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2024; Dec (14):480:495.

Doi: 8.24394 /JAH.2024MJAS-2409-1267

ISSN: 2735-430X (Print); ISSN: 2735-4318 (Online)



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**MORPHOLOGICAL STUDY AND CONSERVATION OF HISTORICAL SYRIAN SHAWL, AND A PROPOSAL STUDY TO RE-DISPLAY IT**

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**To cite this article:**

*Moushera Ismaiel, Journal of Arts & Humanities.*

Vol. 14, 2024, pp.480 -495. Doi: 8.24394/ JAH.2024MJAS-2409-1267

**Received:** 07, 09, 2024; **Accepted:** 01, 12, 2024; **published:** Dec 2024

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**Abstract**

This study describes the conservation of textiles in Egypt that were in an uncontrolled state of storage. Highly decorative and multi-colored fabric fibers from the Syrian heritage costumes between 1890-1945 and explores the deterioration aspects found due to suffering from several degradation factors during the previous museum exhibition for an archaeological Shawl, the most common conservation processes of a textile object include cleaning, stabilization, restoration, exhibition, and storage.

The microscope was used to identify the dust, To identify the types of dyes, and ATR-FTIR was used To determine the type and condition of the fibers, The effect of cleaning agents on natural dyes has been tested, and the test gave positive results, which confirms the lack of stability, and then it can be excluded washing process without any damage to the colors, This presentation will go through the step-by-step save treatment. Old save fixes have been removed, Mechanical cleaning was performed. And the use of new silk fabrics dyed with natural dyes to complete the missing parts. The fabric was supported on a new canvas stretched over a wooden frame. The research presented a proposed method to re-present it and present a method for visual completion of the missing parts

**Keywords:** Display, Mordant, Supporting, Textile, Silk.

**Introduction**

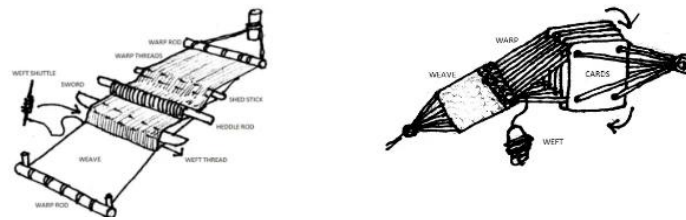
The term "textile" is used to describe fibers and all goods manufactured from them using any processing technology, including spinning, weaving, knitting, lace, releasing, needlework, and so forth, even if its original meaning is derived from the Latin word texture, which means to weave. Accordingly, all flat and linear textile goods as well as those created from them are included in the term textiles. The term "textiles" has recently been used as a synonym for "textile." [1], One of the oldest industries in human history is the textile sector. According to several scholars, the textile industry originated in Syria and Mesopotamia. Since the beginning of time, clothing has been one of the three basic needs of humans, along with food and shelter. Thus, research and development are crucial in the textile sector. [2], One of the most fundamental human requirements is fabric, which is used for both practical and decorative purposes in addition to clothing. The fabric-forming or fabrication process affects the fabric's look, texture, suitability for its intended application, and other aspects. [3]

At first, Damascus produced different manuscripts and natural silk based on the hues of the fabric. Older designs used manual boiling, glazing, and needleing, which resulted in fewer than one loom or more. Today's display changes according to drawings that differ in color according to the number of needles. [4], The Syrian capital Damascus is famous for the textile industry and Syrian textile products have been known throughout the world as the Damask and Prokar fabrics, which are still famous today [2] -(Fig. 1)



**Fig.1.** Models of the Syrian shawl

In Syria, weaving is regarded as an art form and is still done by a select few: Bedouins in the deserts, rural residents at home, and weavers organized into family workshops in the towns. Fabrics can be identified by area because different people have historically created diverse technologies, weaving processes, and weave types utilizing a variety of tools and looms to create textiles with different qualities and designs (Fig. 2). [5], Heritage is among the most delicate items that frequently require preservation and restoration. Unsuitable weather conditions, whether caused by light or biological, physical, or chemical factors, are the primary causes of damage to them. [1],



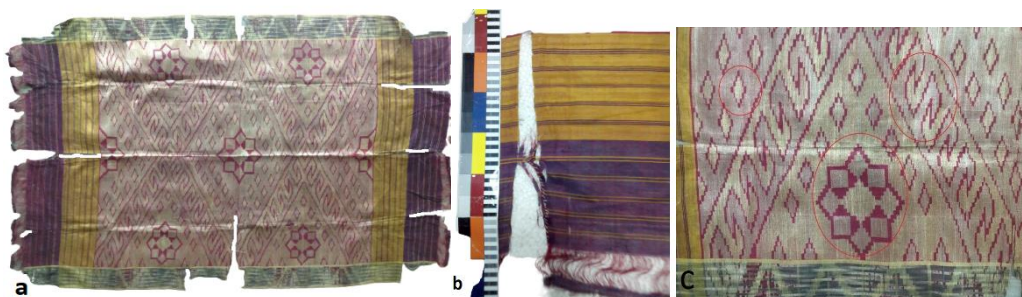
**Fig.2.** The simplest type of loom used in Syria is the tablet-loom

This paper aims to know the types of fibers, dyes, and dust. The paper refers to the preservation treatment of the object such as cleaning, old restorations, completing missing parts, fixing separated parts, and making a new display in the museum. This research deals with the treatment of a Syrian shawl preserved in the Museum of the Faculty of Applied Arts, Cairo, Egypt- after it was found in a severe state of deterioration that led to the weakness and erosion of the fibers. Thus, this research aims to clean, support, and prepare it for the appropriate museum display, using needle operation on a background of linen cloth, especially since this technique is characterized by the feature of healing without exposing the tissues to any damage upon the jaw. and at the end of the study, a wooden display frame was prepared; This is to ensure the strength of the frame and its endurance to tighten and fix the linen used as a reinforcing layer, and thus it was possible to achieve the best possible technique of reinforcement that ensures the preservation of the archaeological fabric, in addition to a proposed presentation method for the piece

## Methodology

### *Description of the object under study*

The object is preserved in the faculty of Applied Arts museum, Helwan University, Cairo, Egypt under record number 125/6. The actual area of the piece is 123 x 170 cm (Fig.3a). The piece is a rectangular area divided according to its decorative design into a rectangular area bordered by a “canar” frame from the top. It's down (Fig.3b), All the decorations in the square of the object are geometric motifs and have Various geometric shapes (Fig.3c),

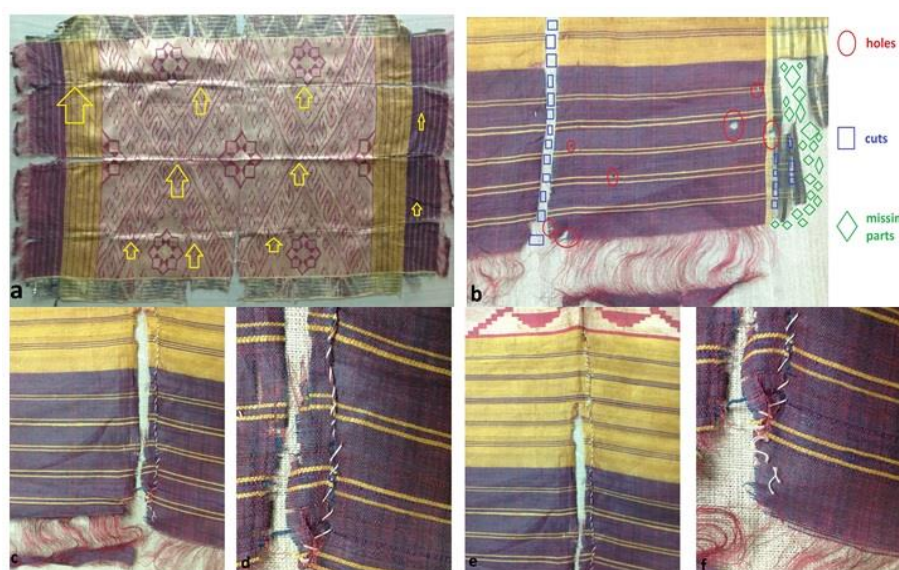


**Fig.3.** The object in the Faculty of Applied Arts Museum; a- The object complete;

b - crop of the object (canar);

c - decorations in the square of the object and geometric motifs

**Visual examination:** The first step in the documentation of the historical object is a visual examination; the piece was woven by tapestry technique. And a large part of it was missing and fragmented. It was fixed with sewing stitches with a white cotton thread with a saddle stitch. Yellow and purple motifs Weave plain weave of 3/3 regular warp rib weave. It is a very important step in the conservation process. The visual investigation showed some types of deterioration without needing SEM or other examination methods. It appears the weak condition of the object as visible lines due to fabric crease marks (Fig. 4a), cut-out pieces of fabric, missing parts, and holes (Fig. 4.b), dirt, and stain in different parts of the object, Finally the object has wrong previous restoration works (Fig.4 c, d, e, and f)



**Fig.4.** Types of deterioration

a- lines due to fabric crease marks; b- cut out pieces of fabric, missing parts, and holes  
c, d, e, and f- wrong prior restoration works

## Methods

Using USB Digital Microscope was used for Magnification power from 20 X – 200 X - 1.3 Mega Pixel, and then using Axio Cam ERc 5s used with all microscopes stands from Carl Zeiss – in the faculty of fine arts -at Minia university-Egypt, Samples were collected from the background and decoration. The filaments were examined using a Scanning Electron Microscope (SEM) (FEI-QUMTA 200SEM) in Central Lab. For Microanalyses, Minia University, Egypt, Fourier transform infrared (FTIR) is one of the important analytical techniques for researchers. This type of analysis can be used for characterizing samples in the forms of liquids, solutions, pastes, powders, films, fibers, and gases. This analysis is also possible for analyzing the material on the surfaces of the substrate [6] In this method the sample is diluted with KBr (IR grade) so that the concentration of the sample is 1%. Fabrics were measured by (Smart Performer ATR) unit accessory with Zinc Selenide crystal. ATR accessories require minimal setup and are easy to clean. Samples are placed directly

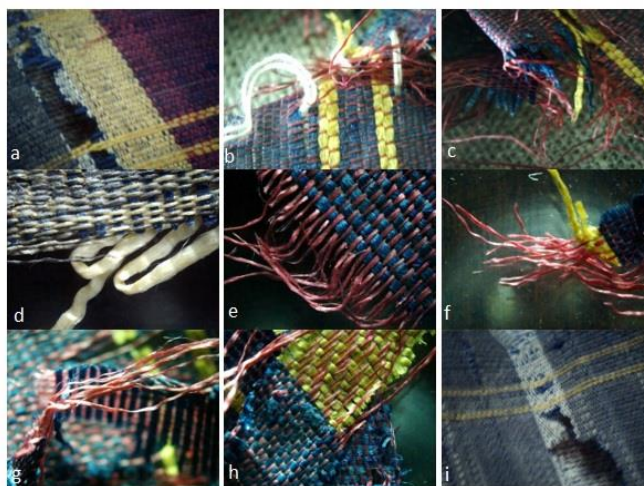


onto the crystal surface itself. Single-bounce crystal modules tend to be the most versatile since most are supplied with a pressure device and are appropriate for a variety of organic liquids and powders [7], Fourier transform infrared spectroscopy coupled with attenuated total reflection Specifications of the ATR-FTIR device that was used in this study and the operating conditions were as follows: Bruker infrared device model VERTEX 70 has a source of mid-infrared and equipped with an ATR unit for measuring samples without preparation and damage to the sample, the spectral range of the device is 600-4000  $\text{cm}^{-1}$ , IR spectrum in absorption mode, resolution 4 $\text{cm}^{-1}$ , number of scans 16 per spectrum located in Projects Sector at the Ministry of Antiquities -Egypt.

## Results

### *Optical Examination:*

The initial examination by two types of digital Microscope of the object showed that it was exposed to a severe state of deterioration that caused a set of changes, whether on the level of the existing fibers or pigments, which had a significant impact on the arrival of the state of deterioration to a level that can be judged to be a dangerous level of deterioration in addition to the method of storing it, and the occurrence of mechanical damage it is represented in cuts, holes (Fig.5a), and erosions (Fig.5b,c), as well as exposure to rips and fragmentation (Fig.5e,f,g) in many areas, Through a visual examination of the fabric, It was suffered from severe cases of wear and tear. It was concentrated on the weft threads because they are more susceptible to the factors of damage than the warp threads by the textile composition, and most areas of wear were concentrated in the white ornaments. (Fig.5d) In addition to many separated parts, missing area (Fig.5h), discoloration for fabrics and their dyeing (Fig.5i). Discoloration and fading the decorations color, as well as the color of the background.



**Fig.5.** Optical examination using USB Digital Microscope for deterioration

a- cuts, holes; b, and c-erosion; d- erosion were concentrated in the white ornaments

e, f, and g- rips and fragmentation; h- loss and detachment

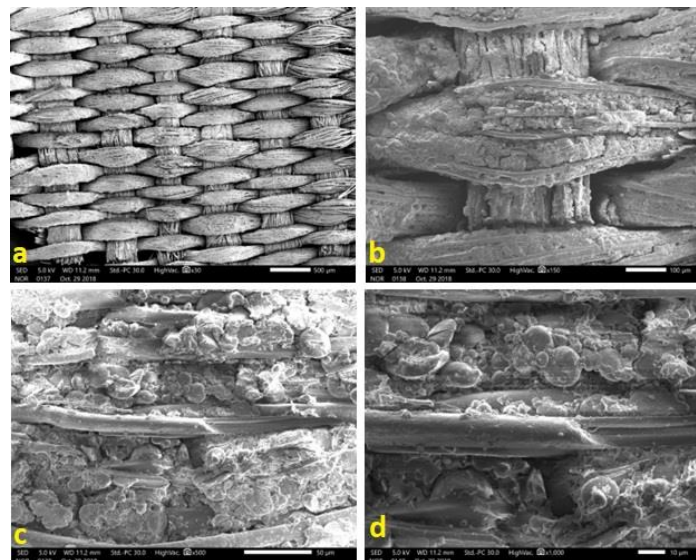
i- discoloration of fabrics and their dyeing



**Fig.6.**different shapes of deterioration under Axio Cam ERc Microscope

### **SEM:**

To study the surface morphology as well as aspects of damage to these fibers. Samples were taken from the textile for SEM testing. The smallest sample was taken from the loose threads, which were available from different parts, to investigate the morphology of the surface of the fibers, as well as the damage aspects of these fibers. SEM photos of examining textile are illustrated in (Fig.7) The most common changes in the morphology of the fibers were surface damage, scratches, large slights, holes, broken with transverse cracking of fibers, longitudinal splitting, the fragile ends (Fig.7a, and b) the fibers were subjected to a severe case of dust accumulation between the textile fibers as well as the sharp edges of the grains of attraction, dirt results in the fibers tearing and sliding into the cracks, and the widening of those cracks, and thus the tearing of the fibers erodes. There is a layer of dust on the object (Fig.7 c, and d).



**Fig.7.**SEM images of the textile samples:

- The figure shows SEM images, one can see that the ground fibers are silk.
- Tearing and deformation of the surface appearance of the fibers
- The fibers are extremely damaged, broken, and fractures
- The appearance of dust and silica granules clearly between the fibers

**EDX:**

Analysis was done, and the elements shown in the analysis were as follows (Table 1-Fig.8): Carbon (C) and Oxygen (O) as an organic compound, Aluminum (Al), and silicon (Si) are possibly indicative of Aluminum Silicates in the environment. Like amounts of Potassium (K) and Calcium (Ca), essentially found on surface samples of brown wool were analyzed by EDX attached to an SEM (Philips XL30). We can find different elements such as Silicon (Si) which can be interpreted as one of the basic components of the soil accumulated on the surface of the fiber, and Nitrogen (N) considered one of the air pollutants that can accumulate on the surface of the fibers in the industrial atmosphere, Aluminum (Al) and Calcium (Ca): was existed in small proportions in the sample evidence that they are one of the components of accumulated dust and dirt on the surface of the sample attributed to that location of the museum on a street crowded with cars, As for the presence of chlorine (Cl), it is attributed to air pollution or modern paint materials used in the museum as a pollutant, their presence can be attributed to contamination by the environment [8].

**Table 1** SEM-EDS, elemental analysis

<i>Element</i>	<i>mass percent</i>	<i>Atomic percents</i>
O	47.45	42.75
C	36.1	43.32
N	11.54	11.87
Al	0.63	0.33
Si	0.99	0.51
Cl	0.59	0.24
K	0.43	0.16
Ca	2.28	0.82

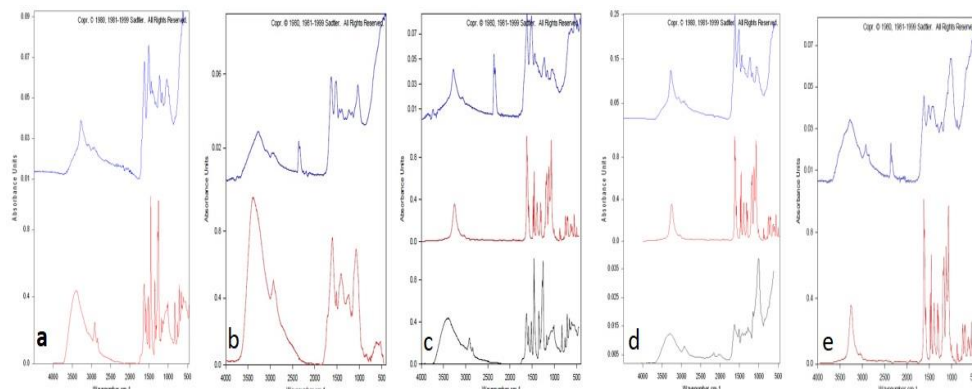
  

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**Fig.8.** Statistical table showing the percentage of items through analysis**ATR- FTIR:**

Small samples were taken of different colors and investigated them. Then, brought all the dyes which give this color and investigated them. After that, compared the original samples with new dyes to find

the following (Red is madder (Fig.9a) - yellow is Safflower dye (Fig.9b) - violet color Indigo dye with madder dye (Fig.9c) - a green mixture between indigo and turmeric dye (Fig.9d) - blue indigo dye (Fig.9e)



**Fig.9. FTIR Spectra**

- a. Red is madder; b. yellow is Safflower dye; c. violet color Indigo dye with madder dye;  
d. green mixture between indigo and turmeric dye; e. blue indigo dye

### Conservation procedures:

Research and development in the subject of cleaning historical textiles is ongoing. Cleaning falls within the heading of curative conservation and is an irreversible process. Anything that has been brushed or disintegrated cannot be restored. Cleaning an artifact is a difficult decision that requires careful consideration of several factors before moving forward. Generally speaking, grime and soil on an artifact detract from the textiles' beauty. Additionally, scientific studies have demonstrated that grit can sever weaker fibers and that dirt on textiles accelerates deterioration due to acidity however, in certain instances, the artifact's soiling may serve as proof of a significant occurrence. The decision to do cleaning in these situations is challenging and is considered after all parties involved have been consulted. There are usually trade-offs when cleaning ancient textiles: between preserving evidence and improving the textile's long-term preservation of its component elements, and between efficiently removing soil and avoiding potential damage from cleaning. [9]

### Testing the stability of dyes results:

Textiles can be colored by using organic or inorganic colorants, whether pigments or dyes, each of them requires considerably different application methods because of its physical and chemical properties, it also leaves specific chemical signatures on the fibers [10] Testing the stability of dyes in colored tapestry and is a very important step before the wet cleaning process. This step was done by using a washing solution in small sparse parts of the object [11], Dye stability test was carried out on the object step by step before the wet cleaning process the test was carried out first with distilled water, then with washing solution, and at all grades where the test gave positive results, which confirms that the color is not stable, and therefore it cannot be performed washing process

### The mechanical Cleaning of the object



The goal of conservation cleaning is to get rid of dangerous dirt that could be deforming or causing a textile to get damaged physically or chemically. The type of soil present as well as the textile's composition, structure, and state all influence the choice of cleaning technique. To find the best approach and ascertain how the textile reacts to cleaning solutions, extensive testing should always be done first. Free dust and debris are removed from the fabric's upper layers using a variety of fine brush types. A vacuum was used to remove surface dust. [12], The conservation of textiles includes the entire range of treatment and processing of valuable items [13], This technique is designed to remove dust and compacted sand particles from textile items. Various types of rough and smooth brushes were used to accomplish this. Additionally, despite their simplicity, brushes with an air blower and tapered tools for breaking up and quickly removing calcified sand from various brushes are quite successful at removing a large proportion of sand and dirt. [14], as shown in (Fig.10)



**Fig.10.** Mechanical cleaning process

### *Temporary fixing*

The first step is removing the old restorations (Fig.11a, b, and c), Then the piece was temporarily fixed on the textile support by using needlework, precisely using a thin needle with light blue cotton yarn. The piece was put on the textile support considering putting the piece correctly in the middle, The piece was fixed by working longitudinal, straight, and parallel lines and each line length was 5cm and away from the next line to it a distance of about 5cm, first, start the work on the lines of the first row and after completing it comes to the second row, so that mediates the distance between the first lines row, then comes the third row as the first alternately until fixed was completed we also fixed the weak places of the piece (Fig.12), The sides of the fabric were saddled to protect them from disintegration and abrasion by using the Stitch Blanket Stitch due to its ability to trap those eroded ends, while the eroded areas were protected by a group of cross stitches, to protect them from further weakness and dislocation.



**Fig.11.** a, b, and c, removing previous restorations

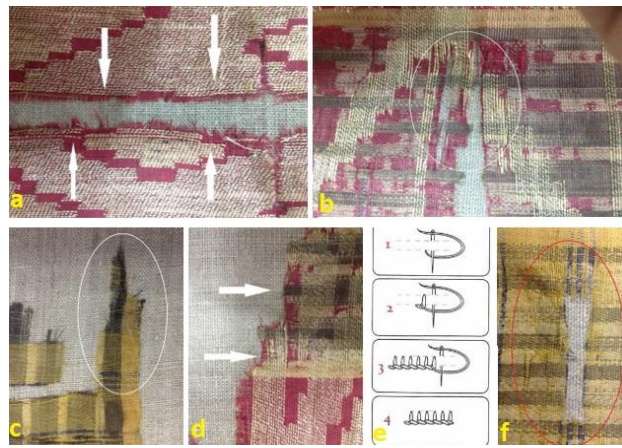


**Fig.12.** Temporary fixing

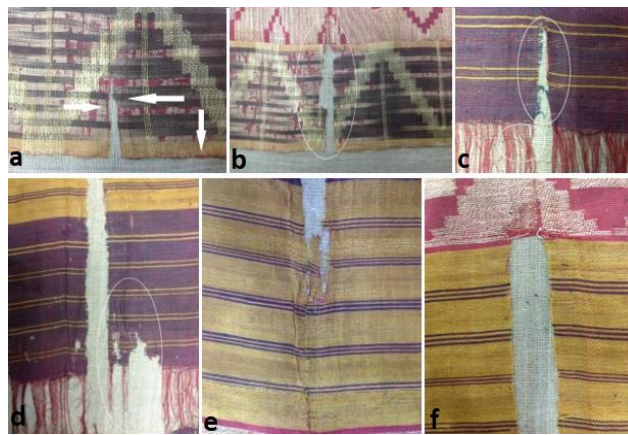
### ***Permanent fixing***

SEM, FTIR, And These analyzes showed a weakness in the structure of the archaeological fabric of the piece, and after performing the color sensitivity test, a decision was taken that the piece needed to be restored using a needle work with the use of silk threads dyed with natural dyes close to the color of the piece with a background made of natural linen and dyed with natural dyes in accordance with the fabric combinations. Damage appears in the form of small scratches.

Mordant and dyeing Consolidation with a needle and the dyeing procedure for silk yarn and linen fabric; the silk threads were colored to match the piece; In textile conservation, stitching is arguably the most popular treatment technique. It is an adaptable technique that may be used for a variety of tasks, including mounting, retouching, and other types of damage. Learning the fundamentals of conservation stitches while pursuing a degree to become a textile conservator learning that various materials or object types require various types of stitches, thread, and support fabric. [15], To enhance the hierarchy, stability, and perspective of objects, conservationists employ a variety of "fill in the blank" strategies. Cloth braces are frequently used by textile repair personnel to give optical fill in missing sections and reinforce weak areas of the fabric. The most widely used method is using materials that have been dyed a single color, but basic pigmented support offers adequate reinforcement. [16], After completion of the object treatment and temporary fix, tacking stitches were used with a very fine needle and fine silk thread to fix the object into the linen support (Fig.13). At the beginning of the final stage, the edges of the object all around and the edges of the missing parts were attached by sewing with a small stitch technique (blanket stitch) (Fig.14, 15) and afterward vulnerable parts were attached by small stitches (Couching stitches) (Fig.16), Similarly, sized stitches were used to attach the body of the object with the supporting textile.



**Fig.13.** a, and b, Fixation of large cuts; c, and d, Fixation of edges; e, The type of stitch used; f, Fixation of small cuts

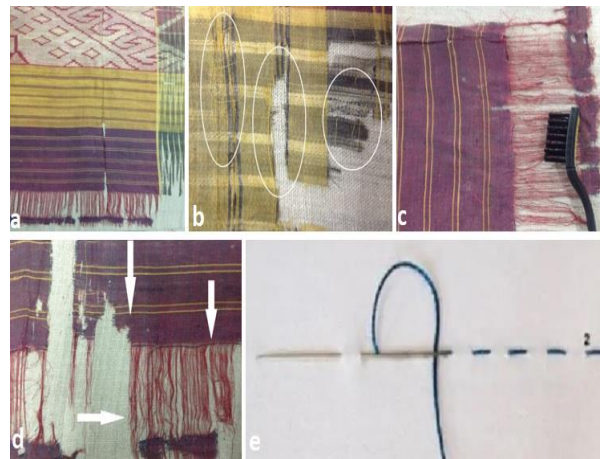


**Fig.14.**a, b, c, d, e, and f, the piece edges are fixed with the blanket stitch



**Fig.15.**a, b, the object's edges are fixed with the couching stitch  
c, the type of stitch used





**Fig.16.** The piece edges are fixed with the couching stitch



**Fig.16.** The piece after-treatment process and became ready for display at the museum

### ***Discussion***

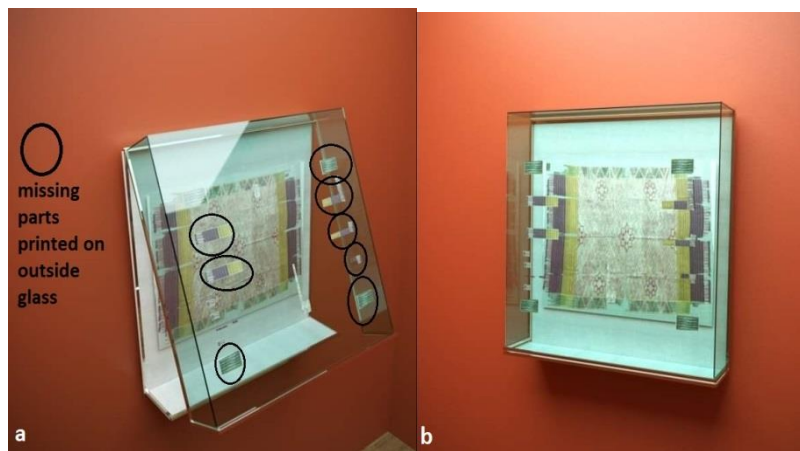
The outcomes of these techniques demonstrate how pigments serve a protective function by shielding fiber shape from the deterioration brought on by heat aging. However, natural dyes also shield fibers and lessen the degradation of their surface morphology. [10], Textiles should be aired outside for one to two hours in a shaded area on dry days to get rid of musty, stale smells. The cloth can be harmed by excessive force, so never bend or jiggle it. Dust, grime, and soil are abrasive, draw insects, discolor the surface of the fabric, and harm the fibers; vacuuming will get rid of them. Always use a piece of fiberglass window screening when vacuuming. Set the suction to the lowest and use the round brush attachment. Vacuum the item's outside and interior. [17], These studies help to provide us with a good understanding of and useful information on how to choose background fabrics or dyes to use with them [18].

As part of this applied study, an archaeological piece of silk fabric was treated and restored to prevent it from breaking apart and eroding. It was also supported by working the needle against a background of linen fabric as a safe and retrievable technique, making sure to use as few and wide stitches as possible, all while getting the piece ready for museum display. [19]



### *A proposed study for museum display*

Depending on science and technology, museum exhibit display design should be based on the safety and security of the exhibits and incorporate certain artistic principles that can better serve the exhibits' social function. These include understanding the theme of the exhibits display, popular art forms, a relatively flawless image of the exhibits display, and a relatively rigorous art structure of the exhibits display. [20], The research using 3D-Max program to presents a museum display showcase design for the piece that has been restored vertically and is hung on the walls and is opened from the bottom up and is tightly closed. The proposed method is to imagine the completion of the missing parts of the artifact and draw it on the outer glass plate and print it on it so that the visitor combines the printed parts on the outer glass with the piece inside the window to complete the pictures of the piece.



**Fig.17.** a. Drawing and imaginary printing of the missing parts on the outer glass (using 3D-Max)  
b. The shape after closing the glass plate is airtight (using 3D-Max)



**Fig.18.** The final look of the object after displaying it (using 3D-Max)

### **Conclusions**

Archeological textiles in in the Museum of the Faculty of Applied Arts are exposed to many challenges such as oscillate relative humidity (RH), changing temperature, effect of light, effect of air pollution, nonstandard storage, and display methods. Choosing a good quality of silk fastening yarns dyed with colors close to the fabric, also had a good variety in the use of several knitting stitches

that suit the conditions of each part of the fabric and the state of weakness and abrasion in the fabric, which helped it in the end to achieve the best possible result from treatment, support, and preparation for the display.

### **Acknowledgments**

This research is part of a private project of the author, Moreover the author is grateful acknowledges the help of Prof. Dr. Enas Ameen, The professor of conservation Department, Faculty of Fine Arts, Minia University.

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