

## **Environmental conditions Assessment and their impact on the Archaeological collections from the Al-Mafraq Museum in Jordan**

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### **Abstract:**

The present research paper discusses evaluating the environmental conditions (relative humidity- temperature) and their impact on the exhibited archaeological collections at Al-Mafraq Museum in North-eastern Jordan. The function of the museum focuses mainly on the conservation, exhibition, and preservation of collections. Also, it fulfills an educational, scientific, cultural, and touristic mission. Archaeological collections and found items are the main elements of the museum. Thus, they must be preserved and protected to fulfill their cultural mission. Al-Mafraq Museum contains many collections made of different organic and inorganic materials, such as wood, stone, pottery, ceramic, and metal that require different environmental conditions for exhibition, preservation, and storage. The present study aims to study, evaluate, and monitor the degrees of relative humidity and temperature inside Al-Mafraq Museum and their role in the deterioration of its collections. It was carried out using visual examination, measurement, and monitoring of relative humidity and temperature inside the museum over a year from November 2019 to October 2020 by Datalogger. Moreover, the portable digital optical microscope and X-Ray Diffraction Analysis were employed to examine some deterioration manifestations of the collections. The obtained results showed that the average degrees of relative humidity and temperature are high in most of the year. The highest value of relative humidity (78.6%) was reported in March, whereas the highest value of temperature (33.5°C) was in September, resulting in the deterioration of some exhibited and stored items. Ultimately, the relative humidity of most collections should range (45%- 55%) and should not increase or decrease by 5%, whereas temperature should not exceed (18°C). Thus, rapid intervention should be carried out to resolve this problem and keep these collections.

### **Key Words:**

environmental conditions, relative humidity, analysis, Al-Mafraq museum, Jordan.

## Introduction

Museums are the focal point between the past, present, and future. Holding ancient artifacts mainly distinguishes their environment from the environment of other buildings (Askari, H. Sh., and Abu, Hijleh, B., 2018). Jordanian museums hold huge collections of priceless artifacts that perpetuate the glory of the Hashemite Kingdom of Jordan throughout the ages and define the identity of the Jordanian people. They are sui generis buildings as they express the history and culture of the Jordanian people. Despite the considerable progress of museology, most museums of Jordan lack many requirements and needs (Mazen Rasmy Rateb, 1993). Al-Mafraq Museum is affiliated to the Department of Antiquities, Al-Fudayn to the west of Al-Mafraq in the eastern region of Jordan; a semi-desert region.

The Museum is administratively affiliated to Al-Mafraq Department of Antiquities, the General Department of Antiquities. It is managed by the curator. It is worth noting that there is no ticket office, and entrance is free of charge.

Al-Mafraq Antiquities Office and Museum was established in 1983. It has become a facility for keeping artifacts discovered by foreign missions and the projects of the General Department of Antiquities at the time. It was owned by a citizen in the early 1980s and covered an area of about 150 square meters. Its small rooms were used to keep the artifacts. The present building is old as it was built in the mid 1970s. Because of its poor condition, the General Department of Antiquities carried out conservation and restoration in recent years.

In 2010, Al-Mafraq Antiquities Office and Museum was named Al-Mafraq Directorate of Antiquities. Because there was an urgent need to build a large hall to keep artifacts, a hall (5×10m) was added, and artifacts were moved to it.

The Museum holds about 3,000 organics, inorganic, and composite artifacts discovered in many archaeological sites in Al-Mafraq governorate, such as Al-Fudayn, Rehab, Alkharba Alsamraa, Om Aljaal, Om Alqateen, Alsafawy, and Hayan Almoshref. These artifacts were made of several metals, e.g., iron, copper, silver, bronze, gold, wood, basalt, limestone, pottery, marble, glass, and ivory. They date back to different periods from the Paleolithic, Neolithic, Chalcolithic, Bronze, Iron, Nabataean, Roman, Byzantine, Umayyad, Abbasid, Ayybid, Mameluke, and Ottoman eras. Figure (1) shows the office building and the Museum of Antiquities of Mafraq from the outside.

It is an important museum because:

- It is located in Al-Mafraq city and affiliated with Al-Mafraq Department of Antiquities, which helps activate, disseminate, and promote culture and tourism.
- It is located in Al-Fudayn Archaeological Site, so foreigners and locals can visit the site and museum.
- It offers a rich museum material that mimics the story, products, and creations of civilizations in Al-Mafraq governorate and archaeological sites.
- It saves the time and effort of the visitor by seeing artifacts from all over the governorate, which is large in terms of area.
- It offers all forms of facilities for researchers, academics, university and school students, and the local community to study the artifacts and their significance.
- It protects archaeological collections against deterioration and damage.

- It promotes the vision and mission of the General Department of Antiquities that a museum is a cultural and educational institution that revives the cultural heritage of the society and consolidates the concept of national identity and the heritage of ancestors.



Figure (1) shows the office building and the Museum of Antiquities of Mafraq from the outside

### Materials and Methods:

Visual examination was carried out, and relative humidity and temperature were measured inside the museum for a year from November 2019 to October 2020. Non-destructive methods were utilized. For example, the mobile digital optical microscope was used to study the deterioration aspects of some artifacts. Moreover, X-ray Diffraction (XRD) was employed to analyze samples of dust and salts in the museum ground and deposited dirt on some pottery artifacts.

### Discussion of Results:

- The study illustrated the high rates of humidity most of the year. There is a clear fluctuation in humidity and temperature in the museum. Relative humidity plays a key role in the deterioration and damage of all museum collections. Moreover, there is no safe relative humidity globally, and its increase is extremely dangerous because it increases the rates of deterioration of all artifacts (Mary K. Predeco, 2005). There is a close correlation between relative humidity and temperature, especially in closed systems (i.e., an inverse relationship) (NPS Museum Handbook, 2016, p.24-25). Temperature fluctuation throughout the day and the year increases the deterioration and degradation of all organic and inorganic antiquities. Visual examination of the museum and its collections showed that high ground or relative humidity deteriorated many exhibited artifacts, as shown in the crystallization of salts on the ground of the museum and some pottery pots on the floor. Moreover, displaying many artifacts outside the showcases caused the accumulation of dirt and dust on the artifacts. Under high rates of humidity, the dust interacts with and sticks to the artifacts, causing microbiological deterioration.

- Measuring relative humidity and temperature throughout the year using Datalogger showed high rates. The ideal rates of the relative humidity of most museum collections range from (45%) to (55%) and should not increase or decrease by (5%), whereas temperature should not exceed 18°C (NPS Museum Handbook, 2016, p.24-26). The results showed that museum collections were exposed to high rates of humidity. In December, January, and February, relative humidity measured 70.3%, 75.9%, and 76%, respectively. The highest rate of relative humidity was in March, rating (78.6%). In April and May, it rated (74.8%) and (67.1%), respectively. The highest degree of temperature was in September (33.5 °C), whereas the lowest was in February (7.9 °C). These results suggest that the environmental conditions of the collections are uncontrolled, causing quick damage. Thus, there should be early intervention by enhancing the efficiency of this museum or establishing another according to international specifications to keep the stored and displayed collections.
- The results of the analysis using the mobile digital optical microscope showed the deterioration of the exhibited and stored metal artifacts, the corrosion of iron and bronze, the formation of corrosion products on the sword made of iron and bronze collections. The high relative humidity is the main cause of the deterioration of metal artifacts (Standberg, 1998). The green color of the corrosion of the bronze disk may result from chlorides, known as bronze disease, which is the most dangerous form of the corrosion of bronze artifacts, resulting from alkaline chloride compounds (Scott, 2000). Moreover, wood was deteriorated and decomposed due to high humidity. Thus, wood artifacts were prone to microbiological deterioration and weak mechanical properties (Zelinka et al., 2000). Examining the white layer on pottery showed calcium carbonate and sodium chloride.
- XRD analysis of the sample of salt and dust in the ground of the museum showed quartz and kaolinite, indicating dust, as well as mud and sand dirt that contain impurities of iron oxides and halite (NaCl). The results of analyzing the sample of dust and dirt from the surface of a pottery utensil showed that it contained halite (NaCl), which is solvable in water and calcium carbonate that has low solubility in water. Salt crystallization is closely related to high humidity because the movement of these salts in the porous body depends on the surrounding conditions, temperature, and relative humidity (Charola, 2000).

## Conclusions

In sum, Al-Mafraq Antiquities Office and Museum in Jordan and its collections lack many principles and rules of museum establishment. It is a store more than a museum. Moreover, it suffers from high ground and relative humidity most of the year, and there is a clear fluctuation of temperature and humidity. If intervention is not quick enough, the exhibited and stored artifacts will be damaged and deteriorated. The baseline of temperature and relative humidity should be set. Furthermore, it should be considered whether the space inside the showcases of the exhibition offers the optimum museum environment.

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