones; 20 cm wide; 10 cm deep	Add aesthetic value
72	Casing – apse window	A	Frame with cut stones	Add aesthetic value
73	Casing – top window, southern wall, western section	A	Frame with cut stones; 20 cm wide; 10 cm deep	Add aesthetic value
74	Casing – arched window, southern wall, western section	A	Frame with cut stones; 20 cm wide; 10 cm deep	Add aesthetic value
75	Casing – arched door	A	Frame with cut stones; 20 cm wide; 10 cm deep	Add aesthetic value
76	Casing – arched window, southern wall, central section	A	Frame with cut stones; 20 cm wide; 10 cm deep	Add aesthetic value
77	Casing – top window, southern wall, eastern section	A	Frame with cut stones; 20 cm wide; 10 cm deep	Add aesthetic value
78	Casing – rectangular window, southern wall	A	Frame with cut stones; 20 cm wide; 10 cm deep	Add aesthetic value
79	Casing – rectangular door	A	Frame with cut stones; 20 cm wide; 10 cm deep	Add aesthetic value
80	Projection for oil lamp – northeastern corner	A	15 cm projection with cut stone	Place oil lamp; reinforce wall corner
81	Projection for oil lamp – southeastern corner	A	15 cm projection with cut stone	Place oil lamp; reinforce wall corner
82	Arched niche	A	30 cm recession of wall	Place liturgical elements
83	Square niche	A	20 cm recession of wall	Place liturgical elements
84	Rectangular niche	A	20 cm recession of wall	Place liturgical elements
85	Pilaster – northern aisle, western section	A	25 cm cylindrical projection of wall	Add aesthetic value
86	Pilaster – northern aisle, eastern section	A	25 cm cylindrical projection of wall	Add aesthetic value
87	Pilaster – central aisle, northern section	A	15 cm prismatic; 15 cm cylindrical projection of wall	Add aesthetic value
88	Pilaster – central aisle, southern section	A	15 cm prismatic; 15 cm cylindrical projection of wall	Add aesthetic value
89	Pilaster – southern aisle, eastern section	A	25 cm cylindrical projection of wall	Add aesthetic value
90	Pilaster – southern aisle, western section	A	25 cm cylindrical projection of wall	Add aesthetic value

TABLE 3 continued. Characteristics of construction techniques.

ID	Element Name	Element Type*	Construction Technique	Element Role
91	Pilaster – southwestern corner	A	15 cm prismatic projection	Add aesthetic value
92	Top window – northern wall	A	Suspended by head jamb	Provide illumination
93	Top window – southern wall, eastern section	A	Suspended by head jamb	Provide illumination
94	Top window – southern wall, western section	A	Suspended by head jamb	Provide illumination
95	Apse window	A	Vaulted	Provide illumination
96	Arched window – northern wall, central section	A	Vaulted	Provide illumination
97	Arched window – northern wall, western section	A	Vaulted	Provide illumination
98	Arched window – southern wall, western section	A	Vaulted	Provide illumination
99	Arched window – southern wall, central section	A	Vaulted	Provide illumination
100	Rectangular window – northern wall	A	Suspended by head jamb	Provide illumination
101	Rectangular window – southern wall	A	Suspended by head jamb	Provide illumination
102	Arched door	A	Vaulted	Provide public entrance
103	Rectangular door	A	Suspended by head jamb	Provide priest entrance
104	Plaster – vault, southern aisle, eastern section	F	10 cm thick; pink; large aggregates (= 15 mm)	Prevent rain penetration
105	Plaster – vault, southern aisle, western section	F	10 cm thick; pink; large aggregates (= 15 mm)	Prevent rain penetration
106	Plaster – semi-dome	F	3 cm thick; gray	Prevent rain penetration
107	Rough plaster – southwestern wall corner	F	2 cm thick; brownish; straw; fine aggregates (= 3 mm)	Protect plaster surface
108	Fine plaster - southwestern wall corner	F	0.5 cm thick; brownish; fine aggregates (= 3 mm)	Protect plaster surface
109	Rough plaster – vault, southern aisle, eastern section	F	2.5 cm; cream; straw; large aggregates (= 12 mm)	Protect vault surface
110	Rough plaster – vault, southern aisle, western section	F	2.5 cm; cream; straw; large aggregates (= 12 mm)	Protect vault surface
111	Rough plaster – arch, northern aisle, western section	F	2.5 cm; cream; straw; large aggregates (= 12 mm)	Protect arch surface
112	Rough plaster – arch, northern aisle, eastern section	F	2.5 cm; cream; straw; large aggregates (= 12 mm)	Protect arch surface
113	Rough plaster – arch, central aisle, northern section	F	2.5 cm; cream; straw; large aggregates (= 12 mm)	Protect arch surface
114	Rough plaster – arch, central aisle, southern section	F	2.5 cm; cream; straw; large aggregates (= 12 mm)	Protect arch surface
115	Rough plaster – arch, southern aisle, eastern section	F	2.5 cm; cream; straw; large aggregates (= 12 mm)	Protect arch surface
116	Rough plaster – arch, southern aisle, western section	F	2.5 cm; cream; straw; large aggregates (= 12 mm)	Protect arch surface

TABLE 3 continued. Characteristics of construction techniques.

ID	Element Name	Element Type*	Construction Technique	Element Role
117	Rough plaster – northern wall, top section	F	2.5 cm; cream; straw; large aggregates (= 12 mm)	Protect arch surface
118	Rough plaster – northern wall, middle section	F	2.5 cm; cream; straw; large aggregates (= 12 mm)	Protect arch surface
119	Rough plaster – northern wall, bottom section	F	2.5 cm; cream; straw; large aggregates (= 12 mm)	Protect arch surface
120	Rough plaster – eastern wall, top section	F	2.5 cm; cream; straw; large aggregates (= 12 mm)	Protect arch surface
121	Rough plaster – eastern wall, middle section	F	2.5 cm; cream; straw; large aggregates (= 12 mm)	Protect arch surface
122	Rough plaster – eastern wall, bottom section	F	2.5 cm; cream; straw; large aggregates (= 12 mm)	Protect arch surface
123	Rough plaster – southern wall, top section	F	2.5 cm; cream; straw; large aggregates (= 12 mm)	Protect arch surface
124	Rough plaster – southern wall, middle section	F	2.5 cm; cream; straw; large aggregates (= 12 mm)	Protect arch surface
125	Rough plaster – southern wall, bottom section	F	2.5 cm; cream; straw; large aggregates (= 12 mm)	Protect arch surface
126	Fine plaster and whitewash – vault, southern aisle, eastern section	F	0.5 cm thick; cream; fine aggregates (= 3 mm)	Protect vault surface
127	Fine plaster and whitewash – vault, southern aisle, western section	F	0.5 cm thick; cream; fine aggregates (= 3 mm)	Protect vault surface
128	Fine plaster and whitewash – arch, northern aisle, western section	F	0.5 cm thick; cream; fine aggregates (= 3 mm)	Protect arch surface
129	Fine plaster and whitewash – arch, northern aisle, eastern section	F	0.5 cm thick; cream; fine aggregates (= 3 mm)	Protect arch surface
130	Fine plaster and whitewash – arch, central aisle, northern section	F	0.5 cm thick; cream; fine aggregates (= 3 mm)	Protect arch surface
131	Fine plaster and whitewash – arch, central aisle, southern section	F	0.5 cm thick; cream; fine aggregates (= 3 mm)	Protect arch surface
132	Fine plaster and whitewash – arch, southern aisle, eastern section	F	0.5 cm thick; cream; fine aggregates (= 3 mm)	Protect arch surface
133	Fine plaster and whitewash – arch, southern aisle, western section	F	0.5 cm thick; cream; fine aggregates (= 3 mm)	Protect arch surface
134	Fine plaster and whitewash – northern wall, top section	F	0.5 cm thick; cream; fine aggregates (= 3 mm)	Protect wall surface
135	Fine plaster and whitewash – northern wall, middle section	F	0.5 cm thick; cream; fine aggregates (= 3 mm)	Protect wall surface
136	Fine plaster and whitewash – northern wall, bottom section	F	0.5 cm thick; cream; fine aggregates (= 3 mm)	Protect wall surface
137	Fine plaster and whitewash – eastern wall, top section	F	0.5 cm thick; cream; fine aggregates (= 3 mm)	Protect wall surface
138	Fine plaster and whitewash – eastern wall, middle section	F	0.5 cm thick; cream; fine aggregates (= 3 mm)	Protect wall surface
139	Fine plaster and whitewash – eastern wall, bottom section	F	0.5 cm thick; cream; fine aggregates (= 3 mm)	Protect wall surface
140	Fine plaster and whitewash – southern wall, top section	F	0.5 cm thick; cream; fine aggregates (= 3 mm)	Protect wall surface

TABLE 3 continued. Characteristics of construction techniques.

ID	Element Name	Element Type*	Construction Technique	Element Role
141	Fine plaster and whitewash – southern wall, middle section	F	0.5 cm thick; cream; fine aggregates (= 3 mm)	Protect wall surface
142	Fine plaster and whitewash – southern wall, bottom section	F	0.5 cm thick; cream; fine aggregates (= 3 mm)	Protect wall surface
143	Floor covering	F	Cut stone pieces on compressed earth	Cover the church floor
144	Debris layer	D	Unorganized pieces of damaged building elements	--

Notes. A photo, 3D model, and scaled elevation drawing were documented for each element ID. Two additional columns, "Photo" and "Graphic," have been deleted from the table for space reasons. The authors encourage those using assessment tables in their documentation to include these columns for tracking purposes. * LB = Load-bearing, C = Constructional, A = Architectural, F = Finishing, D = Disordered.

TABLE 4. Damages: eastern wall.

ID	Element Name	Type of Structural Failure	Spread of Structural Failure	Type of Material Deterioration	Spread of Material Deterioration	Damage Stage
21	Eastern wall – top part	Collapse	Local involvement	Loss of integrity of material composition	Complete involvement	1
22	Eastern wall – middle part	Partial collapse; crack	Local involvement	Well-developed surface deterioration	Local involvement	3
23	Eastern wall – bottom part	Partial collapse	Local involvement	Well-developed surface deterioration	Complete involvement	2
32	Lintel – square niche	--	--	Well-developed surface deterioration	Local involvement	3
33	Lintel – rectangular niche	--	--	Well-developed surface deterioration	Local involvement	3
54	Wall reinforcement – eastern wall, southern corner	--	--	Some surface deterioration	Complete involvement	3
55	Wall reinforcement – eastern wall, northern corner	--	--	Some surface deterioration	Complete involvement	3
59	Wall plate – apse wall	Decay	Local involvement	Loss of integrity of material composition	Complete involvement	1
65	Cornice – eastern wall	Partial collapse	Local involvement	Well-developed surface deterioration	Complete involvement	1
66	Cornice – apse	--	--	Well-developed surface deterioration	Complete involvement	2
72	Casing – apse	Unobserved	Unobserved	Unobserved	Unobserved	3
82	Arched niche	--	--	Some surface deterioration	Local involvement	3
83	Square niche	Partial collapse	Local involvement	Well-developed surface deterioration	Complete involvement	3
84	Rectangular niche	--	--	Well-developed surface deterioration	Complete involvement	3
87	Pilaster – central aisle, northern section	--	--	Well-developed surface deterioration	Complete involvement	2
88	Pilaster – central aisle, southern section	--	--	Well-developed surface deterioration	Complete involvement	2

TABLE 4 continued. Damages: eastern wall.

ID	Element Name	Type of Structural Failure	Spread of Structural Failure	Type of Material Deterioration	Spread of Material Deterioration	Damage Stage
95	Window of apse	--	--	Some surface deterioration	Complete involvement	3
120	Rough plaster – eastern wall, top section	--	--	Well-developed surface deterioration	Complete involvement	1
121	Rough plaster – eastern wall, middle section	--	--	Well-developed surface deterioration	Complete involvement	3
122	Rough plaster – eastern wall, bottom section	--	--	Well-developed surface deterioration	Complete involvement	2
137	Fine plaster and whitewash – eastern wall, top section	--	--	Well-developed surface deterioration	Complete involvement	1
138	Fine plaster and whitewash – eastern wall, middle section	--	--	Well-developed surface deterioration	Complete involvement	3
139	Fine plaster and whitewash – eastern wall, bottom section	--	--	Well-developed surface deterioration	Complete involvement	2

Note. A photo and map of damages were documented for each element ID. Two additional columns, "Photo" and "Graphic," have been deleted from the table for space reasons. The authors encourage those using assessment tables in their documentation to include these columns for tracking purposes.

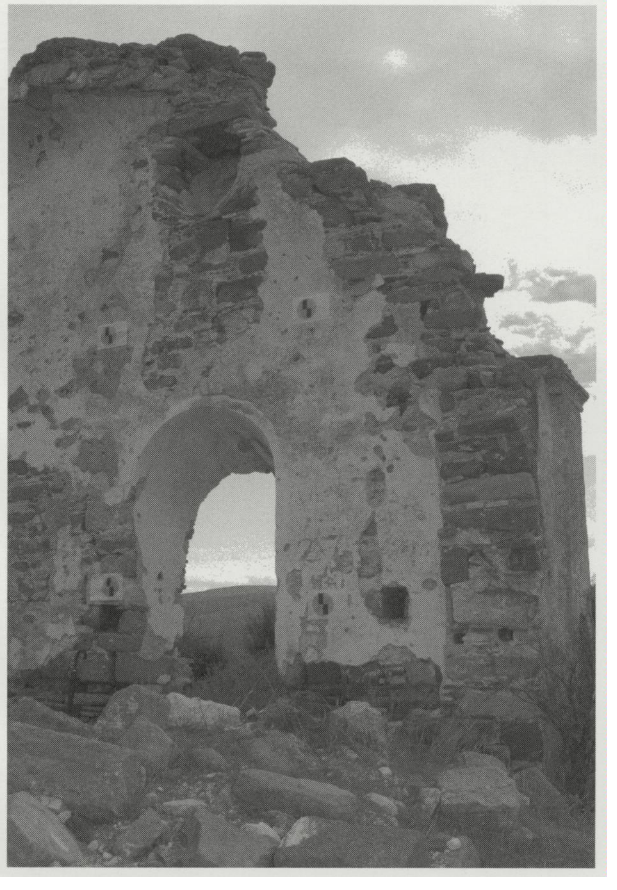

FIGURE 8. Photo illustrating the southwestern corner of the naos; traces of pilaster on the far right provide evidence of the lost narthex.

The number of elements analyzed in each table illustrating the damage stages is 41, 25, 23, and 39, respectively. The maps of damages and the pictorial photographs are relevant for discussing the concepts of this table.

HERITAGE CHARACTERISTICS OF THE ILDIRI CHURCH

In the late Ottoman Empire, the characteristics of religious buildings possessed a number of similarities (Kuban, 2007). Neoclassical design features were frequently observed, while local materials and workmanship provided variety between regions. The basilica organization with three or five aisles was commonly preferred in church architecture. The central aisle, which constituted the building's axis with a western entrance and an eastern apse, was often wider and higher than the other aisles.

Spatial Components

Due to its distinguished position, the monument can be seen in all directions from the Ildiri plain and serves as a cultural landmark in the region (Table 1 and Figure 2). It is a typical late Ottoman church with a three-aisled naos (11.2 m x 17.1 m) organized around an east-west axis and a semi-domed apse (2 m in radius) (Figure 5). The central aisle (4.95 m) is slightly wider than the side aisles. The abandonment of the building with the departure of the Greek population in 1922, followed by a series of earthquakes, led to the deformation of the historic structure; the narthex and the superstructure of the naos are totally lost (Figure 4). The monumental perception of the building is hindered by the partial loss of the mass and extensive plant growth nearby. The loss of the narthex juxtaposing the naos on its west side is evidenced by a pilaster at the southwestern corner (Figure 8). All of the other exterior surfaces are exposed without plastering (Figure 2). As an emergency precaution, we recommend the construction of a temporary roof to prevent rain penetration. After removing the debris and clearing the plants, further documentation can be carried out to prepare a comprehensive conservation project.

FIGURE 9. Photo illustrating the construction of the cornice on the interior facade of the southern wall.

Architectural Elements

The structure has many original architectural elements (Table 2 and Figure 6). The most remarkable ones include the stone water spout with a U-profile channel (20 cm x 15 cm) on the southwest wall (Figure 2); cornices in the neoclassical style that emphasize the border of the walls and the superstructural elements on the interior (Figure 9); cut stone casings (20 cm thick, 10 cm deep) on the exterior around all of the openings (Figure 3); two consoles projecting 15 cm from the eastern wall, which strengthen the building corners and provide space for placing oil lamps (Figure 6); three niches on the eastern wall (20 or 30 cm deep) for placing the liturgical elements; six pilasters (projecting 15 cm) with cubical capitals, which enrich the naos (Figure 4); one rectangular pilaster with a cubical capital, which enriches the lost narthex (Figure 8); three circular top windows (radii approximately 50 cm), which illuminate the naos; an elliptical window in the apse; four arched windows in the naos; two rectangular windows (55 cm x 65 cm on the north side; 55 cm x 80 cm on the south side), which illuminate the apse area; and two doors on the south wall — an arched one for the public entrance (132 cm wide) with a threshold made of cut stone and a rectangular one (75 cm wide) for the priest's entrance (Figure 5).

FIGURE 10. Photo illustrating the relation of the vault, arch, and pilaster on the southern part of the apse wall.

Unfortunately, two of the cornices and three of the casings are partially lost. The casings can only be seen by the traces that remain. Two of the niches, one window, and the two door openings are also partially lost. None of the openings possess joinery.

Construction Techniques

The original construction techniques and material usage can still be observed since almost no interventions have been made (Table 3). Traces of vaults 30 cm thick can be followed over the northern, central, and southern aisles. Traces of arches on which these vaults once rested can be observed above the pilasters (Figure 10). The walls are approximately 70 cm thick. The vaults of the superstructure and the window and door openings, the arches, the semi-dome of the apse, and the walls are made of rubble stone, brick, and mortar in random bond (Figure 11). Two rows of wall plates are made of timber (10 cm x 10 cm), one close to

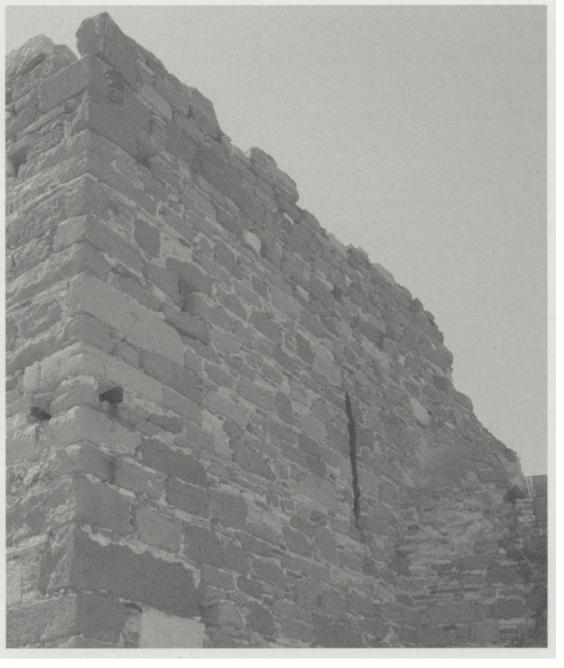

FIGURE 11. Photo illustrating the wall reinforcement and tie-rod anchor at the southeastern corner.

the springing line of the vaults (Figures 7 and 10) and the other just below the window openings (Figure 8). The corner wall plates that reinforce the walls are made of timber (8 cm in diameter) and located diagonally at the middle level of the walls. Cut stone, some of which is gathered from the ancient site, is used to reinforce the outer surfaces of the arches (Figure 10) and the corners of the walls (Figure 3). Four rows of holes (each 15 cm x 15 cm x 70 cm) belonging to the scaffolding that was used to construct the church appear on each wall (Figures 2 and 4). The distance between them is nearly 2.5 m. Stone lintels (15-20 cm thick) span the window, door, and niche openings. The double tie rods of the arches (Figure 10) are almost completely lost, but small pieces of iron (each 2-3 cm in diameter) or stains of iron can be seen around the double holes close to the springing lines of the arches. These tie rods continue throughout the walls and are anchored to the exterior with linear iron elements, each around 80 cm in height (Figure 11).

Iron elements bonding the northern and southern walls to the eastern wall (Figure 11) are a precaution against earthquakes. These are seen close to the upper corners of the walls, and the rods continue in both east-west and north-south directions starting from the two corners. Groups of nails (each 1 cm in diameter), which supported the casing stones, can be observed around the top windows in the areas where the casing is lost. Nails are also seen in the construction of the cornices (Figure 9). First, stones and bricks were laid so they projected from the wall; then, they were reinforced with nails and given a coat of plaster to finish.

The pink plastering (10 cm thick) on the vaults with large aggregates is probably brick-lime plaster with hydraulic character (Boke, *et al.*, 2006). The gray plastering on the semi-dome (3 cm thick), which might be cement, should be considered a later intervention. The exterior surfaces of the walls are exposed without plastering, as in many other local monuments in the region (Hamamcioglu-Turan, 2005, 2006, 2007; Hamamcioglu-Turan and Reyhan, 2005). All of the interior surfaces, however, are covered with a double layer of plastering — a rough layer with large aggregates and straw, cream in color and 2.5 cm thick, and a fine layer with fine aggregates, cream in color, 0.5 cm thick, and whitewashed. These are probably lime plaster. The finishing of the decorative pilaster element in the narthex is also made with a double layer of plastering, but finer aggregates are preferred in the rough layer; this layer, which might be mud plaster, is colored light brown.

The floor is generally covered with debris composed of pieces of the demolished vaults, arches, and walls. In front of the public entrance on the south side, large plates of stone have been detected on leveled earth.

Damages

The damages to the Ildiri Church (Table 4) are visually analyzed in great detail. There are four types of structural failures: collapse of masonry elements, crack in masonry elements, loss of iron elements due to theft, and loss of wood elements due to deterioration. There are three types of material deterioration: some surface deterioration (*e.g.*, plaster-deposit formation and regional detachment, flaking of stone, and crumbling of brick), well-developed surface deterioration (*e.g.*, plaster crumbling, swelling, detachment, and loss; loss of stone and brick pieces), and loss of integrity of material composition (*e.g.*, loss of adhesion and cohesion features of the mortar, leading to decomposition of masonry elements). The problems of each damaged building element are as follows: the superstructure of the northern and central aisles and the western and central sections of the southern aisle has totally collapsed, with no observable traces remaining. The vaults of all of the other sections have also collapsed, but there are some pieces to provide information about their profiles. In the half dome of the apse, one can trace the collapse on the exterior surface (25 cm deep). On its interior, diagonal cracks (2 cm wide) can be observed.

Excluding the western wall, which was totally demolished, the other three walls suffered partial collapse, especially at their top zones. These top zones are extensively damaged, and the adhesion and cohesion features of the mortar have decreased because of rain penetration and wind. A thin layer of rot, which is homogeneously distributed on the surface, is observed on all iron-wall reinforcements at the corners in this zone. In the middle zones, diagonal (1-5 cm wide) and vertical (3 cm wide) cracks are seen close to the building corners. In addition to these local structural failures, well-developed surface deterioration can be observed throughout the surfaces of the middle zone. The bottom zones of the walls have local collapses around the openings, well-developed surface deterioration, or loss of integrity in the material composition. In almost all of the existing lintels, partial loss of stone can be seen.

In the vaults of the openings, partial collapses (10 cm deep) and horizontal cracks can be observed. Well-developed surface deterioration is also seen. Most of the tie rods on the arches were cut and stolen. The left pieces (8-15 cm long) have rotted on their surfaces. The anchors of these tie rods were also stolen or have rotted. Rotting can also be observed in the tie rods on the walls and the nail groups on the cornices. The wall plates have been destroyed completely or deteriorated extensively. Loss of stone can be seen in the water spout. The cornices have partially collapsed or lost their plaster, and stone pieces can be seen. The casings have been demolished, or vertical cracks have formed. Deposit formation can be seen on all of them, as well as loss and detachment of stone. Partial loss of plaster and stone can be observed in the consoles at the interior corners. Partial collapse and loss of plaster are seen in the arched niche.

Stone and brick loss and detachment are present in the pilasters. In the top window openings, partial loss of plaster and deposit formation can be observed. In the other window and door openings, the adhesion and cohesion features of the mortar have decreased; loss of stone and brick pieces, crumbling of brick, partial loss of plaster, and deposit formation can be seen.

Deposit formation can be seen on the plaster of the vaults, whereas the repair plaster of the semi-dome has been partially lost. The fine plaster layer on almost all of the surfaces has decomposed: crumbling, swelling, and detachment can be observed. Either the rough layer has decomposed or some surface deterioration, such as deposit formation and regional detachment, has occurred. These relatively preserved surfaces are hidden within the curvature of the arches. Deposit formation is also observed on stones covering the floor.

Analysis of the spread of damage types (Arioglu and Acun, 2006; Warke, *et al.*, 2003) at the Ildiri Church reveals there are three damage stages in the building system (Figure 7). This basic staging is relevant for guiding later intervention decisions. The first damage stage includes the top part of the historic structure. Here, there is total or partial loss of the vaults; partial loss of the arches and walls; total loss of the mortar's adhesion and cohesion features, which has led to further decomposition of the masonry elements; and loss of plastering. The second damage stage includes the bottom part of the church, which suffers from local failures of masonry elements such as partial collapse and cracks and loss of half or more than half of the plastering. The third damage stage includes the middle part of the church. Here, there are local failures of masonry elements such as partial collapse and cracks and plaster deterioration in some local parts.

DISCUSSION AND CONCLUSIONS

This study has discussed how the digital revolution has provided opportunities for historic documentation with an emphasis on architectural photogrammetric techniques and data-management systems. A combination of these contemporary techniques was used to document an Ottoman church. As a result, we have defined the following documentation guidelines for assessing heritage characteristics:

- Historic buildings with comprehensive conservation problems should be documented in detail with a technique developed specifically for each case.
- The documentation process should include the identification of building characteristics, such as spatial components, architectural elements, and construction techniques, and their alterations and damages.
- A combination of contemporary image-based techniques and conventional techniques for surveying is necessary because both have their own advantages. Photogrammetric surveys should be supported with site observations, pictorial photography, and historical research.
- The presentation of visual results also requires a combination of traditional and contemporary techniques. Pictorial photographs and scaled 2D drawings should be supported with scaled, rectified image mosaics and a 3D digital model.

- The presentation of visual and written results should take into consideration developments in data-management systems.
- Thematic tabling is a prerequisite for effective management of documentary data.
- The tables should be saved in a single digital file prepared in data-management software.
- It is important to give a specific name and number to each building element so that the relation between tables can be followed.
- The characteristics of each building element, with their changes and recommendations for their conservation, should be outlined in the related rows of the tables, with links to the relevant visual documents.

The application of these guidelines has pointed out that the photogrammetric process makes possible the collection of very detailed information about the present condition of the building itself. At the Ildiri Church, the architect-conservators engaged in photogrammetric documentation gained valuable experience in the visual analysis of the monument. The thematic maps prepared on the rectified images of the facades have made it possible to perceive the architectural elements, construction techniques, and damages in a systematic and realistic way. Similarly, 3D presentations have made it possible to comprehend the spatial qualities and related conservation problems, as well as the structural system and its deficiencies. The large appended tables in which the results are presented have fulfilled the necessities of architectural conservation as a whole, such as thematic classification, systematic organization, and storage of all data types including visual and written. One of this study's contributions to the interdisciplinary field of architectural conservation is merging the thematic-analysis approach to architectural conservation with the data-management tools of the digital revolution. The tables make it possible to monitor the condition of each building element, which makes the management of the building as a cultural artifact easier. The related intervention decisions may be expressed in similar tables in connection with the current data.

The limitation to these techniques is that measured surveys based on photogrammetry are time consuming in terms of learning the related tools and laboratory work. Nevertheless, this long evaluation time becomes a positive input in terms of its contribution to the architect's ability to comprehend all of a monument's details. Another limitation is that interactive 3D data management is not possible at present. Future development should be directed at the design of a cultural heritage database with this option. All of the tables include information about the characteristics of the building elements within the limits of the table's theme. They may be further developed so that each includes the alterations and/or damages to the elements, as well as related recommendations.

A number of professional Turkish firms that specialize in conservation applications have been using digital photogrammetric techniques for documentation. Nevertheless, contemporary data-management systems are not used together with these techniques. It is hoped that this study will contribute to the field with its integrating approach. Any data inconsistency will be reduced, and time will be saved. The digital techniques are effective tools when they are used in light of the basic concepts of architectural conservation. Thus, it is good to be aware of the conventional classification strategies, historical research methods, and trace observation and deciphering techniques of architectural conservation and to have confidence in how to apply them, while being knowledgable about the new developments in documentation.

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