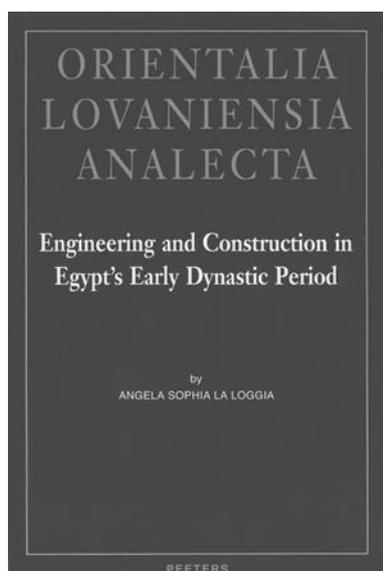


## Engineering and Construction in Egypt's Early Dynastic Period.

Angela Sophia La Loggia

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Angela Sophia La Loggia states that “Engineering has long been a neglected area in the field of Egyptology”, especially since the most popular scholarship regarding ancient Egyptian engineering are the pyramids of Giza.<sup>1</sup> Therefore, there is a need for other case studies. La Loggia’s publication differs by focusing on the engineering features and the social impact made by building the Early Dynastic mortuary monuments from the sites of Saqqara, Helwan and Abydos. This approach is formulated across eight chapters, which analyses the architectural footprint (chapters one and two), the material consumed (chapter three) and the time taken for construction (chapters four and five). Chapters six and seven encompass a culmination of the research by analysing the data collected from the previous chapters, in order to gain a thoughtful account that appreciates the skill and engineering ability of

the ancient Egyptian people. Moreover, the impact that such skills and abilities had on the development of Early Dynastic Egyptian administration and society. From chapter three to seven, there is a brief methodology to help further explain the author’s approach. Finally chapter eight presents the general conclusions of this publication

The first chapter introduces a brief overview of the selected cemeteries, which were chosen for they represent a different social section of the Early Dynastic population; Helwan for the general population, Saqqara for the elite individuals and Abydos as the royal burial ground. It is also explained via a brief literature review what a study of engineering offers, which examines the ‘practical aspects’ of a building’s structural requirements, cost or material estimation and construction administration. These aspects are lacking within most architectural studies in Egyptology, which usually define the structure and/or behaviour of a constructed building for the purpose of dating their changes and developments.<sup>2</sup>

The second chapter researches the resources used by the ancient Egyptians as building materials for tomb construction, then discusses the tools they would have developed for resource extraction, moulding and alignment purposes. This chapter also includes an overview on the manufacturing process of mud bricks and their size estimation from different tomb examples from the featured sites. Moreover, stone used for tomb construction are analysed, especially their geological properties, which determines their extraction method and why they were valuable. Examples taken from the original tomb reports include limestone for aesthetic and security measures, sandstone as roof-

ing slabs and granite for floor paving. Finally, timber usage, methods of scaffolding, plastering and painting are considered.

Chapter three details about the material expenditure for the building of the tombs of the kings, elite individuals and the general population from the cemeteries of Saqqara, Helwan and Abydos, during the 1<sup>st</sup> and 2<sup>nd</sup> Dynasties.<sup>3</sup> Each cemetery has a table drawn to estimate the quantity of materials for each tomb, their accompanying subsidiary burials and separate funerary enclosures (specifically at Abydos). These quantities are measured by the volume excavated for the tomb’s substructure, the total number of mud bricks used for the tomb’s sub/superstructure and the total area that is plastered within each tomb. Additional quantity measures are also added depending on the site studied. For example, the volume of sand added to create the false floor to cover the roof of the tombs at Saqqara as well as the amount of limestone used to line, pave and roof the tomb structures at Helwan. Following these summary tables, a selection of mortuary structures from each site are chronologically arranged and described in more detail, thus highlighting the subsequent development of their unique structural elements.<sup>4</sup> Finally, a summary is made for each site and are accompanied by bar graphs, which compares the material expenditure results between the three featured cemeteries and others from the author’s own research, including Abu Rawash, Naqada and Tarkhan.

The labour force required for the transportation and manufacturing of the materials for the construction of these mortuary structures, is deliberated in chapter four. This labour force would have included skilled workers,

1. La Loggia (2015: 21).

2. La Loggia (2015: 22-3).

3. La Loggia (2015: 43).

4. For Saqqara, eighteen tombs are described, twenty-three tombs for Helwan as well as thirteen tombs and eight funerary enclosures for Abydos.

who performed bricklaying, plastering, painting and carpentry; while there were also unskilled workers, who were mostly used for the transportation of materials. The availability of these workers would have depended on the agricultural demands on the population, which revolved around the different stages of the river Nile's inundation during the year. For example, building construction would have slowed during the crop harvest time, when most of the population would have assisted, thus leaving a small number of skilled workers at the building site. The author uses evidence from later ancient Egyptian periods and modern day construction methods in order to estimate the productivity rates of various working activities during tomb construction within a working ancient Egyptian year. By doing so, this would allow an estimation on the timespan on building a tomb, which is discussed in the following chapter.

Using data from the previous chapters, chapter five estimates the time taken and the number of labourers required for the various working tasks between S3357 from Saqqara and the tomb of King Djer from Abydos; such as the excavation of the substructure, transportation of materials, bricklaying, false floor creation, plastering and the tomb roofing. A construction summary is given for each mortuary structure, while also detailing extra features such as the boat grave for S3357 and King Djer's subsidiary burials and its funerary enclosure. A further summary of results compares the construction working days between Saqqara, Helwan and Abydos.

Chapter six investigates the practical and experimental limits of the com-

mon structural tomb elements from the chosen sites that assisted the actual structure to stand, specifically the roof design, retaining and free-standing walls. Using data collected about these features from the original excavation reports, specifically the height, length, thickness, restraint conditions, roof span and material medium, the engineering principles behind these tombs are assessed. This is combined with the geological information about the sites and physics by determining the potential gravity and earth mass forces against the stabilising capacity of the above mentioned tomb structural elements. This approach, based on the 'Coulomb Earth Pressure Theory', helps the author to emphasise the engineering prowess of the ancient Egyptians behind these empirical tomb designs in different landscapes.

Chapter seven then assesses the implications that construction had on the economy of Early Dynastic Egyptian society. The presence of an administrative system was needed to manage the 'direct labour' at the building sites; especially overseers and officials controlling the work; full-time artisans and craftsmen; and seasonal workers conscripted from the farms.<sup>5</sup> Due to the limited evidence about an Early Dynastic administration, however, this chapter relies on Egyptian economic evidence from later periods and modern day examples of developing nations for assessment, which the author is wary of using. The increasing demand of construction would have led to the explosion of 'indirect labour' from other industries to support the 'direct labour' employed within the building projects, especially those that provided food, clothing and

tools for the workers, not to mention the crafting of funerary equipment. Two figures within this chapter visually depict the complex systems between the direct and indirect labouring associated with the construction activities for better clarification. La Loggia presents her conclusions in chapter eight which repeat the aims of her publication and summarises the results made from the previous chapters.

While the limited evidence of the Early Dynastic period will always be a disadvantage for researchers, it allows the freedom to use multi-disciplinary methods to provide fresher interpretations of the Early Dynastic mortuary structural material. La Loggia's conclusions emphasise that the engineering perspective is one method that must be considered towards analysing such evidence; a view shared with the late Bruce G. Trigger who also stressed that "an engineering point of view" towards the study of ancient Egypt's monuments is essential.<sup>6</sup> The statistical analysis that La Loggia utilises to calculate the cost and material expenditure for her cemetery case studies is a pleasing component for this study. The results gained from such an analysis emphatically declares that Abydos is the royal cemetery of the 1<sup>st</sup> Dynasty compared to Saqqara; anyone who still thinks otherwise should consider reading this book.

La Loggia's publication delivers a fresh perspective towards interpreting Early Dynastic mortuary archaeological material, her approach and methodology should be applied to other engineering case studies across ancient Egypt's history.

Olivier Rochecouste

5. La Loggia 2015: 179.

6. Trigger, B.G., 1993. *Early civilizations. Ancient Egypt in context*. Cairo: 74-75.