

## **Restoration of archaeological establishments from an engineering perspective**

Prof.Dr. Badawi Ismail

Professor of Conservation Heritage -Luxor University

### **Abstract:**

The research addresses the structural restoration from the geometric perspective of the archaeological establishment and highlights the ways and means of restoring the facility in sound engineering methods from reinforcement and reinforcement to reaching the jaw and installation works if required in initiating various treatment processes, it is necessary to know and examine the relationship between the treatment material, the installation of the stone and the methods used to treat the impact. In order for the treatment to be carried out in a meaningful manner, we must not only know the nature and characteristics of the physical or chemical reinforced product and the mechanical functioning of the stone, but also the product's ability to penetrate, treat the quarantine and reduce its location.

**Keywords:** Cracks Restoration- Rebuilding- Disassembly & Reassembly- Lignin Advances-

## **Introduction.**

It is necessary for the restoration of monuments to be preceded by many different studies of extensive scientific analysis and examinations to determine the natural and mechanical characteristics of the stones in order to choose the appropriate treatment method whether the choice of materials or methods of application and greatly benefit in the diagnosis of the state of the impact in terms of the perception of the manifestations of damage and the reasons for it and the choice of appropriate treatment methods for the quality of the stone or the possibility to avoid adverse conditions. Precautions and characteristics make them capable of coping with these conditions. Treatment and restoration work based on thoughtful practical foundations must have many and many technical and scientific precautionary procedures that have the potential to remove or at least reduce the manifestations of damage affecting the works of art.

When initiating various treatment processes, it is necessary to know and examine the relationship between the treatment material, the installation of the stone and the methods used to treat the impact. In order for the treatment to be carried out in a meaningful manner, not only must we know the nature and characteristics of the physical or chemical reinforced product and its mechanical functioning within the quarantine, but also the product's ability to penetrate, treat quarantine and reduce its infertility.

In this study, because of the many destructive manifestations affecting the temple's stones, we had to develop a scientific program with the primary aim of removing all such manifestations or at least reducing them to show how wonderful and beautiful the inscriptions and writings are on the walls of the temple.

### **The scientific steps taken in the treatment are as follows:**

- Conducting mechanical and chemical cleaning operations to remove and reduce the size and quantity of dirt's, organic accumulations and soil from above the sandstones under study. Conducting chemical strengthening and insulation processes in addition to applying certain types of fungal antibiotics.
- Conducting final cleaning and maintenance.

- Undertaking architectural or structural restoration.

### **-Architectural restoration (construction)**

It is the restoration oriented towards the basic architectural elements (contracts - doorstep - domes - columns - cellars) As well as architectural supplements (inscriptions, decorations, writings, sweets) In the archaeological building, which is one of the most important stages of restoration in general, in addition to the fact that architectural restoration is influential in the structure of origin in terms of content, in terms of shape, architectural restoration also has a dominant effect on most other stages of restoration in that it is more visible and influential to ordinary people, specialists or even the restorers themselves. Architectural restoration is the most controversial, debated and different restoration area on the methods, operational methods and operational technology of these methods. This may be due to the accuracy and specificity of the architectural restoration work, which can be dealt with and displayed as mechanisms:

### **Rebuilding:**

These are works that shape and assemble elements of architectural work when they are subject to partial fragmentation or fragmentation due to the attack of a damaged cause such as fires and neglect. The original elements are present, albeit scattered, in the same place as the original archaeological building and using the elements of the old building without any additions. They are the rarest processes available and the hope of the last restoration due to the fall and collapse.

### **Disassembly & Reassembly:**

These works, which are resorted to in some cases where it is not possible to implement engineering solutions for the restoration and repair of one or more parts of the archaeological building and are in place, and if the restorer and engineer may have to dismantle and rebuild as an exceptional solution, are applied only in cases of necessity and after adequate study that there is no other alternative solution, especially with the continued presence of damage factors.

### **Steel and insurance works for ruins:**

Restoration works usually require a solid, bond or partial or total consolidation of the archaeological origin. These works have evolved and extend for concrete periods. External reinforcement steel works require careful structural study to develop the appropriate design of the selected crucifixion, which must be strengthened on the crucifixion or temple bond in full safety without affecting and supporting the building materials or micro-elements. The design of areas containing architectural or decorative details and the design of ribs also takes into account the conditions of the impact site and the soil surface.

### **Reinforcement Stitches:**

They are the hardeners needed to carry out the works of reinforcing the foundations or replacing parts in the walls and the like. In this type of steel, consideration must be given to choosing the right solid quality for both the conditions of the impact and the location, the amount of loads and stresses and the way in which they are carried out, whether hydraulic or static, with the design of the necessary side bond pillars as a supplement to the basic reinforcement herds.

### **- Gradual reduction or withdrawal of ground water bearing the ground of origin:**

In the presence of rising ground water levels and flooding of foundations and lower parts of walls and pole bases, where the gradual reduction is made by surface displacement first followed by the pumping of such water by pipe wells and then discharged into vertical drainage channels and disposed of.

Another proposal is to make a set of wells around origin in which the ground water is permanently withdrawn so that the ground water level falls below the temple floor and these wells are pumped at a suitable distance of about 20 meters from the temple with a number of pedometers working to measure the extent to which these wells affect the surface of the ground water and riding with each deep bulb well. The withdrawn water must be discharged through a concrete barrel lined with insulating materials to the public drainage lines.

**Disclosure of the foundations of origin:**

This step aims to ensure that the foundations are safe and balanced and do not need permanent or temporary reinforcement by means of supporting walls, metal lists or wooden wrenches. The temple's foundations and rules must be disclosed and its status examined to support them by replacing the damaged with blocks of stones and strengthening and isolating valid stones from them.

**- Cutting ground water sources causing salt weathering mechanics:**

**Therefore, the following measures must be taken:**

- Review the region's agricultural policy and control the types of agriculture that need few quantities of water.
- Operation of a drinking water and sanitation network for villagers surrounding the temple site.
- Work a barrier between grazing, sinks and origin.
- The work of a trench surrounding the temple with great depth prevents the arrival of the temple's ground water while transporting all the lines of the facilities surrounding the temple beyond the scope of origin.
- The work of a campus surrounding the archaeological site is not less than 15 kilometers and the removal of buildings located within this range with the work of a wall surrounding the archaeological area.
- Stabilize and strengthen the constructed soil.

**Treatment of soil:**

After the study carried out within the different laboratories and after confirming that the most important cause of damage is soil, treatment is carried out according to the situation and is carried out as follows:

**Grouting & Strengthening of soil:**

The purpose of this process is to work to change soil specifications from poor ones to excellent ones in terms of their stamina, resisting large loads and landing of different types, and to work to increase their porosity and permeability so as not to retain water.

**The injections are as follows:**

1. Moist mud soil: injected with petroleum materials to isolate and reduce humidity.
2. Clay soil that is coherent or has a hard landing is injected by a proportion of silica or by the substances of its silica composition in order to increase its porosity and permeability to reduce the proportion of the soil's water level.
3. Incoherent soil is injected at varying rates depending on the operating conditions of the caulins and lime or injected with a Portland cement solution to raise the interconnectedness and blood ratios of the soil's components and to increase its ability to receive increased loads.

**Linkages and bundles for soil:**

Soil is packed and strengthened using the seeds style on high-capacity soil such as solid, coherent rock soil with high carrying capacity. The seeds are distributed according to a map or croquet of the site prepared by the project manager. Or it uses a method of lifting and substituting new soil with better specifications than the old, decaying soil specifications and descending to the depths that give the necessary and better capacity to carry and according to the desired mode of operation. In the case of disintegrated and uncontrolled soil, the project officer may have to cancel the calculation of the soil's ability to carry and lift origin on rocky soil that may exist at a large depth up to 15 meters deep by using lifting and loading methods on concrete bases and breaks Piles (Piles) are based on a highly resilient and shock-tolerant rocky soil.

**Types of pigments used for this purpose and foundations:**

**Franki:**

A barrel of iron is vertically lowered at the designated location, and begins to close the bottom of the barrel from the bottom with a layer of ordinary concrete and its height ranges from 60:90 meters, with this concrete well decked with the hammer of the duck, and this layer helps to lower the barrel inside the layers of the soil and prevents the entry of groundwater or beneath the surface into the barrel. The barrel is lowered

from the top with a steam band weighing 1.5: 3.5 tons depending on the diameter of the barrel and the nature of the soil layers. When the barrel reaches the specific proportion, the ordinary concrete in the barrel is cracked by the crushing piece and this concrete is pushed out to form a base for the yoke. The barrel is attached from above with iron wire to tighten the barrel upwards and then starts to throw the ordinary concrete and knock it well with the handkerchief and the blood continues until the appropriate abstinence is reached and the appropriate base is formed. It continues to pull the barrel upwards and fill the hole that is in normal concrete with your regular concrete blood formed by the scalp. Thus, the concrete is coherent with the layers of the soil surrounding the hole formed by a coarse surface that gives the greatest amount of friction between the tusk and the soil surrounding it.

### **Simplex:**

The pepper heel is made of cast iron heel in cone form 5 mm more than the outer diameter of the pepper. The heel is placed in the designated place of the pepper and then erected on it an iron barrel by special hammering machine. The diameter of the barrel ranges from 0.40: 0.45 m. The barrel is sounded from above by a steam handkerchief weighing 2 tons or more depending on the type and nature of the soil and during the lifting of the barrel compresses the layers of the soil surrounding the hole and is well held. The barrel is filled with ordinary concrete and drawn at the same time. This shaft consists of ordinary and armed concrete during the period of doubt and primary solidification of the concrete leaks part of the cement mortar into the wipe of the hole and hardens and coheres with it a layer of friction. The potting with a drop of 0.40 m bears a voltage ranging from 40:45 tons to the potting with a drop of 0.45 m bears a load voltage estimated at 50:60 tons and the distance between each khazouk adjacent to 1 m.

### **Soil treatment against water:**

The restorer may resort to the work of a belt or a dam of isolated tanks against water sources after determining the type and sources of water. This belt is defined as a fish, depth and direction so that it becomes deep below the level and source of water as well as after which it identifies the

archaeological campus of origin so that it can stop the source of water and damage to dry and harden the soil. Substances used to inject soil to increase its carrying capacity:

- 1-Cements Grouts
- 2- Asphalt Emulsions
- 3- Asphalt Emulsions
- 4- Asphalt Emulsions

It may contain a mixture of cement-clay or (Cement + clay + sand) or (net cement) and newly used colloidal moonshot, it is only convenient for coarse granular soil to inject with suspended cement, and is done when the diameter of the pore size is greater than 0.1 mm, there are some additives added to the cement mortar to give it certain properties depending on the operating method of:

Add metal slag cement and fuel ash powder or volcanic soil which is used with Portland cement to resist acid water. Add natural or industrial bentonite at 3:6% dry weight to secure filler and fill pores resulting from the effect of bulge bentonite properties. Chemically treated bentonite clay is used to create non-waterproof barriers and the basis of work is the use of bentonite with Portland cement with silica.

### **Chemical Solutions:**

Sodium silicates are used with calcium chloride, aluminium savat or any heavy metal salt where silica gel, which is sticky, half solid, and stiffness is gradually during the loss of its water content and binds the grains of sand together an ingredient similar to sandstone that does not dissolve in clear water or salt water. Lignin Chrome: From the products of paper mills, water soluble powder and formed gel is a rubber material with a dark brown color that does not dissolve in water to be organically solvent and non-waterproof.



### **Lignin Advances:**

It is one of the waste paper industry and mixed with sodium dichromate be waterproof gel and there are other materials of polymer, acrylamide, resin and gum.

### **Cracks Restoration:**

Restoration and treatment of heavy and deep cracks: -

These are cracks that have a detrimental effect on the structural efficiency of the walls and address the moulding, reprocessing and synthesis of stone blocks and rings or replacing the bloodshed with other bloodshed intact and can follow some steps: Solid ceilings and reasonable floors are loaded in the part of all roles to be replaced. The steel is used using metal lists based at the level of the ground floor on handles of pontiff wood and its well-known contact with the ceilings for loads from the ceilings to those lists while keeping the ceilings intact.

- Determine the area in which the work will be carried out so that the cracks are included in the consideration as well as the distance of the two sides of the crack and with sufficient amplitude to work within the wall part to be dispersed. The disintegration of your blood stuffs at the deeply defined point into carefully cracking and rising according to the following: -

"In the case of accidental and oblique cracks, the upper and lower of the crack shall be disassembled with a compact height and a width not exceeding 1.00 meters.

In the case of vertical cracks, which are located in the temple in the two corridors around Holiness, the upper and lower parts of the crack are disassembled by Med Makin and some not more than 1.00. In both cases, the bricks extracted must be kept as intact as possible and kept in isolated places until reused: Clean the walls of all salts stuck with them and disassembled materials and compressed air can be used to ensure the implementation of the parts. 6mm diameter stainless metal steel wire indicators are installed according to the details proposed according to each inch and approximately every 40 cm in the entire perimeter of the old wall connection with the new replacement bricks. The installation is done with

holes using mechanical drill with about 10 depths and 8 mm diameter and then dip the tip of the ligament wire into an epoxy material and take into account when choosing the hire fixing site to intersect with the Aramis mortar with the walls.

Muna uses the specifications of the mortar used in the temple after selecting its components to give less fracture stress and moisturize the sides of the wall and is covered with a layer of mortar before starting construction operations. Work begins from the bottom up with regulation so that the new brick bladders will be the previous rows and built with the same way to achieve the same original wall shape in the event of a shortage of loose brick preparation when preparing required to fill the previous vacuum fully discharged, construction can be supplemented by newly manufactured bricks and similar old bricks.

Restoration and treatment of medium permeable cracks and depth.

As for the cracks caused by the separations between the stones that represent the stents of the building and the irregular stones adjacent to them, in the case of sound stones, these stones can be linked to the stones by means of the stone stents. (Anesthesia) using horizontal iron skewers and large lengths are buried with appropriate depth (about 5-7 cm) inside the stones and fixed inside the wall at the ends using a suitable epoxy material and this is repeated at a vertical distance (from 40: 60 cm) Then a wire clamp is placed on both sides of the separator with a distance of 100 cm on all sides. In the case of healthy stones adjacent to the stone supports, these dividers are filled with the original building volume until the internal spaces are filled and the previous steps in covering the parts being anaesthetized are repeated.

#### **Restoration and treatment of narrow cracks:**

In some cases, the right of simple separations between stones and the same material can be satisfied with the need to ensure that all the internal spaces between the stones are filled (also, injection can be made using a mortar in construction Portland cement faster and free of acid salts + pure silica + calcite, limestone powder or filtered lime according to the required proportions and operating method.

### **Filling of Missing Parts and Pits:**

The following steps are followed:

Decoding the old completion mortars that were carried out without taking into account any scientific concepts. This was done using simple tools so that the rest of the stone parts will not be damaged and lost as a result of the removal of this moon. Conducting mechanical cleaning operations to remove the remains of old mortars and damaged materials as they are not suitable for use now that some fabrics and fibers are used as fillers.

Cleaning and extracting salts in parts that have been disassembled using freshwater free of salts and removing the remnants of old restorations and leaving them until they are completely dried, then spraying them with some suitable antifungals and preparing them to accept the layers of preparation that will carry the layers of completion and the state in which the use of some adhesive materials is taken into account, most notably the primal 3% and 5%. 1:1 With the addition of some appropriate stone fracture (sandstone) as a filling material, these layers must be rough in texture so that they are prepared for the good adhesion of the mother stone on the one hand and the final finish layer on the other and leave the Jetty completely dry.

### **Unwinding and installation of archaeological buildings:**

If there is a serious risk and deterioration on the effect, it is necessary to disassemble and re-install it again, whether in the same place or elsewhere, but relying on guaranteed structural engineering methods. To achieve this goal, the implementation of the implementation must be carried out in accordance with the proposed scientific program, taking into account the following points:

- Provide the necessary funds.

Saving time for work of about 3-5 years' duration.

- Eliminate all administrative and bureaucratic difficulties to complete the work in the fullest manner.

- Provide trained scientific and technical personnel to perform such tasks.

- Finding points of cooperation between the executive and administrative bodies entrusted with the work of the project.

-The steps taken are summarized at the following stages:

1. Archaeological, architectural, photographic and photographic recording processes required.

2. Numbering and preparing temple stones for jaw blinds.

3.Implementation of a drainage system for water sources surrounding the temple.

4.Dissolution and integration of ancient soils and implementation of two peshtin (two layers) of ordinary concrete and armed below the temple.

5.reconstruction.

### **Restoration and maintenance.**

Monument, Architectural, Photographical, and Registration:

It is one of the preliminary and necessary processes to be carried out to record all archaeological, historical and architectural elements and data of the archaeological building. This is done through archaeologists, renovators and architects trained in such cases under the close supervision of the antiquities authority experts and scientists specializing in universities and research centers. These operations include the following means:

Photography of all elements of archaeological origin internally and externally.

Execute and draw a number of architectural paintings in which all of the building's distinctive architectural characteristics are illustrated by pillars, doorsteps, bases, walls.

Video photography and Photogrammetry stereotyping cameras, which are more elaborate scientific means with the aim of using them in reconstruction operations. These steps must be carried out before and after numbering.

These steps represent the stages of the acquisition of available information and data on the archaeological origin of all the effects on them. The following form illustrates an engineering perspective of the origin in its current situation.

### **Numbering of Stone:**

Numbering is one of the first, most important, and even most dangerous, asset preparation because it is an important basis for distinguishing and defining stones and their places and their distinctive artistic and architectural characteristics from reconstruction. We must bear in mind the following points during this process:

1.Complete the numbering process with the utmost precision by following several methods using signals, numbers and letters to achieve the greatest possible mastery.

2. Complete numbering processes with non-removable substances by water or by hand and with tools and materials that do not affect mechanically and chemically the stones of origin and are also not highly resistant to sunlight.

The following method has been proposed for use in the numbering of originating stones, which symbolizes each aspect of the originator's representation with a symbol indicating a trend as follows:

#### **Disassembly and Storing of Stones:**

It is the third step or phase of science to be implemented to protect the stones of origin from all the damaging factors affecting them. This phase represents the basic philosophical part of the architectural restoration processes in any major restoration work. Here, we must take into account all scientific tests and measurements from the study of physical, chemical and mechanical properties carried out on samples of the stones of origin and soil in order to avoid any risks that may result from this process, which is known as the diagnostic.

#### **The process's steps are summarized as follows:**

Start removing all the mon and related materials found in all parts of origin and work to dislocate the lime blocks mass and with great care using simple tools to avoid the damage that may result from the used tools and then lift them by packing them with metal chainsaws and transporting them to storage places. For large and embossed blocks that are feared to be transferred as a single block, it is preferable to divide them into two or more blocks depending on their size and to treat them the same as the previous laboratory, bearing in mind that the cutting and partition of large stone blocks is minimal and also to take place in places free of inscriptions and texts whenever possible. Placing the stone blocks after unwinding on wooden bases insulated with polyethylene chips. The space between each neighboring block is sufficient on all sides and each block is separated by a pole of insulated wood to create an opportunity for the ventilation and drying operations necessary for the stone blocks and also for the ease of cleaning and strengthening of each block individually. Preparation of a sanitation project for the area around the temple.

#### **Domestic Washing Project:**

It is one of the most important projects and steps to be implemented to protect the archaeological area, especially around the temple in the long term. This project is being implemented in the city or for the surrounding residential area. It is proposed to implement an urgent sanitation programme to protect the temple's archaeological stones from the impact

of destructive drainage water because of its saline characteristics. The steps of this project are summarized at the following points:

-Implementation of a number of beams (matching) on the basis that the average height of buildings in the area around the temple ranges from three to four rounds. The distance between each of the two rigid apps should be between 30 and 40 meters. There's an application at the intersection of every street in the area.

Figure No. () illustrates a model of the project proposed for implementation.

### **Replacing and Compacting a New Soil and Tow Concert Layers:**

It is one of the main steps in the reconstruction of the temple, in which the following steps are followed:

-Drilling the floor below the temple 2.5 m deep so that the drilling cube is equal to  $44.5 \times 27.5 \times 2.5 = 3059.38 \text{ m}^3$ .

-Placement of a substitution soil with height of 105 m where the substitution cube is  $44.5 \times 27.5 \times 1.5 = 1836 \text{ m}^3$ . The substitution soil consists of (0.8 m<sup>3</sup>/z, 0.4 m<sup>3</sup>/sand) per m<sup>3</sup>.

-A layer of ordinary concrete of 1.25 m<sup>3</sup> height so that the ordinary concrete cube is equal to  $42 \times 25 \times 1.25 = 1313 \text{ m}^3$ . The cubic meter therein consists of (0.8 m<sup>3</sup> mixtures, 0.4 m<sup>3</sup> sand, 300 kg sulfate resistant cement) per m<sup>3</sup>.

-Work a layer of concrete 1 m high and the concrete cube shall be area  $39.5 \times 22.5 \times 1 = 889 \text{ m}^3$ . The cubic meter of reinforced concrete shall consist of (0.8 m<sup>3</sup> batch, 0.4 m<sup>3</sup> sand, 450 kg sulfate resistant cement) per m<sup>3</sup>.

-The substitution soil works in stages with layers each 30 cm with good blood by appropriate mechanical means as well as tests required at the site.

-Insulation by permitted additives of previously used chemicals with the ability to insulate temple stones from ground water and concrete layering components.

### **Reconstruction:**

This is the final basic process of architectural restoration, in which the temple's stones are installed from the bottom up to the exact opposite of the unwinding process, i.e. the beginning of the last stone block and then unwinding it by its own number. This process is carried out in accordance with the following steps:

1. Installation of pole bases by installing them in metal crests (coefficients) installed in concrete bases so that each stone base of columns is installed

on top of another concrete base within the design of the reinforced concrete layer. The first pyramids began to be installed in the same way as the pillar bases with a small difference, which is to be installed with only two metal inputs. And install the rest of the array in an air discharge method with appropriate paste moon position. Note the installation of step-by-step column blocks in conformity with the temple walls until the completion of the reconstruction process. Interlock the ceiling tiles and install them on the pillars and pillars and connect them to each other with the appropriate aurora. Then the final restoration and maintenance of the above materials will be carried out.

### References:

- Aufrere –S, L Egypte restituee . Sites et tempeles de haute Egypte – 1991 .
- Abd El Hady, M. M. "Effect of Pollution on the deterioration of the historical building", Assiut univ., development, 1995..
- mnrao havnrao air pollution new delhi 1992 .
- Bassam Mohamed Mustafa - Study the impact of the planning ocean on the architectural implications of archaeological buildings and ways of restoring and maintaining them in application to the Bazarah Agency - Master's thesis - Faculty of Antiquities - Cairo University - 2000.
- Fusey , P . and Hyvert : The causes and effects of moisture on old monument – 1967.
- Mohammed Ahmad Awad that anesthesia is summarized in the lifting of old stone blocks that are disassociated or molten and have other dangerous cracks modern of the same kind of old stone and their specifications and glasses. It may be used in larger sizes than the previous to strengthen and strengthen the place of the fault or crack time extension and visit a size (about Mohammed Ahmad Awad Awad, previous reference P299)
- Smart Senses of Building Diseases Detected, Treated and Prevented - Library of World of Books - 1999-1st Edition, pp. 140-144
- Mohammed Ahmed Awad - Restoration of Archaeological Facilities - Arab Knowledge House - Cairo -1994 - p. 86.
- Mohammed Kamal Khadaf - Study the Treatment and Maintenance of Archaeological Works in Cairo Applying to Mosaic-Ornate Quarries Master's Thesis 2000
- Mohammed Jaber Barakat - Geology - Publications and Ministry of Education - Cairo - 1992.
- Expressive references
- Giorgio Turaka - material technology and maintenance of archaeological buildings - translation of Ahmed Ibrahim Attiyah - Dar al-Fajr publishing and distribution.
- James Becky - Egyptian Monuments in the Nile Valley - Part IV.
- Robert Lavon Haramsson Pollution - Translation by Nadia al-Qabani Review George Aziz - Cairo - 1977.
- Stanley H-Pine -Dunal Kram - Organic Chemistry -Vol. II - 4th Edition - International Publishing and Distribution House Translation Ahmed Abdul Aziz - Jamal Hassan and Others 1992.