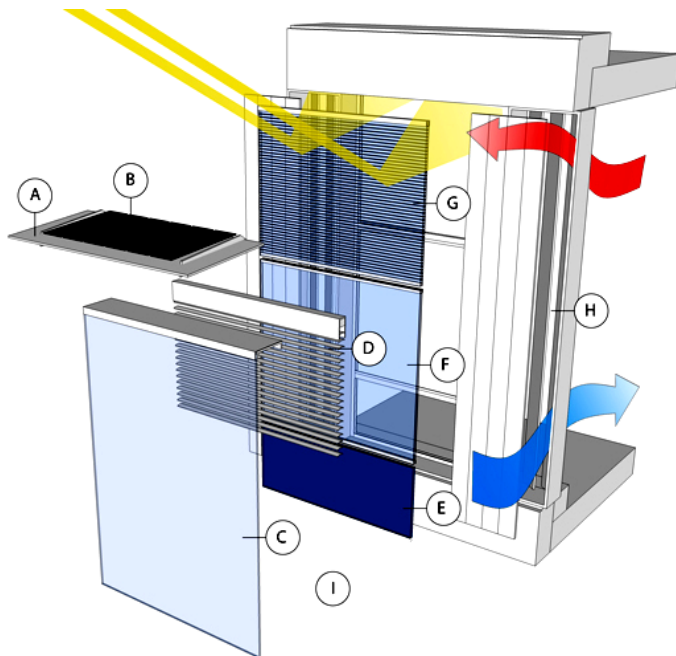


TOPIC OF THIS NEWSLETTER: Environmental Considerations for Building Envelopes

Façade Elements

A building's envelope is its skin; directly interacting with the environment its efficiency is critical to the performance of the building. Ideally the façade element will be made up of components with active and passive functions that work to regulate the energy consumption and the comfort level of the residents.

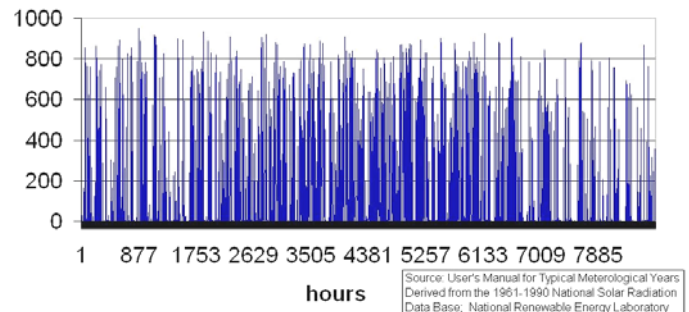


Intelligent façade element with potential components

- A. Sun shade device
- B. Photovoltaic (PV) cells
- C. Outer pane of glass – Clear monolithic vision glass with low-e coating
- D. Operable Blinds
- E. Insulating opaque panel with nanogel filling
- F. Clear vision glass – Insulating glass unit with low-e coating
- G. Insulated sun protective glass with fixed mirror blinds
- H. Operable vent for natural air ventilation with heat exchange and evaporative cooling.
- I. 24" Airspace between inner and outer glass

For each major city in the US there is a typical, statistical chart (see figure below) for the sun intensity, hour by hour, for each hour of the year, based on decades of observation. These charts allow us to simulate the façade behavior, calculate thermal stresses, and accurately estimate the amount of energy that can be harvested with each PV panel.

**Solar Irradiance, normal to sun rays [Wh/m²]
for Toledo, Ohio**



Example of a standard chart of hourly sun intensity

Contrary to hermetically sealed glass enclosures in the past, net-zero energy buildings require facades that are almost like “living skins”. They allow local adjustments of shades for each room of a building, openings for natural air ventilation, and redirection of sun-light into the interior of the room.

The goal is to decentralize many of the functions that consumed much of the external energy in the past, while creating local comfort with a minimal use of external energy.

This will change the architectural appearance of these buildings away from the smooth mirror- like surfaces of tinted, seamless glass facades to technically sculptured, double-skin facades with many elements interacting between interior and exterior spaces (see Figure 1, left)

Similar to a homeopathic cure, there are only unique solutions developed based on location, orientation, use, and the individual architecture of the building; no general designs exist.

Thermal analysis

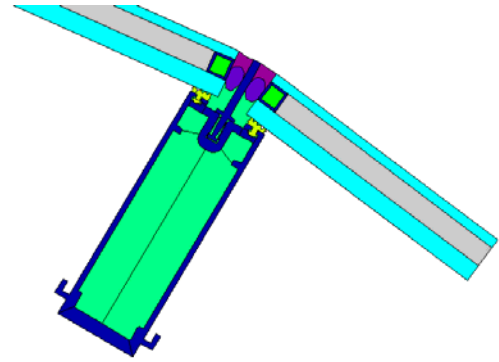
Glass is an integral component of almost all buildings. Sunlight and natural views have several benefits. Energy costs can be reduced by lessening the dependence on electricity to artificially light a room. Also, studies have shown that there are many benefits to building occupants including a reduction in stress levels and decreased anxiety. However, to truly decrease energy costs, the window system needs to be designed efficiently.



Interior photo of glass skylight

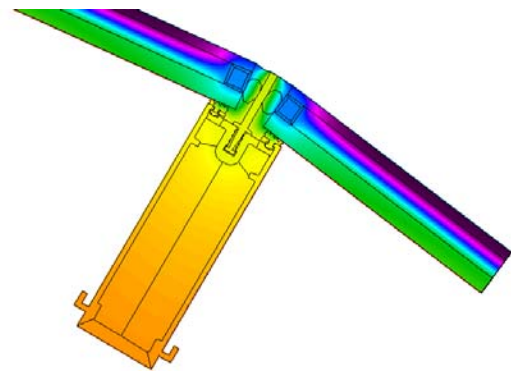
The National Fenestration Rating Council (NFRC) has developed multiple processes to evaluate the thermal properties of windows and window systems. There are four values that are typically evaluated when designing a window system, the U-factor, the Solar Heat Gain Coefficient (SHGC), the Visible Transmittance (VT), and the Condensation Resistance (CR). The U-factor is a measure of the thermal transmittance of a window or door from interior air to exterior air (a lower value has a better insulating value). SHGC is the percentage of solar radiation that passes through a window. VT is the percentage of visible light that passes through a window. The CR, as defined by the NFRC, is the resistance of a fenestration product to the formation of objectionable condensation at the specified environmental conditions, (a higher value is desirable).

STUTZKI Engineering uses simulation software developed by the Lawrence Berkeley National Laboratory ([LBNL](http://www.lbl.gov)), to evaluate window systems for the abovementioned values. Once a window system has been designed it is imported into a thermal simulation program where each component is modeled. A typical detail is shown in the following figure; each color represents a different material.



Typical skylight detail in THERM

The U-factor and temperature gradient of the component are then calculated as shown below. Temperatures range from 70°F (red-orange) on the interior to 0°F (purple) on the exterior.



Thermal gradient of analyzed model

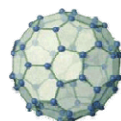
An overall U-factor, the SHGC, VT, and CR values are then calculated for the system based on the values calculated for each component and for the glass. This process allows the client and the engineer to improve the details and develop an energy efficient facade system.

STUTZKI Engineering provides innovative solutions to Architects and Contractors. We specialize in the structural applications of glass products, cable structures, blast resistant design, and thermal analysis.

STUTZKI Engineering is an AAMA Consultant and a registered Small Business Enterprise.

For more information about STUTZKI Engineering please call 1-414-455-4815 or visit:

www.stutzkiengineering.com



Stutzki Engineering, Inc.
338 N. Milwaukee Street, Suite 101
Milwaukee, WI 53202