



# Building Production Processes Planning and Management in Classical Greek Era; Comparison with Contemporary Practices

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## Abstract

Through the example of the Classical Greek Era, the study focuses on seeking an answer to the question of whether managerial techniques and strategies were developed in building production processes in ancient times. The study aims to identify and examine the stages planned in the building production processes and the construction management and organization techniques developed during the Classical Greek period (VI.-IV. century BCE), which played an important role in the development of building art and to compare the practices of the Era with today's construction and management practices. The research methodology is based on the interpretation of historical data from the Classical Greek Era, consisting of construction texts written on stone slabs and their epigraphic explanations, and the comparison of the practices of the Era with contemporary practices. The stone slab samples with the construction texts used in the study were taken from the Sara B. Aleshire Center for Greek Epigraphic Studies catalogs at the University of Berkeley. The epigraphically analyzed descriptions of these inscriptions by different authors were obtained by searching the literature sources through the catalog numbers given to the samples. In the classical Greek Era, three main administrative public bodies made decisions on construction, planning, and managing the construction processes. These include the Senate, Ecclesia (people's assembly), and building commissions. By the decision of the people's assembly, building commissions were established to manage and supervise the construction process from a financial, administrative, and technical perspective. This research has contributed to the understanding that today's building production strategies and management theories have their roots in ancient times, thereby contributing to the universality of construction and management theory. Due to the dynamic nature of the research, the period analyzed was also compared with the current production management theories. The study's uniqueness lies in interpreting historical documents and observing and comparing current conditions. Hence, while the construction and management systems in the Classical Greek period are understood, two different processes are analyzed in their own contexts, and their differences and similarities are highlighted.

## Keywords:

Construction management, construction production process, ecclesia, Greek period.

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## INTRODUCTION

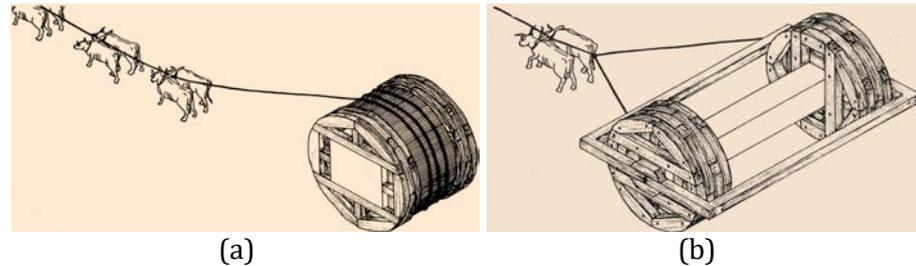
In ancient times, as it is today, construction projects are a production, and their outputs emerge from managerial decisions and planning. The building production process encompasses all the actions and relationships from beginning to end (Yaman, 2009). Labor, materials, machinery equipment, money (capital), and management parameters, which are the inputs of the building production process, emerge as value-added and are presented to the user. Construction management is the most crucial factor in the production process of adding value (Akbiyıklı & Dikmen, 2019). Construction management is the definition and planning of the time, quality, and budget organizations carried out in the construction processes that continue until the emergence of a new building as a need, the decision to build, design, project design, construction and commissioning, and the description and planning of the relations of those involved in production for building production. Along with the careful design and use of quality construction materials and construction techniques, the planned phases of the construction process and the effective execution of the construction management and supervision systems have also played a significant role in maintaining the monumental historic buildings constructed during the old period. Large-scale public constructions such as the Egyptian pyramids, the Great Wall of China, the Parthenon, Hagia Sophia, and Süleymaniye were the product of long and complex production processes and efforts that required well-planned construction management strategies and organizational techniques.

Like other civilizations, the Greeks used building art and technology to demonstrate their power, especially during the Classical period (6th to 4th centuries BCE). By this means, the construction activities in prominent Greek cities such as Samos, Naxos, Athen, and Corinth formed the basis for Greek architecture. A number of Greek architects, including Theodoros of Samos, who studied in Egypt and designed and managed the temples of Artemis in Ephesos and Hera in Olympia during this period, as well as Skopas of Paros, who constructed the temple of Athena in Tegea, made a significant contribution to the development of building art and technique during this period. In addition, some architects, such as Kallikrates, the designer and builder of the Parthenon in Athens, were both architects and builders, working in design and construction. (Pfarr, 1985).

On the other hand, the Greeks also developed new techniques in construction during the Classical period. In particular, they used the wheel to transport large-sized stone blocks and used beasts of burden instead of humans as traction power (Coulton, 1977). For easy transportation of large stone blocks and column drums, circular wooden wheels (Paconius method) and wooden frame systems attached to the wheels (Metagenes method) were developed (Figure 1).

**Figure 1.** Transportation of large stone blocks and column drums by wooden wheels (Coulton, 1977, fig. 62), (2023).

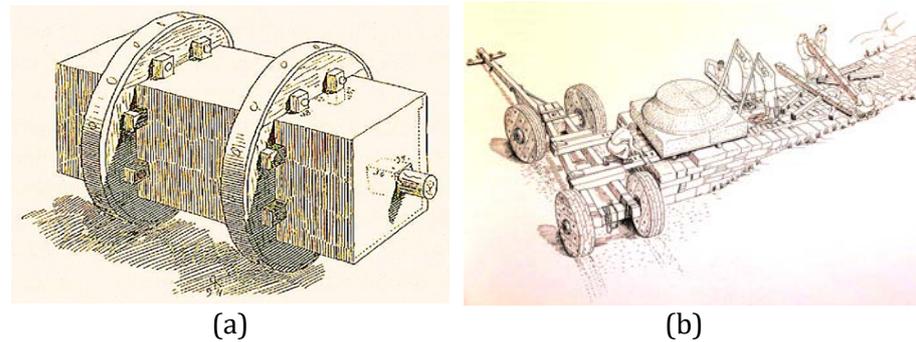
- a. Transportation by Paconius method
- b. Transportation by Metagenes method



These applications, which were only used once, such as the transportation of column drums with wooden wheels, were abandoned over time and replaced by carts manufactured when the wheels were combined with a carrier (Figure 2).

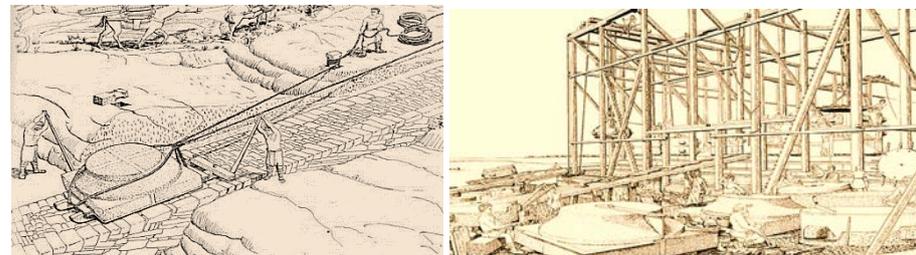
**Figure 2.** Transportation of column tanbur and column base with wooden wheels and wheeled carts, (2021).

- a. Transportation of the column drum by base placing it between the hoop wheel pulley (Koldewey and Puchstein 1899, Figure 98)
- b. Transportation of the column base by wheeled car, (Korres, 2000,



However, if the transport route was inclined, wooden sleds and ropes that provide a braking effect were used to prevent the stone blocks from sliding. In addition for the first time, wooden piers that can be raised gradually were used instead of high ramps like the Egyptians used, and materials were carried up to the upper levels in the building area (Figure 3).

**Figure 3.** Transporting the column base stone and restitution view of the wooden pier used in the construction of the Parthenon (Korres & Vierneisel, 1992), (2020).



Additionally, wooden skids and ropes were used if the transportation route was inclined to provide a braking effect and prevent the stone blocks from slipping. Meanwhile, instead of high ramps, as the Egyptians used wooden scaffolds with a gradual rise to carry materials up to the upper floors of the building area for the first time.

Construction texts on stone slabs unearthed during excavations at Greece's sacred sites such as Boeotien Livadia, Delos, Delphi, Epidauros, and Athens are the essential sources providing information about the stages in the production process and the management of construction projects undertaken during the Classical Greek period. Through epigraphy, some of the stone slab texts have been analyzed by different scholars. Through these inscriptions, it was possible to understand how meticulously the buildings of the Classical Greek period were planned

and constructed and how regularly management and organization systems were designed and implemented. Depending on their importance in the construction process, stone construction texts explaining administrative decisions and processes generally provide information on;

- Information on the decisions taken by public organizations on the implementation provisions of construction projects,
- Project descriptions,
- Technical specifications, tenders, details of suppliers, and information such as type, quantity, and price of materials to be used in the construction,
- Construction contracts between building commissions and contractors,
- Justification documents, including periodic reports on the source and use of construction-related funds provided by building commissions.

Initially, literature sources that provide information on the construction processes and management of the Classical Greek Era were analyzed. As part of the research process, three stone slab samples explaining construction practices of the period were selected from the Sara B. Aleshire Center for Greek Epigraphic Studies at the University of Berkeley, and the epigraphically analyzed explanations of these samples by different researchers were obtained by scanning the literature sources based on their catalog numbers in order to develop the research topic. Among the examples, the first plate, "I.G. I.3.35" describes the decision of the people's assembly on the construction of the Temple of Nike on the Acropolis of Athens and the establishment of the building commission, the second plate, "I.G. IV.2.1.102" describes the acquittal document for the Temple of Asclepius at Epidauros, where the post-construction accounts were checked, and the third plate "IG II/III (2). I.1.1.6" describes the general administrative specifications prepared by the building commission for the reconstruction of the Temple of Athena Alea in Tegea. In addition, the stone slab numbered IG II 167, on which the construction contract and technical specifications of the Telesterion of Eleusis were inscribed, and the sample data containing the epigraphic explanations of the inscription were obtained from Lattermann's doctoral dissertation in 1908. Based on the interpretation of the epigraphic descriptions of the epigraphic texts of the stone slabs selected as examples, and with the support of other stone inscription texts published by different researchers, the data was able to determine the building production processes and administrative techniques valid during the Classical Greek Era, and these were presented as figures and tables. By comparing construction management theories developed today under different perspectives with those developed during the study's period of study, the construction and management practices of the period were assessed.

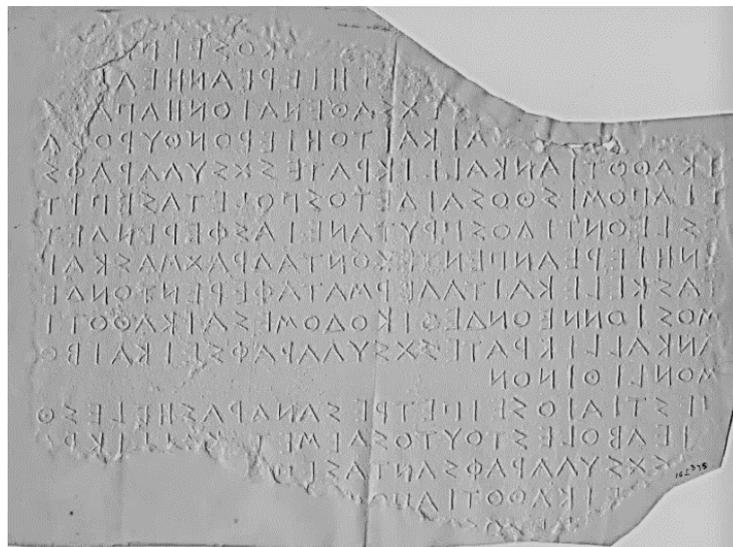
Research on this subject is, however, generally limited to the interpretation of stone inscriptions by linguistic experts through epigraphy or linguistic interpretation. No original study examines the building production processes and administrative techniques of the

period under study and interprets them by comparing epigraphic data with contemporary practices. This study aims to fill this gap as well. However, due to the limited number of stone slabs unearthed as a result of the excavations and the fact that some of the slabs were fragmented and the inscriptions on their surfaces were eroded to the extent that they could not be read, the number of examples that provide holistic information on the subject of the research constitutes a significant challenge for this study. Over the course of 50 years of excavations at Epidauros, only 30 stone inscriptions were found, some of which could not be read at all, and some were partially read but could not be interpreted. (Prignitz, 2014).

### **BUILDING PRODUCTION PROCESSES AND STAGES IN THE CLASSICAL GREEK ERA**

In the classical Greek period, when a public building was to be constructed, it was first necessary for the Ecclesia (the people's assembly) to decide on the construction (Maier, 1961). The construction decision taken in the Ecclesia was submitted to the Senate, a higher authority, for approval (Bingöl, 2004). Based on the construction decision approved by the Senate, a building committee was established by the people's assembly depending on the type of construction (Honsell, 2010). If the building to be constructed was a temple structure, the commission was called the "temple building commission" (Naopoioi; temple builder), and if it was a city wall structure, it was called the "wall building commission" (Teichopoioi; wall builder) (Burford, 1969). The construction process is initiated by the establishment of building commissions following the decision of the Ecclesia to proceed with the construction.

The construction decision taken by the Ecclesia regarding the Temple of Nike (5th century BCE) on the Acropolis of Athens is an important example in this regard. An example of the stone plate numbered "I.G. I.3.35" on which this decision is inscribed given in Figure 4.



**Figure 4.** Figure 4. Resolution Adopted by the Ecclesia for the Construction of Temple of Athena Nike, (<http://aleshire.berkeley.edu>), (2020).

The epigraphic decipherment of the decision of the Ecclesia inscribed on the stone plate I.G. I.3.35 is presented below ([www.2.hu-berlin.de/winckelmann](http://www.2.hu-berlin.de/winckelmann)).

For the construction of the sanctuary of Athena Nike, a priestess was chosen by lot from among all Athenians, an entrance to the sanctuary was built according to the plan of the architect Kallikrates, citizens from the prytane (pioneer) of the Leontis region were paid to work on this project, the priestess received 50 drachmas and the thighs and skins of the victims, The construction of a temple and a marble altar according to the plan of Chalicrates, the establishment of a building committee consisting of three people to take care of the construction and materials, the commission to carry out the planning together with Chalicrates, and the declaration of every work done to the Ecclesia at the end of the contract.

In this construction decision taken by the Ecclesia, it was stated that the architect was pre-selected and that the selected architect should work with the building commission. A public announcement of the decisions of the people's assembly was placed or posted in a public place. (Pfarr, 1985).

The first task of the building commission is to obtain the estimated costs of the building to be constructed. Once the approximate cost of the building is obtained, the commission organizes the budget based on the estimated cost values by utilizing public and local resources to cover the construction costs. (Osthues, 2014). This process involves the building commission tendering the construction work to a contractor at the estimated cost values following the technical and administrative specifications, where the source of the construction work has been prepared in advance. The signing of the construction contract follows this. (Osthues, 2014).

In the classical Greek period, for large-scale public constructions such as temples, theaters, stadiums, and city walls, no general contractor could complete the entire construction based on a single contract. The construction was therefore divided into work groups, and separate tenders were issued for each work group, resulting in multiple contractors being employed during the construction process. (Thür, 1984). The Temple of Asclepios building commission at Epidauros tendered the stone works to 13 different contractors and the metal works to 12 different contractors, resulting in 25 separate construction contracts for a single building (Burford, 1969). Similarly, 42 different contractors were hired to construct the Temple of Athena Alea at Tegea (Thür, 1984). The stone inscription of the Telesterion of Eleusis reveals that the construction was tendered to 3 different contractors, and contracts were made (Lattermann, 1908).

There is a construction contract between the building commission and the contractor of the Telesterion of Eleusis, inscribed on a stone slab numbered IG II 167 and dated 330 BCE (Figure 5).

**Figure 5.** Construction contract between the building commission and the contractor of the Eleusis Telesterion (Lattermann, 1908). (2023).



There is a general description of the construction contract for the Eleusis Telesterion in general terms. Approximately eight months of work will be performed from December to August each year, the works must be carried out in accordance with the architectural drawings and the tender conditions, and the architect Philon and Epistat Melanopos will supervise each phase of construction. The building commission would penalize the contractor if he did not adhere to the contract terms, and the tender would be canceled and re-tender. In the technical specifications section of the contract, there are technical explanations on the type of stones, the width and thickness of the stylobate stones in steps, the number and height of columns, the length, width, and thickness of the other row, and cornerstones to be used, and that the stones should be connected with dowels and clamps before the lead is poured. (Lattermann, 1908).

A stone inscription found in the Boeotian Livadia region of Greece in 1875 contains a contract between the temple building commission and a contractor, including technical specifications and payment terms. In the contract;

The temple building commission states that the metal and stone work, the preparation of the inscription plates, and the ornamentation work will be done at the same price, while the Poros stonework will be done for five drachmen per stone. For the transcription and painting of the letters, the contractor will be paid one stater and three obolens per 1000 letters. The contractor is to start work immediately after receiving the prepayment and complete the work within ten days with at least five technical assistants. The contract then moves on to the penalty clause. In this section, it is stated that if the contractor fails to comply with the conditions specified in the contract or makes deficient or faulty work, the contractor will be severely penalized by the temple building commission on the grounds of unjust gain once this situation is detected by the Epistates, who are in charge of supervision. The contractor will also receive prepayment for the decorations he is required to make based on the inscription plate given to him, and after depositing ten percent of the prepayment amount as collateral, he will receive payment for the second

stage if he proves that he has completed the work in accordance with the terms of the contract and to the satisfaction of the temple construction commission and the architect. Upon completion and delivery of the entire work, and if no penalty has been imposed on him during the construction process, he will also receive the ten percent deduction of this portion of the amount he has left as collateral. The other part of the contract includes the technical conditions of the work. Accordingly, the company will place eleven ornaments on the existing inscription plates. Following the previously given model and the specifications specified by the commission, the existing iron clamps on the plates will be removed and forged, deep holes will be drilled, a lead will be poured, and the plates will be placed back in their proper place. After deducting ten percent as collateral, the operator will receive the second payment after showing that the forged inscriptions have been replaced by pouring lead and that the decorations have been mounted on the inscription plates. The builder will receive the remaining payment along with the collateral once the decorations have been completed and approved by both the People's Assembly and the architect. The last part of the contract explains that other matters not covered by this contract will be dealt with in accordance with the law on construction control and the general law on temple construction regulation (Dörpfeld, 1882).

It is seen that contracts with contractors stipulate that each stage of the work undertaken will be controlled and that one stage cannot be started until the other stage is completed and delivered. In addition, the contractor is given a prepayment with a surety guarantee before the start of construction. An amount equal to 10% of the prepayment given to the contractor is deducted as collateral, and this collateral is returned to the contractor at the first payment after the final acceptance of the work. After receiving the advance payment, the builder has to start construction at the time set by the building commission. If the contractor did not start work within the time specified in the contract, he had to pay back double the amount of money he received (Thür, 1984). In addition, if the contractor failed to fulfill all or part of the work undertaken or did it incorrectly, the construction commission would tender that part of the work to another company. The company whose work is to be terminated in this way must pay to the temple construction commission the advance payment given to it at the beginning of the work, all payments it has received so far for the construction based on the general sum, and the penalty of 1/5 of the total cost imposed on it by the commission and other penalties if any (Pfarr, 1985). If the enterprise fails to pay the advance payments and penalties, the money is collected from the guarantor, who, according to the contract terms, acts as surety for the enterprise (Bohn, 1982). A certificate of acquittal is issued as the final acceptance of the construction after all contractors have completed the work according to the contract terms. (Bingöl, 2004). I.G. IV.2.1.102 is one example of a stone slab prepared by the building commission in the first half of the 4th century BCE., which contains part of the acquittal document presented to

the assembly of the people. In Figure 6, the breakdown of the work performed during the five-year construction period for the Temple of Asclepios of Epidauros, which was designed by Theodotus, is presented along with the payments and names of the contractors and guarantors.



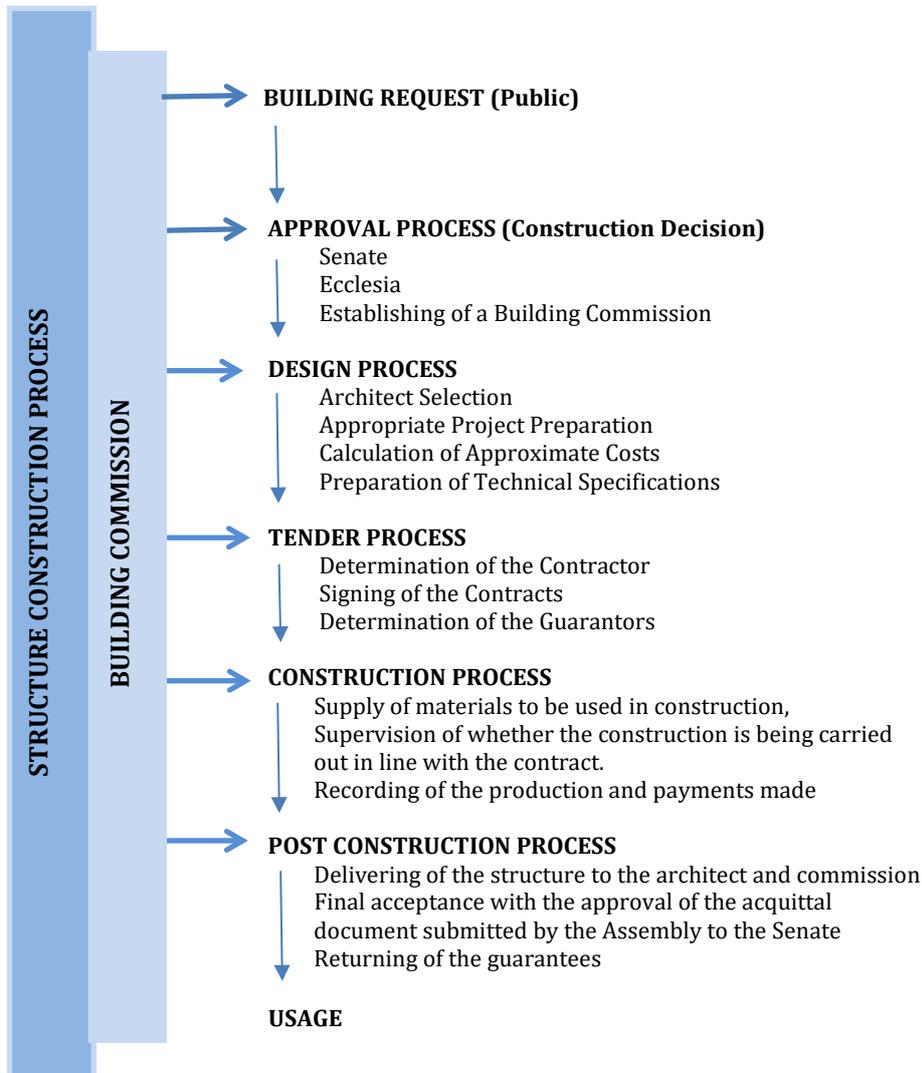
**Figure 6.** Certificate of release on a Stone Plate at Temple of Epidauros Asclepios (<http://aleshire.berkeley.edu>), (2020).

Part of the analysed version of the text of the release certificate written on the stone plate shown in Figure 6 is given in Table 1 as a general example. (Burford, 1969).

**Table 1.** List of expenditures of the temple of Asclepius in Epidaurus

Amount Paid (Drachmas)	Payee (Constructor)	Guarantor	Work Done
9800	Thrasymedes Pythokles	Theopheides Hagemon	Construction of balustrades in between the ceiling, interior door, and columns
6400	Lykios (Corinth)	Orsias Hagemon	Quarrying and transportation of stones for Peristasis,
6167	Euterpidas (Corinth)	Pyrrhias Aristandros	Quarrying and transportation of stones for half of the cella,
4400	Achilles (Corinth)	Milatos, Orsias	Quarrying and transportation of stones for half of the cella,
4320	Mnasillos Lakrines,	Euanthes	Quarrying and transportation of stones for the floor and ramps
3200	(Argos).....	Stratos	Construction of the cella
3068	Sotades (Argos)	Aristolas	Peristasis construction
2800	Kaphisias Lysion,	Nikaios	Glue for the door
2340	Theodotos	Theoxenidas	Pediment: acroters
2000	Mnasikles (Epidauros)	Kleanor	Quarrying, transportation and avement of stones for the foundation,
1610	Hektoridas Philoklidas,	Timokleidas	Completion of half of the pediment
1400	Damophanes	Aristophylos	Delivery of nails, rings, ring bearings, and latch for balustrades between columns
1385.	Antimachos (Argos)	Nikatas	Quarrying, transportation and pavement of stones for the foundation of the cella,
1336	Marsyas Antikritos,	Aristophylos	Polishing of internal and external columns
1050	Polemarchos Lykinos	Peristase:	Painting using Encaustic technique or painting the illustration of Stymphalos
900	Timotheos	Pythokles	Making and supplying of Typoi
882 Dr/3 Ob.	Euterpidas	Epistratos	Provision and transportation of stone ballast, and putting up of walls
843 Dr/2 Ob.	Lysikrates Eudamidas,	Lakrines	Quarrying, transportation and pavement of stones for the laying of the foundation
799	Mnasikleidas	Aristomedes	Supply of bricks
550	Kleandrides (Corinth)	Kleidikos	Polishing of the inner walls of the cella
540	Dorkon (Corinth)	Kleanor	Coloring of the cella and painting of illustrations
353	Theodotos	Architect	Annual charge

Based on the information obtained from the epigraphic descriptions of the stone slab samples presented in this article, as well as from epigraphic studies conducted by other researchers, it is evident that building production processes during the Classical Greek period consisted of seven successive and interrelated stages (Figure 7).



**Figure 7.** Chart of the Structure building production Process in Classical Greek Period

### **Building Management Organization; Operation of Public Units And Their Duties**

In the classical Greek Era, three primary administrative public bodies made decisions regarding construction as well as planned and managed the construction process. These are the Senate, the people's assembly, and the building commissions. (Osthues, 2014).

#### **A. Senate and Ecclesia**

In the 6th and 4th centuries BCE., the classical Greek period, the highest body deciding on construction was the Senate and the popular assembly. The name of the people's assembly is Ecclesia. The popular assembly functions as the citizens' government in the Greek city. The popular assembly and administrative staff were selected by lot (Akad et

al., 2017). In practice, participation in city governance corresponds to a wide range of roles in the city's political and social life. Despite the breadth of roles in the political life of the city, such as civil service, military service, tax obligation, the right to vote and the right to be elected as an administrator, the right to sue, the right to judge, the right to take part in the people's assembly, and the right to be an archon, each of them is characterized as citizenship (Akkoç, 2014). It is seen that different roles in the city's political life were distributed to citizens in proportion to their wealth. While the poor thetes could only participate in the public assemblies, noble landowners or the rich in trade could become administrators. (Ağaoğulları, 2013).

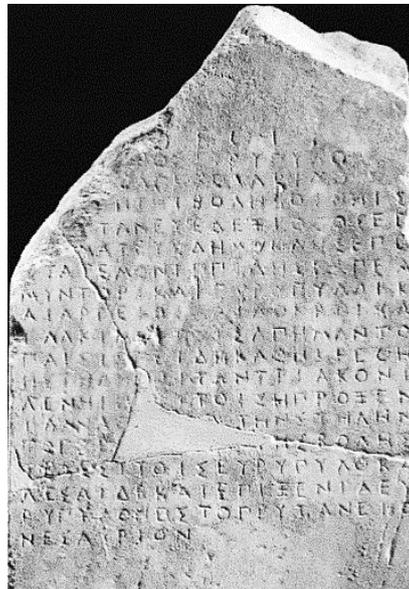
In this regard, every application for construction that comes to the popular assembly consisting of theteses has to pass through the Senate. Therefore, both assemblies are responsible for a construction decision (Bingöl, 2004). Following the construction decision taken by voting in the Senate, decisions regarding the establishment of the building commission, how many and from whom the commission would be composed, the commission's working period, and the architect's selection were also decided in the people's assembly. (Honsell, 2010). Philon was appointed by the popular assembly to oversee the technical aspects of the construction of the Eleusinian Telesterion (Lattermann, 1908). In addition, the final acceptance of the completed building and the acquittal of its accounts were also possible with the approval of the popular assembly and the Senate.

### **B. Building Committees**

In the classical Greek Era, a building committee was established for every building to be constructed with the decision of the people's assembly. The members to be elected to the building committee were required to be over the age of 30 and not owe any debt to the state (Kahrstedt 1969). The names given to the building commissions differ depending on the region. In Athens, the building commission for the construction of the Parthenon was called Epistatai, in Miletus, the building commission for the construction of the temple of Didyma was called Erlogistai; and in Tegea the building commission was called Esdoteres (Bingöl, 2004). The number of members in the commission is determined by the people's assembly, depending on the size and type of building. In general, the commission consists of a chairman, a chief sage (a priest or priestess if it is a temple building), an "Epistat" who oversees the construction of the building in compliance with the contract and specifications, two "Tamiiai" who organize all the financial affairs of the construction and make all payments associated with the construction, and a clerk who records the work and payments and prepares reports that are submitted to the people's assembly at the end of the work to be voted on and acquitted in the Senate. (Wittenburg, 1978). From the accounts of the building committee for the Parthenon (447/6 - 433/2 BCE), it is assumed that the commission consisted of 3-5 members, except

for one clerk. While a new commission was elected every year until the 11th year of the Parthenon's construction, the same commission served for the last four years (Osthues, 2014). The chairman of the building commission is usually the chief administrative officer of the region. In Miletus, Stephanephoros, the city governor, was elected as the chairman of the commission established for the construction of the Didyma Temple of Apollo (Bingöl, 2004). The names of epistates are also found in some inscriptions. Melanopos was assigned as an epistat for the construction of the Eleusis Telesterion (Lattermann, 1908). Meanwhile, in the Classical Greek Era, the financing problem had to be solved for a building to be started, as is the case today. Several methods were used during this period to generate income to meet the construction costs, which were among the most important duties of the building commission. The most prominent of these was public financing, including undertaking a portion of the construction costs through foundations established by top administrators, tax revenue, and transferring unused budgets from some buildings. Further, revenue-generating solutions have been developed through the use of materials derived from the demolition of an old building, the sale of animal skins sacrificed for religious reasons, donations from the city government, and the use of public properties for revenue generation. The columns built by the Lydian king Croesus for the Temple of Artemis at Ephesos at his own expense in 560-550 BCE, and the naos of the Priene Athena temple, financed by Alexander the Great and engraved on the wall of the built section, are examples that show that rulers covered some of the construction costs as a reflection of their piety (Gaertringen, 1906). Furthermore, Antiochus, the eldest son of King Seleucus, had a stoa of one stadium length built in Miletus in the early 3rd century BCE, and the annual revenues from the rental of the stoa were used as the king's grant for the construction of the Temple of Apollo in Didyma. (Günther, 1971). Moreover, for the reconstruction of the Propylaia on the Athenian Acropolis, the sale of building materials and the skins of sacrificed animals from the demolition of the old propylon and the renting of a house (temple) of a god built in 435/6 BCE for 132 drachmas per month were used (Wittenburg, 1978). Another example of generating revenue for construction is the aid provided by city-states to maintain, improve or restore political relations between them. Lampsakos (Lapseki) and Kyzikos (Erdek), two of the most important city-states of Anatolia, allocated 70 and 46 gold Stater, respectively, for the construction of the Parthenon (Bingöl, 2004). As these examples indicate, in the Classical Greek Era, construction costs were not of a magnitude that could be borne only by the public or an individual. For this reason, the building commissions created the construction budget by providing income sources in various ways in order to meet the construction costs. After the building commissions established the construction budget, a construction specification was prepared in line with the decisions taken in the public assembly, and tenders were organized as an agreement platform with these contractors. The

constructions were tendered to the contractor offering the lowest price through dutch auction. (Thür, 1984). Sometimes the contractors were the building owners themselves, and they made the contract with the building commission. In Miletus, the employer of the Temple of Didyma, that is, the owner and builder of the temple is the city administration. The city administration undertook the construction of the temple itself by making a contract with the building commission established by the people's assembly. (Bingöl, 2004).Tegea Athena Alea Temple which was unearthed in Piali, Greece (today's Alea) in 1860, had a general list of specifications for its construction, which laid out the legal rules regarding the tender. The building, after being burnt down in 395/400 BCE, was rebuilt where Skopas of Paros also worked as an architect. The stone plate numbered IG II/III (2).I.1.6. which includes the text of the specifications prepared by the Building Commission set up in Tegea, is given in Figure 8.



**Figure 8.** General Specification Prepared by the Building Commission for the Reconstruction of Tegea Athena Alea Temple (<http://aleshire.berkeley.edu>),(2020).

The epigraphically analysed explanation of the specification text, which consists of six articles, is shown below (Thür, 1984: 475).

- 1 . The building commission shall be in charge of solving a problem that may arise between contractors. The complainant is obligated to report their complaint to the commission within three days after the incident and to ensure that a decision is taken.
2. In a state of war, if the construction process has stopped or the completed structural elements have been destroyed, the decision of the Boule on this issue shall be binding. This council shall make the necessary investigation and take the decision. If the situation is determined to be true, the necessary compensation shall be made from the loot. In cases where an outbreak of war occurs before the construction process begins, the building commission shall annul the contract, and the contractor shall return the prepayment that was received. Should any person prevents the tender to be awarded, or vitiate the tender, he shall be punished.

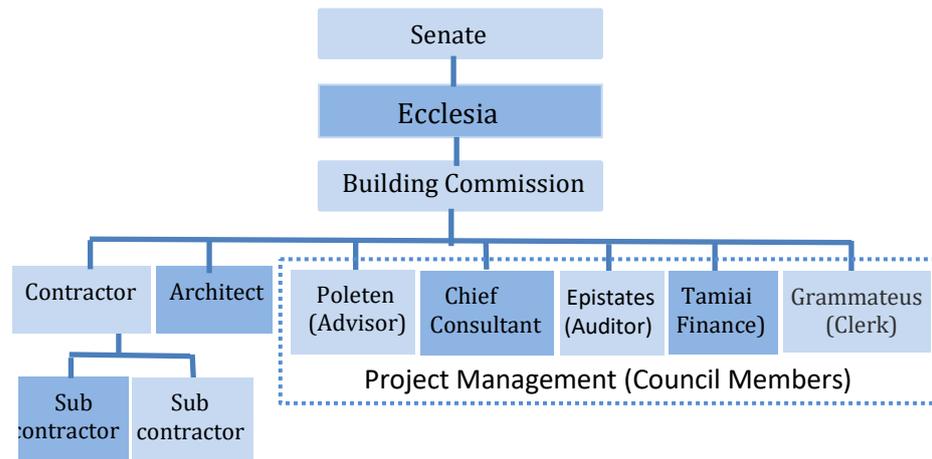
3. Not more than two contractors shall participate in any tender, and one contractor shall not participate in more than two tenders simultaneously without the consent given by the "haliast" unanimously (the name given to the People's Assembly in the Doris region). Otherwise, for each extra work undertaken, the contractor shall be obligated to pay a fine of 50 Drachmas each month until the end of the work.

4. Should the contractor damage religious, social, or private structures in defiance of the agreed-upon contract, he shall be obligated to repair the inflicted damage at his own expense and within the working period determined in the contract.

5. Legal action shall be initiated in cases of indiscipline, riposte to the discourse of construction supervisors, or non-execution or non-payment of penalties.

6. These provisions shall be valid and binding for all labor after the award of the tender.

Another task of the building commissions in the classical Greek period was to issue a certificate of acquittal after the construction was completed. Similar to today's certificates of completion, acquittal certificates consisted of a report recorded by the scribe members of the building committee during construction, in which the breakdown of the work done, the work groups, the money paid to the contractors, and the cost of the workgroups, and the names of the guarantors of each work group were written item by item. The primary purpose of preparing these account reports, defined as a certificate of acquittal written on stone and on which no corrections are allowed, is to determine whether the resources provided for construction were used correctly and to prevent embezzlement (Wittenburg 1978). These documents, prepared by the building commissions, are approved by the Senate, and the people's assembly and the construction are acquitted (Bingöl, 2004). The account documents of the Parthenon in Athens first indicate the source of the money and its intended use. First, the amount remaining from the previous commission, namely from the previous year, was recorded in the document. Especially from the second year (446/5 BCE ) until the 14th year (434/3 BCE ) for 15 years, at the top of each account list, it is recorded that 70 gold Stater from Lampsakos (Lapseki) and 271/6 gold Stater from Kyzikos (Erdek, Belkis) were continuously transferred and not spent. The amount of money remaining in hand is written at the end of the record. The document also includes expenditures on purchased materials and wage earners. Expenditures on purchased materials and wage earners are also included in the document. There are records of payments in general, but payments to workers in Pentelikon marble quarries, including transportation of blocks from Pentelikon and their processing, are expressly mentioned (Budford , 1969). In this context, the findings obtained in the research were evaluated and the construction management and organization chart, together with the titles of the members of the building commission, who took part in the building production processes in the Classical Greek period (Figure 9).



**Figure 9.** Organizational Chart of Construction Process in Classical Greece

### C. Architects

Greek philosopher Plato, who wrote that the architects who were not involved in the building commissions but worked in the construction and management organization, also stated that the architect was in a leadership position in the construction site and was also responsible for coordinating the contractors (Sekler, 1959). Bundgaard (1957); stated that there were no detailed plans and general models prepared for the structures constructed in the Classical Greek period, only the stone inscriptions that explained what should be done until the final stage of the construction. It is clear that in such a work style, the fact that the architect explained what had to be done within the framework of the traditional plans to the subcontractors in writing, and rarely by using plans and models, shows that the architects played an active role especially in the construction phase Plato also emphasized that a Greek architect must be trained by practicing with an experienced expert (Sekler, 1959). This shows that in the Classical Greek period, the duty of an architect was not only to design a new temple or to construct a new structure, but also to carry out the construction of a building that was decided to be built under different ground conditions. Therefore, the architect had to have sufficient knowledge about buildings and conventional plan types, and in the construction process, carry out all organizations in the construction site (Ricken, 1977). As it can be understood from here, it is seen that the architects independently managed and supervised the construction technically.

### FINDINGS AND COMPARISON

The findings of the evaluations made on building production processes, stages and management, which have been obtained based on the analysis of the stone inscriptions of the Classical Greek period and the literature review, are given below with their general characteristics:

- In the Classical Greek period, financial, administrative and technical organizations, which were designed according to the laws prepared regarding public productions, led to the formation of a production-management system and organization that shaped functions and duties.



- Building production processes consist of multiple phases that follow each other but are not separated by definite boundaries, which started with the establishment of the Building Commissions by the People's Assembly after the approval of the construction decision in the Senate.
- There were also specific administrative and technical organizations formed by certain institutions and people who were involved in the building production processes. The construction management and organization chart were shaped accordingly.
- In the reviewed period construction expenses were too high to be covered by the public or an individual alone. In the financing of the construction, besides the use of public resources, solutions were produced such as contributions made by the high-ranking officials through their foundations, or citizens' undertaking a part of the construction costs.
- The construction works were awarded to the contractors who made the lowest bid, in accordance with the technical specifications prepared before the construction. Down-payment was given to the contractors who won the tender and guarantees such as guarantor collaterals were received from the contractors in return. Advance payments made to the contractors aimed at securing the builder, while the guarantors' collaterals aimed at securing the construction.
- After the construction was completed in the period under review, "Release documents" were drawn up as a report showing the total cost of the construction together with expenditure items. After these documents were approved by the highest institutions of the state, the phase of use in construction started.
- During that time, there were laws explaining the rules to be followed regarding the construction. These were Building Control Law and Construction Regulation Law.

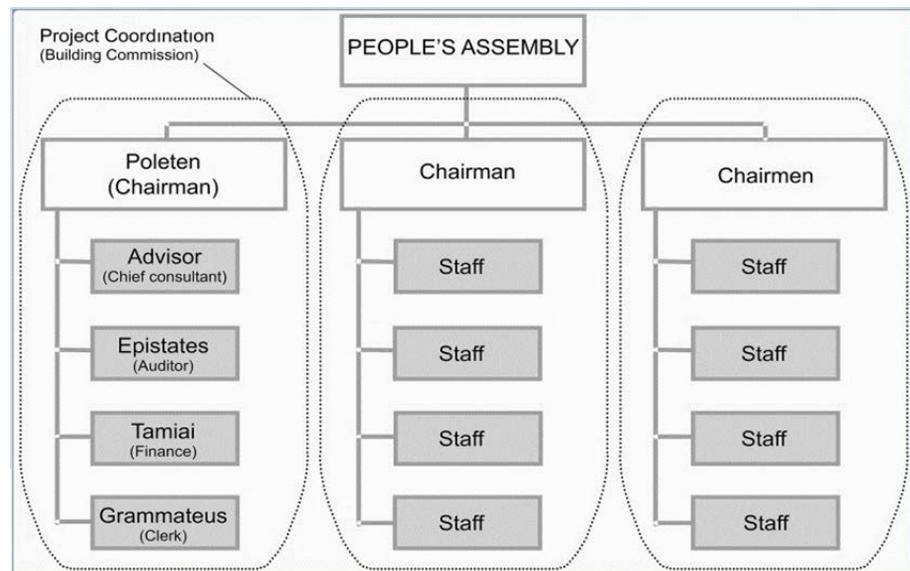
Table 2 shows the findings based on the stone inscriptions relating to the stages followed in the building production processes in the classical Greek period, the institutions and people involved in the stages.

**Table 2.** Building production process stages and management table specific to the period examined

Stages	Institutions	Actors	Regulations	Project Management and Construction Method	Collaterals and Guaranties	Architectural Organization
Construction Decision Approval Design Cost calculation Tender Construction Acquittance document General acceptance	Senate Ecclesia Building Commission	Chairman Chief consultant Financier Auditor Clerk Architect Contractor	Building Control Law	Building Commission  Tender Contractor)	Guarantor	Freelance architects

The purpose of construction management in ancient times, as it is today, was to effectively manage the production processes in a

construction project and build and deliver the targeted structure. Construction management strategy was the coordinated set of decisions that drove a construction project organization. Construction teams in a construction project consisted of employers, designers, managers, builders and auditors (Akbiyıklı & Dikmen, 2019). In addition, project structure organizations were usually "coalitions" formed as "ad hoc multi-organizations" (Hobday, 1998). When the production was completed, the organization disbanded. In the period under review, the construction team consisted of employers (public assembly and senate on behalf of the public), designers (architects), managers (building commissions) and auditors (architects and Epistats). Although the strategic decisions regarding the construction were taken by the public assembly and the senate, the main actors of planning and production management in the construction processes were the Building Commissions. For each new construction project, new building commissions consisting of different members were established depending on the type of building, and these temporary organizations were dissolved after the construction was completed and delivered. This situation shows an analogical overlap with the current project-based construction management organization scheme. The project-based construction management organization chart, specific to the Classical Greek period, created by adaptation from PMOBK (2009) is shown in Figure 10.



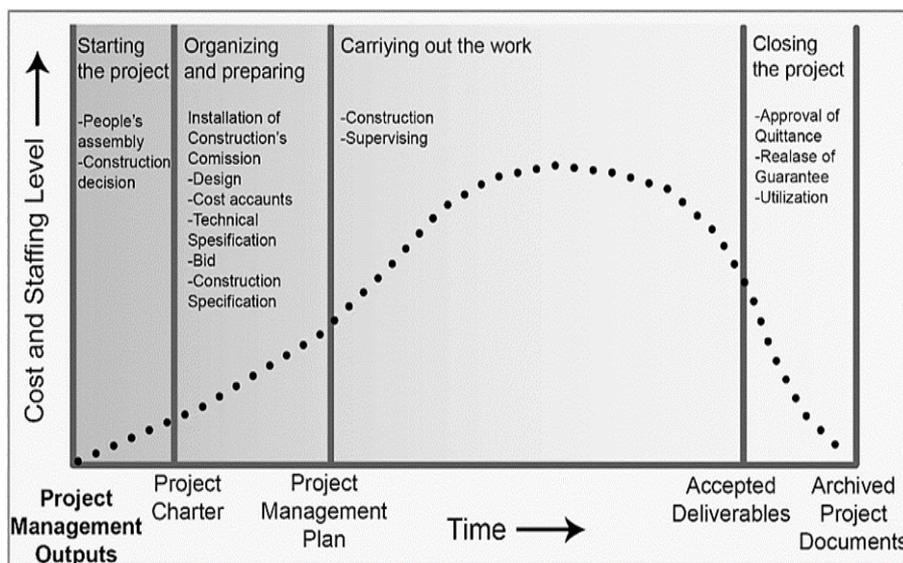
**Figure 10.** Classical Greek Period Project Based Production Management Organization Chart

On the other hand, according to the “transformation view” that emerged as the dominant approach in the 20th century, production has been conceptualized as the transformation of inputs into outputs. Here, production envisages the division of total transformation into smaller transformations, jobs and minimization of each job independently

(Koskela, 1999). In the period under review, the productions were similarly divided into small business groups, each work group was

independently awarded to different producers and many production contracts were signed. However, the fact that the construction was divided into work groups and built in small parts in the period under study was due to the lack of a general contractor to construct a building completely, rather than the cost minimization purposes. The managerial and performance problems that would surely arise especially during the construction process due to the multi-part structure of the construction projects specific to the periods examined, were sought to be eliminated by effective audits as well as administrative sanctions and financial penalties imposed on construction contracts. Also, every construction project had a life cycle. Turner (2006) emphasizes the natural existence of five steps in the life cycle of projects (stages): Concept, Feasibility, Design, Application and Closure (Turner, 2006). In the project life cycle stages presented by Turner (2006), It seems that the first three steps cover the pre-production process; the fourth step includes the implementation process, and the fifth step covers the post-production process. These steps are also valid for the project life cycle stages specific to the period examined. The general diagram created by adaptation to PMOBK (2009) and which shows the project management processes corresponding to the current project life cycle steps and the levels of those involved in cost and project management in the Classical Greek period is shown in Figure 11.

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**Figure 11.** General Diagram showing the construction processes and the level of those involved in cost and project management in the period reviewed Organization Chart

The Project Management Knowledge Guide (PMI Guide, 2017) prepared by the Project Management Institute also models and defines the project management processes and activities that should be used in the execution of a project. PMBOK approach is based on three theories; planning and organization (pre-construction process), execution and control (construction process), completion and termination of the project (post-construction process). In this approach, the project life cycle management shows an analogical overlap with the period examined as

seen in Figure 8. Project life cycle stages managed in the Classical Greek period were compared with project life cycle steps created by Turner (2006) and European Commission (2012) Etogether with project life cycle steps mentioned case analysis table in the "Construction Methods and Management" work by Nunnally (2001), (Table 3).

**Table 3.** Comparison of life cycle stages and operations performed in construction projects

Nunnally Project Life Cycle Stages	European Commission Project Life Cycle Stages	Turner Project Life Cycle Stages	Classical Greek Period Project Life Cycle Stages
Construction idea Concept and feasibility works	Construction idea Conceptual analysis Economic and technical feasibility Construction approval	Construction Idea Concept Feasibility	Construction idea Construction decision Construction approval
Engineering and Design	Design and engineering Works Cost Calculations	Design	Design Cost calculations
Supply	Technical and Administrative Specification Payment terms Tender	Supply	Technical and administrative specification Payment terms Tender
Construction	Production (audit)	Application Monitoring performance (audit)	Production (audit)
Implementation (trial)	Provisional acceptance	Implementation (Trial)	<b>Provisional acceptance</b>
<i>Operation Usage</i>	<i>Final acceptance Usage</i>	<i>Final acceptance Usage</i>	<i>Final acceptance/ Certificate of release Usage</i>

As can be seen in Table 3, the phases and activities managed in building production processes in the period under study coincide with the modern project life cycle steps, which are put forward under different opinions, in terms of their basic characteristics. The steps and activities that make up today's "Project Life Cycle Management" system, such as determining the project idea (building idea, analysis, approval), planning and scheduling the project (specifications, financing, duration, tender), implementing and supervising the project, and completing the project, are found to be applied during the period. As can be understood from the research, in the classical Greek period, as in today, effective supervision-based construction management and organization techniques based on post-production accountability were used in the construction processes. Thus the organizational, financial, and legal systems developed for the construction processes as well as the approach of civilizations towards a building or a building group reveal the construction management schemes of their periods.

**CONCLUSION**

It would be appropriate to emphasize the following fact that emerged as a result of the research and observations on the production processes and management of public construction projects in the Classical Greek Era, which established civilization in Europe and Anatolia and played an essential role in the development of building art. In the construction

processes of the period under study, as well as in the Roman and later periods, the financial, administrative, and technical organizations that were defined in relation to construction led to the formation of a construction-management system and organization in terms of its functioning and duties. In ancient times as well as today, the basis of quality building production was formed by construction processes carried out in regular and disciplined phases and construction management practices in which effective control was ensured at each stage.

The construction and management of public buildings were carried out by writing texts on stone slabs during the Classical Greek Era. In addition to the information obtained from the literature, historical data consisting of stone inscription examples presented in the article on the subject of the study contributed to the understanding of the construction practices of the time. Table 4 presents examples of which data are derived from which stone inscription, their epigraphic sources, and their catalog numbers.

**Table 4.** Examples showing which data is taken from which stone inscription

Explanations	Stone Slab Number	Name of Structure	Epigraphic Explanation Sources
<b>Ecclesia construction decision</b>	IG I.3.35 IG II/III(2)1.6 IG IV2.1.102	Nike Tempel Athena Alea Tempel Epidaurus Asklepios Tempel	www2.huberlin.de/winckelmann Thür, 1984 Budford, 1969
<b>Establishment of the building commission</b>	IG I.3.35 IG II/III(2)1.6 IG IV2.1.102 IG II 167 - -	Nike Tempel Athena Alea Tempel Epidaurus Asklepios Tempel Eleusis Telesterion Parthenon Tempel -	www2.huberlin.de/winckelmann Budford, 1969 Budford, 1969 Lattermann, 1908 Ousthues, 2014 Dörpfeld, 1882
<b>Architect selection</b>	IG I.3.35 IG IV2.1.102 IG II/III(2)1.6 IG II 167 -	Nike Tempel Epidaurus Asklepios Tempel Athena Alea Tempel Eleusis Telesterion Parthenon Tempel	www2.huberlin.de/winckelmann Pfarr, 1985 Thür, 1984 Lattermann, 1908 Pfarr, 1985
<b>Tender data</b>	IG II/III(2)1.6 IG II 167 -	Athena Alea Tempel Eleusis Telesterion -	Thür, 1984 Lattermann, 1908 Dörpfeld, 1882
<b>General and technical specifications</b>	IGII/III(2)1.6 IG II 167 -	Athena Alea Tempel Eleusis Telesterion -	Budford, 1969 Lattermann, 1908 Dörpfeld, 1882
<b>Acquittal Documents</b>	IG IV2.1.102 -	Epidaurus Asklepios Tempel Parthenon Tempel	Budford, 1969 Budford, 1969

As shown in Table 4, construction decisions were made by the popular assembly during the Classical Greek Era. Based on the construction decision taken, building commissions were established in hierarchical order with the decisions of the popular assembly in order to ensure the architectural, technical, financial, and administrative execution and supervision of the building to be built, and the construction management

and organization scheme was shaped accordingly. Although their names vary depending on the region, such as "Epistatai," "Erlogistai," and "Esdoterai," building commissions are the primary actors in the planning, organization, and management of construction production processes. As "project management," building commissions played an active role in all production processes until the construction was completed and put into use, such as the creation of the construction budget, preparation of technical and administrative specifications, bidding, signing contracts, making payments, supervising the construction, and preparing accreditation documents. Building commissions, which were established as project-based organizations, as is still the case today, are "temporary multi-organizations," a "coalition" consisting of several members: the chairman (Poleten), the chief sage (consultant), the auditor (Epistat), the organizer of financial affairs (Tamiai) and the clerk (Grammateus). Once the construction is completed, this multiple organization disintegrates.

As is the case today, it is observed that the state was the major employer in public construction in the period under study. Since the state bears public responsibility, it has also determined building production and management principles. In both periods, there was a civil servant logic order dominated by the state and formed by appointments. For this reason, the principles of construction management and organization used in the building production process were determined through the implementation and supervision of institutions established by the state. Additionally, it has been observed that three basic processes across both periods shaped building production processes: pre-construction processes started with the decision to build, during which planning, programming, design, economic and technical feasibility studies were conducted; construction processes, and post-construction processes, during which final acceptances were made. In both periods, the constructions were tendered to the contractor offering the lowest price in accordance with the general and technical specifications prepared in the pre-construction process, and then the construction process started. Currently, the construction of public buildings is managed and supervised by the technical staff of architects and engineers within state-owned institutions or by independent auditing firms based on plans and details prepared in advance. In the period under scrutiny, architects appointed by the decision of the people's assembly, although not taking part in the building commissions, explained to the contractors what should be done within the framework of traditional plan types in writing, but very rarely using plans and models, indicating that they took part in the construction process, especially at the construction site stage, and managed the construction in terms of technical aspects. Epistates serving on building commissions, on the other hand, are recognized to have supervised the administrative and technical aspects of construction. After the construction was completed, completion certificates were prepared, and in the Classical Greek Era, acquittal certificates were prepared, and after the acceptance of these documents by the public authorities, the

building was put into use. The construction processes taken as a basis for both periods overlap with the project lifecycle phases identified by the European Commission.

On the other hand, based on the information obtained from the stone inscription texts and comparisons, the main point that is tried to be explained here is to emphasize the universality of the theory of construction and management as the roots of today's building production strategies and managerial theories date back to ancient times. Despite the scientific development of construction and management occurring over the last few centuries and continuing to use modern techniques today, construction and management has developed throughout the ages and achieved their current values with accepted methodologies as a universal and multidisciplinary field. The study shows that the construction and management techniques and managerial strategies such as planning, design, tender, commitment and supervision, which are relevant in the construction of today's public buildings, were also used in the Classical Greek period (6 - 4 th BCE). Based on the research findings, it shows that today's conditions and the conditions of the Ancient Greek period are compatible with the basic principles.

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### **RESUME**

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