Architecture and Mathematics in Ancient Egypt by Corinna Rossi

Reviewed by
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Ancient Egyptian monuments include some of the most recognizable architectural elements in the history of design. We seem to acquire a familiarity with Egyptian style at an early age; and even people with little interest in ancient history recognize pyramids, obelisks, and temple pylons as quintessentially Egyptian. The more attuned eye, looking at tourist knick-knacks or the efforts of interior designers to produce an Egyptian-themed dining room in a suburban dwelling, can easily identify items displaying the 'wrong' proportions, or an intrusive Greek column, or hieroglyphs which are clearly gibberish.

The West's love affair with Egyptian style, which mushroomed after the discovery of the tomb of Tutankhamen, has produced a small but pervasive influence on today's built environment. The style known as 'Egyptian Revival' influenced buildings from cinema façades to house porches (often introducing wholly fictitious elements such as coffin-shaped apertures and obelisks balanced on spheres) in homage to a civilization which was thought to embody in varying proportions the elegant, the exotic, and the enigmatic.

The edifices on which these modern attempts are modelled have a particular and revered place in the canon of architectural styles, traditionally presented as the precursors to the great Greek orders. The Egyptian lotiform columns and massive pylons are often portrayed as the transition between the primitive, almost accidental, monolithic efforts of societies without the elevated talents of art and geometry, and the enlightened, graceful classical buildings with which the popular imagination associates the birth of democracy, science, and modern civilization. Egypt's reputation for arcane knowledge and the desire of enthusiasts to place Egypt as the birthplace of proportion and spatial order are factors which, joined by scholarly interest in the early

development of architecture and construction, have inspired vigorous investigation about the 'rules' on which the architecture was founded and the level of knowledge and insight that the ancient architects may have employed.

Corinna Rossi's book appears at an interesting juncture. The heady days of lone enthusiasts galloping all over Egypt measuring and hypothesizing are over; but, in the field of Egyptian architecture, the conversation about the significance of geometry within Egyptian monumental buildings in general, and a few famous individual structures in particular, is continuing. Rossi's book reflects on the dialogue so far and offers a considered, even cautious, set of observations about the analyses put forward by her predecessors. Her approach, flavored by her background as an architect, is investigative, practical, and unemotional. The book treats buildings, blocks of stone, methods, rituals, and plans as items of evidence, viewed in a cultural context which never becomes overpoweringly symbolic: 'one must never forget the weight of stone', as the author warns in her conclusion.

The book's central issue, the relationship between architecture and mathematics, is discussed (following the structure of the book itself) with reference to proportion; Egyptian drawing, calculating, and religious practices; and those most mathematical of edifices, the pyramids. As the author observes in the case of the tomb KV2, for which a plan has survived, the outcome of the tension between mathematical theory, religious ideals, and construction methods seems often to have been that

> the final result appears to be a compromise between ritual ideas and practical considerations, which does not seem to leave room for the idea that dimensions could have been of specific, numerical interest.

Part 1 discusses the search for a 'rule', a set of guidelines which the ancient architect or site foreman would have used to lay out and complete important buildings. The approach to identifying the rule is usually by trying to deduce it from (plans of) Egyptian structures. Rossi describes several historical attempts at finding geometrical systems based either on polygons (such as pentagons or particular types of triangles) or on series of numbers (most famously the Fibonacci series) which yield ratios or proportions for room plans, column heights

and placing, and façades. The author details all the problems with such schemes—lack of accurate plans, questionable reconstructions of damaged or lost buildings, and the difficulties of working with tiny drawings where the width of a pencil line could lead to variations of several feet in real life—before concluding that Alexander Badawy's identification [Badawy 1965] of a triangle with proportions 8:5 seems to have enough evidence of repeated use for Rossi to distinguish it as 'the most successful among the geometrical constructions listed above, whereas all the others may be dismissed without losing any significant detail.'

Part 2, 'Ancient Egyptian Sources', moves away from analysis of modern plans in order to review the evidence contained within documents and contemporary plans for Egyptian perceptions of space and geometry. Surviving Egyptian plans are rare and fascinating documents which, while resembling only weakly the accurate and strictly planar modern architectural working drawings, contain information about dimensions, relationships between components, and aspects of both the plan and the elevations. Sources for Egyptian plans and architectural models are listed and analyzed. For example, comparison of three modern interpretations of a structure depicted on an Eighteenth Dynasty wooden board [Davies 1917] illustrates the ambiguities which the modern eye finds in the ancient style. Rossi infers techniques which the architect would have used (a cubit rod to draw straight lines) and constraints which he accepted when making the drawing (fitting it to the shape of the drawing surface). She notes that one was expected to 'read the labels, not measure the lines' and concludes that sources of this type 'seem to have been just quick reminders of a few details of a building'. The details would have been supplied by 'long consolidated building practice', the tradition of craftsmanship and transmitted ideas which we expect from the conservative Egyptian civilization.

The final section of part 2 is entitled 'Foundation Rituals', starting with the 'stretching of the cord' ceremony about which the author presents no new conclusions. The issue of astronomical alignment, which one would expect to have appeared by this point, is not discussed and is mentioned only parenthetically as a factor in establishing the outline of the new building. This is an indication of how focused the book is on the practical analysis of its central themes.

The third and final part is devoted entirely to pyramids. Here, Rossi uses data from more than 80 pyramids for which dimensions are available or can be inferred. The data, complete with references, notes, and calculated ratios, is presented in the appendix. The range and distribution over time of the angle of slope (expressed in the Egyptian units, *sekeds*) used for pyramids is analyzed. Rossi suggests that some of the slopes may be related to triangles formed by using 'Pythagorean triples' (sets of integers a, b, and c which satisfy the relationship $a^2 + b^2 = c^2$). The attestation of Pythagorean triples in ancient Egypt is generally accepted from the third century BC [Parker 1972] but is contentious before that date, even for the simplest triple, 3-4-5. *Sekeds* which can be related to triangles based on Pythagorean triples were used in the Sixth or even the Fourth Dynasty, and Rossi speculates that choices of pyramid angles lend weight to the argument that Pythagorean triples were known at that time. Rossi is herself cautious about drawing this conclusion; but it must also be noted that the way the *seked* unit is produced (being related to two side lengths of a triangle) will, within the range of *sekeds* such as we see in pyramids, produce some Pythagorean triple triangles fortuitously. Our own type of circular angular measurement would have been far less likely to result in the spontaneous appearance of Pythagorean triangles.

In summary, this book provides a detailed examination of a relatively narrow subject area. There are no grand theories emerging, but instead, a reflective and practical methodology for analysis of past theories, and guidelines for thinking about present data. Rossi's book will appeal to those looking for a coherent and reasoned explanation of controversial topics such as explicit knowledge and use in ancient times of abstract mathematical and geometrical concepts. The book also serves as an ideal counterweight to the proliferation of home-grown 'temple theories' available on the internet. Finally, this book should also find a readership among architects who are interested in the history of building design and construction. The section containing Egyptian plans and working drawings will in particular emphasize the antiquity and continuity of their profession.

BIBLIOGRAPHY

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