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KONGRE KİTABI

EDİTÖR
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MAJOR DAMAGES IN TURKISH HISTORICAL MOSQUES

Adem DOĞANGÜN

Prof. Dr., Bursa Uludag University
ORCID: 0000-0002-1867-7103

Tuğçe ISAFÇA KAYA

PhD. Student, Bursa Uludag University
ORCID: 0000-0002-9331-1339

Abstract

There are many historical structures in Turkey that were built for different purposes in different periods. Historical mosques are among the most important examples of these structures. These structures have been exposed to many negative effects throughout their long lifespan. These effects have caused various damages to the structures. While some of these damages are easy to define, some specific cracks and deterioration are not similar to known types of damage and become difficult to define. In this case, accurate diagnosis is also difficult. Therefore, there is a possibility that the restoration to be implemented may not be successful. Whether the cracks originate from the upper structure or from the supporting soil is one of the most hesitant points in practice. This paper aims to debate the damages of historical mosques by opening the discussion and help engineers and architectures to make more accurate diagnoses. For this purpose, mosques and religious monuments were built using different materials such as Urfa Halfeti Ulu Mosque, Erzurum Şenkaya Bardız Mosque, Bursa Sinanpaşa Madrasa and Ardahan Posof Kol Mosque were selected as examples. During the study, the causes of damages in historical structures, apart from the earthquake effect, the development of the damage and the applications that can be done to prevent damage are examined. Thus, as a result of the evaluations made within the scope of the paper, it will contribute to the expansion of the perspectives of view of our young colleagues who will prepare static reports in restoration projects.

Keywords: Turkey, historical mosques, damage, restoration

1. Introduction

Turkey is a very rich country in terms of historic structures due to being an old settlement. As it is known, these structures were built for different purposes. Among these structures, historic mosques have an important share. Historical mosques carry the traces of the past to future generations with their features such as size, construction technique and materials. For this reason, it is important to protect these structures (Çakır et.al., 2015).

Over time, there has been a change in the architectural features of historical mosques due to the changes in the needs of the society, construction technique and geographical conditions. For example, as time progressed, the number of arches, columns, domes and balconies of mosques increased. Historical mosques were generally built as a masonry structure consisting of stone and brickwork units or with a wooden load-bearing system. It was stated that brick material was preferred in historical mosques built during the Seljuk period, stone material was preferred in historical mosques built in the Ottoman period, and Khorasan Mortar was used to connect stone and brick (Ural and Çelik; 2021).

In Turkey, historic mosques have been exposed to various physical, chemical and biological effects throughout their long lives. The earthquake comes first because in Turkey, devastating earthquakes occur. Damages to mosques caused by earthquakes are included in the literature (Çakır et al. 2015; Doğangün et al. 2007; Doğangün and Sezen 2012). While some historical mosques survived these earthquakes undamaged or with minimal damage, some of them were seriously damaged or partially demolished. Damages caused by earthquakes are excluded from the scope of this study. Therefore, in this study, the damages observed in mosques due to effects other than earthquakes and the way these damages progress and the measures that can be taken are explained. As a result of these effects, cracks occurred in various level in some of the mosques or material deterioration occurred. Knowing the cause of cracks and other damage/deterioration in historic mosques is very important in taking the right measures in conservation and repair works. Otherwise, there may be a possibility of failure of the restoration work, which sometimes leads to the deterioration of the originality of the historic mosque. While the cause of some cracks and damages in the structures can be determined easily, it is more difficult to determine the cause of some special cracks. In this study, the damages were detected in some historic mosques and religious buildings in Turkey such as Urfa Halfeti Ulu Mosque, Erzurum Şenkaya Bardız Mosque, Bursa Sinanpaşa Madrasa and Ardahan Posof Kol Mosque were examined.

2. Damages and Cracks in Historical Mosques

Damages and cracks can be seen in different parts of historic mosques in Turkey, such as domes, minarets, arch-bearing walls and columns. The type and progression of these damages and cracks provide information about the cause of the damage. Some damages and cracks that may occur in historic mosques as a result of effects other than earthquakes are summarized below;

2.1.Subsoil-Induced Damages

Subsoil-induced damage, especially settlement, is one of the important causes of damage in historical mosques. Changes in groundwater level effect the soil properties. To control the groundwater, which has the greatest impact after the earthquake for masonry structures, cisterns or wells connected with galleries were built under or near the foundations in some structures, and a groundwater drainage system was arranged (T.R. General Directorate of Foundations, 2019).

The inadequacy of the foundation system in historical masonry mosques contributes to the more common occurrence of subsoil-induced damage. Since the vertical elements of the masonry structure are masonry walls, the foundation system is usually the sub-wall masonry foundation. It was not possible to make the raft foundation system, which is widely used in today's buildings, with the technology and application skills of that day. The photograph presented in Figure 1 shows the masonry wall damage that occurred due to a line excavation near the Kol Mosque in the Posof District of Ardahan Province. In the photograph presented in Figure 2, cracks in the upper structure of the mosque are seen due to the change in the water level due to the dam lake in the Urfa Halfeti Ulu Mosque.



Figure1. Damage on the masonry wall of Kol Mosque in Posof District of Ardahan Province (Doğangün and Angın, 2009)



Figure 2. Damage to the Urfa Halfeti Mosque (Doğangün and Livaoglu, 2015).

In the photograph presented in Figure 3, cracks in the madrasa walls can be seen due to the change in the ground water level and soil properties in Bursa Sinan Pasha Madrasa.



Figure 3. Crack on the wall of Bursa Sinan Pasha Madrasa (Livaoğlu and Doğangün, 2014)

2.2. Damages Caused by the Design of the Building

The upper structure of historic mosques built in Turkey usually consist of domes. The weight of the domes is generally quite high, because of this weight, tensile stresses can occur at the circular base. To carry the tensile stresses in a load-bearing system consisting of masonry units, some additional measures must be taken. As seen in Figure 4, one of the applications made for this purpose is that the main dome is supported from the outside by other pier-type masonry elements.

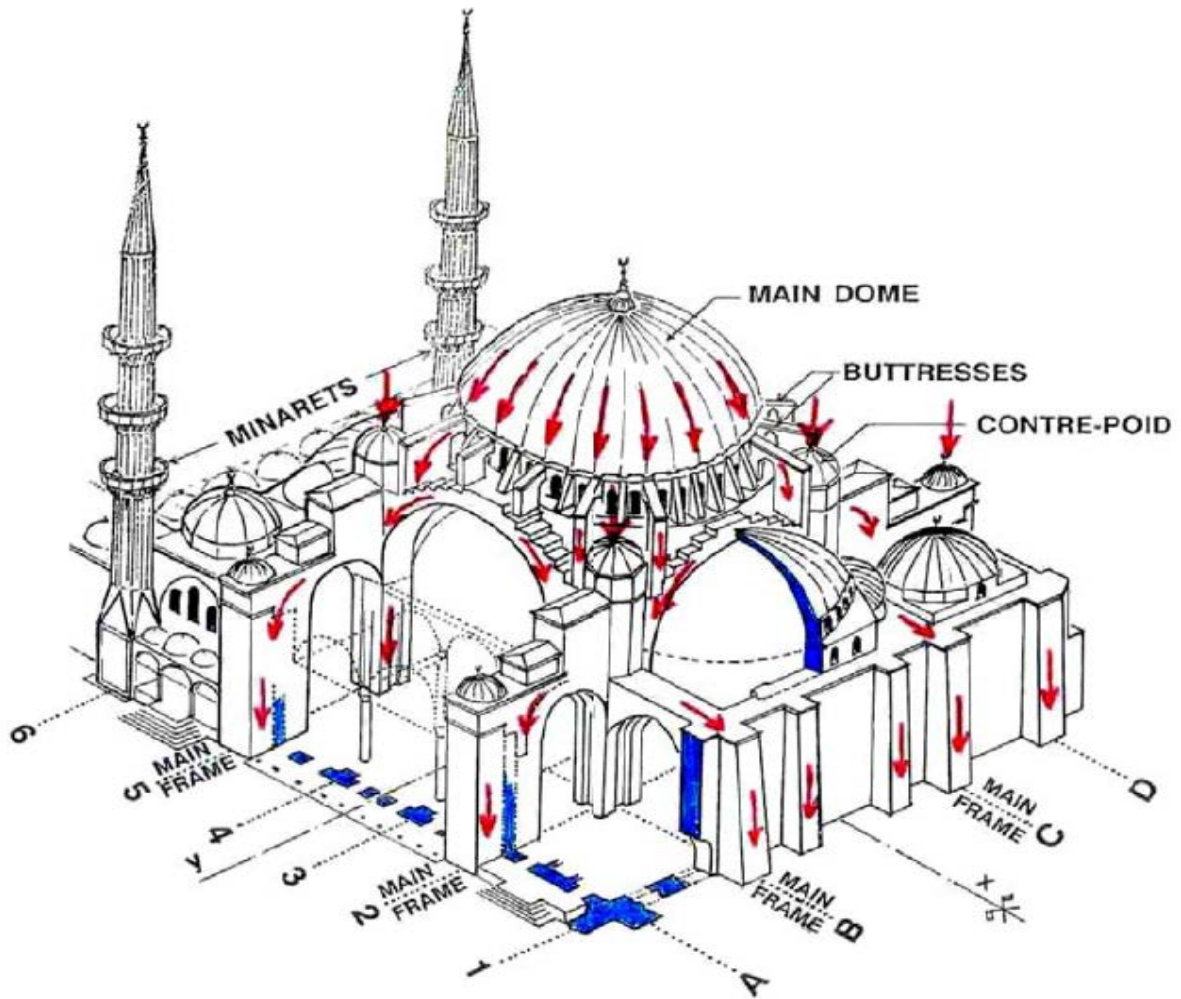


Figure 4. Istanbul Süleymaniye Mosque main dome and its transport system (Arioğlu and Anadolu 1973)

One of the applications to resist the tensile stresses in the region where the dome mounted is to place circular steel elements in this region as shown in Figure 5.

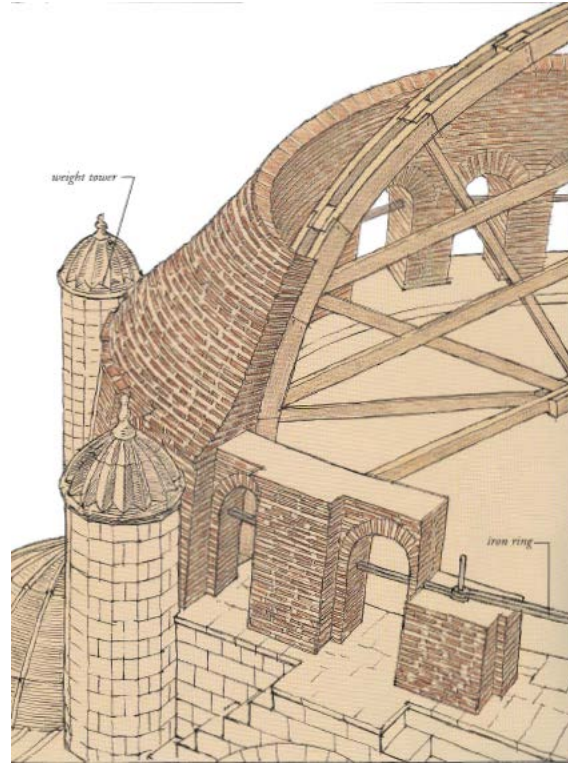


Figure 5. Appearance of the dome drum (Macaulay, 2008)

An example of the damage caused by the expansion of the dome's base is the damage that occurred in Erzurum Bardız Mosque. As shown in the photograph presented in Figure 6, the crack in the lower part of this mosque's dome has grown so much that it has become a cleft.



Figure 6. Serious damage in Erzurum Bardız Mosque (Doğangün and Acar, 2009).

3. Results

Turkish historic mosques are among the most important structures to be preserved and passed on to future generations. Ground movements, especially settlement, are one of the most important causes of damage in such structures. If it cannot be determined that the damage was caused by the ground, the restoration works to be carried out on the superstructure will be in vain in a short time. Because after the restoration is over, the ground will move again and the historical mosque will be damaged again. In this case, both the mosque will be damaged and financial losses will occur.

Since the domes are in the highest positions in historical mosques and their weight is too much if they were built-in masonry, it is essential to carry them without being damaged. For this, it must be designed in such a way that there is no tensile stress in the base. This type of critical sensitive damage was observed in damage in the Bardız mosque.

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