BIRTH OF A NEIGHBORHOOD

Sunny by Design
Shining Light on Vampires
The Home that Grows on You
Built-In Community

Cohousing communities balance the traditional advantages of home ownership with the benefits of shared common facilities and ongoing connections with neighbors. These communities consist of private dwellings with their own kitchens, living-dining rooms, and so on. Residents also have common facilities, such as a dining room, a community kitchen, lounges, meeting rooms, a laundry room, recreation facilities, a library, workshops, or a childcare area. The typical cohousing community has 12 to 40 attached single-family homes arranged along a pedestrian street or clustered around a shared courtyard.

Developing a cohousing community offers a unique opportunity to provide more sustainable and energy-efficient housing than is possible with typical single-family-home construction. By sharing common facilities, cohousing residents often cut down on the energy, resources and overall space required to house, feed, and provide amenities for families compared to families living in typical suburban dwellings. For example, when twelve families moved from single family homes into Doyle Street Cohousing in Emeryville, California, nine years ago, they realized an average 75% drop in their annual energy bills.

Homeowners collaborate in the development process, allowing more time to research and consider the best available materials and equipment from a resource perspective. This may be the most important role for cohousing: bringing sustainable methods into production housing. Future residents' participation can also allay the developer's fears regarding potential difficulties in selling a home with features that aren't standard in the marketplace.

A new project that demonstrates the energy and resource efficiency potential of cohousing is the Pleasant Hill Cohousing Community, a 32-unit neighborhood of clustered town houses on 2.2 acres in Pleasant Hill, California. The residents started to move in September 2001. This project's sustainable-building innovations fall into three categories: (1) reducing occupants' energy use, (2) sustainable construction practices, and (3) ecological and personal health.

Reducing Energy Use

Most of the methods used to reduce energy use in this project involve little appreciable cost and allow architects to use familiar methods with a wider palette of materials. The resulting average

by Chuck Durrett
heating/cooling costs will probably amount to less than $1 per day per house (see “Lessons Learned at EcoVillage”). These houses have no electric air conditioning—an impressive feat, since all of the households moving into the community from within the Pleasant Hill area currently have air conditioning, in an area that has over 1,000 cooling degree days.

The strategies we used when designing the heating/cooling system for this community relied on our ability to plan for multiple housing units that were cooperative. We emphasized passive techniques and judiciously added active techniques where these were needed.

Because summer days in this hot, fairly dry climate can often reach highs of 110°F passive-cooling measures were essential to eliminate the need for air conditioning.

Window shading and cross ventilation. Carefully placed trellises and trees on the south and west exposures provide summer shade while allowing in winter sun. Windows are shaded by built-in awnings, and trellises will support abundant growths of hops. The homes are only 30–40 ft deep, so operable windows and ceiling fans provide excellent cross ventilation.

West windows will require further shading, both externally with trees and trellises, and internally with opaque reflective shutters. Some occupants may install portable room air conditioners until the trees mature. Most have ordered whole-house fans for night cooling and ceiling fans to facilitate evaporation and improve thermal comfort.

**Wide overhangs.** Building 3 ft 6 inch overhangs is not a simple task in production construction, but the sombrero-like effect plays an important role in keeping direct sun out of the houses.

**Polar Ply radiant barrier.** Radiant barriers greatly reduce solar heat gain from the roof and reflect about 80% of the sun’s direct radiation, according to the manufacturer, Energy Conservation Technologies, and research by the Florida Solar Energy Center. Because the reflective layer had been applied directly to the roof sheathing, it went on as regular roof sheathing would.

Energy conservation advocates have long lobbied for this to be required in states like California. We hoped to further that possibility with data provided by this project. (Subsequent to the design of this project, radiant barriers have become required by state law Title 24.)

**Corrugated metal roofing.** The light blue corrugated metal roofing from Western Metal Sales also blocks solar gain (see “Roofs Reflect Better Savings,” *HE* July/August ’01, p. 24). The heat it collects dissipates rapidly and the corrugation makes for natural ventilation.

**Low-e windows.** Energy-efficient low-e windows were installed throughout the project to keep heat in in the winter and out in the summer. (see “Energy Star Windows Make a Difference,” *HE* Sept/Oct ’01 p. 16).

**Thicker and denser gypsum board.** By specifying thicker, denser gypsum board throughout (7/8-inch and sometimes doubled 1/2-inch, rather than the typical 1/2-inch), we added a thin thermal mass that stores solar energy in the winter and takes advantage of night cooling in the summer. The added cost for the upgrade was $200–$300 per house for materials and installation. Further benefits of this novel technique include straighter walls (in these days of crooked framing lumber), a stronger structure (important in earthquake country), and better sound and fire resistance than typical 1/2-inch gypsum board can provide.

**Lightweight concrete floors.** By using “gycrete” in some units (the flats), we added more mass to absorb and distribute solar energy in the winter and for night cooling in the summer. The product also adds sound and fire resistance.

In addition to these passive heating/cooling techniques, we designed other passive and active energy-saving measures into the Pleasant Hills community that are not standard in production houses.
Extensive natural lighting. We minimized the need for electric lighting in the houses during daylight hours by judiciously locating windows and skylights. Windows were located high for maximum sky light.

Dual-purpose water heater. A shared, dual-purpose water heater provides hot potable water and radiant baseboard heating for each cluster of houses. Instead of having two separate pieces of equipment for each house, as is usual in single-family homes, this project groups up to six houses around a single heater for all heat and hot water. This system dramatically cuts the amount of energy capacity required for a single household, from about 130,000 Btu per hour to approximately 26,000 Btu per hour per house. Eliminating extra heating systems increases the efficiency of the total heating system, reduces initial capital costs, simplifies construction, and eliminates waste.

Efficient water fixtures. Toilets, showerheads, and faucets are all low-water-use fixtures. The group will probably purchase front-loading, horizontal-axis washing machines for the common house laundry facility to reduce water consumption and water-heating consumption of gas.

Efficient lighting. We installed CFLs wherever possible to conserve electricity.

Wet-blown cellulose insulation. Wet-blown cellulose provides insulation levels of R-22 in the walls and R-38 in the ceilings, exceeding state energy use standards (R-15 and R-30, respectively) by a considerable margin. The insulation we used is 45% recycled cardboard and 45% recycled newspaper. We used cotton denim batts in hard-to-reach areas. The insulation contractor, California Coastal Insulation, said that the Pleasant Hill project was the first production housing project in which he had installed this product. He said he usually only insulated "rich people's houses who can afford to be more sustainable." In this way, sustainable methods are introduced into production housing. Blown-in insulation reduces infiltration by at least 38% compared to batt insulation, according to empirical data provided by the supplier.

Perimeter insulation. In the 70s, the passive heating literature said, "If you're not using perimeter insulation around the bottom of your house, you're out in the cold without your pants on." When you put the cold—and sometimes frozen—ground next to a building with a concrete slab foundation, you suck the warmth right out of the building. Then the energy crisis "subsided" and we were back to the good old days of excessive energy use. Now, however, perimeter insulation is back to guard against slab edge heat loss, resulting in a 5%-10% savings in energy use.

Smaller, simpler, less. Just as significant as the features we included in the project are the features that we eliminated. For example, these new homes have no garbage disposals (to reduce the waste stream and encourage composting) or fireplaces (for better air sealing). Most significantly, these houses are much smaller than the average U.S. home. Efficient, open plans and the large shared common house allow for an average private unit of 1,230 ft², much less than the 2,100 ft² average for new houses in the United States, according to E Magazine. This leads to reduced land usage, as well—about one-third of the land the residents collectively lived on before they moved in.

Community's Role. The role of community is crucial. As in the South, where people sit on their front porches and rock back and forth to let the air cool them off, this traditional use of front porches seems most welcome where people know each other and like chatting with their neighbors. A close-knit community draws people outside into the cool evening air, eliminating the perceived need to artificially cool their homes.

This housing project has a reduced environmental impact beyond its physical design. Located near the new Pleasant Hill downtown area and BART subway station, and adjacent to the local bicycle path, the project encourages the use of bicycles, mass transit, and walking. The community goals (to share tools, meals and childcare, and to organize group social activities) dramatically reduces residents' car trips and redundant appliances like lawn mowers. A study by one planning department showed that
cohousing residents make 25% fewer car trips per household than the residents of adjacent condominiums and single-family houses. Also, living in a community makes it easier to pool resources and to handle waste materials that are not picked up at curbside.

The 4,426 ft² common house is the focal point of much cohousing life. There cooperation allows for innumerable opportunities to save energy. For example, in our community last Sunday, the common spaghetti dinner allowed us to boil 1 pot of water instead of 12.

Cooling Tower. The common house has been designed with a passive cooling tower. The tower is designed to collect and remove hot air from the building, to create a breeze when needed, at evacuate hot air at night, replacing it with night air that serves to cool down the building's mass. The mass is then ready to absorb the next day's heat. When air doesn't flow naturally—as when the atmosphere is stagnant—thermostatically controlled fans force hot air out of the tower, bringing cooler air into the building.

Sustainable-Construction Practices

The people who collaborated on the design of their community expressed a strong desire to incorporate as many sustainable-construction practices and materials as we could. For many reasons—especially financial reasons—their goal was eased by the strength of their numbers. Here are some of the innovations we incorporated:

Gravel driveways and crushed-gravel pathways. Gravel eliminates the need for large amounts of asphalt. This community has an average of 318 ft² of asphalt per household, compared to 1,200 ft² associated with the typical American home. The permeable surfaces allow "car drip," with its plethora of associated pollutants, such as benzenes and other petrochemicals, to run directly into the ground, where microbes in the soil can digest them. This precaution is particularly important to the creek at the east of the site, where concentrated pollutants from runoff could harm animal life.

Concrete with 15% fly ash. Fly ash is a waste product from coal-fired power plants that makes concrete stronger and more workable. This blend replaces some of the energy-intensive cement. (In the future we'll use up to 50% fly ash.)

Sustainably grown lumber. The group allocated $20,000 for wood certified by the Forest Stewardship Council to be used throughout the framing of the project. Sustainably grown wood is wood that does not come from clear-cut forests.

Advanced framing. By using studs 24 inches on center; minimal headers, and engineered-wood members, we reduced the use of wood and minimized the need for large-dimensional lumber. We strive to use one-third fewer trees for cohousing by making use of advanced framing and engineered-wood systems. This is one of those places where thinking ahead is an inexpensive substitute for just throwing wood at a building. Advanced framing also leaves a lot more room for insulation at walls and windows headers. By reducing the need for headers, advanced framing allows windows to be higher, letting in more light.

High-quality waterproofing and flashing details. The number-one destroyer of wood (and therefore trees) is not fire or earthquakes, but rot. We used lots of metal flashing, and details that separate wood from water, prevent potential capillary action, and release surface tension where water runs down the building to preserve the wood for the long term.

Sustainable flooring. Flooring made from bamboo plank (a fast-growing grass) was used in some units. Flooring made from certified sustainably harvested wood was used in others. Linoleum, which was used extensively, is made up of 50% linseed oil and 50% cellulose. It not only lasts longer than sheet vinyl, it also biodegrades.
completely in landfills after its useful life.

**Trex decking.** This deck material is made of 50% recycled plastic and 50% sawdust and binders. It also lasts significantly longer than typical decking, which has a life of only about 20 years.

**Careful design.** Unnecessary remodeling and rebuilding wastes materials, time, and money. The way to reduce waste is to design the project carefully in the first place. By deeply involving the future residents in the design process, we encouraged input and cross-pollination of ideas from the people who will actually use the spaces. We believe that this "soft" product—design and thinking—in addition to hard materials, is the best way to use less.

**Ecological Health.** The future residents were also deeply concerned about building a healthy housing development, both for themselves and for the earth. We incorporated many materials and practices that should improve indoor air quality and reduce radioactive and electromagnetic emissions.

**Nontoxic interior materials.** Materials with minimal impact on indoor air quality were used wherever it was economically feasible. These included low-volatile organic compounds (VOCs).

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**Lessons Learned at EcoVillage**

- of burners and combustion heat exchangers.
- The system was cost competitive with a system made up of individual boilers.
- The houses use 4 to 5 Btu per heating degree-day for combined heat and hot water. We estimate that roughly 50% of the heat energy goes to hot water, based on an analysis of the run time meters and the estimated average

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EcoVillage at Ithaca, New York, is currently made up of 30 tightly clustered homes lining a pedestrian street. Completed in August 1997, the cohousing project was the first completed in New York state and the 25th in the United States.

A variety of strategies were employed to achieve high energy efficiency and improve overall sustainability. Heat is provided by a shared hot-water system, with one gas boiler per cluster of eight homes. Centralized “energy centers” will facilitate integration of future renewable energy inputs.

The community has used a central heating system with a cost allocation system for four years. Each of the four “mini-district heating systems” supplies a cluster of six to eight housing units. Each household loop in the system is connected to both a fan coil unit and a storage-type hot water heater with a heat exchanger. This type of “common” or shared system was selected for a variety of reasons:

- It allowed all combustion to be moved outside the building envelope. A pair of boilers provides all heat and hot water.
- The monthly meter charge, as much as $14 per month for a gas meter, was removed. Thirty-one meters were consolidated down to five for a saving of $364 per month.
- The hourly metering system selected was inexpensive and was thought to be accurate enough given the low energy use of the units.
- Reductions in maintenance costs result from a reduction in the number

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but who wants a cold shower? We taught residents to automatically turn their heat up fifteen minutes before they took a shower.

We learned a number of interesting lessons. The lack of a true energy (Btu) based metering system has caused a number of problems.

The central heating system has losses due to a control system design “feature” that has resulted in the boilers retaining too much heat. The lack of a clear cost factor has made it difficult to direct the attention of the community to this problem.

People are not inclined to set their water heater temperatures at a common level. Once we dropped the loop circulating temperature to 140°F to save energy, the variations in hot water temperature became a very important influence on the energy transfer rate per hour.

Boiler sizing at the time was an issue. High efficiency boilers were limited to a size that would have required three boilers instead of two, driving up the cost. Also, the architect and heating contractor did not support the high efficiency equipment. We ended up with 84% efficient cast iron boilers. Accordingly, standby losses are higher. A low-mass boiler design would have been more efficient, especially given the intermittent summer load.

A paper describing the EcoVillage energy systems in Adobe Acrobat format can be obtained by writing to gthomas@psdconsulting.com

—by Greg Thomas
interior paints, water-based interior clear finishes, wool carpeting, and linoleum in place of typical sheet vinyl. Whenever possible, we used solid wood and plywood to avoid the high formaldehyde content and off-gassing of particleboard subfloors, exterior sheathing, and interior trim.

**Photoelectric smoke detectors.** Instead of the more common radiation-based ones, photoelectric smoke detectors were used to eliminate the use of radioactive materials.

**Underground electric supply lines.** Although electromagnetic fields (EMF) haven’t been proved harmful, electrical supply lines were undergrounded as a precaution. And it looks better, to boot.

**Low-toxicity wood preservatives.** For mudsills and much of the deck framing, we specified ACQ Preserve, a low-toxicity alternative to the usual highly toxic arsenic-based (ACA or CCA) preservatives. (see “A Green Wood Deck,” *HE* Jan/Feb ’01, p. 7).

**Future Possibilities**

Most of the work to incorporate sustainable options costs little extra—in many cases only the cost of the time it takes the architect and residents to research those options. Some of the materials (such as the ACQ, certified redwood, low-VOC paints, and recycled floating floor pad) cost 5%-10% more than the standard material. Some of the energy-efficient products (such as the CFLs and the horizontal-axis washing machines) cost far more than the alternatives, but they pay for themselves in energy savings in a few years.

Higher levels of sustainability will be possible as the learning process continues from project to project. And as suppliers sense increased demand, more environmentally friendly options will become available in the marketplace.

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The *Architectural Resource Guide*, prepared by members of the Northern California Architects, Designers and Planners for Social Responsibility proved particularly useful. It includes excellent descriptions of the pros and cons of different approaches, as well as extensive national contacts for manufacturers and distributors of materials. To order a copy, send $20 ($18 for the book plus $2 shipping and handling) to ADPSR, P.O. Box 9126, Berkeley, CA 94709-0126.

General cohousing information is available from The Cohousing Network, 1460 Quince Ave., Ste. 102, Boulder, CO 80304. Tel: (303)413-9227; Web site: www.cohousing.org.

Also very useful are some of the computer databases of sustainable materials, such as the Sourcebook from EcoLiving International in California. Tel: (510)542-0500.

The Energy Efficiency and Renewable Energy Clearinghouse (sponsored by your tax dollars) is a good toll-free source of information on energy efficient design. Tel: (800)DOE-EREC.

For radiant insulation materials, contact Energy Conservation Technologies, 8095 South Lake Circle, Granite Bay, CA 95746. Tel: (800) 426-6200 or (916) 791-4572; Fax: (916) 797-3022; E-mail: rwp@quiknet.com.

Fly ash should be available through RediMix and other local concrete distributors. If they are not familiar with it, contact Pozzolanic International at (800)426-5171 or Mineral Specialties at (406)656-2334.

ACQ preservative treated wood should be available through local lumberyards. For help in finding a local distributor, contact Chemical Specialties, Incorporated at (800)421-8661.

Sustainably harvested wood, including framing, hardwoods, and all wood and bamboo flooring products (including pads from recycled tires), is available through EcoTimber at (510)549-3000 and at a growing number of other suppliers. Ask your local lumberyards first. If you can’t find a source of certified lumber in your area, check with the certifiers: Rainforest Alliance at (212)677-1900 and Scientific Certification Systems at (510)832-1415. Johnson Hardwoods offers a wide array of engineered sustainably harvested hardwood floors.

Wool & other natural fiber carpets are now available from a large number of national carpeting distributors.

Recycled plastic carpet is manufactured by an increasing number of companies throughout the United States.

Recycled paint is made by E-Coat and Recycled Paint Products at (916)920-0550 and distributed by Kelly-Moore.

Low- and no-VOC paint is made by Benjamin Moore at (408)727-3565.

Photoelectric smoke detectors are now widely available.