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Detection of Stone Material Deterioration in Historical Masonry Buildings by Observational Methods: Mardin Former American Missionary College

Tarihi yapılardaki taş malzeme bozulmalarının gözlemsel tespiti: Mardin Eski Amerikan Misyoner Kolejii

Lale Karataş[1]

Öz

Taş yapıları incelemek, sorunları anlamak ve koruma ihtiyaçlarını belirlemek için bozulma modellerini doğru bir şekilde tanımlamak temel bir gerekliliktir. ICOMOS sözlüğünde standartlaştırılmış çeşitli bozulma tipleri belirlenmiştir; ancak, bu metodolojiler karmaşık durumları yorumlamakta yetersiz kalabilmektedir. Bu nedenle, bozulma tipleri coğrafi bağlamlarına uygun olarak tanımlanmalı ve haritalanmalıdır. Bu amaçları çeşitli ülkelerde sürdürmek bağlamında, tarihî binalardaki malzeme problemleri ve müdahaleler için belirlenen aşamaların coğrafi bağlam içinde sistematik olarak örneklenmesi önemlidir. Bu bağlamda yürütülen çalışma, Mardin'deki tarihî taş binalardaki malzeme problemleri ve müdahaleler için belirlenen aşamaları sistemli bir şekilde örneklemek amacıyla, Eski Amerikan Misyoneri Koleji Hastanesi örneği üzerinden sürdürülebilir bir şekilde gerçekleştirilmiştir. Mardin Eski Amerikan Misyoneri Koleji Hastanesi, Mardin'de korunan bir kentsel arkeolojik alan içinde bulunan, birçok çevresel etkiye rağmen yıllara dayanan eşsiz bir kültür anıtıdır. Eski Amerikan Misyoneri Koleji Hastanesi ile ilgili malzeme bozulmalarını belirlemek ve belgelemek için bir sınıflandırma yapılmıştır. Çalışmada, literatür araştırması, gözlem yoluyla belirleme ve fotoğraf çekme yöntemleri kullanılmıştır. Elde edilen bilgiler betimleyici ve sistemli analiz yöntemleri aracılığıyla değerlendirilmiştir. Çalışmanın, Mardin Eski Amerikan Misyoneri Koleji Hastanesi'nin taş malzeme problemlerini ele almanın yanı sıra bu coğrafi bağlamdaki diğer binalarla ilgili bozulma tiplerini ve koruma önerilerini örneklemesi beklenmektedir.

Anahtar Kelimeler: Mardin, Geleneksel Taş Bina, Taş Bozulmaları, Bozulma Tipleri, Koruma

ABSTRACT

It is essential requirement to define the deterioration models correctly to understand the problems, and to determine the conservation needs and conservation acts, when investigating the stone buildings. Various deterioration types standardized as in the dictionary of ICOMOS are appropriate to achieve the stated objectives; however, these methodologies remain incapable to interpret the situation in complex cases. Therefore, deterioration types must be defined and mapped in accordance with their geographical contexts. Within the context of ensuring the continuity of these objectives in various countries, it is important to exemplify the determination and articulation stages intended for the material problems and interventions on the historical buildings systematically within the geographic context. The study conducted within this context is to exemplify the determination and articulation stages intended for the material problems and interventions systematically within the geographic context, based on Former American Missionary College Hospital case, to manage the material problems on historical masonry buildings in Mardin, which is a unique geographic context, in a sustainable manner. Mardin Former American Missionary College Hospital, which remains within the preserved urban archaeological site in Mardin, is a unique cultural monument, which survives over the years, despite exposure to many environmental influences. A classification was made to determine and document the material deteriorations regarding the Former American Missionary College Hospital. Literature research, determination via observation, and documentation through photographing methods were used in the study. The information obtained was assessed via the descriptive and systematic analysis methods. The study is expected to make contribution into the literature both in terms of addressing the

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stone material problems of Mardin Former American Missionary College Hospital and of exemplifying the deterioration types and conservation suggestions regarding the other buildings within this geographical context.

Keywords: Mardin, Traditional Stone Building, Stone Deteriorations, Deterioration Types, Conservation

1.INTRODUCTION

Stone monuments are valuable factors for a countries culture. But historical stone buildings expose to many deteriorations such as cracking, swelling, bursting, partitioning, colour change, and biodegradation due to various causes arising from the external environment, particularly the atmosphere (Jo & Lee,2014). The complexity of conservation practices and situations that require urgent intervention to historical structures are a situation that is frequently experienced in our country recently due to earthquake, flood, etc. factors. Such situations often necessitate the detection of material deterioration on the structures in question in a limited time frame. At this stage, various patterns for the intervention method are very important points in obtaining reliable results.

The main building material in traditional Mardin buildings is stone. Yellow limestone, where quarries are abundant in the immediate vicinity, forms the main material. However, the stones that are used as decorations and the ones that are produced are different from each other in terms of colour and texture. Light yellow and hard limestone was preferred for structural use, and dark yellow limestone, which is soft when it comes out of the quarry and is easy to work, but hardens afterward, is preferred for decoration purposes (Alioğlu, 2000). Mardin structures (except for a few official and private buildings made with modern architectural techniques in recent years) were entirely made of cut stone material. The stone used is a light-coloured yellow limestone in the south, as opposed to basalt in the Diyarbakir region in the north. This calcareous formation, which is easily processed and hardens after a while after it comes out of the quarry, has been used with the same ease in every period of Mardin structures. The easy processing of the stone and the tradition of stone art, which has been established for centuries, prevented the use of wooden materials in Mardin buildings (Altun, 1971). Former American Missionary College Hospital, which remains within the protected urban archaeological site in Mardin, is a unique cultural monument. The purpose of breaking the material structures on the historical masonry buildings in Mardin province was based on the example of the Old American Merision College Hospital, and the material deteriorations and interventions were determined in a geographical environment system.

1.1. Literature Review

Cesare Brandi has presented a phenomenological and ontological approach by separating the restoration subject from the other modern approaches for conservation (Brandi, 2005) and argued that ontological approach must be developed by adjusting it according to the new conditions. Within this scope, various deterioration types and conservation standards, which stereotype the stone deteriorations by ontological classifications in restoration, have been set forth by various countries from past to present (Fitzner et. al, 1995; Fitzner, 2002; Vergès-Belmin, 2008; Normal 1/88, 1990; VDI 3798, 1998)

The studies which make material decay definitions on the stone buildings in various countries, by using these stereotyped deterioration types (Adamopoulos & Rinaudo,2021; Alaimo et. al, 1997; Bozdağ et. al, 2019; Cassar,2002; Cutler et. al, 2013; Delgado Rodrigues, 2015; Ergin et. al, 2021; Dal & Yardımlı, 2021; De Gennarovd.,2001; Evans,1970; Fitzner, 2002; Hatır et. al, 2021; Heinrichs, 2008; Jo & Lee, 2014; Kramar et. al, 2011; Küçükkaya,2004; Korkanç,2013; Kottke,2019; Lee & Yi, 2007; Lee et. al, 2005; Salonia & Negri,2003; Scolastico,2006; Lisci et. al, 2003; Patil et. al, 2021; Siegesmund &

Snethlage, 2011; Silva et. al, 2010; Sanjurjo-Sanchez & Alves,2012; Topal & Sözmen,2003; Uchida et. al, 1999; Zarif & Gürpınar; 2012). In some of these studies, the types of deterioration were explained by the mapping technique (Hatır et. al, 2021; Patil et. al, 2021; Kramar et. al, 2011; Bozdağ et. al, 2019; Adamopoulos & Rinaudo, 2021; Delgado Rodrigues, 2015; Siegesmund & Snethlage, 2011). The common ground of these studies is that they use these deterioration types via mapping technique. In the study of Patil et.al (2021), which is a significant example, mapping method was used for the detailed documentation of decomposition forms on a stone monument, and the findings have demonstrated that the deterioration reasons of basalt were mostly due to the air pollution and climate. Kramar et. al (2011) were defined deterioration patterns via mapping and it was found that the most important deterioration on interior and exterior spaces of the monuments that were under investigation was the formation of soluble saline.

According to Delgado Rodrigues (2015); the deterioration patterns defined in ICOMOS dictionary and by Fitzner et. al (1995) and mapping technologies are appropriate to achieve the specified objectives; however, these methodologies remain incapable to interpret the situation in complex cases. In such case, supplementary data is needed to support a more consistent diagnostic. Since the internalization of the terms and putting forward the new ones depend on the language and culture, defining the same deterioration problems may require any national and even any regional society to use different words. Therefore, still further studies are needed for the transition to professional practise of conservation actions from the scientific analysis of deterioration processes.

Problems seen in limestone material; surface loss, fragmentation, gap-hole formation, hollow surface formation, crack, spalling, foliation, joint discharge, surface pollution, crust formation, flowering, plant formation, algae formation, corrosion, loss of form, colour change and incorrect repair application. It is seen under a total of seventeen different titles (Karataş & Perker, 2017). Depending on the geographical region where it is extracted, the deterioration forms of limestone differ in each country according to properties of the stone. (Bradley & Middleton,1998; Cardell et. al,2003; Corvo et. al, 2011; Fahmy et. al,2022; Graue et. al, 2013; Karataş et. al,2022; Karataş,2023; Martinho et. al,2014; Moroni et. al,2004; Rothert et. al,2007; Ruiz-Agudo et. al,2007; Scrivano & Gaggero, 2020; Webb et. al,1992). Within this context, it is necessary to define and map the deterioration types in accordance with the geographical context of the countries. Therefore, within the context of ensuring the continuity of these objectives in also different countries, it is necessary to exemplify the determination and articulation stages intended for the material problems and interventions on the historical buildings systematically within the geographic context. In our study, Mardin Former American College is addressed as case analysis, based on these requirements specified in the literature.

2. METHOD

Mardin Former American College, which remains within the protected urban archaeological site in Mardin, is a unique cultural monument, which survives over the years, despite exposure to many environmental influences. A classification was made within the scope of the study, based on the deterioration patterns intended for the material deteriorations in the literature, to determine and document material degradation regarding the Former American College. Literature research, determination via observation, and documentation through photographing methods were used in the study. The information obtained was assessed via the descriptive and systematic analysis methods. The deterioration types obtained in the first stage of the study were obtained by carrying out an archive review regarding the stone material deterioration types. In the field research stage, Mardin Former American College was investigated and photographed. As a result of the observations, the deteriorations determined on the stone materials used in the building were

classified based on the principle of dividing the building into its elements and stone materials. In the last stage, all information, drawings, photographs, and assessment results of the building under investigation were textualized in the classification made because of determination of the stone material deteriorations observationally, and the study is concluded. The charts created as part of the survey are charts used to record stone degradation. The goal is to make the maps produced as part of the survey usable in the context of the current geography, also for different masonry buildings (Map 1). The types of stone degradation shown in the graph are described in Section 2.1.

NATURAL STONE CONSTRUCTION ELEMENTS				PROBLEMS ENCOUNTERED ON CONSTRUCTION ELEMENTS MADE OF MASONRY MATERIAL IN MARDIN FORMER AMERICAN COLLEGE																		Faulty Repairs		
				Loss of surface	Fragmentation	Formation of gap/ hole	Pitting	Cracks	Spalling	Foliation	Discharge of jointing	Surface	Shell formation	Efflorescence	Crystallization	Formation of plant	Formation of moss	Corrosion (Rust stain)	Tear	Loss of form	Colour change	Use of cement	Fall of plaster	Other
VERTICAL	SINGLE Lengs	Leg		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
		Column																						
	CONTINUOUS Legs	Wall		X	-	-	-	X	-	-	X	-	-	X	-	X	-	-	-	-	X	X	-	-
HORIZONT	FLOORINGS	Flat		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Curvilinear	Vault	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X	-
			Dome																					
STAIRS				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-
WALL OPENINGS	Window		Lintel/jamb	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Sill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
	Door		Lintel/jamb	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Sill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Arch			X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-

Chart 1. Documentation of the problems in Former American Missionary College Hospital

2.1. Material Deteriorations Seen on Stone Structures

The effects encountered by the structures in time cause the problems of different material deteriorations, particularly on the stone structures, and determination of deterioration types have a great importance in terms of identifying the correct intervention methods. A literature review-based problem classification was taken as basis under the study. Accordingly, the problems seen on the masonry material used in prayer buildings are examined under seventeen different headings in total. Loss of surface is the washing and dissolution of the stone surface occurring due to the reasons caused by the internal causes, or due to the external factors such as water, wind, wetting, and drying, and the wear of the stone material in time. Fragmentation: Fragmentation occurs on the surface of the stone because of the cracks caused by several impulses or effects originating from other sources by generating pressure on the internal structure of the stone and the force applied by these cracks on the other parts of the stone (Vergès-Belmin, 2008).

Formation of Gap -Hole; the volume created by the holes, which may be caused by human or other reasons, becomes unguarded against various impacts, and these reasons also accelerate the other

deterioration processes. Pitting; the surface of the stone takes a deteriorated, pitted appearance in time due to the atmospheric effects such as sun, water, wind, wetting, and drying, and the cross-section of the stone is reduced as a result of the emptying out of the surface due to the pits, as well as the deterioration area is increased because of pitting of the surface, and therefore the wear of the stone is accelerated. Cracks: they may occur due to the earthquakes, tremors, various loads, settlement of the buildings, or the pressure on the stone caused by a metal element, which has been corroded, behind the stone. Foliation occurs because of the swelling of the surface of the stone material in the form of layers due to various atmospheric impacts and taking an appearance of leaf, and the processes result in shedding in the later stages (Vergès-Belmin, 2008).

Discharge of jointing is destruction of mortar, which is used as the binding material in the gaps in stone structures, for different reasons, and its surroundings becomes unprotected. Surface contamination is the deterioration that is seen in the form of a thin grey layer on the surface, occurring on the stone structures due to the air pollution. Shell formation is the deterioration that is seen in the form of a thick shell, generally in dark grey – black colour, on the surface, occurring on the stone materials due to the air pollution. Efflorescence: Saline causes different types of deteriorations under different environmental conditions. While gypsum crystallization causes the scaling and weathering of limestone, as well as formation of shell and efflorescence, magnesium sulphate hydrates only occur as efflorescence indoors. Sugaring is a type of deterioration seen on the marbles. Formation of plant is a type of deterioration caused by the seeds, which settle into the small gaps within the walls and enroot within this environment in time and cause other various deformations such as cracks and fragmentation on the stones surrounding due to the damages on the structure of the stone caused by the roots. Formation of moss; as a damp environment is needed for the formation of moss, this damp is present here. Stone starts to decompose and becomes mossy after a while, if the damp causing this is not removed, as the mosses release much diluted acids and cause the rock to dissolve very slowly. This moss is seen at that point. Corrosion (Rust) stain; the iron element used in the windows and railings corrode in the structures. As a result, it is seen that it leaves stains in different colours ranging between brown to red on the stone with the impact of the rain. Tear: it occurs on the surfaces of the materials because of the human-driven causes. Loss of Form; loss of form and legibility of the outer contours of the decorations on the stone surfaces, in whole or part is called as the loss of form. Change of colour; it is defined as the colouration, discolouration, darkness of the damp area, and staining on the stones due to the chemical change occurring on the minerals forming the stone with the effects of daylight, water, moisture, or any flow (washing because of the corrosion of metals, etc.). Defective repair: it is faulty applications made to repair, use of cement, covering with an inappropriate material (Vergès-Belmin, 2008).

2.2. Location and History of Former American Missionary College Hospital

Mardin Former American College is located on Block 542, Plot 5 within the urban archaeological site The building was being used as American Missionary College Hospital in the past. Buildings of Missionary College, Clinic, and Lodging are present within the area, where it is located. Today, the property owners are changed, and it is not used for habitation. South frontage of the buildings is the part, through which the entry is provided. Building units were constructed in cross vault structure. A bay window is present on the terrace parts, which creates an overhang. There are 22 units present in total. Units are being used to keep ovine (pigeon) today. The building, which the primary hospital part and mentioned as the first building in the layout plan, was investigated under the study (Figure 1).

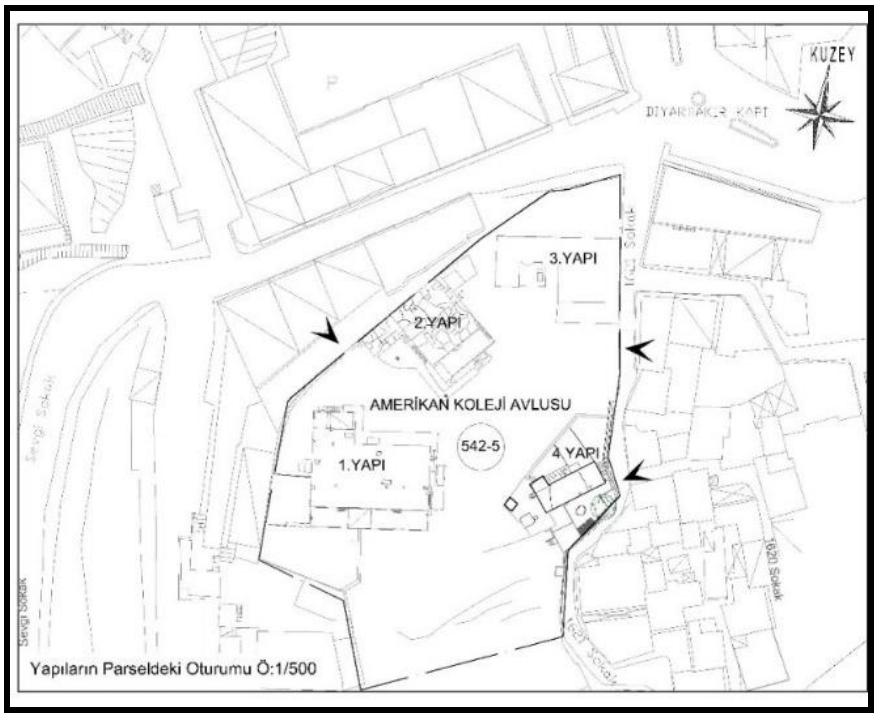


Figure 1. Location of Former American College Hospital (Mardin Metropolitan Municipality,2022)

2.3. Spatial plan and facade features

The ground floor is built in rectangular form and the first floor is built in I plan type, and the upper floor was planned with terrace area. Entrance to the building is provided on the South frontage. Separator wall was included between the arched pillars in time, and they were made separate rooms. It is consisted of 22 units. The ceilings are with cross vaults. The ground sitting has an area of 606.10m² (Figure 2).

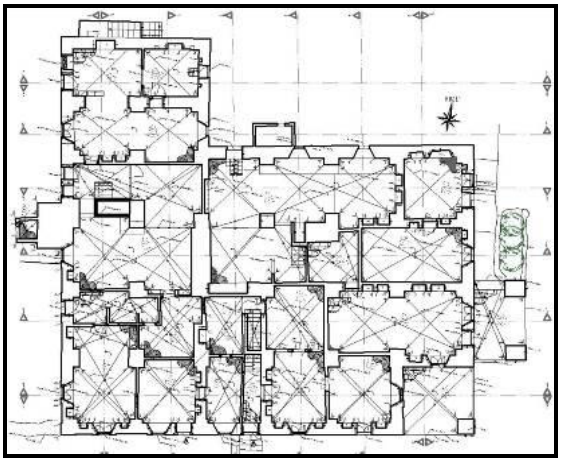


Figure 2. Plan of Ground Floor (Mardin Metropolitan Municipality,2022)

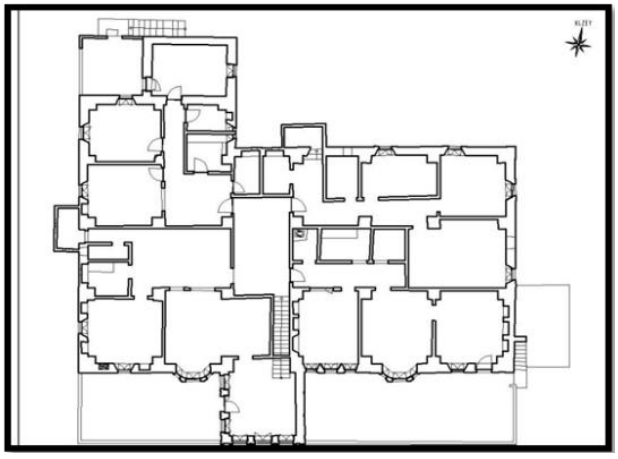


Figure 3. Plan of the First Floor (Mardin Metropolitan Municipality,2022)

Plan of the first floor which were separated into room through attachment walls. Some units are being used to raise ovine. The first floor's sitting has an area of 589 m². There is window opening, in bay window style, in the terrace areas. The ceiling of the units is cross vault (Figure 3).

The South frontage is the front entry facade of American College. It is consisted of ground and first floors. Building preserves its original status also today. The Iwan on the right side of the frontage is covered with a canvas. Plug-in iron guardrails were placed in front of the windows seen on the frontage. Buttress was made to the building on the right side of the frontage. Colour change, cement-based mortar, plant formation, cracks, discharge of jointing, and surface contamination are seen on the surface of the frontage. The height of the frontage is approximately 10m (Figure 4).

The east frontage is the right-side frontage of American College. It is consisted of ground and first floors. Building preserves its original status also today. The Iwan on the left side of the frontage is covered with a canvas. Plug-in iron guardrails were placed in front of the windows seen on the frontage. There are iron doors, which provides access to the units, on the frontage. Buttress was made to the building on the right side of the frontage. The height of the frontage is approximately 10m (Figure 5).

The North frontage is the rear frontage of American College. It is consisted of ground and first floors. Building preserves its original status also today. Plug-in iron guardrails were placed in front of the windows seen on the frontage. There is a wooden door, which provides access to the downstairs, on the frontage. The height of the frontage is approximately 7.7m (Figure 6).

The west frontage is the left side frontage of American College. It is consisted of ground and first floors. Building preserves its original status also today. Plug-in iron guardrails were placed in front of the windows seen on the frontage. There is an iron door, which provides access to the downstairs, on the frontage. The height of the frontage is approximately 10m (Figure 7).

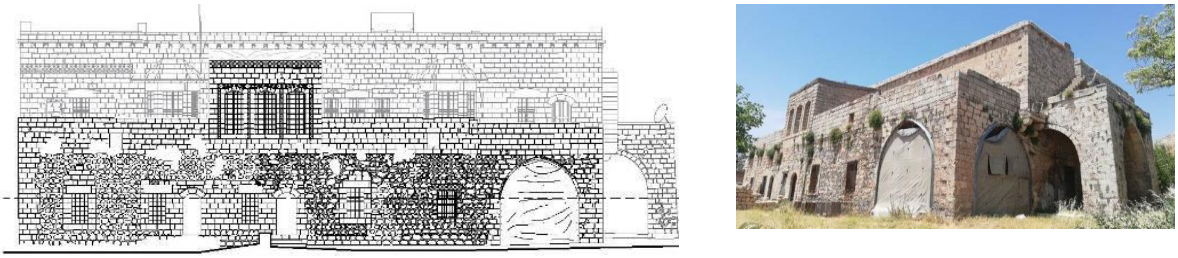


Figure 4. South Frontage (Mardin Metropolitan Municipality,2022)

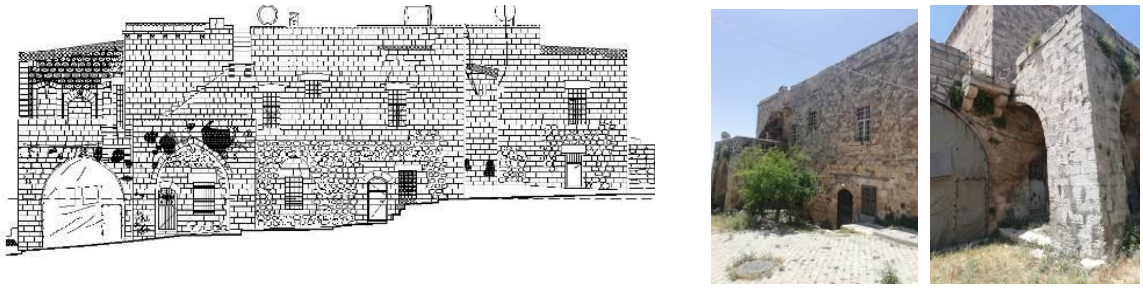


Figure 5. East Frontage (Mardin Metropolitan Municipality,2022)

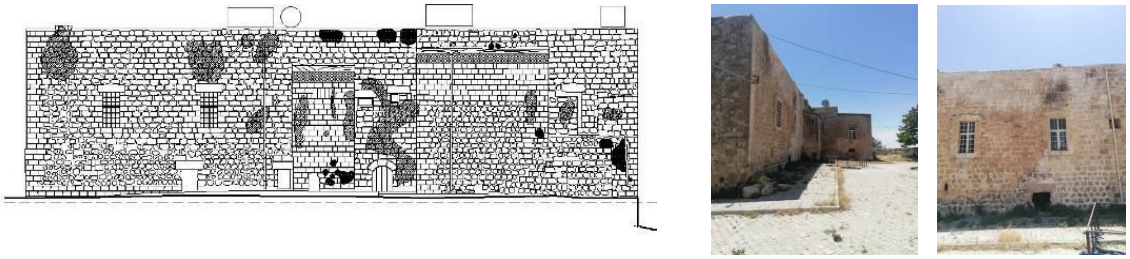


Figure 6. North Frontage (Mardin Metropolitan Municipality,2022)

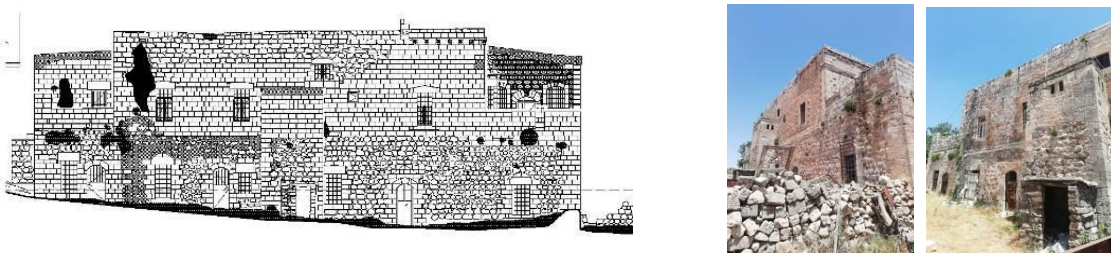


Figure 7. West Frontage (Mardin Metropolitan Municipality,2022)

3. Findings

The types of material deterioration, which were determined observationally, are marked on the chart prepared, and the results are assessed. In the chart prepared, stone decays are addressed based on the construction elements such as vertical bearings, horizontal bearings, stairs, wall openings, and auxiliary elements (Chart 1). In this section, the results regarding these assessments are presented.

3.1. Problems Seen on the Vertical Bearings

Vertical bearings are investigated in two sections as the vertical single bearings and continuous bearings. Pillars are seen in the building as the single legs.

3.1.1. Problems seen on the single bearings

Defective repairs caused by the used of cement on the pillars, which have been made by using cut stone material and bear the upper cover, were observed (“Fig. 8”)

Figure 8. Defective repairs caused by use of cement on the pillars (Karataş,2022)

3.1.2. Problems seen on the continuous bearings

Formation of plant, discharge of jointing, use of cement, loss of surface, efflorescence, surface contamination, and cracks were determined on the wall surfaces, which are continuous legs, in the examination carried on the wall surfaces (Figure 9-13)

Formation of plant, use of cement, and loss of surface were found on the South frontage (Figure 9).

a. Plant formation b. Use of cement c. Loss of surface

Figure 9. Material deteriorations of South Frontage (Karataş,2022)

Efflorescence, plant formation, colour change, surface contamination, use of cement was determined on the North frontage (Figure 10).

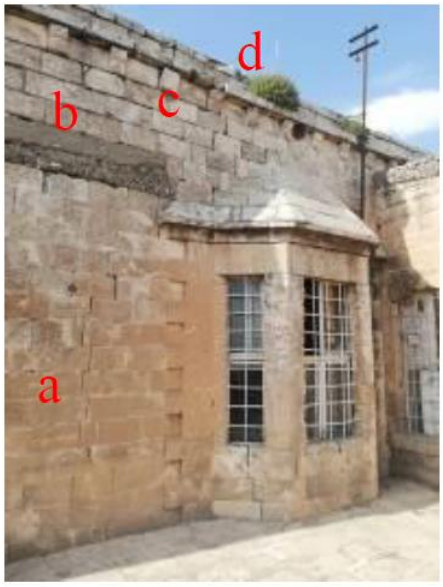
a. Efflorescence b. Plant formation c. Colour change d. Surface contamination e. Use of cement

Figure 10. Material deteriorations of North Frontage (Karataş,2022)

a. Plant formation b. Efflorescence

c. Use of cement d. Loss of surface

Figure 11. Material deteriorations of West Frontage (Karataş,2022)



a. Cracks b. Use of cement c. Discharge of jointing d. Plant formation

Figure 12. Deteriorations seen on the terrace wall (Karataş,2022)

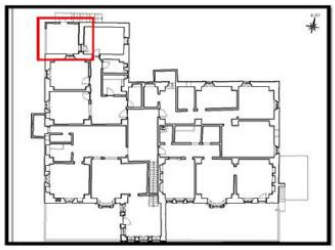


Figure 13. a. Efflorescence b. Use of cement c. Discharge of jointing d. Plant formation (Karataş,2022)

3.2. Problems seen on the horizontal bearings

Damaged domes and vaults on horizontal carriers were examined. Fall of plasters and formation of moss due to humidity were not observed on the vaults, which are the horizontal bearings (Figure 14-15).

Figure 14. Examples of plaster fall on the vaults (Karataş,2022)

Figure 15. Examples of formation of moss caused by humidity on the vaults (Karataş,2022)

3.3. Problems Seen on the Stairs

Problems of tear and colour change are seen on the stairs, which were made of smooth face stones (Figure 16).

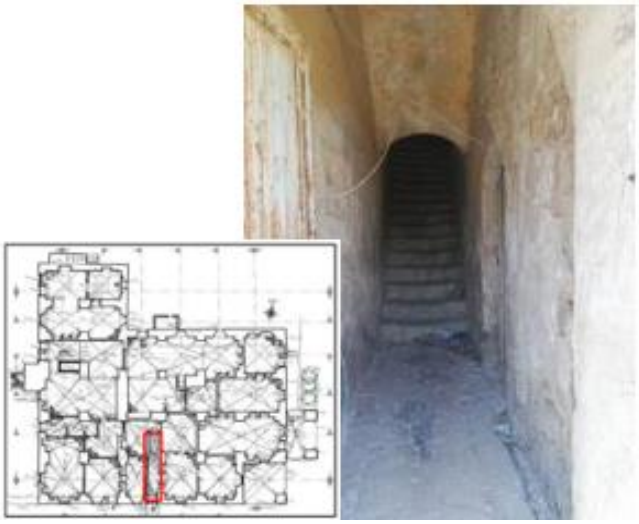


Figure 16. Tear and colour change on the stairs (Karataş,2

3.4. Problems Seen on the Wall Openings

Windows, doors, and arches are seen as the wall openings in the building. Colour change on the arches, tear on the door sills, and colour change and loss of surface on the lintels over the windows were determined (Figure 17-20).

Figure 17. Colour change on the arches (Karataş,2022)

Figure 17. Colour change on the arch, tear on the sill (Karataş,2022)

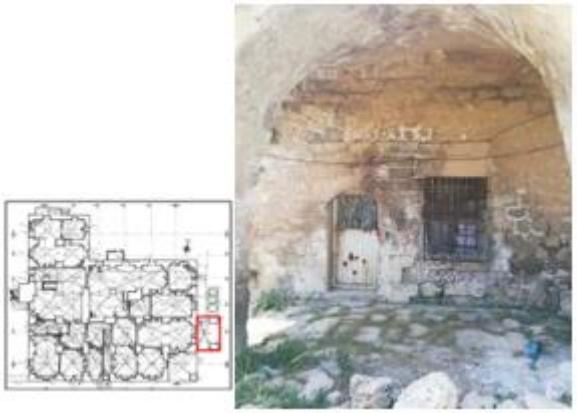


Figure 18. Colour change on the arch and lintel (Karataş,2022)

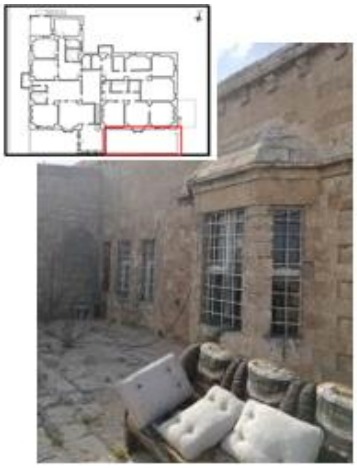


Figure 19. Surface loss on the lintel (Karataş,2022)

Figure 20. Surface loss on the arch and lintel (Karataş,2022)

3.5. Problems Seen on the Auxiliary Elements

Elements such as stalactite and Turkish triangle, which are defined as the auxiliary elements, are not present in the building. Therefore, any material deterioration regarding these elements is not present.

CONCLUSION:

According to the data obtained because of the observations made on the building, the most frequently encountered problem on the stone construction elements of Former American Missionary College Hospital is using of cement. This is followed by efflorescence, colour change, discharge of jointing, plant formation, fall of plaster caused by humidity, surface contamination, formation of moss, and tear, respectively. The types of stone material deterioration such as the formation of gap – hole, formation of pitted surface, spalling, foliation, formation of shell, crystallization, loss of form were not observed on the building.

The determinations obtained are in contradiction with the finding of the study conducted by Kramar et. al (2011), in which the limestone has been examined within a different geographical context, stating that the most important deterioration of limestone on the monument under investigation was the formation of soluble salts. Moreover, it also contradicts that of Patil et al. (2021) states that the reasons for basalt degradation are mainly due to air pollution and climate. This finding determined in our study demonstrates that the stone monument deteriorations in our country are caused by human-driven causes, beyond the atmospheric conditions, when compared with the other countries; and precaution must be taken immediately against this.

The stages of diagnosis, cleaning, reinforcement, cosmetic and plastic repair, and use of water repelling and surface protecting materials are applied in the repair of stones. The first step before cleaning is the determination of the status and contamination of the stone, and the cleaning method of the stone is determined after the stage of diagnosis. Some tests and examinations must be conducted on the stone for the intervention method to be applied to the stone, and type, status of the stone is the main criteria that identifies the stone cleaning method to be applied. In addition, the status of the other structural materials located in the vicinity of it, type and amount of the contamination to be removed, changes or deteriorations caused by the environmental factors on the stone are the factors that shall determine the stone cleaning method to be applied, and different methods are developed to remove the contaminations occurring on the stone structures. Each method, which is used in removing the contaminations, has its specific terms of use, benefits, and disadvantages, and methods such as mechanical cleaning, washing with water, cleaning via laser, controlled sanding, chemical cleaning, biological cleaning, and desalinization are used in stone cleaning (Eyüpgiller& Zakar 2015). Reinforcement, repair, and surface protection stages must be carried out respectively on the cleaned surfaces.

Our study conducted within this context exemplifies the determination stages intended for the material problems and interventions systematically within the geographic context, based on Former American Missionary College Hospital case, to manage the material problems on historical masonry buildings in Mardin, which is a unique geographic context, in a sustainable manner. The study is expected to make contribution into the literature both in terms of addressing the stone material problems of Mardin Former American Missionary College Hospital and of exemplifying the deterioration types and conservation suggestions regarding the other buildings within this geographical context. More specifically, deterioration patterns may be defined being supported by visual investigation in future studies and mapped in different scales in computer-aided design (CAD) or geographical information systems (GIS) environment. Mapping is a relatively cost-effective technique, and it is considered that it may reduce the costs of diagnostics and conservation procedures assisting the planning of sampling and laboratory tests, when combined with other on-site investigations.

Conformity with the Ethical Standard

Conflict of Interest: *The authors declare that there is no interest of conflict.*

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