Designing For and With Community

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Ecovillage at Ithaca

View from the EcoVillage Common House tower
facing east towards Ithaca and Cornell (CNN)

AN INTRODUCTION TO ECOVILLAGE AT ITHACA

The EcoVillage at Ithaca project has been recognized as an international leader in the development of sustainable clustered housing. Under development since 1992, the last of thirty housing units in the “First Neighborhood” was occupied in summer of 1997. The project has received considerable media attention including an internationally broadcast feature on CNN, feature broadcasts on NPR and Nickelodeon, the front page of the New York Times real estate section, feature articles in Popular Science and American Demographics, coverage in the Wall Street Journal, the Washington Post and numerous other publications.

Members of EVI and other interested parties from Cornell and the Ithaca area participated in the creation of “Guidelines for Development.” This document is being used by EVI to provide direction for the development of the land by various residents’ groups. The guidelines, summarized here, provide the following guidance related to energy:

1. To demonstrate a comprehensive approach to more sustainable energy use.
2. To reduce energy use through efficient transportation systems.
3. To use strict conservation practices to minimize energy use.
4. To use the most environmentally benign sources, particularly renewables including solar, wind and biomass.
5. To provide for a smooth transition to renewable energy sources.
6. To maintain an acceptable level of comfort and convenience.

In 1992 the EVI First Resident's Group (FRG) was formed. This group of future residents began meeting with the intention of developing a co-housing neighborhood at the EVI site. Co-housing describes a type of housing development pioneered in Denmark. This type of development is characterized by the participation of future residents in the design process, limitations on vehicle access in order to create a central pedestrian commons, the construction of “common house” to provide optional shared diner dining and a laundry, among other features.

The FRG developed a sophisticated group process, recruited members, worked toward the establishment of the financing mechanism for the project, and participated in basic site planning and neighborhood program development. The FRG went through a preliminary development process, then selected a local design/build firm, House Craft Builders, to act as architects, builders, and development consultants.

Affordability was a primary goal of the group, along with environmental concerns. As the project proceeded, this created many difficult decisions, as varying levels of levels of personal financial resources placed constraints on first costs. This particularly impacted decisions relative to energy efficiency and renewable resources, as these decisions are typically characterized by trading increased first costs for long term operating cost reductions.

The energy systems in the First Neighborhood project were designed to meet the following criteria:

- High efficiency
- Filtered fresh air in every room, even if the door is closed
- Individual household accountability for energy use
- Master metering to avoid increasing individual meter charges
- Isolation of combustion from the living spaces
- Reduction of the future cost of adding renewable energy sources or other fuel switching
- Integrated heat, hot water, and ventilation
- Implement an open systems concept that recognizes the rate of change of technology

Based on these criteria, the design team (Gregory Thomas, Taitem Engineering, F.E. Schwartz Plumbing and Heating, and Housecraft Builders) and residents together chose to implement a mini-district heating concept, with a pair of boilers serving from six to eight households in a thirty household neighborhood. The individual duplexes in a six to eight house cluster are linked by underground pipe chases.

These pipe chases also contain the plumbing, electrical, telephone and cable services for each house in the cluster. The chases were subsequently used to install a neighborhood-wide ethernet based local area network. (The ethernet links households to a central neighborhood email server and Internet connection. Development of a high speed, shared Internet connection is underway.)

The boilers are located in four “Energy Centers”, one center for each cluster of housing units. The boilers provide heat to an air handler with hot water heating coils and domestic hot water heater storage tank with a heat exchanger in each housing unit, (This offers more independence of water usage than a central storage tank and allows for the sub-metering.). Hot water flow to each household is set at the same flow rate using constant flow valves and an innovative piping and control valve design.

Individual sub-metering for each household is currently accomplished using run time meters connected to zone valves for each household. (The run time based sub-metering strategy has not proven to be sufficiently accurate for domestic hot water usage and offers only simple single set point control of the boilers and primary circulating loop.) The air handlers in each dwelling unit provide fresh air intake, filtration and circulation of air. A summary of the energy features of the First Neighborhood follows.

BASIC EFFICIENCY COMPONENTS

For the purposes of this paper, the basic components of a high performance building are defined as:

1. Solar orientation (for new construction and rehab)
2. High R values in walls, attic, windows, floor.
3. Balanced heating/cooling system (leakage, flow to zones, and return from zones)
4. Air tight construction
5. Constant mechanical ventilation and direct vent kitchen exhaust
6. Properly sized, high efficiency, closed combustion heating system
7. Properly sized, high efficiency cooling system
8. Energy conserving DHW measures
9. Energy conserving lighting measures
10. Energy conserving appliances (primarily refrigerator)
11. Control of moisture and other pollutant sources
12. Air filtration

For a community, as compared to stand alone single family housing, additional design factors include the impact of location on transportation energy use, the impact of common walls and the opportunities for developing shared or “common systems.”

A description of the EcoVillage design process and the considerations taken into account for each of these components follows.

Transportation

The energy efficiency investments began by selecting a location close to town. Future transportation savings offset increased up-front land costs. The following analysis compares the transportation costs of neighborhoods 2.5 miles from town with neighborhoods 10 miles from town. The analysis assumes that thirty households are making an average of one trip per day. The group saves an estimated $31,500 per year in auto costs due to choosing the site 7.5 miles closer to town. Assuming that the cost of money is 8%, the net present value of the savings is roughly $357,000 or close to what the group paid for the land actually purchased. Sites located far from town have a lower up-front land cost but a higher transportation cost and therefore higher energy and environmental impact. The 30 year savings for five neighborhoods exceeds $1.7 million.

EcoVillage Transportation Cost Analysis

Households (1 neighborhood)	Round trips per day	Miles per round trip	Days per year	$ spent per mile	$ spent per year
30	1	5	350	$0.20	$10,500.00
30	1	20	350	$0.20	$42,000.00
				Annual Savings in Gas	**$31,500.00**
				Monthly Savings	$2,625.00
				Years of Mortage	30
				Interest Rate	8.00%
				Present Value of 30 Year Transportation Savings	**$357,744.17**

Households (5 neighborhoods)	Round trips per day	Miles per round trip	Days per year	$ spent per mile	$ spent per year
150	1	5	350	$0.20	$52,500.00
150	1	20	350	$0.20	$210,000.00
				Annual Savings in Gas	**$157,500.00**
				Monthly Savings	$13,125.00
				Years of Mortage	30
				Interest Rate	8.00%
				Present Value of 30 Year Transportation Savings	**$1,788,720.86**

Assume inflation and energy costs cancel

House Design

The future residents were educated on the potential impact of orientation on heating energy consumption. A discussion on solar real estate ensued, contrasting the potential impact of maintaining equal access to solar resources, with the potential impact on neighborhood design. As part of a program development workshop facilitated by House Craft Builders, small groups of FRG members were given scaled wooden blocks and asked to develop a layout for the neighborhood. Each of the groups optimized building orientation for maximum winter heat gain.

As a result, this factor was then utilized by House Craft Builders as a primary design consideration in the development of the neighborhood footprint. The resulting neighborhood has two clusters each with an irregular north and south “row.” The common house is placed at west end of the west cluster. The house designs are varied for north and south to maintain kitchens towards the center pedestrian commons, a typical co-housing design feature that supports increased social interaction between residents.

The resulting house designs capture major energy savings from orientation and structure. A passive solar north-south orientation for all houses in neighborhood provides roughly 30% heating energy savings and reduced cooling load in summer. The use of duplexes reduces exposed surface area and materials (Fire code made true multifamily expensive). Reduced size houses displace individual services and space into the common house. Appliances in the houses are smaller because of ready access to larger equipment in the common house.

An open systems concept recognizes that technology is continually evolving. There are connections between the buildings and within the buildings that allow piping and wiring to be added without high additional cost. As technology changes, the buildings can adapt.

High R values in walls, attic, windows, floor

The building envelope uses high R walls and windows for low heat loss and comfort. The walls are insulated with high-density cellulose behind a UV stabilized plastic vapor barrier, with an interior airspace provided for wiring. The buildings use triple glazed, thermally stable fiberglass frame windows.

House Craft Builders (HCB) has a great deal of experience with production building of super insulated housing. Based on this experience, HCB has developed a wall system that has high levels of insulation, is easy to build and is easy to air seal. The wall system is based on a 2x6 wall with 2x2 horizontal strapping on the interior separated by a high quality, durable vapor barrier. This keeps all wiring inside the vapor barrier. Other measures are taken during construction to minimize the effort required to produce a very tight building.

Insulations under consideration included: fiberglass, cotton and cellulose. Cotton and cellulose have environmental advantages, fiberglass has a cost advantage, and cellulose has the best performance. The HCB wall system would allow the cellulose to be blown into the covered cavity formed by the vapor barrier. The strapping would allow the install to reach a high-density level. This would enhance the air sealing and sound absorption impact of the cellulose. Batt insulation (cotton and fiberglass) can be installed by lower cost labor and has less potential impact on job scheduling.

Cellulose was installed in the walls and attics and a sealed fiberglass was installed above the crawlspace. The common wall between the duplexes was insulated with dense pack cellulose. The dense pack reduces sound transmission considerably. The combination of the tight construction, the dense packed walls, and the triple glazed windows created a very soundproof home. This contributes greatly to the sense of privacy, an important consideration in clustered housing.

The dense pack cellulose pushed the vapor barrier into the interior air space, increasing the R-Value of the wall. Roughly two thirds of the wall is insulated with eight inches of cellulose instead of six inches.

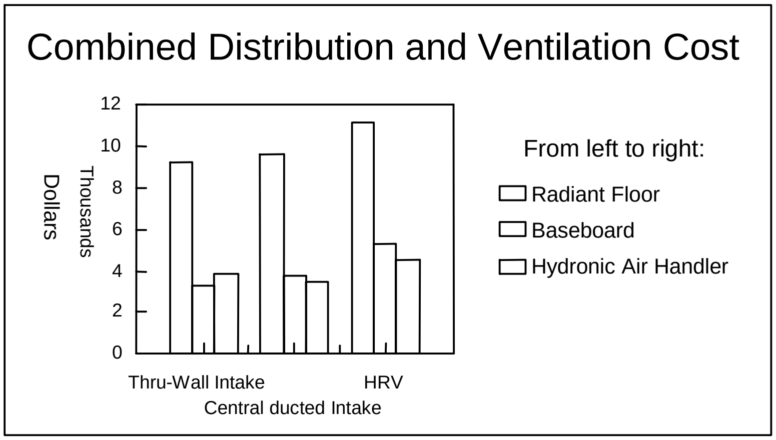
Balanced heating/cooling system

The mechanical system provides filtered fresh air to all rooms, even with the door closed. Each room has an individual room return air grille, so that closing the door to your bedroom for privacy doesn't compromise air quality.

The central air handler provides heat, fresh air intake, air circulation and air filtration. The heating distribution system was designed to avoid creating pressure imbalances when the circulating fan is operating. This required either dedicated cold air returns in each room, or transfer grills that use the top and bottom or a wall cavity to connect two rooms, or room doors undercut adequately to match the return air requirement.

Extra effort was made in the design process to place the heating distribution system entirely within the heated space. This reduces heat losses from duct system and reduces the potential impact of duct leakage. Duct systems are typically very under-insulated relative to other building components, typically R-5 duct insulation compared to R-19 to R-30 floor insulation or even higher typical values for attics.

Radiant heating was a favorite of a significant portion of the residents' group but was eventually eliminated from consideration in the housing design. Reasons for the selection of a ducted system included: First cost, ability to support the ventilation of closed rooms, and better responsiveness to solar gain. (Radiant floor systems have a large thermal mass that does not respond quickly to solar gain. Floors continue to radiate even after the thermostat stops calling for heat. This situation is aggravated in a house with a low heat load and significant south facing glass.)



This graph indicates the cost comparisons when comparing the combined system cost of various heating systems with ventilation systems. The hydronic air handler with central exhaust ventilation provided the lowest installed cost with satisfactory ventilation performance.

Air Tight Construction

The buildings are of air-tight construction with constant fresh air mechanical ventilation. Natural ventilation gives too little ventilation in the spring and fall and too much in the winter. Mechanical ventilation provides consistent levels of fresh air year-round.

Occupied buildings require fresh air to be supplied to occupants through either natural convection or through mechanical ventilation. Natural convection is driven by the air temperature differences between the interior and exterior of the building. The outside temperature varies dramatically through the year, resulting in large variations in natural convection-driven ventilation through the year.

Buildings that are built tight (less than .35 average seasonal Air Changes per Hour) require mechanical ventilation. Occupant comfort, system efficiency and building durability can be improved by building to less than .1 Air Changes per Hour and supplying a minimum constant ventilation rate that is appropriate to the occupancy of the building. Testing of a number of EcoVillage units showed air change rates of less than 2.5 ACH at 50 Pascals correlating to a average seasonal natural air change rate of roughly .17 Air changes per hour (divide by 15).

Residents required little additional information to proceed with the decision to build tightly. Some of the additional ramifications of building tightly did create subsequent discussion as noted below.

Constant mechanical ventilation and direct vent kitchen exhaust

The mechanical system provides filtered fresh air to all rooms, even with the door closed. Each room has an individual room return air grille, so that closing the door to your bedroom for privacy doesn't compromise air quality. The central air handler provides heat, fresh air intake, air circulation and air filtration.

The baseline system proposed for the buildings supplies made it possible for all rooms in the building to get adequate fresh air even with the doors closed. Concerns with up front installation costs indicated that the most cost effective baseline system would be a single, very quiet, remote mounted, in-line fan exhausting continuously from the bathrooms.

Heat recovery ventilators (air-to-air heat exchangers) were made available as an option to those households able to afford the additional investment in comfort and efficiency. No one subscribed to the option.

The kitchen hood exhausts directly to the outside. Both bathrooms and kitchens are major sources of moisture and indoor air contaminants and ventilation is provided directly in both.

Properly sized, high efficiency, closed combustion heating system

Combustion should not take place within airtight buildings or must be very carefully controlled and monitored. For an individual house, this typically means that the sources of heat for space heating and cooking should be non-combustion (electric) or must not come in contact with the interior air of the building. Sealed combustion equipment provides a fresh air duct to provide combustion air directly to the burner and vents the products of combustion directly out without any contact with the interior air of the building.

In the case of EcoVillage, this requirement was met by installing electric stoves and by placing the combustion for the space heating and domestic hot water in an energy center, a small shed attached to one duplex in a four duplex group.

Some residents sought to space heat with sealed combustion wood pellet stoves and use point-of-use electrically heated domestic hot water, but analysis of operating costs indicated that option was only cost effective for very small households (one occupant) and would be very expensive for larger households (up to six occupants).

Properly sized, high efficiency cooling system

Cooling is typically not necessary in the Upstate New York climate. Cooling for the dining hall and office building will be supplied from pond water. Buildings are designed with trellises covering the south glass. A number of different plantings, including grapes and morning glories, are being experimented with by building occupants. The grapes taste very good.

The lighting is designed for low energy use.

High windows provide considerable daylighting of the primary living space. The buildings have indirect T8 fluorescent lighting in kitchen and living room area and compact fluorescent fixtures in the remainder of the house. Lighting is being designed to utilize high quality fluorescent lighting. Designs include compact fluorescent fixtures and indirect fluorescent lighting. Daylighting is also a feature of the design.

Energy conserving appliances

Residents anticipated that a considerable percentage of their dinners will be taken in the common dining hall and office building. As a result, residents selected a reduced size refrigerator, that was highly energy efficient for its class. The more efficient of the smaller refrigerators (18 cubic feet) were not yet available with super efficient features, but the selected model used less energy than the larger super efficient models.

In practice, meals are prepared in the Common House three to four days per week. It is not uncommon to find a resident in the Common House in the evening, using the oven, stove or other commercial cooking equipment

Gas-fired cooking stoves in the residences were eliminated from consideration by the design/builder who did not wish to assume liability for any unsealed combustion in the buildings. Residents instead selected an electric stove top with two radiant burners that provide much of the instant on/off and control that gas burners provide.

The oven selected is a combination microwave/convection oven that saves space and reduces the consumption of energy and materials.

Two high efficiency tumble clothes washers were selected for the common house were they are shared by thirty households. The payback on the $1000 each units was less than one year taking into account, reduced hot water energy use, reduced water use, and reduced clothes drying energy.

Other water saving features include low flush toilets (1.6 gpf), low flow showerheads and faucets. The units are plumbed for separate gray water piping.

Control of moisture and other pollutant sources

Healthy materials were selected for a healthy indoor environment. There are no wall to wall carpets. Glues, surface treatments, plywood, etc., were selected for minimal out-gassing. There is no combustion in the buildings. Kitchens include a variety of electric stoves including radiant and halogen. The halogen stoves were particularly well liked by the residents. As indicated above, bathrooms and kitchens served by controllable exhaust systems.

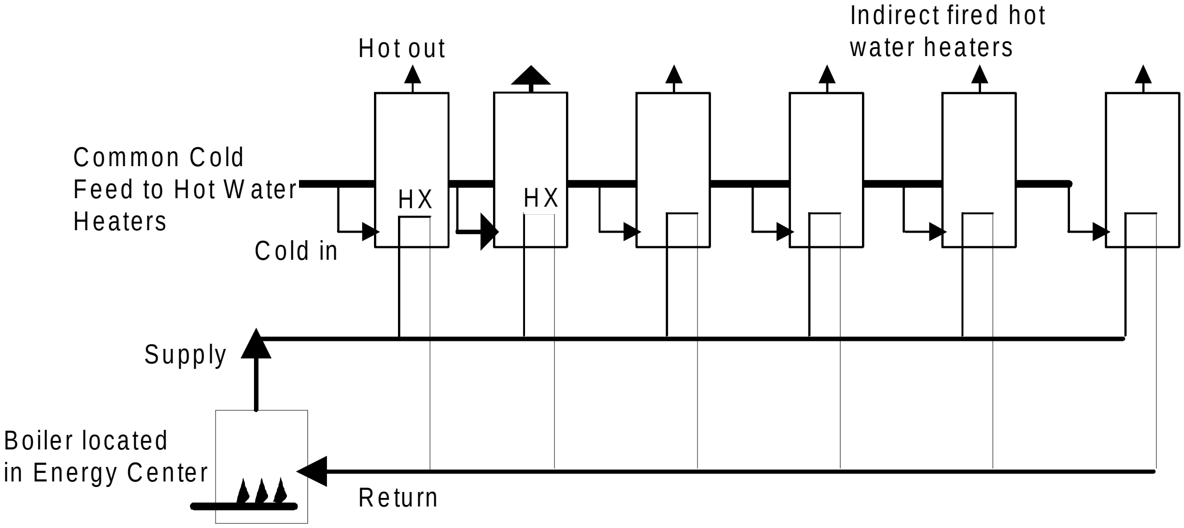
Air filtration

The selection of air distribution system also allows for the inclusion of a high quality air filtration system. A high efficiency 4” deep pleated filter is used.

Heating and Domestic Hot Water

The heating and hot water use a mini-district heating system, to cut out utility meter charges and make fuel changes to renewable energy much less expensive. Sub-metering saves roughly $15 per month per household. The monthly meter charge is avoided because there are five gas meters in place of 31 gas meters. The system is metered to allocate energy use for heat and hot water. All combustion takes place at the central boilers in the “Energy Center” attached to each cluster of 6 to 8 units. Hot water is provided by individual hot water storage tanks heated by central boiler.

Common Systems



Boiler water circulates and heats water stored in tank in each house

Information on the set of problems driving the development of the common system follows.

COMMON SYSTEMS DEVELOPMENT

The following issues were major considerations in the development of the advanced heating and hot water systems for EcoVillage. These issues are common to multifmaily housing.

It is important to develop energy efficient advanced heating, hot water and ventilation design solutions for multifamily and clustered housing. Clustered and multifamily housing includes low rise and high rise multifamily, condominiums and townhouses, cooperatives, and adaptive re-use of commercial buildings into residential housing. Multifamily and clustered housing reduce land use, a very important feature in urban settings where high land use costs are often matched with lower costs (and therefore energy use) for transportation. The shared wall features of multifamily family housing also reduce building material consumption and lower heating energy consumption. In fact, hot water energy use can easily rival heating energy use in multifamily housing particularly as exterior envelope insulation levels are increased.

Multifamily heating and domestic hot water design solutions should promote individual accountability for energy use. Individual accountability for energy consumption is also an important energy conservation feature. Increases in the accountability for energy use are recognized by US Department of Housing and Urban Development to produce reductions of from 10% to 30% in energy use. Naturally this makes accountability for energy bills an attractive feature for landlords in both the public and private sectors. Current sub-metering solutions such as Btu meters are expensive and do not provide any centralized control or additional performance monitoring features. Other commercially available sub-metering technologies provide accurate allocation for heating systems but typically not for domestic hot water. (See ASHRAE Guideline 8-1994 Energy Cost Allocation in Multiple Occupancy Residential Buildings) To date, this has often meant the installation of individually metered electric heat and domestic hot water in multifamily housing. The low first-cost of installation, combined with individual metering, has caused this approach to be favored despite the higher operating cost of electric heat for the occupants of the building, often low-income tenants.

Multifamily heating and domestic hot water design solutions should address both the total cost of operation and the health and safety of the occupants. In situations where individual through-the-wall gas space heaters have been installed as a heating solution, the water heaters often remain individual electrically heated, particularly in retrofit situations. In addition, through the wall gas space heaters do not provide solutions to the issues of ventilation and air conditioning. When furnaces are installed, the combination of non-sealed combustion gas fired water heaters with the frequently leaky return duct work of furnaces is an easy recipe for the backdrafting of combustion products into the living space. The interior and exterior designs of most apartments do not accommodate the placement and venting of individual sealed-combustion gas-fired water heaters.

Individual monthly meter charges are climbing and have a significant impact on smaller users of energy. As deregulation moves the market towards a more accurate representation of the true costs, the fixed monthly meter charge for each customer is increasing to better reflect the actual fixed cost of maintaining the gas and electric distribution systems. Monthly meter charges for residential gas customers in NYSEG territory have gone from $7 to over $15 per month during the past several years. Increases in Niagara Mohawk's service territory are similar. The utilities have been requesting even higher monthly meter charges but have been rejected by the Public Service Commission. A monthly meter charge of $15 per month represents an annual cost of $180, a significant percentage of the total energy bill of a multifamily housing unit. An annual heating and hot water energy bill of $720 would be increased by 25% by the individual gas meter charge. Larger users are affected less by the increase in the meter charge, because they benefit more from reductions in the cost of energy. Combining smaller users reduces meter charges and provides better opportunities to obtain lower energy rates.

Multifamily heating and hot water design solutions ideally should allow for the cost-effective incorporation of renewable energy sources and possible fuel switching. Clustered and multifamily housing also present opportunities for incorporating renewable energy sources. It is more cost-effective to serve multiple households with a single renewable energy system, than to install individual systems for each household. For example, the eight household systems at EcoVillage at Ithaca could incorporate a central solar hot water heater, a wood fired pellet boiler, or a fuel cell, at a much lower cost than providing eight such systems, one for each individual household. Access to the hot water usage of eight households makes fuel cells and other co-generation technologies much more cost effective.

Fuel switching is also much more cost effective for EcoVillage. If fuel prices change in the future, a single central boiler conversion will be much cheaper. Dual fuel interruptible systems might even be cost effective. The current stock of individually metered electrically heated housing is expensive to convert away from electric heat because there is no air or water distribution system. An air or water distribution system allows the user to convert at a much lower cost.

HEATING AND HOT WATER CONTROL DESCRIPTION

DHW Priority Scheme

The domestic hot water tanks are controlled such that the a call for heat from the water tank will take priority over the call for space heating. This was done to reduce the total required boiler capacity. The boiler output would need to be roughly 500,000 Btus/Hour to meet the maximum possible combined load of all space heating and DHW.

By taking advantage of the slow rate at which the houses lose heat and by increasing the output of the individual space heating systems slightly, we can size the boilers much smaller (roughly 320,000 Btus/Hour).

In practice, the water heater may operate for 20-30 minutes, during which time the house will cool slightly below the set-point, before the space heating will be able to operate. These houses will take considerably longer to drop 1 degree F than typical houses. There have been some complaints when a setpoint change in a clock thermostat has coincided with a number of showers.

Pumping Setup

The pumping arrangement has been designed to minimize energy loss from boiler off-cycle losses, piping heat loss, and pumping energy.

Each boiler has its own small pump, which connects that boiler to the main circulating loop. This allows the boiler not in use to cool off when it is not operating. (Boilers with hot water circulating through them when not in use are very much like radiators losing energy to the boiler room.) If one boiler or boiler pump should fail, the second boiler can meet much of the load until a repair can be accomplished.

Two pumps serve the units to each side of the Energy Center. This two zone arrangement allows for a call for heat or DHW to occur without needing to heat up the piping on the other side. A simple piping crossover allows one zone pump to temporarily serve all 8 units if one pump fails.

Running a smaller pump to meet an individual call for heat/DHW will also reduce the pumping energy particularly in months with little heating energy requirement (April to October for these houses).

Boiler Controls

The boilers are controlled with a simple Tekmar two stage set point control. An outdoor reset control would make the metering difficult and does not fit with the domestic hot water arrangement.

The Tekmar control operates the boilers as two stages. The first stage operates on a call for heat/DHW. The second stage is set for a set point slightly below the set point of the first stage and will also go through a time delay before firing. This allows the first stage time to heat up the loop. More stages of boilers would have been better but were eliminated as part of a budget effort.

Each boiler has a run time meter and the boilers are wired to allow for easy manual switching of the lead lag arrangement.

The efficiency of this arrangement could be improved by allowing better control over the hot water heater operation and by reducing the amount of heat left in the boilers when the loop shuts down. In addition, wide variations in hot water heater settings, combined with the 140oF operating temperature of the loop has caused wide variations in the metering of domestic hot water usage. There has also been a problem with the snap switch thermostats on the water heaters. They appear to be intermittently sticking on, perhaps due to the low delta T between the heat exchanger loop loop and the DHW tank.

COMMON HOUSE PERFORMANCE FEATURES IN BRIEF

- Passive solar orientation
- Integrated offices (8) reduce transportation costs
- Radiant floor heating
- Heat recovery ventilation
- Walk in cooler
- Root cellar
- 12 V task lighting in dining area
- Pond water cooling
- High efficiency horizontal axis clothes washers (2 washers serving 30 households)

INITIAL OBSERVATIONS

1. Large glass areas and increased building height have the potential to cause drafts and cold areas and should be carefully modeled to avoid comfort problems.
2. Low energy buildings with lots of glass respond quickly to solar gain. Heating systems with fast response and low thermal storage capacity have response times in keeping with the solar gain.
3. Design the building around the HVAC system and don’t try to retrofit the HVAC into the design. Architects need to accommodate the HVAC system design into early design drawings. Similarly, put thermal mass into the design early. After the even the early drawings are made, it gets more expensive.
4. Proper installation of materials that requiring sealing in toxic off-gassing is difficult to manage. As materials are installed there are frequent cuts and punctures that break the seal and subsequently are difficult to reseal because of the surrounding materials.
5. Peak hot water demand controls the boiler sizing for integrated heating appliances. The heating load in these units is small enough that the peak hot water load is high than the peak heating load.
6. Radiant and halogen electric stoves are a big hit for ease of use and don’t put pollutants in the room air. These stoves are easy to use and easy to clean.
7. Use electronic ballasts on lighting. Magnetic ballasts may be cheaper but the flicker is annoying.
8. Interior core forced-air systems have limitations. Placement of all the supply and return ductwork on interior walls may be less expensive but when there are large glass areas and tall ceiling heights the systems may not perform well in cold weather. Put cold air returns low on the first floor and high on the upper floors.
9. The open systems concept was quickly used to add local area network and internet connection wiring. The channels under the building were used to add an ethernet local area network after construction was complete. This network now provides high speed internet access for the cost of a $50 network card and the shared cost of a very high speed DSL connection to the internet.

10. Control systems should be either very smart or very dumb. Very simple control systems can work well with very simple systems. As systems get more complex, the investment in digital control technology provides more control, diagnostics and alarms, and the ability to cheaply modify strategies.
11. Avoid over-sizing pump and fan sizes and pay attention to efficiencies. Equipment may come with oversized pumps, which can impact the electrical bill. Specify the pump and fan sizes to increased electrical costs.
12. Multi-level design contributes to stratification. There are close to three stories in most EcoVillage buildings. The height contributes to the clustered feeling but affects comfort by increasing drafts and overheating.
13. Specify “permanent” metal ductwork for all heating, cooling and ventilation. If you do not specify metal ducts for heating and ventilation, you will be putting a temporary material into a permanent wall.
14. Build a test house(s) and learn from it, then make the necessary performance adjustments to the design. Build a house or two then be ready to make some changes before proceeding immediately into the remainder of the buildings. Innovation has risks and requires installation to realize all the system impacts of change.

OPTIONS FOR FUTURE PROJECTS

1. A system for estimating global warming impact for consideration by the decision-making process of the group.
2. A smart control system for metering and monitoring.
3. Exhaust ports under the sinks, in garbage cabinet, and in closets to depressurize sources of contaminants.
4. Access panels into plumbing chase and into truss joist space between floors.
5. Full warm and dry basements not crawl spaces for more flexible space.
6. Smaller boiler pumps and timer controls on fans to reduce power consumption.
7. Renewables (solar, wood, wind) or fuel cells plugged into the energy centers (the mini-district heating system).

BACKGROUND ON THE ECOVILLAGE AT ITHACA NOT-FOR-PROFIT

EcoVillage at Ithaca, Inc. (EVI) is a 501(c)3 not-for-profit organization incorporated in New York State in 1989. EVI was founded to promote the transition to a sustainable society by modeling an alternative land use pattern and focusing on the consumption of resources in the construction and operation of residential housing. In 1992 EVI purchased a 176 acre plot of land, two miles from downtown Ithaca. The land was purchased from a developer who had planned to put 170 single family tract houses on one acre lots on the property. The purchase was financed by a group of interested individuals who provided a mortgage with a three year abeyance in payment. EVI holds the title to this land. This outstanding mortgage created an important time pressure on the project.

EVI is managed by a 9 member board of directors and has two part-time staff members who work out of the Center for Religion, Ethics and Social Policy (CRESP) at Cornell University. EVI produces a quarterly newsletter, sponsors educational events and lectures, and generally promotes sustainable living. Additional background information is available in the EVI annual reports, which can be purchased for reproduction costs from EVI. EVI sold land to the EcoVillage Co-housing Cooperative to develop the first neighborhood on its land.