

edilportale[®] TOUR 2014

La mostra convegno in 18 tappe
su Efficienza energetica,
Luce e Ventilazione naturale,
Acustica e Active House.

in collaborazione con **VELUX[®]**

partner **SCHÜCO** **ROCKWOOL** **KNAUF**

Roma, 15 maggio 2014

**Il protocollo Active House in clima mediterraneo:
ricerche e sperimentazioni sviluppate nel laboratorio VeluxLAB al Politecnico di Milano**

Marco Imperadori – Politecnico di Milano



POLITECNICO DI MILANO

VELUX® lab



Non è la specie più forte o la più intelligente a sopravvivere ma quella che si adatta meglio al cambiamento.

Charles Darwin, L'origine delle Specie, 1859





Net Zero Energy Emissions

Net Zero Energy Emissions

Net Zero Source Energy

Net Zero **Site Energy**

Net Zero **Source Energy**

Net Zero Site Energy

Net Zero **Source Energy**

Net Zero Site Energy

Net Zero **Energy Costs**

Net Zero **Energy Emissions**

Net Zero Energy Costs

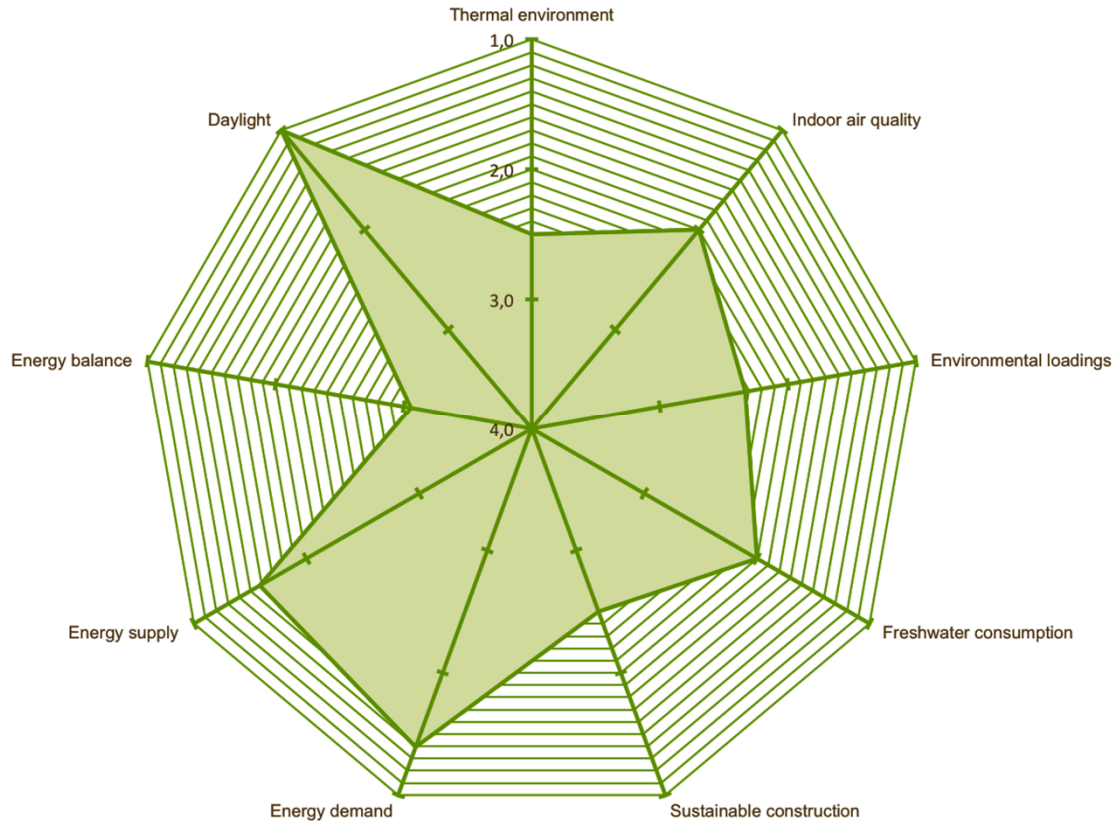
Net Zero **Energy Emissions**

Net Zero **Energy Costs**

Net Zero Site Energy



Dati Radar

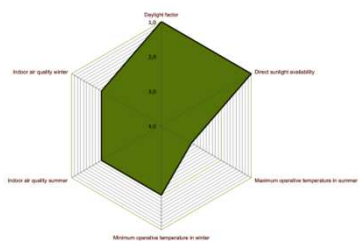


activehouse.INFO
NETWORK AND KNOWLEDGE SHARING

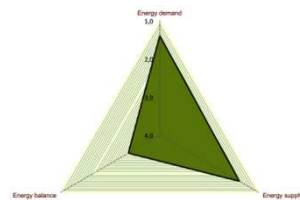
Primo edificio italiano "Net Zero Energy" inserito in un campus universitario

Prima Active House registrata in Italia

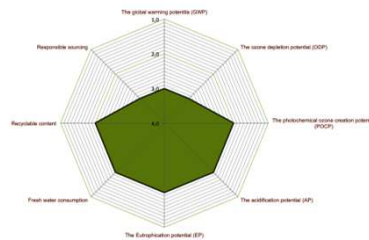
Comfort



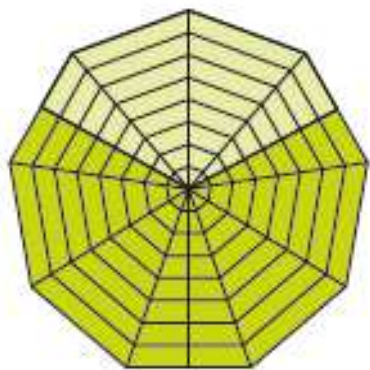
Energia

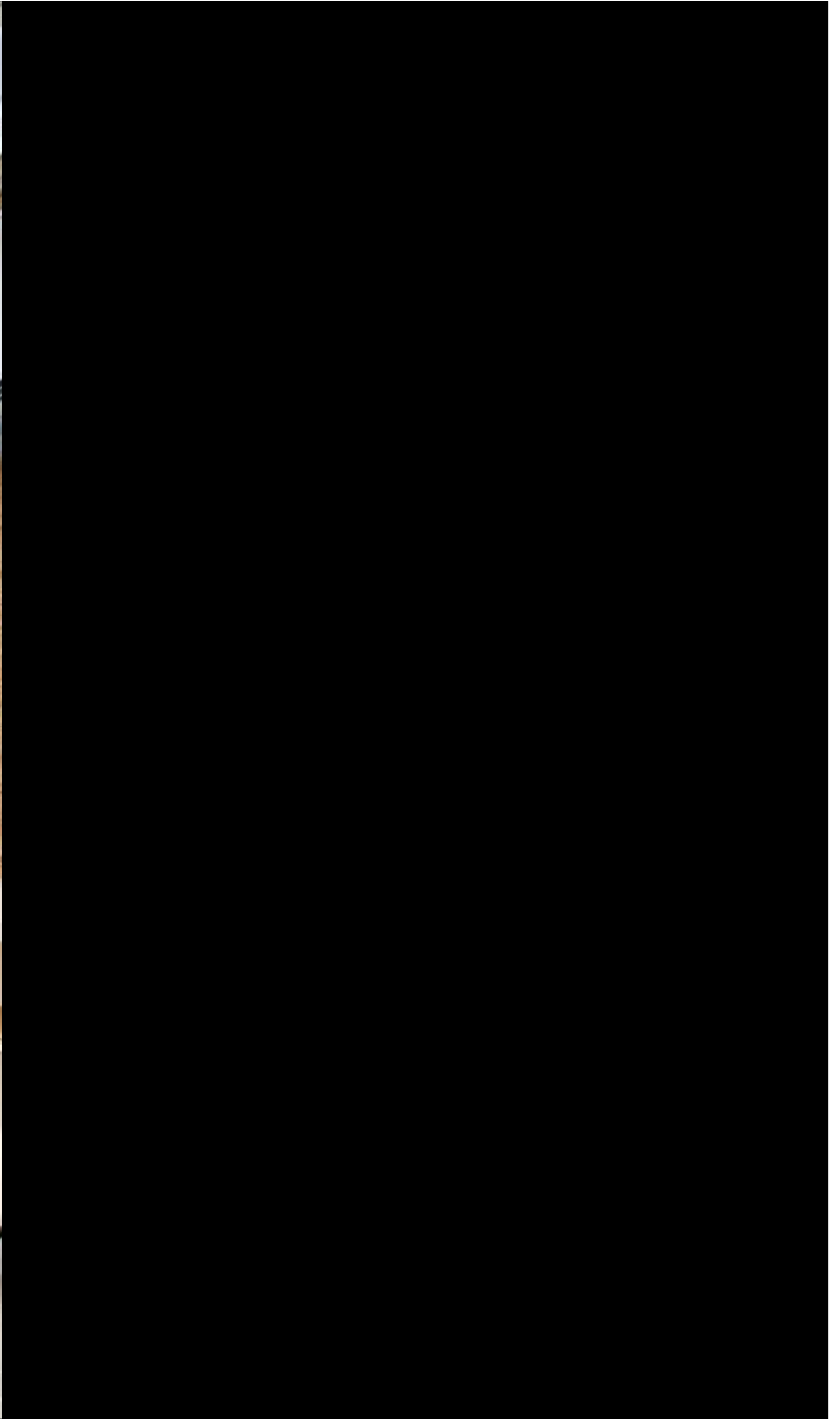


Ambiente



COMFORT





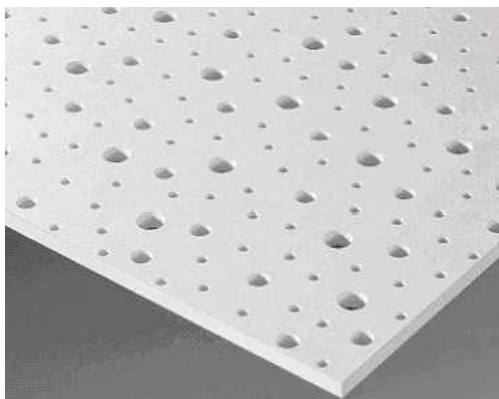
Componenti



Struttura in acciaio, solaio a pavimento in lamiera grecata e getto collaborante



Iper-isolamento in poliuretano, polistirene, in lana minerale e lana di legno



Pannello in gesso e zeolite KNAUF-CLEANEO



Vetrare triplo vetro basso emissivo. Serramento a taglio termico SCHÜCO



Finestre tetto VELUX ad alte prestazioni

Isolamento copertura

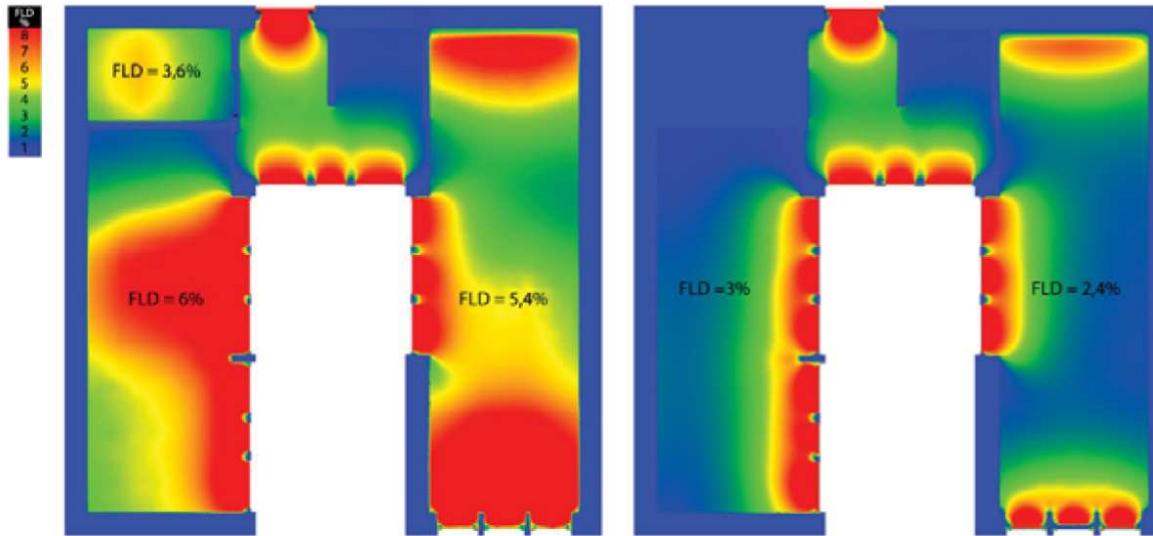


Controsoffitto "Knauf-Cleaneo"

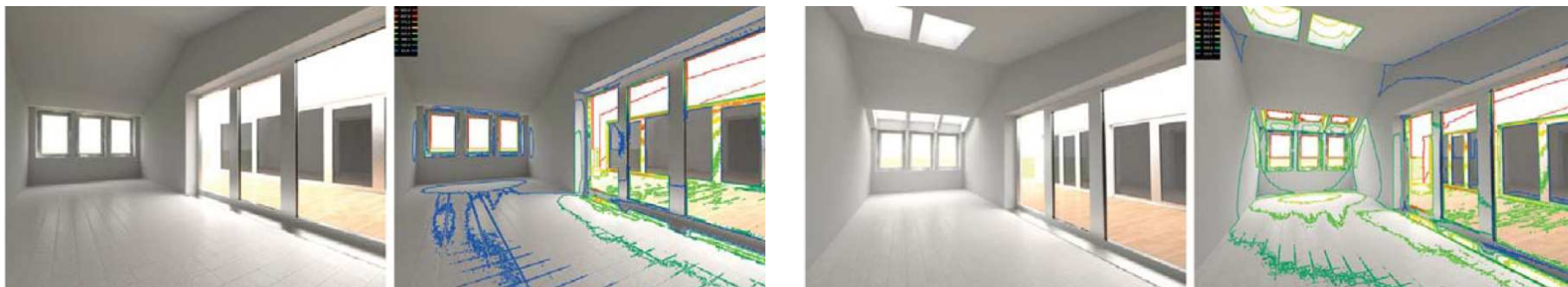




Analisi illuminotecnica

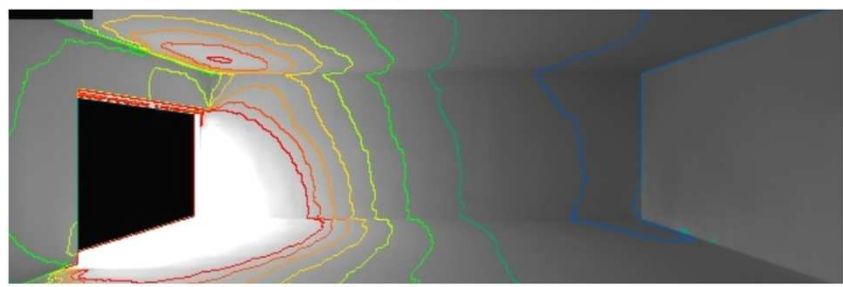


Fattore medio di luce diurna e Rapporto aeroilluminante. Nella situazione reale (a sinistra), la luce zenitale assicura alti valori di FLD e di RAI (0,10 minimo - Comune di Milano), rispetto alla situazione di studio (a destra) priva di aperture zenitali.

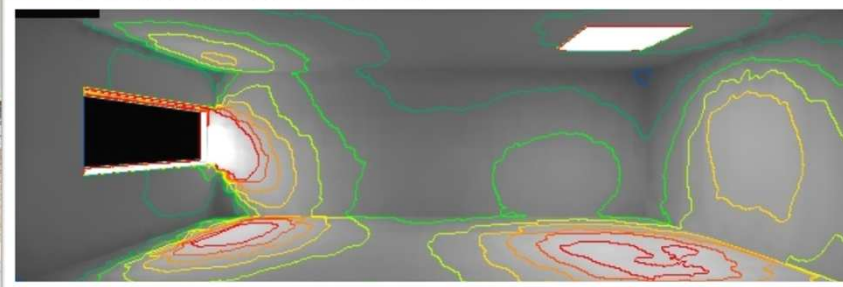


Luminanza. Il confronto della luminanza (21 Giugno - h 12:00) fra la situazione reale (in presenza di lucernari) e di studio (in assenza di lucernari), mostra come la luce zenitale renda i valori più omogeneamente distribuiti all'interno dei locali. Inoltre, il fenomeno dell'abbagliamento è ben controllato dai sistemi di schermatura posti all'esterno.

Distribuzione della luce con aperture zenitali



6m² superficie vetrata
154 lux medi



4m² superficie vetrata (-33%)
225 lux medi (+45%)

Agua de MARMORE



Team:

Luigi Ferrario
Camilla Massironi
Alice Schinella



Fig. 3.4.57

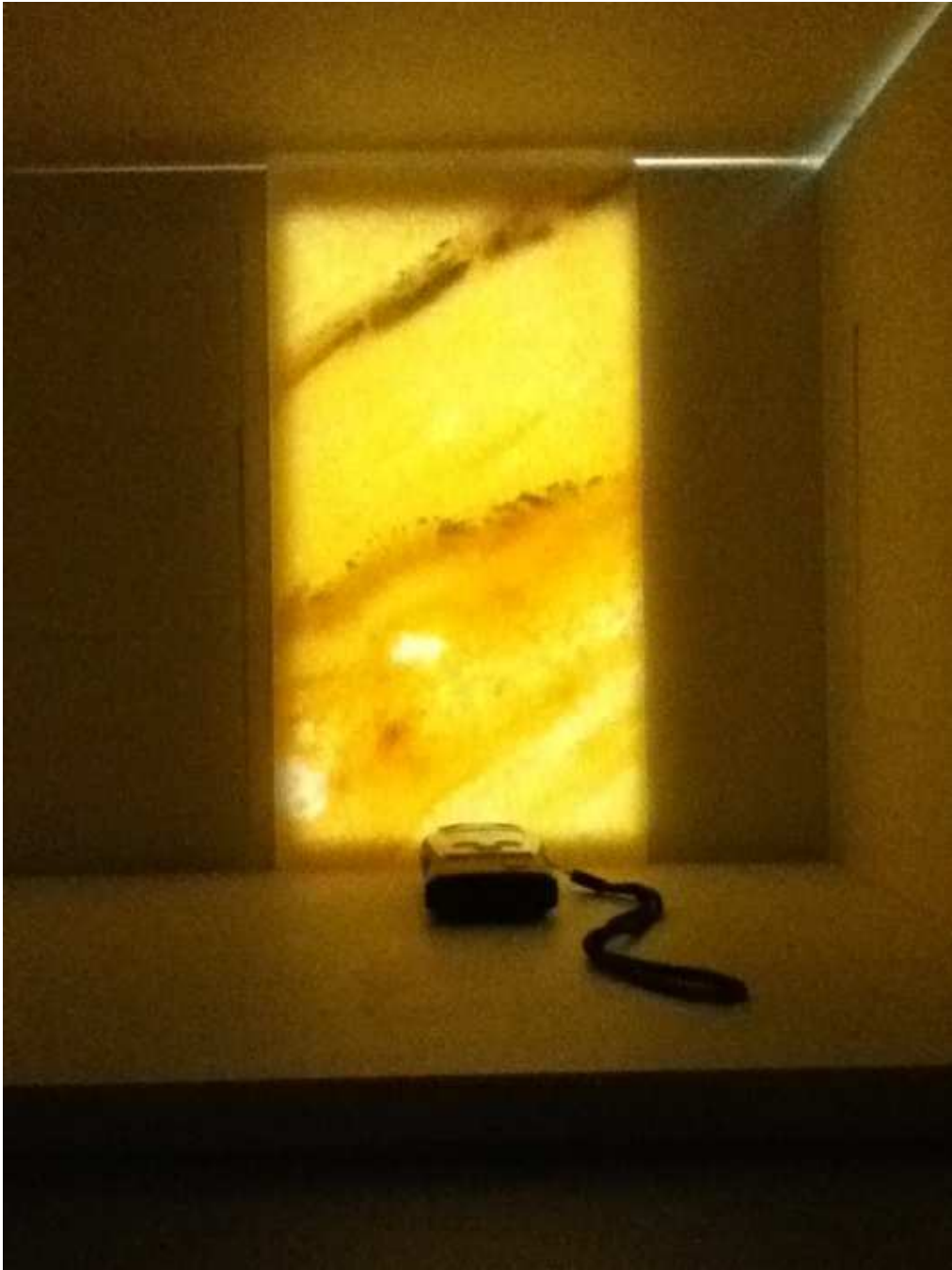


Fig. 3.4.58



Fig. 3.4.59





Supreme Court Singapore (Norman Foster)

Facciata Taltos

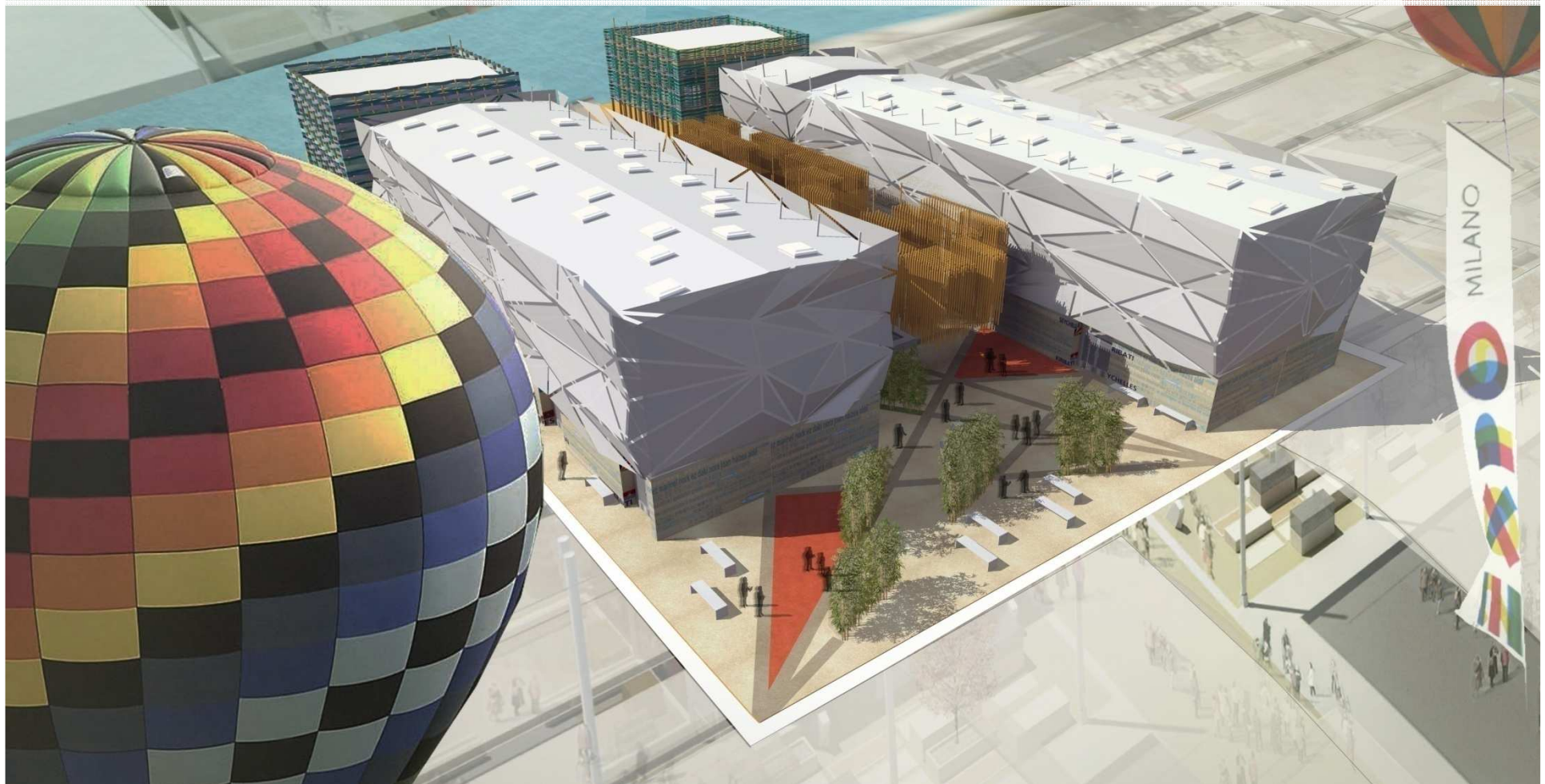


Fig 34.77

Fig 34.78

Il Cluster "Island, sea and food"

RYTHM OF DISCOVERY



Team:

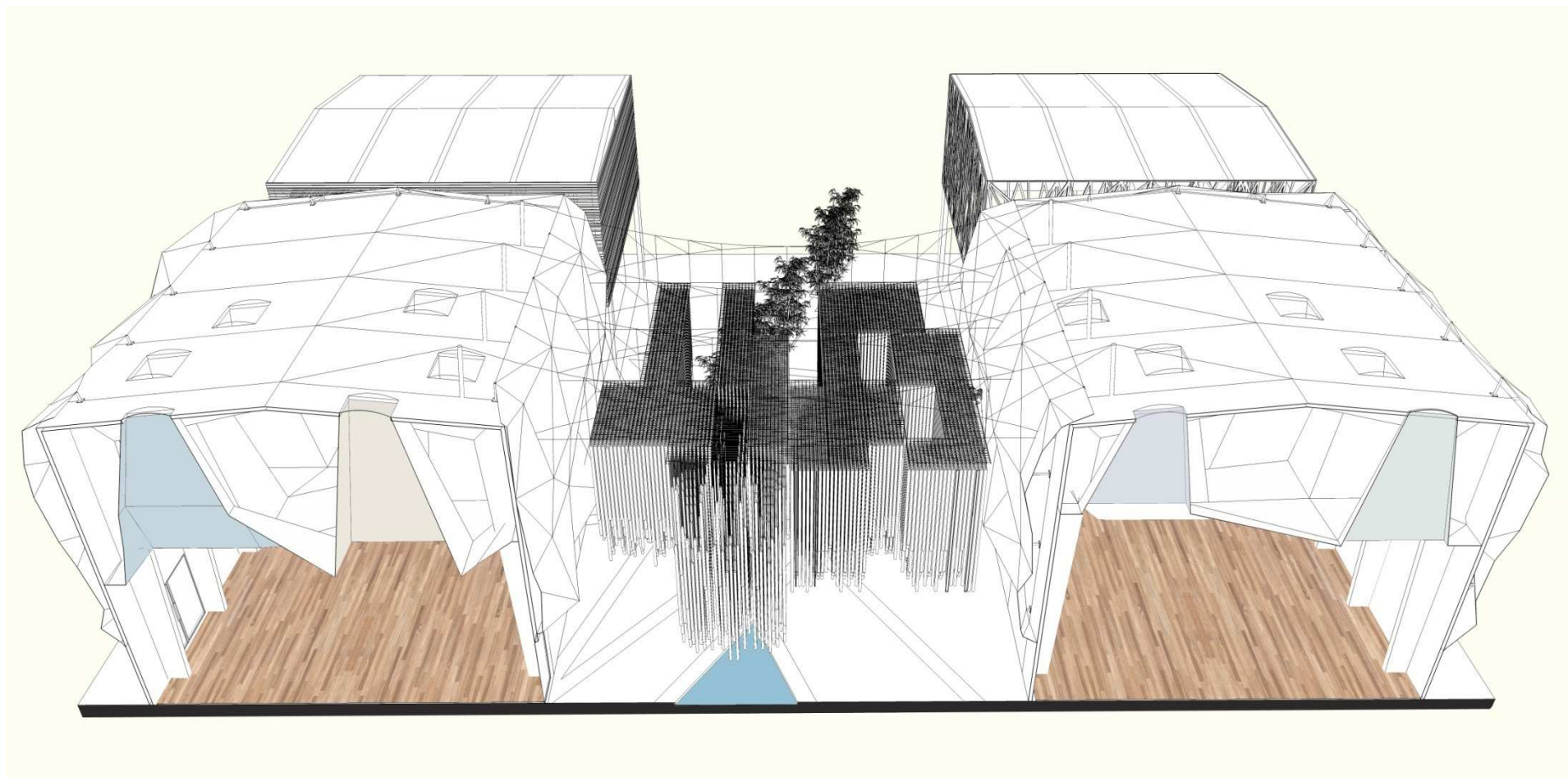
Giuliana Iannacone
Andrea Vanossi
Paola Trivini
Valentina Gallotti
Chiara Valsecchi



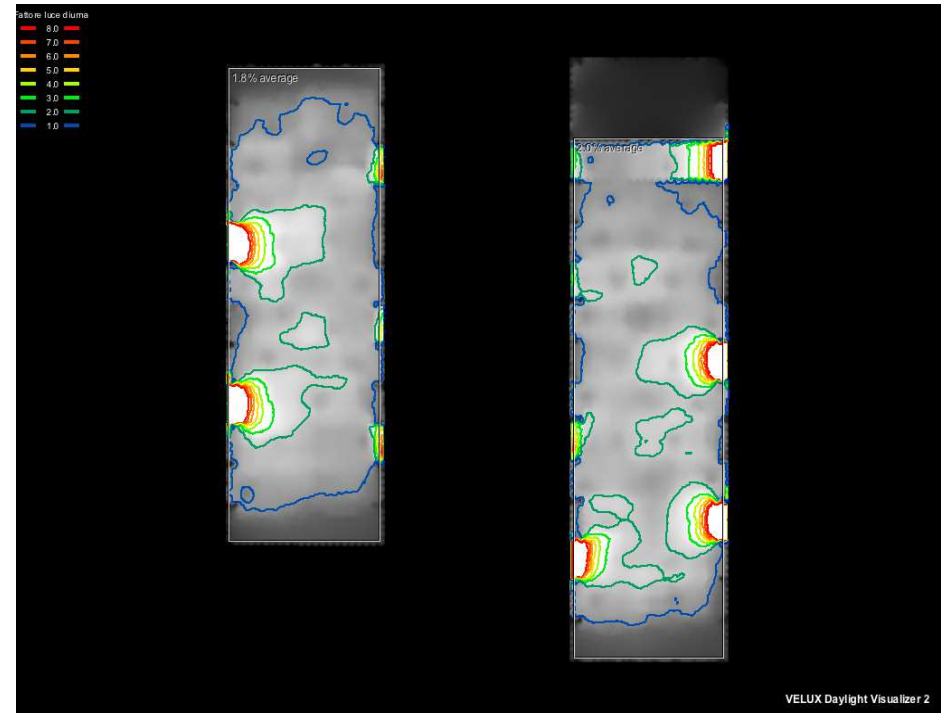
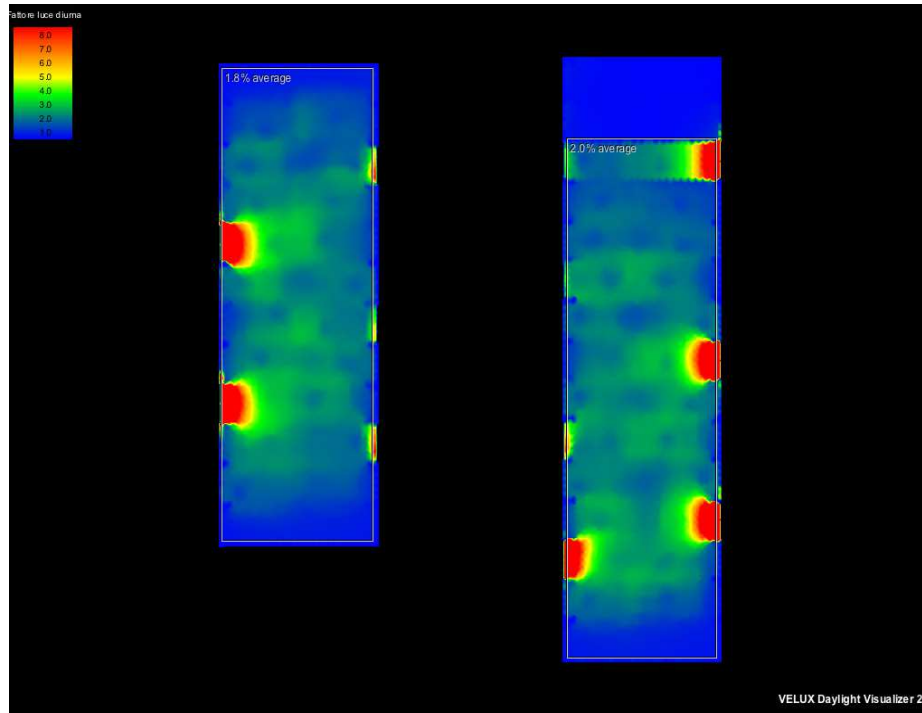
MILANO 2015

NUTRIRE IL PIANETA
ENERGIA PER LA VITA

Analisi illuminotecnica



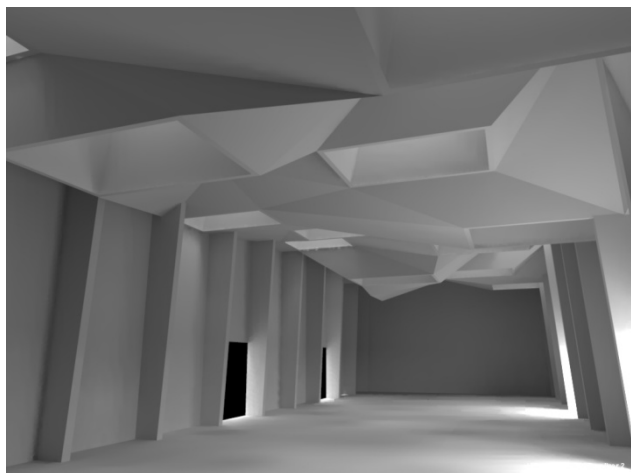
Analisi illuminotecniche



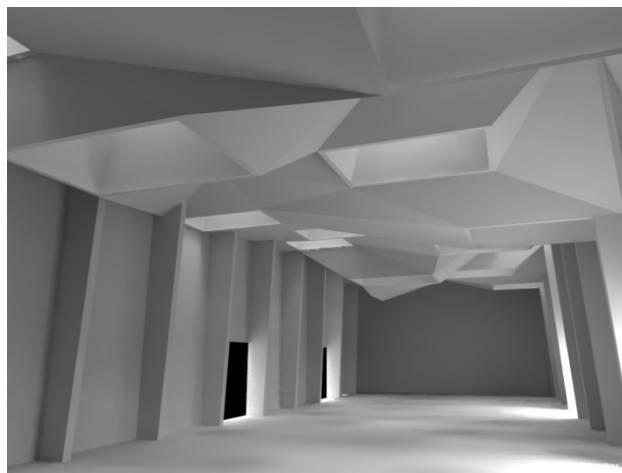
FATTORE MEDIO DI LUCE DIURNA (F^{mld})

Le simulazioni consentono di rilevare buoni valori di F^{mld} con una distribuzione omogenea della luce al di sotto dei "Vulcani di luce" nonostante questi siano elementi puntuali. Si verifica quindi il corretto funzionamento del controsoffitto nel diffondere la luce diretta.

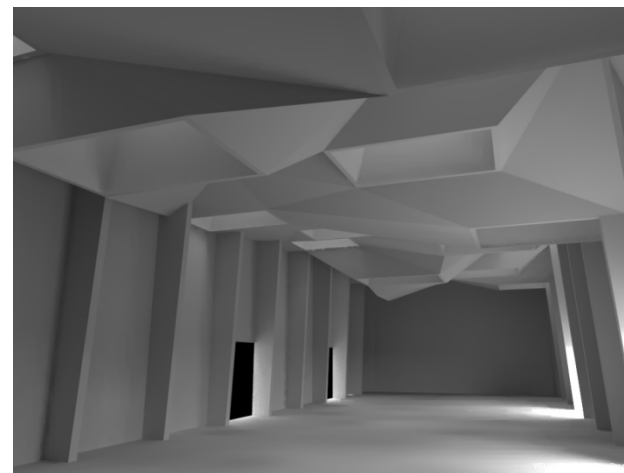
Analisi illuminotecniche



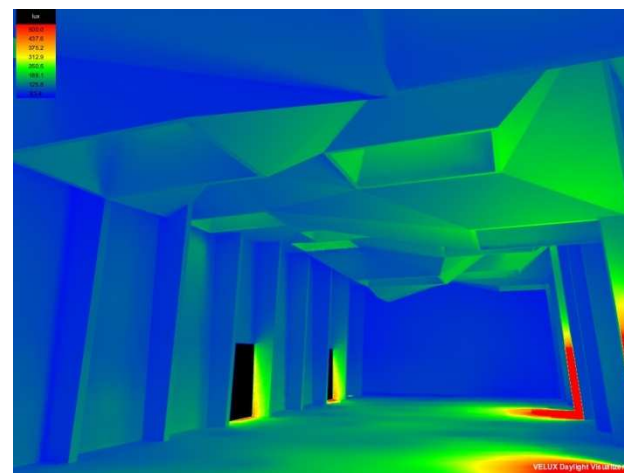
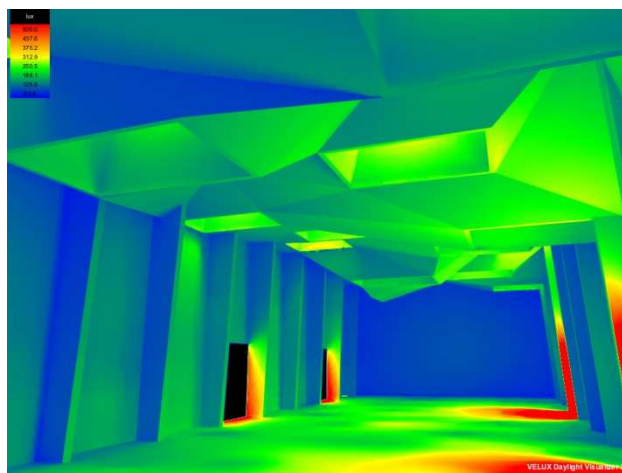
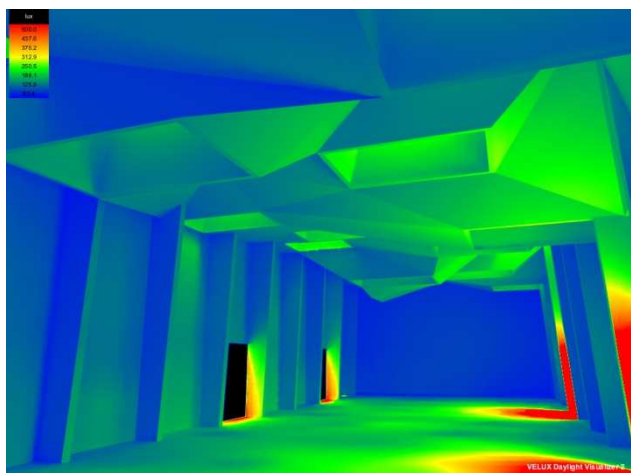
21 aprile



21 giugno



21 ottobre



ILLUMINANZA - Padiglione EST - Cielo parzialmente coperto

In condizioni di cielo coperto è possibile verificare ottimi livelli di illuminamento dell'intero spazio espositivo con valori di illuminanza omogenei e prossimi ai 250 lux. È quindi possibile verificare l'efficacia dei "Vulcani di luce" anche in condizioni meteo meno favorevoli.

a building and the complement to a life
attractive as intensity of Tokyo.



Prof. Ing. Marco Imperadori
Rector's Delegate For East

VELUXlab is the first Italian Nearly Zero Energy Building. It is placed in Bovisio Campus of Politecnico di Milano and it represents a study case of high energy efficiency building, integrating in the future scenario required by the European Directive 2010/31/EU. VELUXlab was born as a Mediterranean Model Home for VELUX, called Anika, designed by J.A. Cantalejo and R.A. Ronda from ACXTI/OCA studio. It personalized the prototype of energy efficiency building for the Mediterranean Region and it is the result of an important architectural and performance retrofit. The renovation was led by Atalier2 with the supervision of Professor Imperadori and Professor Moris from Politecnico di Milano. The collaboration between Politecnico di Milano and VELUX Italia gave the opportunity to create a new lab, a sort of test building, where it is possible to develop the experimental research on going in the University in this way VELUXlab became itself an experimental laboratory in the building. Innovative solutions and energy efficiency coupled with an energy efficient system, makes VELUXlab the first Italian nearly Zero Energy Building in the University Campus. The integration of VELUXlab in the energetic scenario of the building, for the new scenario toward future scenario in the collaboration between Politecnico di Milano, VELUX and the University, last and foremost, is the result of the integration of VELUXlab in the energetic scenario of the building.

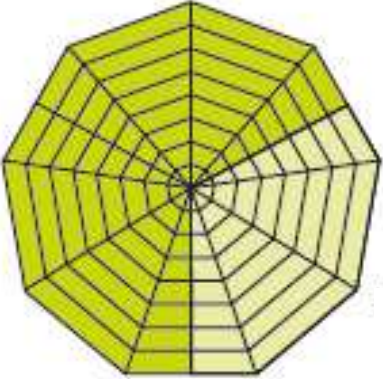
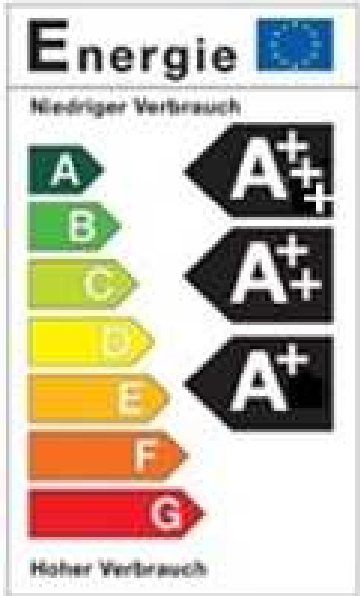
VELUXlab : innovation between ART and SCIENCE



Getting light and air in essential in low ~~density~~ and dense urban systems → velux / roofspace simple yet key (S)

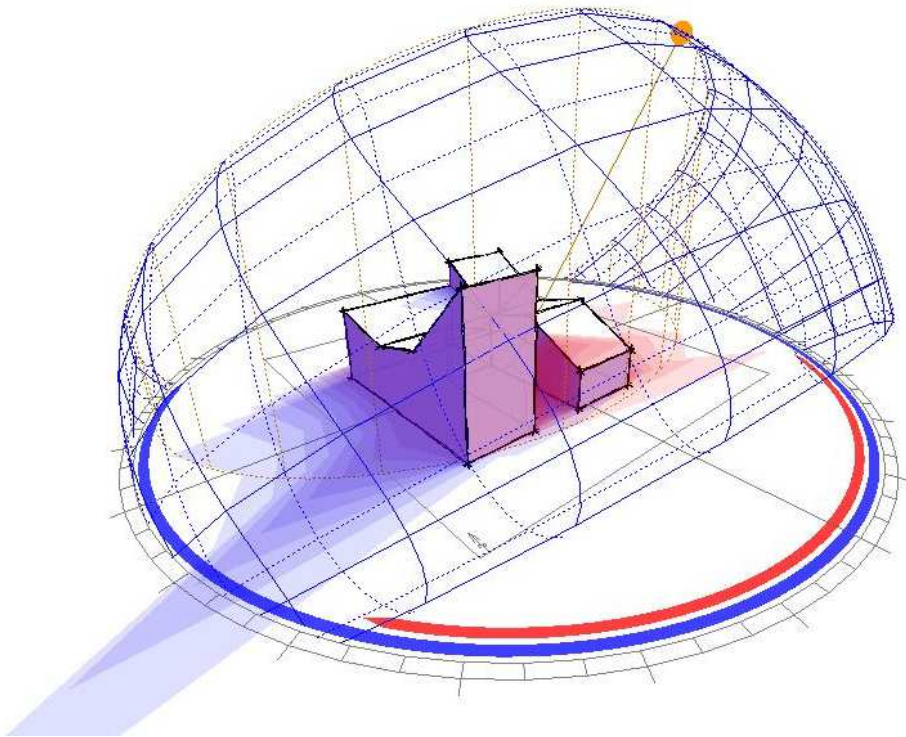


ENERGIA

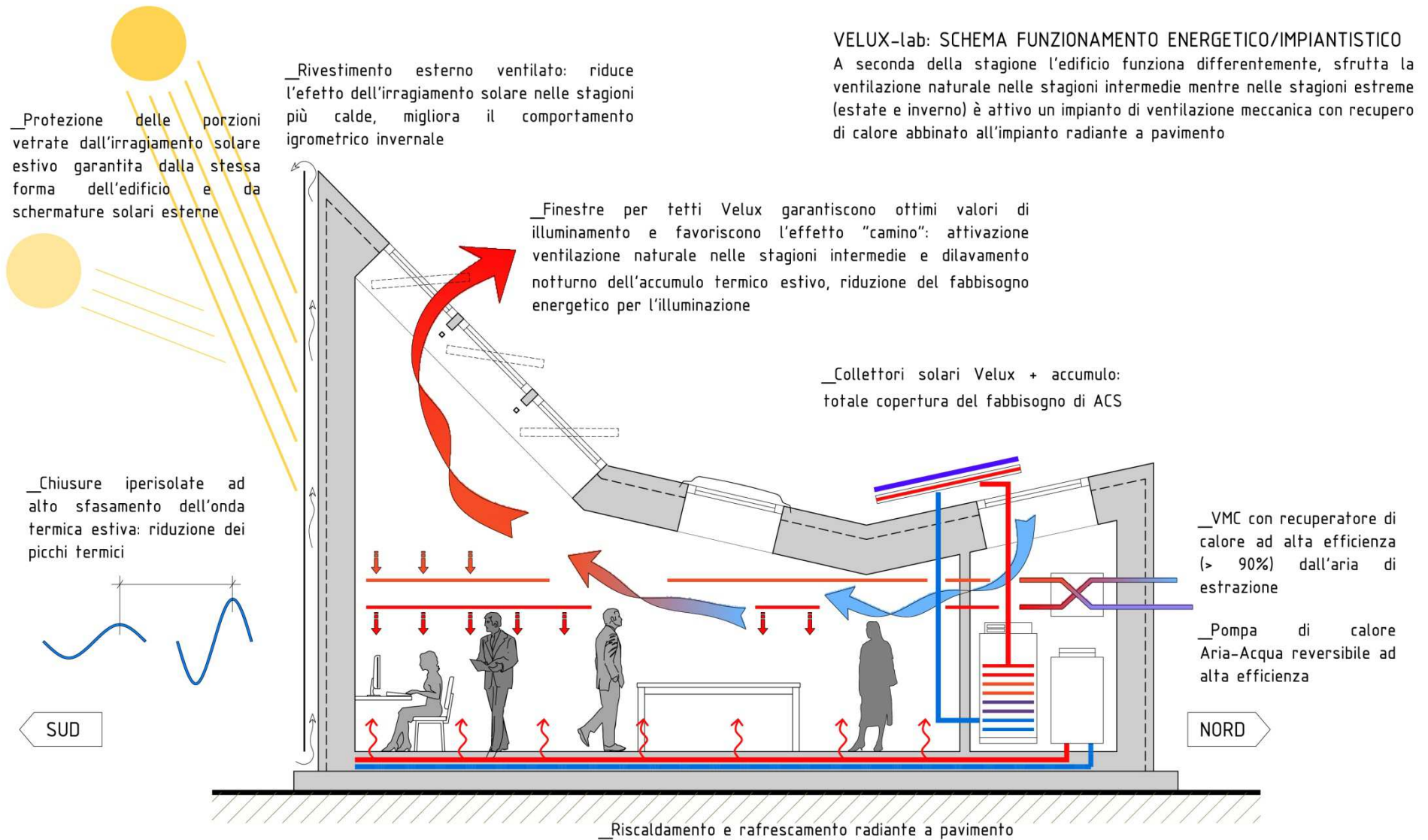


VeluxLAB:

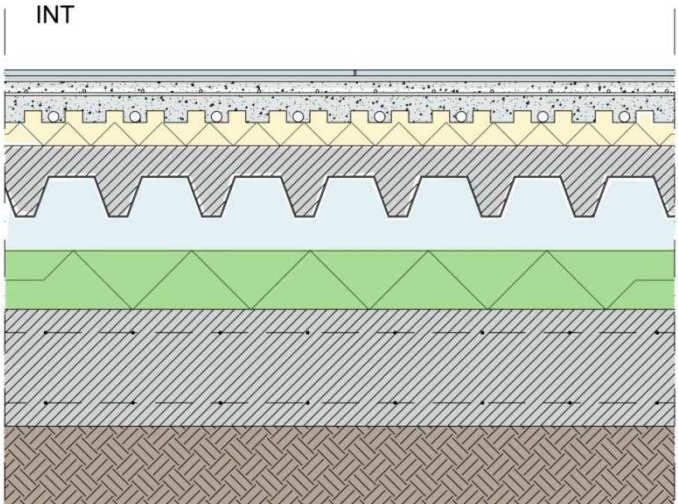
- _ ottimizzazione luce e ventilazione naturale
calcolo FLD
- _ ottimizzazione energetica
- _ Rilevazione dati continua



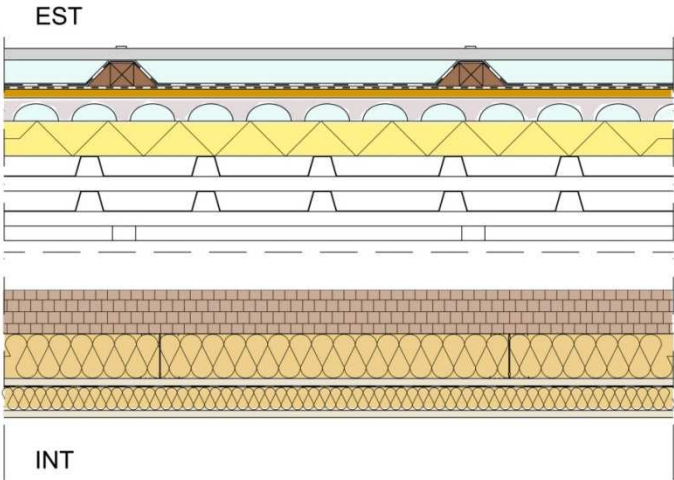
Schema energetico



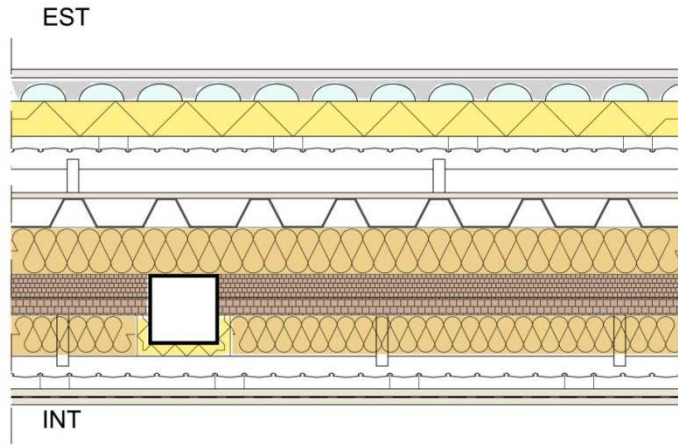
Prestazioni



▲ **Solaio controterra $U = 0.214 \text{ W/m}^2\text{K}$**
Ground floor slab



▲ **Copertura $U = 0.133 \text{ W/m}^2\text{K}$**
Roof



▲ **Chiusura esterna $U = 0.124 \text{ W/m}^2\text{K}$**
External wall



Installazione finestre



Impianti



Ventilazione meccanica (portata massima 470 m³/h) con recuperatore di calore (>90%)

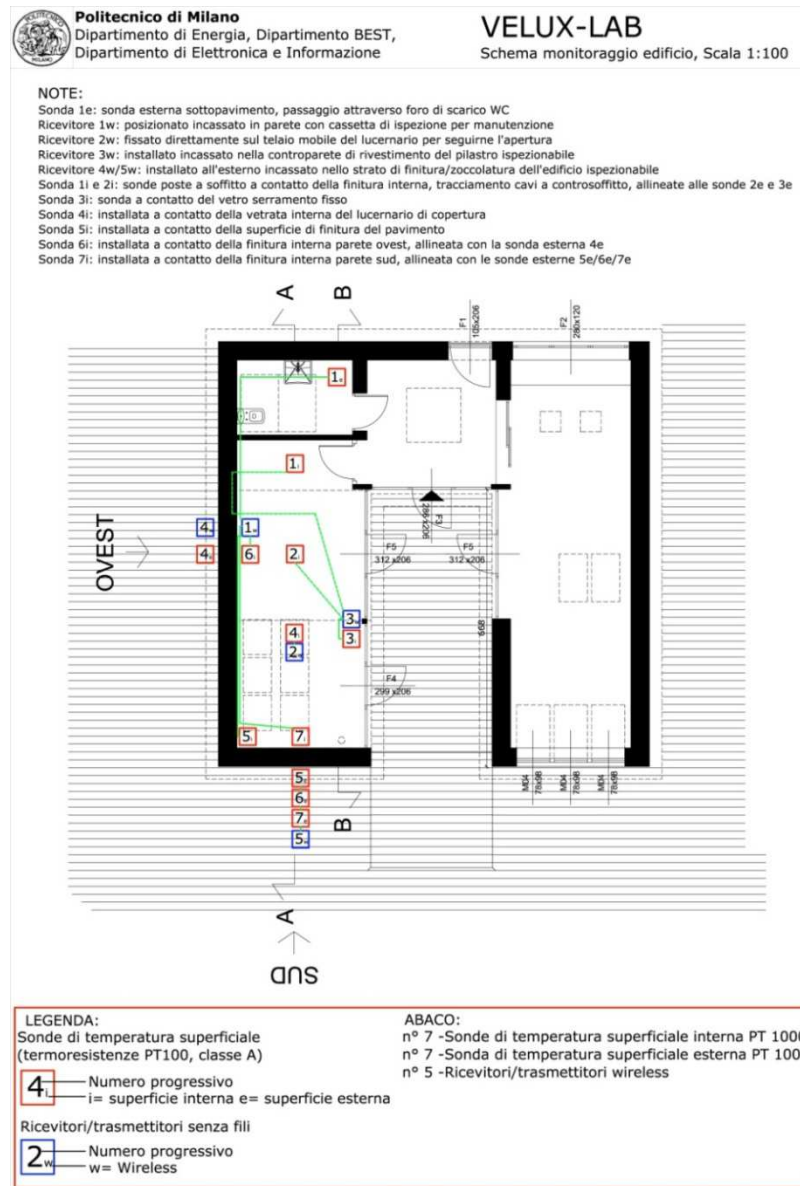


Riscaldamento (90 W/m²) e raffrescamento (30 W/m²) radiante a pavimento

Pompa di calore aria-acqua (7 kW per riscaldamento, 6.1 kW per il raffrescamento). Solare termico (3 collettori solari, 160 l serbatoio di accumulo)



Sistema di monitoraggio Wireless



Sistema di monitoraggio Wireless

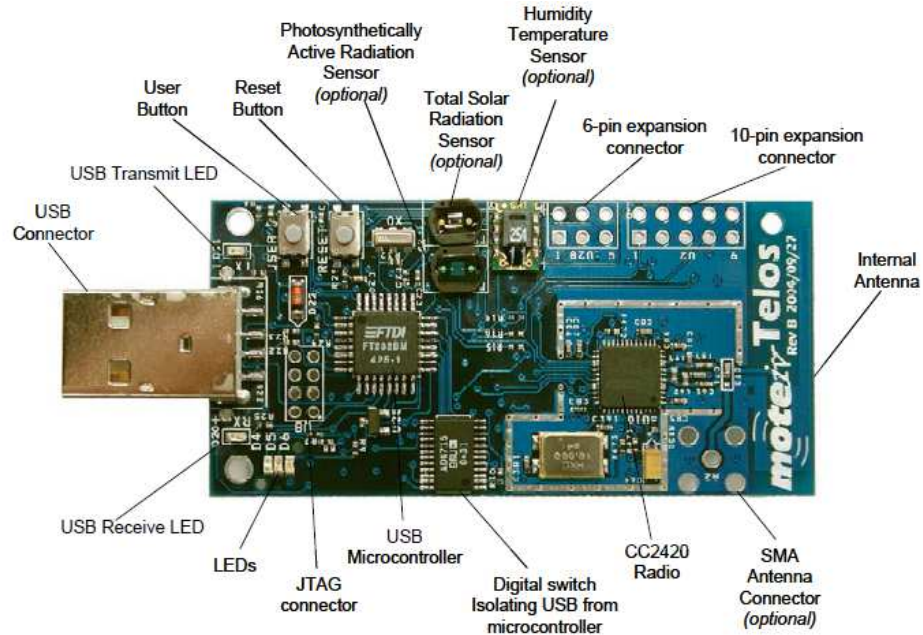
Rete di sensori wireless (WSN):

_Nodi realizzati mediante dispositivi **TelosB** ai quali è stata collegata una scheda di acquisizione dati progettata ad hoc (< 0,1 ° C di errore nella lettura della temperatura) utilizzando sonde PT1000.

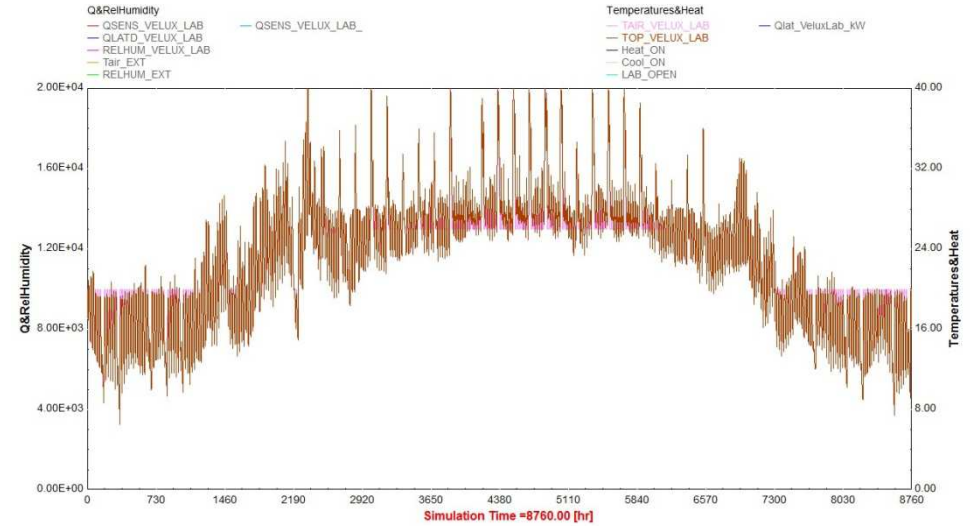
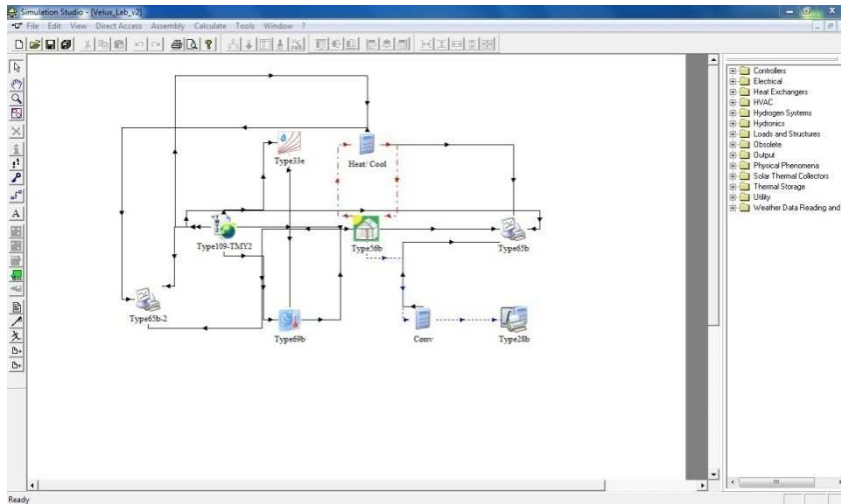
_Software messo a punto dal **dipartimento DEI del Politecnico di Milano**.

I sensori installati:

- **14 Sonde di temperatura** superficiale **PT 1000 classe A** con elemento sensibile al Platino per il monitoraggio dell'involucro
- **6 Sonde di temperatura** superficiale **PT 1000 classe A** con elemento sensibile al Platino e **3 contatori elettrici** dedicati per il monitoraggio dell'impianto
- **7 Micro Data-logger** wireless **TelosB** a cui sono collegati i sensori di temperatura

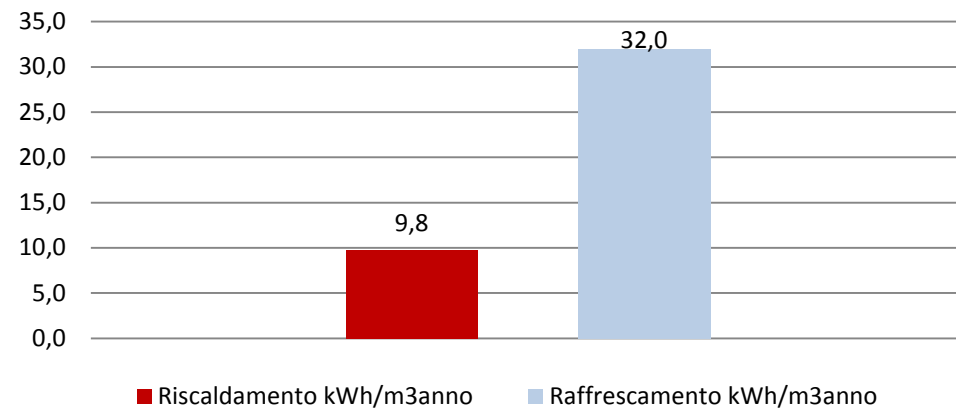


Simulazioni energetiche e sistema di servizi

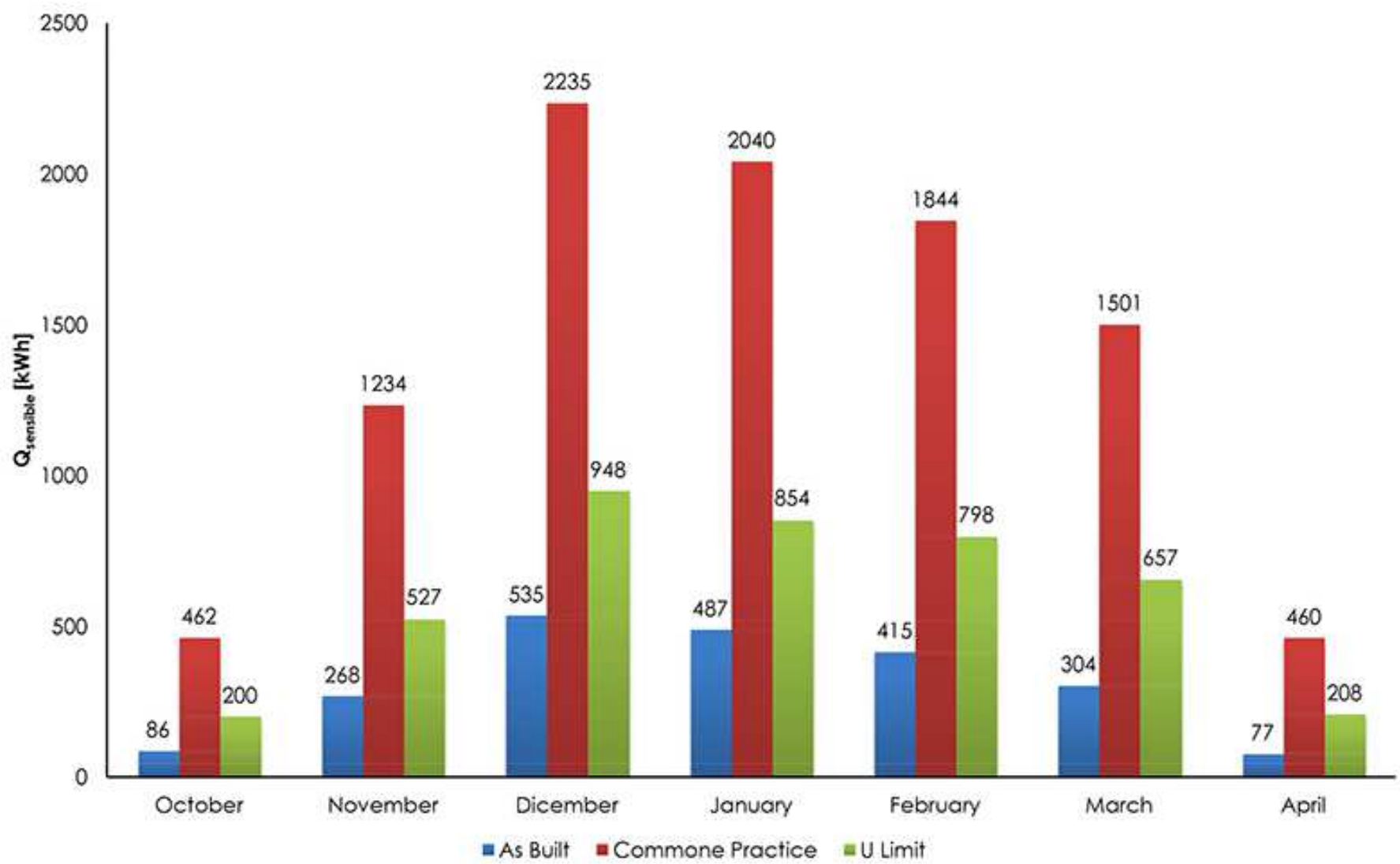


Valutazione energetica dell'edificio mediante simulazioni energetiche in regime dinamico svolte con il software **TRNSYS**.

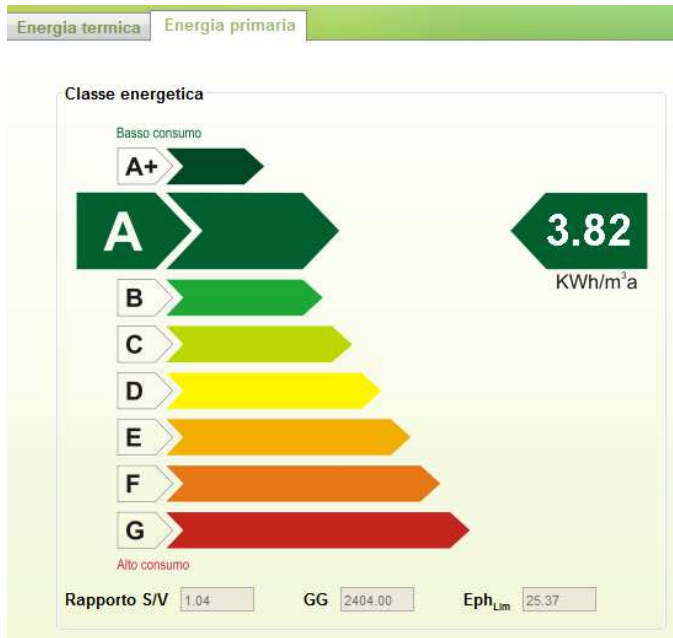
Fabbisogno energetico senza apporti energetici da fonti rinnovabili



Fabbisogno energetico mensile _ VeluxLAB Campagna sperimentale inverno 2013



Certificazione CENED+



VELUXlab si inserisce nello scenario futuro degli **Edifici ad Energia Quasi Zero** (Nearly Zero Energy Building) previsto a partire dal 2020 dalla **direttiva europea 2010/31/UE** ed è inserito nel progetto più ampio, voluto dal Politecnico di Milano, chiamato "**Campus Sostenibile**", azione primaria del Politecnico nell'anno del suo 150° anniversario.



PLEA2013 - 29th Conference, Sustainable Architecture for a Renewable Future, Munich, Germany 10-12 September 2013

Comfort and Energy Assessment of the First Italian Nearly Zero Energy Building in a University Campus

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¹Department of Architecture, Built Environment and Construction Engineering, Politecnico di Milano, Milan, Italy

ABSTRACT: The aim of the work proposed in this paper is to test and evaluate the dry stratified construction technology for building envelope in warm climate (such as in Milan, Italy), showing the actual comfort and energy assessment of the first Italian Nearly Zero Energy Building in a University campus. Analyses are conducted on the VELUXlab building, recently opened within the Politecnico di Milano (Italy). VELUXlab is an experimental laboratory coming from a deep energetic and technological retrofit done on the VELUX Atika model home. During the construction phase an innovative wireless sensors network has been installed, including 14 surface temperature sensors on the building envelope. Here is proposed a comparative analysis between the actual data recorded and the theoretical data analysed through dynamic energy simulations. Further analyses are conducted in order to compare VELUXlab data with the data of average existing Italian buildings, and with the theoretical data referring to the minimum requirements suggested by Italian regulations for new buildings.

Keywords: NZEB, thermal comfort analysis, dynamic thermal modelling

INTRODUCTION

VELUXlab is the first Italian NZEB in a University campus. It is placed in Bovisa Campus of Politecnico di Milano and it is a prototype and a case study for the future buildings. The recent European Directive 2010/31/EU states that, by the end of the 2020, all the new buildings shall be "nearly zero energy". Actually there are no clear suggestions about these new type of constructions [1, 2], and a real example of their peculiarities and features could be a concrete way to make architects aware about the needs of a sustainable design and to provide a sample to follow. In 2011 Velux, the worldwide leader in roof windows, in collaboration with Politecnico di Milano and the design firm Atelier2, converted the demo-house Atika into an experimental laboratory with very low energy request and very high energy efficiency. Thanks to dynamic simulations it was possible to calibrate the intervention in order to minimize the energy needs of the lab, keeping as much as possible the old materials. New technological layers were added in order to optimize the building for the warm climate of Milan. The building envelope was designed as a multi-layer dry construction, based on the duo structure/envelope, and the adopted technology was studied and defined in order to represent a feasible possible solution for zero-energy buildings in Mediterranean region [3, 4]. Furthermore, during the construction phase, an innovative wireless sensors network was installed.

In this paper first results about VELUXlab behaviour are proposed, concerning both energy consumption and indoor environmental quality. A comparison between

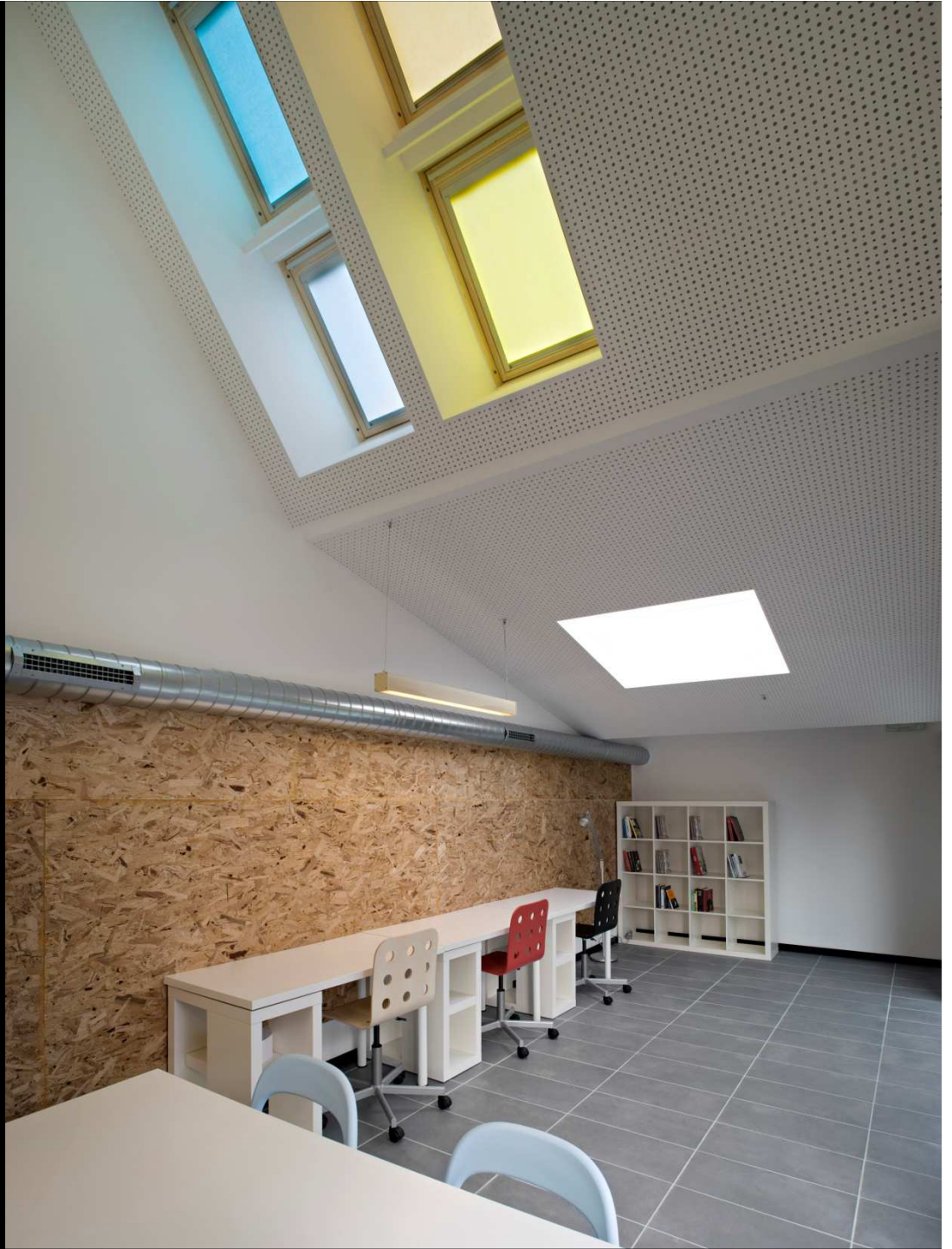
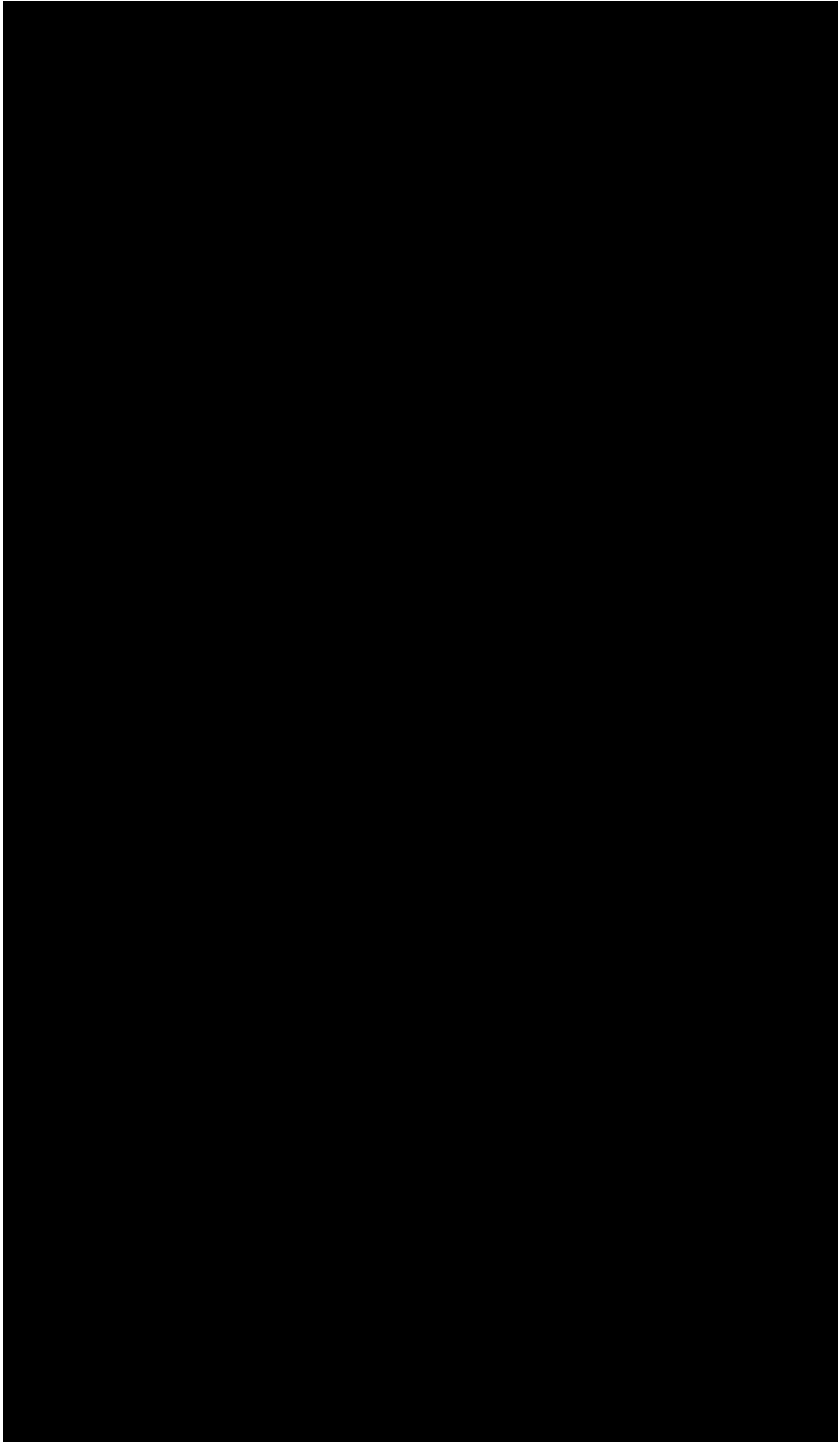
the data recorded by the sensors during the first year and the theoretical data obtained from the dynamic simulations is addressed in order to understand how much a NZEB behaviour is affected by external and unpredictable interferences. Studies show that, for other NZEBs, during their real life, due to the assumptions and simplifications of the virtual model, the energy consumed is more than the predicted one [5, 6, 7]. In this paper analyses are conducted on VELUXlab in order to quantify and evaluate the real performances of the building. This is the first step to define a nearly zero energy building optimized for Mediterranean climate through the evaluation and comprehension of its real operative performances.

BUILDING STOCK ANALYSIS

In order to comprehend which is the level of improvement introduced with the project, a comparison between VELUXlab and the existing building stock is proposed. The comparative analysis refers to CENED certificated buildings in Lombardia (a region in the north of Italy), where VELUXlab is placed, to figure out strengths and weak points of the intervention.

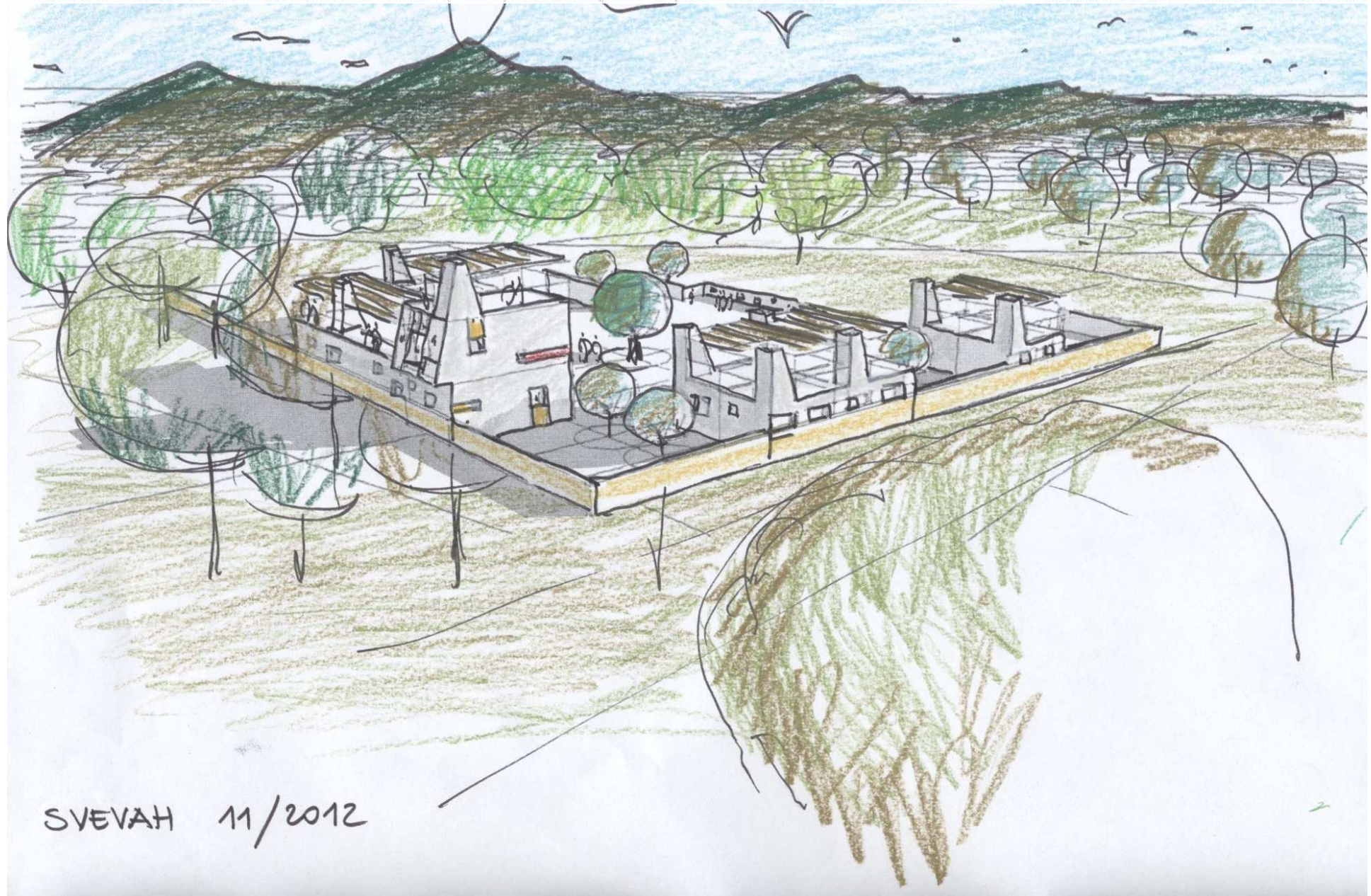
The European Directive 2002/91/CE was emanated with a double purpose: a reduction of the energy consumption with limited emissions of GHG and the respect of the responsibilities taken with the Kyoto Protocol, reducing at the same time the dependency of the EU from the external fossil fuel sources.

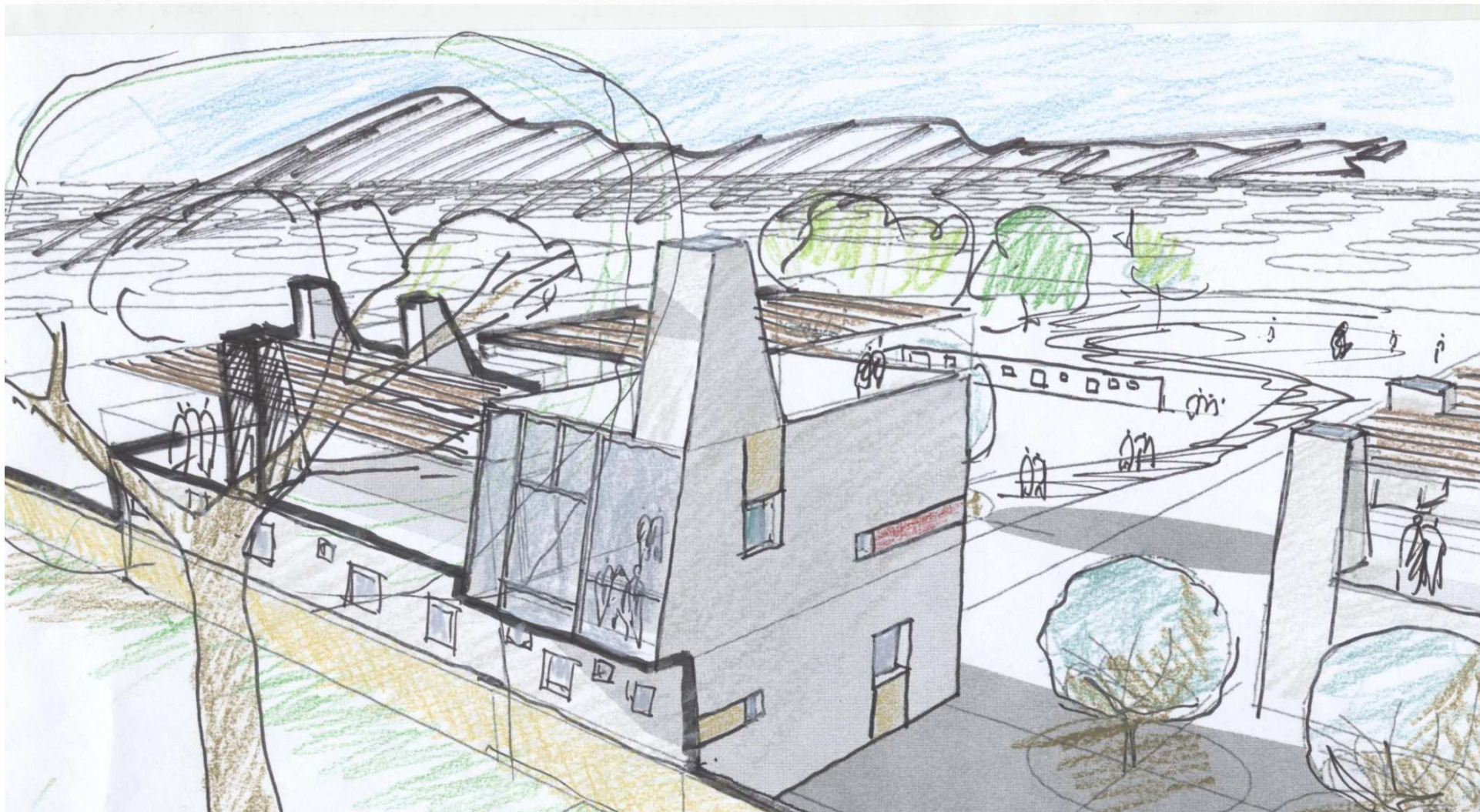
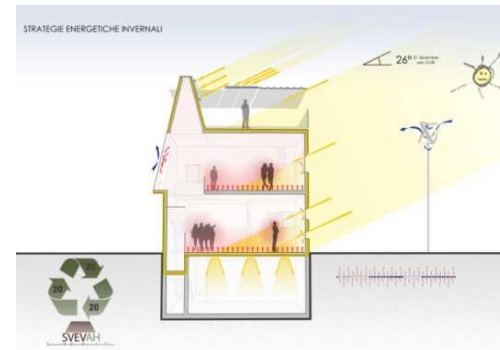
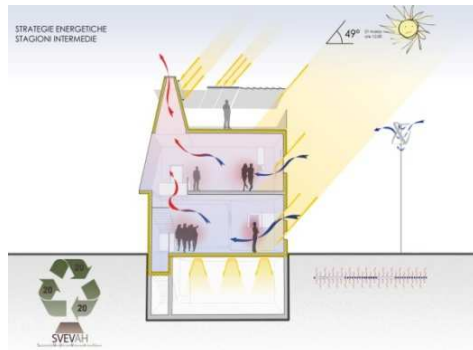
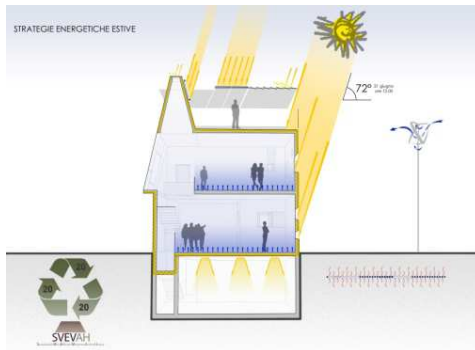
The Directive leaves the responsibility to create the certification system to a National or Regional level,



SvevAH

Arianna Brambilla (Politecnico di Milano – Aalborg University)





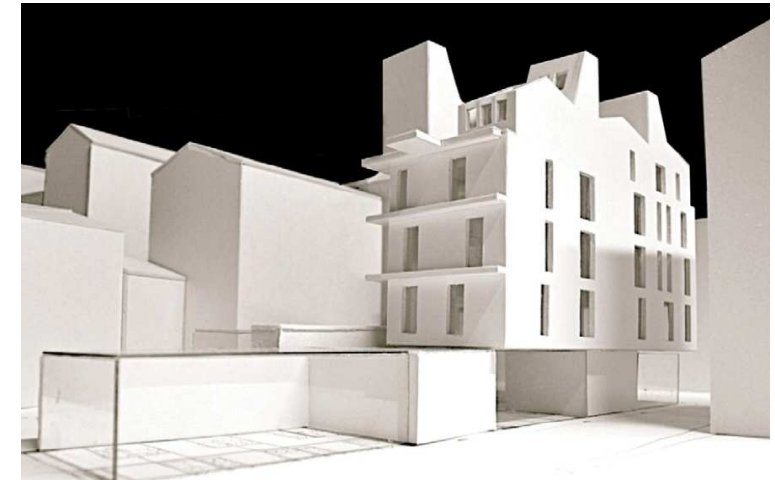
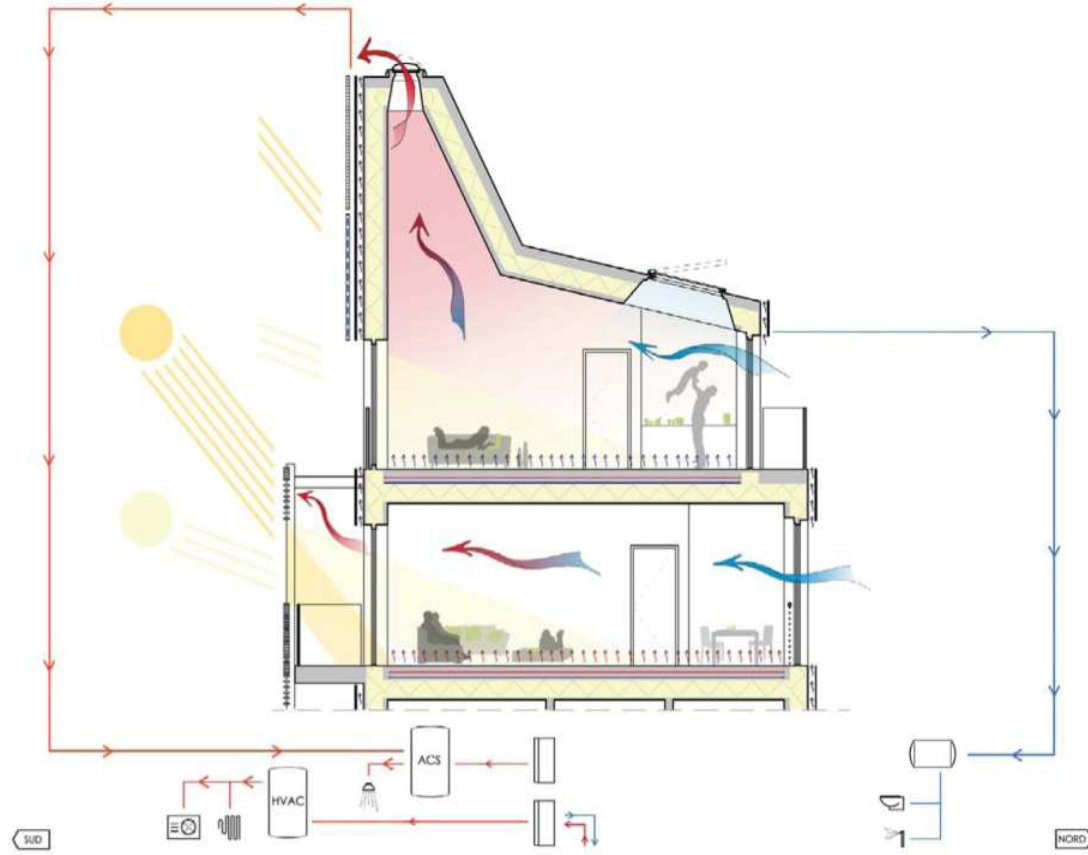
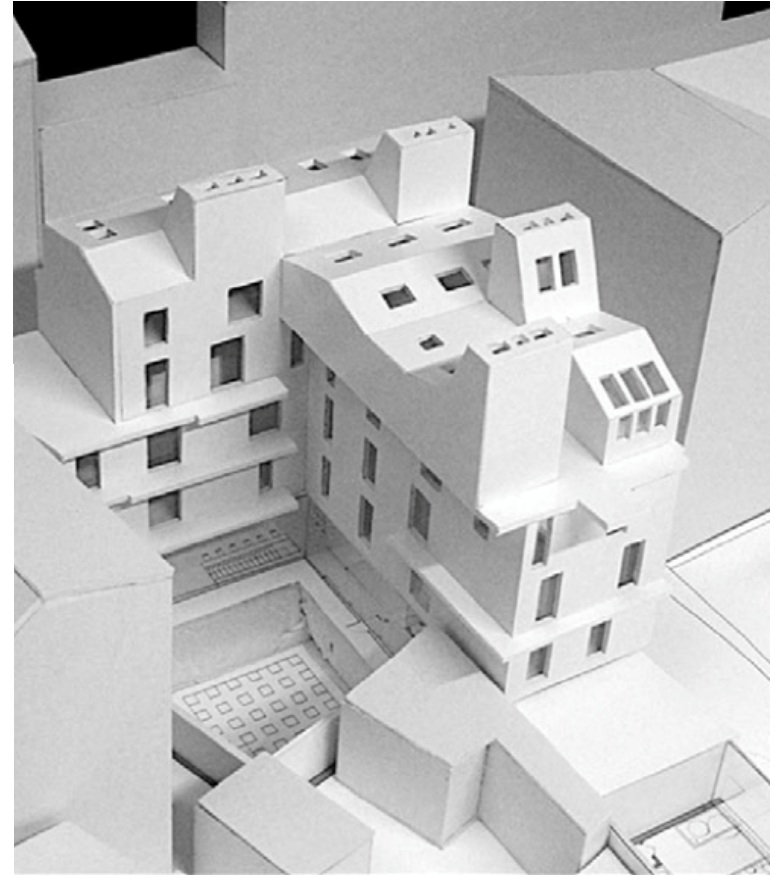
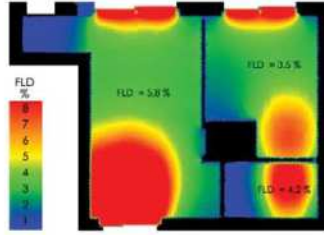
BrerAH



Team:

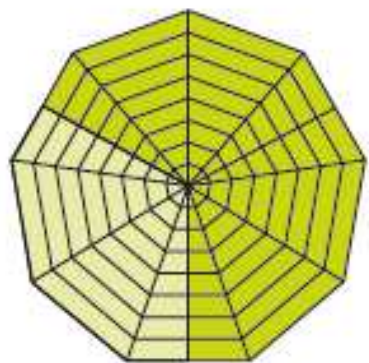
Nicola Falcone
Chiara Zanello
Valentina Zorzi







AMBIENTE



VELUXlab: Cantiere

Riuso dell' edificio



Bilbao 2007



Roma 2008



Milano, Rho Fiera, 2009



Politecnico di Milano, Campus Bovisa, 2011



1° Agosto 2011, h 6:00
Politecnico di Milano, Campus Bovisa



VeluxLAB: inizio del cantiere



4 mesi di lavoro:
Più di 20.000 viti, 100 m³ di isolamento

Materiali



Pannelli isolanti in fibra di legno



Pannelli isolanti in lana di roccia



Sistema isolante composto in poliuretano



Polistirene sbriciolato



Pannelli in OSB



Isolanti interni in lana di roccia



Installazione impianto fotovoltaico



Caratteristiche impianto fotovoltaico:

9 pannelli (1652x994 mm) ovvero 14,8 mq.

Potenza di picco nominale: 2,16 kWp

Produzione stimata: 2688 kWh/anno

Compensazione: >90% del fabbisogno dell'edificio



Il sistema di fissaggio sopra il dogato di alluminio garantisce la ventilazione del pannello (il pannello surriscaldandosi perde circa 0,5% di efficienza per ogni grado di temperatura)

Esperimento Drone







POLITECNICO DI MILANO
VELUX lab





POLITECNICO DI MILANO
VELUX lab



Prima Active House a Bergamo – Maison Verte

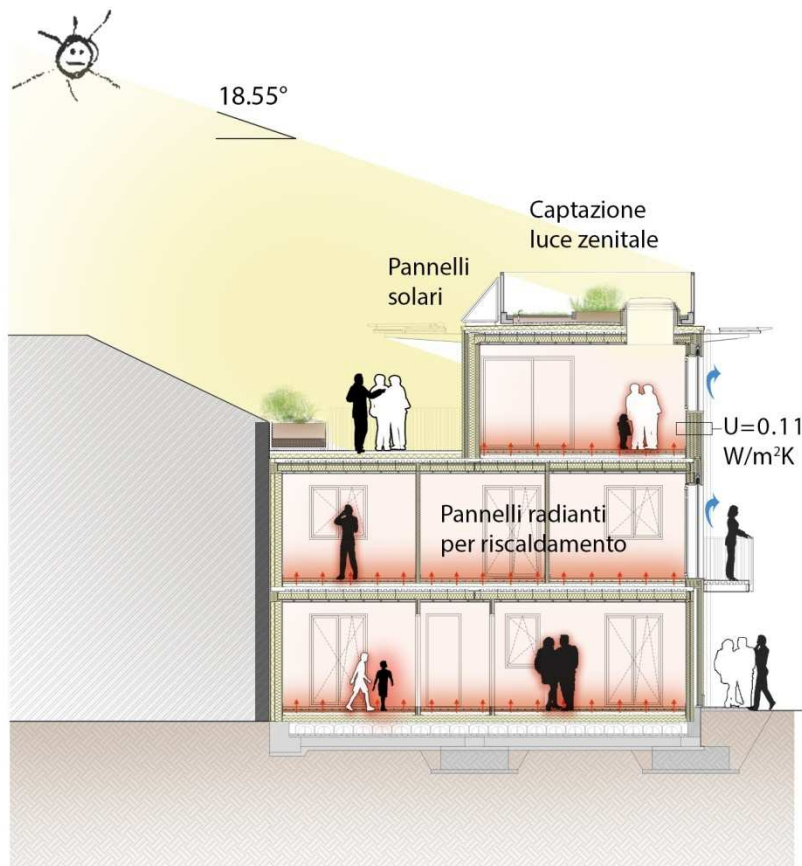


Schema energetico

SCHEMATIC DESIGN

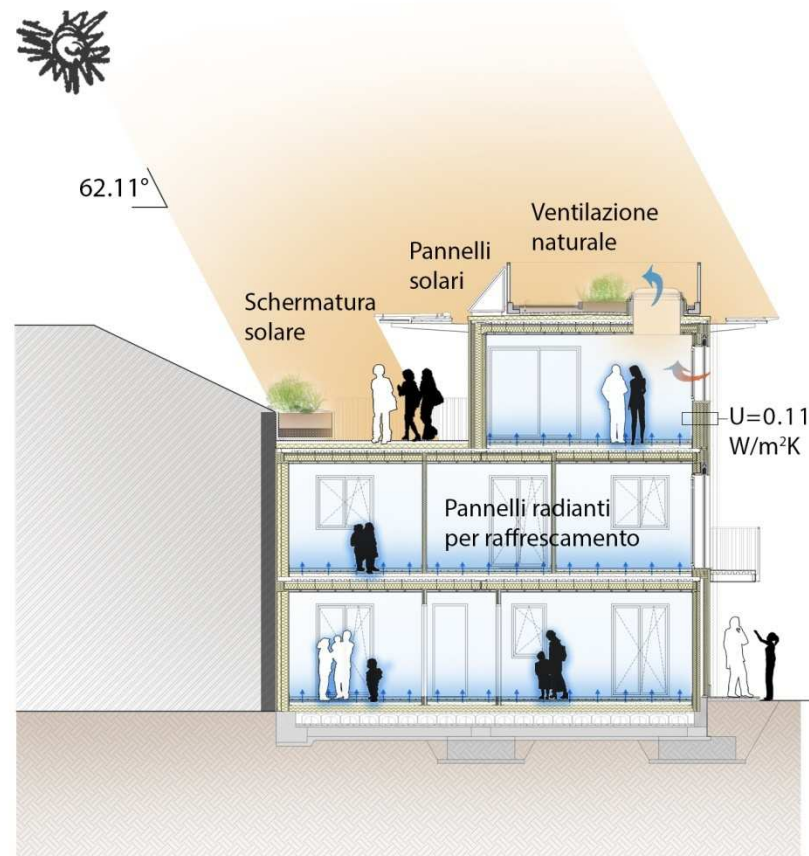
Strategie energetiche invernali

- Iperisolamento con strati differenziati di isolante nelle chiusure opache
- Termotrasmittanza chiusure opache $0.11 \text{ W/m}^2\text{K}$
- Pannelli radianti a pavimento per riscaldamento
- Captazione luce zenitale
- Pannelli solari termici
- Tetto giardino



Strategie energetiche estive

- Inerzia termica delle chiusure opache
- Termotrasmittanza chiusure opache $0.11 \text{ W/m}^2\text{K}$
- Pannelli radianti a pavimento per raffrescamento
- Ventilazione naturale/VMC
- Pannelli solari termici
- Schermatura della radiazione solare
- Tetto giardino



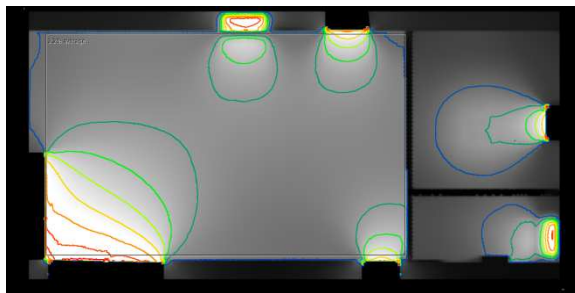
Analisi illuminotecniche

Fattore medio di luce diurna.

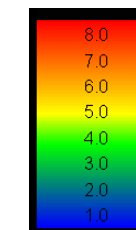
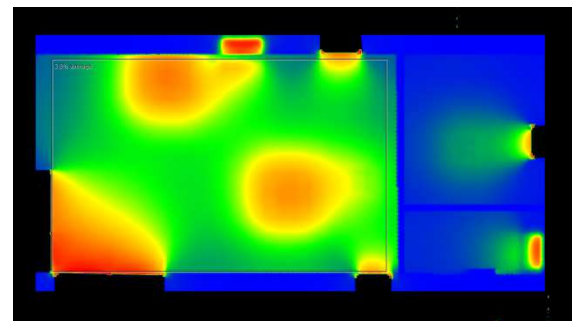
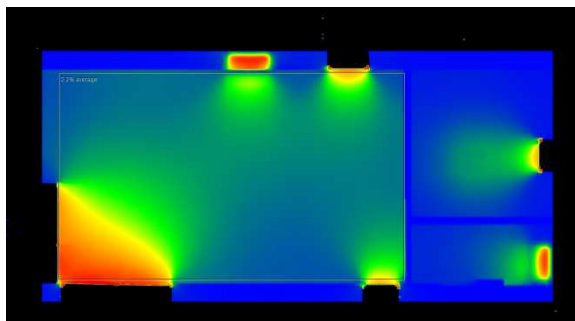
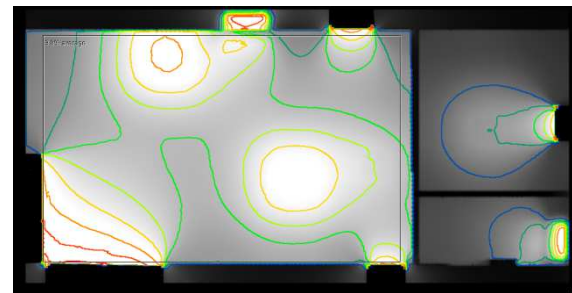
Nella situazione con i cupolini (a sinistra), la luce zenitale assicura alti valori di FLD con una distribuzione omogenea della luce rispetto alla situazione senza cupolini (a destra) priva di aperture zenitali.



FLDm= 2,2% situazione senza cupolini



FLDm= 3,8% situazione con cupolini

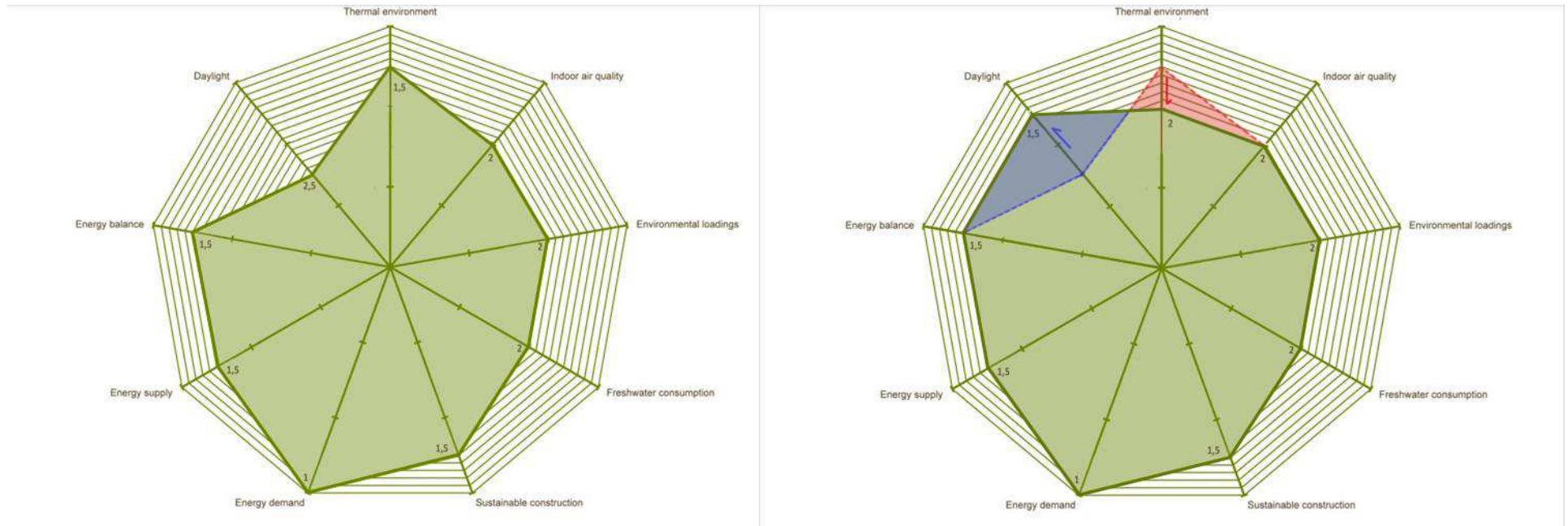




Validazione Active House

Situazione senza cupolini
Parametro Daylight= 2,5

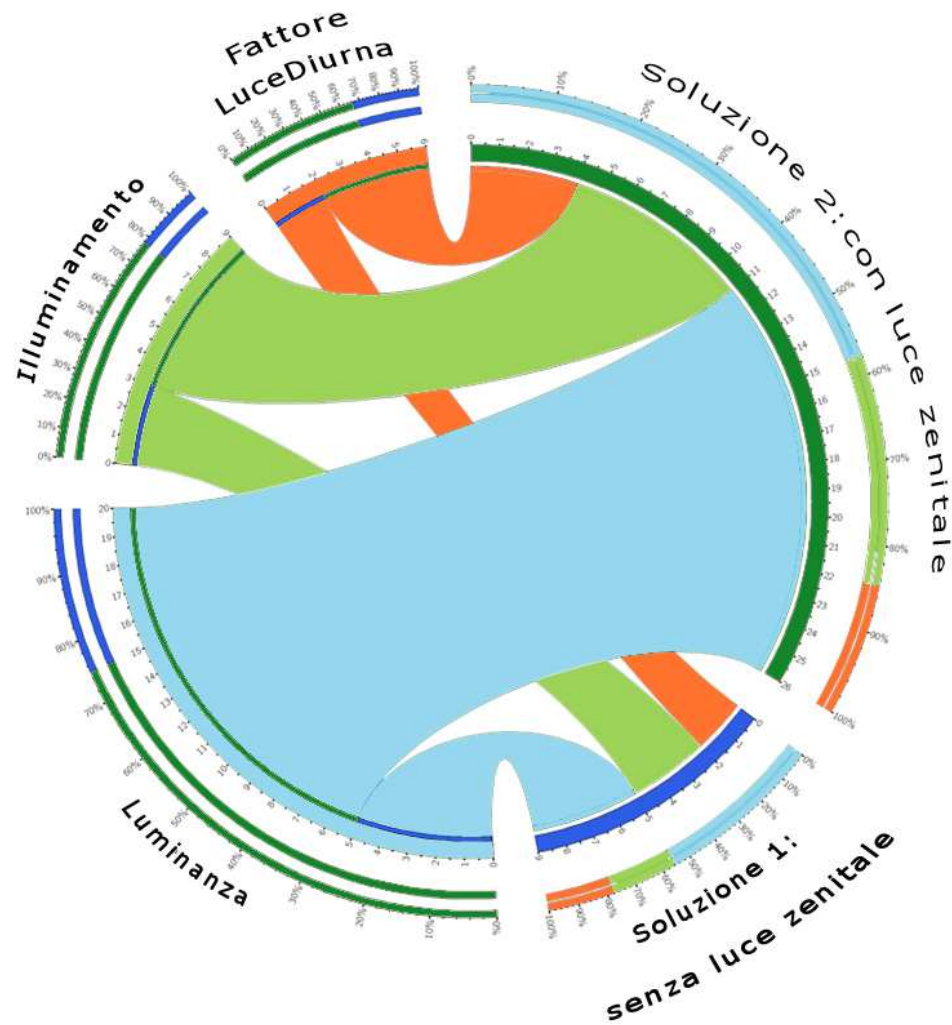
Situazione con cupolini
Parametro Daylight= 1,4



Dati Radar di progetto.

Radar Active House realizzato in fase progettuale come strumento per l'ottimizzazione e l'individuazione delle criticità. Variazione del parametro di Daylight nella situazione senza aperture zenitali (sinistra) rispetto alla soluzione con i cupolini (destra)

Analisi comfort interno

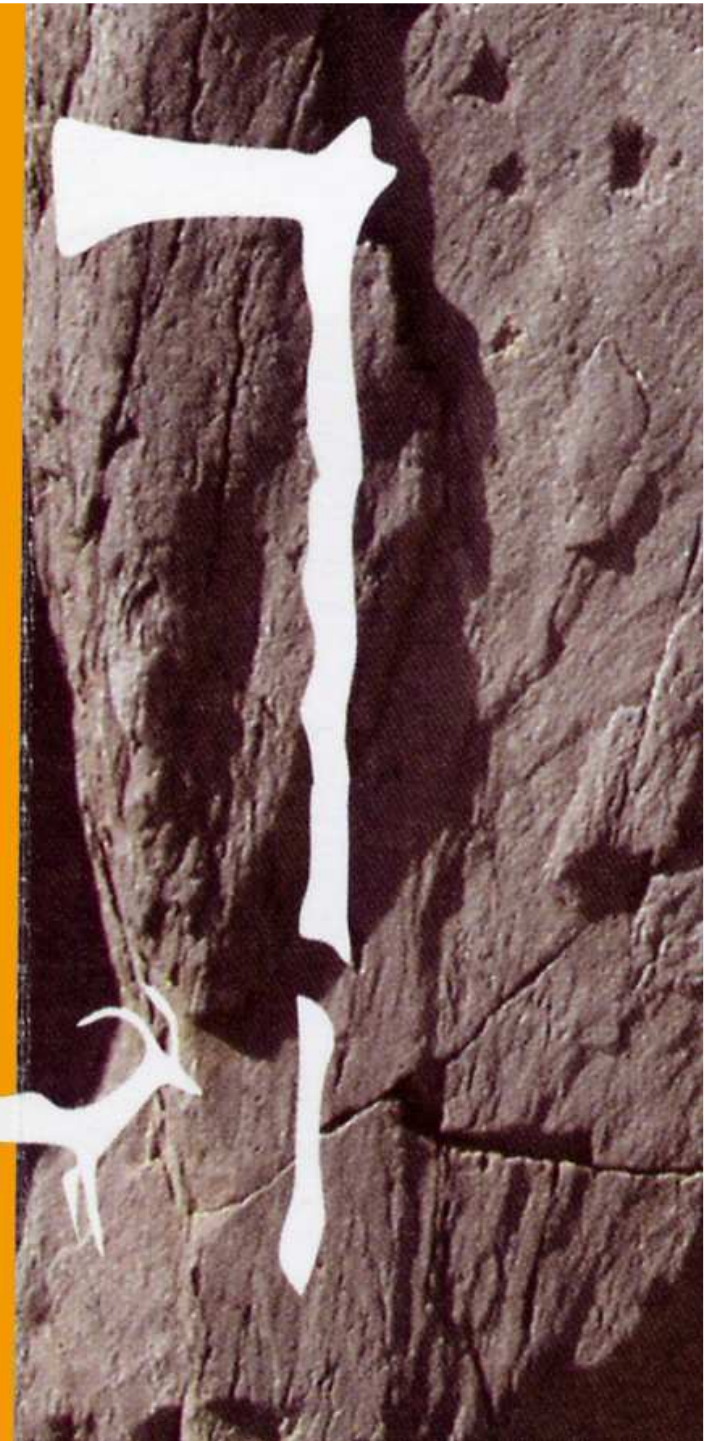


DATA	SOL1	SOL2
FLD	2.2	3.8
ILLUMINAMENTO	255.2	689.3
LUMINANZA	4.6	15.4

Analisi della differente incidenza dei parametri di comfort luminoso (FLD, Illuminamento, Luminanza) nella situazione senza aperture zenitali (SOL1) rispetto alla soluzione con i cupolini (SOL2)

Il sole è nuovo ogni giorno ...

Eraclito







Si sente la necessità assoluta di muoversi.

E soprattutto di muoversi in una direzione particolare.

Una doppia necessità: muoversi e sapere in che direzione.

D.H. LAWRENCE, Mare e Sardegna



