FUNERAL STRUCTURES IN TEBAN NECROPOLIS, (EGIPTO) (2nd C, B.C.)

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Abstract
Within the framework of the Conservation and Restoration of the Architectural Heritage, the purpose of the present study is the analysis of building materials in funeral architecture, throughout the XVIII Dynasty in the ancient Thebes (Egypt).
The objective will be the determination of stone, limestone and sandstone lesions, for possible techniques of repairing structural and constructive problems arising from material degradation, in order to achieve structural stability.

Within the framework of the Conservation and Restoration of the Architectural Heritage, the base of study is the construction works in stone, carried out in the Teban Tombs, located in the Asasif necropolis, Luxor, in Egypt. The period in which these were built is approximately, from 1,550 to 715 B.C.

The object of study is the material used and constructive methods in the funeral sets, characterization and use of the stone, as well as injuries to the material.

The area began to be excavated by European archaeologists, at the beginning of the 20th century. Most remain unexcavated. The tombs are excavated in the rock of the area, mashing each other, despite belonging to different periods and times. Some have already been excavated and enabled to visit them, but not all have access to the public, due to their structural state.

Funeral concept; religion, thought and typologies

Religion as a way of life, politic and society was a constant throughout the entire Egyptian civilization. Without this concept, none of the aspects of culture can be explained. Everything is governed by the religious conception as a unique pattern of behavior, government and education. The world is structured according to religion, which is a complex system of beliefs and rites.

Pharaoh is the divine incarnation of God on Earth. Politic-Religion, is a unique concept. The divine representation on earth and the human in heaven, is the intermediary between the earthly and the divine world.

Cosmogonies and beliefs are varied according to the historical period and geographical area, being important its impact.

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- The idea of God is a complicated concept, and religion is polytheistic with different gods.
- Cosmogonies and Theogonies are numerous. As significant to understand the funeral rites, the most important god is Osiris. After his death he became the king of the world of the dead, creating eternal life in the other world. The deceased kings identified with him, creating a continuity, where the dead king identified with Osiris, thus overcoming death.

***Osiris and the Four Sons of Horus, Nebamun and Ipuky Tomb (1400–1352 B.C.)*[1].**

- There is religious anthropology, with gods with human, animal and mixed form. Cults and rituals depend on the different gods.

As for the thought; religious and political power are joined throughout the history of Egypt. Construction is used as a religious symbol. Starting from the concept of divine monarchy; Architecture, sculpture and painting have ritual purposes, all artistic representation does not exist as such if it is not linked to a ritual and symbolic function.

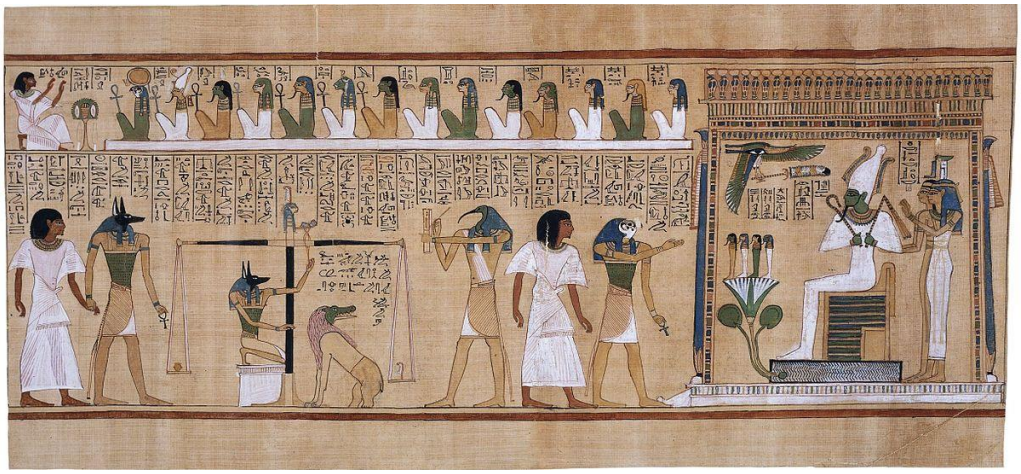
In ancient Egypt death was understood as the beginning of a new life in another world. Every man besides the body possessed a soul (*ba*) and a spiritual double (*ka*). When the person died, the ba was still living on earth and at night he rested on his body. The ka, came and went between the earth and the other world. Both *ba* and *ka* had to recognize the body to be able to materialize, so it was so important to preserve the body itself in the best conditions, so mummification was born. As this new life after the resurrection could last forever, the powerful made themselves build large and

[1] MET. Osiris and the Four Sons of Horus, Nebamun and Ipuky Tomb (1400–1352 B.C.).

sumptuous stone tombs, while the humblest social classes tried to emulate them with adobe tombs and simple hypogea.

Funeral burials or tombs are created with two functions. On the one hand, to protect the body from exposure to the weather, on the other, to hide them from thieves looking for the grave goods or treasure. The higher the person's social rank, the more luxurious and important the tomb was. After death the pharaohs became gods.

Another characteristic of religious beliefs is that the deceased also required all kinds of objects to be able to comfortably continue with life in the afterlife. Apart from all kinds of everyday tools, there was also a statue of the mummified person, and a copy of the Book of the Dead. The walls are usually painted with scenes of daily life. The goodness of the person guaranteed his transit to the other world, and many of the tombs included the Judgment of Osiris. It is represented weighing on a scale the heart of the deceased with a pen, a symbol of truth. The scribe of the gods, Thot, pointed the result in the presence of Osiris. Those who did not pass this test were condemned forever.



The Judgement of the dead, Hunefer papyrus (1275 BCE) [2]**.**

Liturgies and rites are proposed for magical purposes, in order to guarantee the access of the soul of the deceased to the other world, and the spiritual well-being of society.

The main constructive typologies are produced as a result of certain needs. Most of the daily constructions were made in adobe, so they have not been preserved, but the symbolic ones were made in stone to guarantee their permanence in time.

- Temples. They are the symbol of eternity, with a basic structural axis.
- Palaces. Royal residences, self-sufficient complexes, with all kinds of facilities.
- Tombs. Complex funeral sets, where religious beliefs set the architectural concepts. 3 different spaces; for the solar cult, the cult of the deceased and the

[2] BRITISH MUSEUM. Page from the Book of the Dead of Hunefer, c. 1275 B.C.E., 19th Dynasty, 45.7 x 83.4 cm, Thebes, Egypt © Trustees of the British Museum.

osiriac space. There are 3 determining factors in the approach of the tombs, which are:

- Orientation, along an axis.
- Location, to the west of the river, where the sun sets, and in determined places, according to the time and Dynasty in which they were built.
- Sacred geography, with locations where topography and landscape refer in some way to religious elements.

The main burials of kings and nobles were Pyramids, Mastabas and Hypogeums. The cost of the first two types, and the incessant looting gave way to the Hypogeum. The Hypogeum is a type of tomb carved into the rock, with great length and depth. In the Middle Kingdom this type was already used in Beni Hasam, however, until the New Empire its use was not generalized. It was in Thebes, in the Kings and Queens Valley, where these burials were built for several dynasties.

Initially the structure was simple, consisting of a corridor and a funeral chamber. Later it was expanded, with more rooms, and luxurious decoration on the walls. They were complemented by a funerary temple beside the river. The main hypogea are located in the Kings Valley, and in the nearby necropolis of the western shore.

Structures Types, morphology and construction systems

The Teban Necropolis are located in the valleys that make up the funerary area located on the west bank of the river, very close to the monumental complex such as Deir el Bahari.

They extend from north to south, along 3 km between the hills that delimit the desert and the Nile river bank. They are divided into several sectors; El Tarif, Dr. Abu El Naga, Asasif, El Joja, Sheikh Abd el Gurnah, South Asasif and Gurnet Murrai. The area of Deir el Bahari, object of study, is located in the small valleys that make up the funerary area on the west bank of the river.

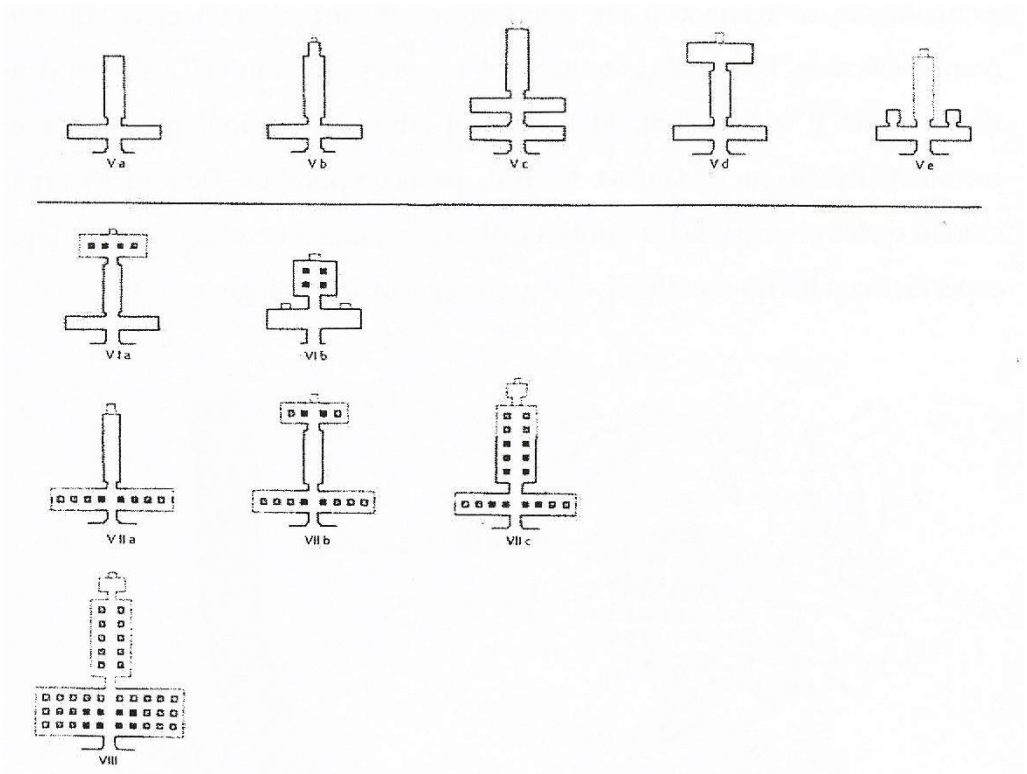
The periods range from Dynasties XI to XXII (2.061-1.080 B.C).

The types and morphology vary according to the time they were built, and the dynasty prevailing at the time. They evolve in distribution, proportion and dimensions, according to the funeral rites, and the prevailing ideology at each stage.

The types of tomb, as well as the architectural plan changes, evolving over time, according to the beliefs of each period, and the funeral ritual.

The functional scheme is very similar, only that more importance is given to certain parts of it, as well as to the decorative program.

The typologies varied according to the construction factors of each burial, but the religious conception that determined the architecture was a constant in the area.



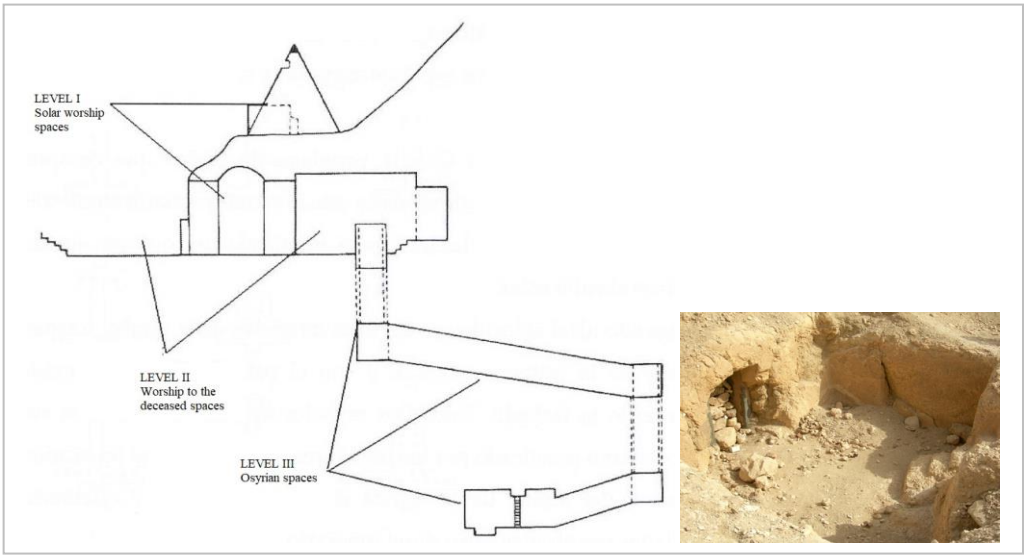
Typological classification of the Teban tombs (F. Kampp) [3]**.**

Its dimensions vary, depending on the importance of the nobility character to which they belong, and are composed of a columnar room and the solar patio.

The architectural structure is defined by religious beliefs, each space is destined to a different part of the cult or ritual.

In this way, the components of the spaces are separated; the space to the solar cult, the space for the cult of the deceased, and the osiriac space, collected in the scheme that differentiates 3 levels.

[3] Kampp-SeyFried, F. 2003 *The Theban necrópolis: an overview of topography and tomb development from the Middle Kingdom to the Ramesside period*, en Strudwick, N. y Taylor, J. (eds.): The Theban Necrópolis: Past, Present and Future, London: 2 - 10.



Ritual levels of the Theban tomb (K.J.Seyfried) [4]**.**

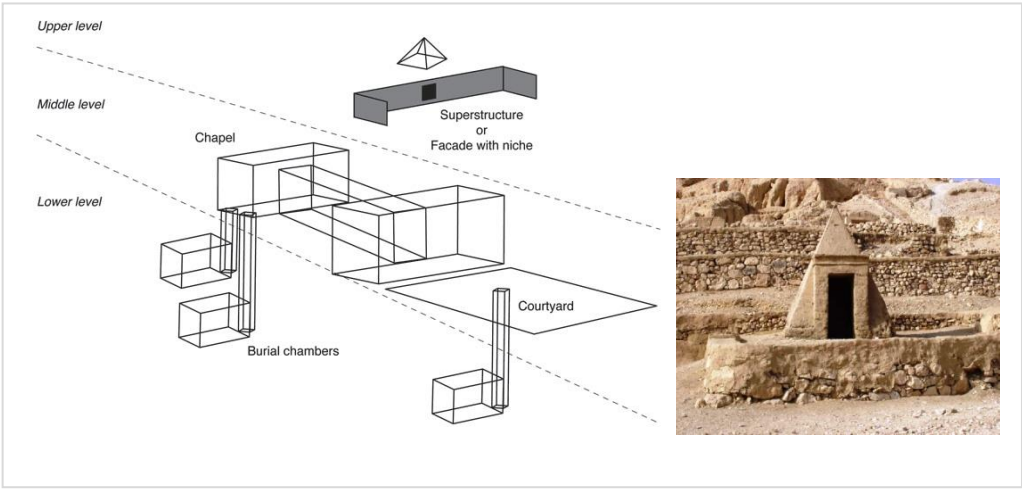
The orientation of the funerary constructions follows a longitudinal main axis in the east-west direction, on which the solar patio is located, a room with columns and the closed part that contain the funerary area.

The patio was accessed from a ramp, and it is common for this access to be shared for several tombs. This is because the funerary space was subsequently reused in other Dynasties.

The Egyptian tomb was divided into three parts; the outer chapel, the shaft and the burial chamber.

- The outer chapel: With several rooms, accessible to relatives of the deceased and priests. There the family went to make offerings. It was also used to celebrate religious rites. In it the deceased showed how his life had been, his achievements and the wealth obtained
- The vertical well: Located next to the chapel, to introduce the coffin in the burial chamber.
- The burial chamber: It kept the mummy, and was closed to preserve it.

[4] K.J. Seyfried, *Entwicklung in der Grabarchitektur des neuen Reiches als eine weitere Quelle für theologische Konzeptionen der Ramessidenzeit*, in Assmann J, Burkard G, and Davies V (eds), Problems and Priorities in Egyptian Archaeology (Studies in Egyptology, London 1987), p. 219-53.



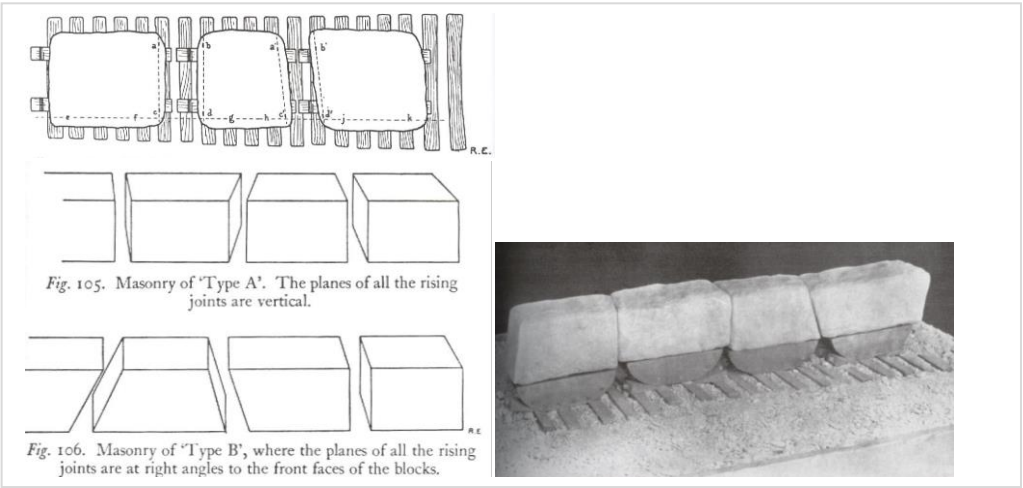
In Thebes a great necropolis was developed for the tombs destined for the kingdom great characters, and the royal tombs were located in the Kings Valley.

The chapels were located in the area accessible to the population, in order to facilitate the worship of family and religious rituals. Over time, many became temples (Goornah, Rameseum, Medinet Habu and Deir el Bahari).

Once the material had been extracted, the construction system was simple. The cutting procedures of the ashlars were varied, but the ultimate goal was to get contiguous pieces whose joints would perfectly match to ensure the flatness of the built walls.

Fragmented pieces of the same rock were chosen and placed on wooden boards stretchers. The fractures were used, so each block was adjacent to the one from which it had separated. Then the sides of each block were worked and polished, so the planes were matched.

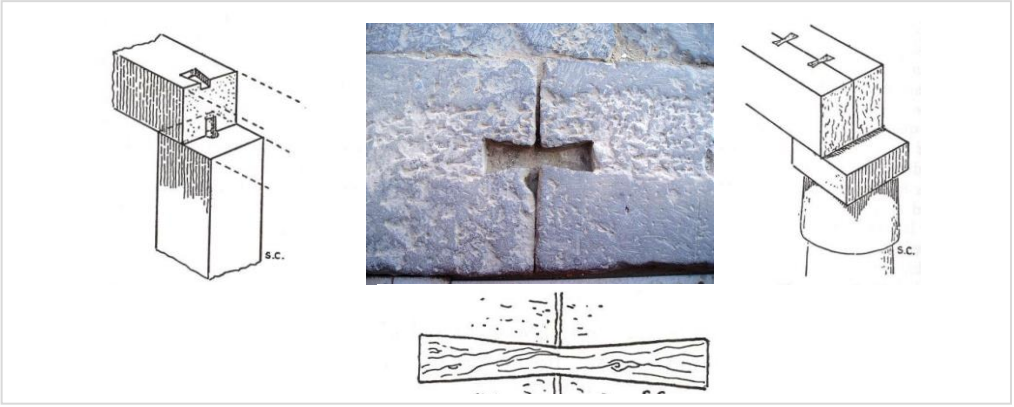
The joints between blocks could be oblique, not necessarily at right angles, and these oblique joints appeared either in the horizontal joints, or in the vertical ones. Although attempts have been made to find a mechanical justification for this method, both types of joints appear in the same buildings, as well as orthogonal joints, so that the randomness of their arrangement can be justified by a better optimization of the stone.



Stone cutting, and joint (S. Clarke) [5]**.**

The blocks joined together without any type of mortar, instead wood or metal staples shaped like a dovetail were used. Occasionally in large stone blocks corners a light mortar was used to finish off the edges. On the exterior facade carved into the stone a block coating was added to match the exterior finish. In the courtyards area the exempt blocks were placed, forming walls or perimeter porches.

The use of this technique is dated from the time of the Old Empire, and was used especially in important constructions. The pillars or pilasters joint with architraves was done by pins, while the union with columns used a double piece of architrave. In this way the structural piece was reinforced and greater lights could be achieved.

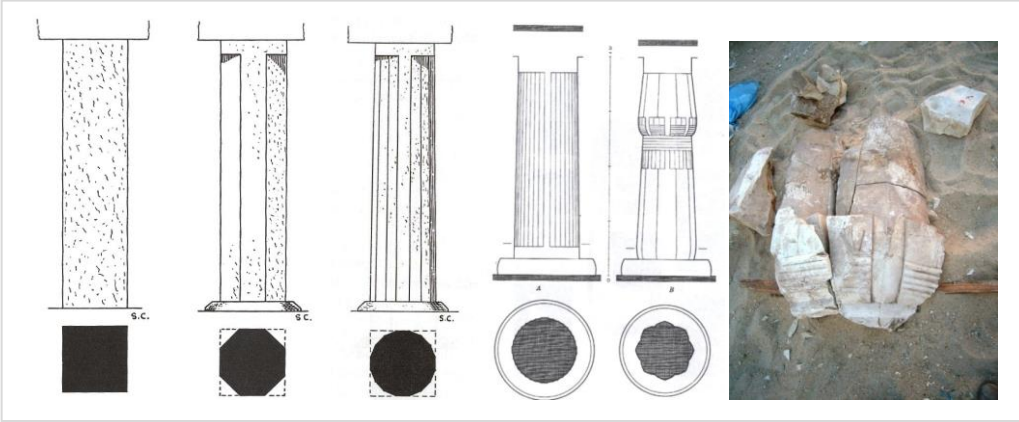


Joints of architrave pieces, dovetail (S. Clarke).

[5] Somers Clarke, R. Engelbach, *Ancient Egyptian construction and architecture*, in Dover publications, (New York 1990).

Dovetails have been found made in various materials; wood, lead, copper and occasionally stone. Its function was the reinforcement of the masonry. The limit of tensile strength or the ability to oppose the shear, with the dovetail may not be enough to prevent any tendency to buckling on the wall, for which the pieces are also worked horizontally.

The architecture was linteled, with pillars and lintels structures. The columns and pillars typologies were varied, complicating themselves in times of greater wealth and ornament.



Polygonal pillars (left), Striated and papyriform columns, TT192 (right), (F. Ch. Nims).

Materials. Availability and geology

The choice of construction materials was conditioned by the lack or abundance of them in the immediate area. While wood was scarce, and needed to be imported from other neighboring countries such as Lebanon, the stone was abundant and easy to work.

Basalt and quartzite were materials widely used in sculpture and architecture. But limestone is the most abundant material in Egypt, in different varieties, of better and worse quality. The entire Nile Valley is structured by limestone rock formations, so it was the most used stone at all times. The extraction was carried out by quarries located especially in areas close to the works.

In domestic and popular architecture, the use of Nile mud was widespread, being accessible and easily crafted. With it the bricks were elaborated, that once dried in the sun they were used in the construction of public and private buildings.

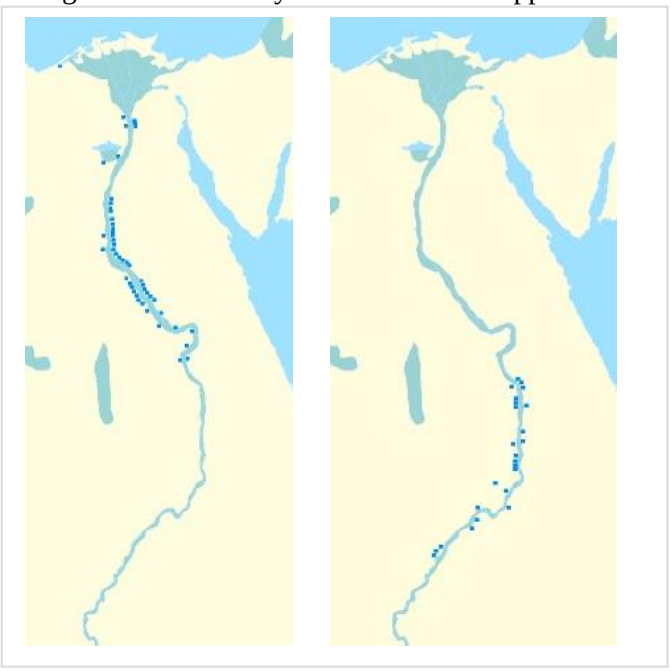
However, the appearance of the stone as a material was conditioned by two factors;

* The intention of durability of some buildings associated with worship and religious beliefs. The eternity concept, directly linked to death, required a material that did not disappear over time.

* The abundance of quarries and stone materials, which took advantage of the supply of the stone for the constructions.

Geologically, the Nile Valley was mostly made up of extensive sandstone and limestone strata, the stones used for the main buildings. Limestone deposits were mainly in southern Upper Egypt, while sandstone deposits were found along the rest of the Nile. Deposits of other stones such as granite, basalt and calcite were more localized, and the material was transported large distances from quarries specifically valued for its stone characteristics.

In the attached images we can identify the main sites in Upper and Lower Egypt.



Deposits of sandstone (left), and limestone (right).

The geographical location of the material determined its use. Thus, the use of certain stones can be identified according to the area;

* Limestone: Among the most commonly used stones was the lightest and softest material. It was located north of Tura on the border of Upper and Lower Egypt and that of the Gebel Silsila area, Asuan, and the south. It was the most used stone in the constructions of half of the XVIII Dynasty.
* Sandstone: It was a slightly heavier sedimentary rock, but like limestone relatively easy to work. It was found in abundance in the areas of Tura in the north, in Gebelein, near Thebes, and along the Nile between Luxor and Asuan. Important quarries were located in the regions of Abydos and Amarna.
* Granite: Igneous rock composed of quartz, feldspar and mica, heavier and more complicated to extract, transport and carve. Of red or black colours, it was used promptly in representative building elements (obelisks, stelae, column bases, door

jambs and lintels). In later times its use was reduced to temple structures. The Asuan area supplied enough granite, although the stone was sometimes brought from farther areas.

* Basalt: A black rock was the heaviest of the stones. Found in the first buildings, it was used for everyday objects and pavements. The main basalt deposits were located in Asuan, Abu Za´bal, Bilbeis and Kirdasa.
* Quartzite and calcite (alabaster): From the desert they were hardly used in buildings.

The type of material most used in the construction of the Thebes area were sandstone and limestone.

This variety and stone abundance resulted in excellent stonework and carving, reaching up to 40 different varieties. Its hardness and quality required a different use and treatments depending on each type.

The stone for different structures in the same area was often transported by different means, depending on the period. In Theban necropolis, the use of sandstone was gradually replaced by limestone in the middle of the 18th Dynasty, probably due to the sandstone Gebelein quarries depletion, and perhaps because it was believed to be more impermeable and resistant to flooding. In any case, limestone turned out to be a stronger material and allowed the construction of architraves and longer blocks, facilitating the construction of greater lights.

Within the geological aspects related to the stone used in the constructions, the following points can be indicated.

* Origin
  - Volcanic Rocks Formed by the lava cooling on land surfaces or under the sea (Basalts).
  - Plutonic rocks. Magmatic rocks formed by slow cooling in large magma masses. (Granites, Granodiorite, Diorite, Porphyry).
  - Metamorphic rocks. Formed by pressure and high temperatures. (Blackboards, Shale, Quartzite)
  - Sedimentary Rocks formed by the sedimnets accumulation subjected to physical and chemical processes. (Sandstone, Limestone).

* Physical-chemical characteristics and mechanical behavior.
  The properties of the materials will be defined by their chemical characteristics. The materials most used in this type of construction were sandstone and limestone. For the granulometric classification, the reference values can be found in the Udden-Wentworth Table.

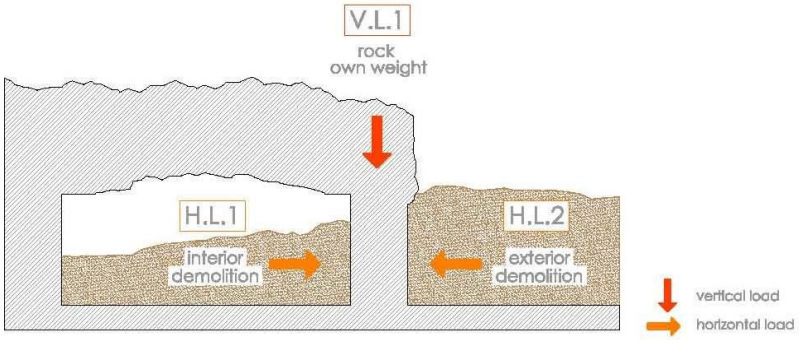
  - Limestone: Sedimentary rock, mainly composed of calcite ($CaCO_3$). Occasionally it contained fossils and some impurity such as; dolomite ($CaMg(CO_3)_2$, quartz (SiO_2), ferric oxides (Fe_2O_3, $HFeO_3$), and clay minerals. The rock is relatively soft and easy to work due to the high proportion of calcite it presents (hardness 3 in E. Mohs), and porosity. The limestone hardening and its duration is due to other components presence that improve its mechanical

behavior; recrystallized limestone in calcite, dolomite of greater hardness (3.5-4 E. Mosh) and quartz. The lower porosity typically associated with the presence of these materials, also contributes to increasing their hardness. This is why crystallized limestones have sometimes been confused with marble.
The limestone deposits were widespread throughout Egypt, from Esna to the north reaching the Mediterranean coast, along the Nile Valley, and to the desert platform to the east, identifying up to eighty-eight limestone quarries. The use of the material was widespread in the Teban necropolis.
Limestone was probably the first rock used for construction purposes, and was replaced by sandstone in the Thebes area from the 18th dynasty

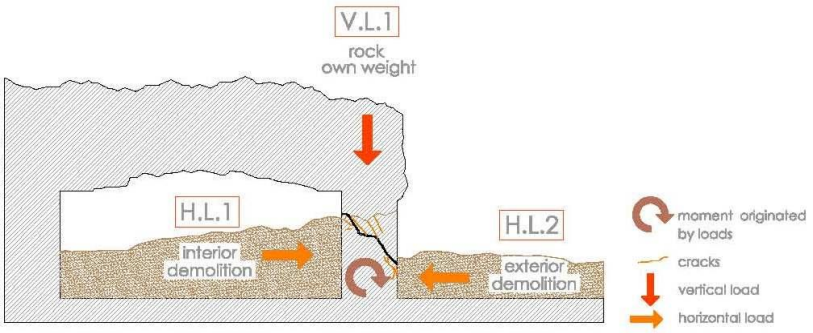
- Sandstone: Sedimentary rock composed mostly of sand grains (0.063-2mm) of debris, and grouped with quartz, calcite, clay iron, oxide and other binders. Like limestone, sandstone deposits spread throughout the country, identifying up to 34 old quarries. It belongs to the Nubian Group stratigraphic sequence. Today, many remain covered by the waters of Lake Nasser.
The main composition of the material was 75% quartz, with a remaining percentage formed by feldspars. The sandstone was highly porous and poorly cemented with quartz, iron oxides and chlorite clay. These three binders were almost always present, and often kaolinite clays and occasionally calcite. Not being solidly consolidated, the sandstone is easy to extract and carve. This strength and durability is caused by quartz, which is present on time, and the iron oxide that gives the typical reddish color.
The first building uses dating from the sandstone correspond to the first dynasties, and it is in the 18th when it becomes the main building material of the Thebes area, in tombs and temples. The choice of sandstone in building on other types of stone coincided with the implementation of a new religious and political regime in Thebes with the beginning of the New Kingdom, and with the discovery that the sandstone was superior to limestone in terms of size and strength. These attributes facilitated the construction of large buildings with major lights.
Although the sandstone was easier to work, lighter, and quickly disposed, the limestone was still more solid and durable over time.

Intervention and conservation

Pathological states are important, as are the degradation of monuments due to material, hydrography, and lack of heritage conservation. Excavation works involve earthworks, wich give rise to structural failures, as can be seen in the following schemes.



1 CONDITION - Balanced loads H.L.1= H.L.2



4 CONDITION - Draft of the wall and rock´s break

The material degradation is due to its composition, the actions it has suffered, as an impact, for use of quarry, or fire in the reuse of buildings.

Stratigraphic analyzes performed reveal that the formations of the Thebes mountains were deposited during the Eocene (60-52 Ma) in a pelagic marine environment, above the phototropic zone. Shale, marl and limestone, were deposited on a platform rich in carbonate, with a high rate of plankton production. These sediments are of marine origin.

Tomb interior was sometimes used as a quarry. Applying fire, the stone was fragmented for later use in other constructions. They were also reused for burials, or as a shepherd and cattle shelter.

Different types of rock damage in Teban Tombs (Assasif).

The types of damages are varied, mainly due to erosion by wind and water, structural efforts, presence of igneous fuels, presence of salts, and biological or plant sediments.

Urgent actions to be carried out in the work area should be organized in stages.

* Research and documentation with comparison. Collection of previous technical data, and geotechnical study of the area. Identification of the physicochemical characteristics of the stone materials in the area. Material analysis and characterization for improvements in the restoration.

- Monument planimetries, for structural analysis and load evaluation. Types of construction and execution study, to establish clamping modes and immediate measures.
- Restitution of damaged parts, and specific actions on paraments and injection of consolidants. Evaluation of possible loads that affect structures, reinforcement, and land containment systems. Load sharing on new items.
- Once the structures have been repaired, commissioned, with a technical project.

Conclusions

Architecture was directly linked to religious beliefs. Any space, distribution, planimetry and decoration fulfilled a mystical function.

The possibility of immediate access to the supply of material facilitated the fast construction of temples and tombs.

The durability of the buildings has been thanks to the use of this material, and not other perishable ones (mud, reeds and adobes).

The use of lighter and easier to work stones, guaranteed speed, and easy carving but not the solidity of the monument and its preservation over time.

The structural problems were not completely resolved, since the megalomania of the buildings required excessive use of supports, which in roofed constructions was in detriment of the spatial perspective.

Most of the stone pathologies are the result of the combination of three factors, presence of water, salts and porous structures capable of absorbing them.

Much of present-day Egypt was covered by the Mediterranean Sea millions of years ago. The abundance of limestone is explained by the fossilization of marine wildlife, which implies that the Nile River water has a presence of salt minerals. The old monuments were built with sandstone and limestone, but the salt presence in this type of rocks causes terrible effects on their structure.

The population growth, and the increase of farmland on the banks of the river, causes an ascent of the phreatic level under the monuments. The salts that the rock itself contains chemically react with humidity and water particles. This crystalline compound solidifies, producing cracks in the rock, atomizing it, until it breaks and turns into dust. In this way the structural capacity of the material disappears, and the constructions collapse. This process is more damaging on the walls and columns, since the reliefs of the surface disappear and the paintings flake. It is urgent to take corrective measures to safeguard the heritage.