



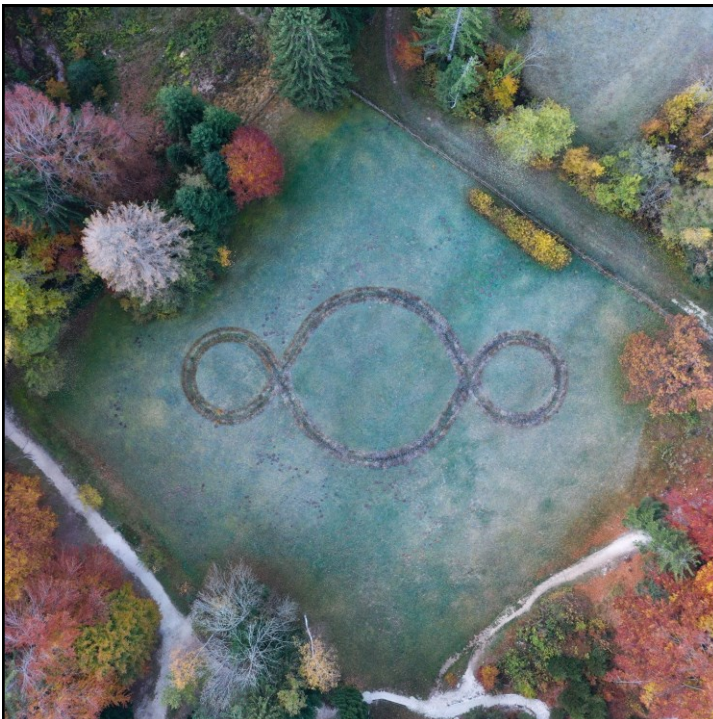
POLITECNICO
MILANO 1863

The *sense* of Cognitive Architecture

Marco Imperadori
Full Professor, Rector's Delegate Far East
marco.imperadori@polimi.it

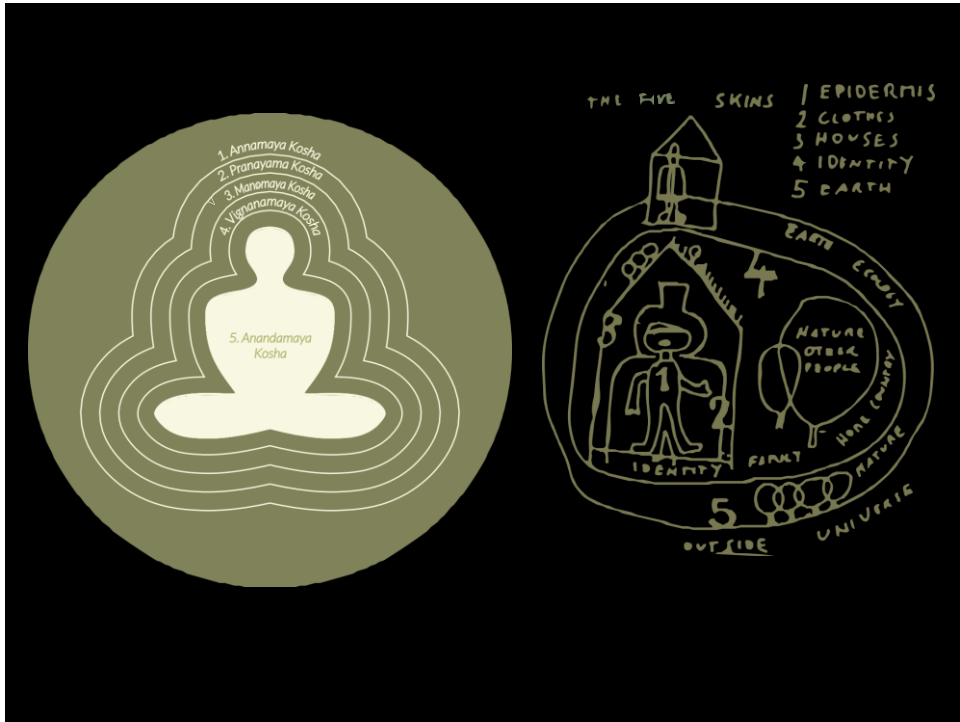
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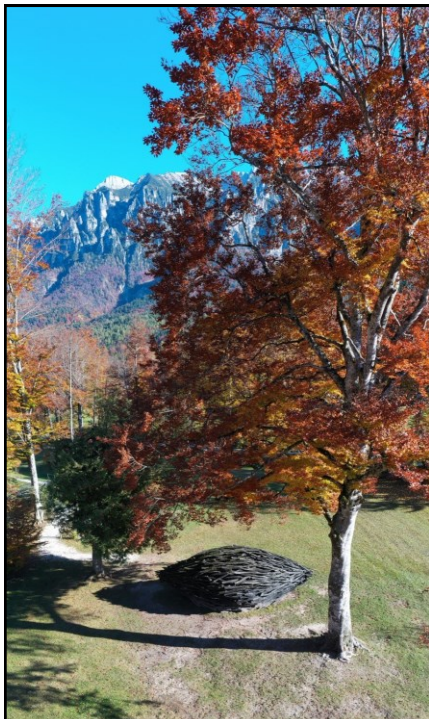


Ph. Giacomo Bianchi, Arte Sella

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Ph. Giacomo Bianchi, Arte Sella

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Copenhagen International School



Location Copenhagen, Denmark
Project type New construction
Use Educational building
Design C.F. Møller Architects
Year 2017

Photo: Adam Mørk

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Copenhagen International School
 Has the **largest European BIPV**—Building
 Integrated Photovoltaic.

activehouse.info
 NETWORK AND KNOWLEDGE SHARING



COMFORT – improve focus and learning into a better indoor environment

ENERGY – integrated design between envelope, systems and renewable energy

ENVIRONMENT – NZEB for a lower environmental impact

Credit: Active House Alliance

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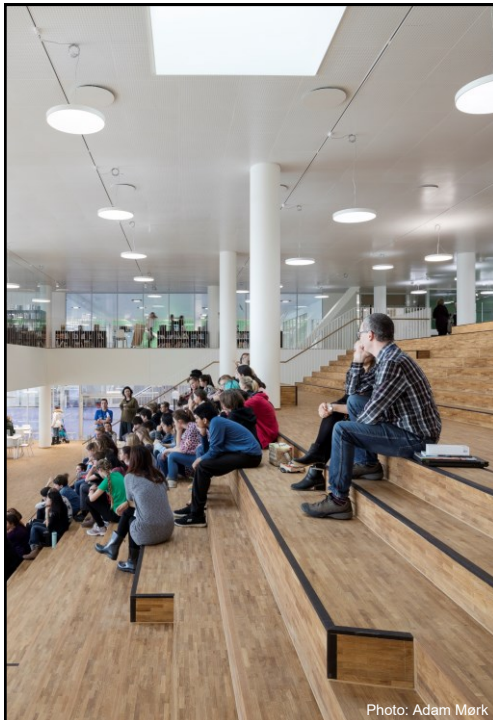


Photo: Adam Mørk

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NETWORK AND KNOWLEDGE SHARING

COMFORT – improve focus and learning into a better indoor environment

- DAYlight and LEDlight
- 20% window/floor area
- 21-26°C thanks to good insulation and heat recovery ventilation system

ENERGY – integrated design between envelope, systems and renewable energy

- 15 kWh/m²y
- 6000 m² BIPV
- 69% renewables covering the energy demand

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Renewable sources and high energy-efficiency within architecture towards **healthier buildings**

Photo: Adam Mørk

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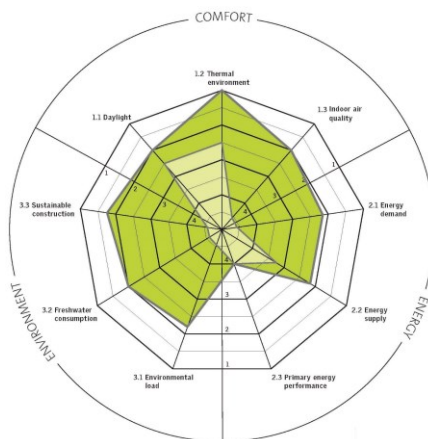
Green Solution House



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Green Solution House the Active House principles under monitoring survey

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NETWORK AND KNOWLEDGE SHARING



COMFORT – visual comfort in living and working spaces

ENERGY – smart management for lower consumption

ENVIRONMENT – sustainable construction

Credit: Active House Alliance

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Photo: Adam Mørk

COMFORT – visual comfort in living and working spaces

- Skylights and solar tunnels (DFmin 6,6%)
- greenwall and specific finishing materials to purify indoor air, absorbing pollutant particles and balancing humidity levels.

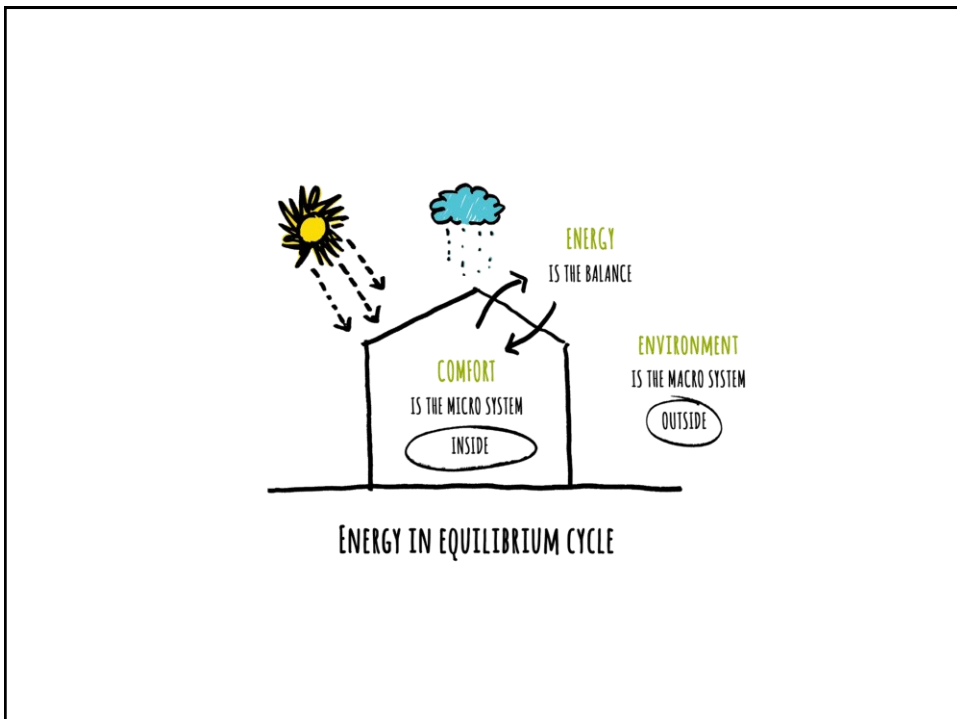


Milano, the “impermanent City”



courtesy Velux, Indoor Generation

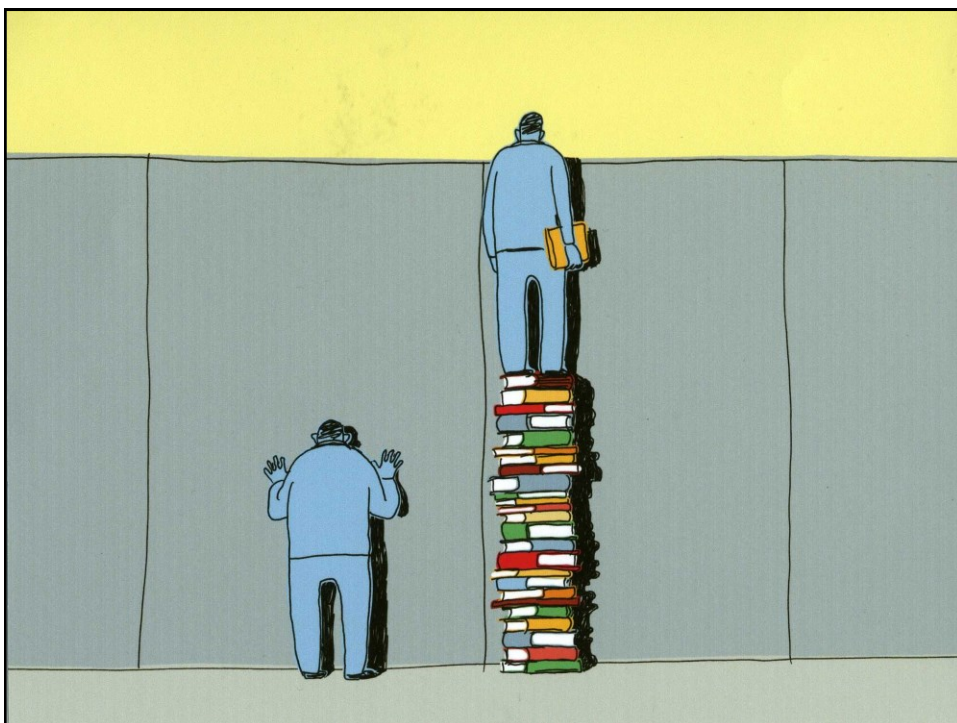
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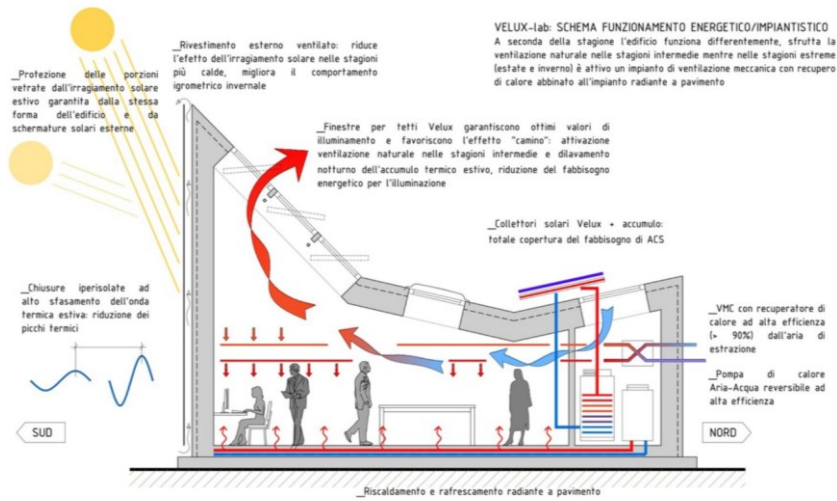


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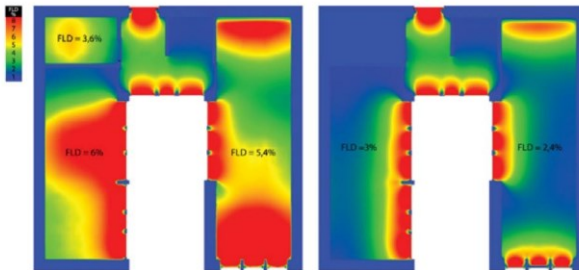
Schematic design



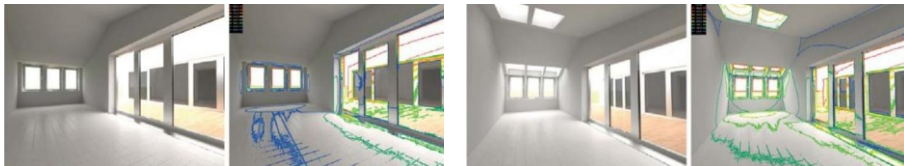
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Lighting analysis

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NETWORK AND KNOWLEDGE SHARING



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.

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Energy simulations and machines system

VELUX lab



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



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

Pompa di calore aria-acqua (7 kW riscaldamento, 6.1 kW raffreddamento), solare termico (3 collettori solari, 160l serbatoio di accumulo)



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July 2013 – Drone Experiment (Drone experiment)



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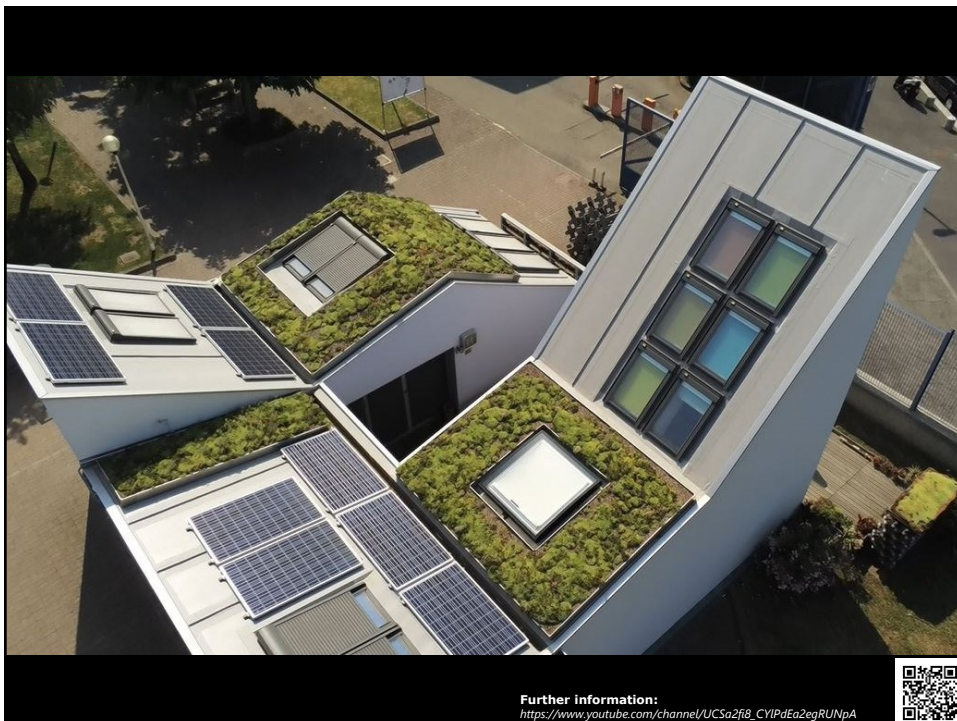
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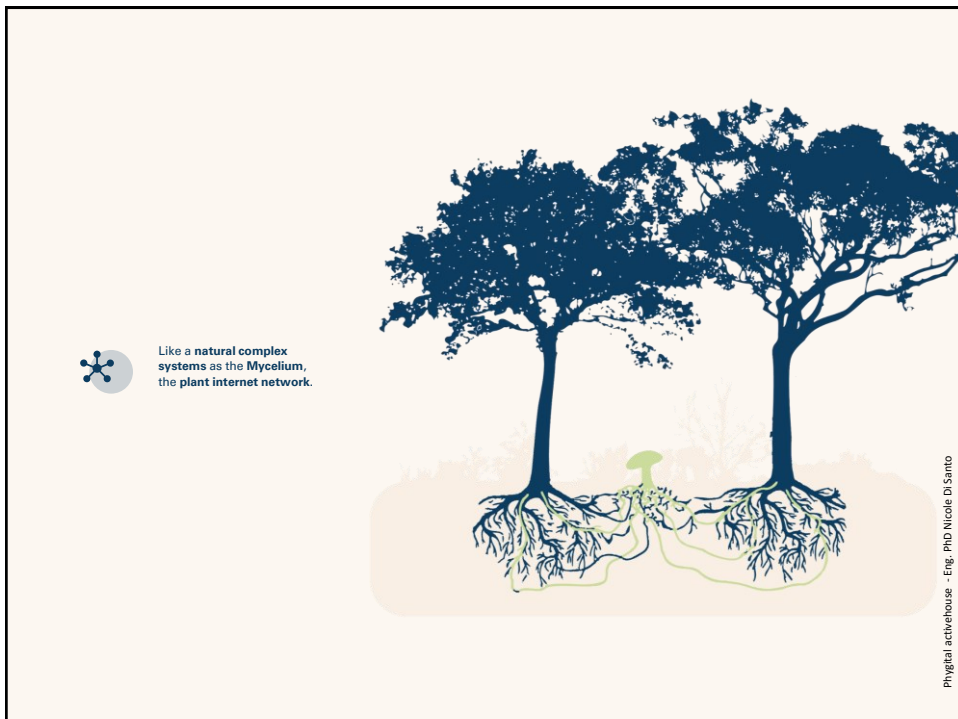
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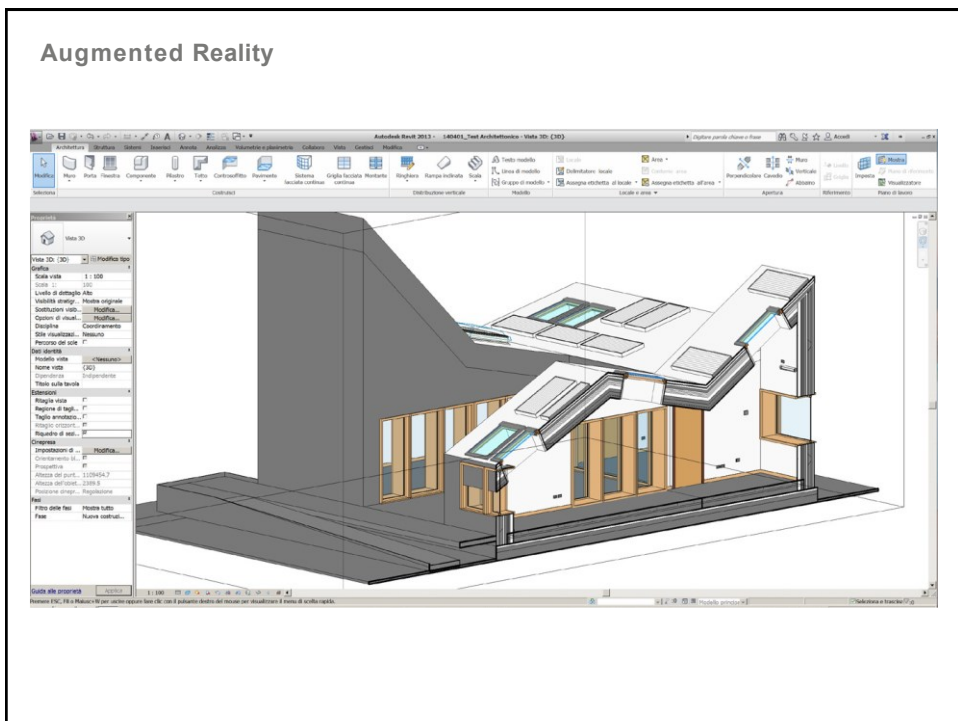
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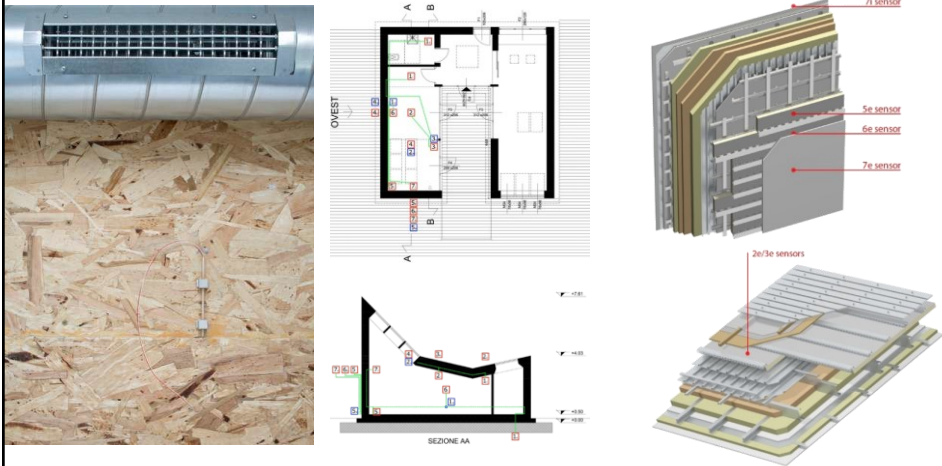


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Wireless sensors network monitoring systems



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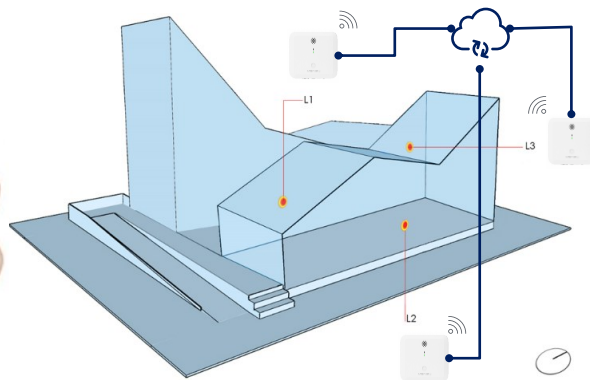
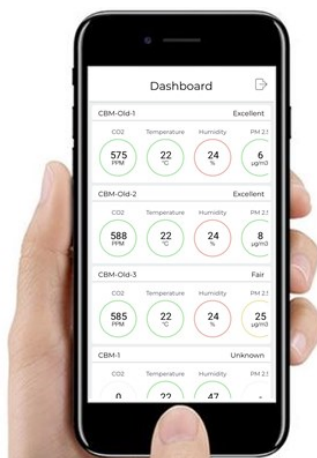


It is not the strongest nor the most intelligent that survives but the one that is ready to adapt to changes.

Charles Darwin,
The origin of species, 1859

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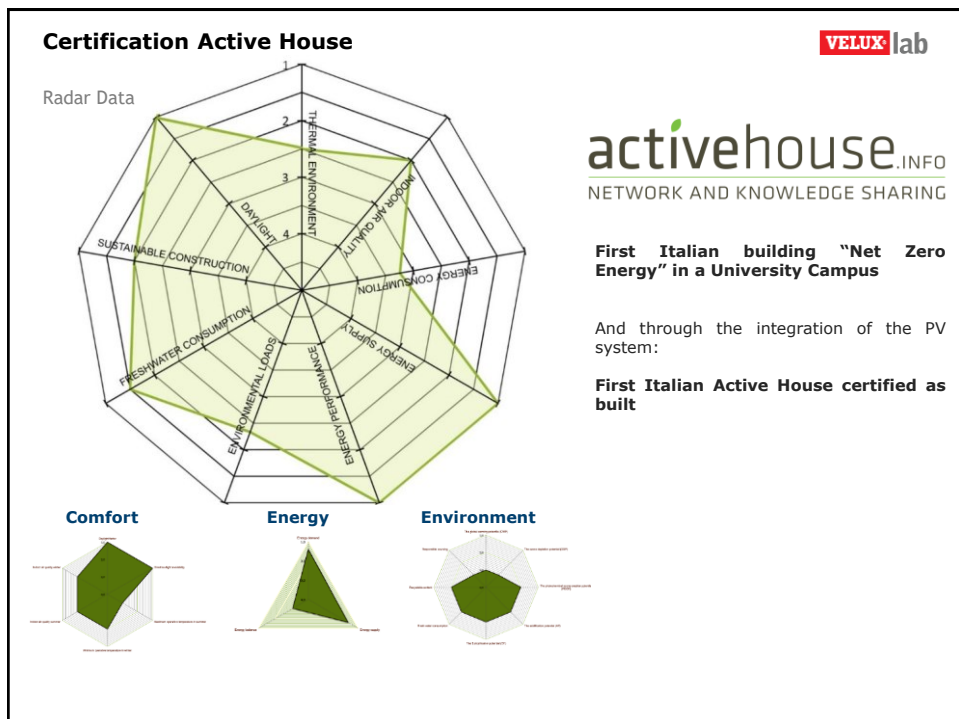
Case study - VELUXlab: COGNITIVE BUILDING and DATA VISUALIZATION



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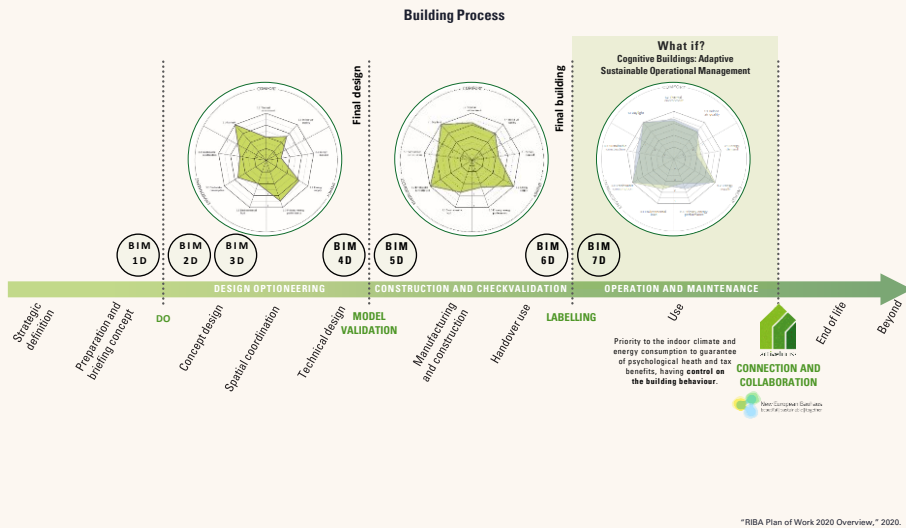
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Active House

- a user-centered method for the entire building process



Physical activehouse - Eng. PhD Nicole Di Santo

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Applications and Future Developments

A field study with different cases



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CPH Village

unit/district



A student housing with two offices surrounded by a calm urban forest, developed under the living small concept. It is under test for monitoring.



Physical activehouse - Eng. PhD Nicole Di Santo

Fig. CPH Village, Jernbanetorvet, Copenhagen, Denmark

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CPH Village

unit/district



The building sensors installed with different benefits.

AirBird

Standard Sensors:

CO2: 0 - 5000 ppm (± 30 ppm $\pm 3\%$ of reading), NDIR
Temperature: -20 to +60 Deg C ($\pm 0.5^\circ\text{C}$)
Relative Humidity: 1-99% ($\pm 3\%$),

MiniNode

Standard Sensors:

CO2: 0 - 5000 ppm (± 30 ppm $\pm 3\%$ of reading), NDIR
Temperature: -20 to +60 Deg C ($\pm 0.5^\circ\text{C}$)
Relative Humidity: 1-99% ($\pm 3\%$),

AmiNode

Standard Sensors:

CO2: 0 - 5000 ppm (± 30 ppm $\pm 3\%$ of reading), NDIR
Temperature: -20 to +60 Deg C ($\pm 0.5^\circ\text{C}$)
Relative Humidity: 1-99% ($\pm 3\%$)
Barometric pressure: 300 - 1100 hPa ($\pm 1\%$)
Particle Sensor: PM 2.5, PM 10, ($\pm 15\mu\text{g}/\text{m}^3$)
Lux meter (Lumens/SqM):
Decibel Meter: 30-110 dBA (20 Hz - 20 kHz), ± 1 dB



<https://leapsight.leapcraft.com/>

Phygital activehouse - Eng. PhD Nicole Di Santo

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CPH Village

unit/district



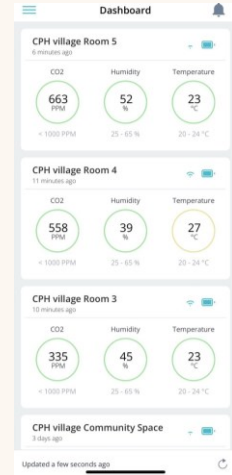
<https://leapsight.leapcraft.com/>; <https://en.climalid.dk/>; <https://lcpvillage.com/>; <https://www.velux.it/>

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CPH Village

unit/district



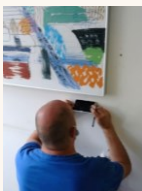
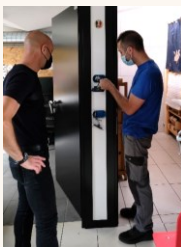
Physical activehouse - Eng. PhD Nicole Di Santo

<https://heapsight.leapcraft.com/>; <https://en.climalid.dk/>; <https://cphvillage.com/>; <https://www.velux.it/>.

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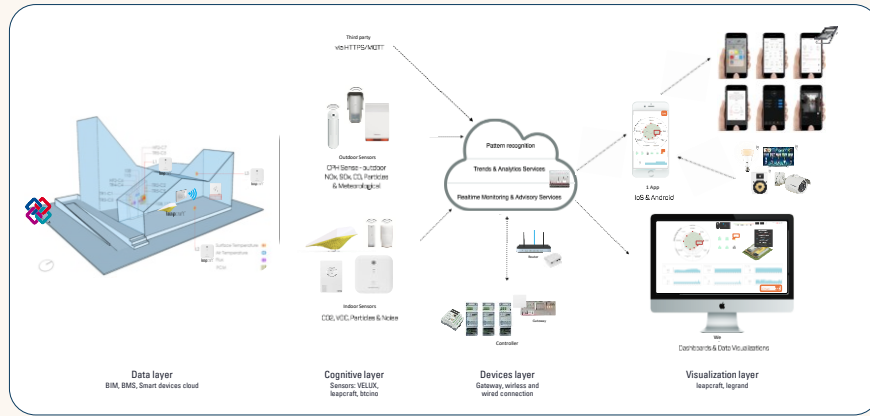
VELUXlab

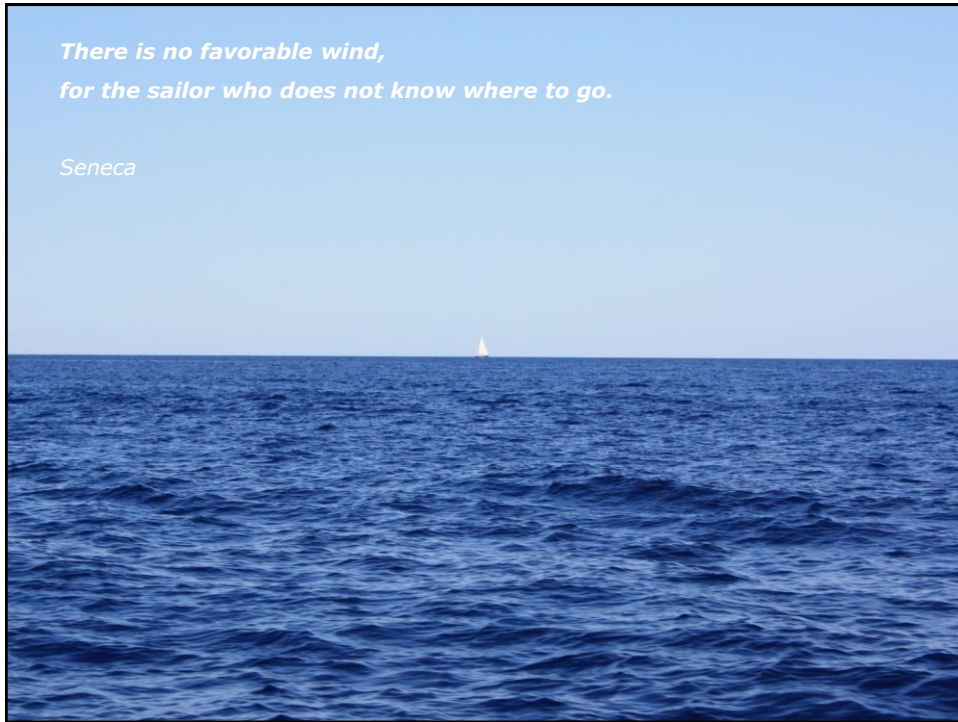
Installation VELUX-BTCINO-POLIMI



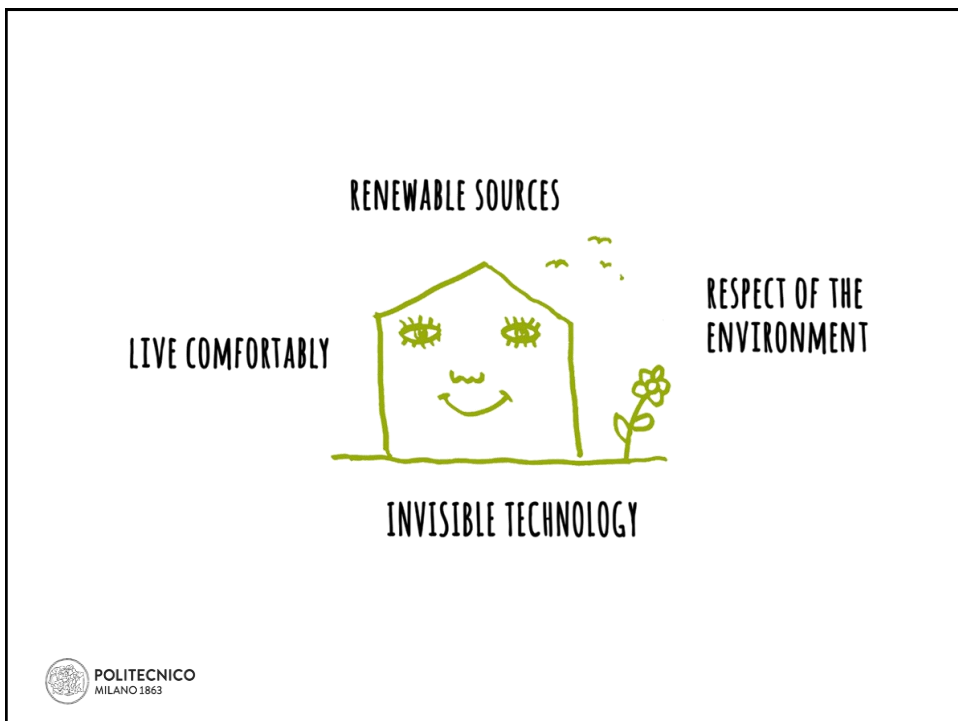
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