THE TRADITIONAL COURTYARD HOUSE OF CENTRAL AND SOUTH SARDINIA: *METHODOLOGICAL HYPOTHESIS FOR THE TYPOLOGICAL PERFORMANCE RENOVATION OF "CASA DEMURTAS" IN ESCOLCA (CAGLIARI, SARDINIA)*

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Abstract

The genius loci of vernacular architecture allows one to understand the intimate relationship which folk buildings establish with the site by responding to local environmental conditions[1] . In its numberless expressions, vernacular architecture is strongly characterized by technical aspects, related to the community's material culture and socio-cultural evolution, and typological aspects, which very diverse buildings share in relation to spatial and functional organization and dwelling patterns. It is widely agreed that, to understand vernacular architecture, one must not prescind from the understanding of traditional construction techniques and building materials, and analysis of typological features. Typology, in fact, responds to the environmental and climatic features of place, economy, culture, local availability of resources and construction techniques, which have developed within local craftsmanship (Kelbaugh, 1990).

The present need for preservation of architectural heritage calls for reflection on the dwelling opportunities that some vernacular rural building types could still provide. Once closely related to the agro-pastoral life and economy, they may still be able to provide high-quality life standards.

By focusing on a case study of a "courtyard house" of Southern Sardinia, this paper attempts to test whether, and with which technological and typological adjustments, this typology can meet contemporary dwelling needs as well as current technical and environmental requirements.

The paper presents ongoing research which puts forward a hypothesis for the renovation of "Casa Demurtas", in Escolca, and proposes a methodology that considers construction and typology as possible keys to the reading of the building, in order to re-establish the lost connection between architectural making, materials manufacturing and building techniques development. The final goal is to assess the method's validity for its prospective application to other local contexts.

Keywords: *Construction, Typology, Courtyard house, Environmental and technical performance renovation*

[1] Norberg-Schulz, C., 2000. Architecture: Presence, Language, Place. Milano: Skira.

Introduction

Vernacular architecture is characterised by "technical aspects", connected with the technical and material culture of local communities, as well as by "typological configurations", which derive from people's life and work patterns.

Construction and typology of vernacular architecture are almost always consistent with the cultural tradition and the place: a sensitive yet contrasting dialogue, which is always nature and landscape sensitive[2] .

Historic dwelling patterns inform our present: elements of the past are transformed and projected towards new dwelling modes.

Traditional buildings of Sardinia meet Caruso's definition of vernacular architecture (1999): they are a product of a construction act, they do not concern appearance but presence, they show themselves as artefacts containing the traces of the social and technological context, slowly but continuously evolving, where they are produced. These are the guiding principles of our research and methodological proposal for the adaptive reuse of traditional buildings. In Sardinia as all over the world they require a sensitive interpretational approach, which does not produce "genetically modified organisms", but rather "genetically evolved organisms".

Traditional rural domestic architecture in Sardinia

Expression of a relationship with the place

In the 12th century, an evolution of the relationship between the lords and the populace determined life and work conditions in the fields. These conditions underlay the settlement and transformation patterns that led to the farming landscape of Sardinia. Gradually, the people settled and constructed houses - initially isolated, later in blocks - which allowed them to inhabit the hinterland and gave birth to villages [3].

The size and typology of the buildings was dependent on the work activities of the family and on the possibility, granted by the lords, to extend the house in order to accommodate agricultural produce and farm animals. For this reason stables, barns, gardens and courtyards have appeared next to domestic spaces. The interplay of these factors produced, in Sardinia, many different architectural typologies, which have responded for decades to a "complex" land (both from a morphological and socio-cultural perspective) by dividing it in "historic regions".

Three main classes of typologies have been identified according to morphological conditions, settlement patterns and availability of raw materials: a) the "courtyard house" of the cereal regions of Southern Sardinia; b) the "multi-storey cellular house" of the mountainous farming regions of Central-Eastern Sardinia; and c) the "basic cellular house" of Northern Sardinia, which features different heights, depths and internal layouts (Sanna et al,2008, p.2).

[2] *Rapoport, A., 1969. House form and culture. Englewood Cliffs, N.J.: Prentice-Hall, Inc.*

Marmilla, the historic region we are focusing on, is confined by Sarcidano's limestone rock to north, Mount Arci to the east, and Mount Trempu and the sloping basalt flow of Giara di Gestori to the west (Baldacci, 1952, p.90).
The entire area, characterised by gentle hilly valleys, alternating with low mountains, lends itself to cereal crops, tree planting and sheep-farming, so favouring the settlement and development of the "cereal courtyard house".
The walls of the building and the courtyard are built out of resistant local stone (limestone, marlstone, basalt, trachyte), allowing for the construction of up to two storeys, and are provided with several windows in order to catch as much sunlight as possible, especially in the uplands.
The building is nearly always located to the north border of the enclosure, of which it is an integral part, in order to allow visual control inside and outside.
The building has usually two courtyards: a "public courtyard" facing the street, surrounded by the different spaces of the house, is a sheltered meeting and work space, where agricultural and sheep-farming products are stored and processed; and a "private courtyard" at the back is used as a garden.
The courtyard's enclosure is a tall wall with a big street door lined with the porch. The door is the only decorated element of the complex, with its construction date engraved on it.
The porch, which is called "sa lolla" in the local dialect, has less and narrower arcades than in Campidano, where it is very common. Sometimes the porch consists of one arch and works as a corridor; sometimes it works as a buffer zone which shades from the southern sunlight and mediates the transition between the building and the courtyard.
The kitchen is the largest and most used space of the house. It is usually located in the right part of the building, which faces east, in order to catch the cold winds coming from Mount Gennargentu. It can be entered from the courtyard and can accommodate different functions, including use as a servants' bedroom.
The upper floor is normally used as a storage, but can also be used as a bedroom if the family is large. A masonry staircase, under the porch, or alternatively a lightweight wood and reed staircase inside leads upstairs.

The case study

Historic, social and cultural aspects

Populated in the past by villages, which today are archaeological ruins, the land still maintains its original morphological characteristics.
Presently, like most of the villages in Central-Southern Sardinia, the municipality of Escolca suffers from continuing depopulation. This is due to a lack of job opportunities and inefficient links to the nearby city of Cagliari[4] .
Paradoxically, despite the high living standards provided by the local natural environment and landscape, young people are pushed to look for a job somewhere else. The villagers abandon the country and "take refuge" in the built-up areas.

[3] *For a full understanding of the relationship between settlement cultures, urban development and urban governance refer to F. Clemente's writings and, in particular, to Clemente, F., 1968. Per una metodologia di interpretazione dello spazio fisico come spazio sociale. Città e Società, 3, pp.8-11.*

[4] *Brigaglia, M. & Tola, S. eds., 2007. Dizionario storico-geografico dei Comuni della Sardegna. Volume 2 "E-L". Sassari: Carlo Delfino Editore.*

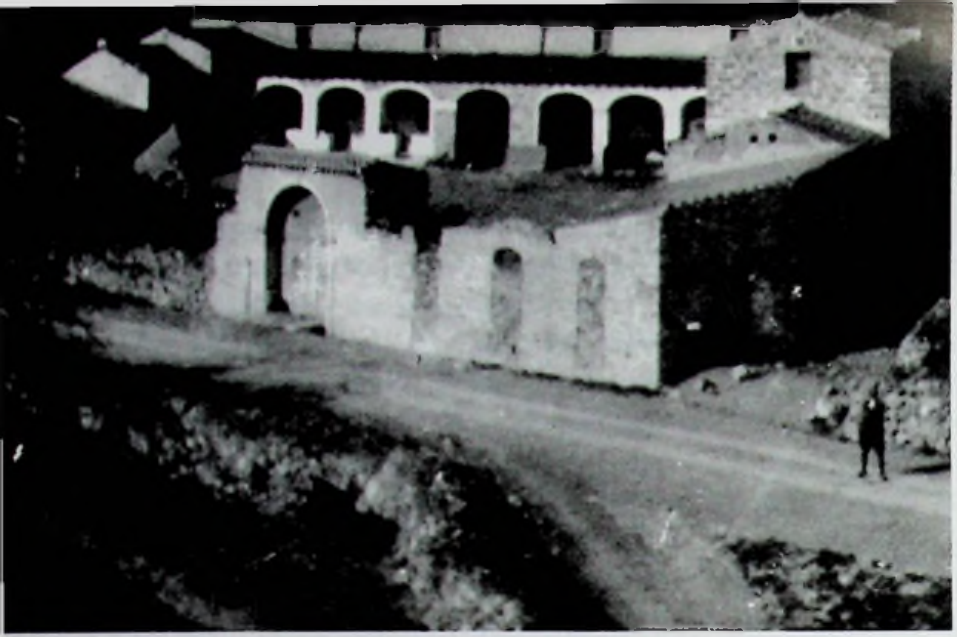


Fig.1: the building complex in the early 20th century (photo: De Murtas archive)

Typomorphological analysis

Casa De Murtas, located in Escolca's historic centre in Southern Sardinia, is a typical example of traditional architecture of the Marmilla-Sarcidano region.

The building was originally built with a "public" courtyard in the main front, which was entered through a big street door in the enclosing wall, and a rural "private" courtyard, at the back, which was reached through a large passageway in the northern part of the enclosure (Figure 1).

The main block, which was the owner's residence and dates back to 1912, occupies the north side of the courtyard. It is a long building with an adjoining porch, which previously acted as a circulation space between the various rooms on the ground floor. The adjacent spaces were used for production, as servants' rooms or as storage for tools and animals (Caniggia, 1979).

During recent years new needs have introduced new uses: after the division, the north block became a stable, while the east block was turned into the living quarters. This preserved the kitchen and the storage on the ground floor (keeping with the original typology) and accommodated the bedrooms on the upper floor[5] .

The walling of the courtyard, which reflects the typological definition of the complex as well as the identity and ownership of the family, was erected after the construction of the first building, in 1925, as the street door inscription attests. Later, the courtyard was subdivided into two distinct properties: the eastern block remained unchanged, while the western block was completely demolished and rebuilt in a modern fashion. However, it is still possible to detect traces of the block demolished.

Technological performance analysis: materials and construction techniques

The building elements and materials constitute a framework of technological performance, and should be taken as the starting point for any performance renovation proposal[6] . The arrangement and orientation of the blocks, which are single detached units, respond to sunlight and prevailing winds. The masonry thickness and construction depend on the

[5] *Bertoldini, M., 1996. La cultura materiale e lo spazio costruito. Milano: Franco Angeli.*

[6] *Molinari, C., 2006. Elementi di cultura tecnica. Napoli: Edizioni Sistemi Editoriali.*

materials available on site: stone, timber, lime, clay[7] . The span between opposite walls is constrained by the section of the floor timber beams. The span has imposed the adoption of "Palladian" timber trusses to support the roof (Rondelet, 1831).

Most of the windows open onto the courtyard (to the south) being almost absent from the north-facing wall; on this side, in fact, the building needs to be protected from the cold, and there is no need for visual control of the backyard.

The walls of the house block are rendered in lime and clay.

The courtyard's floor, which extends into the buildings, is made of small stones laid on a soil bed[8] , according to the traditional "*imperdau*" technique.

The buildings' floors are made of timber beams and planks.

The structure coincides with the building envelope and the foundation and walls are built out of different size limestone blocks (with minor content in clay and marl), bonded with lime.

Partitions are made of stone masonry on the ground floor, and of reed mats, reinforced with wool fibres and rendered in lime and earth, on the first floor[9] .

The roof is in timber and consists of rafters and battens, which support a reed mat covered in lime-based screed. Clay tiles are laid on that in the "Sardinian fashion", though some have been replaced by flat "Marseillaise" tiles.

Inside, the space is measured on the dweller's activities and functions; outside, on the contrary, it depends on the building's representation and identification role[10] . The relationship with the *physical environment*, the *material culture* and *the socio-cultural structure* of its regional context is analyzed here according to a methodological framework consisting of a threefold interpretation of architectural regionalism: *Environmental Regionalism, Technological Regionalism, Typomorphological Regionalism*[11] .

Based on the three facets of regionalism is the analysis of the case study (Figure 2), which aims at visualizing its simultaneous *environmental, technological* and *cultural appropriateness* for the context.

The framework of change: issues related to "re-inhabiting"

Inspiring principles

The renovation goal is the "re-inhabiting" of the building, which can only take place if job opportunities are created which are connected

[7] *Achenza, M., Sanna, A., 1999. Abitare la terra. Atti del Convegno Villamassargia-Samassi 12-15 novembre 1998. Cagliari: Edizioni CUEC.*

[8] *See Carbonara, G., 1996. Trattato di restauro architettonico, Volume 2. Torino: Edizioni UTET, p.249).*

[9] *See standard UNI 8290-1:1981, "Edilizia residenziale. Sistema tecnologico. Classificazione e terminologia", and UNI 8290-2:1983 "Edilizia residenziale. Sistema tecnologico. Analisi dei requisiti"*

[10] *Oliver, P. 2006. Built to meet needs. Cultural issues in vernacular architecture. Burlington, Ma: Elsevier.*

[11] *This analytical-interpretational methodology has been proposed by Giamila Quattrone for the investigation of the regionalist features of a building in her PhD Thesis The relationship between dwelling patterns and appropriate technologies for regionalist contemporary architecture. From contemporary Australian design experience to the proposal for a metadesign tool in the Mediterranean area, supervisors Prof. Adriano Paolella, Prof. Consuelo Nava, Prof. Michael J. Ostwald, Università degli Studi Mediterranea di Reggio Calabria, DASTEC Department, 2008.*

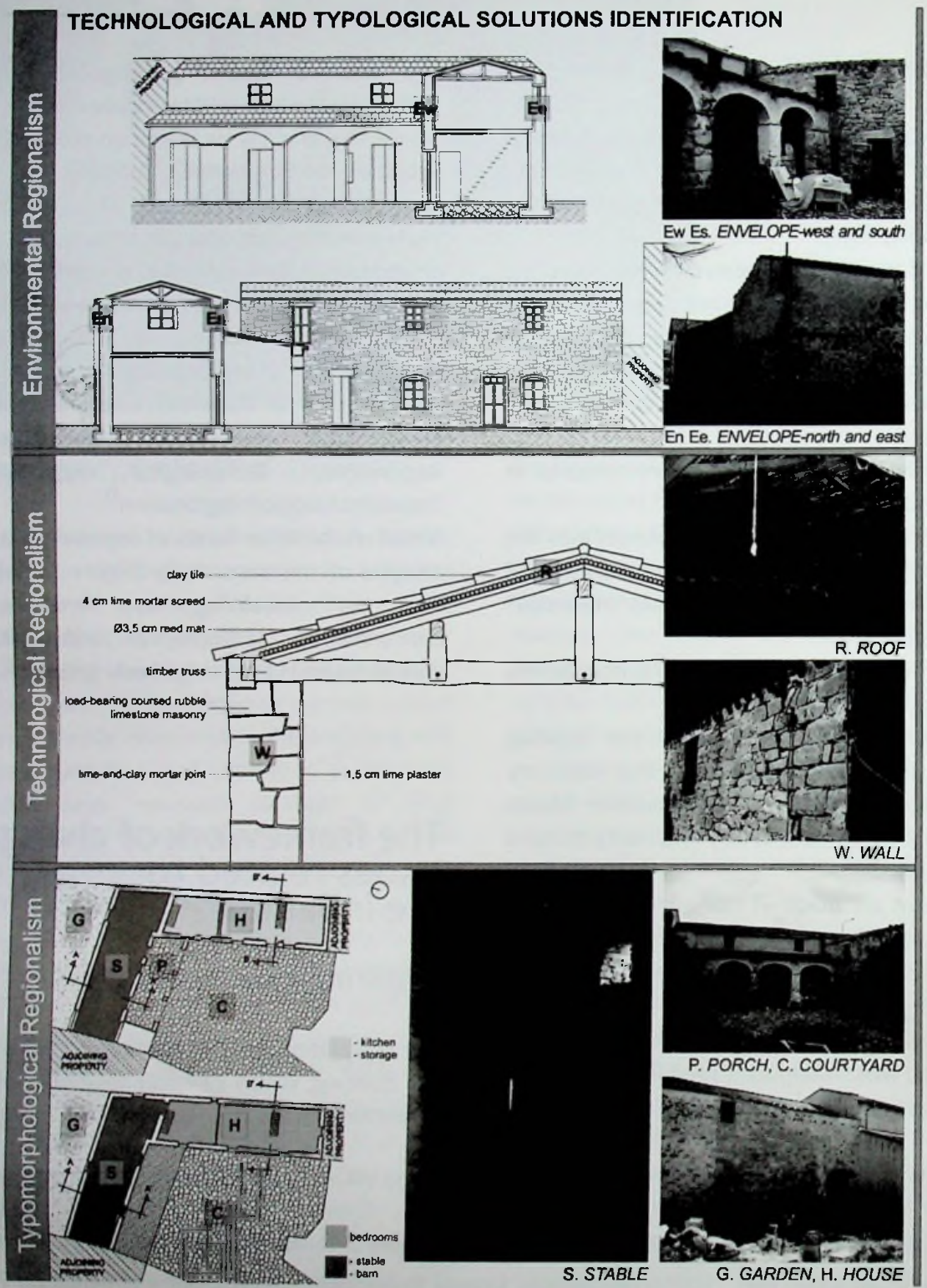


Fig.2: analysis panel of the regionalist features of Casa De Murtas, based on the methodological framework proposed (drawings: G. Quattrone, photos: A. Monsù Scolaro)

[12] *See www.sardegnafilieracorta.com.*

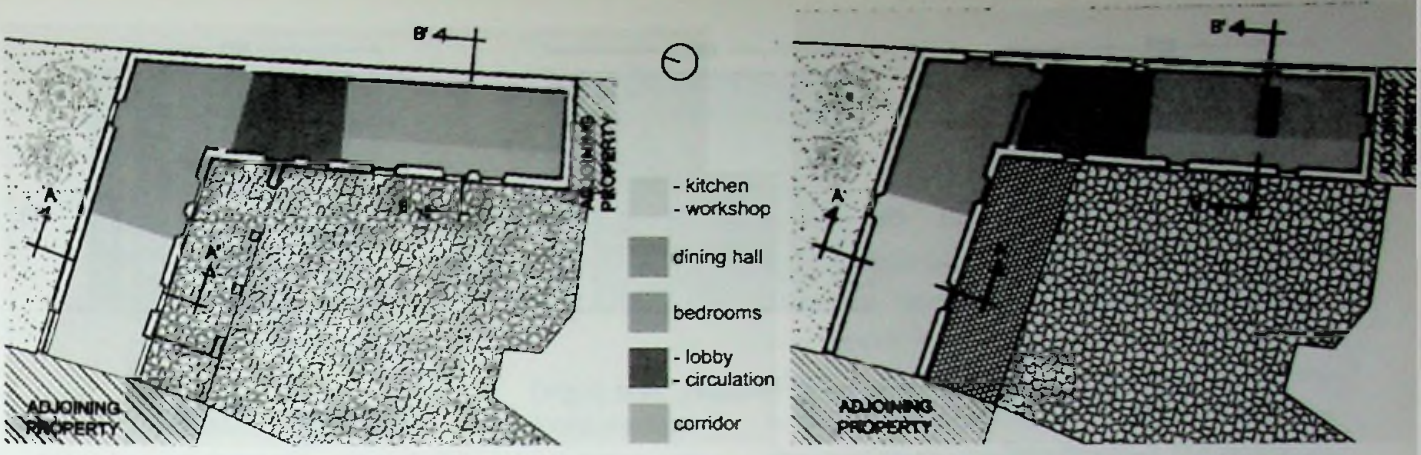


Fig.3: hypothesis of adaptive reuse: layout of the new space arrangement (drawings by G. Quattrone)

with and respectful of the peculiarity of these places: agriculture and produce processing.
Produce could be eaten on site and marketed within a few kilometre radius, which would preserve their basic organoleptic properties[12] .

Typological and climatic issues

The Mediterranean courtyard house has always performed well in relation to thermal comfort, thanks to the natural ventilation which its typological arrangement promotes. As explained by Egyptian architect Hassan Fahty (2000, p.51), with reference to Islamic courtyard houses, the courtyard space works as a temperature regulator: during the night cool air settles on the bottom of the ground floor and enters the surrounding rooms, cooling down the walls, the roof, the floor and the fittings.
Enclosed by the external walls of the building, the courtyard remains cool until late in the afternoon. The cooling effect of the courtyard is maximised by cross ventilation, with air flowing through facing windows and doors.
The thermal mass contained in the stone load-bearing walls helps delay thermal flows and losses, thus keeping the interiors cool and warm when required.
The porch works as a buffer area: it protects the south-facing wall from direct sunlight and provides the dwellers with a sheltered yet open space.

Technological issues

The performance renovation, on the one hand, retains the building's original typological, morphological and technical features, on the other hand, introduces experimental design solutions, which innovate the original construction by employing locally available materials[13] . The renovated building has to meet the demands of present-day living. This implies an assessment of the physical-chemical compatibility of techniques and materials[14] , and of the visual, textural and chromatic integration of the building with the landscape.

Methodological profile for an experimental reuse of Casa De Murtas

Typological adaptation, climatic aspects and new living needs Turning the house into a farm, and offering local produce as well as holiday accommodation, could prove as a feasible way to give the building new life through a modern

[13] *Sinopoli, N. & Tatano, V. eds., 2002. Sulle tracce dell'innovazione. Tra tecniche e architettura. Milano: Franco Angeli.*

[14] *Germanà, M. L., 2002. Significati dell'affidabilità negli interventi conservativi. In: A. Sposito, ed. 2004. La conservazione affidabile per il patrimonio architettonico. Atti della Tavola Rotonda Internazionale, Palermo 27-28 settembre 2002. Palermo: Dario Flaccovio Editore, pp.24-31.*

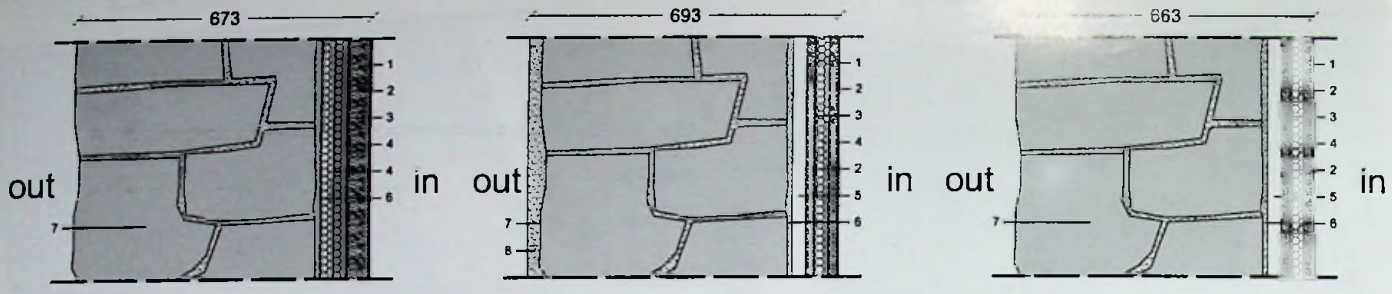


Fig.4: 1:20 section of the north (left), south (middle), west (right) wall
(drawings: G. Quattrone)

ENERGY PERFORMANCES

(testing done through Termolog Lt)

1. *3 mm lime-based plaster, specific for humid walls*
2. *20 mm (south wall) and 50 mm (north wall) wool wood board*
3. *30 mm wool mat*
4. *PE vapour barrier*
5. *30 mm air gap obtained by means of a cork oak studwork*
6. *10 mm NHL 3,5 finishing, specific for humid walls*
7. *550 mm limestone existing wall*
8. *30 mm NHL 3,5 finishing, specific for humid walls*

NORTH WALL: 673 mm
thermal transmittance: 0,3191 W/m²K
interstitial condensation: 0,0234 Kg/m² (max value)
SOUTH WALL: 693 mm
thermal transmittance: 0,2986 W/m²K
interstitial condensation: 0,0376 Kg/m² (max value)
WEST WALL: 663 mm
thermal transmittance: 0,3044 W/m²K
interstitial condensation: 0,0380 Kg/m² (max value)
ROOF: approx. 375 mm

mixed use. The adaptation of the building to the new use involves the development of a visitors' domain and a managers' domain. The former, which would include the sleeping spaces, could be accommodated in the house block; the latter, which would include the cooking and dining spaces, could be accommodated in the stable block. The junction room, which contains the staircase, could become a lobby and circulation space.
The new layout would be based on a climatically correct orientation (Figure 3):

1. the bedrooms would face east, thus benefiting from the morning sun;
2. a west-facing corridor, running along the house block and overlooking the courtyard, would let the sun in during the afternoon;
3. the workshop for produce processing would occupy the west end of the property, on the ground floor, providing access to the garden through the existing arched door, and benefiting from the shade of the attached porch and the adjoining property, thus preserving the produce;
4. the kitchen would be to the same end of the building, on the upper floor, benefiting from the southern sunlight and the view of the courtyard;
5. the dining hall would occupy both floors, at the east end of the stable block, providing access to the courtyard and sunlight.

[15] *See the manufacturers' websites www.edilana.com, www.calcidrata.com, www.tassullo.com, www.tettoproject.it.*

Operational technical tools: testing of the building elements' performance

The new space arrangement would require upgrading of the building envelope in accordance with the new interior space orientation.

The design has the goal of making the building envelope more energy efficient, by complying with the requirements provided by the latest Italian regulation on energy efficiency and saving (Dlgs 311/2006 and DPR 59/2009).

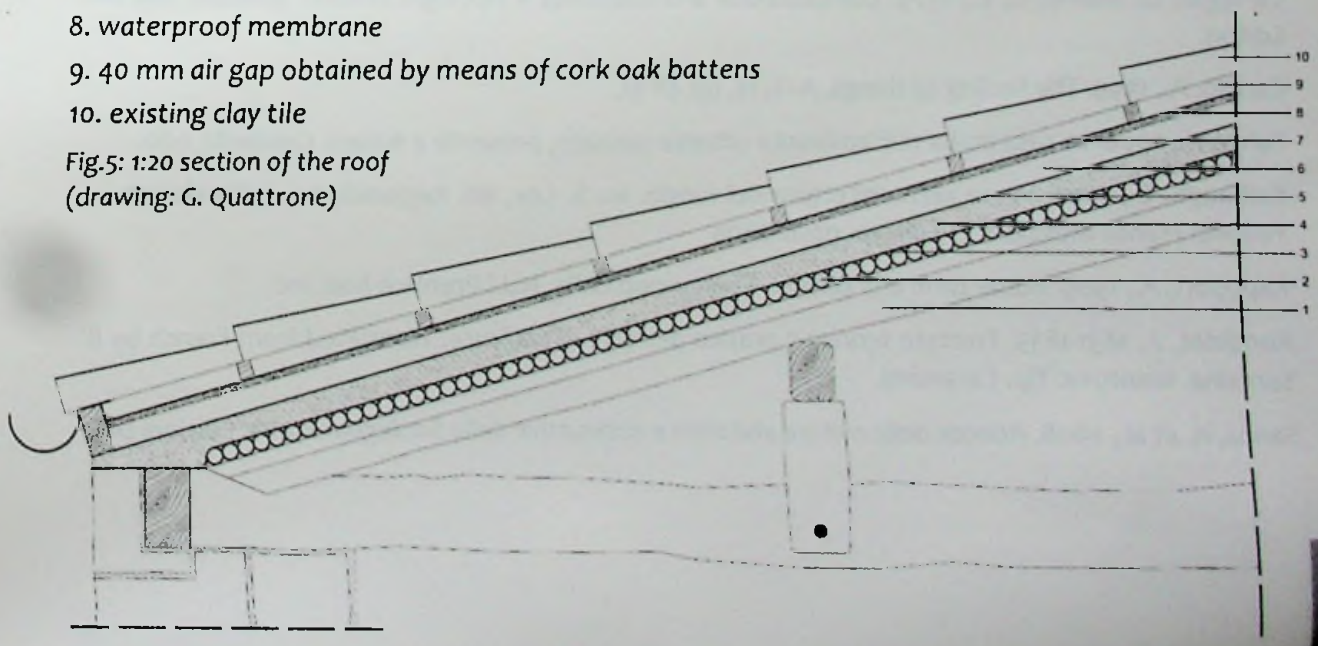
The construction of three walls (Figure 4) and the roof (Figure 5) is redesigned by employing local natural, recyclable and recycled materials: wool insulating mats, cork oak studs and battens, natural hydrated lime mortar for plaster and screed, OSB boards and wood wool boards[15].

These materials have been tested using the software Termolog LT and have performed well under the restrictions imposed by the aforementioned regulations. Concerning the walls: the *thermal transmittance* is lower then the maximum value permitted for buildings located, as in our case study, in areas climatically classified as "D" (U max=0,324 W/m²K); the *interstitial condensation*, which reaches its peak in February, has acceptable values, and there is no *superficial condensation*; the *superficial mass* is higher than the minimum value permitted (SM min=230 Kg/m2).

Concerning the roof: the *thermal transmittance* is lower than the maximum value permitted for buildings located (U max=0,228 W/m²K); there is no *interstitial condensation* or *superficial condensation*, and the *superficial mass* is higher than the minimum value permitted (SM

1. existing timber truss
2. 35 mm existing reed mat
3. PVC vapour barrier
4. 55 mm NHL 3,5 fibre-reinforced screed
5. PE non woven fabric
6. 50 mm air gap obtained by means of cork oak battens
7. 15 mm OSB board, lined with reflective aluminium foil
8. waterproof membrane
9. 40 mm air gap obtained by means of cork oak battens
10. existing clay tile

Fig.5: 1:20 section of the roof (drawing: G. Quattrone)



min=230 Kg/m2).

Conclusions

We have described a methodology used to assess the technical feasibility of the adaptive reuse of traditional rural architecture in a low density population region, and have tested to what extent it can be adapted to contemporary uses.

A socio-economic feasibility study, however, should be done to sustain the re-inhabitation plan. This research infers that, on the technological and environmental side, we could realistically apply it, with further adjustments, to other geographic areas and socio-cultural contexts, in an attempt to re-establish the relationship between man and his environment.

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