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THE HISTORY OF THE DEVELOPMENT OF ARCHITECTURAL FORMATION WITHOUT THE USE OF COMPUTER TECHNOLOGY IN THE ANCIENT WORLD

Abstract: *The article discusses the historical stages of architectural formation through building materials and structures on the example of Ancient Egypt, Greece, Rome. The relationship has been made between inventions and the further impact of discoveries on architecture in subsequent generations.*

Key words: *Architecture, formation, building materials, structures.*

Language: *English*

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Introduction

Mythology is one of the values of human perception, which allows to explain the inexplicable, expressed by some images, which are perceived by the easy logic of perception. This is a real source of control of a small fraction of the human community over a huge flow of other human thoughts. Myths are put into our consciousness as a miracle of a flower that allows us to judge the price of life situations in which the thought reveals an irresistible helplessness, and an impeccable desire to join this flower, grow it on its window sill and daily feed it with new information that confirms the life of this living plant.

Often this plant revealed the role of architectural formation, which tried to confirm the power of empires, an individual king or priest, who takes over the reins of government and power. This is how empires lived, putting in people's heads the seed of the postulate, for which it is necessary to give the most valuable and expensive thing that a man has, turning into a whole art that makes the average man give up his property himself, in favor of what he simply believes in, and the laws once again confirm his faith, creating fear of violation of the postulate.

Materials and Methods

The task of the architects was aimed at the perfect fulfillment of the desire of the customer (the Tsar) to go directly to the more comfortable living conditions, embodying these postulates in life. The life of geniuses was sometimes allowed into a more thought-out model of the world around, connected with politics, location, as well as the way of undeniable content of the rulers of the ancient world. They descended into the holy of holies of their consciousness, into a certain area of darkness, accessible only to them and embodied in life. From the choice of the location of the site to the attitudes of the small architectural forms in the thriving cities, the architect, like any service-provider, considered his position and reward for the more expensive work of his time, developing professional skills that were passed on to an even narrower circle of masters describing his skills as a gift from God. Correspondingly, the masters resorted to perfecting their work in the implementation of these sacred ideas, and the development of architectural structures began with the presented sources of Windruvius: "Thanks to the discovery of fire, people began to communicate, gather and live together. They began to come together in many ways and, being naturally endowed with those advantages over other animals, which they walk without bowing down, but directly, looking at the splendor of the sky and stars, and easily do, Some of them started to make huts out of green branches, others began to dig in the cave mountains, and others, imitating the nests of swallows and the methods of their construction, began to make their own shelters out of clay and rods. Here, observing other people's dwellings and adding new ones to their own fantasies, they built better and better types of huts day by day" [1].

Taking into account the data of archeologists and researchers, it becomes possible to trace the history of architectural architecture from the earliest surviving buildings, which coincide with the Neolithic revolution and the transition of people to a settled way of life in the creation of the first settlements, which developed in larger cities, and over time and in the powerful state.

The beginning of the historical inquiry on formation of architectural formation on the remained more ancient constructions, it is possible to trace architectural skill on an example of Ancient Egypt.

The natural and climatic conditions of ancient Egypt predetermined the emergence of astronomy associated with the tide and flow of the Nile River; for the distribution of irrigated surfaces appeared geometry, creating a special systematic thought and disciplining it, subject to special climatic data.

The present form of board of ancient Egypt was despotism, creating an order and complete totality of life of the population, in which nature and the community was a single whole.

The mysticism of ancient Egypt flourished with the idea of a more advanced image of the temple of Pharaoh. Initially, the first mastab burial vaults (Figure 1) built according to the established ancient canon, made of raw brick, allowed to plan the burial vault as already known at that time - a truncated form of the pyramid. The established type of construction, and as earlier described by Vitruvius the development of housing construction, was based on imitation, respectively, the performance of the architectural image was carried out in accordance with the already established tools of the ancient world, and the symbol of imitation was the "World Mountain" in the middle of a flat desert surface [20].

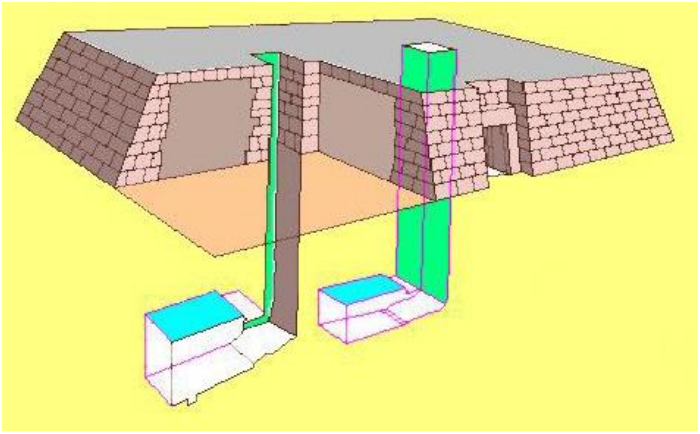

Figure 1. Mastab

It was established that the inhabitants of Babylon solved mathematical equations algebraically, i.e. they knew algebra, and the builders of the pyramid of Cheops, in the structure of the pyramid, laid the number π (millionth of the earth's circumference), therefore, at that time were already familiar and the value of π and the proportion of the earth's circumference [2]. But during the construction of one of the first solid stone structures, which was the pyramid of Djoser built around 2650 before BC, the

architect Imhotep had to build a pyramid, not based on other objects of imitation, despite the fact that the architect originally intended to create a mastaba [3], but in the process of construction it turned into a stepped pyramid. The image of the pyramid, thanks to the innovation of Imhatep, predetermined the future development of burial tombs in a similar architectural concept, which spread to other empires.

Architect Imhotep is one of the outstanding architects of the ancient Kingdom of Egypt. At the time of the construction of the pyramid, with full confidence of the king (as evidenced by the fact that the name of Imhotep is depicted on the statue of Djoser, where after all the titles of the Pharaoh followed by the titles of the architect), as well as the construction of the first step of the temple, the architect can be considered a professional. At the time of construction of something else-the pyramid, he used materials and devices that were used earlier in the performance of various tasks. It can be assumed that once a scientist, architect Imhotep pointed to the parchment General vision of the structure, and the knowledge of mathematics, made it possible to enclose the object of the appropriate size when showing a small layout, which can be built from local materials. It is also possible that the retreat of the Nile river on the formed wet surface, it was possible to depict the full size of the object in terms of the overall representation of the massiveness of the structure. But it is possible to lean to the first version of the first image of the object on parchment, with the possible representation of the image in the form of a layout to show it to the king.

In the future, once directly at the construction site, started new problems with the construction of the object. Initially, it was necessary to level the surface. During the construction of the mastaba earlier, during the pouring of the Nile river, a surface between the dams was formed, but the place of construction of the pyramid of Djoser was a desert where there was no water at all. But despite this flat ground was formed using a level where long work was embodied by a large number of labor, just arrived from the conquests of the king. The second task was the orientation of the object. This problem was solved with the help of astronomy, where, observing the chosen star "Sirius" and indicating its marks of sunrise and sunset, dividing the distance between the marks in half, the direction was obtained with an accuracy of a fraction of a degree North-South. During the construction of the pyramid itself, the experience of working with the famous architect material – raw brick, remained unchanged. Stone blocks were small and the method of laying is similar to brick laying (layered masonry, tilted inward).

When performing tasks, you can see how from other areas of science, such as astronomy or work with the alignment of the site using the level that was used by surveyors at the time of the Foundation of the pre-Nile territory, knowledge passed into the sphere of construction.

The architect Imhotep is also credited with the initial use of columns, the surfaces of which, to give them an organic form (reed, Lotus, etc.) were cut. This innovation was used in subsequent constructions of the ancient Egyptian complexes, for example, in the great hypostyle hall of Karnak (the building dates back to 1224 BC), where 16 rows in set 134 columns, some of which reached a height of 24 m. In their setting was carried out of natural motives, they were decorated with hieroglyphs (figure 2).

Figure 2. Illustrations of ancient Egyptian columns made in 1849-1859 by Carl Richard Lepsius

The covered colonnade in the complex of the pyramid of Djoser went from the walls of the fences to the South. The passage was made of limestone ceiling, creating the image of solid trees, which created a massive masonry at the two doors. Behind the passage there was a hall with 20 pairs of columns made of limestone, which consisted of drum segments carved in the form of plant stems, the height of which reached 6.6 m. [4]. These columns were attached to the wall, which formed a ledge from the masonry.

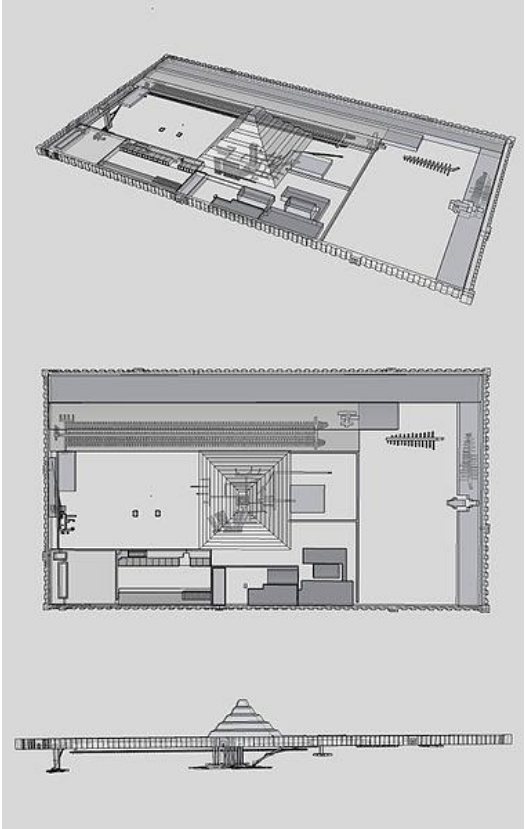

Figure 3. Volume model of the complex of the pyramid of Djoser

You can also track and determine some progress of the architect, which has not changed to this day. General drawings of the future object were made on parchment, presumably a layout for the approval of the image of the object, and the beginning of construction works. The main and significant difference between the work of the ancient architect and the modern type of profession is the inability to separate the knowledge about the design of the object with the direct implementation of construction, i.e. knowledge of the laws of planning, placement, image with its real technical construction. In this regard, it is possible to imagine that the sketches made on parchment took place only in the view of the king, but for the architect himself had no price, since it was the construction of the object that was the main thing, and the architect's mental abilities did not take place to be unacceptable and even more so, the creation of a labyrinth under the pyramid, it is impossible without orthogonal projections, it should be noted the achievement of the architect - with the help of imagination to recreate the image of a three-dimensional system of passages (figure 3), especially without paying attention to the fact that the original idea was mastaba.

Subsequently, after the construction of the pyramid of Djoser and in an attempt to change the appearance of the pyramids, in the construction process, new tasks were set, which were solved directly in the construction stages, and errors in the design allowed to predict the stage of problems in the subsequent experience of the construction of the pyramids.

Blurring in its greatness over its predecessor, the pharaohs ordered to build a tomb greater than the previous one. Began the dissipation of the pyramids around ancient Egypt. Architects, builders have moved from one building to another, solving new and complicated tasks set by the king, having the experience, which was preceded by old buildings.

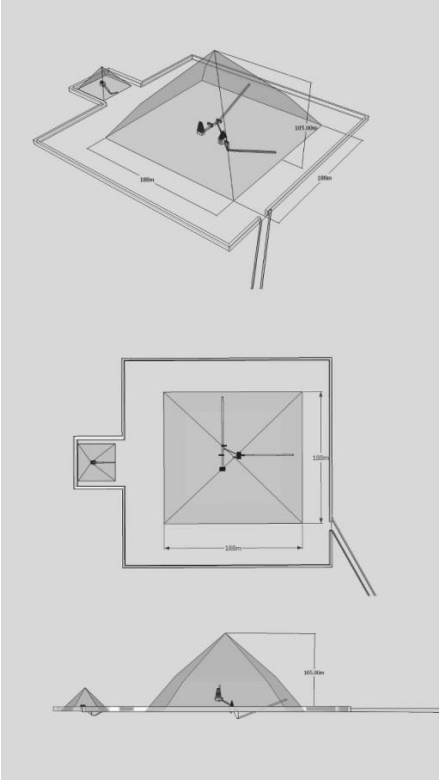

Figure 4. Broken pyramid

After the construction of the step pyramid of Djoser, the construction of the following step pyramids was carried out: the pyramid of Sehemhet, the layered pyramid of Pharaoh Hub, etc. After the construction of step pyramids, there were attempts to build the smooth sides of the pyramid: the pyramid in Medum (pyramid of irregular shape and of the same material – stone limestone blocks), a broken pyramid, etc.

On the example of a broken pyramid, you can see how the appearance of the building applied to itself a completely new form, the formation of which there are several hypotheses.

Bent pyramid was designed for Pharaoh Sneferu, the approximate year built approx 2596 BC it is Not excluded that the original appearance of the buildings were correctly isosceles pyramid with smooth walls, but directly on the site design has undergone changes (figure 4).

There are several hypotheses related to shape change [5]. One consists of the assumption that the Pharaoh died before the construction of the pyramid, and for the speed of construction it was decided to change the angle of construction. Another hypothesis suggests that a parallel pyramid in Dahshur is beginning to collapse under possible torrential rain and a modification of the original design has been applied to prevent destruction (figure 5).

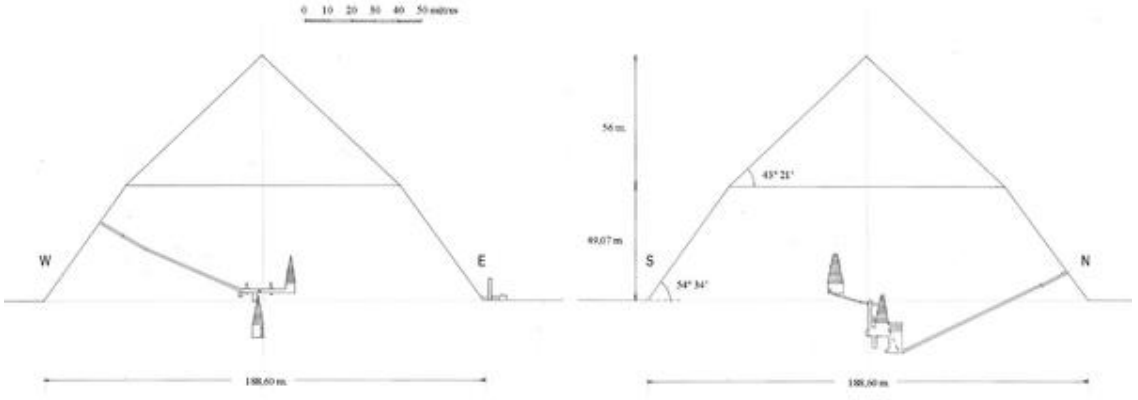

Figure 5. Bent pyramid, the facade

Archaeologists found that the construction of the pyramid was in three stages of construction:

- Initially, the building for the acquisition of a stable structure was changed by the location of stone blocks, and the restructuring revealed a large number of cracks with the possibility of destroying the entire object. In the first stage of construction was made the 1st part of the object: about 12.7 m in height, entrances, tunnels;

- In the second stage, with an increase in structural reliability, it was decided to reduce the angle of inclination of the object, but during construction again at an altitude of 49 m. the pyramid was changed;

- At the third stage, in order to reduce the load, the slope of the upper part of the pyramid was again changed to 43 degrees, with a change in the height of the pyramid to 105 m.

In the planning structure, the appointment of the entrance group from the Western side remained a mystery, since for religious reasons the entrance was built only from the Eastern side. The Western entrance was a masked slab, thanks to this slab archaeologists have identified a device for masking the entrance of the building of the pyramids.

Regardless of the original plan of the object, the architectural shaping of the tomb itself changed. If this is a mistake in the calculations of the architects, the errors taken into account have grown into experience, and further construction of the pyramids directly no longer had a similar shape. If this is a task in the accelerated construction, it once again indicates full awareness and knowledge of their skills of the masters of the time. Knowledge of the climatic characteristics of the region, the building material, structural system led to the creation of objects of antiquity, architectural appearance, the form has varied, depending on these factors given the imitation, and experience has determined the execution of the task, to the full satisfaction of shaping, for example, already the next "pink" of the pyramid, which already had the correct stereometric pyramidal form.

It is noteworthy that it is possible to trace the work of one project approach of the architect to the decision of the construction of the pyramids. For each pyramid, the angle of inclination is decided in different ways, therefore, a departure from the already formed image of the previous pyramids is traced, unless one of the masters installed several pyramids. It is possible to assume that at design and direct construction of a pyramid any template method of definition of a wall corner was used, but at different corners of pyramids this template was not transferred from the master to the master, and each stone block, having the brand, was pushed aside on a place directly on a building site.

The Egyptian Empire, increasing its state by seizing new territories enriched itself with labor and building materials, and each Pharaoh entrusted to him Empire created a tomb greater than the previous one. So there was one of the tallest buildings of his time and to this day the highest pyramid – the pyramid of Cheops (figure 6).

The great pyramid of Cheops was developed as a separate project, as well as other pyramids and temples of ancient Egypt. In his inimitable original basis of his time lay a large gallery, dissecting the body of the pyramid masonry, creating a high nave; there was a false arch, which until then was not used in Egyptian architecture. According to the design features of the pyramid, it is also possible to trace the changes that were not carried out according to the original ideas of the architect.

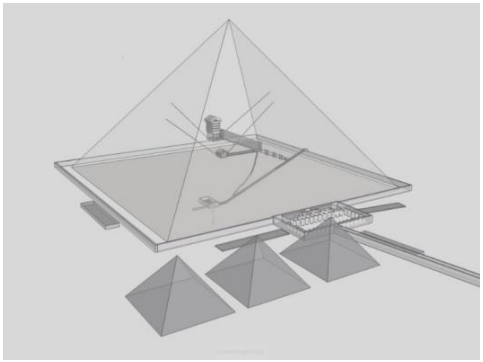

Figure 6. Pyramid of Cheops

So when cutting a large gallery in the pyramid (figure 7), according to the description of the researchers, in the lower part of the narrow gallery, going up, the masonry of limestone blocks lies horizontally, in contrast to the upper part, where the blocks are stacked obliquely. In connection with this change of masonry, we can assume the first change of a project to core drill of the burial of the Queen. In the future, it becomes possible to predetermine the subsequent changes of the project: a smooth stone ramp is shown on the cross section of the pyramid, along which the ledges are raised by steps, in which rectangular niches are cut; also on both sides of the gallery are small ditches that are adjacent to the ledges. The researchers concluded that the niches served for a temporary platform, which was held by

pillars and ropes. After the funeral procession, all these structures were dismantled or burned, which eventually led to the sealing of a narrow gallery when sliding on a granite ramp down granite blocks.

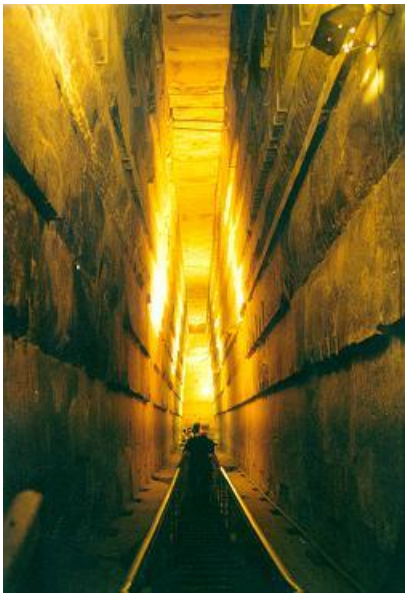

Figure 7. Grand gallery

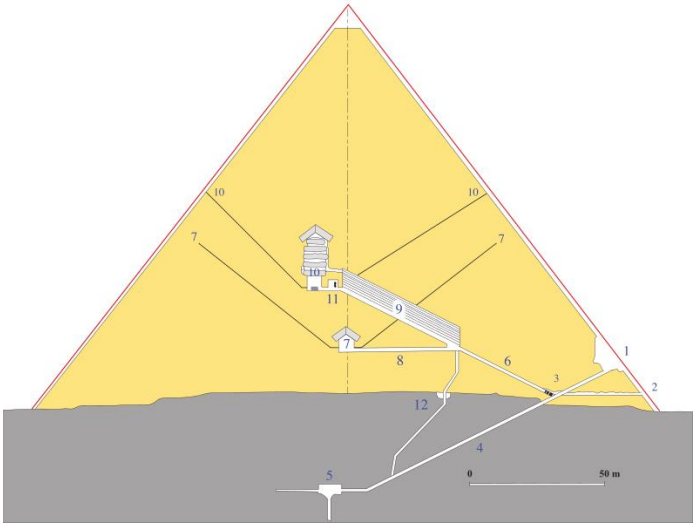

Figure 8. A cross-section of the pyramid of Cheops

1. Main entrance; 2 entrance; 3 the intersection; 4 declining channel; 5 unfinished underground chamber; 6 the rising channel; 7 the chamber of the Queen; 8 is a horizontal tunnel; a large 9 gallery; 10 chamber of the Pharaoh with the air duct; 11 a pre-chamber; 12 grotto.

When sealing the narrow gallery inside the burial were working, which is clearly not included in the plans of the architect. So developing the third stage of construction: the workers who remained inside the pyramid, engaged in the dismantling of temporary structures, had to go outside, so that there was an emergency well at the point of transition of the inclined corridor and the corridor leading to the burial of the Queen. In the study of this well, it was found that the workers deviated from the exit in search of it, cutting through the well in a hurry, trying to blindly find the lower corridor (figure 8).

When considering the work of Imhotep in the design of the pyramid of Djoser, you can see his free work with the plan on the center drawing, but when the architect worked on the great pyramid of Cheops, it is possible to trace in this way the flawless work of the architect with architectural cuts, and according to John Romer, planning the progress of work was in laying out parts of the plan on the spot on a scale of 1:1 [6].

Also, by working with the architectural transverse and longitudinal sections, it is possible to trace the work of the builders when laying ventilation

channels going to the faces of the pyramid from the burial chamber of the king.

Analyzing the construction of all ancient Egypt revealed evidence of brilliant ability to solve new architectural and construction tasks, which changed at each subsequent stage of construction of pyramids, temples of ancient Egypt. The approach to the construction of the pyramids changed, but the shape did not change. Not the variability of the forms assumed by the inability to Express the reflexive analysis of the professional skill of the ancient Egyptians, in spite of his outstanding professional achievements of the ancient state.

The professionalism of ancient Egypt is reflected not only in the construction sense, but also in other crafts. One can trace the messages of Ptahhotep (the great sage of ancient Egypt), how one of the oldest philosophical components of the ancient Kingdom was built, where the sage called people to seek knowledge, not to look at greed, greed, where the chief should be a good-natured and sympathetic person, etc. In these attempts to describe the work of the chiefs of ancient Egypt, it is possible to assume that the most common human factor of the "ruler" was manifested in all the commanding works, but the desire for knowledge left the history of Egypt not only in architectural monuments, but also in reliefs, writing, pottery, painting, etc. So in the tomb of Ptahhotep is depicted the main message to the descendants:" Art has no boundaries and no artist has reached perfection", with these words can also be traced and the essence of ancient Egypt, where the subtlety of the same reliefs, painting was not disclosed in its entirety. For example, there was a hierarchy in painting, where the drafters applied the drawing with red brushes, but only one, the main draftsman had the right to own a black brush, which he amended and kept the old traditions. According to this principle, modern artists work only by changing the color of the brush, which is also very remarkable for our time.

The same approach can be traced in the mathematical abilities of the ancient Egyptians. The Egyptians mastered mathematics perfectly, keeping the principle of staging for a long time solving geometric problems. This principle of staging could not exist in architectural activity, because with the help of the show you can solve the problem of geometry, repeat any easy craft, repeat the drawing, but the architectural construction could not go in a similar course of action. There were various functions or handicraft types of work it: bricklayers, drafters, carpenters, etc., but architecture as a separate art form was not specified. The architect was prepared as a person familiar with the work of stone, i.e. building material, structures, and the work on the object again and again changed, where it was necessary to solve problems in a new way with the help of already known at that time tools.

What is left as a legacy of the architecture of ancient Egypt – is the work brought to perfection with the building material (limestone stone block), a combined structural system, the first false arches (which were used in Mesopotamia, where there were prototypes of farms at large spans called circled), the organization of construction processes, etc., as well as from other ancient States, left a legacy of more different architectural and construction work. For example, as well as the city-state of Mohenjo Daro ("hill of the dead", the modern territory of Pakistan), which left a legacy of work with ventilation ducts, the builders of which used in the construction of granaries or their Sewerage system [16]. Mesopotamia, which effectively worked out the design of the core of raw brick with asphalt waterproofing (asphalt waterproofing was also used on Sumerian ships), etc.

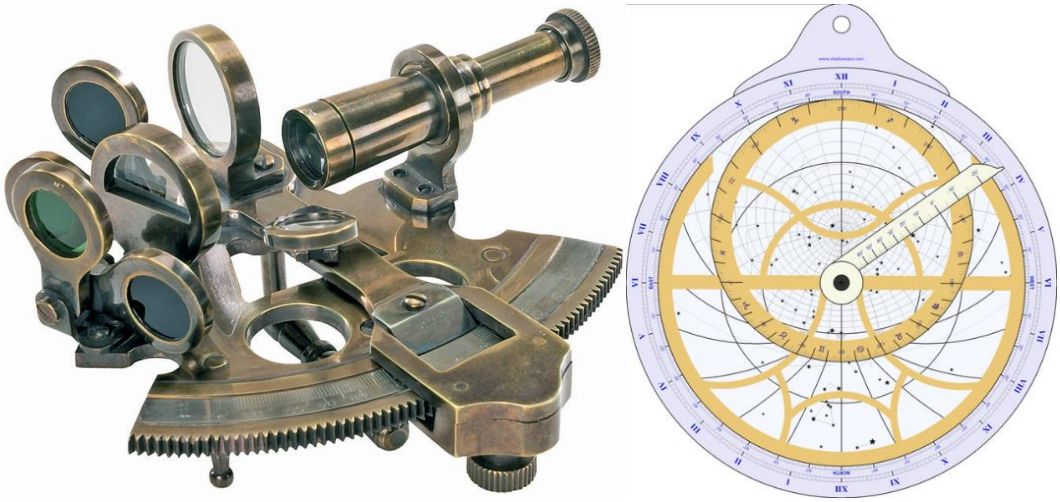

Figure 9. The sextant and the astrolabe

In the field of work on projects, as well as work on the construction site, the ancient Egyptians used methods of constructing a right angle with a triangle, the device patterns (which described Herodotus). Reached our days and some papyri on which are represented the instruments in the likeness of the astrolabe and sextant (figure 9), preserved papyrus, which shows a small portal on a square grid, with proportions, which was perceived by the Greeks as a strict drawing (figure 10).

Some adaptations of ancient Egyptians, such as plumb, level for different designs, methods of calculations of sand, stone and other construction materials which were used in ancient Egypt reached our days.

To understand their future skills, to fully explain the skills and further training, in ancient Egypt, there were schools for children. According to the frescoes and sculptures depicting students at the tables (figure 11), it is known that the ancient Egyptians were educated, despite the fact that archaeologists have not been able to find a single school building. There is a possibility that the Egyptians were educated in temples, houses of scribes, public schools. Under these conditions, students were educated in the chosen specialties: adopting the experience of masters, artisans and artists were trained, priests, officials or doctors were formed from scribes. Of course, not everyone could receive a decent education in their time, so the children of peasants were taught in schools until 10 years, after which they went to work in the fields [7].

The landscape of ancient Egypt subordinated the creation of the city along the Nile river, therefore, developed a rectangular planning grid of the cities themselves. Houses, facing one another, created quarters, having a closed courtyard in the interior, which creates an introverted system of life, from the outside facing the opposite to the sociality [20].

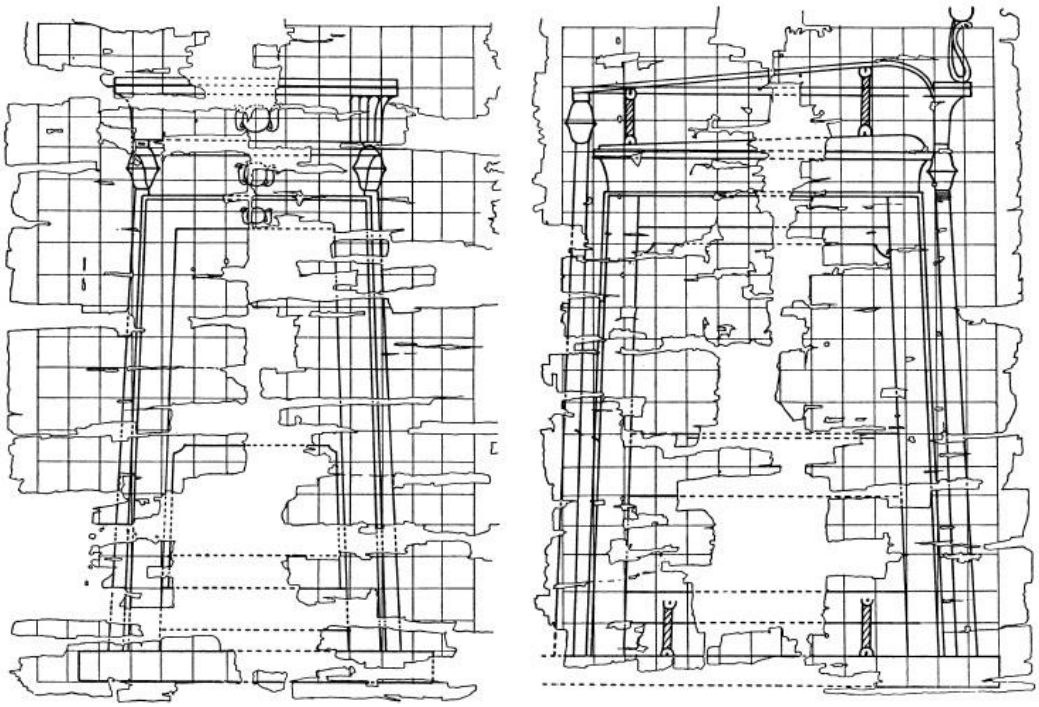

Figure 10. Facade and side view of the chapel, depicted on the papyrus. XVIII dynasty. From Gurabo. The plan was executed in black ink on a piece of papyrus, lined with red squares

Figure 11. Statuettes found in the tomb of Meketre

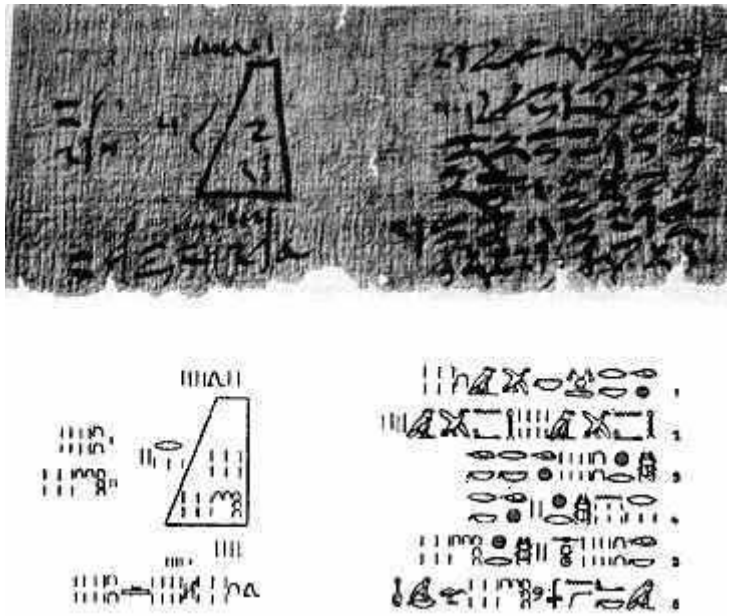

Figure 12. A papyrus with mathematical problems and solution, nineteenth century BC

According to the program of school education were given compulsory classes in mathematics, reading, calligraphy, history, etc. (figure 12). Students were engaged in rewriting texts, documents, learned the Akkadian language (considered a diplomatic language), and at the end of training passed exams. Especially gifted children continued their education at the temples in the" Houses of life", where they were directly engaged in science, they were given access to libraries, where scientific books were also copied.

The ability of ancient Egypt to create architectural objects (and not only) admired and pondered many Greek scientists: Plato, Aristotle, Herodotus, etc. In the VII century BC there is evidence from Herodotus that was the message between the Egyptian pharaohs and Greek sages, in the city of SAIs, where the Saite Pharaoh Psammetik, allocated between the Nile river land for Greek scholars, giving and Egyptian youths for the study of Hellenic language. By the end of this century the city has established trade relations with Greek city-States and hosted many Greek scholars for the exchange of knowledge and the exaltation of the history of Egypt because after the weakening of the Assyrian oppression of the Saite pharaohs began to show an interest in the history of their own country. The country was visited by Solon [8], ROIC and Theodore, Pythagoras, Herodotus, the same scientists lured the amount of knowledge and instilled the knowledge into

Greek culture in the subsequent through the development of literature.

In addition to obtaining knowledge from ancient Egypt, the Greek policies gained knowledge from other Eastern empires. For example, the Spartans were astonished by the planting of trees that were the same height, the Persian satraps; in the territory of little Asia, through Lydia, which began the first in the history of the coinage of king Croesus, the policies of Miletus, Phocaea, and others in imitation of began to mint gold coins and to join trade with the rich countries of the East.

Prosperity of the Greek cities passed through trade routes, but on natural and climatic features of the cities: flora, soils were identical, as well as on the continent, and in colonies. From this it follows that the trade was mainly not only through products, namely the special quality of products: a special taste of wine or olive oil, a special form or decoration of ceramic vessels, etc. It is the property of the object, which was formed by the concentration of the master's skills and led the trade possible, leaving a special appearance of the development of Greek history, and the transformation of knowledge obtained from other civilizations through rethinking, understanding, reasoning, the course of evidence, show a special property of Greek culture.

According to natural and climatic data, the main building materials used in the construction of buildings also come out. In the free access of the ancient Greek builders was a stone, thanks to the rocky terrain. Limestone was also available [9]. In Greek cities, such as Paros and Nixos, there was an abundance of high-quality white marble, as well as on the Islands and the mainland, which was the main decoration of architectural and sculptural details that adorned the architectural buildings [10]. Throughout Greece there were deposits of high-quality pottery clay, especially near Athens, which was used for shingles and architectural decoration [11].

Due to the sea climate, many events were held outdoors, and temples were located on the tops; theaters were located on inclined places; colonnades and courtyards protected people from the sun and winter storms.

In place of the Egyptian despotism in Greece there was a democratic system, which changed the system of life from the "man-machines" of ancient Egypt, a citizen who is able to participate in the life of the city-policy and manage it. The new meaning of life was man himself, both in the arts and in architecture itself.

In comparison of the landscape of Egypt and Greece, there are important differences that contribute to the modification of the vision of the planning structure and the architectural image of the space as a whole. For example, to replace the monotonous landscape of Egypt comes a variety of developed valley, fenced rock, rich flora.

With good trade, a strong political structure of policies, constantly feuding with each other, a new relationship between the customer and the contractor. The tyrants of the Greek Polis call to their service poets, historians, artists, architects, sculptors, to perform a number of works while maintaining the prosperity of a particular policy, as well as supporting the throne of the tyrant himself, because of the struggle between the aristocracy and the poor, providing masters with all means of existence. There are individuals-executors of the task of policies, begin trade relations between the ability of the master and the customer (similar to modern relationships). Knowledge and skills valued starting material.

Thus, in Corinth to support trade routes, by collecting customs fees for the passage of merchant ships, a large engineering structure was organized – to lay a marble path through the isthmus on bronze rollers, on which the platform was located, for the passage of ships by land; in Migara, the largest water supply system in Greece is laid; in Samos, a tunnel is being built along which a water conduit for supplying the city with clean water (figure 13); With the help of Chaldean formulas Thales of Miletus was counting on a solar Eclipse (studying in Egypt and Babylon astronomy and geometry) [12], was given (as claimed by the rumor) the bed of the river Galis for Lydia; of the comparative discussion about proportions (arithmetic, harmonic, geometric), Architect, displays a General doctrine about the pre-Euclidean proportions and architectural building; Theodore and ROIC, who loved new technology, he studied mechanics and optics in Egypt.

Figure 13. The tunnel in Samos

Greek temples, to the end of the VIII century BC reminded the Mycenaean Megaron (figure 14), the sculpture was primitive, but by borrowing skills, travel East and South through literature and the Foundation of the schools opened by these same scientists and travelers, in architecture, as in the whole culture in General, is redefining. As noted in the article, Rozin V. M.: "Greek geometry and elements of algebra appeared out of nowhere, and the entrance of reconstruction of the Greek mathematicians of Babylon (and possibly Egyptian) tasks and ways of their solution. Yes, it is the reconstruction of solutions to Babylonian problems that is one of the ways leading to both geometry and algebra."

In the early archaic cities of ancient Greece are the most primitive disordered buildings and freely flowing down the city of storm water. People's houses were built of raw brick. Even rich people did not try to stand out in the city building houses, because of the fear of the common people, but keeping the house rich decoration and decoration, for example, mosaic floor (figure 15). Early cities had Agora (formerly the gathering area, later the market square), Acropolis (fortified part of the city, located on a hill), temples.

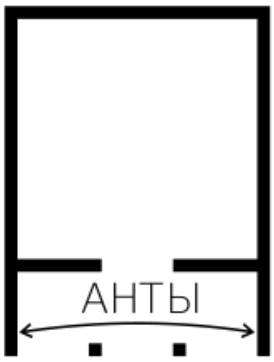

Figure 14. Plan of an ancient Greek temple of Megaron type

Figure 15. The plan of the House of Colline, 2nd century BC Mosaic floor of a house on Delos

In the same era, the building material of the temples were clay, brick, marble, all kept on stone structures. Columns and superstructures were made of wood, as well as wooden boards protected doorways and ants. The original wooden structures influenced the further architecture of ancient Greece over the centuries [13]. To emphasize the cult place of the deity, in the form of a statue, a canopy was built, which was held by the columns, this kind of portico that surrounded the temple on all sides, was the ancestor of the temple architecture of ancient Greece. The use of the portico in the temples to see the temple from all sides, heralded the development of the periptera, arranged also at the rear of the temple that has become a necessary and integral part of the aesthetics of the temples. In the future, the planning structure of the temples changed and was designated by type (figure 16).

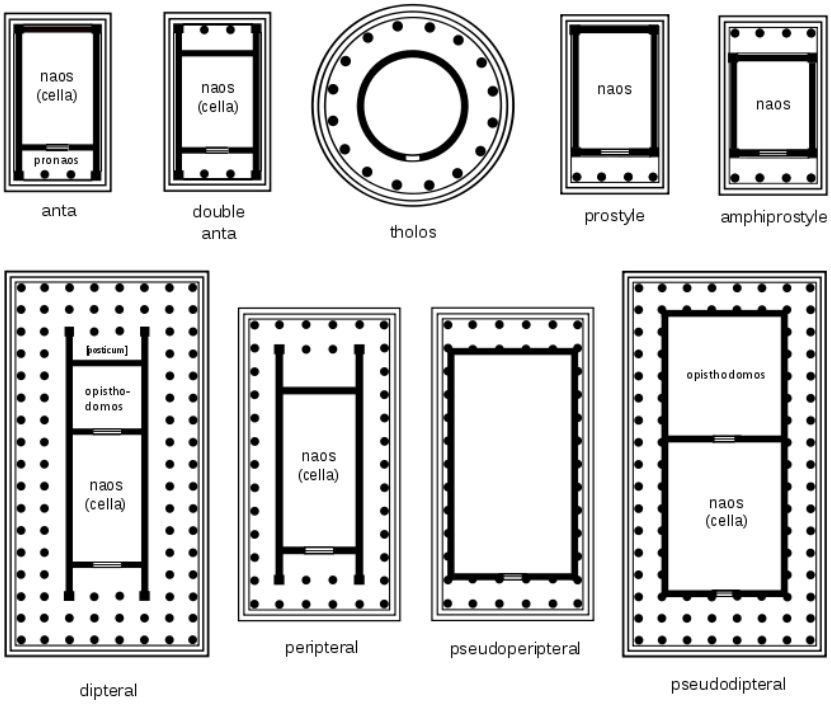

Figure 16. Types of planning structures of temples: 1. Bows; 2. Double bows; 3. Lotus; 4. Pro style; 5. Amphiprostyle; 6. Dipter; 7. Peripter; 8. Pseudodispar; 9. Pseudoperipteral

Peripter was the main type of ancient Greek temples in the early archaic. It was a rectangular structure, surrounded on all sides by columns made in the Doric style. The inner part of the periptera consisted of a pronaos (figure 17) and the naos, was located behind opisthodome [14].

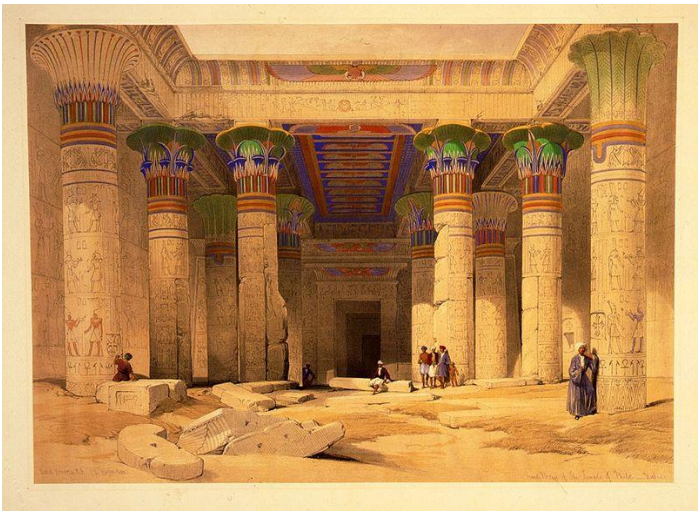

Figure 17. The pronaos of the temple on the island of Philae (Egypt)

So in Samos on the site of the burned temple, Geryon, began construction of a new Herione, architects which was rayk and Theodore. You can trace the development of the construction of temples, as they acquired new qualities. Simple periptera old temple changed Diptera, consisting of 150 columns with dimensions of 43 m. 107x that visually can be called a "forest of columns". Monitored the work of architects in a geometrically correct staking plan in place buildings that created the composite schema. The temple was built in 570-550 BC [15]. This temple had a repetition in other buildings of temples in Attica, Olympia, Sikion.

After the temple was built, Theodore published a book about which Vitruvius wrote:" on the Doric temple of Juno on Samos, Theodore published a book " [1]. So during the construction of the temple of Diptera, with a double colonnade (figure 18), there is a book source on Diptera written by the author of the building; perhaps in ancient Egypt were textbooks about the construction of the texts, but could not be copyright works because in the East the ideal type of construction could not apply to individual manifestations (author's interpretation).

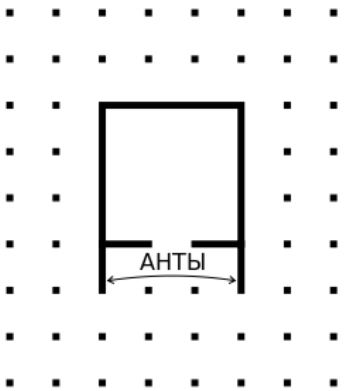

Figure 18. Dipper

Around the same time, the Apollo Temple is being built in Selinunt, Sicily, with a large peripter on a two-stage platform with dimensions of 110x50 m (Figure 19.20). The temple has specific features regarding the depth of the side porch, which was 13 m. (which effectively represented a wide facade); in terms of the layout of the temple there is a main aisle, which was the inner gallery and was under the open sky [17]. The temple has a Doric order (proto-doric order was used in ancient Egyptian architecture), which was strengthened in Greece, with a clear thinning of the columns at a height of 8.65 m., and the distance between the columns was increased.

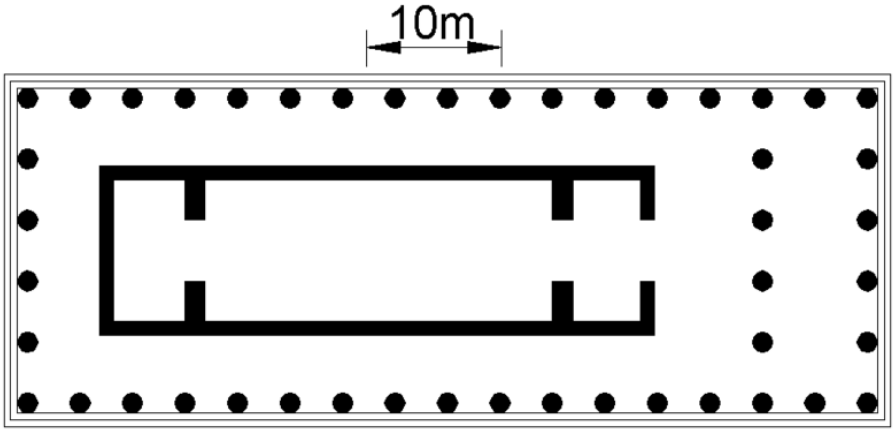

Figure 19. Plan of Apollo Temple in Selinunt

Figure 20. Apollo Temple in Selinunt

In the temple of Apollo in Selinunt on the columns there is an elongated, meter long and flattened echoin with reinforced neck excavation and a Doric warrant, which can not be said about the next generation of columns. The trunk is thickened during the transition to the capitel, therefore, the canelure is lost under the echinema. In new temples, the capitel has a steeper angle of inclination of the pillow with a reduced corking, and the column in a later period, during the transition to the capitel, shows the neck, which is divided by the strap and hypotrachelium [2], which looks more organic, for example, in the Parthenon (Figure 21).

It was designed by Parthenon Ektin and built by architect Kallikrat in 447-438 BC in Athens, was a Doric peripter with elements of the Ionic order. The Parthenon project is the most thought-out planning structure [18]. In order to increase the integrity and installation of a bulky statue of Athens, the hall was enlarged in width up to 9.82 m, and the statue itself was slightly moved away from the back of the columns, for a visual effect of the visibility of the statue between the columns. The inner hall was also framed by the columns. The portico was changed from a standard 6 to 8 column. Despite the Doric order on the columns outside the temple, the interior used an Ionic order (which was used by Alberti in the church of Rimini after fifteen hundred years), in addition to the Ionic order, in the interior was installed a sculpture of the Corinthian capitol (protocolinfskaya, which was used by Ectin already in another temple of Apollo in Baasah, which was considered the earliest known temple where the Corinthian column is used).

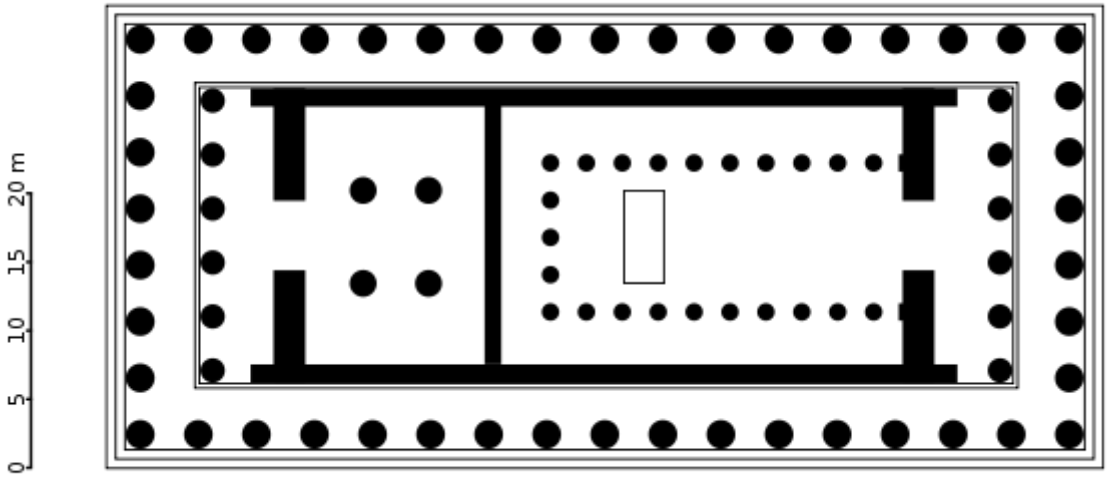

Figure 21. Parthenon's plan

The geometric curvature of the temple created a whole direction - curvature, marked as a slight bend of horizontals in the width of the intercolumn and the diameter of the columns at the corners of the temple. Transformation of the stylobate into a curve surface with a slight rise in the center means the use of an architectural template, which is useful for the construction of the curve for the architrave. In the ancient world there was no possibility to create a scale drawing from improvised means, therefore, thanks to calculation of length of a perpendicular the curve of the restored tangents has been received. This kind of work of the designer can be safely characterized as skill.

In addition to the development of architecture as a whole, the development of architectural sculpture. Architectural development of sculpture was transformed from the archaic period, where the original sculptures were certainly not so pronounced, but as the development took full place of the skill of ancient Greek sculptors. Thus, the works of researchers, on the example of Parthenon, can be traced as round sculptures in a triangular timpane reminiscent of the musical style of the Figueen. Consequently, the form is supplemented, from music theorists, by instruments of harmonization [19]. With the development of theatrical art, through literature, architecture has penetrated into each of the arts.

After the construction of the Parthenon, Ictin and Callikrat publish a book, which again contains the author's work of architects [1]. The intellectual work of architects is revealed by the system of comparisons, evaluation of perfection. Each of the buildings is erected as a new work of art, directed by an individual. In this regard, architectural planning of cities acquired new laws and regulations. At the end of the 5th and beginning of the 4th centuries, in the cities, there are nets of paving stones on the streets; the agora is framed by a colonnade; there are fountains in the middle of the streets; all this is connected with the development of a regular plan of Hippodamus Miletus, who was a student of Pythagoras. Under the open sky there appear theatres, usually located on a slope of hills; social centers; for the Olympic Games are built hippodromes, stadiums (pals) (Figure 22), etc. [10].

With the development and dispersal of new public objects, the possibility of architects to work on the space is traced, and the development of the interior contributes to the formation of more and more luxurious halls. Hospitals, arsenals, harbours, libraries, gymnasiums, etc. appear. Changes in the forms of architectural objects is noticeable in the structural elements of the archaic, three-dimensional, cumbersome, and to the classical period has become more elegant, refined, from once simple to established mathematical complexity of plans and superstructures.

Figure 22. Palestra in Olympia

The intellectual approach of the architect's work on the execution of architectural construction was revealed in the system of considered, controlled skill, not having certain laws and norms. Architects themselves modify the same laws and norms, as a result of which create new, i.e. tasks are solved in a purely individual way, respectively, the main departure from the ancient Egyptian architecture was the creation of an extraverted plastic organization. Accordingly, the reverse structure of perception of form formation occurred in ancient Rome, embodying the principles of the intravert organization again, developing the inner space through the interior [20].

The Roman architecture has absorbed elements of the Greek architecture, but differing from the Greek architecture has created a new direction of style. The Romans of Greek architecture adopted the outer shell of buildings, their volume, developing interior systems. Instead of the rack-beam system, which was used in ancient Egypt and ancient Greece, Roman architects used the concept of material shell, which created the inner space [20].

But a departure in constructive features from the Greek temples began already after the founded Rome. At board of the first tsars of Rome, till the middle of II century BC, architecture reminded Etruscan character and the majority of constructions was perceived for the benefit of city. During this period the roads were built, for example, the Appian road (Figure 23); channels for removal of sewage from the city, aqueducts, a basilica, a prison (Mamertinskaya prison, in which, according to legend, held in the conclusion of the Apostles Paul and Peter). The temples were originally built of piperine and travertine.

Figure 23. Appian Road, 312 BC.

From the middle of the 2nd century B.C. to the 1st century B.C., the use of marble material began, based on examples of Greek temples, for the construction of Roman temples, which resembled both the planning structure and the constructive structure of Greek temples, such as the temple of Portuna, built in about 100 B.C. (Figure 24).

The temple of Portuna follows the Greek tradition of temple architecture. In the planning structure of the temple has a cella, a portico; the columns are made with an ionic warrant, the material was travertine, tuff [21].

Figure 24. Temple of Portuna

The most significant changes in the architectural form of formation refers to the use of Roman concrete in the construction of buildings and structures. The space created by the Romans made it possible to perceive the structure as a monolithic whole environment, freeing from rectangular forms dictating by building materials of brick or marble. The inner part of the building, made of hewn stone, was filled with concrete, creating a formwork that formed the core, which is solid, monolithic. This made the beam and pillar system meaningless. The unity of supports, which were connected by vaults, revealed more reliable efficiency instead of the rack-beam system [20].

In a constructive solution, the connection of supports with an arch, a vault, was not a novelty. The first primitive arches have been applied in ancient Egypt where at construction of pyramids were used in unloading systems which reduced pressure of a stone file of a pyramid on overlapping of internal space or an input [22]. Vaults have been applied and in Dvurechye in a tomb of the tsar in the Ure constructed in XXVI century BC Arches, vaults were used in Dur-Sharrukin, in a palace of tsar Sargon, approximately 712-707 BC. The brick vaults were also not only the support of the hanging gardens in the palace of King Nebuchadnezzar, but also the overlapping of the throne room with the existing span of 15 m [23].

With increase in density of the population of city of ancient Rome increased. New public buildings and constructions appeared: aqueducts, amphitheaters, baths, bridges, circus, dams, harbors, temples, libraries, basilicas, sewers, etc. Although the architecture of the Roman Empire was initially inferior to the elegance of classical Greek architecture, the art of engineering surpassed everything. So, looking at known dome designs on the form in ancient Mesopotamia, Persia, Greece, the Roman engineers are the first founders of difficult, correct on proportions of domes [24].

In the I century B.C. there appears a fundamental treatise by Marcus Vitruvius Pollion "10 books on architecture", where the architect, mechanic, scientist described the architectural skills of time, which absorbed the centuries-old experience of architectural formation and engineering, dedicating his work to Octavian Augustus [25].

In his book Vitruvius included 6 principles of architecture as a science:

1. Ordinatio - in which the principles of architectural architecture are described: the formation of volume, proportions, ratio of sizes. The triad of Vitruvius is enclosed, which became fundamental: strength, utility, beauty [25];
2. Dispositio - describing the organization of space, the basics of design data through drawings (floor plans, perspective, drawing view);
3. Eurythmia - a principle that describes a composition that defines beautiful proportions;
4. Symetrai - the symmetry of the structure, which relies on parts of the human body;
5. Décor - describing the order system;

6. Distributio - a way of using the object from an economic point of view [26].

In I book Vitruvius describes architecture as a science, coupled with other links with other sciences, which the architect must master;

Book II describes the construction materials;

Book III describes the proportions in which the Vitruvian man is described;

In IV - the description of temples, their planning structures is given;

V describes forums, basilicas, theatres, baths and shipyards;

In VI the structure of premises and foundations is described;

In VII - preparation of paints;

In VIII - hydraulic structures, such as wells, water pipes;

In IX - sundial and water clock;

In X the mechanisms of machines, water mills, ballists, catapults are described.

This treatise was used by many architects and architects not only in the Roman Empire, but also later on. The book was rewritten many times, had a lot of reissues.

Figure 25. Maison Carré Temple

By order of Emperor Augustus, in Rome was reconstructed 82 dilapidated or neglected temple. There was a magnificent temple of Mars the Avenger, richly decorated with Carrara marble, whose columns were Corinthian. In addition to Rome itself, buildings were erected throughout the empire, spreading throughout present-day Europe. For example, the beautifully preserved temple of Maison Carré in present-day France (Figure 25).

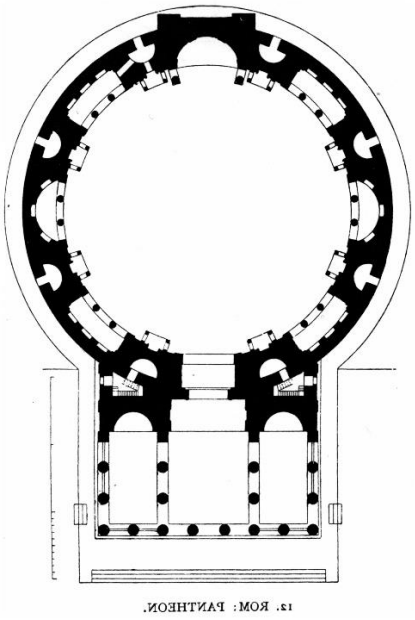

Figure 26. Pantheon's plan

The Pantheon was built under Augustus, and one of the most impressive monuments of Roman architecture, the unique central-dome Pantheon (Figure 26), which was built with the participation of Apollodor of Damascus, was built on its site already under Adrian.

The Pantheon's rotunda, made of brick and concrete, was covered by a dome with a diameter of 43 m. (which was for a long time the largest dome in the world). The dome, standing on the bearing walls form a single shell, as a cylinder and half of the sphere (Figure 27). Inside the dome has a caissonized structure to facilitate the construction of the dome hanging over the space. Corinthian columns were used in the temple.

The only window opening in the temple is a circular hole in the center of the dome, which has a diameter of 9 m. [27]. In the case of rainfall, water enters the room through this hole, so the building has a special drainage system [28].

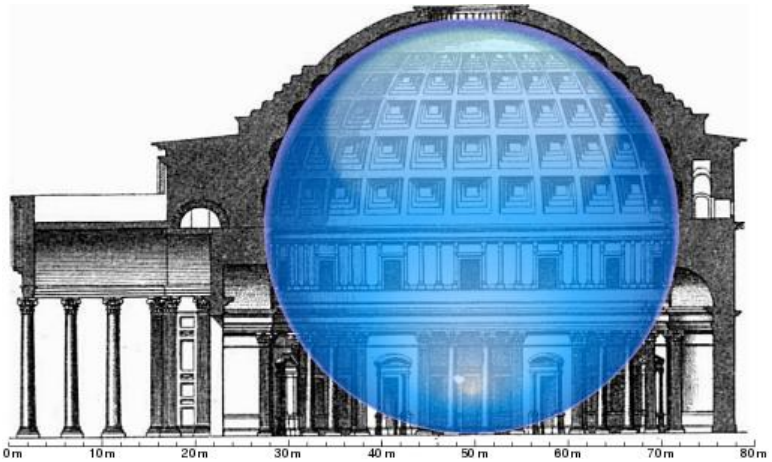

Figure 27. The Pantheon section.

Apollodor of Damascus was known as the builder of the bridge over the river Danube during the wars of 105-106 years. The Romans had extensive experience in hydraulic engineering, and Apollodor had a book by Vitruvius. Of course, this was not enough to solve the problems, but the knowledge was passed through the literature of Vitruvius, for more consciousness of the actions. After the construction of the bridge, Apollodor built Trajan Harbour in Ostia, Trajan Forum, Trajan's column, Trajan's Arc de Triomphe.

For the first time in the Roman Empire, a triumphal arch was built for the triumphant entrance to the winner's city. The arches had several spans (1,3,5), also had overlaps with semi-cylindrical vaults, which ended in an entablature and attic (a decorative wall above the eaves, first used in the Roman Empire).

Triumphal arches were also popular after the Roman Empire in France, Russia, etc.

On the example of the "Golden House" of Nero, which was the residence of the Emperor named gold because of the gilded dome, you can trace how the dome structure was first used not in the temple, and in private buildings. The largest amphitheatre of Flavius at that time, the Colosseum, was built (Figure 28).

This ellipsoidal complex, in the planning structure, repeats many stadiums built in our time. All around the perimeter there are many entrances (80 entrances), so that the Romans could fill the entire Colosseum in 15 minutes, leave it in 5 minutes, it is at the rate of over 50 thousand spectators.

The length of the ellipse is 524 m with the length of the arena at 85.75 m, and the width of 53.62 m, the height of the walls varies from 48 to 50 m. From the structural part of the building has 80 radially directed walls, which are load-bearing for the floor vaults. The foundation of the Coliseum is 13 m thick and there is also a base/plinth.

Figure 28. Colosseum, general view

The Colosseum was divided into four parts. The first three levels are arcades (previously used by the Marcellus Theatre). On the first level of the arcade there are columns with a Doric warrant. The arches of the first level were mainly numbered and served as an entrance [29]. The second tier has columns of lower height, made in the Ionic style, based on the attic. The attic was also a support for the third row of Corinthian-style columns at the third level. The uppermost part of the wall is solid, decorated with Corinthian patterns. Tents were used on the roof to protect the audience from the sun.

In the planning structure, carefully designed, not only the entrances and exits, but also the visual areas corresponding to the rank of the visitor and his political status are fully thought out.

During the reign of Adrian, opposite the Colosseum, a magnificent temple of Venus and Roma is being built (Figure 29). The temple is located on a huge platform (145x100 m.), is a pseudoperiper, with two kelly, each of which were installed statues of Venus and Roma, sitting on the throne. The kisses were designed "back to back" and looked in 2 directions. So the statue of the Roma looked to the west at the Forum, and Venus looked to the east, where the Colosseum was built.

In 1913, the German architect J. Bülmann reconstructed the interior of the temple, where he depicted a colonnade of Corinthian columns that created the central nave. A dome-shaped caisson ceiling was installed above the sitting statue. In the cella with Venus (goddess of love) the Romans could make a sacrifice as newlyweds.

Figure 29. Temple of Venus and Roma

During the reign of Adrian, no less outstanding building was built - Adrian's mausoleum (Figure 30). The shape of the building is a cylinder, standing on a rectangular platform, furnished with columns. The mausoleum was made of travertine and framed by marble, on top of which there was a dome with a statue of a bronze chariot with the emperor. In front of the mausoleum the Tiber River flowing through which the bridge was established. The mausoleum survived the looting and later became the castle with the papal residence, where Giordano Bruno spent 6 months of his imprisonment.

Figure 30. Adrian's Mausoleum depicted in picture C. F. Shchedrin

Roman cities used an orthogonal planning structure. The scheme of the city included a defensive structure and a public one. A straight-line grid of streets surrounded the forum, city services, enclosed in defensive walls. To reduce the time of movement, diagonal streets were created that crossed the square streets. Cities were located near rivers to provide water supply and sewerage. The roads were made of stone covered with small stones and pebbles. The square between the roads was a prototype of the block, which was filled with various buildings. The area outside the wall defences was intended for agricultural buildings, and aqueducts were organized outside the walls [30].

Public places with different kinds of pastime and meaning (function) were formed in the city:

The basilica (Figure 31) was a large building for solving business and legal issues, trade and judicial, usually located next to the forum. The shape of the basilica was different, containing internal colonnades, which were divided into several passageways. Most often, basilicas were framed by high naffes [30]. Intervals between the columns were as wide as possible to install benches, and balconies were also installed. The size of the basilica was set by the number of inhabitants [1];

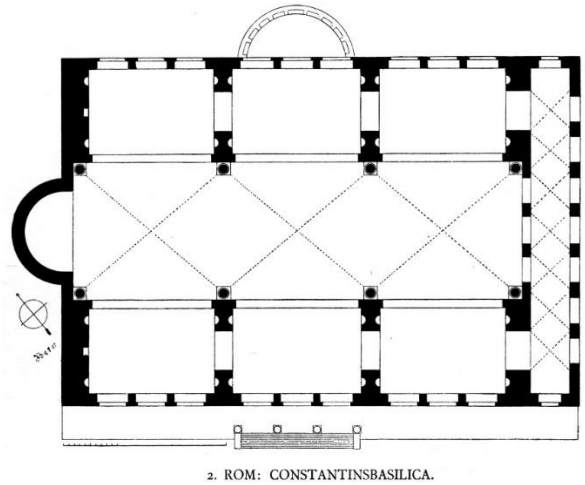

Figure 31. Basilica plan Mexencium

The Roman Empire Forum was a public marketplace that represented a large free space, such as the Trajan Forum (Figure 31). The Trojan Forum was a covered colonnade with seats along the walls, measuring 200x120 m. [31]. Architect Apollodor of Damascus dug out most of the Quirinale Hill and the Capitoline Hill, placing the forum between the hills. The five nefs of the forum, from the apse to the apse, create a transverse organization of space [2];

Figure 32. Traian's Forum

There were multi-storey apartments in the Roman Empire, called insulas, which were rented out (Figure 33). According to the planning structure on the first floors of insulas there were shops and warehouses. The first floors of insulas were considered elite and safer. So the cheapest apartments were located in the upper floors, because of the unsafe environment, in case of possible fire, without plumbing and sewage;

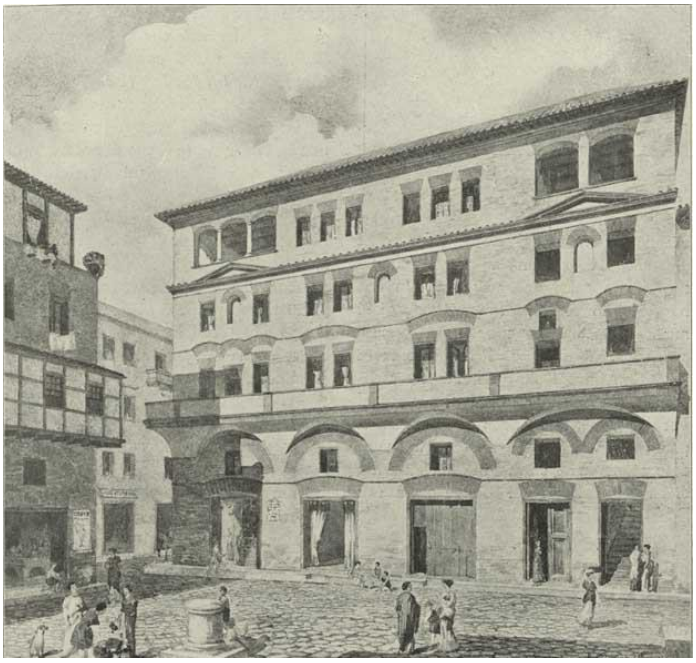

Figure 33. Insula

One of the most popular places in the Roman city was the baths (Figure 34). Thermal baths are antique baths. Architects of the Roman Empire developed heating systems with floor and wall heating. With the help of stoves water and air were heated and, accordingly, during their circulation under the floor (the floors had a few coverings, so that it was not too hot) and the walls in the baths were always warm. The ceilings were made of stone. The size of the baths, as in the basilica, was calculated from the number of visitors. The pools were located under the window in the ceiling for lighting. The location of the baths was the warmest place in the city [1];

Figure 34. Roman baths

The Roman villa was considered a country house for a man of the highest class. According to the descriptions of Vitruvius, the villas were calculated by designing the rooms on the sides of the world, using the material most suitable for their climate. Comparing the profession of the customer, the houses were designed with full compliance with his activities, from people of the highest class to receive political guests and places to communicate with them, to people with livestock or other household property [1];

Figure 35. Villa in the USA built on the example of Roman villas

The Egyptian, Greek and Persian methods of gardening impressed the Roman gardens, which were divided into 3 species:

1. A broken garden on the open terrace, which was joined by a portico;
2. Garden with flowers, trees, which was a place of walks, spending time;
3. It was an alley.

In the gardens, thanks to hydrotechnical progress, were equipped with fountains, water reservoirs. The principles of Roman gardening were spread in the later epoch in the garden art;

On the floors of the villa and other architectural structures used mosaics, which immediately gained popularity after the campaigns of the legions in Greece;

In Roman architecture, the creation of spiral staircases, which appeared in Rome thanks to the Trajan's Column, was also enshrined. Spiral staircases were used in a number of buildings, such as: temples, basilicas, steam rooms.

The architecture of ancient Rome is remarkable for its monumental character. The Romans aspired to systematicity and functionality, which will work, therefore, in architecture can be traced the spatiality, universality, the use of various spatial combinations. For achievement of the Roman spatiality concrete vaults, with their durability and form-forming variety have been applied. Taking the Greek architecture horizon and vertical, they added arched structures, applied new order systems, adding to the existing three two more: Tuscan (a simplified version of the Doric, with a smooth frieze and cornice, set without the canelures) (Figure 36), a composite order (combining the Ionic and Corinthian, using currencies, ornaments in the form of leaves) (Figure 37). Reflecting the following generations, Roman architecture to the fullest extent, with a comparison of engineering thought, gave rise to many styles, reflected already in the Middle Ages and subsequent centuries.

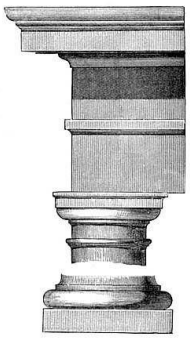

Figure 36. Tuscan Warrant

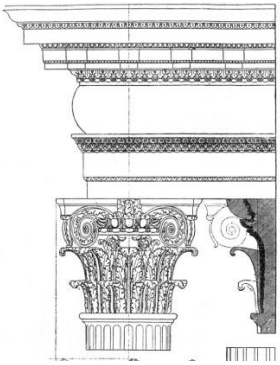

Figure 37. Composite order

Conclusion: Analyzing the structure of the formation of the ancient world, the ancient Egyptian buildings, such as the Ponzi scheme, caisson, introduced to facilitate the construction of the dome in the Pantheon, becoming part of the interior, it can be argued that the structural feature of the building along with construction materials, such as Greek buildings of churches that use marble, the Roman introduction of arched structures with the discovery of concrete, as well as the organization and process of construction influenced the formation of architecture.

One can see how the movement of information to solve problems in construction affects many countries, moving in all directions, as through literature and other arts transmitted knowledge and skills, and through the ideas, rumors and visions of war.

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