

SUMMARY

In archaeological buildings , Mehrabs have varied according to their building materials and the style of decoration . There are stone and stucco Mehrabs decorated with colored and gilded wood , with stucco , marble coatings , Marble Mosaic , or colored or gilded glass Mosaic .

Deterioration factors have varied . There are physio – chemical factors , biological factors and human ones . Besides there are natural disasters such as Earthquakes .

Moreover , the materials and Methods of Treatment and Conservation of these archaeological Mehrabs have varied according to the state of each one of them . The research deals with the study of treatment and conservation of archaeological Mehrabs in Cairo with application on Mehrabs decorated with Mosaic .

The research is divided into seven chapters :

Chapter 1

This chapter deals with the study of the evolvement (beginning) of archaeological Mehrabs and their development . It includes the origin of the word Mehrab , its definition and origin in Islamic Architecture .

Also , it deals with the parts of which the Mehrab consists of , I . e , niches which consists of shafts and tops , arches , Columns with their types and style of forming , and bases.

It also involves the study of Juggled Viossoirs and stalactites , their forms and their development .

it Includes also study of the development of Mehrabs in Egypt during the Islamic periods and the artistic value of designing and forming of archeological Mehrabs .

Chapter 2

This chapter deals with the study of Mehrabs building materials , That includes Limestones, their kinds and sources of these limestones which were used in building the archaeological Mehrabs in Cairo . These sources include the quarries in

Gebel El Mokattam , in east and south east of old Cairo , in Tura and El Massara beside those quarries in Helwan .

It also concerns with the style of using these limestones in building the niches of the archeological Mehrabs .

It involves cutting the stones , preparing the surfaces , and the tools used and their kinds and styles of Building with stones .

Moreover , the chapter deals with marble and its role in shaping the Columns which represents part of the architectural building of archeological Mehrabs , It also includes the sources of marble and its Egypt such as .

Abo – Sowyl in the Eastern desert , El Daghabag and El Gindi .

It also involves the work of cutting and smoothing of marble .

It deals with the study of fired Bricks or (Backed Bricks) , their role in building archeological Mehrabs , methods of their manufacture during the Islamic periods .

Last , it deals with the study of the mortars used in building the niches of the archeological Mehrabs especially Gypsum and lime .

Chapter 3

This chapter deals with the materials and styles used in decorating the archeological Mehrabs. It includes the decoration of these archeological Mehrabs with stucco .

It also involves the styles of decoration , the tools used , and some examples of archeological Mehrabs decorated with stucco in some of the archeological buildings in Cairo .

Moreover the chapter deals with the study of decorating archeological Mehrabs with wood either coloured or gilded . It also concerns the styles of shaping and gilding this wood .

Besides , it deals with decorating the Mehrabs with marble coatings and the different ways of this process . They include engraving , relief , Inlaying still , the chapter deals with decorating archeological Mehrabs with Imperial porphyrite and Mosaic . This part also concerns the evolvement (beginning) of Mosaic , its development , its structure , and Its layers in archeological Mehrabs. It also concerns

the methods of preparing the surfaces for Mosaic , the mortars used and the different styles of decoration with Mosaic .

Last, the chapter deals with the study of using marble Mosaic to decorate archaeological Mehrabs Providing Examples. It Involves The study of using glass Mosaic , This part involves the manufacture of glass during the Islamic periods and the methods of getting coloured and gilded glass providing examples of the remaining archaeological Mehrabs which were decorated with coloured or gilded glass .

Chapter 4

This chapter deals with the study of deterioration factors and phenomena in archeological Mehrabs , These factors include physiochemical factors , changes in relative humidity and temperature , the effects of underground water and salts , and air pollution , It also includes the effect these factors on the deterioration of Mehrabs walls, mortars , marble coatings , Mosaic decoration . Examples are also provided for the deterioration phenomena resulting from these factors in archeological Mehrabs .

The chapter involves the biological factors which include bacteria , algae , fungi and lichens . Examples are also provided for the effects of these factors on the archaeological Mehrabs .It also Includes the study of human factors and their effects on archaeological Mehrabs , These factors include :Fault restoration works ,The great number of visitors or prayers ,The effect of transport ,Using iron bars and nails to fix the coatings and decoration And.The effect of natural disasters such as earthquakes on archeological Mehrabs

Chapter 5

This chapter deals with the methods of treatment and conservation of archeological Mehrabs as follows :

First , the study of the processes of mechanical and chemical cleaning of marble Mosaic coverings and decorations .

Second , the study of extraction of soluble salts of archaeologica Mehrabs walls, the study of poultic poultices which are the most useful way , and the study of methods of removing insoluble salts of archeological Mehrab walls .

Third , the study of consolidation methods of archeological Mehrabs , This part includes the essential conditions of consolidated materials which are divided into

two divisions : organic and inorganic consolidants In organic consolidants include Silicate consolidants and basic Earthy hydroxides organic consolidants are divided into two parts : thermoplastic resins such as vinyl resin and Acrylic resin , and thermosetting resins such as Epoxy resin , poly Ester resin and silicon resin . This part also includes the methods used for the Application of consolidants on surfaces and basic foundations of archaeological Mehrabs .

Fourth , the study of Isolation of foundations and walls of archaeological Mehrabs from sources of moisture which includes physical methods and chemical Insulation with water physical methods and chemical isolation methods using water repellent chemical solutions .

Fifth , the study of treatment and conservation of Mosaic decorations in archeological Mehrabs which include :

- A- steps of removing Mosaic out of archeological Mehrabs walls using strappo technique .
- B- Consolidation of deteriorated or fragile mortar layers .
- c- Fixing the mortar layers which are disintegrated out of the walls of archeological Mehrabs hold Mosaic .
- d- Filling the missing lacunae of Mosaic decorations in archeological Mehrabs .

Chapter 6

This chapter deals with the analytical study of the building materials and deterioration phenomena in Madrasa the selected Mehrab of Abu Bakr Mozher and some other archaeological Mehrabs decorated with Mosaic As follows :

First : X –Ray Diffraction Study

- 1- The study included analysis of some limestone samples used in buildings. This analysis involved the Mehrabs of Gamal El-Din El-Astadar Mosque, Abu- Bakr Mozher Madrasa, Taybarsya Madrasa and El- Mansour Qalaon Madrasa .

All the samples consisted mainly, of calcite Mineral. The sample taken from the Mehrab of Gamal El-Din El-Astadar Mosque contained Dolomite Mineral, in small proportion All of the four samples contained Halite salt .

- 2- A study of the Mortars used in fixing Mosaic on Mehrabs walls was carried out using X-Ray diffraction. The study included the Mehrabs in Abu Bakr Mozher Madrasa, Taybarsya Madrasa, Al-Azhar Mosque, Alaa El-Din Akbokha Mosuleum, A kbokhaoya Madrasa, Gamal El-Din El-Astadar Mosque and El-set Meska Mosque. They consisted mainly of calcite, Gypsum and Quartz minerals .
- 3- A study of the decoration Materials of archeological Mehrabs has been made Samples from Marble Mosaic in the Mehrabs of Abu-Bakr Mozher Madrasa have been analyzed by X-Ray diffraction. These colored materials are red, black or white. It has become clear that they consisted mainly of calcite mineral and that Hematite is the cause of the red color in Mosaic .

A study of salt samples in archeological Mehrabs decorated with Mosaic was made using X-Ray diffraction from Abu Bakr Mozher Madrasa, El-Set Meska Mosque, El-Mansour Kalaon Madrasa, Gamal El-Din El- Astadar Mosque. There has clear that there are Gypsum and Halite salts in all samples .

Second : polarizing Microscope [P.M.] Examination .

- 1) The study of a sector Imperial prophyrite proved that it mainly, consisted of wathamite mineral and Oxy Hornblend mineral. The distinguishing porphyrite texture also appeared in addition to the transformation of some minerals into others such as the transformation of plagioclase to Epidote and Biotite into Muscovite .
- 2) The study of white marble Mosaic proved that it consists, mainly of calcite Mineral that of red marble Mosaic proved that it also, consists of calcite mineral in addition to Hemaitte mineral which is the cause of the red colour. The study of yellow and black Mosaic proved that they mainly, consist of limestone from calcite mineral, Quart, clay mineral and Iron oxides. These iron oxides moved and dissolved inside Mosaic pieces which led to their deterioration .

Third : Scanning Electron Microscope (SEM) Examination .

- 1) Some limestone samples from the previous Mehrabs have been analyzed using scanning Electron Microscope .

This analysis, showed the full extent of deterioration caused by crystallization of salts on calcite crystals. It led to their disintegration and cracks which led to the deterioration of the walls of the archaeological Mehrabs .

- 2- A study of coloured marble Mosaic samples was carried out using scanning Electron Microscope. It has become clear that crystallization of salts in calcite crystals led to the disintegration and deterioration of Mosaic pieces .

Forth : Atomic Absorption Analysis .

- 1) Atomic Absorption Analysis for underground water samples from Al-Mas El-Hageb Mosque, El-set Meska Mosque and Abu-Bakr Mozher Madrasa. The results proved presence of a high proportion of calcium and sulfate ions which asserts the presence of calcium sulfate salt. It also proved the presence of chloride and sodium Ions which asserts the presence of Halite salt (NaCl) .
- 2- A study of glass Mosaic samples in archeological Mehrabs from El-set Meska Mosque, Abu-Bakr Mozher Madrasa was done Atomic absorption analysis. The results were as follows :

There has been an addition of colorant oxides so as to blain colored Mosaic. These oxides were Iron and Manganese oxides for the green colour and the Iron and copper oxides for the black or blue colour

Fifth :- Infra Red Analysis.

There have been Analysis by Infra Red of Inlaying Coloring Putty Marble , The Results Proved That It Consists Of 3 Parts Of Calaphony To1 Part Of Wax Addition To The Coulorant Oxide .

Amicrobiological study for Underground water :-

Amicrobiological study for there samples from the previons archeological places showed that there are there kinds of bacteria in these samples which are :

- long rods bacteria .
- Short rods bacteria
- Cocai bacteria .

It also showed three kinds of fungi which are

- Aspergillus sp .
- Alternaria sp .
- Mucor sp .

The total accounting of bacteria , fungi And yeast in these samples were as follows :-

1- El-Set Meska Mosque sample .

Total accounting of fungi and yeat 82×10^5 Cell / Per Gram

Total accounting of bacteria 106X10⁵ Cell / Per Gram

2- Abu – Bakr Mozher Madrasa .

Total accounting of fungi and yeast 11X10² Cell / Per Gram

Total accounting of bacteria 295X10⁶ Cell / Per Gram

3- Al- Mas El-Hageb Mosque .

Total accounting of fungi and yeast 58X10³ Cell / Per Gram

Total accounting of bacteria 101X10³ Cell / Per Gram

Chapter 7

This chapter includes the treatment, restoration and conservation of Mehrab of Abu Bakr Mozher Madrasa decorated with Mosaic .

- 1) Were carried out chemical cleaning tests the solution consisting of (100 cm³ of distilled water + 10 grammes of Non Ionic soap 41cm³ of Ammonia) proved high proficiency in cleaning. Also, Mora poultice proved the same proficiency in cleaning Marble Mosaic decorations. As for glass Mosaic, (EDTA) compound (Ethylene Di-Amine Tetra-Acetic Acid) solution proved high proficiency in cleaning processes.
- 2) There have been tests of restoration of Marble Inlaying with putty which consisted of wax and calophony at a percentage of 1 to 3. The red, black and green colourant oxides have been added. This was applied to a piece of Marble and gave a good result .
- 3) There have been tests of restoration of glass pillars decoration the Mehrab. The compound which consisted of Alcidite resin, glass powder, Blue colourant oxide and gave a good result .
- 4) There have been tests of gilding. This process was applied to two pieces of wood using gilding paper .

There have been Tests of consolidation of Lime stone , Marble and Mortars using Six Materials As follows :-

- A) Ethyl Silicate : consists of Tetra Ethoxy Silane
- B) Wacker –H : consists of Methyl Tri Ethoxy Silane +Tetra Ethoxy Silane
- C) Kem Tekt-20 – consists of potassium Methyl Silicon
- D) Addicon : consists of Methyl –Methyl Methacrylate
- E) Methyl Methacrylate

F) poly Methyl Methacrylate .

Ethyl Silicate Material gave high proficiency in Consolidation and Isolating of Lime Stone and Mortars but wacker –H Material proved high proficiency in consolidation and Isolating of Marble .

The material and methods which gave good results in the previous section were applied in restoration, and conservation of the Mehrab of Abu Bakr Mozher Madrasa as follows :-

First

The Mechanical cleaning was applied to remove dust and old Mortar remains and fault restoration processes that used gypsum and cement .

Second

The Mechanical cleaning of Marble and glass Mosaic decorations .

Third

Removing of salts crystallized on the surface and among Mosaic pieces Mechanically, beside to using paper poultices .

Fourth

Restoration of the two pieces of wood on the Columns capitals , then regilding them using gilding paper .

Fifth

Restoration of coloured putty Inlaying with Marble .

Sixth

Restoration of glass columns decorating the Mehrab beside the glass Mosaic pieces .

Seventh

Finally consolidation and Isolation of the Mehrab, its decorations and the carrying Mortars were carried out .

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