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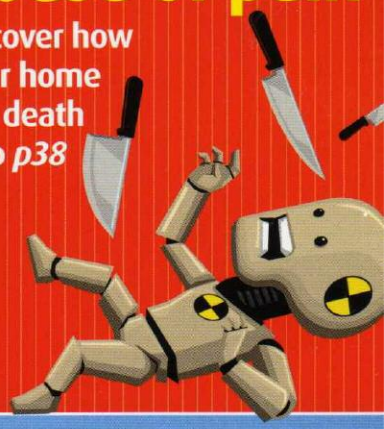

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Q&A

Tackling your queries each month

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Meet this month's *BBC Focus* **Q&A special** expert panel

SIR DAVID ATTENBOROUGH
Sir David has been making wildlife documentaries for the BBC for over 50 years

SIR PATRICK MOORE
The long-term presenter of *Sky at Night* is the world's best-known astronomer

JAMES LOVELOCK
The renowned environmental scientist and author is the inventor of the Gaia theory

COLIN READER
Colin is geologist to the exciting Saqqara Geophysical Survey Project in Egypt

How were the pyramids built?

ANDY THOMAS, STAINES

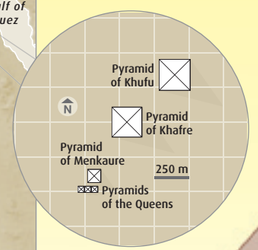
GUEST EXPERT Q&A Colin Reader

Built 4500 years ago, the Great Pyramid of Giza is the largest and most perfect of some 50 major Egyptian pyramids. At 147m high it was the tallest building in the world until the Eiffel Tower was built in 1889. With sides 230m long, its base covers 50,000m²: enough room for the Houses of Parliament and St Paul's Cathedral with space to spare. Estimates for the number of stone blocks used in its construction range from two to four million. All this for the burial of an ancient king, Khufu, in a small granite-lined chamber, deep in the heart of the pyramid, over 100m below its peak. Egyptologists still don't agree on exactly how the millions of stone blocks were raised as the pyramid grew, and how the stone was quarried and transported. Here are some of the most likely theories.

Giza and other pyramid sites, close to the ancient Egyptian capital, Memphis, and the location of the quarries

Preparing the site

Giza provides strong bedrock foundations and clear views from the plateau. The ground around the foot of the Great Pyramid was levelled, but the pyramid itself sits over a natural rocky hill

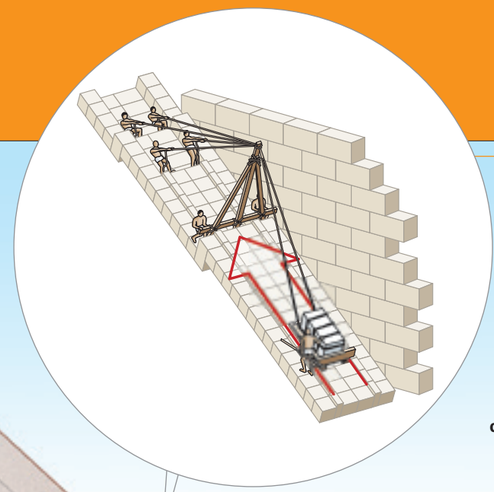


Passages and Chambers

From the entrance a sloping passage leads down to an unfinished chamber cut into the bedrock, 30m underground. A second ascending passage splits into a passage to the lower Queen's chamber and the Grand Gallery, which leads up to the King's chamber

Sarcophagus

The 1m-wide granite sarcophagus in the King's Chamber is only a few centimetres narrower than the chamber's entrance. It was probably placed there before the walls were built. No sarcophagus exists in the Queen's chamber – another enduring mystery

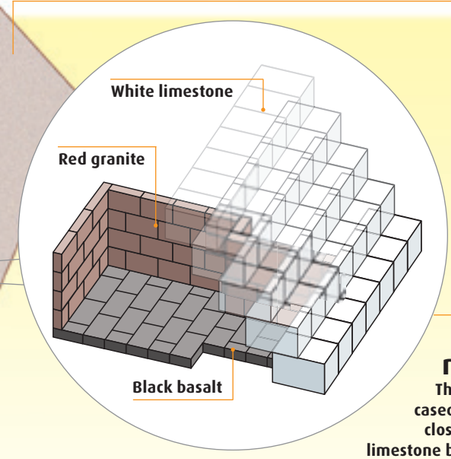


Wooden machines

A range of devices, including wooden levers, ropes and cradles might have been used to haul the blocks up the pyramid face. Perhaps the face was protected during construction with earth or mud-brick

Ramps

Another possible way the blocks were raised. Spiral ramps require less construction material than straight ones but, as the spiral ramp grows and hides the pyramid, error in the angle of the pyramid sides is more likely. However, straight ramps would have been huge – up to four times larger than the pyramid

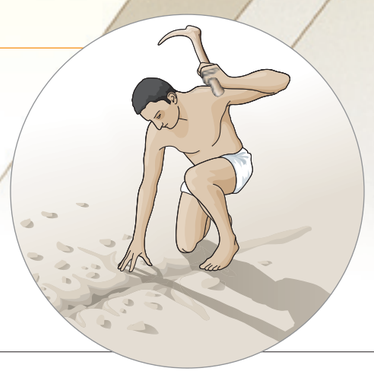


Lining materials

The pyramid was cased with 2m-long close-fitting white limestone blocks, brought from across the Nile, which were worked to create the smooth sloping face of the pyramid. Red granite was carried 650km down river, to line the walls of chambers and passageways. Black basalt was used for the temple floors

Cutting the stone

The pyramid core was built from limestone quarried at Giza. The quarry rock consisted of hard stone separated by softer layers, which were probably removed with hammer stones or antler picks. Once free, the harder stone could be broken along natural faults into roughly rectangular blocks. But as many of the blocks were irregular, mortar was needed during construction to fill the gaps

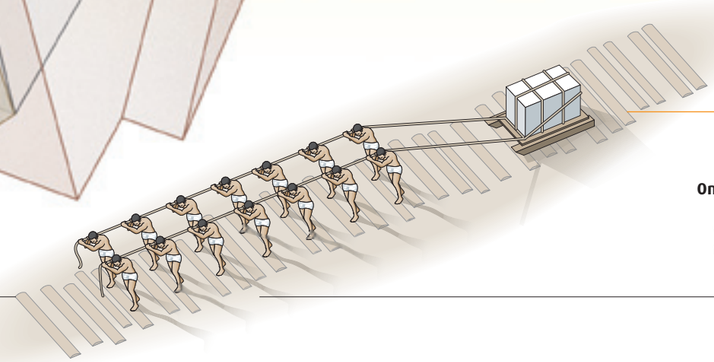


Aligning the pyramid

The pyramid was probably aligned to the compass points either by sighting on stars or by using the Sun's shadows. Each side is 230m long to within 58cm. Distances were possibly measured using ropes or wooden rods

Transporting the blocks

Once quarried, the stone blocks were probably dragged on wooden sleds, perhaps along trackways prepared with wet clay and timber beams



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