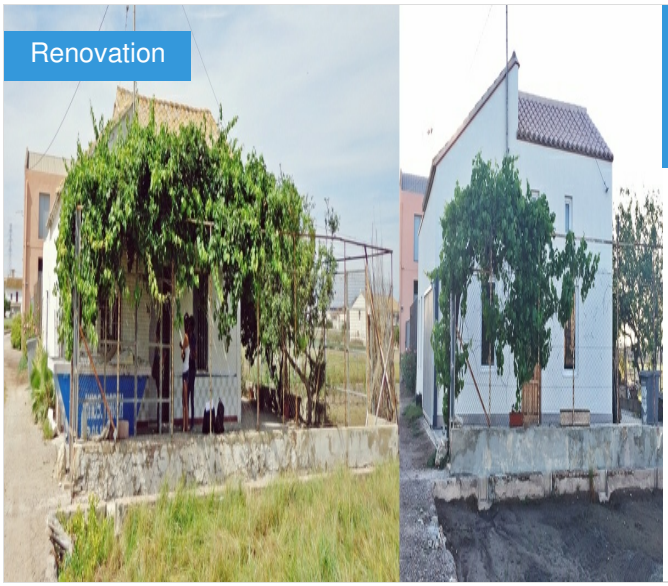
Refurbishment project of an Alqueria to get almost zero HVAC energy demand

by Martínez Ana / 2017-06-08 16:03:10 / Espagne / 8737 / ES



Primary energy need :

14.38 kWhpe/m².year

(Calculation method : Other)

ENERGY CONSUMPTION

Economical building *Building*

< 50	A
51 à 90	B
91 à 150	C
151 à 230	D
231 à 330	E
331 à 450	F
> 450	G

Energy-intensive building

Building Type : Isolated or semi-detached house
Construction Year : 1930
Delivery year : 2017
Address 1 - street : - 46120 VALENCIA, España
Climate zone : [BSk] Mid-latitude Dry Semiarid (Steppe)

Net Floor Area : 120 m²
Construction/refurbishment cost : 80 000 €
Number of Dwelling : 1 Dwelling
Cost/m2 : 666.67 €/m²

Proposed by :

General information

The aim of this project is the refurbishment of a traditional Valencian orchard house, whose constructive typology is called Alquería, in order to achieve a negligible HVAC energy demand

The objective of this project was defined considering the current worldwide energy and environmental situation and the risen cultural interest for the traditional edifications.

With that purpose, an energy model was developed using energy software TRNsys 17 following these consecutive steps:

· First the necessary data sets such as climatic data and construction building characteristics were collected and studied.

· Then, an original housing energy model was performed in order to get a validation of the model (RMSE 1.63°C, MAPE 5.88%).

· After that, an energy optimization strategy was proposed. The following step was implementation of energy efficiency measures.

· Finally, the corresponding results were carefully analyzed.

The overall conclusions obtained from the analysis were:

a) A good matching of the energy model is fundamental in order to reproduce the specific thermal behavior of the studied building

b) Enhancing the building envelope is the most effective proposal to achieve the reduction in the HVAC requirements of the building.

Finally with the application of passive measures (measures applied to the building which do not require additional energy) was gotten zero energy demand of active air conditioning (Heating Demand: 0.7kWh/year m2, Cooling Demand: 2.2 kWh/ year m2).

A Blower Door test was carried out for the purpose of verifies if the tightness level is the appropriate according to the Passivhaus standard. The result was 1.49 renovations per hour, satisfying the tightness demand for building rehabilitation according the Passivhaus standard.

Presently, the project is in the phase of the construction process, remaining to be done some finished and the fitting of shadowing devices. Any active HVAC system and heating recovery haven't been implemented.Pretending supply the HVAC requirements with natural ventilation in summer and with passive solar heating.

Coming, temperature and humidity sensors will be placed into of the house in order to prove if the house really has a nearly zero energy HVAC demand.

Data reliability

Self-declared

Stakeholders

Stakeholders

Function : Designer

Ana Martínez

Developing energy model by means of energy software TRNsys 17. Energy analysis through simulation in order to chose the most effectiveness energy efficiency measures.

Owner approach of sustainability

Refurbishment of interest cultural house such as the Alquería, trying to keep its characteristics and by means of implementing passive energy measures, achieve a nearly zero HVAC energy demand.

Architectural description

The house is a single isolated dwelling and consists of two floors, built in the first half of the XX century in the stage prior to the II Spanish Republic (1930). The house is located in a Valencian orchard, 820 meters from the Mediterranean coast, in the municipality of Alboraia (Valencia). The architectural typology is the modern alquería, a typical orchard farmhouse from the east and southeast coast of Spain and of Hispano-Muslim origin. Its main façade is orientated towards the east to take advantage of the breeze from the sea for ventilation and cooling of the farmhouse, especially during the summertime. These types of buildings were houses of tillage in which the ground floor was used as a house, and the “cambra” or zone under the roof was for the storage of the harvest or for the breeding of silk worms. The geometry of the floors was typically rectangular, or as in our specific case, it could attach two rectangles forming a 90˚angle. The ground floor of the house is 60 m2 in area and 2.8 m. high. Briefly, the constructive characteristics of the building are: solid brick masonry walls, without any thermal insulation. The floor and deck structure is made of wooden joists and beams. The pillars are solid brick. The south-facing shed roof is supported on the end gable of the roof east-west. The roofs are finishing with curved tiles. Previously to the house’s refurbishment, an energy simulation study was carried out in order to achieve a negligible HVAC energy demand house. The analyzed measures for reduce the HVAC demand, were: Passive energy efficiency measures: The thermal insulation of the whole building enclosure. Optimizing the windows area depending on the orientation. Selection of the best characteristics for the windows. Shading devices. Free cooling obtained from cross ventilation. Active energy efficiency measures: Heating recovery. Mechanical ventilation system. Through the simulation was gotten the best option of each measure, being the HVAC requirements results of the developed simulation model with all of the proposed measures implemented close to 0. Finally was decided not implementing heating recovery and mechanical ventilation systems in the building, only the passive measures will be implemented. On the other hand in the refurbishment of the house has been tried to respect as much as possible the original appearance of the dwelling and the materials. The structural consolidation of the building was needed. Due to its bad state, the deck was completely rebuilt, retaining its original typology, on its constructive elements. The intermediate floor was reinforced and was anchored to the walls. The walls in bad state were repaired following the original configuration. Briefly, the changes regarding to the original house, have been the following: Thermal insulation has been placed in all of the façades and the deck. In the walls has been disposed on the external face by means of SATE system. In the south façade the original windows and doors has been replaced for four windows in order to get a properly passive heating by means of direct solar radiation. For the purpose of avoiding overheating in windows facing to east, west and south orientation are going to be installed awnings. The type of windows has been substituted for tilt PVC windows with LowE double glass. The situation of the house enable good natural ventilation, therefore cooling requirements can be supplied by it.

Energy

Energy consumption

Primary energy need : 14,38 kWhpe/m^2.year

Primary energy need for standard building : 54,52 kWhpe/m^2.year

Calculation method : Other

CEEB : 0.0005

Breakdown for energy consumption :

The house is in refurbishment process yet.
Energy model was developed using energy software TRNsys 17.
HVAC demand simulations results were:
With heating recovery system implemented: Heating Demand: 0.7kWh/year m2, Cooling Demand: 2.2 kWh/ year m2.
Without heating recovery system: Heating Demand: 7.4kWh/year m2, Cooling Demand: 2.8 kWh/ year m2.

More information :

Before the renovation process, the house was uninhabited and in ruins, therefore there aren't any data concerning energy consumption.
On the other hand, currently, the house is in refurbishment process, so does not exist any data concerning primary energy consumption.

Initial consumption : 1,00 kWhpe/m^2.year

Envelope performance

Envelope U-Value : 0,17 $W.m^{-2}.K^{-1}$

More information :

Have been placed in all of the façades and the deck thermal insulation. In the walls has been disposed on the external face by means of SATE system.

Building Compactness Coefficient : 1,90

Indicator : EN 13829 - n50 » (en 1/h-1)

Air Tightness Value : 1,49

Renewables & systems

Systems

Heating system :

- No heating system

Hot water system :

- Individual electric boiler

Cooling system :

- No cooling system

Ventilation system :

- Natural ventilation

Renewable systems :

- Solar absorption chiller

Other information on HVAC :

Any active HVAC system and heating recovery haven't been implemented. Pretending supply the HVAC requirements with natural ventilation in summer and with passive solar heating according with simulation results.

Will be implemented a solar thermal energy system

Solutions enhancing nature free gains :

Have been placed south-facing windows to get a passive solar heating. Cooling requirment will be supplied with natural ventilation.

Environment

Indoor Air quality

Is assured through the natural ventilation according to the necessities of the owner.

Comfort

Health & comfort : During the simulation study was defined a complex strategy of energy optimization in order to achieve the best option of the energy saving measures analyzed, avoiding unfavorable effects, being the aim get a health and confort indoor conditions for the customers.

Measured thermal comfort : Los resultados de la simulación muestran que al menos el 84% de las horas en un año las temperaturas interiores de la vivienda están dentro de la franja de confort (Temperaturas comprendidas entre 26ºC y 21ºC)

Products

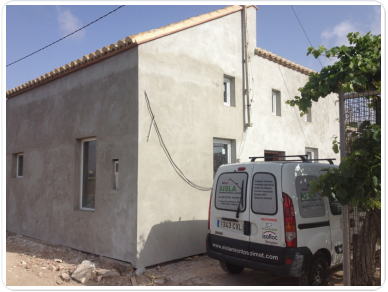
Product

External Thermal Insulation Composite System

Aislamientos PIMAT

C/ Sequia Real del Xuquer 8, 46260 Alberic, Valencia

http://www.aislamientospimat.com/



Product category :

The SATE System: External Thermal Insulation Composite System (ETICS), is an EPS system of thermal and acoustic insulation of facades by the exterior. While other insulation is incorporated to the façade by means of a work, the SATE System is a prefabricated insulation panel that adheres to the façades by means of a mixed fixation (by means of mechanical and adhesive fixing), which gives the façade of an enclosure Thermal insulation that improves energy efficiency and minimizes heat leakage and moisture entry.
As a result of its expanded polystyrene composition the SATE system is an insulation panel that provides thermal insulation on the exterior of the home. It also has a reinforced lining and acrylic mortar.
As a result, the SATE System (Exterior Thermal Insulation System) has these advantages:
-Thermal insulation that reduces the loss of heat in winter up to 70%.
-Thermal insulation that reduces internal heat in summer up to 30%.
-Acoustic isolation.
-Resistance to solar impact.
-Protects the facade of the weather (long durability).
-It guarantees the perspiration of the facade.
-Reduces the risk of condensation.
-Installation on the exterior of the facade (does not consume internal m^2).
-Low maintenance cost (hardly needed).
-Raincoat.
-Incombustible (A1)
-100% natural
-Easy and quick to install
-Allows variety of finishes, even dark colors.
Therefore, PIMAT Insulation considers that this SATE System is a system of thermal insulation suitable for both new constructions and to rehabilitate deteriorated exterior façades as it provides a greater thermal and acoustic insulation capacity. In addition, it improves the resistance to external agents and hardly needs maintenance.

This product was very appropriate because it was been easy to install, and it presents a very high resistance to heat transfer.

Costs

Urban environment

The building is situated in a growing area closet to irrigation ditches, also is near to the coast and to the Universitat Politècnica of Valencia.

Building Environnemental Quality

Building Environmental Quality

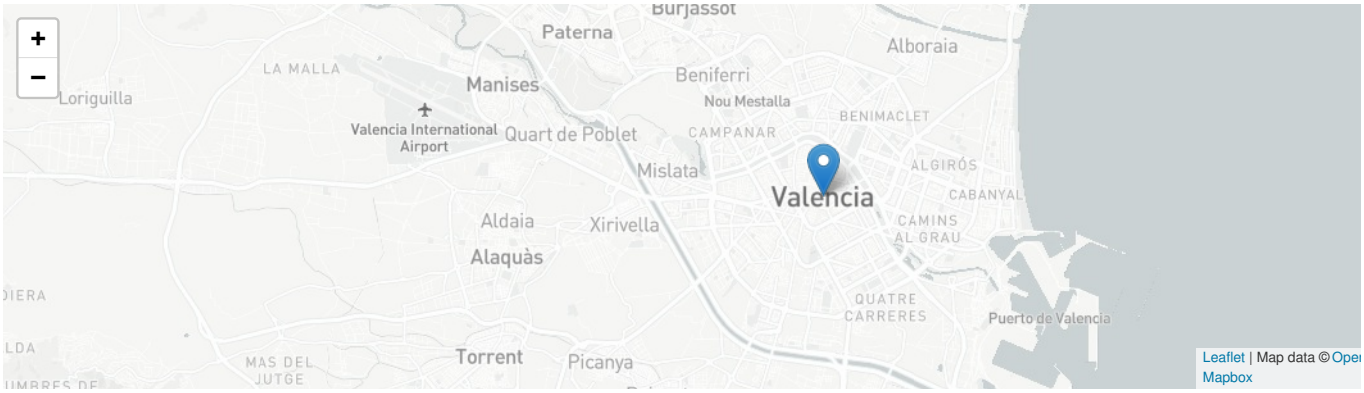
- comfort (visual, olfactive, thermal)
- energy efficiency

Contest

Building candidate in the category

Energía & Climas Templerados

Premio de los Usuarios



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