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# **AGRIBUSINESS PAESAGGIO & AMBIENTE**

*Il punto di svolta del Mosaico paesistico-culturale:*

*Rinascimento Rivelazione Resilienza*

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# **AGRIBUSINESS LANDSCAPE & ENVIRONMENT**

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*Renaissance Revelation Resilience*

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## **LOCAL IDENTITY AND TECHNOLOGICAL INNOVATION. URBAN AND TERRITORIAL POLICIES FOR THE RE-GENERATION OF THE HISTORICAL CENTRE OF SADALI (SARDINIA)**

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**Abstract.** *The aim of this study is to propose a technological urban regeneration method by applying innovative techniques of energy conservation to a local stone material of high landscape value, from the historical centre of Sadali (central Sardinia). Basic assumptions for this work are concepts of energy saving in buildings and use of local materials. The two main themes of research are the renovation of existing buildings according to local building materials and construction techniques whilst paying attention to comfort temperature and relative humidity of the building and the complete reconstruction of parts of buildings, or entire buildings, using new techniques and new structural solution, but always using the local stone to respect the building typology.*

**Keywords:** *Historical centre, Technological rebuilding, Energy, Local Material*

### **Introduction**

Depopulation and the progressive abandonment of the smaller historical centres [23] [8] are a problem that can no longer be ignored [9] [22], nationally and internationally. It is within this context that this research fits, proposing a scientific contribution of new technology with the commitment of local materials.

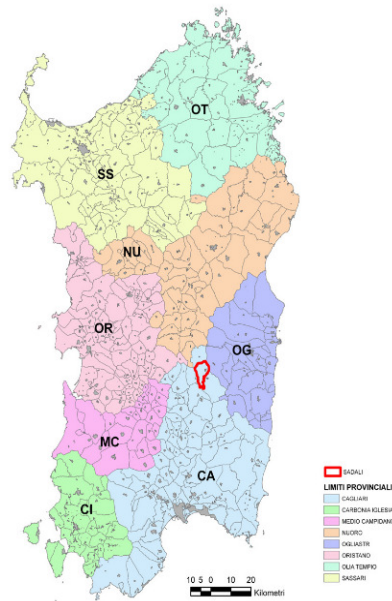
This study focuses on themes related to the technological redevelopment of historical centres, using local stone material and innovative techniques aimed at saving energy, with a special attention to inclusion and harmonisation with the landscape.

### **The research in the historic centre of Sadali**

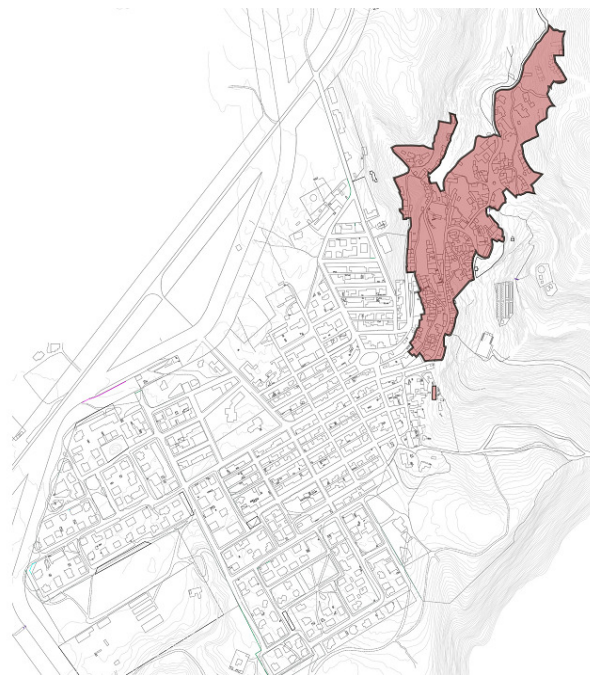
The chosen field of study is the historic centre of Sadali, a sparsely populated town (948 inhabitants, Istat 2015) in central Sardinia (Italy). (FIGURE 1,2)

Various configurations could be realised using the sandwich panels: its versatility offers different solutions depending on the architectural point of

reference. This research shows that it is possible to intervene in the existing buildings to ensure the achievement of significant energy conservation requirements thereby obtaining a qualified class in the building energy certification. In conclusion, the proposed technological innovation with local stone material, can create innovative systems of support to policies designed to improve energy conservation and, in promoting the historic architecture, to develop areas where there is harmonic transition between urban zones [27].



*Figure 1. Geographical location of the historic centre of Sadali, Sardinia*



*Figure 2. Historic centre borders in the urban centre*

In 1961, with the deployment of the Urban Plan drawn up by the municipality, the country has expanded considerably, leading to the emergence of a new urban area to which the population has almost entirely transferred [21]. While this shift has led to the depopulation of the original nucleus of the old town, at the same time it has managed to preserve almost entirely its original characteristics (FIGURE 3).



*Figure 3. The old town preserved its original configuration*

The historic city of Sadali is a unique area in terms of urban system evolution: its development and growth model looks almost anomalous when compared to the expansion general case studies of other centres due to its specific features (FIGURE 4).





*Figure 4. The natural landscape which surrounds the historical centre*

The historic settlement is deeply integrated with the water [7], both in terms of the production system and of connotations of artful compromise between nature and artifice (FIGURE 5).



*Figure 5. The St Valentain waterfall marks the centre of the historical settlement*

In this sense, it should be emphasised the quality and uniqueness of the processes of growth, adaptation and transformation of residential and production areas in harmony has worked with the various natural springs but has been modified according to the needs of drinking water consumption and to functional transformations in the production system (FIGURE 6) [20].



*Figure 6. Water courses in the old town*

The study has also examined in depth the issues related to the implementation in the area of regional and national legislation on “Sustainable Development and energy saving”: historical areas are subject to numerous restrictive constraints and rules for their protection and preservation, but those rules fail to recognise the potential of new technologies in assuring preservation and sustainability [5] [17].

The interest in this issue focused the analysis and identification of possible solutions in order to give a positive contribution to the objectives of preservation and sustainability.

Due to the urban form of the town and its stratification, two modes of action have been hypothesised:

1. interventions of ordinary and extraordinary maintenance in existing buildings;
2. reconstruction and harmonisation in buildings on the border of the historic area (zone A) and the completed residential area (zone B).

Both interventions are based on the need of reducing buildings energy consumption using new techniques and new structural solutions with the use of local traditional stone, always respecting building typology.

For this purpose, a study has been carried out on local stones used in the past to build the old town, identifying the main rock types and their areas of prevalence [6]. This initial recognition tests identified the main types, which are: 1) Palaeozoic shales and 2) Mesozoic dolostones, used in the past to make irregular

blocks; this latter rock type is still readily available, and it is still extracted in small quarries close to the town.

Two main dolostone quarries have been identified: they exploit the Jurassic dolostones of the Dorgali Formation, part of the Mesozoic successions of central Sardinia [11]. At present, these rocks are no longer used as construction stones, and are now crushed to be exclusively employed as aggregates for concrete.

Petrographic and mineralogical characterisations have been performed by optical microscopy and X-Ray Diffractometry (XRD) analyses. This analysis distinguished five different types of materials, mainly according to textural features (e.g. grain size, presence of microfractures), mineralogy, and to the grade of alteration of the rock.

Tests for compression and flexural strengths, and thermo-physical analyses (FIGURE 7) have then been performed; results have been compared with the characteristics of some previously analysed rock-types such as “trachyte” (welded pyroclastite), granite, basalt and “Orosei marble” (micritic limestone from central Sardinia). (FIGURE 8)



Figure 7. Laboratory tests

	Densità (Kg/m <sup>3</sup> )	Conduttività termica W/(m·K)	Diffusività termica mm <sup>2</sup> /s	Calore specifico J/(Kg·K)
TIPOLOGIA 1	2609,00	4,678	1,951	914,33
TIPOLOGIA 2	2793,25	4,369	1,841	848,28
TIPOLOGIA 3	2642,87	2,663	1,210	838,85
TIPOLOGIA 4	2551,00	3,544	1,860	796,25
TIPOLOGIA 5	2654,50	3,895	1,718	864,85
TRACHITE	2750,00	2,900	-	1000
BASALTO	2900-3000	1,9-2,2	-	1000
GRANITO	2500,00	2,7-3,5	-	790
MARMO DI OROSEI	2600,00	2,300	-	1000

Figure 8. Test results recap

After these characterisations and physical tests, the study continued analysing urban morphologies and typologies of the 25 structures that form the old town [4]. For each of them, a template has been filled, including the following information: the number and the name of the structure, a list of individual buildings, the type of exterior trim (plaster or stone) and the state of its preservation (e.g. efficient, needing intervention, in state of ruin). (FIGURE 9)

At the end of the analysis, the availability of material in local quarries was compared with the amount required to redevelop all the buildings, resulting in a positive balance, an outcome that meets requirements of economic feasibility.

The first type of intervention is used on existing building. During the study of each old town block, special attention has been given to the comfort temperature-humidity conditions of the buildings, as presence of moisture within the building units, heat dissipation of the walls and horizontal base and cover closures.

Energy analysis has been conducted for each constructive element (masonry, base closure and closing of cover) and, starting from the actual building conditions, the capacity of thermal dispersion has been calculated. Intervention hypothesis on individual structural elements have been evaluated, together with reflections on the best heating systems to install: this therefore establishes the energy class performance of the building and sets its performances for winter heating, summer cooling and the production of hot water.

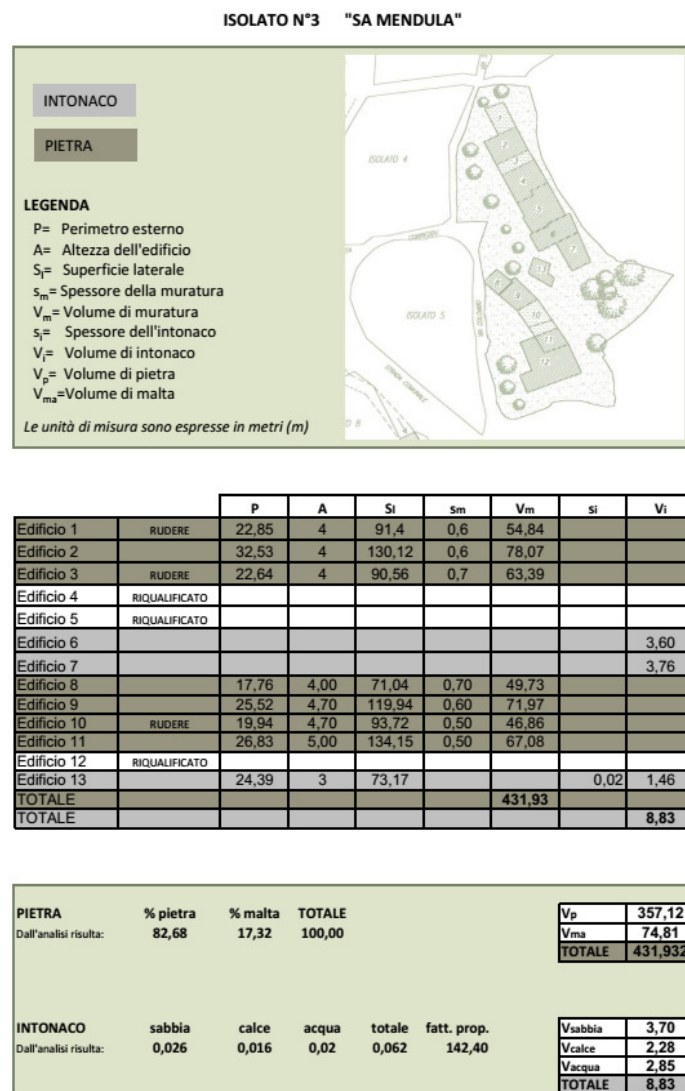
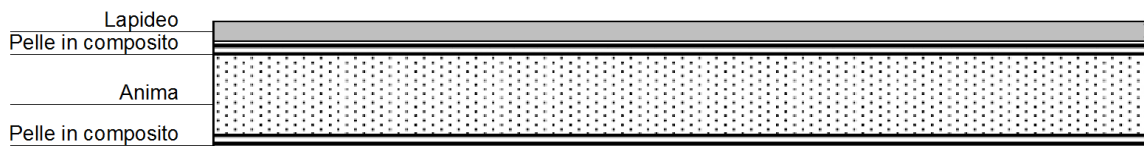


Figure 9. Form template for the structure analysis

The second type of intervention involves the complete reconstruction of entire buildings or parts of them, using new techniques and new structural solutions based on local stone and is respectful to the building typology [10] [13].

This action shows that, despite preserving the main characteristics of the old town (e.g. type of dwelling and materials), it is still possible to address new policies for energy conservation and use of environmentally friendly materials. Therefore, there is a clear case for the proposal of using local materials such as coated stone facade assembled in sandwich panels with thermal insulation (FIGURE 10) [14].



*Figure 10. Composition of a sandwich panel with stone coating*

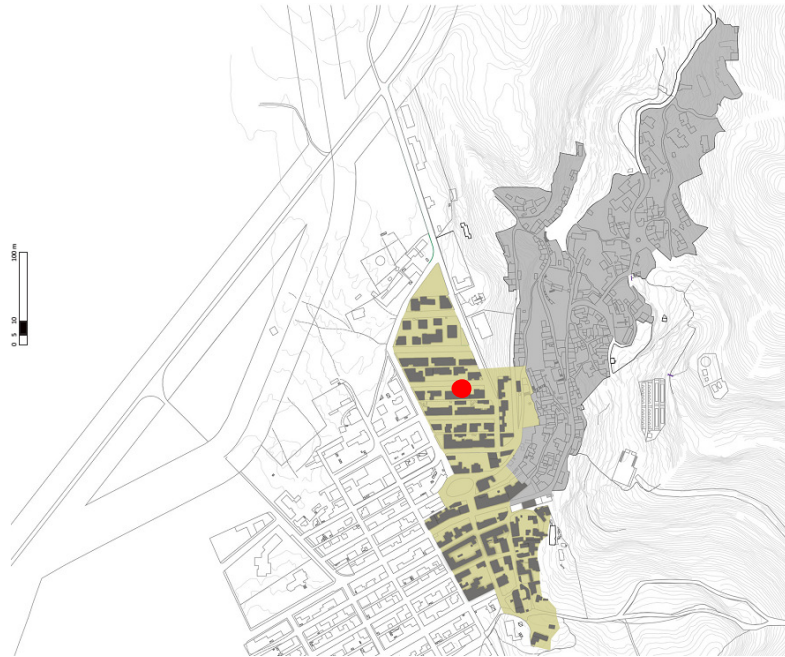
The importance of these panels is related to the function to simulate, in a modern way, the typical local stone masonry traceable in the old town (mixed masonry dolomite and shale of irregular shapes), through the creation of new configurations (FIGURE 11). These panels allow the local material to rediscover a new use, much more flexible thanks to modern technology.



*Figure 11. Sandwiches panels examples*

The study shows that it is possible to intervene in existing buildings to ensure achievement of significant energy requirements and enables therefore a qualified energy certification class for the buildings to be issued. Several sandwich panels configurations are possible: this versatility offers different solutions depending on the architectural context of reference.

The area identified for the second type of intervention is a crucial one as it integrates visually with the historic area (FIGURE 12).



*Figure 12. The border area marked between the old and new town*

Inside the border area there are some examples that show how the old town has continued over the years to influence the new areas of expansion. The influence is more with regards to the materials used, as the building typologies have changed.

The new volumes resulting from extensions or new buildings can be designed according to a new architecture which combines and harmonises the A (old town) and B (new town) areas.

Buildings in the B area are mainly family houses created to allow building expansion; expansion can be done by adding new floors or realizing new parts, both linked or separated from the main building.

The study tried to get a homogenisation between the two areas through the use, as a coating material for the new volumes, of the sandwich panels based on local stone material. The use of this material is justified by the strong connection with the local landscape, and also in terms of energy as it stays within the parameters set by the law.

The project allows to recovery volumes (even in the outer zones) adapting to urban standards (height of the volumes, lighting and ventilation), giving at the

same time a new architectural look and creating a link with the old town (FIGURE 13).



Figure 13. An example The old town influences on Area B

In conclusion, the proposed study aims to assist in planning the regeneration of historical areas by considering historical heritage, natural materials and local materials. This therefore permits the use of innovative systems to pursue energy savings policies, creating a new urban decor that is inspired by the past whilst incorporating a strong technological component aimed at sustainable and ecological living.

### Summary

This study focuses on themes related to the technological redevelopment of historical centres, using local stone material and innovative techniques aimed at saving energy, with a special attention to inclusion and harmonisation with the landscape. The chosen field of study is the historic centre of Sadali, a weakly populated town in central Sardinia (Italy). This research shows that it is possible to intervene in the existing buildings to ensure the achievement of significant energy requirements and obtain a qualified class in the building energy certification. In conclusion, the proposed technological innovation using local stone material can create innovative systems of support to policies addressing energy conservation and, in promoting the historic architecture, to develop areas of harmonic transition between urban zones. The study has also examined in depth the issues related to the implementation in the area of regional and national legislation on sustainable development and energy saving: historical areas are subject to restrictive constraints and rules for their protection and preservation, but those rules fail to recognise the potential of new technologies in assuring preservation and sustainability. Due to the urban form of the town and its stratification, two modes of action have been hypothesised: 1. interventions of ordinary and extraordinary maintenance in existing buildings; 2. reconstruction and harmonization in buildings on the border of the historic area (zone A) and the area of residential completion (zone B). The project allows to recovery volumes (even in the outer zones) adapting to urban standards (height of the volumes, lighting and ventilation), giving at the same time a new architectural look and creating a link with the old town.

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**DICHIARAZIONE SOSTITUTIVA DELL'ATTO DI NOTORIETA'**  
**(Art. 47 D.P.R. 28 dicembre 2000, n. 445)**

**DA PRESENTARE ALLA PUBBLICA AMMINISTRAZIONE O AI GESTORI DI PUBBLICI SERVIZI.**

la sottoscritta BALLETTO GINEVRA

nato a ROMA il 25 gennaio 1971

(data di nascita)

residente a CAGLIARI

in Via SEBASTIANO SATTA, 29 CAGLIARI

consapevole delle sanzioni penali, nel caso di dichiarazioni non veritiere, di formazione o uso di atti falsi ,  
richiamate dall'art. 76 del D.P.R. 445 del 28 dicembre 2000

DICHIARA

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Dichiaro di essere informato , ai sensi e per gli effetti di cui al D.Lgs. N. 196/2003 che i dati personali raccolti saranno trattati, anche con strumenti informatici, esclusivamente nell'ambito del procedimento per il quale la presente dichiarazione viene resa

20 ottobre 2016, Cagliari

**Il Dichiarante**

Genevra Balletto



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