POLITECNICO DI TORINO
SECOND SCHOOL OF ARCHITECTURE
Master of Science in Architecture
Honors theses

Transparent Inertia: Design and experimental validation of a facade component with multi-wall polycarbonate and PCM

by Bruno Giampà and Gianluca Gindro
Tutor: Orio De Paoli
Co-tutors: Elena Montacchini and Valentina Serra

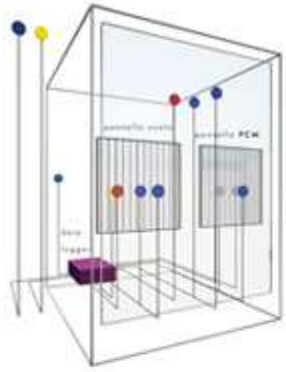
This thesis aims to explore potential uses of Phase Change Materials (PCM), in order to obtain thermal inertia qualities in lightweigth buildings and glazing facades.
Because of their lightness and transparency, windows are generally overly sensitive referring to solar radiation and external thermal variations. At mid-latitudes windows tend to produce high heat losses during the cold seasons and excessive solar gain during the summer period.
Thermal inertia connected to windows means to achieve more effective thermal control on interior space or optimize solar captation when it is available.

PCM
Phase Change Materials (PCM) include a wide range of substanses (paraffins, salt hydrates,...) which can store large amount of thermal energy as latent heat, during solid-liquid phase change.
Their spread is at the moment restricted to a few applications, while their inner potential is not completely expressed in the construction practice.
PCM should be incorporated in shells or other packagings to avoid leak of the fluid while working.
After screening different polymeric materials to encapsulate the paraffins, we decided to design and prototype a specific system to be tested.
A multi-wall polycarbonate panel is selected to encapsulate the PCM in its cavities, using two paraffins with different melting points, in order to enlarge the operative range and separate winter strategies from summer ones. Panel is than sealed with eligible silicone.

EXPERIMENTAL CAMPAIGN

Due to the experimental kind of technology, an experimental investigation is necessary to verify the effective behaviour of the panel associated with glazing facade. For this reason the PCM component (40 x 40 cm), is integrated in a common glazing facade portion.

This system was monitored in DENER cells during the whole month of april, 2010. Results show how the partition with PCM mantains a lower temperature until afternoon, while during the night it remains 4-5℃ warmer than the glass facade without PCM. Consequently heat flux towards interior space is reduced during the day while heat losses are cut down during the night. This behaviour appears really desirable especially during intermediate periods like autumn or spring.

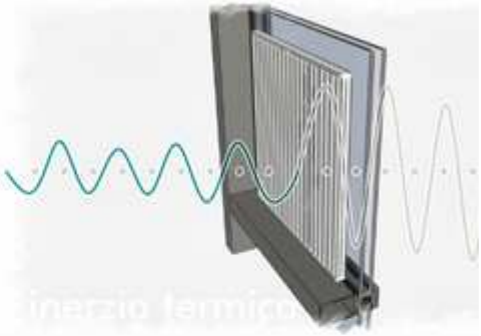


Proprietà termiche

INERZIA TERMICA

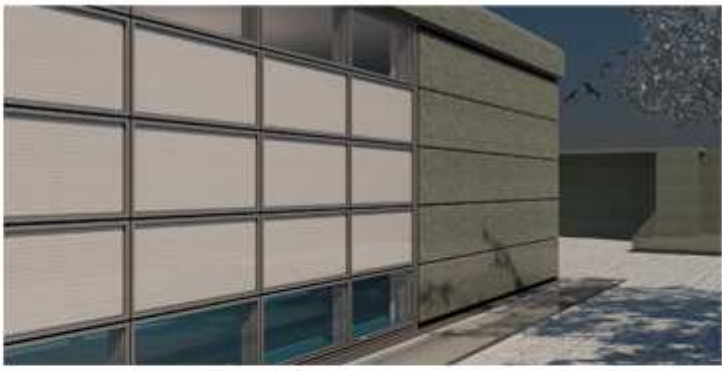
Proprietà ottiche

TRASPARENZA VARIABILE



CONCEPTS

Last part of this work explores design and application possibilities of the tested components for an effective integration in buildings. Some proposals suggest the use of this panels including PCM to realize curtain walls, false-ceiling for glazing roofs, translucent envelopes for precast housing, and also interior furniture. Varied examples will demonstrate that PCM could reach a wide spread of application in the construction area.



For further information, e-mail:
Bruno Giampà: bruno.giampa@libero.it
Gianluca Gindro: giangin84@alice.it