



"How the Great Pyramid was Built" by Craig B. Smith

Finally, here's a book describing the construction of a significant world monument told from the perspective of an engineer. Unlike Steven Ambrose's book on the construction of the trans-continental railroad in the 1860s or even Mathew Parker's "Panama Fever", describing the construction of the Panama Canal, Craig B. Smith's book, "How the Great Pyramid was Built" focuses on the planning and the details of the construction itself. In the absence of any written records, the book provides the logic and insight necessary to understand how the construction of the Great Pyramid of Khufu at Giza, Egypt, took place, a project so immense and constructed with such primitive tools, that if it weren't still standing today, one would think its construction 4,500 years ago would have been impossible.

Until the construction of the Washington Monument in 1885, the Great Pyramid of Khufu was the tallest man made structure in the world. Smith calculates the finished height of the pyramid to be 481 ft. with the average length on each side at the base to be 756 ft. It is comprised of an estimated 2 Million cut pieces of limestone each weighing anywhere from 2,000 lbs to 10,000 lbs. The precision of the work is extraordinary with the variation in length of less than 4" on each side, measured at the base of the pyramid, and the levelness across the entire first course varying by less than $\frac{3}{4}$ ".

Smith's approach was to take modern project management scheduling techniques along with an assumed work breakdown structure and apply these to the facts of pyramid and to what is known of Egyptian society at that time. Using this approach Smith draws conclusions about the duration of construction, (5 to 8 years), the number of workers required for construction, (30,000 during the 3 years of peak construction activity), and the methods for moving the stones from the quarry to the pyramid and then up to their required positions, (no wheels or rollers, only wooden sledges pulled by teams of workers up long ramps). Smith also observes that while the construction activities were simple, the huge number of workers required to carry out these tasks put a premium on careful planning of all activities. This planning had to consider housing and feeding of the workers and their families, the manufacture of copper, wood, and stone tools, the quarrying of the stone, transport of the stone to the site, and to the final placement of the stone.

Smith's conclusion concerning the central question of how the cut blocks of stone were moved up the pyramid is based on the idea that the Egyptians would have taken the path of least resistance. This immediately eliminates the use of an external ramp for moving stone up the entire height of the pyramid since its length, and the amount of material necessary for its construction, would have exceeded the total amount of material necessary for the pyramid itself. Rather, he theorizes a combination approach was used. This meant a wide external ramp was used up to the 55th course of stone. By this point nearly half of all the stone would have been in place. From the 55th course up to the top of the pyramid, at course 218, a ramp was let into the four sides of the pyramid as its construction continued upward. Once the top was reached, the ramp was filled in from the top down.

Craig Smith is the retired former chairman of DMJM, H+N. He wrote this excellent little book based on his personal research including extensive time at the site. This researched was combined with his experiences in the management of major design and construction projects around the world during his years at DMJM, H+N. The book was published by Smithsonian Books in 2004. It has 288 pages including many photographs and useful drawings. It also includes a primer on construction program management which would be helpful for readers not familiar with the planning and construction of large projects.

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