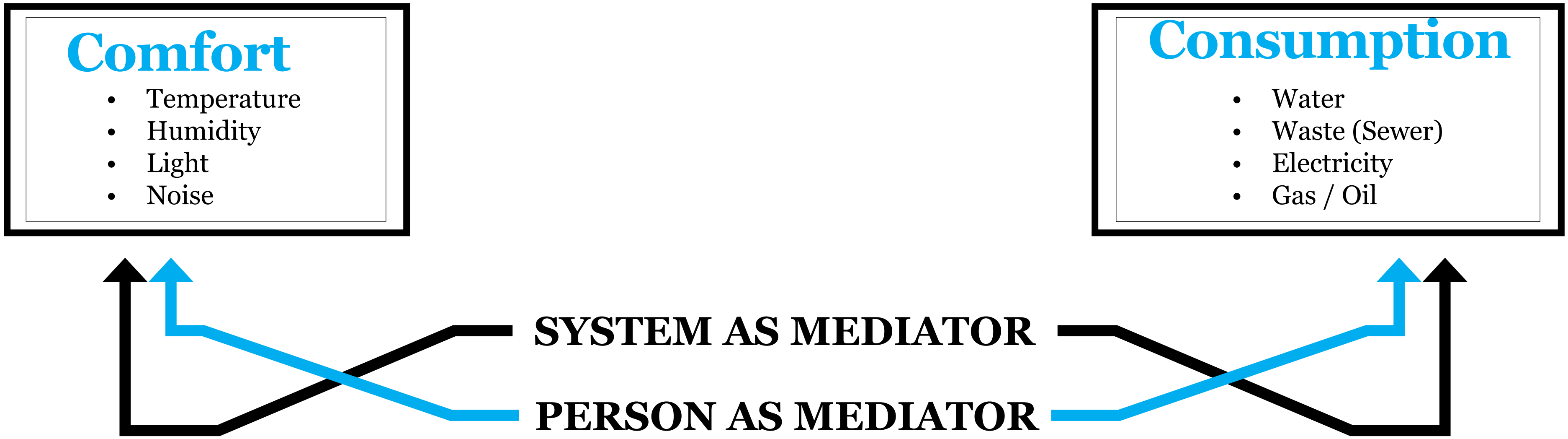
Integrated Systems:
Technology Implementation in Buildings

Carrie Schulz & Jason Andersen

What is a building's function? At the most basic level, buildings keep us dry, temperate, and shaded. Ultimately these systems are best when working in concert. Some of systems can be automated and some require increased human interaction to function. However, it is the points of human interaction and input that become most interesting.

Is the consumption of resources for the sake of comfort is an act of balancing or compromise?


Comfort
Temperature
Humidity
Light
Noise
Consumption
Water
Waste (Sewer)
Electricity
Gas / Oil
SYSTEM AS MEDIATOR
PERSON AS MEDIATOR

Regulating light levels to optimize working conditions without the use of additional artificial light or using automated shades to reduce glare deals with an intake of light is a key consideration. Likewise, many buildings employ devices to shade and reduce solar gain in order to minimize the need for cooling.

Genzyme Center

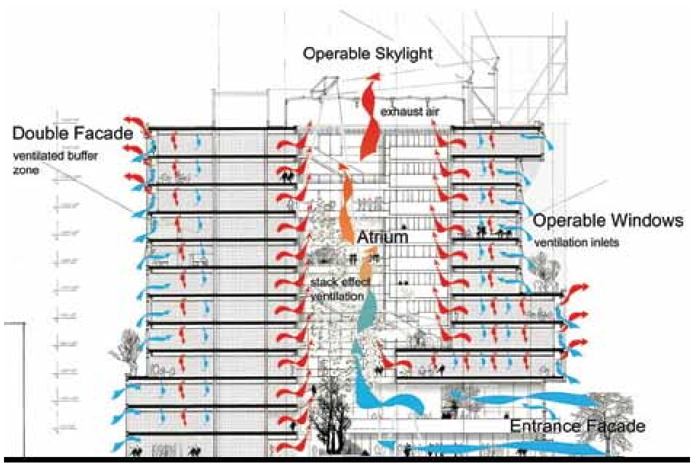
Architect: Behnisch Architekten
Location: Cambridge, MA
Year: 2004

Project Highlights:

- Helio-stats
- Natural Venilation
- Loggia (Light and Air Tempering)

Daylighting was key to the building's design intent. The building is organized around a central atrium that makes the building incredibly open. All regularly occupied spaces in the building have views to the outside, and more than 75 percent of the work spaces where critical tasks are performed are naturally lit.

The natural light is enhanced by a system of roof-mounted heliostats (mirrors) that track the sun's movement across the skylight to fixed mirrors which hang in the open atrium. This acts to help in bringing light in to the center of the building.

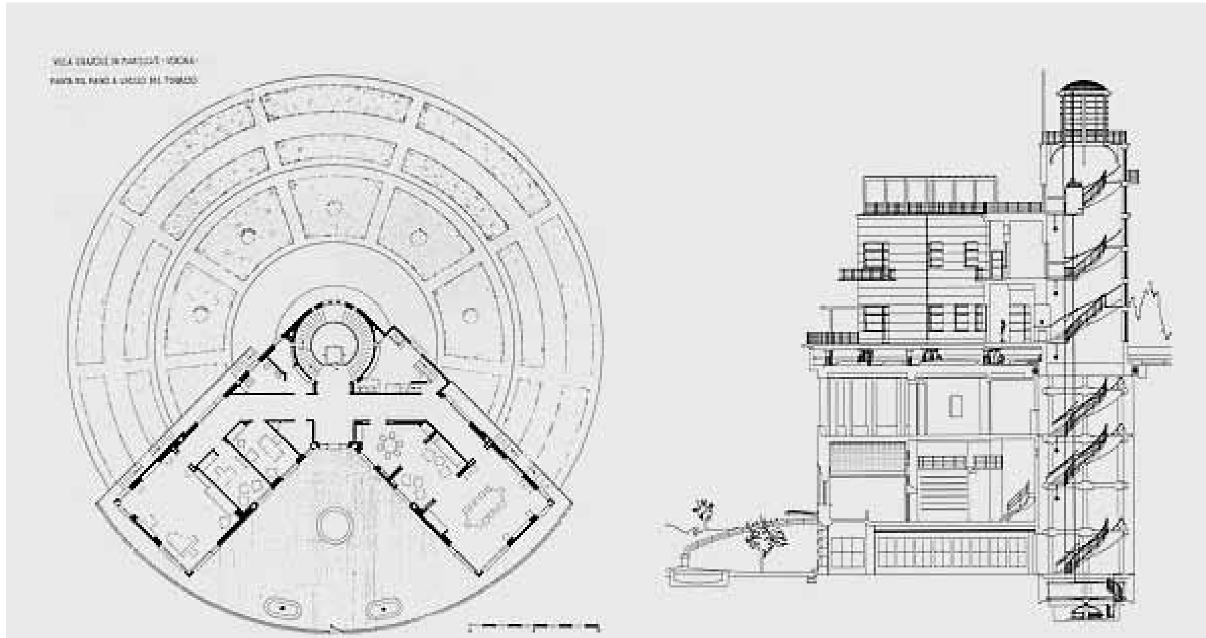


Il Girasole

Architect: Angelo Invernizz
Location: Marcellise, Italy
Year: 1935

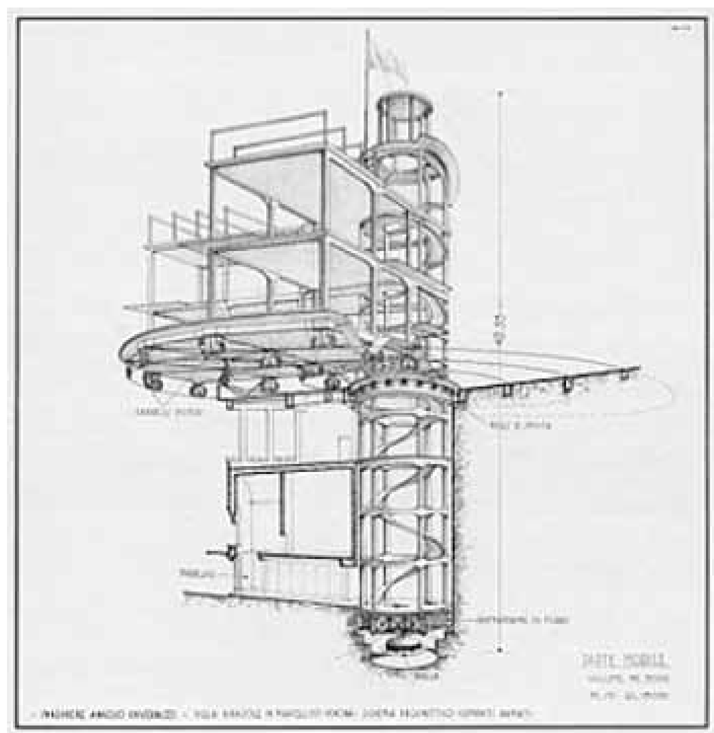
Project Highlights:

- 'Sun Tracking' System



This rotating modernist house is built into a Po Valley hillside in northern Italy. Termed 'The Sunflower', the house was built in the 1930s by architects Angelo Invernizzi and Ettore Fagiuoli, with the help of their artist, sculptor, designer and architect friends.

The house rotates on three circular tracks. 15 trolleys roll the 5,000 cubic meter building at a speed of 4 mm per second. It takes 9 hours and 20 minutes to rotate fully.



While the house is not equipped with technology to automatically track the sun's movement through the sky it can be turned throughout the day to keep orientation. This is however offset by the fact that two diesel engines propel the house.

Video at:
http://www.wallpaper.com/video/architecture/il-girasole-a-house-near-verona/658575065001

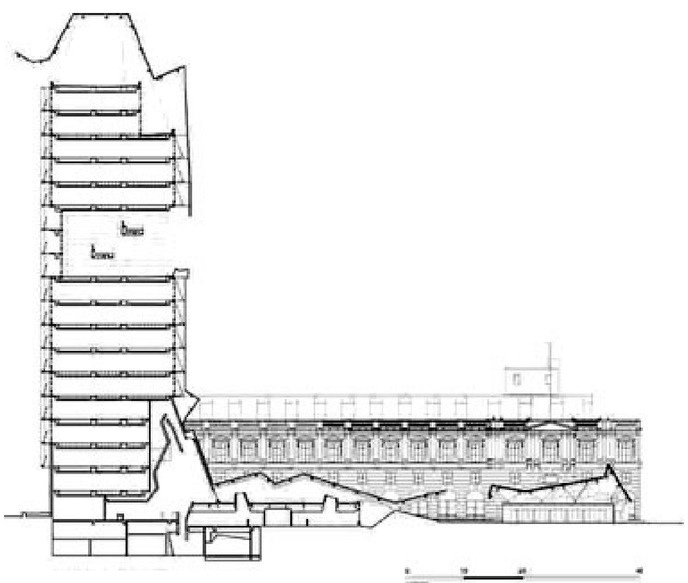
San Francisco Federal Building

Architect: Thom Mayne/ Morphosis Architects
Location: San Francisco
Year: 2006

Project Scope:

- Natural ventilation, operable windows
- Solar screen/shading
- Narrow floor plate

Through the use of solar shading, operable windows and strategic integration of mechanical systems, the building utilizes natural ventilation instead of air conditioning for 70% of the building. Mutable computer-controlled panels within the metal screen adjust to daily and seasonal conditions.



Kiefer Technic Showroom

Architect: Giselbrecht + Partner ZT GmbH
Location: Bad Gleichenberg, Austria
Year: 2007

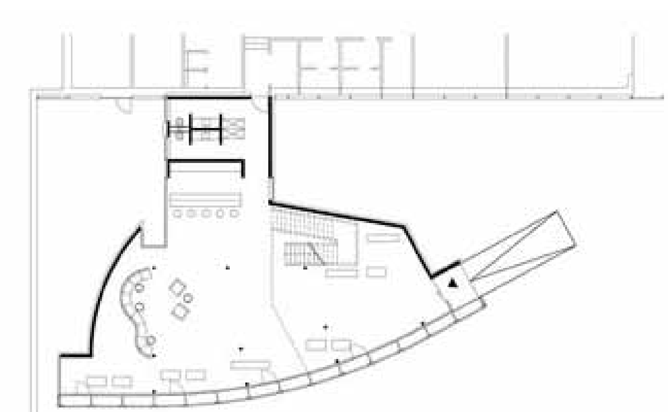
Project Highlights

- Dynamic Exterior Shading System,
- Daylighting

An office building and showroom space with a dynamic facade which shifts throughout the day. The solar shading system consists of panels run with electric motors responding to both exterior conditions as well as user controls.

Video at:
http://www.youtube.com/watch?v=rAn4ldWjw2w

Photos © Paul Ott



Arab World Institute

Architect: Jean Nouvel
Location: Paris, France
Year: 1987

Project Scope:

- Dynamic solar devices

The south facade is screened with a grid reminiscent of latticed screens found on patios and balconies in Arab countries. The geometric motifs are actually motor-controlled apertures which open and close every hour to adjust the amount of natural light which enters the building.

New York Times Building

Architect: Renzo Piano with FX Fowle Architects
Location: NY NY
Year: 2007

Project Scope:
- Daylight strategies,
- Exterior shading
- Internal shading devices

A ceramic-rod screen helps block direct sunlight and reduce cooling loads. The curtain wall, fully glazed with low-e glass, maximizes natural light within the building.

Mechanized shades controlled by sensors reduce glare, while individually-dimmable fluorescent fixtures supplement natural light.

New York Times Building

Architect: Renzo Piano
Location: NY NY
Year: 2007

Heliotrope

Architect: Rolf Disch
Location: Freiburg, Germany
Year: 1994

Project Highlights:

- Dual-axis solar photo-voltaic tracking panel
- Geothermal heat exchanger
- Combined heat and power unit (CHP)
- Solar-thermal balcony railings to provide heat and warm water

The Heliotrope is a private residence which rotates with the sun to maximize its solar intake. Several energy generation systems are used, and the home can produce up to six times its energy usage, which is sold back to the grid.

Water regulation is one of the most crucial and **contentious** aspects of architecture. Shelter keeps us dry. In keeping us dry, often large amounts of water are diverted into other systems. Bringing water into and then back out for both **potable** and **sanitary** purposes is another major job of modern buildings.

Cradle-2-Cradle Competition

Winning Entry: Coates Design, Seattle WA
Year: 2004

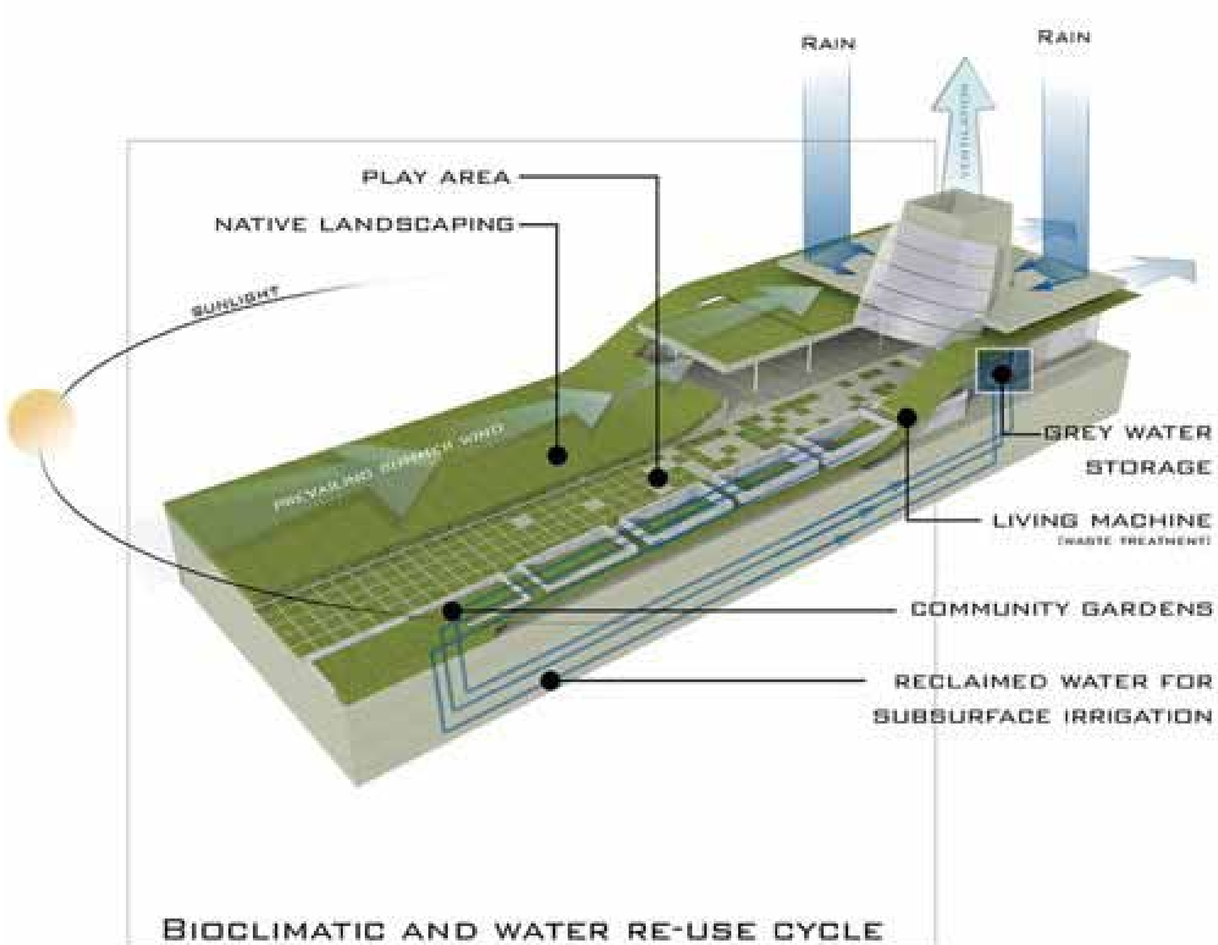
Project Architects: Matthew Coates and Tim Meldrum

Project Highltghts

- Living Machine

The "Spinach Home", the winning entry in the 2004 Cradle to Cradle Home International Design Competition has a photosynthetic, phototropic spinach skin surface and a vegetated roof system that filters storm water. A vertical core with super-conductive photosynthetic plasma that generates 200% more voltage than ordinary solar cells.

In addition this house deals with Water in novel way. I has Rain water collection, Grey water sequestrations to flush toilets, and a Living Machine.



Port of Portland

Architect: Zimmer Gunsul Frasca Architects
Location: Portland, OR
Year: 2010

Project Scope:

- Living Machine - Worrell Water Technologies
- Passive and active daylighting strategies
- Geothermal heating and cooling
- Green roof

This project uses an installation of Living Machine's "Tidal Flow Wetland" wastewater treatment and reuse system. The Living Machine closely mimics a true tidal process by draining and flooding the wetland several times each day through tidal cells, which brings in fresh oxygen to the microorganisms that are naturally cleansing the water. Water is reused for non-potable applications such as toilet flushing and makeup water for cooling towers.

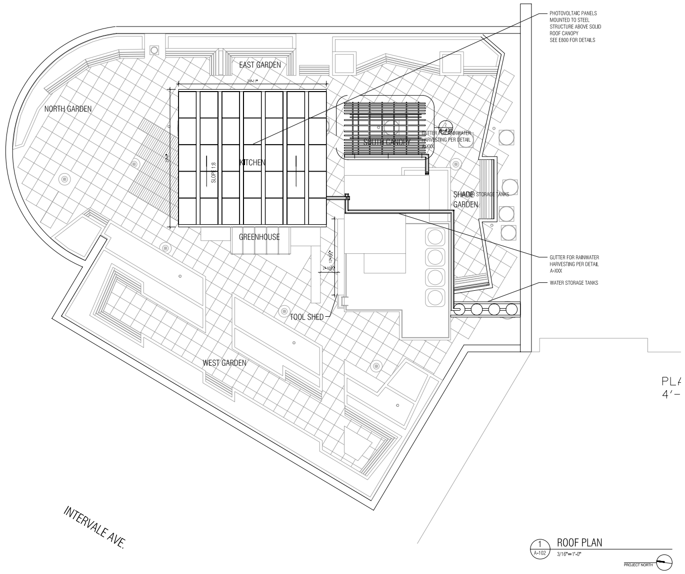
BronXscape

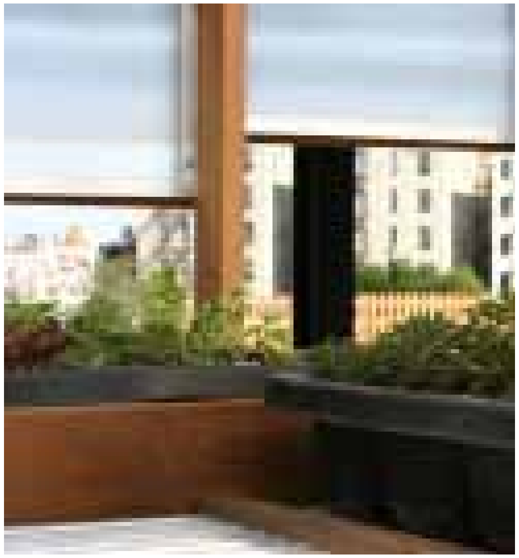
Architect: The Design Workshop 2008
Location: Bronx, NY
Year: 2008

Project Highlights:

- Solar PV
- Roof gardens
- Water collection & distribution

Designed around the central covered pavilion is a perimeter of plants providing a lush atmosphere for the majority of the year. Integrated benches and lighting provide a safe, relaxed environment for socialization. The west side of the roof has planters for more intensive gardening, and the southern area has a relaxing shade garden to provide a cool spot during even the hottest summer months.





Center for Urban Agriculture

Architect: Mithun Architects
Location: Seattle Washington
Year: 2007 (unbuilt)

Project Highlights:

- Water collection & recycling
- Urban Agriculture
- Solar PV

Designed to be independent of the city water supply, the project would utilized water collection and recycling. Massive PV arrays would collect energy to be regulated and stored as hydrogen gas in underground tanks.

Are you hot or cold right now? Can you tell where fresh air is coming from? Of all building systems, HVAC may have some of the most advanced devices and monitoring interfaces available - all dealing with one of our most basic physical registrations of comfort.

Genzyme Center

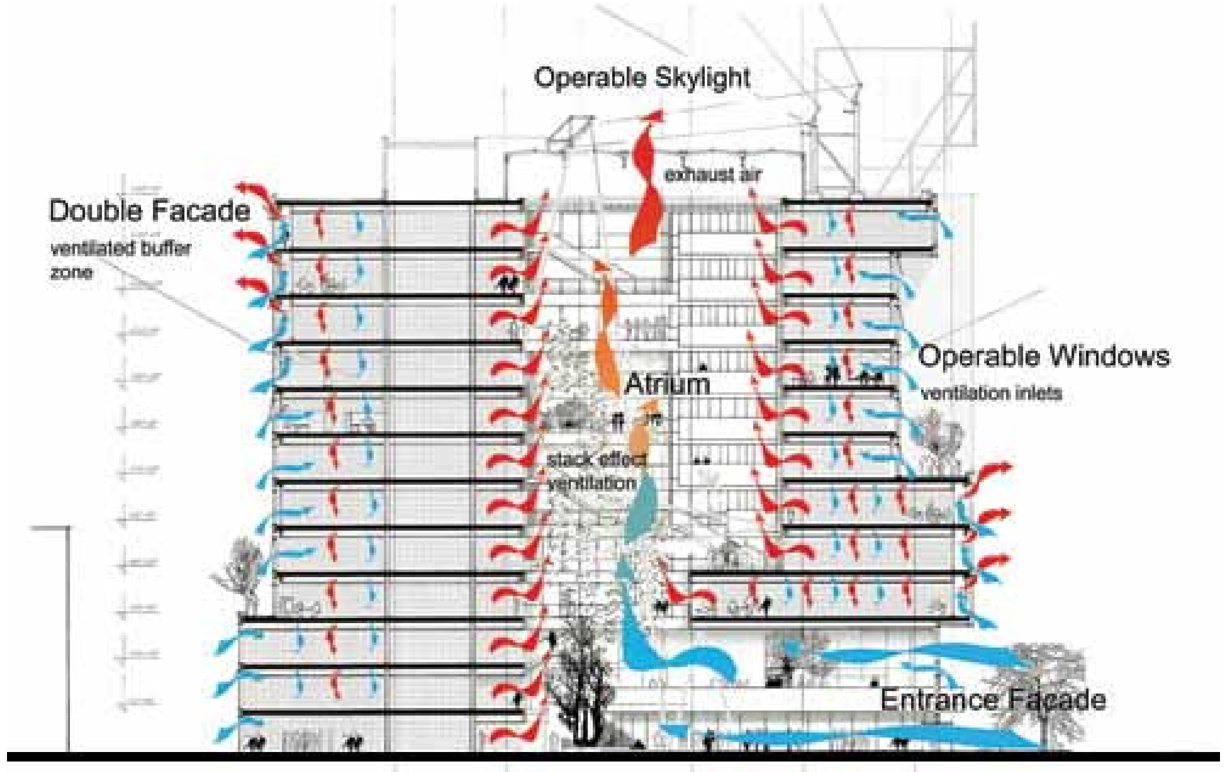
Architect: Behnisch Architekten
Location: Cambridge, MA
Year: 2004

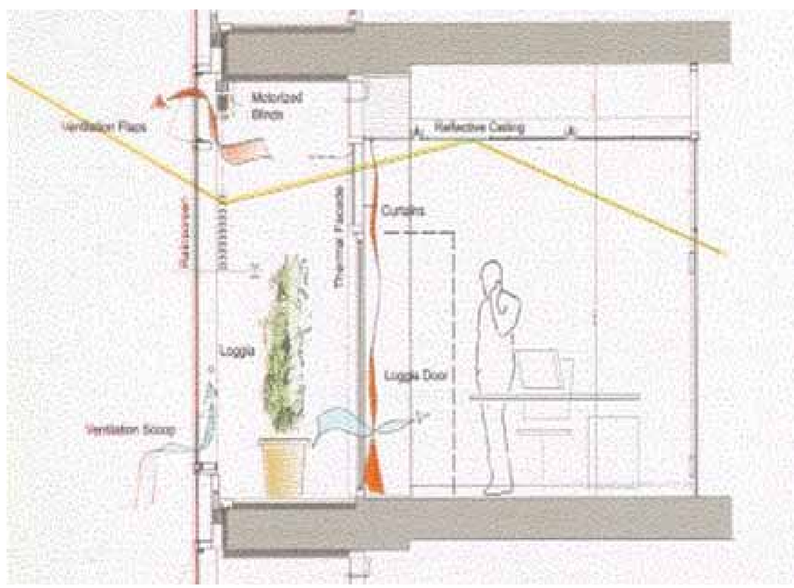
Project Highlights:

- Heliostats
- Natural Ventilation
- Loggia (Light and Air Tempering)

Indoor air quality is also an important element in this building. Almost a third of the building is behind a two-layer window system that creates a thermal buffer between the building and the exterior, much like a very deep storm window.

In summer, this space is ventilated to keep solar gain from building heat inside the building, while in winter this heat is captured and helps keep the building warm.





The (New) Autonomous House

Architect: Brenda & Robert Vale
Location: England, varies
Year: 1975 - ongoing

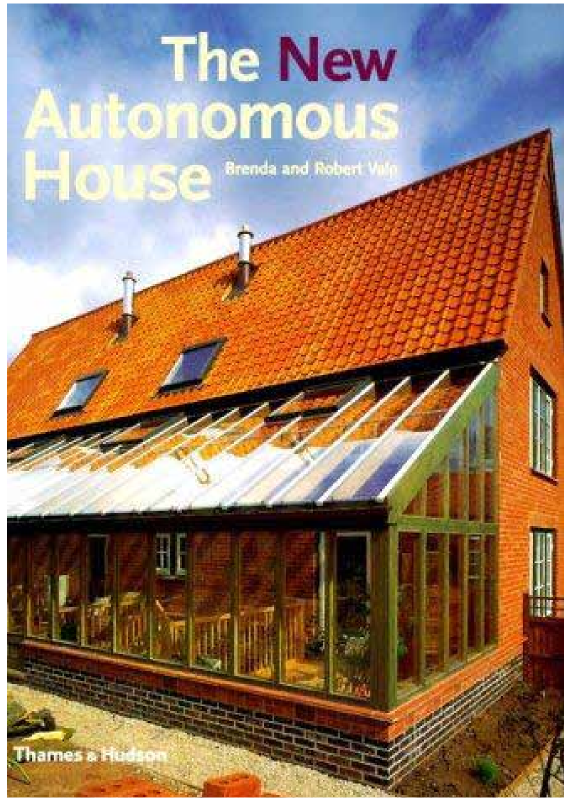
Project Highlights:

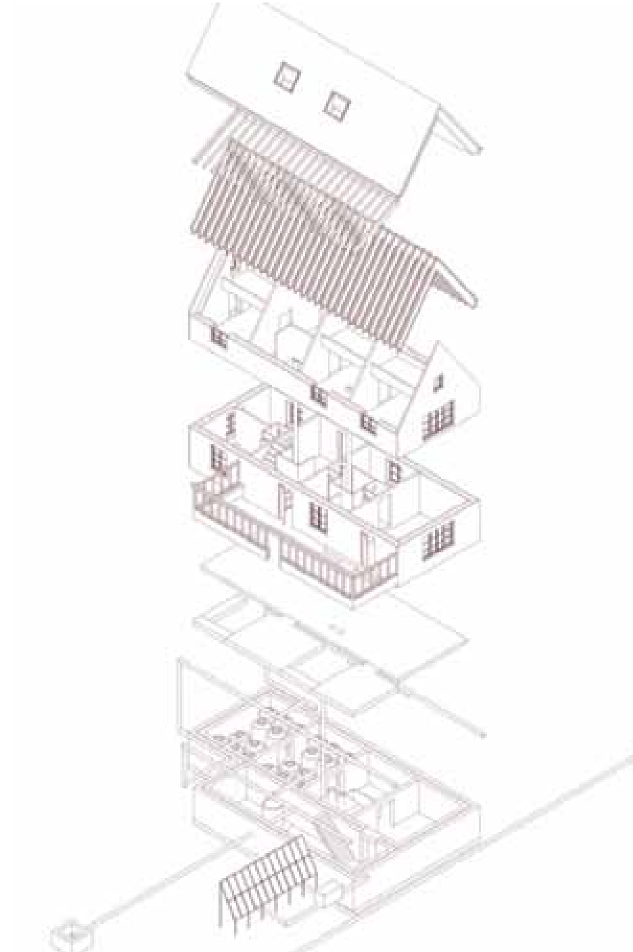
- Super-Insulation
- Passive Solar Design
- Gray water systems
- Solar hot water
- Water Collection

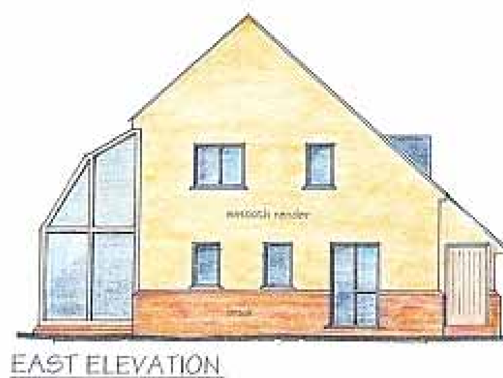
The subject of a book entitled; “The new autonomous House” by Brenda and Robert Yale.

The house was conceived of by the Yales through a rigorous understanding of their consumption of resources and energy. They achieved the highly energy efficient house through super insulated walls and roof. South facing glazing captures solar heat gain in the mild climate and a complete ‘reordering of their water usage.

Possibly the most remarkable point is that they shared their designs and performance data which they had collected for years. The dissemination of actual usage data for public consumption is rare in architecture.







AustriaHaus

Developer: Tyrolean Future Foundation
Location: Whistler, BC
Year: 2010

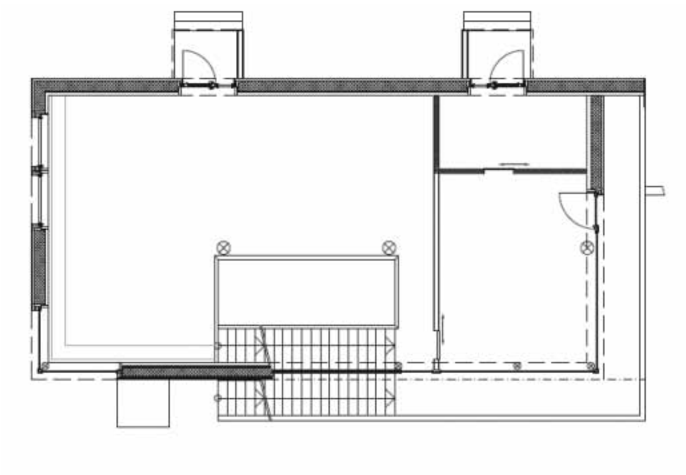
Project Highlights:

- PassivHaus Standard
- Super-insulation,
- Low-impact Ventilation,

The house was built to be home base for Austrian Olympic officials, media and athletes during the 2010 Winter Games

This PassivHaus is engineered to heat and cool itself through thick insulation, solar energy, ground heat and an airtight building envelope.

Video at:
http://www.youtube.com/watch?v=NgDRKSQp2RI



Heidelburg Firestation

Architect: Peter Kulka
Location: Heildelburg, Germany
Year: 2007

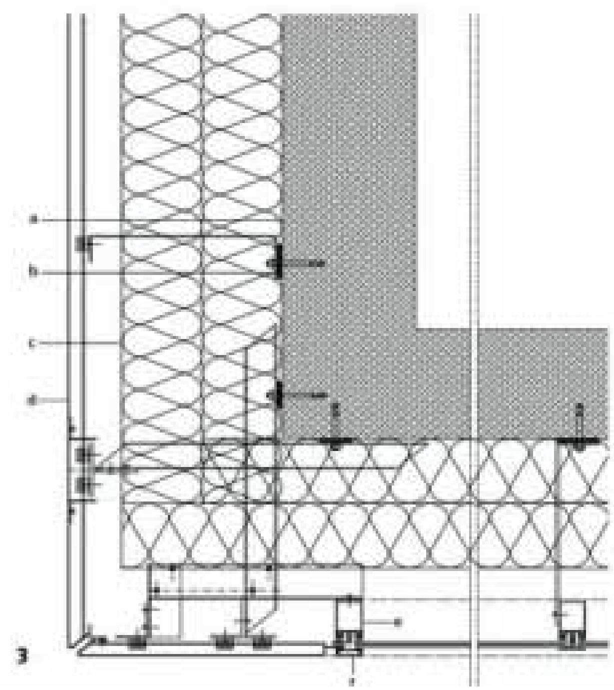
Project Highlights:

- PassivHaus
- Super-insulation,
- Ventilation,
- Solar PV
- Strom Water Runoff

As the apparatus bay and maintenance shop can't be airtight due to ventilation conflicts, only the 'living' areas of the fire station meet the PassivHaus standard. The concrete walls consist of 30cm (12″) mineral insulation and has a U-value of 0.127 W/m²k (R-45). The roof, with a U-value of 0.096 W/m²k (R-59) consists of 40cm (16″) EPS insulation with extensive green roof above. A highly efficient HRV provides necessary ventilation and supply air is preheated (or pre-cooled in summer) with a ground-coupled heat exchanger. District heating (CHP) is utilized for domestic hot water.

Windows are triple-glazed, thermally broken and insulated aluminum storefront, manufactured by Wicona. The windows achieve a U-value of 0.80 W/m²K (R-7).

In the eastern corner of the site, a rain garden allows runoff to slowly percolate into the ground.



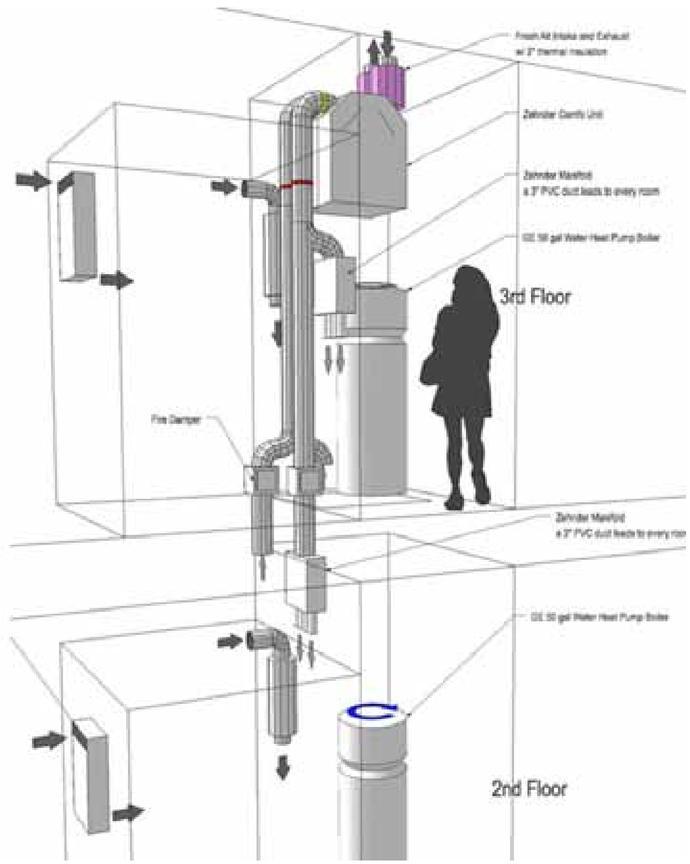
174 Grand Ave

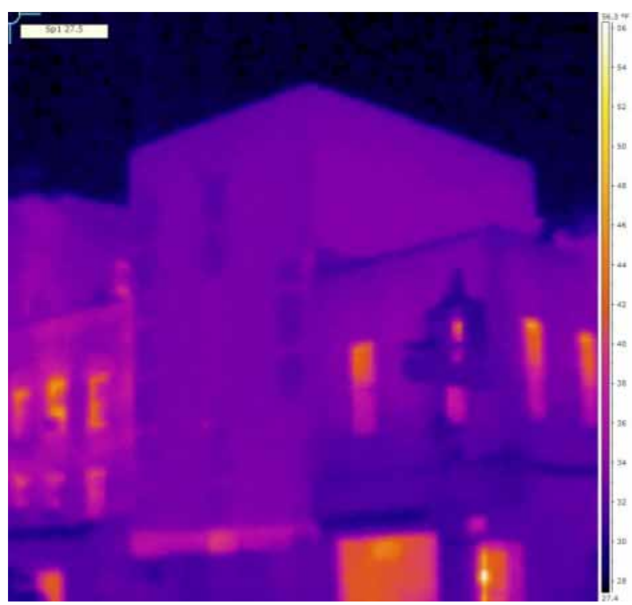
Architect: Loading Dock 5
Location: Brooklyn, NY
Year: 2011

Project Highlights:

- PassivHaus
- Super-insulation,
- Efficient Ventilation,

NYC's first new building which fulfills the strict German PassivHaus standard.





Google Data Center

Architect: Google Data Center Operations
Location: Hamina, Finland
Year: 2008

Project Highlights:

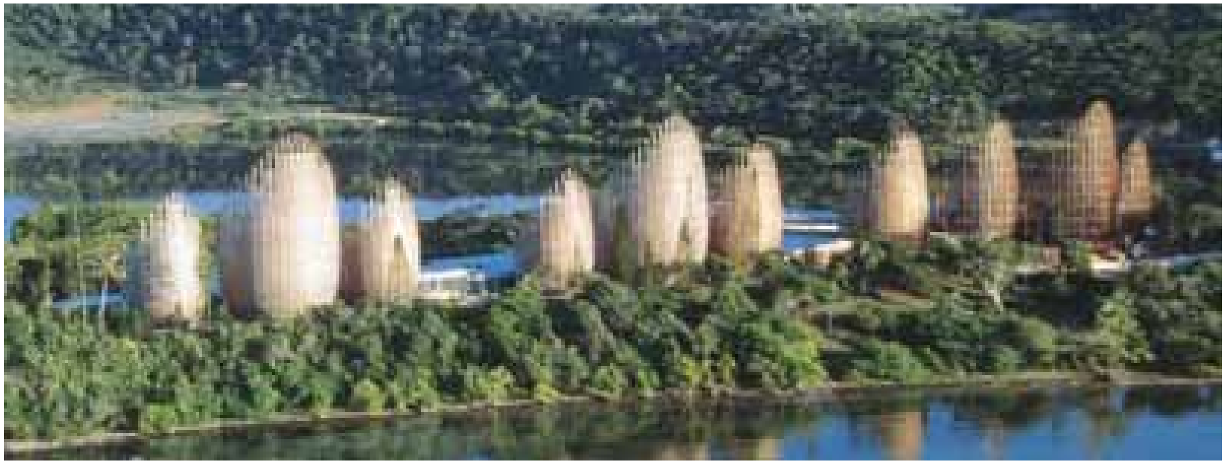
- Sea Water Cooling

Google made use of an existing quarter-mile long seawater tunnel that had already been constructed to deliver seawater to an old paper mill on the site.

It also had to consider seawater's corrosive properties. Google used fibreglass reinforced piping and titanium plates in sea water exchanges and has four levels of filtration and screening from course to very fine to maintain the integrity of the system.

Marie Tjibaou Cultural Center

Architect: Renzo Piano Building Workshop
Location: Noumea, New Caledonia
Year: 1998



Project Highlights:

- Natural ventilation (sea winds),
- Solar shading
- Dynamic inner facade

Ten conical pavilions are arranged across the site each a different size. Each pavilion uses a double roof structure in tandem with a double skin. The outer shell of wooden ribs and slats acts as structure and solar shading. An inner skin includes glass louvers open and close in tandem, responding to current wind speeds.

Marie Tjibaou Cultural Center

Architect: Renzo Piano Building Workshop
Location: New Caledonia
Year: 1998

We create space to provide comfort. Achieving comfort relies on consumption. Frequently in our work we look at the play between these factors through passive and active building systems as means and methods to control or regulate our comfort and consumption. How can we control our comfort not only more efficiently, but more effectively? Where does our agency lie as designers and participants in architecture?