

Building Technology:

After the oil crisis forced us to stuff our wall cavities with insulation, we learned that air infiltration was the biggest energy thief. Housewrap was marketed to meet that need, with the much-touted advantage over felt paper of being vapor permeable.



While batt insulation was reported to suffer R-value degradation from air movement in wall cavities, spray-in-place foams like Icynene offered an attractive alternative — insulation and air barrier in one. But the current higher price of these foams has limited their appeal.



Cellulose insulation was commonly blown into closed wall cavities in the energy retrofits of the '70s and '80s. ParPac developed a way to use it in open framing as well: The cellulose is trapped behind a reinforced poly, which allows for visual inspection of the job.

15 years OF CHANGE

To celebrate JLC's 15th anniversary, we looked back over the sweeping changes that have taken place in our industry since we first opened our doors in mid-1982. What we call "standard building practice" today is actually the result of years of trial and error by builders and remodelers who were looking for better ways to get the job done. This article highlights the products and technologies, culled from JLC back issues, that had the greatest impact on the lives and work of our readers.

by Sal Alfano

ENERGY EFFICIENCY

Perhaps the greatest changes in home construction over the past decade and a half started with the energy crisis of the early 1970s. The wave of energy conservation that followed spawned a wide array of new building products and techniques — some later abandoned as impractical and prohibitively expensive — but many surviving and becoming as common as Sheetrock and 2x4s.

Most of the early strategies focused on raising insulation levels in the building shell. Almost overnight, 2x4 walls with R-11 insulation became 2x6 walls insulated to R-19 — or greater with the help of foam plastics such as Styrofoam and later foil-faced urethanes and phenolics. In western Canada and parts of the northern U.S., many builders went so far as to build double-stud shells with over R-40 in the walls and R-60 in the ceiling.

Soon experts realized, however, that insulation alone did not make an energy-efficient house. Study after study found that adding lots of insulation did not make a house tighter and that air leakage had become, in many cases, the leading energy waster in the building shell.

So the next big battle on the energy front was learning to build a tighter shell. Cutting-edge builders devised elaborate ways to wrap their buildings in polyethylene film cleverly threaded through band joists and folded around windows in a fashion more like Origami than home construction. They sealed the seams in the vapor barrier with non-hardening acoustical sealant fondly nicknamed “black death.” Products like 3M contractor tape made it easier to seal the seams in the poly and one-part aerosol foams like Touch ‘N Foam and Great Stuff were just the thing to seal around doors, windows, plumbing stacks, and penetrations.

Still contractors sought a simple one-step approach to building a tight, well-insulated shell that didn’t cost a fortune. Many innovations appeared. Stress-skin panels offered high-insulation and a built-in air and vapor barrier in one step. After the banning of urea-formaldehyde foam, some builders experimented with filling stud cavities with high-R polyurethane foam for the same effect.

Several new approaches to blown insulation also made their appearance during this period. The Par-Pac system (cellulose) and Insul Safe III blow-in-blanket (fiberglass) both use a perforated netting stretched tightly across the face of the studs to hold the loose insulation in place. Wet-spray cellulose systems have been slower to catch on, mainly because of the danger of overwetting and the nuisance of prolonged drying times.

The hottest spray insulation products on the market these days are light-density foams such as Icynene and Demilec, which are improved versions of the urea-formaldehyde insulation banned in the U.S. and Canada in the '70s. These are applied as liquids, but expand within seconds, completely filling stud bays with such a tight seal that typically no air/vapor barrier is needed.



While insulation technology moved ahead, so has the efficiency of heating and cooling equipment. Condensing furnaces like Carrier's WeatherMaker offer efficiency ratings above 90%, while its sealed-combustion feature eliminates the problems of depressurization and backdrafting in today's tighter homes.



Hydronic radiant heating also reestablished itself in the last decade, with claims of greater comfort at lower thermostat settings. Radiant floors have become a much-desired feature in high-end work throughout the U.S.



A decade and a half of improvements in gas fills and glazings have boosted achievable center-of-glass insulation values to R-8 and above. Meanwhile, integral flashings have simplified weathersealing efforts.



The development of rigid foam board made possible an innovative foundation: a slab-on-grade that would resist frost movement even in the coldest climate. Developed in Scandinavia, the so-called shallow frost-protected foundation now has code approval in the U.S.



You get two-for-one with some of the new foundation technologies: Form-A Drain (top left) is a footing form that becomes a drain tile, while Insul-Drain (top right) provides insulation and a drainage course. But the bigtime category winner is the stay-in-place insulating concrete form (above), which is now regularly used not only for foundations but for entire houses.

The transformation of energy sealing details wasn't complete without a better way to seal the outside of the building as well. Despite debates over its energy-saving value, Tyvek, introduced by Dupont in 1979, rapidly became the product of choice. Complaints about degradation in sunlight, even when exposed for only a few weeks, led in 1988 to the inclusion of a UV-inhibitor, both in Tyvek and its competitor Typar. Today, these and a host of similar products are part of the standard spec.

WINDOWS

Improvements in energy performance have revolutionized the window industry, most notably the introduction of low-E coatings by Southwall Technologies in 1981. Their Heat-Mirror system, which uses a coated film suspended in the air space in double-glazed windows, is still unique and offers the highest window R-values values available. Since then, low-E coatings have become the industry standard, whether used in the Heat-Mirror system or applied directly to the glass.

By 1987, manufacturers boosted window R-values even further by replacing the air between double-glazed panes with inert gas, beginning with argon, but eventually including krypton and other variations. The overall effect of all of these changes has been an increase in window R-values from around R-2 in 1982 to R-8 in 1997.

While wood windows are still popular in many areas, vinyl- or aluminum-clad units have become the standard, both for ease of maintenance and their superior air- and water-sealing qualities. Coupled with high-tech glazings and tighter sash-to-jamb seals, windows are no longer the weak link in a house's energy envelope.

HVAC

As builders succeeded in devising cost-effective ways to build tight homes, however, they unleashed a new set of concerns in the area of air quality and moisture problems — issues that have spawned yet another wave on innovation in the form of air-to-air heat exchangers and other residential ventilation systems, such as Aldes's VMP-K central exhaust system, nick-named the "Octopus." One effective solution to these problems — and the simplest — is the quiet bath fan, pioneered by Panasonic.

Upgrades in the building shell were matched by improvements in hvac equipment. Long before 1992, when furnaces were required to have an AFUE (Annual Fuel Utilization Efficiency) of 78% or more, new "condensing" models, such as Lennox's Pulse furnace, had raised efficiency to more than 90% by capturing heat from exhaust gases as they condensed to liquid. Early models faced a rash of problems with corrosion due to the acidity of condensation in heat exchangers and flues. The substitution of better alloys and high-temperature plastics has all but eliminated these problems.

Another set of concerns facing hvac designers was back-

drafting and spillage caused by the increasing tightness of the building shell. One answer was sealed combustion, which draws combustion air and vents exhaust gases through a side wall without a chimney.

One of the most exciting hvac developments has been the growth of radiant floor heating, spurred in part by new formulations of PEX (cross-linked polyethylene) tubing. Typically, the heating loops are embedded in a concrete slab, but by using special fins and proper insulation, radiant heat can now be retrofitted under wood floors as well. Advocates claim that the comfort from radiant heating systems is unsurpassed. They also provide modest energy savings primarily due to the lower water temperatures used.

FOUNDATIONS

“Foam Forms Catching on in New England” is truer today than it was in 1987, when it ran as an Eight Penny News headline. Back then there were two manufacturers; today there are more than 40, each with its own unique design. And now that builders have overcome their fear of blowouts, stay-in-place foam concrete forms are making their way into the mainstream, not only below grade but above-ground in one- and two-story houses. Contractors who have written about foam forms for *JLC* like the fact that the blocks or sheets can be installed using ordinary carpentry tools, and because the foam systems don't require a subcontractor, builders can take back control of the notoriously delay-plagued foundation schedule.

Not everybody needs a full foundation, of course, and these days that number is dwindling due to a system that first appeared in *JLC* back in 1990. Called the frost-protected shallow foundation, the system uses high-density foam to insulate under and around a slab-on-grade, eliminating the need for full-depth frost walls. The system, which recently received code approval, can shave thousands of dollars off the cost of a typical addition — money your clients can use elsewhere in the building.

ROOFING

In 1980, I was asked to repair several fixed-glass skylights that had begun to leak. The glazing was mounted flush to the roof surface (a sleek but impractical trend that has thankfully been dropped in favor of curbed skylights), and no amount of caulking at the cover boards could keep rainwater out. Eventually, I found a special-coating subcontractor who solved the problem using a brand new bituminous membrane from W.R. Grace called bituthene. Originally designed as a below-grade waterproofing system, the unique combination of rubberized asphalt and polyethylene adheres to almost any material and seals itself around penetrations. Today, it's known as Ice and Water Shield, and Grace and other manufacturers have developed self-sticking versions that are routinely used as waterproofing at eaves and valleys

Business: Going Pro

As if it weren't enough for the typical construction company owner to keep up with all the new products, materials, technologies, and methods that have come down the pike, the last 15 years have brought far-reaching changes to the business side of the industry as well. Depending on where you work, a simple room addition may require a building permit; an engineering plan review; a written safety plan; testing for radon, asbestos, and lead paint; and MSDSs (Material Safety Data Sheets) for most products used on the site. On top of that, many states require special contract language regulating the maximum amount of preconstruction deposits, arbitration clauses, proof of licensing and insurance, and a host of other stipulations that have transformed craft-minded carpenters into frazzled administrators.

Meanwhile, the cost of maintaining a payroll has gone through the roof, due to a number of factors: The labor shortage of the mid-'80s has deepened, pushing wages up for a dwindling number of available skilled workers; federal measures to bail out an ailing social security fund have raised both the rate and the taxable wage base; and higher medical costs and an increase in fraudulent claims have caused workers comp rates to increase rapidly — sometimes by as much as 500%.

On the upside, these pressures, plus the after-effects of the recent recession, have forced residential contractors to become more professional. Companies that just a few years ago were started out of the back of a pickup truck have learned that their continued survival depends on their ability to earn consistent profits on every job. Those who learned from hard experience that the feast-or-famine approach cannot be sustained in a volatile construction economy have come to realize that past customers and referrals are the source of most of their work. They have responded by developing sophisticated sales and marketing programs that target these groups, and while many still bid competitively for jobs, some have embraced design-build as a business strategy, while others use their limited time and resources to pursue only negotiated contracts with highly qualified prospective customers.

All indications are that the industry as a whole, while experiencing a strong recovery, will be even more competitive in the coming years. The contractors who survive will be those who recognize that service to their clients is just as important as quality craftsmanship. This is nothing new to *JLC* readers: A June 1982 story titled “Avoiding Callbacks” cited a survey showing that 68% of construction customers ceased doing business with a particular firm because they felt they had been treated with indifference. Only 9% cited price as a factor. This is not likely to change anytime soon, as the increasing cost of construction causes consumers to expect more for their money.

—S.A.



Filling cathedral ceiling rafter bays with insulation left little room for air movement, resulting in rotted sheathing from trapped moisture and shingle degradation from overheating. Builders relying on soffit-to-ridge venting systems drove the demand for a variety of premade venting products.



In messy climates, nothing protects high-exposure roof areas from leaks like self-adhering eaves membranes. Grace's Ice & Water Shield was the first, but now there are several competitors.



Single-ply membranes began showing up on residential low-slope roofs, products like EPDM and the peel-and-stick Kwik-Ply, shown here.

and around chimneys and skylights.

The biggest development in roofing during the last 15 years, however, has been the growth in the use of fiberglass shingles. Despite misgivings about the strength and durability of the thinner fiberglass shingles compared with the organic asphalt standard, fiberglass had captured 75% of the market by 1982. But in 1992, a *JLC* feature reported on a battle between the Asphalt Roofing Manufacturers Association and the Western Roofing Contractors Association over premature failure of fiberglass shingles. The controversy called into question both the tear strength of the fiberglass mat, which in some cases was below ASTM standards, and a new formulation of the tar adhesion strip introduced by manufacturers around 1987 to improve the shingles' resistance to blow-offs, but which also made them less flexible. At the time, *JLC* recommended using organic asphalt shingles, but since then many fiberglass roofing manufacturers have taken steps both to replace failed roofing and to change the composition of their shingles to prevent future failures.

ENGINEERED LUMBER

As the supply of mature trees has dwindled over the last 15 years, builders and remodelers became frustrated with the increasing difficulty of working with the reduced size, poor grade, and instability of dimensional lumber sawn from younger stock, and began to look for alternatives. Added impetus from wild price fluctuations, which more than doubled the price of S-P-F lumber in the early 1990s, prompted many contractors to experiment with a variety of alternatives, including structural stress-skin panels, steel stud and joist systems, and panelized and modular components. But by far the most enduring alternatives have been wood-based "engineered lumber" products, such as OSB (oriented strand board), wood I-joists, and LVL (laminated veneer lumber). Since *JLC* first began to report on these materials in 1984, initial skepticism among contractors has slowly grown into an appreciation for the dimensional stability of engineered lumber as well as its ability to support longer spans and heavier loads than the solid-sawn variety.

The learning curve has been steeper than many anticipated, as carpenters modified familiar rules of thumb in favor of new techniques for handling, cutting, and notching engineered composites. Stiffer code requirements for fasteners and connections, prompted by lessons learned in the aftermath of numerous natural disasters, have also spurred a newfound respect for the steel hangers and hold-downs required for both conventional and engineered framing systems in areas susceptible to hurricanes and earthquakes.

The trend toward engineered products has also made its way into exterior finish products. As with engineered

lumber, these new wood-plastic composites, too numerous to name, but including various trim, siding, and decking products, were less a substitute for conventional wood than a true alternative, requiring new installation and fastening techniques. As the industry has adopted the new methods, the advantage of these materials — longer lengths, less waste, dimensional stability, and paintability — have led to growing acceptance.

SIDING & EXTERIORS

When it comes to siding, carpenters like working with wood, but homeowners are looking for alternatives that require less maintenance. The big winner of the last decade is vinyl, which in 1994 passed wood siding for new home construction, and continues to increase its lead. Like it or not, vinyl siding is here to stay, but other alternatives are also on the increase.

Fiber-cement planks and panels have become popular in the South, where there is little threat of damage from extreme freeze-thaw cycles. In colder climates, pressurized steam curing, or autoclaving, has reduced the tendency of fiber-cement siding and roofing to absorb moisture, solving the freeze-thaw problem but also making the material more brittle and a bit harder to work.

Traditional three-coat stucco is still a staple, although some plasterers have found that the quick-drying characteristics of “one-coat” synthetic varieties can produce a durable finish while saving weeks of curing time. On the other hand, EIFS barrier systems continue to experience problems and have even been banned in some southeastern states. The problems stem primarily from water leaking through cracks in the surface and around window and door openings. Once moisture penetrates the finish, it accumulates on the sheathing and in wall cavities with no way to escape. New solutions, such as USG’s “Duro-Screen 1000” water-management system, may provide a solution by creating a drainage plane that allows any water that penetrates behind the finish surface to weep out through openings in the bottom of the wall.

KITCHEN, BATH & INTERIOR

In 1980, when I first used Corian as an alternative to stone for finish tops on several electric resistance storage heaters I was installing, I had no idea I had stumbled onto the material that would come to dominate the custom kitchen and bath countertop market. Solid surfacing use grew rapidly over the next ten years, and for obvious reasons: The material had nearly the same heat resistance as stone, could be worked into almost any shape with ordinary carpentry tools, and could be surface-reconditioned with only a light sanding.

Plastic laminate still makes for the most economical countertop, although “new” formulations, such as Formica’s Color-Core, have added medium-priced



Though it still has only a small share of the overall framing lumber market, engineered lumber is no longer a stranger to the job site. Floor systems and beams are the main uses, though wood I-joint rafters and engineered studs are becoming more common.



With the cost of clear wood trim rising sky-high, lumber manufacturers began pushing engineered trim. The dimensional stability of engineered products such as Prime Trim (top), a hardboardlike product, and Clear Lam, an LVL trim with a MDO face (above), promises to improve paint performance.



As the industry searched beyond pressure-treated lumber for the perfect decking, plastic-wood composites like Trex grabbed the spotlight.



Wood engineering didn't stop with framing and trim, as floor manufacturers developed prefinished "floating" floors that promised to solve movement problems. And "prefinished" means no messy sanding at the tail end of a job.

options. Ceramic tile is also making a comeback in both the kitchen and the bath, but the news here is in the substrate. The major improvements have come with the development of epoxy-based thin-set mortars and grouts, and with water-resistant backer boards such as Durock, Wonderboard, and Den-Shield, all of which were developed in the last 15 years.

Keeping pace with the development of exterior wood composites and engineered lumber and exterior finish materials, manufacturers have developed wood composites for everything from strip flooring to door and cabinet panels. By the late 80s, companies such as Bruce, Junckers, and Harris-Tarkett were marketing veneered products as part of "floating floor" systems that relied on mechanical or glued connections between individual pieces rather than on fastening to a substrate. The technology revolutionized the way wood flooring is applied over concrete slabs, and solved some of the problems associated with seasonal movement of finish floors.

Tools

Few developments have changed the way builders work more than the advances made in tool technology. After wooing the D-I-Y market for years, most manufacturers have once again focused their efforts on developing tools designed specifically for day-to-day professional use. While nearly every tool category has seen improvement, one of the biggest changes has come with cordless technology. Cordless drills were the first to catch on, but the lack of power and need for frequent charging made early models better suited to light-duty operations like mounting door hinges. In the last few years, however, improvements in the battery size and capacity have led to 14.4- and 18-volt cordless versions of not only drills, but small circular saws, reciprocating saws, and even hammer drills that can nearly match the power of corded versions.

I didn't tool up for pneumatic nailers until the mid-'80s, and even then I took a long, hard look before making the investment. Today, pneumatics are a given not only for use in framing and sheathing, but for applying siding, roofing, and finish trim. Feedback from contractors in the field about common problems encountered with early guns have led to subtle but important design changes: Today's models jam less frequently and are easier to clear when they do; most nailers can be adjusted for depth-of-drive, eliminating the need to fool with compressor settings; improved anti-vibration strategies reduce user fatigue; and safety features, like lock-out switches, lessen the chance of injury from accidental firing. And for the ultimate in convenient operation, there's Senco's line of oil-less nailers, and Paslode's hoseless framing and trim nailers.

Back in the mid 1980s when I first laid eyes on Makita's lightweight portable table saw, it was love at first sight. I

bought two on the spot and never regretted it. Those of us who complained about the flimsy fences on early models and their tendency to bog down easily have been pleasantly surprised by the increased power and accuracy of newer models. The latest portables even feature a rip capacity that will accommodate a full sheet of plywood.

Finally, the chop saws and power miter saws that first replaced radial arm saws on site are being overtaken by sliding compound miter saws. The first major improvement came with increased cross-cut capacity, followed by saws that rotated and tilted in both directions. The addition of positive stops, secondary fences, and table extensions have made sliding compound miter saws some of the most versatile tools on the job.

THE ELECTRONIC OFFICE

In July 1987, in *JLC*'s first special issue devoted to computers, author Martin King wrote: "The computer is not a labor-saving electronic device — it is an irresistible social force." We now know that he was dead on, but it took a lot longer for builders to jump on the bandwagon than anyone had predicted. One reason was cost: Without a clear idea of just how computers would help their businesses, contractors instead spent the \$7,000 to \$10,000 needed to buy into the new technology (including computer, printer, and software) on table saws and pickup trucks.

By the early '90s, however, prices for complete systems had been cut in half, while processor speed, RAM, and hard drive capacity had doubled and redoubled. More important, software developers had begun to adapt products originally designed for main-frame computers to the desktop PC. Unfortunately, the accounting, CAD, and estimating programs in which contractors were most interested were not only among the most expensive software programs, but were much too complicated for novice computer users to learn without devoting hundreds of hours of time that were better spent selling and supervising jobs.

Why did the "irresistible social force" eventually win out? In part, it was the appearance of utilitarian, easy-to-use accounting programs like Quicken (and later QuickBooks), CAD software like Chief Architect and MiniCAD, and contact management programs like ACT!, which made it possible for contractors to see immediate results. But many builders I've talked to credit another digital office machine — the fax — with easing the transition. Most construction offices were equipped with fax machines long before computers, and the new technology was particularly well-suited to handle the variety of information builders worked with. More recently, the fax and the notebook computer have also begun to turn the job site into a mobile office, making it possible for contractors to, in effect, be in two places at once. Now that's what I call virtual reality.



What started as a lone product called Corian is now an established category in the kitchen and bath countertop arena: Solid Surfacing.



In one of the most far-reaching changes in the bathroom, a 1994 federal law mandated the use of low-flow toilets in all new construction.



When the first 7.2 and 9.6-volt cordless drills hit the market in the early '80s, they offered a tantalizing freedom from tangled extension cords, but they were generally too light-duty for the job site. Today, beefy 12- and 14.4-volt versions are as common as hammers.



The last 15 years saw tablesaws get small and rugged while miter saws got more flexible. Hitachi's release of the first sliding compound miter saw set a new standard for job-site accuracy.