

INDIANAPOLIS, IN — The Indiana Office of Energy Policy has spun its home energy rating program — Energy Rated Homes of Indiana — into the private sector, where it will become a regional, market-based (for-profit) operation. Reflecting the entity's broader mission, it's been renamed Energy Rated Homes of the Midwest. Mark Jansen, who guided the development of Energy Rated Homes of Indiana, has left state service to serve as the program's new coordinator.

WASHINGTON, DC — According to a poll conducted by the Sustainable Energy Coalition, renewable energy and energy efficiency are gaining popularity among Americans while nuclear energy and fossil fuels continue to slide. In a sampling of 1,000 registered voters, 72% of those expressing a preference said that the US Department of Energy should give its highest priority to funding renewable energy and energy efficiency R&D. The support was consistent among Republicans, Democrats, and independents. The poll was conducted

by International Communications Research (Media, PA), with a $\pm 3\%$ margin of error. The Sustainable Energy Coalition consists of 33 national organizations that include environmental and consumer groups, energy efficiency advocates, and business associations.

ARLINGTON, WA — Trace Engineering, a maker of inverters and power equipment for alternative energy systems, has teamed up with BP Solar (Fairfield, CA) to give away ten 100-watt, grid-connected photovoltaic systems. The winning homeowners must be willing to work with local utilities to ensure system compliance and to share their experiences with other consumers. "The give-away will help promote the use of grid-connected PVs, enable us to further test our Microsine inverter, and perhaps break some new ground with utilities that aren't familiar with the technology," says Von Kalanquin, a marketing assistance with Trace.

RESEARCH AND IDEAS

How Town and Country Homes Reinvented Itself Through New Designs and Quality Control

On February 3, 1996, there was an earthquake of sorts inside the Westchester, Illinois, headquarters of Town and Country Homes (T&C).

"We called in all our contractors — framers, siders, insulators, HVAC, everybody — and told them we were changing the specs on our homes," says David Pennabaker, the company's director of quality assurance. Considering that the company builds about 1,000 homes a year in the Chicago, Minneapolis, and Orlando metropolitan areas, this was no small deal.

While the changes undertaken that day dramatically improved the energy efficiency and comfort of T&C's homes, that's not why they were made. "It was the need to reduce our callback expenses that drove those decisions," says Mike Ryan, president of T&C. "The energy savings and comfort improvements that resulted are wonderful, but they're gravy to the main meal."

The problems that were hounding T&C's service department and taking a big chunk off the company's bottom line are familiar to builders everywhere: leaky windows, drywall cracking, frozen pipes, ice dams, dust marks on the carpets, cold rooms over garages, and condensation on windows. Pennabaker, who was hired as a "problem solver," spent six months investigating callbacks to see which problems were isolated events and which were widespread, or systemic.

"In a lot of cases, we found that our service department was addressing the same problem — such as frozen pipes — in the same houses, on multiple occasions," says Pennabaker. "We had a bunch of nice people in our service department, but they were only doing band-aid work."

For example, the lack of draft blocking in eaves, cantilevered assemblies, interior soffits, dropped ceilings, and around showers and tubs turned out to be a widespread problem that was producing a lot of complaints. "We learned that the service department was responding to these situations by stuffing the leaky cavities with insulation," says Pennabaker. "Whether we like to admit it or not, a lot of builders, contractors, and service people in the industry still think you can stop an air leak by stuffing the cavity with insulation."

Moving from Band-Aids to Serious Diagnostics

After six month's worth of site visits and serious diagnostic work, Pennabaker persuaded the company's top management to introduce new details that would change the way Town & Country Homes were framed, sealed, and insulated, and called the February 3 meeting to introduce them to the trades. "We explained the changes that were going to be made," says Pennabaker, "and equally important, told our contractors why. We then proceeded to negotiate new contracts with them, reflecting the additional costs they were going to incur."

In some quarters, Pennabaker was accused of being a "custom builder" trying to introduce unrealistic changes into the world of production building. (Pennabaker was, in fact, a successful custom builder and remodeler before joining T&C, so his reputation preceded him.) "I kept telling everyone, over and over, 'I just want to save the company money. And I want to show the trades how they can save money.'"

Because of T&C's size, the site managers only achieved 70% compliance with the new details during the first quarter that followed their introduction. "We kept making site visits and inspecting the details to make sure they were being done correctly," Pennabaker says. "In some cases, we held back part of the contractor's pay until he went back in and did it correctly. That got their attention, I can tell you." Over the subsequent two quarters compliance rose to about 85%. A year after the details were introduced, compliance company-wide had climbed well into the 90% range.

But making sure that the changes were implemented in every house in every development was only part of the challenge. Pennabaker was also determined to create an "institutional memory" inside the company. "There was a 10- to 20-year period in the construction industry when a lot of builders quit using building paper, because they forgot why it was there and took it out to save money," he relates. "That's what I call a loss of institutional memory. And it's happening all the time.

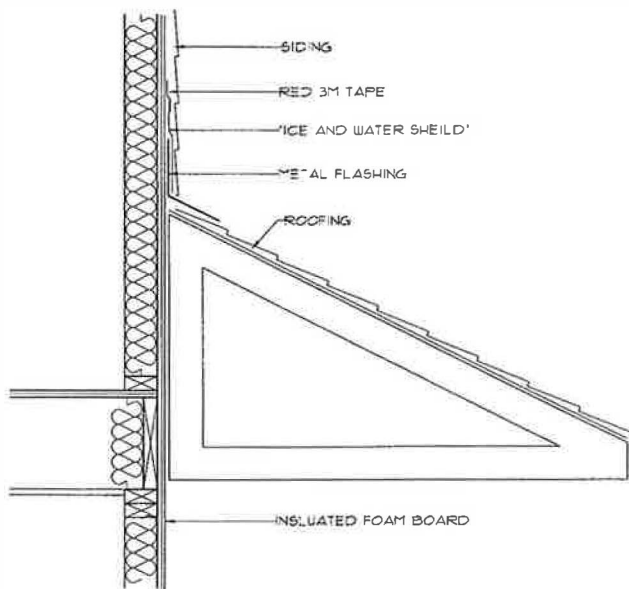


Figure 3 — Roof to Wall Flashing.

The Problem: Contractor's tape did not provide a durable seal between the drainage plane (Dow foam or housewrap) and the metal flashing on dormers, shed roofs, etc., because the materials have different expansion rates.

The Solution: Grace Ice and Water Shield is used to counterflash the intersection on foam, and building papers are installed outside or over the tins.

To create institutional memory inside Town & Country Homes we post our details in a central location on each job site; we discuss the details with the tradespeople involved to make sure that they know why the detail is there and who's responsible for seeing it done right. New people are trained to the same level of understanding, not just in the how, but in the why."

With regard to responsibility, T&C's drawings often include a note that assigns clear responsibility to a specific tradesman (e.g., "by sider," "by painter"). For example, on projects that use housewrap as the secondary weather barrier and drainage plane, the carpenter is specifically assigned responsibility for window details, making sure that the housewrap is wrapped over the top of the nailing flange at the header and under the flashing at the sill.

T&C's program has saved hundreds of thousands of dollars in callbacks and warranty claims. For example, in the year prior to the changeover, the company had about 450 callbacks related to frozen pipes. Those, coupled with another 900 from previous years, cost the company a whopping \$750,000 to repair. The new draft-blocking details that T&C introduced have virtually eliminated that problem.

Draft-blocking details have also reduced the number of callbacks related to filtration soiling. (Filtration soiling occurs when drafts pull airborne dust and lint into the carpet along the baseboard, producing a dirty accumulation.)

Thanks to better drainage plane and flashing details, callbacks related to leaky windows have also seen dramatic declines. Lastly, by sealing the envelope over unconditioned spaces (bedrooms over garages), T&C

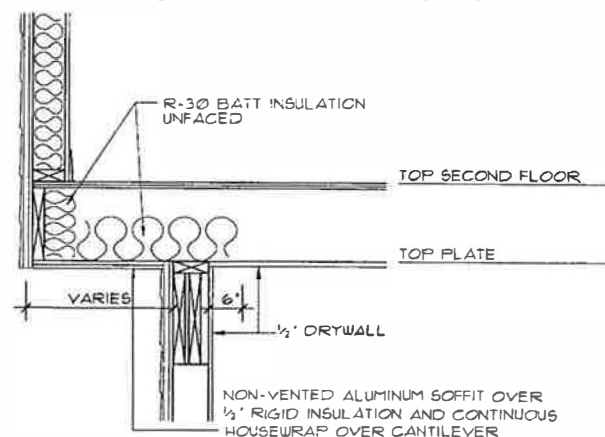


Figure 4 — Cantilever Detail

The Problem: The lack of draft blocking in the overhang allowed cold air to infiltrate the floor cavity, freeze pipes, and make the floor above extremely cold.

The Solution: The overhang is sealed with a sheet of 0.5-inch rigid insulation and continuous housewrap.

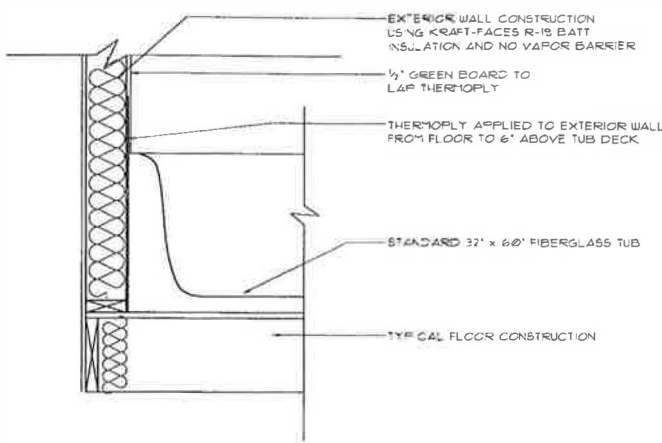


Figure 5 — Draft Stopping Behind Standard Tub

The Problem: Big holes were left in the house behind the bath tub, creating a cold tub and an air by-pass up the adjoining wall.

The Solution: Draft blocking is applied to the exterior wall, overlapped with water resistant drywall. (Similar detail recommended for soaker tubs and shower pans.)

eliminated its most common complaint. In fact, call-backs company-wide are down 70% overall and the number of employees in the service department has been reduced by about 75%.

There's No Devil in These Details

Figures 3 through 9 present some of the key details that T&C has implemented over the past two years. Over that same time period there have been some interesting changes in the way that materials are used. For example:

- Caulk is no longer used as a weather sealant around windows, doors, and exterior corners — only as a cosmetic product to cover rough seams. Instead, the company takes great pains to make sure that the flashing and drainage plane details are done correctly. In other words, the company *assumes* that caulk will leak and puts its faith, instead, in the secondary weather barrier/drainage plane, which might be housewrap, building paper, or insulating foam sheathing, depending on the project. Trim at the corners and around windows and doors goes *over* the siding, so there's no need to caulk joints.

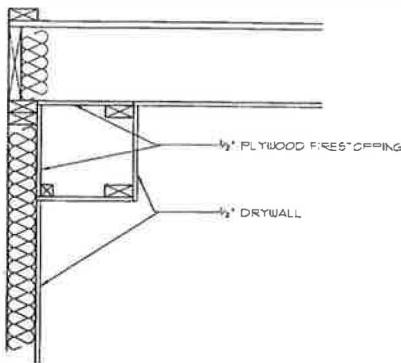


Figure 6 — Interior Soffit

The Problem: Lack of draft blocking over the soffit created a large thermal bypass from the attic (or second floor cantilever) into the wall and floor systems below.

The Solution: Plywood draft blocking (fire stopping) is installed and sealed.

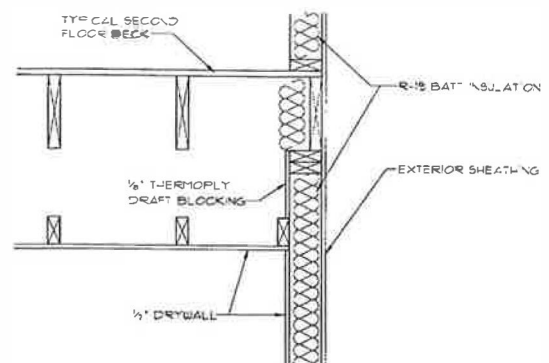


Figure 7 — Dropped Ceiling Detail

The Problem: Lack of draft blocking let conditioned air bleed into the wall, creating potential condensation problems.

The Solution: Thermoply draft blocking is installed.

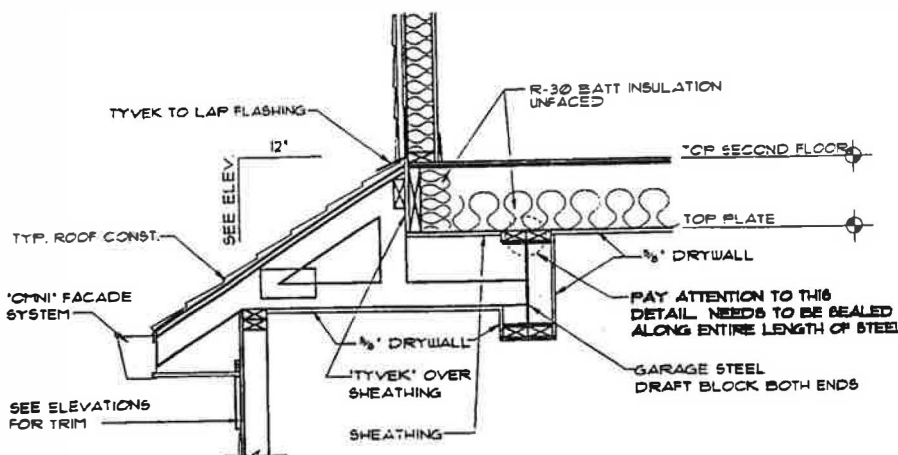


Figure 8 — Draft Blocking in Garage Ceiling

The Problem: Area over the steel I-beam was insulated but not air-sealed, allowing cold air into the floor cavity and bedroom above.

The Solution: The ends of the beam are sealed with foam or construction adhesive, and the floor is treated the same as a cantilever (sheathed with 1/2-inch insulating sheathing).

- The company has started using several sheets of 1/8-inch Thermoply per house as draft-blocking material. "It's good for the application and relatively inexpensive," says Rick Bush, vice president of purchasing.
- The company now uses Grace Ice and Water Shield to counterflash dormers and shed roofs (see Figure 3). "The Shield forms a much more durable seal to metal flashing than tape," Pennabaker explains.

Fewer Lines Between Production and Custom Building

While the aforementioned changes are impressive, T&C isn't resting on its laurels. The company's newest project — Centennial Crossing — in Vernon Hills, Illinois, will offer the kind of quality construction and variety of options that was once reserved for custom builders.

The project has been dubbed "Blue City," because all 200 of the new houses (about 50 are completed) will be wrapped in 1-inch, tongue-and-groove Dow Styro-foam. By carefully taping the seams, the foam serves as both air barrier and drainage plane.

The new houses, which range from 2,400 to 5,000 square feet, will incorporate other notable features, including:

- 2x6 stacked framing optimized at 24 inches O.C. (This results in a 35% reduction in lumber, more room for fiberglass insulation in the stud bays, and less drilling as plumbers and electricians run their pipes and wires.)
- Raised-heel roof trusses permit a better insulation job over the top plates.

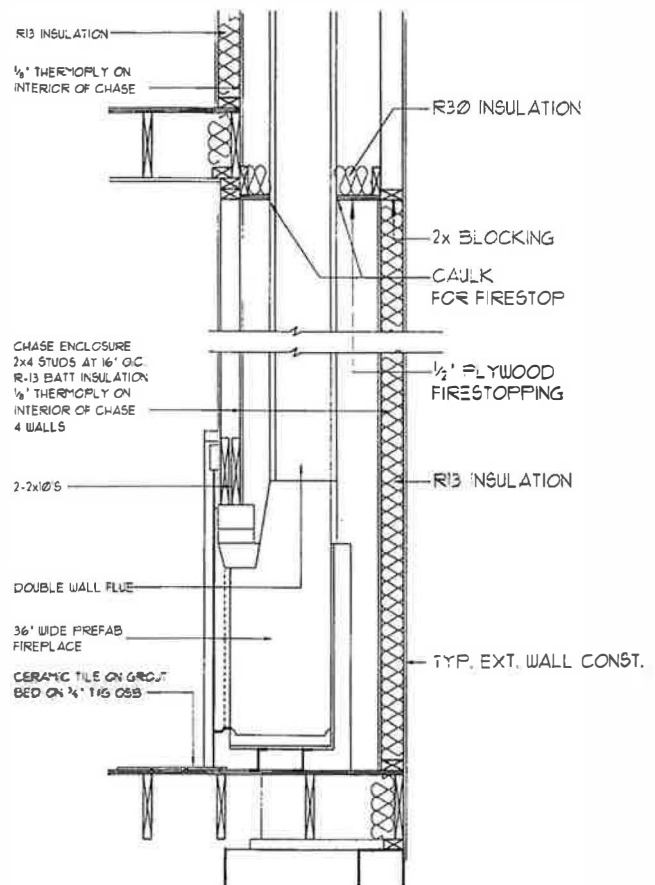


Figure 9 — Pre-Fab Fireplace Chase Detail

The Problem: Lack of insulation and draft blocking in the chase caused the fireplace to draw poorly and/or leak cold air into the adjoining wall and floor assemblies.

The Solution: The chase is insulated and sheathed — that is, treated as a conditioned space.

How Much Are Stars Really Worth?

While the energy efficiency of the new homes at Centennial Crossing is excellent by any standard, they fall just shy of qualifying for a five-star Energy Star rating.

David Pennabaker, director of quality assurance at Town and County Homes, tells *EDU* that by insulating the homes' basements (+\$900) or installing high-efficiency gas furnaces (+\$500), the company could qualify the houses for a five-star rating, but that the potential energy savings don't really justify the added costs. When you consider, for example, that the monthly heating bills for these houses are expected to run just \$40-50 a month using mid-efficiency gas furnaces, you have to conclude that the payback on an upgrade to a high-efficiency furnace would stretch far into the next century.

"While these improvements don't necessarily make sense to us from an energy efficiency standpoint, we may go ahead with them because they make sense from a financing and publicity standpoint," says Pennabaker.

The honchos at the US Environmental Protection Agency and the US Department of Energy should be delighted to hear that. They created the Energy Star home-rating program to give builders like T&C some added incentive to adopt energy-saving technologies that might not be cost-effective on their own. Builders of five-star homes can get a leg up on the competition because their buyers may qualify for more favorable mortgage terms and because the Energy Star rating makes super advertising copy.

- Low-e glass standard.
- Downsized heating and cooling equipment (e.g., a 60,000 Btu furnace and 2-ton air conditioner for a 3,000-sq.-ft. house).

The Centennial Crossing project is T&C's first participation in the US Department of Energy's Building America program. Joe Lstiburek, leader of the Building

Science Consortium, one of four Building America teams, provided important design and research assistance on the project.

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New Burner Technology Will Boost the Efficiency of Oil-Fired Equipment

A new low-input, two-stage oil burner developed by Heat Wise, Inc. (Ridge, New York), in conjunction with Brookhaven National Laboratory (BNL), has the potential to raise the efficiency of oil-fired boilers and furnaces 3-5% and substantially reduce their emissions of nitrogen oxide and some other pollutants.

The Pioneer burner, which recently received UL approval, is rated to burn 0.3 to 0.65 gallons of fuel oil per hour (40,000-90,000 Btu/hr), well below the firing rates of conventional retention head burners, which are rated above 0.5 gallons per hour (gph).

By incorporating the patented burner in new oil-fired boilers and furnaces, manufacturers will be able to compete in the small design load residential market, where gas-fired equipment and heat pumps have dominated.

"While the new burner could be used with single-stage firing, it's greatest potential is as a two-stage burner," says Bola Kamath, president of Heat Wise. "In a two-stage configuration, it would fire at 0.3 gph most of the time, shifting to 0.5 if there's demand for more heat." Two-stage firing would work well with a control strategy employing an outdoor temperature sensor, says Kamath, so the thermostat could anticipate the need for a high fire rate.

"The Pioneer is also quite friendly to the atmosphere," Kamath notes, "since it produces 40-50% less nitrogen oxide than conventional burners [40-70 ppm versus 100-150 ppm]."

Overcoming a History of Problems

Heat Wise is the first company to commercialize a fan atomized burner (FAB), combining its own R&D efforts with those of BNL researchers Yusef Celebi, Thomas Butcher, and Roger McDonald. The idea of using fan air pressure to atomize liquid fuel is nothing new, but past efforts to develop advanced burners based on this concept have failed to reach commercial status because of high costs, poor reliability, or excessive complexity.

Previous FAB prototypes have relied on a small compressor to provide a flow of air at 5 to 20 psi to the nozzle for atomization and a conventional fan to provide the rest of the air needed for combustion. But the Pioneer's low-pressure, high-volume nozzle gives it an inherent advantage: all of the air required for both atomization and combustion can be supplied by a single fan (see Figures 10 and 11). That spells simplicity and lower costs.

To field test the Pioneer, Heat Wise installed the burner on seven different types of residential boilers, including Slant/Fin, Columbia, Smith Boilers, and Weil-McLain. These were installed in the occupied homes and monitored during the winter of 1997-98.

The BNL staff used a new system monitoring software called Advanced Flame Quality Indicator (AFQI), developed by Insight Technologies (Bohemia, New York), to get real-time performance data during the trial period. AFQI, which was developed as a service tool for fuel oil dealers, monitored the burner's flame, fuel filter, temperature conditions in the home, primary safety control, water spillage in the boiler (pressure/fill valve release), the fuel tank level, and other parameters, reporting the data back to BNL's computer via a dedicated phone line.

As a result of the field tests, Heat Wise decided to abandon its low-pressure fuel pump in favor of a standard 100 psi pump, to be used in combination with an in-line metering orifice and a nozzle shut-off valve. Kamath says that this further improvement of the prototype offers several advantages. It will:

- make Pioneer less susceptible to dirt accumulating on the nozzle strainer, which adversely affected the burner's firing rate during the field tests;
- enable the company to eliminate the oil pressure gauge and suction regulating valve;
- permit the use of an off-the-shelf pump, rather than a specialty pump.