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WEATHERING TYPES OF STONES USED IN ABDÜLMÜMIN MASJID (KONYA, TURKEY)

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ABSTRACT

Located in the center of Anatolia, Konya has hosted many civilizations from ancient times to the present day. Among these civilizations, Konya became the capital during the Anatolian Seljuk period and the city experienced its brightest period. The monuments built during this period have shaped the cultural texture of the city today. However, due to the rapid population growth in recent years and unconscious planning decisions, some Anatolian Seljuk monuments were left between high-rise buildings and this caused the weathering of the urban texture. In addition to the weathering of the urban texture, shadow regions caused by high-rise buildings accelerate the weathering processes in monuments and threaten cultural heritage. In this study, the types of anomalies in Abdülmümin Masjid, where the effects of weathering are high due to environmental effects, have been investigated. The data obtained from the study will constitute an important basis for the protection-restoration of the masjid.

Keywords: Abdülmümin Masjid, weathering, weathering processes.

1. INTRODUCTION

Stone materials, which are frequently used in the construction of immovable cultural assets, deteriorate over time as a result of anthropogenic and environmental effects, causing the aesthetics and originality values of monuments to decrease. Restoration treatments should be planned according to the types of anomalies, as the progressive stages of the weathering processes may create structural problems in monuments. The determination of the types of decay, which is the most important stage in preserving the integrity and architectural features of monuments, is determined by in-situ observations (İnce et al. 2018; Remember et al. 2019). In this study, the weathering types in the Abdülmümin Masjid included in the UNESCO tentative list under the title of "Konya-A capital of Seljuk Civilization" were investigated. The reasons for the development of anomalies were investigated by macroscopically investigating the decays in the mosque, which is one of the monuments with the highest level and types of weathering among the Seljuk structures in the Konya region.

2. DESCRIPTION OF THE ABDÜLMÜMİN MASJID

Konya, which has hosted many civilizations with its geopolitical location, lived its brightest period during the Anatolian Seljuk period (Figure 1a). Monuments such as mosques, masjids, madrasahs and tombs built during this period constitute the identity of the city today. Among these cultural assets, Abdülmümin Masjid is one of the important heritage that reflects the characteristics of its period in terms of both its plan scheme and construction method. The monument, with a square plan scheme, was built in 1275. The entrance to the mosque is through a low arched door (Figure 1b). The top cover of the building is a dome and a pendant is used as a transition element to the top cover. Stone (marble, travertine, dacite and pyroclastic) on the walls of the mosque and brick building materials were used in the dome (Figure 1c).

Figure 1. Location of Konya city and views of Abdulmümin Masjid; a) Konya, b) entrance door of the masjid, c) general view of the masjid.

3. WEATHERING TYPES OF BUILDING STONES USED IN AbDULMÜMİN MASJID

The types of weathering observed in the mosque are defined according to the classifications specified in ICOMOS (2008) and explained in subtitles.

3.1. Crack

Cracking occurs as a result of atmospheric processes such as salt crystallization, wetting-drying, freezing-thawing and thermal shock and static changes due to load (Hatir et al. 2020; Hatir, 2020). When the building stones in Abdulmümin Masjid were examined, the crack anomaly was determined in pyroclastic and dacite rocks (Figure 2).

Figure 2. The view of crack anomaly.

3.2. Detachment

This type of weathering develops as a result of weakening of the mineral bonds between the rock surface and substract as a result of atmospheric processes (Hatir, 2020). Contour scaling (Figure 3a-c) and flaking (Figure 3d-f) anomalies under this group were detected in the studied monument. Among these types, flaking is the separation of layers of different scales varying from mm to-cm, parallel to the rock substract, while contour scaling is mm scaling exfoliation. Both anomalies have been identified in the pyroclastic, dacite and travertine lithologies of the Abdulmümin Masjid. These types of weathering occurred due to the water content in the capillary region of the building. Water movements in this region triggered the freezing-thawing process to work effectively and weathering progressed up to 5cm scale especially in contour scaling anomaly.

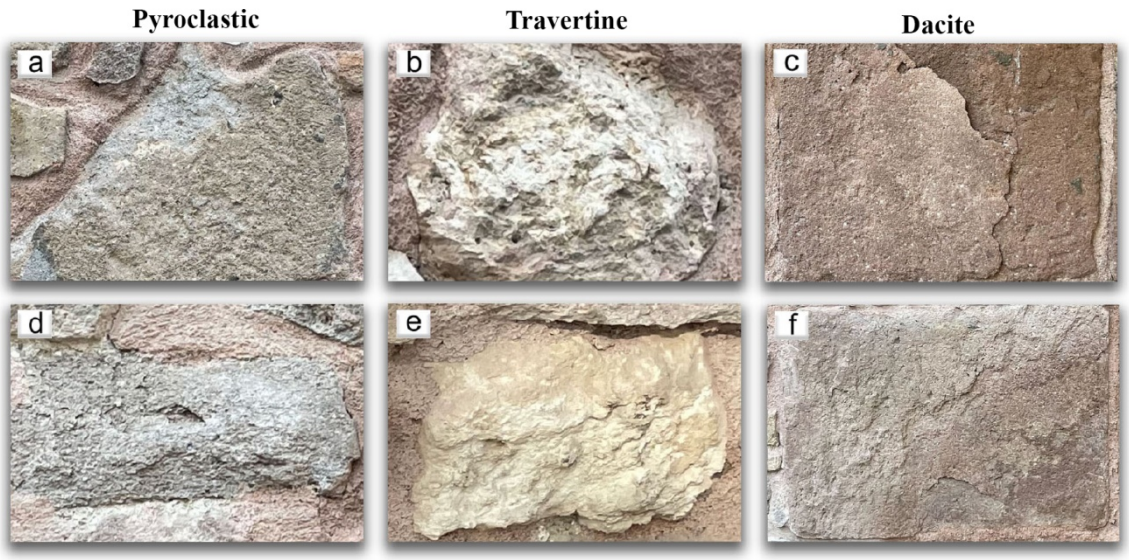

Figure 3. The view of contour scaling and flaking (d-f) in different building stones; a-c) contour scaling, d-f) flaking.

3.3. Features induced by material loss

They are types of weathering that occur due to physical and/or chemical changes in the internal structures of rocks. Differential eresion and missing part types were determined in dacite building blocks of the monument examined in the study. Differential eresion of these types is formed by differences in the composition of the dacite rock as a result of atmospheric processes (Figure 4a). Missing part type, on the other hand, is the loss that occurs in some part of the stone as a result of the decay processes (ICOMOS, 2008). This anomaly is observed in the west of the building (Figure 4b). In addition, there are losses in joints in this region.

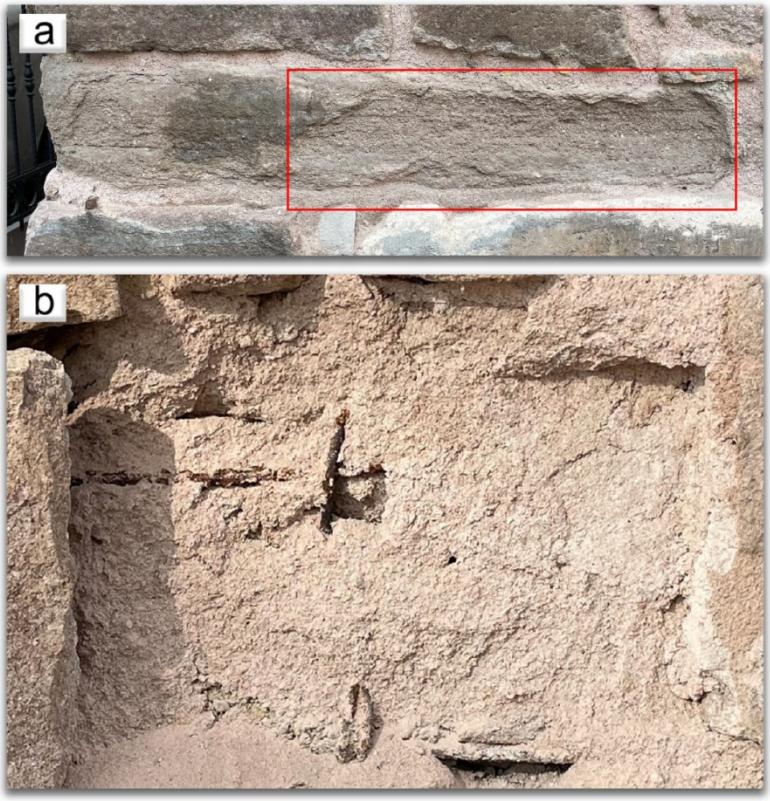

Figure 4. The views of features induced by material losses; a) differential eresion, b) missing part.

3.4. Discoloration and Deposit

Moist area, one of the types of weathering under this group, is the darkening of the stone surface due to moisture. Depending on the water content in the capillary region of the structure examined in the study, a darker surface appearance was formed in the pyroclastic and dacite rocks (Figure 5). As a result of the reaction between CaCO3 origin rocks, atmospheric pollutants and water, a black crust form occurs on the stone surface. Abdulmümin Masjid, located in the city center of Konya, is constantly exposed to pollutants such as PM, SOx and NOx due to the high use of solid fuels in the environment and the intensive vehicle traffic. In addition, with the presence of water at the capillary level, a black crust anomaly occurred in some types of travertine stones (Figure 6a) and marble entrance gate (Figure 6b).

Figure 5. The view of moist area.

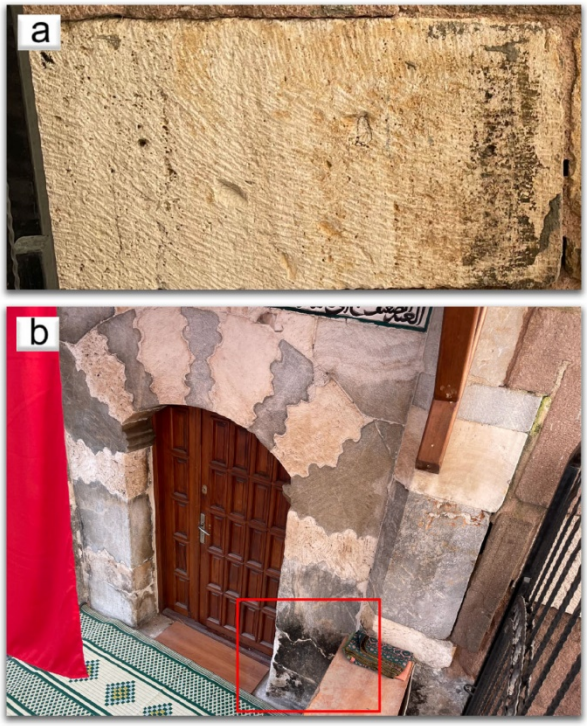

Figure 6. Black crust in different building stones used in Abdülmümin Masjid; a) travertine, b) marble.

3.5. Biological Colonization

Biological colonizations such as algae, lichen and fungus in this group settle on stones with high surface roughness and develop under organic material accumulation, humidity and suitable temperature conditions (Korkanç & Savran, 2015). Within the scope of the study, lichen formation occurred only in a part of the eastern front (Figure 7).

Figure 7. The view of lichen effects in dacite.

4. RESULTS AND DISCUSSIONS

In this study, the weathering types in the Abdülmümin Masjid belonging to the Anatolian Seljuk period in Konya city were examined. The main source of anomaly developments in the monument is the capillary level, reaching a height of approximately 2.5m. Although the monument is lower than the road level, rain water cannot be evacuated due to the absence of a drainage line in the building. In addition, the height of the buildings around the mosque, together with the canopy at the entrance of the building, prevents sunbathing and prevents the accumulated water from evaporating. This causes the water to rise as capillary, triggering the active functioning of decomposition processes such as freezing-thawing and wetting-drying. Crack, flaking, contour scaling (max: 5cm), differential erosion (max 6cm) and missing part (max: 12 cm) anomalies were detected in the capillary area of the monument. In addition, the development of black crust and lichen was determined with the water effect in this region.

Different types of weathering have been identified in marble, dacite, pyroclastic and travertine stones used in the construction of the monument. (Table 1). Only black crust and a limited number of contour scalings and flaking were determined in marble and travertine lithologies with high engineering properties. In the other two stone types, it was determined that flaking, contour scaling and differential erosion anomalies developing from mm scale to max 6 cm developed intensely.

Table 1. The types of weathering observed in different stone lithologies in the Abdülmümin Masjid.

	Type of weathering	Stone lithologies in Abdulmümin Masjid			
		Marble	Dacite	Pyroclastic	Travertine
Crack	Crack	-	+	+	-
Detachment	Flaking	-	+	+	+
	Contour scaling	-	+	+	+
Features induced by material loss	Differential eresion	-	+	-	-
	Missing part	-	+	-	-
Discoloration and deposit	Black crust	+	-	-	+
	Moist area	-	+	+	-
Biological colonization	Lichen	-	+	-	-

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