Pontes country house

Project summary

Background for renovation and energy concept

The abandoned house needed to be thoroughly renovated in order to become livable again. Taking advantage of recent growth in tourism activities all over the surroundings, the renovated building will be used for sustainable tourism activities. During the renovation works it will be subjected to:

- Structural renovation and reinforcement (wooden and stone structures)
- Energy efficiency measures in the envelope (insulation of walls, roof, windows, doors)
- Recovery of housing conditions (present state is not habitable)
- Installation of efficient energy systems (space heating and domestic hot water)

Site:	**Lugar de Pontes** **Castro Laboreiro, Melgaço**
Altitude:	726 m
Heating degree days:	2770 (base temp. 20º C)
Owner:	Carlos Moedas
Architect:	Inês Cabral
Engineer	André Coelho Ecoperfil, Sistemas Urbanos Sustentáveis, Lda.

Contact Person:	**André Coelho**
Important dates:	Building permit in July, 2013 Estimated start of the renovation works in October 2013
Date completed:	20 January 2014

Building description /typology

- Located in a small rural village in the hills of Peneda in the northwest of Portugal
- Individual vernacular stone (granite) wall house
- Originally built in 1940
- Currently inhabitable, almost in ruins
- Gross heated area: 180 m^2

Country house before intervention (south east and southwest facades)

Building envelope, heating, ventilation, cooling and lighting systems before the energy renovation

Description of building (building situation, building system, renovation needs, renovation options)

The Pontes country house shares the patio with the commune stove and was bought in 2012 for sustainable tourism activities and aims at providing accommodation with sustainability principles (optimal use of environmental resources; respect and interaction with the host communities; viable, long-term economic operations, providing socio-economic benefits to all stakeholders that are fairly distributed). Its original state was almost a ruin, severely degraded in its wooden elements, lacking windows in some places, and affected by rot and moisture. Inside temperatures closely followed exterior variations, and frequent chilled air drafts. Moisture deterioration was present in wood structures, both in floors and roof, and also through seepage and/or condensation on walls.

Building envelope

Uninsulated granite stone walls (without coverings), wood structure floors and roof (not insulated), ground floor in direct contact with soil (animal shelter), single glazed windows with wooden and frames (degraded). Original stone walls were massive but loosely arranged in some areas (need of structural reinforcement)

Heating, ventilation, cooling and lighting systems before retrofit

The house was not serviced by running water, electricity or phone access. Heating was provided by a fireplace, also used for cooking. The house was not served by any support system, including lighting, water supply and sewerage. Renovation potential was at its maximum, in order to gain confortable living conditions.

The building has a strong architectural image, very much linked with the region's traditional life style and architecture, but without suitable comfort conditions it will not attract visitors. The global intention of the renovation is therefore to provide that comfort, at a minimum energy and resource expenditure, according to construction sustainability principles, while maintaining the building's identity and historical features.

Roof condition and characteristics

North elevation

Element	U-Value before renovation W/m²K	U-Value after renovation W/m²K
Exterior walls	1.82	0.45 (average)
Ground floor	Direct contact with soil	0.5 (average)
Doors	2.7	0.81
Windows	4.6	2.05
Roof	4.55	0.23

Energy renovation features

Energy saving concept

The main principles of the energy saving concept were limiting the heat losses during winter, use energy efficient heating equipment and take advantage of the sunlight to capture the thermal energy. Low embodied energy materials were preferred.

Technologies

- Building insulation
- Windows replacement
- Balanced mechanical ventilation with heat recovery and free cooling
- Geothermal heat-pump
- Efficient lighting
- Thermal solar panels for domestic hot water (DHW)

Building

- Walls: creation of an interior closed air space, placement of insulating cork boards (ICB) and light covering elements (in general MDF boards over wood support). This solution allows maintaining the existing materials and avoids new construction while preserving the external architectural identity of the building.
- Roof: wooden false ceiling, creation of closed air space, structural oriented strand board (OSB), placement of ICB , water tight covering.
- Floor: ICB under floor slab
- Windows: replacement of all existing windows and placement of new double glazed ones with low emissivity layers, within wooden frames (4+16+6 mm).

Strategy	Impact / purpose
Reinforcing structural stone walls	Maintain structural elements, avoiding new construction (less environmental impact). Maintenance of historical features.
All interior and roof structures made of wood	Use of a local, low embodied energy material. Use of waste wood (MDF and OSB). Maintenance of historical features (although with new wood elements).
Creation of closed air spaces in walls and roof	Additional free insulation (air has good thermal resistance) and use of these spaces as service ducts, avoiding waste generation in infrastructure placement.
No ceramic bricks and no cement based mortars	Use of concrete bricks, which are less energy intensive than ceramic bricks, and use of lime based mortars (eliminating the energy intensive cement in used mortars)

Systems

- Heating: and heat — 16 kW geothermal heat pump (space heating and DHW) distribution with radiators
- Cooling: windows — Natural ventilation, free cooling and wooden shutters on
- Ventilation: and — Heat recovery box with 91% efficiency. Fresh air supply exhaustion of all spaces.
- Lighting: — Up to date fluorescent and LED based lighting

Renewable energy systems

- Thermal solar panels for DHW production (6.8m^2)

Energy Savings, CO2 reductions and Life Cycle Costs

Energy needs [1]	Before renovation	After renovation
Heating needs	477.9 kWh/m².y	123.8 kWh/m².y
Cooling needs	12.1 kWh/m².y	10.4 kWh/m².y
DHW needs	54.8 kWh/m².y	13.5 kWh/m².y [2]
Energy label [3]	F	A+

[1] Only values for calculated energy needs are presented once the original condition of the building didn't had non-renewable energy consumption and wasn't able to provide comparable thermal comfort conditions.

[2] Value for DHW needs already includes the solar thermal contribution

[3] Buildings energy certification scheme in Portugal ranks the energy performance of each building from level G to level A+, being the first the less efficient. The higher level A+ means that the building calculated non-renewable primary energy consumption is under 25% of the maximum allowed value for new buildings.

Calculated energy needs reductions:

Heating energy needs reduction - 74.1%
Cooling energy needs reduction - 13.7%
DHW energy needs reduction – 75.4%

RES contribution:

Solar thermal energy contribution: 4.2 MWh/year

Overview economic efficiency and costs:

Total retrofit cost: 143 260 €
Total energy operation costs after renovation: 2160 €/year

Building context

Costs	EUR	EUR/m²
Craftsmen	135 260 €	751 €/m²
Consultants	8 000 €	44 €/m²
Total	143 260 €	796 €/m²

Existing window sills

Overall improvements, experiences and lessons learned

Energy

Energy needs reduction for heating, cooling and DHW, compared to original state over 75%.

Energy Certification Scheme, label **A+** (less than 25% of the maximum calculated non-renewable primary energy consumption allowed for new buildings)

Indoor climate

Absence of drafts

Absence of condensation phenomena

Comfort all year round

Economics

Renovations, especially those carefully driven by sustainable construction principles, as this one, is always good for the local economy. Now, tourists enjoying nature can be housed there and enjoy comfortable conditions with minimum environmental impact. Tourism economic benefits may also be used to pursue more retrofitting of regional traditional houses.

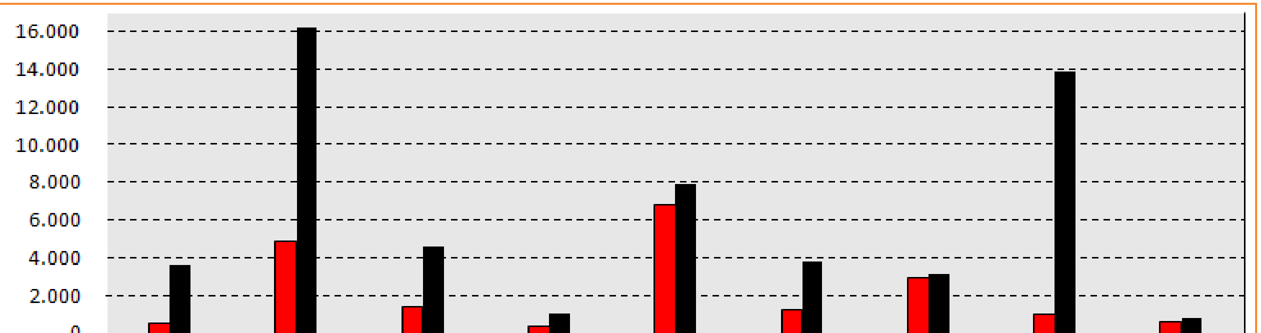
Decision process – barriers that were overcome

Barriers in this case were essentially related with the bureaucracy for obtaining the building permit and funding sources. The building permit from the municipality and national tourism entities is still a time consuming process that causes delays and doubts for the business plan. With respect to the investment costs, the building owners not always understood the unconventional nature of this renovation project, and therefore expected conventional costs as well, whether for the renovation works as for the consultants.

Non-energy benefits

Reuse of an abandoned traditional building, with preservation of its architectural value.

Development, in an economically depressed region, of tourism activities with sustainability principles (optimal use of environmental resources; respect and interaction with the local community; long-term economic operations providing fairly distributed socio-economic benefits to all stakeholders).



Kg CO2 eq.	Windows and doors	Structure	Nonstructural suports	Paints and varnishes	Cladding	Plaster and mortar	Water proofing screens	Insulation	Bricks and Blocks
Current solution	3.631	16.233	4.588	1.049	7.953	3.815	3.177	13.917	859
Alternative solution	546	4.881	1.400	376	6.862	1.265	2.950	1.062	586

Embodied CO2 eq. amount for current and alternative material selection

Summary

An existing traditional country house, located in Pontes village, in Castro Laboreiro, Melgaço, is being renovated from a ruined condition. Its non insulated and deteriorated present condition would lead to very high energy consumption, if occupied.

The present renovation project was elaborated aiming the architectural preservation, the low environmental impact and the offer of suitable comfort conditions for tourism exploitation. Global energy consumption reduction can be as high as 94% when compared to the hypothetical use of the building at its present state, which could mean almost 6000€/year of potential savings.

The right kind of message is put forward to other possible regional initiatives as sustainability and nature protection are the core drivers of this project.

Ackowledgements

Inês Cabral – Architect and project coordinator. Deep knowledge of regional construction characteristics and sustainability in construction.

André Coelho – Civil engineer and energy in buildings specialist. Responsible for the thermal/energy analysis of the house, and its HVAC systems. Structural design and engineering disciplines coordination.

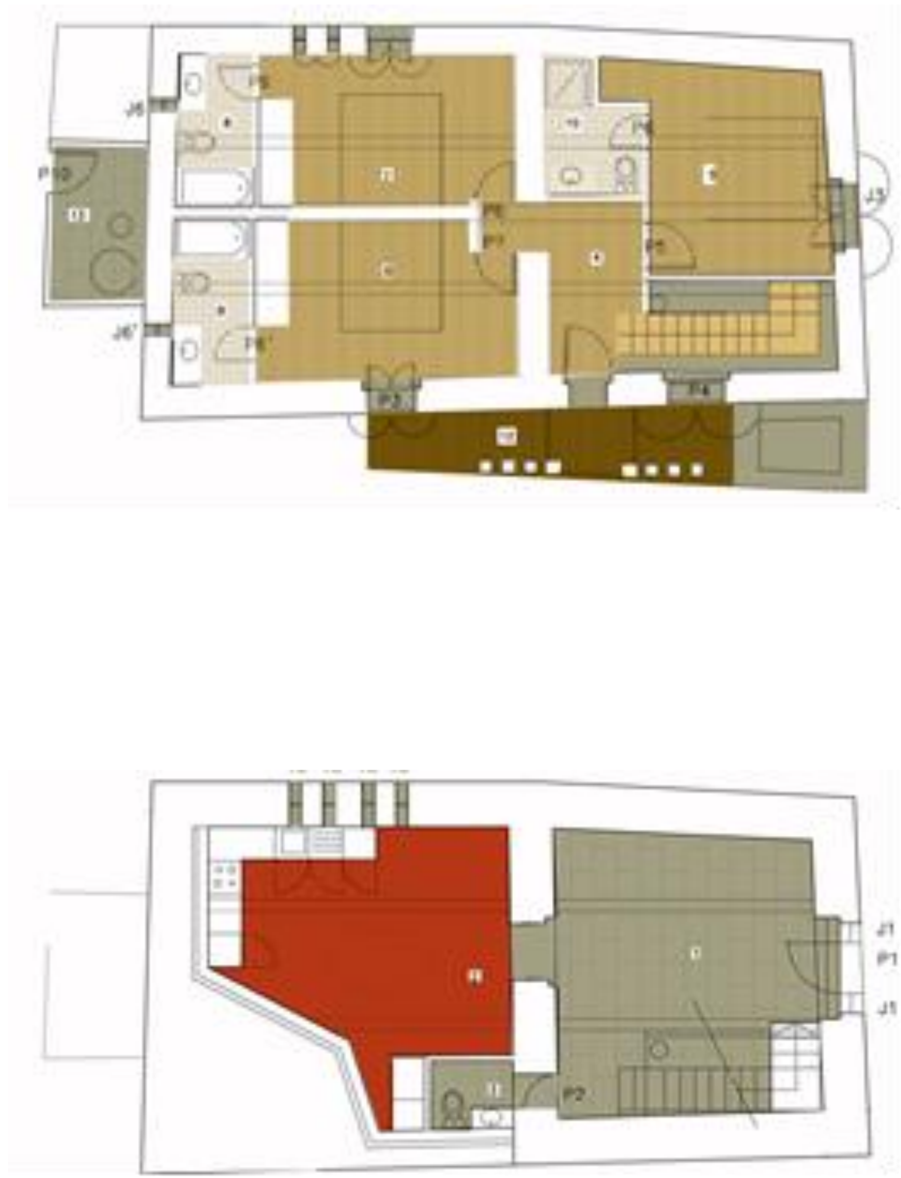
Gonçalo Machado – Architect, energy in buildings consultant and specification of materials specialist. Responsible for the materials environmental impact analysis.

Ecoperfil engineers, for this project – André Batoréu (water supply and waste water drainage), Luís Rato (electricity and telecommunications), Rodrigo Castro (acoustic design)

References

[1] – Cabral I., Coelho A., Gonçalo M., 2013. Assessing energetic self-sufficiency and low environmental impacts in protected areas with rehabilitation needs: Pontes Village case study. Proceedings of CIAV Conference 2013, Vila Nova de Cerveira

[2] – Project for Casa de Campo, municipal reference 2048/2013 (Câmara Municipal de Melgaço)



Lower and upper architecture plans of the retrofitted house