Coastal Contractor

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September/October 2007 $4.95

Paint It Green

Making Sense of Low-VOC Paint Regs

Standby Generators

Plywood vs. OSB

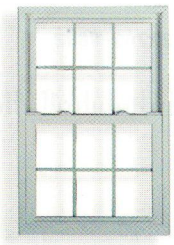
Gambrel Structure

coastalcontractor.net

CRAIG SAVAGE

6:14 PM

Hurricane Bruce moves slowly toward



Bruce Allen is hauling windows to a jobsite. The problem is, Bruce isn't quite "hauling." It's closer to "moseying." And for the builder that means disaster. Because late windows mean late closings. And late payments. Which is why you should order StormBreaker Plus™ windows from Simonton. We have our own fleet of trucks, and drivers who know the importance of an on-time delivery. Plus, we have an ultra-

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Circle #12

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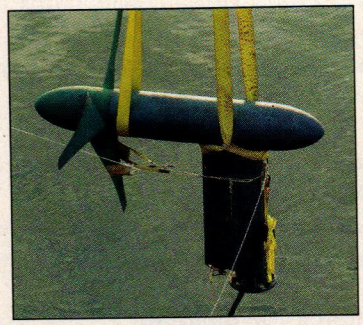
Paint It Green

As federal and state governments try to get a handle on the pollution problem and the impact of "volatile organic compounds," or VOCs, they're turning their attention to paint. A cascade of regulations, moving from the EPA down through regional commissions and finally taking effect at the state level, is putting the squeeze on suppliers to reduce the solvent content of all paint, stain, and primer formulas — or else take the products off the market. Paint makers are staying ahead of the curve. After years of adjusting to California requirements, most suppliers can now provide low-VOC products that come close to matching the performance of the old solvent-borne formulations. But a close match isn't a perfect substitute — and therein lies the rub. For contractors in the field, reports Ted Cushman, the new formulas may call for some changes in the way they choose, handle, and apply their products. — *page 34*



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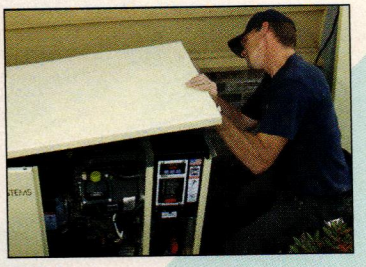
Blackout Power Solutions

The small, gasoline-powered portable generator is the classic ad hoc response to a major power outage. Yet it may be the homeowner's worst possible choice. Able to provide only enough output for a few lights and a refrigerator, gas-powered generators need frequent refueling and make a lot of noise. Of even more concern is the fact that in a storm situation, portable generators often kill a few people, either by carbon monoxide poisoning or by electrocution. What's more, gasoline spills occasionally cause structure fires and serious burns, and if the do-it-yourself user decides to get creative and wire the generator directly into a home circuit, a generator set can "back-feed" the utility, sending lethal voltage to utility workers repairing lines. Our Staff Report looks at the available alternatives to portable generators and guides you in selecting the right size, switch, and wiring options for your needs. — *page 50*



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Volume 4, Number 5. *Coastal Contractor* (ISSN 1932-4235) is published six times per year (Jan/Feb, Mar/Apr, May/Jun, Jul/Aug, Sep/Oct, Nov/Dec). Annual rates for non-qualified subscriptions: US states and possessions, $19.95; Canada, $39.95 (US funds); all other countries, $49.95 (US funds). Publisher reserves the right to determine qualification. Single copy/back issue price: $8.00 per copy. For new or existing subscriptions please visit **www.omeda.com/coco** or call toll-free: 888/269-8410. Fax: 847/291-4816. E-mail: **coco@omeda.com**.

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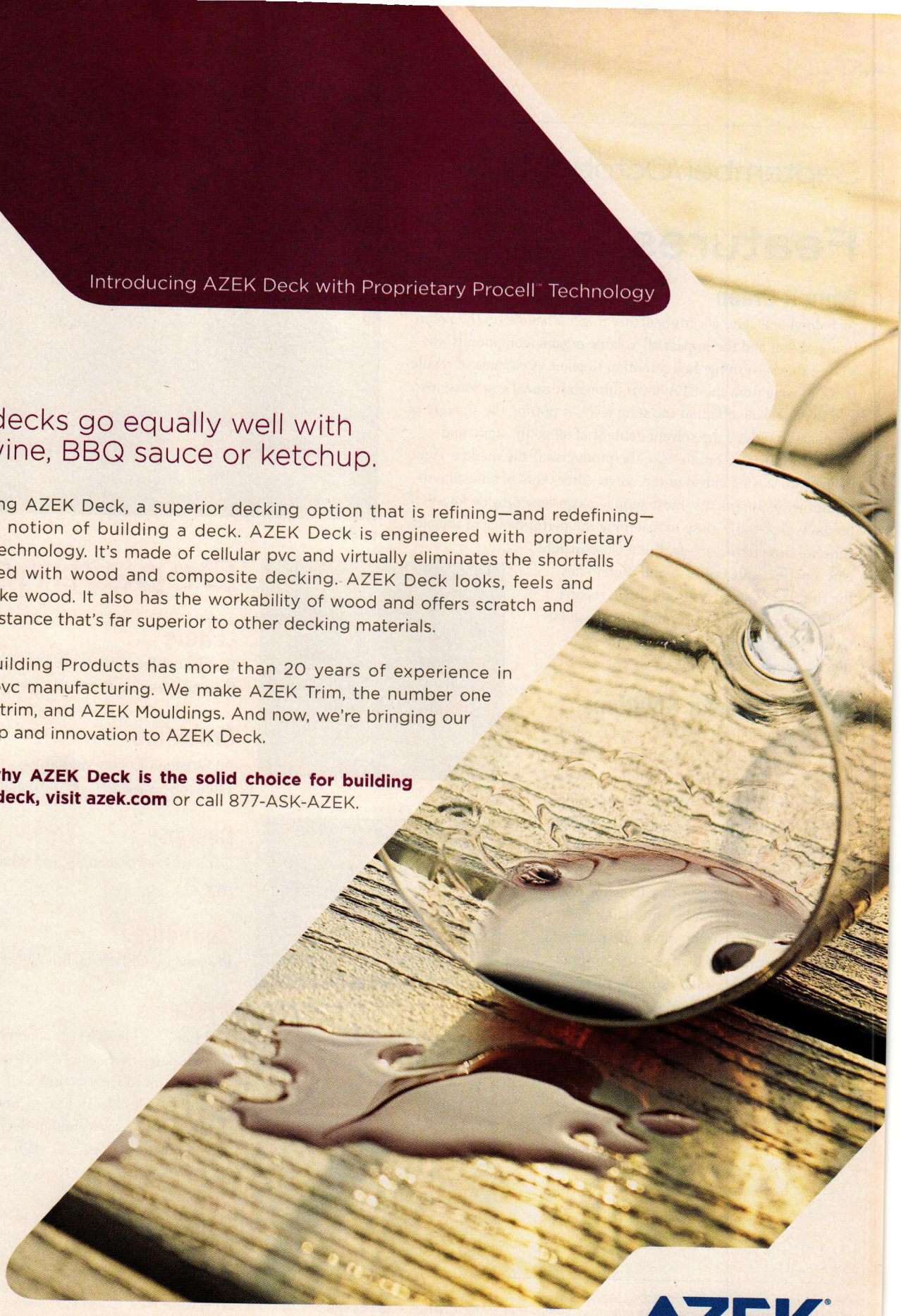

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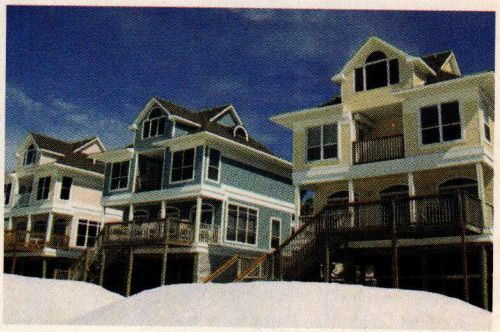

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Online Newsletter: *Coastal Connection*

Sign up for our monthly newsletter at **www.coastalcontractor.net**.

You'll get free access to all past archives, and we'll provide you with a myriad of additional resources on how to build for coastal living.

Residential Framing Revised

I was reading the article "Solving the Uplift Puzzle" in your July/August 2007 issue, and I could not agree more [with the new approaches]. We are a residential framing contractor in Jacksonville, Fla. We frame approximately 1,200 houses a year in northeastern Florida. Recently, we partnered with a lumber company, Panel Tek, and a local residential engineer to put together a very aggressive style of engineering that has eliminated 90% of the steel connectors in the houses we frame. We've been incorporating this style of engineering in our framing for about a year now and have found that the savings to the builder, and ultimately the consumer, are substantial. The combined use of uplift and shear in the wall sheathing panels is the basic ingredient to this new style of engineering.

Mark Bedford
Vice President of Construction, S.A. Robinson Construction
Jacksonville, Fla.

Backdrafting Reminder

I think that this magazine is highly worthwhile. In the last issue (July/August 2007), however, there is a slight yet very important oversight in the article "Air Leaks: Hidden Moisture Movers." Depressurization due to improper air movement can, and often does, cause backdrafting of combustion appliances, which introduces carbon monoxide (CO) into the building. The lack of understanding of this issue ranges from improper CO detector placement (remember CO is lighter than air) to tightening a house without calculating required air exchanges. We strongly support building science and looking at what it takes to build a whole, interconnected unit. It would be nice to see a follow-up article that includes the testing guidelines from the Building Performance Institute.

Jerritt Gluck
Bonded Building & Engineering
Oyster Bay, N.Y.

Information about the Building Performance Institute's technical standards can be found online at www.bpi.org/contractor/standard.htm.

No Free Lunch

Aaron Hoover's article on so-called "zero energy" homes ("Extreme Green," *Breakline*, July/August 2007) was well written and informative. Advancing the energy efficiency of homes should be a goal of builders throughout the United States and particularly in the South and South Central regions, where household energy consumption leads the nation. But I'm disappointed that your magazine continues to promote the "zero energy" fallacy. This term suggests a kind of perpetual motion machine that's not really possible. While the technology exists for homes to generate their own power, the net result will never be zero energy. Even the NAHB Research Center, in its wildly optimistic assessment of the potential impact of zero-energy homes, concludes that only a partial reduction of energy usage is deemed possible:

> By 2050, ZEH with a tax incentive for solar technologies can reduce the energy consumption of all single-family homes by 19%, while over the same time, the stock of single-family homes increases by 39%.

Homes will always require more energy to operate than they can feasibly produce. To suggest otherwise sets unrealistic expectations.

Robert O'Keefe
Charleston, S.C.

The often cited definition of a zero-energy home is one that can return as much energy to the utility as it takes on an annual basis. However, net savings are tabulated in different ways. Some argue, as you do, that the net energy provided on site should equate to 100% savings on total energy used, while others factor in the total efficiency of the home to arrive at a net savings compared to the usage of a conventional home. Still others claim that if the home runs on energy from renewable sources, regardless of where this energy is produced, it qualifies as net zero energy.

It's worth noting that the report you cite from the NAHB Research Center is advancing a claim about the energy usage "of all *single homes" (our emphasis), not of ZEH homes only. However great the reduction of reputed ZEH homes, even these cannot account for the energy usage in all none-ZEH homes.*

Your point is still well taken. Regardless of how the savings are accounted for, the more precise term now preferred by the U.S. DOE's Building America team is "near zero energy" (which is also used by Mr. Hoover in his article). This would have been the better term to use throughout.

We want to hear from you!

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Please include the city, state, and a daytime phone number with your correspondence.

Case Study: Community Underground PropaneTanks.

Innovative design and energy efficiency make StoneField Estates a winner.

More builders are choosing to use propane to provide gas to customers who live beyond natural gas service and are interested in energy conservation. Outlook Construction is a leading example of creating energy-efficient homes with propane. For one of their recent projects, Outlook Construction was awarded the *2007 PROPANE Exceptional Energy® Homebuilder Award* for homes costing less than $250,000.

This energy-efficient home is among the 116 being built at StoneField Estates that is connected to an underground community propane tank.

Outlook Construction was honored at the 2007 International Builders' Show for its *Energy Star Idea Home* at StoneField Estates in Mt. Cobb, PA. This home is just one of the 116 propane homes being built at StoneField Estates & Commons. Outlook is one of Pennsylvania's first builders to adopt the Energy Star program.

StoneField is being built completely around propane. Five-hundred gallon tanks ensure constant and consistent gas pressure to StoneField Estates homes. These tanks supply propane through a metered distribution system, and each home has its own propane meter. According to Chuck Skowronski, CEO of Outlook Construction, "[Propane] allows my homebuyers to have the benefits of saving energy by installing high-efficiency propane furnaces and water heaters; to enhance the beauty of their homes with gas lights, logs, and fireplaces; and to enjoy the flexibility of adding luxury items such as pool and spa heaters and backup generators for comfort and recreation."

"Homeowners can enjoy the aesthetic benefits of underground propane tanks which offer secure, dependable fuel storage, while maintaining the natural beauty of their home's landscape," adds Skowronski. Outlook generally develops custom homes that cost $250,000 - $500,000 in urban areas. For StoneField Estates, Outlook Construction chose propane for its efficient use and comfort. Like Outlook, more builders are choosing propane for its below-ground storage advantage, as the "underground movement" becomes more popular. To learn more about the benefits of underground community tanks, visit usepropane.com.

About underground propane tanks.

- They're constructed of heavy steel and painted with a mastic coating to prevent corrosion.
- Only a small dome protrudes a few inches above ground that allows access for refilling and servicing.
- They can fuel single-family homes as well as whole developments.

A quick look at StoneField Estates.

- Location: Mt. Cobb, PA (15 minutes outside of Scranton.)
- 500-gallon underground propane tanks servicing 116 homes.
- The tanks supply propane through a metered distribution system.
- Each home has gas appliances, like water heaters, furnaces and cooktops. And the opportunity for outdoor living areas.

Underground tanks are long-lasting, easily maintained, and environmentally friendly.

Community tanks serve small and large developments.

Access comes through a metered system, just like natural gas.

MEET THE 30,000-GALLON PROPANE TANK. WATCH IT DISAPPEAR AND FUEL AN ENTIRE COMMUNITY.

You want to offer high-value homes. Your homeowners want gas appliances – and the efficiency and reliability that comes with them. Community underground propane tanks are a winning proposition for both sides. You're able to fuel an entire development of several hundred homes. And, since the tanks are underground, your homeowners are able to get curb appeal. Dig deeper at **usepropane.com.**

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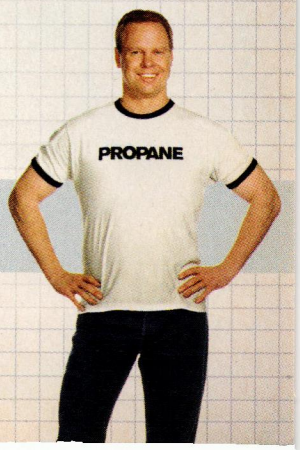

Circle #31

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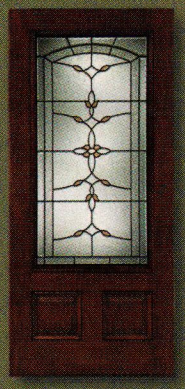
Camed Designs



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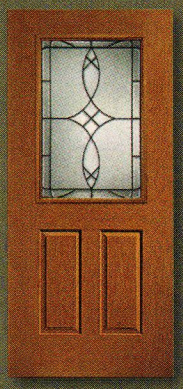
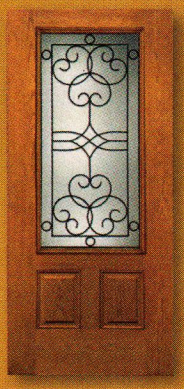


Blackstone

Wrought Iron Designs

Camino



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Circle #37

An Ocean of Energy

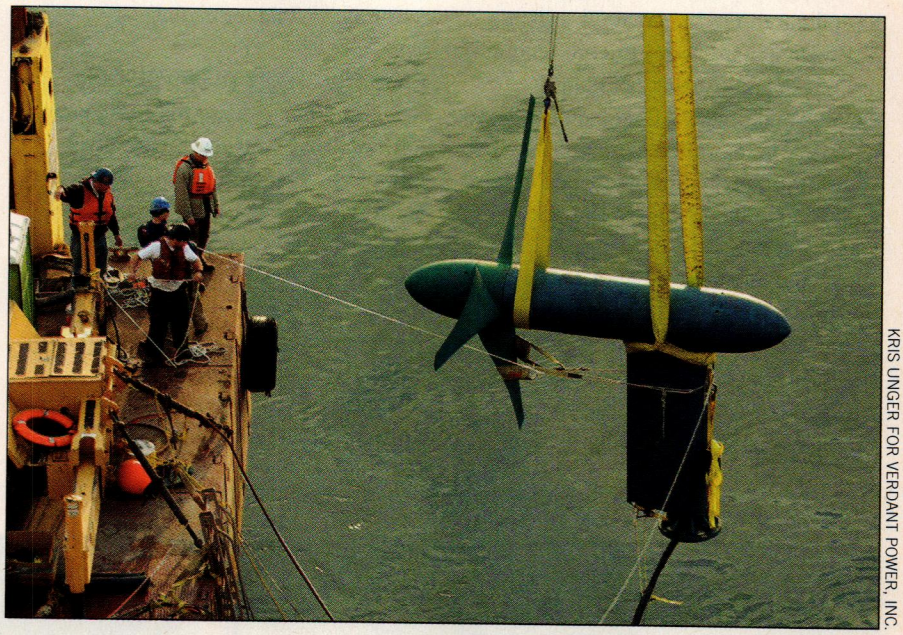
Generating electricity from tidal flows and wave action

Harnessing the constant motion of waves, tides, and currents to generate electricity has long been one of the holy grails of energy futurists. Now, thanks to advances in technology and a nationwide push for renewable energy, that dream appears to be closer to reality than ever before — with East Coast residents likely to see the greatest gains in Florida and Maine.

"It's really a confluence of the fact that these technologies are basically borrowing technology and components from other industries — the offshore oil industry, wind, and submarine. All these things come together in our designs," says Chris Sauer, president and CEO of Miami-based Ocean Renewable Power Company. "Number two, there is such a tremendous influence on renewable energy that we are actually able to attract investors."

Driven largely by small start-up companies, there are projects in the water or in the development and permitting stages in Hawaii, Alaska, Oregon, Washington State, California, New York, and Rhode Island, says the Ocean Renewable Energy Coalition, a trade association founded to promote energy technologies from clean, renewable ocean resources.

But efforts differ sharply on the two coasts. With large, regular waves, the West Coast is considered ideal for turbines or other mechanisms that generate electricity from waves, so "wave farms" are among planned projects there. Waves along the Atlantic coast, by contrast, are small and irregular, a result of west-to-east global wind flow. That leaves tides and currents as the main available sources of East Coast ocean energy.



KRIS UNGER FOR VERDANT POWER, INC.

Tidal turbine. The first of 100 turbines planned for New York's East River is lowered into the water. When completed, the project is expected to generate enough electricity to power 8,000 homes.

TAPPING TIDES

Late last year, Verdant Power became the nation's first to tap tides when the company placed a turbine in New York's East River. The 35-kilowatt turbine affixed to the river bottom on the eastern shore of Roosevelt Island generates power for a grocery store and parking garage. Verdant says the project will eventually have at least 100 turbines and generate 10 megawatts of electricity, enough to power nearly 8,000 homes.

Enthusiasts say the Verdant project is just the start. The really promising spots for tidal and current energy have yet to be tested, they explain. Oddly, such sites lie at the coast's two most distant points: South Florida and northern Maine.

The Gulf Stream, the narrow but powerful ocean current that carries water north from the Gulf of Mexico to Newfoundland and on to Europe, flows within sight of Fort Lauderdale and Miami beaches, making that area ripe for current-driven turbines. Meanwhile, Maine's Bay of Fundy, where tides can vary as much as 40 feet in a single cycle and islands act as funnels to accelerate water flow, suggests a huge energy resource.

"We have the Gulf Stream going past the state 24/7, so that makes it attractive," says Manhar Dhanak, professor

and chairman of Florida Atlantic University's department of ocean engineering. "If we could harness a fraction of the energy of the ocean, then that could be a significant contribution to Florida's energy needs."

Florida lawmakers last fall gave $5 million to FAU to create the Center of Excellence in Ocean Energy Technology to explore just that possibility. Dhanak and other FAU researchers hope to have a 1- to 3-meter, and at least 50-kilowatt prototype turbine placed in the Gulf Stream by the end of the year, Dhanak says.

Meanwhile, more than 1,800 miles north in Eastport, Maine, Ocean Renewable Power is working on a small demonstration turbine the company says it will place in the Bay of Fundy's Western Passage by November. The unique turbine is designed to turn the same direction no matter which way the water flows, maximizing energy efficiency throughout the tidal cycle, Sauer explains. If successful, "We believe we can build a 20-megawatt [plant], and we believe we can build that for $38 to $40 million," Sauer claims.

FROM PROTOTYPE TO PRODUCTION

Sauer and Dhanak are the first to admit, however, that growing the prototypes into production facilities won't be easy. Corrosive saltwater remains an issue despite improvements to technology. Underwater cabling is another challenge: the deeper and more distant the site, the harder and more expensive it is to move the power to land efficiently.

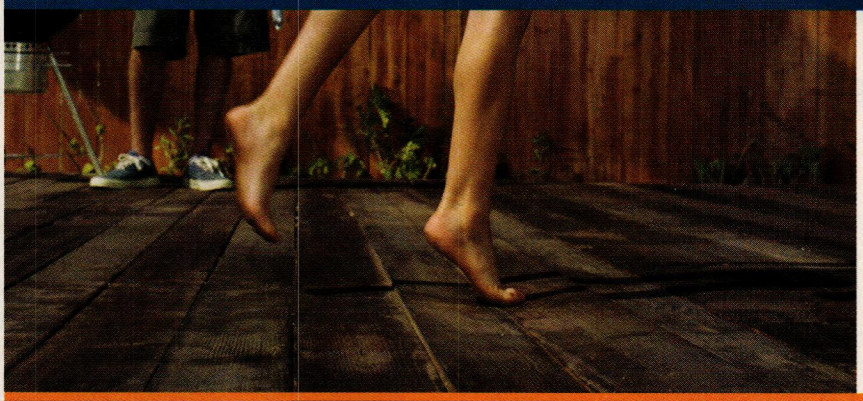
Currents move relatively slowly and meander somewhat, meaning any Gulf Stream production power facility would likely have to be quite large and expensive, with many turbines spaced over a relatively wide area. Tides move more quickly but are intermittent, so they will never provide the steady supply available from nonrenewable sources such as coal and nuclear energy.

Still, Sauer says he thinks ocean power could one day produce 10% to 20% of the East Coast's energy needs. Dhanak estimates the Gulf Stream and other South Florida ocean energy projects could provide 20% of Florida's demand.

"It's not the silver bullet," Sauer says. "It's one of many solutions that, when combined with wind and other resources, will basically wean us from imported oil." — *Aaron Hoover*

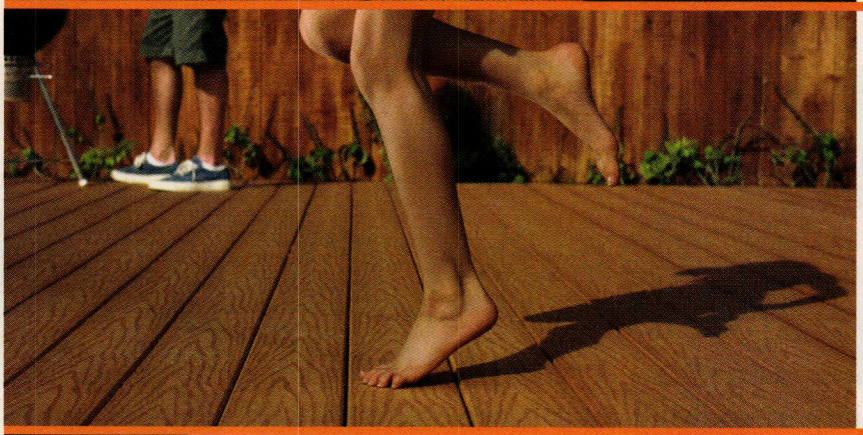
Breakline continues on page 14

No one should have to work on a deck.



If you don't build the right deck in the first place, time and weather will wear it away.

So we engineered our LP WeatherBest decking to resist warping and splitting and applied our SmartGuard™ zinc borate treatment to resist decay. That means it looks beautiful, lasts longer and needs less maintenance. And that leaves more time for what you really want to do on a deck. Nothing at all.



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Circle #2

BUILD WITH US.®

Virtual Tsunamis

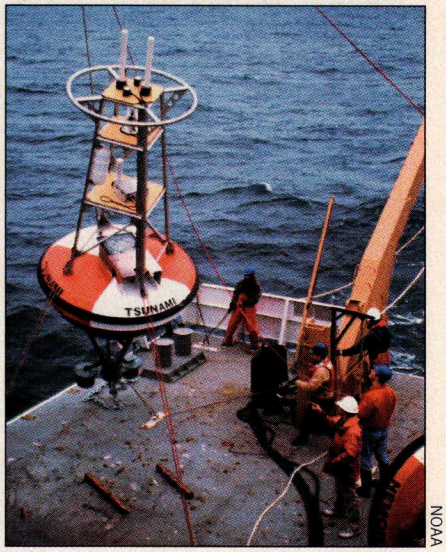
As if hurricanes weren't bad enough

Thousands of people cavort on Daytona Beach on a hot Sunday in August when, out of nowhere, a 15-foot wave floods the beach. The water swamps the sun worshippers and rushes into buildings along Highway A1A.

Emergency managers in Daytona's home of Volusia County sought to prepare for just such an event during a drill earlier this year. Their morning-long exercise was part of a growing effort by local, state, and federal officials to plan for a catastrophe so rare on the East Coast that few hurricane-hardened residents have pondered it: a tsunami.

"The thing about a tsunami is, it's a low probability, high-impact event," says Daniel Noah, a Ruskin, Fla.–based warning coordination meteorologist for the National Weather Service. "We've had them before, and we're going to have them again."

Many tsunamis occur when an earthquake causes rapid movement of the ocean bottom, displacing vast quantities of water. Others well up from underwater landslides or volcanoes. Most tsunamis happen within the seismically and volcanically active "Ring of Fire" surrounding the Pacific. An 8.0-magnitude quake

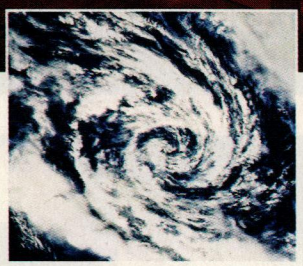


NOAA

Seismic sensor. Six tsunami-detecting buoys like this one have been deployed in the Gulf of Mexico. If the warning system works as intended, coastal municipalities may have an hour or more to prepare before the wave washes ashore.

Every home is a safe haven.

At least, it should be.



Marvin Windows and Doors' StormPlus products meet the strictest building codes and regulatory changes in every state. StormPlus options include energy efficient Low E II glass and reflective coatings that help to limit UV rays, control heat gain or loss and protect décor from fading. When it comes to codes, we've considered everything. And delivered a superior solution.

The perfect fit for any home, no matter where it's built...or which storm comes its way.

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there was the source of the tsunami that left 52 dead in the Solomon Islands in early April 2007.

Although recent tsunamis have struck Asia, they are not unheard of in Europe and the U.S. Perhaps most famously, a massive 1755 earthquake off the coast Lisbon, Portugal, caused a tsunami that killed tens of thousands of the city's 275,000 residents. Modelers believe that earthquake, which occurred in the Azores-Gibraltar fracture zone near Portugal, spurred successive tsunamis that raced across the Atlantic — striking Florida with a series of 7- to 10-foot waves, Noah explains. Florida and other southeastern states are also threatened by undersea earthquakes in the Caribbean's Puerto Rico Trench and by the Cumbre Vieja volcano in the Canary Islands. A fracture zone between Cuba and the Yucatan could cause a Gulf tsunami.

The largest tsunami to strike the East Coast in recent memory came in 1929, when a likely underwater landslide on the Grand Banks created a 6- to 23-foot tsunami in Newfoundland and reported as far south as South Carolina, according to the U.S. Geological Survey. Overall, there are probably one to two tsunamis every century along the East Coast, Noah estimates. But the hugely devastating Indian Ocean tsunami of December 2004 prompted U.S. officials to expand the warning system already in place for Alaska and Hawaii — the U.S. states most prone to tsunamis — to the Atlantic coast, Noah said.

Today, the National Weather Service's Alaska Tsunami Warning Center monitors the East Coast's seismic hotpots. Because not every quake causes a tsunami, the service has a total of six tsunami-detecting buoys — most installed in 2006 — in the Gulf, Caribbean, and Atlantic. If seismologists detect an earthquake of at least 6.8 magnitude, the center may issue a tsunami warning, while also seeking to confirm the tsunami via the buoys. That warning goes to the service's Melbourne office and then to other coastal offices, which issue flood warnings to emergency managers and the media.

The weather service believes East Coast communities could face a maximum of a 15-foot wave extending 300 feet inland. On much of the Gulf Coast, where the extensive underwater continental shelf would dissipate the wave's energy, the biggest wave would be about 18 inches, accompanied by strong currents.

If the warning system works as intended, coastal municipalities may gain an hour or more to prepare, which with efficient evacuation procedures could go a long way toward getting everyone off the beach before the tsunami arrives. — *A.H.*

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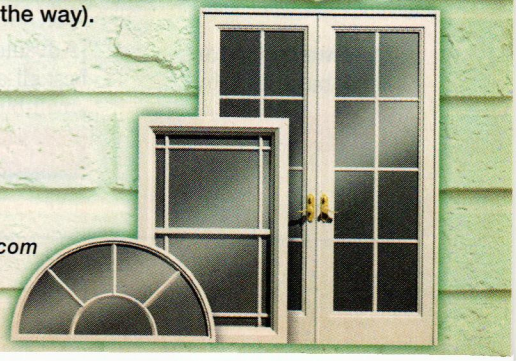

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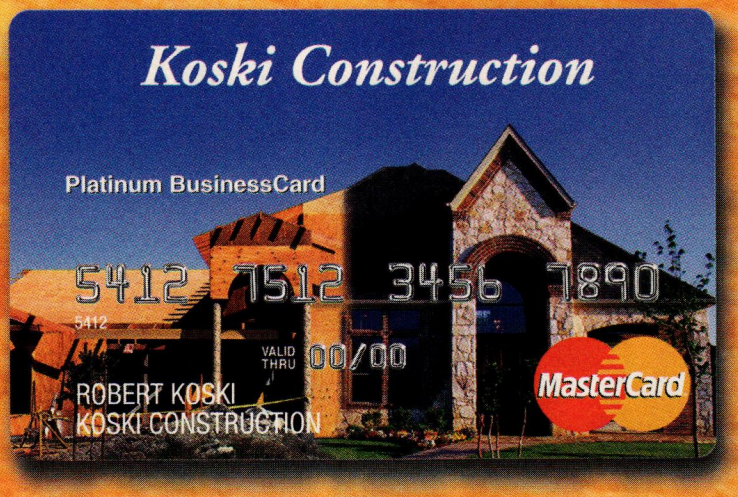

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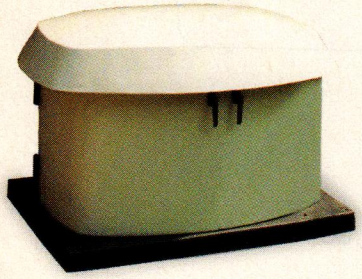

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Circle #29

Gambrel Roof Structures and Wind Uplift

Understanding how engineering meets design

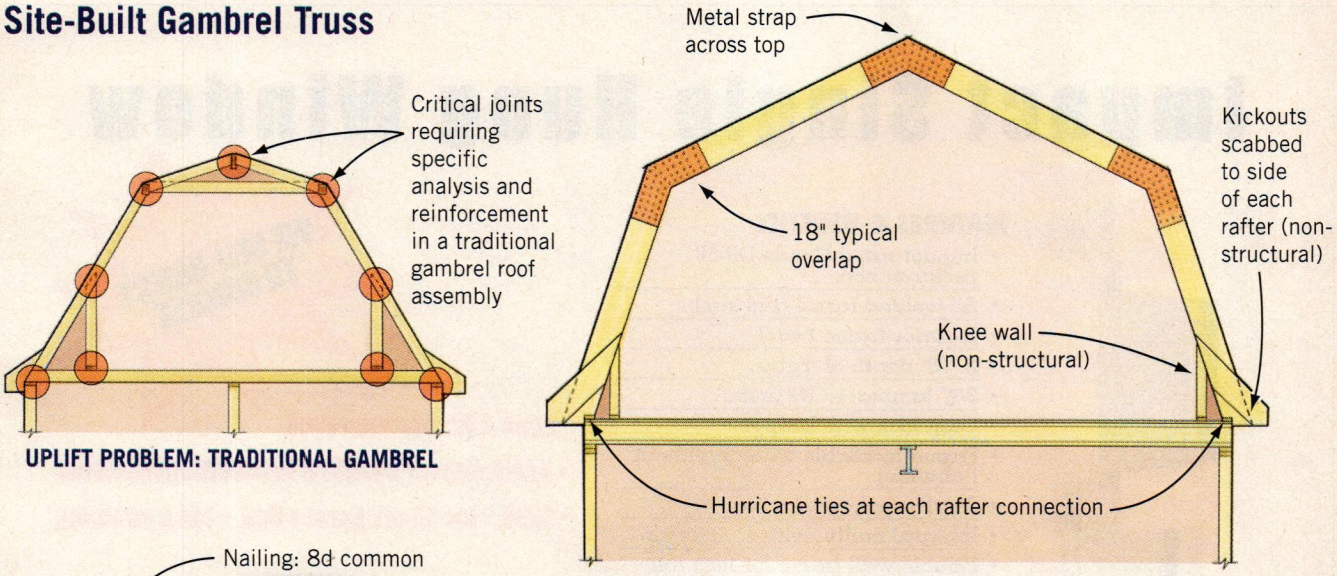
by Andrew P. DiGiammo

As I discussed in the previous *Design* column ("Making Gambrels Work," July/August 2007, available at www.coastalcontractor.net), I've been interested in the gambrel form for a long time. Besides being a traditional architectural style in my area, it also offers aesthetic and practical advantages. I like roofs that spring from the first-floor wall plate, the way gambrels and capes do, rather than from the second floor. Such forms are more interesting and visually satisfying. But the gambrel has some advantages over the cape: in particular, I like how the gambrel allows me to enclose more useful space within the framed volume. And the gambrel can be very simple to frame as well.

In the previous issue, I compared the traditional way of framing a gambrel — two rafter systems joined by a horizontal nailer at midroof — with a more modern method that employs gusset joints at the mid-rafter span. I examined one aspect of this roof structure: the way it handles gravity loads. As a result of new hurricane-related codes that have come into force along the East Coast, however, builders now have to determine wind loads too, which can complicate the roof design issue considerably.

The gusset system for framing gambrels is simpler than the traditional methods, and it handles the gravity-related loads as well as, or better than,

Site-Built Gambrel Truss



A traditionally framed gambrel (top left) requires a complicated structural analysis and extensive, labor-intensive reinforcing with metal hardware at each connection in order to direct uplift forces through the complex, multiple load paths that exist in the frame — all of which add considerable time and expense.

The gussets (detail, left) in the gambrel system above (designed by the author) create a three-hinged arch out of each frame, which simplifies the load analysis significantly. Hardware is required at only three points (as opposed to nine different joints in the roof assembly of a traditionally framed gambrel), making the system considerably easier to build.

CHUCK LOCKHART

the older methods. But will the system also handle wind-related loads, including lateral pressure and uplift? When I analyzed a gambrel design for wind loads, I was pleased to find the answer is yes: the gusseted gambrel is more than adequate to meet the wind-resistant construction standards that apply in my coastal area, and it's easy to conceptualize and analyze. I won't go into all the numbers and calculations involved, but the basic idea is outlined here.

ANALYZING TRADITIONAL FRAMING

To understand the traditional framing system, think of the steep-sloped lower rafters as sloped walls, and think of the upper rafter pairs, connected from rafter base to rafter base by their collar ties, as a rigid triangle. In this case, even the simple gravity loads involved are really not so simple: the short, lower knee walls can get involved and bring some of the loads down to the floor, and even the floor has to be looked at for how it can handle that weight. Where the lower rafters rest on the knee walls, the rafters get placed into an odd bending situation, and they have to be looked at in terms of how they might tend to rotate around that intersection point. The whole assembly also depends on the collar tie across the ceiling, which has to be securely nailed and sized large enough so that it can restrain the spreading of the upper rafter pairs.

> Will a gusset system handle wind-related loads, including lateral pressure and uplift? In short, yes.

Throw a high wind into this picture, and you've got a real can of worms. Now you need to make sure that uplift on the upper roof won't pull any of the joints apart — not at the peak and not at either elbow joint. Also, because any uplift force on the lower rafters will tend to separate the knee wall from the rafters or from the floor, you need to consider whether that joint also needs reinforcement with some sort of rated metal connector.

ANALYZING THE GUSSET SYSTEM

The gusset system relies on a pair of 3/4-inch fir plywood gussets at each joint, with the rafters sandwiched in the center. Taken together, the plywood pieces have the same thickness as the rafters themselves. As long as the joint

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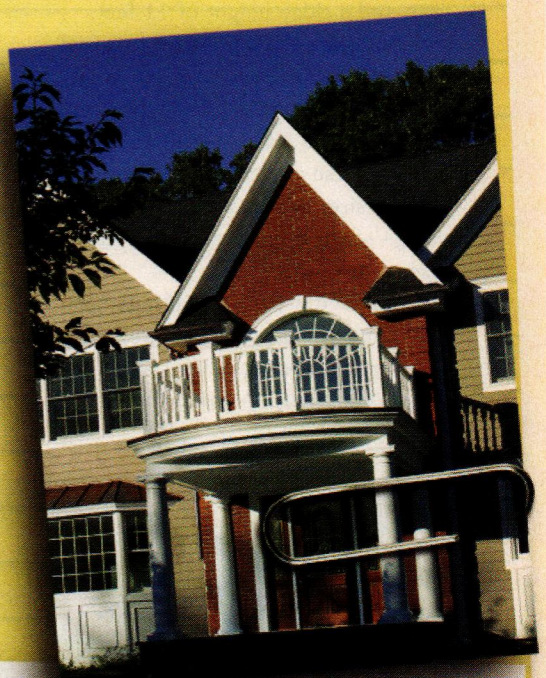

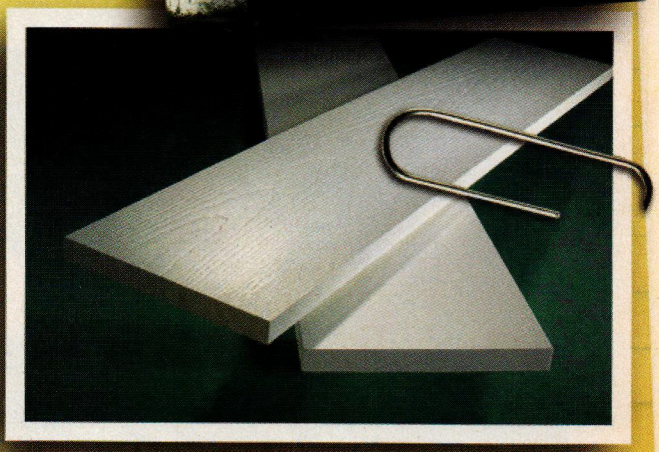

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is adequately nailed, the assembly acts as a single unit and is equivalent to a continuous sawn-lumber rafter. However, because of the angled shape and the lack of the ceiling collar tie, the rafter experiences an increased bending moment, and should be sized appropriately. In the case shown (see illustration, page 21), I have a 22-foot span and a ridge height of 11 feet, which requires a 2x12 rafter (upsized from a 2x10), with gussets extending 18 inches onto each side of the joint, nailed with 8d nails at 4 inches on-center. These variables — gusset material and size, nailing details, and rafter sizing — will vary for each particular case in the field.

Compared with the traditional gambrel frame, this method removes almost all of the complex analysis. Using the gussets eliminates the need for the collar tie. I can now analyze the whole roof system as a simple three-hinged arch. Uplift forces create a need for reinforcement at only three points: at each of the two rafter bases where the rafters meet the walls, and at the ridge. In each case, a simple metal connector will do the job — an ordinary rafter or truss anchor at the bases of the rafters, and a metal strap across the opposing rafter tops at the peak. The numbers vary depending on your local design wind speed zone, but the bottom line is that you can use the same hardware here that you would use if the roof were an ordinary 12-pitch roof with straight rafters.

DESIGN PHILOSOPHY

This approach conforms to my general design philosophy when in comes to the structural design of houses. I'm both an architect and a builder, and I build my own designs. Over the years, I've learned to consider structural aspects of the design problem early on in the process, before I commit myself to particular room layouts or building shapes. If you think about your main load-bearing assemblies and your main wind-force resisting system right at the beginning, you can design a home so that the main structural elements are easy to analyze and simple to build. By contrast, if you wait until too late in the process before you consider the structural problems, you often end up with complicated structural dilemmas that must be solved with expensive or time-consuming work-arounds.

Architect and builder Andrew P. DiGiammo owns and operates a custom design/build firm based in Assonet, Massachusetts.

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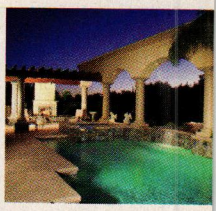

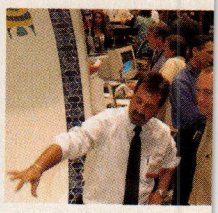

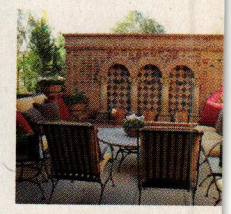

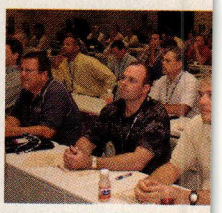

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Plywood vs. OSB: Which Is Better?

Q. Is there a real difference in performance between plywood and OSB for coastal applications? Which is a better product, plywood or OSB, for floor, wall, and roof sheathing?

A. *Steve Easley responds:* First, let me state that I think OSB is an "okay" product. However, for it to perform properly over a long period of time, you must keep it dry and pay careful attention to how you install it. Having said that, in my opinion, plywood is a "better" product, or at least a more forgiving one. After studying building problems for more than 25 years, I believe four- or five-ply exterior-grade plywood performs better in wet and humid climates for a variety of reasons.

DURABILITY

Based on my experience of performing in-the-field forensics on homes for builders, plywood holds up much better in the face of common water intrusion. I've seen many more instances of OSB deterioration from even minor amounts of moisture over relatively short periods of time. OSB is often made from aspen, which studies have shown is prone to attack from decay fungi. I also believe OSB holds more water and is slower to dry.

But let's be very clear: Not all OSB is created equal. We shouldn't confuse run-of-the-mill OSB sheathing panels with some of the OSB siding and trim products or with some of the newer OSB panel products. Unlike ordinary panels, many trim and siding products are manufactured with special resins and borates, which make them resistant to decay. I have had Louisiana-Pacific SmartSide (www.lpcorp.com) OSB trim on my own home for several years, and it still looks like it did the day I put it on. And some of the new floor sheathing products, such as Huber Engineered Woods' AdvanTech (www.huberwood.com), hold up better than ordinary OSB panels. Also, some of the newer OSB wall sheathings from Huber Engineered Woods, Norbord Inc. (www.norbord.com),

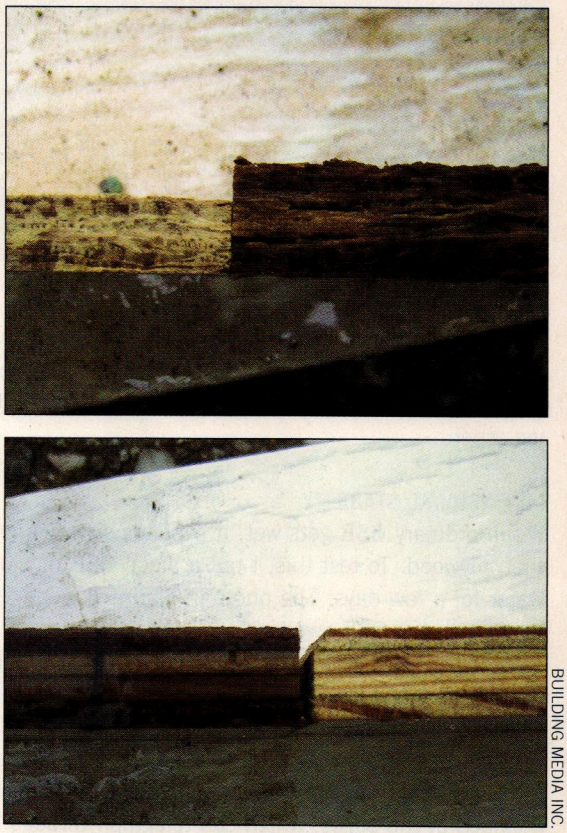

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FIGURE 1. Saturated OSB (top) swells considerably, and does not shrink back to its original dimension when it dries out. Plywood soaked in the same way (above) does not swell to the same degree, remaining dimensionally stable.

Percentage of Swelling	
Plywood	Average swell = 6% to 8%, depending on thickness
OSB	Average swell = 10% to 15%, depending on thickness

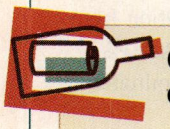

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FIGURE 2. Panel swell is most sensitive along the edges where it is critical for flooring and roof sheathing to match up and not show through the finish flooring or roofing materials. At left, the edges of an OSB subfloor swelled significantly from rainwater blowing through window openings during construction. Below, the swelled edges of OSB sheathing show prominently through the shingles.

and Roy O. Martin Lumber Management (www.martco.com) are reportedly made with a high resin content and with southern yellow pine, which is more dimensionally stable than fast-growing aspen.

DIMENSIONAL STABILITY

When ordinary OSB gets wet, it expands significantly more than plywood. To test this, I put a piece OSB in a bucket of water for a few days. The photo in **Figure 1** (page 29) shows how much the OSB swelled.

This extreme swelling is a problem when OSB panels get exposed to heavy rain during construction. Over a period of time, when subjected to high humidity or a series of dramatic wetting events, ordinary OSB, in my opinion, is more prone to panel swell than plywood. This tendency is especially pronounced at the edges, which can telegraph through roof shingles, stucco, and cladding (**Figure 2**). Some manufacturers make subfloor products with grooves to drain the water and extra-long tongues to help provide clearance for expansion.

Whereas wet plywood dries out, returning to nearly its original size, when OSB dries out, it does not shrink back to its original dimension. If a subfloor constructed from ordinary OSB gets wet, you often have to grind the raised edges smooth before applying finished flooring (**Figure 2**).

On wall-sheathing applications, a common mistake is not leaving enough space between OSB panels for expansion. This can cause wavy siding syndrome or "oil canning" (**Figure 3**, page 32).

Plywood is not immune to moisture problems, however. It has had some history with delamination in conditions of repeated wetting and drying. I recommend a four-ply or greater product for wall and roof sheathing, as it resists delamination better than three-ply panels. Georgia-Pacific makes a very durable plywood product called Plytaninum DryPly, which is specially treated to resist deterioration from moisture. According to the manufacturer, it absorbs 40% less water and has a 100% guarantee against delamination, joint swell, and edge sanding.

CREEP

Creep is the measurement of the sustained deflection, or sag, between two supports, such as the sheathing span between two floor joists or two trusses. Creep usually results from a sustained load that gradually deforms the panel.

Research done by the USDA Forest Products Laboratory (Research Paper FLP-RP-574) shows that over a period of time at low temperatures under constant loads such as snow, and in a stable environment at 50% relative humidity, the performance of plywood and OSB is about the same. But

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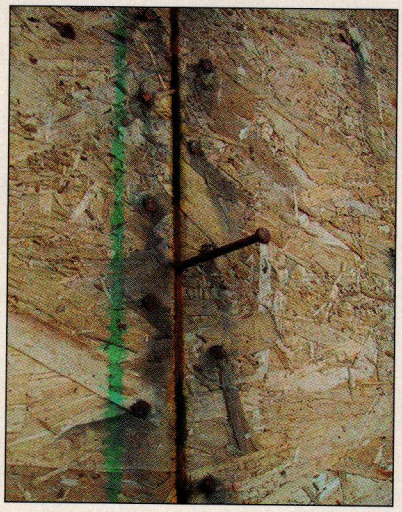
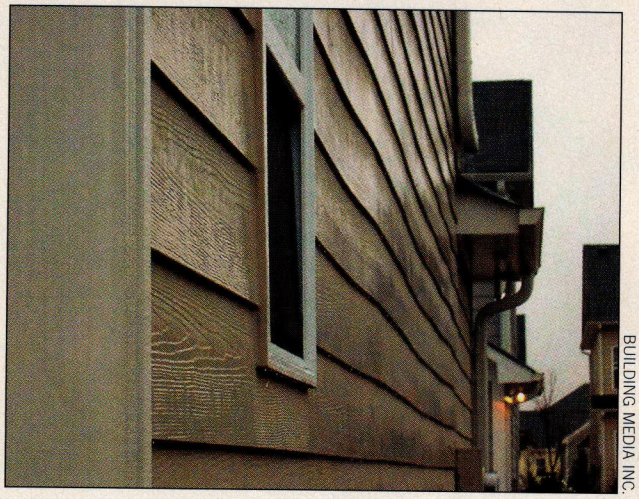


FIGURE 3. All wall and roof panels should be gapped to accommodate expansion of the panels. If installed too tightly, the panels can buckle the siding — a condition called "oil canning."



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under the same sustained loads in wet conditions, OSB will sag or "creep" more than plywood. This could be an issue for a subfloor in a bathroom that supports a tile floor, for example. In my opinion, plywood would be the better choice for the subfloor in any wet location.

RACKING STRENGTH

Wood panels create a safer, stronger structure. OSB and plywood test about the same with regards to shear strength. Whether plywood or OSB is used, sheathed walls do an excellent job of helping structures resist wind and seismic forces (see "Wall Bracing and the IRC," July/August 2006, available at coastalcontractor.net).

Steve Easley is principal of Steve Easley Associates, a company based in Danville, Calif., that provides building-science training and quality assurance consulting for builders nationwide.

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Circle #14

As rules limiting solvents get tighter, painters and suppliers are adjusting to a new kind of chemistry

Paint It Green

by Ted Cushman

If you've gone to the beach on a calm day in midsummer, you've probably seen the haze: a thin, brownish gray soup in the air that's not quite smoke, not quite fog, and not quite a cloud, veiling the horizon and dimming your view of the distant hills. What you can't see — but what is often there, along with the visible haze — is ozone. In the upper atmosphere, the ozone layer is good: it shields the earth from harmful ultraviolet radiation. But at ground level, ozone is bad: it's a corrosive form of oxygen that can irritate the eyes and nose or trigger asthma symptoms. Ozone even damages plants, causing billions of dollars of crop losses every year.

House paint plays a role in both the ozone and the haze. The "volatile organic compounds," or VOCs, evaporating out of paint solvents react with powerplant and vehicle emissions to help form the harmful ozone molecules as well as the tiny, light-scattering airborne particles that we see as haze. So as federal and state governments try to get a handle on the pollution problem, they're turning their attention to paint. A cascade of regulations, moving from the U.S. Environmental Protection Agency (EPA) down through regional federal/state commissions, and finally taking effect at the state level, is putting the squeeze on suppliers to reduce the solvent content of

Three painters work together on the shady side of a house to get the paint on quickly. Modern acrylic paints and stains tend to dry quickly compared with older, higher-VOC formulas.

all paint, stain, and primer formulas, or else be forced to take the products off the market.

The gears of government grind slowly, however, so the regulations aren't ramping up overnight. Southern California imposed strict VOC rules starting in the 1960s, but the Northeast and Mid-Atlantic states are just beginning to regulate VOCs. Some coastal states have rules in place already, while others are still phasing them in. With plenty of lead time to adapt, paint makers are staying ahead of the curve, at least on the East Coast. After years of adjusting to California requirements, most suppliers can now put low-VOC products on East Coast shelves that come close to matching the performance of the old solvent-borne products they replace. But a close match isn't a perfect substitute — and therein lies the rub. For contractors in the field, the new formulas may call for some changes in the way they choose, handle, and apply their products.

WHAT'S A VOC?

The "volatile" of VOC means the material evaporates easily; "organic" means it's based on carbon; and "compound" just means that it's a molecule made up of different kinds of atoms. Alcohol and gasoline are examples of VOCs; in paint, the typical VOCs are solvents with

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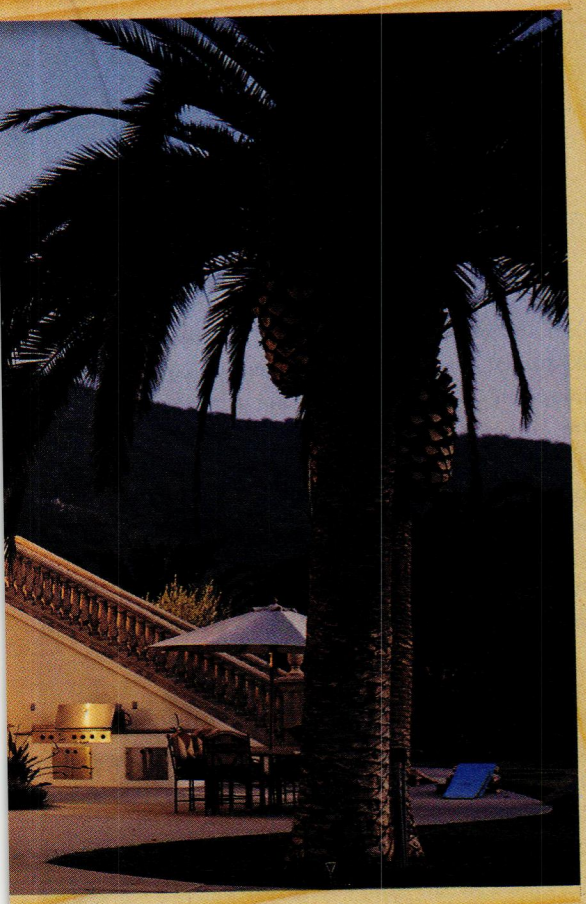

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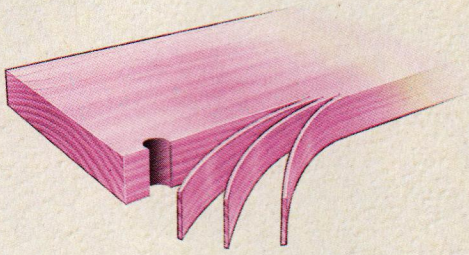

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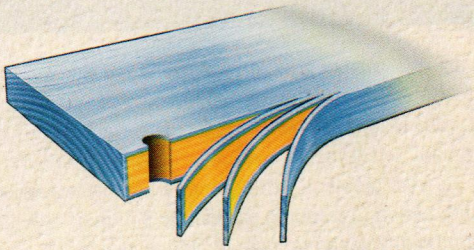

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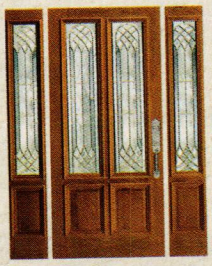
Dip-treated wood is only protected on the surface

NOTE: Colors are used for illustration purposes only; AuraLast wood has a clear pine color.



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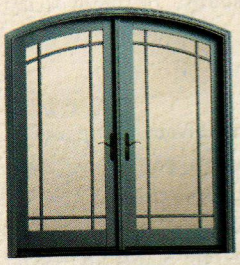

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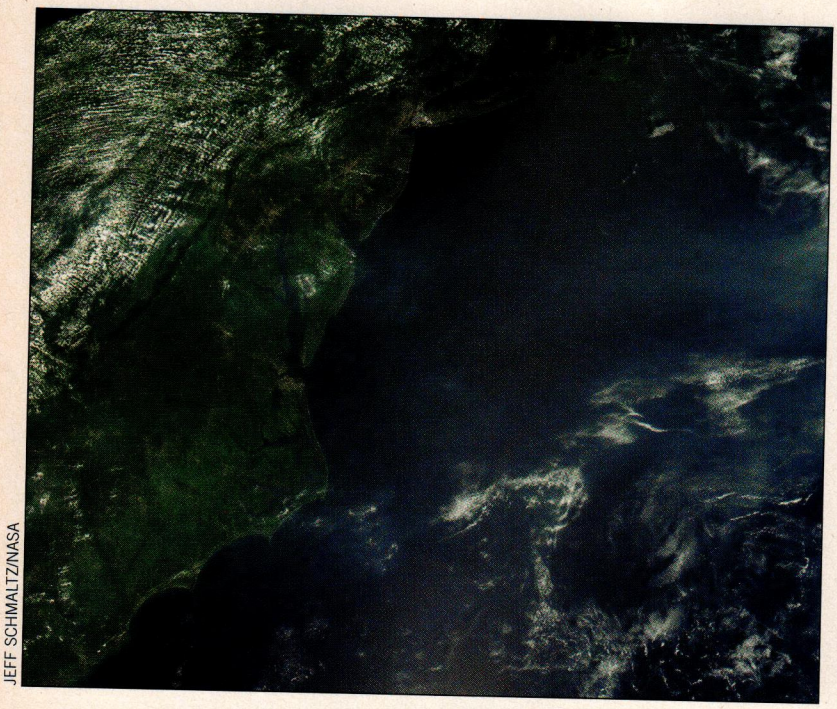


JEFF SCHMALTZ/NASA

Not quite a cloud nor fog, the haze of ground-level ozone is clearly visible in this image captured from NASA's *Terra* satellite on the morning of August 2, 2006, off the mid-Atlantic coast. Also known as smog, this ground-level ozone is created when VOCs react with power-plant and vehicle emissions. Paint solvents contribute a small but significant part of the VOC problem. At the time, a high heat advisory was in effect for the region. In addition to trapping particulate pollution near the earth, high heat, stagnant air, and humidity generate more ground-level ozone.

names like toluene, benzene, acetone, and ketone. Most VOC solvents come from crude oil: the most common solvent in house paint or primer is a generic mix of petroleum distillates called "Stoddard solvent," also known as "white spirits" or "mineral spirits," or simply "paint thinner."

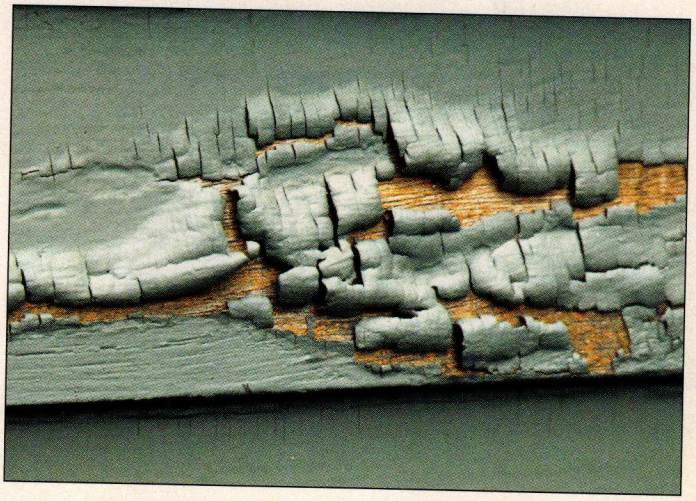
OILS VS. ACRYLICS

When you talk about solvent-borne and waterborne house paints, you're basically talking about oil (or, more precisely, "alkyd") paints versus acrylics. And as the VOC rules get tighter, oil paints are taking the brunt of the heat. That's because of the different manner in which oil and acrylic paints are formulated: as a result of their different chemistries, oil paints and stains are typically solvent-borne, while acrylic coatings are always waterborne.

Alkyd paints oxidize as they dry; oxygen reacts with the string-like alkyd molecules and helps them "cross-link" together. So an alkyd paint coating actually becomes a continuous, chemically connected film as the paint cures. That's how oil-based paints develop their particularly desirable properties, such as high gloss, hardness, abrasion resistance, water repellency, and washability. But there's a downside, too: the oxidation process continues indefinitely. Exposed to sun and air, the paint will eventually yellow, become brittle, shrink, and crack in the process known as "alligatoring."

For house paints, longer-chain alkyd molecules tend to provide a better mix of properties than shorter-chain oils, but it takes a lot of solvent to keep those bigger alkyds in solution, and multiple coats are required to achieve a really good film build. Cutting down on the solvents makes the paint thick and heavy, which means it doesn't flow or handle as well. As a result, it's hard for an alkyd paint maker to even come close to the new VOC limitts and still make a paint that will perform the way it's supposed to. As the rules get tighter, traditional alkyd paints are increasingly ruled out.

Acrylic latex paints are a very different animal. Polyacrylic is a plastic polymer derived from petroleum, rather than from plant-based oils. Polymers are long, repetitive chains built up out of short links.



Solvent-borne alkyd formulas react with oxygen, leading to eventual brittle failure over time. Shown here is an advanced case of "alligatoring" of alkyd paint over old clapboards.

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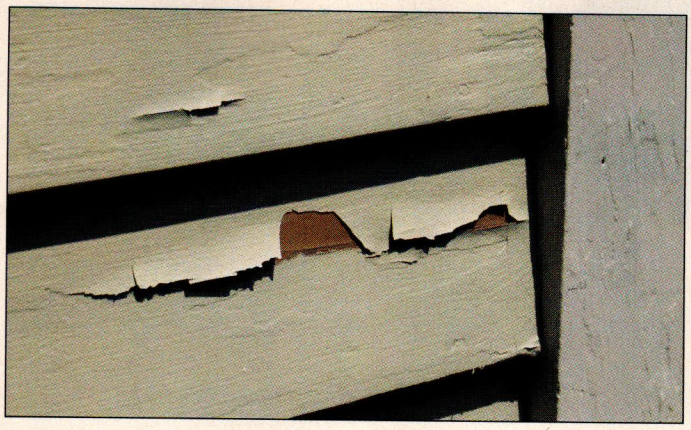

Acrylic paint resins "coalesce" as they dry, creating a continuous film on top of the wood. As long as the surface is prepped well, the paint will stick. But acrylics are particularly intolerant of conditions such as mill glaze and dirt, and surfaces should be sanded to give some "tooth" to which the paint can bond.

Chemists can control the laboratory process to grow the big polyacrylic molecules to whatever size they like, out of a soup of short "acryl" pieces. And by varying the ingredients, they can modify the molecules to get special properties they desire, creating, for example, an acrylic polymer that is hard, soft, or somewhere between.

An acrylic polymer doesn't dissolve in the hydrocarbon solvents used for oil paint. In fact, acrylic won't dissolve in water, either. Instead, chemists blend the acrylic into water as an "emulsion" or "dispersion" — in simple terms, whipping the materials together with soapy surfactants and thickeners to form a smooth mixture, like making a milkshake. These surfactants and thickeners, along with flow agents, help to keep the mixture stable in the can, and help it flow and level out in use.

Compared with the small, stringlike alkyd paint molecules dissolved in a high volume of solvent, acrylic paint resins are more like large, semisoft balls suspended in a relatively small amount of water and customized additives. It's called a "high solids" formula. And as the paint dries, acrylic doesn't cross-link: instead, the bits of acrylic gradually soften and melt together, or "coalesce," to form the continuous film. Because it's not chemically active when it's dry, acrylic paint ages better than alkyd paint, especially outdoors, holding its color and gloss longer and not readily shrinking or cracking.

In addition to the acrylic binder, acrylic-based paints contain pigments and light blockers, to add color and to protect against sunlight. As the paint dries, it's tricky to keep the pigments and the binder evenly distributed, rather than clumping together and forming a faulty, inconsistent film. Because of this, waterborne paints generally have some kind of "coalescing agent" or "coalescent" additive that helps the acrylic molecules melt together around the pigment, trapping the pigment within the acrylic film. Coalescents are slow-evaporating VOC solvents — which is why even most waterborne acrylic paints contain at least 5% or 10% VOCs in the can, and it's why an acrylic paint job may take a week or more to fully harden and to stop smelling like fresh paint. As the rules get stricter, even some acrylic paint makers find it challenging to squeeze the VOCs out of their formulas to squeak in under the regulatory limit and still get the good film formation they want.

PAINT MAKERS ADAPT

Paint formulation is a game of trade-offs, explains Stewart Williams, director of the Rohm and Haas Paint Quality Institute. Even the very strict, 50 grams per liter, VOC limit enforced in smoggy Los Angeles is doable in a flat or semigloss acrylic paint, he says. "But if you go to the higher gloss, it's more challenging — because you've got to deliver those enamel-type properties that we've all grown accustomed to. I can give you a zero-VOC gloss today, but it won't have that enamel hardness or the other 20 things you may want."

Rohm and Haas and its competitors spend hundreds of millions of dollars on research each year. Advanced paints that don't exist today will be on the shelves in a few years. "There is no question that there are going to be breakthroughs," says Williams. "Whether it's on the acrylic end, or in the acrylic/alkyd hybrid end, or what have you — it's going to happen."

On the acrylic side, companies are working on natural, nonevaporative substitutes for petrochemical coalescents, hoping to get away from VOCs entirely. Acrylic polymers continue to evolve as well: Rohm and Haas' Avanse technology uses custom-brewed polymers to evenly embed pigments within the acrylic binder matrix, for better and more efficient coverage and hiding. Benjamin Moore's new Aura paint line goes a step further: the company claims its new poly-

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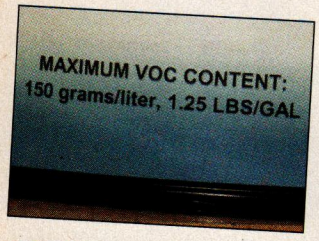

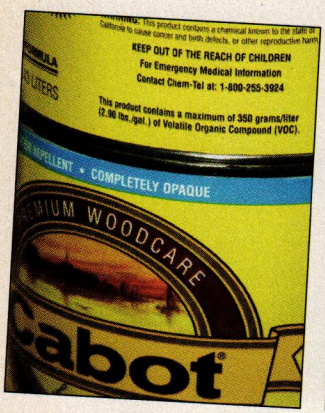

As rules tighten, 150-g/L flat acrylic paints (top left) and 350-g/L alkyd stains (above left) will be disappearing from shelves in the few coastal states where they can still be found. Taking their place may be advanced formulas such as Benjamin Moore's Aura brand (above right), a near-zero-VOC acrylic with an innovative colorfast pigment system.

merization method actually encapsulates paint pigments completely within the small spheres of acrylic polymer, achieving better gloss as well as more durable and brighter color — and with a zero-VOC formulation.

Meanwhile, oil-based alkyd suppliers are working to break away from their solvent-borne past with a new "alkyd dispersion" technology, grafting modified alkyd chains onto acrylic polymers and blending them into a mostly waterborne matrix. That technology is only a few years old and still in its early stages of development. The hybrid alkyd/acrylic chemistry is tricky — it still needs some solvents to work, and it may not yet supply all the benefits of both the alkyd and acrylic ingredients. But already, ICI (Imperial Chemical Industries) has introduced a line of "advanced alkyd technology" paints under the Dulux brand, based on the alkyd/acrylic hybrid resins, that promises the hardness and gloss of an oil paint with the convenience of soap-and-water cleanup and the advantage of lower VOCs. The raw ingredients for the new waterborne oil paints are available to any paint company from outside sources, so as the method advances, more enamel and gloss paint brands are likely to appear using water-compatible alkyds.

IN THE FIELD

What does all this mean for the professional painter? Most agree that modern paints perform as well as, or better than, traditional coatings: they stick better, last longer, and hold color better. But the new paints tend to behave differently on the brush or in the sprayer. For many painters, adjusting can be a challenge.

Nigel Costolloe runs Catchlight Inc., a custom painting company in the Boston, Mass., area. Says Costolloe, "Years of habit and practice and skills, honed in the application of one type of material, when confronted with a material that behaves markedly differently, is a challenge for anyone." If a painter is accustomed to brushing or spraying oil formulas, he'll find modern acrylics tricky at first.

To keep a house looking good, walls need to be routinely washed and repainted every few years. In coastal zones, three years between recoats is fairly good performance for paint or stain over wood siding and trim.

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Circle #33

Oil paints dry slowly and provide lots of "open time" for painters to brush back into their work, and oil paints relax gently, allowing brush marks or lap marks to disappear more readily. Modern acrylic paints dry much faster — especially if the weather is hot, dry, or breezy — and so lap or brush marks are harder to avoid.

New England painter Charles Gilley has modified his technique to accommodate the faster-drying new acrylics. On a building exterior, for example, he has to paint fewer courses of clapboards at a time, in order to maintain a wet edge as he works. On sunny days, Gilley has to hustle to stay on the shady side of the building — once a wall is hot and sunny, the paint dries too fast. And for wood-panel doors, Gilley now follows a meticulous pattern, painting first the panels, then the rails, and then finally the stiles, so that cross brushstrokes won't create visible lap lines across the door's component parts.

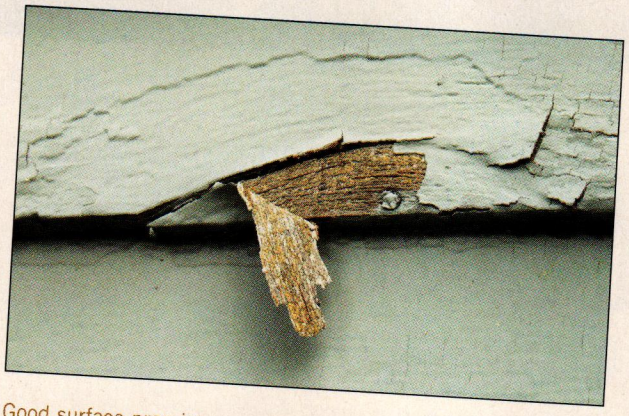
A thorough and vigorous washing is the best prep for routine repainting. Don't neglect the areas under eaves — they can accumulate salt and grime deposited by moisture rising up from soil around the building.

Traditional painters particularly regret the loss of solvent-borne primers for repainting jobs on old weathered wood exteriors. The traditional method, which Gilley and other painters have practiced for years, is to start with an oil-based primer, and then apply an acrylic top coat. The solvent-borne primer wets the wood more readily and soaks in better, explains Gilley, and it can partially overcome difficult-to-remove dust and grime. "Just take some fine dust, like drywall dust, and put a drop of water on it, and you'll see what I mean," says Gilley. "Water will bead up on the dust. But if you put some paint thinner on that same dust, it will soak right in." In the same way, argues Gilley, oil paints will soak into wood through dust or dirt, where a water-based paint will get repelled and fail to form a bond.

Even Rohm and Haas, the acrylic specialist, won't argue with that tradition, says Stewart Williams. "If your substrate is sufficiently damaged and in need of repair, then yes — instead of moving large balls of acrylic through pores, you're moving string-shaped molecules with a solvent that penetrates. It's not just some belief that is out there — I think it has proven out that you get much better performance on difficult substrates by going with the old faithful alkyd primer followed by an acrylic top coat."

But Nigel Costolloe points out that a penetrating primer is no substitute for good surface preparation. Oil-based formulas may have better wetting power, he says, but years of accumulated grime and pollution can repel even an oil-based formula and prevent good adhesion. "I've seen oil-based primer flake and peel off a house prematurely when somebody didn't take the time to do the proper surface prep," he explains. "But if you do make sure that the existing paint is cleaved and the wood is sanded off to remove the deteriorated cellulose that has been damaged by ultraviolet light, and clean the surface, in my experience a waterborne primer can adhere just as well as an oil-based primer."

Even Costolloe, however, sees situations in which he prefers to use alkyd paints. "In the residential market, if you already have multiple existing coats of



Good surface prep improves the performance of any paint. Here, sun-damaged wood fibers and remnants of an old prime coat are sticking to the back side of peeling alkyd paint. A thorough sanding and washing and a high-quality prime coat would have helped this paint job hold up longer.

alkyd paint on a house, it's better to stay with an alkyd," he notes. Alkyd and acrylic paints expand and contract at different rates in response to changing weather, he explains, and where a base of alkyd paint already exists on the wall, another coat of alkyd on top of it is more compatible.

Ultimately, argues Costolloe, it's craftsmanship, not paint formula, that makes or breaks a paint job. "I think the greatest challenge for any painter is reading a label," he says — only partly in jest. "The painting business does not have a barrier to entry," he notes. "A car, a small ladder, and $65 worth of tools, and you can be up and running. And education and continuous learning and the concept of self-improvement are almost alien to our industry." But good learning resources are available, he says, including educational sessions put on by paint companies and by local chapters of the Painting and Decorating Contractors of America.

> Ultimately, it's craftsmanship, not paint formula, that makes or breaks a paint job

Costolloe likes a three-hour CD-ROM training tool produced by the Quality Paint Institute: "We put all our new hires through it, and every employee retakes the program once a year." The CD is available from the Paint & Decorating Retailers Association at www.pdra.org/shop.php.

Even with the best of paints and the best of training, however, paint is temporary — especially in a coastal climate. In mild exposures, a good exterior paint job won't last a decade, admits Great Barrington, Mass., painter Paul Shepard. Some paint companies promise 12 years for a wall painted with their primer and top coat, but Shepard counters, "That's B.S. — and you can tell them I said so. I tell my customers a paint job is good for five to seven years. If I say 12, they'll come back to me after 11 years demanding satisfaction." Shepard remembers painting a house whose owner had used a paint that promised 20-year performance. "He actually waited 20 years to repaint it," says Shepard. "That wood was crying."

And Shepard works a hundred miles inland. On the coast, you're lucky to get five years from a paint job; three years is more typical. Martha's Vineyard builder John Abrams, CEO of South Mountain Company, Inc., has a simple solution: he doesn't paint exteriors. "We try to have a zero-maintenance exterior, and in our environment, paints just don't last," he says. "We've tried a lot of different kinds of paint. But in order to keep a house looking well cared for and keep the wood protected, you basically had to repaint every three to five years. And that just seemed insane."

So now, Abrams relies on aluminum-clad wood windows, white cedar shingles from the sustainable forests of Maine's Seven Islands Land Company, and recycled cypress trim. "The shingles are good for 25 to 40 years without paint," he says. "The cypress will last virtually forever."

For coastal builders who do use paint, this is a time of transition. In Virginia, Delaware, Pennsylvania, Maryland, and New York, suppliers stopped shipping high-solvent formulas at the beginning of 2006, although retailers are still allowed to "sell through" any existing inventories. Other states aren't on board yet: in Massachusetts, VOC limits may not take full effect until 2011. Will effective new formulas be available by the time existing stocks of oil-based paints run out? Only time will tell. ~

A former frame and finish carpenter, writer Ted Cushman has been covering construction business and technology since 1993. All photos by the author except as noted.

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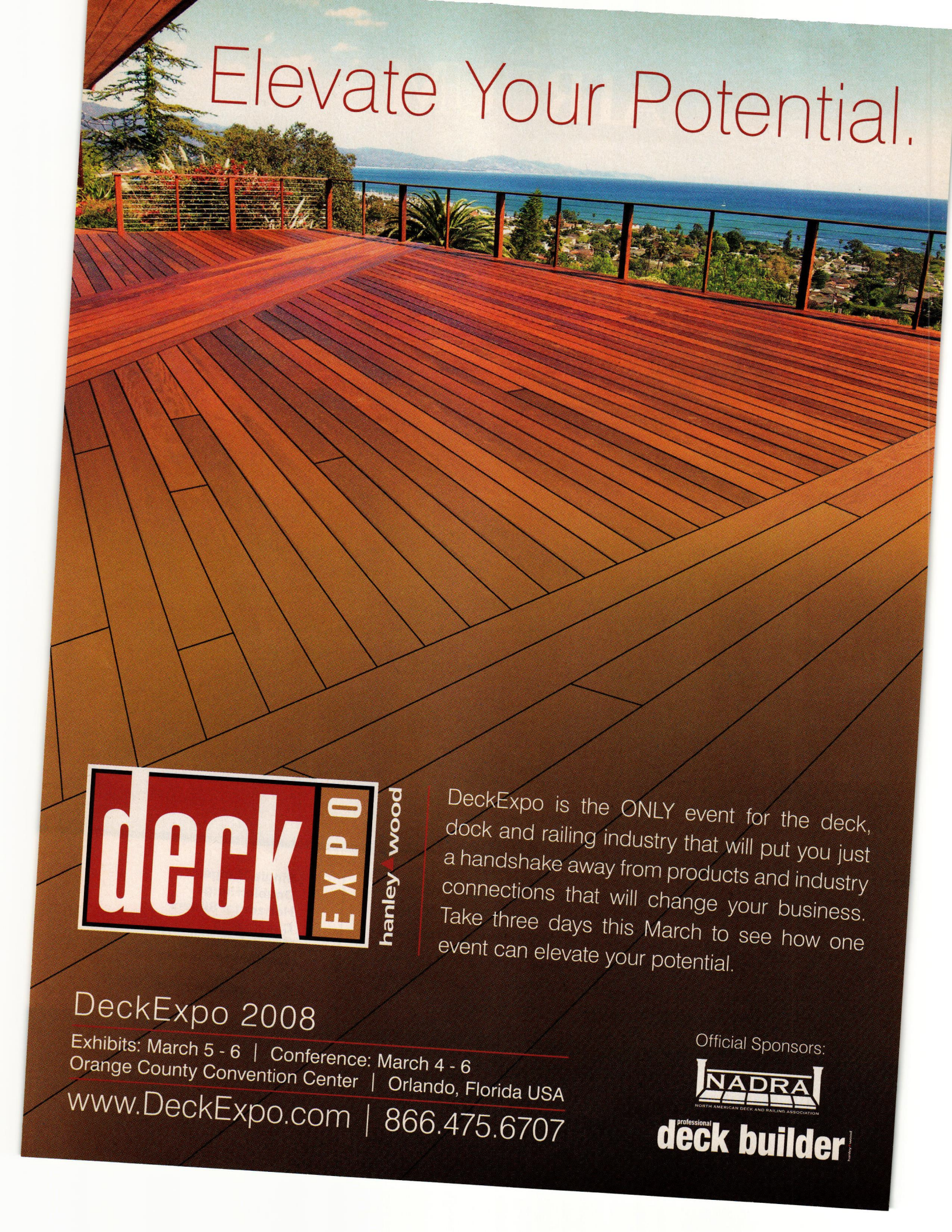
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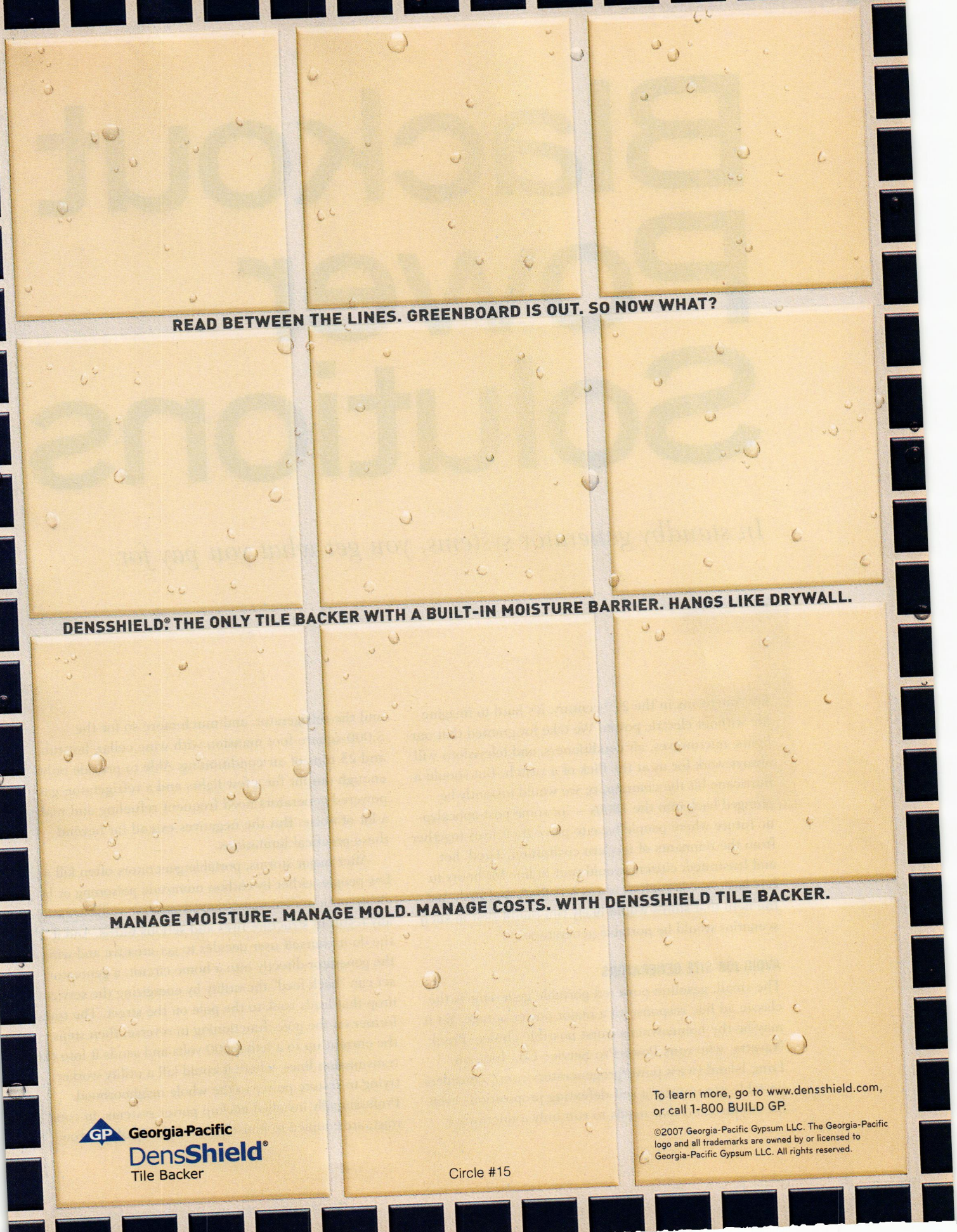
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For Americans in the 21st century, it's hard to imagine life without electric power. We take for granted that our lights, microwaves, air conditioners, and televisions will always work for us at the flick of a switch. But should a hurricane hit the community, we would instantly be plunged back into the 1800s — or some post-apocalyptic future where people have to piece their lives together from the remnants of modern civilization. Tired, hot, and frustrated, citizens would wait in line for hours to buy basic needs such as water, ice, food, and fuel. And the item that stores would likely run out of first in such scenarios would be portable generators.

AVOID JOB-SITE GENERATORS

The small, gasoline-powered portable generator is the classic ad hoc response to a major power outage. Yet it may be the homeowner's worst possible choice. Frank Navetta, who runs PowerPro Service Co., Inc., on Long Island (www.powerprogenerators.com), considers portable generators "a self-defeating proposition" even for a household that needs to run only a microwave and the refrigerator, and much more so for the 8,000-square-foot mansion with wine cellar, hot tub, and 25 tons of air conditioning. Able to provide only enough output for a few lights and a refrigerator, gas-powered generators need frequent refueling and make a lot of noise. But the negatives extend far beyond these practical limitations.

After major storms, portable generators often kill a few people, either by carbon monoxide poisoning or by electrocution. Generator-caused gasoline spills occasionally result in structure fires and serious burns. And if the do-it-yourself user decides to get creative and wire the generator directly into a home circuit, a generator set can "back-feed" the utility by energizing the service drop that leads back to the pole on the street. The transformer on the pole, functioning in reverse, then steps the current up to a lethal 600 volts and sends it into the transmission lines, where it could kill a utility worker trying to restore power to the whole neighborhood. Professionally installed backup power systems, in contrast, are coupled to house power by a "double-throw"

KOHLER

Compared with a portable gasoline-fueled generator, permanently wired and professionally installed generator sets fueled by natural gas, liquid propane (LP), or diesel are a safer, more reliable way to back up utility power.

switch that maintains safe grounding. The switch disconnects all generator-powered circuits from the utility service before it connects those loads to the generator.

SELECTING A STANDBY SYSTEM

Beyond portable generators, backup power systems come in a range of sizes, usually categorized by output capacity:

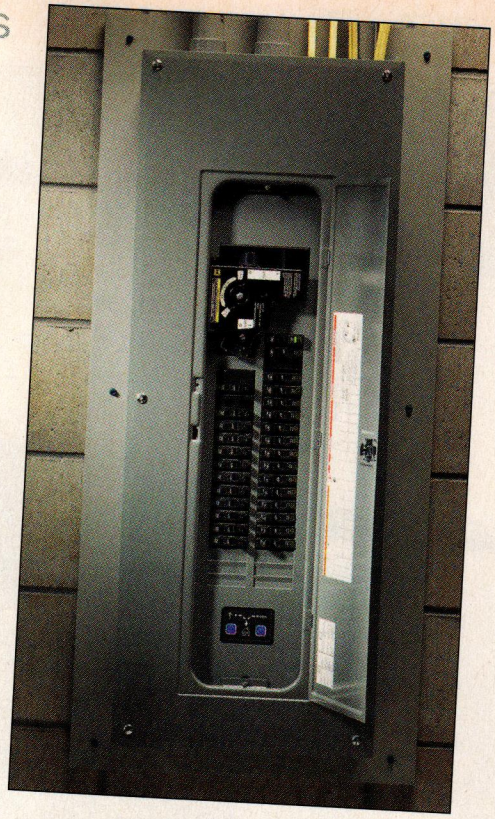
From 7 kilowatts up to about 15 kW, systems have enough power for a modest-sized home, depending on air conditioning needs. These systems use air-cooled engines like those manufactured for chain saws, lawnmowers, or small lawn tractors. These units can also be converted to run on LP or natural gas.

Air-cooled machines are intended for occasional use. During an extended power outage, someone will have to stop the unit every 8 to 10 hours, at a minimum, to check the oil and air filters.

Above 15 or 16 kW, the generator engines are conversions of standard water-cooled General Motors or Ford auto and truck engine blocks. An 8-liter-displacement V-8 motor can power a 125-kW generator on LP, and up to a 150-kW generator on natural gas fuel. Diesel engines from companies like John Deere are also used to power generator sets in this midsize range.

Above 150 kW, generators jump to industrial packages, built by companies such as Caterpillar, Cummins, or Waukesha. Top-end unit are typically designed to run on natural gas and LP, though less expensive diesels are usually an option, too.

Diesels have some special maintenance needs, however. Like all generators, they have to be started up and test-run (some models self-test on a weekly or monthly cycle). Diesels, in particular, must be allowed to warm up and run at full load and normal operating temperature for 20 minutes or more, *each* time they start. Otherwise, unburned fuel will clog valves and the fouled machine may not start or run when it's needed. In very cold winter conditions, diesels may need a fuel adjustment: a 60/40 mix of diesel fuel and kerosene won't gel at subzero temperatures the way straight diesel fuel will. (All generators, whatever the fuel, should have engine



An integrated double-pole, double-throw transfer switch safely disconnects house circuits from the utility before connecting them to the generator, while maintaining a continuous ground for both power sources. The switch may be manual (above) or automatic (right).

GROUNDING GUILDELINES

At hookup, it's critical to pay attention to how the unit is electrically grounded.

Typically, a generator set's ground wire is connected to the home's main ground wire at the main service panel, which leads to a copper ground stake driven into the earth. That ground is hard-wired, not switch-controlled: the generator, the circuits it powers, and the other home circuits all stay grounded all the time (so throwing the transfer switch transfers the connection for the live wires but not the continuous ground wire). However, a generator set may be provided with a means to ground the generator frame directly to its own copper stake, and some supplier manuals say to make that independent ground when the set is installed. Since double grounding is usually a no-no, the issue can throw electricians off stride.

What's the answer? Experts say that for residential applications, tying the generator's ground to the main house ground is the way to go — an additional separate ground at the generator set is unnecessary, and doing so could even cause a hazard in the case of a ground fault. (The separate grounding option on some generator sets is provided in case the application is for what the electrical code terms a "separately derived system" — not usual in a residential setup.) But not all systems are the same, and grounding is an issue for the local inspector to decide. Always have the installation inspected, and let the local inspector make the call.

block heaters that warm the engine oil reservoir when temperatures drop below 40°F. Standby generators don't idle for 10 minutes at startup as a car might on a cold morning. They are designed to come up to a full 3,600 rpm or 1,800 rpm in about 10 seconds.)

Natural gas and LP have their own set of drawbacks, though. In the event of a power outage, natural gas pipeline pressures may drop below the operating requirements of the unit. It's important to make sure the gas flow through the meter is rated high enough to supply the generator, as well as any other loads in the house for cooking, heating, or clothes drying. Also, pay attention to the length of the supply pipe and the number of bends, warns Jay Blevins, of Kinsley Power Systems in East Granby, Conn. (www.kinsleypower.com). "Just because the unit has a half-inch fitting doesn't mean that a half-inch pipe will work. If it's too long or has too many elbows, it may not."

For extra backup, some backup power specialists can provide dual-fuel generators that can automatically switch to bottled propane if the natural gas supply falters — without dropping the load.

SYSTEM SIZING

When choosing a generator, the first question must be "How big?" At the low end, the answer depends mostly on whether the homeowner wants to power the entire house or just a few critical circuits. "Typically, the hinge point is air conditioning," says Frank Navetta. "A

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Source: www.gillettegenerators.com

Electric motors need more power to start up than they use once they're running. Shown here are estimated operating watts and starting watts for a few common household motors. Standby generators must be sized to supply sufficient startup current for all the connected loads.

15-kilowatt machine can do heat, refrigeration, a handful of lights. You can do sump pumps. You can even get away with occasionally using a window air conditioner. But if someone has two or three 5-ton air conditioners, the inrush current to start those compressors is so high that you end up needing 30 or 40 kilowatts. And once those air conditioners are started, now you have all this extra current. You might as well use it to run the whole house."

Builder Paul Buske, of Kitty Hawk, N.C.–based Stormont & Co. (www.stormontandcompany.com), builds primary residences as well as second homes and vacation rental properties on North Carolina's Outer Banks. Buske reports that his area's power reliability has improved considerably since the 1980s: "We used to have brief outages all the time, just because of salt corrosion and arcing on transmission-line transformers. But our utility has moved a lot of powerlines underground, and these days we have fewer interruptions." Backup power nowadays is more about storm readiness than about day-to-day convenience, notes Buske. Rental property investors rarely opt for standby power systems, he adds.

"We have set a lot of year-round houses up with generators, but nobody yet has decided that they want a generator big enough to run the whole house," explains Buske. "So we go through the house with them, while they pick and choose what they feel they will really need during an outage; and we size the generator to fit that need."

Most of Stormont & Co.'s year-round houses are laid out with main living space on the first-floor level, and extra bedrooms and baths on upper floors. Each story is served by its own heat pump and air conditioner, which makes it easy to split the power supplies between floors. "Our generator normally runs the air conditioner for the main level, a refrigerator and freezer, the kitchen appliances, and enough light circuits so that the main living level isn't in the dark," says Buske. Circuits that will run off the generator are isolated onto a separate subpanel.

PAUL BUSKE

If only selected circuits are to be powered by a generator, a separate subpanel is usually installed for just those circuits behind the transfer switch.

POWER ISSUES

Some loads, like ordinary lighting, are easy to estimate. But loads involving motors — well pumps, sump pumps, air conditioner compressors, and so on — are trickier. Compressor, pump, and fan motors — just like power tools — draw more power starting up than they do when running. Generators have to be sized to handle the startup draw of all the equipment they serve, not just the equipment's operating requirements. Otherwise, big appliances like air conditioners won't even start.

Smart switches. Temporary power requirements can be accommodated with smart load-management circuitry. Many residential power systems, including models from Briggs & Stratton (www.homegeneratorsystems.com), Generac (www.generac.com), and Kohler (www.kohlerpower.com), include "smart" switches and load-control circuitry that can prioritize between various current draws.

Air conditioning manufacturer Rheem (www.rheemac.com), which markets the Briggs & Stratton standby generators under the Rheem and Ruud brands, offers the smart load-management systems as an option. "All of our transfer switches come with an air conditioner control module," explains Rheem product manager Art Berg. "If the home is on generator power, and the air conditioning system calls for cooling, the control module looks to see if it has the wattage available to start the air conditioner." If the power's not available, the switch waits. "Every 15 seconds it will

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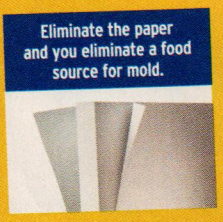

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PAUL BUSKE

Ordinary household loads like lighting or stoves aren't fussy about power quality, but modern electronic equipment needs "clean power" with a smooth, regular waveform and without excessive harmonic distortion. Units with electronic governors and digital voltage regulators, such as this one on a Generac unit, can maintain fine control over power quality.

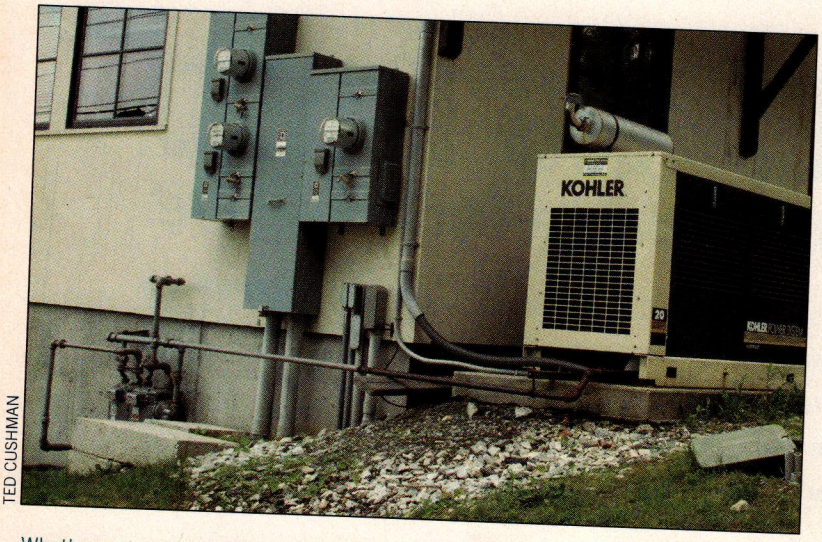
keep looking for the power," continues. "As soon as any appliance goes off-line — if you turn off the oven or the clothes dryer stops — it will find the power, start the air conditioner, and go back into operating mode."

For even finer control, systems may also include a load-control center that has "load-shedding" capability. This feature allows you to select up to six appliances that can go off-line when it's time to start the air conditioner. So when the thermostat calls for air conditioning, the smart box will first check to see if it has the wattage to start the air conditioner. If it doesn't, it will start shutting down the selected appliances just long enough to give the air conditioner its starting wattage. When the air conditioner goes into operating mode, the smart box brings the other loads back online again.

Coupled with the smart controls, a standby generator can afford to be as much as 10 kW smaller, according to Berg. "Using the load-control center, a 12-kW unit will replace a 20-kW unit, and a 15 kW will replace a 25 kW, in most cases." These smaller 12- and 15-kW generator sets are significantly cheaper to buy.

Power quality. Simple "linear loads" like incandescent lighting or electric stove heating elements can tolerate current fluctuations, but new devices, including fluorescent lighting, computers, plasma televisions, and "uninterruptible power system" (UPS) equipment all require "clean power."

Clean power means a smooth, 60-Hz (60 cycles per second) sine-wave electrical signal. To produce this, generators have to spin at exactly 3,600 rpm if they have a two-pole alternator, and at exactly 1,800 rpm if they have a four-pole alternator. However, a cheap, underpowered generator tends to run at a little faster under light loads, slow down under heavier loads, and speed up again as a mechanical governor kicks in to compensate. This fluctuation creates harmonic distortion — a deformation of the sine wave dubbed "dirty" power that can damage sophisticated solid-state circuitry. In fact,



TED CUSHMAN

Whether natural gas or liquid propane (LP) is the fuel, gas meters and supply lines must be sized to supply sufficient fuel to operate the generator as well as the home's other gas appliances (such as heating equipment or cooking stoves). Advanced "dual-fuel" systems can use natural gas as the main fuel source, with an LP backup source available in case natural gas pipeline pressures drop during a power outage.

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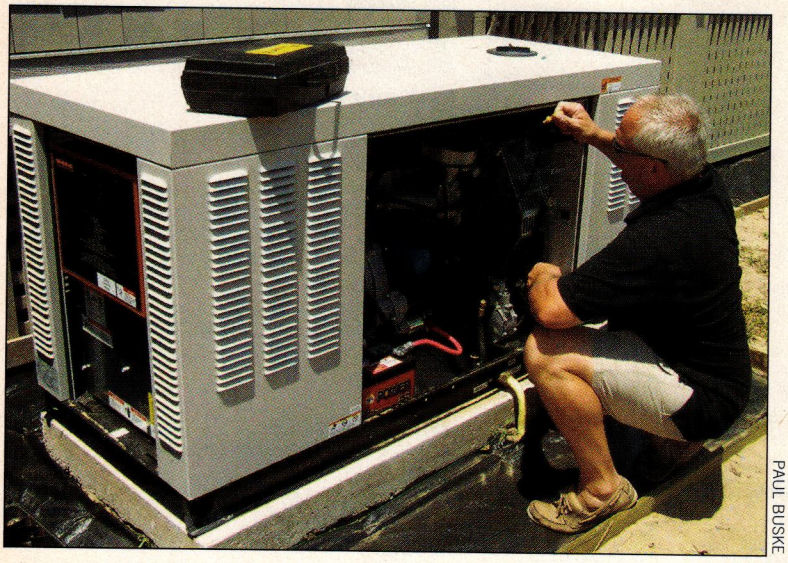

PAUL BUSKE

A professional contractor who specializes in generators must be part motorhead, part sparky, in order to best install and maintain the equipment. Here, contractor Jay Hart of Hart Power Solutions (www.hpsobx.com) in Kill Devil Hills, N.C., performs routine motor maintenance on a generator set at a new home built by Kitty Hawk, N.C. builder Stormont & Co. (www.stormontandcompany.com).

KOHLER

Local codes determine the foundation requirements for a generator set. A gravel pad or concrete slab is typically required (above). In high-wind zones, however, generators may need to be anchored, and in flood zones, they often have to be elevated (right).

PAUL BUSKE

UPS systems and some solid-state controls on the newest furnaces and air conditioners may refuse to operate at all under fluctuating generator power.

Top-of-the-line units are able to maintain near exact speeds by means of electronically controlled governors and digital voltage regulators that can keep engine rpms and power output within at least 1.5% of the desired 60 Hz.

HOOK UP

Once the right-sized generator is chosen, it needs to be wired into the house. If only selected loads are to be generator-powered, those circuits typically get their own subpanel. Upstream of the subpanel (or upstream of the main circuit breaker panel if the generator is intended to serve the whole house) is the key safety device: a "double-pole, double-throw" switch that disconnects the house circuits from the utility grid power feed before connecting them to the generator. "We call it a 'break-before-make' switch," says Jay Blevins. "The switch breaks the connection to the utility before it makes the connection to the generator."

If it's a manual switch, the homeowner will have to physically throw it during a power failure. If it's automatic, it will switch over on its own and send a signal to the generator to start. But either way, the important thing is that the house loads never be connected to the generator and the utility at the same time — and that the generator never, ever, be connected to the service drop connecting the house to the pole. Besides the life and safety risk created if the generator is able to back-feed the utility powerlines, there's a risk of damage to the standby generator if the generator is accidentally hooked into the grid when the utility power is on.

Team sport. If a builder is handling the hookup, it will involve multiple trades. Notes Buske: "My electrician has to work hand in hand with my generator guy. My heat and air guy has to be involved. All these people have to be able to work together — cause what I don't need at the end of this job is one guy pointing his finger at the other saying, 'You didn't do your job right.'"

The builder's best bet is to go with a specialist, argues Frank Navetta — a full-service generator set supplier with trained maintenance crews, who can professionally install the unit and offer the homeowner a service plan. A builder may save a few hundred dollars by purchasing the generator set himself and paying his electrician to install it, but if it doesn't work, it becomes the builder's headache. ~

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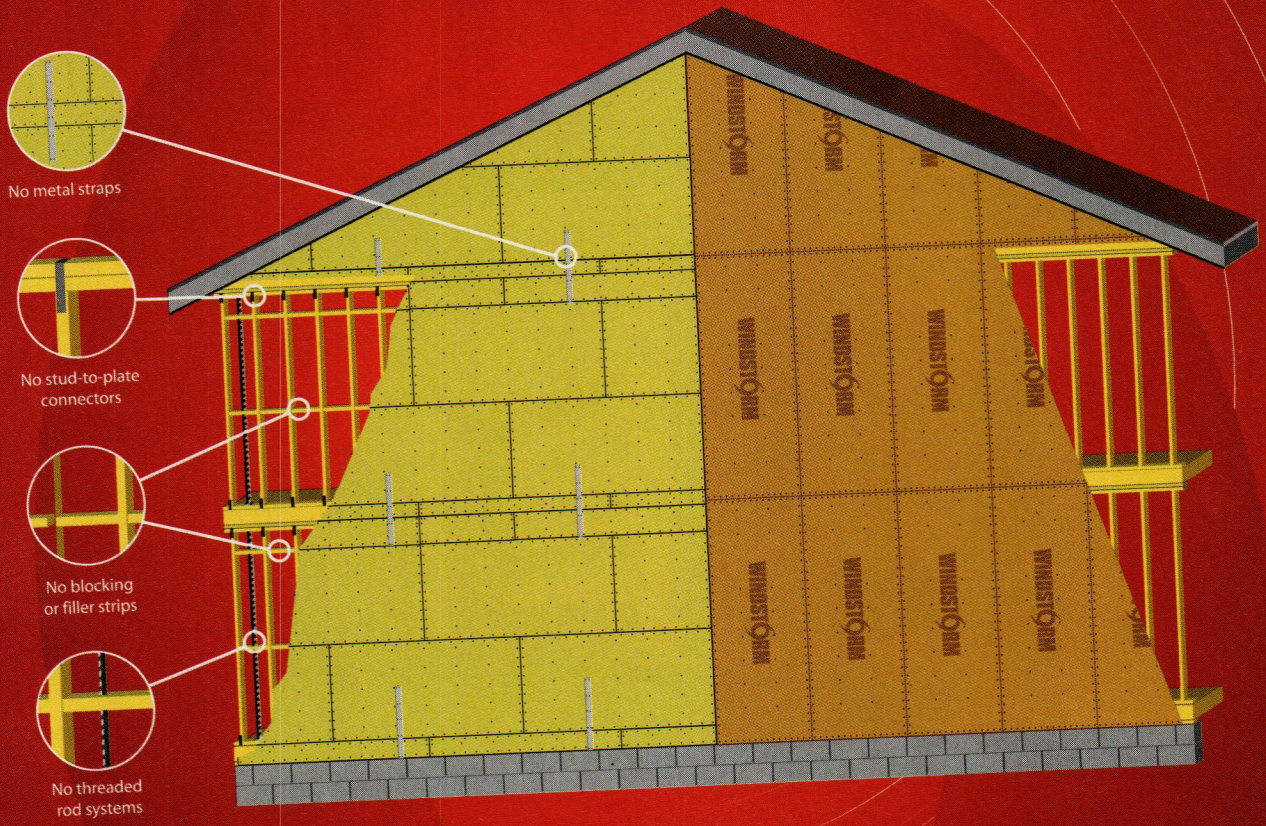

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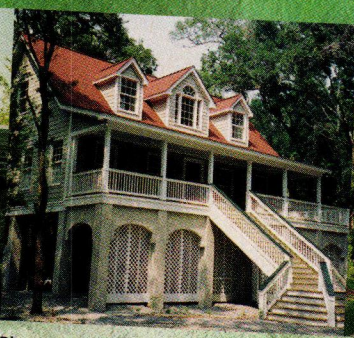

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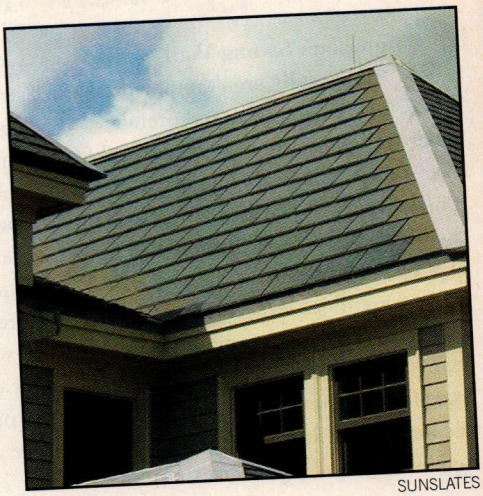

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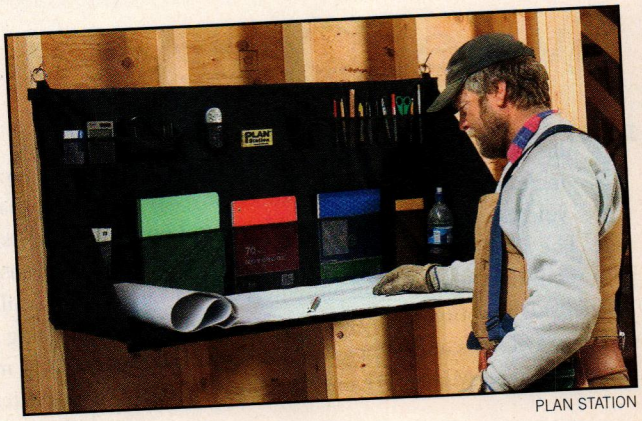
CertainTeed's **Presidential TL Ultimate** "shakes" may be the thickest asphalt shingle available, providing an ultra-durable roof when installed correctly. The "TL" stands for triple layer. Each shingle is composed of three layers of heavy-duty fiberglass shingle mat laminated together. When installed, this product is actually thicker than cedar shingles, providing authentic shadow and texture as well as a Class A fire rating and 110-mph wind resistance. Each square weighs in at 480 pounds — not as much as slate or concrete tile (which weigh in at 750 to 900 pounds per square) — but it will be more durable and more fire resistant than a wood shake roof. CertainTeed offers a limited lifetime warranty on the shingles and a 15-year warranty against streaking (the granules include 15% copper flake that protects against the streaking and discoloration caused by airborne algae). For more information, contact CertainTeed, 800/345-1145, www.certainteed.com.

Job-Site Desktop

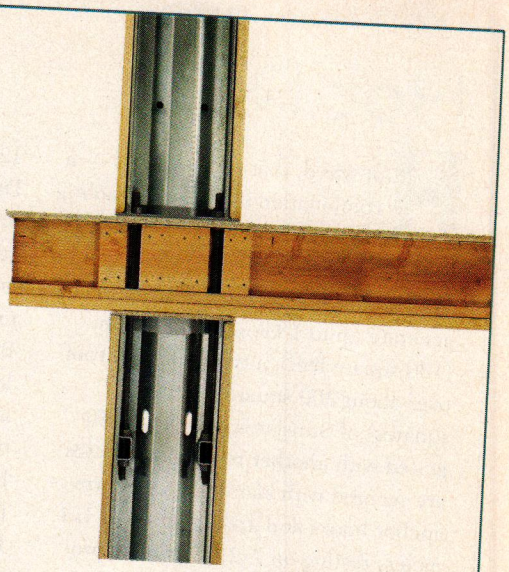
Finley Products offers a portable workstation made of durable ballistic nylon that can be hung on a wall. It unfolds quickly, creating a 2- x 4-foot work surface for blueprints and laptop computers. Dubbed the **Plan Station**, this workstation offers professional contractors, architects, and engineers the ability to take their desks to the job site. Multiple storage pockets can hold documents, office supplies, cell phone, coffee cup, and other needed goods for organizing a project. For more information, contact Finley Products Inc., 888/626-5301, www.planstation.biz.



PLAN STATION

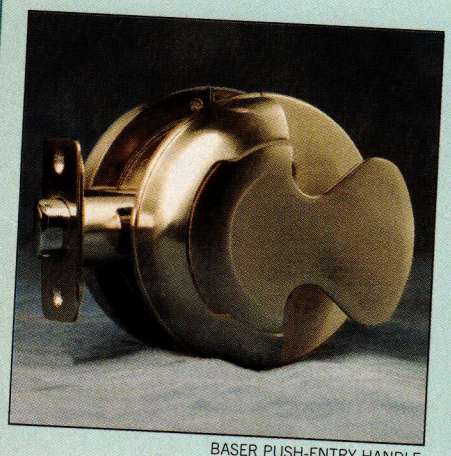
Strong-Wall Resource

Simpson's **Strong-Wall Shearwalls** aren't a new product. The engineered prefab shear-wall panels have been around for over a decade. But the company offers a new Strong-Wall catalog that explains the different types of Strong-Wall products now available and clarifies the many ways these structural systems can be used. Chief among these is the "two-story stacked shear-wall solution." Stacking two steel-panel shear walls accomplishes two things: it provides high load values, and it uses minimal wall space — both key in meeting structural requirements in contemporary home designs. Namely, the stacked Strong-Wall design takes up very little wall space, allowing more room for openings in extra-high window walls. It also provides the moment resistance required for wind-loaded, open-style "great" rooms up to 20 feet tall. The new Strong-Wall catalog is available for downloading at www.strongtie.com/strongwall, or contact Simpson Strong-Tie at 800/999-5099.



STACKED STEEL SIMPSON STRONG-WALL

ADA-Approved Door Handles

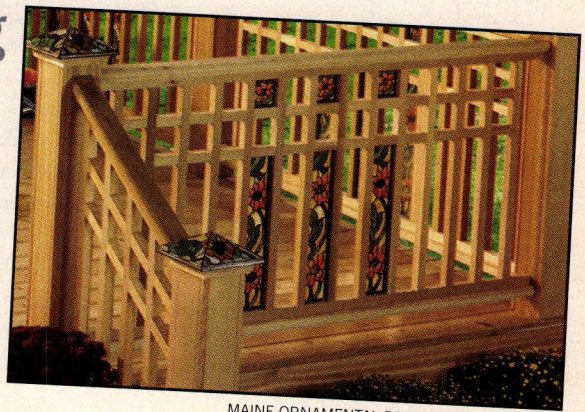


BASER PUSH-ENTRY HANDLE

According to their inventor and manufacturer, Owen Baser, these prizewinning door handles are ADA compliant. Baser Door Handles' new **Push-Entry** model opens with less than one pound of pressure, and there's no grabbing or twisting required, making them ideal for homeowners with any kind of physical limitation. The Push-Entry is comprised of only three parts, and is available to fit all standard bore sizes, which is good news for contractors. Made of a zinc alloy, the new Push-Entry model comes in only nickel and brushed brass, for now. As any contractor in coastal regions knows, salt air usually tarnishes and corrodes hardware finishes quickly. According to Baser, these handles have a "grade one" finish that survives a 90-hour salt-spray test. Go for the nickel, known to last longer in salt air. All handles cost $39.95 plus $6.75 shipping and handling. For more information, contact Baser LLC, 800/569-0935, www.baserdoorhandles.com.

Sweet Cedar Railing

The **Maine Ornamental preassembled cedar railing system** includes glass rail inserts and Tiffany-style post caps that may provide the perfect accent to a Victorian home or Shingle-style cottage. The handrail comes packaged in fully assembled sections, complete with mounting brackets and all required hardware, and is available in 34-inch-high sections in both 6- and 8-foot lengths. Matching 42-inch cedar post sleeves and 6-foot stair rails are also available. For more information, contact Maine Ornamental, 866/780-3507, www.postcaps.com.



MAINE ORNAMENTAL PREASSEMBLED RAILING

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Flexible Arches

Interior archways

Need a fast way to frame-out arched interior doorways? **Easy-Arch** is a simple piece of curved sheet steel with upturned flanges along each edge that can be screwed to the framing of a rectangular opening. Once it's secured, this curved track provides a nail base to support interior drywall. Easy-Arch comes in two widths to fit 2x4 and 2x6 framing and can be used in steel or wood framing. Various styles available to form quarter-circle, half-circle, eyebrow, elliptical, and compound-radius arches. For more information, contact Easy-Arch, 800/854-2461, www.easy-arch.com.

EASY-ARCH

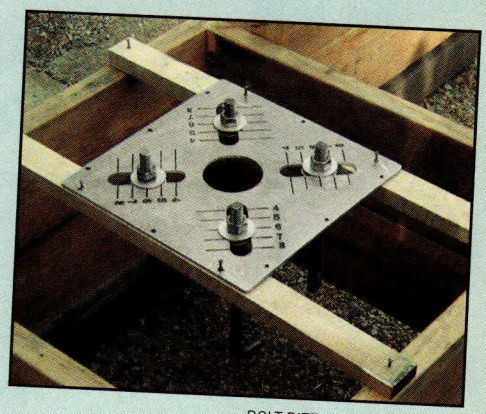
ARCHCLIP SYSTEM

Exterior brick archways

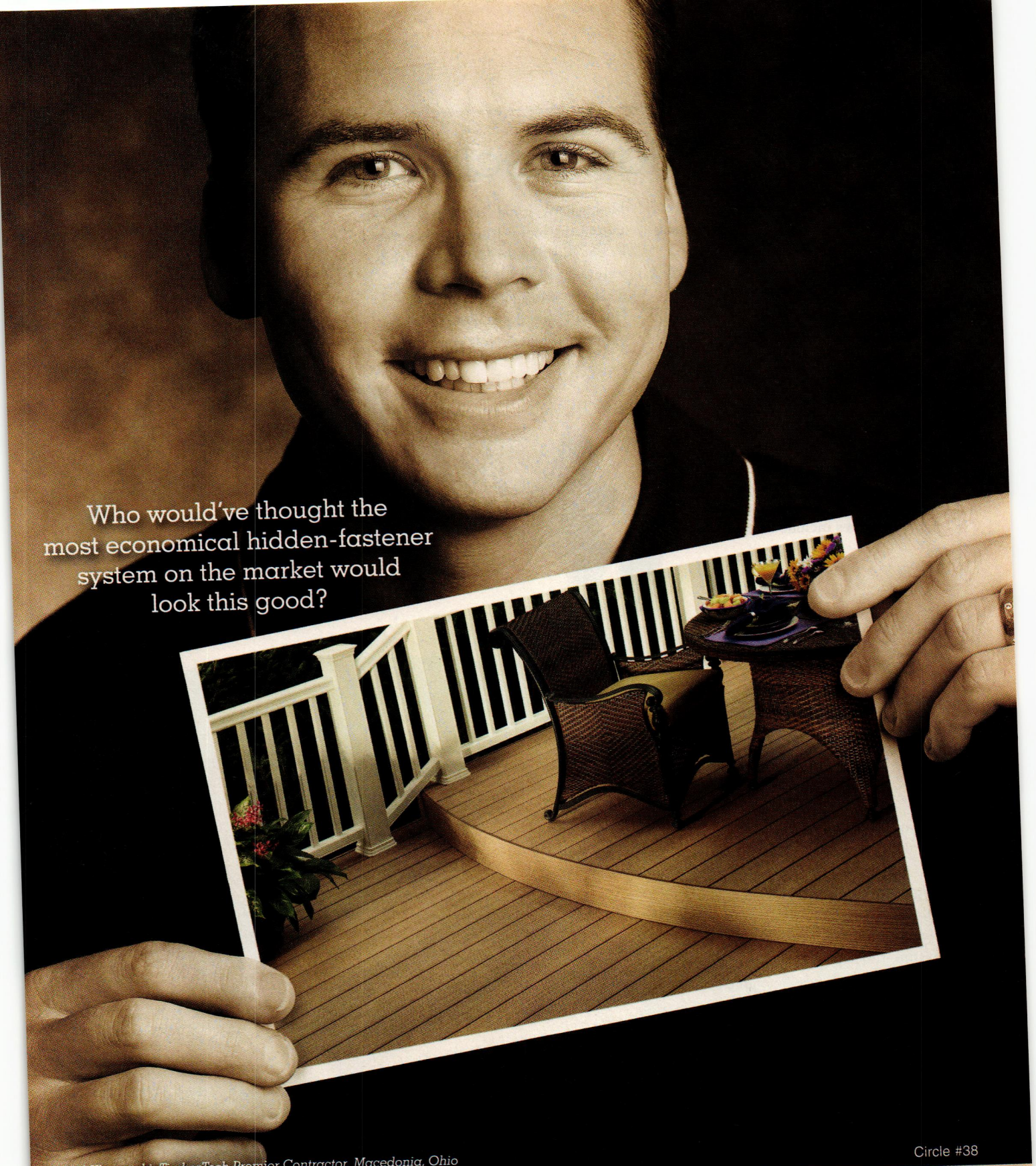
A new system designed by Estate Products promises to dramatically reduce the time and expense involved in building masonry arches. The **ArchClip System** consists of two components: an ArchClip and an ArchStrip. The clip is a 16-gauge galvanized metal clip that gets positioned around an arch window. A self-adhesive backing holds the clip in place for fastening with a nail (and also self-seals around the fastener to avoid water penetration, claims the manufacturer). Next, the ArchStrip — a 16-gauge flexible metal strip — feeds into the mouth of each clip, creating a perfect arch that serves as a support form for laying the brick. The strip is removed once the arch is built, and it can be reused. No weight from the brick rests on the window, eliminating any window warranty issues. For more information, contact Estate Products, 800/264-5141, www.archclip.com.

Steel Column Templates

The typical steel column base has a four-bolt anchor connection to the footing — a very strong tension connection that's particularly frustrating to align correctly prior to the concrete pour. **Bolt-Rite's** adjustable templates not only enhance the precision required for this task, but also save time by eliminating the usual plywood templates that get made and then tossed between jobs. The aluminum templates can be cleaned easily as well. They are available in standard sizes for 9- x 9-inch columns (single, $14.94; 10-pack, $139.44) and 14- x 14-inch columns (single, $27.81; 10-pack, $257.30) with anchor bolt sizes from 5/8 inch up to 1 1/2 inches. Centering layouts can be adjusted from 4 to 6 inches on the 9- x 9-inch templates, and from 5- to 10-inch centers on the 14- x 14-inch templates. For more information, contact Bolt-Rite, 530/243-0181, www.boltrite.com.



BOLT-RITE 4-BOLT TEMPLATES



Phil Klonowski, TimberTech Premier Contractor, Macedonia, Ohio

Circle #38

Phil figured it out. That's why he built over 50 TimberTech composite decks last summer and recommends Floorizon® planks to his customers. Only TimberTech uses virgin materials giving our products the necessary rigidity to manufacture the industry's leading tongue-and-groove plank. Virgin materials also give TimberTech the advantage in dependable quality and consistent board-to-board color–keeping homeowners happy and callbacks to a minimum.

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For information on TimberTech's Contractor programs, visit www.timbertech.com or call 1-800-307-7780.

Low-Vibration Recip Saw

Got to do some demo? Hitachi has introduced a new reciprocating saw that reduces motor vibration and promises to significantly decrease end-user fatigue. This is accomplished, says the manufacturer, with a counterweight mechanism that reduces the vibration transferred to the user. The **CR13VBY Reciprocating Saw** also offers a "swing cutting" mechanism (for the same kind of aggressive cutting action you get with "orbital" action) and a 1 1/4-inch stroke with 0 to 3,000 strokes-per-minute variable-speed control. Other features include tool-less blade changes and "triple-seal" protection of the motor from dust generated by demolishing drywall, say, or from water when cutting into pipes. For more information, contact Hitachi Power Tools, 800/829-4752, www.hitachipowertools.com.

HITACHI CR13VBY RECIP SAW

Uplift Panel

For improving moisture resistance, Roy O. Martin's new **WindBrace OSB** side-wall panels are specially designed for coastal applications: thanks to their high-resin, southern yellow pine composition, they offer a significant moisture-resistant option over ordinary aspen OSB panels (see *Soundings*, page 29). In addition, the 7/16-inch-thick sheathing comes in panel lengths each 1 1/8 inches longer than conventional 8-, 9-, and 10-foot-long panels, so there's enough meat to tie into the top and bottom plates on standard framing or to lap over the floor framing in multistory construction. In wind zones, this uplift connection will require an aggressive nailing schedule (see "Solving the Uplift Puzzle," July/August 2007; available at www.coastalcontractor.net). When asked about resistance to nail pull-out, Roy O. Martin stated that these panels shouldn't be any different than any other sheathing panel. In green-building applications, WindBrace OSB Sidewall can also be ordered as a FSC-certified product, providing assurance about the sustainable origins of the product's wood content. For more information, contact Roy O. Martin Lumber Management, LLC, 318/448-0405, www.royomartin.com.

WINDBRACE OSB SIDEWALL

Impact Curtain

Shield Technology Group's new **ImpactShield** improves on most other shutter systems and storm panels for ease of use and aesthetics. Made of waterproof, UV-resistant polyethylene fabric, this translucent shield deploys from a tube, which is installed over each opening (all you need is a drill, says the manufacturer). To operate, the shield is hand-cranked down like a bedroom shade and fastened into another tube along the bottom of each opening, then back-cranked to stretch the fabric as taut as a trampoline. Shells can be painted to taste. Standard sizes (37 x 60 inches) start at $199 (an entire house is estimated at $4,000) and do not require support bars — but larger, customized sizes might. Two-panel glass door sizes are also available with larger sizes coming soon. Although novel enough to be recognized by the History Channel's Modern Marvels Invent Now Challenge and strong enough to meet the standards of the American Standards Testing and Measures (ASTM), the Florida Building Code, the International Building Code, and the International Residential Code, the ImpactShield awaits Miami-Dade impact certification. According to the manufacturer, the product has passed the necessary windborne debris testing, but this would be the first fabric shutter approved. A new test may be needed to set the standard for future fabric shutters. For information, contact Shield Technology Group, 866/443-0046, www.shieldtechinc.com.

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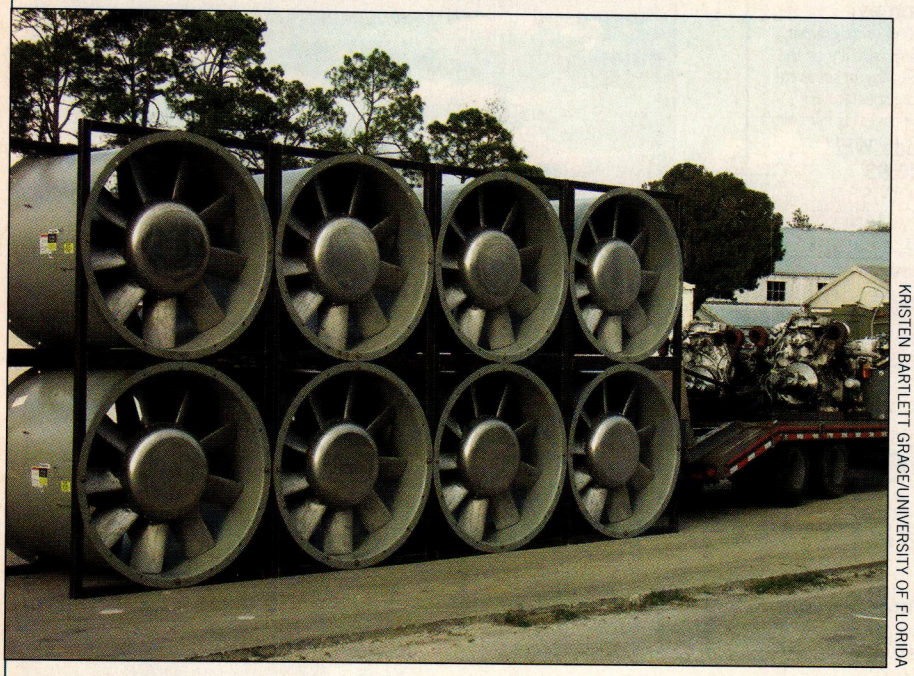
Storm Maker

Have hurricane simulator, will travel

It's huge, deafening, and can muster a 130-mph wind capable of tearing off roofs and knocking down walls. But University of Florida engineers say they may first deploy a new 3,800-hp hurricane simulator to solve a more subtle problem: how wind-driven rain enters homes.

What engineers call "water intrusion" was a huge damage-producer during the 2004 and 2005 Florida storms. Although soffits have been identified as a leading cause, much remains uncertain about where to cast blame when windblown rain soaks wood floors, collapses ceilings, or damages drywall, says Forrest Masters, a UF assistant professor of civil and coastal engineering and lead designer of the new machine.

The machine, the world's most powerful such portable wind machine, can pelt windows and other components, as well as entire structures, with steady or intermittent bursts of wind and raindrops, mimicking real hurricanes. That should give engineers the chance to test walls, framing connections, windows, doors, and soffits — both how they perform together on an actual house and how they perform separately. "We have a water-intrusion issue, and we need a systems approach to identify the origin and mechanism of the intrusion," Masters explains.



KRISTEN BARTLETT GRACE/UNIVERSITY OF FLORIDA

The latest "hurricane machine" developed by engineering professor Forrest Masters will be deployed first to troubleshoot effective ways to deter wind-driven rain.

This updated "hurrican machine" is the latest version of a growing arsenal of more and more massive hurricane simulators being produced by UF, Florida International University, and other research universities in the U.S. and Canada. It has eight 5-foot-tall industrial fans powered by four marine diesel engines. The engines get their cooling water from a 5,000-gallon water tank aboard the machine's tow vehicle, a tank that is also the source of the simulated rain. At full power, the fans produce winds of about 100 mph. A custom-built duct funnels the air, accelerating the wind to 130 mph, speeds equivalent to a Category 3 hurricane.

The UF engineers first tested the machine shortly before hurricane season began June 1. A few weeks later, Masters met with code officials and representatives from major window companies and test laboratories. He is now working with these representatives on a research agenda for the machine.

The wind engineers will also put the machine to use in myriad other investigations. One of the more surprising: how hurricane winds affect trees. Kurt Gurley, a UF associate professor of civil and coastal engineering, notes that the researchers plan to work with horticultural scientists to learn more about pruning trees for storm survivability. The goal goes beyond canopy protection, he says.

"If you could create some pruning policy for various species of tree that reduces how much wind they feel," he explains, "it would perhaps be nice preventive medicine for keeping power lines up longer." — *Aaron Hoover*