

Sustainable Building Conference 2013

SB13 Graz



Image: Total Quality Project Wienerberg, Gebäudes

Naturwall: active timber wall for renovation of existent buildings

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Graz

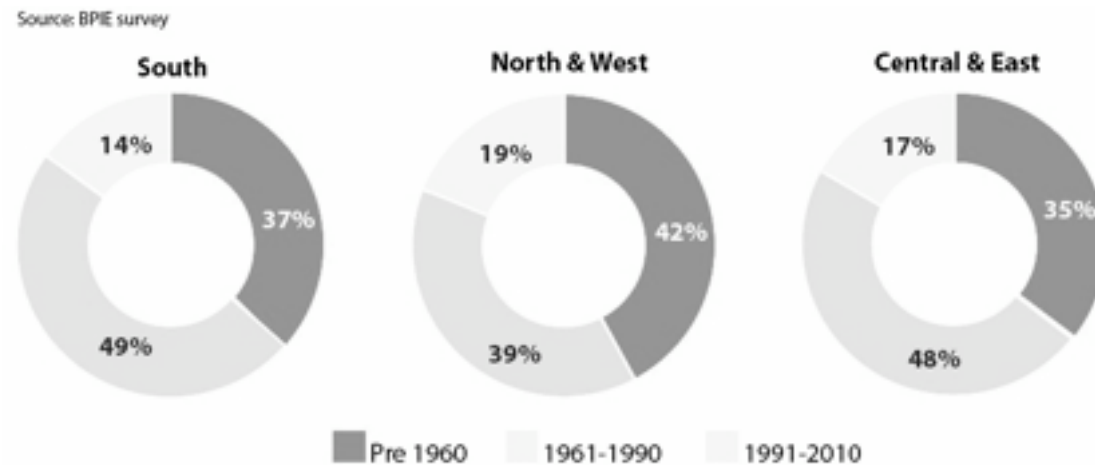
SB13

WIRTSCHAFTS UNIVERSITÄT GRAZ

ökosan¹³

Introduction - Refurbishment of existing buildings

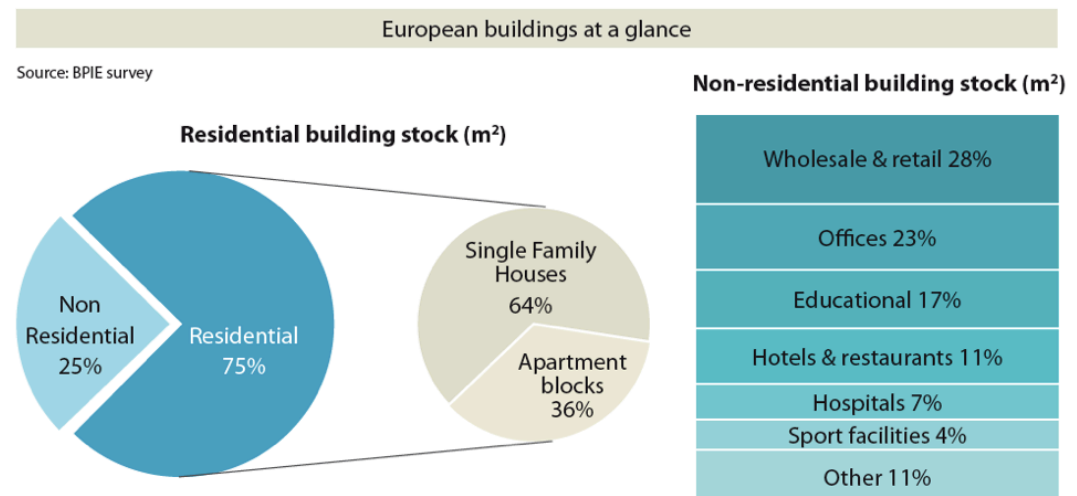
Renovation is the **key issue of recent European policies** in energy saving. The renovation of existent built environment is driven by new European rules and projects on building efficiency (see the recent Smart City program, EU climate action "20-20-20" or the last EPBD directive 2002/91/EC).



Categorization by age of housing stock in Europe (Economidou 2011)

Introduction - Refurbishment of existing buildings

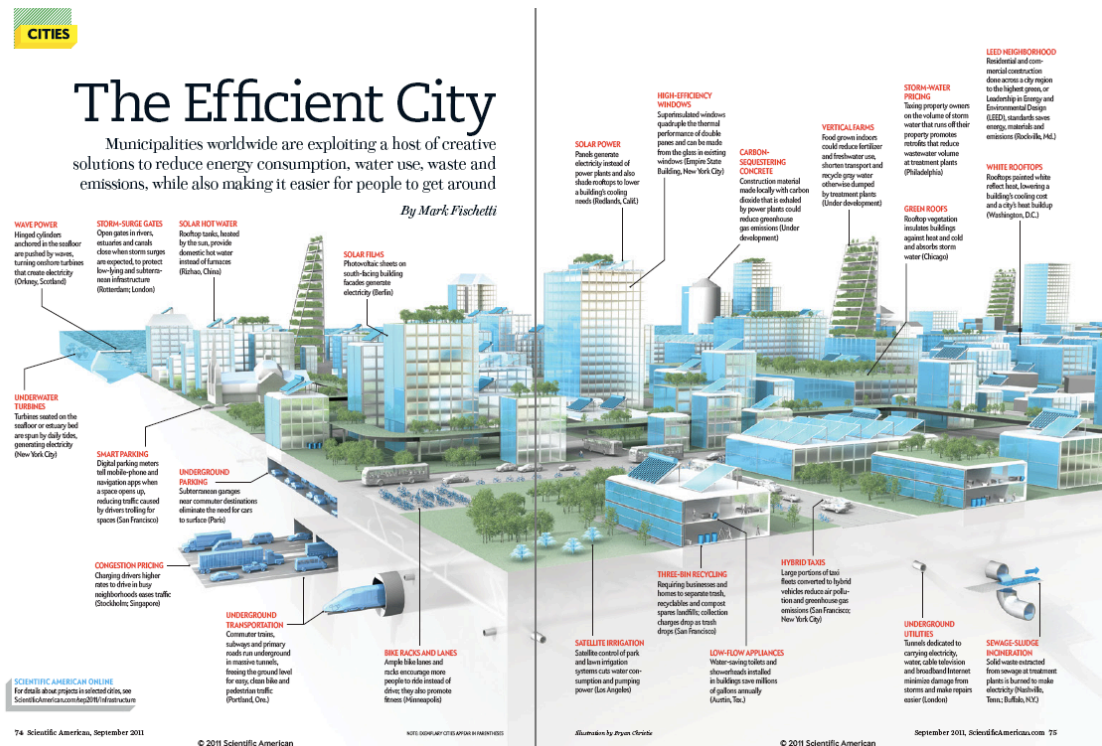
It is estimated that there are 25 billion m² of useful floor space in the EU27, Switzerland and Norway. A substantial share of the stock in Europe is older than 50 years with many buildings in use today that are hundreds of years old. **More than 40% of our residential buildings have been constructed before the 1960s when energy regulations were very limited.** Non-residential buildings account for 25% of the total stock in Europe.



¹ The European countries have been divided based on climatic, building typology and market similarities into three regions

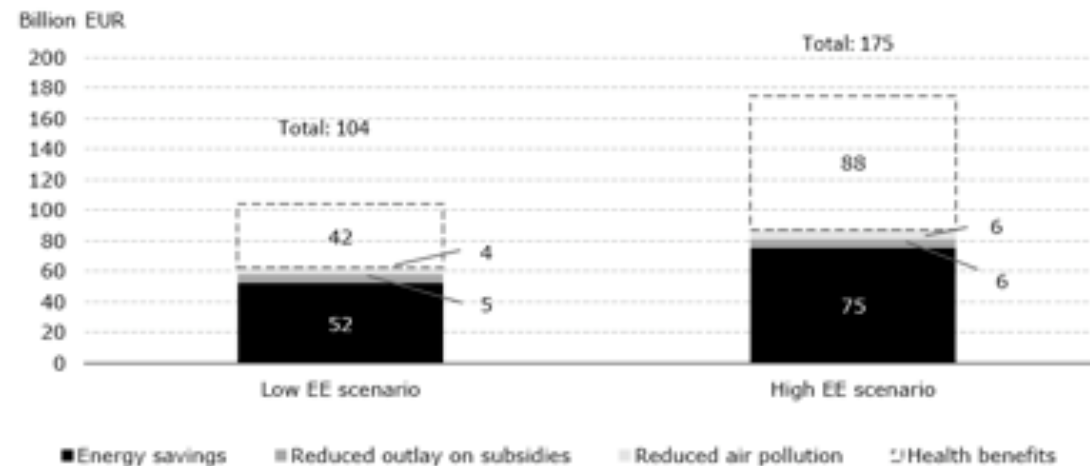
Introduction - Refurbishment of existing buildings

The most effective way of achieving future targets is through a combination of renewable technologies, optimizing the process, and developing strategies more competitive on the renovation work instead on the new construction



Introduction - Refurbishment of existing buildings

Building energy performance needs to be significantly improved in order to reduce overall energy demand and, most importantly, to reduce carbon dioxide emissions in line with the cost-effective potential and Europe's GHG emissions objectives. The question for policymakers is how to proceed.



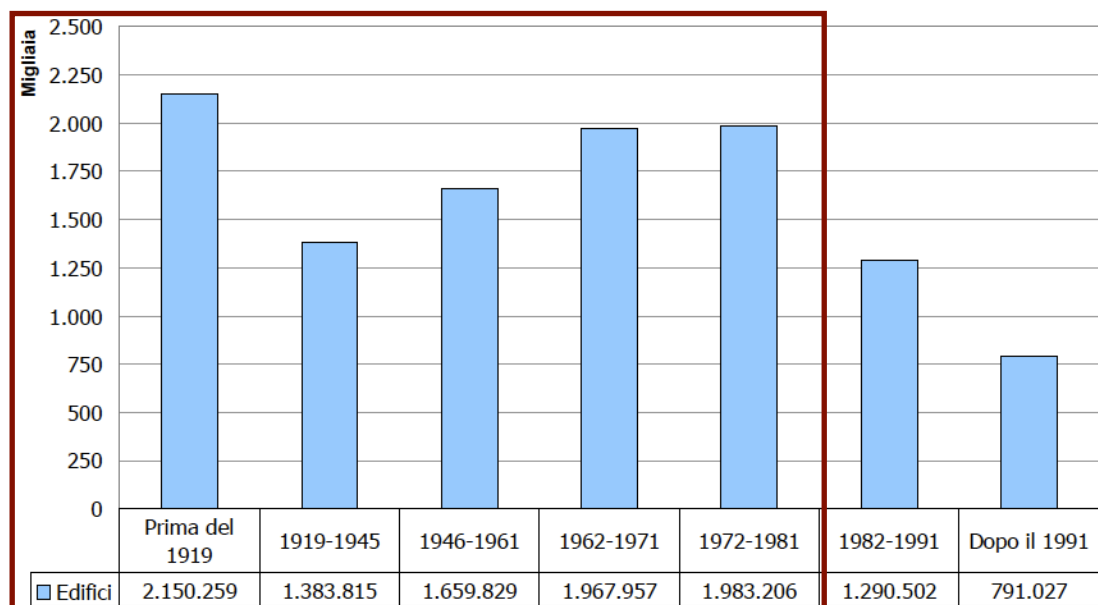
Note: These results include the rebound effect, and can therefore not be compared with the sub-results derived in Chapter 1. We have applied a rebound effect of 20 per cent.

The total does not equal the sum of each element due to rounding.

Source: Copenhagen Economics

Introduction - Renovation process in Italy









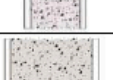


ISTAT Data _Numbers of buildings divided for time of construction (Italy Census 2001)



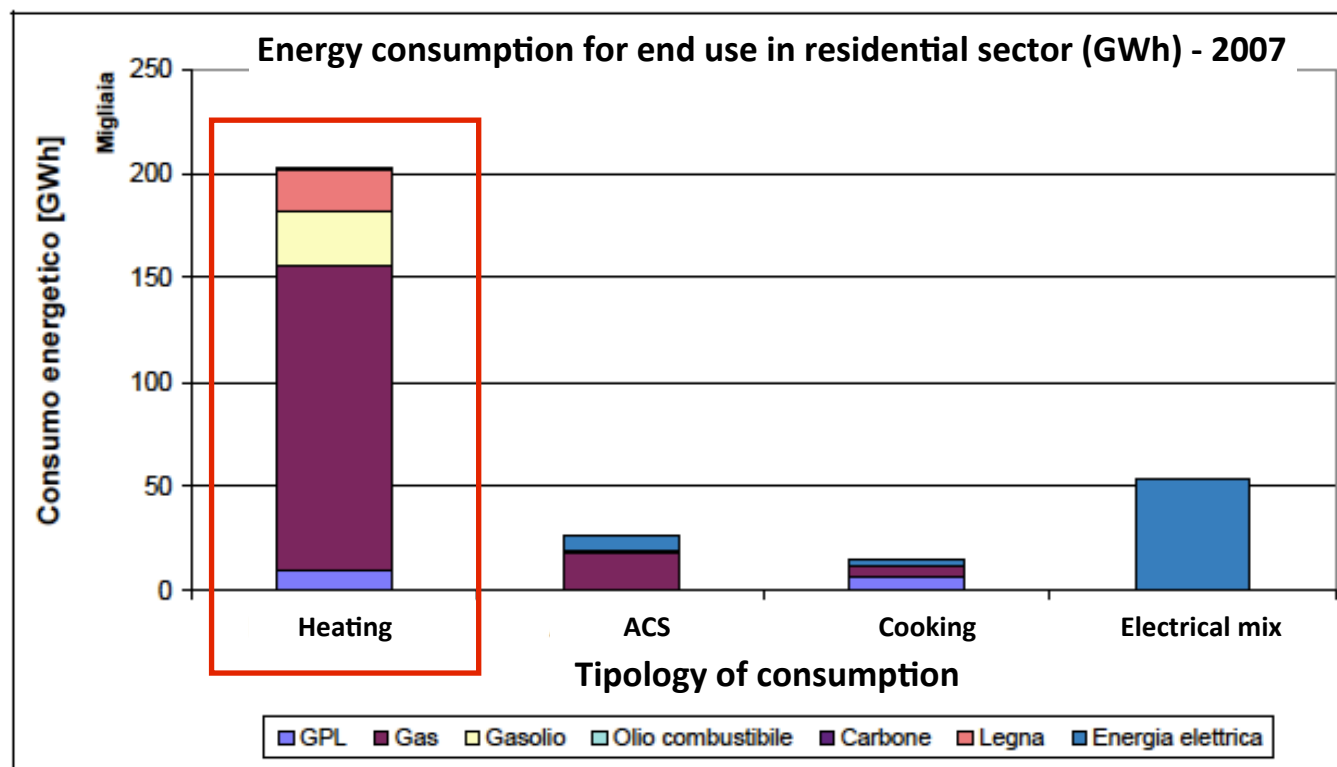
In Italy more than the total of the built environment was erected until the '70 energy crisis

Existent building stock in Italy

CLASSE DI EPOCA DI COSTRUZIONE	Area climatica media	CASE MONOFAMILIARI	CASE A SCHIERA	EDIFICI MULTIFAMILIARI	BLOCCHI DI APPARTAMENTI
	1 Fino al 1900				
	2 1901-1920				
	3 1921-1945				
	4 1946-1960				
	5 1961-1975				
	6 1976-1990				
	7 1991-2005				
	8 Dopo il 2005				

	Period		U-value (W/m²K)
	1900	1950	1,48
	1900	1950	1,14
	1900	1950	1,02
	1930	1975	1,15
	1930	1975	1,10
	1930	1975	1,26
	1950	1975	1,76
	1950	1975	1,26
	1955	1975	3,40
	1955	1975	2,80
	1976	1990	0,78

The problem of energy saving in Italy?

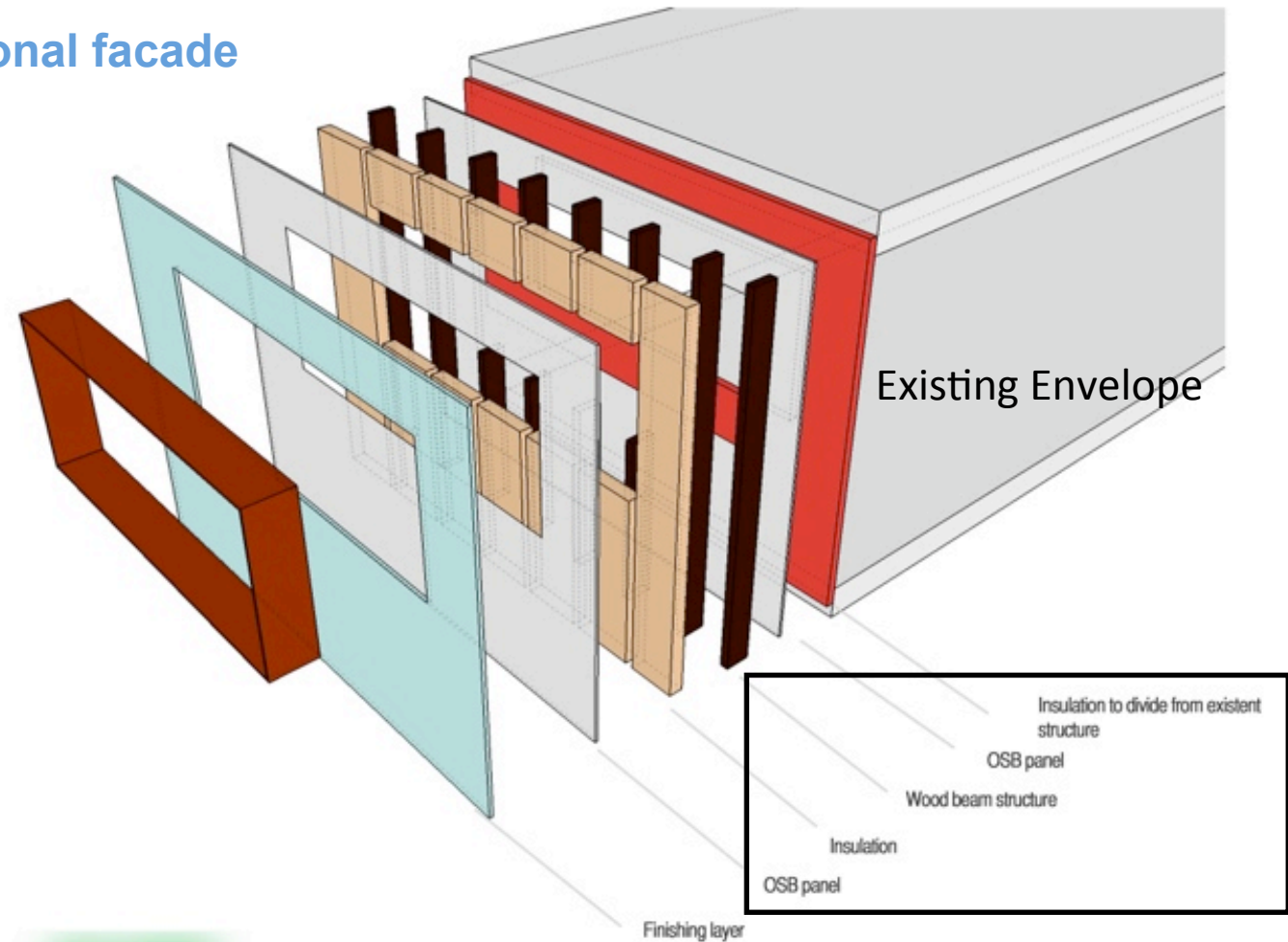


Introduction - Renovation, in which way?

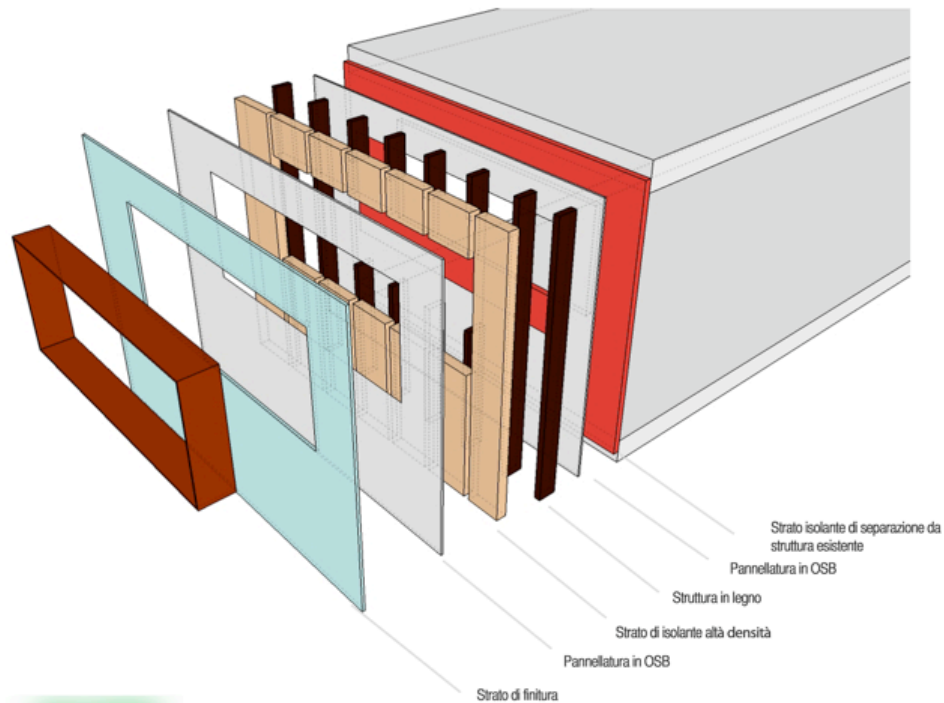
Naturwall® is an Italian project, promoted by Giovanni Gorla Foundation and the Politecnico of Turin (DAD) with a local PMI support. It consists in an innovative energy saving system for existent buildings, by using wood multifunctional components. The project meant to introduce an industrialized design method in the renovation of city existent building environments, it highlights the opportunity given by "off site" production, without neglecting the aesthetical values and the possibility to change the architectural image. The project aims to create a representative model of solution that will be promoted in Italy.



Naturwall multifunctional facade



Naturwall multifunctional facade



NaturWall

Simple process

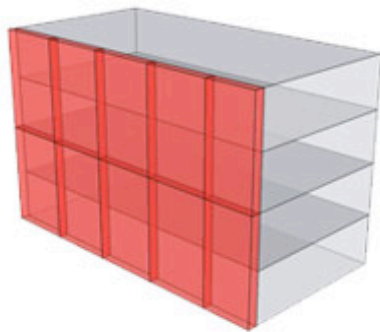
Renewable technology

Use of local materials

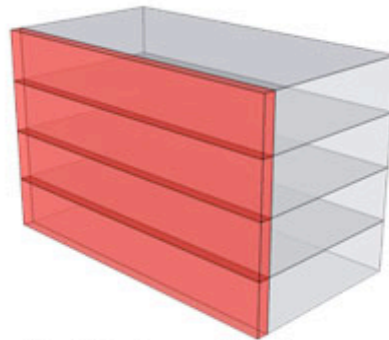
Controlled and optimized process

Certainty of time and cost

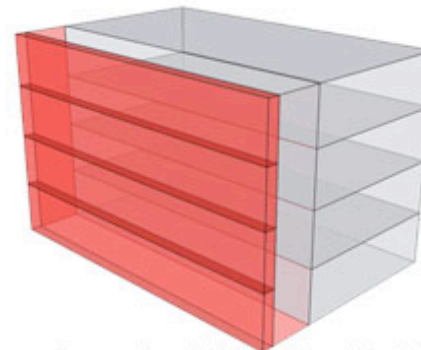
How is it apply? prefabricated assembly



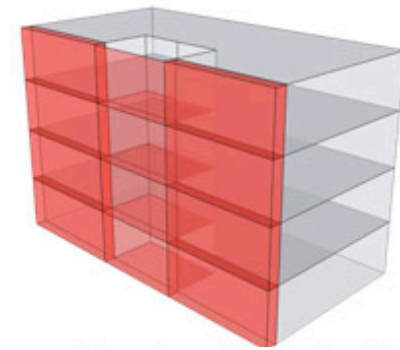
Vertical Assembly



Horizontal Assembly



**Extension of existent
facade**



**Integration of
balcony into the
facade**

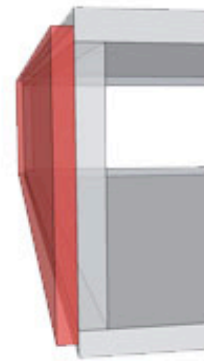
How is it apply?



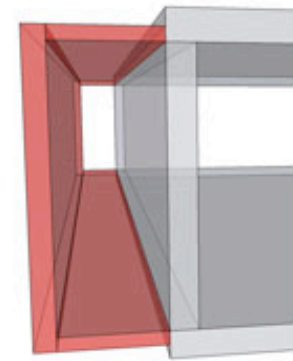
The wall replace the existing envelope between floor



The wall replace the existing envelope over the floor



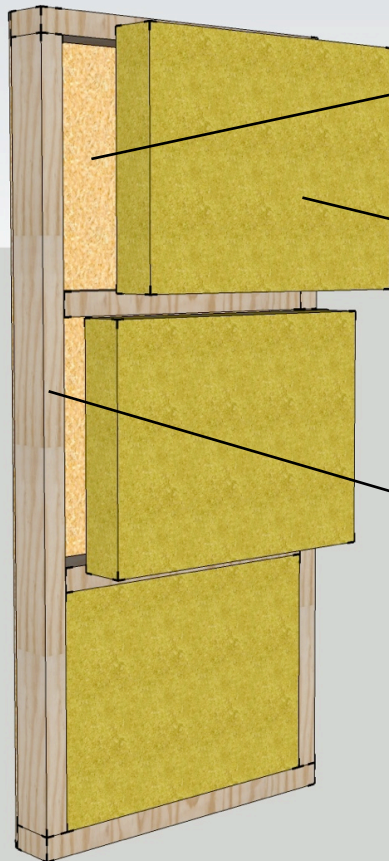
The wall cover the existing envelope



The wall extend the existing envelope (e.g. a loggia)

All wood products are made from local forest located in Piedmont

Posizionamento isolante in
pannelli di fibra di legno



Cellulose insulation

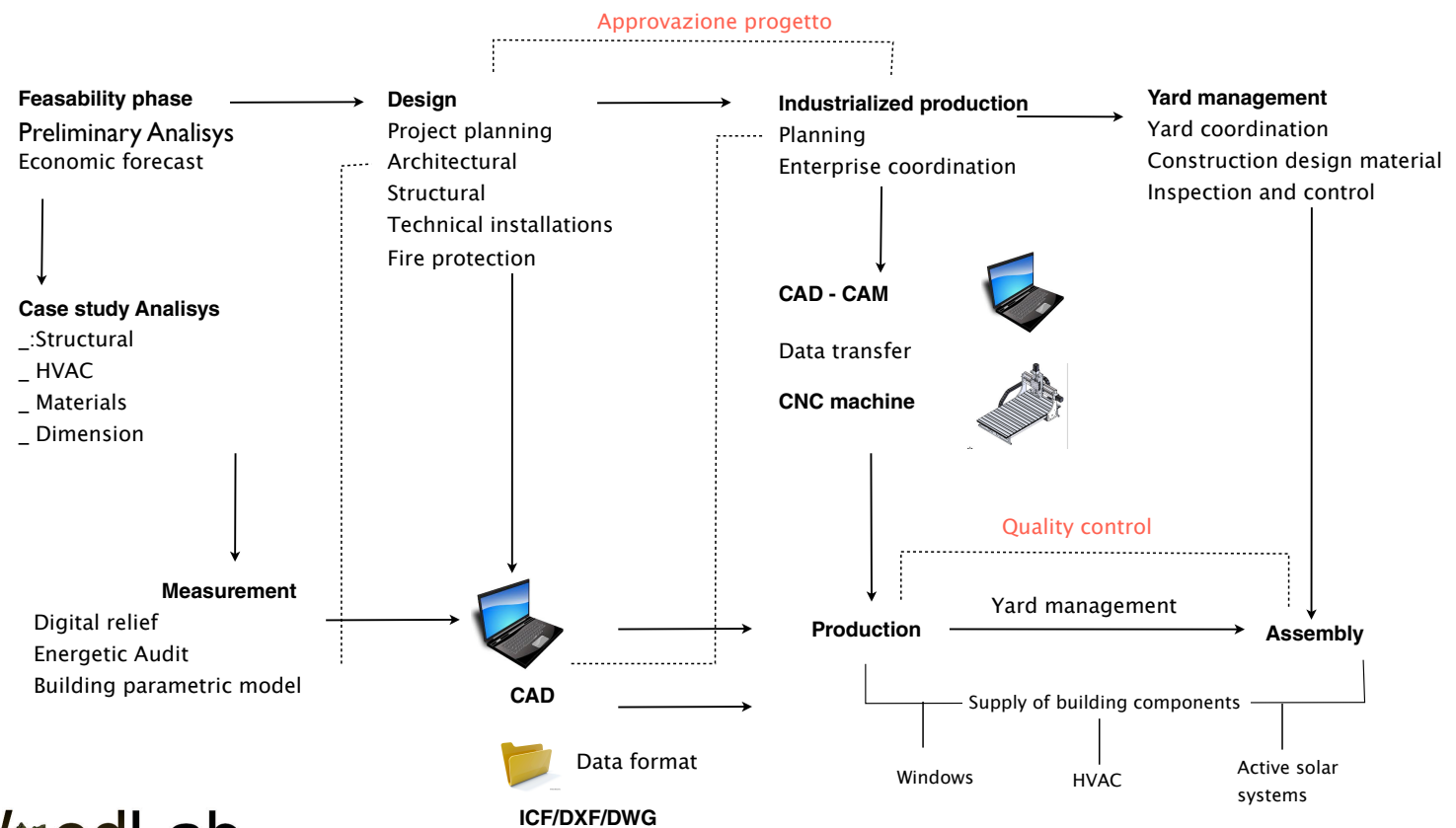
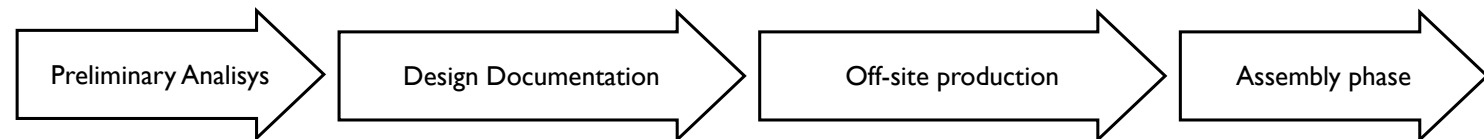


Poplar Plywood



Wood from certified forest

How does the process work?

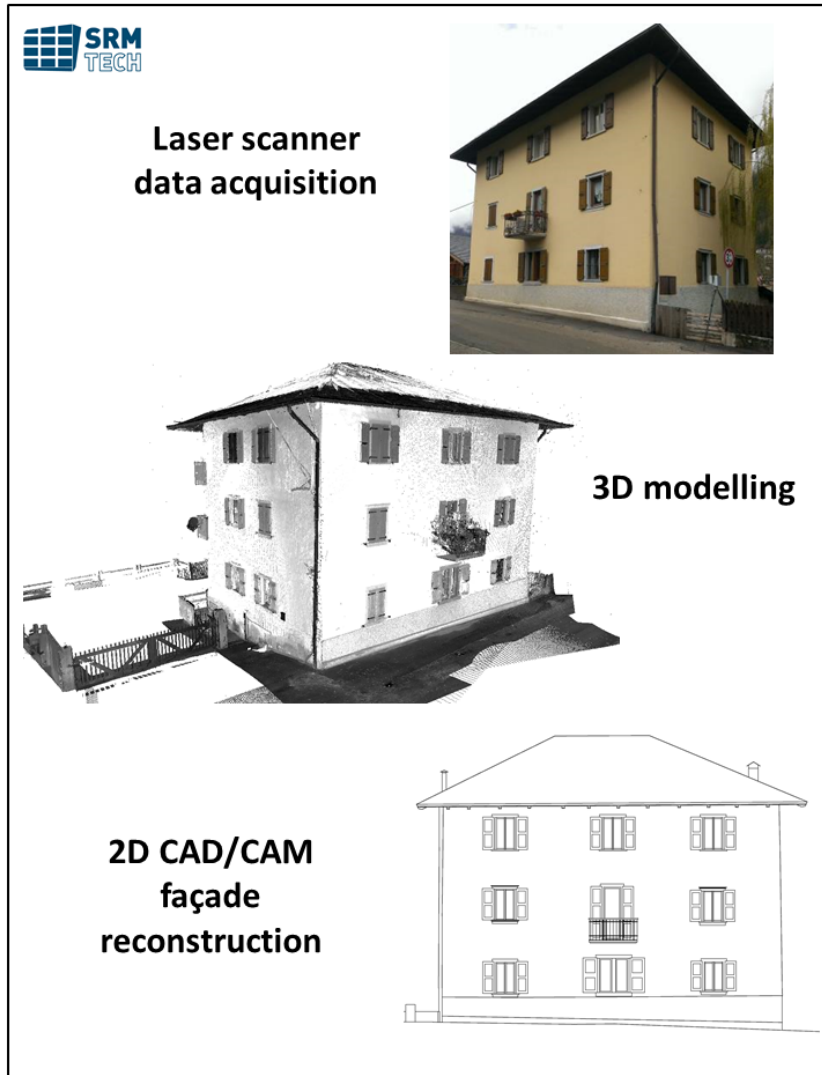


The role of relief phase

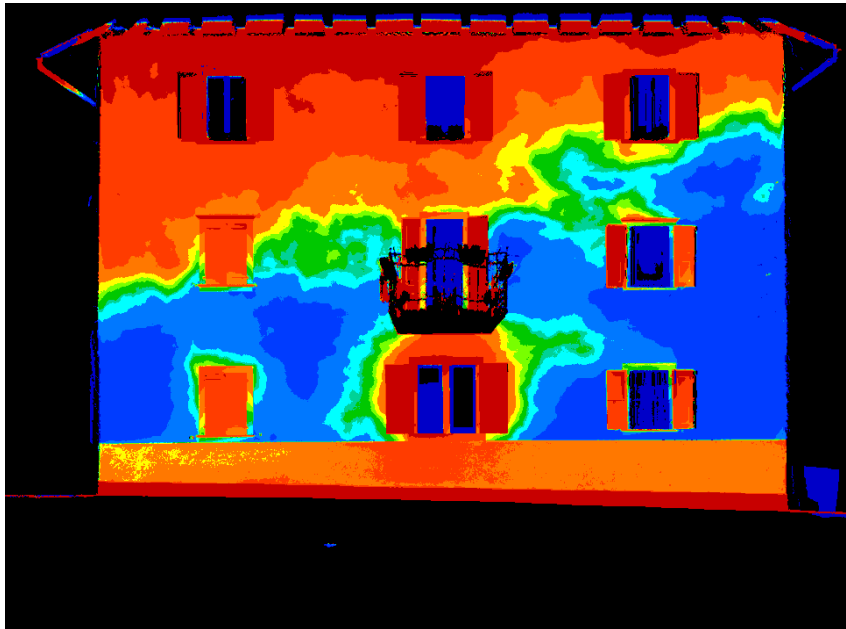
- High level detailed 3D model
- 2D representations to understand critical points
- CAD/CAM file format for CNC production machine



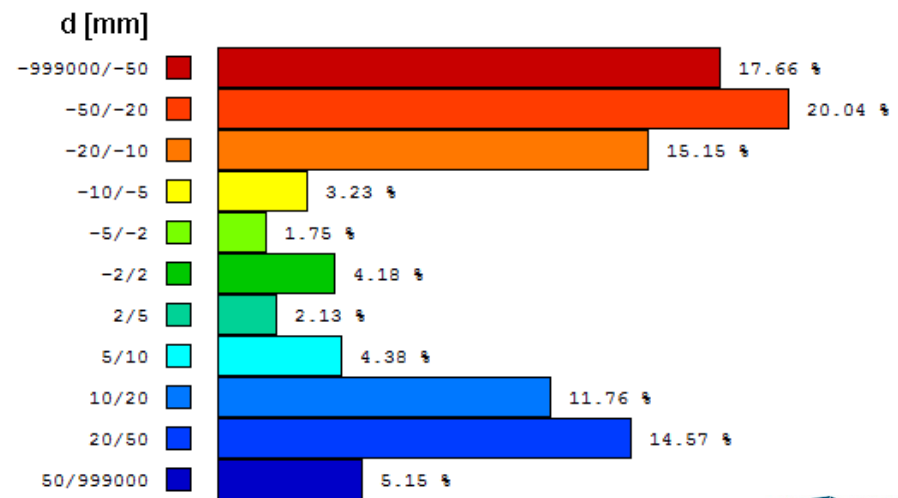
- ✓ Investigate in details the starting condition of the building
- ✓ Reduces the high liability risk of the requalification project
- ✓ Stringent requirements in terms of accuracy and profitability become calculable
- ✓ Reduces resources and times in the whole design and fabrication process



Control of deformations

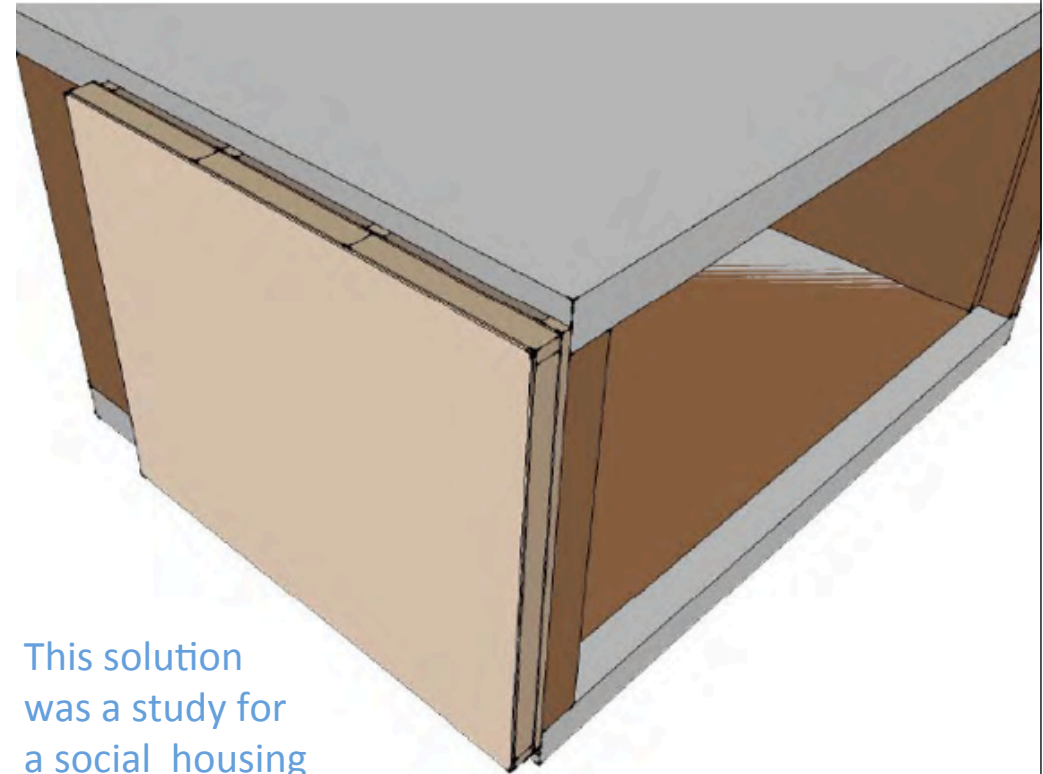
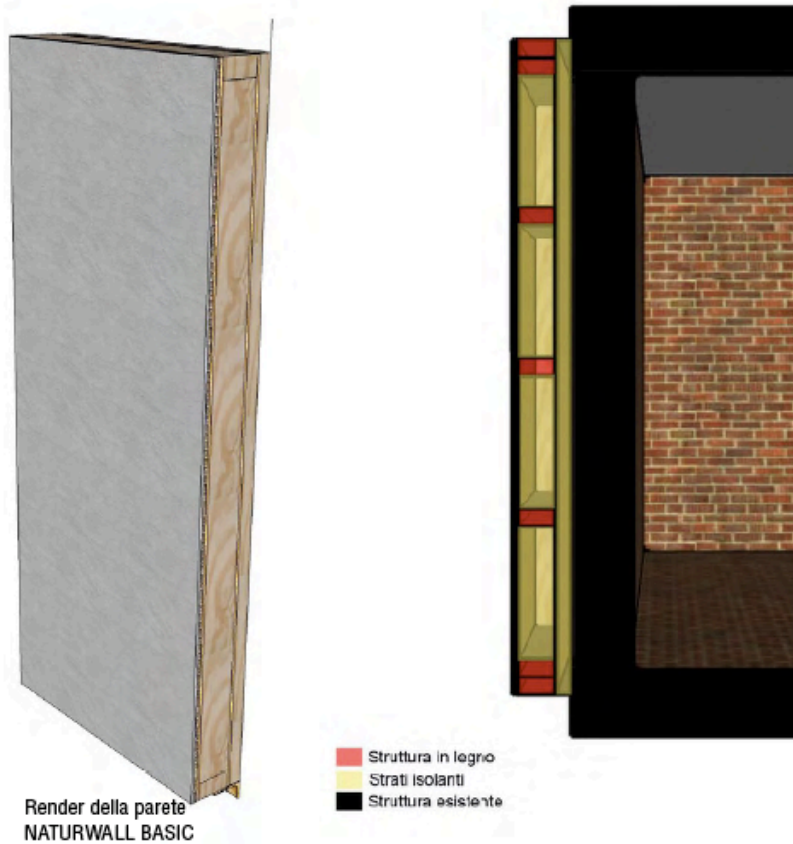


Deformation analysis $\phi = \pm 80.5$ mm



Deformation analysis allows to extract different important parameters in order to plan the most suitable installation program and conceive the proper support structure devoted to the component installation (bracket, trestles, etc.)

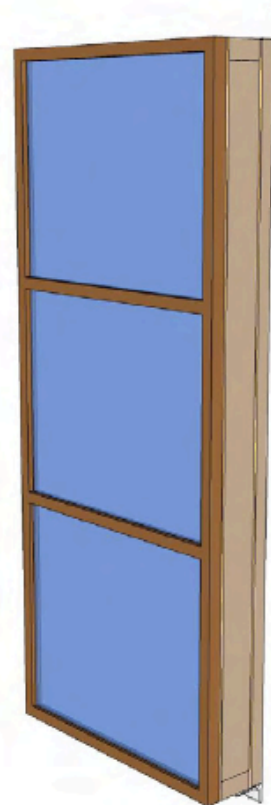
Naturwall Basic layout



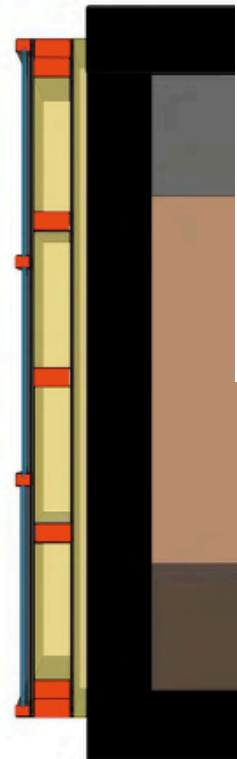
This solution was a study for a social housing project, maximizing the cost effect.

Material	s [m]	λ [W/m2K]	p [kg/m3]	c [J/kgK]
Intonaco di calce idraulica per legno	0,015	0,63	1500	
Pannelli Celenit Sughero compresso	0,03	0,043	170	1500
Osb Pioppo	0,012	0,13	620/640	1800
Fibra di legno	0,16	0,042	160	2100
Osb	0,012	0,13	620/640	1800
lana di vetro	0,02	0,032	48	1030

Naturwall Plus layout - responsive building element



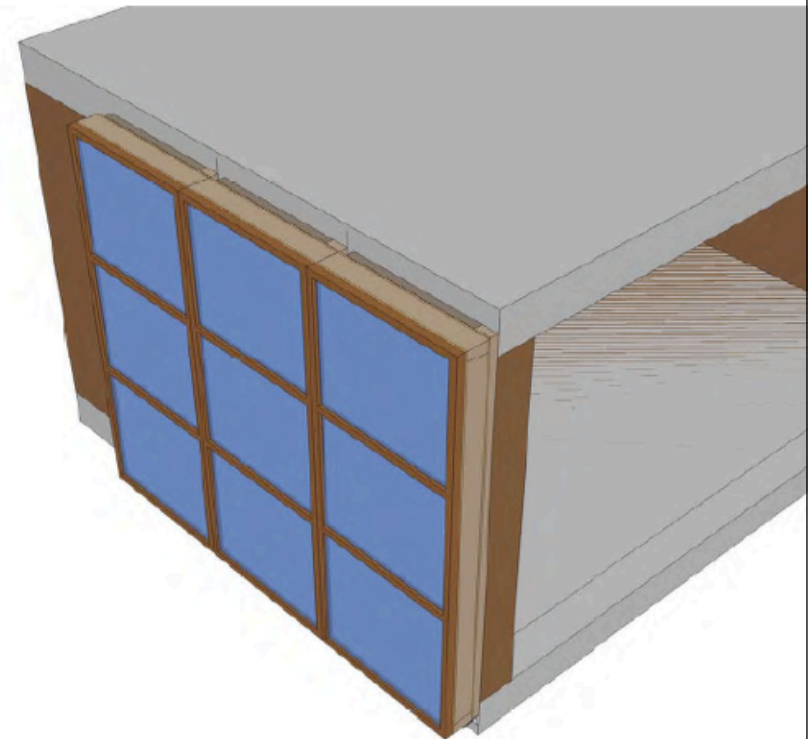
Render della parete
NATURWALL PLUS



■ Struttura in legno
■ Strati isolanti
■ Struttura esistente

The component could integrate pv modules, passive energy systems, installations and sensors.

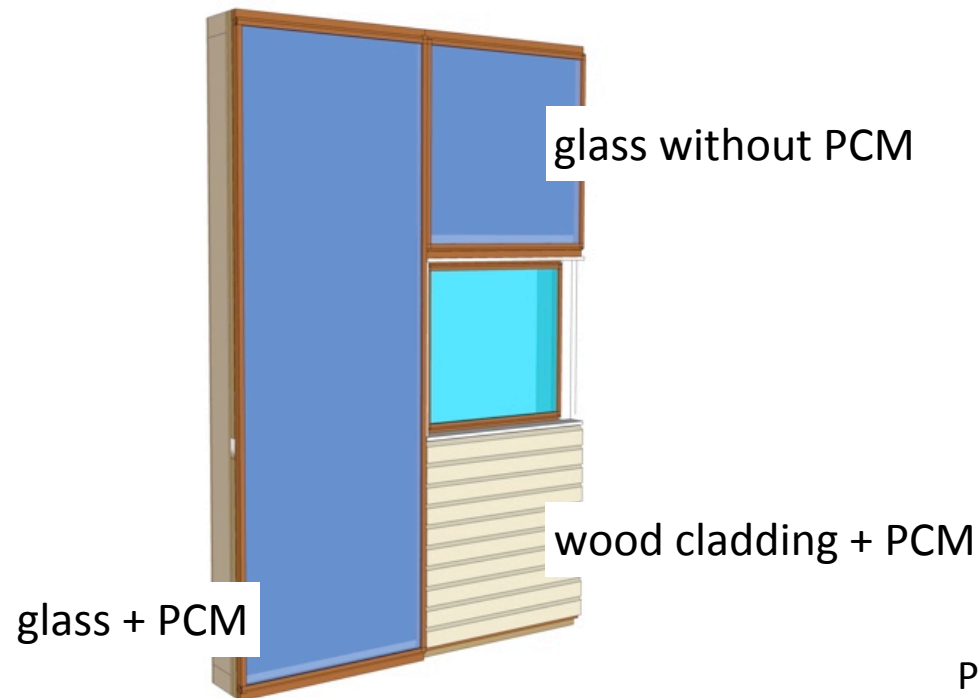
All the materials are products made locally from wood coming from certified forestry



	Material	s [m]	λ [W/mK]	ρ [kg/m³]	c [J/kgK]
NaturWall PLUS	Vetro Singolo LoE	0,006	0,04	140	840
	Air (ferma)	0,03	0,025	1,23	1008
	Pannelli Celenit Sughero compresso	0,03	0,043	170	1500
	Osb Pioppo	0,012	0,13	620/640	1800
	Fibra di cellulosa	0,16	0,038	45	2150
	Osb	0,012	0,13	620/640	1800
	lana di vetro	0,02	0,032	48	1030

U- value naturwall Plus : 0,138 W/m²K

Phase of experimentation - mock-up - November 2013



Text on the thermal behaviour will be held at
Politecnico di Torino at the end of August 2013



Partners:

Natural House (Italy) wood construction company
SRM Tech (Italy) Innovative relief technology
Omnicolor (Italy) - Decor Glass Design
IBL-I-Pan (Italy) - Italian poplar OSB
Nesocell (Italy) - italian cellulose insulation
Dupont (France) - Tyvek and Energain

Case study in Piedmont

The building was erected in the '70 with a concrete insulated system. We studied three different apartments, calculating its baseline energy performance and then the Naturwall effect on it.



Figura 1. Pianta Piano Tipo



Figura 2. Edificio in analisi sito in via Pietro Cossa

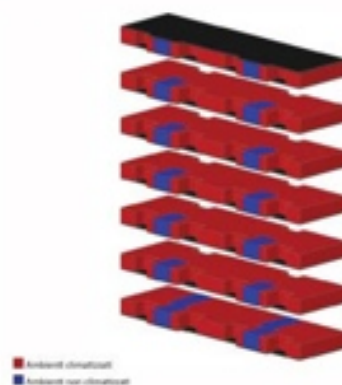


Figura 3. Ambienti riscaldati e non climatizzati

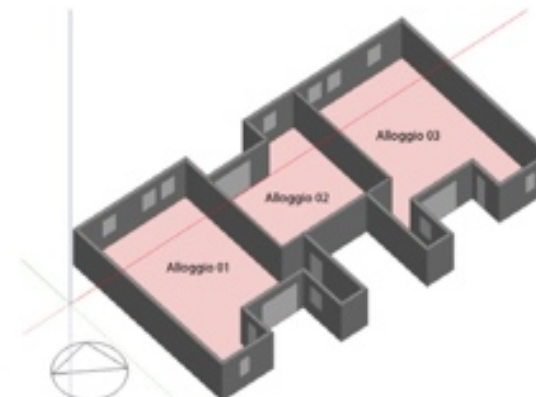
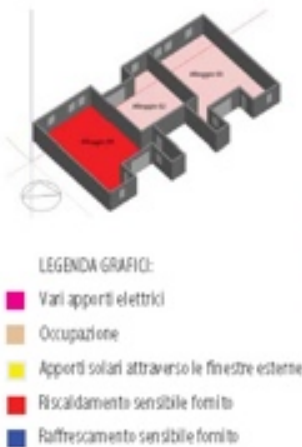


Figura 4. Alloggi studiati per le analisi energetiche

Case study in Piedmont

Appartment 1: the heating and cooling consumption is around **145 Kwh/m² a** but with the application of the Naturwall base it decreases until **55 Kwh/m² a**, with Naturwall Plus at **40 Kwh/m² a**. All consumption are calculated without considering electrical ones.



Consumption of existing building



Consumption with Naturwall Basic

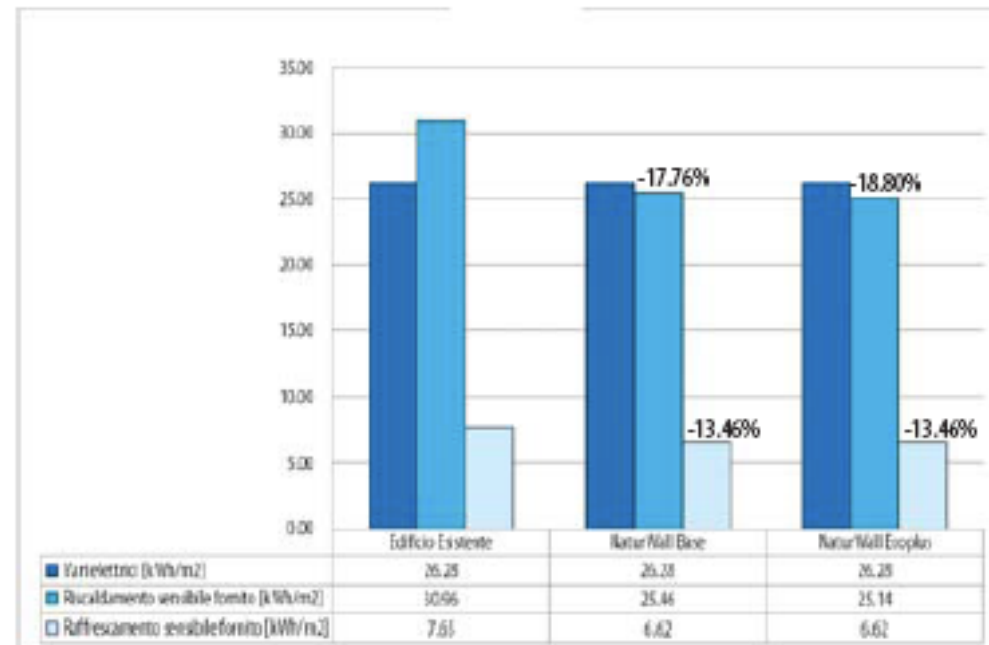


Consumption with Naturwall Plus

Case study in Piedmont

Appartment 1: the reduction of the consumption is around 30% -40% of the total amount, just adding a new wall on the exterior one (including windows).

For electrical energy consumption, we thought of integrating, in the wall, some PV modules or to cover the load with PV panels on the roof.



Conclusion - The use of timber in retrofit design process

Today, wood can be seen as the most suitable material for interventions in the built environments:

_ it permits a reflection of the different way to renovate existing building stock

_ It permits “re- thinking” of the design, planning and construction of buildings, shifting to the production plant some of the checks that were traditionally carried out on site, thus restoring the architectural project to its central role

_ it offers the opportunity to reduce energy consumption and CO2 emissions during the entire construction process and the building life cycle



Any questions?

Thank you



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