

Project Name:

**Restoration and Rehabilitation of Zyada House Phase II**

Mosul, Iraq

Date: 25 January 2023

**1- INTRODUCTION**

The house of Zyada was built around 1870 AD. The area of the house is about 533 m<sup>2</sup>. Some parts of the house were built over an arch under which there is a path for pedestrians to walk to the "Al-Badan" area. The house is characterized by the presence of many suites, annexes, and rooms. In the middle of the house is a courtyard with an orchard, and in the south is a suite consisting of a basement above which is an "Ewan", (two rooms and a deck). There are corridors on two floors on the north side, including the upper floor staircase, the northern basement door, and another door from the courtyard that leads to the bathroom and utilities. The internal structure of the house consists of the courtyard, it is rectangular in shape, furnished with alabaster tiles, overlooking two "Ewans", one to the south and the other to the west, and it has an entrance that leads to the basement and "Al-Rahrah" (shallow basement). On the "Ewan" there are a number of rooms with windows overlooking the courtyard, and there is a kitchen in a square shape.

This house is full of artistic and architectural elements that represent a good diversity that qualifies this house to be a model of the Mosel house of perfection. It has a variety of windows and decorations, ventilation and lighting holes, grills and geometric decorations.

The house is now owned by the Department of Antiquities in Mosul city which belongs to the Iraqi Ministry of Culture, Tourism and Antiquities.

Unfortunately, the house was severely damaged during the liberation of Mosul city from ISIS. Large parts of the house were completely demolished, and other parts were damaged as a result of the direct bombing of parts of the house

The demolished parts of the house were reconstructed as part of the first phase of the reconstruction of the house. In the first phase, the foundations of the building were strengthened by injecting cement grout under the foundations of the building. The weak parts of the building were also strengthened and rehabilitated.

**2- ACCESSIBILITY TO THE HOUSE**

The house site can be accessed by two routes. One route is about 3m wide which is near AL-Zewanee Mosque. This route is curved horizontally and vertically. The second route is along the fortress wall which is about 4m wide, and there are many obstacles along this route which are the relatively low electric wires that obstruct the movement of the high machinery and trucks.

### **3- GENERAL CONSIDERATIONS**

Work experience in the rehabilitation of heritage buildings is essential in this contract. Passion for historical sites and buildings is desirable and a welcome trait in the contractor. The contractor must have the ability to manage time and meet deadlines.

The contractor must provide materials and skilled labor to perform all items in the best way and according to the specifications and instructions of the UNESCO Engineers within the contract duration.

### **4- REPAIRING AND POLISHING ALABASTER STONES**

Some alabaster stones have small cavities and cracks due to many reasons. These stones should be repaired with the following steps:

- a. Clean the surrounding area before you repair any cracks or holes. Wipe the surface with a mix containing white spirit, de-ionized water, and a small quantity of non-ionic detergent on a microfiber cloth. Allow it to dry, then apply denatured alcohol with a microfiber cloth or cotton swab. Once the surface is clean, allow it to dry again before continuing.
- b. Glue any broken fragments back together using a strong adhesive or specialized stone adhesives with an acrylic or polyester base such as epoxy-resin-21 T or equivalent material. Acrylic-based adhesives form a clear, strong bond that will not impact the appearance of the alabaster. Many polyester-based adhesives are designed specifically for alabaster and marble and cure rapidly at room temperature.
- c. Mix your epoxy resin, adding pigment to match its color to the alabaster (usually powdered oxide colors) and glass powder as filler material if necessary. Apply it over each crack. Spread it over the damaged area with a soft, flat-edged tool such as a rubber palette knife or spatula. Push it into the crack and wipe away any extra epoxy with an alcohol-soaked cloth.
- d. Cure the epoxy by letting it dry for 24 hours, then sand it to blend its surface with that of the surrounding stone. Use medium-grit sandpaper to even out the surface, followed by fine-grit sandpaper to smooth it.
- e. Clean the surface again with denatured alcohol to remove any dust. Allow it to dry. Apply water-repellent material type Sikagard-703 W or equivalent material to protect the surface. Sikagard-703 W is applied with a conventional low-pressure spray, brush, or roller, in various passes wet on wet from bottom up until saturation of the substrate is reached. Do not allow the product to run, remove runs in products with a dry cloth prior to drying. Apply the product and allow a dwell time of 10-15 minutes. Then wipe off any residual sealer still present on the surface of the stone with a clean dry cloth.

A piece of similarly colored alabaster was used as the new replacement for the base, using polyester resin adhesive and stainless-steel cramps set into the original holes of the base. The two remaining iron cramps were then removed from the left side of the base and replaced with stainless steel.

## 5- CLEANING AND MAINTENANCE OF ALABASTER STONES

To improve the appearance of the building and provide a clean surface, the alabaster stones should be cleaned. Generally, abrasive cleaning methods are not appropriate for use on heritage and historic masonry buildings (9).



**Figure 1** Pictures of colored alabaster stones

Alabaster should be cleaned using mild solvents. Dirt or soiling material on a building should be removed by the gentlest means possible. Soot and smoke, for example, require a different cleaning agent to remove than oil stains or metallic stains. The type and strength of solvents have to be determined by on-site tests but the most usual is a mix containing white spirit, de-ionized water, and a small quantity of non-ionic detergent. The actual cleaning is carried out using cotton wool swabs dampened by the solvent.

Most of the steel windows are missing and some others are in poor to fair condition, only a few are in a good condition (Figure 3). The contractor shall repair as much as possible of the original windows. The decision to replace windows (when they are beyond repair) shall be made by the UNESCO Engineers.



**Figure 2** Steel window in a good condition

Replacement windows for damaged or missing windows should be similar to the original windows. All of the house doors are missing. Doors shall be made according to the design drawings and materials as in the bidding documents.

## **6- LIME-GYPSUM PLASTERING**

### **Step 1: Surface preparation**

Before applying gypsum plaster, the surface of the wall needs to be prepared properly.

- The joints and cavities in walls should be filled with Lime-gypsum mortar a day before the application of GFRP wire mesh.
- GFRP wire mesh of Alkali resistant (AR) type should be fixed tightly at the joint of walls and cracks in walls. The weight of the mesh should be at least 225gm/m<sup>2</sup>. Also, ensure the overlap of at least 150 mm on both sides
- All holes and cracks on the surface of the wall should be repaired before plastering.
- Ensure that all the electrical conduits and plumbing lines are placed inside the work (If they are concealed).
- Ensure that the wall's surfaces are free from oil, loose materials, or any other agents.
- To reduce cracks, ensure GFRP wire mesh (AR type of 225 gm/m<sup>2</sup>) is installed at around door frames, around window frames, and opening for electrical & plumbing lines.
- Check the verticality of the wall surface using plumb level and remove undulations, if any.
- Clean water on wall surfaces should be applied 10 minutes before plaster application to control the suction.

### **Step 2: Applying Lime-Gypsum Plaster on Walls**

Lime-Gypsum Plasters can be applied directly to masonry wall surfaces.

- Check the thickness of the plaster that needs to be applied to the wall. It should not be more than 13 mm.
- Prepare the plaster mixture in mixing proportions as follows; 2 hydrated lime: 1 gypsum: 1.5 clean fine sand. The lime should be soaked in clean water for at least 24 hours before use.
- Apply the leveling Lime-gypsum plaster layer on walls using aluminum guides at 80 cm c/c with firm pressure.
- When the plaster stiffens, do more flattening.
- Apply the last layer using lime putty only. The lime putty is prepared by soaking hydrated lime for at least three days.
- Trowel the surface progressively to get a smooth matt finish.
- Finish surface should be protected from continuous exposure to moisture.
- Painting work should be only started once the surface has become completely dry.

The minimum thickness of plastering is 8 mm to avoid cracks and debonding.

All horizontal lines and surfaces should be tested with a level.

All the corners have to be checked if they have been smoothly finished and are in right angle.

## **7- ROOF WATERPROOFING**

Roof waterproofing should be done to maintain the “breathability” of the roof without allowing rainwater to infiltrate through it.

The waterproofing of the domes should be carried out with the following steps:

- Clean the surface of any debris and dust by washing it well with water and a plastic brush.
- A flat surface should be obtained with a slope of 1.5% toward the gutters before applying the finishing layer.
- Apply a breathable waterproof screed type (Momentum FN-50) or an equivalent material with a thickness of at least 20 mm with the specified color, into the overall screed surface. GFRP mesh should be used in the waterproofing screed. The GFRP type shall be alkali resistant (AR) with an opening size of 25 x 25 mm. The weight of the GFRP mesh shall not be less than 225 g per square meter.

The work should be carried out according to the datasheet of the special building materials and be carried out by workers specialized in this type of work. All work shall be carried out in accordance with the instructions of the UNESCO Supervising Engineer.

## **8- APPLICATION OF LIMESTONE TILE FLOORING**

Limestone tiles application in the outdoor courtyard area should be 50mm in thickness and dimensions as per the design. The edges of the lime tiles should be cut with a saw and finished at right angles. The tiles should be applied using sulfate-resistant cement mortar of proportions 1 cement: 3 sand with a typical joint width of 3 mm between tiles. An SBR material should be added to the mortar to ensure a good bond of the tiles with the mortar. The SBR dosage rate is 100ml per kg of cement (5 liters per 50 kg bag). The joints shall be filled with white cement and finely ground limestone powder with a mix ratio of 1 white cement/ 2 limestone powder. The tiles should be laid down to ensure water run-off into outdoor exposed areas only. The work should be done in accordance with the instructions of the UNESCO supervising Engineer.

## **9- ALABASTER TILE REPAIR AND RE-INSTALLATION**

Some of the house's original alabaster tiles are in storage, some are still in place and others are damaged. The work in this item includes:

- Removing the alabaster tiles, old mortar, and bedding after documenting the position of each tile with numbers and photos.
- Repair all old alabaster tiles with epoxy as described in Item 4 of this report. The Missing parts should be replaced with other tiles of the same texture, color and dimensions as the original pieces.
- Re-installing each alabaster tile in its original position using sulfate-resistant cement sand mortar (1:3) with SBR. The SBR dosage should be 100 ml per kg of cement (5 liters per 50 kg bag). Tiles should be laid to ensure water runs off to the drain point.

- All finishing is to be dry sanded, followed by wet sanding for a scratch-free, polished appearance, and further sealed with a natural locally available porous stone sealer.

**Note:** All construction debris and waste must be safely removed and disposed of in a landfill site approved by the municipality and the UNESCO supervising engineer. All work shall be carried out as instructed by the UNESCO Supervising Engineer.

## References

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- 4- *Heritage Building Conservation Technical Advice Sheet 3, Looking after limestone walls*, [www.fremantle.wa.gov.au/cityservices/planning/conservationandcareofheritagebuilding](http://www.fremantle.wa.gov.au/cityservices/planning/conservationandcareofheritagebuilding).
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- 8- Maharajpur, *Cracking in building (Causes and Prevention)*, February – 2004
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- 11- Paolo Foraboschi, "Strengthening of Masonry Arches with Fiber-Reinforced Polymer Strips", DOI: 10.1061/(ASCE) 1090-0268 (2004) 8:3(191)