

The Present Condition of Saqqara Monuments from the Beginning of First Dynasty to the End of Old Kingdom

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[Abstract]

Egypt has many ancient names. The famous names are "Tawy" that means the Two Lands, or "Kemet" that means Black Land. Saqqara used to be a part of the big necropolis of Memphis. Ancient Egyptians rested their bodies after death for their eternal life. Saqqara is one of the most important archaeological sites in Egypt. The monuments of this area are suffering from the effects of climate changes, human activities, variations in groundwater level, the problems of earthquakes and the geology of Saqqara plateau. Saqqara has a very long history, beginning with the unification of Egypt around 3200 B.C.

From the point of conservation, Saqqara monuments can be divided into several categories according to the stability of its monuments. Those monuments include tombs of kings and queens, and tombs of sacred animals and private tombs. Those in turn can be classified into superstructure and substructure buildings.

Over the years, all types of monuments, both in its superstructure and substructure, suffered from severe deterioration due to natural and/or manmade phenomena that are caused by several forms and factors. Those natural/manmade factors include falling, separating, deterioration of rocks, weathering, humidity and temperature fluctuation and the added stress from our modern civilization.

The following paper discusses the factors and forms of deterioration, the treatment methodology, and the measures to protect and maintain Egyptian monuments taken by the SCA and other restoration missions in Egypt.

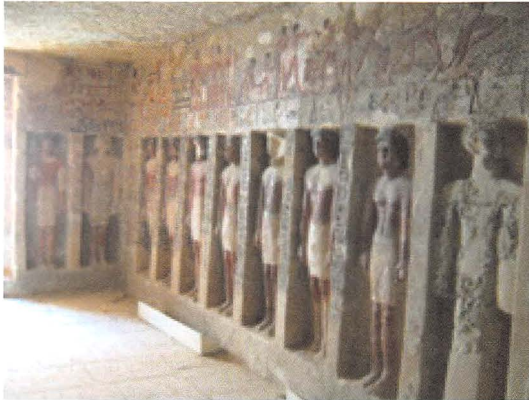
1 Introduction

Saqqara is one of the most important archaeological sites in Egypt. The monuments of this area are suffering from the effects of climate changes, human activities, variations in groundwater level, earthquakes and the geological features of Saqqara plateau. Saqqara has a very long history, beginning with the unification of Egypt around 3200 B.C. Egypt has many ancient names; the famous names are "Tawy" that means the Two Lands, or "Kemet" that means Black Land. Saqqara used to be a part of the big necropolis of Memphis for resting her people's bodies after death for eternal life.

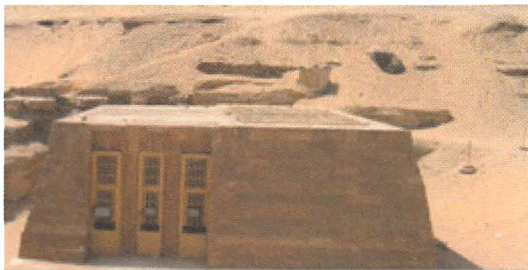
Saqqara monuments can be divided into three main categories from the point of view of conservation:

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- 1) Tombs of kings and queens. The pyramids in Saqqara, superstructure or substructure, suffered a lot both internally and externally from the effects of natural factors (wind, climate changes, earthquakes, rise of underground water) and from human activities. The Step Pyramid is a good example to show how the SCA saved the Step Pyramid by a great project that started in 2006.



- 2) Tombs of sacred animals. Saqqara has a great Serapeum, tomb of the sacred bull Apis, and galleries of baboon and ibis. Because all these tombs were cut in Saqqara plateau, therefore, they all suffer from the same forms of deterioration, affected by the same factors like underground water, climate changes, human activities, earthquakes, nearby military training or means of transport. To showcase state we will take the Serapeum as example to explain how the SAC efforts to save it.
- 3) Privet tombs (mastaba, rocky and shaft tomb)



These can be classified into two main forms: superstructure and substructure building.

2 Tombs of Kings and Queens

2.1 Tomb Development in Saqqara

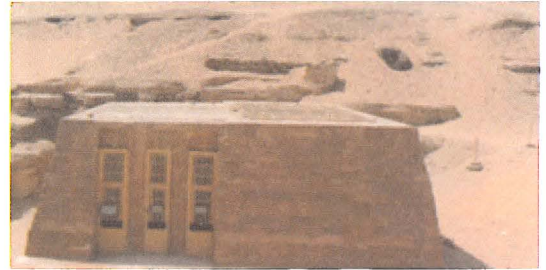
Saqqara is home to pyramids, private tombs and sacred animal galleries. It is considered one of the most important necropolises in Egypt. Saqqara was the first necropolis of Memphis. The name Saqqara refers to the god of the dead "Sokar" or the tribe "Abanaa Sakar" who lived in this area in the Middle Kingdom.

From my point of view as conservator, Saqqara tomb have developed in four steps:

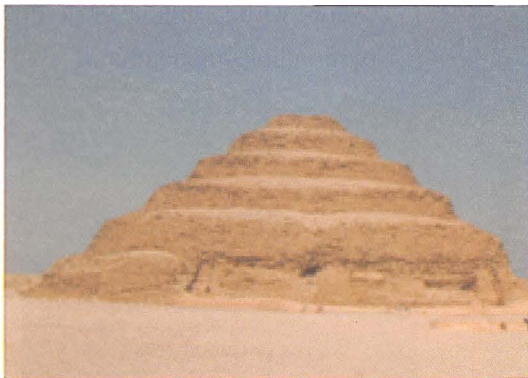
1) Simple grave



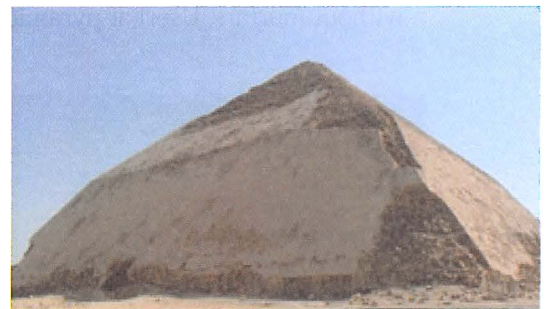
2) Mastaba



3) Step pyramid



4) Complete pyramid



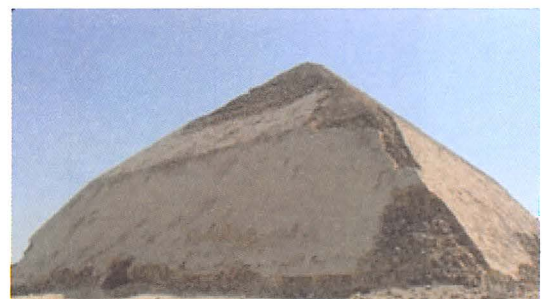
The tomb in the beginning was a simple grave "hole." They cut in the bed rock or dug in sand for burying, then they made a little mound above it. This type of tomb is used up till now to bury the dead in Egypt. This tomb developed to "mastaba" which was built from mud brick to the end of Second Dynasty, afterward from limestone. It has two main parts: superstructure and substructure. In the time of Djoser many stones started to be used in building by the leadership of a great architect Imhotep, vizier and chief of craftsmen, "Great Seer" of sun god Re. His name of Imhotep means "the one who comes in peace." He started by building a big mastaba for his king, then he changed it by enlarging it with additions to six steps. Finally Sneferu built two pyramids in Dahshur; the first one is the Bent Pyramid, and the second is the Red Pyramid. The Red Pyramid is the first complete pyramid in the world.

First, the pyramid is the tomb of kings and queens in the Old Kingdom. Pyramid is the "*pr dt*" which means the "house of eternity." The Egyptians most likely saw it as a staircase by which the king could ascend to heaven. Pyramid mainly consists of six categories according to the building method from the point view of conservation:

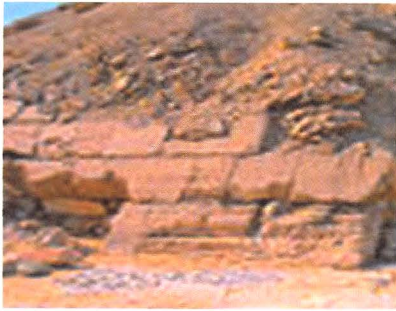
1) Pyramid built with big stones without casing, "Step Pyramid"



2) Pyramid built with big stones with two parts of casing, "Bent Pyramid"



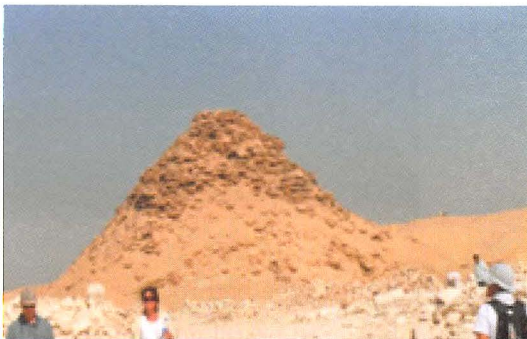
- 3) Pyramid built with big stones covered with a casing, "Fourth Dynasty pyramids and Unas pyramid in Saqqara"



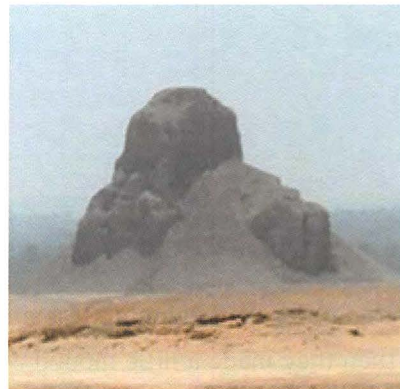
- 4) Pyramids built with little stones with casing layer, "pyramids of Sixth Dynasty"



- 5) Pyramid with its outer casing and with filling big stones in the inside without mortars, Userkaf pyramid.



- 6) Pyramid built from mud bricks, then covered with casing layer of limestone, "pyramid of Amenemhat II"



The superstructure is, from the outside, a solid superstructure which has corridors and chambers. The substructure consists of corridors and chambers cut in the bed rock and of shaft to burial chamber.

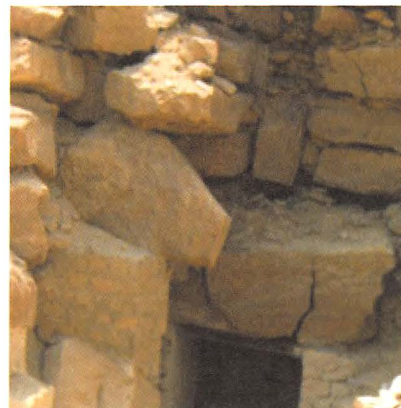
In addition to these, pyramid complex contains mortuary and valley temples and causeway. The mortuary temple is usually on the east side of the pyramid except Djoser where it is on the north and Userkaf where it is on the south. The valley temple is in a valley near agricultural area, and it looks like a port as Valley Temple of Unas. Then the causeway is between those two temples.

2.2 Deterioration Forms of the Superstructure of the Pyramids

- 1) Falling rocks



- 2) Moving rocks



3) Deteriorated rocks



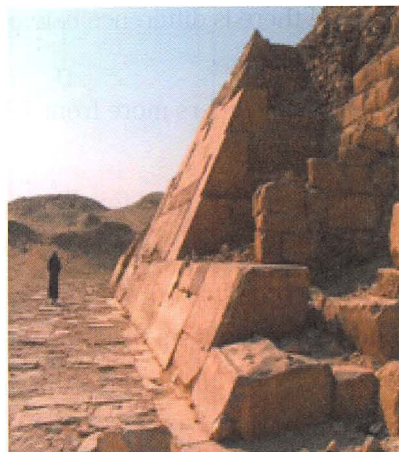
4) Rock that lost its structure ability



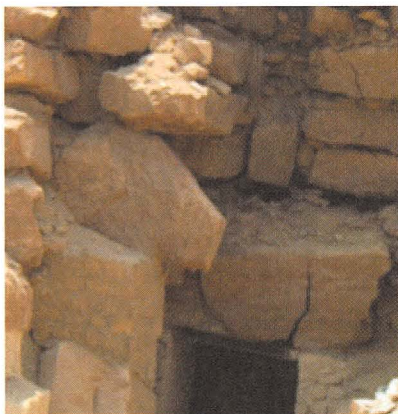
5) Separation areas



6) Missing rocks



7) Cracks



8) Faults

9) Losing the casing layer, especially the additional stones as casing: the outer layer of Red Pyramid or Unas pyramid (except Step Pyramid and Bent Pyramid).

2.3 Deterioration Factors of the Pyramid Superstructure

Several factors of deterioration are mentioned in this section.

1) Weathering (Wind and Rain)

2) Earthquakes which happen from time to time (the last one took place in 1992).

3) Human factors (Human activities)

- They used pyramids as a source of stone to build tombs.
- The next civilization used pyramids as source of stone to build their new tombs and building.
- People of the local areas used pyramids as quarries 120 years ago to build their house foundation to make tools like the grind stone.
- Visitors who visit these places increases the humidity and CO₂ pollution.

4) Temperature changes

The temperature is not stable. For example, the difference between the 12 pm and 12 am may be 15°C and there is difference between the seasons all over the years.

5) Humidity changes

When the RH differs more from 12 am to 12 pm the problem of salt crystallization may appear.

6) Type of mortar

Ancient Egyptians used two kinds of mortar: the first with gypsum and the second mainly clay. The first was used for the surface and the second was for the core.

7) Method of building

Good big stones were used for the surface and smaller ones from local or from the rest of the big blocks were used for making the core.

8) Kind of materials

Pyramid itself was built from different kinds of stones: limestone, granite, two kinds of mortar, and sometimes wood.

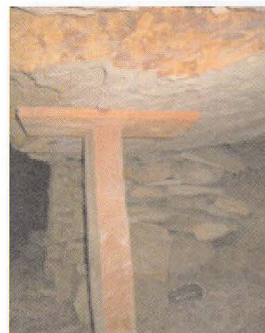
2.4 Deterioration Forms of the Substructure of Pyramids

The forms of deterioration of the substructure of pyramids are enumerated here:

1) Cracks



2) Isolated surface



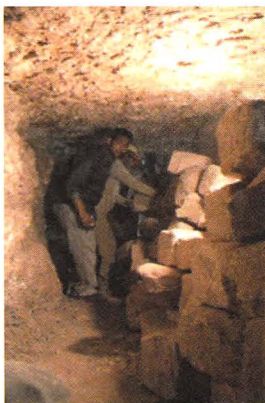
3) Deteriorated surface



4) Unstable walls



5) Falling of the additional walls



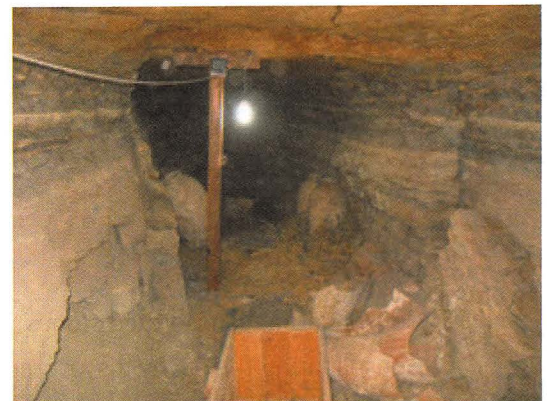
6) Bulking in the additional wall



7) Swelling the clay everywhere



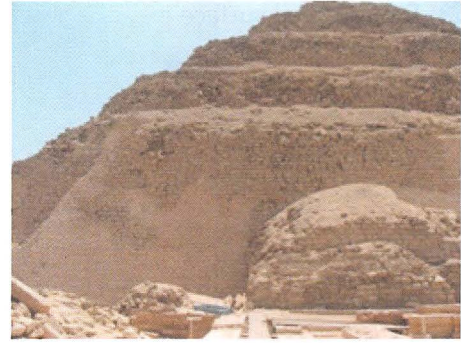
8) Falling clay layers



9) The galleries take the shape of arch to protect themselves from collapsing of "arch failure."

2.5 Djoser Pyramid as an Example

The Step Pyramid in Saqqara dates back almost 4,600 years ago, to the reign of Djoser, the first king of Third Dynasty. In recent years the deterioration has accelerated with the rising water table level and other changes to the environment. Then, the SCA initiated a major effort to save the Step Pyramid for future generations. The relentless force of the desert wind over the millennia, combined with increasing underground moisture as the water table rises all over Egypt, have weakened this incredible monument.



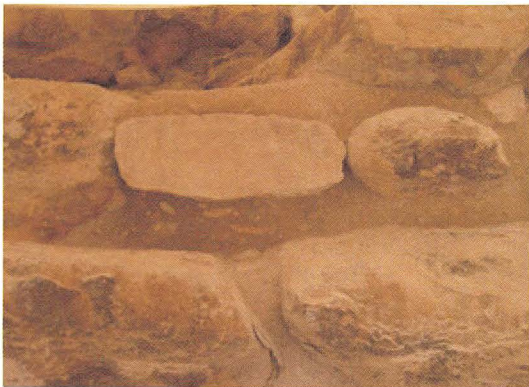
2.5.1 Superstructure of Djoser Pyramid

There are many places where missing, falling or moving stones had left hollows and overhanging sections, and therefore the surrounding masonry is vulnerable to collapse. The falling stones were carefully collected and cleaned before being re-used to fill gaps in the body of the pyramid. The destroyed corners were restored, and the south and east façades in a critical state were supported. The SCA's current project supporting the superstructure from the outside is a continuation of Lauer's restoration.

2.5.2 General Works to Save the Step Pyramid (superstructure)

General works to save the Step Pyramid can be shown here:

- 1) Filling the gaps and the areas between stones



- 2) Consolidating deteriorated stones
- 3) Consolidating the newly discovered places
- 4) Completing the unstable areas and around to get them stable by filling the big gaps
- 5) Injecting the separated areas like in the south façade by natural mortars



- 6) Removal of the sands and debris from the steps of the Pyramid to eliminate salts and to reuse the falling stones from this debris for restoration.



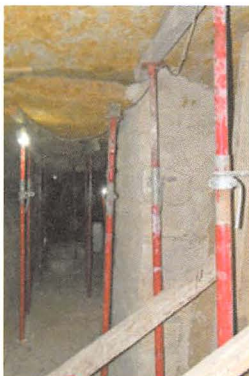
2.5.3 Substructure of Djoser Pyramid

Inside the Step Pyramid, the burial chamber of Djoser was also in disrepair and very dangerous to be entered. The experts have decided that the only way to save it was to construct a scaffold to support the walls and the ceiling. We will not remove the king's sarcophagus, but will leave it in the burial chamber and restore around it.

2.5.4 Step Pyramid may not be Solid Superstructure

All the galleries and chambers had been cut in the bed rock of Saqqara, which created the problems of instability especially when they were cut in the mud clay layer, as in the galleries of the Step Pyramid, due to the physiochemical properties of clay "swelling and shrinking according to the water content." The following solutions have been taken:

- 1) Temporary metal support for ceiling



- 2) Steel support on the corridor



- 3) Filling the gaps by injection



Although the restoration works have been done, there are still many pyramids in need for restoration in Egypt: pyramids of Userkaf, Unas, Pepi I, Teti, the Bent Pyramid, the Red Pyramid in Dahshur, and funerary temple of Sahure.

All the restoration works were studied by Egyptian specialists headed by Professor Hassan Fahmy and his team, and the works have been done by an Egyptian company with large staff of supervisors from different specialties under the supervision of Dr. Zahi Hawass and his assistant Samir Abdelraoof.

3 Sacred Animal Tombs

Saqqara has many galleries of sacred animal: tombs of Apis bull (Serapeum), of baboon, and of ibis.

3.1 The Serapeum

The Apis bulls are the most famous animals which were buried in Saqqara. Their tombs are in the tunnel which was carved into the plateau of Saqqara.

3.2 Deterioration Factors of the Serapeum

The deterioration factors of the Serapeum are as follows: water table, rain, earthquakes (natural and artificial), the type of rocks in Saqqara plateau, the Rest House, the breathing of visitors, rising of RH (rain, water table, visitors).

Examples of deterioration forms are shown below:

1) Roof cracking



2) Roof collapsing (in pieces after cracking and then separation into small blocks)



3) Arch failure (nearly 0.5 m between the top and the feet of the arch)



4) Wall compression



5) Mechanical cracks along the galleries



6)



3.3 General Works to Save the Serapeum

Works are as follows:

1. Supporting the niches of sarcophagus by steel.
2. Supporting the main passage by injection (the archways that lead into the burial chambers are being fixed. Supporting by injecting the stone; this strengthens and protects the stone and will stop the ceiling from collapsing).
3. Protecting the layers of the ceiling from collapsing by injection
4. Treatment of the clay wall
5. Eliminating the interior pollution by ventilation method and dehumidifiers
6. Protecting the floor (the floors are also being protected by covering with special kind of wood)
7. Using a new system of light
8. Using new ways to monitor the changes of humidity (it can have a serious effect on the stone and so the monitoring system was set up to record the humidity levels).
9. Ventilation and dehumidifiers to control the pollution.

Dr. Zahi himself came continually to follow the work in Serapeum and solved all the problems which faced the team of supervisors, consultant office and the Egyptian company who were doing this work.

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