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Visual and Comparative Analysis of Stone Surface Deterioration Observed in Gaziantep Stone Fountains

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ABSTRACT
Gaziantep is one of the cities that stands out with its rich historical heritage and traditional stone architecture. In this study, a visual analysis method was applied to two historical fountain examples (Köseç Ahmet Ağa and Kumandan Fountains) located in Gaziantep, and stone surface deterioration was examined in physical, chemical, biological, and anthropogenic categories. Within the scope of the study, the deteriorations observed on the facades of both structures were classified and documented with photographs. The findings reveal that the fountains exhibit different levels of deterioration directly related to their usage status and environmental exposure. At the Köseç Ahmet Ağa Fountain, which is actively used, chemical and biological deterioration due to moisture effects are more prominent, while at the Kumandan Fountain, which is no longer in use, physical and anthropogenic effects are more pronounced. The data obtained show that the accurate documentation of deteriorations observed in stone structures is of critical importance for the healthy restoration and sustainable conservation of these structures.
Keywords: Gaziantep, fountain, stone deterioration, deterioration, cultural heritage, visual analysis

1. INTRODUCTION
Gaziantep has been under the rule of various civilizations throughout history, which has contributed to the city's rich cultural heritage. Due to its geographical location on the Historic Silk Road, Gaziantep features architectural examples from the Ottoman period in particular. The oldest architectural traces in the city date back to the Ayyubid period (Altın, 2015). Stone structures such as mosques, caravanserais, bathhouses, castles, fountains, and covered markets constitute an important part of this heritage.

A significant portion of these structures have survived to the present day; some continue to serve their original function, while others are used for different purposes. Natural stone was the main building material used in these structures. Due to its durability, ease of processing, and aesthetic value, stone has been the preferred material in traditional architecture for many years (Adi̇n, 2007; Öcal & Dal, 2012).

However, over time, various alterations occur in stone structures as a result of environmental conditions and human activities. The exposure of natural stones to environmental effects and their alteration through physical, chemical, biological, and anthropogenic processes threatens the structural integrity and aesthetic value of the building(Douglas-Jones, Hughes, Jones, & Yarrow, 2016; Heinrichs, 2005). Deterioration processes can begin for various reasons and, in some cases, can trigger each other, leading to greater damage (Biçen Çelik, Ergin, Dal, & Ay, 2023a; Dal & Öcal, 2017).

In this context, it is necessary to correctly identify the types of deterioration occurring in stone structures, determine their causes, and take appropriate measures to prevent such damage. Documenting deterioration provides a basis for determining the current condition of the structure and for conservation efforts. Incorrect practices, especially during restoration processes, can further increase deterioration (Ay & Ergin, 2023a; Fitzner & Heinrichs, 2001; Hasbay & Hattap, 2017).

The main objective of this study is to identify the types of stone deterioration occurring in fountain structures located in the historical fabric of Gaziantep province and to determine the causes of their formation.

This study seeks to answer the following research questions:
1. What types of stone deterioration are observed in the fountain structures of Gaziantep's historical fabric?
2. What are the similarities and differences between the deterioration observed in these structures?

The significance of this study lies in the systematic examination of the deterioration occurring in the stone fountain structures that constitute Gaziantep's rich cultural heritage, the scientific analysis of its causes, and the preparation of a basis for sustainable conservation recommendations based on documentation. The data obtained as a result of the research will provide a technical infrastructure for restoration projects and contribute to the transfer of historical structures to future generations.

2. MATERIAL AND METHOD

2.1. Characteristics of the Field of Work

Gaziantep is located at the intersection of the Southeastern Anatolia and Mediterranean regions and is one of the most populous cities in the region. Due to its border location, it has been under the rule of many states throughout history, which has resulted in different architectural influences being reflected in the city.

Although the city remained under the rule of Islamic states for a long time, most of the buildings in the city date back to the Ottoman period. There are no known buildings from the Umayyad, Abbasid, Timurid, or Seljuk periods, while the oldest examples date back to the Ayyubid period (Altın, 2015).

The first settlement in Gaziantep began around the castle and its surroundings, with the Alleben River dividing the city into north and south. Its architectural fabric was shaped by climate, topography, and social life; in particular, the hot summers paved the way for the formation of courtyard-centered living spaces known as “hayat” (Geyyas, 2019; Kılıç, 2007).

Its location on the Silk Road and strong commercial ties with Aleppo have made the city an important trading center throughout history. This commercial vitality increased during the Ottoman period, and the city's fabric developed around the trade axis. However, with the spread of apartment living over time, traditional houses began to be abandoned.

Gaziantep, which bears traces of different civilizations, is home to many historical structures such as caravanserais, bathhouses, mosques, castles, fountains, and madrasas.

2.1.1. Geographical Features of Gaziantep Province

Gaziantep is located between 36° 28'–38° 01' east longitude and 36° 38'–37° 32' north latitude, at the intersection of the Southeastern Anatolia and Mediterranean regions. It is bordered by Şanlıurfa to the east, Adıyaman to the northeast, Kahramanmaraş to the northwest, Osmaniye to the west, Hatay to the southwest, Kilis to the south, and Syria to the southeast (Ataş, 2023; Ay & Ergin, 2023b; Tatlıgil, 2005). The city's location on the map of Turkey is shown in Figure 1.

Figure 1. Location of Gaziantep in Turkey

Gaziantep has an area of 6,222 km², 52% of which is mountainous and 48% is flat. The city center is located at an average altitude of 850 meters above sea level. Elevation increases from the Euphrates Valley in the east to the mountainous areas in the west; the highest point is Mount Sof at 1,496 meters.

Gaziantep is located in a transition zone between the Arabian Plateau and the mountainous region, on the southern extension of the Taurus Mountains. The terrain is shaped by hills that slope down towards the east. The Amanos Mountains separate the Gulf of Iskenderun from the Islahiye Plain, while the Sof Mountains extend to the west and northwest, and the Sam and Dülükbaba Hills extend to the north. The Oğuzeli and Barak Plains are located to the east, the Ganibaba and Sarıkaya Hills to the west, and the Gaziantep Plateau to the south. The city's main axis runs north-south, while the Alleben River flows along an east-west axis (Tatlıgil, 2005). A physical map showing the landforms of Gaziantep is shown in Figure 2.

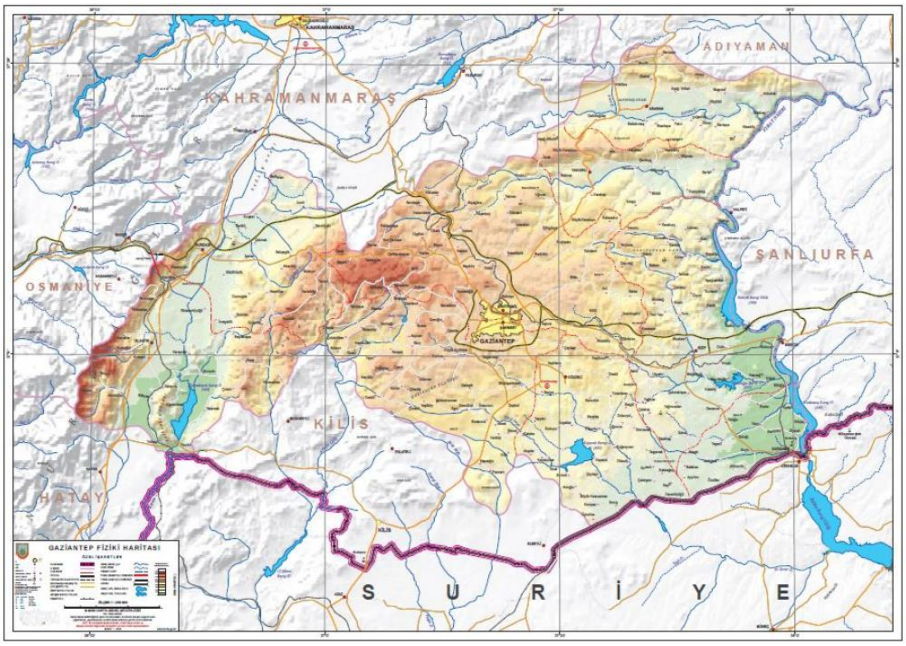

Figure 2. Physical map of Gaziantep ('Harita Genel Müdürlüğü', 2025)

2.1.2. Climatic Characteristics of Gaziantep Province

Gaziantep is located at the intersection of the Southeastern Anatolia and Mediterranean regions, and therefore exhibits characteristics of both continental and Mediterranean climates. Summers are hot and dry, while winters are cold and rainy. The mountainous areas to the north play a decisive role in the climate; in summer, they block the cool air currents coming from the northeast, while in winter, the high-pressure area forming in the north causes cold air to prevail (Ay, Ergin, & Dal, 2023).

According to data from the General Directorate of Meteorology, between 1940 and 2024, the coldest month in Gaziantep was January, with an average temperature of 3.2 °C, and the hottest month was July, with an average temperature of 28.1 °C. The lowest temperature recorded was -17.5 °C (January 15, 1950), and the highest temperature was 44.0 °C (July 29, 2000, and August 14, 2003). Sunshine duration increases during the summer months (peaking at 10.6 hours in July) and decreases during the winter months (reaching a minimum of 3.5 hours in December and January). The highest rainfall occurs in January (102.6 mm), while the lowest rainfall is observed in August (5.4 mm). Climate data for Gaziantep Province from 1940 to 2024 are presented in Table 1.

Table 1. Climate data for Gaziantep Province, 1940–2024 ('Meteoroloji Genel Müdürlüğü', 2025)

GAZİANTEP	January	February	March	April	May	June	July	August	September	October	November	December
Average Temperature (°C)	3,2	4,5	8,2	13,5	18,9	24,3	28,1	27,9	23,5	16,8	9,9	5,1
Average Highest Temperature (°C)	7,6	9,6	13,9	19,8	25,6	31,3	35,3	35,4	31,2	24,3	16,3	9,8
Average Lowest Temperature (°C)	0,6	0,3	3,1	7,4	12,0	17,2	21,2	21,1	16,4	10,2	4,6	1,2
Average Sunshine Duration (hours)	3,5	4,3	5,4	6,8	8,4	10,3	10,6	9,9	8,7	7,0	5,3	3,5
Average Number of Rainy Days	13,00	11,67	11,68	9,67	6,87	2,04	0,49	0,47	1,45	5,88	8,14	11,79
Average Monthly Total Precipitation (mm)	102,6	81,9	81,9	52,0	30,9	8,2	6,9	5,4	7,0	36,5	61,9	97,3

Climatic conditions have a direct impact on physical wear and deterioration (alteration) observed in stone structures. Therefore, daily and annual temperature differences are considered an important factor in the deterioration process of building materials (Biçen Çelik, Ergin, Dal, & Ay, 2023b; D. G. Price, 1995; Vergès-Belmin, 2008).

2.2. Architectural Features of Fountains

Gaziantep's historic commercial district was formed along a route stretching from the south of the Alleben River towards Aleppo. One of the important structures along this route are the fountains. There are six historic fountains in the city that have survived from the past to the present day: Ali Nacar, Köseç Ahmet Ağa, Kürüm, Tekke, Kumandan, and Gazi Fountains. Some of these are still active, while others are no longer in use. Most of these fountains are located in mosque courtyards, and some have been excluded from evaluation due to damage to the mosques caused by the February 6 Kahramanmaraş earthquakes. This study focuses on the Köseç Ahmet Ağa and Kumandan Fountains.

The Köseç Ahmet Ağa Fountain, located in the İsmetpaşa Neighborhood of the Şahinbey district of Gaziantep, was built by Köseç Ahmet in 1289 AH (1872 AD). Located south of Gaziler Caddesi and Yeniçeri Sokak, the fountain sits on a slightly sloping ground and is still in use today. Its facade, made of black and white cut stones, is visually striking. The fountain, which is 2.95 meters wide and 3.75 meters high, is a single-facade structure with only its north facade open. On this facade, the horizontal arrangement of the stones and the eaves detail consisting of grooved moldings stand out. It is located adjacent to the structures west of Hüseyin Paşa Hamamı and is situated at a higher elevation than its surroundings (Figure 3).

Located in the Seferpaşa neighborhood of Gaziantep's Şahinbey district, south of Dere Kenarı and Kepkep streets, adjacent to the north of the Historic Kır Kahvesi, the Kumandan Fountain was built in 1333 AH (1915 AD) by Mayor Miralay Şükrü Bey and District Governor Kumandan Abdullah Mir İlmi Bey. The fountain, whose source was cut off due to water shortages in the 1960s, was later connected to the city water network but does not flow today. Built on a flat surface, the structure has a hexagonal plan with an octagonal basin. The lower section is made of black and white cut stones, while the upper section is made of wood. Each of its 0.60-meter-wide facades is quite simple, with only the two-tone stonework serving as decoration (Ay, Dal, & Ergin, 2023). The upper part is separated by a flat cornice protruding outward, and the structure is covered with a green and white painted onion dome. There is a finial at the top of the dome (Figure 4).

Figure 3. Köseç Ahmet Ağa Fountain

Figure 4. Kumandan Fountain

2.3. Method

The visual analysis method used in this study aims to systematically document the deterioration observed on stone surfaces. During the examination process, four main categories were identified based on the types of deterioration commonly accepted in the literature: physical, chemical, biological, and anthropogenic alterations. Specific types of deterioration that can be observed under each category (e.g., cracks, loss of fragments, salting, color change, moss growth, intervention marks, etc.) have been defined, and the presence, intensity, and spread of these signs on building facades have been recorded.

3. FINDING

Stone has been one of the basic elements of buildings throughout history. Once used for defense, tomb construction, and leaving messages for the future, stone is now preferred in residential buildings and as a decorative element. Thanks to its durability, there are many stone structures, most of which have survived to the present day (Biçen Çelik, Ay, Ergin, & Dal, 2024; Sabbioni, Brimblecombe, & Cassar, 2010).

The purpose of use is of great importance in stone selection; the characteristics of stones to be used indoors and outdoors differ (Ay, Ergin, & Dal, 2025; Semerci, 2017). Therefore, knowing the petrographic properties of the stone ensures that the material is used in the right place and in the right way.

Over time, stone surfaces undergo alteration due to factors such as internal properties, climatic conditions, environmental influences, and human activities (Dal & Öcal, 2013). These alterations can affect the durability of the stone. It is necessary to understand the causes of these alterations and take appropriate measures to protect the structures (Hasbay & Hattap, 2017; Karkaş & Acun Özgünler, 2021). In addition, one type of alteration can accelerate the formation of others (Ergin, Dal, & Biçen Çelik, 2020). If appropriate measures are not taken or incorrect practices are used, permanent damage may occur to stone structures (Ay & Ergin, 2023a; Khooshroo, Javadi, Yardımlı, & Hattap, 2017; C. A. Price & Doehne, 2011).

Deterioration observed in buildings is examined under four main headings in order to correctly identify their types and processes: physical, chemical, biological, and anthropogenic deterioration:

- **Physical Deterioration:** The fragmentation of stones through mechanical effects without changing their chemical structure. Temperature changes, freezing and thawing, salt crystallization, moisture effects, and mechanical abrasion cause physical weathering. This type of weathering reduces the durability of the rock, causes cracks to form in the structure, and facilitates the progression of other types of weathering. It is particularly common in continental climates (Tokmak & Dal, 2020).
- **Chemical Deterioration:** This is the chemical change in the mineral structure of stones due to atmospheric effects. Reactions with water, air, and pollutants cause processes such as dissolution, oxidation, and carbonation. Salting (blooming, swelling) is a typical example of chemical deterioration. Chemical deterioration impairs the aesthetic and structural integrity of the stone and usually progresses alongside physical and biological processes (Fehér & Török, 2022).
- **Biological Deterioration:** Deterioration caused by the growth of microorganisms, lichens, mosses, fungi, and plants on stone surfaces. These organisms cause effects such as color change and mechanical weakening on stone surfaces. Biological deterioration can accelerate physical and chemical deterioration and must be controlled with appropriate interventions (Korkanç, 2013; Timoncini, Brattich, Bernardi, Chiavari, & Tositti, 2023).
- **Anthropogenic Deterioration:** Deterioration caused by human activities. Incorrect repair practices, air pollution, vandalism, improper cleaning, and lack of maintenance cause damage to stone materials. Anthropogenic effects accelerate natural deterioration processes and can cause permanent damage to structures. Therefore, approaches based on scientific and material analysis are important in conservation and restoration (Giesen et al., 2014; İnce, Bozdağ, Tosunlar, Hatır, & Korkanç, 2018).

The stone surface deterioration observed at Köseç Ahmet Ağa and Kumandan fountains was examined using visual analysis methods and documented with photographs. In order to apply the correct interventions, the deterioration was classified into four groups: physical, chemical, biological, and anthropogenic. The fact that both structures are not actively used and are in a state of disrepair has contributed to the emergence and progression of the deterioration.

The physical deterioration observed at the Köseç Ahmet Ağa Fountain is presented in Figure 5. As a result of the structure being abandoned and exposed to temperature differences,

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cracks (Figures 5a, 5b), piece detachments (Figures 5c, 5d), and surface abrasions (Figures 5e, 5f) have formed.

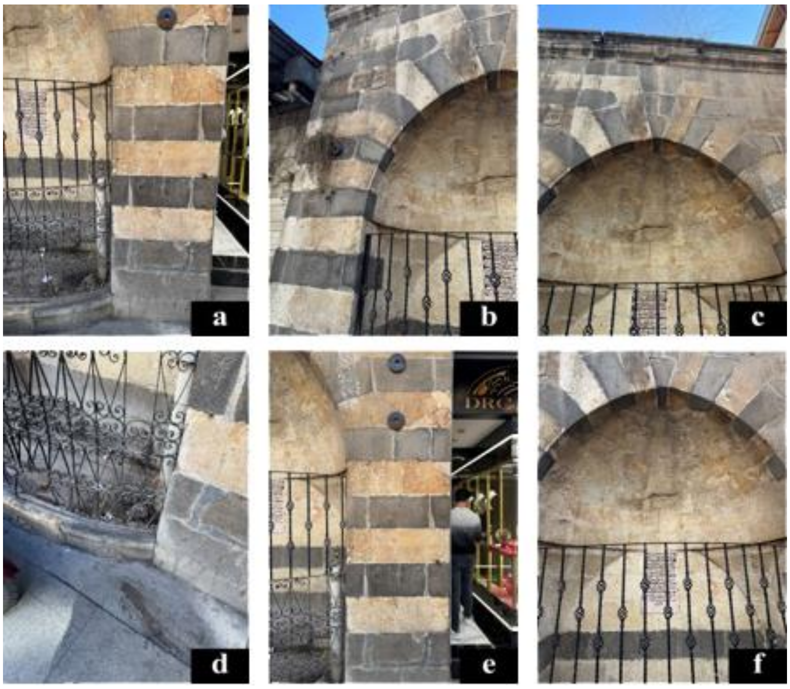

Figure 5. Physical deterioration observed at the Köseç Ahmet Ağa Fountain

Similarly, the physical deterioration observed at Kumandan Fountain is also shown in Figure 6. Due to climatic conditions, cracks (Figures 6a, 6b), piece losses (Figures 6c, 6d, 6e) and abrasions (Figure 6f) have occurred in the structure.

Figure 6. Physical deterioration observed at Kumandan Fountain

Chemical deterioration due to adverse climatic conditions has been observed at the Köseç Ahmet Ağa Fountain (Figure 7). On the stone surfaces, salt precipitation (Figures 7a, 7b) due to the dissolution and evaporation of salts under the influence of moisture and temperature, color changes (Figures 7c, 7d) due to the reaction of minerals with atmospheric gases, and atmospheric pollution on the surface (Figures 7e, 7f) have occurred.

Figure 7. Chemical deterioration observed at the Köseç Ahmet Ağa Fountain

Similar climatic effects caused chemical deterioration at Kumandan Fountain, where surface contamination (Figures 8a and 8b), color changes (Figures 8c and 8d), and salt deposits (Figures 8e and 8f) were observed.

Figure 8. Chemical deterioration observed at Kumandan Fountain

Biological deterioration caused by organic matter at the Köseç Ahmet Ağa Fountain is shown in Figure 9. Plant growth resulting from the interaction of seeds settled in capillary cracks in the stones with water (Figures 9a, 9b) and algae traces resulting from the stone surfaces remaining moist due to the fountain's use (Figure 9c) were detected.

Figure 9. Chemical deterioration observed at the Köseç Ahmet Ağa Fountain.

At Kumandan Fountain, due to long-term use, the stone surfaces remained damp, causing moss growth and associated spalling, particularly in the fountain area. This biological deterioration is shown in Figure 10.

Figure 10. Biological deterioration observed at Kumandan Fountain

Anthropogenic deterioration caused by humans at the Köseç Ahmet Ağa Fountain is shown in Figure 11. Cement-based joint repairs made to the structure (Figure 11a), neglect due to the structure not being used (Figures 11b, 11c), and spray paint applications damaging the stone surfaces (Figure 11d) were identified.

Figure 11. Anthropogenic deterioration observed at the Köseç Ahmet Ağa Fountain

Similar anthropogenic effects are also observed at Kumandan Çeşmesi. Due to prolonged disuse, the structure has suffered deterioration of its stone surfaces due to neglect, which has led to increased physical, chemical, and biological alterations. The anthropogenic deterioration at Kumandan Çeşmesi is presented in Figure 12.

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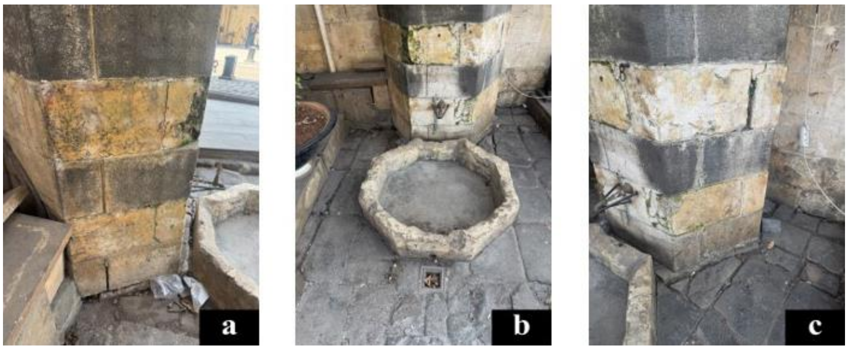

Figure 12. Anthropogenic deterioration observed at Kumandan Fountain

4. DISCUSSION

The stone fountains that form the historical fabric of Gaziantep are considered not only as a means of water supply, but also as important carriers of urban memory, architectural aesthetics, and cultural identity. The Köseç Ahmet Ağa and Kumandan Fountains examined in this study are among the unique examples of traditional stonework from the Ottoman period; however, they have been exposed to serious physical and chemical deterioration due to factors such as environmental conditions, changes in use, and lack of maintenance. The findings indicate that not only aesthetic and historical values but also material science-based approaches should be decisive in the preservation of these structures.

The visual analysis method used in the study has been an effective tool, especially in terms of classifying types of deterioration, with its structure based on on-site observation and documentation. However, the limitation of the method is that it cannot fully reveal the internal causes of deterioration (e.g., cracks caused by mineralogical or petrographic structure). This situation highlights the need for visual analyses to be supported by microscopic, chemical, and physical-mechanical tests in future studies (Fitzner & Heinrichs, 2001; C. A. Price & Doehne, 2011).

When the types of deterioration were examined, the results obtained were largely consistent with the alteration processes defined in the literature. Physical alterations (cracking, abrasion, fragmentation) are particularly common in continental climate regions where temperature fluctuations are intense. (D. G. Price, 1995; Tokmak & Dal, 2020). Gaziantep's climate, which is hot and dry in summer and cold and rainy in winter, makes stone materials vulnerable to processes such as thermal expansion, freezing and thawing, and salt crystallization. This situation was clearly observed in the study and was particularly evident in the widespread cracks and piece losses at the Köseç Ahmet Ağa Fountain.

In terms of chemical deterioration, salting, color change, and surface contamination were noted in both types of stones. These findings are classic examples of the reactions exhibited by stones when they interact with atmospheric pollutants and soluble salts, and they tend to progress more rapidly in regions with high humidity (Fehér & Török, 2022; Vergès-Belmin, 2008). At this point, the fact that the Köseç Ahmet Ağa Fountain is still a structure with water flow explains the typical chemical deterioration caused by salt crystals dissolving and recrystallizing, leading to blooming and swelling on the surface.

Biological deterioration manifested itself in the form of algae growth and plant colonization in both fountains. Such biological effects are generally associated with humid environments and result in color changes on the surface, mechanical pressure, and deterioration of the surface texture of the stone (Korkanç, 2013). However, the study observed that biological alterations also directly trigger chemical processes, which aligns with the concept of interaction between deterioration processes frequently emphasized in the literature (Douglas-Jones et al., 2016).

In terms of anthropogenic effects, structural deterioration has accelerated in both structures due to reasons such as lack of maintenance, inappropriate intervention, and vandalism. Cement-based repairs, in particular, reduce the breathing capacity of the stone, increasing both physical and chemical deterioration (Dal & Öcal, 2017). This finding highlights the importance of material compatibility in conservation practices.

In conclusion, the findings of this study clearly show that deterioration processes in stone structures have a multidimensional structure and that types of deterioration develop interactively with each other. As in the case of Gaziantep, the protection of historic stone structures should be approached holistically, including not only identification but also process monitoring, scientific analysis, and material-focused restoration approaches. Additionally, considering the cultural heritage value of such structures, a more coordinated conservation policy should be developed between local authorities and experts; regular maintenance, monitoring, and public awareness-raising activities should be implemented to prevent deterioration.

5. CONCLUSION AND SUGGESTION

This study was conducted to identify stone deterioration in fountain structures that form the historical fabric of Gaziantep province and to reveal the types and causes of this deterioration. As a result of visual analyses conducted on the Köseç Ahmet Ağa and Kumandan Fountains, it was determined that the structures had undergone multifaceted deterioration due to long-term environmental, biological, and human-induced effects.

The deterioration was classified under the following headings: physical (cracking, loss of pieces, surface erosion), chemical (salting, color change, contamination), biological (algae growth, plant growth), and anthropogenic (inappropriate intervention, vandalism, lack of maintenance). Although similar types of deterioration were observed in both fountain structures, the current use of the structures, their architectural features, material structure, and environmental conditions caused differences in the intensity and forms of deterioration.

The Köseç Ahmet Ağa Fountain continues to be used today, albeit to a limited extent. This use increases moisture-related biological growth and chemical deterioration on the structure's surface. In particular, chemical effects such as salt crystallization, efflorescence, and swelling have been observed; algae growth and color changes caused by microorganisms have been widely detected. Additionally, inappropriate repairs carried out in the past (cement-based joint applications) and vandalism traces such as spray paint have negatively affected the structure's aesthetic and material integrity. Due to its exposed location, the structure also exhibits physical deterioration caused by simultaneous effects of temperature differences and humidity.

The Commander's Fountain has been unused and neglected for a long time. Although its disuse has partially reduced the effects of moisture, physical and anthropogenic deterioration has become more prevalent due to lack of maintenance. In particular, cracks, stone detachments, and surface abrasions are noticeable. Although chemical salting and contamination are limited, algae growth is still observed on the structure. Anthropogenic effects have developed mainly through neglect and wear and tear; the lack of any protective measures around the structure has also contributed to this situation.

The common conclusion for both structures is that natural stones develop sensitivity to environmental and anthropogenic effects over time. In particular, incorrect or incomplete interventions accelerate the deterioration process and threaten the load-bearing capacity and aesthetic quality of the structure. In this context, the systematic documentation of types of deterioration and their support with scientific analyses is essential for making sound intervention decisions in restoration and conservation work.

Although the study evaluates only two sample structures, it also allows for conclusions to be drawn about the general condition of Gaziantep's traditional stone building stock. These data provide a technical infrastructure that will guide future restoration, maintenance, and conservation projects (Table 2).

Table 2. Comparative Analysis of Stone Deterioration Observed at the Fountains of Köseç Ahmet Ağa and Kumandan

Type of Deterioration	Köseç Ahmet Ağa Fountain	Kumandan Fountain
Physical Deterioration	Cracks caused by temperature differences Loss of pieces on the stone surface Surface erosion	Cracks caused by sun and wind Falling pieces Flaking on the natural surface of the stone
Chemical Deterioration	Salt crystallization and efflorescence Color changes (atmospheric interaction) Surface contamination	More limited salt stains Moderate contamination and color changes
Biological Deterioration	Algae growth on damp surfaces Plant roots settling in stone gaps	Intense algae growth in the fountain basin and trough Small amount of grass and plant growth
Anthropogenic Deterioration	Spray paint applications Cement-based faulty joints Dirt accumulation due to neglect	Long-term neglect Lack of protection Spatial dysfunction and environmental deterioration
Current Condition of the Structure	Still functional to a limited extent; water flow is present Active use increases the effect of moisture	Out of use, water connection cut off Neglect, increasing overall deterioration
Predominant Type of Deterioration	Chemical and biological effects are prominent	Physical and anthropogenic effects are predominant

The comparative findings presented in the table reveal that similar types of deterioration have been observed in the Köseç Ahmet Ağa and Kumandan Çeşmeleri, but that their intensity and distribution differ depending on the structure's usage and environmental conditions. At Köseç Ahmet Ağa Çeşmesi, chemical and biological deterioration are particularly prominent, and the moisture effect caused by active use has accelerated these processes. In contrast, at Kumandan Çeşmesi, physical wear and tear and anthropogenic effects are more prominent due to the structure's long period of disuse. In both structures, lack of maintenance, environmental exposure, and inappropriate interventions stand out as common factors that deepen the deterioration process of stone surfaces.

This study documents the deterioration of stone surfaces observed in two historic fountains in the city center of Gaziantep, drawing attention to micro-level material deterioration that has been overlooked in conservation practices. Based on the findings, the following recommendations are made for the conservation of both the structures examined and similar traditional stone structures:

- **Documentation and Monitoring Systematics Should Be Developed:** A systematic documentation process based on periodic visual analyses should be established to detect deterioration in stone structures over time and monitor its development. These documents should be collected in digital archives and serve as an infrastructure that provides data for conservation processes.
- **Technical Training Programs for Local Practitioners Should Be Organized:** In order to prevent interventions that cause material incompatibility, such as cement-based repairs, training programs on stone materials, types of deterioration, and appropriate intervention techniques should be prepared for local practitioners and restorers.
- **Visual Analyses Should Be Supported by Laboratory-Based Techniques:** In order to increase the scientific accuracy of visual analysis findings, the production of supporting data through petrographic, chemical (XRD, SEM, etc.), and physico-

mechanical tests should be encouraged in future studies. This will enable a detailed understanding of the internal causes of deterioration.

- **Intervention Methods Appropriate for Types of Deterioration Should Be Developed:** Since the predominant type of deterioration varies for each structure, conservation interventions should not be uniform; targeted techniques such as salt extraction for chemical deterioration, surface disinfection for biological effects, and micro-injection for physical cracks should be applied.
- **The Role of Stone Structures in Urban Conservation Plans Should Be Strengthened:** The conservation of cultural assets with public significance, such as historic stone fountains, should be addressed not only at the structural level but also within the context of urban integrity. In this regard, regulations regarding the conservation of such structures should be clearly defined in urban planning documents prepared by municipalities and relevant conservation committees.
- **Public Awareness and Participation Should Be Increased:** Since a significant portion of the deterioration is caused by human intervention (vandalism, unconscious use), activities that involve the public in the process, such as informative panels, guided walks, and local educational activities, should be encouraged to raise social awareness.

In line with these recommendations, it is emphasized that the deterioration of traditional stone structures should be addressed not only in technical terms, but also in socio-cultural and administrative contexts. The methods and findings presented in this study have the potential to serve as a model for the documentation and preservation of stone structures with similar characteristics.

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