An approach for the reconstruction of a traditional masonry-wooden building located in an archeological area. Part II: Building reconstruction

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ABSTRACT
The study, which consists of a pair of articles, covers the reconstruction process of a traditional masonry-wooden mansion structure, which was built based on the Turkish house typology on the historical peninsula of Istanbul in the 1880s, and was then intentionally demolished in 1948. The paper, which constitutes the second part of the study, presents reconstruction operation in the location of the demolished building. In this context, the construction is carried out with a new approach in which the building load was transferred to the retaining system in order to protect the cultural layer in the construction area. In the reconstruction, steel frame system is preferred instead of the original wooden construction system and material. In contrast, the construction gauge and plan scheme of the original building was taken as a basis in reconstruction. It is concluded that the presented approach is suitable as a new construction technique considering the parameters such as seismic effect, archeological ruins, building–environment relationships and needs analysis in reconstruction of the demolished historical buildings.

1. Introduction
Buildings with historical identity may be destroyed or demolished partly or completely due to human or natural disasters over time. In time, unqualified structures can be built at the location of the buildings, so that traces of the original structure are lost. In addition to the role of the mentioned structures in the point of witnessing the history, its construction techniques and structural materials is an important factor in the revival of such structures. To consider its original form in the revival of the buildings is mandatory in terms of preserving the cultural value of the buildings. As a result of this situation, it is preferred to use original construction methods and equivalent material properties in reconstruction of the historical buildings. On the other hand, modern building systems and techniques can be used instead of traditional methods depending on the reasons such as structural safety, needs analysis and building–environment relationship. This approach is also described as in Article 10 of The Venice Charter (1964) as “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”.

Various purposes are considered in the reconstruction in accordance with its originality of historical buildings that does not exist, currently. The first of these aims is to return historical identity in the area where the building is located. Thus, it is ensured that the structures continue to be witnesses of ancient traditions, construction systems and materials, as well as being an architectural work. Another objective in reconstruction is to representative to be the root in community memory of a state that existed in the past, or revival of a political view in the past.

The third goal is that the reconstruction process benefits educationally. In this respect, experiencing the process makes it easier for the experts to understand the past, while those who are not experts can obtain new information by looking the whole construction. As an example, the renewal of the Temple of Ise in Japan as a religious cult every twenty years ensures that reconstruction is both instructive and preserves a tradition and intangible value (Bilgili 2018). Besides, reconstructions are preferred for tourism purposes or to increase public-private sector revenues. An example of this is the Hwangnyongsa temple in the Republic of South Korea (Stanley-Price 2009).

Reconstruction of demolished or destroyed buildings is usually preferable to construction of new ones after demolition of an authentic buildings (Sedlákův et al. 2020). However, there are also opposite views of this approach (Alioğlu 2013). Reconstruction is preferred in the context of reconstructing a part of the building in historical buildings (Murgul 2015).
2. Fieldwork

The location of the demolished building, as the focus of the study, has a construction area of 1139 m² (Figure 1). Constructed in the early-1880s, the masonry-wooden building was built on the historical peninsula of Istanbul. The historical process of the building is clarified by providing information and other documents related to the demolished building. By evaluating the information obtained, the structural and architectural features of the original building are obtained and presented in the first part of this study. The plan and section views of the building are given in Figure 2. In this section, soil work performed in the construction area is given as a basis for the design of the building. In this context, the soil characteristics are determined by evaluating geophysical measurements performed and the test results of the soil samples gathered from the construction area by mechanical drilling. First, mechanical drilling work is carried out in four locations using a Rotary drilling machine and equipment in accordance with BS 5930 standard (BS 5930 2015). Secondly, standard penetration tests are executed in situ. Subsequently, in the seismic study achieved in compliance with Eurocode 8 (EN 1998) standards, surface wave and seismic refraction measurements are performed using seismograph along two profiles.

2.1. Drilling study

Mechanical drilling work is implemented at depths of 20 m, 15 m, 15 m and 20 m in the construction area (Soil report 2010). The lithological information obtained according to the results of the drilling work is given in Table 1. In the four drillings made in the area, there are fill layers at the upper parts and then argillaceous limestone corresponding to Bakirköy formation below these levels. The filling layer has been specified as two levels as embankment and ancient filling. The filling thicknesses continue up to 8.7 m. and 13.5 m. in the eastern part of the area (D-2 and D-3), while it varies between 2.5 m. and 6 m. in the western part (D-1 and D-4).

Based on the results of the soil work, it is necessary to pay attention to several points in the foundation excavations. Accordingly, controlled excavation should be done during excavation works, additionally, the excavated parts should not be exposed to external factors for
2.2. Analyses

The wave vibrations are emitted from a source, be it a sledgehammer or the geophone. The waves of P and S types are then propagated through the ground and their amplitude is measured at certain distances. The wave velocities are determined by a time–distance relationship using the records obtained. The wave velocities are classified as direct waves, diffraction, refraction and refraction depending on the geological environment. The wave velocities are then measured using a Geometrics brand seismograph. The measurements are then used to determine the wave velocities as P and S types. The measurements are made at certain distances to study the wave propagation and its effects on the geophysical environments.

Table 1. Lithological data obtained as a result of drilling.

| No  | Depth (m.) | Layer definition                           |
|-----|------------|-------------------------------------------|
| D-1 | 0 to 2.5   | Embankment                                 |
|     | 2.5 to 9   | Limestone fragmented clay                  |
|     | 9 to 15    | Argillaceous limestone                     |
|     | 15 to 16.5 | Clay (yellowish)                           |
|     | 16.5 to 20 | Clay (blueish)                             |
| D-2 | 0 to 2.5   | Vegetable soil and embankment             |
|     | 2.5 to 13.5| Mostly clayed ancient filling including tiles and brick parts |
|     | 13.5 to 15 | Argillaceous limestone                     |
| D-3 | 0 to 1.5   | Vegetable soil and embankment             |
|     | 1.5 to 8.7 | Mostly clayed ancient filling including tiles and brick parts |
|     | 8.7 to 11.3| Carbonated clay (green)                    |
|     | 11.3 to 15 | Argillaceous limestone (beige)             |
| D-4 | 0 to 1.5   | Embankment                                 |
|     | 1.5 to 6   | Ancient filling                            |
|     | 6 to 8.2   | Limestone with marn-clay                   |
|     | 8.2 to 11.5| Carbonated clay-marn sequence (beige)       |
|     | 11.5 to 16.5| Clay-limestone-marn sequence (green)        |
|     | 16.5 to 20 | Very solid clay (dark blue)                |

a long time. In case the excavations are opened upright, temporary and/or permanent retaining structures measures must be built in order to damage the road and adjacent buildings. It is appropriate to adjust the cut slope to 2/1 (horizontal/vertical) without the surcharge load. Engineering structures are not built on the infill layer. For this reason, the filling part should be excavated and removed from the area, then the foundation should be constructed on the natural ground level.

2.2. Analyses of seismic refraction and surface wave

Two methods, seismic refraction and surface wave, are used to determine the wave velocities defined as P and S on the construction area. Waves emitted from any source are classified as direct waves, diffraction, refraction and refraction depending on the environment. The refracted waves are dependent on P and S velocities due to propagate in both environments with two velocities. Measurements are made using Geometrics brand seismograph along two profiles in the examined area. In the seismic refraction technique, which is the first method, the wave provided from a source passes by refracting through different environments. This process is recorded by geophones known as sensors placed at certain distances on the surface. Layer velocities are calculated by determining the time–distance relationship using the records obtained. Layer thicknesses, and layer’s elastic parameters are calculated using the velocities. The second method is divided into two parts as active and passive resources. In active source application, seismic waves are recorded by shooting with a sledgehammer at a certain distance to the geophones located along the linear line. In passive source application, geophones are placed and records are taken at certain times using measurement equipment. In the application, environmental traffic, factories, sea wave, atmospheric pressure, etc., vibrations resulting from noises are recorded. \( V_p \) and \( V_s \) velocities were determined...
based on the time-distance data in the seismic wave records obtained. The propagation of seismic waves underground depends on the elastic properties of the soil environment. Therefore, since the calculated seismic velocities reflect the elastic properties of the soil, shear and longitudinal wave velocities are calculated for each profile and then layer thicknesses are determined (Soil report 2010). As a result of the seismic measurement, the depth–velocity relationship obtained for P and S waves of both profiles is given in Figure 3, and the average velocity values for each layer are given in Table 2. The environments determined as the first two layers given in the Table are compatible with the lithology defined as the soil and ancient fill determined in the drilling study. The main soil layer in the construction area is determined as clayey limestone, which is the third environment in seismic measurements, and drilling study. It is not appropriate to build the foundation of the building over the soil embankment. Therefore, the velocity parameters of the third environment should be selected in determining the soil parameters.

Soil parameters can be calculated using the $V_s$ (Masw) and $V_p$ (refraction) velocities in Eqs. (1–7). The values obtained are given in Table 3.

\[
\text{Density (g/cm}^3\text{), } \rho = 0.2V_p + 1.6 \quad (1)
\]

Poisson ratio,
\[
v = \left\{ \left[ 1 - 2\left( \frac{V_s^2}{V_p^2} \right) \right] / \left[ 2 - 2\left( \frac{V_s^2}{V_p^2} \right) \right] \right\} \quad (2)
\]

Dynamic shear modulus (kg/cm$^2$), $G = \rho \times V_s^2 \quad (3)$

Figure 3. The relationships of depth-velocity and elevation-distance for P ve S waves. Line 1 (left), Line 2 (right).

**Table 2.** Seismic velocity values for two profile.

| Profile no | Layer | $V_{p,av}$ a | $V_{s,av}$ b |
|------------|-------|--------------|--------------|
| Line 1     | 1     | 380          | 230          |
|            | 2     | 290          | 200          |
|            | 3     | 430          | 265          |
| Line 2     | 1     | 428          | 257          |
|            | 2     | 540          | 222          |
|            | 3     | 646          | 240          |

a$^P$-wave velocity (m/s), b$^S$-wave velocity (m/s).
Table 3. Seismic refraction results and dynamic elastic parameters for Lines 1 and 2.

| Profile no | Layer | \( V_s/V_a \) | \( \rho \) g/cm\(^3\) | \( v \) kg/cm\(^2\) | E kg/cm\(^2\) | k kg/cm\(^2\) | \( T_e \) sec. | \( k_s \) ** t/m\(^2\) | \( q_{s, **} \) kg/cm\(^2\) | \( q_{s, ****} \) kg/cm\(^2\) | A |
|------------|-------|----------------|-----------------|-----------------|---------------|--------------|----------------|-----------------|-----------------|-----------------|-----|
| Line 1     | 1     | 1.52           | 1.37            | 0.12            | 872           | 1951         | 852            | 0.46            | 1771            | 2.25            | 3.42 \(^{(1)}\) | 0.75 a |
|            | 2     | 1.45           | 1.28            | 0.05            | 522           | 2092         | 401            | 1.476           | 1906            | 2.31            | 3.74 \(^{(3)}\) | 1.46 b |
|            | 3     | 1.62           | 1.41            | 0.19            | 1011          | 2414         | 1314           | 0.49            | 1900            | 2.18            | 3.62 \(^{(4)}\) | 0.91 c |
| Line 2     | 1     | 1.67           | 1.41            | 0.22            | 950           | 2313         | 1368           | 0.49            | 1900            | 2.18            | 3.62 \(^{(4)}\) | 0.91 c |
|            | 2     | 2.45           | 1.49            | 0.40            | 738           | 2066         | 3460           | 1.34            | 2154            | 1.40            | 3.75 \(^{(6)}\) | 1.14 d |
|            | 3     | 2.69           | 1.56            | 0.42            | 918           | 2605         | 5404           | 1.40            | 2348            | 1.40            | 3.75 \(^{(6)}\) | 1.14 d |

*compactness, **vertical coefficient of soil reaction, ***allowable bearing stress, ****bearing capacity of soil, \(^{(1)}\) (2)/(1), \(^{(2)}\) (3)/(2), \(^{(3)}\) (5)/(4), \(^{(4)}\) (6)/(5)

Table 4. Soil classification according to \( V_s > 30 \) in Eurocode 8.

| Soil type | Definition | Limit value (m/s) |
|-----------|------------|-------------------|
| A         | Rock or other similar formations | \( V_s > 800 \) |
| B         | Too tight sand, gravel or very hard clays | \( 360 < V_s < 800 \) |
| C         | Tight or medium tight sand, gravel or hard clay | \( 180 < V_s < 360 \) |
| D         | Cohesionless soils from loose to medium tight | \( 180 > V_s \) |

Dynamic young modulus (kg/cm\(^2\)),

\[
E = 2 \times (1 + v) \times G
\]

Dynamic bulk modulus (kg/cm\(^2\)),

\[
k = ([2 \times (1 + v)] \times G) / [3 \times (1 - 2v)]
\]

**Soil vibration period (sec.)**, \( T_o \)

\[
T_o = \sum 4h/V_s \quad \text{in where} \quad V_s > 30
\]

\[
= 30 / \sum _{i=1}^{n} (h_i / V_s) \quad \text{in m/s}
\]

Soil amplification, \( A = 68 \times V_s \times 30^{-0.6} \) (midoriwaka)

According to Eurocode 8 soil classification (EN 1998) given in Table 4, it is determined that the soil class corresponds to C type for the third layer based on the velocity distributions of the soil. The class is considered in the seismic analysis of the building.

3. The design process for reconstruction

Traditional timber-framed buildings are composite structures, characterized by upper storeys composed of a timber frame load-bearing system constructed on top of a masonry ground storey (Aktaş and Türer 2016). There are some post-disaster studies presenting a favourable seismic performance of the buildings (Güçhan 2007; Gülhan and Özyörük 2000; Aktaş 2017; Aktaş et al. 2017). Demolished timber framing buildings are reconstructed using different construction systems provided that preserving the dimensions and facades of the authentic building. This causes the structures to lose its historical and cultural identity. In other words, imitating these structures using modern materials and systems does not meet authentic features of the structures. In addition to all these, in recent years, mimicking approaches have been presented in this direction due to the need analysis related to function change. However, in this study, the original construction system was not preferred as a result of the function change of the examined building.

The construction system has been determined considering the authentic building and needs analysis. The parameters taken into consideration in the selection of the system are listed as follows:

i. The function of the authentic building was to respond the residential needs, and it was designed considering the demands of that period, as well. It was deduced that the new building was intended to be an administration office for the technical works of Istanbul University. Therefore, traditional room typologies in the authentic building were converted into office and technical spaces depending on the need that specified throughout the planning of the administrative building.

ii. All applications in Süleymaniye Renovation area, located in UNESCO cultural heritage region, were carried out in line with the suggestions, opinions and approvals of the Cultural Heritage Preservation Board. Accordingly, the Board decided to remove of the findings which was found during the archeological excavations in the construction site. Soil improvement was not allowed by the Board to prevent possible damages on archeological findings. For this reason, it was decided that the building load is transferred to the ground through well foundations at the boundaries of the construction area. This task was achieved by utilizing a steel frame system.

iii. In terms of administrative building function, it has been mandatory to have the parking area, archive and technical rooms such as fire water tank, boiler room, generator, air-conditioning plant in accordance with the relevant regulations. Furthermore, it was decided to employ a steel system to carry the loads exposed on the basement storeys.

iv. Since the original building has a wooden-masonry system, the upper storeys were initially designed as...
timber framing. However, the section dimensions of timber columns and beams were not match with the original member dimensions of the authentic building in case of using timber elements on the upper storeys. In addition, the element deflection values exceeded the regulation limit values when the original building element dimensions were considered in the design. In this case, the timber elements can be separated from its joints in these deflection values, and also the provided vibration results to reduce the comfort of use. Due to all these reasons, the deflection values have been minimized by using steel frames and cross members on the upper storeys. Therefore, it was decided to build the structure using a steel frame system to preserve the original facade and provide deflection limits.

The original form of the demolished building consists of a ground- and two typical-storey over the semi basement. Within the scope of the reconstruction, instead of the original function (mansion-residence) for the building, the function of the administrative office building required for the university is given. A second basement was added to the new building. In this context, the building is included of three typical storeys and two basements (Figure 4). The plan scheme is adapted in line with the needs analysis. Entrance to the building is provided from two sides in Süleymaniye Street (Figure 5, North-West view). Moreover, vehicle and visitor/users will be accessed in from north and south, respectively. Typical storeys consist of office, meeting room and wet areas while basement storeys consist of garage, archive, shelter, warehouse, technical area and kitchen. In the second basement storey with an area of 824 m², archive and warehouse location is foreseen considering the needs of the University

Figure 4. Sectional elevations of the building for reconstruction.

Figure 5. Facade views of the building for reconstruction.
(Figure 6). From here, the first basement with 745 m² area is accessed by elevator or stairs (Figure 7). The first basement, which is illuminated by abat-jour, includes administrative units and a car park located under the back garden. The indoor car garage consists of a separate mass added to the building in the northwest side. Thus, the outer contours of the building approach to the boundaries of the plot on Northwest and Southeast facades. On the ground storey with an area of 413 m², interior spaces are provided using the original data of the building (Figure 8). The building’s original floor area and its outer contours begin from the ground storey with two entrances. Selamlık entrance in the original building was used as the main entrance in this building. The other entrance is arranged for emergency use. The staircase hall, which was originally defined as the circulation area, was organized as the circulation area in the reconstruction project. The first storey, with
Figure 8. The plan view of Ground storey for the reconstruction.

Figure 9. The plan view of First storey for the reconstruction.
an area of 422 m², consists of the head’s office, lounge, the restroom, the restroom for the head, the department secretariat, Editorial office, two meeting rooms and a manager’s office (Figure 9). Finally, interrelated working offices are formed on the second storey of the 422 m² area reserved for usage office purposed (Figure 10).

4. Building reconstruction

The construction of the building consists of two stages. In the first stage, the construction process related to the retaining system is presented. Subsequently, the construction of the superstructure is completed using a novel construction technique. The construction period of this building was completed in five years, including the archeological excavation phase. All cost of the works performed is 5,150,349,00 USD.

4.1. Construction of retaining system

In the reconstruction project prepared within the scope of the study, the foundation elevation of İbrahim Efendi Konagi is determined as −6.6 m. According to the data of the drilling work carried out in the area where the building is located, there is a soil embankment up to a depth of 0 to 6 m, brown-green colored clay up to a depth of 6 m to 9 m, and a layer of khaki green colored carbonated clay under 9 m. (Section 2.1). The existing ground level is −2.3 m and the filling layer continues to a depth of −8.3 m accordingly. It is stated that there is a need for a retaining system to prevent damage to the surrounding buildings and the road during the removal of the embankment layer (Section 2.1). The retaining system is determined the possible solutions as: i. prestressed anchored bored pile, ii. cantilever bored pile, and iii. well foundation system. Feasibility, structural safety and economic criteria are taken into consideration in the selection of the retaining system. First of all, the suitability of the anchored bored piles and cantilever bored piles systems are examined. It is determined that there is no minimum distance required to work between the adjacent buildings and the machine for the operation of the pile machine during pile construction. In addition, it is not possible to

| Parameter                              | Value |
|----------------------------------------|-------|
| Shear wall height (Level 1), m.        | 4.3   |
| Level 2 height, m.                     | 4.8   |
| Length per the foundation part, m.     | 3     |
| Slope angle for filled soil, β         | 0°    |
| Surcharge load, q, (kN/m²)              | 10    |
| Angle of internal friction of soil, β  | 25°   |
| Background density (kN/m³)             | 16    |
| Friction coefficient of the soil, μ     | 0.55  |
| Building importance factor, I          | 1     |
| Structural behaviour coefficient, R₁   | 1.5   |
| Soil class                             | C     |
| Concrete density, p (kN/m³)            | 25    |
reach the bored pile machine to the area due to the narrow the road used to access the construction site. Within the framework of the specified limitations, it is determined that the suitable approach as the retaining system is the well foundation system. The design of the system is prepared using Istcad software (İstCAD 2015) based on the values given in Table 5. Afterwards, sliding and overturning stability are checked for without earthquake effect based on the results of the analysis. In the sliding calculation, the sliding force \( F_s \) and total resistance force \( F_r \) equal to 270 kN/m and 700 kN/m are obtained, respectively. Based on two values, the slipping safety coefficient \( S_c \) has been calculated as 2.6 and the limit condition is provided since it is greater than 1.5.

![Figure 11](image1.png)

**Figure 11.** The locations and the cross-sections of the well foundation in the plan.

![Figure 12](image2.png)

**Figure 12.** Application stages of the well foundation. (a) Preparation of the formwork and human-powered excavation, (b) Excavation in 8.9 m depth (c) Construction of well foundation by skipping one by one, (d) After the excavation, completing the formwork, steel and concrete stages for the well foundation consisting of Level 1 and Level 2. Then, excavation in the middle part excavated on both sides.
Similarly, the overturning (\(M_{o}\)) and resistance moment (\(M_{r}\)) are calculated as 890 kNm/m and 1710 kNm/m. Overturning safety coefficient (\(S_{o}\)) determined as 1.9 by using these values provides the limit value.

At the beginning of the well foundation construction, soil is excavated as controlled using manpower. Thus, possible damages in adjacent buildings is prevented. The construction of the well foundation system, consisting of Levels 1 and 2, are performed with 43 wells drilled with an area of 3.00 m.×2.75 m. Plan and section views of the foundation are given in Figure 11. The construction stages of the well foundation consist of excavation, formwork, placement of steel bars and concrete pouring, respectively (Figure 12). The overview of the construction area after the construction of the well foundation consisting of 43 parts is shown in Figure 13.

### 4.2. Construction of steel frame

After the construction of the well foundation, it is prepared that the structural model including the design of the steel structure system is determined taking into account the soil properties, dead and live loads (Figure 14). The model is analyzed by using Sap2000 software (SAP2000 2015) to determine the element cross-section dimensions. Sectional detail drawings are prepared using Tekla Structures (2015) software. Based on the dimensions of the sections, steel profiles are manufactured and transported to the construction site. Although it is stated in Section 2.1 that the soil embankment should be removed, no soil improvement such as excavation or jet grout is performed to protect the cultural layer on the construction area. In this context, it is aimed to assemble of the steel structure system without excavation at the construction site. To this end, a new technique has been developed in which the building load is transferred to the well foundation system. In this scope, firstly, RC encasements are located over the well foundation. The locations of the encasements are given in Figure 15. Then, the encasement over the well foundation system are supported by steel beams. Thus, the superstructure load is not transferred to the construction area.
The construction steps for each encasement on the three sides of the building area are listed below:

- Eight rod holes with $\phi 21$ are drilled in order to place the plates in place of the encasement (Figure 16(a)).
- The holes are cleaned with compressed air and the rods with a length of 1 m. are fixed using epoxy. Then, a total of 34 plates (57 cm×57 cm) are fixed with bolts through the rods to be adjusted to the upper level of the encasement (Figures 15 and 16(b)).
- For the construction of RC encasement, molds are prepared first. Subsequently, steel rebar placement is performed in two stages. In the first stage, holes are drilled in the concrete for the steel rods to be fixed to the concrete surface, the holes are cleaned with compressed air and the rods with L-form were
Figure 17. Construction stages of encasement along the North-West direction (a–c).

Figure 18. (a) RC encasement and (b) steel truss over the encasement.

Figure 19. Placing the steel truss over RC encasement (indicated as 1 and 3), anti-vibration elements (indicated as 2a and 2b).
anchored. In the second stage, longitudinal rebars and stirrups are placed in the mold (Figure 16(c)).

- At the last stage, 18 encasement elements with a dimension of 0.7 m×2.0–3.7 m. are completed by pouring concrete (Figure 16(d)).

The same steps are repeated for encasement in the northwest direction, which is the other direction of the building. In this scope, encasement with nine plates are produced as a single part with a dimension 0.9 m×27.6 m. in the northwest direction (Figure 17). Thus, the encasements for the steel trusses are completed in the building construction area (Figure 18(a)).

Firstly, steel beams are supported on the encasements in the construction of the superstructure (Figures 18(b) and 19, indicated as 1 and 3). Additionally, RC elements with a dimension of 1.5 m×1.5 m. are placed at the joints of the steel elements in order to prevent vibrations in the beams (indicated as 2a and 2b in Figures 19, 20). The placement of the elements in the plan is given in Figure 21. Subsequently, the steel column and braced members are assembled (Figure 22(a-c)). After this stage, roof and facade coating steps is started (Figure 22(d-e)). In parallel to this, in basement and ground floor, composite slab is constructed using trapezoidal, mesh steel and strut elements, respectively (Figure 23(a-c)). Solid oak parquet was covered over light wooden plates on the upper floors including roof floor, excluding wet areas (Figure 23(d)).

With these processes, the structural steel system is completed. Finally, the facades of the building are covered using sheet pile with timber in accordance with the original structure, and thus the building reconstruction is completed (Figure 24).

5. Conclusions
The study, which consists of a pair of articles, covers the reconstruction process of a traditional masonry-wooden mansion structure built in the 1880s, which was later intentionally demolished in 1948 and called İbrahim Efendi Konağı. In the first article, a methodology consisting of six main steps is presented in order to perform the reconstruction process of historical buildings, effectively. In addition, studies regarding the first three stages of the methodology include the historical research, site survey and restitution process, are given in detail in Part I. The last three stages of the methodology, consisting of field & laboratory, design & analysis and approval & implementation, are presented within the scope of this article. In this article, seismic effect, archeological area, building–environment relationship and needs analysis parameters are considered in determining construction system and structural material in the building reconstruction phase. The building–environment relationship was effective in determining the retaining system. In this context, well foundation was chosen as the retaining system considering the interaction of the building with the structures in the adjacent buildings. Seismic effects and needs analysis parameters are effective in selecting of load-bearing system. In this context, it is determined that the steel frame is the most suitable construction system considering the need analysis as well as the location of the examined structure in the region exposed to an earthquake effect. In addition, construction gauge, plan scheme and facade appearance of the constructed building are provided to be compatible with the original building. Beyond these, the positioning of the building in the archeological area was effective in determining the construction technique. In this technique, the construction is completed by transferring the building load to the well foundation system. Based on the
Figure 22. Application stages for steel frame (a–e).

Figure 23. (a–c) Application stages for composite slabs and (d) Slab with light wooden plates.
positioning in the urban archeological area of the building, and the archeological data given in detail in Part I, the first structural design project of the demolished/authentic building, considering the soil's bearing capacity and seismic effect criteria, is modified in order not to damage the possible cultural layers such as archeological layer located under the foundation. In this regard, the destruction of the cultural layers belonging to the previous periods was prevented, and then the building is constructed on the basis of this approach.

Consequently, by this pair of articles, the construction process is completed based on the reconstruction approach determined as a result of a holistic evaluation based on building–environment relationships, seismic effects, needs analysis and archeological ruin criteria. The study is novel in terms of construction technique in which the building load is transferred to the retaining system by means of steel beams without excavation in the archeological area. In addition, a methodology that will be an important tool in the reconstruction process of historical buildings, is presented within the scope of the study. It is expected that this study provides a methodology which can be used in the assessment of similar cases regarding reconstruction process of historical buildings.

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