

An Approach For The Reconstruction of a Traditional Masonry-Wooden Building Located In An Archeological Area. Part I: Methodology

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Abstract

This study, presented in a pair of articles, defines a comprehensive methodological approach to the reconstruction of a traditional masonry-timber mansion building constructed in the 1880s of the Turkish house typology on Istanbul's historical peninsula area that was intentionally demolished in 1948. A historical process research was carried out in the first stage of the study, after which ground penetration radar measurements and an archeological excavation were carried out to determine any possible remains or ruins of the structure, and the original architectural features of the demolished building were ascertained from the obtained data. The proposed stages in the current paper can be considered a comprehensive approach to the determination of the authentic properties of demolished or destroyed buildings in historical areas, given that the methodology allows for the integration of construction features obtained separately and independently through different activities, such as excavations, georadar measurements and historical surveys. The result is a versatile approach to the complete and realistic reconstruction of historical buildings.

1. Introduction

The current study presents a comprehensive methodology for the reconstruction of historical buildings. The entire process is illustrated through a case study of a historical building that was intentionally demolished in 1948 (Figure 1). The building, known as *İbrahim Efendi Konağı*, was built in the 1880s on Istanbul's historical peninsula, and as a prime example of the traditional Turkish houses built in the Süleymaniye region at the time, it has considerable historical significance. The building served as a secondary school until 1945 and was demolished in 1948, and while aerial photos from 1950 and 1966 show two buildings, no buildings have been constructed on the site since 1982. The original architectural features of the building were ascertained in three stages: (i) a historical process research, (ii) ground penetration radar measurements, and (iii) archeological excavation. The original form of the building in terms of its façade and plan was determined in the present paper. The reconstruction applications will be described in Part II of the study.

Cultural assets are destroyed by both natural events, such as earthquakes, or by fire, or may be completely demolished as a result of anthropogenic factors, urbanism movements, wars, and vandalism over time. Historical buildings that are symbolic of a political view, on the other hand, may be demolished by people with different views. The term "restoration" refers to the return of a place to an earlier known state through the removal of accretions or the reassembly of existing elements without the introduction of new material. Reconstruction, on the other hand, is a building process in which the first known state of the building is recreated [1]. Ancient materials must be preserved through the addition of further elements to achieve an adequate degree of safety and functionality. The reconstruction of a building that is defined as cultural heritage, however, should only be carried out in exceptional circumstances, while the reconstruction of partially or completely demolished buildings may be acceptable if sufficient documentation is available [2]. In this respect, one of the most important stages in a reconstruction is the restitution stage, in which the original building features are determined. At this stage, many sources are

accessed, such as old photographs, documents, technical specifications, drawings, similar building typologies and communications related to the period. The parameters can then be associated with each other to ascertain the features of the original building.

1.1 Reconstruction approach

One of the interventions to which historical buildings are subjected is the reconstruction approach. Article 10 of the Venice Charter states, “*Where traditional techniques prove inadequate, the consolidation of a monument can be achieved by the use of any modern technique for conservation and construction, the efficacy of which has been shown by scientific data and proved by experience*” [3]. Several principals and limitations related to reconstruction processes are defined in the Burra Charter [4], in which Article 18 states “*reconstruction should reveal culturally significant aspects of the place*”, while Article 19 says “*reconstruction is appropriate only if there is sufficient evidence of an earlier state of the fabric*”. The following article states: “*reconstruction is appropriate only where a place is incomplete through damage or alteration, and only where there is sufficient evidence to reproduce an earlier state of the fabric. In some cases, reconstruction may also be appropriate as part of a use or practice that retains the cultural significance of the place. Reconstruction should be identifiable on close inspection or through additional interpretation*”. Accordingly, four approaches to the reconstruction of historical buildings are: i. The engagement of existing and new elements, ii. Minimal interventions aimed at improving structural performance, iii. The reconstruction of new parts that respect the plan, and iv. The engagement of new elements and some demolitions [5].

Reconstruction is the preferred approach in the event of the complete demolition of a historical building or group of buildings that have been defined as a cultural asset. In such situations, the reconstruction has didactic purposes, since new functions focus on the reconstruction of only the external envelope, rather than on construction techniques and materials, such as carpentry, joints, masonry organization, etc. In the case of a partial demolition, repair should generally be the preferred option. Reconstructions are made in line with an expected outcome, such as for the rehabilitation of society; for the addition of symbolic value to buildings in the city and society; and for preventing losses of cultural identity and memory. In addition, the reconstruction process must be implemented carefully to ensure the preservation of the original values, and the process is to be carried out considering the scientific purposes, and should include an evaluation to check whether all tasks in the entire process have been fulfilled. In international codes, it is noted that reconstructions should be made appropriate by relying on exact information and documents, and by performing scientific studies [6]. The reconstruction of demolished or destroyed buildings can sometimes be challenging due to limitations in the knowledge of the architectural properties and construction approaches, as well as the historical processes. Thus, the planning of a reconstruction should include an assessment of various alternatives. The reconstruction of a historical building should follow a technical approach and should be based on historical knowledge to ensure the conservation of the cultural identity of the building in question. Furthermore, the current international conservation charters and standards should be considered in all of the above-mentioned processes. A reconstruction

operation should be preceded by an interdisciplinary study to identify the construction technique, and the structural elements and material features of a building, in accordance with historical documents [7].

Various opinions can be sought when deciding whether or not a reconstruction is appropriate. The opinions against reconstruction claim that reconstructed buildings are little more than imitation, and do not reflect the true value of the demolished building. New construction systems and techniques have emerged since the construction of the building examined in the present study, and from this point of view, questions may be raised regarding the preservation of the original building system and/or construction technique of a demolished building in a reconstruction application. One such issue is the interaction of a studied building with its neighboring buildings in the design stage, while another is the seismic performance and the results of the needs analysis in the selection of an appropriate construction type and construction materials.

1.2 The background

Historical buildings are defined as cultural assets that are considered a part of a national and/or international identity [8]. Such buildings may disappear over the years for various reasons. In the reconstruction of such buildings, many issues should be considered. It is crucial to seek balance between several parameters, such as refunctionality and need, to ensure that the cultural and architectural values are not damaged when the functions of historical buildings are changed to meet current and future needs. The reconstruction of the structures to their original state in the period in which they were built is an important factor in the protection of the cultural and historical value of a building [9–11]. In addition, the relationship of the building with the environment is also to be taken into consideration in reconstruction efforts [12, 13], for which there are various approaches, including model-based methods and BIM, in reconstruction [14–17]. An approach to the planning of construction projects, including those involving the reconstruction of historical buildings are presented [16]. To overcome the problems associated with the reconstruction planning of structures, especially those of historical significance, a digital tool has been described that was utilized in the modeling and analysis phases of a project to reconstruct a historical retaining wall. In another approach, reconstruction projects were prepared based on a statistical analysis and multiple criteria decision-making methods, making use of BIM technologies [17], and a methodology proposed for the identification of problems with the potential to influence the design, construction and maintenance of reconstruction projects. The advantages brought by BIM to the avoidance of preidentified problems in reconstruction operations were subsequently discussed. When dealing with the reconstruction of structures, structural safety and the results of a needs analysis are also considered in the selection of the optimum structural system and materials. In a related study, Pohle and Jager [18] reported on the reconstruction needs of a masonry building, based on their investigation of the characteristics of the building and functional requirements from the reconstruction, as well as the materials to be used in the reconstruction. Financing and duration are other criteria that need to be taken into account related to a reconstruction project. In a study addressing this issue, a financial model was proposed for the reconstruction of residential structures following an earthquake [19], with critical issues such as the timing and funding of the reconstruction also being analyzed. The reconstruction efforts

following earthquakes [20–22] may include the renewal of all buildings in a region through reconstruction or strengthening [23]. Post-earthquake reconstruction is a complex field, with economic, social and technological aspects, including those related to reconstruction [24], and decision-making methodologies have been suggested to guide reconstruction operations following seismic events. The attitudes of central and local governments towards post-disaster reconstruction in terms of disaster assessment, reconstruction management and the current policies should be investigated [25], and to this end, a comprehensive reconstruction scenario has been put forward for earthquake-affected regions [26]. In the next stage a series of tasks should be performed for the reconstruction of buildings after a disaster, ensuring their careful implementation [27]. In this stage, 3D visualization approaches are applied to steer the reconstruction based on old maps, plans, and drawings after they have been sufficiently digitized and quantified [28].

1.3 The scope

A remarkable amount of researches exist putting forward various approaches to the reconstruction of destroyed buildings, and many such studies have reported the reconstruction process of buildings that have been partially or completely destroyed by earthquake or fire. This study, which is presented in two parts, describes the reconstruction process of a specifically selected three-story traditional masonry-timber building with a semi-basement and some unique features that was built in the 1880s and demolished in 1948 due to anthropogenic reasons. Since that time, a number of buildings have been built on the site but later demolished. In 1/1000 conservation master plan, only the original building was given permission to be built on the site, preventing any modern construction, and so to satisfy a need of Istanbul University for new buildings, as the owner of the site, a decision was made to reconstruct the building for use as an administration facility. In the first part of this two-part study, a comprehensive methodology is presented for the reconstruction of historical buildings.

The first three stages of this methodology are presented in the current paper, while the reconstruction phase and the other three stages are described in Part II [29]. The methodology proposed in this paper can be considered an effective approach to the reconstruction of demolished buildings, and is presented here in four sections: i. A presentation of the original architectural and structural features of the building based on historical documentation, ii. GPR measurements for the determination of archeological findings and any remains of the original building on the site, iii. An archeological excavation of the construction site based on the GPR measurement results, and iv. a presentation of façade views as well as floor and roof plans as the architectural features of the original building.

2. Methodology

The proposed methodology can be considered a comprehensive and appropriate approach to the reconstruction of demolished or destroyed buildings, and is conducted in six stages, with each stage providing data for the subsequent stages. Fig. 2 presents the methodological approach to perform the reconstruction process.

The first stage involves a historical research, for which historical documents such as specifications, photographs, official decisions and maps related to the building were obtained. Then, the common building typologies, structural elements and material properties from the time the building was first constructed were investigated. The obtained information served as reference data for the examined building.

In the second stage, georadar measurements were carried out in the area in which the building was located to identify any remains or possible archeological findings that may have belonged to the original building. Any anomalies that could indicate the presence of foundation ruins detected in the georadar study were investigated with archeological excavations, and any findings uncovered by the excavation work were documented and removed from the site for exhibition at an appropriate location.

In the third stage, the plan and façade features of the building were ascertained from the data obtained in the first two stages. Accordingly, the size of the building spaces and their relationships with each other were calculated, and the features of the interior doors and windows, the window forms on the façade and the cascading were determined. At this stage, the construction type and techniques were investigated and the material properties of all structural and non-structural elements were determined. In cases where the planning scheme of a demolished building cannot be obtained, the plan types of buildings from the same period are considered, from which floor plans and façade features can be prepared. The Süleymaniye district, where the examined building is located, has experienced many fires and earthquakes, and so new materials with appropriate seismic and fire-resistant properties should be used in buildings to be constructed in the area. The use of original materials (especially timber) can be financially difficult for the user due to the constant maintenance costs and unsustainable use. Currently, the reconstructions of such buildings is quite laborious and expensive, and furthermore, user satisfaction is linked to specific features of the building related to low heat loss, sound-acoustic performance and new technological infrastructures. For example, the original guillotine windows on the exterior façade lead to significant heat loss as the original details of these windows cannot prevent heat transitions, thus increasing the heating costs of the building. Moreover, insulation and plaster coatings to the inner surfaces of external walls both prevent water penetration and provide thermal insulation at the maximum level. Also, an elevator system had to be included in the design to make the building disabled-friendly, which was not a requirement in the original building. In this case, it may be apparent to users that the reconstruction works were carried out considering the different construction periods. The results of these initial project stages were submitted to the relevant municipalities and cultural asset protection boards for approval, as a mandatory step prior to the launch of the next phase.

In the fourth stage, boreholes were drilled, and seismic refraction and surface wave analyses were carried out to determine the soil characteristics. The data obtained in this stage were used in a structural numerical analysis.

In the fifth stage, the original building system, the applied construction techniques and the construction materials may be revised considering seismic effects, functional requirements, and the building-

environment relationship. In other words, sometimes original building plans may not be considered. In this case, a new spatial organization to suit the new function of the building was arranged for the reconstruction project, ensuring the original façade layout was maintained along with its material properties. On the other hand, the use of modern building materials may be preferred instead of the original materials to suit the new function, although in this case the construction area and plan features of the building were preserved. A structural model was prepared based on the selected steel-frame construction system, and considering seismic effects, a numerical analysis of the model was carried out, and thus the dimensions of the structural members were determined. Final design and construction projects were then prepared based on images of the original façade and the plan features of the building utilizing all the obtained data.

In the sixth and final stage, the prepared reconstruction project proposal was submitted to the relevant municipalities and cultural assets protection boards for approval, and after approval was granted, the tender and contract phases were completed. During the application process, the structural members were produced and transported to the construction site, and the construction began.

1. Historical data Old maps, drawings, plans Documents, Photographs Period analysis/Typology Art history research
2. Site survey & Board Georadar measurements Electromagnetic study Archeological excavation Documenting / Removing
3. Plan of the original building & Approval Plan properties & Facade Construction type Material properties
1st Approval by National council on monuments approval
4. Field & Laboratory Sampling (Soil) Lab tests Seismic refraction Surface wave analysis
5. Design & Analysis Functional requirements Building-environment rel. Construction technique Numerical analysis
6. Operation & Approval Final Approval by National council on monuments Bid & Contract Material supply Construction stage

The original building served as a residence and a school building, however the University had no need for a building with such functions and so the floor plan of the building was redesigned to include technical office spaces, in accordance with the needs of the University. The sustainability of a building depends on its usefulness and its satisfaction of requirements. Since the original interior details (layout, materials and configuration) were unknown, instead of a fictive interior design, a building was designed that met the current needs of the University, but with its original appearance, thus contributing to the preservation of the historical memory, and the project was sent to the Ministry of Culture Protection Board for approval. The original load-bearing system could not be adopted due to the current seismic regulations related to public buildings. Furthermore, while the maintenance and sustainability of timber buildings is possible for relatively small structures, in the present case, it was not applicable due to the size of the building.

A reconstruction project was prepared for the site, which is detailed on the 1/1000 conservation master plan, and was granted approval by the relevant conservation board. The application was made in accordance with the approved project. We believe the contribution of the project to the cultural environment to be very high. Since the project site is within the Süleymaniye quarter, it attracts the

attention of many local and foreign visitors, and a sign has been placed at the entrance informing visitors that the building has been reconstructed. The intention in the project was not to create a new history, but to offer a common value and make to contribute to the cultural environment and the University.

Literature contains many studies charting the reconstruction of buildings that have been damaged or collapsed as a result of an earthquake, and in these approaches, the existing/available materials associated with the buildings that were affected by seismic effects have been used in the reconstruction process. The methodology presented here is proposed for buildings that have been intentionally demolished or destroyed many years ago of which there are no surviving materials or ruins other than the foundations. Hence, the proposed approach differs from other methodologies in certain aspects, and so can be considered appropriate for demolished or destroyed masonry or timber buildings.

3. The Historical Context Of The Building

The masonry-timber building detailed in the present study, known as *İbrahim Efendi Konağı*, was constructed in Istanbul in the 1880s (Fig. 3), and comprised a partial basement, a ground floor, and two further floors (Fig. 4). The mansion original stood on a site that now belongs to Istanbul University in the Süleymaniye neighborhood of the Fatih district on the historical peninsula of Istanbul, which has been included on the UNESCO World Heritage list [30]. The examined building is located in a renovation area [31, 32]. The area and the subsurface remains were decided to be registered as a cultural asset by the Istanbul Renovation Areas Protection Regional Board of Cultural and Natural Assets, based on the qualifications specified in Law 2863 on the Protection of Cultural and Natural Assets [33], and in accordance with Article 18 of the Law, the building falls under Protection Group II. The reconstruction application was accepted upon a decision of the Superior Council of Cultural and Natural Heritage [34, 35]. Based on photographs in the archives of the German Archeology Institute and the Abdulhamid II Collection, we concluded that the examined building was constructed in the 1880s. The building is described as a secondary school on the German blue maps from 1913, the Pervititch maps of 1935 and the Istanbul aspect map of 1945. The building is absent from a photograph dated 1948 (Figs. 5 and 6), leading us to conclude that the building was demolished some time between 1945 and 1948. In photographs dated 1950 and 1966, in the decades following the demolition of *İbrahim Efendi Konağı*, two buildings can be seen on the site (Fig. 6a, 6b), while a 1982 photograph shows the site to be empty (Fig. 6c), and no construction has taken place since.

4. Field Study

Ground-penetrating radar (GPR) is a significant underground scanning technique that is mostly preferred in the initial stages of field researches, and so was considered for the development of the project. Georadar measurements were conducted to identify any evidence of the foundation ruins of the original building, or the presence of possible archeological findings [44].

4.1. Georadar method

A field study was made of the site of the building (Figure 8). The area is currently serving as an outdoor sports facility within Istanbul University. For the GPR measurements, a Zond 12e-brand georadar control unit, transceiver antennas and battery were used, and a total of 1480 m measurements were taken on the site along 41 lines with 300 and 500 MHz antennas. Accordingly, two- and three-dimensional radargrams were obtained from the continuous form measurements along with parallel profiles, and any anomalies detected on the radargrams were transferred to radargram diagrams. Using 2D radargram sections and 3D radargram block diagrams, the anomaly distributions were specified, and the anomaly images were thought to indicate the foundations of the original İbrahim Efendi Konağı. In the 3D radargram sections, the distribution of anomalies below ground was determined in 3D sections prepared by selecting the equivalent amplitude distributions.

Following the field research, it was ascertained that the GPR data could make a clear identification of foundation ruins, since the examined area was littered with the remains of former buildings, and the fact that the site had undergone considerable compaction and infilling to allow the ground to serve as the sports field for which it was being utilized at the time of measurement. Furthermore, the contribution of 2D and 3D imaging anomalies from the GPR scans was only limited.

4.2. Archeological excavation

Based on the findings of the georadar surveys, archeological excavations were carried out to identify any existing foundation ruins and to any ancient findings in the construction area. The excavation locations are given in Fig. 9a. A total of four boreholes were drilled for excavation analysis: Borehole no. 1, measuring 3.1 m × 2.3 m, was made in the eastern corner of the plot, while borehole no. 2, measuring 3.3 m × 3.6 m, was in the southeast of the area. During the excavations carried out in these locations, various marble items were found at different depths, the geometric and material properties of which are presented in Table 1. The finds were relocated to a place within the Central Campus of Istanbul University, where other fragments were also collected (Fig. 9b).

Table 1
Physical and geometrical features of the remains

Remain ID *	Definition	Material	Dimension (cm) **	Elevation (m)
r ₁	Cladding stone	Marble	<i>h</i> :48, <i>l</i> :60, <i>t</i> :6	-4.9
r ₂			<i>h</i> :114, <i>l</i> :60, <i>t</i> :9	-4.7
r ₃	Shaft part of column	Gray veined marble	<i>h</i> :93, <i>d</i> :34	-4.4
r ₄	Railing post	Marble	<i>h</i> :61, 14·10	-5.5
r ₅	Shaft part of column	Gray veined marble	<i>h</i> :87, <i>d</i> :34	-3.5
r ₆			<i>h</i> :58, <i>d</i> :34	-3.6
r ₇			<i>h</i> :67, <i>d</i> :40	-3.6
r ₈	Column base	Andesite	<i>h</i> :35	-4.9
r ₉	Column heading	Marble	75·48	-3.0
r ₁₀	Shaft part of column	Marble	<i>h</i> :103, <i>d</i> :56	-6.2
* r ₁ , r ₂ : The late Byzantine Era, r ₃ to r ₁₀ : The Byzantine Era, ** <i>h</i> : height, <i>l</i> : length, <i>d</i> : diameter, <i>t</i> : thickness				

Borehole no. 4 in the center of the site produced a remnant of which the formal features and architectural characteristics were unclear (Fig. 10). An examination of the general appearance and the construction technique applied to the item suggested that it came from a cistern (reservoir, water tank) that was probably built in the Late Ottoman era (the 18th or 19th centuries). The mass of the item was around 400 kN, and in situ observations and examinations showed that material deterioration had occurred in some structural materials, such as brick, stone, joints, fillings and plaster mortars. Furthermore, another small reservoir with relatively weak joints and grouts was identified in the northern part of the first construction area. In parallel to this, it was understood that the mortar on the architectural find had significantly lost its binding properties. The Cultural Assets Preservation Board decided that the finding had no architectural or historical value, and could thus be removed from the area. After the completion of the documentation procedures, the remains were removed, and excavations restarted for the construction of the retaining system. The justification for the selection of a well foundation as the retaining system is presented in detail in Part II, Section 4.1 of the study [29].

An excavation was also carried out for the well foundation-shear wall on all sides of the construction area (Fig. 11). Soil embankments were identified during excavations on the north, west and eastern edges of the site, while the remains of a stone wall at a depth of 2 m were determined during the excavations to the southwest part. The wall, which was built using a mud and sand mortar, measured 0.6 m high and

0.26 m wide, and ran in a northwest-southeast direction, and three cut stones were found behind it, side-by-side, at a depth of -1.85 m, that were determined to be unconnected. In another excavation carried out in the southwest of the site, foundations from the Turkish republic era were identified that were assumed to belong to buildings constructed following the demolition of *İbrahim Efendi Konağı* in 1948.

During the excavations for the construction of the well foundation, marble finds of various types and dimensions were identified at different depths (Fig. 12), the geometric and material properties of which are given in Table 2. It was decided to carry out an excavation work of the entire area under the supervision of the Directorate of Istanbul Archeology Museums, since it was believed that more unearthed remains could exist across the construction area [45], although no such cultural assets, whether movable or immovable, were found during these excavations. All remains were documented with survey reports and photographs and were removed from the site [46]. Thus, no ruins of the foundations of the mansion building were identified during either the archeological or well foundation excavations.

Table 2
Physical and geometrical features of the remains

Remain ID *	Definition	Material	Dimension (cm)**	Elevation (m)
s ₁	Cladding stone	Marble	<i>h</i> :60, <i>l</i> :47, <i>w</i> :6	-10.2
s ₂	Attic-ion column heading	Gray veined marble	<i>h</i> :30, <i>d</i> :88	-9.5
s ₃	Column heading	Marble	<i>h</i> :74, <i>d</i> :57	-3.8
s ₄	Shaft part of column	Gray veined marble	<i>h</i> :112, <i>d</i> :37	-9.5
s ₅			<i>h</i> :89, <i>d</i> :40	-11.1
s ₆			<i>h</i> :115, <i>d</i> :28	-9.5
s ₇	Paving stone	Marble	<i>h</i> :45, <i>l</i> :73, <i>w</i> :4.5	-3.0
* s ₁ , s ₇ : Late Byzantine Era, s ₂ -s ₆ : Byzantine Era, ** <i>h</i> : height, <i>l</i> : length, <i>d</i> : diameter, <i>w</i> : width				

The archaeological excavation was initiated in the light of the GPR data. During the excavation, the possibility of finding a cultural layer was considered, and so the process was carried out for the entire area. The cistern base identified on the construction site is thought to have been linked to the original building, although all of the remains revealed during the excavation were the archaeological fill or residuals from the other buildings constructed after the demolition of the original building. With the excavation, the potential destruction of a cultural layer was eliminated. Great care was taken in efforts to identify the original foundations of the building, but none of these led to any such discoveries. If foundation remains had been found, they would have contributed considerable to the understanding of the building's plan and spatial arrangement.

5. Architectural Features Of The Building

In the Ottoman period, in addition to their use in daily life, Istanbul's mansions also had official and social functions. All houses with more than 20 rooms were defined as mansions at the time, and they served mostly as the residences of chancellors such as the grand vizier, sheikh al-Islam and cadilesker, but were also used as government offices. In addition to their use for official business, they were also used to host meetings on science and for the presentation of inventions [47]. *İbrahim Efendi Konağı* was a three-story building with a semi-basement, featuring two timber stories built on top of a masonry ground floor. The building, a masonry/timber mansion, could be considered a large building for its time.

The architectural and structural features of the building were estimated based on: (i) the Istanbul Archeology Institute Archive, (ii) Abdullah Brothers' Albums (The brothers were photographers of international fame during the late Ottoman Era), (iii) historical Süleymaniye photos in the Abdulhamid II Collection, (iv) old Turkish house typologies, and (v) timber mansions in Süleymaniye region. The traditional Turkish house type – primarily two- or three-story timber buildings – was common up until the end of the 19th century in the Ottoman Empire, and especially in the regions inhabited by Turkish people, such as in the *Rumeli* and *Anatolian* regions within the borders of the Ottoman state. It was the preferred accommodation type for local people for 500 years, and is well known for its unique characteristics. The relationship of the building in the present study with its surroundings was determined based on information obtained from the German blue maps of 1913, aerial photographs dated 1918 and the Pervititch insurance maps of 1935. The outer façades of the building were determined from the measurements on the map of Istanbul from 1945, while the Pervititch map was used for the entrances to the *harem* (the women's quarters) and the *selamlık* (men's quarters) at the front of each flank, as well as the servant and basement entrances [48–52].

The plans of buildings built in the same period that served the same functions can be used to obtain such missing information as plan type, stair shape, location, the *harem-selamlık* separation and the spaces such as the anteroom in these structures. In this case, spatial planning was made based on the predictions of a typological study. Most of the information about the building was obtained from the Pervitich maps, from which the entrance directions, construction area, material types and simple façade layout were obtained, and as can be understood from the obtained data, the exterior of the building was clad in timber. The *sofa* (anteroom) is the most important space in a traditional Turkish house, and all rooms are accessible through it, and such buildings characteristically have a symmetrical plan with a central anteroom.

In the Islamic culture, houses are traditionally divided into separate sections for men and women, and especially palaces and mansions. The most common plan type in Ottoman-era Istanbul, especially in medium-sized mansions, are therefore buildings with *harem* and *selamlık* sections, with two stories and lobbies. *İbrahim Efendi Konağı* was a medium-sized mansion with a *harem* and *selamlık*, and so carries traces of the traditional Turkish house. The plan types of the timber mansion buildings in the Süleymaniye region, where the building is located, played an important role in the reconstruction of

İbrahim Efendi Konağı. In such traditional Turkish houses, all rooms are located around an anteroom – known traditionally as a *sofa*. In this plan type, possible changes to the shape, size or qualities of rooms are limited, although the *sofa* can take various forms. Iwans, known traditionally as *eyvan*, are recessed spaces within the central anteroom that are added to bring air, light and decoration to the anteroom. The main factors behind the preference for anterooms in such mansions are the shelter and effective heating the design provides. Turkish house-plan types can be classified as: i. without anteroom, ii. with an outside anteroom, iii. with an inner anteroom, and iv. with a central anteroom. Locating the sofa in the center gives the house plan a squarer or nearly square rectangular form. In this house-plan type there are generally four large rooms and four corners, between which, service spaces such as stairs, iwans, storerooms and kitchens are located. The plan type with a central sofa allows alternative plan layouts, and so this type was generally preferred over other types in the larger mansions and palaces in Istanbul. *İbrahim Efendi Konağı* features a central anteroom, giving it a symmetrical plan. In other words, the plan of the mansion matches with the buildings in this typology (Fig. 13).

The examined building is located in the Süleymaniye region, where houses with an ancient typology were planned to protect privacy. The houses sit within a garden and are separated from the street by walls. The rooms around the sofa are usually located on the upper floors with views of the street and the garden, meaning that a connection with street life was maintained through the upstairs rooms and exits. An examination of the general features of the timber mansions in Süleymaniye revealed that the residences were mostly built with a central anteroom. The sofa is the central area of the house, extending also into the upper floors, while the other rooms are accessed via the stairs at the end of the sofa. Windows on either side of the entrance door provide illumination to the anteroom, and the other rooms are located around the anteroom in an almost square geometry. These houses have a two- or three-step rise in the anteroom at the main entrance. Typology studies in this region revealing all the above information were taken as reference, as the examined building's façade and plan features corresponded to those of the other timber mansions [53]. The mansion building attracts particular attention with its façades, as can be seen in old photographs of the Süleymaniye region. In these photographs, the walls of the building, which appear as polygons, can be clearly perceived, resembling half an octagon, and these polygonal walls descend to the ground on three sides of the building, and are seen as exhedras on one façade. In the middle of the rear façade, a solid rectangular console continues up to the first and second floors.

The façades of the building were symmetrical in layout. The façade layout of the building was arranged in a traditional timber architectural style in the Süleymaniye region. While arched windows adorned the ground and basement floors, guillotine windows were preferred for the upper floors. The guillotine windows, which had timber casings and sills, gave the façade a linear rhythm, and timber moldings at each floor level broke the monotony of the design by providing dynamism to the façade. Consistent with the traditional elements of timber architecture seen in the Süleymaniye region, timber veneer boards decorated the façade of the building. Aerial photographs show also a symmetrical layout to the roof. Although the bright lanterns on the roof of the building are uncommon elements in this typology, there are other rare examples in the Süleymaniye region. The fact that the building had two different entrances indicates that it was designed with a *harem* and *selamlık*. Similar to the typological ceiling features of the

period, traditional geometric decoration forms were created using timber slats on the building, and it is believed that similar ornamentations could be seen in other houses, although with minor differences [49]. As stated earlier, the dimensions and proportions of the façade of *İbrahim Efendi Konağı* were garnered from historical maps, photographs and old documents. The internal organization of the spaces was based on the typology of the building and from references obtained from the façades. In the light of all this information, in addition to the floor and roof plans prepared for the building, the estimated sectional elevations and façade views are presented in Figs. 14 to 17.

Due to the two mentioned entrances, situated on the northeast-southwest axis of the building, of which the one on the north-eastern façade faces the main street, there is only space for the staircase to the *selamlık* on the southwest side. A set of stairs on the southwest façade leads to both the entrance and the *harem*, with a sofa in the center of this spatial layout. No exact match with similar buildings from the same period can be expected. The room plan was changed according to needs in the reconstruction study, and a new office arrangement was implemented.

6. Conclusions

The current study presents details of a project for the reconstruction of a traditional masonry-timber mansion building that was built originally in the 1880s, and that was intentionally demolished in 1948. A comprehensive methodology is proposed for the effective reconstruction of historical buildings. Although no residuals of the building were identified from excavations or georadar surveys, the proposed approach provided details of the building as a functional and comprehensive method based on the use of various datasets obtained using different tools and measurements. Similar buildings in the near vicinity did not contribute to the study, since almost all of the buildings from the period have been demolished or destroyed in time through vandalism. The presented methodology can be applied by other researchers as an effective approach to the reconstruction of demolished buildings in historical areas.

Such projects that may emerge during multi-dimensional and multi-disciplinary works to access information about demolished buildings can involve a long implementation process after obtaining the approval of the relevant institutions, resulting in demolished buildings being brought back to cultural life. *İbrahim Efendi Mansion* is an example of such buildings. As a result of long and laborious efforts, a reconstruction decision was made and implemented, and the building today has an important role in the historical positioning and the sustainability of the Süleymaniye region, while serving also as a guide to further renovations and reconstructions of the surrounding buildings, and a source of fascination for both local and foreign visitors. The building is the outcome of a reconstruction process that involved both its interior design and its harmonious contribution to the historical texture through its exterior façades. Accordingly, it can be considered a successful reconstruction project, given the great effort that went into reproducing its original form and preserving its originality.

Declarations

Availability of data and materials

Not applicable

Competing interests

No potential conflict of interest was reported by the authors.

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Authors' Contributions

C. Akcay introduced the background and reviewed all the published papers. N. M. Korkmaz was the main responsible for the georadar research and archeological excavation. B. Sayin developed the methodology and presented the major contributor in writing and organization the manuscript. All authors read and approved the final manuscript.

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References

1. The Burra Charter. The Australia ICOMOS Charter for the conservation of places of cultural significance, 2013.
2. The Cracow Charter. Principles for conservation and restoration of built heritage, ICOMOS, 2000.
3. The Venice Charter. The Venice ICOMOS Charter for the restoration of historic monuments. Adopted at the second International Congress of Architects and Technicians of Historic Monuments, Venice, Italy, ICOMOS.org/charters/venice_e.PDF, 1964.
4. The Burra Charter. The Australia ICOMOS Charter for Places of Cultural Significance 1999, australia.icomos.org/publications/charters, 1999.
5. Caponette R, Sebastiano d'urso S, Rosso R, Poggioreale SM. Urban monument to negligence restoration strategies, Proceedings of the 4th Biennial of Architectural and Urban Restoration, BRAU 4 host of the itinerant congress hidden cultural heritage: Under water, under ground and within buildings, 2018.
6. Deniz M. Conservation theory's perspective on architectural reconstruction (Koruma Kuramının Mimari Rekonstrüksiyona Bakışı) Mimarlık dergisi. (J Archit). 2014;380:72–7. (in Turkish).

7. Yildizlar B, Sayin B, Akçay C. A case study on the restoration of a historical masonry building based on field studies and laboratory analyses. *Int J Archit Herit.* 2019;13:4,1–19.
8. Wallace I, Knight BD. in: Hampson FO, Reppy J, editors, *Societies in Space and Place, Earthly Goods: Environmental Change and Social Justice*, Cornell University Press, Ithaca, 1996, pp. 75–95.
9. Schildgen BD. *Heritage or Heresy: Preservation and Destruction of Religious Art and Architecture in Europe*. New York: Palgrave Macmillan; 2008. p. 266.
10. Dushkina N. Historic reconstruction: prospects for heritage preservation or metamorphoses of theory?, conserving the authentic: essays in honor of jukka jokilehto, in: Nicholas Stanley-Price and Joseph King, *ICCROM Conservation Studies*, vol. 10, 2009, pp. 83–94. Roma.
11. Bilgili B. An Assessment of Lost Cultural Heritage and Reconstructions: Examples from Istanbul Historical Peninsula, *Symposium on Strengthening and Preserving Historical Buildings and Cultural Heritage-5*, vol. 2, Union of Chambers of Turkish Engineers and Architects, Chamber of Civil Engineers, 2015, pp. 415–430, in Turkish).
12. Kong X, Liu D, Tian Y, Liu Y. Multi-objective Spatial Reconstruction of Rural Settlements considering Intervillage Social Connections. *Journal of Rural Studies* Article in Press. 2020.
doi:10.1016/j.jrurstud.2019.02.028.
13. Shabiev SG. 2003. Architectural Concept for Reconstructing Social Facilities, Based on the Environmental Requirements, In: *Proceedings of XXIII Russian School on Scientific and Technological Problems*, 638–648. Moscow: Russian Academy of Sciences.
14. Di Miceli E, Bianco V, Monti G, Filetici MG. 2017. “A Reconstruction Hypothesis of Collapsed Archaeological Masonry Barrel Vaults Employing Frictional Bearings, with Application to the Case Study of the Galleria Delle Volte Crollate.” Rome, *COMPdyn 2017: 6th ECCOMAS Thematic Conference on Computational Methods in Structural Dynamics and Earthquake Engineering*. 2587–2606. Greece, 15–17 June 2017.
15. Shindler K, Bauer J. 2003. “A Model-based Method for Building Reconstruction.” *First IEEE International Workshop on Higher-Level Knowledge in 3D Modeling and Motion Analysis, 2003*. First IEEE International Workshop on Higher-Level Knowledge in 3D Modeling and Motion Analysis.
16. Radziszewska-Zielina E, Śladowski G, Sibiłak M. Planning the reconstruction of a historical building by using a fuzzy stochastic network. *Automat Constr.* 2017;84:242–57.
17. Pavlovskis M, Migilinskas D, Antučevičienė J, Urbab I, Zigmund V. Problems in reconstruction projects, BIM uses and decision-making: Lithuanian case studies. *Procedia Engineer.* 2017;208:125–8.
18. Pohle F, Jäger W. Material properties of historical masonry of the Frauenkirche and the masonry guideline for reconstruction. *Constr Build Mater.* 2003;17:651–67.
19. Di Ludovico M, Prota A, Moroni C, Manfredi G, Dolce M. Reconstruction process of damaged residential buildings outside historical centres after the L’Aquila earthquake: part II—“heavy damage. reconstruction. *B Earth Eng.* 2017;15:693–729.

20. Astaneh-Aghda SM, Mir Ghaderi SR, Heidarinejad G. 2006. "Reconstruction of Housing Destroyed in the 2003 Bam-Iran Earthquake." 100th Anniversary Earthquake Conference. San Francisco.
21. Tringali S, De Benedictis R, La Rosa R, Russo C, Bramante A, Gavarini C, Valente G, et al. 2003. "The Reconstruction of the Cathedral of Noto." *Constr Build Mater* 17: 573–8. doi:10.1016/S0950-0618(03)00052-7.
22. Curti E, Podestà S, Resemini S. The Post-earthquake Reconstruction Process of Monumental Masonry Buildings: Suggestions from the Molise Event (Italy). *International Journal of Architectural Heritage*. 2008;2:120–54. doi:10.1080/15583050701646703.
23. Murao O. 2020. Recovery Curves for Housing Reconstruction from the 2011 Great East Japan Earthquake and Comparison with Other Post-disaster Recovery Processes. *International Journal of Disaster Risk Reduction* 45: 101467. doi:10.1016/j.ijdr.2019.101467.
24. Yaoxian Y. Decision-Making for Recovery and Reconstruction Following a Strong Earthquake. *Post Earth Rehab Reconstr* 1996;59-68. 10.1016/B978-008042825-3/50009-0.
25. Li Q, Umaier K, Koide O. Research on post-Wenchuan earthquake recovery and reconstruction implementation: A case study of housing reconstruction of Dujiangyan City. *P Disaster Sci*. 2019;4:1–10.
26. Khadka B. Mud masonry houses in Nepal: A detailed study based on entire reconstruction scenario in 31 earth-quake-affected districts. *Struct*. 2020;25:816–38.
27. Liu C, Fang D, Zhao L. Reflection on earthquake damage of buildings in 2015 Nepal earthquake and seismic measures for post-earthquake reconstruction. *Struct*. 2019;30:647–58.
28. Tobiáš P, Cajthaml J, Krejčí J. Rapid reconstruction of historical urban landscape: The surroundings of Czech chateaux and castles. *J Cult Herit*. 2018;30:1–9.
29. Akcay A, Korkmaz NM, Sayin B. An Approach for the Reconstruction of a Traditional Masonry-Wooden Building located in an Archeological Area. Part II: Building reconstruction. *J Asian Archit Build* 2021;1–17.
30. Ahunbay Z. Conservation and restoration of historical environment (Tarihi çevre koruma ve restorasyon) YEM publishing, 2004;134. ISBN: 975-7438-38-3 (in Turkish).
31. Republic of Turkey. Ministry of Culture and Tourism, Regional protection board for Istanbul renovation areas, Decision no. 6848 dated 12.07.1995.
32. Republic of Turkey, Ministry Board. Decision no. 10501 dated 24.05.2006 based on Law 5366 dated 16.06.2005.
33. Republic of Turkey. Ministry of Culture and Tourism, Regional Protection Board for Istanbul renovation areas. Decision no. 1301 dated 18.12.2010.
34. Republic of Turkey. Ministry of Culture and Tourism, Protection Board for Cultural and Natural Assets, Principle decision no. 660 dated 05.11.1999.
35. Republic of Turkey. Ministry of Culture and Tourism, Protection Board-4 for Cultural and Natural Assets, Decision no. 2478 dated 28.11.2008.

36. Istanbul satellite map. (2012) Istanbul Metropolitan Municipality, Available at: sehirharitasi.ibb.gov.tr (Accessed on December 2020).
37. DAI. Deutsches Archaologisches Institut, Istanbul Photo archive, 1880.
38. Library of Congress Prints and Photographs Division. Washington. D.C. 20540.0000. USA: Abdulhamid II collection, 1880.
39. Pervititch J. Istanbul in the insurance maps of Jacques Pervititch. Axa Oyak, Tarih Foundation publishing; 1935.
40. German blue maps. Deutsch syndikat für staebaliche arbeiten, 1911–1913.
41. Dağdelen İ. The map of Istanbul and Rumeli aspects, Istanbul Metropolitan Municipality, Directorate of Library and Museums, 2005 (in Turkish).
42. Panoramic aerial view of Istanbul. Available online at: harita.gov.tr/urun-256-haritasi.html&katid=14 (Accessed on August 2019).
43. Restoration report. Surveying, restitution and restoration project for Istanbul University, Rectorate Building, İstanbul İl Özel İdaresi. 2011 (in Turkish).
44. Yüksel AF. Examination of archaeological remains using GPR method for Istanbul University, İbrahim Efendi Konağı building, Project no. 2010/7160, 2010.
45. Republic of Turkey. Ministry of Culture and Tourism, Regional Protection Board for Istanbul-I renovation areas, Decision no. 150 dated 18.07.2012.
46. Republic of Turkey. Ministry of Culture and Tourism, Regional Protection Board for Istanbul renovation areas, De-cision no. 624 dated 06.03.2013.
47. Kuban D. Turkish house (Türk “Hayat”lı Evi), Eren publisher, 1995, Istanbul (in Turkish).
48. Bektaş C. Turkish house (Türk Evi), Yapı Kredi publisher, 1996, Istanbul (in Turkish).
49. Eldem SH. Turkish houses in Ottoman period I-II-III (Türk Evi Osmanlı Dönemi I-II-III), Istanbul, TAÇ foundation publisher, 1984 (in Turkish).
50. Eldem SH. Plan types in Turkish houses (Türk evi plan tipleri), İTÜ, Architecture Faculty publisher, 1954, Istanbul (in Turkish).
51. Eldem SH. Turkish architectural works of art (Türk mimari eserleri), 1975, Istanbul (in Turkish).
52. Küçükerman Ö. Rooms in terms of space organization in traditional Turkish house of Anatolia (Anadolu’daki Geleneksel Türk Evinde Mekan Organizasyonu Açısından Odalar), Apa publisher, 1973 Istanbul (in Turkish).
53. Uysal ÖN. Research about the interior planning of traditional Turkish house and analysing the examples from Süleymaniye zone, Mimar Sinan Fine Arts University, Science Institute, MSc thesis, 2007 Istanbul (in Turkish).

Figures



Figure 1

The project area (*white-marked by dashed lines*) (left); 3D illustration of the proposed building (right)

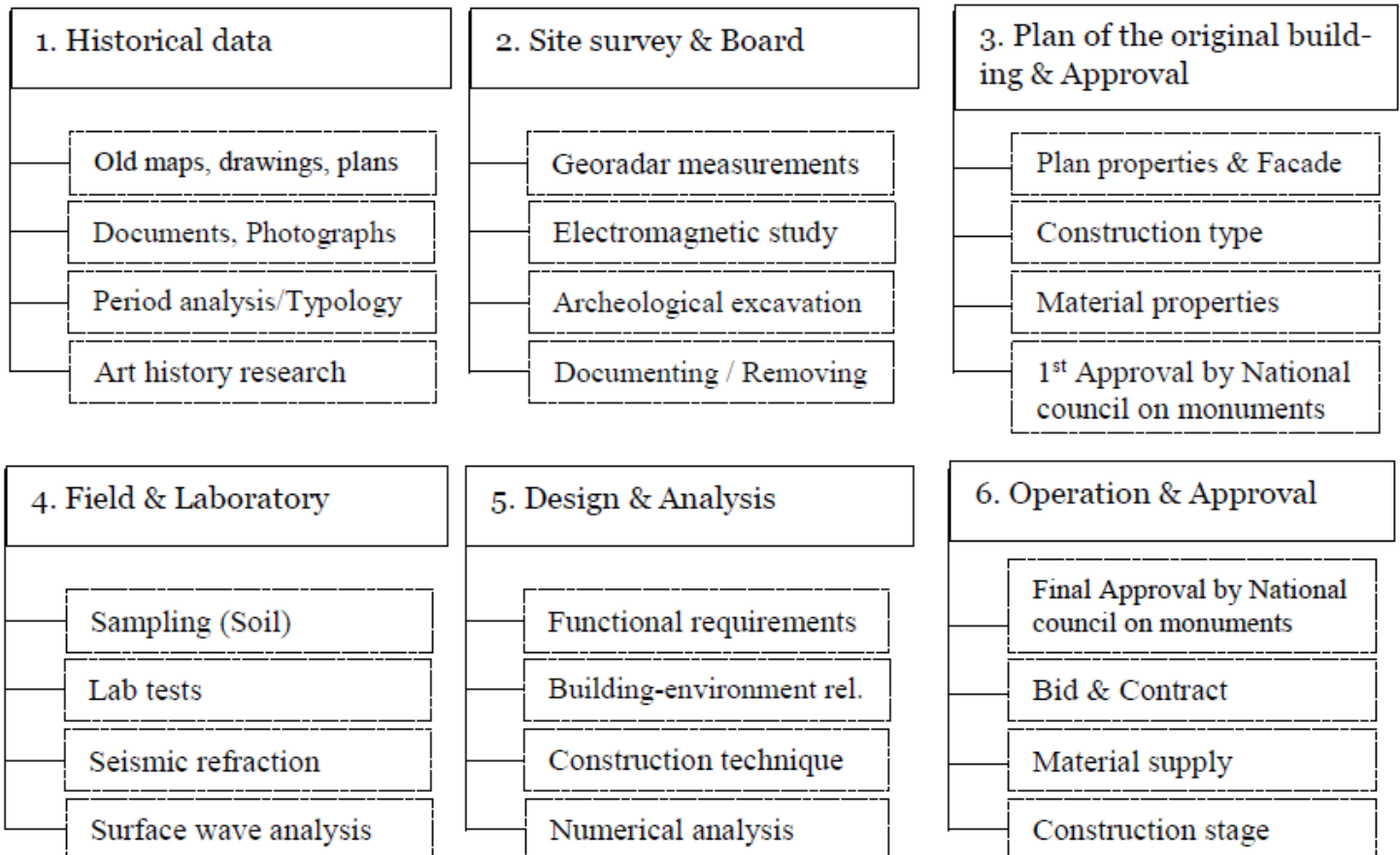


Figure 2

Flowchart detailing the methodology followed for the building reconstruction (Stages 1 to 6).



Figure 3

The location of the site of the demolished building on the historical peninsula [36] (*yellow-marked by dashed lines*).

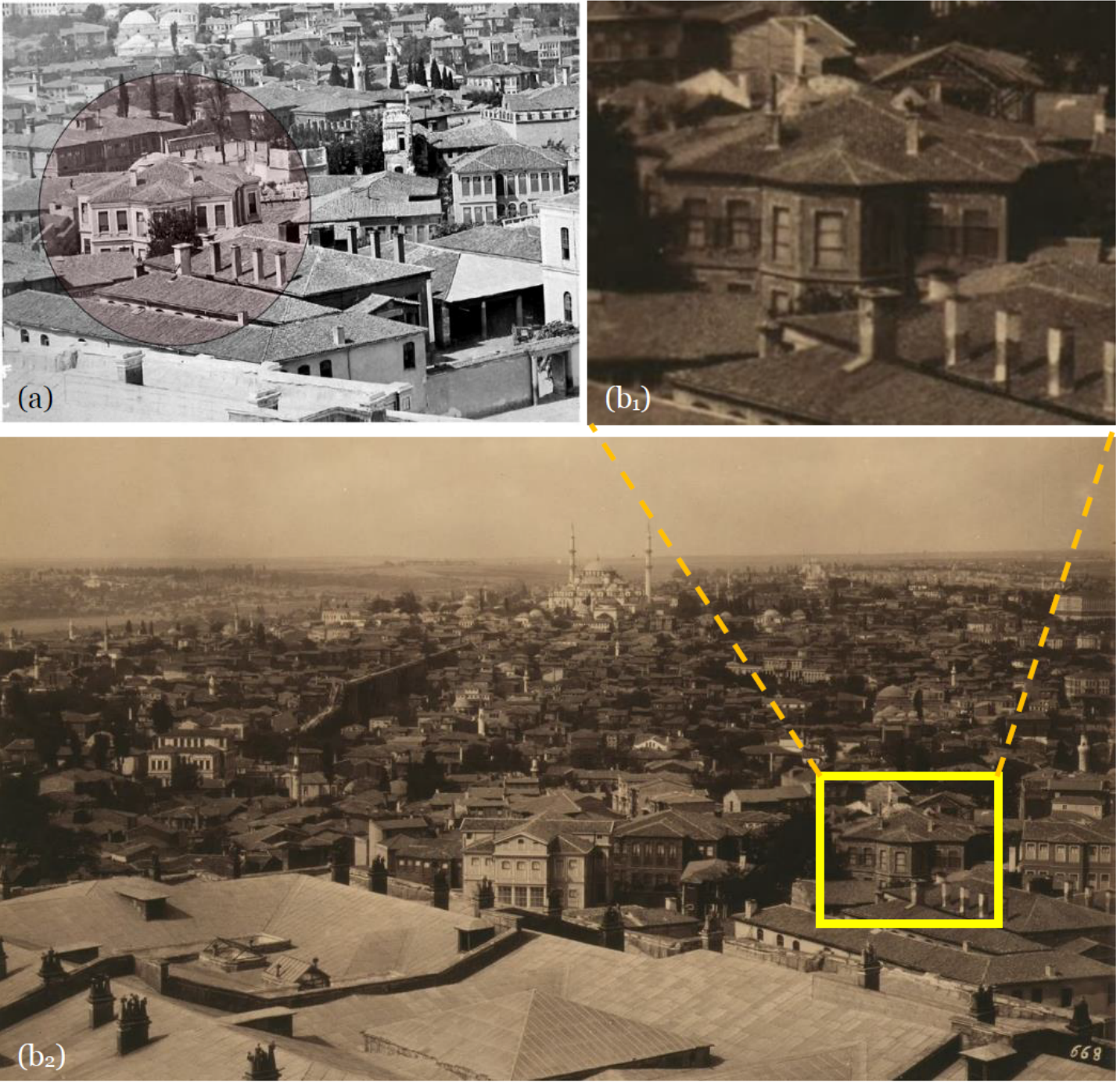


Figure 4

The view of the mansion building in the 1880s from (a) DAI [37] and the (b1, b2) Abdulhamid II Collection [38].

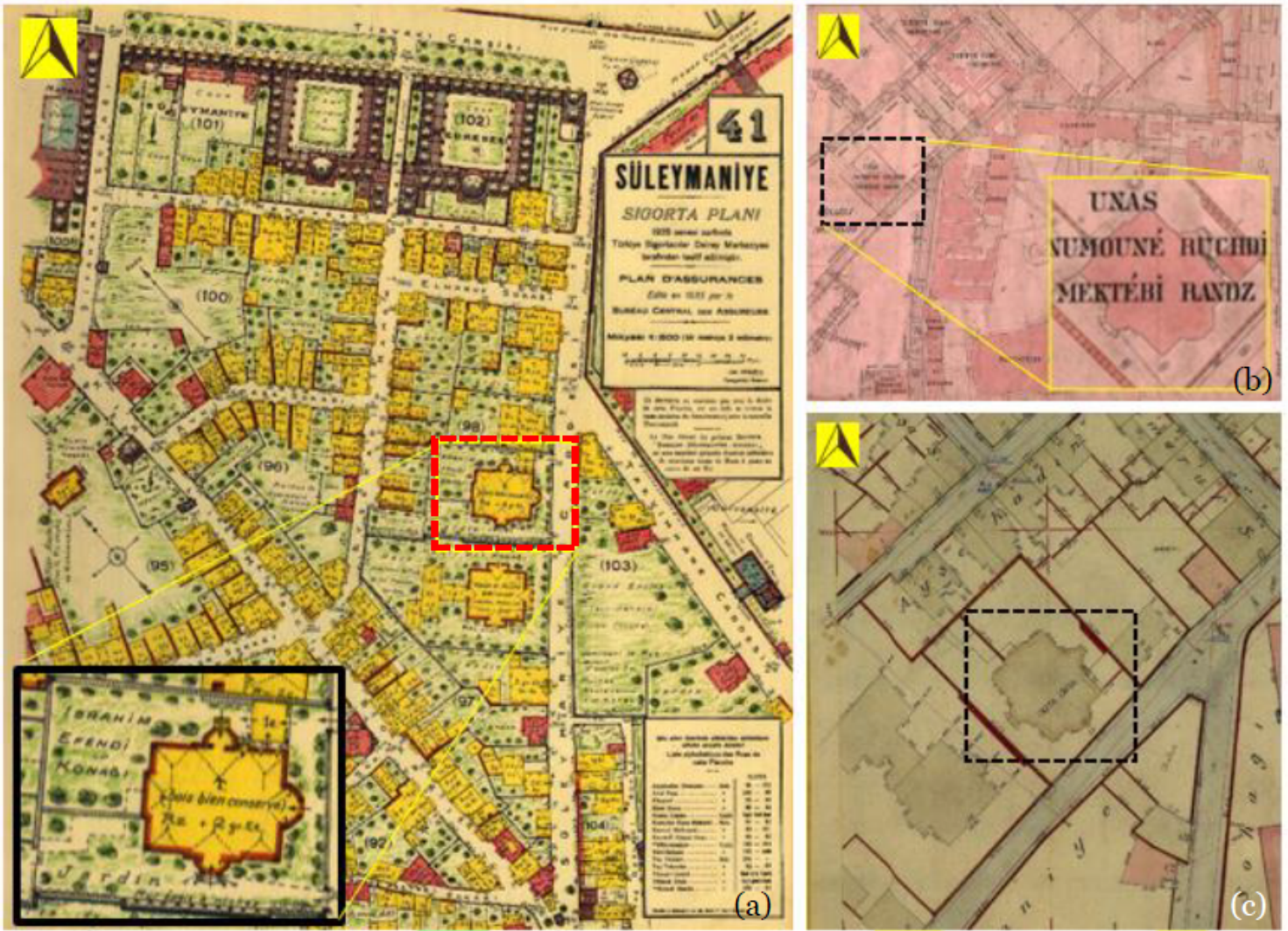


Figure 5

View of the building on old maps. (a) 1935 [39], (b), 1913 [40], (c) 1945 [41].

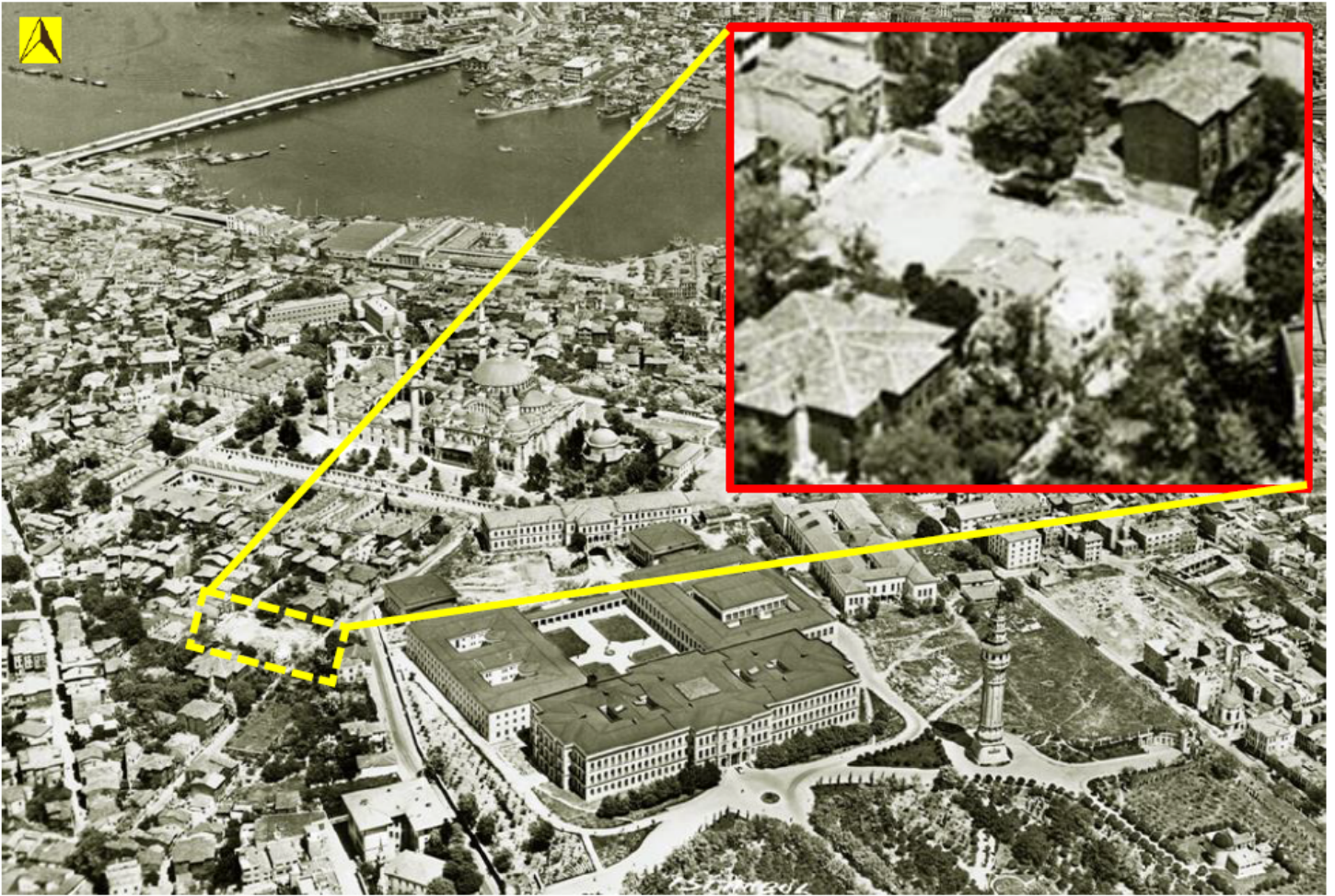


Figure 6

Aerial view of the area in 1948 [42].

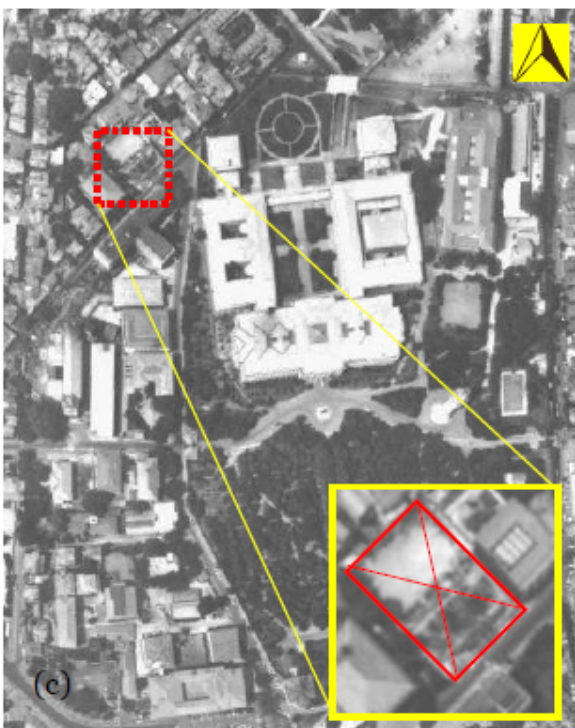
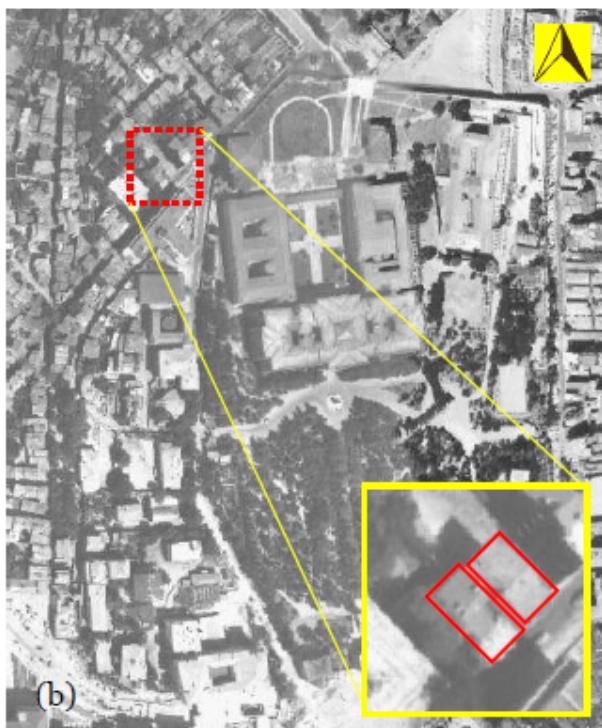


Figure 7

Views of the area: (a) 1950 [43], (b) 1966 [36], (c) 1982 [36], (*marked by dashed lines*).



Figure 8

The area subjected to georadar study (*marked by dashed lines*).

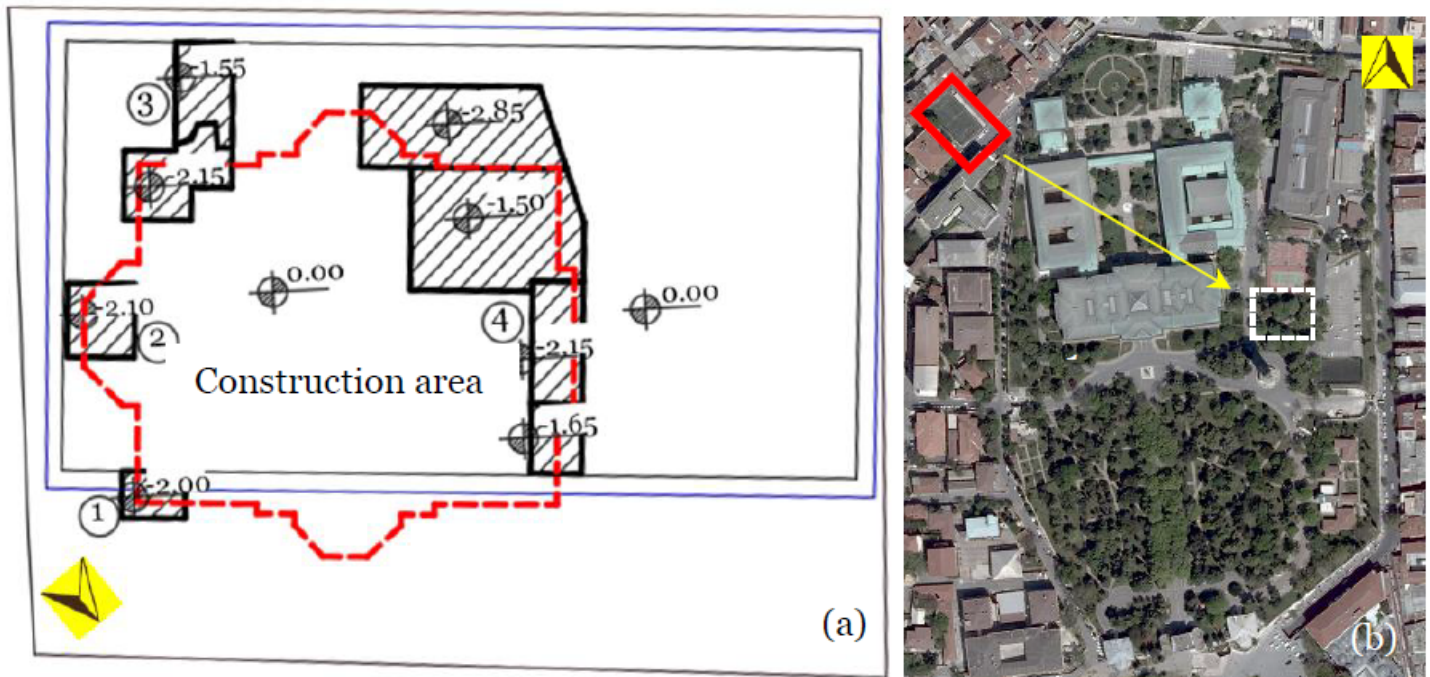


Figure 9

(a) Archeological excavation points (1 to 4) in the construction area, (b) The site of the relocated architectural fragments (*marked by dashed lines*)

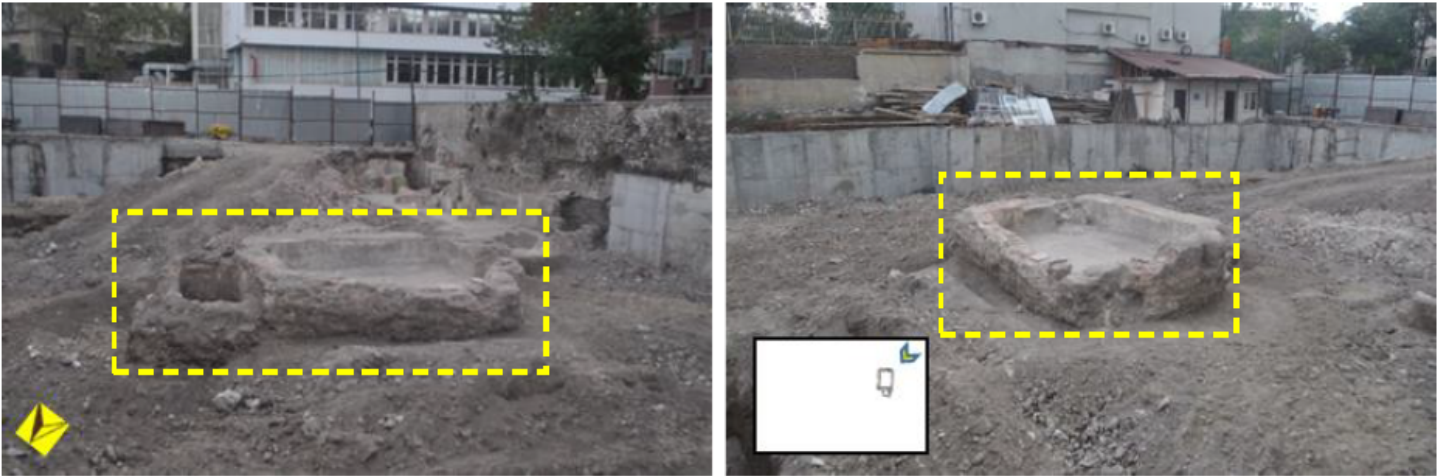


Figure 10

Views of the cistern on the project site.

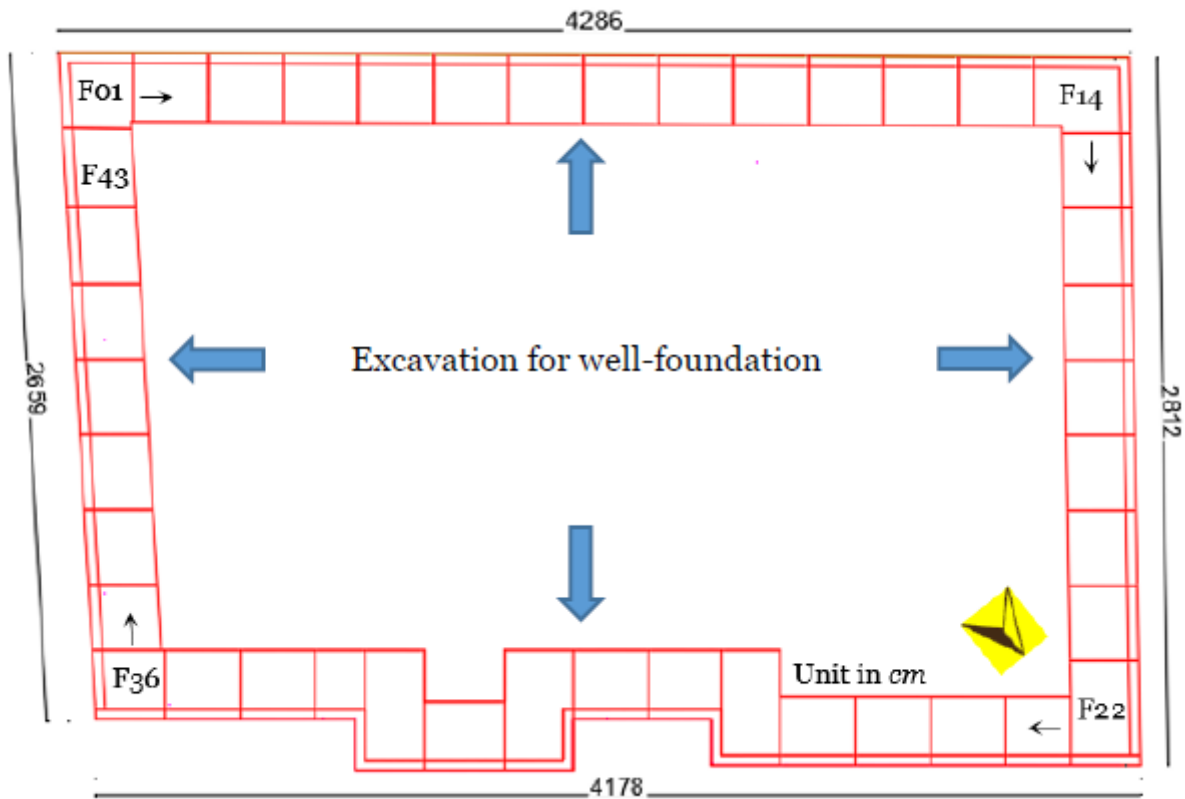


Figure 11

Excavation locations of the well foundation (F01 to F43).



Figure 12

Archeological finds during excavations for the well foundation

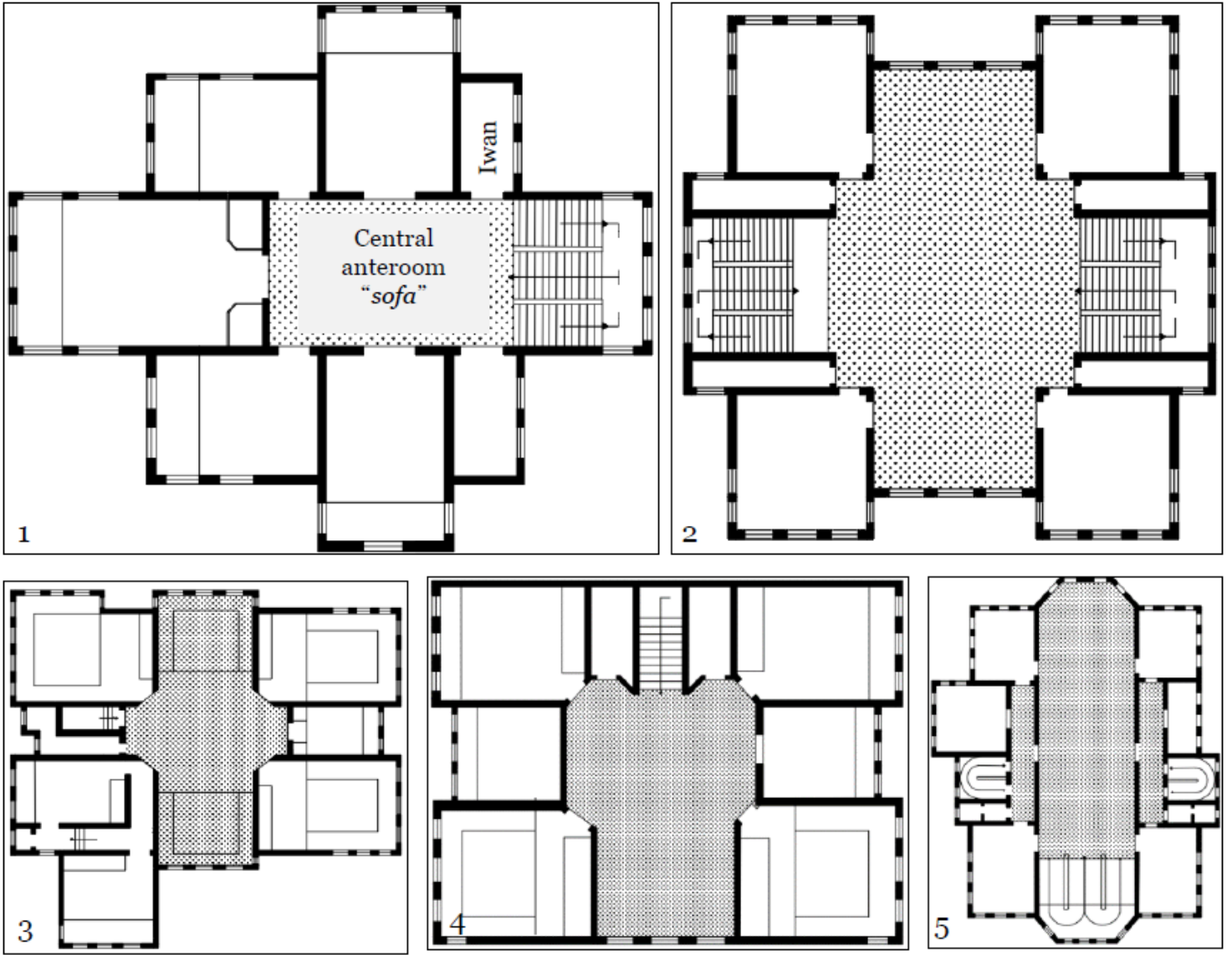


Figure 13

Mansion plan types with central anterooms in 19th century [50]. 1: Kalamış, İstanbul, 2: Çengelköy, İstanbul, 3: *Türkmenzade İsmail Konağı*, İstanbul, 4: Kavafyan, İstanbul, 5: *Yusuf İzzeddin Efendi pavilion*, İstanbul.

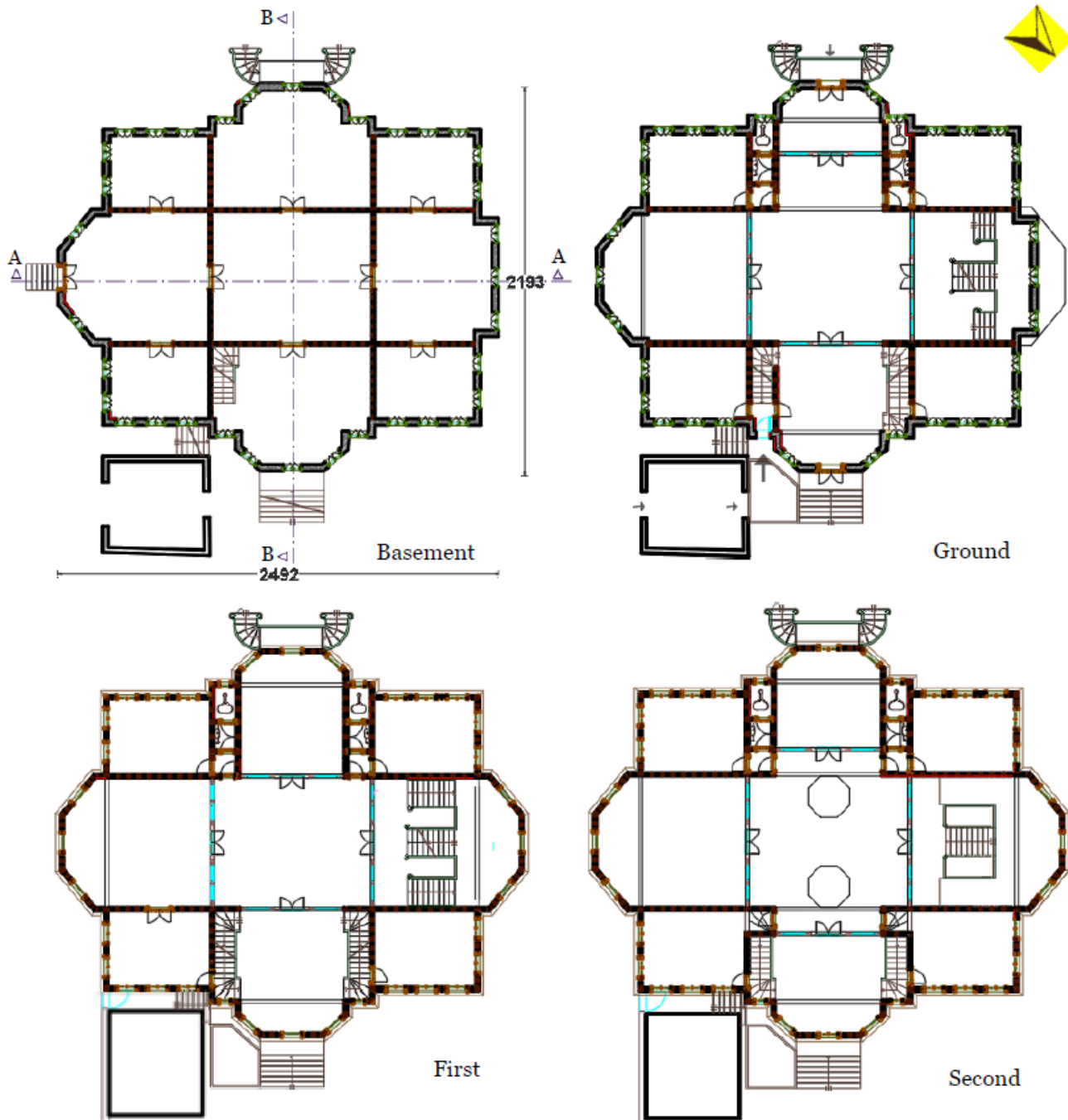


Figure 14

Floor plans of the building.



Figure 15

Sectional elevations of the building (*Section lines shown in Fig. 14*).



Figure 16

Façade views of the building.

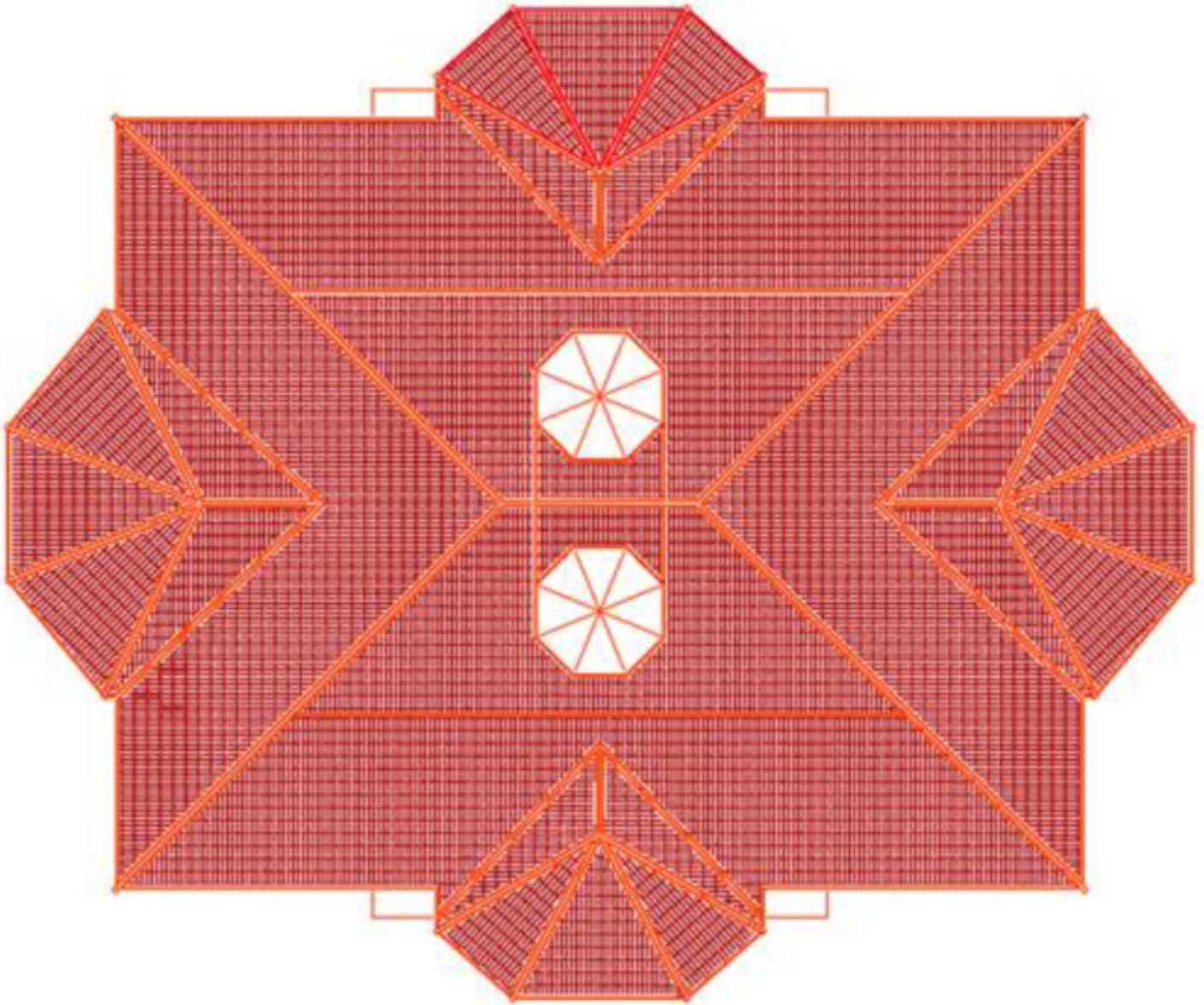


Figure 17

Roof plan of the building.