



Research Article

**ICONARP**  
*International Journal of Architecture & Planning*  
Received 07 Apr 2019; Accepted 20 May 2019  
Volume 7, Issue 1, pp: 286-313/Published 28 June 2019  
DOI: 10.15320/ICONARP.2019.76-E-ISSN: 2147-9380



**ICONARP**

# Moving Techniques For Traditional Buildings As An Architectural Preservation Method

**H. Hale Kozlu\***  
**F. Burcu Batukan Dördüncü\*\***

## Abstract

With the growth of urbanization and the economy, new ideas and technologies have been becoming more of an issue today in the preservation of the cultural traditional buildings. Moving has been a rarely preferred method in the preservation of historical buildings, and it should not be preferred unless there is a serious necessity in the field of architectural preservation. This method is the process of moving a historical building to a suitable predefined area by taking it from its original location and from its surroundings when it is impossible to preserve the building where it stands. When moving processes carried out until today are considered, it has been observed that there are two basic methods used for moving buildings: a) moving intact, b) partly or totally disassembling.

In this study, the techniques for preservation used when the historical buildings have to be relocated to a different place from their original locations due to the necessity, have been examined. By evaluating moving examples both in the world and in Turkey a comparison has been made between advantages and disadvantages of the method.

**Keywords:** Preservation, conservation, Traditional Buildings, Moving Techniques

\*Assist. Prof. Dr. in Architecture department  
in Erciyes University, Kayseri, Turkey  
[ORCID](#)  
Email: halekozlu@gmail.com (Corresponding  
Author)

\*\*MSc. Architect in Kayseri Metropolitan  
Municipality, Kayseri, Turkey [ORCID](#)  
Email: fbbatukan@gmail.com

## INTRODUCTION

Architectural preservation studies aim to maintain the survival of historical buildings, retain the nature of the buildings' fabric as themselves, or even the relationship of the buildings to their settings and integrity, and pass these buildings to future generations and adapt them to changing convenience conditions. This is an interdisciplinary field that includes both tangible and intangible values, which ensures the continuity of the cultural richness it represents as well as its physical characteristics. Restoration methods with physical intervention, such as reinforcement, renovation, re-integration, reconstruction and moving, applied to the buildings, which are intended to be protected, are determined according to the level of factors such as deterioration, demolition that the building exposed to; the social situation, the place in historical process and the functional requirements. In some cases, the combination of several protection methods might be necessarily used. Therefore, the preferred method should be a reinforcement method with minimum intervention. The method can be a moving method when all other possible ways for saving a structure from demolition have been investigated and when the result shows that moving method is the only proper method for the building's moving. Along with the physical damages that may occur in the building context when it is extracted from its context of original location for being moved to another area, and when this process damages the historical fabric and reference of it in the cultural memory, the tangible and intangible values of the building are both harmed in an irreversible way, as well.

Moving as a preserving method is used especially in cases that cultural heritage is threatened by various reasons such as zoning policies, or as the damage of the nature conditions to the building. If it is decided that the relocation of the monument is inevitable, it should primarily be determined which technique to be being used with the least possible damage relocation can cause to a historic building as a whole and with regard to ornamental detailing.

Being based on different factors, it has been referred to technological methods in various dimensions during the transportation process of the moving operations. In this study, the moving methods for the preservation of the historical buildings - when the situations require that the buildings should be carried to a different place from its original location- have been examined and issues to be considered during transportation have been discussed, as well. The moving cases in the world and Turkey have been evaluated by comparing the advantages and disadvantages

Note: Moving cases have been developed based on the master thesis entitled as "Analysis of the influence of moving technique for architectural conservation on cultural memory using the case of Kayseri", by Burcu Batukan under the supervision of H. Hale Kozlu in Erciyes University, Kayseri.



of these techniques. This is significant because it allows us to compare the differences of techniques for moving. These techniques are the most complex methods of conservation, and there are very few publications in the literature about that subject

### **MOVING AS AN ARCHITECTURAL PRESERVATION METHOD**

Moving is the process of transporting a historical building to a suitable predefined area, separated from its original location and its surroundings when it is impossible to protect it (Ahunbay, 1996). Article 7 of the Venice Charter contains the provision that;

*“A monument is inseparable from the history to which it bears witness and from the setting in which it occurs. The moving of all or part of a monument cannot be allowed except where the safeguarding of that monument demands it or where it is justified by national or international interest of paramount importance.”* (Venice Charter, 1964).

Preservation of monuments in their environment is one of the main objectives of preservation as stated in this article. However, when the environment cannot be maintained and the external factors that accelerate the deterioration process cannot be intervened, moving the monument to a new position becomes inevitable in order to sustain a valuable historical source and to sustain its existence.

The need to relocate the historical building; in some cases, it appears due to the topography problems in the current area, but it is generally due to the zoning decisions, and operations. In addition to the natural conditions such as sea/river water rise, earth movements, landslide hazard, construction activities such as dam construction, determination of new routes or road widening decisions have led to the relocation of many historical buildings. During the transportation process, which is a costly technique and usually results in the loss of original values. When the monument is moved, one of the basic principles to be considered is the least damage and minimal intervention in the integrity of the monument (Feilden, 1982; Zakar & Eyüpgiller, 2015).

After deciding to move the monument, initially, it should be determined which method is to be carried out, and all parameters according to the selected method should be considered. Physical damages of the building, topography characteristics of the current location, potential new areas where the building is to be transported, environmental factors, financial opportunities, technological needs and restrictions in the new location should be

taken into consideration when making these decisions. Accurate assessment of economic and physical conditions is important to ensure that the building is transported as soon as possible and with minimal damage. With an interdisciplinary work, it should firstly document the current situation in details, perform damage analysis of the building and take temporary measures to prevent the building from suffering more damages than existing ones during transportation. Then, the physical conditions of the new location should be adapted to the building's layout and the route should be planned. Disassembly, transportation and installation should be carried out with a company having experienced and expert staff in the application phase. Finally, after the building has been placed in its new place, re-consolidation and maintenance procedures should be applied.

### **THE MOVING TECHNIQUES AND SAMPLES OF MOVED BUILDINGS**

First examples of the building transportation have been witnessed in the 18<sup>th</sup> century that rest on the buildings moved in New Zealand and the USA. When a historical building is moved, considering the risk of losing its historical fabric and environmental impact it is seen that this process requires a very serious cost and experience if the historical character and the environmental impact will not lose (Peltola, 2008). During transportation, different techniques are applied depending on factors such as the location of the building, its static situation and economic and technical facilities. (Curtis, 1979; Lamar and others, 1999).

When moving processes until today are examined it has been seen that there are two basic techniques used in moving. These techniques are grouped under two main headings: moving partially or totally disassembled; and, moving intact.

#### **Moving Techniques by Disassembling or Dismantling of The Building**

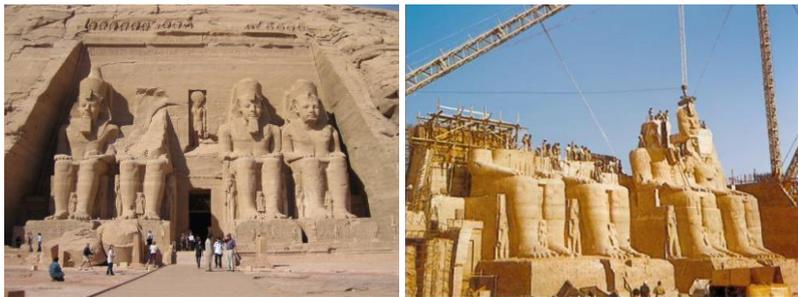
In some cases, where moving intact is not possible it is preferable to move the monument by disassembling it into its components. In this case, the building is rebuilt in its new place with its own materials and construction technique. During the planning, follow-up and implementation of the rebuilding process, working with an expert team on the subject are the basic steps for the building to avoid damaging the structural elements (Zakar & Eyüpgiller, 2015).

In some cases, the monument is severed into pieces, but in some cases components of the building are extracted by enumerating them and reassembled at the new site. In both cases, the first stage is the process of documenting the building in detail. Before carrying out the transport process, the detailed survey study should be completed. This study must be supported with photographs, videos and 3D models.

### ***Techniques by Disassembling The Monument***

This technique is generally applied to works that cannot be dismantled as sculptures and carved rock structures. The building is divided into large blocks and these parts are reassembled at the new site. During this process, the construction technique loses its originality, while the blocks are joined together, new binding materials such as binders, clamps etc. are used. Although produced mortars will not harm the original building materials with laboratory analysis, these new mortars or metal binder elements are the components of a new construction technique, such that the building is not at the time it was first designed.

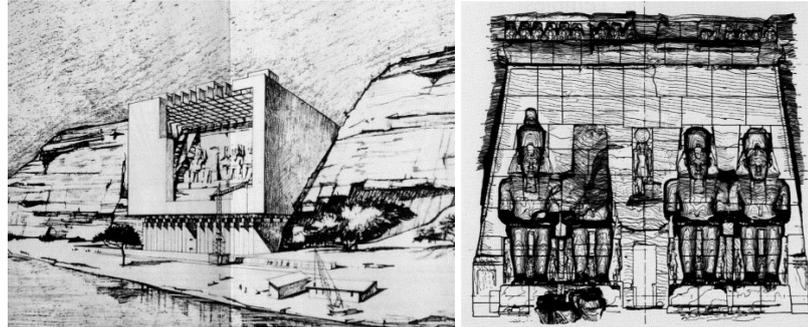
One of the most known works moved by this technique, is the Temple of Abu Simbel in Egypt. The temple, taking place in the World Heritage List of UNESCO, was carved into sandstone cliffs in 1250 B.C. (Figure 1) As a result of the rising water of the Aswan Dam on the Nile in the 1960s, a rescue project was initiated by UNESCO. Within the scope of the project between 1960 and 1968, the temple was removed from its place (Figure 2) and relocated in a higher position (Allais, 2013).



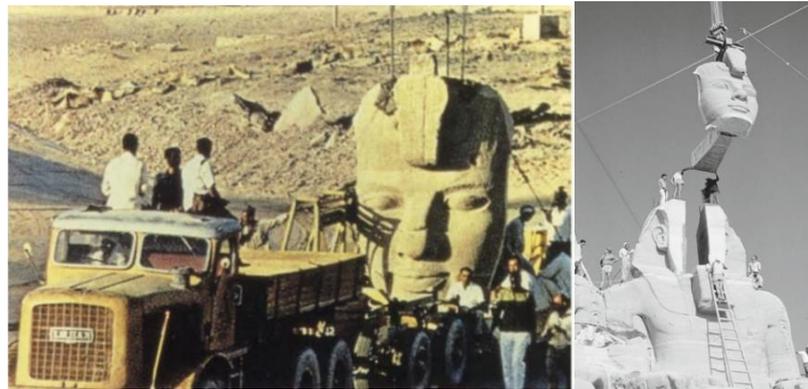
**Figure 1., 2.** Abu Simbel Temple (URL 1) and process of moving (URL 2)

Prior to transporting, the monuments were filmed, photographs were taken, and photogrammetric measurements (plans, sections, facades, details) and survey were prepared. (Figure 3, 4). The soft sandstone which forms the main rock has been stabilized in an effort to save the monuments from being torn down, and dispersion during transportation. The giant sculptures processed on the rock were severed to form large blocks with fine stone saws. The 7047 blocks are numbered and removed by hydraulic

jacks. The sculptures were located 200 meters behind and 65 meters above the current location (Figure 5, 6)



**Figure 3., 4.** Abu Simbel Temple moving schemes (Allois, 2013)



**Figure 5., 6.** Transporting process of building components (Hawass, 2000; Kirwan, 1963)

When assembling the blocks, a mortar produced from the sand of the area was used, and epoxy mortar was injected on the surface to secure it. In the new location of the monuments, an artificial hill with concrete shell structure was formed behind the large sculptures in order to simulate the surrounding landscape. After the rock blocks had been severed, it was mounted on this reinforced concrete structure (Kirwan, 1963; Ahunbay, 1996, Allois, 2013).

### ***Techniques by Dismantling and Reassembling The Building Components***

This technique is generally preferred in buildings constructed with materials that can be dismantled and reassembled, such as wood and stone. In this process, all the elements of the building structure are numbered, dismantled and reassembled elsewhere. Since the joining technique is very complicated, it is not suitable to move the buildings made of rubble stone by this technique. It is impossible to associate the stones that are dispersed during the dismantling process with the same stones.

Before the dismantling stage, each stone row and each stone in the interior and exterior facades are numbered at ashlar buildings. Horizontal and vertical lines are drawn to show the relation of stones with each other and with adjacent stones. Detailed pictures

of the general condition of the building are taken (Figure 7). Then the stones are carefully dismantled and stacked in order so that the horizontal rows are not mixed. The blocks that are disintegrated during the dismantling and which cannot be reused are replaced by a new material which is compatible with the original. Stone parts are then assembled on the prepared base in accordance with the previous numbering scheme (Ahunbay, 1996).



**Figure 7.** Ledger lines used in the numbering and dismantling stage (Curtis, 1979).

Enumerating each piece during disassembly and reassembly process is commonly applied procedure in many countries of the world and in Turkey, as well. Small buildings such as fountains have been usually moved, sometimes to nearby to current location, sometimes to different settlements of the city. In particular, there are many examples of historical fountains that remain on the route during road widening or new road works. Tophane Kılıç Ali Pasha Fountain was moved to the corner of the complex when it was at the corner of the barracks opposite the mosque. The Hekimoğlu Ali Pasha Fountain, which was originally on Kabataş embankment, taken to the Kabataş pier square when Meclisi Mebusan Street was opened in 1957. Sadrazam Koca Yusuf Pasha Fountain, next to the Fındıklı Mosque, was removed from its original place to Kabataş during widening the Tophane-Dolmabahçe road. II. Abdülhamit Fountain located in front of the Nusretiye Mosque was moved to the corner of Maçka Park because of road widening works, too. The Bereketzade Fountain (Figure 8, 9) located next to Bereketzade Ali Efendi Mosque in Galata, was moved to the square where Galata Tower has been located (Can, 1993; Pilehvarian & others, 2000; Urfalıoğlu, 2008; Memiş, 2013).

**Figure 8., 9.** Old and new views of the Bereketzade Fountain (Pilehvarian & others.)



Unlike above mentioned examples which were carried to a nearby place of the same street, or district where they were originally located Hacı Mehmet Fountain (Figure 10, 11), Hüsrem Fountain (Figure 12, 13), Binbaşı Hacı Hayri Fountain and Kalemkırđı Mosque were moved to completely different districts of Kayseri Town Centre. Some of these fountains were moved to Seyyid Burhaneddin Cemetery from different locations of the city during the road widening works, and it was tried to be exhibited in a kind of open air museum. Similarly, Kalemkırđı Mosque was moved near Seyyid Burhaneddin Cemetery and opened for worship services.

**Figure 10., 11.** View of Hacı Mehmet (Kaptan Pasha) Fountain before moving (Archive from K.K.V.K.B.K.) and its location in Seyyid Burhaneddin Cemetery (Batukan, 2017)



**Figure 12., 13.** View of Hüsrem Fountain before the relocation (Archive from K.K.V.K.B.K.) and its location in Seyyid Burhaneddin Cemetery (Batukan, 2017)



Baysungur and Çelebi Ali Mosques in the district of Pertek in Tunceli were moved from the old Pertek to the new Pertek because of the threat of falling under the waters of the Keban Dam Lake. The stones, that were enumerated and dismantled, were

transported to Pertek Town Centre depending on study outcomes found at Faculty of Architecture of the Middle East Technical University between 1971-73, and were re-assembled in the place where it is today. (Figure, 14, 15). They have been opened to worship service. In this process, the stones were separated from each other by means of pickaxes hammers and levers. The dismantling process was started from the minaret, then the mihrab, minbar, windows and other stone faces were removed, and all of them were put and arranged in a row around the building. The dome and rubble stone walls were taken in the last stage. The structural elements were reassembled on the concrete foundation and reconstructed in the place (area) where it was moved. During reconstruction new materials were used. (Tükel & Bakırer, 1970; Danık, 2004; Parlak, 2004; Burat, 2006).



**Figure 14., 15.** The state of the Baysungur Mosque before the moving (Danık, 2004) and the numbering of its stones during the transportation process (Parlak, 2004).

### Moving Techniques used to Move The Building Intact

The process of moving buildings intact is a technique applied in many countries, especially in the USA. Unlike the techniques of separating the structure into its components it is essential to maintain the integrity of the building while performing this process. In this context, first of all, after the preparation of the survey, restoration and static projects, the building structure is separated from the existing foundations with the help of temporary supports or with the suspension technique (Figure 16-18). If necessary, precautionary measures are taken to reinforce structural elements by strapping or connecting equipments. The building, which is lifted with the help of lever jacks, is transported to the new location with the chosen technique and the assembly process is carried out on the reconstructed foundations.



**Figure 16., 17., 18.** The process of separation from the foundations of the structure (N.F.P.C., 1990)

In the earlier applications, buildings were mainly drawn by rolling over stumps or rubber rollers with human and animal labour.

With the advancement of technology, this process has been being fulfilled by using equipment such as railroad tracks, skids, hydraulic jack and pistons, pallets (Figure 19-21). In general, three different ways are observed by tracks, by cylindrical rods and slides or by road vehicles such as trucks and trailers (Lu & others, 2010)



**Figure 19., 20., 21.** Examples of equipment used in traditional and modern methods of moving historical buildings (Goblet, 2006)

### *Moving by Tracks*

Implementation of the technique of moving buildings has been seen commonly in the United States that goes back to the 18<sup>th</sup> century. However, examples of moving by tracks have been usually seen in the 19<sup>th</sup> century. Considered to be the first example of a large masonry structure in the country, the Boston Pelham Hotel was built (Figure 22). The hotel, built with stone and brick material (Figure 23) has weighed about 5000 tons. In order to expand the road in the first stage, it was thought that some of the spaces in front of the hotel were to be demolished but it was determined that the transportation of the hotel could be fulfilled (realised) at a lower cost than the cost of this process and the building was suitable for moving. With a carefully prepared rail system, the hotel was towed about 2.54 cm in 5 minutes towards its new place, and, finally total replacement distance reached to 4.21 meters (Figure 24). During this 3-month-long transportation process, non-stop services were provided by utilising flexible pipes in plumbing and gas services, while workplaces and some hotel rooms on the first floor continued to serve during the moving process (Close, 1875; Curtis, 1979).



**Figure 22., 23., 24.** Transporting process and new location of Pelham Hotel (Close, 1875; Curtis, 1979; URL 3)

Due to coastal erosion in 1888, New York Brighton Hotel, which has been accepted as one of the first examples of a wooden frame building's moving in the US, was relocated in its new place. The transportation process was not carried out with the concern of protection, but rather to allow the long-term use of the building.

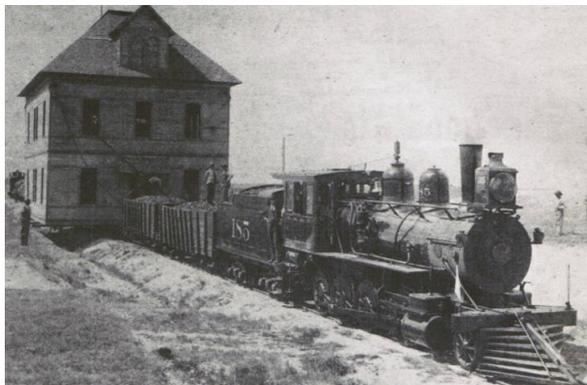
Although the hotel was not a historical building and only a twenty-year-old building when it was moved, it was replaced by technological equipments instead of human or animal labour. The Brooklyn and Brighton Coast Railroad, the owner of the hotel, thought that moving the building in parts would cause the cost to rise. Thus, they decided to carry this building, which weighed approximately 600 tons, by using locomotives for towing. At a cost of about \$ 12,000, the building was carried 180 meters from the sea to the land (Figure 25). 112 platform cars were used for the transportation of the hotel and cars were connected to each other by using 168 lumber. In order to place the building on the platform cars, 13 hydraulic jacks with high weight lifting capacity were used. After the building was lifted, the cars were slid underneath the building and the building was towed to the new location by 6 locomotives (Peltola, 2008)



**Figure 25.** Transporting process of Brighton hotel in 1888 (Peltola, 2008)

296

A similar process applied to the Brighton Hotel was held in Nebraska in 1889 for the Box Butte Courthouse, as well. As the Burling railway passed through the entire town of Box Butte, it was decided to move the district centre to the Alliance district, and decided to move the existing ten-year-old courthouse instead of constructing a new one. Approximately 95 tonnes of masonry building, by using 9 platform cars, was moved 14 km far away from its current location at the speed of 10 miles per hour (Figure 26) on the Burling railroad (S.A.A. 1899; Curtis, 1979)



**Figure 26.** Transporting process of the Box Butte Courthouse by the locomotive (S.A.A. 1899; Curtis, 1979).

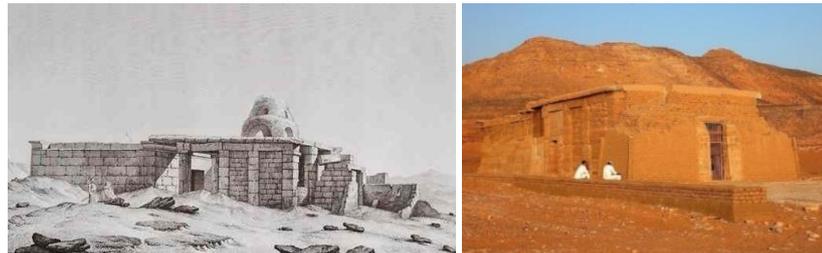
North Caroline Cape Hatteras building, the highest lighthouse in the United States, was moved 880 m away from its current location in 1990 due to ground abrasions caused by ocean waves.

The lighthouse, which measured 63.4 meters high, and a 2540 tons weight, was transported on tracks to its new place (Figure 27). Moving process took 23 days and cost about \$ 10 million (Booher ve Ezell, 2001; Peltola, 2008)



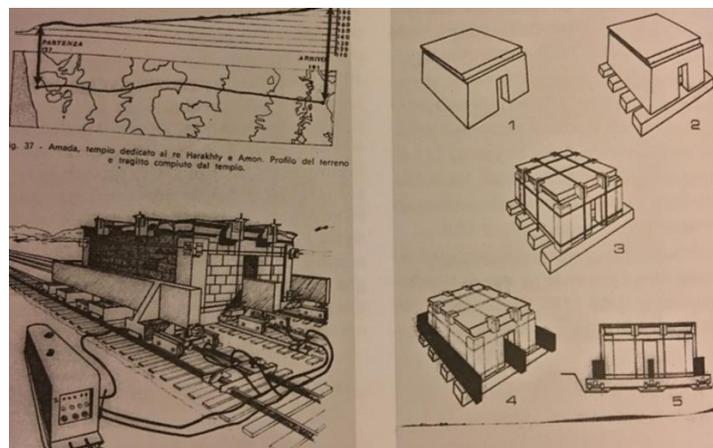
**Figure 27.** Transporting process of the Cape Hatteras lighthouse (Booher ve Ezell, 2001)

One of the examples of transportation of a building on tracks outside the US is the Harakhty and Amon Temple's relocation in Egypt Amada (Figure 28, 29). Due to the rising dam waters, it was moved to its new location, where was at a distance of 2.5 km and at a height of 65 m., and was carried on tracks and mounted there by utilizing hydraulic system between 1964-75 (Wilkinson, 2000).



**Figure 28., 29.** Amada Temple in 1800s (URL 4) and now (URL 5)

During the transportation process, after the temple was placed on the reinforced concrete foundation beams, its circumference was strapped tightly. Pulling on tracks was carried out with the help of beams passing through the monument, and through two sideways of it (Figure 30) (Ahunbay, 1996).



**Figure 30.** Transporting process of the temple (Ahunbay, 1996)

One of the historical relics carried by tracks in Europe is the Cathedral of the Assumption of the Virgin Mary in the Town of Most in Czechoslovakia (Figure 31). Due to the weakening of the ground by the tunnels dug during the operation of the coal mines, and collapses in the tunnels, it was lowered to 841 meters down from top of the hillside where it was constructed in the mountain in 1975. Firstly, the structure of the cathedral was reinforced, then, the walls of the cathedral were severed close to the ground and it was taken on a track system. The structure cut off from the ground was placed on the steel truss and carried down from the hillside at a low speed (Curtis, 1979; Ahunbay, 1996)



**Figure 31.** Transporting process of the cathedral (Curtis, 1979)

The Oerlikon Machinery Factory (Maschinenfabrik Oerlikon (MFO)), a 122-year-old building in Zurich, Switzerland, was moved 60 meters forward from its settlement by sleds as it intersected a railway being overhauled (Figure 32). The structure, which was separated from the foundation, was placed on the piles and was placed on the foundation previously excavated after being transported by tracks. The transport of 6200 tons of building at a speed of 4 km per hour was carried out at a cost of \$12.7 million. (URL-6)



**Figure 32.** Transporting process of Oerlikon Machinery Factory (URL-6)

In Turkey, Atatürk Mansion in Yalova Thermal District is the oldest example of moving a building on the tracks. When Atatürk visited the mansion in 1930, the workers informed him that a branch of the plane tree next door was wreaking damage on the roof and wall, and asked for permission to cut the branch of the plane tree stretched out on the mansion. Atatürk, instead of cutting the branch of the plane tree, wanted them to move the building on the tram tracks to a place a little forward of the building. The relocation of the mansion was carried on in two stages. First, the terrace part of mansion was hauled, and then, the main building was moved on the tracks so, the building was moved about 5 meters away to the east (Figure 33, 34). Thus, the Mansion was rescued from being demolished, and plane tree survived. After that the mansion began to be called as the “Walking Mansion” (Ulusu, 2008).



**Figure 33., 34.,** Transporting process of Yalova Atatürk Mansion (Bulut, 2013)

### ***Moving by sliding technique***

Sliding platforms, skids or cylindrical rods have been generally used in sliding method of moving buildings. The sliding technique on cylindrical rods is a preferred method especially in small span structures. In this method, the cylinders on which the building will be placed are steel or concrete filled tubes. This method can be advantageous if the new location of the building is close to its current location. On sliding platforms two fixed or movable runners are used. This method is preferred in buildings with spans of different widths. It is especially used in buildings that will be moved up or down in the vertical plane (Lu and others, 2010).

*“The relocation of buildings by the sleighs, wheels and rollers has been a fairly common occurrence in the United States since the late 18th century. The cross bracing was used to provide added support for the structure during its move on wooden wheels.”* (Figure 35) (Curtis, 1979)



**Figure 35.** Moving a building in Walnut Street-Philadelphia in 1799 (Curtis, 1979)

Moving by sliding has been often preferred in China. The Shanghai concert building, which has weighed 4500 tons, was moved up to 66.46 meters forward and 3.38 meters upwards in 2004 by using a sliding platform to prevent noise and environmental pollution coming from the motorway next to it (Figure 36, 37) (URL 7)



**Figure 36., 37.** Transporting process and the new location of the building (URL 7)

The place of the Jinlun City Hall in Qing Dynasty, China, was relocated by sliding 102.5 meters using cylindrical rods in 2001 (Figure 38, 39). Another example of the method of moving by cylindrical rods is the Quyuan temple in China (Figure 40, 41). The temple was moved to a location 3 km further in 1976 in order to be rescued from being underneath the water of the river (Lu and others, 2010).



**Figure 38., 39.** Old and new view of Jinlun City Hall (URL 8)

**Figure 40., 41.** Transporting process of Jinlun City Hall and Quyuan Temple (Lu ve diğ., 2010)



Bakırköy Train Station Building was moved to the opposite side of the road during the construction of Marmaray, in 2018. In order to realise this process, firstly a cage system was prepared which surrounded the building both inside and outside. The building was lifted with hydraulic jacks from the ground, then the skids were installed underneath and a bridge system was installed on the stone blocks because it had to be placed against the road. The building was slid and placed in the new space on the opposite side of the road with the help of hydraulic pistons. (URL 9) (Figures 42-44)

**Figure 42., 43., 44:** Transporting process of the building (URL 9)



### ***Transport on Highways with Vehicles such as Trucks and Trailers***

In this technique, similar to the others, the building, which is separated from the foundation and reinforced where necessary, is loaded onto the road vehicles with the help of cranes and jacks and is transported to the new location. The size and weight of the building is important during this process. When heavy buildings are transported, it is possible to face situations such as the collapse of highways. It is a preferred method especially for small and light structures in many countries of the world.

The mansion of Captain Samuel Brown, on the edge of the Monongahela river in Pennsylvania, USA, was moved in 1903 due to its existing site's being stood on the Baltimore and Ohio railway route. The landlord decided to move his property to a big orchard belonged to him, and it was 50 meters above the building's existing location. In order to move the building weighed about 800 tons, 8 planks 30x40 cm of size and 25 m. of length were placed underneath of the building. First, the structure was lifted up to 9 meters by means of two cranes connected to the peak of the cliff next to the house. (Figure 45), Each crane used in this process was pulled by two horses. This process was repeated 4 times, and was

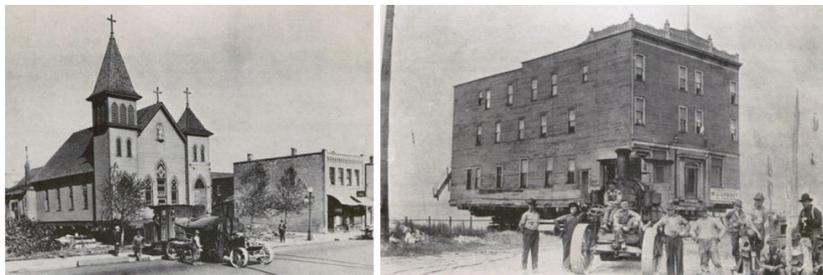
moved 60 meters back and 48 meters up the original site of the house (S.A.A., 1923; Curtis, 1979).



**Figure 45.** Transporting process of Captain Samuel Brown's mansion (S.A.A., 1923; Curtis, 1979)

After the discovery of iron mines under the ground of US city of Minnesota Hibbing, it was decided to move one third of the city to another location in 1919. The buildings were moved slowly to the outskirts of the city in approximately three years (Figure 46, 47). In this transport process, buildings were usually towed by locomotives, and pulled by horses and platform cars (Fisher, 1971; Curtis, 1979).

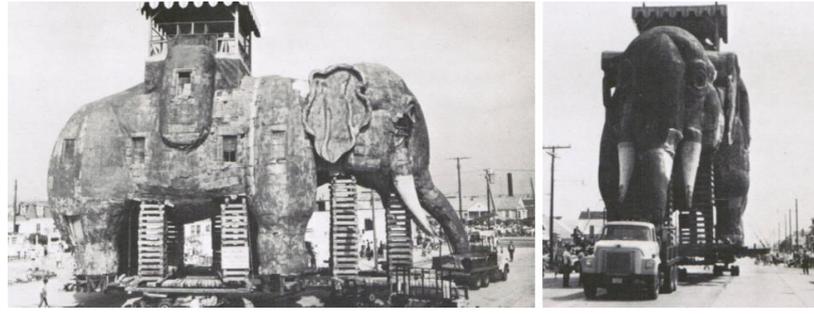
302



**Figure 46., 47.** Moving the buildings made of different materials and used with different functions in the city of Hibbing (Fisher, 1971; Curtis, 1979)

Lucy, The Margate Elephant is one of the most unusual structures that has been replaced by moving method in USA. It was built in the form of an elephant in New Jersey-Margate in 1881 on the ocean side using wooden materials and steel plates. The structure was damaged by the ocean waves, tornadoes, and currents over the years. In 1970, it was decided to move the building inward further away from the sea shore. In order to carry out the transportation process, the structure was lifted by using hydraulic jacks and placed on a steel platform supported by three sets of wheels and moved to the new location by means of trucks (Fig. 48, 49). After the building was moved, it was restored and started to use as a museum (Curtis, 1979; Page, 1976).

**Figure 48., 49.** Transporting process of Lucy (Curtis, 1979; Page, 100-101)



The building numbered 51 at the New Jersey Newark International Airport was moved 1.2 km away from the airport during the renovation and expansion works there (Fig. 50, 51). The moving process of the terminal building, which weighed 7400 tons, lasted for 5 months. Before moving, the terminal building was disassembled into three parts and transported by 176 wheeled vehicles at a speed of 30 meters per hour. The building is currently used as an airport administration building (PANYNJ, 2017).

**Figure 50., 51.** Transporting process of the terminal building (URL 10)



Another example of moving buildings in Turkey is Kalkandere Hüseyin Hoca Köyü Sahil Camii's relocation in Rize. The wooden mosque, left unattended in Keler, where was an over-migrating village, was moved to Hüseyin Hoca Köyü in 1977. For the mosque was constructed by timber only and without a foundation it was, for the first step, placed over a warehouse for tea purchasing. After the warehouse became dilapidated after 34 years it was moved for the second time. After removing the non-original roof, steels laid diagonally under the building, and steels laid over the building were attached together by calculating centroid of area, and formed a steel cage in which the building was placed. The building was lifted by a crane and placed in a lot 20 meters far away (Sav, 2012) (Figure 52-55).



**Figure 52., 53., 54., 55.** Relocating the mosque in its new position by means of a crane (Sav, 2012)

There has been an on-going dam construction on the Stream of Kars in Susuz district of Kars. Whereas, the historic Çamçavuş Iron Bridge, built by Russians in 1899, was located on this stream. The bridge was 65 meters long, 5.60 meters wide and weighed about 100 tons. Since the construction of the dam has been on-going, and by the time it will have been finished it will have had a dam reservoir, and the bridge will have been underneath of the waters, the bridge has had to be moved to the Campus of Kafkas University. Thus, the bridge was taken by the General Directorate of Highways from its location by means of hydraulic system vehicles in 2015, and it took them two days to transport it to the Campus<sup>58</sup> (Sömen and others, 2015) (Figure 56).



**Figure 56.** Transporting process of the bridge (Sömen and others, 2015)

During the construction of Marmaray, it was decided to move the Yeşilköy Train Station Building between 2016-2017. In order to accommodate the 4.16x5 m sized structure on the truck's trailer, a cage system that inwardly and outwardly surrounded the building was designed and the total weight of the building increased to 90 tons. The building was removed from the ground

with hydraulic jacks and tracks were installed underneath. It was placed on the truck's trailer with the help of tracks and hydraulic pistons and moved to its new position at a distance of 90 m. Before transportation ground was reinforced on the road in order to prevent any collapse due to the weight of the vehicle and the load on it (Kösebay, 2007, URL 9). (Figure 57-60)



**Figure 57., 58., 59., 60.**  
Transporting process of Yeşilköy Train Station Building (URL 9, URL 10)

One of the significant operations of moving buildings, carried out in recent years, in Turkey, has been the relocation of Zeynel Bey Tomb and Artuklu Bath, located in Batman's Hasankeyf district. (Fig. 61, 62). A science commission has been established against the threat of the buildings being flooded by the Ilisu Dam. This commission has evaluated the alterations including protection, and recommended that the buildings be moved intact and should be placed in the Cultural Park in new Hasankeyf (Ulucam, 2016).



**Figure 61., 62.** Zeynel Bey Complex and Artuklu Bath (Ulucam, 2016)

Before the tomb was moved, firstly, damage assessment and reinforcement studies were carried out (Figure 63-65). A high foundation for lifting the building was constructed around the tomb and 28 lifting beams were produced for being used on the lower parts of the walls. Lifting plate was completed by applying post tensioning of a 90 cm height, and 44 hydraulic jacks were installed. For transporting the buildings, SPMT (Self Propelled Modular Transporter), a vehicle capable of carrying the desired weight up to 4% of the slope on standard road conditions, was used, and tomb was transported by 6 SPMTs. In this context, accelerometers were placed on the building to measure the

movement of SPMTs during transportation. All these sensors and systems were integrated with the control module of the SPMTs that would carry out the transportation, and integrated with a special computer program prepared only for this building (URL 12). The Artuklu Bath, which was moved in 2018, was also relocated by a similar system. (Figure 66).



**Figure 63., 64., 65.** Restoration process before moving (Ulucam, 2016)



**Figure 66.** Transporting process of Artuklu Bath (URL 13)

## CONCLUSION

Preservation is a form of advocacy that promotes the applicability of limited resources, encourages the appreciation of works produced by previous artisans, and respects previous cultures. The moving method used in obligatory situations is also one of the ways to extend these limited resources as a preservation technique (Goblet, 2006).<sup>66</sup> With the advancement of technology, the development of techniques used in the field of preservation has led to the discussion of the potential for moving the buildings and their application in many countries.

Factors such as the ones having negative impact of moving on cultural memory and social perception, as well as changes in physical properties of structural elements and materials, has been questioning the necessity of moving buildings. In addition, in case of relocation of the monument, it is the subject of discussion among the conservators about the possible damage on the structural integrity and design of the traditional building. However, in some cases, the existence of the building may be more

prominent than other factors. When the moving a building becomes unavoidable for protection, it's decided that one of the different moving should be chosen by evaluating the current position of the building, and new environment of the site where the building is planned to be moved. Parameters, additionally to the above mentioned ones, such as conditions of the transportation route, the size of the building, construction technique, building materials, physical condition, and damage levels should be taken into consideration, as well.

When the samples of moving buildings in different countries of the world have been examined, two main methods come to the fore: a) moving partly or totally disassembled, and reassembled in the new location or b) moving intact and grounded on a new foundation. In the case of moving small-size and ashlar buildings, or rock-carved structures, the technique of disassembling the components is generally preferred. However, moving intact can be applied to all kinds of buildings as long as the economic and technological facilities allow. In this technique, the equipment that can handle the maximum capacity is used according to the weight calculations of the planned building. If the building is to be moved intact, what kind of transportation is carried out, is decided according to the distance between the current and the new locations, as well as the condition of the road route.

When the examples are examined and the applied moving techniques compared, it is seen that the method of disassembling the structure into components is more inconvenient than other methods in many aspects. No matter how much carefully is drawn the schemes, and written the numbers on the components, during dismantled building components are transported, it is very likely that wrong applications and damage in the fabric of the building will occur during reassembly process. Furthermore, considering the authenticity of the traditional building as well as the construction materials and its system characteristics, it is inevitable to damage this value even if a material close to its original one is used as the joining material, and combined with the same construction technique.

Moving the building intact that preserves its structural integrity and, is not being reassembled, minimizes possible wrongdoings in reassembling details, is more advantageous than moving the building by dismantling technique. However, creating a new and artificial context by disconnecting the building from the original context, and also by constructing a new structural foundation system and forcing the historical structure to adapt to this new



system is one of the main disadvantages of both moving techniques.

Historical relics, which are defined as “immovable cultural heritage” become “transportable” as a result of having the choice of moving method of protection. This issue has been handled with special importance in the field of architectural conservation. It is very important to determine an interdisciplinary working method and to study with a team of experts in order to achieve a successful moving application and principles of preservation ethics. The first stage is the decision to move. In order for this decision to be taken, restoration experts, conservation institutions and local government units should ensure that there is no other means to protect the building and it is mandatory to move it to a new site. If the necessity of moving the building is arised from the ground’s weakness, ground stabilization and reinforcement solutions should be tried; if it is caused by environmental factors, deterioration factors should be cleared away; if it is caused by zoning decisions, these decisions should be changed by local administrations/municipalities. After the decision is taken, the second stage comes as the process of identifying alternatives for the new location where the building will be moved. The primary preference at this stage should be possibly as close as to the current location in terms of the sustainability of the cultural memory.

The project stage is a process that must be meticulously fulfilled. Surveying, restitution, restoration, conservation, static, mechanical, soil strengthening and transportation/reconstruction projects prepared by experts from different disciplines should include all the details that can be anticipated. After obtaining the necessary permits from the affiliated institutions, detailed reports should be prepared for the application and the projects should be revised in unexpected situations during implementation and every stage of the application should be documented with drawings, photographs and videos.

The first stage for implementation is the agreement with the carrier. It is important that the company that will carry the building should be familiar with the historical buildings and especially the new location where it will be moved. Local carrier firms are usually familiar with the official institutions and rules of the region and they have the control of the transportation method which is suitable for the region (Peltola, 2008). Carrier should be selected according to timing, moving technique and type of building. The reason for timing as the criterion is the importance

of the process required for the transport process. In the contract to be made with the carrier company, it is necessary to include the terms for determining the responsibilities of the owner of the building and the carrier company, as well as for the solution of the damages that may occur with natural or environmental factors and the possible financial problems. In addition to providing reliable sources and references, the level of experience of employees is also one of the most important factors that should be taken into consideration (Paravalos, 2006). During the transportation process, if the contracted firm does not have the necessary technical equipment or if an alternative agreement is made with another alternative firm as a precaution against the possible violations, the process will ensure a healthier process (Curtis, 1979).

Another step in the implementation stage is to determine the route for the transport of the building. According to the weight of the building and the method of transport, it is planned to repair the roads in the route, to strengthen and to place temporary equipment such as tracks, bridge and platform. It may be necessary to remove, cancel or repair the heating elements such as heating, electricity and water before carrying out the construction. Before or simultaneously with the preparation of the building, ground and foundation preparations at the new location are completed. Then, the transport process is carried out with the chosen technique and the rebuilding of the building is constructed with the same meticulousness in the dismantling phase. In this process, restoration and re-use projects are prepared if necessary. Implementation of regular maintenance and inspection procedures after carrying out the transportation process is important in order for the building to continue its life in a healthy way and to avoid new conservation problems.

Although the techniques used in the transport of monuments vary, it is observed that there are different disadvantages in all methods, especially in terms of contextual and authenticity values. However, as stated in the study, it is seen that in some cases, these negativities remained more in the background and that the continuation of the existence of the building gained importance. For this reason, considering the moving as an architectural protection technique, it is necessary to act carefully in decisionmaking, project, application, maintenance and inspection stages. Conducting all stages by expert teams and carrying out the process, knowing that the moved building is, above all, a cultural asset and a world heritage, will enable the minimization of possible contextual and structural problems.



## REFERENCES

- Ahunbay Z. (1996). *Tarihi Çevre Koruma ve Restorasyon*, YEM Yayınları, İstanbul.
- Allais, L. (2013). Integrities: The Salvage of Abu Simbel, *GreyRoom*, 50: 1-45
- Booher, M. & Ezell, L. (2001). *Out of Harm's Way*, Eastwind Publishing, Annapolis, MD.
- Batukan F. B. (2017). Korumada Taşıma Yönteminin Kültürel Hafızaya Etkisinin Kayseri Örneği Üzerinden İrdelenmesi, Erciyes Üniversitesi, Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, İstanbul.
- Bulut, S. (2003). *Büyük Atatürk'ten Küçük Öyküler*, Can Sanat Yayınları, İstanbul
- Burat, O. (2006). Pertek Baysungur Camii'nin Taşınması, *Vakıflar Dergisi*, 10: 289-298
- Can, C. (1993). *İstanbul'da 19. Yüzyıl Batılı ve Levanten Mimarların Yapıları ve Koruma Sorunları*, Yıldız Teknik Üniversitesi, Fen Bilimleri Enstitüsü, Doktora Tezi, İstanbul.
- Close, C. S. (1875). Moving Brick Houses, *Journal of the Franklin Institute*, 70(3): 178-180.
- Curtis, J. O. (1979). *Moving Historic Buildings*, U.S. Department of the interior heritage conservation and recreation service technical preservation services division, Washington, D.C.
- Danık, E. (2004). Pertek Baysungur-ve Celebi Ali Camii, *Vakıflar Dergisi*, XXVIII: 185-210.
- Feilden, B.M. (1982). *Conservation of Historic Buildings*, Third Edition, Architectural press, New York USA.
- Fisher, M. (1921). Moving hibbing by tractor and truck, *American City*, 25: 105.
- Goblet, N. (2006). *Moving Historic Buildings: One Means of Preservation*, Cornell University, PhD thesis, USA.
- Hawass, Z. (2000) *The Mysteries of Abu Simbel*, The American University of Cairo Press, USA.
- Kayseri Kültür Varlıklarını Koruma Bölge Kurulu (K.K.V.K.B.K.) Arşivi
- Kirwan, L. P., (1963). Land of Abu Simbel, *The Geographical*, 129 (3): 261-273.
- Lamar, K, Pan, D. & Stan, B. (1999). Photo from Southcombe's Collection, *The Structural Mover*, 17: 1.
- Lu X. L., Lu W.S. & Zhang, X. (2010). New resolution for historic building conservation by building moving technology, *Advanced Materials Research*, 133-134: 19-25.
- Memiş, F. Z. (2013). *İtalyan Mimar Raimondo D'Aronco'nun İstanbul Yapılarının Koruma Durumlarının Araştırılması*, Yıldız Teknik Üniversitesi, Fen Bilimleri Enstitüsü Mimarlık Anabilim Dalı, Yüksek Lisans Tezi, İstanbul.

- N.F.P.C. (National Flood Proofing Committee), (1990). *Raising and Moving the Slab-on-Grade House*, US Army Corps of Engineers. USA.
- Page M. (1976). Lucy, the Margate Elephant, In *Historic Houses Restored and Preserved*, New York: Whitney Library of Design, s. 195-198.
- PANYNJ (Port Authority of New York and New Jersey), (2017), *Written Re-evaluation and Record of Decision for the Environmental Assessment for the Terminal, A Redevelopment Program at Newark Liberty International Airport*, Department of Transportation Federal Aviation Administration Eastern Region, New Jersey.
- Paravalos, P. (2006). *Moving a House with Preservation in Mind (American Association for State and Local History)*, AltaMira Press, Lanham, USA.
- Parlak, L. (2004). *Yukarı Fırat'ta Tarihi Eserler*, İstanbul Matbaası, Elazığ.
- Peltola, X. (2008). *Moving Historic Buildings: A Study of What Makes Good Preservation Practices When Dealing with Historically Significant Buildings and Structures*, A Thesis Presented to The Graduate Schools Of Clemson University And The College Of Charleston, Clemson University, USA.
- Pilehvarian N., Urfaloğlu N. & Yazıcıoğlu, L. (2000). *Osmanlı Başkenti İstanbul'da Çeşmeler*, YEM Yayınları, İstanbul,
- S.A.A. (Scientific American Archive), (1899). *Courthouse going to court*, V. 81, s. 232.
- S.A.A. (Scientific American Archive), (1923). *Curious feat of house moving*, V. 25, s. 105.
- Sav M. (2012). Tarihinde ikinci kez taşınan ahşap cami: Rize-Kalkandere Hüseyin Hoca Köyü Sahil Camii, *Restorasyon Yıllığı*, 4: 161-169.
- Sömen A.D., Ateş S. S., Durmuş F., Sert H., Partal E. M., Nas M., Yılmaz, S., Demirci H., Avşın A. & Turan G. S. (2015). Tarihi Çamçavuş Demir Köprüsü'nün taşınması, 5. *Tarihi Eserlerin Güçlendirilmesi ve Geleceğe Güvenle Devredilmesi Sempozyumu*, Erzurum.
- Sutton, Q., M. (2013,) *Archeology: The Science of the Human Past*, Routledge.
- Tükel, A. & Bakırer, Ö. (1970). "1968 Yılı Keban Projesi Restorasyon Çalışmaları Ön Raporu", *1968 Yaz Çalışmaları*: 183-186 Ankara.
- Uluçam, A. (2016) Hasankeyf'teki Kültürel Mirasın Bugünkü Durumu, *XX. Uluslararası Ortaçağ Türk Dönemi Kazıları ve Sanat Tarihi Araştırmaları Sempozyumu*, C. 1: 14-36.
- Ulus, M. K., (2008), *Atatürk'ün Yanı Başında, Çankaya Köşkü Kütüphanecisi Nuri Ulus'unun Hatıraları*, Doğan Egmont Yayıncılık, İstanbul.



- Urfaloğlu, N. (2008). *İstanbul'un Çeşme ve Sebilleri*, T.C. Marmara ve Boğazları Belediyeler Birliği Yayını, 60: 22-23.
- Wilkinson, R. H. (2000). *The Complete Temples of Ancient Egypt*, Thames&Hudson.
- Zakar L. & Eyüpgiller K. K. (2015). *Mimari Restorasyon Koruma Teknik ve Yöntemleri*, Ömür Matbaacılık A.Ş., İstanbul.
- (URL 1) [whc.unesco.org/en/documents/108536](http://whc.unesco.org/en/documents/108536)
- (URL 2) <http://pousse-toidemonsoleil.eklablog.com/labo-d-archeologie-l-egyptologie-a114960582>
- (URL 3) <http://lostnewengland.com/2014/09/hotel-pelham-boston/>
- (URL 4) <https://ascendingpassage.com/N-11-Hassaya-Amada-Temple.htm>
- (URL 5) <https://www.egypttoursplus.com/amada-temple/>
- (URL 6) <http://www.bbc.com/news/world-europe-18168278>
- (URL 7) <http://www.enerpac.com/en-us/projects/markets/buildings-and-stadiums-0/the-shanghai-concert-hall-lifting-and-moving-project>
- (URL 8) <http://www.thatsmags.com/guangzhou/directory/gallery/21868>
- (URL 9) [https://youtu.be/kd\\_DbzTve9E](https://youtu.be/kd_DbzTve9E)
- (URL 10) <http://science.howstuffworks.com/engineering/structural/heaviest-building-moved4.htm>
- (URL 11) <https://www.linkedin.com/company/somun-in%C5%9Faat-proje-ltd--%C5%9Fti>
- (URL 12) <http://dsi.gov.tr/docs/default-document-library/dsi-zeynel-bey-t%C3%BCrbesi-.pdf?sfvrsn=0>
- (URL 13) [http://www.hasankeyfgirisimi.net/wp-content/uploads/2018/10/Artuklu-Hamami\\_1.jpg](http://www.hasankeyfgirisimi.net/wp-content/uploads/2018/10/Artuklu-Hamami_1.jpg)

## Resume

*H. Hale Kozlu, graduated from Selcuk University, Department of Architecture of Engineering and Architecture Faculty in 1999. She was entitled to get her post graduate degree in 2002 by the master's thesis titled "Architectural Properties of Traditional Develi Houses" at the same university. She followed her PhD studies at Istanbul Technical University and completed her degree by the dissertation titled "Characterization of Historical Mortars and Features of Restoration Mortars in Kayseri District" in 2010. She has still been pursuing her academic career at the Faculty of Architecture, Department of Architecture, of Erciyes University in Kayseri.*



*F. Burcu Batukan Dördüncü, graduated from Erciyes University, Faculty of Architecture in 2013. She was entitled to get her post graduate degree in 2017 by the master's thesis titled "Analysis of The Influence of Moving Technique for Architectural Conservation on Cultural Memory Using The Case Of Kayseri". Currently, she works as an architect at Kayseri Metropolitan Municipality.*