

# Mechanical Engineering in Ancient Egypt, Part 101: Tomb-Pillars Industry

**Galal Ali Hassaan**

Department of Mechanical Design & Production, Faculty of Engineering,  
Cairo University, Giza, Egypt  
Email: galalhassaan@ymail.com

## Abstract:

This paper is one in a series of research papers aiming at investigating the role of ancient Egyptians in the development of Mechanical Engineering. It studies the production of tomb-pillars during a Period from the 4<sup>th</sup> to the 20<sup>th</sup> Dynasties of ancient Egypt. It presents the design and production of tomb-pillars and possible decoration. The characteristics of the tomb-pillars are investigated in some details.

**Keywords** — Mechanical Engineering history, tomb-pillars, pillars design, pillars production, pillars decoration, Dynastic Periods.

## I. INTRODUCTION

The ancient Egyptians were able to carve rock-pillars to support the ceilings of their tombs. They could decorate the pillars with colored scenes and hieroglyphic texts sustained for thousands of years. This was a real engineering work for its need to calculate the cross-sectional area and height of the pillar to support a huge load on the ceiling. They did this without computers not specialized programs such as finite element packages.

Carter and Gardner (1917) in their paper about the tomb of Ramses IV presented the engineering drawing of the tomb as drawn by the ancient Egyptians and recorded in in the Turin Papyrus [1]. Arsmar (1993) in her paper about the iconography of the Nefertari wall paintings presented a lower stairway with view into the burial chamber of Queen Nefertari with two pillars carrying a thick architrave all decorated with hieroglyphic text, cartouche of the Queen and Mat scene. He presented also a photo for the North wall of the entrance area showing a pillar with a scene for the Queen on one side and a hieroglyphic funerary text written on the other side [2].

Cwiek (2003) in his Ph.D. thesis about the relief decoration in the Royal funerary complexes of the Old Kingdom presented a line drawing for three

pillars with abacuses and architraves, two of them with decorated architraves and one with decorated shaft [3]. Kroenke (2013) in her paper about the motif alignment project presented a photo for the burial chamber of Pharaoh Merenptah in his tomb KV8 showing three square pillars without any decorations [4]. Hemeda (2018) in his paper about failure analysis and design of support systems for ancient Egyptian monuments in the Valley of Kings at Luxor presented and analysed the damage in the 16 pillars in the tomb of Pharaoh Ramses II (KV5) of the 19<sup>th</sup> Dynasty. He outlined that this tomb was one of the largest rock cut tombs ever found in Egypt having a total area of 2155 m<sup>2</sup>. He concluded that the pillars decoration and structure were damaged [5]. ARCE (2020) in his article about the anatomy of a tomb, ancient and modern designation for chambers and features presented a number of pillars in some of the Royal Tombs of the 18th Dynasty with and without decorations [6].

Hassaan (2020) in his paper about the inscription of the 18<sup>th</sup> Dynasty tombs presented some of the decorations of the pillars in the tomb of Sennefer, Mayor of Thebes during the reign of Pharaoh Amenhotep II of the 18<sup>th</sup> Dynasty [7]. Studying the inscriptions of the 19th and 20th Dynasties tombs, he presented the decorated pillars in the tomb of Pharaoh Seti I of the 19<sup>th</sup> Dynasty and the decorated

pillars in the tomb of Pharaoh Ramses IX of the 20<sup>th</sup> Dynasty [8].

## II. PILLARS IN THE 4<sup>TH</sup> DYNASTY TOMBS

The 4<sup>th</sup> Dynasty of Egypt is the second Dynasty in the Old Kingdom Dynasties extending from 2613 to 2494 BC [9]. We have one example from this period:

- The example is from the rock-carved mastaba of Queen Meresankh III, G7530-G7540, Great Royal Wife of King Khafra, 4th King of the 4th Dynasty, 2558-2532 BC. Fig.1 shows two pillars in the mastaba with two-levels architrave [10]. The pillars have square cross-section and decorated by colored scens for the Queen while the architrave is decorated by hieroglyphic inscriptions. There is no failure signs in the pillars which means that they were properly designed from the engineering point of view. On the other hand the pillars reflect the pioneer experience of the ancient Egyptians to produce pigments that can sustain for thousands of years [11].



Fig.1 Pillars in the mastaba of Queen Meresankh III from the 4<sup>th</sup> Dynasty [10].

## III. PILLARS IN THE 12<sup>TH</sup> DYNASTY TOMBS

The 12<sup>th</sup> Dynasty is the second Dynasty of the Middle Kingdom of ancient Egypt extending from 1991 to 1802 BC [12]. The example we have is from tomb QH31 of Sarenput II, Governor during the reign of Amenemhat II, 3<sup>rd</sup>

King of the 12th Dynasty, 1929-1897 BC shown in Fig.2 [13]. Fig.2 shows a rectangular cross-section pillar decorated by a scene for the tomb owner and a black hieroglyphic text inscribed inside a bounded column with yellow background. The colored inscriptions look as they are inscribed today not 3900 years ago. It reflects the glory of the ancient Egyptian civilization.



Fig.2 Pillar in Sarenput II tomb from the 12<sup>th</sup> Dynasty [13].

## IV. PILLARS IN THE 18<sup>TH</sup> DYNASTY TOMBS

The 18<sup>th</sup> Dynasty of ancient Egypt is the first Dynasty of the New Kingdom extending from 1550 to 1292 BC [14]. We have three examples of tomb pillars in the 18th Dynasty tombs two of them for Nobles and one for a Pharaoh as depicted in the following examples:

- The first example is from the tomb of Sennefer TT96, Mayor of Thebes during the reign of Amenhotep II, 7<sup>th</sup> Pharaoh of the 18<sup>th</sup> Dynasty, 1425-1398 BC shown in Fig.3 [15]. The pillars in Sennefer's tomb are the most beautiful pillars in their design, carving and decoration. Fig.3 depicts two of the pillars having the characteristics:

- Each pillar has rectangular cross-section for most of the pillar-shaft.
- It meets with the roof with large fillet.
- The pillar is used to support the roof and provide extra area for the wonderful colored decorations in Sennefer's tomb.
- The pillars are decorated by colored scenes for the tomb owner with two Wadjet-eyes hieroglyphic text written in vertical columns and a wonderful rectangular frame bounding the scenes.

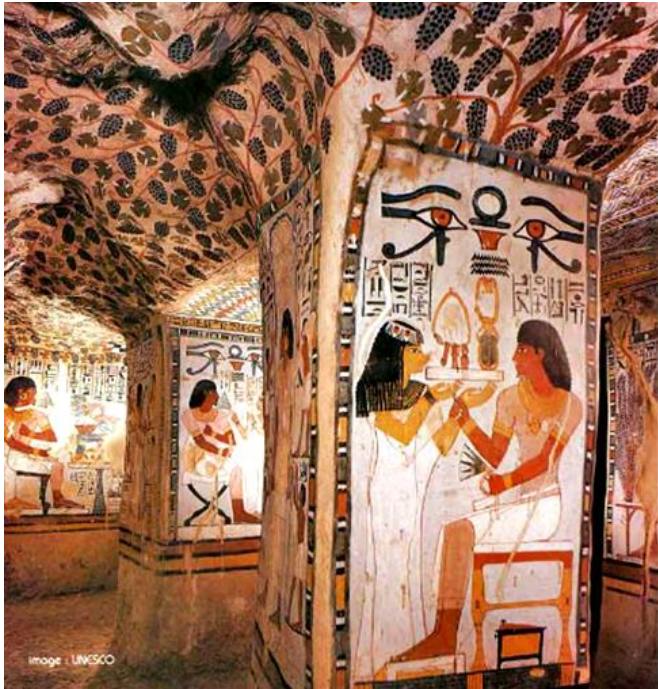


Fig.3 Pillars in Sennefer tomb from the 18<sup>th</sup> Dynasty [15].

- The second example is a Djed Pillar in the tomb of Kheruef (TT192), Steward of Queen Tiy, Great Royal Wife of Amenhotep III, 9<sup>th</sup> Pharaoh of the 18<sup>th</sup> Dynasty, 1388-1350 BC shown in Fig.4 [16]. The pillar has the characteristics:
  - The pillar has a concave shape over all of its length.
  - It supports an architrave.
  - The pillar is decorated by horizontal colored bands of changing thickness.
  - The architrave area and the surrounding area at both sides of the pillar are decorated by

hieroglyphic text and the Cartouche of the Pharaoh.



Fig.4 Djed pillar in Kheruef tomb from the 18<sup>th</sup> Dynasty [16].

- The third example is the Pillared Hall in the tomb of Horemheb (KV57), the 15<sup>th</sup> Pharaoh of the 18<sup>th</sup> Dynasty, 1319-1292 BC shown in Fig.5 [17]. The pillars have the characteristics:
  - The Pillars Hall comprises six pillars arranged in two rows (three per row) .
  - The columns are exactly similar.
  - Each pillar has a rectangular cross-section.
  - All the pillars have right-angle with the roof and was properly designed as there is no failure signs on them.
  - All the pillars are not decorated.



Fig.5 Pillars Hall in Horemheb tomb from the 18<sup>th</sup> Dynasty [17].

## V. PILLARS IN THE 19<sup>TH</sup> DYNASTY TOMBS

The 19<sup>th</sup> Dynasty of ancient Egypt is the second Dynasty of the New Kingdom extending from 1292 to 1189 BC [18]. We have seven examples of tomb pillars in the 19<sup>th</sup> Dynasty tombs one of them for Nobles and six for Royal as depicted in the following examples:

- The first example is a pillar in the tomb of Ramses I, founder Pharaoh of the 19<sup>th</sup> Dynasty, 1292-1290 BC (KV16) shown in Fig.6 [19]. The pillar has the characteristics:
  - It has a rectangular cross-section.
  - The pillar has right-angle with the roof without fillet.
  - It was properly designed as there is no failure signs on its surface.
  - The pillar is not decorated even though all the wall surfaces around it are decorated by colored scenes.

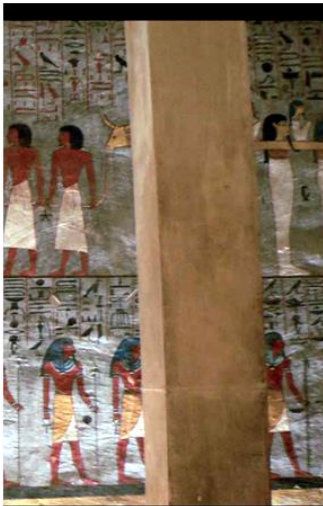


Fig.6 Pillar in Ramses I tomb from the 19<sup>th</sup> Dynasty [19].

- The second example is pillars in the tomb of Seti I, 2<sup>nd</sup> Pharaoh of the 19<sup>th</sup> Dynasty, 1290-1279 BC (KV17) shown in Fig.7 [20]. The pillars have the characteristics:
  - They have rectangular cross-sections.
  - Each pillar has right-angle with the roof without fillet.
  - They were properly designed as there is no failure signs on the surfaces.

- They have decorated capitals and black-painted bases with same cross-section as the shaft.
- The pillars provided extra surfaces for tomb decoration with colored scenes for the Pharaoh with some of the Deities and hieroglyphic text written in vertical columns including the Pharaoh's Cartouche.



Fig.7 Pillars in Seti I tomb from the 19<sup>th</sup> Dynasty [20].

- The third example is a pillar in the tomb of Nefertari (QV66), Great Royal Wife Ramses II, 3<sup>rd</sup> Pharaoh of the 19<sup>th</sup> Dynasty, 1279-1213 BC shown in Fig.8 [21]. The pillar has the characteristics:
  - It has rectangular cross-section.
  - It has right-angle with the roof without fillet.
  - It was properly designed as there is no failure signs on the surfaces.
  - It has black-painted base with same cross-section as the shaft with separating red band.
  - The pillars provided extra surfaces for tomb decoration with colored scenes for the Queen with some of the Deities and hieroglyphic text written in long vertical columns including the Queen's Cartouche.



Fig.8 Pillar in Nefertari tomb from the 19<sup>th</sup> Dynasty [21].

- The pillars provided extra surfaces for tomb decoration with colored reliefs for the Scribe and his wife with different daily activities.



Fig.9 Pillar in Ramses II tomb from the 19<sup>th</sup> Dynasty [22].

- The fourth example is two pillars in the tomb of Ramses II (QV7), 3<sup>rd</sup> Pharaoh of the 19<sup>th</sup> Dynasty, 1279-1213 BC shown in Fig.9 [22]. The pillars have the characteristics:
  - It has rectangular cross-section.
  - It has right-angle with the roof without fillet.
  - It was properly designed as there is no failure signs on the surfaces.
  - The capital was decorated by vertical signs.
  - The pillars provided extra surfaces for tomb decoration with colored reliefs for the Pharaoh with different activities and facing his Royal Cartouche.
- The fifth example is a pillar in the tomb of Neferrenpet (TT178), Chief Scribe of the Treasury of the Estate of Amun-Re during the second half of the reign of Pharaoh Ramses II of the 19<sup>th</sup> Dynasty, 1246-1213 BC shown in Fig.10 [23]. The pillar has the characteristics:
  - It has rectangular cross-section.
  - It has right-angle with the roof without fillet.
  - It was properly designed as there is no failure signs on the surfaces.
  - The capital was decorated by vertical signs.



Fig.10 Pillar in Neferrenpet tomb from the 19<sup>th</sup> Dynasty [23].

- The sixth example is pillars in the tomb of Merneptah (KV8), 4<sup>th</sup> Pharaoh of the 19<sup>th</sup> Dynasty, 1213-1203 BC shown in Fig.11 [24]. The pillars have the characteristics:
  - They have rectangular cross-section.
  - They have right-angle with the roof without fillet.

- They were properly designed as there is no failure signs on the surfaces.
- There is no indication of pillars decoration.



Fig.11 Pillars in Merneptah tomb from the 19<sup>th</sup> Dynasty [24].

- The seventh example is two pillars in the tomb of Tausert (KV14), Last Pharaoh of the 19<sup>th</sup> Dynasty, 1191-1189 BC shown in Fig.12 [25]. The pillars have the characteristics:
  - They have rectangular cross-section.
  - They have right-angle with the roof without fillet.
  - They were properly designed as there is no failure signs on the surfaces.
  - The two pillars support an architrave.
  - The pillars and architrave are decorated with colored reliefs.

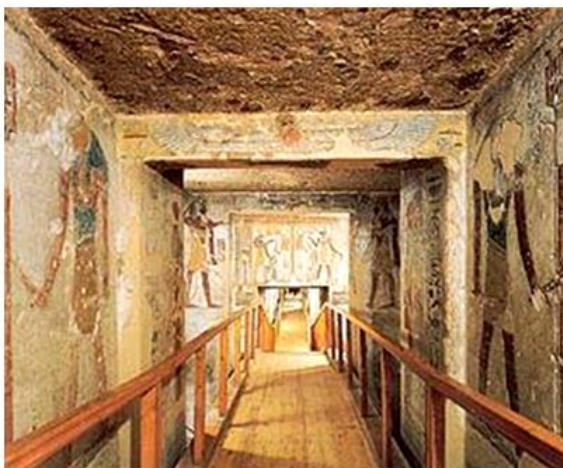


Fig.12 Pillars in Tausert tomb from the 19<sup>th</sup> Dynasty [25].

## VI. PILLARS IN THE 20<sup>TH</sup> DYNASTY TOMBS

The 20<sup>th</sup> Dynasty of ancient Egypt is the third Dynasty of the New Kingdom extending from 1189 to 1077 BC [26]. We have four examples of tomb pillars in the 20<sup>th</sup> Dynasty tombs all of them Royal as depicted in the following examples:

- The first example is pillars in the tomb of Ramses III, 2<sup>nd</sup> Pharaoh of the 20<sup>th</sup> Dynasty, 1186-1155 BC (KV11) shown in Fig.13 [27]. The pillars have the characteristics:
  - They are arranged in two rows around a corridor.
  - They have a rectangular (or square) cross-section.
  - The pillars have right-angle with the roof without fillet.
  - They were properly designed as there is no failure signs on their surfaces.
  - All the pillars are decorated.
  - The capitals are decorated by a repeated symbol.
  - All the shafts are decorated by scenes for the Pharaoh in offering positions with his Cartouches in front of his face.



Fig.13 Pillars in Ramses III tomb from the 20<sup>th</sup> Dynasty [27].

- The second example is two pillars in the tomb of Ramses IV, 3<sup>rd</sup> Pharaoh of the 20<sup>th</sup> Dynasty, 1155-1149 BC (KV2) shown in Fig.14 [28]. The pillars have the characteristics:
  - They have a rectangular cross-section.

- The pillars have right-angle with the roof without fillet and support an architrave.
- They were properly designed as there is no failure signs on their surfaces.
- The pillars are decorated by hieroglyphic text written in columns.
- The architrave is decorated by colored scenes including a scene for Nekhbet filling the whole bottom surface. .



Fig.14 Pillars in Ramses IV tomb from the 20<sup>th</sup> Dynasty [28].

- The third example is pillars in the burial chamber of Ramses VI, 5<sup>th</sup> Pharaoh of the 20<sup>th</sup> Dynasty, 1145-1137 BC (KV9) shown in Fig.15 [29]. The pillars have the characteristics:
  - They are arranged in two parallel rows.
  - They have a square cross-section.
  - The pillars have right-angle with the roof without fillet and support architraves.
  - They were properly designed as there is no failure signs on their surfaces.
  - The pillars are decorated by hieroglyphic text written in bounded columns and scenes for the Pharaoh and his Cartouches.
  - The architraves have no decorations.



Fig.15 Pillars in Ramses VI tomb from the 20<sup>th</sup> Dynasty [29].

- The fourth example is two pillars in the tomb of Ramses IX, 8<sup>th</sup> Pharaoh of the 20<sup>th</sup> Dynasty, 1129-1111 BC (KV6) shown in Fig.16 [30]. The pillars have the characteristics:
  - They have a rectangular cross-section.
  - The pillars have right-angle with the roof without fillet and support an architrave.
  - They were properly designed as there is no failure signs on their surfaces.
  - The pillars are decorated by hieroglyphic text written in bounded columns.
  - The architrave is decorated by colored scenes covering the whole surface. .



Fig.16 Pillars in Ramses IX tomb from the 20<sup>th</sup> Dynasty [30].

## VII. CONCLUSION

- The development of Mechanical Engineering in ancient Egypt was studied through investigating the industry of tomb pillars in ancient Egypt.
- The study covered pillars industry during a time span from the 4<sup>th</sup> to the 20<sup>th</sup> Dynasties of ancient Egypt (2613-1077 BC).
- The ancient Egyptians decorated tomb pillars during the 4<sup>th</sup> Dynasty with colored scenes and hieroglyphic texts
- They designed tomb-pillars during the 12<sup>th</sup> Dynasty with capitals and colored decorations on their shafts using hieroglyphic texts.
- During the 18<sup>th</sup> Dynasty, they invented unique tomb-pillars with extensive decorations. This covered pillars with extremely large fillets with the roof providing more surfaces for colored decorations and pillars Djed-shape fully decorated using colored horizontal bands.
- During the 19<sup>th</sup> and 20<sup>th</sup> Dynasties, they designed square tomb-pillars with decorated capital and base and using the shaft surfaces for decoration using colored scenes.
- Most of the tomb pillars has right-angle with the roof.
- They designed a pair of pillars supporting an architrave forming an inverted U-shape with full decoration during the 19<sup>th</sup> and 20<sup>th</sup> Dynasties.
- During the 20<sup>th</sup> Dynasty, they designed tomb-pillars arranged in in two rows with full colored decorations using scenes and hieroglyphic texts written within bounded and un-bounded columns.

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- Has got his Ph.D. in 1979 from Bradford University, UK under the supervision of Late Prof. John Parnaby.
  - Now with the Faculty of Engineering, Cairo University, EGYPT.
  - Research on Automatic Control, Mechanical Vibrations, Mechanism Synthesis and History of Mechanical Engineering.
  - Published more than 285 research papers in international journals and conferences.
  - Author of books on Experimental Systems Control, Experimental Vibrations and Evolution of Mechanical Engineering.
  - Chief Editor of the International Journal of Computer Techniques and International Journal of Engineering and Techniques.
  - Member of the Editorial Board of some international journals.
  - Reviewer in some international journals.

## BIOGRAPHY



### Galal Ali Hassaan

- Emeritus Professor of System Dynamics and Automatic Control.
- Has got his B.Sc. and M.Sc. from Cairo University in 1970 and 1974.