Architectural Sciences and Cultural Heritage
Historic Matter

CHAPTER-10

Using Digital Methods on Cultural Heritage Conservation- Case Study Erzurum

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1. Introduction

Historical cities and urban areas are spatial formations that describe the evolution of a society and its cultural identity; they are part of the natural and man-made environment. Historic cities and urban areas are living evidence of the past that shaped them. Therefore, the architectural heritage of a place contains all the material and spiritual traces and codes of that place in the historical process. They are tangible manifestations of that place's identity (Ulusoy Binan, 2017).

Traditional buildings create a local or regional identity suitable for the environment. Style, form and appearance consistency are examples of traditional design approaches and construction techniques, which are transferred anonymously due to the use of traditional building types Before any intervention to a traditional building, the form and structure of the building should be examined in detail, documented and reported (URL1, Icomos Charter of Traditional Architectural Heritage,1999). The process for the conservation of the architectural heritage; It consists of documentation, research, analysis, interpretation, determination of diagnosis and protection approach, definition of practical intervention, implementation and monitoring. Experts from related professions should be involved in this process (URL2, Icomos Türkiye Mimari Mirası Koruma Bildirgesi, 2013).

Cultural heritage is the values that bring the life, traditions, architecture, art and ethos of the past periods to the present. The object of conservation is to prolong the life of cultural heritage and, if possible, to

clarify the artistic and historical values without the loss of authenticity (URL3, Guidelines On Education and Training in The Conservation of Monuments, Ensembles and Sites,1993). The first step of the conservation action, which defines all the operations to “preserve the authentic qualities" of a building or property, is "to understand the object, to collect data about its physical condition before any action or intervention that can change it" (URL4, Operational Guidelines of World Heritage Sites, 1998). The purpose of the conservation action is to “preserve the authenticity”. The first step is to record the “current status of the heritage”. Projects carried out within the scope of the protection of cultural and architectural heritage are the projects of survey, restitution and restoration. The implementation process begins after these analytically prepared projects are approved by the relevant board (URL5.principle nr. 660, 1999, URL6. law nr. 2863).

Documentation for cultural assets is the "physical description" of the structure, together with its surroundings, under threats such as deterioration, destruction or inappropriate interventions (wrong restoration practices without a project). The "Analytical Survey" study is carried out together with the photographic, linear and written determination of the image of the building and its environmental relations as well as analytical data such as material detection, age detection and damage assessment (URL5. principle decision nr. 660, 1999, URL7, Principles for The Recording of Monuments, Groups of Buıldıngs and Sıtes,1996).

This data is also the study that forms the basis for the “restitution project”, which analyses the authenticity of the building when it was first built and the “restoration project”, which functions in accordance with current comfort conditions. There are advanced documentation technologies used together with conventional methods in the documentation of cultural assets. It has become possible to process the data collected by different methods at the point of data collection from the field, by means of data acquisition with Terrestrial Scanning methods, laser technologies such as airborne lidar, mobile lidar and photographic methods such as drone and panoramic shooting. By using such measurement methods together, the disadvantageous parts can be eliminated.

Over the years, research to increase the sensitivity of documentation has led to the use of these technologies together and to the point of scanning the entity with 3D laser scanning devices today. The importance of coordinated and precise measurement has increased in the documentation of the current situation in order to identify the lost parts of the civil architectural examples that need to be preserved in the context of the cultural texture and to make their reconstructions.

Documentation of cultural heritage by digital methods is mentioned in article 3 of Icomos Principles for the Conservation and Conservation of Wall Paintings / 2003PDFENICOMOS Principles for the Preservation and Conservation-Restoration of Wall Paintings, 2003, "Conventional methods in the documentation of wall frescoes" It is stated that the

documentation made with writing and drawing can be supported by digital methods (URL8, Icomos, 2003).

Documentation of the current state of cultural assets is carried out with analytical survey sheets, in which deformations and materials used are examined, along with the measurement and drawing stages. In addition to the measurement and calibration photo shooting method made with 3D laser instruments in documentation, conventional methods can still be used in detail documentation. Laser scanning technology is especially necessary in the survey works of structures that have lost their integrity. Even the worst condition construction component can be traced from the 3D scan of the structure. In this way, the authentic plan and facade can be read.

Erzurum has been an area dominated by Hurrians, Urartians, Romans, Seljuks, Byzantium and Ottomans since 1600 BC. The city, which was known by many different names until it was named Erzurum today (Konyali, 1960), stands out with its cultural layers and many cultural assets (Yilmaz, 2010). The city where the Erzurum Congress was held played an important role in the start of the national struggle.

The borders of the city, which was a castle settlement in the past, have expanded today and a small part of the castle and its surrounding settlement texture has survived to the present day. The traditional neighbourhood mentality, street structure, stone houses and urban equipment of Erzurum Historical City Core, which has been destroyed for various reasons (war, earthquake, poverty, etc.) since its

establishment, has caused the cultural and social structure to be destroyed as well. The Registered Civil Architecture Examples around the Castle were documented and conservation projects were designed within the scope of the Cultural Road Project, which is planned to be carried out in order to protect, sustain and economically evaluate the immovable cultural heritage, which are considered the most important values of cultural identity.

2. Material and Method

In this study, experience in the project processes of 14 buildings, which are registered examples of civil architecture in the Kale region of Erzurum from field survey to restitution projects will be shared. The act of conservation of cultural heritage aims to reveal the value of "authenticity" and to protect it. According to the World Heritage Convention guide, “authentic features of the heritage” are a prerequisite in this context (URL4, Operational Guidelines of World Heritage Sites, 1998). Restitution projects, which periodize the interventions of the cultural heritage over time and reveal the situation in the period in which it was made, with historical research and comparative analysis methods, are an important stage in terms of performing the restoration works on the right basis (URL9, Tek Yapı Ölçeğinde Rölöve, Restitüsyon Ve Restorasyon Projeleri Teknik Şartnamesi, 2023). For this reason, this study is reviewed in the context of survey and restitution projects.

Survey studies around Erzurum Castle were started in December 2011 and terrestrial laser scanning method was used for measurements in the

field and supported by conventional methods. In addition, high resolution photo shoots were performed. The fieldwork lasted for a total of three weeks with five-day periods. In the same process, detail measurements were taken with a working group consisting of 12 architects and restorers in total. After the data process, the surveys consisting of 2D-cad base drawings were completed in three months by a team of 6 architects and 6 restorers. In the survey study, the 3D point cloud data was dropped according to plan, section and elevation improvement, drawn in Zmap and exported to AutoCAD. Analytical drawings were prepared on the survey drawings with legends authentic, non-authentic parts, the material used, the deformation and deteriorations that occurred.

The restitution projects, which show the autentic condition of the buildings, were produced through the survey study. Periodical additions of the buildings were investigated in the research studies on restitution based on the survey. The restitution projects were carried out with the identification of the currently lost and ruined building sections and according to authentic state the reintegration of the cultural heritage.

In the restoration projects designed on the basis of the Restitution Project, the authentic architecture of the buildings has been functionalized with appropriate public uses. In the restoration, comfort conditions suitable for current needs were added. Restoration works of buildings whose survey, restitution and restoration projects have been approved by the Monuments Board and implementations continue.

3. Findings and Discussion

It is necessary to protect and sustain the immovable cultural heritage, which are considered as the most important values of cultural identity and to make use of them economically. Therefore, within the scope of the Cultural Road Project, which is planned to be carried out in order to protect the urban culture of Erzurum, projects have been designed for the purpose of documenting and preserving the Registered Civil Architecture Examples around the Castle (Figure 1,2).

As a result of the development of the sciences of conservation of cultural heritage, the new concept of Cultural Routes shows the evolution of ideas with respect to the vision of cultural properties, as well as the growing importance of values related to their setting and territorial scale, and reveals the macrostructure of heritage on different levels (URL10, The Icomos Charter On Cultural Routes, 2008).

Examples of traditional architecture, local architecture and civil architecture, which are formed based on the location, natural environment, topography, material resources, climate, and past disaster information, are more fragile than the most monumental heritage in terms of protection (Sezgin, 2006, Ulusoy Binan, 2017).

Geography, traditions, lifestyle and production style determine the local housing architecture in Turkey. The geography and culture determine the material, plan and facade character of the buildings and the construction system (Sezgin, 2006). Eldem traditional houses named the according to the regions and collects them in seven big groups. (Eldem, 1984).

In traditional buildings, wood, stone, brick and adobe materials are used in different forms and structures depending on the region. Stone material appears with structures of different character from the Aegean coastline to Eastern Anatolia (Sezgin, 2006).

Erzurum houses, with their rubble stone and wood-framed constructions, display a simpler quality than the face stone structure seen in Kayseri (Gündoğdu, 1986), Cappadocia (Binan, 1994), Mardin and Diyarbakir regions, and closer to the character of Bitlis and Siirt houses. Erzurum houses are the buildings of special quality with their designs shaped by the geography and culture they are located in and bearing the traces of traditional life and climate. Wooden beam-frame system was used in the stone masonry walls used as building material due to the fact that it is an earthquake zone.

The residential buildings are located within the borders of the outer castle outside the inner castle. One of the most common problems faced by conservation specialist architects is that the time allocated for projects is less than the work period. However, conservation projects are large-scale and sensitive studies that start with the present condition assessment (survey) and include research, analytical work and design. The basis of these studies is “Documentation”. Proper documentation ensures that all other project work is done correctly. In areas such as Erzurum where terrain conditions are difficult, documentation should be fast and measurement, detail and photographic works should be done quickly and

accurately. At this point, it is important to conventional measurement methods with current technologies.

Property owners in the project area left the buildings due to economic, urban migration or comfort reasons. The field survey was carried out under very difficult conditions due to the poor structural conditions of cultural properties, security problems in the surrounding area and climatic problems (snow and cold).

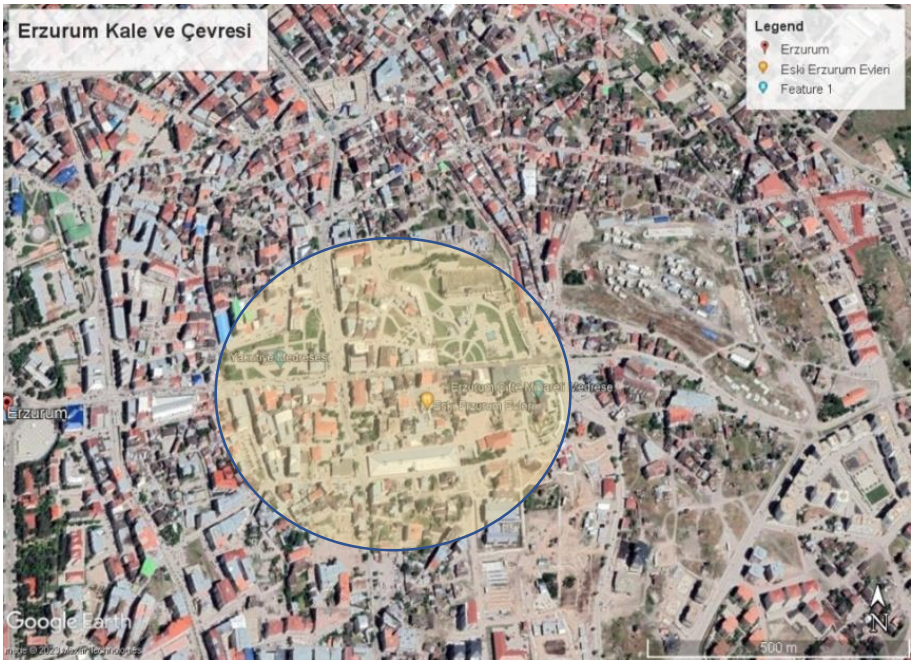


Figure 1: Erzurum Castle, Google Earth Pro, 30.07.2023

Figure 2: Erzurum Castle, (kulturportali.gov.tr), 11.07.2023

According to the traveller Ibn-Batuta from the 14th century, the first houses built in this region have gardens. J.B Tavernier, who came to Erzurum in the 17th century, mentions that the buildings inside the Castle were built with wood and earthen materials in an unpleasant way (Fig3, Sakaoglu, 1996).

Evliya Celebi, describing the province of Erzurum again in the 17th century, stated that there were 70 Turkish and 7 Armenian neighbourhoods and no Gypsies or Jews. During the suppression of the revolt that broke out in the Erzurum Sanjak in the 17th century, the castle and its surroundings were damaged. He mentions the size of the inner castle and the fact that there is a spring water in the inner part of the

fortress. Today, this water still flows from the many fountains we see in the region (Evliya Celebi, 2002).

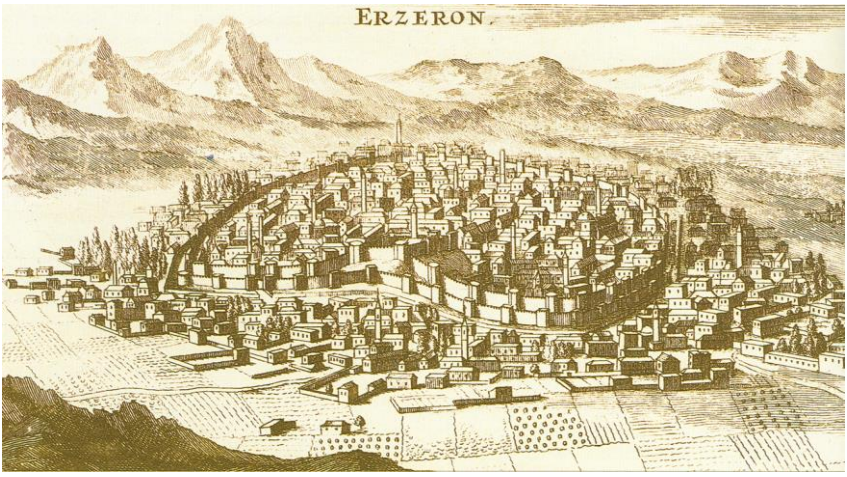


Figure 3: At the beginning of the 18th century, Erzurum, Tornefort (Sakaoglu, 1996)

Evliya Celebi talks about the "Pasha palaces" in the area, which we see today as the inner castle settlement (Evliya Celebi, 2002).

The city, which was devastated during the Ottoman-Russian war in the first half of the 19th century, was shaken by an earthquake in 1859. In the photographs of the end of the 19th century and the beginning of the 20th century, it is seen that the buildings in the city have lost their integrity to a large extent. In Erzurum, which had the opportunity to revive after the Independence War, the buildings were left to their fate due to migration to the big cities in the 1970s. Since the 1980s, when international initiatives related to cultural heritage and world heritage showed their effect in Turkey, the value of civil architecture examples began to be

appreciated. Erzurum Castle and its surroundings were declared a protected area in 1993 (Sekmen, 2023).

Figure 4: A panoramic view from Erzurum (H. Hepworth, Through Armenia on horseback, London, 1898, URL11).

The masonry structures of Erzurum houses, which have a different structure from the typical Turkish House character, also make it difficult to document these structures (Figure4). For this reason, 3D laser scanning method was used together with conventional methods in the survey studies. Most of the buildings in the project area have been abandoned. Within the scope of autenticity and integrity, it has been determined that some parts of the buildings, which are in a very bad condition, were demolished or completed using non-autentic materials. During the creation of the Restitution Projects, it has been tried to reach the autentic state of the building by analysing the autentic parts and through the existing traces and old documents that can be found (Figure5). On the other hand, it was aimed to restore the buildings to

their autentic state and up-to-date equipment and functions were introduced for the continuity of conservation in restoration projects.

Figure 5:Erzurum houses, 1900, Maps | Province of Erzurum : Houshamadyan - a project to reconstruct Ottoman Armenian town and village life, (11.07.2023)

The castle and the surroundings were declared a protected area in 1993. After this date, detection and registration studies started in the area and a conservation development plan was carried out in 1993 and 2012. Upon the continuation of the detections in 2013 and the expansion of the conservation area, the plan studies were started again in 2015 and it was approved in 2019 (URL12, Erzurum Belediyesi, 2023).

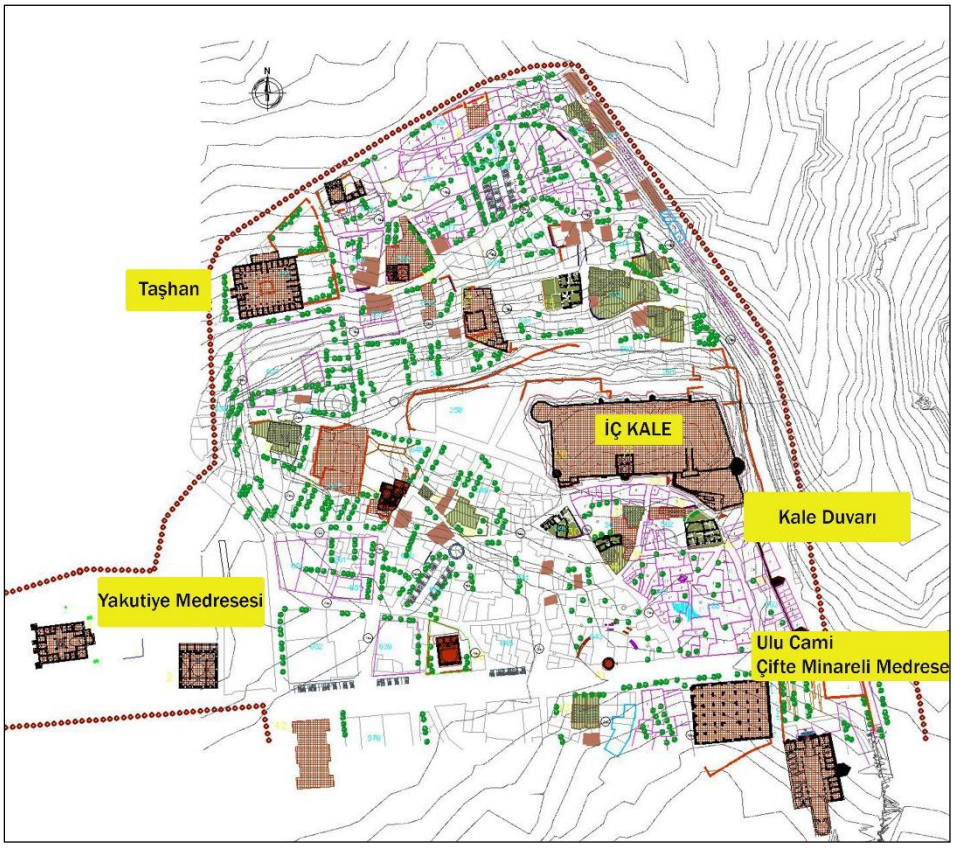


Figure 6: Cultural properties in Erzurum Castle and in the surroundings

The area where the study was carried out is located in the first city centre within the outer castle around the Inner Castle structure built in the 5th century (Figure 6). Projects of 14 registered buildings in 8 building blocks (Assessment, Restitution, Restoration and Engineering) have been designed. All of the buildings with a living area of between 95 m^2 and 1300 m^2, among which the oldest mansion building in the region Zirnikli

Vehbi Bey Mansion (1739) is located, are two-storey buildings with masonry stone-wood beam construction specific to the region.

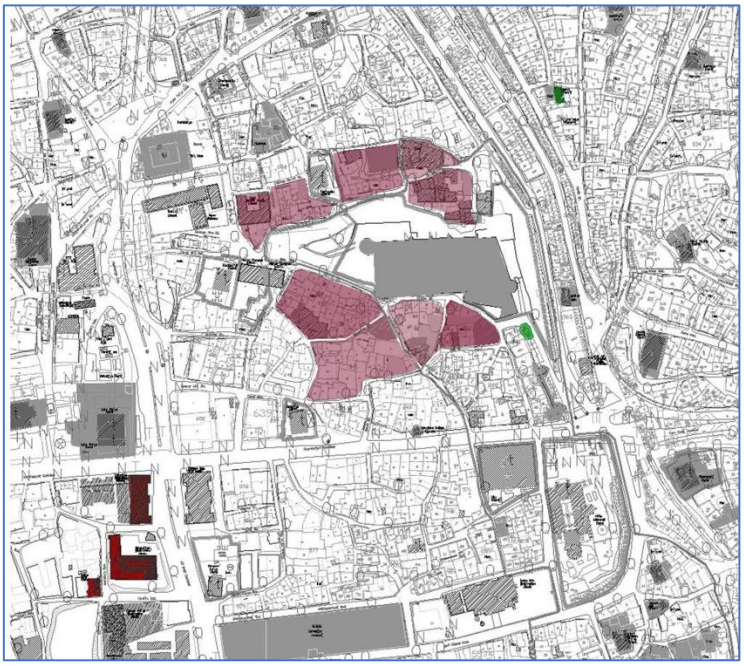


Figure 7: Location of the Blocks with Surveyed Buildings

3.1. Data Collecting

Before the fieldwork, office work was carried out and planning was made regarding the study team and data collection method. Study groups and measurement methods were planned by examining the layout sheet and satellite photograph, the building layout area and the state of the building (Figure 7, 8, 9). The planning was made for a short time and to be completed in a few times considering the climatic conditions of the area such as cold weather and daylight duration.

Due to the necessity of keeping the working time in the field short and the difficulty of distinguishing the autentic materials (stone-soil-wood) of the buildings from the land, which arose due to the deterioration of their nature and integrity, has led to the preference of the terrestrial laser scanning method.

Figure 8, 9: Location of the Blocks with Surveyed Buildings (googlearth-2012)

Conventional methods have been used in spaces that are too narrow for laser scanning or where there are too many items. Conventional methods have also been preferred for 1/1 scale architectural details such as doors, windows, ceilings and cabinets. This method is preferred in architectural details due to factors such as frequent scanning prolongs the working time in the field, working with the laser scanning team in the field and the architectural team finishing the detail drawings during the laser scanning process (Table 1).

Table 1: Measurement Methods Used

ERZURUM CULTURAL HERİTAGE DOCUMENTATİON									
number	Island	Parcel	Building Area - Ground(m2)	Building Area-Measure	Traditional Methods		Geodesic	3d Laser Scanning	
					İnterior	Detail	Coordinate	Exterior	İnterior
1	515	1	332,00	480,00					
	515	2	808,75	292,00					
	515	3	95,00	136					
	515	5	190,00	187					
	515	6	298,32	188,00					
2	561	8	220,00	150,00					
3	561	9	200,00	120,00					
4	561	12	267,78	320,00					
5	562	4	287,76	233,00					
6	562	5	857,38	800,00					
7	566	12	150,79	150,79					
8	567	10	100,00	200,00					
9	567	12	200,00	200,00					
10	567	13	318,00	420,00					
11	581	7	1.285,69	1.320,00					
12	641	10	163,00	163					
13	642	1	399,18	798,36					
14	649	27	154,00	308,00					
	TOPLAM		6.327,65	6.466,15					

3.1.1. Conventional measurement

Measurements are taken by meters, plumbing, and scales in conventional methods. Starting from a point in the area, continuous measurements are taken in a clockwise direction. Before starting the measurement, +1 m level is marked or drawn horizontally by pulling a rope horizontally so that the level differences on the ground do not cause wrong measurement, then the continuous measurements are supported with diagonal measurements. Diagonal measurement ensures that each measuring point is verified by measuring from a reference point at least twice. Measurements are taken with a profile comb for architectural details such as doors, windows and ceiling profiles. A sketch is drawn and the dimensions are engraved on it (Figure 10).

Figure 10: Instruments used in conventional measurement.

Conventional methods are used exclusively or in combination with digital methods, depending on the characteristics of the structure studied. The work on the structures around Erzurum Castle was started in December 2011. The survey of 14 buildings on 22 parcels was conducted using terrestrial laser scanning and conventional methods together. Restoration Specialist Project Manager (1), 6 Architects, 6 Restorers, 2 surveyors and 4 surveyors took part in the project. The field program was carried out by the survey team taking the external measurements with laser and the architect-restorer team measuring with sketches and conventional methods . This method has been followed, considering that the laser scanning device will not work comfortably due to internal debris, furniture, etc. reasons. The digital method was also used in the interior measurements of the buildings where the interior space is empty. Conventional measurements were made with teams of 3 people. Measurement studies in the field have progressed in 3 times with 5-day planning (Figure 11. 12).

Figure 11. Indoor measurement studies with conventional methods.

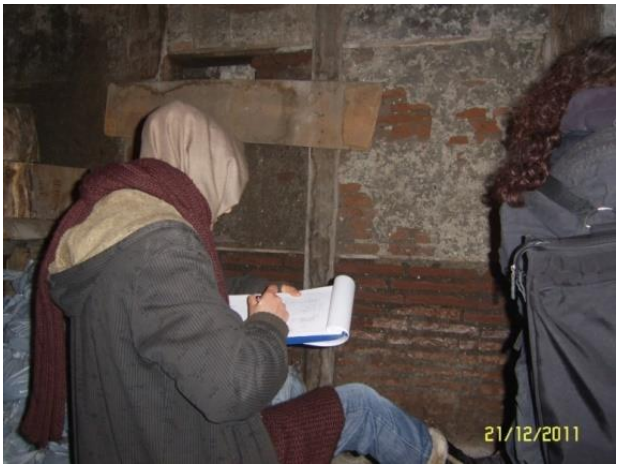


Figure 12. Indoor measurement studies with conventional methods.

Figure 13. Indoor measurement studies with conventional methods.

3.1.2. Digital measurement

Digital documentation methods, which we call advanced documentation methods, have developed with photogrammetry and lidar techniques (Gulec, et al., 2011, Alshawabkeh, et al., 2023). These 3D documentation methods, which enable the virtual transfer of the field to the office, greatly facilitate the work of architects and eliminate measurement errors. With the software developed today, it has become possible to produce and combine the data obtained in both methods as a “3D point cloud". In this way, the data of the field taken from different angles are combined on the same platform and can be vectorised (Figure 14).

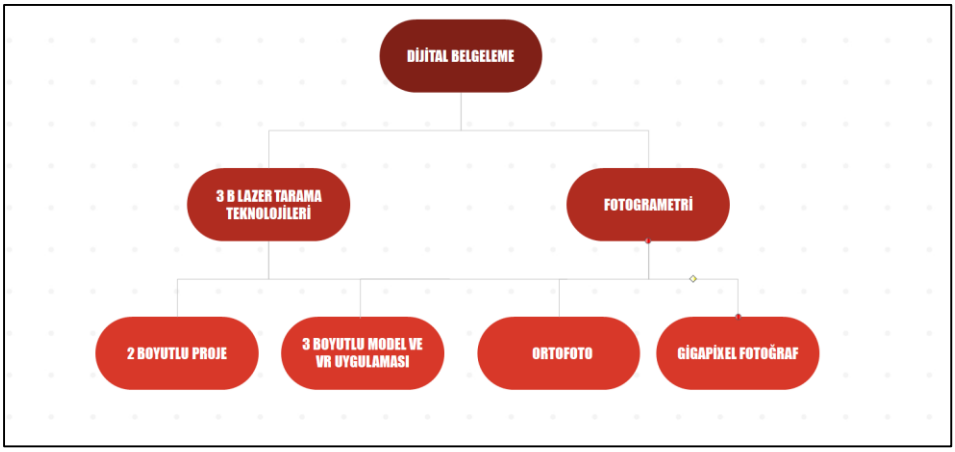


Figure 14. Digital documentation methods

The first field work was started in December 2011 under very unfavourable conditions due to the cold and rainy weather and the general survey of the land (Figure 15, 16).

Figure 15: Terrestrial survey studies

Laser scanning data was taken with two devices and three-person teams using terrestrial scanning devices with built-in digital cameras. 200 terrestrial scanning sessions were held in the entire field and another 100 sessions were held for coordinating. Photographs were taken with calibrated cameras. Data measurements were made with an accuracy of 2-4 mm.

Figure 16: Terrestrial Survey Studies

3.1.3. Data pre-processing

Pre-processing data consists of two stages. The first stage is the stage in which the data obtained from a large number of laser scanning sessions are combined. It is the stage of colorization by the colours assigned from the photographs taken by the camera placed on the top of the laser scanner and laser point clouds are georeferenced and combined with the precision of 2mm (Figure 17-18).

Figure 17: Terrestrial survey studies

Figure 18: Terrestrial survey studies

Figure 19: Terrestrial scanning studies (drawing studies)

The combined point cloud data obtained from laser scanning is saved as.las or other formats, then exported to the software that can be used for CAD drawing phase (Şekil19).

Vector drawings of 3D point cloud data can be made in AutoCAD today. In the Erzurum project, drawings were performed with a special software developed to make 2 or 3 dimensional drawings from the relief bases point cloud and then exported to the AutoCAD program (Figure 20).

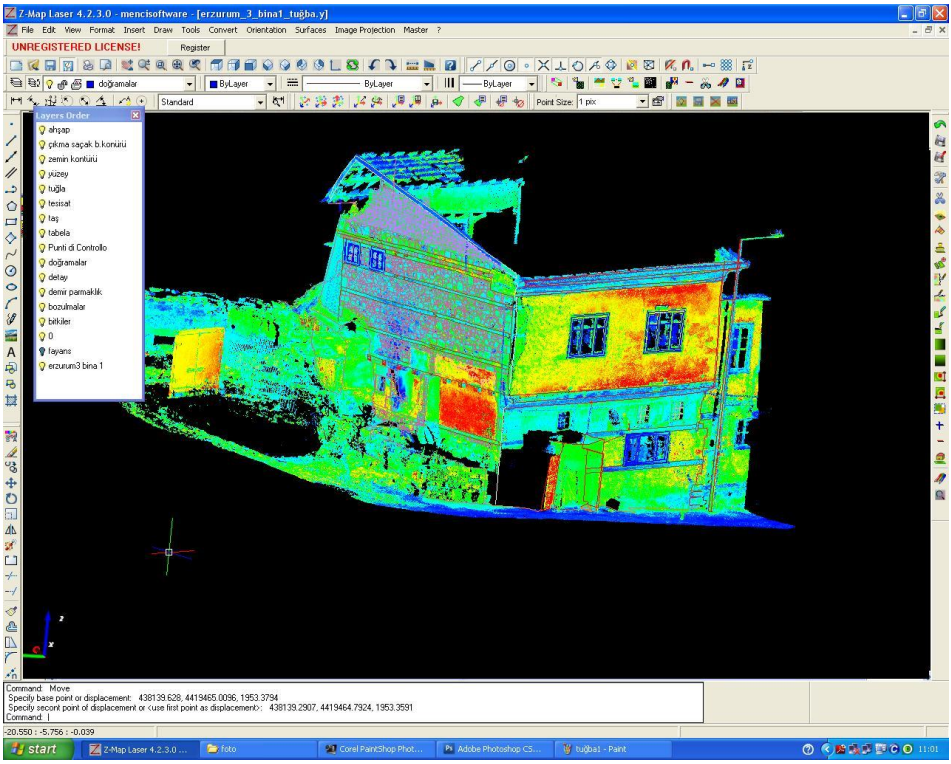


Figure 20: Terrestrial scanning studies (Vector drawing)

3.2. Project Design:

Practices made within the scope of the conservation of cultural heritage are carried out according to the deterioration of the structure by using one of the methods of maintenance, repair, simple repair and fundamental repair (URL5.principle nr. 660, 1999) Within the scope of the Conservation Development Plan being made in Erzurum Castle and its surrounding area, it was brought to the agenda that the examples of civil architecture should be restored by giving them cultural functions that would increase their value, in the context of the theme of creating a

cultural route together with the monuments in the area (Figure 21). In this context, survey, restitution and restoration projects were conducted in accordance with the “fundamental repair" method.

Figure 21: View of the texture around from the castle (2012)

General information about the Architectural Cultural Heritage Examples on the 9 blocks located around the Castle, which was studied within the scope of the project, is given in the tables below. The assets in the study area are named according to the lot and parcel numbers and projected. Tables includes the street view, location and ground floor plan of the buildings. (Table 2-11)

Table 2: Lot 561

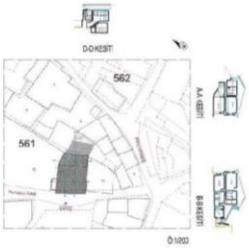
561/8		
		
561/9		
		
561/12		
		

Table 3: Lot 562

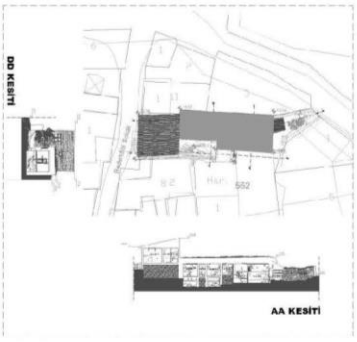
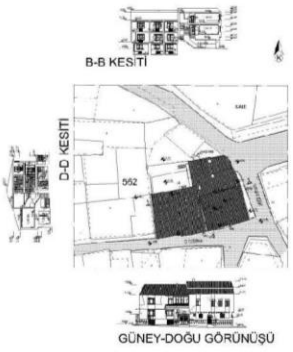
562/4		
		
562/5		
		

Table 4: Lot 566

566/12		
		

Table 5: Lot 567

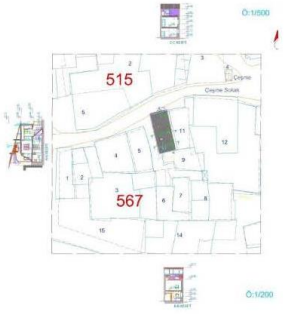
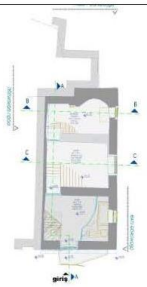
567/10		
		

Table 6: Lot 567

567/ 12	 	
567/13		
		

Table 7: Lot 581

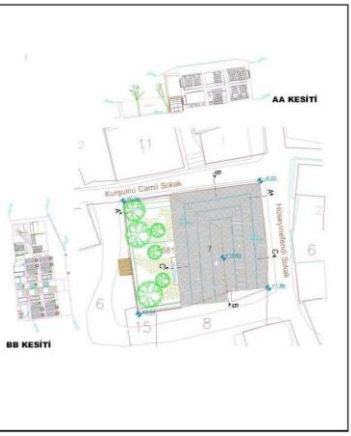
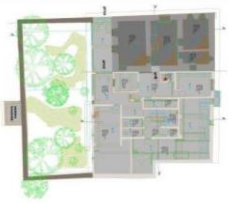
581/7		
		

Table 8: Lot 641

641/10		
		

Table 9: Lot 642

642/1		
		

Table 10: Lot 649

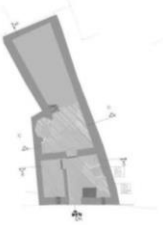
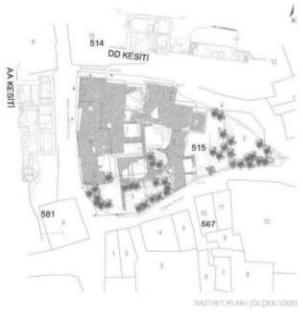
649/27		
		

Table 11: Lot 515

515/1,2,3,4,5,6		
		

3.2.1. Analytical survey

Analytical Survey is the study that shows the material used in the building, the construction technique, the structural features, the deterioration and deformations of the structure and the material, with legends and mapping method, on the drawings designed for the current state of the building (URL9, Tek Yapı Ölçeğinde Rölöve, Restitüsyon Ve Restorasyon Projeleri Teknik Şartnamesi, 2023).

Analytical survey forms the basis for restitution and restoration studies. This study plays an important role in making restitution decisions and allows for the preservation of authentic parts and the exploration of spaces in restoration work. The area where the study is performed is to house the last remaining examples of a traditional texture. "Analytical

surveys" were carried out by processing the materials and deteriorations on the surveys conducted during the field measurements and office work.

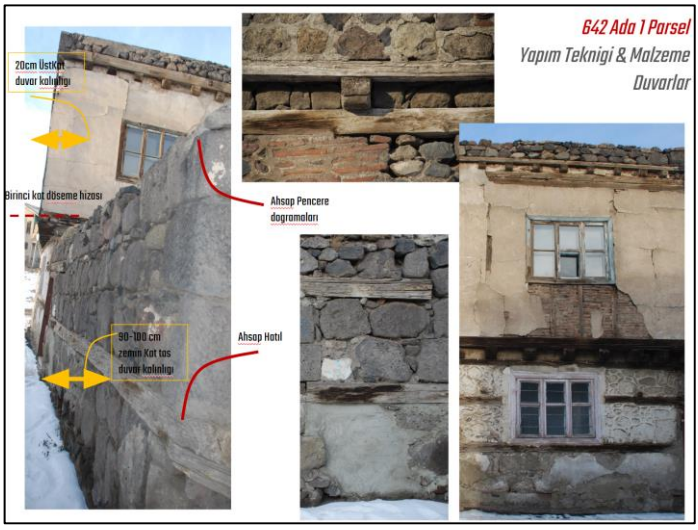


Figure 22: Dijital photos used in material analysis (The ground floor of the building in 642/1)

Figure 23: Example of analytical survey (The ground floor of the building in 642/1 parcel)

Authentic and additional walls, materials and distortions were processed on plans and sections in relation to the legend in the analytical evaluation. The building on block 642, parcel 1, given as an example, consists of two open courtyards and indoor spaces combined with a triangular outer wall.

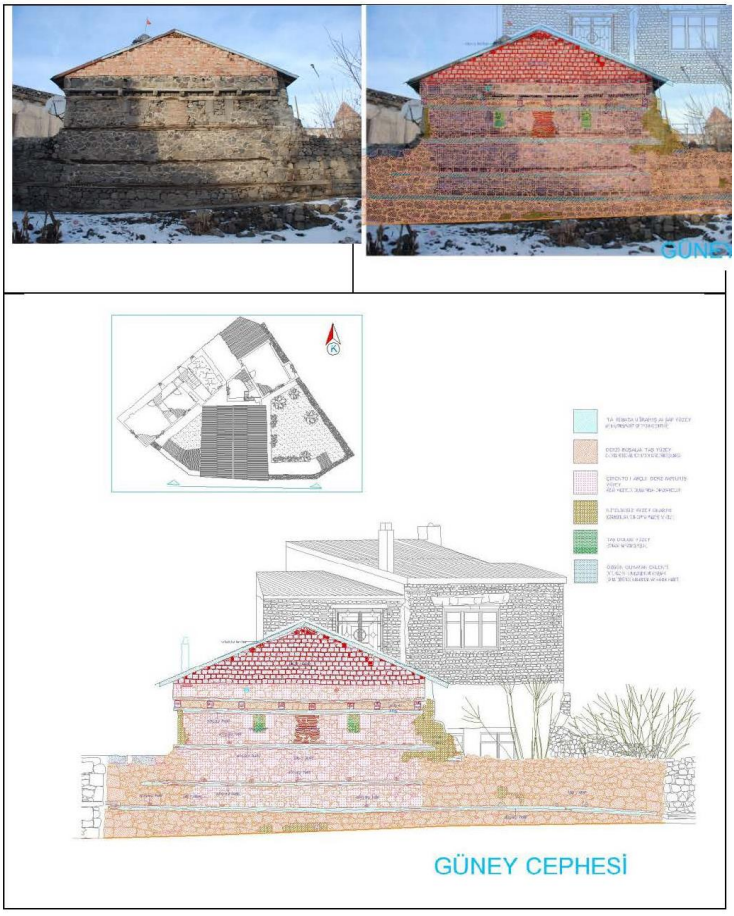


Figure 24: Analytical survey, Digital Photo, OrtoPhoto, Drawing, (642/1)

3.2.2. Pre-restitution surveys

According to Relating to The Conservation and Management of Historic Cities and Urban Areas, the form, appearance, interior and exterior features of the buildings defined by their structure, volume, style, scale, material, color and decoration should be preserved (URL13, Icomos-Valetta Principles, 2011). Conservation of cultural heritage in all its forms and historical periods is rooted in the values attributed to the heritage. Our ability to understand these values depends, in part, on the degree to which information sources about these values may be understood as credible or truthful (URL14, NARA, 1994).

The analysis of the original parts and the parts added later is an important step in the conservation process. Before the restitution work to be carried out after the survey work, historical research, comparative studies and period analyses are made about the building and its surroundings (URL9, Tek Yapı Ölçeğinde Rölöve, Restitüsyon Ve Restorasyon Projeleri Teknik Şartnamesi, 2023)

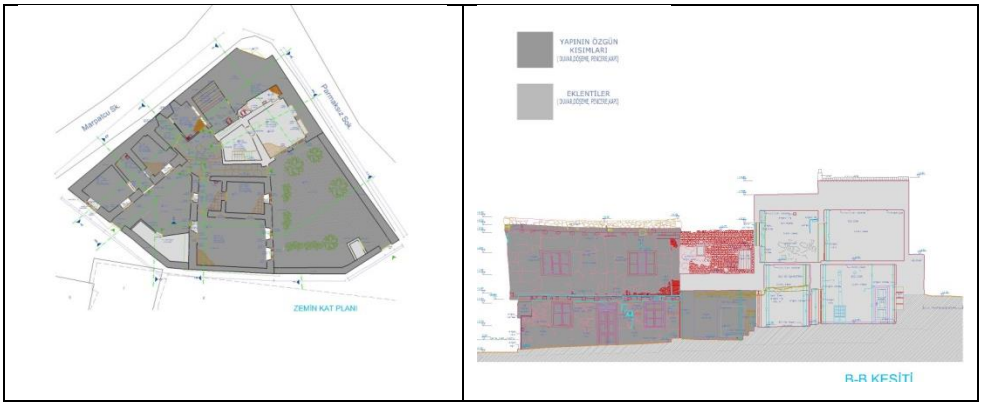


Figure 25: Studies before restitution (data from the property), analytical survey section-view

At this stage, general information such as historical researches, archival documents, previous surveys, old photographs, aerial photographs, maps, city plans, engravings and repair records of the building and its surroundings were compiled.

In order to find a solution for the missing parts of the building, a typology was created to analyse it comparatively with similar structures within the scope of the same period/same settlement, different period/same settlement, same period/all settlement.

The most important architectural element of Erzurum houses is the tandirevi (kitchen-like place where households spend most of their time), which is the main place of the building. The buildings are the structures with courtyards whose outer walls and sometimes the upper part are closed. When we look at the plan typology, besides the single-storey houses with fewer examples consisting of a room, tandirevi, courtyard, barn and merek (storage-pantry), two-storey house types with a tandoori

house on the ground floor and many rooms on the lower and upper floors are seen more commonly. There are also courtyard mansions with haremlik and selamlik sections (Karpuz, 1984).

The main plan scheme of Erzurum houses is determined by the relationship between the courtyard and the tandirevi on the ground floor. The courtyard, which is entered from the main space, gives passage to the side spaces, the upper floor and the tandirevi. Thus, it emerges as an important distributive, organizing space.

Depending on the location of the tandirevi in the ground floor plan, the courtyard can be elongated or square. The lighting of the courtyard is provided by the windows above the door. The floor is flagstone paved. While the tandirevi is used in the winter, in the summer people sit in the courtyard and do housework.

The ground floor can also be seen as a service floor. If there are merek, barns and warehouses, these are settled on the ground floor. In addition, the tandirevi is located on the ground floor as a characteristic item in Erzurum Houses. This place, whose upper cover is sort of dome-shaped, has a high volume and no space is placed on it. The tandirevi has a stove, wooden bench, cabinets and shelves.

On the first floor of the houses, there is an ‘iwan room', the main room in the style of the oriel, which dominates the facade and is often defined by a cantilever. The rooms are large in size and high in height. The dominant fiction in the upper floor plans is that there is a sofa that provides access to the rooms. The staircase is usually located in a

separate hall space. If there is a shortage of space, this staircase can be a single-armed staircase in the sofa space (Table 12).

Table 12: General Architectural Features of Erzurum Houses

Construction system and material	They are mostly masonry structures and cut stone or rubble stone was used on the bearing walls.The load-bearing walls of the houses are supported by wooden beams by making a frame every one meter.
Ground Floor	It spreads over a wide area on the ground and accesses from space to other spaces are quite frequent. Houses usually have barns. It has one or more courtyards. Courtyards are the living space where daily life takes place, there are often a fountain. Courtyards can be covered or uncovered. Access to other spaces is provided here.
Second Floor	Rooms are located on the upper floors. The high dovetail ceiling of the tandoori house, which is the main place, rises on this floor. There is access to the top of the covered courtyards.
Facade features	The entrance to the buildings is from the open-closed courtyard. The ground floors are massive and enclosed. Window spaces are narrow. The upper floors should sometimes emerge along the facade, sometimes in the form of a room. The protrusion depth is approximately 50-70 cm. The window and wall ratios are equal on the upper floor facades.
Interior features	Most houses have a tandoori room, the masonry building with stone walls is covered with a unique wooden beam system defined as the “dovetail roof”. The tandirevi (tandoori room) is the main space.

3.2.3. Restitution

Restitution works are the processes in which the interventions faced by the cultural assets from the time they were built are surveyed and the "authentic" state of the building when it was first built is revealed. This study has been conducted with the help of data obtained from the traces on the building, from sources such as photographs, drawings, documents, narratives belonging to the past periods or by analogy.

Restitution projects of the building were carried out by using data coming from the building itself (additions that are not in the authentic structure of the building and made in different periods, elements in the authentic structure of the building that are not observed today, elements in the authentic structure of the building and observed today but changed during the period, traces of different scales and qualities that cannot be interpreted), archive documents, old documents (if any), typology research (Karpuz, 1984) and comparative studies.

The data traced on the building during the restitution phase are data with a high degree of accuracy. In areas where the working environment is suitable, review essays are performed from various points of the building (ceiling, floor, wall) and it is tried to reach the correct data. In the Erzurum project, it was not possible to carry out such researches due to the negative climatic conditions and the general conditions of the buildings and the time constraint. Through the use of digital documentation methods, it was ensured that the data of the parts of the building that cannot be accessed could be retrieved. Although the

research excavation could not be carried out and even the obstacles such as garbage and furniture in the spaces were not removed, the measurements of the spaces were made. Floor plans could be drawn thanks to the legibility of the foundation and wall traces in the outdoor measurements in the obtained point cloud data. With the support of coordinated data, the connection between the lower and upper floors was established and the typologies of the missing spaces were completed (Figure 26-27).

Figure 26: 581/7 and 561/12 survey and restitution projects

Figure 27: 642/1 and 562/5 survey and restitution projects

The data used in restitution studies and their reliability are evaluated according to the fact that the source is concrete and robust in a way that does not allow interpretation.

Low: Data obtained from verbal sources such as title deed registration, description, story, etc. of the building.

Medium: Data obtained from historical maps, aerial photographs or old cadastral information.

High: Facade and interior photographs of the building itself or the street where it is located, plan sketches or data of a similar structure.

Very high: Data obtained by researching and drilling on the structure or previous surveys and projects of the structure.

Table 13: Datasets Used in Restitution Studies and Their Accuracy Levels

Area in Which Data Provided	Accuracy Level			
	Low	Medium	High	Very high
Traces taken from the building itself				
Archive documents (Photo, Drawing, sketch, map)				
Previous Projects				
Analogy (via building type, building period typology)				

The data obtained from the structure appear as the safest data in terms of accuracy (Table13). In this context, it is possible to say that the use of fast and reliable data sets provided by digital documentation methods is

effective in obtaining the autentic plan type. In the work of the project of Zirnikli Mansion, which is the oldest mansion structure studied in the area, this process is explained on the basis of structure (Kan, et al., 2017).

4. Conclusions and Suggestions

Documentation is the first step in the conservation process. The concern for fast and accurate documentation and the requirements of the age have made digital documentation mandatory. Photogrammetry and laser scanning methods, which are advanced documentation techniques, allow rapid acquisition of reliable data in field studies by producing a 3D digital model of the terrain. These methods, which were first used in the fields of cartography, are used as a safe and fast method within the scope of documentation of cultural heritage, especially in areas that have lost their integrity.

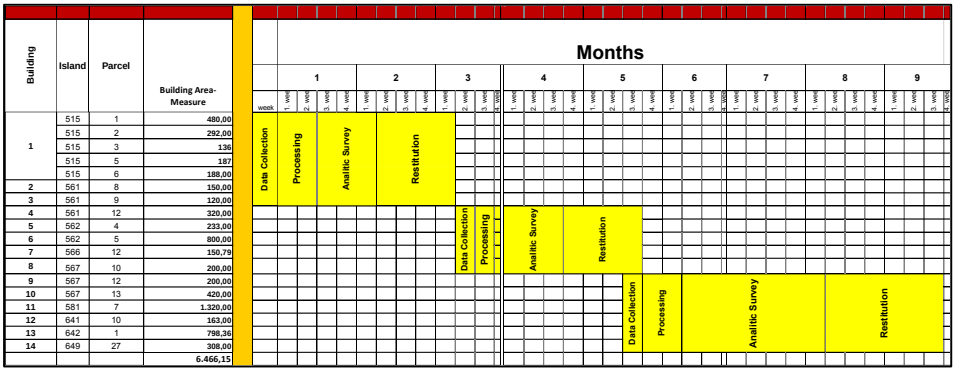
In cultural heritage sites, time is important because of the deterioration processes of the structures to be preserved. It was observed that the buildings measured in Erzurum continued to disappear even during the work. In fact, there were controlled demolitions for security reasons. Therefore, the use of laser scanning and other digital methods is a reliable method in terms of providing fast and accurate recording of data.

In the Erzurum project, the preparation of analytical surveying and restitution projects, including field work, was completed in nine months in a total project area of 6.466.15 m2 (Table 14). Receipt of buildings from the administration and waiting processes are also included in this.

The realization of these deadlines for a study of this scale was made possible by the use of digital documentation methods.

Table 14: Erzurum Survey and Restitution Studies Working Periods

Building	Island	Parcel	Building Area-Measure
1	515	1	480,00
	515	2	292,00
	515	3	136
	515	5	187
	515	6	188,00
2	561	8	150,00
3	561	9	120,00
4	561	12	320,00
5	562	4	233,00
6	562	5	800,00
7	566	12	150,79
8	567	10	200,00
9	567	12	200,00
10	567	13	420,00
11	581	7	1.320,00
12	641	10	163,00
13	642	1	798,36
14	649	27	308,00
			6.466,15



Digital documentation methods need equipment, software and hardware support. Such needs require investment. In addition, the fact that the land planning, research team, expert architect and expert mapping teams were involved in the work ensured the effective use of the methods (Table 15).

Table 15: Digital Methods Used in the Study and Place of Use

Work		**Laser Scanning**	**Digital Photogrammetry**
Survey	**Data collection**		
Analytical Survey	**Visual examination**		
Restitution	**Visual examination, crossreference, comparative analysis**		

The presence of digital methods used in field work in the Erzurum project played an important role for analytical studies and restitution studies (Table 15) (Picture 26).

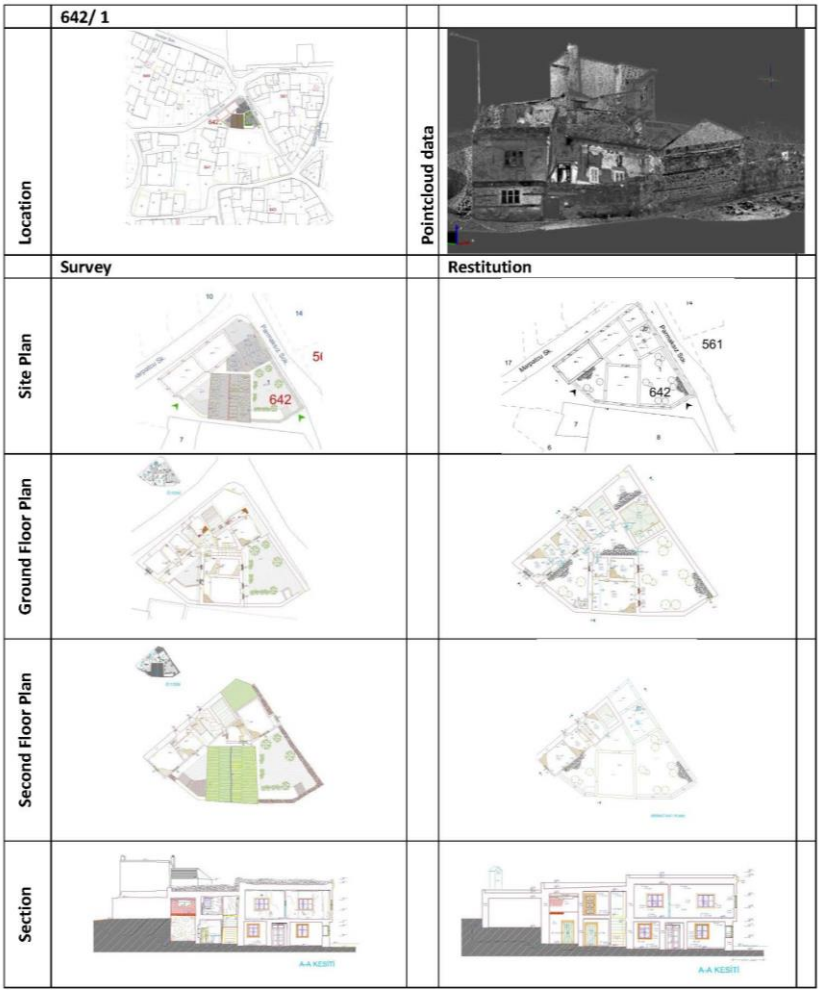


Figure 28: Point Cloud, Survey and Restitutions of the Building in Block 642, Parcel 1

Table 16: Advantages and Disadvantages of Digital Documentation Methods

	Advantage	**Disadvantage**
Terrestrial Scanning	Fine Detail Scanning, interior measuring, high dense data	Insufficient Roof and high-level elements, powerful hardware necessity
Airborne lidar	Site Scanning	Insufficient Detail measuring
Drone lidar	Site scanning, roof scanning	None interior measuring
Mobile lidar	Street and site measuring	Low quality data
Photogrammetry	High resolution data	Interior measuring and background data

It has become possible to process the data collected by different methods at the data collection point, by means of the software developed today, by combining terrestrial scanning methods, airborne lidar, mobile lidar technology and drone or terrestrial photogrammetry methods in the same datasets (Table 16). By using such measurement methods together, the disadvantageous parts can be eliminated.

Depending on the characteristics of the study area, it may be possible to use airborne lidar, mobile lidar and drone technologies as well as terrestrial scanning and terrestrial photogrammetry. This hybrid method, in which all data are integrated with the georeferencing method, enables the holistic digitization of cultural assets or cultural texture (digital twin).

In Architectural Documentation, the processes of documenting, researching, analysing, interpreting and diagnosing the structure should continue during and after implementation (URL3, Icomos Türkiye Mimari Mirasın Korunması Bildirgesi, 2013). In this context, the use of digital methods supports the work of conservation specialist architects, thanks to its capacity to receive and compare data quickly and periodically.

Conservation of architectural heritage is inherently a multidisciplinary field (URL15, The Washington Charter, 1987). The “architect specializing in conservation” is responsible for the coordination and management of the whole of this multidisciplinary field. Digital documentation techniques are a "measurement" technique and a reliable tool for documentation. The choice of documentation method (laser scanning, photogrammetry), preferences for data acquisition density and shape (terrestrial, aerial, mobile), and interpretation and evaluation of the obtained data must be done by Conservation Specialist Architects with architectural and protection knowledge. The conservation process is completed by restoring and using the building in a way that integrates it with current conditions. It should not be forgotten that the act of conservation the historic environment is a matter of analysis, evaluation and design.

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