



Think \$50 per square foot and \$50 a month for utilities are unattainable?

Small House,

Government-sponsored research proves otherwise.

BY BETSY PETTIT

Many architects, builders, and consumers are in denial about the true cost of a house. Beyond the price tag, there are operating and maintenance costs. Indirectly, there are ecological and political costs.

The U.S. Department of Energy's Building America program (sidebar facing page) uses a team-design strategy to identify trade-offs that make houses less expensive to build as well as less expensive to own. The homes that my firm designs and builds, such as the one featured here, are not only affordable but also feature materials and construction details that create healthful living conditions. And the



The Building America program: your tax dollars at work...effectively

The Building America program (www.buildingamerica.gov) provides research money (through the U.S. Department of Energy) to five teams that use building sites as laboratories. They develop prototype houses, test the performance of the houses over time, and then make design adjustments.

The objective of the Building America program is to build homes on a community scale that use less energy, are faster to build, cost less, and

A long-term goal is to build homes that produce as much energy as they consume, also known as "zero-energy homes."

provide a healthful environment for their inhabitants. A long-term goal is to build homes that produce as much energy as they consume, also known as "zero-energy homes."

Building America teams are composed of groups that typically don't work together: architects, planners, engineers, equipment manufacturers, large-scale homebuilders, mortgage lenders, materials suppliers. By working together, they can identify interdisciplinary trade-offs to boost a house's performance and cut costs.

Over the past 10 years, Building America teams from across the United States have built more than 20,000 houses that use 30% to 90% less energy.

Built Right

benefits of a small house that's built right extend beyond the homeowner's checkbook.

Infill houses benefit family, community, and planet

An excellent way to reduce construction costs is to take advantage of existing sewer, water, electricity, and roads. Often overlooked, vacant lots or vacant houses can be diamonds in the rough, keeping property taxes low, cutting the commute, and providing a few more customers for the family-owned corner store. Because infill lots are a particular

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DURABILITY AND AFFORDABILITY

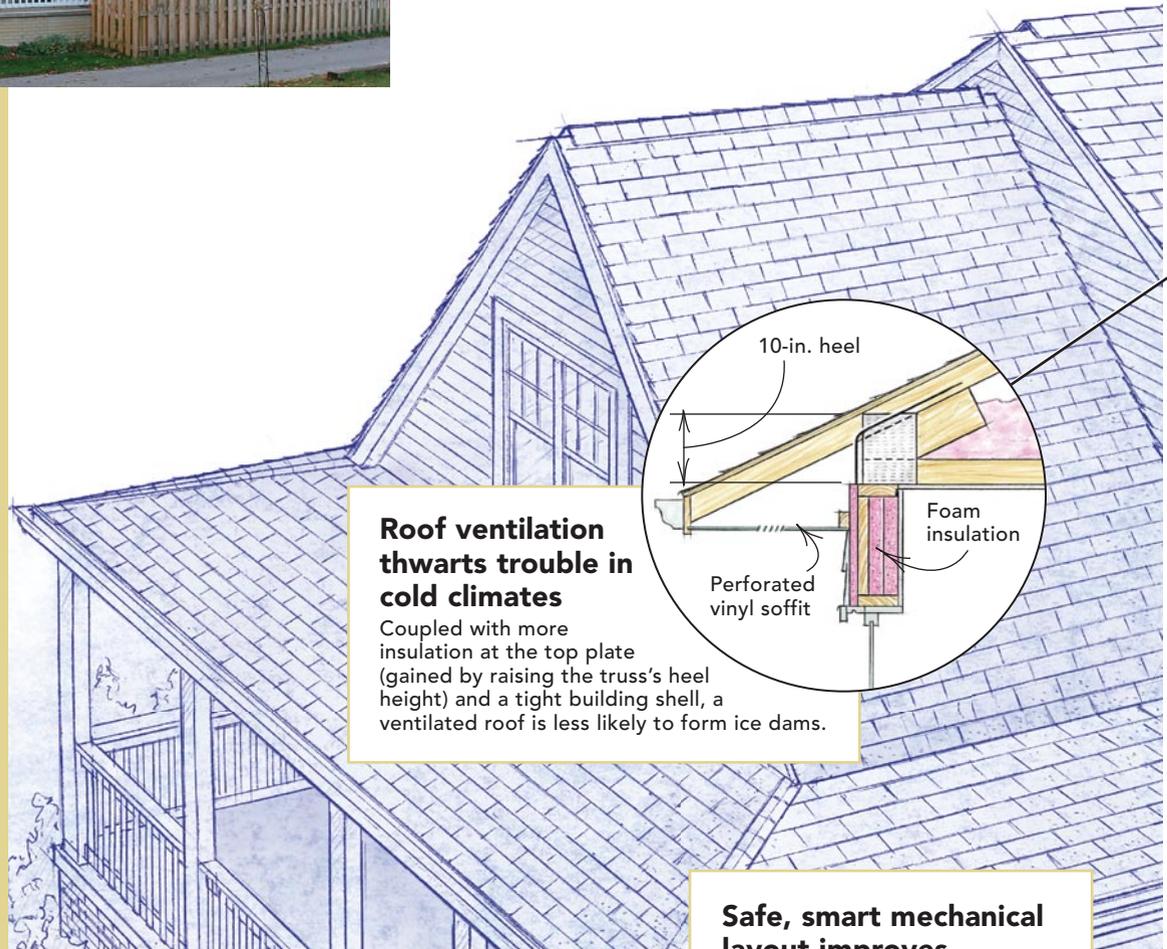
You have to take the house apart to appreciate how well it's put together.

A simple shape is the first step toward affordable construction and operating costs. This two-story design uses space efficiently and fits nicely on the average city lot.

Insulation plays a critical role. Foam sheathing augments the R-value of fiberglass batts and also reduces air infiltration. Smart insulation strategies are also important in the attic, along rim joists, and even in the basement.

High-efficiency HVAC keeps costs down and eliminates the need for a chimney.

Off-the-shelf materials can be affordable, durable, and attractive. They just need to be installed correctly and used creatively.

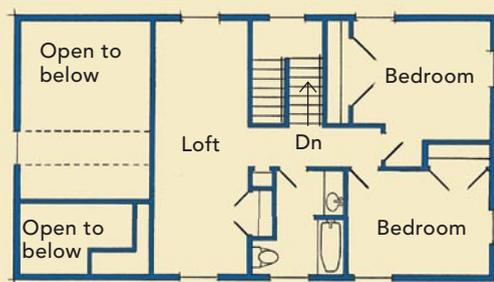


Roof ventilation thwarts trouble in cold climates

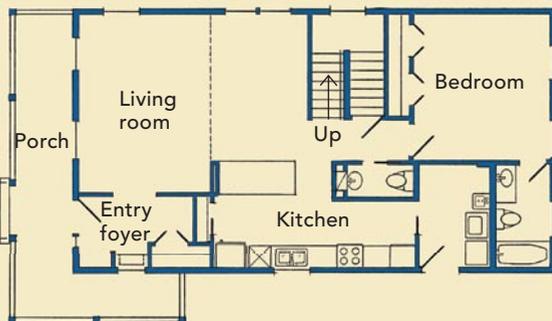
Coupled with more insulation at the top plate (gained by raising the truss's heel height) and a tight building shell, a ventilated roof is less likely to form ice dams.

Safe, smart mechanical layout improves comfort and efficiency

Sealed combustion appliances (high-efficiency furnace and water heater) directly vent combustion gases outside through a double-walled vent pipe that also supplies dedicated combustion air. Because ductwork is placed inside the insulation, there's less heat loss, so the furnace can run more efficiently. There are enough bends in the ductwork to diminish sound transmission, but not enough to cut efficiency. Outside air is brought into the system to keep inside air fresh.



North



SPECS

Bedrooms: 3+

Bathrooms: 2½

Size: 2880 sq. ft. (1824 + 1056 partially finished, and conditioned, basement)

Cost: \$144,000; \$50 per sq. ft.

Completed: 2000

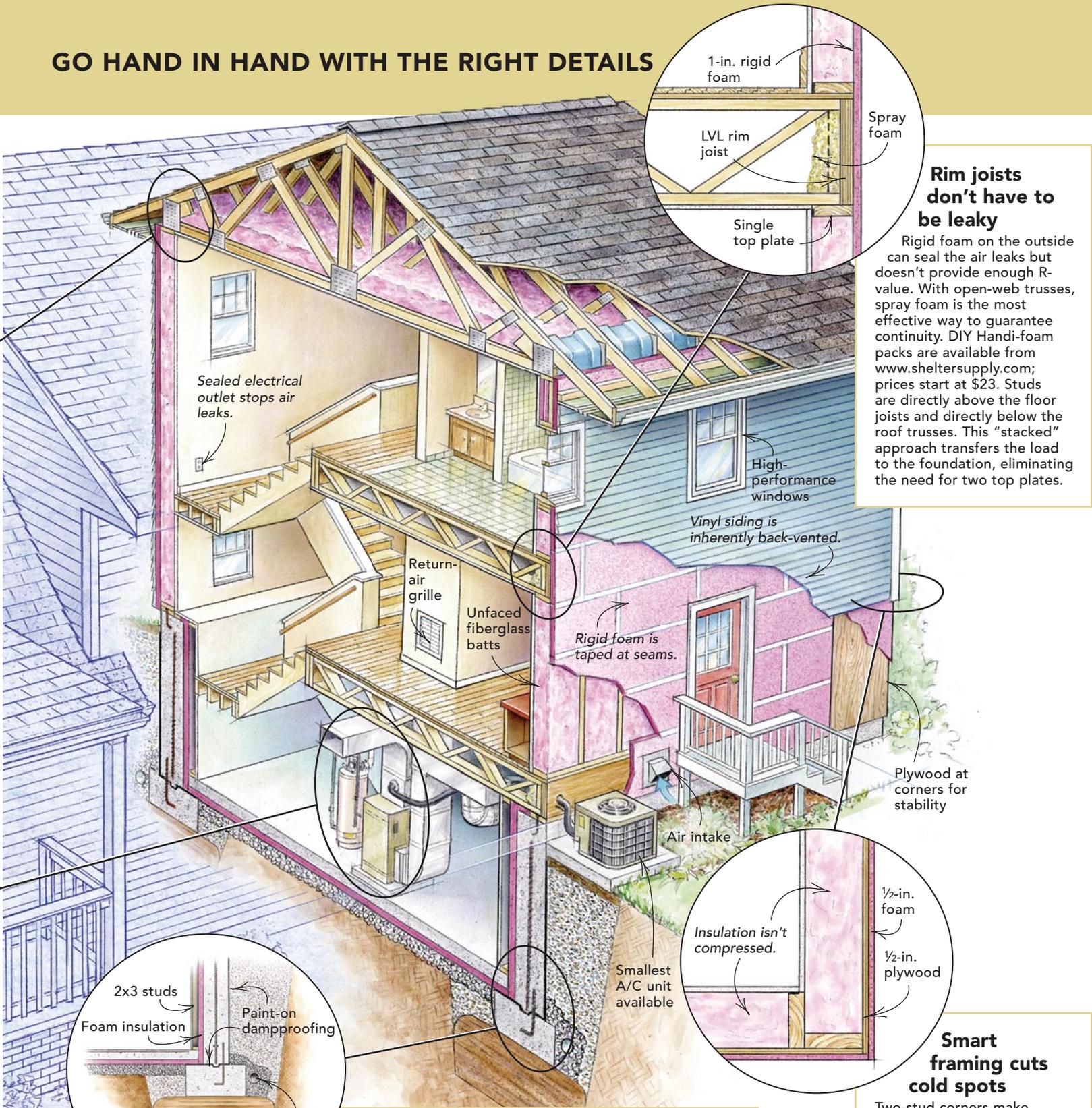
Location: Cleveland, Ohio

Architect: Building Science Corp.

Builder: Tesco Builders

0 2 4 8 ft.

GO HAND IN HAND WITH THE RIGHT DETAILS



Rim joists don't have to be leaky

Rigid foam on the outside can seal the air leaks but doesn't provide enough R-value. With open-web trusses, spray foam is the most effective way to guarantee continuity. DIY Handi-foam packs are available from www.sheltersupply.com; prices start at \$23. Studs are directly above the floor joists and directly below the roof trusses. This "stacked" approach transfers the load to the foundation, eliminating the need for two top plates.

Smart framing cuts cold spots

Two-stud corners make room for insulation and also reduce drywall cracks (use drywall clips or float the corners). Placing studs 2 ft. apart, rather than 16 in., makes even more room for insulation.

A dry basement is a healthy basement

Gravel backfill and paint-on dampproofing stop groundwater from pushing its way in, and perforated drainpipe carts water away from the foundation. Capillary breaks between the footing and foundation wall along with foam insulation under the floor and inside the walls will keep the basement warm and dry, so floor coverings can be installed with little mold risk. An uninsulated stud wall makes wiring easier.

...details that deter bugs, mold, and rot improve air quality in houses.

size and shape, they force compact design. You need to make the best use of the footprint you get. But utilizing infill lots isn't always easy.

Demolition of abandoned houses often involves dealing with toxic materials such as lead and asbestos, and disposing of these materials can be tricky in some cities. Also, existing soils may need to be stabilized before new foundations go in. The trade-off is generally worth it: Infill projects help to revitalize neighborhoods, at the same time reducing development pressure outside the city.

Look for design trade-offs

The key concept in our team-design strategy is finding trade-offs. We realize that a cube has six sides, and that the more time and money we spend on the outside of the cube,



WHAT'S RIGHT WITH THESE PICTURES?

The interior surfaces promote clean air:

- Wood floors are easy to clean.
- No carpet for dust mites to colonize.
- Low-VOC paint.
- Solid-wood furniture (not particleboard).
- Range hood is vented directly outside.

Fresh air throughout the house:

- Cathedral ceiling with ceiling fan moves air between floors.
- Return-air grille is located centrally.
- Transfer grilles above the bedroom doors allow air cycling when the doors are closed.



the less we'll spend on the equipment needed to condition the inside. Some of the trade-offs we incorporate have a five-year payback (such as a more efficient water heater and furnace), so they're no-brainers. Other trade-offs are more qualitative than quantitative, like the living room's vaulted ceiling.

High-performance windows (and thoughtful placement of those windows) can decrease a house's cooling costs. Better insulation details can cut heating costs.

Another trade-off is in our siding choice. We strongly advocate what we call a vented siding assembly on exterior walls, which incorporates a drainage plane behind the siding. By providing an exterior escape route for water that gets behind the siding, we protect the wall assembly from moisture damage. Installing furring strips or a drainage mat behind wood or fiber-cement siding is one way to create a vented siding assembly. But for affordable housing, our siding choice is vinyl. Vinyl siding has a built-in drainage system. Low up-front cost, durability, and zero maintenance are other advantages. When installed well, vinyl can look very good.

Form still should follow function

A box is the most efficient use of materials, and it is the most affordable shape to build. But it doesn't have to be boxy. The design featured here has morphed a number of times from the prototype, but it's basically the same floor plan. The major change was in the roof design. The prototype used many dormers to boost living space on the second floor while giving a compact, 1½-story appearance from the street. But a roof with many dormers is hard to vent properly, and it's time-consuming to build. My solution was to keep the 1½-story look at the front gable end, then 10 ft. back into the house raise up to a second story. This way, we're able to use trusses for the majority of the roof, maximize usable space on the second floor, and keep the quaint curb appeal of the front by running the eaves down to the first-floor walls.

Built right means healthy homeowners

Many systems that we incorporate into a house for energy-efficiency and affordability have the added benefit of creating a healthful space for the folks who live there.

We use three methods to keep inside air clean: source control of pollutants, dilution of indoor air with outdoor air, and filters



A galley kitchen with elbow room. This straight-ahead layout uses space efficiently and provides room for two cooks and a hopeful onlooker. The pegboard wall can't be beat as economical, versatile storage space.

in the air handler. We avoid wall-to-wall carpeting because it can act as a habitat for dust mites and other allergens. Instead, we use wood or tile flooring. Paint should have low volatile organic compounds (VOCs), and furniture should be made with solid wood rather than particleboard, which can outgas. These examples demonstrate pollutant source control.

Bringing outside air into the air handler dilutes indoor air, which can become stale in tight houses. Odors from indoor pollutants such as pets and poisons need to be flushed periodically. Combustion appliances that burn their own exhaust and durable construction details that deter bugs, mold, and rot improve air quality in houses.

Safeguards such as these make Building America houses certified healthy houses, which are affordable the day you buy them and every day afterward. □

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