

CYCLOPEAN STRUCTURES

I have always been fascinated by the massive cyclopean structures found throughout the world and have wondered why early builders constructed them using irregular shaped rocks and how they got to fit perfectly into each other. Good examples of such mortar-free structures are shown in the following picture-

EXAMPLES OF CYCLOPEAN STONE CONSTRUCTION



MYCENAE, GREECE



EASTER ISLAND



ARGOS, GREECE



CUZCO, PERU

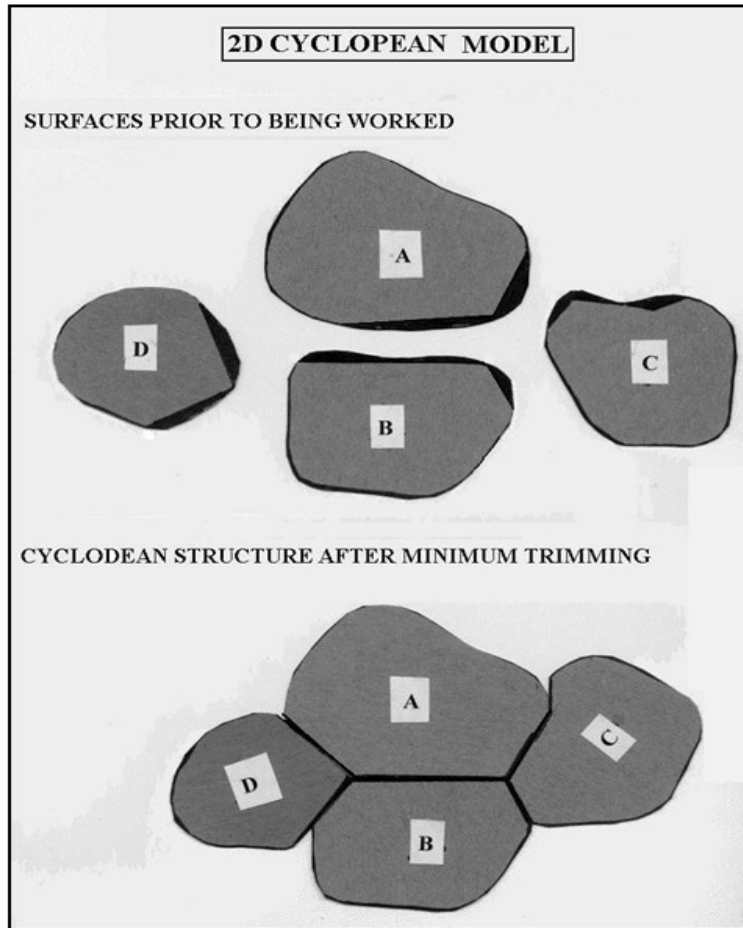
One sees that the stonework differs from modern stone structures mainly due to the use of irregularly shaped stones with only a few having a true rectangular cross-section. People have often speculated why such mortar free designs were used by these early stone masons. Some claim it has something to do with structural resistance against earthquake damage. Others are at a loss as to how such large stones were moved and how they were cut in such a manner that the spacing between neighboring surfaces is sometimes so precise that a knife blade cannot fit between them. I have observed these properties in person at Sacsayhuaman in Peru and at Mycenae in Greece. Some of the stones in Peru measure as large as 8x6x5ft and thus weigh about 24 tons each (estimating the stone density to be about 3 times that of water) In thinking more about these cyclopean structures, I have come to the conclusion that-

The early builders of cyclopean structures used this building technique in order to minimize the amount of rock dressing of the raw stones required. This applies especially to those civilizations (Incans and Easter Islanders) unfamiliar with sawing techniques and thus having to resort to chiseling.

My thoughts are that the ancient stone masons had available a set of large boulders from either river beds or rock quarries. Each stone was probably transported from its source by dragging them using ropes pulled by several hundred men. Each man could probably pull 150 lbs so that dragging a 10 ton boulder without rollers would require about 150 men. The builders would then eye the rocks to find surfaces which nearly match each other. Picking two similar surfaces these would be chiseled flat. The two surfaces would then be brought together. Next another flat surface would be chiseled into the first stone at such an angle as to minimize the amount of chiseling required. The process would then be repeated for other rocks with the largest chiseled rocks placed at the wall bottom. Eventually this leads to a large cyclopean structure very resistant to collapse yet requiring no mortar and relatively little stone cutting required. **The idea behind the procedure is to minimize the amount of stone which must be removed to get a good fit with its neighbors.** Note that if one were to cut standard rectangular cross-section stones, the required stone removal would be much larger and more time consuming. To make rectangular blocks quickly from uncut boulders typically will require the use of saws or the use of rocks amenable to splitting by wedges as is the case for Carrara marble.

To demonstrate the cyclopean construction method we consider a 2D model and four surfaces A, B, C, and D as shown

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We have aligned the four surfaces in a manner where one needs to do very little cutting to make neighboring flat surfaces. Bringing these together shows the tight fitting cyclopean structure. The relatively small amount of surface which had to be removed to achieve this fit is shown in black on the original four surfaces. If one were to make rectangles out of the surfaces A through D, it would require the removal of considerable more material.

The advantage of cyclopean structures becomes less important when the stones become smaller as they are for example at pre-Incan Tiahuanaco near present day LaPaz in Bolivia. Here is a picture I took of the plaza wall of these ruins showing a simpler cyclopean structure using different size rectangular blocks between standing megaliths.. The stone heads shown are life-size.

WALL AT TIAHUANACO, BOLIVIA



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