Ca’ S. Orsola, Treviso

Project summary

Energy concept: Insulation, mechanical ventilation, solar thermal and PV-system

Background for the renovation – reasons

The building was partly inhabited and used as a guesthouse of the convent of Order of St. Ursula and it was abandoned from 2000; It reached a serious state of degradation and a high renovation was needed, but there was a heritage architectural restriction about the external envelope.

Specific goal of project were:

- to achieve A class energy classification according to Italian regulations;
- to consolidate and to reinforce the building structure;
- to improve the indoor thermal and acoustic quality;
- to transform it in a prestigious residence with all comforts.

Site:	**Treviso, Italy**
Altitude:	15 m
Heating degree days:	2378
Cooling degree days:	0
Owner:	Cazzaro Costruzioni S.r.l.
Architect:	Imago Design - Domenico Rocco
Engineer:	Systems - Vincenzo Conte Structures - Giovanni Crozzolin

General view of the building before and after the intervention

Building description/tipology

Listed building located in Treviso, It was the old seat of a Polish Institute

Total site area: 4500 m^2

Gross heated area: 1800 m^2

Gross volume: 6300 m^3

Contact Person:	**Mauro Cazzaro**
Important dates:	Originally built in 1300; Important renovations in 1923 and in 1950 Last renovation started in 2008 and completed in 2012
Date completed:	Template completed in 15-10-2014

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

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

Ca' S. Orsola is located in the historic center of Treviso, in North East of Italy, very close to the Cathedral. The building was the old seat of Polish Institute and now it is a listed building by Historical and Architectural Heritage Superintendence of Veneto.

Originally it was a convent and it was inhabitated until 2000 and during the time it keep intact the original structure and architectural distribution. Then it was bought in 2007 for acting a deeply renovation and converting it in a prestigious residential building. At the beginning of construction phase the structure revealed a quite ruined state of conservation: walls are crooked and presented different solutions, moisture affected wooden elements in the floors and in the roof.

Building envelope before renovation

The construction system was based on bearing masonry with covered solid bricks. The floor had a wooden structure, while the ground floor leaned directly on soil. The roof is made of hollow tiles sheets with a wooden structure and a lightweight ceiling slab. The windows frames were made of wood and the windows used to have a single glass. There is no insulation in the external walls, roof and floors.

Heating, ventilation, cooling and lighting systems before renovation

In the building heating or cooling system was not installed. Heating was provided by a fireplace, also used for cooking, occasionally an electric heater or portable fan coils was placed in any room.

The domestic hot water was supplied by electric heaters with storage tank; there wasn't a ventilation system, so ventilation was made by natural means.

Element	Area m^2	U-Value before renovation W/m^2K	U-Value after renovation W/m^2K
Façade	1300	0,90	0,180
Ceiling	508	1,65	0,788
Windows, doors	140	2,70	1,948-2,035
Roof	508	1,09	0,158

Crooked walls, before renovation

Demolished partition walls left and used as a substrate

Energy renovation features

Energy saving concept

The restructuring aims not only to heal a property that was under the limit of sustainability from the structural point of view, but especially to retrain in terms of energy and acoustic complex.

Technologies

The A energy class has been achieved by means of several design topics among which:

- high insulated windows
- high level of opaque walls insulation
- mechanical ventilation system with heat recovery
- solar thermal panels and PV systems
- water to water heat pumps and chillers

Building

The first step has been the measures taken to consolidate the building structure. Subsequently a detailed study on thermal and acoustic bridges has been developed with the aim to improve the indoor thermal and acoustic quality.

- Walls: the insulation is placed on the inner part of the wall and this solution meet the requirements of the Suprintendent preserving the existing materials and the external architectural identity of the building. Specifically, two types of insulating are used: an expanded polystyrene (EPS) foam, placed directly on masonry, and a rigid rockwool panel with a plasterboard cover;
- Roof: it was replaced with a new wooden structure and it was insulated with wood fiber and water tight covering;
- Windows: all existing windows are replaced with a low-energy double layer ones within wooden frames.

Technical systems

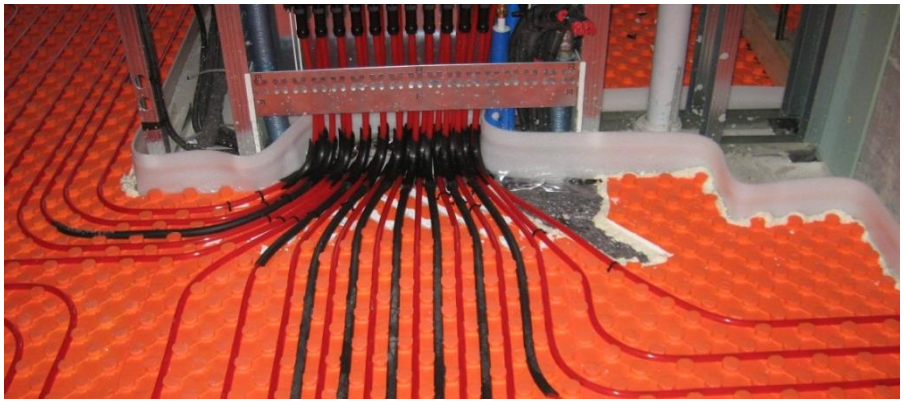
The HVAC generation system is a water to water centralized heat pump/chiller. The underlying well is the hot/cold water source and internal comfort is achieved exploiting a radiant system installed in the floor together with a dehumidification system for the summer period.

Systems

- Heating and Cooling: 32 kW heat pump and distribution with radiant floor system;
- DHW: 20 kW heat pump;
- Ventilation: mechanical ventilation system with heat recovery box with 95% efficiency.

Renewable energy systems

- Thermal solar panels for DHW production (20 m^2) installed in vertical;
- Photovoltaic power plant producing 3230 kWh of total annual energy. The panels are installed on the roof and oriented to the south.



Radiant system

Achieved energy savings, CO_2 reductions and costs

Energy need		Before renovation	After renovation	Saving
Heating	*kWh/m²a*	342,7	42,3	88%
DHW	*kWh/m²a*	44,4	33,6	24%
Total	*kWh/m²a*	387,1	75,9	80%
Energy label		G	A+	
Carbon emissions	*kg CO^2Eq/m^2a*	29,8	5,8	81%

Energy savings and CO_2 reduction

Before renovation there wasn't non-renewable energy consumption, so values for calculated energy needs are presented and provide comparable thermal comfort conditions.

Value for DHW needs already includes the solar thermal contribution.

Costs	EUR	EUR/m²
Craftsmen	2.94 million €	1463,41 €/m²
Consultants	130.000,00 €	64,71 €/m²
Electrical and Plumbling	700.000,00 €	348,43 €/m²
Total construction	3.77 million €	1876,56 €/m²
Thermal solar and PV system	32.000,00 €	15,92€/m²
NPV	13 Years	

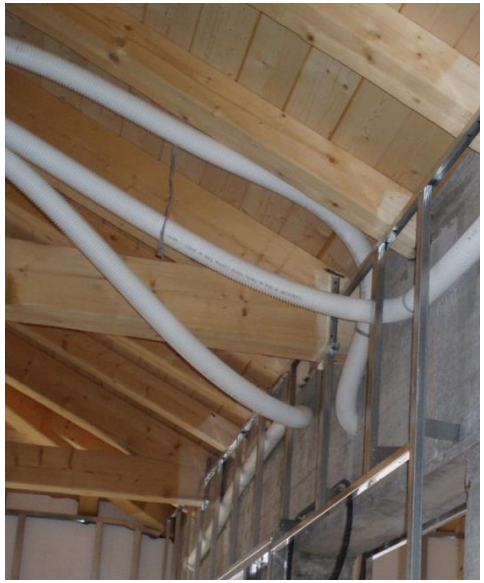
Renovation costs

Construction cost excludes the costs for heating and DHW, the costs related to the purchase of the area, charges, interest, taxes.

RES contribution

PV energy contribution: *3680 kWh a*

Photovoltaic system - TNT underflooring above systems



Mechanical ventilation system

Overall improvements

Energy benefits

Energy savings: 311,2 kWh/m^{2}a (heating, DHW, ventilation)

Indoor climate technical improvements

The indoor climate was improved due to:

– Mechanical balanced ventilation with heat recovery and a carefully adjusted supply temperature;

– Reduction of losses through walls, roof and windows;

– Reduction of the thermal bridges allowing to eliminate related condensation problems;

– Upgrade of the building energy performance. The standard energy performance for new buildings in Italy has been achieved;

– Control of indoor temperature and humidity without relevant energy costs.

Economics

Renovation of existing buildings, especially if listed, is too much expensive than standard, because it need specialized operations and the preliminary count evaluation is upset during the construction phase. After intervention, however, market value increased for this property and also for the surrounding area: all apartments have been sold by the end of the construction phase.

Decision process – barriers overcome

The investment costs were incurred by the contractor, that is also the owner: in this particular situation themes such as sustainability and energy retrofitting were understood and applied; the major barrier was essentially related with the bureaucracy for obtaining the permission by Historical and Architectural Heritage Superintendence of Veneto.

Non-energy benefits

– Radical renovation that transformed a historic building in a prestigious and comfortable residence;

– Better living conditions with more qualified living spaces;

– Improved structural conditions in an uninhabited and listed building by implementing a seismic consolidation;

– Reached acoustic first class according to national standard UNI 11367 that ensures privacy to the occupants;

– Aesthetical improvement returning the identity of the original building and increasing the market value;

Typical living room in a dwelling

Summary

In Treviso, Ca' S.Orsola is a listed building completely renovated and converted into a residential building, with offices and shops at floor plan and dwellings above.
Renovation aimed not only to restore the structure, but also to redevelop the energetic and acoustic situation. The building is equipped with a seismic structure, and each unit is certified in Class A: using low energy glasses, creating a thermal insulation of important thickness and a mechanical ventilation system with heat recovery, integrating solar panels for DHW and heating are main themes for achieving the certification. Living comfort is assured through the use of interior materials with low harmfulness, underfloor heating and cooling with humidity control. Renovation measures decreased global energy consumption, reducting up to 90%; solar and photovoltaic system contributed to minimized energy consumption.
A prestigious location, a renovated historic building with the most innovative technical solutions made a safe and long-lasting investment.

Acknowledgements

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References

[1] http://www.cazzarocostruzioni.it/

[2] CASA&CLIMA, n.47, "Storico, antisismico e in Classe A", pg. 36-44, Quine Business Publisher Edition

Courtyard from west perspective

Main entrance to the building from via Riccati.