



FORUM DELLA TECNICA DELLE COSTRUZIONI

con il patrocinio di:



CONSIGLIO NAZIONALE DEGLI INGEGNERI



FEDERCOSTRUZIONI



ORDINE DEGLI INGEGNERI
DELLA PROVINCIA DI MILANO

INVOLUCRI AD ALTE PRESTAZIONI. TECNOLOGIE E REALIZZAZIONI

Ing. Enzo Bestazzi - Arch. Carlo Micono

Smart buildings in Smart Cities

MADEexpo

Milano Architettura Design Edilizia
Fiera Milano, Rho 05_08 Ottobre 2011



L'ESPERIENZA IN EDIFICI CON INVOLUCRO "SEMPLICE"

→ sistema "INVOLUCRO+IMPIANTO" ad alte prestazioni

CONIUGARE

→ esigenze committenza

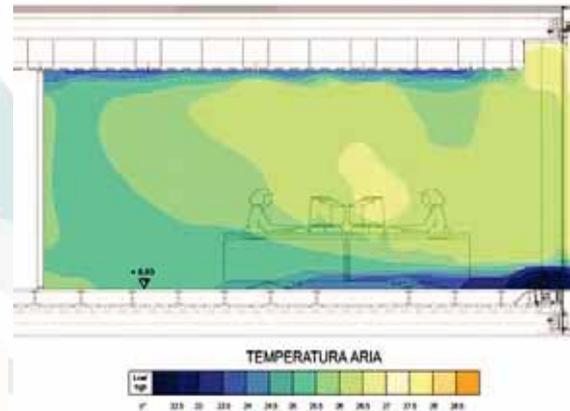
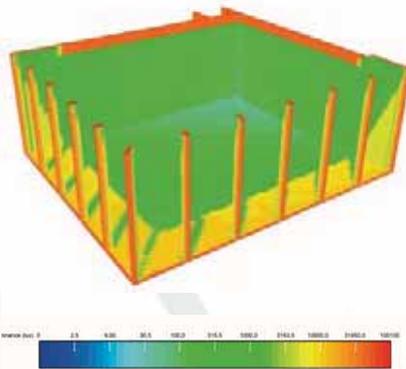
- risparmio energetico
- comfort ambientale

→ esigenze progettuali

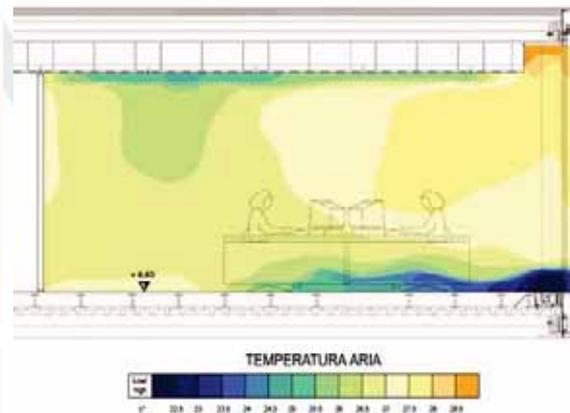
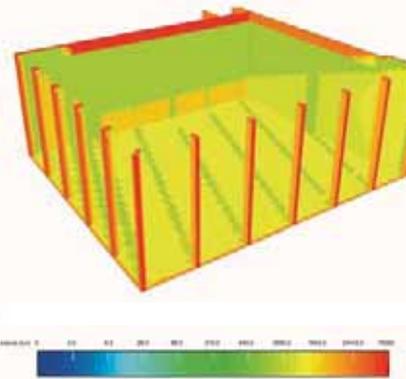
- massima trasparenza
- minima visibilità sistemi tecnologici



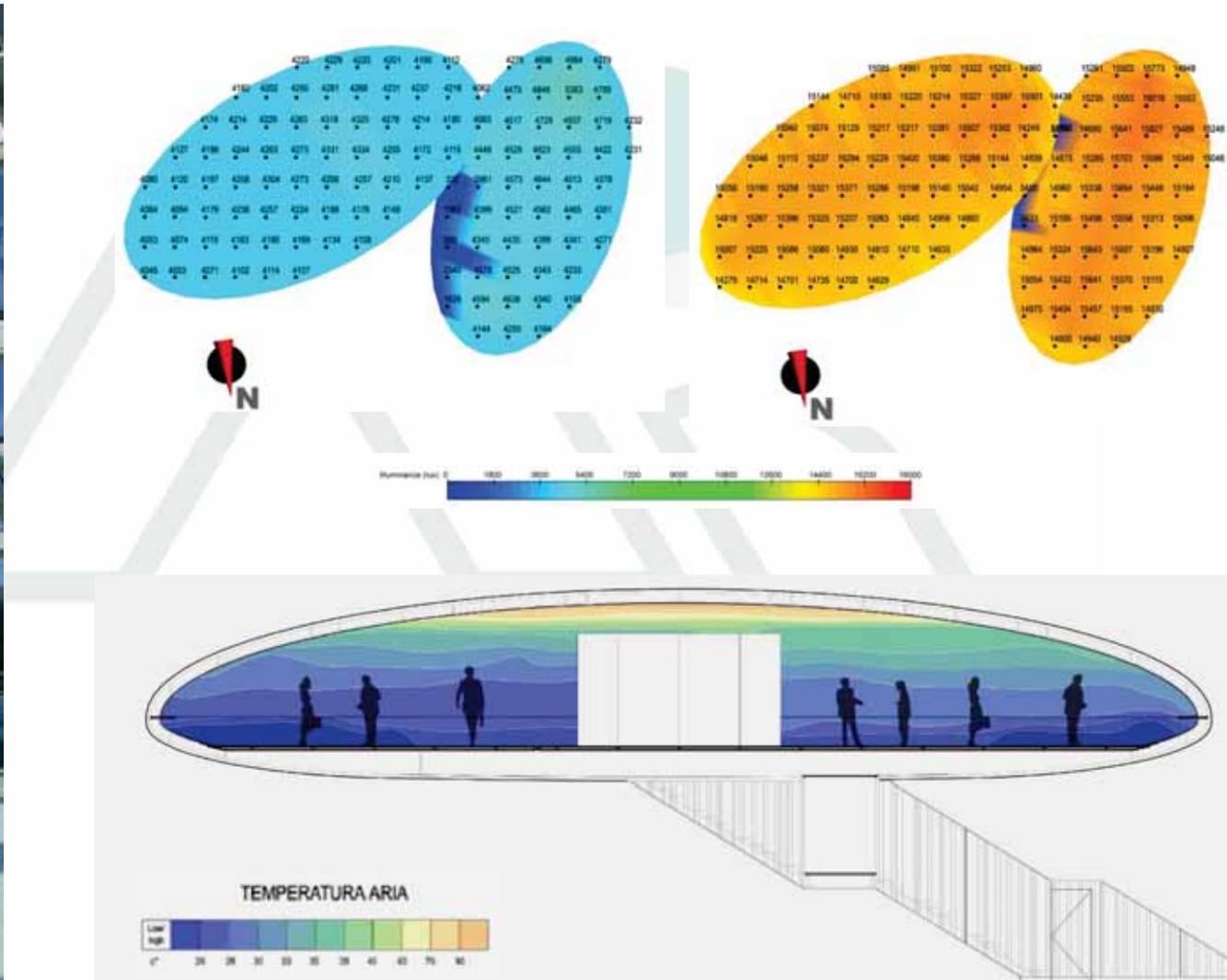
A TENDA ABBASSATA



A TENDA ALZATA

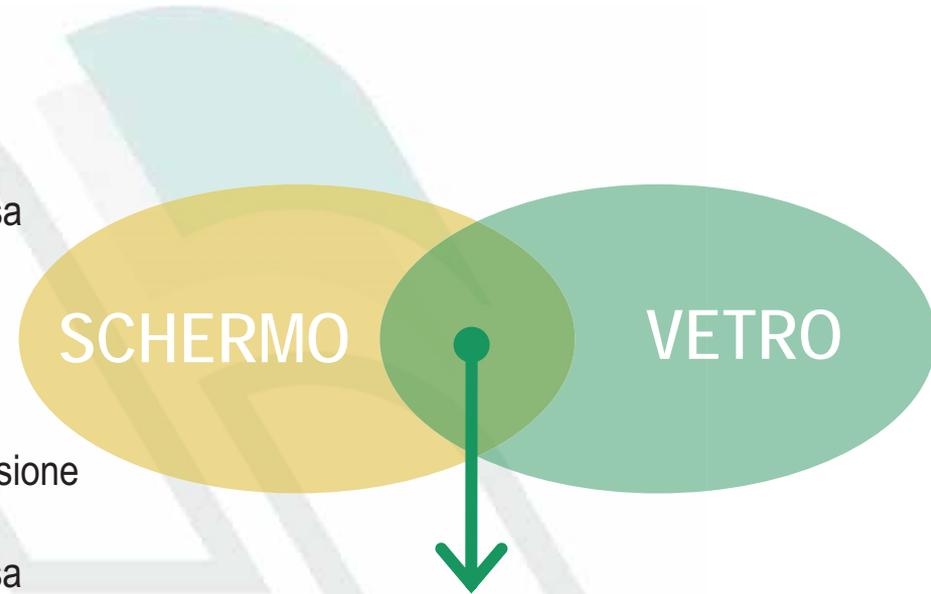
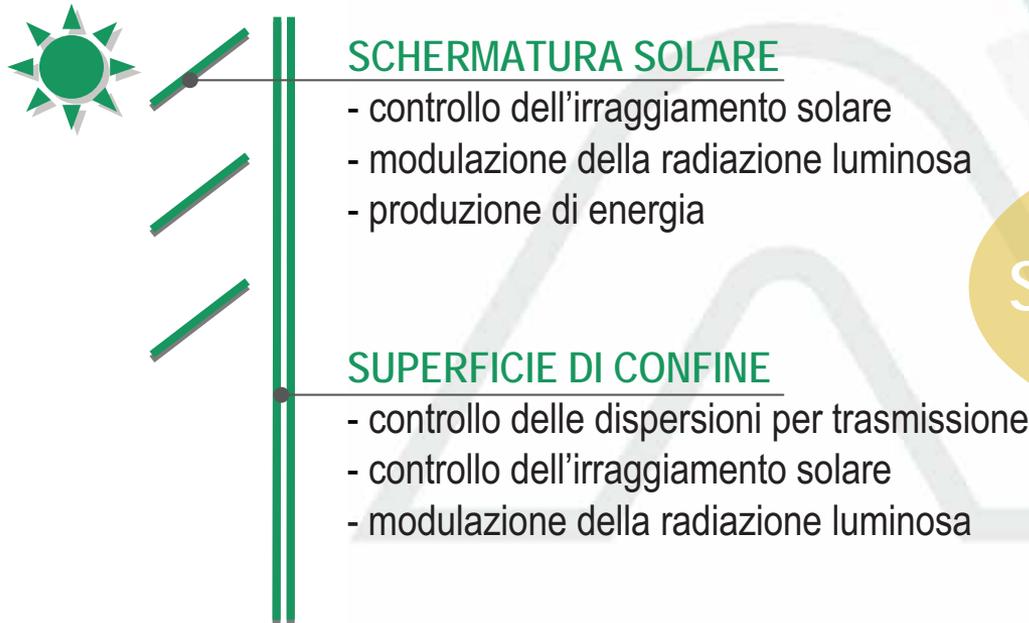


SISTEMA "EDIFICIO+IMPIANTO"



Strati funzionali

Approccio "di sistema"



PRESTAZIONI SISTEMA

funzione del tempo

funzione dello spazio

INVOLUCRO "MULTILAYER"



INVOLUCRO "MULTILAYER"

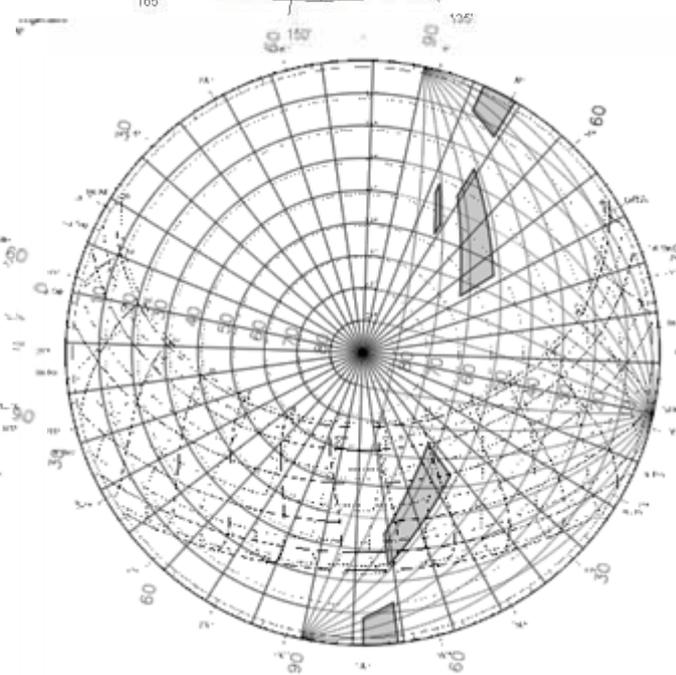
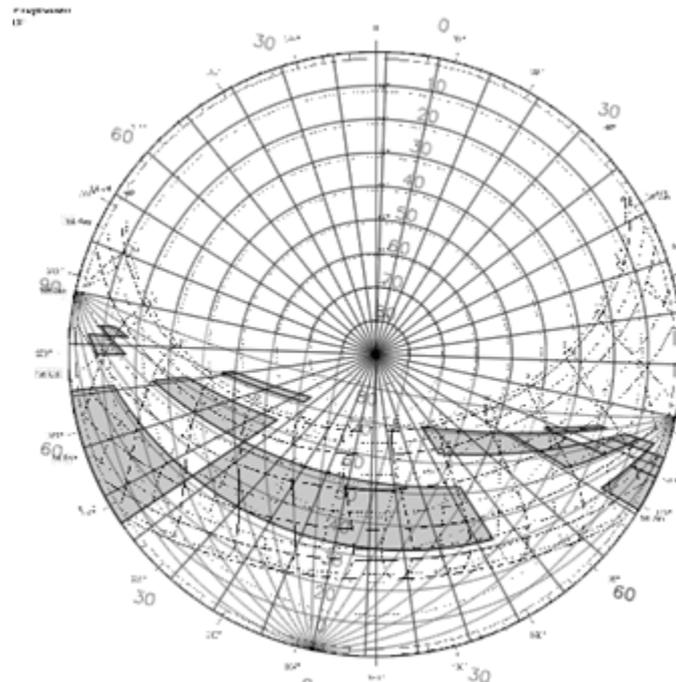
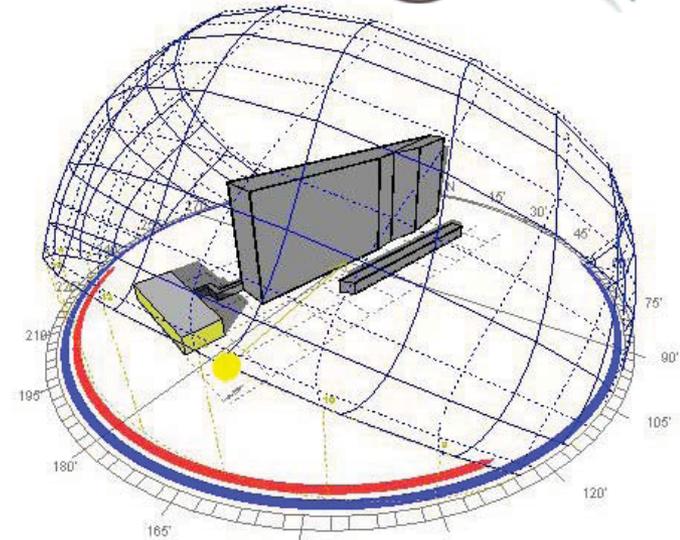


Facciate a pelle semplice



Fiera Milano, Rho (MI) - Progetto architettonico 5+1AA - 2010

INVOLUCRO "MULTILAYER"

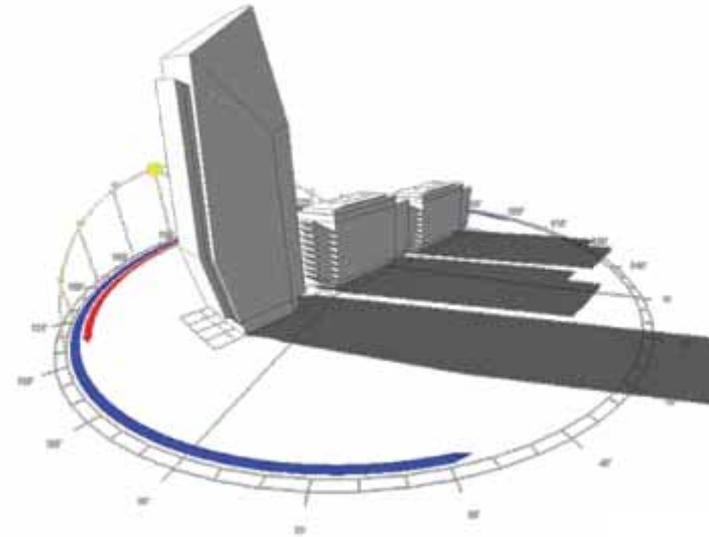
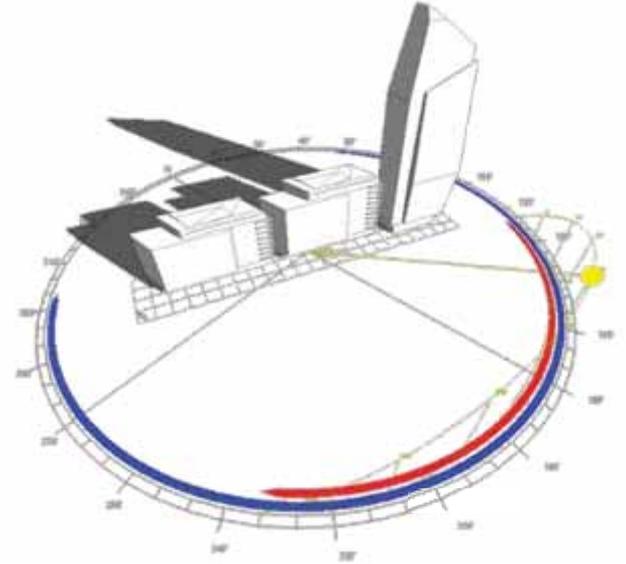


INVOLUCRO "MULTILAYER"

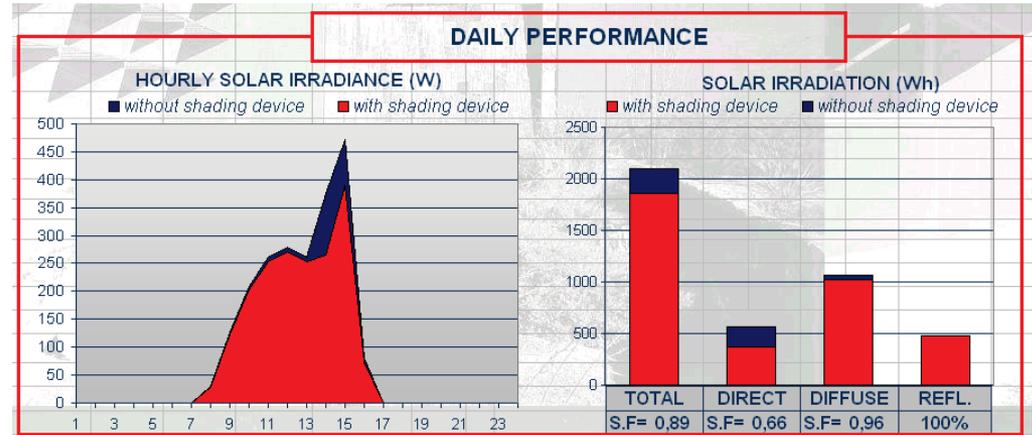
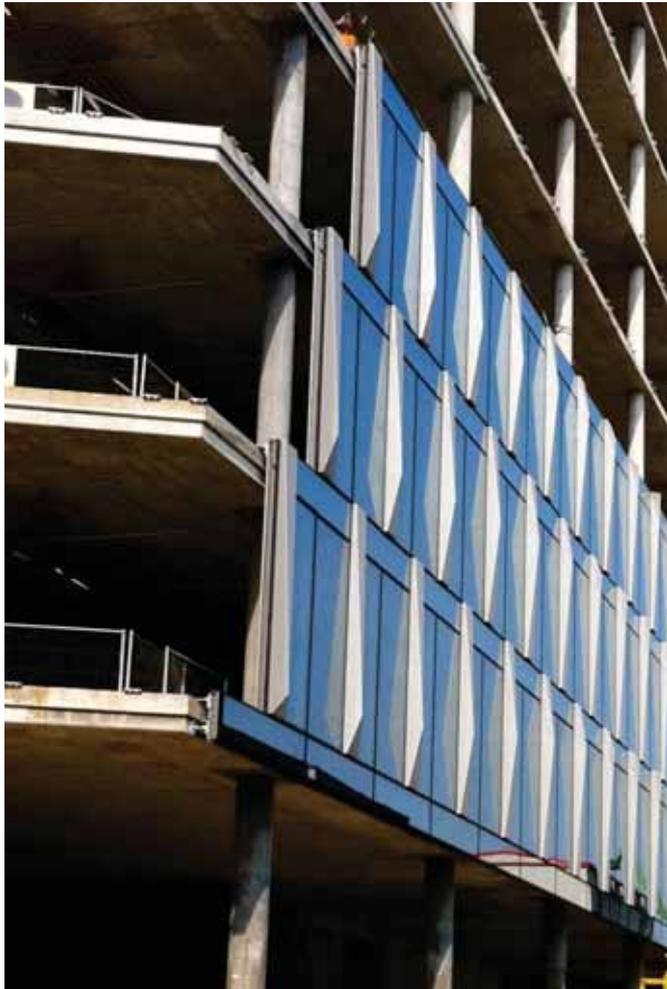


Porta Nuova Varesine, Milano - Progetto architettonico KPS - in costruzione

INVOLUCRO "MULTILAYER"



INVOLUCRO "MULTILAYER"





DOPPIA PELLE



FACCIATA A
DOPPIA PELLE
+ 80% guadagni solarl



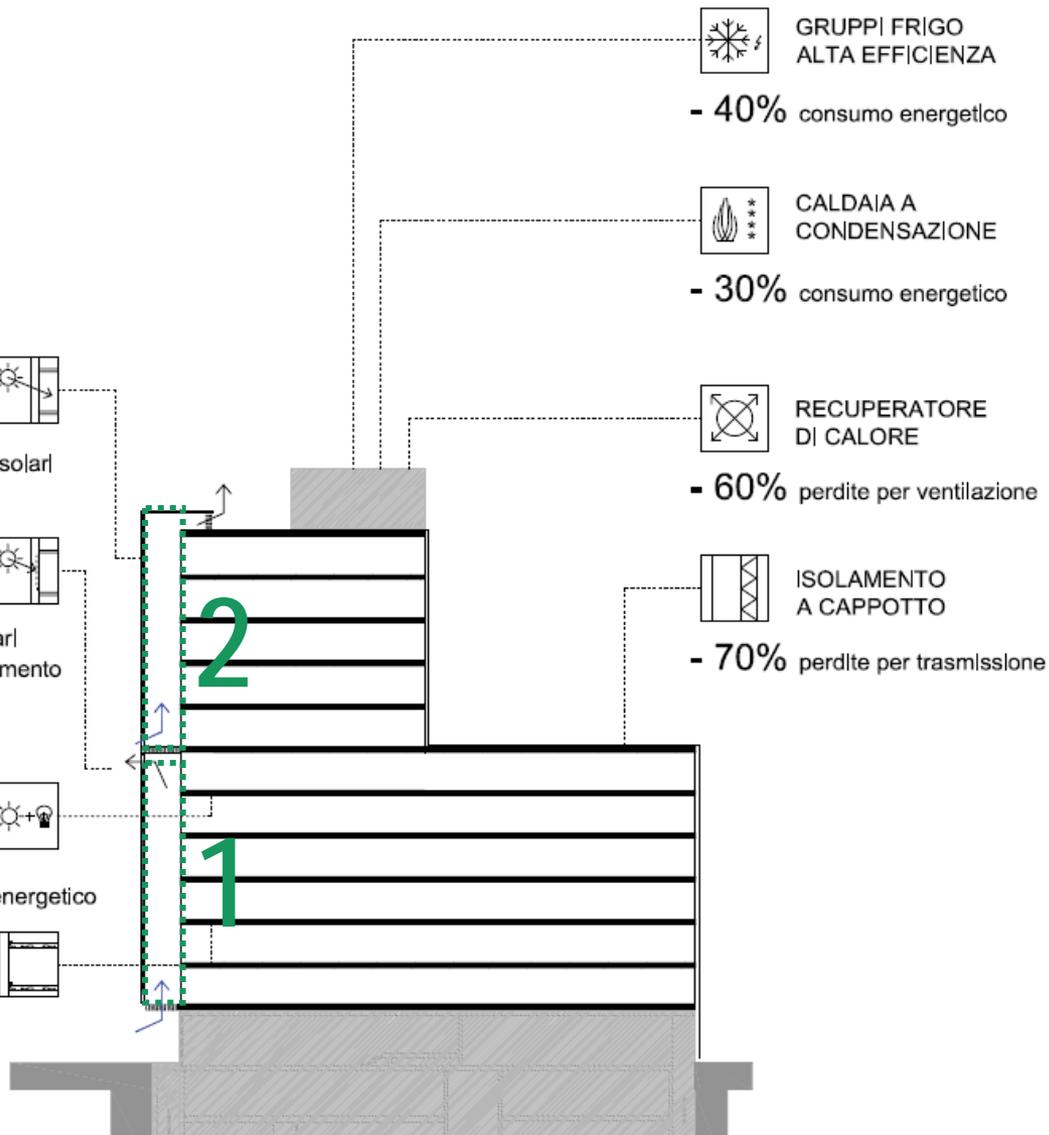
FACCIATA A
DOPPIA PELLE
- 40% carichi solarl
condizionamento



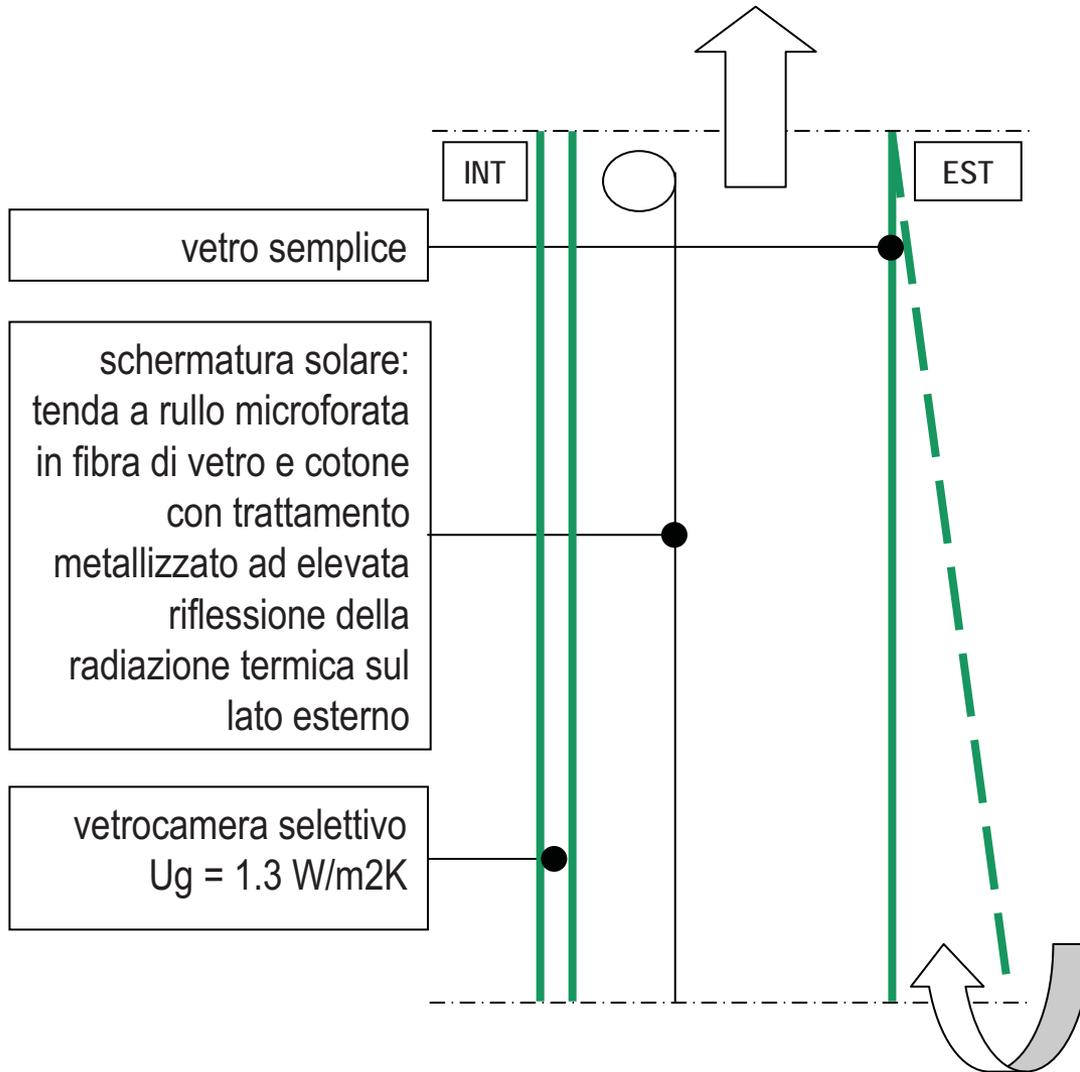
ILLUMINAZIONE
DIMMERABILE
- 40% consumo energetico



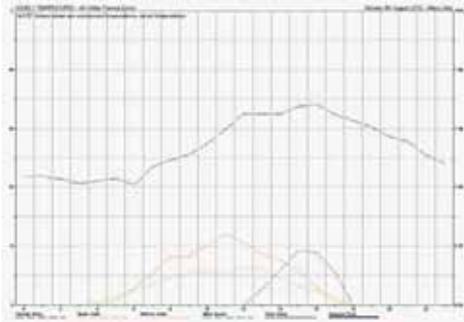
DISTRIBUZIONE
ARIA A PAVIMENTO
> comfort termico
> comfort acustico



Morfologia della facciata

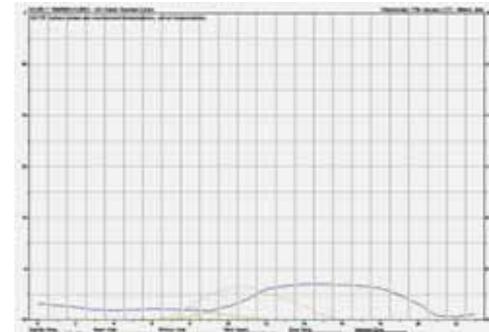


Giornata estiva

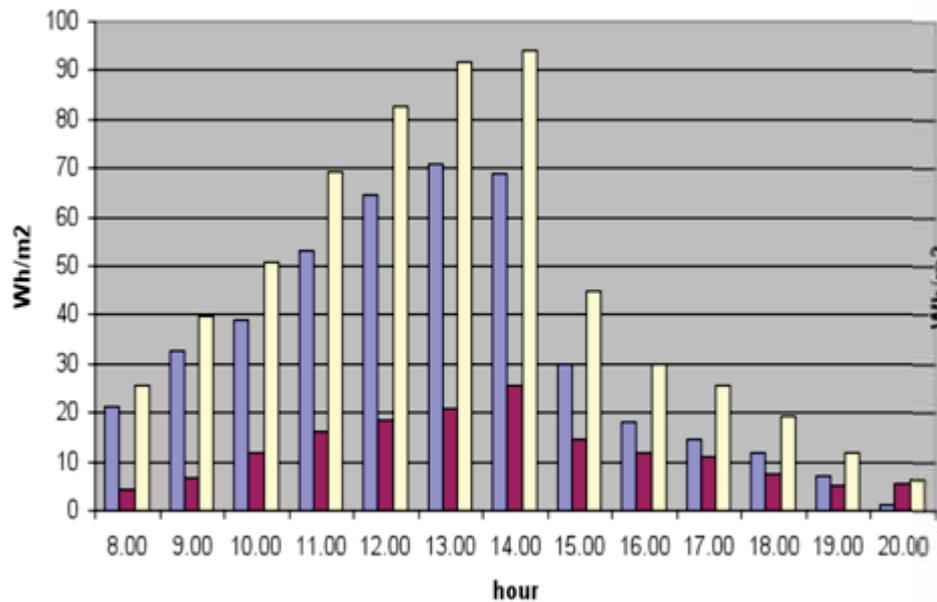


Energia entrante attraverso la facciata

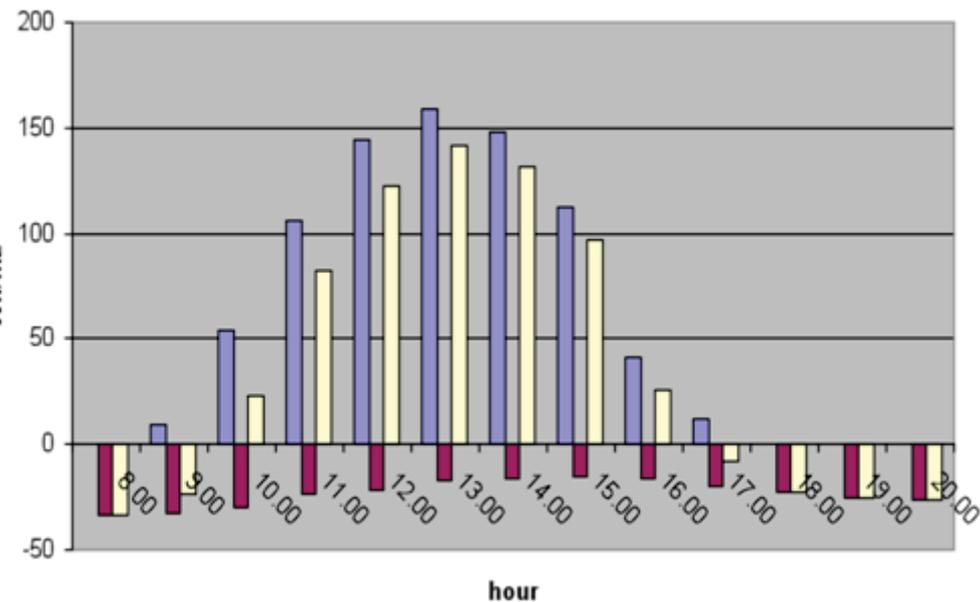
Giornata invernale



Energia entrante/uscente attraverso la facciata



■ Esol [Wh/m2] ■ Etrasm [Wh/m2] ■ Etot [Wh/m2]



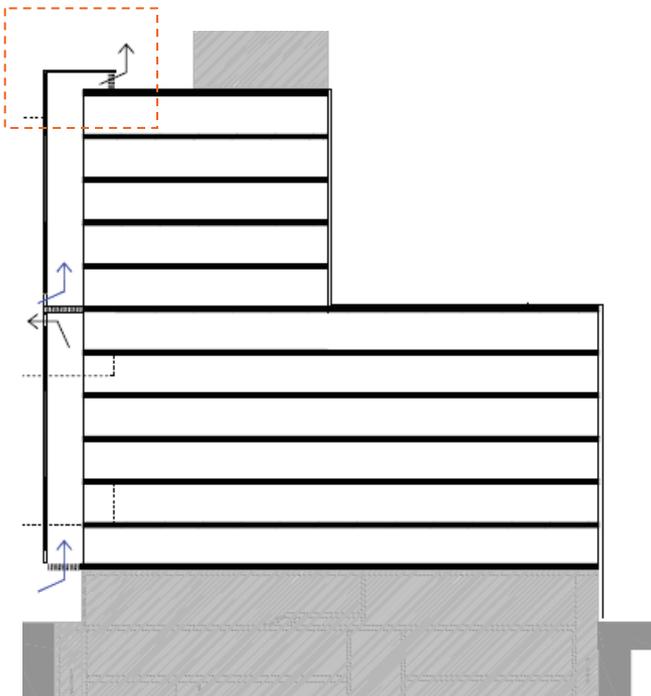
■ Esol [Wh/m2] ■ Etrasm [Wh/m2] ■ Etot [Wh/m2]

Collaudo

Giornata estiva (18 luglio)

$$- t_{a,e} = + 29^{\circ} \text{ C}$$

$$- I = 590 \text{ W/m}^2\text{K}$$



INTERCAPEDINE APERTA

aperture da progetto

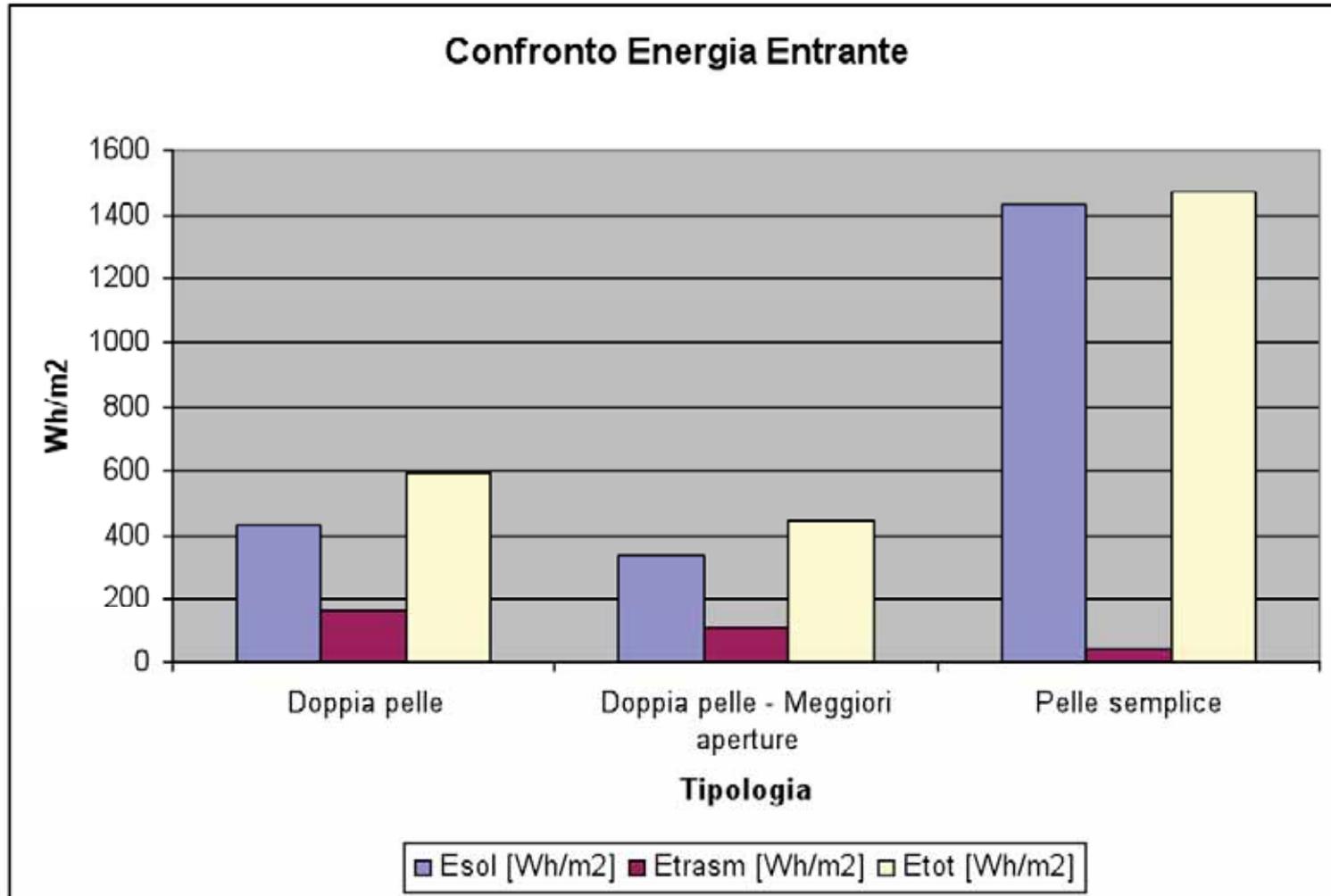
$$t_{a,i} = + 42^{\circ} \text{ C}$$

maggiori aperture

$$t_{a,i} = + 40^{\circ} \text{ C}$$

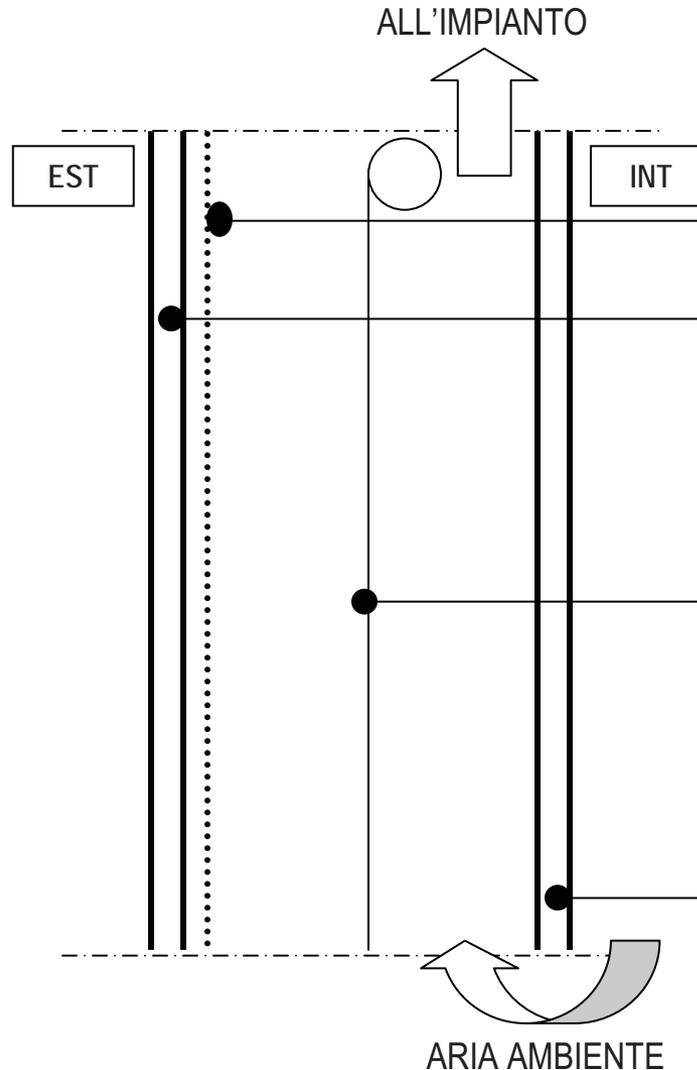


Analisi energetica : confronti





NUOVA CONFIGURAZIONE: MORFOLOGIA E FUNZIONAMENTO



Serigrafia a righe orizzontali chiara
(bianco - grigio) $\geq 15\%$
(Protezione avifauna)

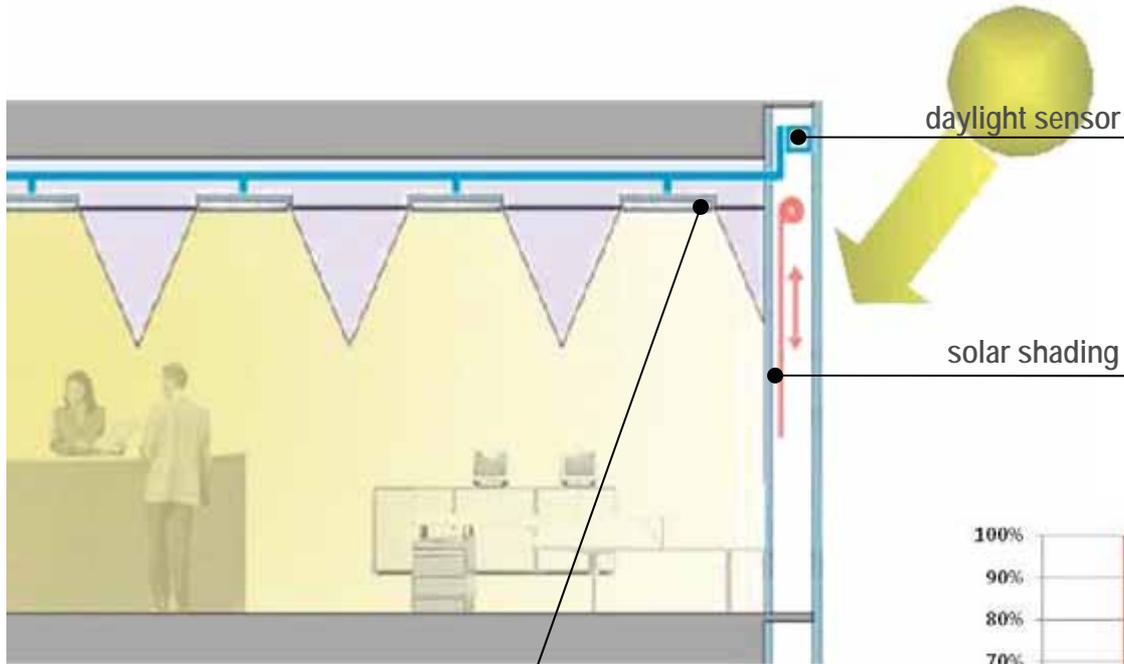
vetro camera esterno extrachiaro
 $U_g = 2.5 \text{ W/m}^2\text{K}$
 $g = 0.60$
 $tl = 68\%$

tenda a rullo microforata in fibra di
vetro e cotone
 $ts = 8\%$
 $rs = 55\%$
 $tl = 11\%$

vetrocamera interno selettivo
 $U_g = 1.3 \text{ W/m}^2\text{K}$
 $g = 0.42$
 $tl = 70\%$

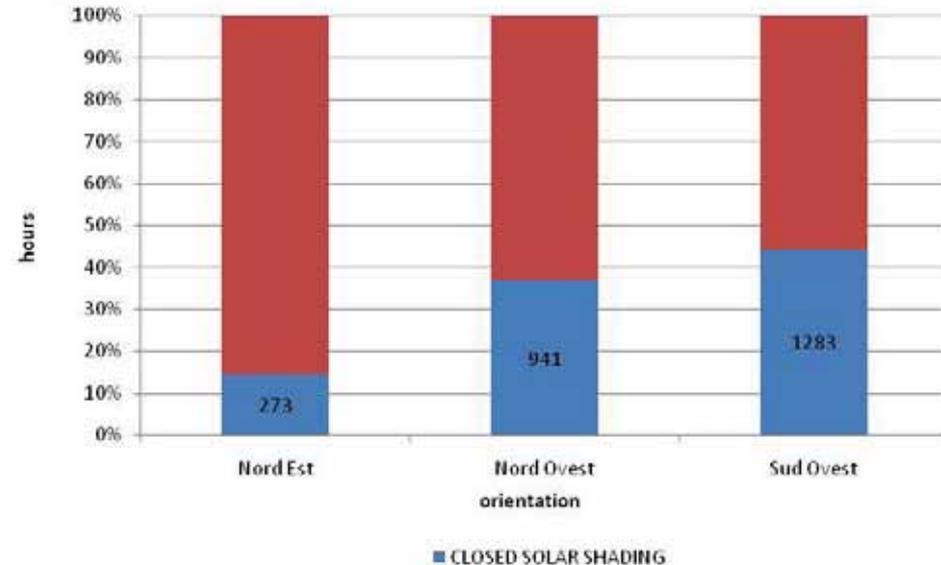
COMFORT VISIVO

[Simulazioni con TAS Building Simulation Tool 9.0.9e e TAS Ambiens]



Luci dimmerate per avere 500lux sul piano di lavoro

Numero di ore con la schermatura aperta e chiusa nei diversi orientamenti



LA SIMULAZIONE

The image displays a software interface for building simulation, likely EnergyPlus or similar. The main window shows a 3D model of a building facade with a color-coded thermal map. The facade is divided into several vertical sections, with colors ranging from red (high heat gain) to blue (low heat gain). The top section is red, the middle section is cyan, and the bottom section is blue. A legend on the right side of the 3D view identifies the colors: red for 'air gain', cyan for 'solar gain', and blue for 'air loss'.

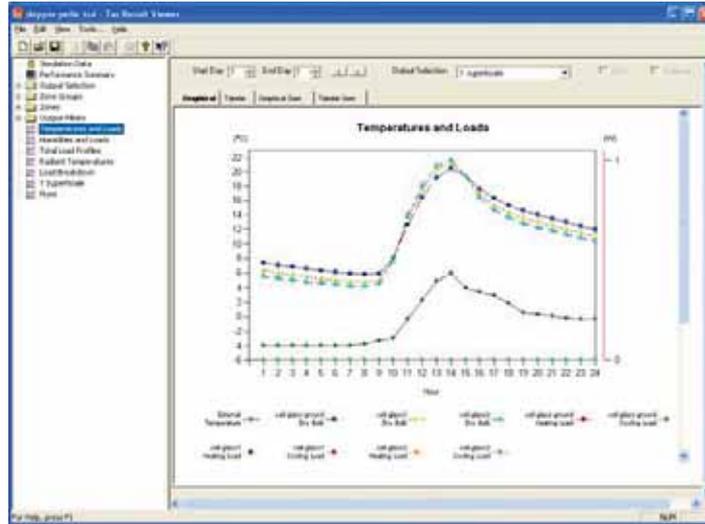
Below the 3D view, there are two 2D floor plan views. The left one shows the 'open wall' and the right one shows the 'open ground'. The bottom left corner shows a tree view of the simulation setup, including 'Zone Group', 'Zones', 'Internal Conditions', 'Schedules', 'Constructions', 'Aperture Types', 'Substitute Elements', 'Feature Shades', 'Surface Output Specifications', and 'Inter Zone Air Movement'.

In the bottom center, there is a table titled 'UIR Values (ISO 1546) (Homogenous)'. The table has three columns: 'Flow Direction', 'Internal U Value (W/m²·K)', and 'External U Value (W/m²·K)'. The rows are 'Horizontal', 'Upward', and 'Downward'. The values are: Horizontal (0.415, 0.436), Upward (0.43, 0.441), and Downward (0.406, 0.428). There are also buttons for 'Show U Values' and 'Show R Values'.

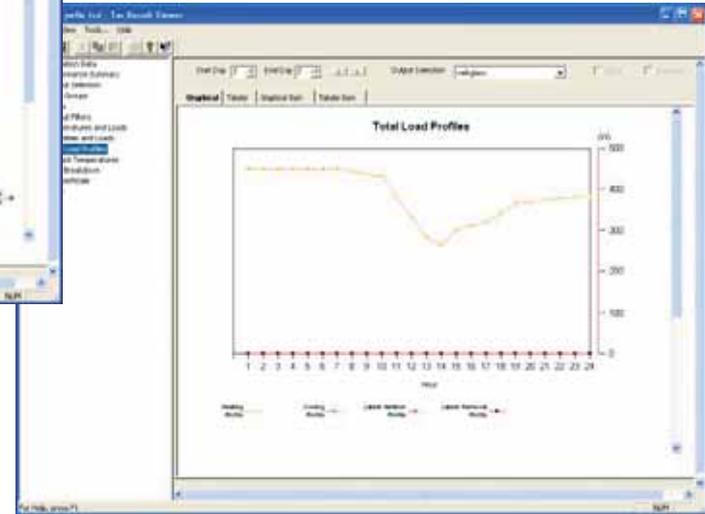
At the bottom right, there is a large data table with many rows and columns, showing simulation results. The table has columns for 'Time', 'Zone', 'Surface', 'Value', and 'Unit'. The data is color-coded, with red for positive values and blue for negative values.

LA SIMULAZIONE : RISULTATI

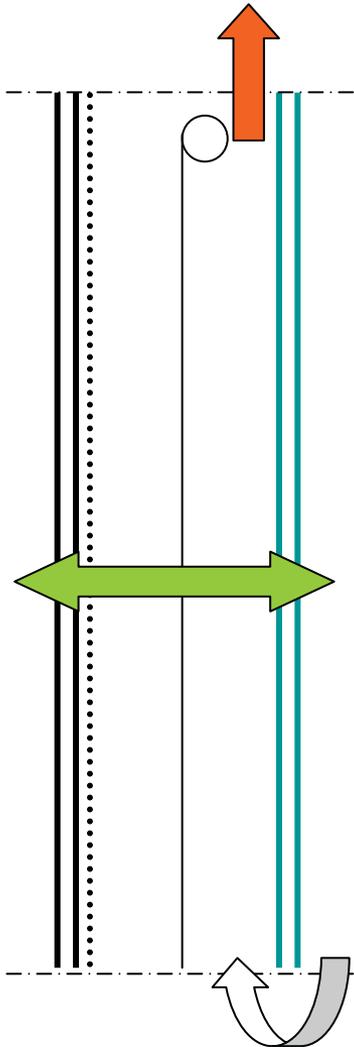
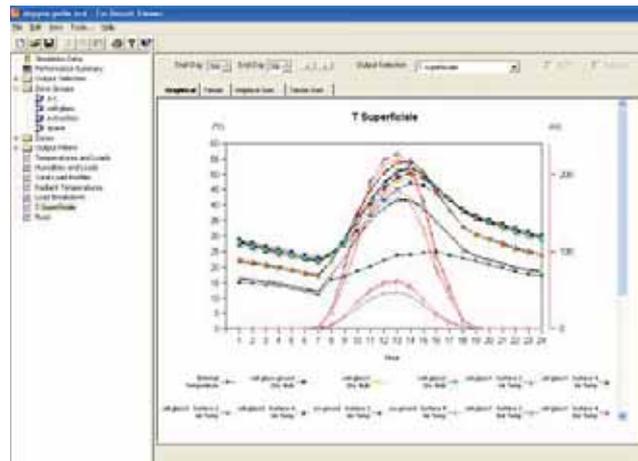
Temperatura aria estratta



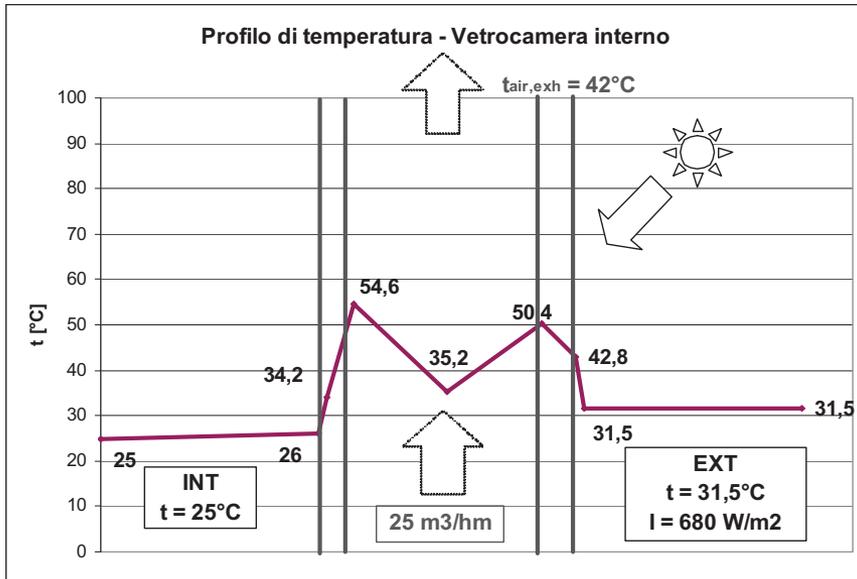
Flussi termici entranti / uscenti



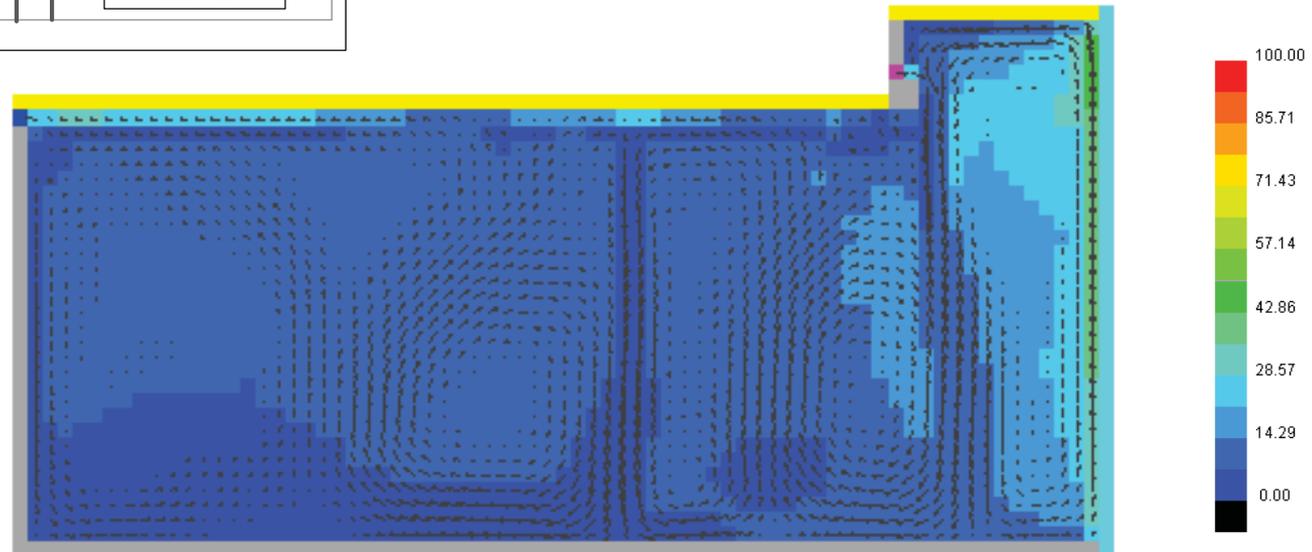
Temperatura superficiale vetri



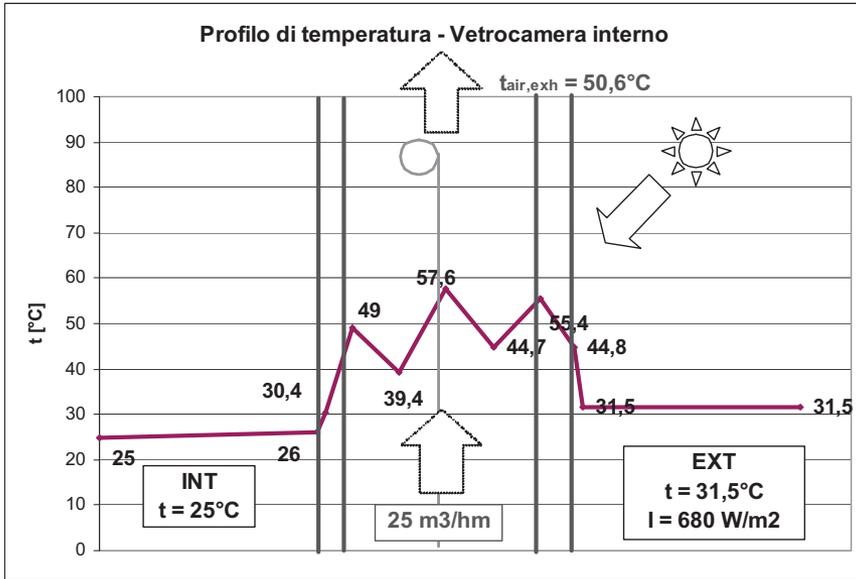
ANALISI DI COMFORT TERMICO



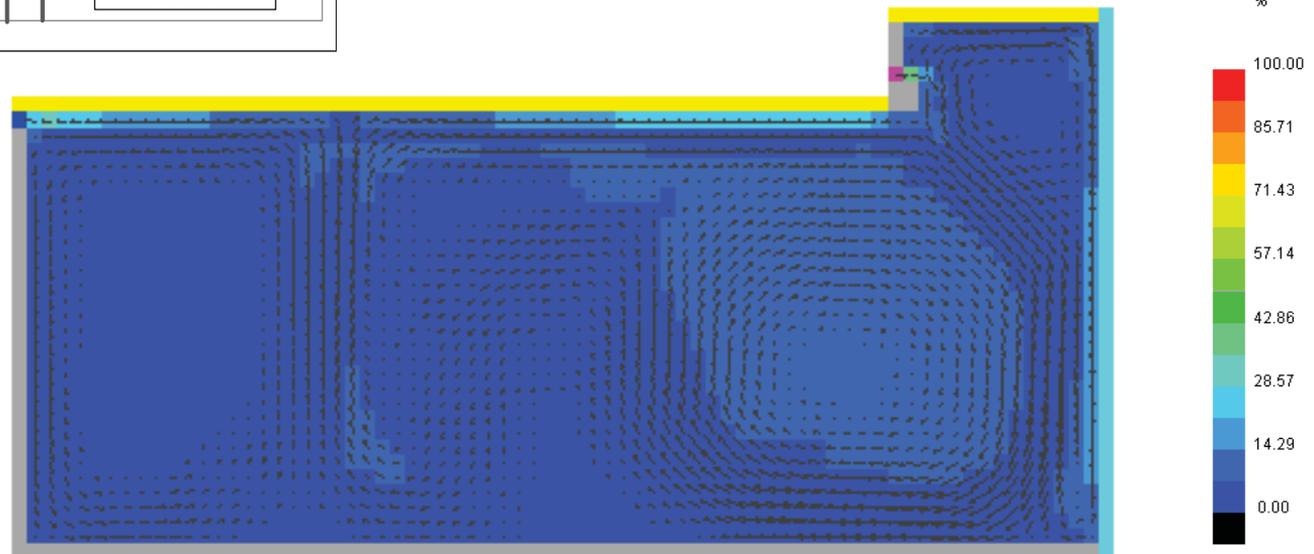
Schermatura alzata



ANALISI DI COMFORT TERMICO



Schermatura abbassata



oice

Associazione delle organizzazioni di ingegneria,
di architettura e di consulenza tecnico-economica



MADEexpo

Milano Architettura Design Edilizia
Fiera Milano, 8ho 05_08 Ottobre 2011



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