

# Sustainable Evergreen: An Exercise in Passive Living

## Background

Built on our understanding of the issues involved in achieving a sustainable energy society from the Fall and Winter Quarter of Energy Systems and Climate Change, our design and model represent a quarter long contract designed to gain further insight and practical experience in the world of sustainable architecture and design.

Using architectural design strategies from G.Z Brown and Mark DeKay's *Sun, Wind, & Light* amongst other resources we investigated the use of passive solar heating to maintain the thermal comfort of a proposed sustainable community to replace the Modular Housing (Mods) on campus.

## Design Strategies

**Passive solar heating.** The design is oriented on a true north-south axis to maximize daily solar gains. A calculated R-value of fifty-five for the walls and one-hundred for the roof coupled with the exposed thermal mass of the concrete foundation and triple glazed windows allow for a 90% reduction in heating and cooling needs.

**Exposed thermal mass.** Dampen temperature swings and provide summer cooling.

**High performance windows.** Triple glazed, argon-gas-filled, low-e windows, used to reduce wintertime heat losses and summer heat gains.

**Energy recovery ventilator.** Reduces energy loss during mechanical ventilation.

**Natural ventilation.** The sliding door and operable windows allow for crossventilation.

**Rubble trench foundation.** Low-impact alternative to traditional concrete spread footings.

**Structural insulated panels (SIPs).** Used as both structure and insulation for the walls and roof of the building, SIPs are constructed out of oriented strand board facings and sandwich seven and a quarter inches of urethane foam in a continuous envelope which virtually eliminates thermal bridging. SIPs construction has twice the strength of traditional stick and batt.

**Green roof.** The design currently supports extensive or intensive green roofs depending on the desired level of student involvement. In addition to being one of the more visible aspects of sustainable architecture employed, both types of green roof would increase the ecological value, insulation and carbon sequestration ability of the house, as well as manage storm water. Runoff will be collected in a cistern for drip irrigation and toilet flushing.

**Shading and daylighting.** The roof overhang is designed to block the high summer sun, yet still allow the constant solar exposure needed to maintain thermal comfort during the winter. Interior finishes and materials throughout the building are lightly colored to promote the even distribution of daylight and electric light.

**Building management system.** The brains of our building controls lighting levels, humidity, and temperature from a central touch display located in the common area. In addition to control this display also serves as an Energy Consumption Display (ECD) for auditing of occupant energy and water usage. The community will be networked to facilitate motivation, social interaction, and goal setting. All appliances are to be Energy Star rated.

**Living machine.** On site treatment of sanitary drainage for recycling/reuse using a series of aerobic/anaerobic tanks.

## Model and heliodon (a device used to simulate the sun's motion relative to a building)

This display was built to demonstrate the basic principles of passive solar heating. The walls of the model were assembled out of black walnut (concrete) and rapidly renewable redwood (SIPs with cedar siding), our representation of the extensive/intensive green roof was assembled using scrap wood from the woodshop. The two LED light bars represent the Winter (smaller) and Summer (larger) solstice, students and faculty will be able to switch between solstices and select different times of day by using the rotary encoder on the baseplate. The corresponding time, date and altitude will be displayed on the graphical LCD.



## Location

The Evergreen State College  
Olympia, WA  
Latitude 47.07  
Longitude -122.96

## Heating Degree Days

5523 base 65° F

## Cooling Degree Days

97 base 65° F

## Solar Radiation

Jan 317.1 Btu/ft<sup>2</sup>/day  
(1.0 kWh/m<sup>2</sup>/day)  
Jun 1870 Btu/ft<sup>2</sup>/day  
(5.9 kWh/m<sup>2</sup>/day)

## Annual Precipitation

50 in.

## Area

1200ft<sup>2</sup>

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