Engineering lessons from the Great Pyramid of Giza

In terms of construction and engineering feats, it's difficult to trump the Seven Wonders of the Ancient World. And yet, much of their wonder comes from stories and records — there's only one Wonder left standing for us to glean the scale of their collective triumph of engineering.

The Great Pyramid of Giza is the last remaining Wonder, with its six fellow Wonder having succumbed to earthquakes, fire, human destruction, or simply not being confirmed to exist at all. It is also the oldest Wonder, so the potential to learn from its staggering longevity is invaluable. Though modern day engineering techniques allow us access to such efficiencies as structure analysis software and top of the range tooling, these modern developments wouldn't have transpired without the successes of the past.

Modern tools

Evidence suggests the use of lathes during ancient constructions in Egypt. We've come a long way from their lathe that required two people to operate — now, we use the trusty CNC lathes to carry out myriad tasks such as facing, threading, drilling, and taper turning. It is claimed that our ancient predecessors used their lathes for carving and cutting wood, but there's some who wonder if they also used lathes for carving stonework.

There's also evidence of the use of surveying tools that are still used in the modern day. Artefacts have shown the use of a plumb level, also known as a plumb bob, in Ancient Egypt. A plumb bob is a simple, yet effective tool made from a pointed weight suspended by a cord, and these tools supported the engineers in their staggeringly accurate achievements in levelling and degree-accurate positioning of the pyramids. Plumb bobs allow for measuring an accurate vertical line for surveying and building, but some suggest the Egyptians used plumb bobs for a lot more. Alongside sighting and levelling tools, they used plumb bobs to aid with astronomy and navigation too. Their accuracy is still relied upon today; for example, plumb bobs are used to make sure Salisbury Cathedral is not beginning to lean.

Modern-day wall building

The materials used in ancient construction have continued to prove useful and are still used today. For instance, the slow-setting gypsum mortar was used to lubricate, move, and set the stones in place. Gypsum mortar, made from plaster and sand is still relied on today to create structures in drier parts of the world.

The stones needed to be moved to the right place before they could be set, of course. The question of how the workers managed to haul the huge stones required to create the pyramids has tantalised historians for years. Some theories posit that the expert canal-crafters manipulated the River Nile, redirecting it so that stones could be ferried over the water closer to the construction site. Once there, many point towards the invention of ramps and levers to help manoeuvre stones into place, just as we do today. Have we been unknowingly continuing on a tried-and-tested practice in construction that dates back to the time of the pharaohs?

Peter James, while speaking to the BBC about the restoration of the pyramids, questions the ramp-theory in regards to the Ancient Egyptian. Another practice had instead been adopted by builders from that age. James claims the pyramids are too tall and would make ramps too steep to move stone. He

theorises that, just as construction workers would build a stone wall today, the Ancient Egyptians built the pyramids from the inside and worked outwards.

The future

Have we gleaned all we can for engineering and construction lessons from the pyramids? Design Intelligence suggests we can still learn from the architects of the past. In particular, they outline the need for modern structures to follow the path of the Great Pyramid of Giza and start to focus more on longevity as a means to practice true sustainability. With a lifespan of thousands of years, the pyramids have lost comparatively little in the grand scheme of things. Though they no longer have their hand-polished white limestone outer façade, the material having long since been stripped away for other work or dissolved to expose the inner material seen today, the structure has remained relatively intact. And they have done so with very little maintenance.

Aligned expectations, a consideration of environmental factors, and a low centre of gravity have all been cited as the reasons for the pyramid's durability through the ages. Where some structures rely on the future promise of maintenance in the event of environmental or external factors impacting the structure to stay standing, the pyramids did quite the opposite — they were built to last. Design Intelligence also notes a key factor in this robust quality of the pyramids. The materials used in its construction were cut before they arrived at the site; the site was a place of assembly, and not a place of cutting materials. This meant improvements to speed as well as quality, and everyone could focus on one job each, rather than multiple tasks.

Imagine if we built to last well beyond our own need. Simply put, if we "pay" a certain amount of carbon emissions each time we build a structure, we can lower the overall carbon impact of creating a building by having it last and be repurposed for hundreds or thousands of years — instead of paying that carbon cost multiple times to replace the structure over the years.

We can learn so much from history. The Ancient Egyptians developed incredible engineering and construction feats over centuries that arguable outdo our own creations today in terms of strength. Instead of looking to the future to innovate the construction industry, perhaps we should look to history.

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