

TRULLI AMAZING DRY STONE WORK

Todd Campbell

A visit to Europe, especially Italy, is a pilgrimage for a stone mason. My bride and I honeymooned in Italy in March and both found inspiration galore, as she is a chef and restaurateur. I've tried to convince her that there are just two food groups; rock and mortar. Or in more technical terms, "stiff and squishy." To her credit, however, she has pegged the two types of stonework; standing and collapsing.

Ironically, some stone constructs still stand because they're squishy, and some collapse because they're too stiff, but I'm sure these principles apply to food items too, like maybe wedding cakes and souffles. Italian cuisine is diverse and highly realized. So is Italian stonework. Massive Roman buildings like the Pantheon illustrate how successfully, with sound engineering and stone and concrete work, a dome can withstand nearly 2000 years of ground movement and water action. In Florence, the dome atop the Santa Maria del Fiore cathedral, one of the largest masonry domes in the world, was built without centering, bracing, forming, or scaffolding by use of intermittent soldier courses. Thinner than an egg shell relative to its size, bricks set the day previous provided "tooth" and stability for the morrow's building.

Everywhere in Italy, structural stonework is given the dignity and beauty of a sculptor's touch. An American mason who is constantly confronted with requests for "phony stone" (nothing 'cultured' about it) and other veneer applications is shamed by the artisan standards of the Old World, where material costs far exceeded labor costs.



Alberobello

As we grow to influence design in our stonework, a nod to fine Italian masonry is nearly a mandate.

In contrast to the amazing works of urban Italy stand the works of Southern Italy's farming communities; huge, guild-sponsored crews of apprenticed masons versus small teams of grape and olive growers. But the same elegance of form and durability prevails. And one of the best examples of graceful, small-scale, dry stack stone construction are the trullo (pl. trulli) buildings in southeastern Italy.

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Viewed from afar, trulli look like clusters of white haystacks. Compelling yet simple, the top of each room in a trullo structure is a beehive-shaped dome of dry stacked limestone. This limestone was culled from what would become growing fields, a labor intensive effort which served both purposes. During our honeymoon, we spent several nights at Masseria Grofoleo, bedding down in a reconstructed trullo, and walking around the trulli-stippled communities near Locorotondo and Alberobello. Our host, Lele Fizzarotti, is a prince of a man, theatrical and generous. He never let our glasses of his white wine approach emptiness. His farmhands live on-premises, tending the orchards and the goats and sheep.

A mile away is the hilltop town of Locorotondo, a shimmering dream of bright stone and whitewash bisected by deep and narrow, curving, foot-polished alleyways. Behind its fortified walls emanate the towers and steeples and minarets which are typical of Italian towns. And scattered below for miles around are the trulli, ancient structures built by a people who are not around to elucidate on the how's and why's of their ingenious design. The trullo influence is seen in some buildings in Greece and Africa which are in similarly arid, rock-rich environs where water collection and conservation is paramount.

In their design, the trulli show strongly repetitive themes which are explored with a thousand nuances. Foremost is the dome atop each room. The rooms are connected via barrel vault or lintelled passages, and the roofline reflects each passage as a parabolic curve from dome top to dome top. The footprint of each room is roughly square, 9-15 feet per wall length, and at door lintel height, the corners

employ "squitches" or corbelling to achieve circularity within one or two courses. Then, it is said, masons built the domes without the use of centering or other support. This exceptional claim is true, and with insight, you can see that the masons maximized every advantage with which the long heritage of stone building informed them.

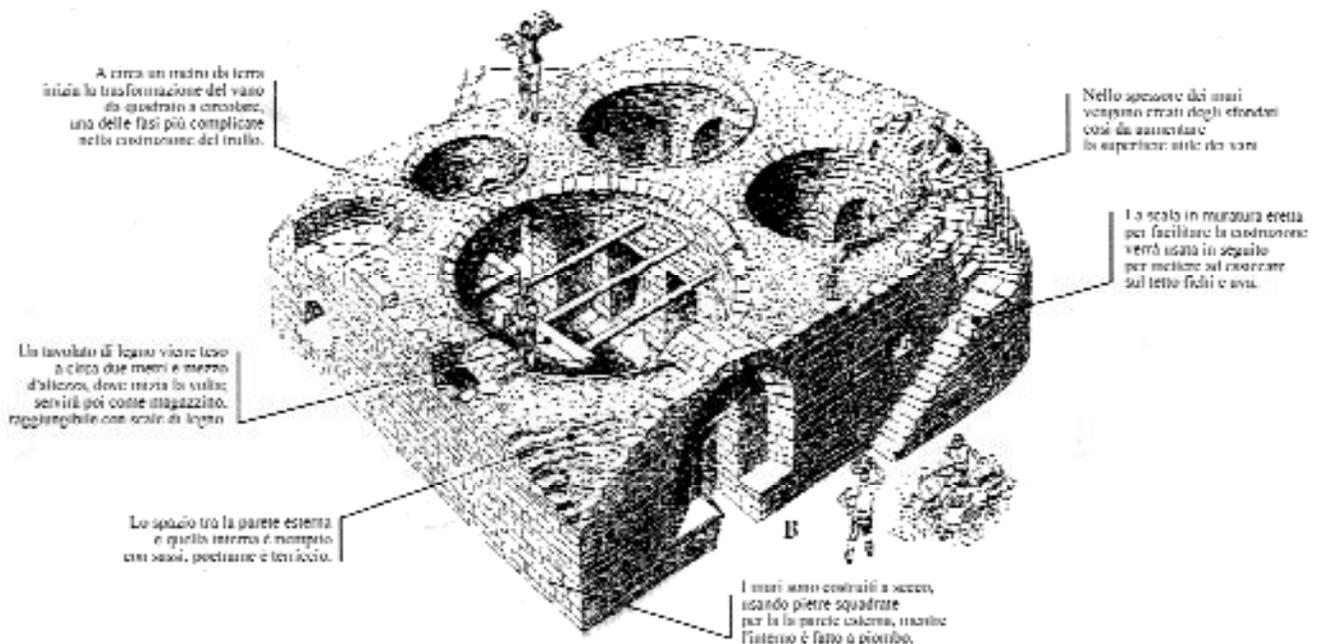
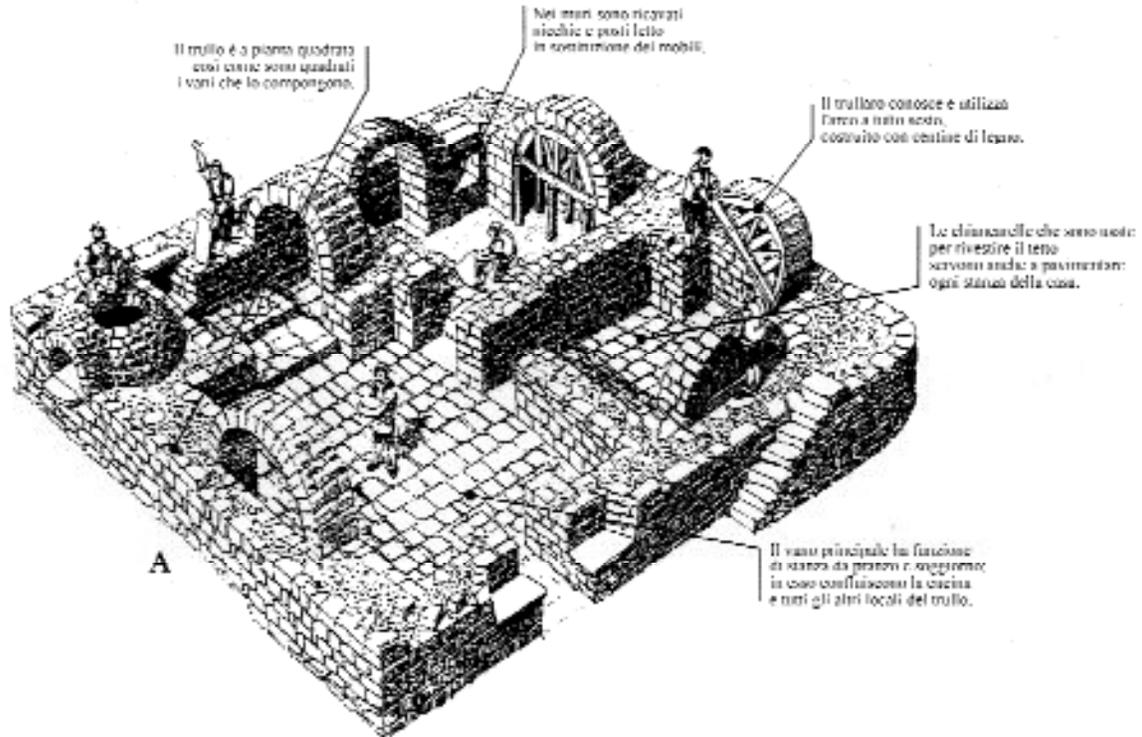
Firstly, the limestone from the fields takes a chisel very nicely. The importance of maintaining surface to surface friction through tight fitting cannot be overemphasized in load bearing dry stack work. A close look at the stones which comprise the dome's outer skin show remarkable workmanship. Each one is slightly radiused with respect to the trullo's central vertical axis, with a slightly tapered top to help shed water. These shingle stones, called *chiancarille*, are laid with an outward pitch just a few degrees below level and are uniform to the extent that, though they are dry laid, it is rare to see any missing in even the unrestored trullo. The rocks which comprise the inner skin of the dome are also finely worked. The top of each one leans out farther than the bottom, but this is not achieved by tipping a rectangular stone; each one is shaped so that the joints stay roughly horizontal when laid. Each stone is a true corbel, projecting past the stones below such that the face conforms to the dome's lateral and vertical curves. The dome is 14-20 inches thick and its two skins entomb a lot of rock shims and fill material.

Secondly, the rural masons who built the trulli knew that each course of a dome, once complete and installed, established load bearing integrity called ring tension. It stands to reason that the outer skin was installed immediately after the inner, course by course, so that each top



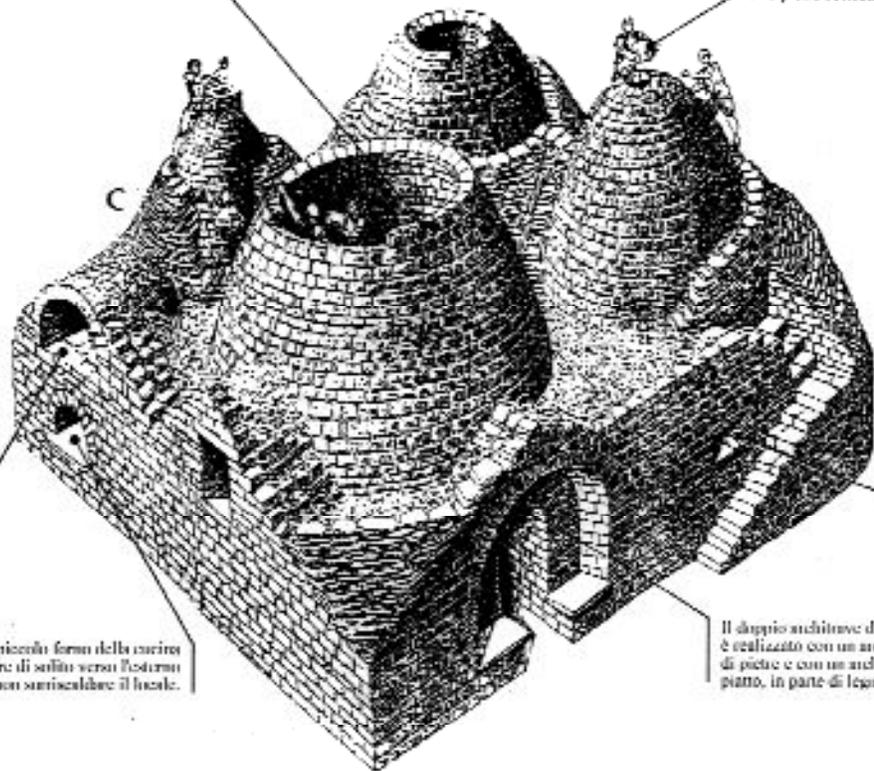
Locorotondo

LE DIVERSE FASI DELLA COSTRUZIONE DI UN TRULLO



Le pietre che formano la volta sono disposte ad anelli concentrici sempre più piccoli dal basso verso l'alto.

L'ultimo anello della volta è chiuso da una lastra circolare che viene ancorata alle pietre sottostanti.



Il deposito della legna è ricavato sopra il forno in modo da ottenere un'ottima circolazione.

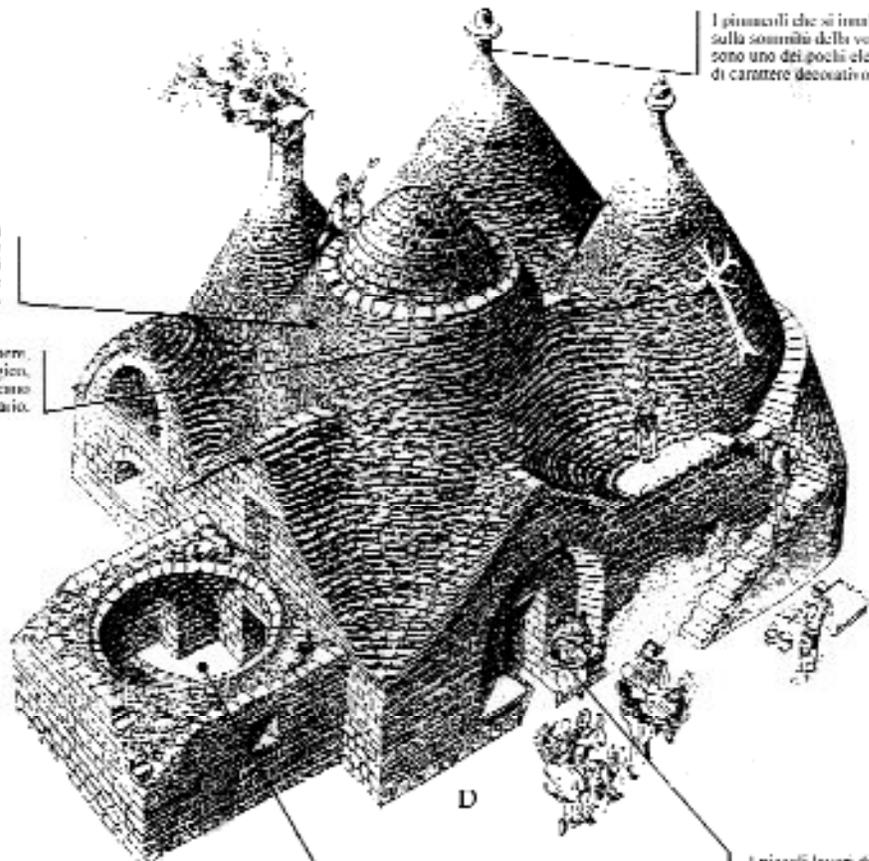
Il piccolo forno della cucina si apre di solito verso l'esterno per non surriscaldare il locale.

Il doppio architrave d'ingresso è realizzato con un arco di pietra e con un architrave piatto, in parte di legno.

Le finestre, piccole e rare, fanno entrare poca luce; a questo si ovvia dipingendo gli interni con la calce.

Una volta costruita, la cupola viene ricoperta con pietre piatte spesse come centimetri dalle chiancette, fortemente inclinate verso l'esterno.

I simboli di diverso genere religioso, profano, magico, disegnati sui tetti identificano il trullo e il suo proprietario.



I pinnacoli che si innalzano sulla sommità della volta sono uno dei pochi elementi di carattere decorativo.

La struttura del trullo consente di aggiungere nuovi locali, collegati sempre al nucleo iniziale.

I piccoli lavori di cucito vengono fatti sui sedili dell'ingresso, piuttosto che all'interno troppo buio.

course would serve as a narrow scaffolding upon which men could walk and work.

Finally, the profile of the interior of the trullo dome closely resembles a kind of blunt-tipped Gothic arch. The Gothic arch has characteristically near-straight shoulders, which eliminates the forces of horizontal thrust better than other arch profiles, thus increasing its stability as a free-standing form. Perhaps Stone Foundation readers are familiar with one version of the Utah license plate, which shows Delicate Arch, a massive freestanding stone perched on the rim of a deep canyon. It has that disheveled haystack shape, slightly straight shoulders, and flattish top that is mimicked more symmetrically in trulli. The trullo I measured had the near perfect dimensions of a shape of Gothic arch called an 'a quinto acuto,' which draws each of its arcs from points one-fifth the distance of its horizontal span. In constructing a trullo, the masons fixed a plumb central axis from which to build their rising concentric rings around. However, to create the dome's distinctive inner shape, it is my theory that a cord attached to a rafter roughly one-fifth across the square room became, when pulled taut, the positioning guide for the first rock of each course.

Thus, the arc scribed vertically by this cord established a consistent radius with which to corbel each course of wrought stone. After establishing the position of the first stone of each course, it would then be a matter of constructing a perfect circle around the plumb, central axis.

Every trullo has a roof pitch of 55-60 degrees from horizontal. The walls of the trullo's base are usually more than three feet thick, and they commonly have in-built niches or crude sinks. The thicker-walled base means that a prominent sill supports the dome. Beautifully worked water-channelling stones on this sill direct rainwater to a single drip point, which in turn directs it to an underground cistern via an accessible sink. After looking at dozens of these amazing buildings, I'm sure that this collected water is routed down through the building's drystack walls! The routing was probably made leakproof with plaster, as plaster was also applied to the inside of the dome upon completion of the stone laying. The cistern sits below the trullo, where evaporation is minimized and convenient access is had. This integrated water catchment helped insure survival in an arid land.

Though the white limestone used to build trulli would surely reflect much of the sun's heat, summer days would have been stifling indoors because the only openings in a traditional trullo are the doorway and the chimney shaft. The shaft included no smoke chamber, but a multiple-level chimney exhaust design which probably created enough draft to keep the smoke moving upwards.



It is generally believed that the trulli's inhabitants used its shelter for various domestic and agricultural purposes, but did the bulk of their living out of doors.

Whatever the extent of their daily involvement with these magnificent structures, trulli builders created a durable and beautiful and simple-appearing monument to agrarian harmony. The frosting on the cake, so to speak, was the building's consecration with a carved capstone, or pinnacoli, to finish and bedeck the dome. Shaped differently, to my eye they look like alien church steeple icons, although the most common is a large round stone on a dish-topped pedestal. It is commonly thought that the capstone was believed to ward off evil spirits.

For the most part, these elegant drystack structures have warded off the evil spirits of erosion and collapse for many many hundreds of years. As my wife would say, "Now, that's food for thought". Trulli amazing.

Todd Campbell is a flintknapper-turned-stonemason contractor from Southern Utah, where nature's abundant rock-work is ever-inspiring.

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