WORLD
Sustainable Built Environment Conference
2017 Hong Kong

Transforming Our Built Environment through
Innovation and Integration:
Putting Ideas into Action

5-7 June 2017

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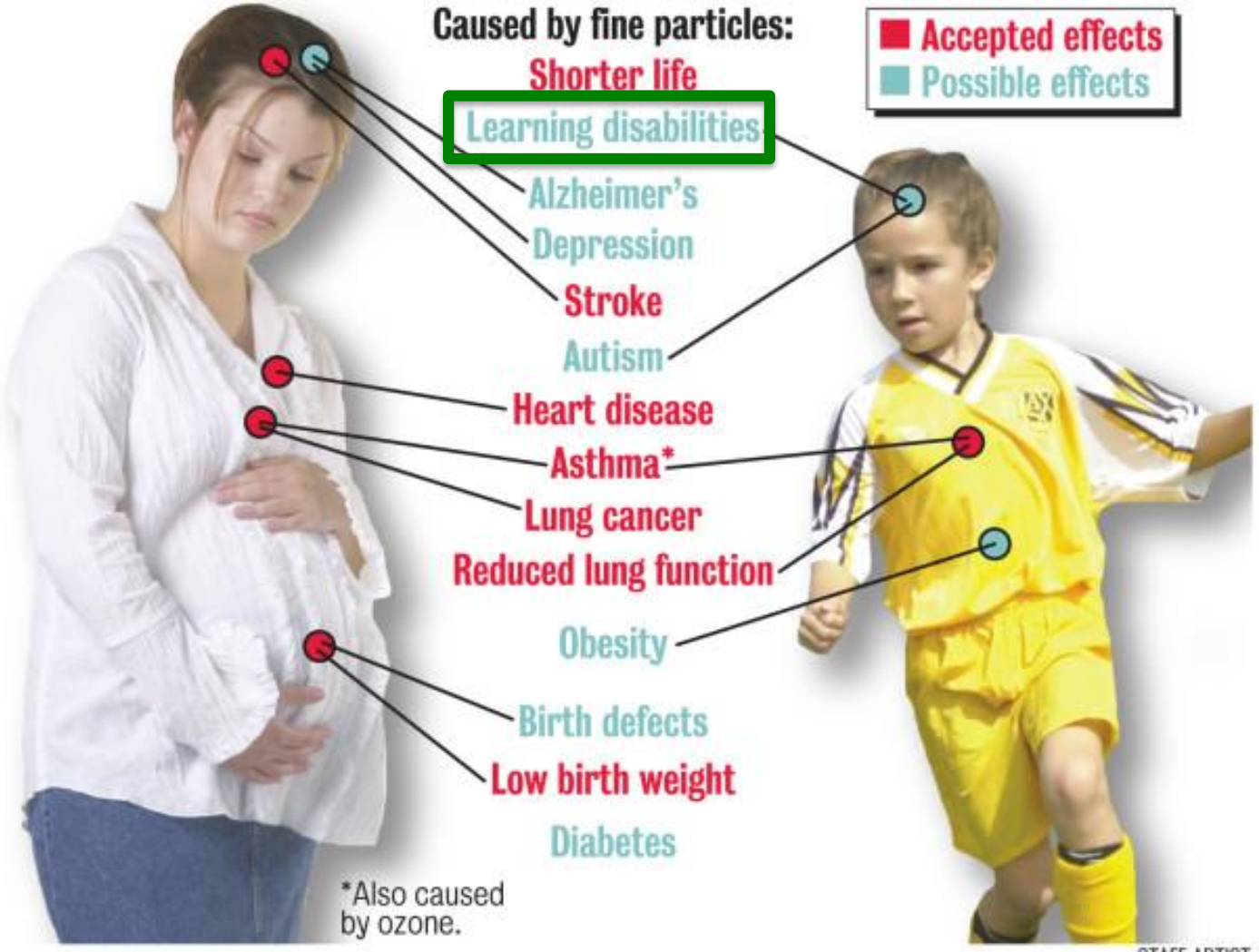
Energetic Refurbishment of a Secondary School as Pasive Building

UNIVERSITY
OF TRENTO - Italy

POLLUTION MATTERS

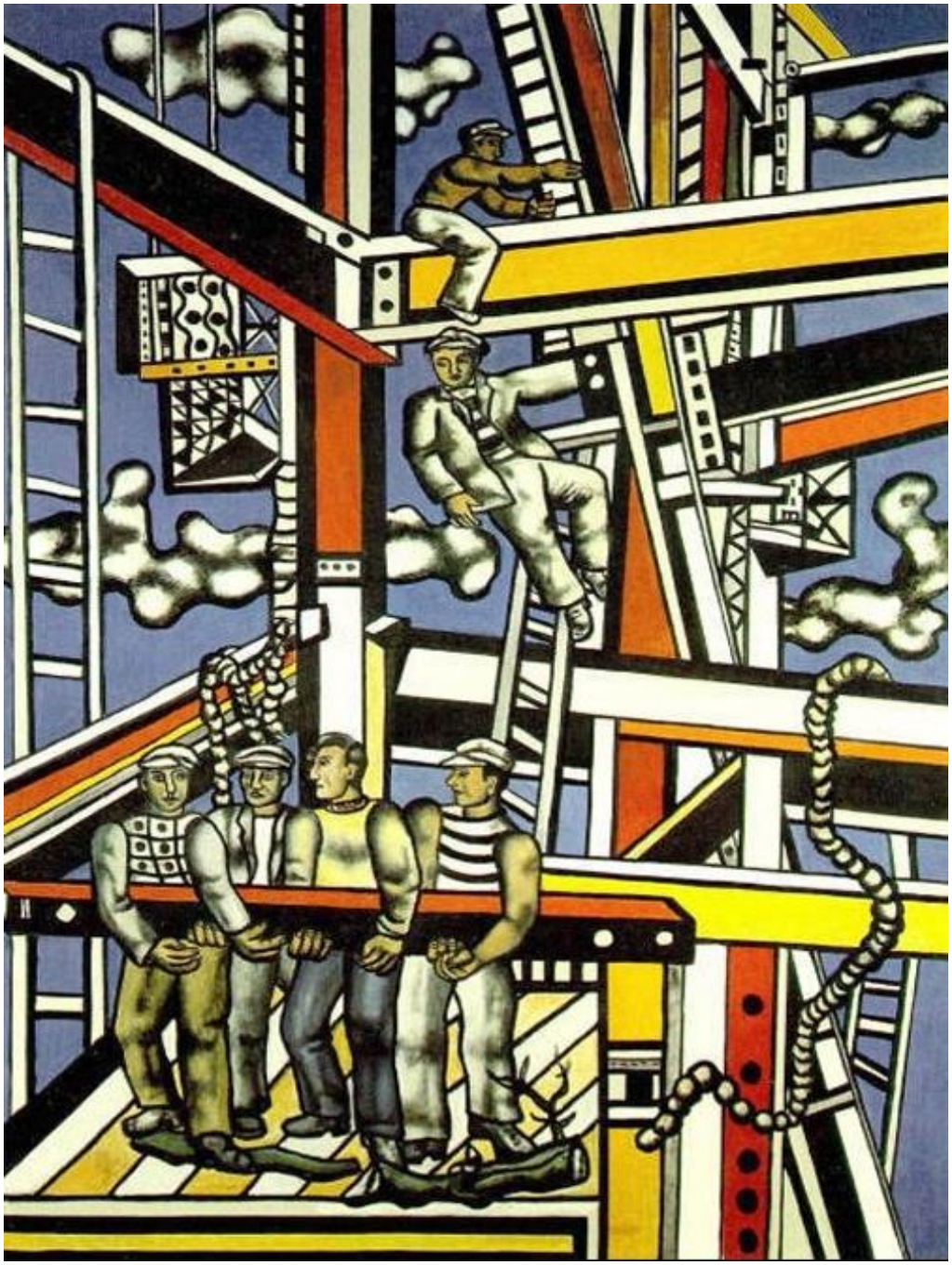
Thousands of studies have shown how air pollution can harm people, causing heart attacks, lung problems and other ailments, and shortening lives. New research is finding possible links between certain pollutants and autism, birth defects and childhood obesity, among other conditions.



STAFF ARTIST

INDOOR AIR QUALITY, THERMAL COMFORT AND DAYLIGHT

Construction of New Buildings




08
09
10
01
02


classe 1ère
classe 2e


U.S. GREEN BUILDING COUNCIL
LEED PLATINUM
2012


SCVOLE


NEVE

Existing Buildings Refurbishment

The refurbishment is finalized
for improving
Thermal comfort
Indoor Air Quality.

Very important is the energy consumption

The Laboratory of Building Design proposed a methodology for developing a sustainable refurbishment of the school buildings

It is articulated in four steps:

- Analysis and monitoring of thermal comfort and energy consumption of the building.
- Proposal of construction solutions to improve the energy efficiency of the whole building.
- Testing of the predicted solutions through the Passive House Planning Package (PHPP software) to reduce the annual heating demand (< 20 kWh/m^2y) and improve the living comfort of the school building.
- Executive project of the energy retrofit solutions.

First step: ANALYSIS

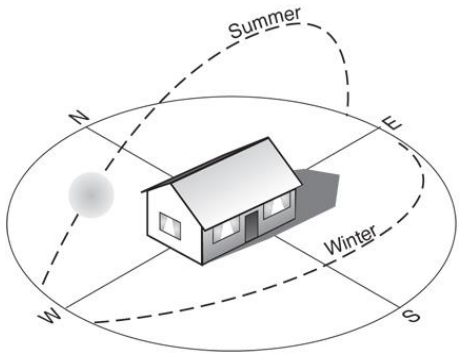
- Survey of the building
- Monitoring of the indoor comfort and evaluation of the building energetic behavior
- Monitoring of the energy consumption

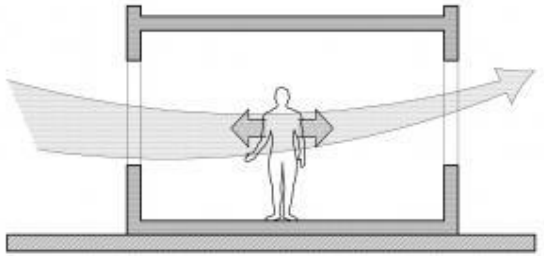
Second Step: PROPOSAL

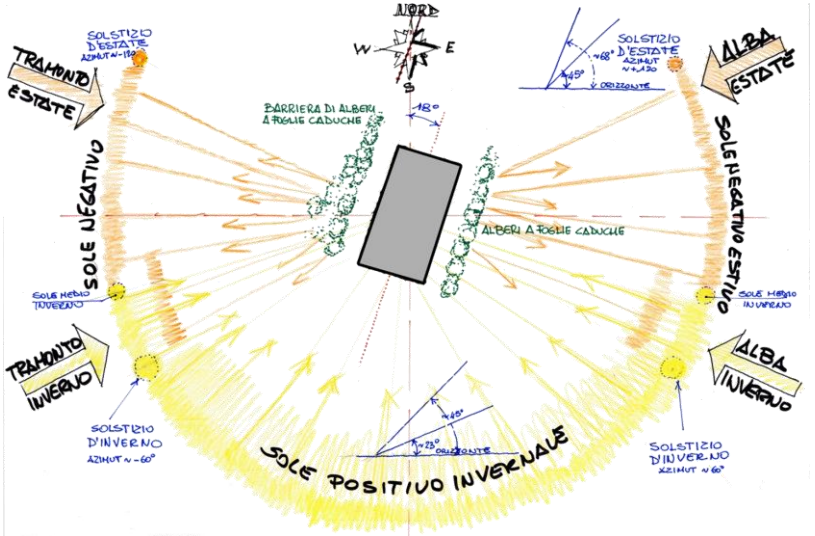
The concept followed for the proposal is the enhancement of the comfort and the reduction of the energetic consumption through

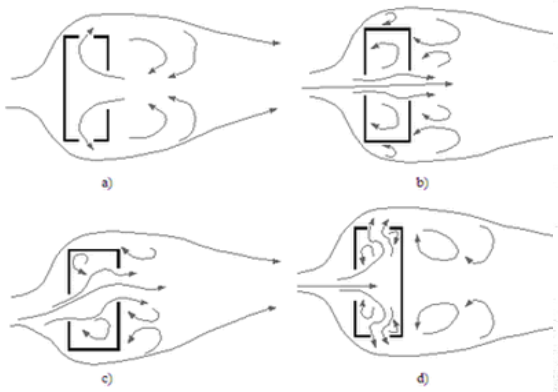
1. Bioclimatic solutions exploiting the free energetic contributions from the local environment
2. Improvement of the thermal behavior of the envelope reducing the thermal bridges
3. Improvement of the thermal insulation
4. Integration of the building with techniques to produce energy from renewable sources
5. Improvement of air quality through the controlled mechanical ventilation in absence through a controlled natural ventilation
6. Improvement of the visual comfort through the management of the daylight
7. Introduction of the building automation to manage the heating, ventilation systems and the daylight
8. use of materials with a low energetic and environmental impact

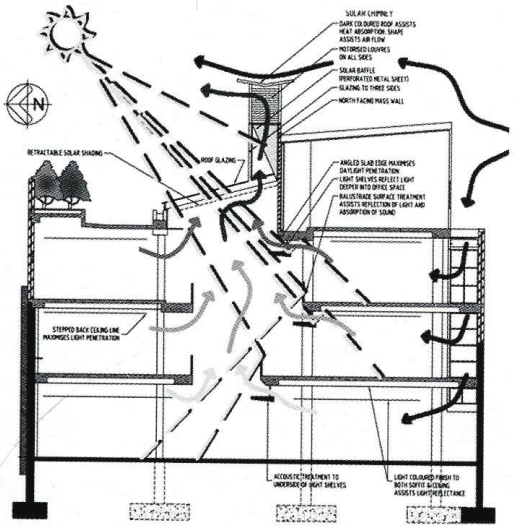
- exploitation of the energetic free contributions from the surrounding

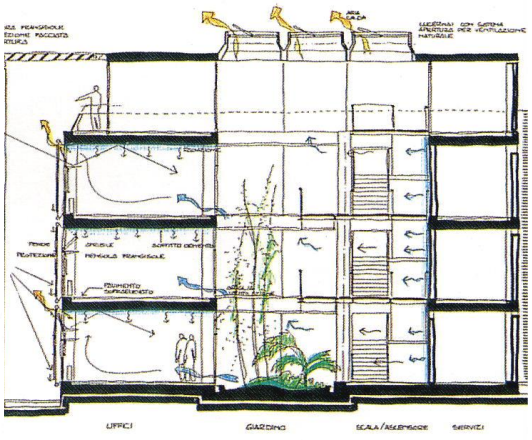




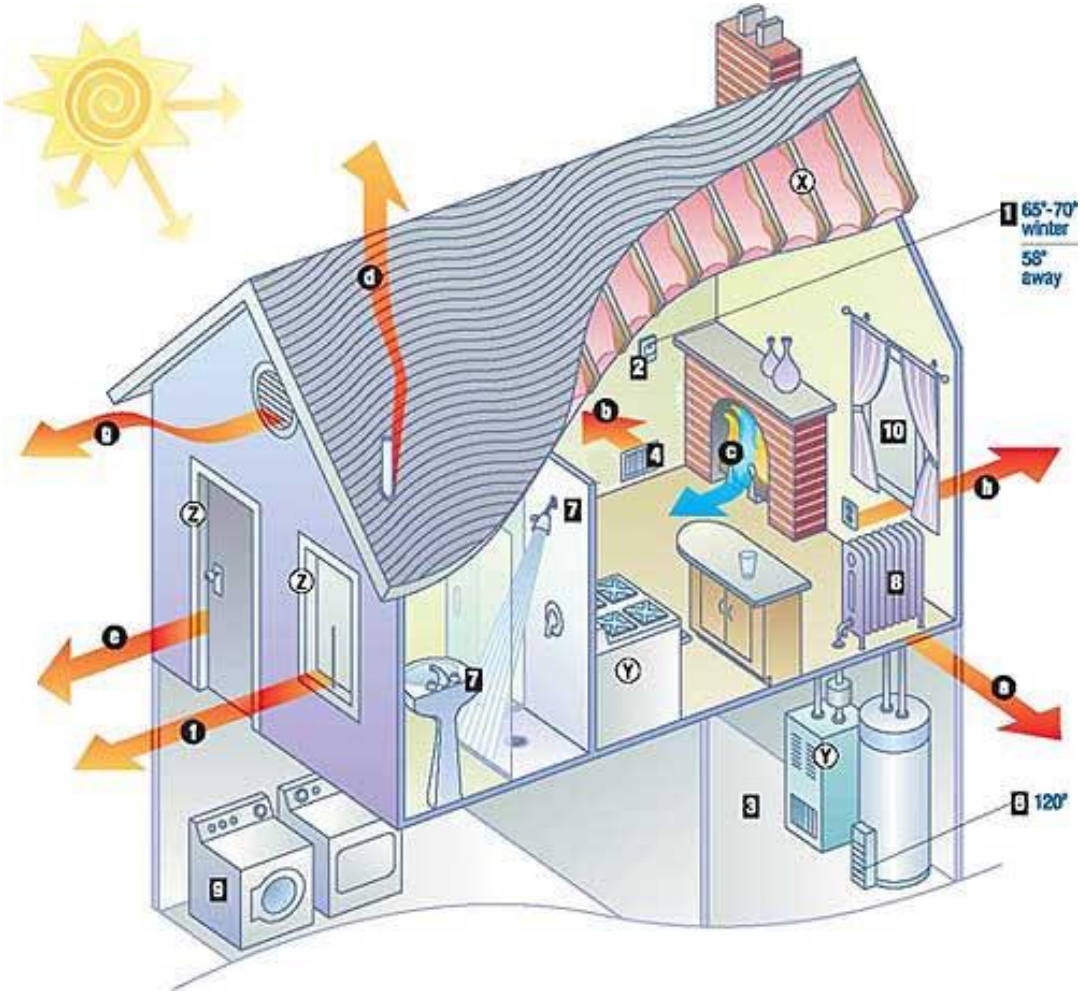






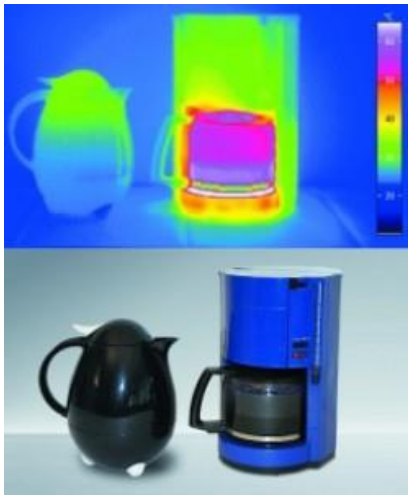


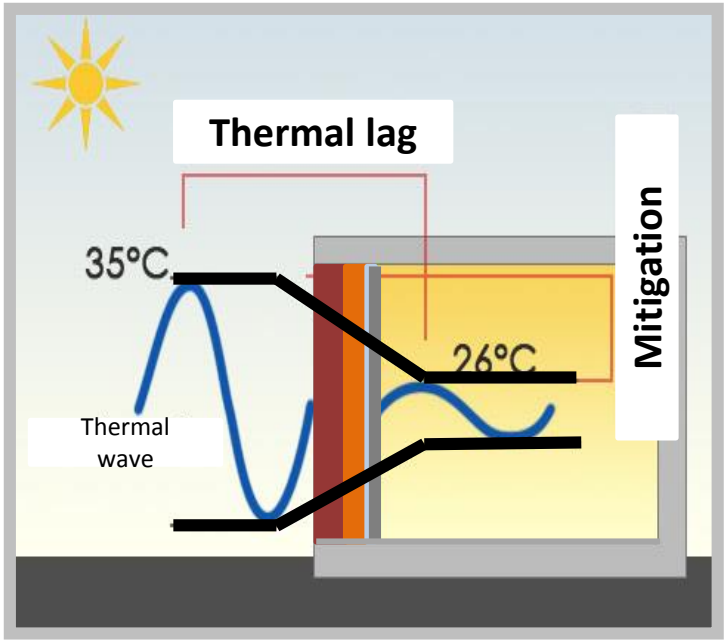
- Improvement of the thermal behavior of the envelope



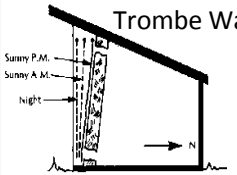
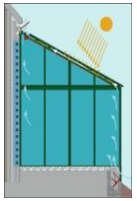
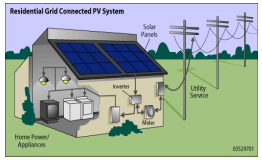
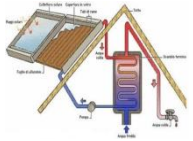
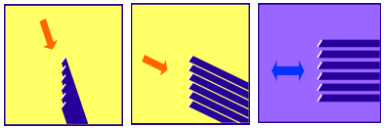
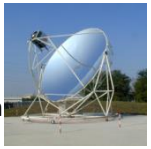
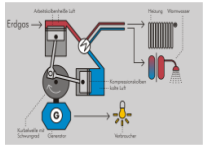
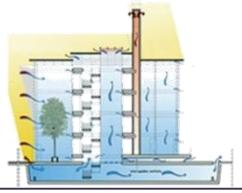
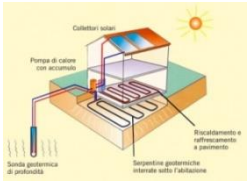
http://www.oxford.gov.uk/PageRender/decEH/Home_Energy_Advice_occw.htm

- Improvement of the thermal insulation coherent with the climate local conditions

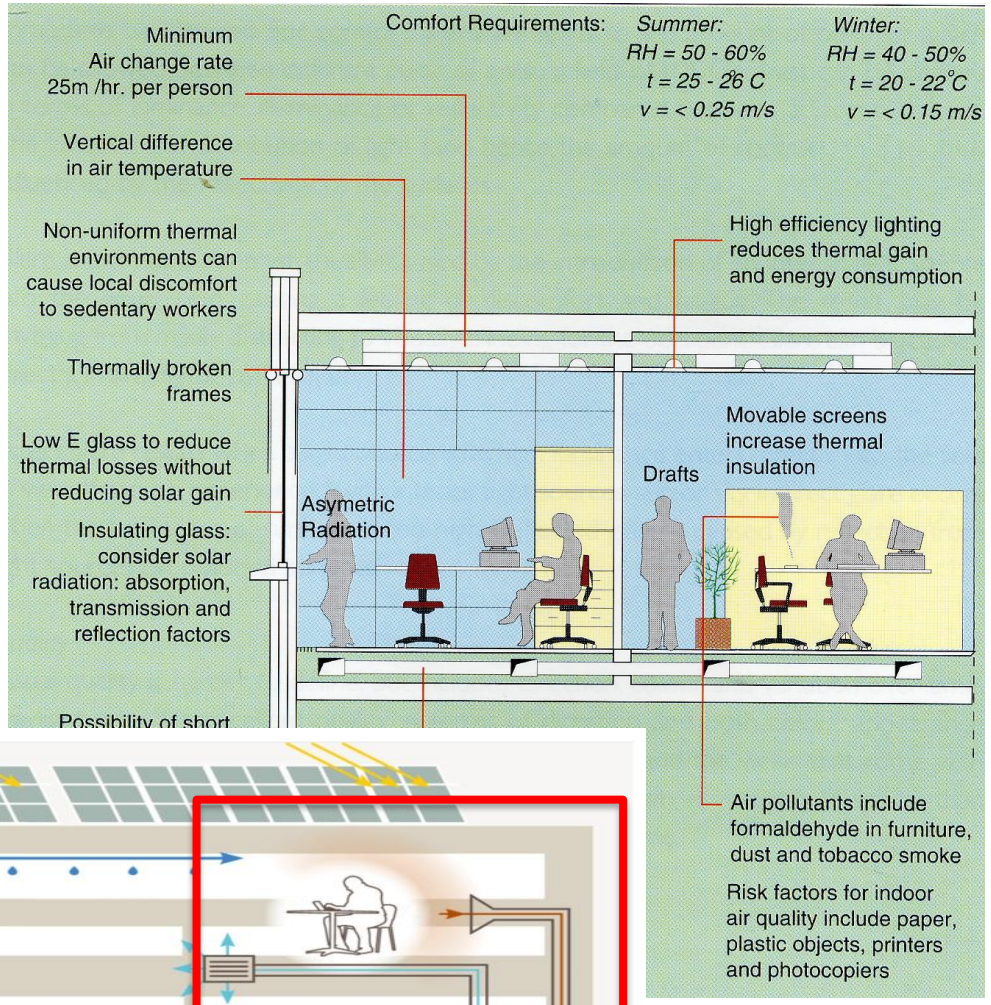


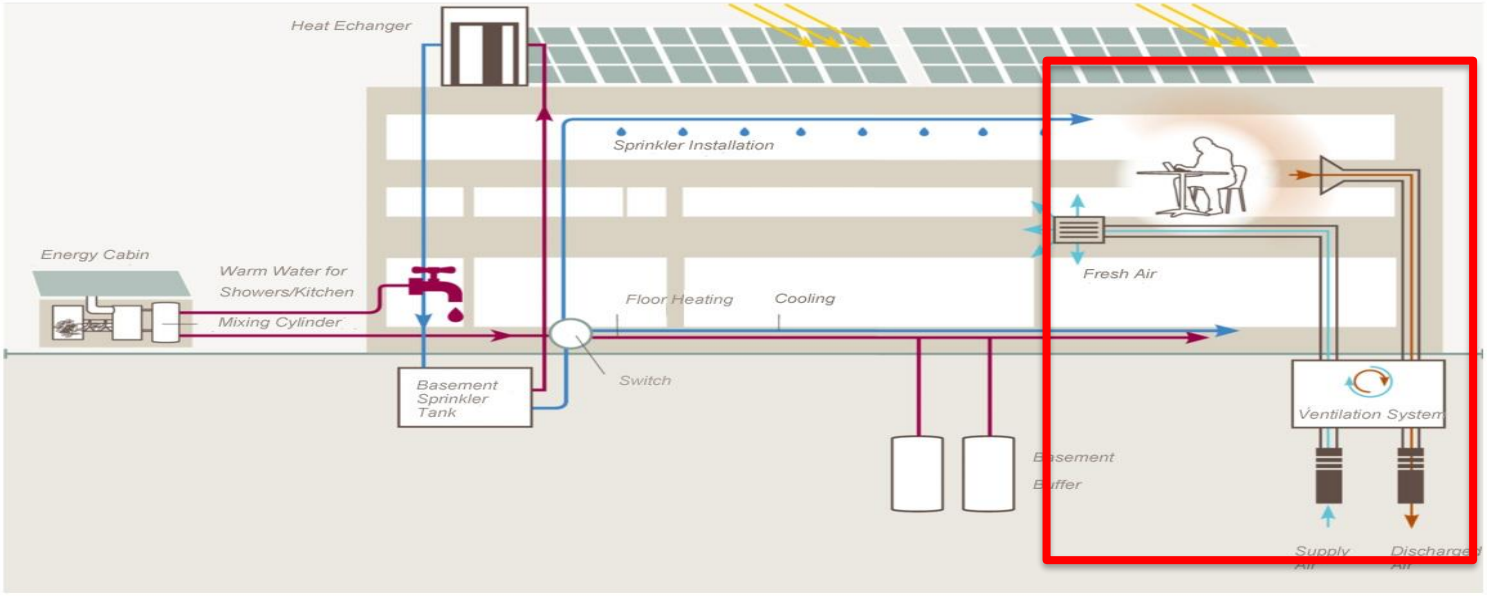


❑ Building integration with energy producing technologies from renewable sources

Source	Passive Systems	Active Systems
	Trombe Walls  Sunspaces 	PV Panels   Solar Panels
	 Natural Daylighting	 Shading
	Static Cogeneration Hybrid Panels 	Dynamic Cogeneration Sterling's Engin  
	Natural Ventilation 	 Wind Generator 
	Tides and wawes 	Hidroelectric Plants 
	 Green Roofs Underground Houses 	Geothermal Sistem 

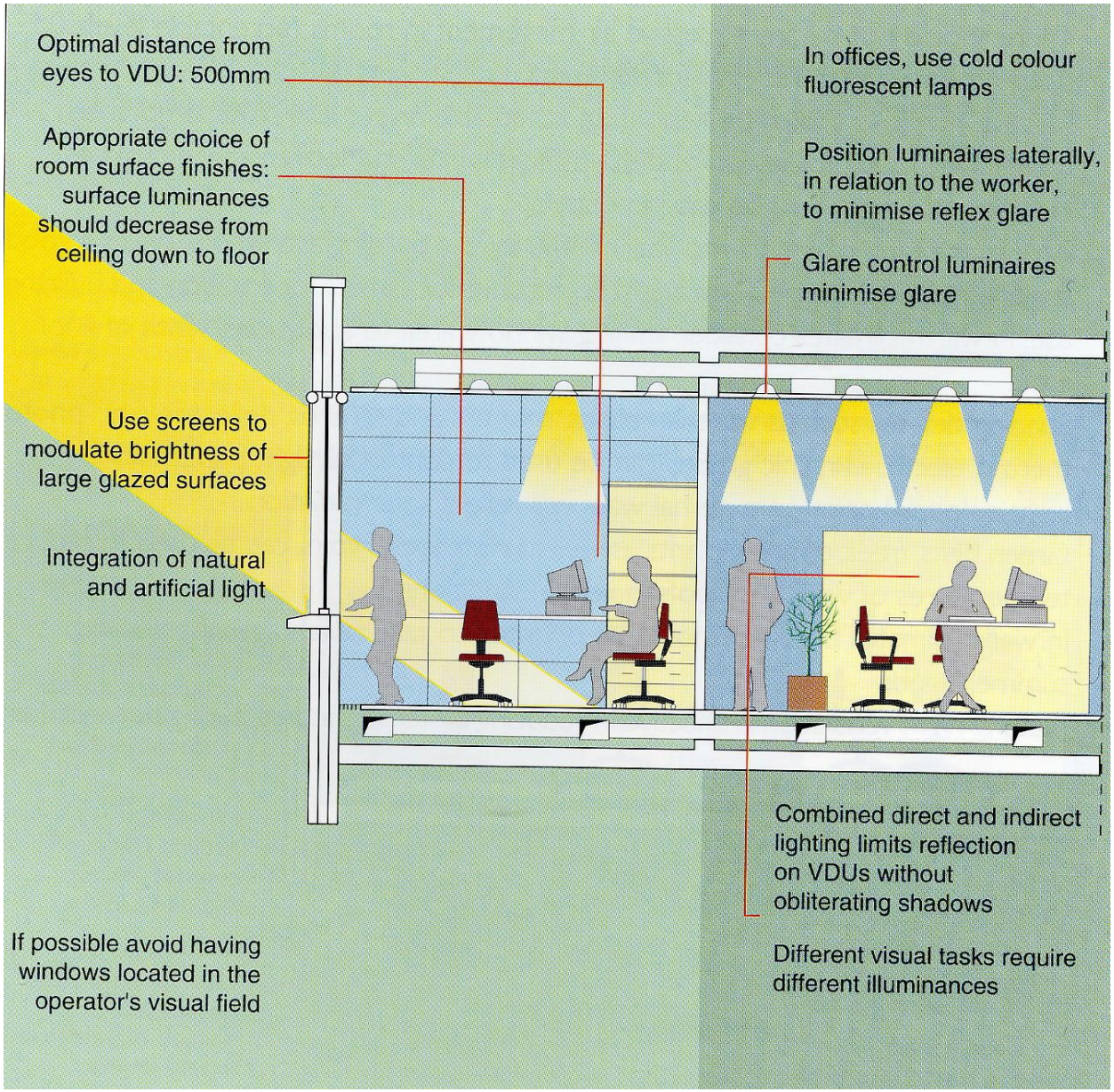
- Building integration with systems for the controlled mechanical ventilation



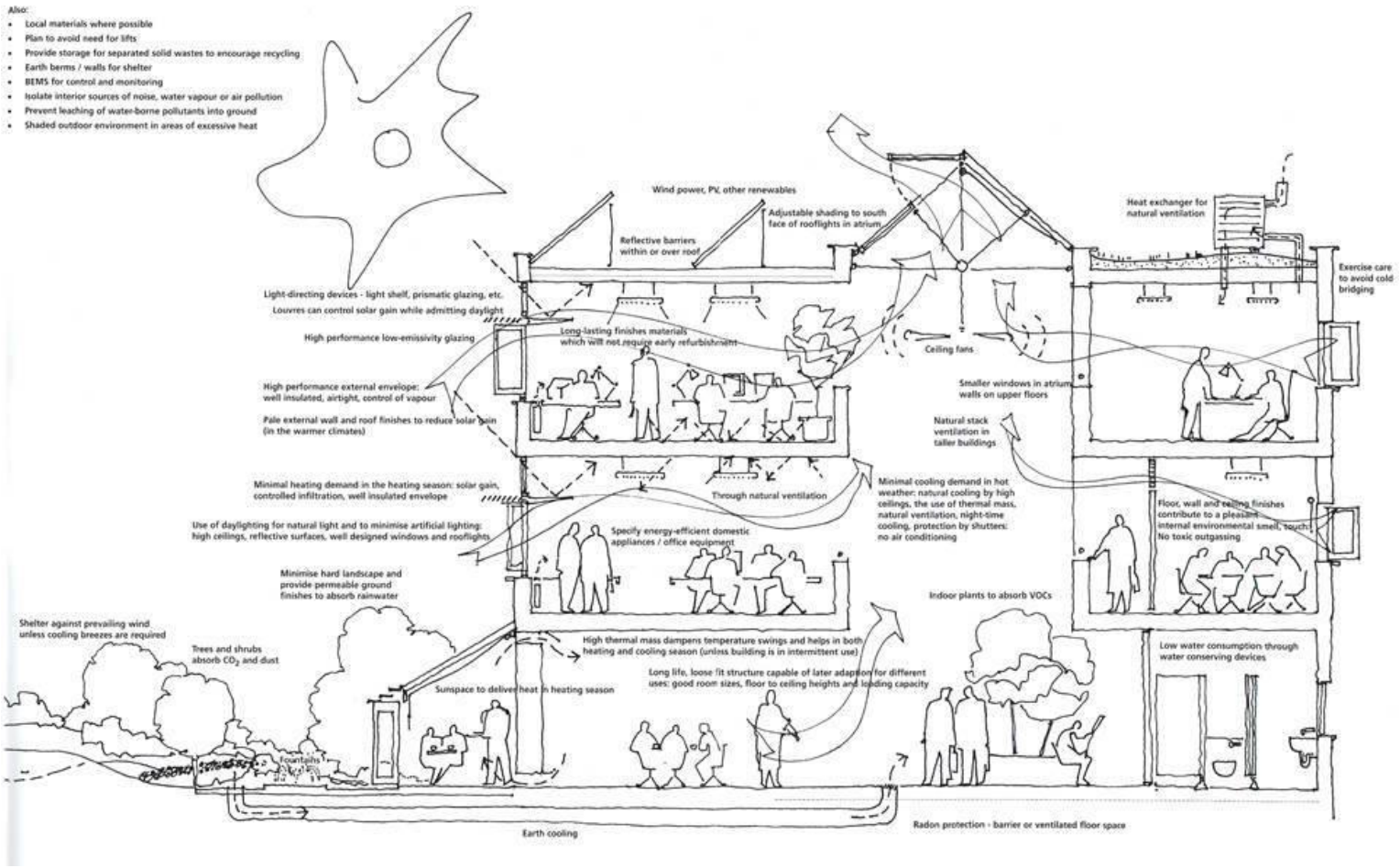


Energy Cycle at juwi Headquarters

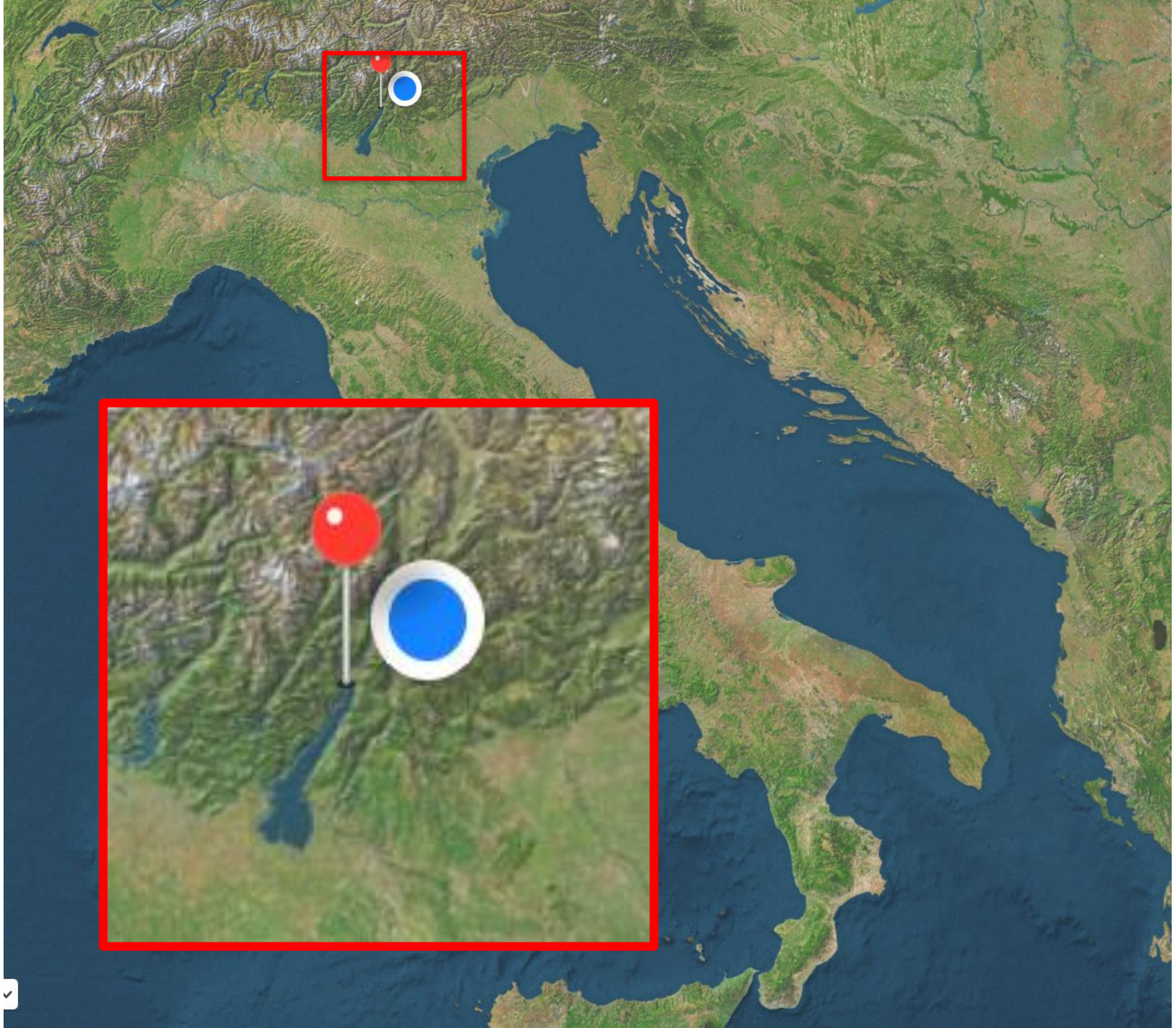
- Improvement of the visual comfort through the management of the daylight



- Introduction of the building automation to manage the heating, ventilation systems and the daylight

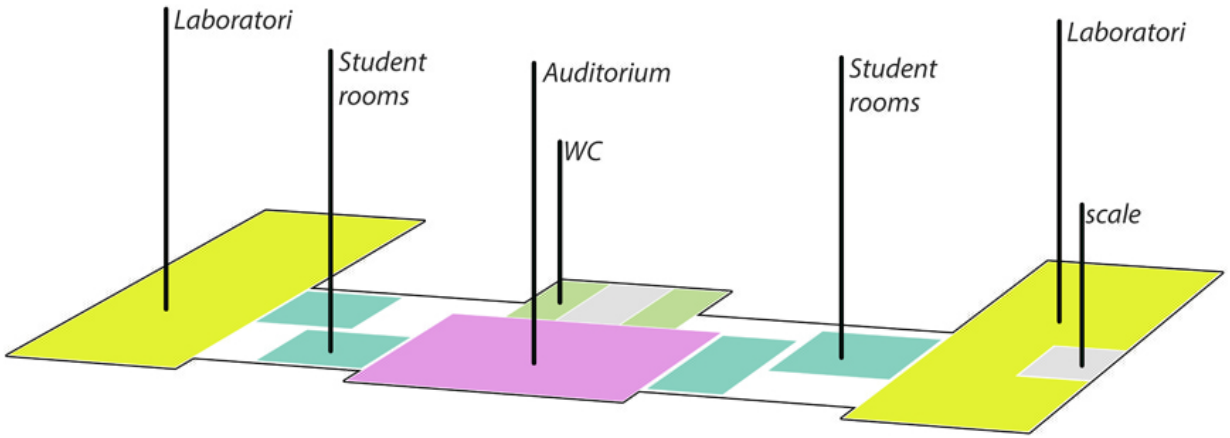


Case Study:
“Floriani” Technical Institute of Riva del Garda

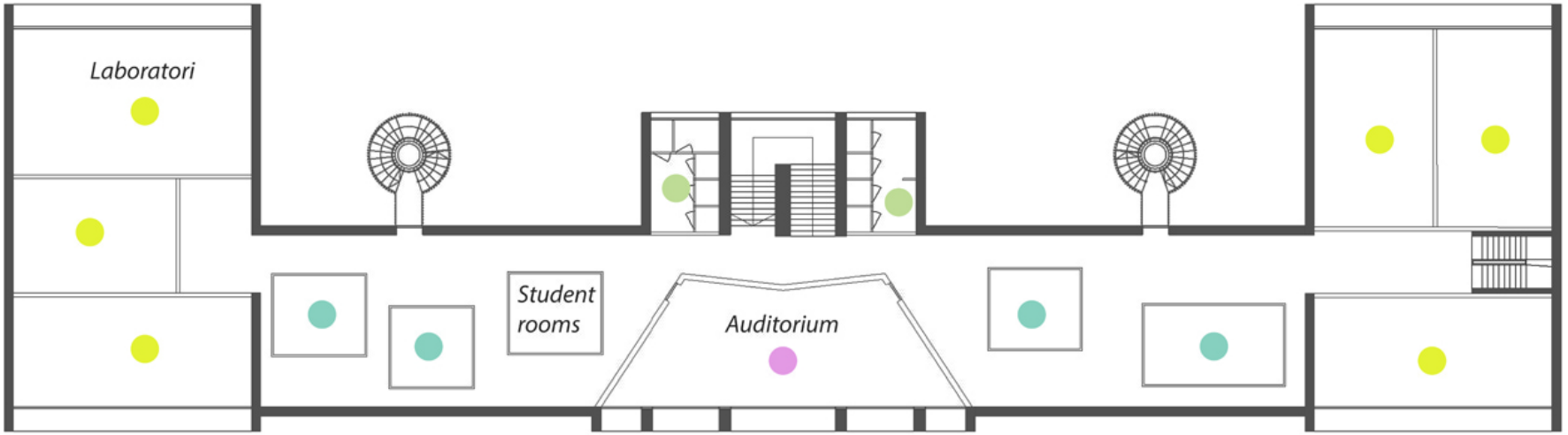



3D

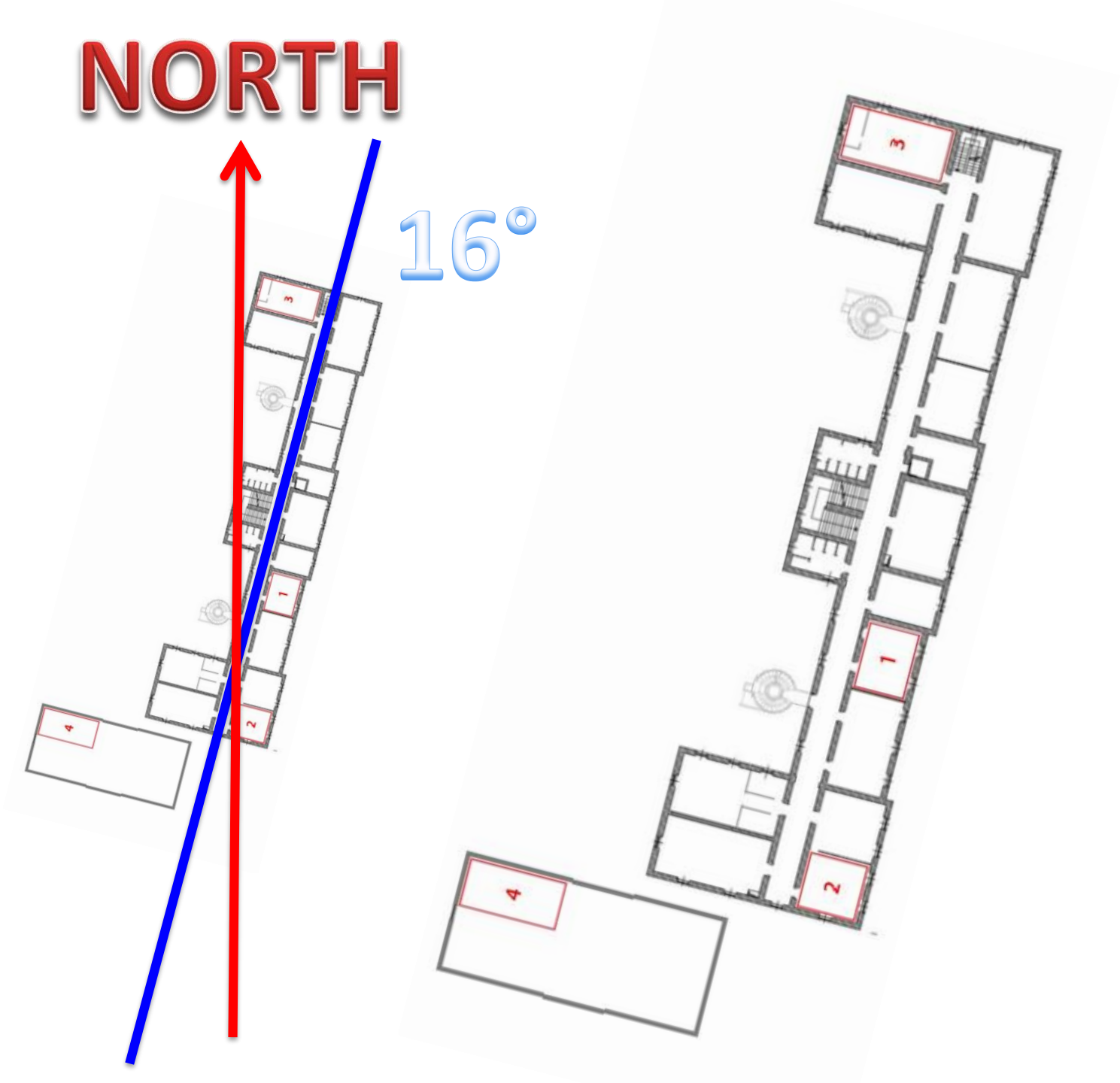
Diagramma delle funzioni - piano sottotetto



Pianta | concept preliminare- piano sottotetto




NORTH
16°


NORTH
16°
3
1
2
4
3
1
2
4

FIRST STEP

Monitoring under the
UNI EN ISO 10551
To evaluate the indoor
comfort level

Used instruments:

- ❑ Hot Wire Anemometer→ air speed
- ❑ Ventilated Psychrometer → Umidity and air temperature
- ❑ Globe thermometer → Radiant Themperature

Calculated Indoor Comfort

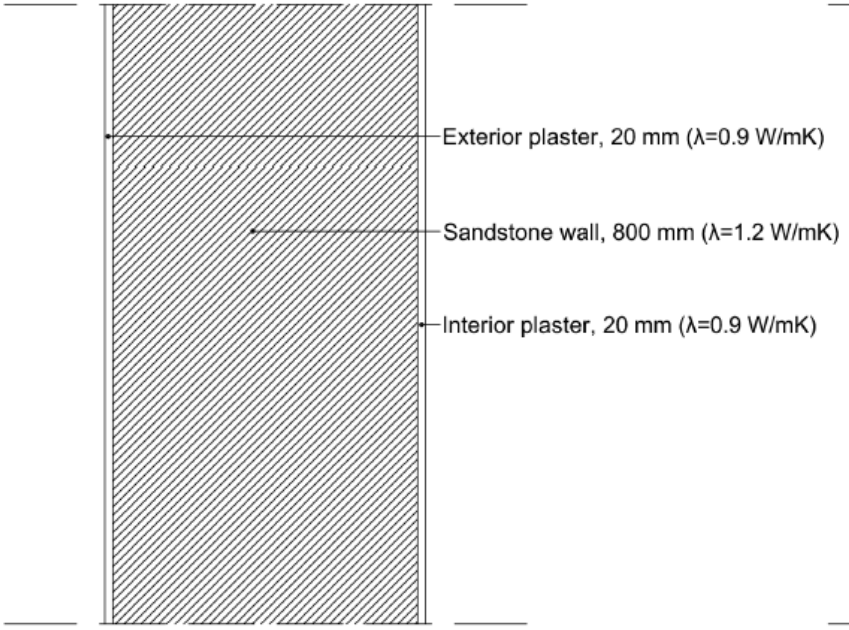
Interview to the Students, Professors and Technicians
for determinating the thermal comfort through the Predicted Mean Vote (PMV)
Basing on the :

UNI EN ISO 7730 (ISO, 1994-2005)	*"Moderate thermal environments – Determination of the PMV and PPD indices and specification of the conditions for thermal comfort"*
EN 15251 (CEN, 2007)	*"Criteria for the Indoor Environment including thermal, indoor air quality, light and noise"*
ASHRAE 55 (ASHRAE , 2004)	*"Thermal Environmental Conditions for Human Occupancy"*

Monitoring of the energy consumption

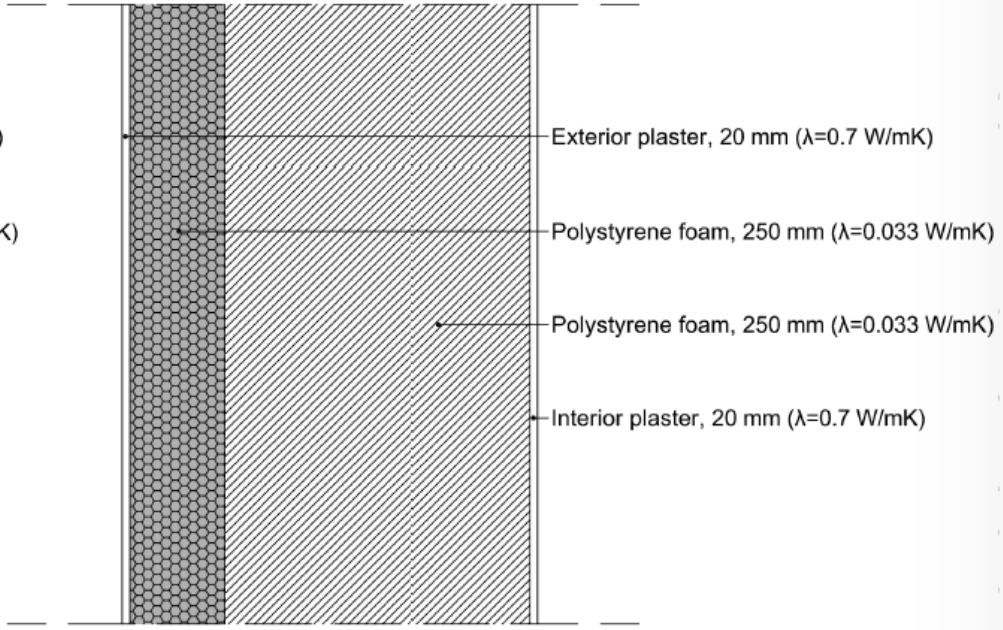
Result: **179 kWh/m² a**

Wall assembly existing building



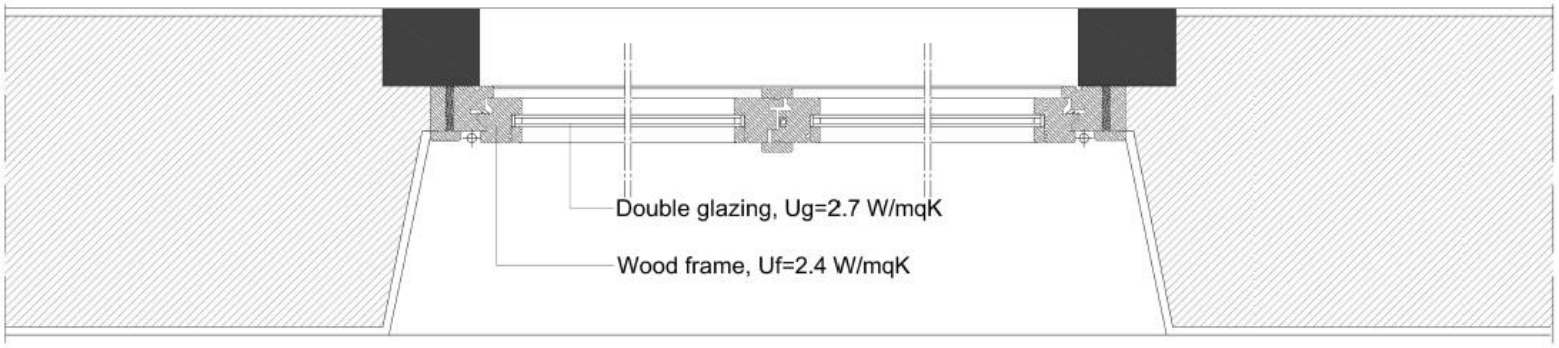
U value = 1.13 W/mqK

Wall assembly retrofit strategy



U value = 0.11 W/mqK

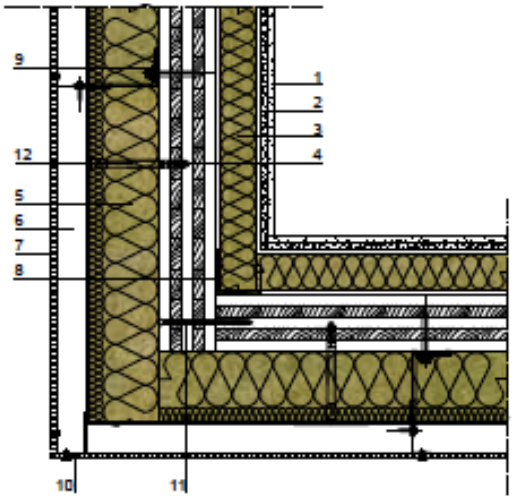
Window installation - existing building



Uw=2.8 W/mqK

Window installation - retrofit strategy

Uw=0.78 W/mqK

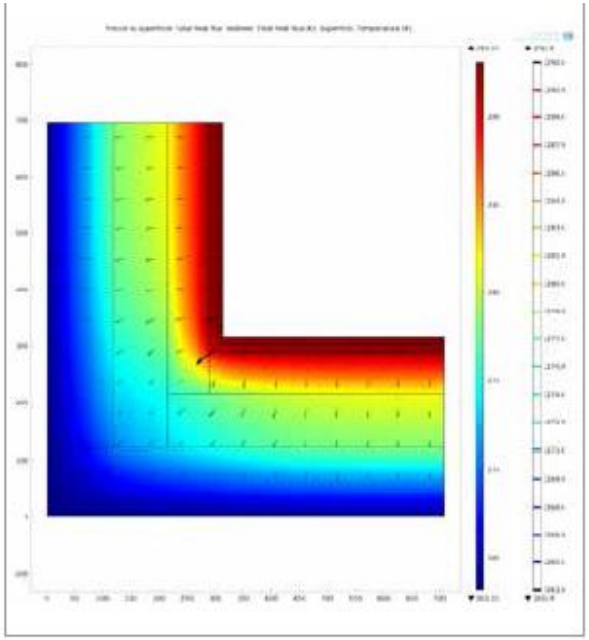


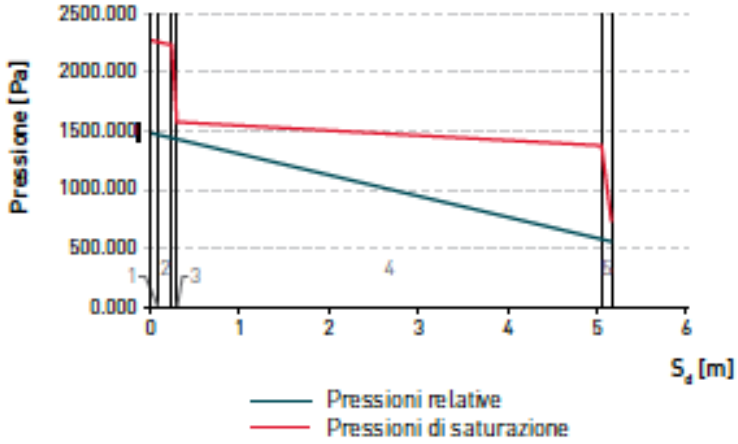
LEGENDA

Parete esterna ventilata

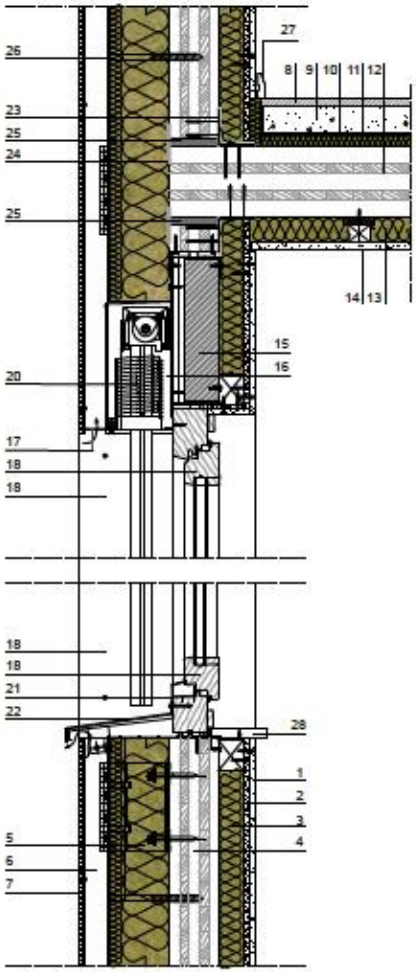
1. Lastra in cartongesso sp.12,5 mm
2. Lastra in gessofibra sp.12,5 mm
3. Struttura a singola orditura metallica in alluminio (intercap. 75 mm) riempita con pannello ROCKWOOL ACOUSTIC 225 PLUS sp. 60 mm
4. Pannello portante in XLam sp. 95 mm
5. Pannello isolante ROCKWOOL VENTIROCK DUO sp. 120mm
6. Sottostruttura in alluminio di supporto al rivestimento / intercapedine ventilata sp. 50mm *
7. Rivestimento a parete ventilata con lastre composite sottili ROCKPANEL®
8. Nastratura per la tenuta all'aria
9. Profilo in alluminio di supporto del rivestimento a parete ventilata
10. Profilo d'angolo di supporto del rivestimento
11. Vite autoforante per legno per giunzione parete-parete
12. Tassello per l'ancoraggio meccanico del pannello isolante

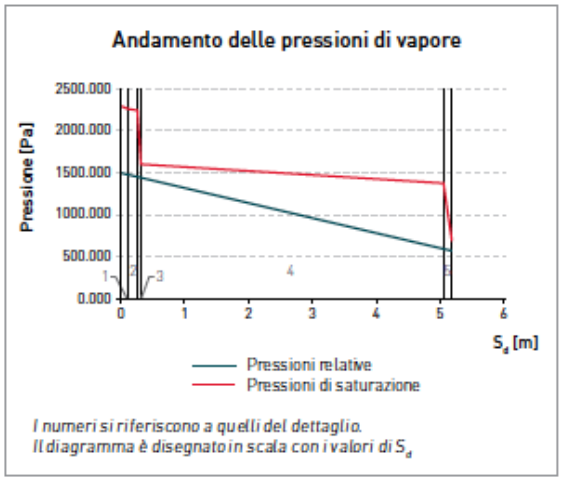
** Da valutare l'utilizzo di elementi di tenuta al vento, viste le peculiarità della tecnologia in legno.*

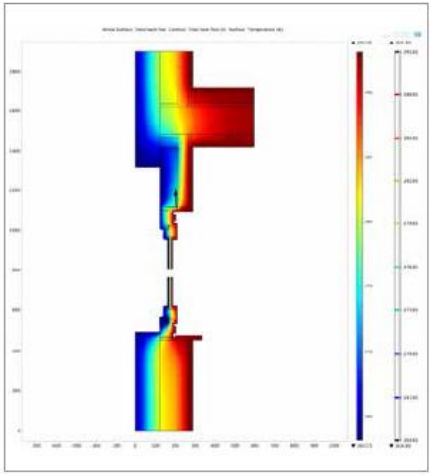




I numeri si riferiscono a quelli del dettaglio.
Il diagramma è disegnato in scala con i valori di S_d







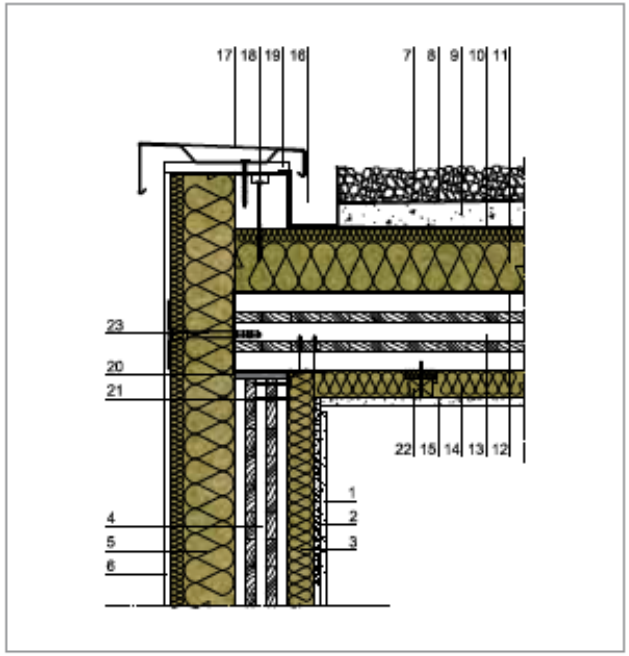
LEGENDA

Parete esterna ventilata

1. Lastra in cartongesso sp. 12,5 mm
2. Lastra in gessofibra sp. 12,5 mm
3. Struttura a orditura in legno riempita con pannello ROCKWOOL ACOUSTIC 225 PLUS sp. 50 mm
4. Pannello portante in XLam sp. 95 mm
5. Pannello isolante ROCKWOOL VENTIROCK DUO sp. 120 mm
6. Sottostruttura in alluminio di supporto al rivestimento / intercapedine ventilata sp. 50 mm *
7. Rivestimento a parete ventilata con lastre composite sottili ROCKPANEL

Solaio intermedio

8. Pavimento in legno duro sp. 15 mm
9. Massetto alleggerito per impianti sp. 60 mm
10. Telo per il contenimento del getto del massetto
11. Pannello ROCKWOOL STEPROCK LD per isolamento acustico anticalpestio sp. 20 mm
12. Struttura portante in XLam sp. 140 mm
13. Pannello ROCKWOOL 220 sp. 50 mm
14. Lastra in gessofibra 12,5 mm
15. Taglio termico del cassonetto sp. 80 mm
16. Cassonetto zincato per frangisole con tavola anteriore e isolamento posteriore
17. Rete di protezione anti-insetti e gocciolatoio profilato in lamiera
18. Serramento in abete
19. Elemento di chiusura perimetrale in legno
20. Frangisole a lamelle orientabili
21. Protezione metallica del serramento
22. Scossalina per l'allontanamento dell'acqua piovana dal piano di facciata
23. Angolari metallici di giunzione dei pannelli e nastratura per la tenuta all'aria
24. Nastratura esterna delle giunzioni dei pannelli XLam
25. Materiale per taglio acustico
26. Tassello per l'ancoraggio meccanico del pannello isolante
27. Battiscopa
28. Controdavanzale



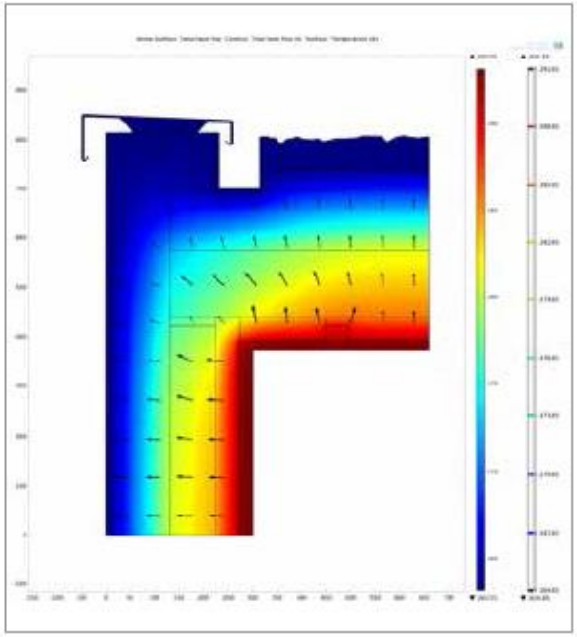
LEGENDA

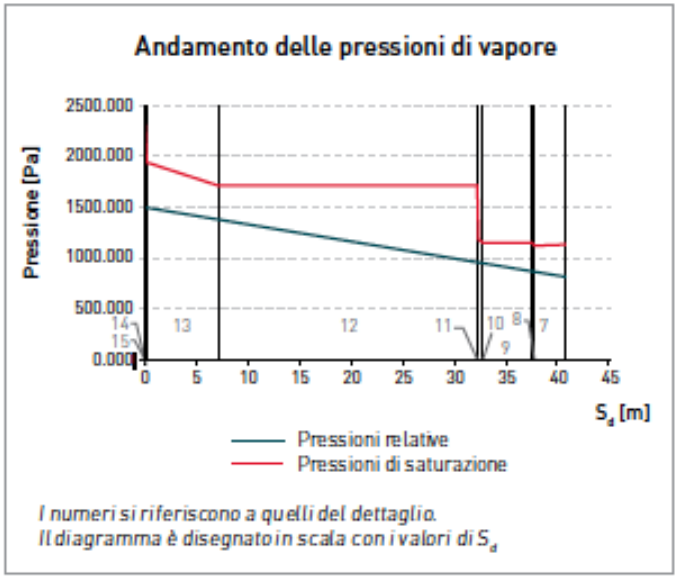
Parete esterna intonacata

1. Lastra in cartongesso sp. 12,5 mm
2. Lastra in gessofibra sp. 12,5 mm
3. Struttura a orditura in legno riempita con pannello ROCKWOOL ACOUSTIC 225 PLUS sp. 50 mm
4. Pannello portante in XLam sp. 95 mm
5. Pannello isolante ROCKWOOL FRONTROCK MAX E sp. 120 mm
6. Finitura per cappotto su rasante con rete portaintonaco

Solaio di copertura

7. Ghiaia sp. 60 mm
8. Guaina impermeabile traspirante
9. Soletta debolmente armata per pendenza sp. 40 mm minimo
10. Telo di contenimento del getto della soletta
11. Pannello ROCKWOOL HARDROCK MAX sp. 120 mm
12. Elemento di controllo del vapore
13. Pannello portante in XLam sp. 140 mm
14. Pannello ROCKWOOL 220 sp. 50 mm
15. Lastra in cartongesso sp. 12,5 mm
16. Canalina di drenaggio delle acque meteoriche
17. Scossalina in lamiera metallica sagomata
18. Segato perimetrale
19. Tavola di chiusura e supporto per la scossalina
20. Materiale per taglio acustico
21. Angolari metallici di giunzione dei pannelli e nastratura per la tenuta all'aria
22. Intelaiatura in legno di supporto del controsoffitto con elementi in materiale resiliente per evitare trasmissione di vibrazioni
23. Tassello per l'ancoraggio meccanico del pannello isolante





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Il diagramma è disegnato in scala con i valori di S_d

Test of the deigned solutions through the Passive House Planning Package (PHPP software) to reduce the annual heating demand (< 20 kWh/m^{2}y) and improve the living comfort of the school building.

Previsional consumption

21,4 kWh/m^{2}a

Conclusion

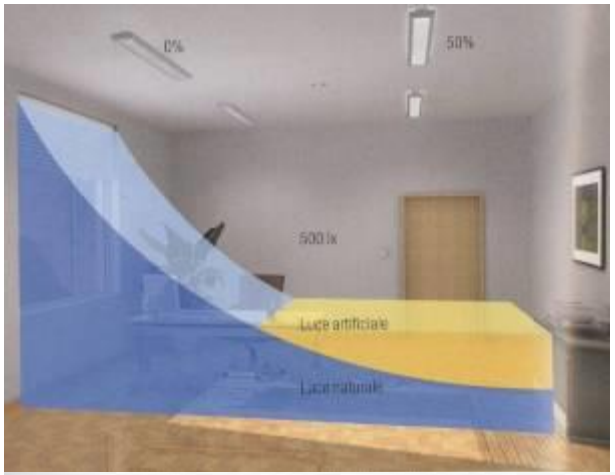
Using the criteria of the Bioclimatic architecture combined with the Passivehaus principles we have been able to refurbish the building to improve the indoor environmental quality and at same time to reduce the energy consumption.

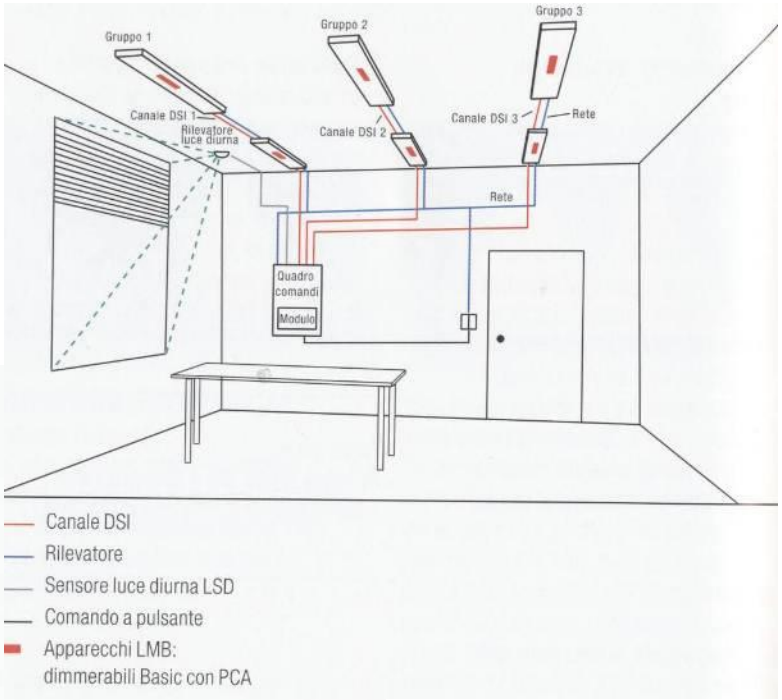
The future development of the research will be how to integrate the building with the “building automation” to manage not only the heating system, but also the daylighting to reduce to the minimum the artificial light and to manage better the energy consumption.

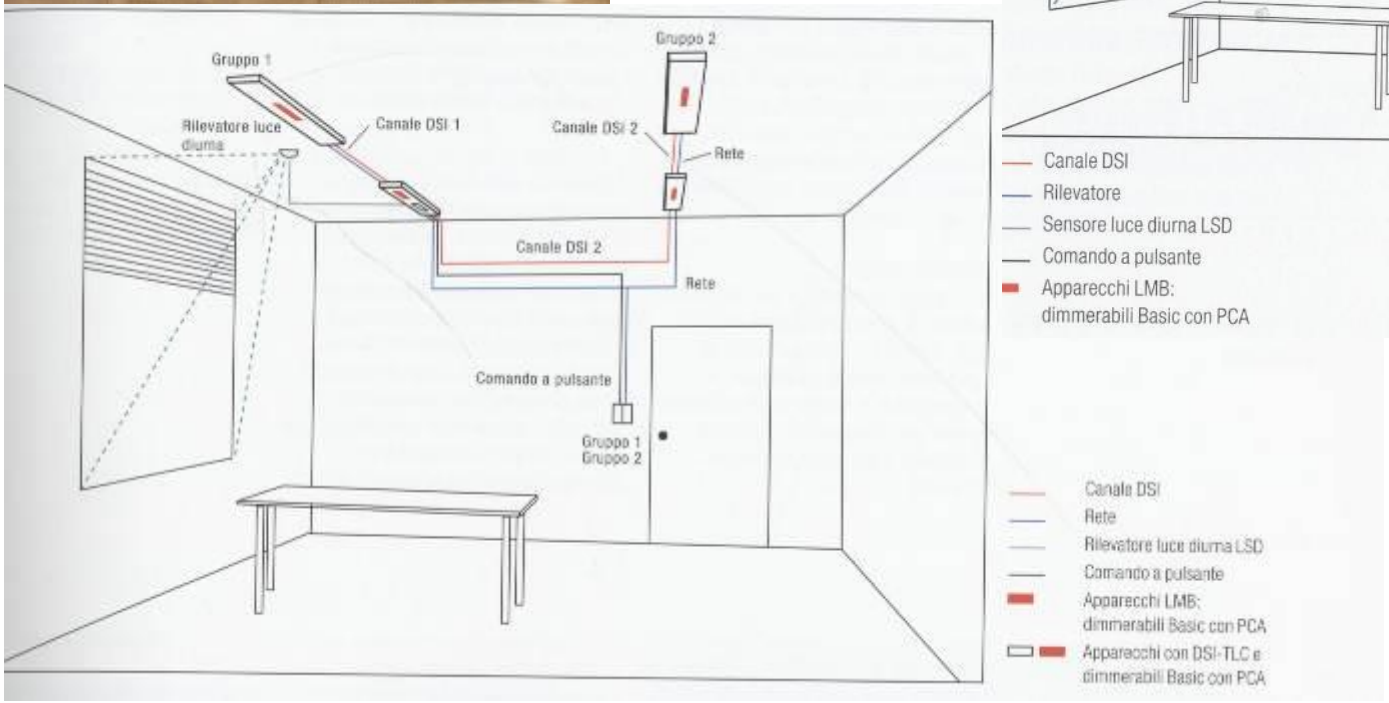
Thank you for the attention

antonio.frattari@icloud.com

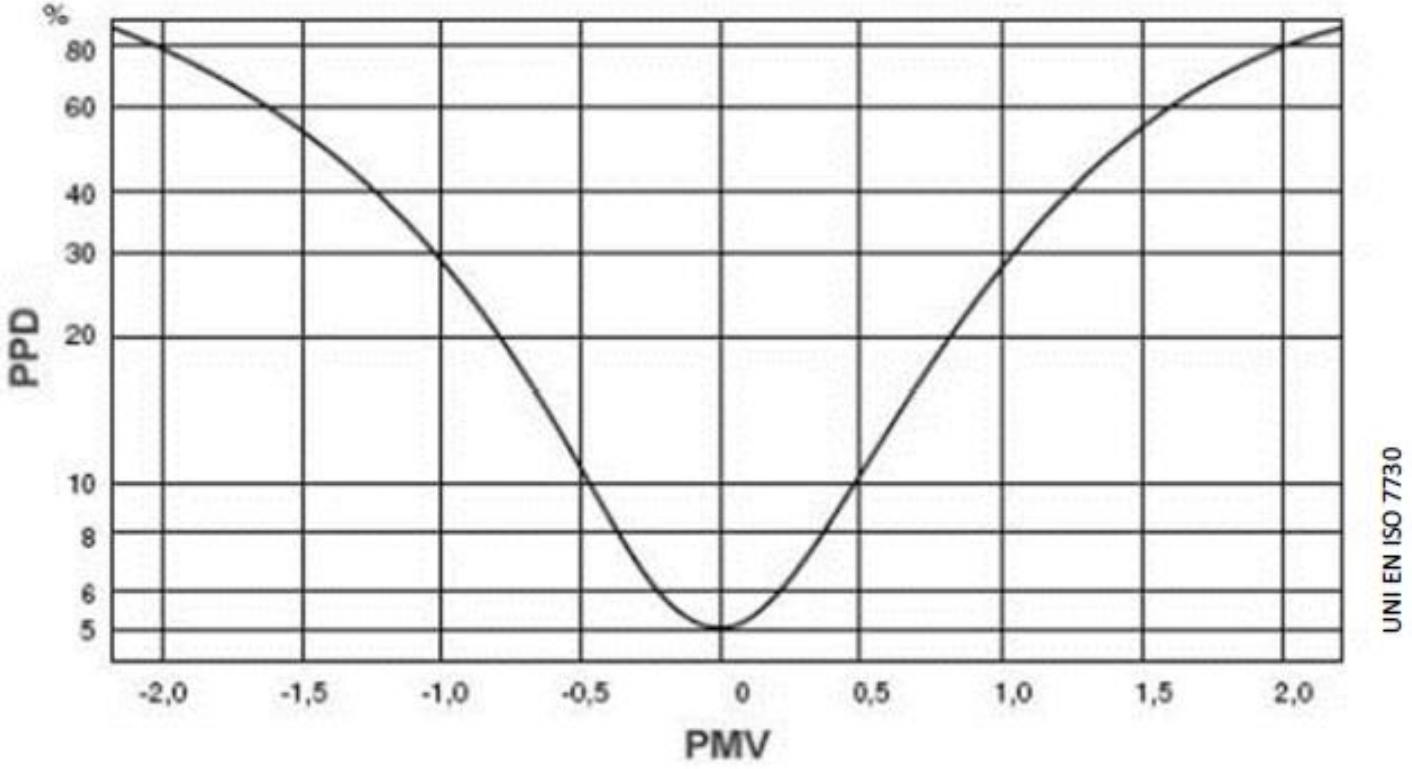
Building automation and daylight







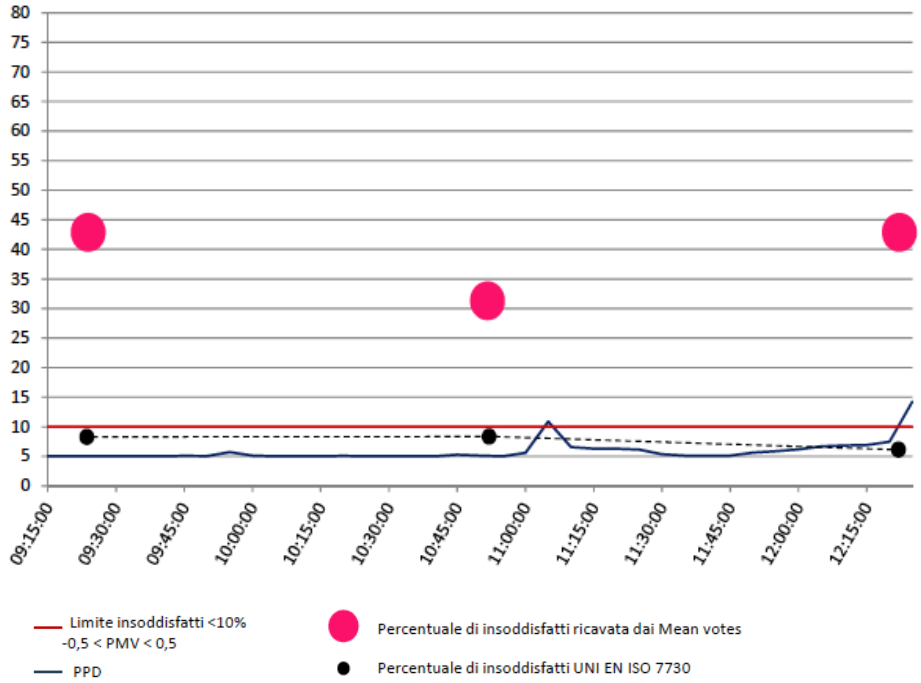
LINK PMV AND PPD



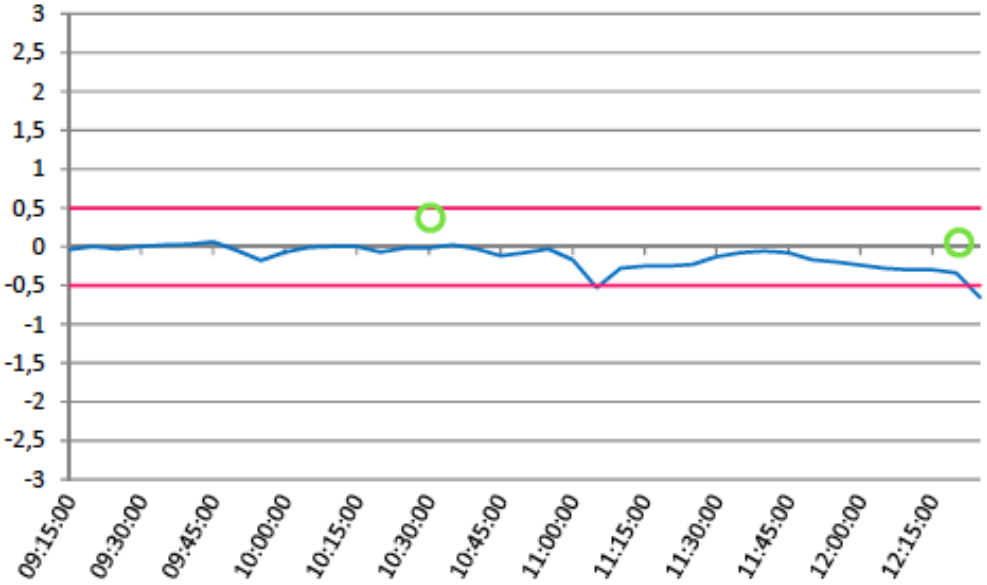
$$PPD = 100 - 95 \times \exp\left(-0{,}03353 \times PMV^4 - 0{,}2179 \times PMV^2\right)$$

PMV (Predicted Mean Vote)

PPD (Predicted Percentage of Dissatisfied)



PMV (Predicted Mean Vote)



PPD (Predicted Percentage of Dissatisfied)