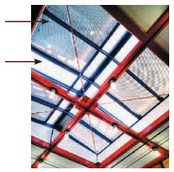
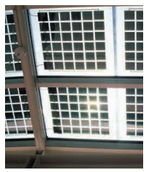
how is this building solar?

solar gain

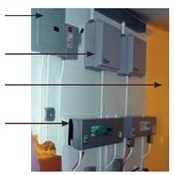


eg: thin film skylight

clear glass skylight



eg: crystalline skylight



panel

combiner boxes

batteries in closet (image far right)

inverters

balance of systems

Passive solar

This pavilion has large glazed doors to the south, which allow winter sun to warm the building. The overhang stops summer sun from penetrating and overheating the building. With the high insulation of the envelope, this means that the building stays warm in the winter and cooler in the summer.

Active solar

This BIPV (building integrated photovoltaic) roof comprises 88 thin film Terrasolar panels. Terrasolar's standard panels are 8sf, 5% efficient and rated at 40W. This means the roof array is rated at 88 x 40 = 3.52kW. Ratings are based on standard test conditions of 1000W per m2 of sunlight, perpendicular to the module and 25°C temperature. In practice the strength of the sunlight, angle of sun and temperature of the module are conditions that vary greatly, affecting output.

The angle of this roof, 30°, is optimized for the angle of the sun at this latitude - a rule of thumb is the latitude ± 10°. (New York is at 40° latitude.)

For PVs to be worthwhile, the house must use energy wisely, rather than wastefully. Conservation, passive solar and recycling come first, and only then PVs. In Arizona 1.2kW systems provide all the energy required by Navajo homes. In Sacramento, California, 3.5kW systems, like the one on this roof, provide enough electricity for typical air conditioned suburban homes.

Types of Photovoltaics

Two types of PV technologies are currently commercially available: Crystalline Silicon and Thin-Film. Crystalline panels are more efficient, converting 10-17% of the light reaching their surface to electricity. Thin-Film Amorphous Silicon panels use less silicon and are less expensive, but have efficiencies of 5-7%. Both technologies cost around $8-15 per watt, installed with the balance of systems.

Balance of Systems

PV modules are connected together in parallel to reach the voltage required by the end use. To provide power compatible with standard appliances, the "raw" DC electricity produced by all PV systems must be converted into AC electricity by an inverter. If the installation is not grid connected, a storage medium (such as batteries) is needed to store electricity for times when there is not enough power coming from the PVs (eg: at night). Other balance of system components may include disconnect switches and transformers.

Advantages

Environmental Benefits - Photovoltaics don't produce greenhouse gases, don't use up finite fossil fuels and do not pollute the air.
Location - Almost anywhere has enough sunlight for photovoltaics, so the systems can be placed where the energy will be used, minimizing wire transmission losses - sometimes up to 30% in conventional systems.
Peak Energy Synchronization - Energy is produced in daylight hours overall when energy usage is highest.
Modularity - A PV system can be constructed to any size needed to meet energy requirements.
Maintenance - PVs are solid-state components with no moving parts. They do not wear out, and have a theoretically infinite lifetime. Cleaning of modules is not required to maintain satisfactory PV performance; dirt and dust reduce efficiency no more than 10% under typical conditions, and regular rainfall restores most of the original performance.
Strength And Constructibility - PV panels are strong and easily incorporated into curtain walls or roofs.

Future

The global photovoltaics market is growing rapidly. In 2001 it grew by 38%, to reach a volume of 400 Megawatts per year. At the same time, system costs are coming down rapidly, with reduction in costs over 300% since 1982. Efficiencies of PV modules are steadily rising, requiring less area for the same output. Current events have also demonstrated the desirability of renewable energy versus fossil fuels. Government incentives for PV installations are numerous and growing. Current incentives in New York can make the payback period - the time required to amortize the capital by lower utility bills - for PV installations less than 10 years. After that the energy is effectively free.

The roof of this building consists of solar electric (or photovoltaic) panels which convert energy from the sun directly into electricity. The roof faces south and is angled to receive the most sunlight.

Large windows on the south wall are shaded by the overhang in the summer but allow low winter sun in to warm the building.

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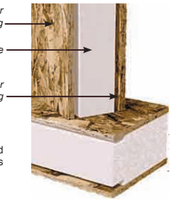
how does this building save?



Exterior Sheathing

Foam core

Interior Sheathing

Structural Insulated Panels

Heat Recovery Ventilator

Heat Pump Air Conditioner & Heater - *Inside*

Heat Pump Air Conditioner & Heater - *Outside*

Structurally Insulated Panels (SIPS)

What are SIPS?
SIPs are high-performance building panels for floors, walls and roofs in residential and low rise commercial buildings. Each panel is made using expanded polystyrene (EPS) rigid foam insulation sandwiched between two structural skins of oriented strand board (OSB). Together these form structural panels which need no additional framing. SIPS combine framing, sheathing, insulation and air barrier into one construction step. EPS is made with pentane gases which produce no HCFCs or CFCs

How do SIPS save energy?
SIPS save energy by having a high R value 'whole wall' insulation value. A 3.5" EPS core SIPS has a whole wall R value of 14, the same as a 2x6 studs at 24" o.c. with 6" fiberglass. The walls in this building have 5.5" EPS core, and the ceiling has 9.5", so the R value is considerably higher. This saves money because less expensive heating and cooling systems are required, and saves running costs since less energy is required to heat or cool the building.

How do SIPS save resources?
SIPS construction is also resource efficient, since it uses less wood than traditional framing, and the OSB comes from young farm grown trees, a more rapidly renewable resource, and there is very little construction waste.

How do SIPS improve comfort levels?
SIPS construction provides a more comfortable interior environment since the envelope is more tightly sealed, resulting in fewer drafts and more even heat distribution. SIPS construction is quieter than most conventional construction systems.

Heat Recovery Ventilator

A well insulated, draft-free house requires mechanical ventilation to provide sufficient fresh air. This building has a heat recovery ventilator, that extracts heat energy from the warm exhaust air and uses it to heat the incoming fresh air. This is located in the bathroom.

Daylighting

Natural light is provided by abundant South facing windows. The daylighting can be controlled with perforated blinds. No lights need to be turned on throughout the day.

Energy Star Windows And Doors.

The windows and doors in this building are double-glazed, wood-framed vinyl-clad energy star windows. More efficient windows and doors could have been used, but were not because of budget constraints on this temporary building. Windows are commercially available with R values over 8.

Heat Pump Air Conditioner & Heater

Heat pumps offer quality performance, save resources and space by combining the two functions of heating and cooling in one unit. The permanent building for this site is designed to have a ground source heat pumps which is even more efficient since it uses the earth as a heat source or heat sink.

Energy Efficient Lighting

Fluorescent lighting is five times more efficient than incandescent lighting. All lights in this building are fluorescent, either T8 linear fluorescent bulbs or compact fluorescent light bulbs. Electronic ballasts are also used for further energy savings.

This building is made of big structural sandwich panels (SIPs). Each panel is made of wood chip boards on the outsides and rigid insulation on the inside. These panels have a high insulation value. There are other energy efficient features, too, so that it takes less money to light, heat and cool this building than the conventional building.

COMMUNITY ENVIRONMENTAL CENTER
A Not-for-Profit Professional Organization

how does this building recycle?

aluminum siding

waterless urinal

linoleum flooring

aluminum siding, edge of PV roof

Recycled Aluminum Siding

The siding used in this building is anodized aluminum with a high recycled content. Anodized aluminum siding is a single material and can easily be dismantled and recycled after use. Aluminum is the most consistently recycled building material.

Aluminum refining is a high energy process (embodied energy), but using recycled scrap metal can result in up to 80% reduction in energy consumption.

Gypsum Wall Board

All the interior walls of this building are clad in gypsum wall board (GWB or 'sheetrock'). The outer skins are made of recycled paper and the gypsum between from industrial waste. GWB from construction waste can be recycled to make new GWB. Synthetic gypsum can also be used, which is a by-product from flue-gas de-sulfurization.

Linoleum Flooring

Linoleum is considerd one of the most environmentally friendly floor finishes because it is very durable and is made primarily from natural ingredients that are based on renewable resources. Linoleum is made from Rosin, Wood flour, Cork flour, Linseed oil, Limestone, Pigments and Jute which are all renewable raw materials harvested or extracted with relatively little energy consumption. Linoleum is biodegradable contrasting vinyl which cannot be broken down by natural processes.

Building Materials

SIPS are modular and allow for prefabricated construction, reducing waste. This building is designed for disassembly at the end of it's life, embracing the concept of Building Deconstruction, an alternative to demolition, allowing building materials to be salvaged, recycled, or otherwise diverted from landfills.

Low VOC Paints

Petroleum based paints also give off VOCs (volatile organic compounds) that smell, contribute to poor indoor air quality and allergic reactions in some people. The lighter shades of paint used here are zero VOC paints, the darker shades are low VOC paints.

Medite MDF

Cabinetry is often made with medium density fiber board, or MDF. MDF is made from sawdust and an unstable urea formaldehyde glue, which can produce harmful gases and poor indoor air quality. Cabinets in this building are made with Medite, which uses a stable urea formaldehyde glue (like exterior grade plywood), and is certified for use in environments for people with chemical sensitivities. There are many other interesting cabinetry board materials now being marketed: wheat, straw, coconut, sunflower seeds and bamboo, which may substitute for wood products in some situations, helping to preserve our forests.

Waterless Urinal

The urinal does not require any water for flushing and has no valves to clog or break. It may be more hygienic than normal urinals. A low specific gravity serves as a trap, and the Blue Seal ® all natural mixture of biodegradable oils and alcohols further prevents odors.

Water Saving Fixtures

One piece toilet, with the tank and bowl integrated into a seamless space-saving design. Exceeds ASME & ANSI standards for low consumption toilets (16 gallons per flush). Faucet aerator installed to provide low-flow 1.5 gallons per minute @ 80 psi.

This building was first used for Earth Day 2000. The whole building was dismantled, stored and put up again here at Stuyvesant Cove Park.

TerraSolar