# Corbelled dome architecture in Spain and Portugal

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Corbelled dome architecture in Spain and Portugal is the result both of agricultural activities and, above all, the transhumant economy.

## Geographical, economical, climatic and geological context

At the same time, the agricultural vocation of some rural areas on the border between Portugal and Spain is one of the other factors that generate the use of corbelled domes for stores, wells, drying places, wine cellars or granaries. In some cases, the combination of a need to keep an eye on crops and monitor livestock, as in Castilla La Mancha, may tally with such watchtower constructions as vineyard observers or cattle watcher huts (Fig. 1).

On the other hand, the transhumant economy in a large part of Iberian Peninsula consists of the shepherds' custom of moving livestock (mainly goats and sheep) from one pasture to another in a seasonal cycle, from the northeast zone of the Peninsula (in spring-summer) to the southwest area (in autumn-winter). For shepherds, place is recognized in terms of time, seasons, arrival and departure, aside from a separable object called 'space'. For this reason, one of the forbears of their shelters could be the wooden stick structure covered by vegetation. Initially this hut, called *chozo de muda* could be moved by shepherds from one place to another according to requirements during the transport of livestock from one pasture to another (Fig. 2).

From this point of view, it is possible to understand the settlements of shepherds made using corbelled dome shelters along transhumant paths.

The relationship between the peasants and the local available resources may be useful in identifying key principles for the understanding of vernacular buildings, human settlements and sustainability.

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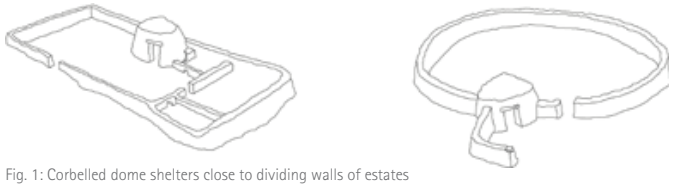


Fig. 1: Corbelled dome shelters close to dividing walls of estates

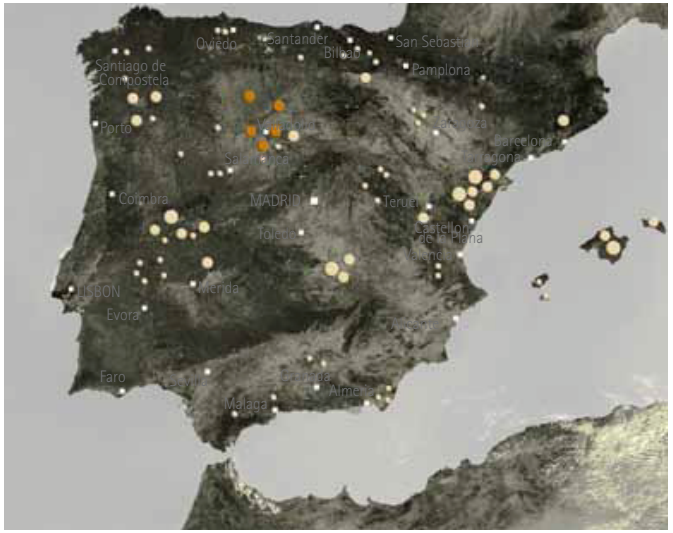
## Urban and architectural morphology and function

The features of Iberian corbelled domes may be outlined according to:

- the surroundings of the hut: some shelters may also appear grouped in series. These constructions always occur close;
- to the natural environment, both on agricultural plains and terraces or hilly pastures, depending on the geographical features of the surroundings;
- the disposition of the hut: agricultural and shepherds huts are mainly free standing. Nevertheless, in areas divided by dry-stone walls, agricultural huts are found upon the edges or angles of these walls to save effort and to avoid the building of more walls (Fig. 3);

Provinces with presence of adobe corbelling domes
Provinces with huge presence of stone corbelling domes
Provinces with medium presence of stone corbelling domes
Provinces with few presence of stone corbelling domes

Typologies of corbelling dome constructions in Spain and Portugal




- the layout of the hut: it is common to find several variants, but in general the layouts may be summarized in circular, rectangular, squared and cell-like (Fig. 4);
- the cross section of the hut: it is common to see many regional changes, but in general the sections can be rectangular, triangular or circular;
- the vault of the hut: it is usual to see cylindrical, cone, half-spherical or combined solutions for the corbelled dome.

Also, regarding the materials and constructive details, it is possible to add some more characterizing features like:

Fig.2 Relationship between the shelter and the landscape (Maestrazgo area – Spain)

- the lintel of the hut: its shape may be triangular, rectangular or half-spherical and formed by some shaped stones or by just one single large lintel (Fig. 5);
- materials and finishing solutions of the hut: the structural stone may be of granite, limestone, slates, bricks or adobes. The finishing of the wall in human dwellings is rendered and occasionally lime washed, both on the interior to guard against insect intrusion and on the exterior in order to protect against the elements. In general, animal enclosures or temporary huts are not rendered or lime washed. Simple dry-stone walls and soil is employed in, for example, pigsty and goat compounds. Another variation consists of crowning the top of the hut with a finishing layer of soil. This solution is used above all in the northwestern part of the peninsula (Extremadura, Galicia, Portugal), for protection against damp (Figs. 6-7-8).

Other interesting aspects are the different functions that these shelters may assume:

- for human dwellings: this is the case in constructions for shepherds, peasants, watchers, etc. The constructions have chimneys, rendered and lime-washed walls, niches for kitchen tools and crockery, as in *bombos*, *barracas* and *chozos;*
- for animal dwellings: in this case the space is mainly for goats, sheep, etc., and rarely for cows. The walls are not lime washed, the soil of the ground and the unfinished details may be visible, as in *barracas and chozos.*
- both for animal and human dwellings: in this case the plan is cell-like, with narrow passages between the quarters of the shepherds and those of the animals for the purpose of heating, as in *ponts*, *barracas*, *chozos* and *bombos*.
- stores: the spaces are relatively smaller compared to those constructions intended for people or animals, as in *espigueiros* and *hórreos*.
- wells: these constructions are generally smaller in dimension than human or animal shelters. Their purpose is to protect well curbs or springs, at flowing water level, covering the source and safeguarding against external threats (Figs. 9-10).

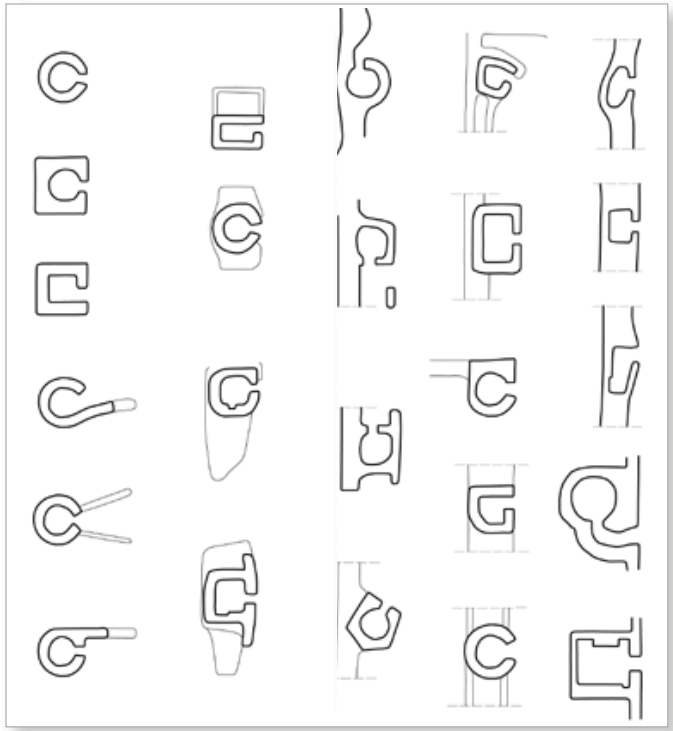


Fig. 3: Possible layouts of corbelled domes; free standing, close to or upon dividing stone walls, with rear side to crag rocks

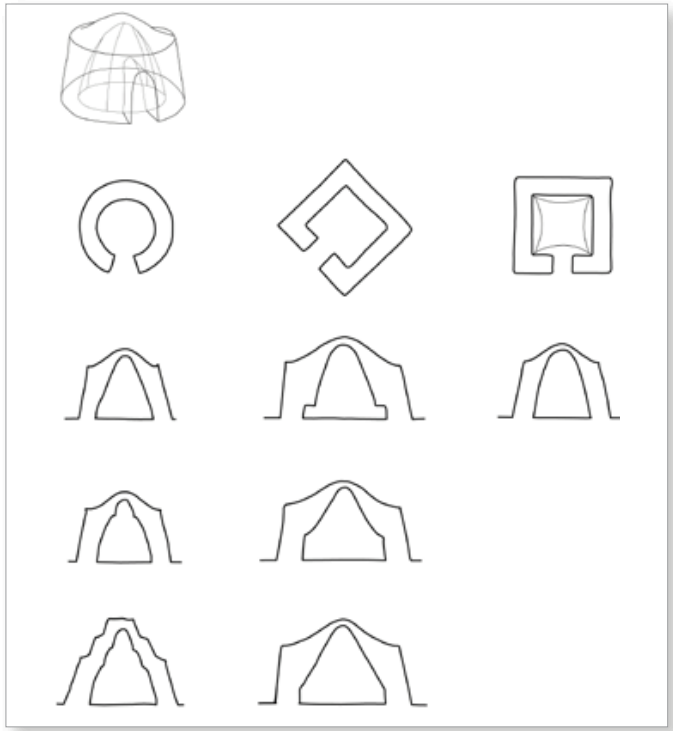


Fig. 4: Variants of some corbelled dome structures according to different combination of layouts and sections

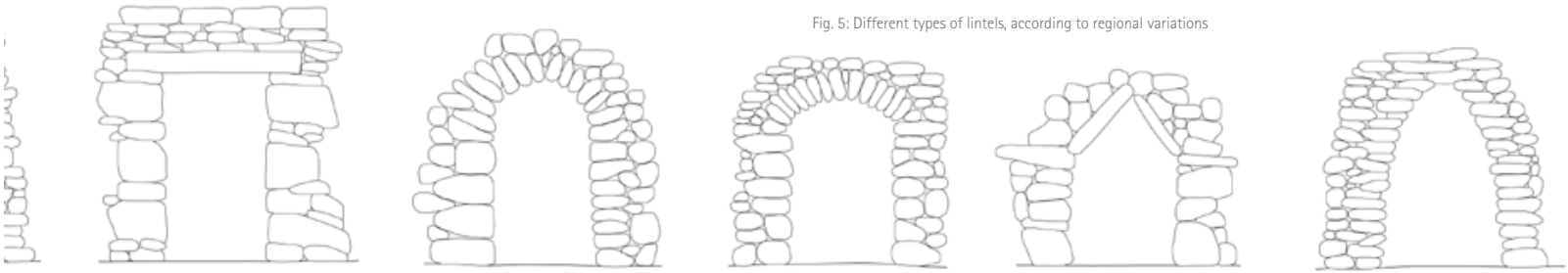
**Material and construction tecniques**

The huts are made using two different and compatible dry-stone techniques: the dry-stone walling system and also the corbelled dome system. The walls, built either in limestone (East of the Peninsula i.e. Cataluña, Baleares, Comunidad Valenciana and Castilla la Mancha), granite or slate (Northwest of the Peninsula i.e. Portugal, Extremadura and Galicia), are erected by bonding the stones without cement or mortar. The dome, called *falsa bóveda* or *falsa cúpula,* is built in horizontal layers, where each stone slightly overhangs the previous.

In some cases we may find adobe corbelled domes, but only in the area of Castilla-León, called Tierra de Campos, which has is a long-standing tradition of earth constructions in the world of vernacular architecture (Fig. 11).

According to regional variations, we may briefly mention some of the most traditional examples in the Iberian corbelled dome constructions.

Fig. 5: Different types of lintels, according to regional variations



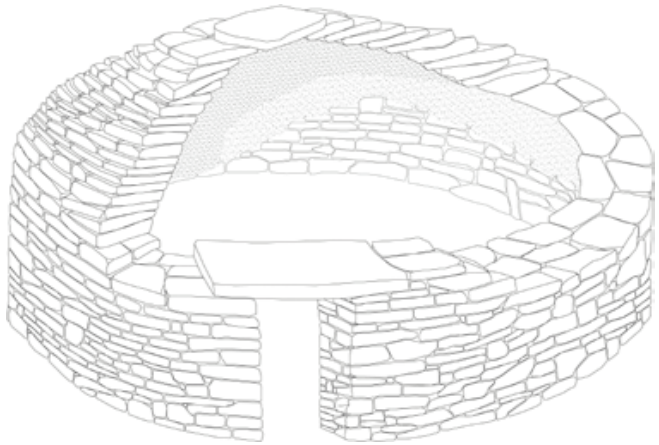


Fig. 6: 3D section of a common corbelled dome structure of *chozos* and *barracas* made with piled stones

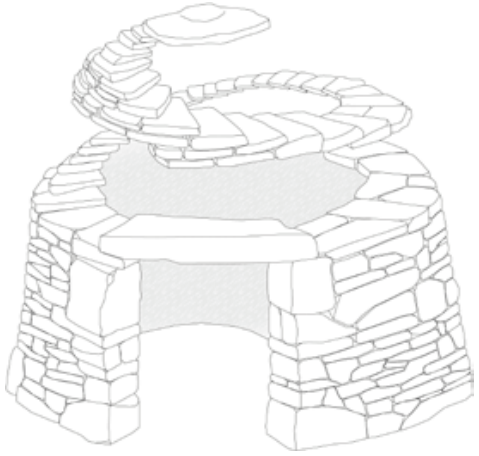


Fig. 8: Sequence of the constructive process of a circular corbelled dome structure, with spiral form ( in Andalusia, in Jaen province, the huts are named *caracoles*, meaning snails, due to the shape of the dome).

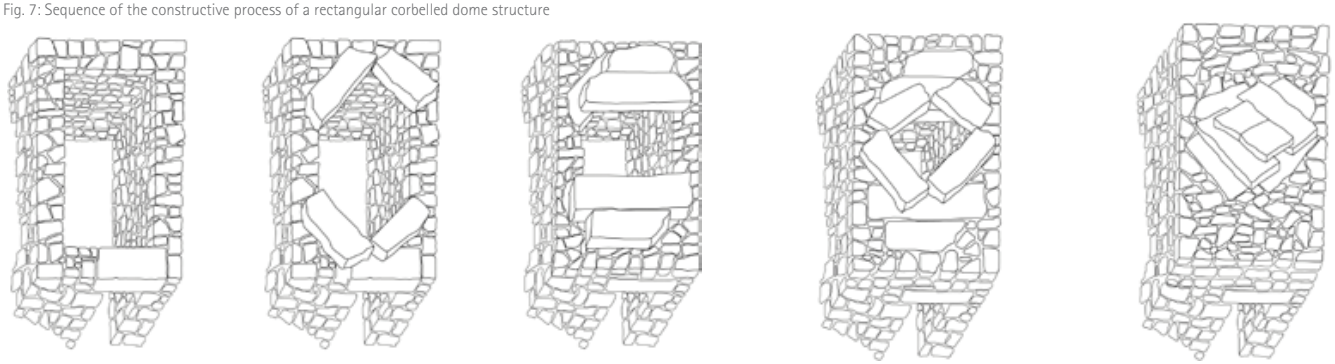
***Chozos***

(Spain: Extremadura, Cantabria, Asturias, Aragón, Andalucía; Portugal: Alentejo). These are shelters for transhumant use. According to the season, shepherds move in for the summer and graze their sheep. During this time, these *chozos* may shelter several people living together in a space of a few square meters. Some constructions are crowned with a corbelled dome in granite or slate, while others with fired bricks. Generally, several of them have an external roof of the same slates, while others incorporate a traditional ceramic tile roof or even a traditional dome, not corbelled. Sometimes the roofs are protected against the rain by a layer of soil or turf, and they appear like huts with grass roofs. Sometimes the stone walls are covered with a clay coating. Usually the section is triangular and the vault is quite conical. These shelters are distributed particularly in the Cáceres (Juvanec 2008), Oviedo, Teruel, Almería (Muñoz Muñoz 2006), Jaén provinces, and along the North Atlantic Range. The name of these constructions changes in each province (, according to regional dialect and variations (i.e. *cucos, monos, choucos, torrucas, chafurdones, caracoles, cubillos, tambores, catxerulos*, and so on) (Fig.12).

***Barracas***

(Spain: inner Provinces of Cataluña, Comunidad Valenciana, Murcia).
These are stone shelters for shepherds mainly to protect themselves and their livestock from bad weather conditions or to keep animals. These may be shelters specifically for agriculture, normally built upon stone walls dividing agricultural plots and terraces. The vault is corbelled, with almost horizontal and overhanging stone layers. The single stones slope slightly outwards of the volume for water drainage. Generally, on top of the dome may be found a horizontal stone plate set in place with the aid of smaller stones. The shape outside varies greatly from one area to another. Nevertheless, it is possible to define three types according to the position of the building: free-standing volumes in brushy wooded hills, shelters partially built upon dividing walls of estates, shelters built with the rear side against a crag rock (Gironés i Descarrega 1999).These are typically found in Cataluña, (Martín i Vilaseca 1990) north Comunidad Valenciana region( Meseguer Folch 2000-2001; Castellano Castillo 2001), inner Murcia province and the east Aragon region (the latter are known as the *Maestrazgo* area) (Figs. 14-15).

Fig. 7: Sequence of the constructive process of a rectangular corbelled dome structure



***Pozos***

(Spain: Aragón, inner Regions of Comunidad Valenciana and Cataluña, Andalucïa, Tenerife and Baleares Islands).

These are stone constructions used as wells, with traditional corbelled dome architecture, using horizontal layers of overhanging stones. The dry-stone constructive system is perfect for the gathering of natural water, allowing ventilation and shielding from dampness or the arising of salts. The shape and dimension vary widely from one area to another, along the dry and arid regions of Spain, like the Canarias or Baleares Islands, where water is a real 'treasure' for peasants and shepherds. It is possible to define different purposes for the shelters: they may be wells, reservoirs, cisterns and so on, in some cases the constructions can be ice stores, not only water deposits, half excavated into the soil, mainly in the inner rural areas of Jaen, Zaragoza (Rivas 2004) and Valencia province (Rodríguez Cervera & Domínguez Bell-Lloch & Galliana Bondía 2004).

***Ponts***

(Spain: Baleares Islands).

These are shelters for shepherds and sheep and basically can have two forms, according to older and more recent examples. The interior region of Menorca holds the most ancient typologies, built with incredible precision as half cubes on a circular ground plan and in two or three stepped heights (Juvanec 2001). They are made of grey stone and carry a capstone at the top or else a devotional cross. The larger and more recent shelters, meanwhile, are located in the northern part of the plains, where horses or bulls are reared (Calviño Cels 1999). Unlike the older structures, they are made with yellowish dressed stone of relatively equal dimension, perhaps smaller than in the case of the more ancient buildings. Because of increased needs, the more recent *ponts* are also larger, accommodating some ten horses, stepped on the outside and pre-dimensioned for safety reasons. They have a stepped form to the top and the terraces are filled with small pebbles (Fig. 16).

The front wall is always completely flat and mangers are built into both sides of the entrance, with triangular compound lintels. *Ponts* always stand within an enclosure that may be a signal of their presence, as exceptional elements in the landscape of the Isle of Menorca (Baleares Islands), both for their dimensions and shape (Consell Insular, Mallorca 2004).

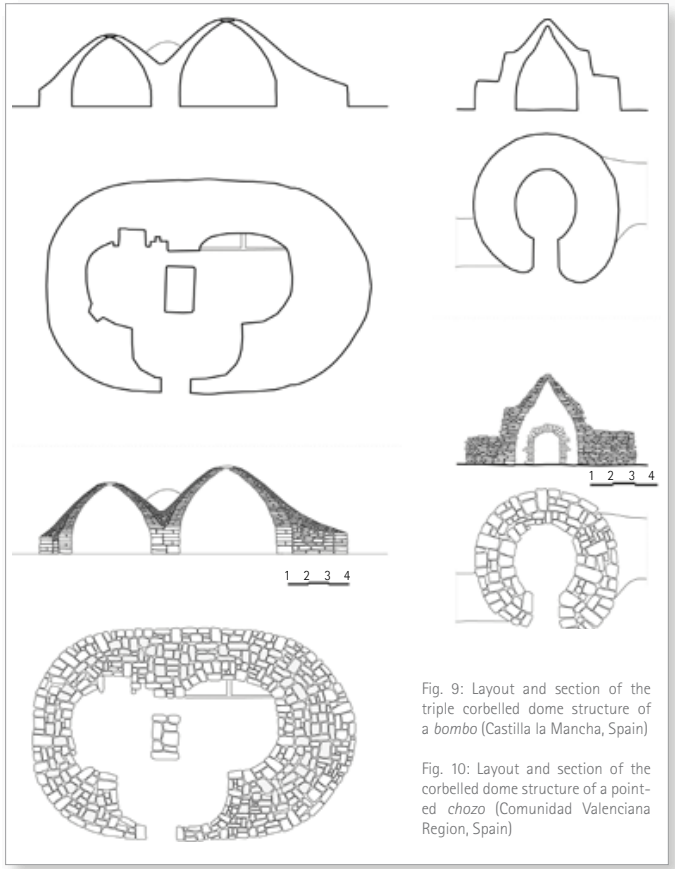



Fig. 9: Layout and section of the triple corbelled dome structure of a *bombo* (Castilla la Mancha, Spain)

Fig. 10: Layout and section of the corbelled dome structure of a pointed *chozo* (Comunidad Valenciana Region, Spain)

Fig. 11: Examples of earth architecture with corbelled dome in Tierra de Campos (Castilla y León, Spain)

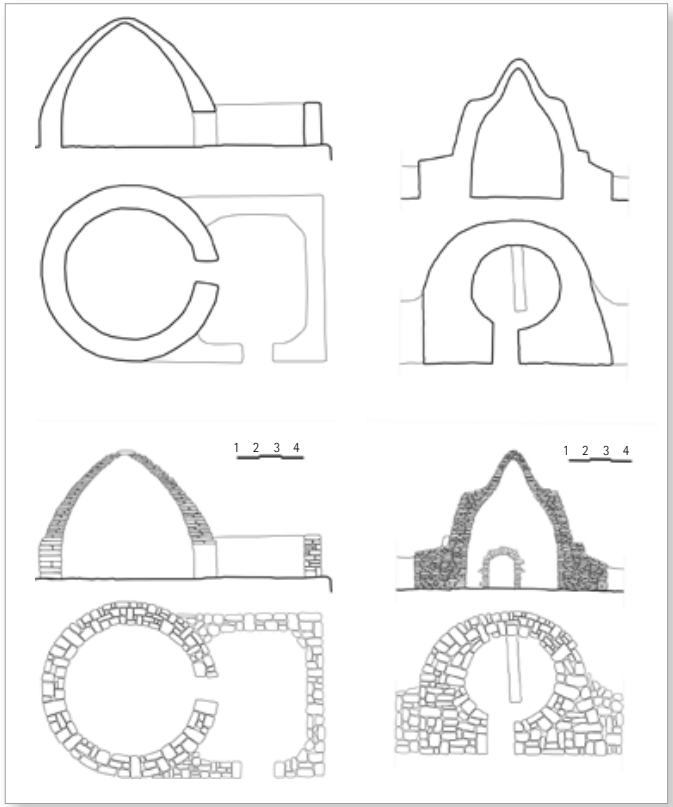



Fig. 12: Layout and section of a *chozo* corbelled dome structure, closing to a yard (Extremadura, Spain)
Fig. 13: Layout and section of a corbelled dome structure of a pointed *chozo*, with dividing areas for shepherds and animals (Comunidad Valenciana Region, Spain)

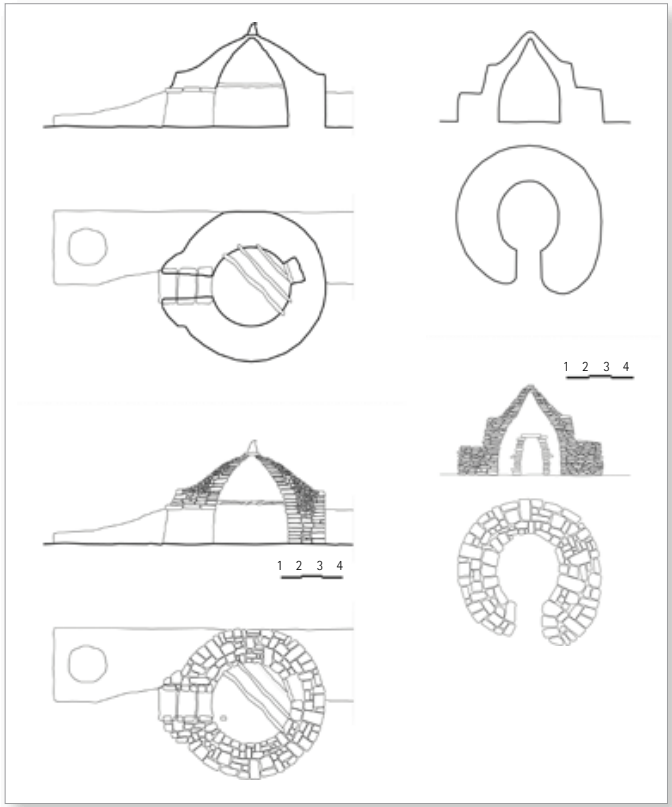



Fig. 14: Layout and section of a *barraca* corbelled dome structure (Aragon Region, Spain)
Fig. 15: Layout and section of a *barraca* corbelled dome structure of Cataluña Region, Spain.

***Bombos***

(Spain: Castilla La Mancha).

These are stone shelters mainly intended for shepherds. They usually have a multiple cell layout (two or three cells) and corbelled vaults to cover the space (with a final layer of gravel). There are rooms both for people and animals connected with low doors so that the shepherd may monitor the livestock. The final shapes appears most natural, like simple stone piles in the flat landscape of the outskirts of Tomelloso (Castilla la Mancha Diputación de Albacete 2001), as if hardly made by the hand of man (Pedrero Torres 1999). The *bombo* has a corbelled construction on the inside and a frame outside, with filler in between. The frame serves only to ensure that the filler does not leak out, and natural slippage of the material results in a harmonious shape. For this reason, due to the presence of filler the interior of the construction remains so peculiar and special in the context of shelter typology, (Juvanec 2001). The shape of the external roof derives from the disposition of the stones falling naturally down the slopes of the dome. Today, the roofs are whitewashed each year with lime (Fig. 17).

***Almacenes***

(Spain: Galicia, Portugal: Montesinho).

These are dry-stone constructions used as granaries with a corbelled dome system (that may or may not appear in the outer volume). Sometimes, ow-

ing to weather conditions, the roof is covered by slates to improve impermeability. The shape is rectangular, with a long and narrow layout (Lozano Apolo 2004).The shape outside varies greatly from one area to another but the base is always made by two or more vertical stones and with overhanging slates (protecting against rodents and animals). These are typically located in the Galicia region, on the Portuguese border, where they are known as *hórreos* (Caamaño Suárez 1999).

***Chozos De Viñas***

(Spain: Castilla Y León, Spain).

These are adobe constructions, usually built within the surroundings of vineyards in order to watch over and look after the estate. The walls are built with adobe and less frequently with rammed earth, approximately 90 cm high. The vault is corbelled, projecting the adobe progressively, as with stone shelters (Alcalde Crespo 1994). The edges between the vault and the wall are covered and smoothed with dihedral corners to drain rainwater. There are some constructions without the perimeter wall, which start directly to corbel the dome almost from ground level, with just a 30 cm high stone basement.

Both constructions have a finishing protection coating made with earth mortar, renovated every other year. Occasionally some vineyard monitoring constructions complete with chimney are still visible, evidence of human dwelling inside.

***Casetas De Pozos***

(Spain: Castilla-León).

They also are adobe or brick constructions, in the vicinity of drinking troughs, used to cover and shelter to wells (Sánchez del Barrio& Carricajo Carbaio 2005).The peasants and shepherds guard the well curb against animal pollution with such protective structures built with stones or even adobe. The vault is a corbelled, with progressively projecting elements. Outside of the construction but close to them, there may be found some basins or drinking troughs for livestock, directly fed with water through a channel from the curb (Fig. 18).

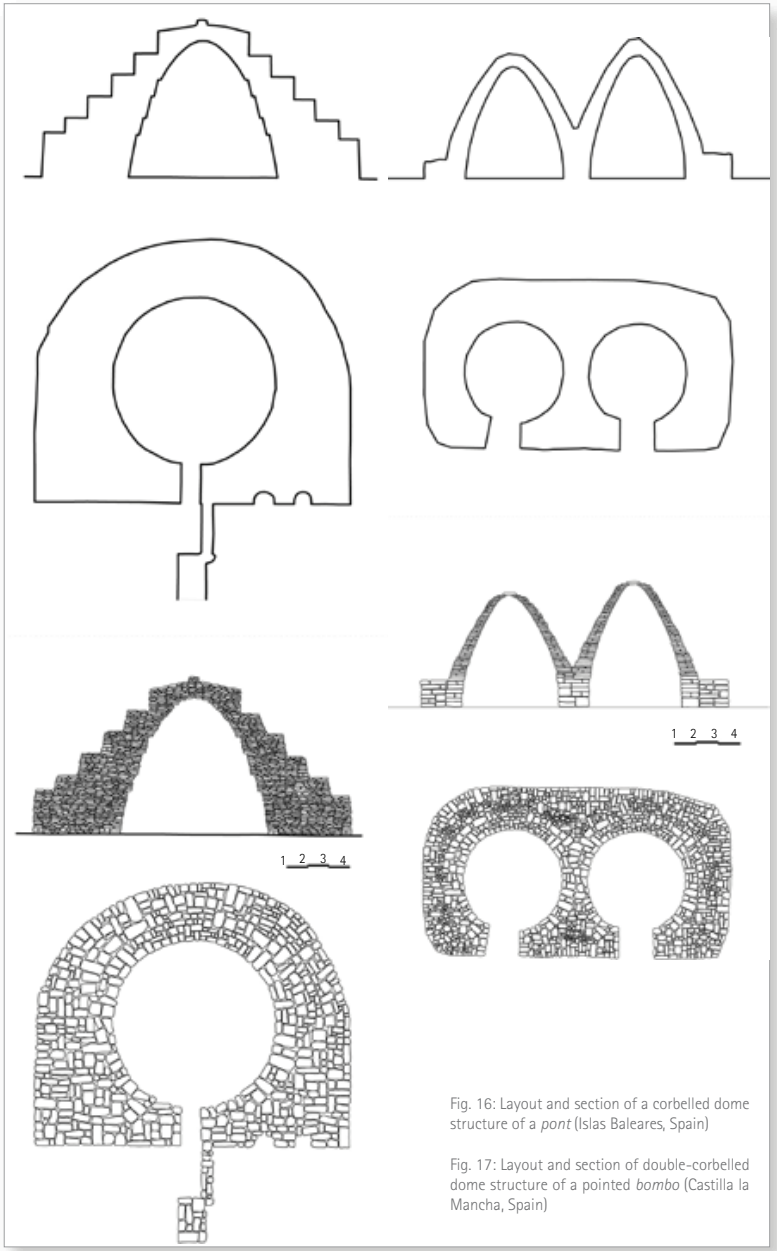



Fig. 16: Layout and section of a corbelled dome structure of a *pont* (Islas Baleares, Spain)

Fig. 17: Layout and section of double-corbelled dome structure of a pointed *bombo* (Castilla la Mancha, Spain)

***Casetas de Labranza***

(Spain: Rioja- Navarra- País Vasco).

These buildings have much the same constructive features as *chozos* but are destined for a different purpose, in that the peasants use them to store the tools, equipment and instruments, etc., of their daily work. The inner space of the shelters, for this reason, may be divided according to the type of tools stocked. They are typically found in rural northeast areas of Spain, like Álava province, southern País Vasco and the southern Navarra region (Fig. 19).

***Espigueiros***

(Northern Portugal).

These are stone constructions used as stores for drying corn (seldom grain). They usually have thatched roofs over the corbelled dome, or sometimes the corbelled vault with horizontal layers of stones appearing through to the exterior. These dry-stone shelters are ideal as they allow the breeze to permeate and facilitate the drying of corn. The shape outside varies considerably from the circular to the rectangular. The dry-stone compositions are bonded with impressive detail, as if not stone masonry but wood joinery. They are typically located in the north of Portugal (Moutinho 1979).

***Dólmenes and Tholoi***

(Andalucía).

Some of the oldest examples of corbelled dome architecture can be found in the Magina area, a nature park, in the Almeria province (Andalucía). Here we have traces of Iberian villages with some archaeological remains of ancient *Tholoi* and *Dolmenes* structures, some of them close to cave typologies, with corbelled dome sheds (Escobedo Molinos 2001).

**Evaluation of the state of conservation**

Some of the most important problems related with corbelled dome architecture may be summarized in the following points:

- the huts are no longer in use in the main part of the Iberian Peninsula;
- very often shelters are under private ownership, not always "protected" by laws, rules or regulations;
- the research on vernacular architecture and the associations of professionals are not always effective enough or powerful enough. There is the problem of localism and a lack of unification of works and research;
- there is also a lack of transmission of information between local well-trained professionals and preservation organizations;
- local professionals are not always involved in the research;
- only in few cases are professionals prepared and trained to maintain and preserve the corbelled dome;
- in some cases, the corbelled dome system is treated with a rather folkloric approach and not a real scientific attitude in publications;
- in general we can see the loss of knowledge concerning this construction technique and the presence of too few local-technical workshops (hands-on training).

At the same time, a reflection may be proposed on the pathologies and the degradation of these vernacular shelters:

- shelters made with dry-stone techniques can survive poor atmospheric conditions (in this case there are no such problems as pathologies related to the material, joints and mortar);
- the presence of animals can damage the structure if not maintained properly. In these cases the huts usually suffer a lack of volume and stones;
- the compact system of the corbelled dome may be seriously damaged in the case where some parts are missing (holes, fractures). The loss of a part of the overhanging vault may seriously affect the well-being of the hut;
- huts are always in aggressive environments that may attack the structure (dampness, fungus, biological attacks, etc.), although in some cases this risk is reduced by the absence of windows and openings.

Fig. 18: Well made using bricks with a coated corbelled dome structure (Castilla y Leon, Spain)

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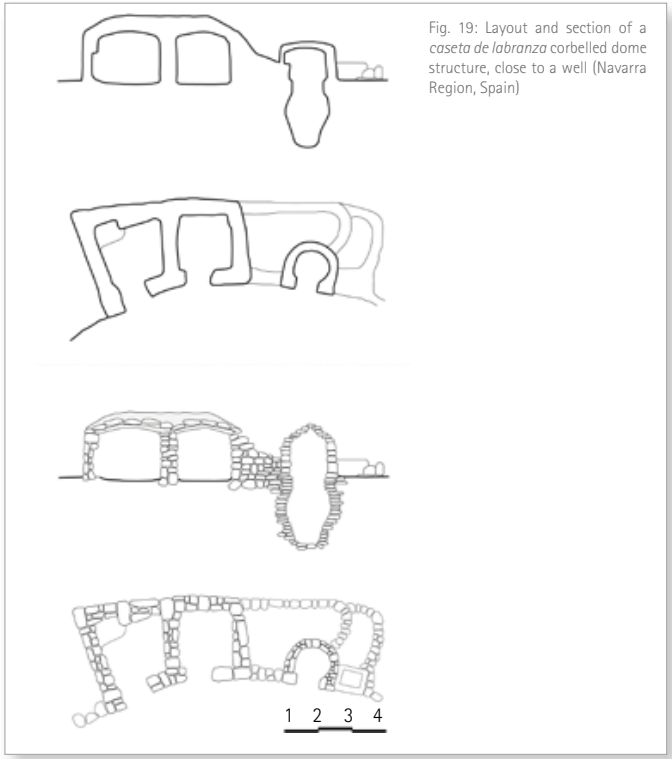


Fig. 19: Layout and section of a *caseta de labranza* corbelled dome structure, close to a well (Navarra Region, Spain)