Promotion of Eco-building Technologies, small Polygeneration and Renewable Heating & Cooling Technologies for Buildings

ProEcoPolyNet Technology Profile

Advanced glazing and windows

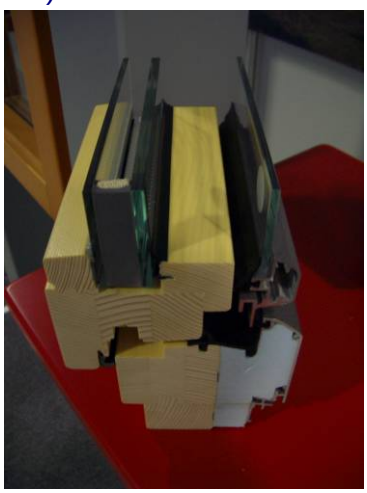
Introduction

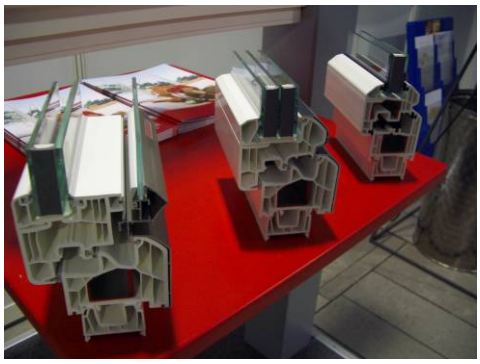
Visual perception is the most advanced human sense. We gain more than 90% of all the information from our environment in this way. Visual contact with the surroundings and proper daylighting of living and working spaces influence visual comfort, general level of complacency, health, and quality of work. Glazing and windows are one of the most important elements of the building envelope. They provide visual interaction with the outside world and daylight, they serve as a means of natural ventilation, and they can significantly influence running costs of a building through increased or decreased heating and cooling demand. Modern glazing and windows combine excellent thermal characteristics (thermal resistance, air-tightness) with still acceptable light transmission. Advanced technologies include highly energy efficient windows, solar protection glazing with high light transmission and thermal resistance (highly selective glazing), or changing of transmission characteristics via outside impulses (switchable glazing).

Description

Energy efficient glazing and windows

Modern windows are no longer as distinct a weak point in the building envelope as they were in the past. Especially in low energy and passive building design their thermal characteristics can reach values comparable to those of moderately insulated walls. Window frames are either multi-chambered (PVC), noticeably thicker (wood), with intermittent thermal bridges (metal), or designed as a combination of different materials. Multiple seals and multi-point locking secure excellent air tightness. In some EU countries technical regulations already prescribe low-E + gas glazing as the minimum threshold (example for Slovenia: U-value_glazing = 1,1 W/m^{2}K, U-value_window = 1,6 W/m^{2}K). In passive house technology glazing is usually multi-layered (triple), with two low emission coatings and inert gas filling. The overall window U-value is 0,8 W/m^{2}K (glazing itself: max U-value = 0,7 W/m^{2}K) or less.



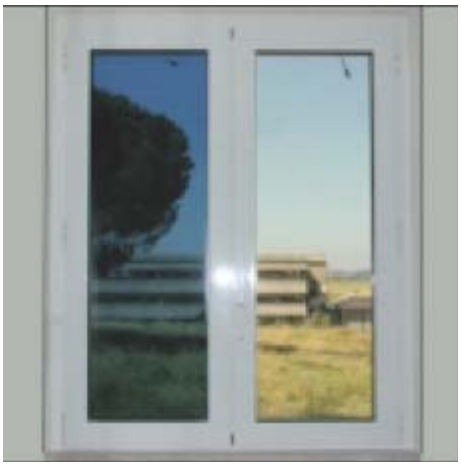


Switchable glazing

Very important work concerning switchable glazing was carried out in the SWIFT project, supported by EC under the 5th Framework Programme (contract no. ENK6-CT-1999-00012). Further text is partially based on the content of the deliverables of this project.

The so-called "*chromogenic*" materials are able to change their optical properties in response to external stimuli, such as an applied electrical field, ion insertion, light intensity or temperature, thanks to particular physical and chemical properties. The kind of variations that characterises chromogenic devices allows a transformation of the material, from a highly transmitting state, through a partially reflecting one, to one absorbing or scattering the whole solar or visible light spectrum. When this

change is sufficient in magnitude, then the material may be useful for building and solar applications.



EC test window at ENEA, Italy (SWIFT project)

Amongst the emerging “smart glass” technologies, *Electrochromics* (EC) and *Gasochromics* (GC), which can be actively controlled to modulate solar radiation, appear to be the most promising in terms of meeting broad daylighting needs and are, probably, even the most advanced as markets products; on the other hand, other technologies (*Photochromic*, *Thermochromic*) may be well suited for specific niche building applications.

Performance

The performances achieved by switchable glazing systems may vary broadly according to the particular task. For reading, writing, and object-manipulation tasks, in fact, the most significant and immediately evident advantage guaranteed by a switchable window is the simultaneous provision of views and the control of interior illuminance. Concerning the visual and solar transmittance levels of a switchable window, a very low transmittance in its fully-coloured state may present great advantages because visual comfort can be improved, while, simultaneously, solar gains can be reduced to a level that expensive external shading is not any more required. In general, switchable glazing alone cannot simultaneously provide control for direct light, solar protection and assure an optimal daylight level for every task, view and solar angles. Satisfying one criterion would be detrimental to the other.

Benefits and advantages

Switchable dynamic glazing provides a means to adapt the building to specific needs varying with time and weather. By continuously adapting to changing light and weather conditions, a dynamic building skin can assure adequate levels of illumination inside the building and sufficient solar protection against overheating, thus reducing the primary energy consumption of the building and creating a pleasant environment for the people inside.

This helps globally to reduce the greenhouse effect by limiting emissions, and locally to keep the investment and operational cost of building technology as low as possible. Use of a façade incorporating switchable windows in combination with internal protection systems can provide benefits such as improved occupant comfort and perhaps performance and productivity - providing a balance between the amount of solar radiation let in the room and the disturbance given by glare and contrast - while always maintaining an unrestricted visibility and transparency to the outside.

Cost/Benefit

It is important to caution against direct cost comparisons, because the use of switchable glazing means generally turning the window into an appliance with a whole new set of features and benefits for the building occupants, which can transform the building character and even reduce annual operations and maintenance costs. Thus, inclusion of hard-to-quantify factors such as comfort, productivity, tenant retention and building amenity should also be included in the analysis. A correct use of a switchable glazing can result in improved energy efficiency and reduced energy demand, with the environmental benefits of reduced consumption of fuels in power plants, reduced emissions from existing power plants, and reduced need for construction of new power plants. Moreover, a reduction of heating and cooling loads means less space required for equipment, smaller mechanical rooms, smaller shafts and less ceiling plenum height, with the consequent economic profits for the builder. Of course, the benefits in terms of energy saving and peak load reduction are dependent very much on the reference technology. The advantage of switchable façades is that they may be as efficient as expensive external shading on top of low-E coated glazing, but have additional advantages as visibility and non-mechanical operation. Therefore, instead of purely financial estimates, other benefits for the client should be considered, such as increased daylighting with reduced glare or

solar gain and increased access to views, which do not need to be obstructed or covered to maintain thermal and visual comfort.

Market situation

Switchable devices are currently surely more expensive than traditional fenestration products, though they will probably decline in cost as the technology and the manufacturing processes mature, and adequate market share is gained.

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Contact and further information

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ProEcoPolyNet is a **Net**work for the **Pro**motion of RTD results in the field of **Eco**-building technologies, small **Poly**generation and renewable heating and cooling technologies for buildings.
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