POLITECNICO DI TORINO

Honors thesis

Degree in

Architecture Construction City

Abstract

REFURBISHMENT OF A TRADITIONAL STONE BUILDING IN AOSTA VALLEY
Intersections between architecture, energy and costs

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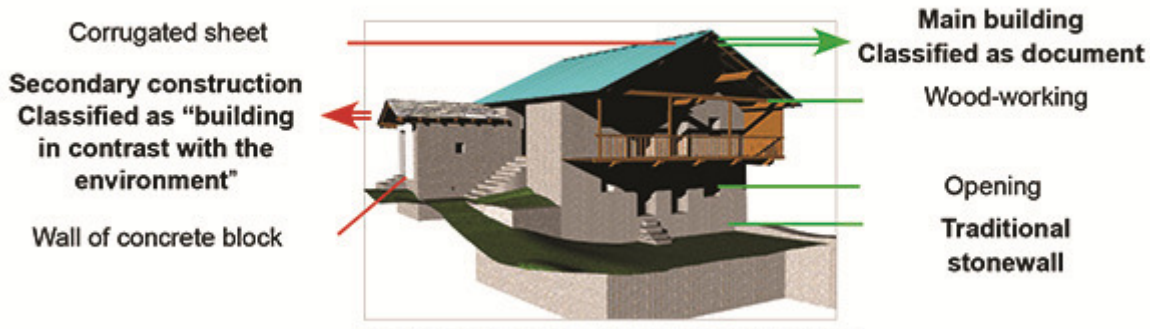
To Keep alive the architectural heritage is one of the most important challenges for those living in the **Val d'Aosta** area, characterized by settlements with a high risk of abandonment due to the changed socio-economic conditions and the needs of comfort required by the contemporary living.
From this awareness comes the need to **preserve and increase in value** the traditional architecture, through compatible and innovative refurbishments, able to reinterpret the existing designs in **high-energy performance projects**.
In addition to energy sustainability, it is also crucial to consider the **economic aspect** of the refurbishments, which occupies a central role in decision-making throughout the building lifecycle.

From these thoughts, in the thesis a requalification project of a **representative building of the rural architectural heritage of Valle d'Aosta** has been elaborated, which defines the interventions to improve energy efficiency, optimal from an architectural, energetic and economic point of view.

Among the traditional architectural types of Val d'Aosta, it was decided to investigate the **stone building with concentrated function**, in which it was later identified a representative existing construction.

In order to find the interventions of energy improvement, it was elaborated a **new methodology**, consisting of three phases and aims to introduce in the building process the complexity of the topics linked to sustainable restoration of existing buildings, taking into account in an integrated way the architectural, energetic and economic aspects.

ANALYTICAL-COGNITIVE PHASE:

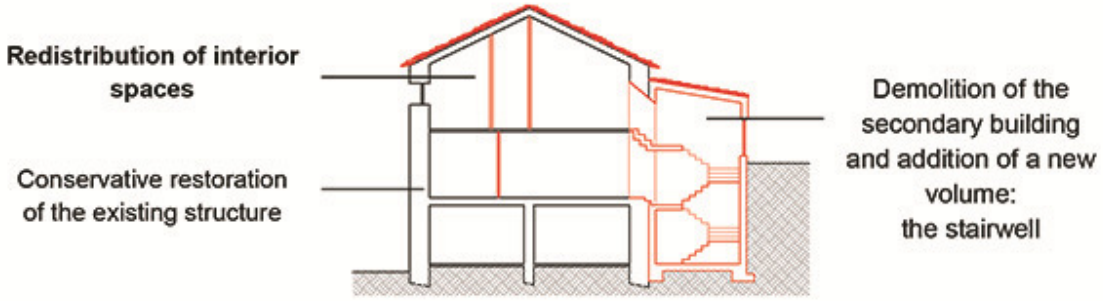


Render of the existing building - South view

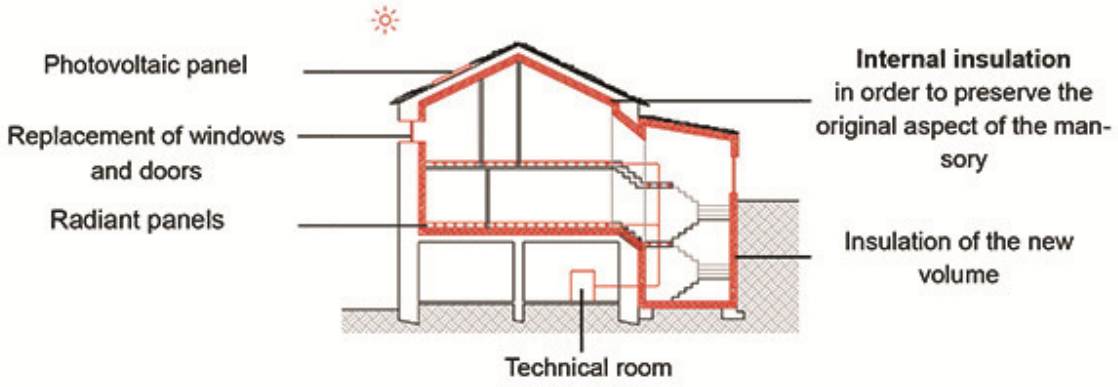
The **analytical-cognitive phase** allows to know in detail the reference building and guide the next phase of the **requalification project**, in which the re-functionalization project and the energy efficiency strategies are developed.
Then it is possible to identify different design proposals for the building envelope and the HVAC system, which, combined, constitute the design scenarios.

REQUALIFICATION PROJECT:

Re-functionalization project:

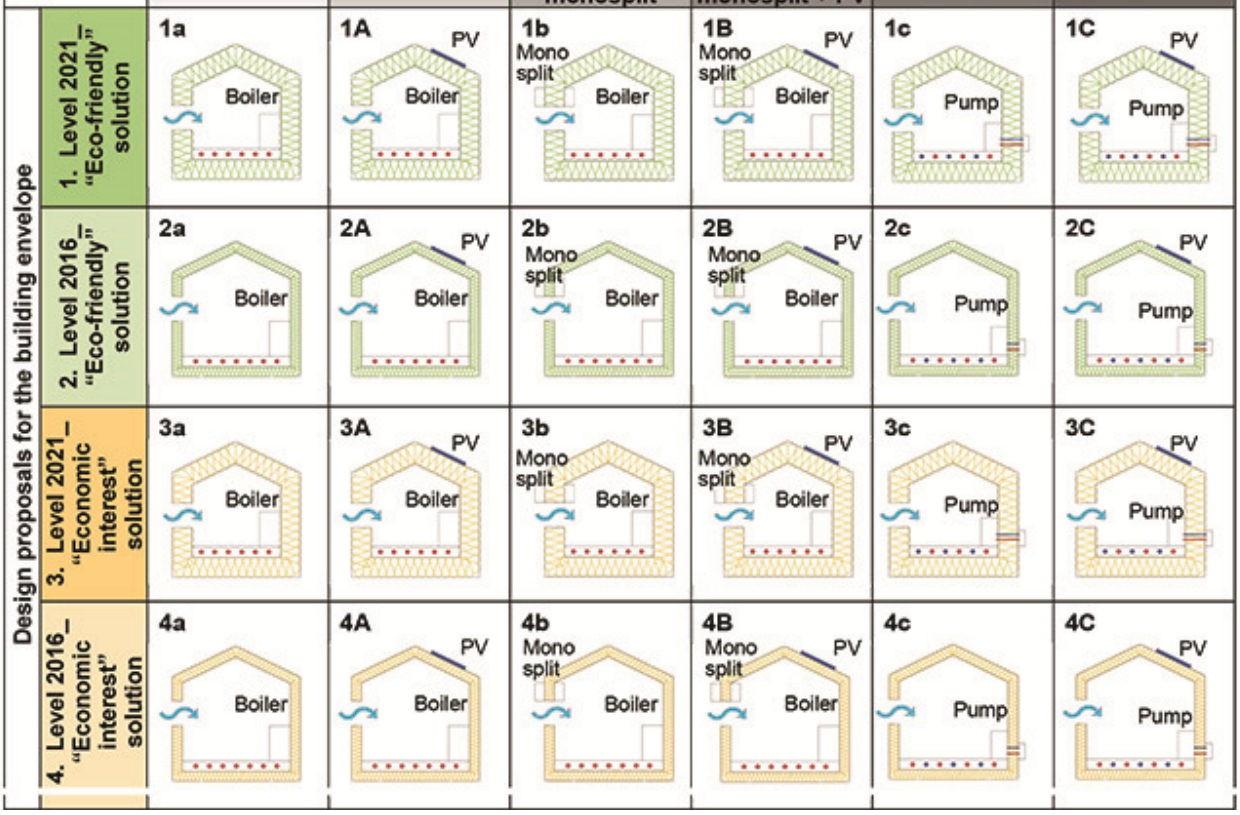


Energy efficiency strategies:



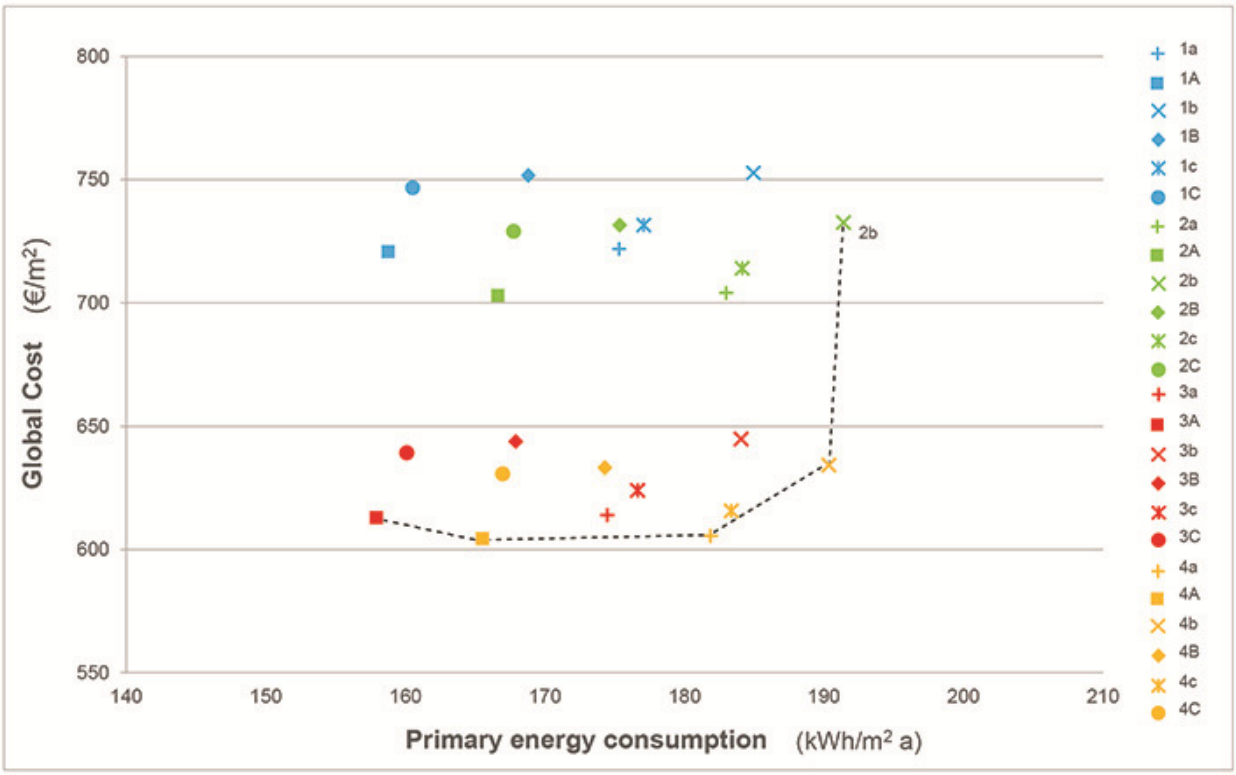
Design scenarios:

Design proposals for the building envelope	Design proposals for the HVAC system					
	Condensation boiler	Condensation boiler + PV	Condensation boiler + monosplit	Condensation boiler + monosplit + PV	Water heat pump	Water heat pump + PV
1. Level 2021_ "Eco-friendly" solution	1a	1A	1b	1B	1c	1C
2. Level 2016_ "Eco-friendly" solution	2a	2A	2b	2B	2c	2C
3. Level 2021_ "Economic interest" solution	3a	3A	3b	3B	3c	3C
4. Level 2016_ "Economic interest" solution	4a	4A	4b	4B	4c	4C



Lastly in the **energy-economic evaluation phase** the different design scenarios are compared using the *Cost Optimal* method, according to their energy performance, assessed using the dynamic simulation software Design Builder, and their financial performance, by the calculation of the global cost during the life cycle of the building.

ENERGY-ECONOMIC EVALUATION:



The thesis has allowed to identify the design scenario for improving energy efficiency, optimal from an architectural, energetic and economic point of view for the reference building, characterized by an **internal wall EPS insulation** and the **replacement of windows and doors**, following the energy performance requirements, and a HVAC system consisted of a **pellet condensation boiler** associated to the **radiant panels** and flanked by a **1.75 kW photovoltaic panel.**
It is also possible to envisage the installation of a monosplit system for a higher inner summer comfort, considering an increase in the global cost of 29 €/m², whereas there would be an increase in costs of 98 €/m² for a more eco-friendly solution with wood fiber insulation.

Since the pre-existence has been chosen as representative of the construction type "stone building with concentrated function", the identified design solutions can be seen as a **collection of "good practices"** that drives design choices for redevelopment of buildings belonging to the same category.
Using the same methodology, it is also possible to extend the research considering other technological solutions for the building envelope and the HVAC system.

The tested methodology in the thesis has proved to be an **efficient support tool for energetic requalification of existing buildings**, but it could be implemented by evaluating also the thermal, visual and acoustic comfort.

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