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AUTHORS: Filiz KARAKUS

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Analysis of the Methods Used in Documentation of Historical Structures with Examples

Filiz KARAKUS

Yıldırım Beyazıt University

Abstract: It is of great importance to pass on the cultural and architectural heritage, which is an important link between us and the past, to future generations. It is very important to carry out documentation studies with correct and appropriate methods in order to carry out the repair and restoration of cultural assets in accordance with their original. In this study, the documentation methods of cultural heritage and the importance of the documentation process are emphasized. In the documentation phase and in determining the interventions to be made to the building, what studies were done and what kind of path was followed were tried to be explained with examples. Documentation of cultural and architectural heritage has different components and characteristics from urban scale to single building scale. Within the scope of this paper, the studies conducted on a single building scale were discussed. Before starting the restoration work of historical buildings, it is necessary to determine the current state of the building, that is to document it. The characteristics of the structure, whether there are cracks in the structure, the presence of a sign indicating that there is ground movement, material deterioration, and determination of previous restorations are of great importance in terms of documenting the structure. With this study, it is aimed to guide the experts working in the field of conservation.

Keywords: Cultural heritage, documentation, survey

Introduction

It has been acknowledged that cultural and architectural heritage should be preserved and documented in order to be passed on to future generations and to ensure its continuity. The success of the studies to be made and the intervention decisions to be made on conservation depends on the sensitivity of the documentation. As a result of the efforts to obtain the healthiest and most accurate information for the building or building groups during the documentation, important developments have been experienced in the documentation methods.

Significant progress has been made with the efforts made in the field of scientific and technology in the methods and techniques used in the documentation studies to be carried out to create a basis for the projects to be prepared for the restoration of registered immovable cultural assets. Along with the developing technology, contemporary documentation techniques have progressed quite rapidly. With these techniques, documentation of historical artifacts can be done more precisely and quickly.

The documentation phase of cultural assets should include the current state of the building, the carrier system and deterioration as well as material analysis. Research on the building should also include the repairs and interventions the building has undergone over time (Tucci: 2009). During the documentation phase, the information needed about the building can be obtained from old photographs, old projects, engravings, archaeological research and travel notes (Kuban: 2000).

In this study, first of all, the definition of the documentation was made and a research was made on the methods used in the documentation. Before making the decision to intervene in a building that qualifies as an immovable cultural property, the documentation studies that were made to form a basis for the restoration projects were examined with different examples and the preparation processes of the survey were discussed. The deterioration sheets of the investigated structures were examined, and the studies carried out while determining the problems and deteriorations in the structure were discussed.

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Definition and Methods of Documentation

Documentation is the physical definition of a building, and the first step of this definition is the survey and photographic work. The analytical survey, which constitutes the second stage, includes the studies carried out to determine the structure of the building and the changes it has undergone, as well as the measurement of the building (Kuban: 2000). Documentation studies provide a basis for the preparation of restitution and restoration projects and are the first and most important step before intervention decisions are made.

Before starting the restoration of cultural assets, it is very important to determine the current state of the building. Historical research constitutes the first step of the determination phase regarding the building. At this stage, literature and archive research related to the historical structure is made, written and visual documents are used. Another step of the determination phase is the preparation of the survey projects. These projects consist of the site plan, floor plans, section, facade and architectural elements in 1/100, 1/50, 1/20 and 1/5 scales according to the characteristics of the building. During the preparation of the survey projects, it is also necessary and important to prepare reports containing the architectural and art history features of the building. It is preferred to carry out photographic examination together with the survey drawings, it is important to mark the place and directions of the photographs on the plan.

As part of the survey projects, structural and material deterioration and originality analyzes should also be made. During the examination of the bearing system and the deterioration of the structure, issues such as plumb line deviation, settlement, collapse are an important part of the examination. If the movement in the structure is still continuing, it is necessary to follow the changes, movements and deformations in the cracks within a certain period (Crocì: 1998). It is extremely important to determine the mechanical, physical and chemical properties of the materials such as stone, brick, wood, mortar, plaster that make up the structure in order to determine the interventions to be made.

Documentation is a process in which experts from many disciplines can work together and contribute. It is important that the people in this team have sufficient knowledge and awareness of the methods to be applied. The people in the team should be in cooperation and harmony, they should work together in the development of the methods used in the implementation process (Bohler: 2005).

In the survey measurements, traditional techniques and methods can be used as well as advanced documentation methods. When traditional methods such as triangulation, vertical coordinates and grids are used, instruments such as tape measure, plumb line, compass, range pole, mira, leveling instrument and theodolite are used. In advanced documentation methods, tachymetric and laser measuring instruments (laser meters, protractors, advanced levels, advanced theodolites, total station), GPS, laser scanning and photogrammetry are used (Uluçpakben: 2013). With the developments in the field of technology, traditional methods leave their place to modern methods in the acquisition of survey measurements. It is faster and easier to take measurements and make drawings with modern methods. In addition, more accurate and more precise information can be obtained with these methods. Since traditional methods are not sufficient in the certification stage of large-scale and complex functional buildings such as castles, palaces and inns, advanced documentation methods are preferred and sometimes different techniques are used together.

With the development and widespread use of computer technology, the use of local photogrammetry in the architectural field has increased. With this method, it is aimed to obtain information about the visual data of an architectural object, geometric definition of this object, the size, shape, texture properties of this object and also its planar properties by using photographs (Güleç:2007; Korkmaz:2011). Terrestrial photogrammetry is a method that enables the creation of two-dimensional drawings and three-dimensional models after the necessary procedures from photographs taken with the aid of a camera from close or far distances (Güleç: 2007).

Laser scanners provide more accurate results than many photogrammetric methods (Almagro: 2007). Two methods are used to obtain three-dimensional modeling from the point cloud obtained by laser scanners. In the first method, geometric shapes in the point cloud are automatically corrected and modeled. In this method, the data occupies less space and is a less costly method. In the second method, mesh models of more complex geometry shapes in the point cloud are created. In this method, the data take up more space and it is a more costly method (Chevrier, 2008).

In this method, the system converts the three-dimensional point coordinates obtained by laser beams sent to the object to be measured into digital data. These data are transferred to the drawing environment on the computer, and the point cloud records obtained with 360 ° rotating camera angles are transferred to microstation and

similar programs and the point data is transformed into digital data. Then these data are transferred to the CAD environment to be drawn in the technical drawing environment. With the help of the views obtained through photographic pictures recorded in digital environment, floor plans, facade and sections of the building can be obtained (Uzun, 2019).

Examination of the Documentation Phase on the Examples

The terrestrial photogrammetry method is used for the surveys of detailed and embroidered sections, especially in historical buildings. Within the scope of this study, applications in the process of documentation of immovable cultural property buildings are discussed.

Çankırı Buğdaypazarı Mosque

The Buğdaypazarı Mosque, located in the Center of Çankırı, is located in the same courtyard with the Buğdaypazarı Madrasa. The survey, restitution and restoration projects of the mosque were drawn by Mithat Zafer Architecture Office. For documentation, FARO FOCUS X330 laser scanner with NIKON D80 camera, GPS, Altimeter, Inclinator, compass sensors and capable of measuring 122,000, 244,000, 488,000 or 976,000 points per second was used. For the drawing of the details, sketches were made and the measurements were taken on site with a tape measure and profile comb. 2056 photographs were taken to cover all points of the building. Laser scanning was done in color and black and white at 120 points and processed and combined with FARO SCENE software.

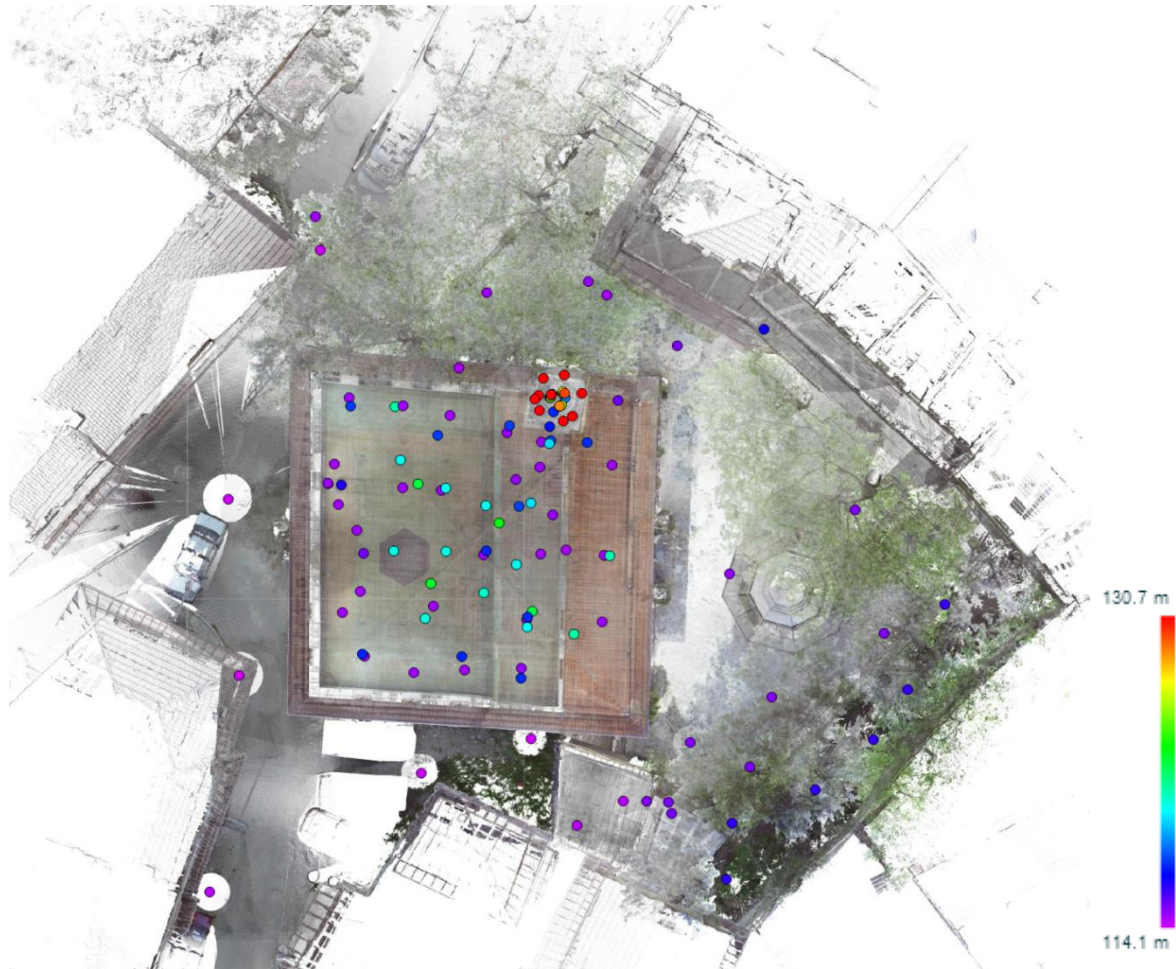


Figure 1. Points read with a laser scanner

The combined point clouds were transformed into drawings in Autocad. For the decorations on the ceiling, orthographic photographs were obtained by wearing photographs on the point cloud and detailed drawings were

made on them. Among the photographs taken, the ones to be used in the album are numbered and shown on the key plan together with the shooting directions. At the stage where the measurements were taken and the drawings of the building were made, written and visual documents related to the building were reached and archive research was conducted. Based on these, an art history report of the building was prepared.

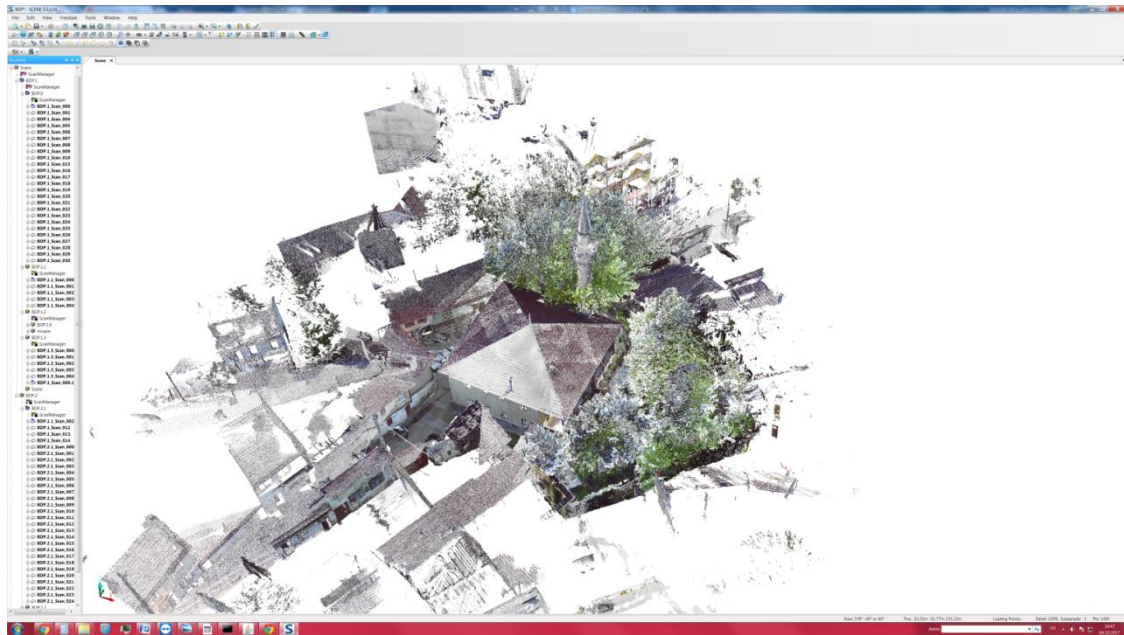


Figure 2. The combined point clouds are transformed into drawing

The deterioration and damage in the building; Structural Distortions, Material Distortions, Color Changes and Unqualified Interventions were examined and worked on the Survey Distortion Sheet. Types of deterioration in the building are determined as "Plaster Crack", "Deflection", "Fibrillation", "Planting", "Oil Paint Applications", "Cement Based Material Use", "Incompatible Material Use" and "Repairs Made with Current Materials". The interventions to be made to the building in line with the detected deteriorations and problems were determined and accordingly, restoration projects were prepared.



Figure 3. Layouts prepared in line with the detected deterioration and problems for Buğdaypazarı Mosque

Ankara- Altındağ Arslanhane Mosque

Arslanhane Mosque, located in Altındağ District of Ankara, is one of the most magnificent examples of the Anatolian Seljuk Period mosques with wooden posts and wooden ceilings. The walls of Arslanhane Mosque were built with a masonry system and the wooden ceiling is carried by 24 wooden columns. Rubble stone, spolia material, bricks and wooden beams were used in the main walls of the building. The survey, restitution and restoration projects of the mosque were drawn by ANB Mimarlık İnşaat ve Ticaret Limited Şirketi. During the documentation phase, advanced documentation methods and traditional methods were used together. Historical research reports were prepared in coordination with the measurements. When the building was measured with a laser scanner and the survey drawings were made, it was determined that the columns carrying the roof were offset by 10-30 cm in the vertical axis and deflection in the ceiling beams. In addition, it has been observed that the moisture problem arising from the rain water that cannot be evacuated on the roof and the materials used in old dated repairs also cause problems in the building. In order to detect these problems, Infrared Thermal Imaging and Mortar and Plaster Analyzes regarding the superstructure were carried out by the METU Material Protection Laboratory. Infrared thermal images clearly show damp areas caused by faults in the roof drain assembly. In the infrared thermal images, the humidity problem rising from the bottom to the top of the building walls is also clearly seen.

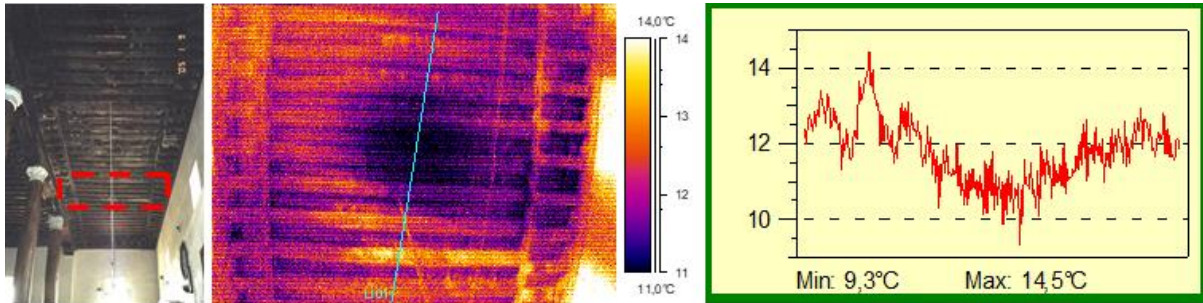


Figure 4. Wooden ceiling infrared thermal image and wood temperature curve

From the temperature curve showing the infrared thermal image of the area in the frame and the heat distribution on the wooden ceiling, we see that the temperature difference on the wooden ceiling surface reaches up to 5 C. This indicates that the cold area is wet and there are moisture problems in the ceiling caused by problems in the roof drainage system (Saltık:2008). For the definition of historical building materials, physical properties of unit weight and porosity are determined. As a result, it has been observed that the mortars have high porosity (31% - 60%) and low unit weight (1.16 g / cm³ - 1.42 g / cm³). Thin sections of some mortar and plaster samples taken from Arslanhane Mosque were prepared; mineralogical and petrographic definitions of aggregates and properties of binder materials.

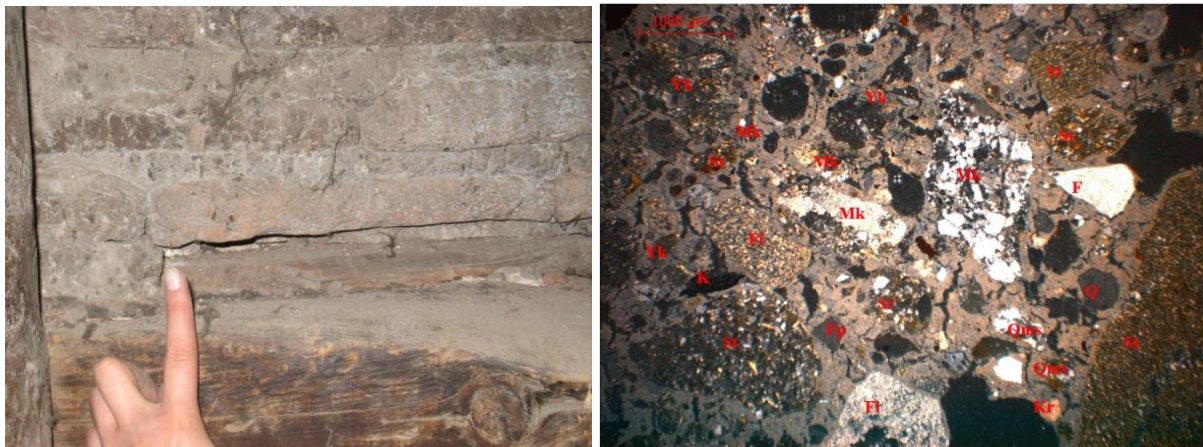


Figure 5. Lime mortar between wood and bricks on the steps of the minaret (left)

Figure 6. Thin section view of the inter-brick mortar sample (AC12) from the minaret F: Feldspar, Yk: Surface Rock Fragment, Mk: Metamorphic Rock Fragment, St: Siltstone, K: Coal fragment, Qms: Quartz-mica-schist, Fi: Fillite, Q: Quartz, Fp: Plagioclase feldspar, Kr: Limestone.

As a result of these analyzes and examinations, the problems in the structure were determined more accurately and solution suggestions were made. In addition, the content of mortars and plasters to be used in repairs was determined in line with the material analysis made. Based on these documentation studies, intervention decisions were made and restoration projects were prepared accordingly.

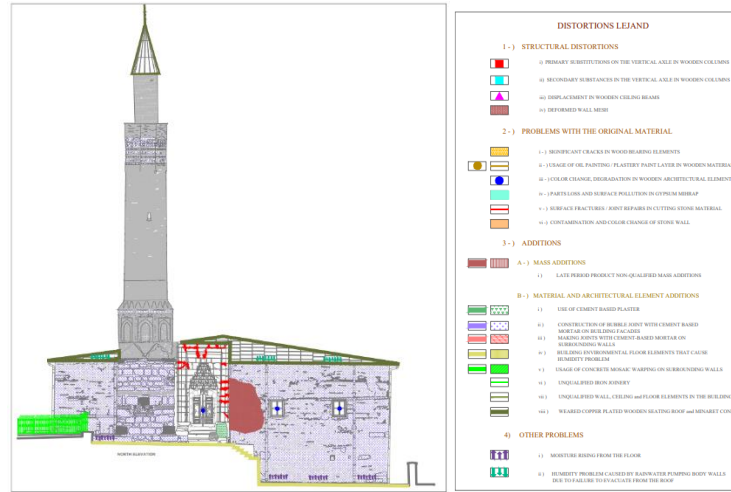


Figure 7. Layouts prepared in line with the detected deterioration and problems for Arslanhane Mosque¹

Bolu-Gerede Aşağıovacık Village Mosque

Located in Bolu Province, Gerede District, Aşağıovacık Village Mosque was built by Sultan Abdulhamid II in H. 1309 / AD 1891-1892. It was understood that Hacı Habib Efendi, who was the chief carpenter of Sultan Abdülhamid, was built as a gift in his village upon his superior services and request. In a document dated 1903 in the Archives of the General Directorate of Foundations, it is seen that the name of the building is "Hamidiye Câmi-i Şerif". The survey, restitution and restoration projects of the mosque were drawn by Erk Architecture Office. Studies to document the current state of the building were carried out in two different digital media, namely "laser scanner and photo-video shooting". The current state of the building, its material and structural features, problems in the structure (types and reasons of material deterioration, structural problem, etc.) and the interventions of the building have been determined. Studies for the documentation of the current situation were completed as a result of the work of a team consisting of architects, art historians, civil engineers and restoration experts. Every bit of information obtained during the survey, restitution and restoration works formed the data (basis) of the next stage. In order for the project to achieve its goals, it was concluded by following the method of completing all phases in a healthy way and transferring the information between the phases correctly.

Conclusion

Keeping the cultural and historical values that make up the historical environment alive and transferring them to the next generations with their unique characteristics is one of the most important problems in the field of conservation. In our country, which carries the traces of various civilizations, it is very important to protect and restore the rich architectural heritage that has survived until today. For this reason, it is necessary to document this heritage and to use the correct methods during the documentation phase. With the developing technology, many advanced documentation methods and devices have started to be used apart from traditional methods. It is of great importance to select the appropriate ones among these methods and to work together from different disciplines on the subject. The correctness of the work done during the documentation phase ensures that the intervention decisions are healthy.

It has been observed that the use of the terrestrial photogrammetry method, whose area of use has expanded and become widespread with the developing technology, is a more economical and easy method in terms of time to make survey measurements, and it is more accurate and accurate results can be achieved compared to other methods.

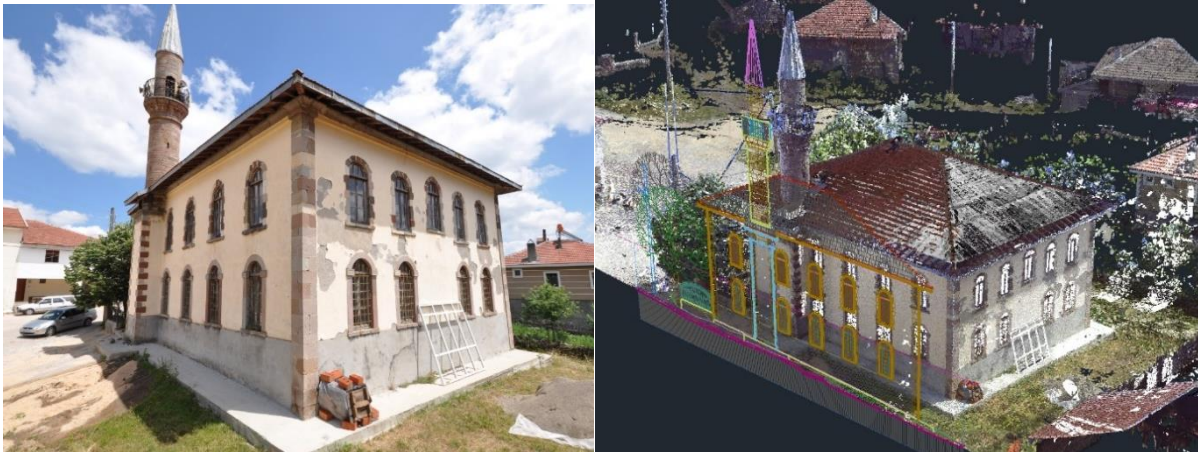


Figure 8. Hamidiye Mosque, northwest view and orthophoto view

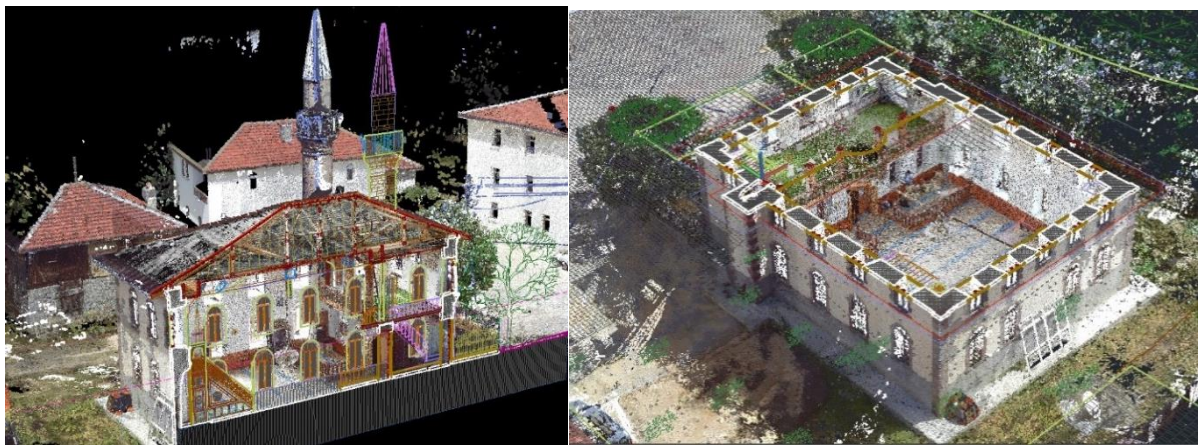


Figure 9. Hamidiye Mosque, section and plan orthophoto views

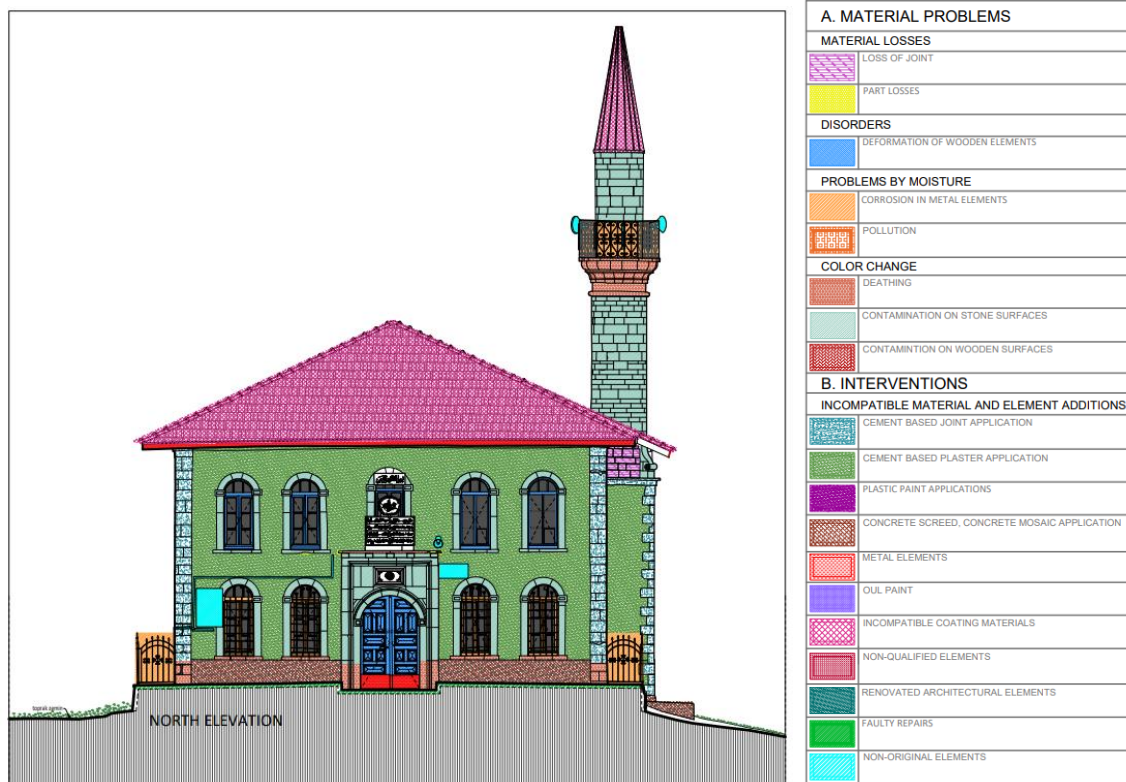


Figure 10. Layouts prepared in line with the detected deterioration and problems for Hamidiye Mosque

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Author Information

Filiz Karakuş

Yıldırım Beyazıt University
Esenboğa Külliyesi Mimarlık Fakültesi D Blok Çubuk
ANKARA
Contact e-mail: ferdemir06@gmail.com
