Carolyn Schwartz

North Carolina–based designer/builders Jim Cameron and Kathleen Jardine combine five tried-and-true features in their energy-efficient Heirloom Houses

5 Ways to Build a Better House

by Kathleen Jardine

Twenty years ago, my husband, Jim, and I became disenchanted with the many dark, moldy houses we had lived in: cold as tombs in winter and hot as ovens in summer, their crumbling parts maddening to maintain. Between the two of us, we had lived in dozens of them.

"There must be a better way to build a house," we agreed.

But we were dubious of new construction. Conventional new houses cost a fortune to heat and cool back then — they still do — and with their plastic components, skimpy overhangs and grandiose throwaway roofs, they didn't look very durable, either.

Gradually, we figured out some better ways to design and build houses. In the last decade we've designed 25 or 30 houses, 12 of which we also built. We call them Heirloom Houses. They cost no more to build than conventional houses. They are beautiful, comforting, light-filled, cheap to heat and cool, easy to maintain, hypoallergenic, have a low environmental impact — and they will last so long they can be handed on and on.

An Heirloom House includes:

- Garden orientation
- Autoclaved aerated concrete (AAC) walls finished with stucco, plaster and clear pine trim
- Galvanized steel roofing on manufactured trusses
- Tinted poured-and-scored concrete floors with radiant hydronic heat systems
- Classic features wedded to passive solar design

Any of these features alone improves a home, but together they result in a radical improvement in livability, energy efficiency and eco-friendliness. In addition, we combine them with careful tradeoffs to hold down costs, because even better ideas are hardly better if they cost more.

ABOVE, RIGHT and OPPOSITE: A garden orientation, with just a single step down from the home to the outdoors, makes it easy and inviting for homeowners to go outside.

Courtesy Kathleen Jardine

Houses built with AAC blocks are durable, soundproof and fireproof, and can withstand hurricane winds up to 140 mph.

Autoclaved Aerated Concrete Walls

Although AAC has been available in the United States for only a decade, it was developed in Sweden in 1914. Aluminum powder was combined with sand, lime, concrete and water to create a mixture that expands dramatically, creating a "foamed," lightweight concrete that is 80 percent air. It is formed into blocks using molds and cured in a pressurized steam chamber called an autoclave. The resulting building material is structural and self-insulating. As a bonus, no pollutants are generated to manufacture AAC.

AAC has been used all over the world to make extremely durable, fireproof, soundproof, termite-proof houses that have excellent track records in hurricanes and earthquakes. It does not mold or mildew. AAC houses can be expected to last hundreds of years with very little maintenance. AAC has only one complicated claim: its insulation value (see **Sorting out the R-Value Issue** on page 51).

More than 200 plants in 35 countries produce this product in a variety of forms. In the United States, it is marketed primarily in 24-by-8-by-8-inch blocks; it is also available in a 12-square-inch block. We use a block made by Aercon, one of four manufacturers in the United States that supply a variety of AAC products.

We prepare a standard footer and CMU (concrete masonry unit) foundation that is filled solid with concrete imbedded with 5/8-by-24-inch J-bolts. A 34-by-50-foot foundation, for instance, requires about 14 J-bolts. Threaded steel rods are coupled to them after the AAC walls are built, passing through factory-cored blocks in every course and connecting the foundation to a concrete-filled continuous-bond beam at the top of the wall. Our houses are thus engineered to withstand 140-mph winds, a necessity in hurricane-prone North Carolina.

The first course of AAC is set with type S cement, which creates a high-strength mortar. Subsequent courses are laid with a thinset mortar similar to that used in tile work. Openings require bond beam lintels to form structural headers, and treated wood bucks for attaching window and door units.

Jim and I built the walls for our first AAC house client, so we have a good idea of the difficulty first-time builders have working with these materials. We also appreciate how expert professional AAC masons, like Martin Noble and Roger Connett of Stonebridge Construction, make the job look easy. They charge about $8 per square foot for materials and labor.

Noble cautions, "Keep your plans simple, especially your foundation. Work in rectangles. Windows should all be at the same height at the top. We need a clean, backfilled site with staged pallets of AAC, or an AAC house will cost you more to build."

Thick AAC walls with real stucco outside and mineral plaster inside make for a classic look. Stucco does not need painting or repainting in its long lifetime; off-gassing of painted surfaces is reduced by using no-VOC (volatile organic compound) water-based paints, such as those made by Pittsburgh Paints.

High ceilings are another classic feature that's easily achievable with AAC. We use 15 courses of AAC to make an insulated floor and a first-floor ceiling that's 9 feet 4 inches high.

Carolyn Schwartz

Garden Orientation

1 Outdoor living space is cheaper to create than indoor space. Also, by annexing the outdoors, you can build a smaller house. Unfortunately, it's so hard to get into and out of many houses that any effective use of the outdoors is negated. A home's layout should make it easy and inviting for homeowners to go outside, an important design feature for sedentary Americans.

A garden orientation specifies that the house sit on a level pad graded for drainage in all directions. Before the invention of the bulldozer, people searched for just such a natural site, called a knoll. Almost any old country house is sitting on one, which is the main reason it is still in one piece.

Perfect drainage is the first requirement for the durability and health of a house. Many new house sites have water rushing straight down a slope to the foundation, which is defended inadequately by waterproofing and drain tiles.

An irregular site also spoils the look of a house. A tall, complicated, stepped foundation and crazy stairs make a house look too much like a mobile home, haplessly plopped down on a ragged site.

We learned this the hard way once, by building just such a house for ourselves. Circumnavigating it was a tiring hike that nearly required crampons and ropes!

We now build all our houses with just one step down to the outdoors. This makes the house and garden continuous, and allows the old or infirm to remain in-residence much longer.

Ken Druse

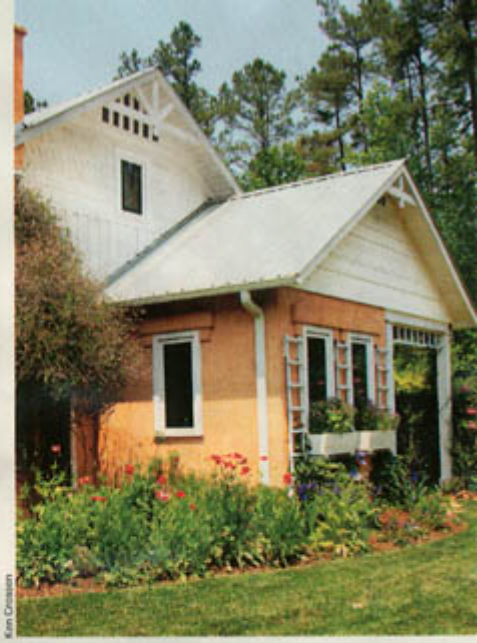
What Makes These Homes Smart

- Garden orientation incorporates outdoor living areas and improves drainage.
- Walls of autoclaved aerated concrete (AAC) create houses that are durable, fireproof, soundproof, termite-proof, resistant to mold and mildew, and stand up well to hurricanes and earthquakes.
- Passive solar design saves energy, resulting in reduced heating and cooling costs.
- A gas tankless water heater and solar energy provide hot water for radiant floor heating.
- Concrete flooring is inexpensive and eco-friendly.
- Steel roofs are affordable and last up to 100 years.

Galvanized Steel Roofs

3 Finished AAC walls cost less to build than brick construction, but they are more expensive than conventional 2-by-4-inch stud walls with fiberglass insulation and wood siding. We offset that cost with other components that are less expensive than their conventional counterparts, such as engineered attic and room trusses with skip-sheathing (1-by-6-foot pine on 16-inch centers) and galvanized steel roofs. We use both painted and unpainted 3-foot-coverage galvanized panels on our roofs; the unpainted variety is widely used on new houses in our region and in the Southwest.

Steel roofs are not only an affordable option, but they also outlast asphalt shingle roofs. In the 100-year life expectancy of a steel roof, perhaps five asphalt-shingle roofs will be sent to dumps. Hydronic radiant concrete floors are similarly long-lasting and less expensive than conventional counterparts.



Kim Cinnamon

Galvanized steel roofs, either painted or unpainted, are affordable and durable, with a life expectancy of up to 100 years.

LEFT and BELOW: Four-inch-thick colored concrete flooring is warmed by a radiant hydronic heat system.

Ken Crousen photos

Concrete Floors With Radiant Heat

"Wow, what is this?" visitors wonder. Our floors look like waxed stone slabs, but they are humble concrete, scored and grouted. These floors are both passive solar thermal masses and radiant hydronic heat systems. They feel *so* good to bare feet in both summer and winter.

We pour these 4-inch-thick floors after houses are roofed, and before windows and doors are installed. Dry pigment, available in many colors, is added to the concrete mix while it swirls in the truck. The colored concrete is finished over the radiant floor system, which is made from loops of oxygen-impermeable pex tubing clipped to 1-inch rigid polystyrene insulation.

An 1,800-square-foot house requires five or six zones of pex loops; they return to a central manifold supplied with warm water from a storage tank and a gas-powered on-demand water heater. This is also the source for domestic hot water.

A couple of our clients have used solar energy as a way to heat water for a radiant floor system, but there are cost issues involved with this approach. If a client can't afford solar panels at the time of construction, we set up the radiant floor system so solar energy can be attached later.

In the meanwhile, many of our houses are heated comfortably with sunlight and firewood. In North Carolina, a 1,800-square-foot house can be kept snug with only a cord and a half of wood. The houses are so cool in summer that air-conditioning systems are used only occasionally, and mostly for dehumidification.

5 We build only passive solar houses, which are not only energy efficient but also feel really good to live in. They are cool and shady in summer, and sunny and warm in winter.

Our climate in North Carolina swings from 0° to 100° F, but thanks to passive solar design, our Heirloom Houses fall to interior temperatures of only about 55° and rise to about 78°

Passive Solar Design

with no heating or cooling systems in operation. In addition, many people report that their winter depression is cured in their passive solar homes. After living in a properly made passive solar house, few would go back to the conventional variety.

We come across people who have seen — or worse, lived in — "bad" examples of passive solar houses. They think the concept doesn't work or is intrinsically ugly. The rules for making a passive solar house are simple, but deviations can be disastrous. Design mistakes cause unpleasant temperature swings, overheating and glare. Among the most egregious are south-facing windows that are sloped, too tall or don't open; uninsulated slabs; skylights; and improperly sized overhangs with no shading.

Often, these houses also use the cheapest, ugliest design features of modernism, giving the impression that this is the only style available. But any type of house can be made passive solar, incorporating overhangs, shading, trellised entries and other passive solar principles.

Passive solar design elements like overhangs, shading and trellised entries keep homes cool in summer and allow natural warming in winter.

We love classic houses because they are so comforting in a time of rapid change. They also can be loaded with charming design elements. Queen Anne and Victorian wedding-cake-style houses may be out of reach as design models, but the farmhouse, bungalow and Southwestern-style house are easy to adapt to passive solar design.

These five techniques and related materials are available to any homeowner who wants to create a better home at no greater cost.

Houses are the biggest investments in most of our lives. They cost too much to be anything less than long-lasting and wonderful to live in. A house should be a beautiful gift to the future — an heirloom. And that's what we believe our homes are.

Based in Pittsboro, N.C., Kathleen Jardine works with her husband, Jim Cameron, in operating their company, James Cameron Design/Build Inc.

Sorting out the R-Value Issue

Like a number of alternative wall systems, aerated autoclaved concrete (AAC) was introduced in the United States with inflated R-values that have taken a while to untangle. Fortunately, Oak Ridge National Laboratory waded into the debate, producing effective R-values for 8-inch AAC block when used in six U.S. climates. The effective R-values shown below compare with R-12.5 for a framed stud wall.

From these figures, we see that AAC generally performs better in climates with wide daily temperature swings and high cooling loads. In cold European climates, a variety of AAC building techniques are used: double-wall construction, jumbo AAC block (almost 15 inches thick) and the application of polystyrene sheets to the AAC block. None of these techniques appears to have crossed the Atlantic, though. The first two are too expensive to compete well in the United States, and the third compromises the environmental superiority of AAC.

Nevertheless, Oak Ridge states that energy demands of AAC houses in the six climates are 18 percent lower on average than houses with 2x4 wood-frame walls. Also, keep in mind that passive solar design considerably improves the thermal performance of a house using any wall system, including AAC.

AAC R-Values for Six Climates

Minneapolis R-11.93
Washington R-13.93
Miami R-13.51
Atlanta R-15.93
Denver R-15.34
Phoenix R-21.10